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New sea anemone (Anthozoa: Actiniaria) from Patagonia: *Andvakia manoloi* sp. nov.

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Abstract

A new species of sea anemone from the intertidal zone of San Matías Gulf is described. *Andvakia manoloi* sp. nov. is a small and inconspicuous species that differs from other species of the genus in number of tentacles, number of mesenteries at proximal and distal part of the column, column division, muscles, cnidae, size, habit and distribution. *Andvakia manoloi* sp. nov. is the first species of the genus from South America and the southernmost record of the genus.

Key words: Cnidaria, Argentina, Río Negro, Benthos, Andvakiidae

Introduction

Sea anemones belonging to genus *Andvakia* Danielssen, 1890 have been recorded from several locations: North Atlantic Ocean, East and Central Pacific Ocean, Gulf of Mexico and the Sea of Cortez; from the intertidal zone to 275 m depth (Daly & Goodwill 2009). This genus has undergone significant recent revision. Daly and Goodwill (2009) described *A. discipulorum* Daly and Goodwill, 2009, redescribed *A. boninensis* Carlgren, 1943, amended the diagnosis of the family, and synonymized *Andvakia* with *Decaphellia* Bourne, 1918. Rodríguez *et al.* 2012 transferred Andvakiidae to superfamily Metridioidea Carlgren, 1893 and synonymized it with Isophellidae Carlgren, 1900, a family previously differentiated by the presence of basilar muscles.

Here I describe *Andvakia manoloi* sp. nov., based on nine specimens found in San Matías Gulf (Río Negro, Argentina). This is the first record for the genus *Andvakia* from the South Atlantic Ocean and the southernmost record for the genus.

Materials and methods

Nine specimens were collected by hand in the intertidal zone of Punta Colorada (41º 46' S, 65º 00' W) (Fig. 1). The specimens were relaxed with menthol crystals for a few hours, fixed in 4% seawater formalin for two months, and transferred to 70% ethanol for long-term storage afterwards.

The specimens were examined whole and in dissection. Histological sections 5–10 µm thick were made from different parts of five specimens and were stained with Azocarmin triple staining (Humason 1967). To assess the presence of basilar muscles, the proximal end of three specimens were sectioned and stained. Since most specimens were covered with sand and small gravel, it was necessary to pretreat the specimens for histology with 40% hydrofluoric acid for 12 h to dissolve the attached particles.

The distribution of the cnidae in the tissues was determined using a light microscope (1000x magnification, oil immersion). I only used two specimens for the cnidae observation; the specimens are small and fragile and there were only four specimens left after histology. Forty undischarged capsules of each type of cnida (when possible) were haphazardly chosen to be measured and photographed with Axio Vision 4.4 software. Mean and standard

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deviation have been provided to give an idea of size distribution since they provide information about variability in capsule size for each type of cnida in each tissue (see Williams 1998; 2000 for minimal requirements for statistical significance in cnida sizes). Cnida nomenclature follows Mariscal (1974).

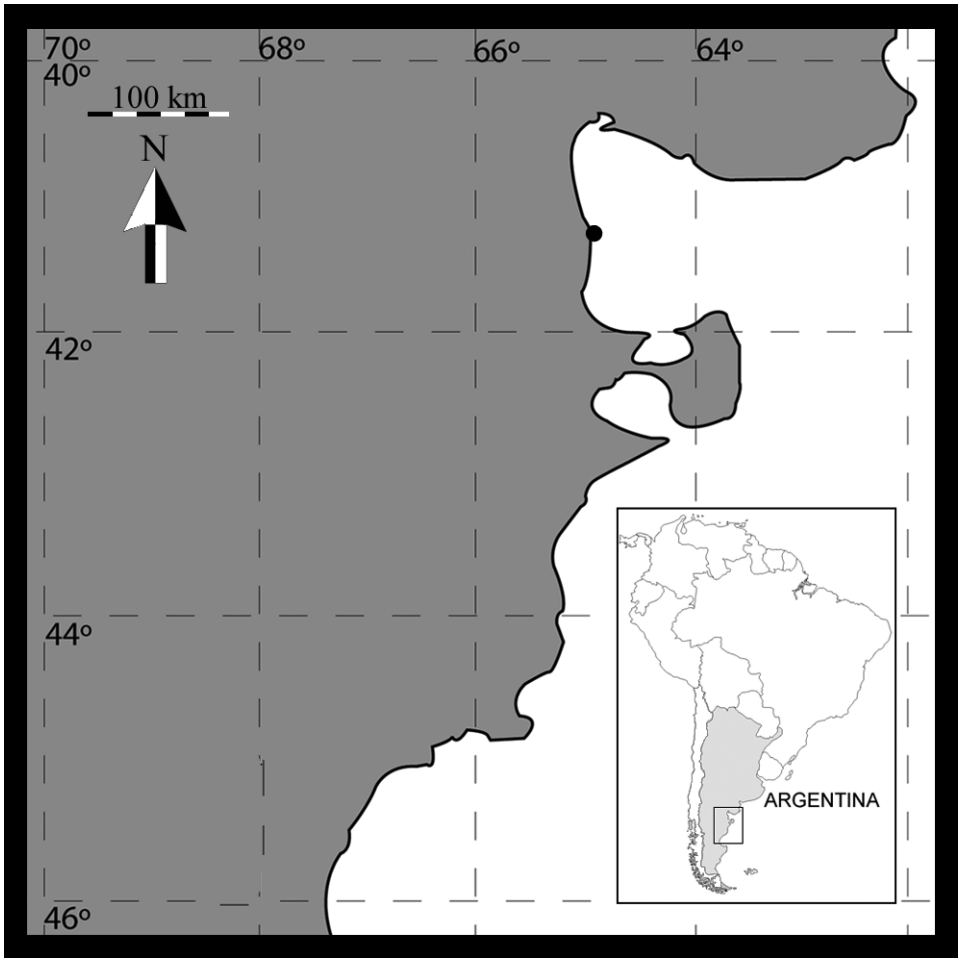

FIGURE 1. Geographic distribution of *Andvakia manoloi* sp. nov.

Systematics

Suborder NYNANTHEAE Carlgren, 1899

Superfamily METRIDIOIDEA Carlgren, 1893

Family ANDVAKIIDAE Danielssen, 1890

Genus *Andvakia* Danielssen, 1890

***Decaphellia* Bourne, 1918: p. 60.**

Description (after Daly & Goodwill 2009, modifications in bold).

Andvakiidae with column divisible into physa, scapus, and capitulum. Scapus with tenaculi. Capitulum **may have few** spirocysts. Physa small, sometimes flattened. More than 12 tentacles. Five or six perfect and fertile pairs of mesenteries with very strong restricted (reniform) to circumscribed retractor muscles; imperfect mesenteries without muscles. Acontia usually few, short. Cnidom: spirocysts, basitrichs, microbasic *p*-mastigophores, microbasic *p*-amastigophores.

Type species: *Andvakia mirabilis* Danielssen, 1890.

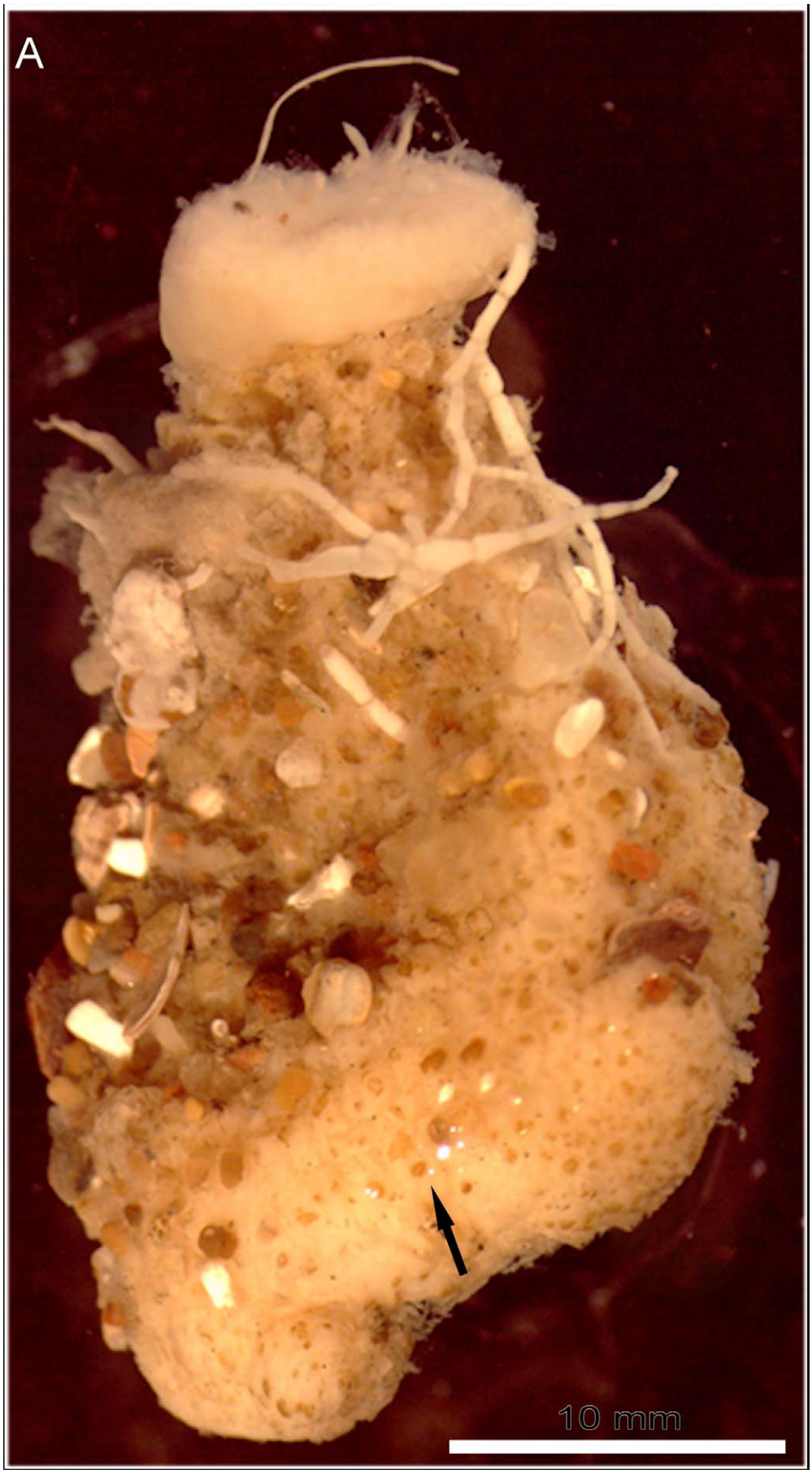

FIGURE 2. External anatomy of *Andvakia manoloi* sp. nov. Arrow points to tenaculum.

***Andvakia manoloi* sp. nov.**
(Figures 2, 3 & 4)

Type material. Holotype: MACN-IN 39033; Punta Colorada, Río Negro, Argentina (41º 46' S, 65º 00' W), November 2010, intertidal zone. Col. Daniel Lauretta. Paratype: Invertebrate collection of MLP 3725, one specimen. Collecting data same as those of holotype. Other material examined: MACN-IN 39034, two specimens. Collecting data same as those of holotype.

Description:

External anatomy. Flat base attached to substratum (rounded in one specimen), to 9 mm diameter. Column longer than wide, 19 mm long and 10 mm wide in preserved holotype; mean of all observed specimens in preservation 19.3 mm long and 10.5 mm wide. Column divisible into physa, scapus, scapulus and capitulum (Fig. 2, 3a). Cuticle covers scapus and scapulus (Fig. 2, 3a, 3b). Scapus brown, with tenaculi to which sand and gravel attach (Fig. 2). Scapulus lighter brown, without tenaculi or attached particles. Capitulum white, without tenaculi (Fig. 2, 3a). When contracted, capitulum and scapulus covered by scapus.

Tentacles very fragile, white (preserved specimens), most inverted in preservation, very difficult to count, 36 (but probably 48 according to number of mesenteries), small to 1.5 mm, inner longer than outer.

Internal anatomy. Twenty four pairs of mesenteries (48 mesenteries) in three cycles plus fourth incomplete cycle (6+6+12+24?=48). First cycle perfect (two specimens had only five pairs perfect). At actinopharynx, only mesenteries of second cycle with filaments (Fig. 3e). Two pairs directives, one attached to more or less differentiated siphonoglyph, second attached to smooth part of actinopharynx. At least a few more mesenteries proximally than distally (Fig. 3c). Retractor muscles strong, restricted (Fig. 3e). Second cycle and additional mesenteries without retractors. Parietal muscles strong, asymmetrical (Fig. 3d), present only on mesenteries of first cycle. Marginal sphincter muscle mesogloeal, strong, reticulate, occupying entire width of mesogloea in upper part of scapulus and lower half of capitulum (Fig. 3a). Longitudinal muscles of tentacles and radial muscles of oral disc ectodermal. Acontia short, poorly coiled, white, on mesenteries of first, second, and third cycle. Basilar muscles absent (Fig. 4).

Cnidom and cnidae distribution.

Spirocysts, basitrichs, microbasic *p*-mastigophores and microbasic *p*-amastigophores (Fig. 5). See Table 1 for distribution and size. Despite making several preparations from tentacles of both specimens, I found no cnidocysts, probably because the epidermis was detached, so data for cnidae of tentacles are from a third specimen.

TABLE 1. Size ranges of the cnidae of *Andvakia manoloi* sp. nov.: mean length by mean width of capsules. MN: mean. SD: standard deviation. n: number of capsules measured. N: number of specimens in which each cnidae was found / total number of specimens examined. Abbreviations: M, Microbasic. Data shown in the table are those of the holotype.

	Range of length and width of capsules (µm)	MN ± SD	n	N
Tentacles				
Spirocysts	(13.9–36.3) x (1.7–4.3)	20.3 ± 5.3 x 2.9 ± 0.7	25	1/3
Basitrichs	(26.9 x 2.9)	--	1	1/3
Capitulum				
Spirocysts	(13.8–21.4) x (2.1–2.9)	18.0 ± 3.8 x 2.5 ± 0.4	3	1/2
Basitrichs	(10.0–13.6) x (1.5–3.0)	10.5 ± 1.6 x 2.0 ± 0.6	6	1/2
M *p*-mastigophores	(12.4–15.4) x (3.0–4.7)	13.8 ± 0.8 x 4.0 ±0.4	28	1/2
Scapus				
Spirocysts	(15.0–25.8) x (2.3–3.8)	20.7 ± 3.9 x 3.0 ± 0.6	8	2/2
Basitrichs I	(8.6–17.1) x (1.4–3.8)	15.0 ± 2.2 x 3.0 ± 0.7	12	2/2
Basitrichs II	(25.7–38.2) x (2.9–4.5)	33.7 ± 4.6 x 3.7 ± 0.6	6	2/2
M *p*-mastigophores	(28.1–32.4) x (3.0–3.7)	29.7 ± 2.3 x 3.5 ± 0.4	3	1/2

..... *continued on the next page*

TABLE 1. (Continued)

	Range of length and width of capsules (µm)	MN ± SD	n	N
Actinopharynx				
Basitrichs I	(11.2–14.8) x (1.4–2.0)	13.9 ± 1.8 x 1.7 ± 0.3	4	2/2
Basitrichs II	(21.9–24.2) x (2.4–3.0)	22.9 ± 0.7 x 2.7 ± 0.2	9	2/2
M *p*-mastigophores	(14.1–22.7) x (3.0–4.3)	20.5 ± 2.2 x 2.8 ± 0.4	13	2/2
Mesenterial filaments				
Basitrichs I	(9.2–20.5) x (1.5–3.9)	15.9 ± 3.4 x 2.0 ± 0.6	12	2/2
Basitrichs II	(27.0–39.2) x (3.4–3.9)	33.2 ± 6.1 x 3.7 ± 0.3	3	2/2
M *p*-mastigophores I	(9.4–18.0) x (3.0–4.5)	11.9 ± 1.5 x 3.8 ± 0.4	38	2/2
M *p*-mastigophores II	(24.9–34.5) x (3.3–4.1)	28.4 ± 2.3 x 3.7 ± 0.7	34	2/2
Acontia				
Basitrichs I	(10.3–20.3) x (1.4–2.5)	13.8 ± 4.1 x 1.8 ± 0.4	5	2/2
Basitrichs II	(33.6–42.7) x (3.3–5.4)	38.3 ± 2.4 x 4.4 ± 0.5	43	2/2
M *p*-amastigophores	(31.3–34.1) x (3.3–5.0)	34.1 ± 1.4 x 4.0 ± 0.4	43	2/2

Distribution and natural history. Members of *Andvakia manoloi* sp. nov. are inconspicuous inhabitants of the upper intertidal zone of the rocky intertidal zone of Punta Colorada. The beach has a strong wave action and semidiurnal tidal regime with an average tide amplitude of 6.01 meters (Servicio de Hidrografia Naval).The nine specimens were found together more or less strongly attached to the rocky wall of a small cave covered by the mussel *Perumytilus purpuratus* (Lamark) and sand, protected from the wave action. During low tide, the specimens remained exposed to the air, but always away from sunlight and sight, so the specimens were discovered by touch. The record of *Andvakia manoloi* sp. nov. in Argentinean waters represents the first record of the genus *Andvakia* for the South Atlantic Ocean and the southernmost record worldwide.

Despite searching since 2007 in both the intertidal and subtidal zone of the patagonic coast from Rio Negro province to Tierra del Fuego province, this was the first and only time that I found this species. The species probably has a broader distribution, but since it is small and looks very similar to the substrata, it is very difficult to locate. It may also occur subtidally. No similar specimens were found in the MACN or MLP collections.

There are no other species belonging to genus *Andvakia* in Argentinean waters, but *A. manoloi* sp. nov. is not the only sea anemone from Argentina with the column covered by cuticle. *Phellia exlex* (McMurrich, 1904) has been recorded from Argentina from 100 m to 400 m deep off Buenos Aires Province (Riemann-Zürneck 1975; Zamponi & Acuña 1991), I compared the specimens found with specimens of *P. exlex*. *Andvakia* and *Phellia* Gosse, 1858 differ in the presence of basilar muscles (Daly & Goodwill 2009: 272). Despite the similarities between both species, *P. exlex* has well developed basilar muscles, so there is no doubt that the specimens found in Punta Colorada cannot be assigned to *P. exlex*.

Etymology. The species is named after Manuel Gallinar Marcos (Manolo), in appreciation for all the time and wisdom he has shared with me.

Differential diagnosis of *Andvakia manoloi* sp. nov. Forty eight tentacles. Six pairs of perfect mesenteries. More mesenteries in proximal part than in distal part of the column. Mesogloeal sphincter strong, reticulated. Retractor muscles of the mesenteries restricted, parietal muscle asymmetrical, strong. Column divided into scapus, scapulus and capitulum.

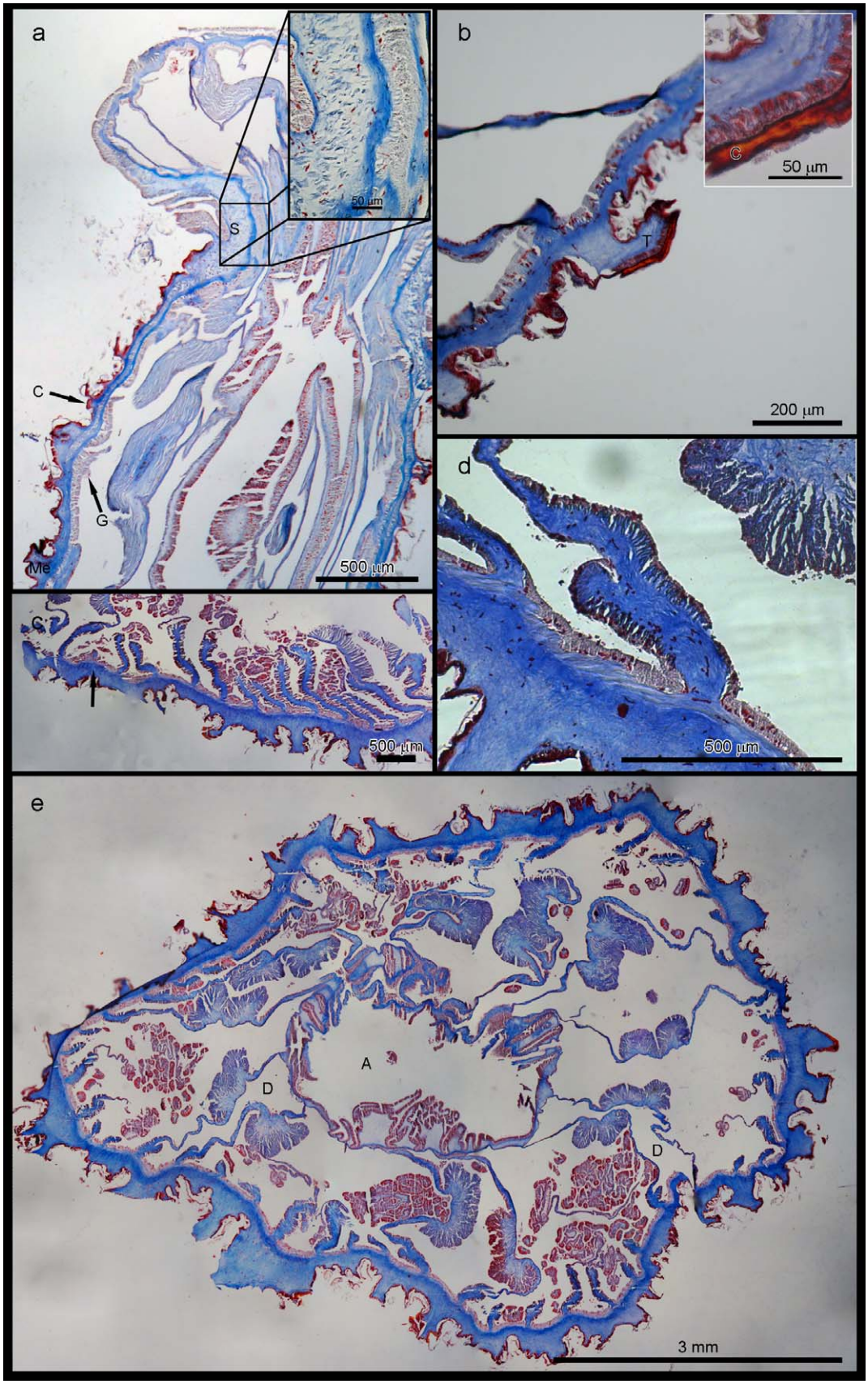

FIGURE 3. Internal anatomy of *Andvakia manoloi* sp. nov. a) Longitudinal section through distal column, showing marginal sphincter. b) Cross section through mid column, showing a tenaculum and cuticle. c) Cross section through proximal column. Arrow points to fourth cycle mesentery. d) Detail of parietal muscle. e) Cross section of the column at the actinopharynx; the holotype display the same arrange shown in the image. Abbreviations: A, actinopharynx; C, cuticle, D, directive mesenteries; G, gastrodermis; Me, mesogloea; S, sphincter; T, tenaculum.

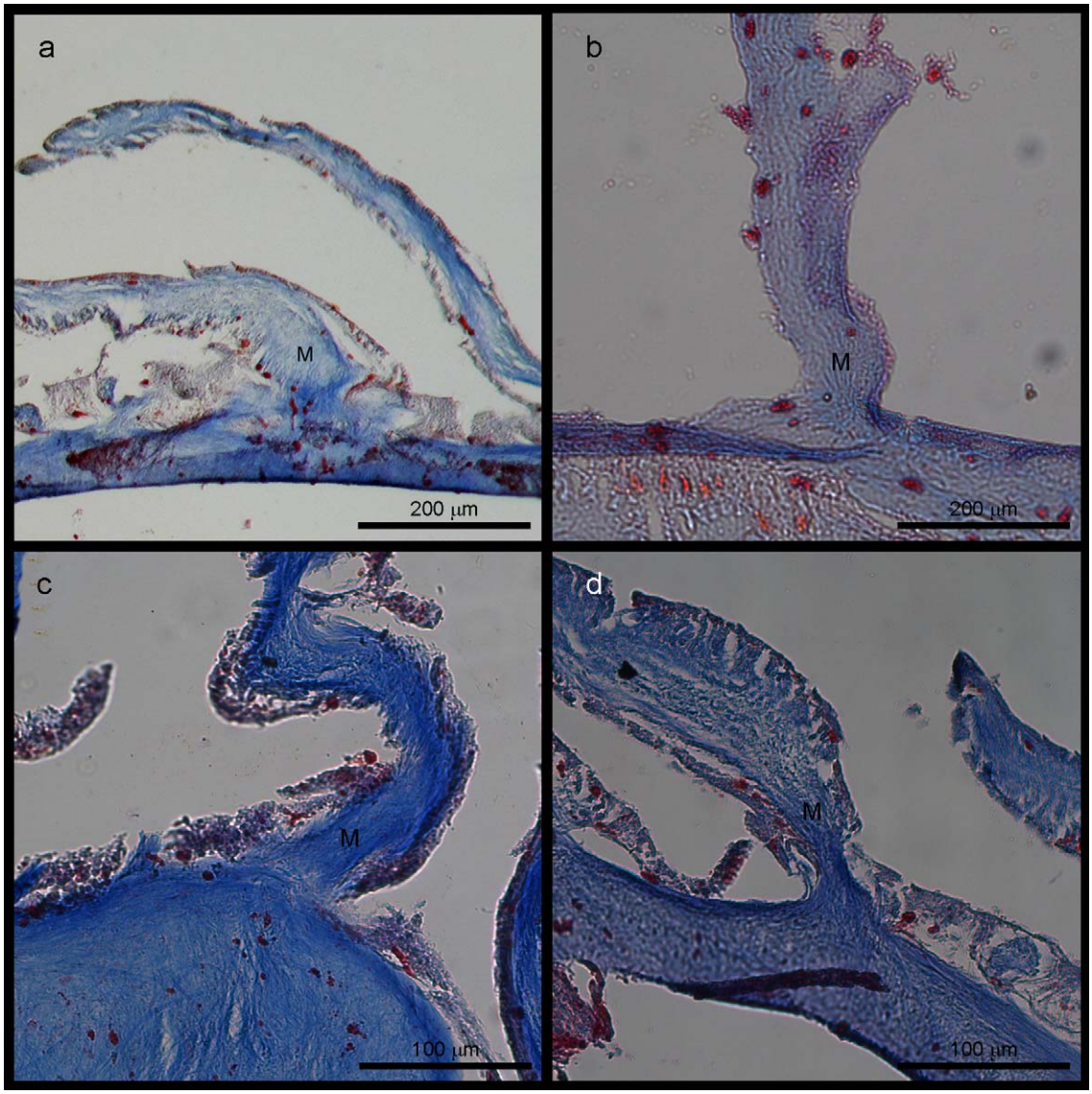

FIGURE 4. Cross section showing the junction between proximal end and a mesentery. Images a and b, and c and d correspond to the same specimens respectively. M, mesentery.

Discussion

Familial and generic placement.

Andvakia manoloi sp. nov. clearly belongs to Andvakiidae, but the generic assignment of the specimens is rather problematic. The family includes nine genera (Carlgren 1949; Daly & Goodwill 2009; Rodríguez *et al.* 2012); Table 2 summarizes the main characteristics of the genera along with their distribution and depth. Five of the nine genera are dismissed as potential assignments for this new species because they lack tenaculi (*Synandwakia*, *Telmatactis*, *Litophellia*, *Euphellia*, *Gymnophellia*), which are clearly distinct and abundant in my specimens. The specimens cannot be assigned to *Flosmaris* (the genus has 12 pairs of perfect mesenteries), *Epiphellia* (it has the same number of mesenteries in proximal and distal part of the column) or *Isophellia* (it has the same number of mesenteries proximal than distal and six pairs of mesenteries plus six mesenteries) which is the only genus previously recorded from Argentina (*Isophellia madrynensis* Zamponi and Acuña, 1992 was cited from the intertidal zone of Puerto Madryn, Patagonia). Finally, all genera except *Andvakia* have basilar muscles. Basilar muscles are easily overlooked, especially in species with poorly developed basilar muscles, but I sectioned several specimens and found no basilar muscles. Although the column of the specimens is less elongated than in other

members of the genus, the overall internal and external anatomy resembles *Andvakia* very much: the specimens clearly have tenaculi, more mesenteries in proximal part of the column, restricted retractor muscles, five or six pairs of perfect mesenteries and have no basilar muscles, so the species belongs to genus *Andvakia*.

TABLE 2. Valid genera of Andvakiidae.

Genera	Tenaculi	More mesenteries proximal than distal	Retractor muscles	Perfect mesenteries	Basilar muscle	Principal references	Cinclides	Depth (m)	Distribution
Gymnophellia England, 1992	No	No	Diffuse, more or less restricted	10–12 pairs	Yes	England 1992	Yes	8	Hong Kong
Epiphellia Carlgren, 1950	Yes	No	Retractors of the macrocnemes very strong, restricted	Six pairs	Yes	Carlgren 1950; England 1992	Probably no	0–3	Australia and Hawaii
Synandwakia Carlgren, 1947	No	Yes	Retractors of the macrocnemes restricted to circumscribed	Six pairs	Yes	Carlgren 1947; Kostina 2003	Yes	0–47	Japan, Korea, Sea of Okhotsk
Litophellia Carlgren,1938	No	No	Retractors of the macrocnemes strong, restricted	Eight pairs	Yes	Carlgren 1938; England 1992	Yes	0–3	South Africa
Flosmaris Stephenson, 1920	Yes	?	Retractors of the macrocnemes strong, restricted (circumscribed?)	12 pairs	Yes	Stephenson 1920; Hand & Bushnell 1967	Probably no	0–?	New Zealand; California, China; Japan; Indian Ocean
Telmatactis Gravier, 1916	No	No	Retractors of the macrocnemes very strong, restricted	First cycle	Yes	Gravier 1916; Carlgren 1938; Carlgren 1950	No	0–62	Worldwide mainly in tropical and subtropical zone
Euphellia Pax, 1908	No	?	?	Six pairs	?	Pax 1908	Yes	0	Canary Island
Isophellia Carlgren, 1900	Yes	No	Retractors of the macrocnemes strong, restricted, with high folds	Six pairs + six mesenteries	Yes	Carlgren 1900; Stephenson 1920; Carlgren 1928; Carlgren 1938	Yes	0–22	South Africa; Argentina; Australia; Tanzania
Andvakia Danielssen, 1890	Yes	Yes	Very strong restricted to circumscribed	Five or six pairs	No	Daly & Goodwill 2009; Rodríguez *et al.* 2012	No	0–275	Pacific Ocean; California Gulf; Gulf of Mexico; North and South West Atlantic

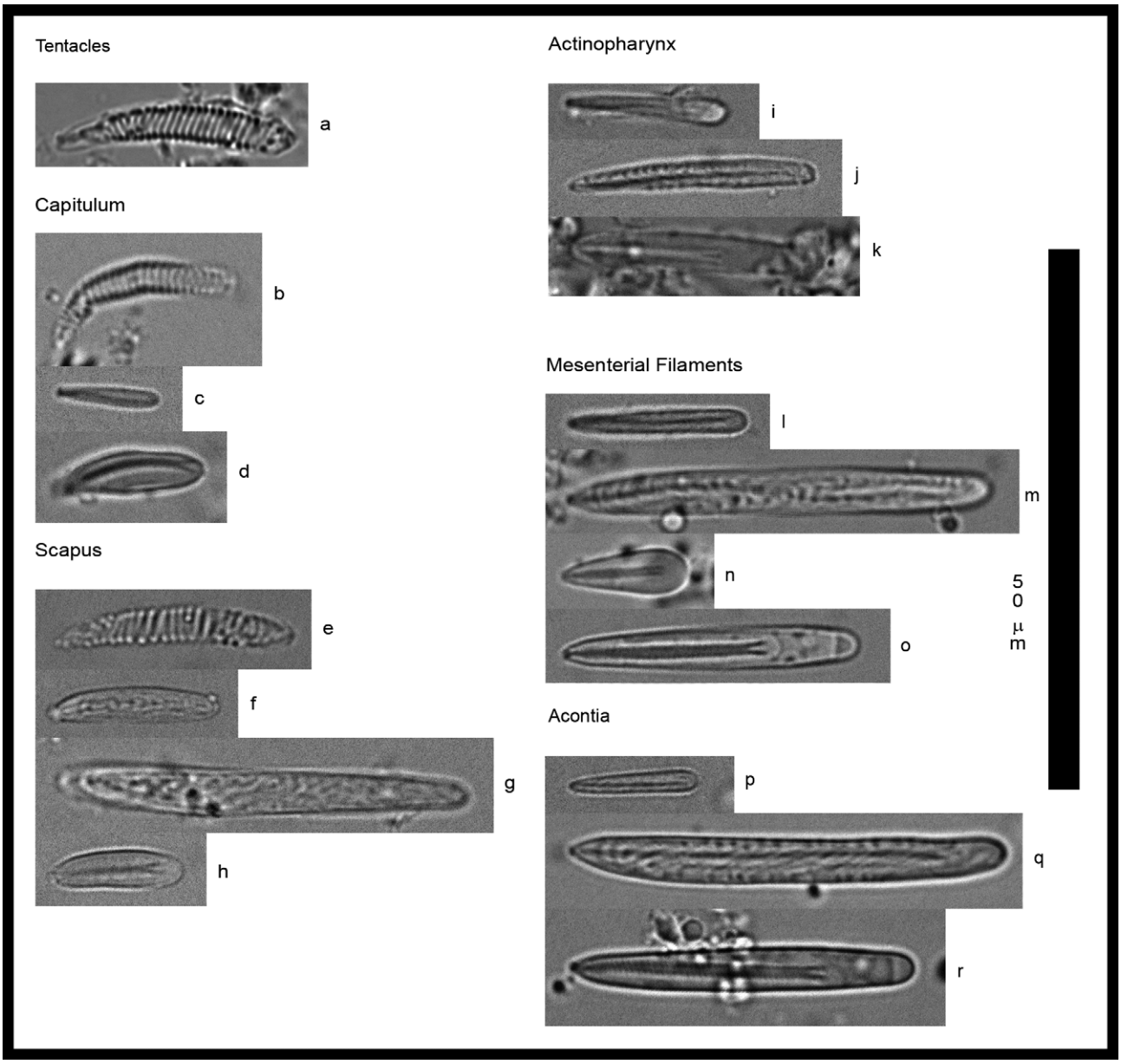

FIGURE 5. Cnidae of *Andvakia manoloi* sp. nov. a) Spirocyst. b) Spirocyst. c) Basitrich. d) Microbasic *p*-mastigophore. e) Spirocyst. f) Basitrich. g) Basitrich. h) Microbasic *p*-mastigophore. i) Basitrich. j) Basitrich. k) Microbasic *p*-mastigophore. l) Basitrich. m) Basitrich. n) Microbasic *p*-mastigophore. o) Microbasic *p*-mastigophore. p) Basitrich. q) Basitrich. r) Microbasic *p*-amastigophore.

Species of *Andvakia* are very similar and differ in number of tentacles, development of parietal and sphincter muscles and size of cnidae (Daly & Goodwill 2009). *Andvakia manoloi* sp. nov. differs from other species in tentacle number, number of mesenteries, habit and distribution (Table 3). *Andvakia isabellae* is the most similar species to *A. manoloi* sp. nov., but differs from it in the shape of the proximal end (flat or round in *A. manoloi* sp. nov. and round in *A. isabellae*), oral disc coloration (grey in *A. isabellae* and white in *A. manoloi* sp. nov.), capitulum (absent in *A. isabellae* and present in *A. manoloi* sp. nov.), size (to 85 mm long in *A. isabellae* and 22 mm in *A. manoloi* sp. nov), cycles of mesenteries with filaments (all in *A. isabellae* and only mesenteries from the first and second cycle has filaments in *A. manoloi* sp. nov.), parietal muscle (asymmetrical and stronger in *A. manoloi* sp.nov.), number of mesenteries in proximal and distal part of the column (same number in *A. isabellae* and more mesenteries in proximal end of *A. manoloi* sp. nov. although the base was in poor condition in Carlgren's specimens, so the possibility of an extra cycle at the proximal end cannot be ruled out), habit and distribution (*A. isabellae* has a burrowing habit and is known from the Gulf of Mexico, Texas, to 18 m. whereas *A. manoloi* sp. nov.

lives attached to hard substrata in the intertidal zone of Playa Colorada, Argentina.). There are also differences in cnidae: *A. isabellae* has larger basitrichs in the actinopharynx, smaller basitrichs in the filaments and acontia, larger microbasic *p*-mastigophores in the actinopharynx, smaller microbasic *p*-mastigophores in the filaments and larger microbasic *p*-amastigophores in acontia (compare Table 1 with Carlgren & Hedgpeth 1952: 149). Since few spirocysts were found in the capitulum, I amended the genus diagnosis to include that possibility.

TABLE 3. Valid species of *Andvakia* and their general characteristics.

Species	Tentacles	Retractor muscle	Parietal muscle	Habit	Distribution	Max. size (long x wide) mm
A. mirabilis Danielssen, 1890	24	Strong	Weak	Burrowing	North Atlantic Ocean, Norway, 180–270 m	70 x 15
A. psammomitra (Bourne, 1918)	24	Strong	Weak	Attached to shells and stones	Eastern Pacific Ocean, New Caledonia	7.5 x 2.75
A. parva Carlgren,1940	20–24	Strong	Strong, asymmetric	Attached to shells and stones	North Atlantic Ocean, Sweden, 60–70 m	10 x 3
A. boninensis Carlgren, 1943	24	Strong	Strong, Symmetric	Burrowing	Eastern Pacific Ocean, Bonin Islands; Western Pacific Ocean: Saipan, Mariana Islands: Intertidal and shallow subtidal	20 x 3
A. insignis Carlgren,1951	24	Strong, reniform to circumscribed	Well developed	Burrowing	Gulf of California, Mexico, Espíritu Santo Island	12 x 4
A. isabellae Carlgren & Hedgpeth, 1952	48	Strong, restricted to circumscribed	Weak	Burrowing	Gulf of Mexico, off Texas, to 18 m	85 x 25
A. discipulorum Daly & Goodwill, 2009	24	Strong	Weak, Symmetric	Aboral end buried in sediment with aboral end attached to solid substrate	Central Pacific Ocean, Hawaii. Intertidal	12 x 2
A. manoloi sp.nov.	36 (48?)	Strong	Strong, asymmetric	Attached to shells and stones	South Atlantic, intertidal	22 x 12

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