

A new *Agelas* (Demospongiae: Agelasida: Agelasidae) from the Thousands Islands, West-Java, Indonesia

N.J. de Voogd, F.J. Parra-Velandia & R.W.M. van Soest

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Nicole J. de Voogd, National Museum of Natural History, P.O. Box 9517, 2300 RA Leiden, The Netherlands (voogd@naturalis.nl).

Fernando J. Parra-Velandia, Universidad Nacional de Colombia, Departamento de Biología and Centro de Estudios en Ciencias del Mar – CECIMAR; INVEMAR, Cerro Punta de Betín, A.A. 10-16, Santa Marta, Colombia (fernando.parra@gmail.com).

Rob W.M. van Soest, Zoological Museum, University of Amsterdam, P.O. Box 94766, 1090 GT Amsterdam, The Netherlands (soest@science.uva.nl).

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Agelas linnaei spec.nov. (Porifera: Demospongiae: Agelasida: Agelasidae) is described from the Thousands Islands reef complex, West-Java, Indonesia. The new species is compared with all other *Agelas* species occurring in the Indo-West Pacific region. The new species differs from these other species by the overall morphology and the size of the verticillated acanthostyles. Surprisingly, this is only the second *Agelas* species ever described from Indonesia.

Introduction

Sponges belonging to the genus *Agelas* are often large and conspicuous reef dwellers. So far, forty nominal species have been described originally as *Agelas* or are subsequently assigned to it from other genera (*Ectyon*, *Oroidea*, *Chalinopsis*), one of which (*A. albolutea*) is no longer considered to belong in *Agelas*, and two are incertae sedis, and six species are considered to be junior synonyms (Van Soest et al, 2005, consulted on 1 November 2007). The majority has been described from the Caribbean (17 spp.) of which fourteen species are currently under revision (Parra-Velandia et al, in prep). Although it is thought that the Indo-Pacific coral reefs are the most diverse in the world, only thirteen species belonging to this genus are found so far and only a single species has been described from Indonesia (Thiele, 1903). A revision of the Indo-Pacific *Agelas* species is urgently needed, because most descriptions are based on small fragments, lacking good morphological characters and in situ photographs. In addition, the variation of the skeletal characters, such as the arrangement of the fibres and the spicule morphology, is very low making the external growth form very important in species identification. The genus *Agelas* is placed in the family Agelasidae and this currently remains a monotypic family (Van Soest, 2002). The taxonomic placement of the family has been in debate for many decades and recently, the family was placed together with the Astroscleridae in its own order Agelasida (Van Soest & Hooper, 2002). In addition, most of these species contain brominated pyrroles, which are known to have cytotoxic, antibacterial, anticancer properties (Vik et al, 2006; Erpenbeck & Van Soest, 2007). During the 2005 LIPI-NNM Expedition, a very conspicuous *Agelas* species was observed in the Thousands Islands reef complex, off Jakarta, West-Java, Indonesia, which appears to be

undescribed. Interestingly, new bromopyrrole alkaloid derivatives along with known compounds have been isolated from this species and some of these substances showed prominent inhibition against L5178Y mouse lymphoma cells (Hertiani, 2007). To avoid adding to the large number of publications on natural products isolated from unnamed sponges, we decided to describe this species first, despite the need for a revision of the

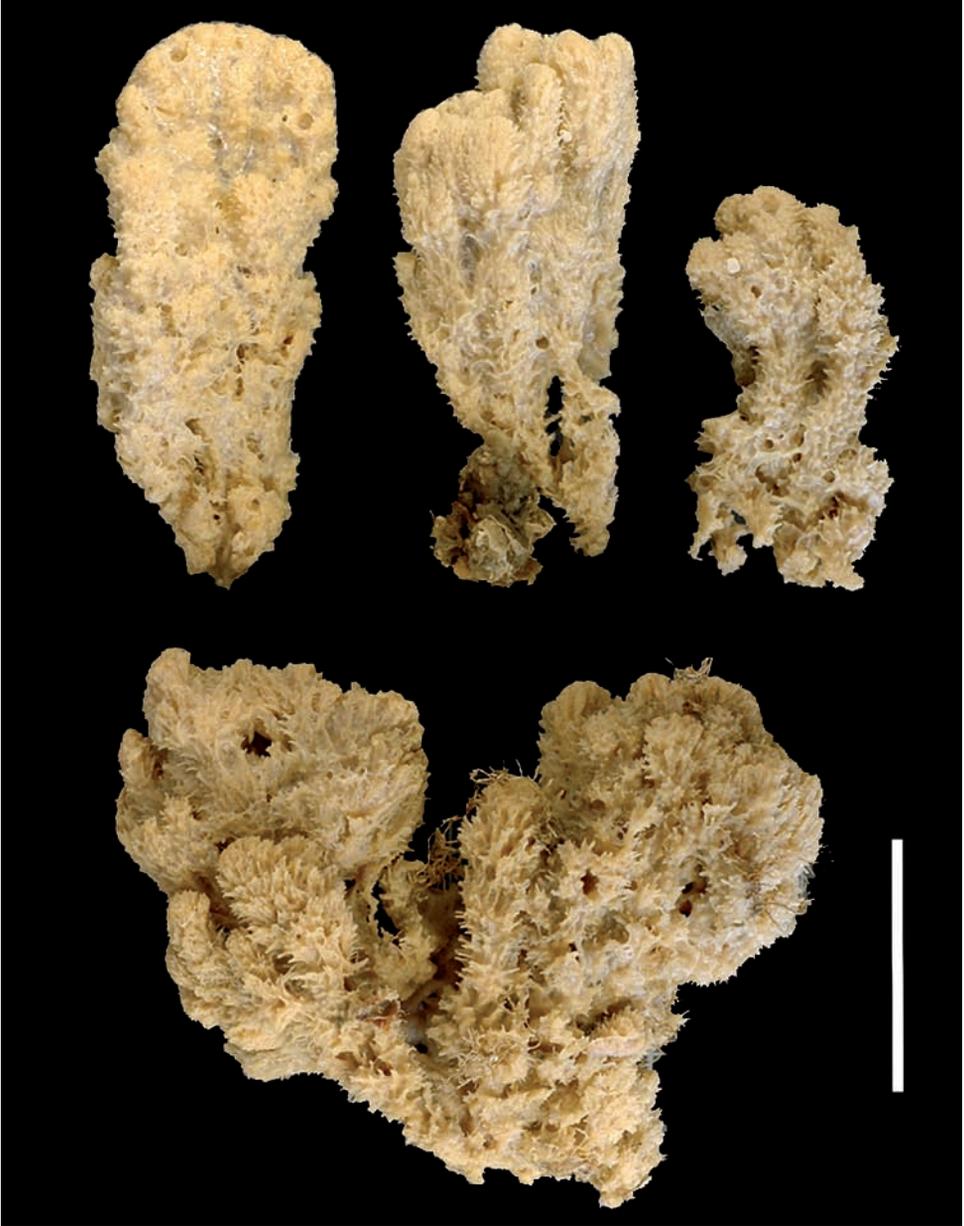


Fig. 1. *Agelas linnaei* spec. nov., preserved specimen of holotype; (scale bar = 5 cm).

Indo-Pacific *Agelas* spp. In the present paper we describe and compare the new species with the other described *Agelas* species from adjacent seas.

Materials and methods

The sponge was collected in the Thousands Islands, West-Java, Indonesia by the first author using SCUBA in September 2005. The specimen is preserved in 70% ethylalcohol and deposited in the sponge collection of the National Museum of Natural History (RMNH Porifera). The description presented below is based on external morphology, skeletal architecture and shape and size of the spicules. Spicule dimensions are given as the mean length (range of length measurements) × mean width (range of width measurements) of 100 spicule measurements. For study of the skeletal architecture hand-cut tangential sections of the ectosome and perpendicular sections of the choanosome were made. The sections were air-dried, mounted in Durcupan® ACM on a microscope slide, and studied under a Leitz high power light microscope. Spicule preparations were made by dissolving a small piece of the specimen in 100% nitric acid (HNO₃), after which the residue was rinsed four times with water, once with 96% ethanol. The spicules were air-dried on microscopic slides and prepared for study with the light microscope by mounting them in Durcupan® ACM, as well as put on aluminum stubs and coated with gold or gold-palladium for study with a Jeol Scanning Electron Microscope and a FEI QUANTA 200 SEM microscope.

To obtain thin sections of tissue to study the three-dimensional arrangement of skeleton and spicules, pieces of about 10 × 10 × 2 mm were cut from each specimen, including the surface, then air dried; these samples were washed several times in a commercial detergent solution (Bold, Ariel) and maintained for 24 h in a warm temp (35–40°C), then were washed and stirred five times in abundant double distilled water, after that washed and stirred twice in ethanol 96%, and finally let to air dry. The images were taken in a HP Scanjet 4070 scanner, with the maximum resolution (2400 dpi) possible.

The classification used here follows the Systema Porifera (Hooper & Van Soest, 2002).

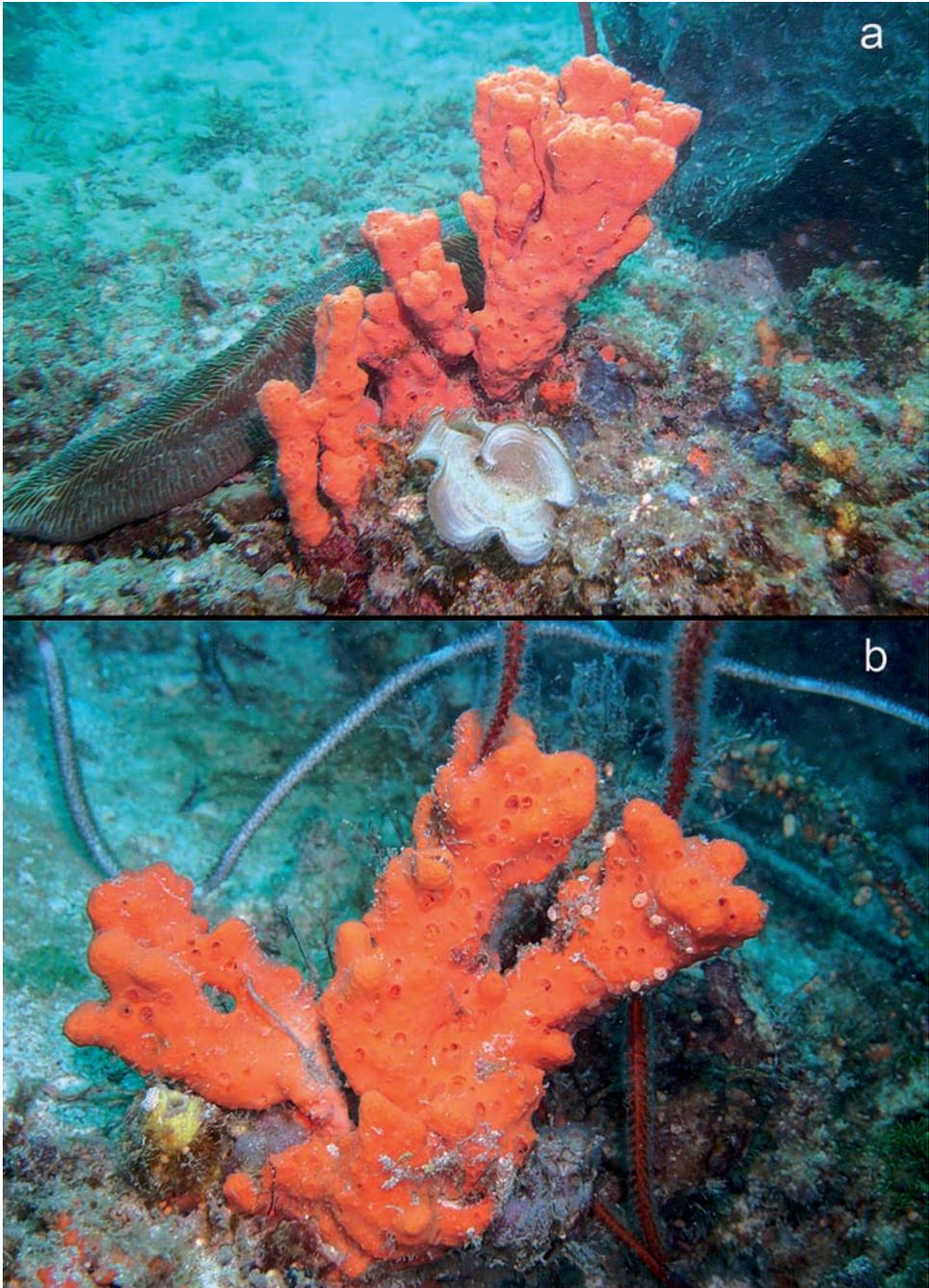
Systematic part

Phylum Porifera Grant, 1835
Class Demospongiae Sollas, 1885
Order Agelasida Hartman, 1980
Family Agelasidae Verrill, 1907
Genus *Agelas* Duchassaing & Michelotti, 1864

Agelas linnaei spec. nov.
(figs 1, 2a-b, 3a-d)

Material.— Holotype: RMNH POR. 2109, Indonesia, NW Java, Thousands Islands, Peniki E Island, 5°41'32"S 106°43'03"E; 15m., 25.ix.2005, coll. N.J. de Voogd, #SER41/250905/147.

Shape and size.— Roundly lobate to thickly flabellate. Holotype consists of four separate pieces. The largest piece is 14 cm in width, 8 cm in height and 2.5 cm in diameter



Figs 2a, b *Agelas linnaei* spec. nov. in situ. Photo's N.J. de Voogd.

(diameter, height, width) (figs 1, 2a-b), but specimens can grow much larger.

Colour.— Bright orange externally to cream-orange internally.

Surface and consistency.— Texture: very soft, spongy; dermis is a bright easily distinguishable membrane, with dense concentrations of conules. The conule height varies from 1 to 3 mm. Small apertures (< 2 mm) are scattered across the body, in between some lobes bigger pores (2-3 mm) may be observed connected to internal axial channels.

Skeleton.— The interior is densely punctured by primary canals 200 μm -2 mm in diameter, from which secondary canals radiate, 100 μm -1.0 mm wide. The conules are reinforced internally by tracts of fibers. The skeleton is an irregular and dense reticulation of spongin fibres; primary fibres (35-80 μm in diameter), aggregated in packs, more or less undulated, heavily cored (1-7 spicules in cross section) and echinated; secondary interconnecting fibres (25-40 μm in diameter) are not cored and less echinated than the

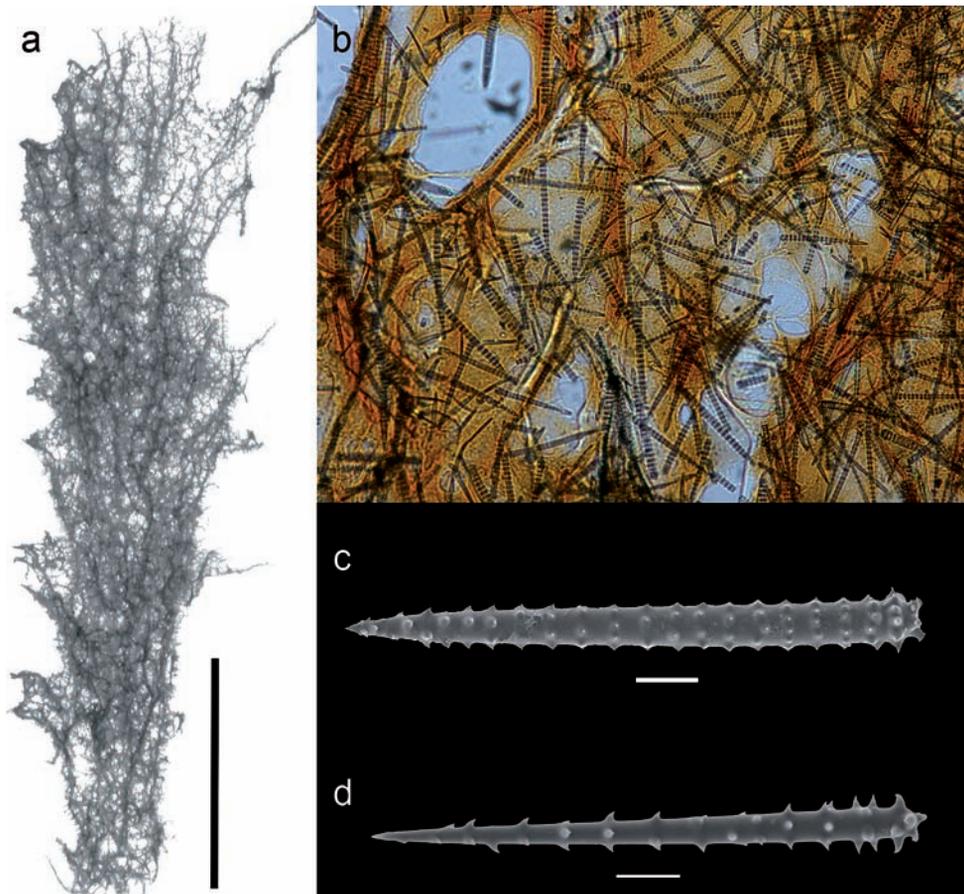


Fig. 3. a, Thin section of skeleton (scale bar = 20 mm), b, cross section of choanosomal skeleton, c, large verticillated style, (scale bar = 20 μm), d, small verticillated style, (scale bar = 10 μm).

primaries; tertiary fibres (20-30 μm in diameter) present and echinated in a similar fashion as the secondaries, also uncored (fig. 3a, b). Meshes irregular from 100-250 μm in diameter.

Spicules.— Acanthostyles ($N = 100$) are straight, but a few are slightly curved; the whorls, measured in the middle third of the spicule, have 5-12 spines depending on the width, they are conspicuous in the spicule center but sometimes faint and irregular at the spicule tip and head; the average length of spicules is 187 μm (78.7-372.3 μm), the average width is 12.1 μm (5.2-24 μm) and the average number of whorls is 19.3 (11-33) (fig. 3c, d).

Ecology.— Locally very abundant, overgrowing other reef invertebrates.

Distribution.— Only observed at type locality, Peniki Island and the island Payang Kecil in the Thousands Islands Reef complex, off Jakarta, West-Java, Indonesia.

Etymology.— The species is named to honour Carolus Linnaeus, or Carl von Linné, to celebrate 250 years of binomial nomenclature.

Discussion

In this paper we describe a new sponge from Indonesia belonging to the genus *Agelas*. *A. linnaei* spec. nov. is characterized by its very soft consistency, surface with conules, the flabelliform to lobate morphology and the dimension of the verticillated acanthostyles. So far the species has not been recorded elsewhere in Indonesia despite its conspicuousness and extensive historical and recent surveys at many localities within the Indonesian Archipelago. Thirty-three species are presently assigned to the genus *Agelas* (World list of Extant Porifera; <http://www.vliz.be/vmdcdata/porifera/>) of which around 13 are recorded from the Indo-Pacific region. Here we compare our new species with other *Agelas* species from Indonesia and adjacent waters. Apart from two records of *Agelas mauritiana* and *Agelas ceylonica* of widespread Indo-Pacific species by Van Soest (1989), only one other *Agelas* species has been described from Indonesia. *A. cavernosa* (Thiele, 1903) from Ternate, Maluku, is an irregular mass with a few short fingerlike projections. Although, the type consists only of a very small fragment, this species clearly differs from our new species by the smaller maximum size of the acanthostyles (200 \times 15 μm). Three other *Agelas* species have been frequently observed (by NdV and RvS) from various localities within Indonesia (e.g. Bali, NW Java, East-Kalimatan, N & S Sulawesi), these are: *A. ceylonica* (Dendy, 1905), *A. nakamurai* Hoshino, 1985 and *A. nemoechinata* Hoshino, 1985. The type of *A. ceylonica* from the Gulf of Manaar consists of a few slender, anastomosing, sub-cylindrical branches arising from an irregular, proliferous basal crust of which the acanthostyles have a maximum dimension of 240 \times 20 μm . *A. nakamurai* originally described from the Ryukyus Islands, Japan is a massive, rounded or thickly encrusting orange to red sponge. Unlike our species, the surface is smooth with uneven irregularly meandering surface grooves. The acanthostyles are all of a similar length, 226 μm (185-267 μm) \times 12 μm (8-15 μm), and the longest is much smaller than those our new species. *A. nemoechinata* is, like the previous species, massive to thickly encrusting, but the colour is brown with an uneven, honeycomb-like surface. The spicules are 189 μm (170-210 μm) \times 11 μm (9-13 μm) in dimension and are occasionally sharply pointed at both ends. *A. semiglaber* Pulitzer-Finali, 1996 is described from Papua New Guinea. The specimen was only a small crust on a pebble, merely suf-

ficient for a spicule slide. The verticillated styles are in two size categories of which the maximum and minimum dimensions are almost similar to our new species. However, we cannot distinguish different size categories, because of the overlap in spicule dimension. In addition, the larger ones are, unlike our new species, completely smooth in the middle ($230\text{--}375\ \mu\text{m} \times 11\text{--}16\ \mu\text{m}$), while the smaller ones are entirely spined ($75\text{--}100 \times 3.5\ \mu\text{m}$). Pulitzer-Finali (1982) described *A. robusta*, from Hong Kong. The type material is $6 \times 3\ \text{cm}$ and was apparently a massive sponge with a tough and resilient consistency and clathrous structure. This species differs from *A. linnaei* in its morphology and by its very stout acanthostyles with short, blunt spines ($170\text{--}250\ \mu\text{m} \times 14\text{--}30\ \mu\text{m}$). *A. gracilis* (Whitelegge 1897) is described from the Funafuti Atoll in the Pacific Ocean from the deeper subtidal ($72\text{--}125\ \text{m}$). It is subcylindrical, unbranched, and the surface is uneven with numerous minute conuli. The consistency is soft but tough. Although Whitelegge only described one size category of verticillated styles ($100\text{--}220\ \mu\text{m} \times 7\text{--}13\ \mu\text{m}$), Lévi & Lévi (1989) also found a specimen from the deeper subtidal ($85\text{--}90\ \text{m}$) in the Philippines with megascleres in two size categories (I. $90\text{--}120\ \mu\text{m} \times 7\text{--}8\ \mu\text{m}$, II. $190\text{--}290\ \mu\text{m} \times 8\text{--}13\ \mu\text{m}$) and an intermediate size class ($150\text{--}190\ \mu\text{m} \times 8\text{--}12\ \mu\text{m}$). They examined the type and concluded that the specimen from the two localities belonged to the same species. This species clearly differs from our new species by its cylindrical branches, smaller acanthostyles and by the fact that it only occurs in deeper water. Two other *Agelas* were described from deep water off New Caledonia; *A. dendromorpha* (Lévi, 1993) and *A. novaecaledoniae* (Lévi & Lévi, 1983). *A. dendromorpha* has a bush-like appearance with acanthostyles in two size categories (I. $60\text{--}100\ \mu\text{m} \times 3\text{--}4\ \mu\text{m}$, II. $130\text{--}260\ \mu\text{m} \times 10\text{--}12\ \mu\text{m}$), which is clearly different from our new species. In addition, the smaller sized acanthostyles are peculiar in morphology, as they do not possess the verticillation. *A. novaecaledoniae* is an ochre-brown elastic thick plate, with an irregular clathrous surface. The megascleres are in two size categories, but contain acanthoxeas ($120\text{--}250\ \mu\text{m} \times 5\ \mu\text{m}$) in addition to acanthostyles ($100\text{--}190\ \mu\text{m} \times 5\text{--}8\ \mu\text{m}$). The type of *A. bispiculata* (Vacelet, Vasseur & Lévi, 1976) from Madagascar consists of five small hemispherical fragments. The acanthostyles are in two size categories (I. $55\text{--}120\ \mu\text{m} \times 6\text{--}10\ \mu\text{m}$, II. $320\text{--}400\ \mu\text{m} \times 6\text{--}10\ \mu\text{m}$), which have a clear differentiation with the larger ones in the axial skeleton, and the smaller ones echinating the fibres. Another species from Madagascar *A.* (as *Ectyon*) *carpenteri* Gray 1867 is a nomen nudum, as the author only gives a brief reference to another species without a clear description. *A. axifera* Hentschel, 1911 from Southwestern Australia is a red-brown, club-shaped sponge with an irregular surface. The megascleres consist of a mixture of acanthostyles and acanthoxeas of similar dimensions ($112\text{--}152\ \mu\text{m} \times 5\text{--}7\ \mu\text{m}$). The morphology and size and shape of the megascleres are very different from our new species. The type of *A. marmarica* (Lévi, 1958) from Saudi Arabia is an orange sponge which covers coral substrate. The acanthostyles are not larger than $230 \times 10\ \mu\text{m}$, which is much smaller than our new species. The type of *A. mauritiana* (Carter, 1883) from Mauritius consists of a small fragment of $5\ \text{cm}$ and the acanthostyles are about $220\ \mu\text{m}$ in length. The description is very concise, but the spicule dimensions do not fit our spicule measurement. There are similarities between Indonesian *A. linnaei* spec. nov. and Caribbean *A. clathrodes* (Schmidt, 1870) and *A. citrina* Gotera & Alcolado 1987, which may – if proven to be of phylogenetic significance – have biogeographic and evolutionary implications. The presence of secondary and tertiary fibers in the skeleton arrangement, the architecture and length of the spicules,

the surface conules and the chrome color are shared with these two species. The most remarkable difference is that *A. clathrodes* and *A. citrina* have an extremely cavernous choanosome while *A. linnaei* spec.nov. is more dense with narrow channels.

In conclusion, although this is only the second description of a new species of *Agelas* from Indonesia, we expect that forthcoming reef explorations will discover more species; hence we expect that the number of *Agelas* spp. present in the Indo-Pacific region will eventually outnumber the Caribbean *Agelas* species.

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