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# Revision of some ophiuroid records (Echinodermata: Ophiuroidea) from Argentina

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## Abstract

The taxonomy of some ophiuroids reported from off Argentina, western Antarctica and the SW Atlantic Ocean is reviewed. The species *Amphilepis sanmatiensis*, known only from the small holotype, is a synonym of *Amphioplus lucyae*. This synonymy removes the only reported endemic ophiuroid from Argentina. The species name "*Ophiacantha ingrata* Koehler, 1923" used for specimens from South Georgia is invalid; the specimens are likely to belong to one of two cryptic species within the *O. vivipara* complex. Specimens of *Amphiura joubini* reported from Argentina are re-identified as *Amphiura princeps*, and specimens of *Ophiactis amator* from the Antarctic Peninsula are re-identified as *Ophiactis asperula*.

**Key words:** Brittle stars, Ophiacanthidae, Amphiuridae, *Amphioplus*, *Amphilepis*, *Ophiactis*

## Introduction

Ophiuroids from Argentina are poorly studied. To date the only taxonomic studies of the group were performed by Bernasconi (1965), Tommasi (1968), and Bernasconi and d'Agostino (1971, 1974, 1975a, 1977). The first local reports of ophiuroids mentioned the presence of *Gorgonocephalus chilensis* (Philippi, 1858) and *Amphipholis squamata* (Delle Chiaje, 1828) in the region (Bernasconi 1926, 1934). A recent bibliographic review listed 32 species from the area in 20 genera from 9 families (Brogger *et al.* 2013). The objective of the present work was to revise some of the ophiuroid material from the Invertebrate Collection of the Museo Argentino de Ciencias Naturales "Bernardino Rivadavia" (MACN).

Abbreviations include d.d. for disc diameter.

## Systematic account

### Family Ophiacanthidae

#### *Ophiacantha vivipara* Ljungman, 1871

(Fig. 1)

*Ophiacantha vivipara* Ljungman, 1871: 471.—Lyman, 1878: 149.—Lyman, 1882: 185–186, pl. 46(7–9).—Studer, 1882: 23–24.—Koehler, 1907: 321–323 (in part).—Koehler, 1908: 276.—Koehler, 1914: 96.—Koehler, 1922: 12–13.—Mortensen, 1936: 246–248, fig. 5a, pl. 7(2).—Bernasconi, 1965: 151–152.—Castillo-Alarcón, 1968: 45–47, fig. R, pl. 1(4,6).—Bernasconi, 1973: 331–332.—Bernasconi & d'Agostino, 1977: 107–109, pl. 10(3,4).—Lucchi, 1985: 133–134, fig. 49–50.

*Ophiacantha ingrata*.—Bernasconi & d'Agostino, 1975b: 19–21, pl. 1(3–4).—Bernasconi & d'Agostino, 1978: 217 [Non *Ophiomitrella ingrata* Koehler, 1908].

?*Ophiacantha vivipara*.—Tommasi *et al.*, 1988: 6.

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**Material examined**. **Argentina**. Isla de los Estados (between Cabo San Juan and Punta Fallows), 54° 45.677′S, 63° 49.114′W, 54 m, 1934, identified by Bernasconi & d'Agostino (1977) (MACN 21956, n=3). East of Isla de los Estados, 54° 47′S, 63° 35′W, 144 m, 1933 (MACN 22277, 13). 38° 31′S, 55° 42′W, 109 m, 1938, identified by Bernasconi & d'Agostino (1977) (MACN 23346, 3). 39° 28′S, 57° 2′W, 90 m, 1941, identified by Bernasconi & d'Agostino (1977) (MACN 25122, 5). 12 miles east from Punta Médanos Lighthouse, 39° 30′S–40° 11′S, 109 m, 1924, identified by Bernasconi & d'Agostino (1977) (MACN 14423, 15). Océano Atlántico Sur, 54° 52′S, 37° 28′W (MACN 28128, 3). M2: stn E9, off Mar del Plata, 38° 50.91′S, 55° 34.585′W, 140 m, 2009 (MACN, 15). Walther Herwig: stn 277, 40° 54′S, 56° 49′W, 300 m, identified by Bernasconi (1973) (MACN 27263, 1). **South Georgia**. Grytviken, 54° 16.905′S, 36° 30.394′W, 0 m, 1933, identified by Bernasconi & d'Agostino (1975b) as *Ophiacantha ingrata* (MACN 26927, 12). Puerto Larsen, 25–27 m, 1929, identified by Bernasconi & d'Agostino (1975b) as *Ophiacantha ingrata* (MACN 18768, 1). Bahía Antartica, 35–36 m, 1929, identified by Bernasconi & d'Agostino (1975b) as *Ophiacantha ingrata* (MACN 18760, 21). Islas Orcadas: stn 18, Georgias del Sur, 54° 21′S, 36° 1′W, 106 m, 1975, identified by Bernasconi & d'Agostino (1978) as *Ophiacantha ingrata* (MACN 28139, 4). **South Sandwich Is**. Islas Orcadas: stn 21, Sandwich del Sur, 57° 47′S, 26° 26′W, 105 m, 1975, identified by Bernasconi & d'Agostino (1978) as *Ophiacantha ingrata* (MACN 28127, 2). **South Shetland Is**. 61° 26′S, 56° 25′W, 1975 (MACN 34933, 25).

**Distribution**. Malvinas/Falkland Islands, South Georgia, Patagonia to Uruguay (north to 37°S), Chile (north to 50°S), Brazil? Macquarie Ridge, 0–1100 m.

**Remarks**. Bernasconi & d'Agostino (1975b, 1978) record a series of specimens from South Georgia and South Sandwich Islands under the name "*Ophiacantha ingrata* (Koehler, 1923)". This is an invalid name, as Koehler did not describe a species under this name in 1923, but included photographs of both five and six-armed specimens under the previously described *Ophioripa ingrata* Koehler, 1908. The five-armed individuals (Koehler 1923, pl. 14, fig 5–6) have the characteristic small rounded granules and thick blunt arm spines found on the holotype of *O. ingrata*, which has been subsequently transferred to the genus *Ophiomitrella* (see O'Hara 1990). Bernasconi & d'Agostino (1975b) are possibly correct in identifying as a separate species the small (< 6 mm d.d.) six-armed specimen photographed by Koehler (1923, pl. 14, fig 5–6), with its even covering of small conical spinelets, but they are in error to re-use the specific epithet (*ingrata*) in a separate genus (*Ophiacantha*) and then attribute this name to Koehler (1923) (who actually considered both photographs to represent the same species).

Bernasconi & d'Agostino (1975b) noted the similarity of their material to the widespread species *Ophiacantha vivipara*, distinguishing the two species by the number of arm spines, 7–8 in "*O. ingrata*" and 10–12 in similar sized (16 mm d.d.) *O. vivipara*. In their synonymy of "*ingrata*", they included a photo of a six-armed specimen from Marguerite Bay, Antarctica attributed to *O. vivipara* by Koehler (1912, pl. 11, fig. 2). Koehler (1912) also included a photograph of a similar looking five-armed individual (pl. 11, fig. 1). Mortensen (1936) interpreted these photographs differently. He considered the six-armed specimen to represent *O. vivipara* and described the five armed form as a separate variety *O. vivipara* var *pentactis* which he also distinguished on the basis of reproduction (the presence of males in *pentactis*) and biogeography (no five armed specimens occur on the Patagonian Shelf), but not arm spine number. *Ophiacantha pentactis* was subsequently raised to species rank by Madsen (1955). Fell (1961) found no difference in arm spine number (11–12) or disc spines between his six- and five-armed specimens from the Ross Sea.

The true identity of *Ophiacantha vivipara* is complicated by the uncertainty over the type locality. Ljungman (1871) recorded it from Altata off the Pacific coast of Mexico, however, this locality has been rejected by a series of authors and the presumed locality is now considered to be the Malvinas/Falkland Islands (Bell 1908; Fell 1961).

There have been two molecular studies that have shed light on the phylogenetic relationships within the *Ophiacantha vivipara* complex. Martin-Ledo *et al.* (2013) found several distinct phylogenetic clades from around Shag Rock near South Georgia that they identify as *O. vivipara*, *O. pentactis*, the five-armed *O. densispina* Mortensen, 1936, a new five-armed species *O. wolfarntzi*, and an undescribed five-armed species (sp. 1). O'Hara *et al.* (2013, 2014) found three clades within *O. vivipara* and several others which were similar to the five-armed *O. rosea* Lyman, 1878. The three clades of "*vivipara*" had separate distributions: 'A' was predominantly circum-Antarctic, 'B' was subantarctic and 'C' occurred mainly around southern Australia and New Zealand. Clade A included both five and six-armed individuals, the others only six-armed forms. A direct comparison of the COI sequences (O'Hara unpublished data) has revealed that clade A is the same as the clade identified by Martin-Ledo *et al.* (2013) as *O. pentactis* and B as *O. vivipara*.

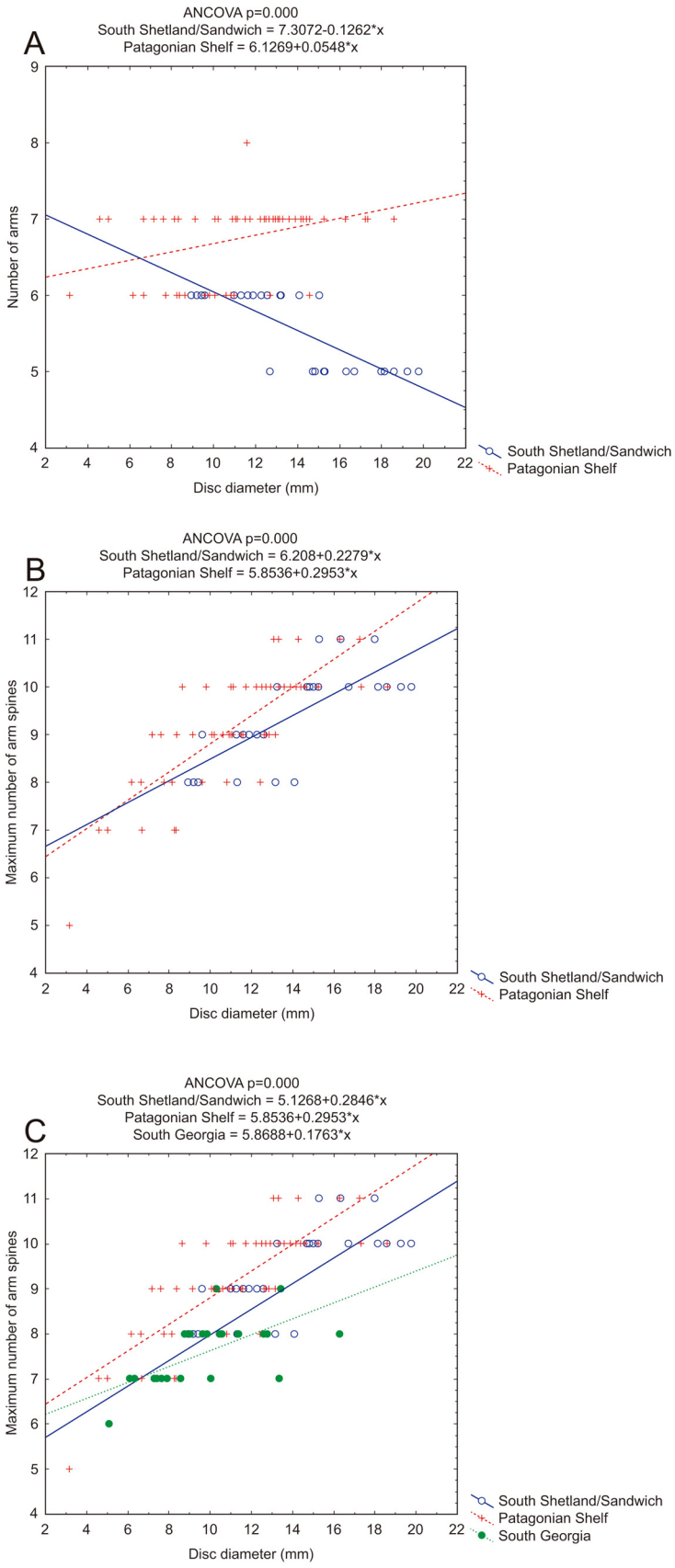


**FIGURE 1.** Graphs of Analysis of Covariance of arm number (A) and arm spine number (B, C) of MACN specimens of "*Ophiacantha vivipara*" from the Patagonian Shelf (n=59), South Georgia (n=26, fig. 1C only) and South Shetland/Sandwich Islands (n=26). All analyses were significant, i.e. arm number and arm spine number differed between populations when disc diameter was incorporated as a covariate.

In summary, there are at least three clades with six-armed forms (as well as numerous clades with only five-armed individuals) within this complex. One clade (clade B of O'Hara *et al.* 2013 and the *vivipara* of Martin-Ledo *et al.* 2013) is known to occur on the Patagonian Shelf, South Georgia and the Macquarie Ridge. Presumably this clade is the one that also occurs further north along the Argentinean coast to Uruguay and in the fjords of southern Chile (although this should be checked with genetic data). It may also occur on other subantarctic islands. The second clade (clade A of O'Hara *et al.* 2013 and *pentactis* of Martin-Ledo *et al.* 2013) is circumpolar Antarctic as well as occurring around South Georgia (Martin-Ledo *et al.* 2013), South Orkney and Bouvet Islands, and on the southern Macquarie Ridge (O'Hara *et al.* 2013). It appears to include both five and six-armed individuals, although this should be confirmed with a study using faster evolving genetic loci than COI which is known to be unable to discriminate some echinoderm species pairs (Williams 2000). The third clade (clade C of O'Hara *et al.* 2013) occurs on seamounts around southern Australia and New Zealand and along the northern Macquarie Ridge. A plausible hypothesis is that these clades represent *O. vivipara*, *O. pentactis* and an undescribed *Ophiacantha* species respectively. Thus many of the records from Antarctica previously considered *O. vivipara* (e.g. Bell 1908; Koehler 1912, 1922; Fell 1961; Madsen 1967; McKnight 1967b) are six-armed *O. pentactis* specimens, and records from Australia and New Zealand (O'Hara *et al.* 2008) are an undescribed species.

The identity of specimens found in other regions remains unclear. No genetic sequences are currently available from specimens collected around Crozet, Marion, Kerguelen or Heard Islands. Specimens from around Kerguelen are frequently seven armed and may be "*vivipara*" (although the name *Ophiacantha kerguelensis* Studer, 1876 is available if specimens from this remote location form a distinct clade). Northern records, such as those found off Brazil (Tommasi 1970; Tommasi *et al.*, 1988), need to be critically compared with the six-armed *Ophiacantha anomala* Sars, 1871 from the North Atlantic.

To test whether arm number or maximum arm spine number varied between the two western hemisphere clades as suggested by Mortensen (1936) and Bernasconi & d'Agostino (1975b), we compared the abundant material in the MACN from two regions: a) the Patagonian Shelf off Argentina and Uruguay (33–55°S) and b) the South Sandwich and South Shetland Islands (57–62°S). The first group (n=59) presumably representing "*vivipara*" and the second "*pentactis*" (n=26). Specimens from South Georgia were excluded from the analysis as this locality may represent a zone of overlap of the two species. We performed ANCOVA (Analysis of Covariance) analyses with region as the categorical variable and disc diameter as the co-variant, as both arm and arm-spine number are potentially related to animal size. We rejected the null hypothesis (no difference between groups, p=0.000) for both arm number and arm spine number (Fig. 1A & B). Animals from the Patagonian Shelf ("*vivipara*") had 6–7 (rarely 8) arms while those from further south ("*pentactis*") had 5–6. Patagonian Shelf specimens tended to have more arm spines at any given disc diameter, however, the maximum arm spine number (n=11) was the same for both forms. In summary, there is no simple dichotomous character to distinguish 6-armed specimens of the two forms. This makes the identity of specimens from South Georgia problematic, as 26 of the 27 specimens examined from there had 6 arms (the last 7). However, many had relatively few arm spines at small to medium disc diameters and so appear to fit the profile of "*pentactis*" rather than "*vivipara*" (Fig. 1C), although the data is not conclusive and needs to be confirmed with a molecular study.

Consequently the final identity of Bernasconi & d'Agostino "*ingrata*" specimens remains uncertain as both *O. vivipara* and *O. pentactis* are possibly present at South Georgia. However, "*Ophiacantha ingrata*" (as distinct from *Ophiomitrella ingrata*) can be removed from the list of species known from the region.

## Family Amphiuridae

### *Amphiura princeps* Koehler, 1907

*Amphiura princeps* Koehler, 1907: 303–305, pl. 12(28–29).—Clark, H.L., 1915a: 235.—Mortensen, 1936: 285–286, fig. 22, pl. 7(10).—Bernasconi, 1965: 150, pl. 1(1), 2(1).—Bernasconi & d'Agostino, 1977: 85–87, pl. 6(1,2).—Lucchi, 1985: 122, fig. 2, 25–26.

*Amphiura joubini*.—Bernasconi & d'Agostino, 1977: 80–82, pl. 7(3,4).

**Material examined**. Akademik Knipovich 4: stn 1063, La Paloma, 34° 42´S, 52° 14´W, 40–45 m, 1967, identified by Bernasconi & d'Agostino (1977) as *Amphiura joubini* (MACN 27848, n=15). Akademik Knipovich 4: stn 1065,

Cabo Polonio, 34° 29′S, 53° 0′W, 50–55 m, 1967, identified by Bernasconi & d'Agostino (1977) as *Amphiura joubini* (MACN 27849, 14). Akademik Knipovich 4: stn 1068, Cabo Polonio, 34° 15′S, 52° 12′W, 55–62 m, 1967, identified by Bernasconi & d'Agostino (1977) as *Amphiura joubini* (MACN 27850, 1). Akademik Knipovich 4: stn 1071, Cabo Polonio, 34° 22′S, 52° 37′W, 36–42 m, 1967, identified by Bernasconi & d'Agostino (1977) as *Amphiura joubini* (MACN 27847, 30). SAO V: stn 216, Golfo San Matías, 41° 13′S, 65° 59′W, 36 m, 1971, identified by Bernasconi & d'Agostino (1977) as *Amphiura joubini* (MACN 27853, 1).

**Distribution**. Patagonian shelf from the Straits of Magellan to Uruguay, 0–107 m.

**Remarks**. The specimens recorded from the Argentinean coast as *Amphiura joubini* Koehler, 1912 by Bernasconi and d'Agostino (1974) proved upon re-examination to belong to the species *Amphiura princeps*. *Amphiura joubini* is an Antarctic species characterised by a spiniform to pointed distal oral papilla, a broadly triangular to spear-head shaped oral shield (widest near the distal margin), long narrow radial shields (>4x longer than broad), an absence of disc plates on the ventral surface near the oral shield, and arm spines that can be elongated into a sharp hyaline (glassy) and/or bent to bifurcated tip near the disc. *Amphiura princeps* on the other hand has a wide, rounded distal oral papilla, an oral shield that is widest near the proximal margin, radial shield approximately 3 times as long as broad, plates on the ventral disc surface and arm spines that can be bent at the tip but are never hyaline. Both species have small disc plates that can appear granular in appearance, especially on the ventral surface. Bernasconi and d'Agostino (1974) separated their "*joubini*" from "*princeps*" by the partially naked disc surface near the oral shield. However, sparse disc plating can also occur in smaller specimens of *O. princeps*.

*Amphiura joubini* has also been reported from southern Brazil (Tommasi 1970; Borges *et al.* 2002) however, it is unclear from the photographs and descriptions whether these animals are also *A. princeps* or another species. New Zealand records (Fell 1958; McKnight 1967a) are mis-identifications of *Amphiura correcta* and *Amphioplus ctenacantha* (Mills & O'Hara 2013).

### ***Amphioplus lucyae*** **Tommasi, 1971**
(Fig. 2)

*Amphioplus lucyae* Tommasi, 1971: 6, fig. 19–20.—Tommasi *et al.*, 1988: 6.—Borges *et al.*, 2002: 42, fig. 23c–d.—Borges, 2006: 28–29.—Carranza *et al.*, 2007: 104–105, fig. 2.
*Amphilepis sanmatiensis* Bernasconi & d'Agostino, 1975a: 356–358, fig. 1–3 [new synonymy].

**Material examined**. SAO II: stn 126, Golfo San Matías, 41° 42′S, 64° 59′W, 20–25 m, 1971, holotype of *A. sanmatiensis* (MACN 27862). Golfo San José, 42° 20.103′S, 64° 19.9706′W (MACN 28152, n=15).

**Comparative material**. ***Amphioplus affinis*** (Studer, 1885): Bahia Schleiper, 18 m, 11/1929, identified by Bernasconi & d'Agostino (1975b), (MACN 27100, n=2). Base Petrel, 250 m, 1968 (MACN 27685, 1). ***Amphioplus albidus*** (Ljungman, 1867) collected 1932 (MACN 26825, 3). La Paloma, 12 m, 1975, MACN 27897. La Paloma, 34° 30′S, 54° 15′W, 2 m, 2/1974, identified by Bernasconi & d'Agostino (1977) (MACN 27863, 3).

**Distribution**. Brazil (22°S) to Argentina (42°S), 0–510 m.

**Remarks**. Bernasconi and d'Agostino (1975a) described a small (2.8 mm d.d.) unique specimen from the Golfo San Matías, Argentina as a new species of *Amphilepis*, *A. sanmatiensis*. The additional material of various sizes now available at the MACN indicates that this specimen is in fact a juvenile of the Brazilian species *Amphioplus lucyae*. This specimen appears to have on each jaw a single apical tooth, flanked by two small rounded papillae, two long narrow papillae near the distal end of the jaw slit, and oral pores placed some distance away from the jaw slit each protected by a minute adoral shield scale (Fig. 2B). With growth (Fig. 2D & F), the small flanking papilla moves to the apex of the jaw to become one of the infradental papillae, the distal papilla become the buccal scale (of which only the proximal tip is obvious in ventral view), and the oral pore moves to the base of the jaw slit with the adoral shield papilla becoming the middle of a curved series of three distal oral papillae. On the dorsal disc surface, the primary plates, contiguous in small specimens (Fig. 2A), gradually separate (Fig. 2C & E). The dorsal arm plates, as wide as long on small specimens, become twice as wide as long on larger specimens (6 mm d.d.). The ontogeny of the jaw is similar to that described for *Amphioplus abditus* (Verrill, 1871) by Hendler (1978).

Several other *Amphilepis* species have been found to represent juvenile *Amphiura* or *Amphioplus* species. Bernasconi and d'Agostino (1974) themselves synonymised *Amphilepis antarctica* Koehler, 1908 with *Amphioplus*

*affinis* (Studer, 1882) and Madsen (1967) suggested that *Amphilepis gymnopora* Hertz, 1927 was probably a juvenile of *Amphiura belgicae* Koehler, 1901. Other *Amphilepis* species (e.g., *A. ingolfi* Mortensen, 1933) retain the paedomorphic jaw into maturity.

Thomas (1975) suggested that *Amphioplus lucyae* may prove to be a synonym of *Amphioplus albidus* Ljungman, 1867. However, both species occur along the Argentinean coast and are quite distinct. *Amphioplus albidus* can be distinguished by the small disc scales, the primary plates barely noticeable, 5 arm spines (compared to 4 on *A. lucyae*), wide oral shields that are twice as wide as long (only as wide as long on *A. lucyae*), and the presence of a small gap between the middle and distal oral papillae (see Bernasconi & d'Agostino 1977, pl. 5). The new records listed above represent a range extension for *A. lucyae* to southern Argentina.

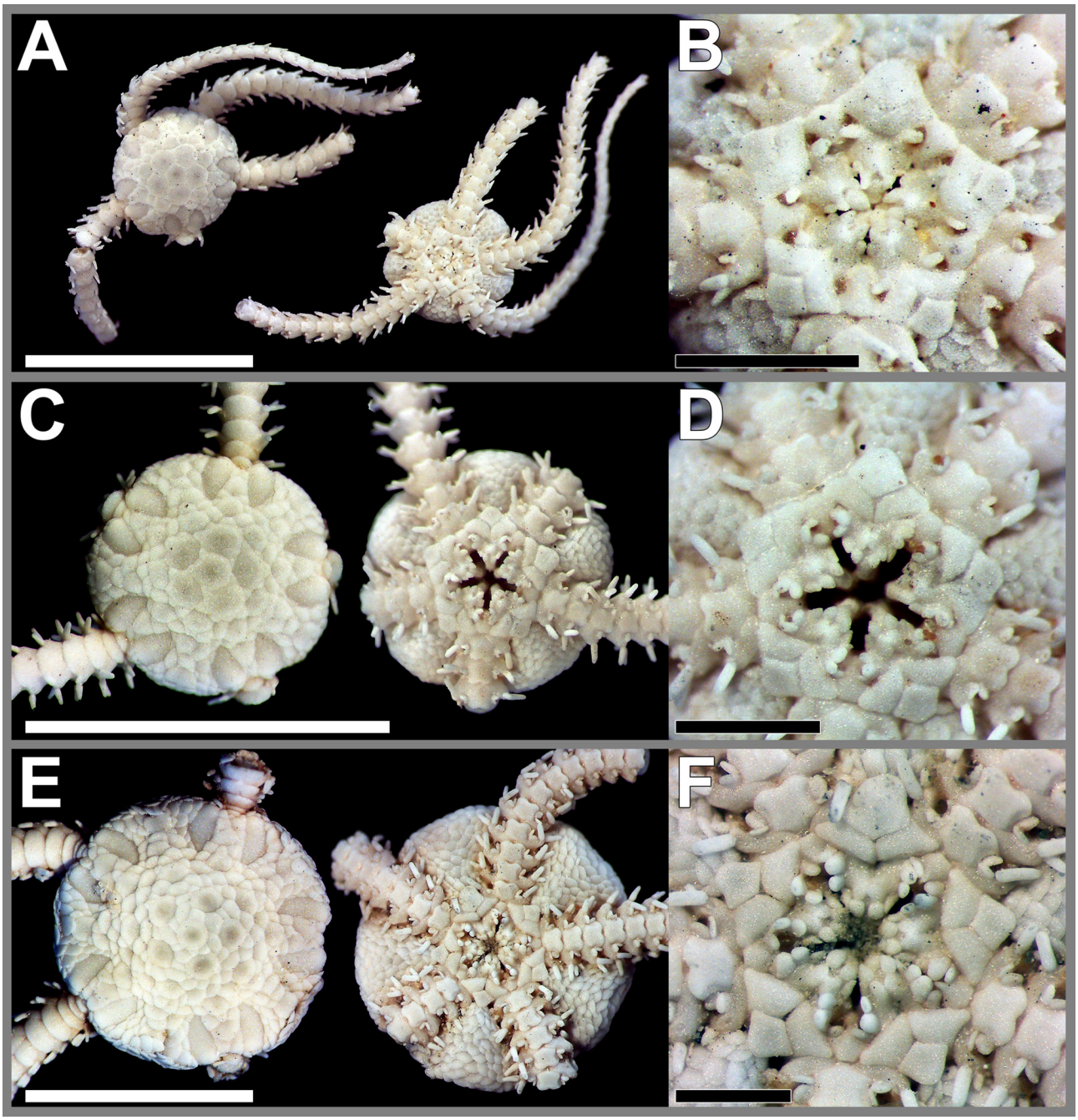


**FIGURE 2.** *Amphioplus lucyae*. A: MACN 27862 (holotype of *Amphilepis sanmatiensis*), 2.7 mm d.d., general view of aboral (left) and oral (right) sides; B: MACN 27862, detailed view of the mouth; C: MACN 28152, 3.4 mm d.d., general view of aboral (left) and oral (right) sides; B: MACN 28152, detailed view of the mouth; E: MACN 28152, 6.0 mm d.d., general view of aboral (left) and oral (right) sides; B: MACN 28152, detailed view of the mouth. White scale bar = 5 mm, black = 1 mm.

**Family Ophiactidae**

***Ophiactis asperula* (Philippi, 1858)**

*Ophiolepis asperula* Philippi, 1858: 267.
*Ophiactis magellanica* Ljungman, 1866: 164 [synonymised by Lyman, 1882].
*Ophiactis asperula*.—Lyman, 1879: 41.—Lyman, 1882: 116.—Studer, 1882: 18.—Koehler, 1907: 310.—Koehler, 1908: 272.—Koehler, 1914: 40.—Clark, H.L., 1915a: 259, pl. 10(11–12).—Clark, H.L., 1918: 310.—Koehler, 1922: pl. 81(8–9).—Mortensen, 1936: 262–264.—Mortensen, 1952: 15–16.—Bernasconi, 1965: 152.—Castillo-Alarcón, 1968: 41–43, fig. P, pl. 2(1,9).—Bernasconi & d'Agostino, 1977: 104–107, pl. 9(1,4).—Lucchi, 1985: 132, fig. 12,45–46.—Tommasi *et al.*, 1988: 6.—Jaramillo, 2008: 118–121.
*Ophiactis amator*.—Bernasconi & d'Agostino, 1974: 129–130, pl. 11(3–4) [Non *Ophiactis amator* Koehler, 1922].

**Material examined**. Petermann Island, 65° 11´S, 64° 10´W, 200 m, 1968, identified by Bernasconi & d'Agostino (1974) as *Ophiactis amator* (MACN 27637, 2). Bahía Esperanza, 63° 24´S, 56° 59´W, 200 m, 1967, identified by Bernasconi & d'Agostino (1974) as *Ophiactis amator* (MACN 27638, 1).

**Distribution**. Southern America, Chile (north to 41°S), Argentina and Uruguay (north to 35°S), Malvinas/Falkland Islands, Burdwood Bank, Shag Rock, ?western Antarctic Peninsula, 0–575 m.

**Remarks**. Bernasconi & d'Agostino (1974) recorded three specimens from the western Antarctic Peninsula as *Ophiactis amator* Koehler, 1922. However, these specimens (7–8 mm d.d.) have 5–6 arm spines and relatively wide oral shields (> 2 times wider than long) compared with *O. amator* with up to 4 arm spines and oral shields <= 2 times wider than long. In this respect, the western Antarctic Peninsula specimens are much more similar to *Ophiactis asperula,* which is common around the southern coasts of South America. Bernasconi & d'Agostino (1974) did not compare the two species. Possibly these animals represent ephemeral populations of *O. asperula* on the western coast of the Antarctic Peninsula or mistaken locality records as no other *Ophiactis* has been taken from that area before or since.

Records of any *Ophiactis* species from Antarctic waters are very rare, the only other example being Koehler's (1922) paratype of *O. amator* collected from the coast of eastern Antarctica at 280 m depth. However, the collection locality for this record is also dubious, as all other specimens of *O. amator* have been found at lower bathyal depths (1750–3500 m) around south-eastern Australia and New Zealand (O'Hara *et al.* 2014). The holotype of *O. amator* was collected from 1300 fathoms (2337 m) off Maria Island, Tasmania (see Koehler 1922, page 86), not the 300 fathoms (540 m) mis-printed under the species description (page 34).

## Discussion

The current study confirms comments by Brogger *et al.* (2013) that a revision of the taxonomy of Ophiuroidea from Argentina is needed. It is expected that future benthic studies, particularly from mid to lower continental slope depths, will add more species to the known Argentinean brittle star fauna.

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