Six New Agelas Species (Demospongiae: Agelasida: Agelasidae) from Kosrae Island, The Federated States of Micronesia

Chung Ja Sim1, Young A Kim2,*

1Department of Biological Sciences, Hannam University, Daejeon 300-811, Korea
2Korea Institute of Ocean Science & Technology, Ansan 426-744, Korea

ABSTRACT

This paper describes six new species of sponges in the genus Agelas from Kosrae Island, The Federated States of Micronesia. Most Agelasid sponges are known from only tropical regions. All the new Agelas species; A. fragum n. sp., A. kosrae n. sp., A. purpurea n. sp., A. bakusi n. sp., A. vansoesti n. sp. and A. incrustans n. sp. are compared with other valid species that were studied. Six new species differ from the other species by morphology, growth form, skeletal fibres, habitats and spicule size. Agelas fragum n. sp. is characterized by its tuberculate surface and primary fibres with brush-like spicules. Agelas kosrae n. sp. is differs in skeletal structure and have tertiary fibres. Agelas purpurea n. sp. is characterized by having primary, secondary and tertiary fibres are all cored with spicules. Agelas bakusi n. sp. is similar to Agelas clathrodes in shape, but differs in the primary fibres. Agelas vansoesti n. sp. is characterized by having acanthostongyles. Agelas incrustans n. sp. is distinguished by its enourcngting and not cavernous interior.

Keywords: Porifera, Agelasida, Agelasidae, Agelas, new species, Kosrae, Micronesia

INTRODUCTION

Little is known about the sponge fauna from Kosrae, one of four Federated States of Micronesia (FSM). The sponge fauna of FSM are summarized by Kelly-Borges and Valentine (1995), based upon the work of de Laubenfels (1954) and Bergquist (1965). De Laubenfels (1954) report one species, Agelas mauritiana from the Marshall Islands. No species of Agelas were recorded from Truk and Ponpei Island, located near Kosrae. Studies of the genus Agelas in tropical regions were made by Duchassaing De Fonbressin and Michelotti (1864), Carter (1883), Wilson (1902), Wiedenmayer (1977), Thomas (1980, 1981, 1998), Pulitzer-Finali (1982, 1986, 1996), Alcolado (1984), Hoshino (1985), Zea (1987), Van Soest and Stentoft (1988), Lehner and Van Soest (1996, 1998) and Mothes et al. (2007). Assmann et al. (2001) reported the new species A. cerebrum and recorded other Agelas species from the Carribbean. De Voogd et al. (2008) reported one new species, A. linnaei from Indonesia and compared it with all other Agelas species occurring in the Indo-west Pacific.

MATERIALS AND METHODS

Sponge collections were made from the region of Kosrae, the most eastern of the Caroline Islands. The island is located approximately 370 miles (600 km) north of the equator (5°19’ N, 162°59’ E) between Guam and the Hawaiian Islands. They were taken from depths of 10 - 50 m using scuba diving, 23 - 30 Jan 2011, 8 - 15 Jan 2012, 18 - 28 Oct 2012 and 20 - 24 Nov 2013. The GPS coordinates of each site were recorded (Table 1, Fig. 1). Collected specimens were frozen and some preserved in 95% ethyl alcohol and were identified based on their morphological characters. The external feature of sponges was observed with a stereo microscope (Stemi SV 6, Carl Zeiss, Jena, Germany). The skeletal arrangements and spicules were studied under a light microscope (Axioscope II, Carl Zeiss) and SEM (HITACHI S-3500; Hitachi, Tokyo, Japan).

SYSTEMATIC ACCOUNTS

Order Agelasida Hartman, 1980
### Table 1. Geological information for collection sites

| Station | Collection site          | GPS                     |
|---------|--------------------------|-------------------------|
| 1       | Molsron Tukunsru         | 5°17′07″N, 162°54′11″E  |
| 2       | Foko Fukunsral           | 5°15′32″N, 162°59′22″E  |

**Fig. 1.** A map showing the collection sites.

Family Agelasidae Verrill, 1907
Genus *Agelas* Duchassaing & Michelotti, 1864

**1** *Agelas fragum* n. sp. (Fig. 2)

**Type specimen.** Holotype (MABIK IV00151590), Molsron Tukunsru Village, Kosrae, Micronesia, 22 Oct 2012, Rho HS, by scuba, depth 10 m, deposited in the MABIK, Seocheon, Korea.

**Description.** Thin encrusting small pieces, size up to 9 × 6 × 0.1–0.3 cm, more or less tuberculated on the surface, attached tightly to the broad rocky substratum. Microscopically the tubercles are rugose with openings and with spicule clusters that protrude from the surface. Surface of many round projecting conules (1–2 mm height) with oscules. Texture hard at surface, soft at bottom. Color dark red.

Skeleton. Primary fibres cored and echinated, 65–78–232 μm in diameter, the end of primary fibres have densely echinated spicules. Secondary fibres 35 μm in diameter. Secondary fibres make large meshes, less echinated at the sponge base. The top of the surface, tubercle has many echinated brush-like bundles of spicules, mixed with thin smooth Acanthostyles. Tertiary fibres 20–30 μm in diameter, no echinating spicules.

Spicules. Acanthostyles 110–200 × 10–15 μm, number of spine whorls 11–17.

**Etymology.** This species named after the strawberry-like surface characteristics of the specimen.

**Remarks.** This sponge is similar to *Agelas nakamura* Ho-shino, 1985 from the Ryukyu Islands, Japan, thickly encrusting with orange to red color. The surface of *A. nakamura* is smooth with uneven and irregularly meandering surface grooves whereas our specimen is rough with tubercules. Sizes of spicules are larger than those of our new species.

**2** *Agelas kosrae* n. sp. (Fig. 3)

**Type specimen.** Holotype (MABIK IV00151591), Molsron Tukunsru Village, Kosrae, Micronesia, 22 Oct 2012, Rho HS, by scuba depth 15 m, deposited in the MABIK, Seocheon, Korea.

**Description.** Irregular elongated repent sponge with several branches, size up to 20 × 6 × 1.5–2 cm thick. Some wide parts of sponge attached tightly to the substrate. Surface smooth. Texture firm, compressible and hard to tear. Oscules sparse on the surface. Color live, purple on the surface and beige in the choanosome.

Skeleton. Primary fibres rarely cored and rarely echinated, 100–200 μm in diameter. Secondary fibres echinated, 30–60 μm in diameter. Secondary fibres meshes 83–163–232 μm in diameter. Tertiary fibres 10–20 μm in diameter are very rarely echinated.

Spicules. Acanthostyles 110–140 × 6–8 μm, number of spine whorls 19–22. Acanthoxeas 150–170 × 6–8 μm, number of spine whorls 18–22.

**Etymology.** This species is named after the type locality, Kosrae, Micronesia.

**Remarks.** This new sponge is similar to *Agelas cervicornis* (Schmidt, 1879) in branching type but different in skeletal structure, and no tertiary fibers.

**3** *Agelas purpurea* n. sp. (Fig. 4)

**Type specimen.** Holotype (MABIK IV00151592), Molsron Tukunsru Village, Kosrae, Micronesia, 22 Oct 2012, Rho HS, by scuba, depth 15 m, deposited in the MABIK, Seocheon, Korea.

**Description.** Subcylindrical, irregular branched, size up to 13 × 2 × 1.8 cm, attached to the sponge *Agelas kosrae*. Two specimens not fused to each other as they grow separately but adherent. Surface rough with small tubes, and numerous elevated oscules 2–5 mm in diameter. Texture soft and compressible. Color dark purple in life. This sponge is less dense than *A. kosrae*.

Skeleton. Primary fibres, 50–100 μm in diameter, heavily cored; secondary fibres, 30–40 μm diameter, cored; tertiary fibres 10 μm in diameter, cored. All fibres rarely echinated; free spicules occur in the choanosome.

Korean name: **1**매장아겔라스해면(신칭), **2**코스레아겔라스해면(신칭), **3**보라아겔라스해면(신칭)
Fig. 2. *Agelas fragum* n. sp. A, Entire animal (*in situ*); B, Surface of sponge; C, Skeletal structure; D, Terminal brush of spicules; E, Acanthostyle; F, Head of spicule; G, Thin acanthostyle; H, Head of spicule. Scale bars: E, G=50 μm, F, H=10 μm.
Spicules. Acanthoxeas 150–180 × 6 µm, number of spine whors 20–21. Acanthostyles 150–220 × 5–8 µm, number of spine whors 19–21.

**Etymology.** This species named after the live color purple.

**Remarks.** This new species is similar to *A. kosrae* but differs in the skeletal structure. The primary, secondary and tertiary fibres are all cored. Texture is softer than in *A. kosrae*.

---

**Agelas bakusi** n. sp. (*Fig. 5*)

**Type specimen.** Holotype (MABIK IV00151593), Foko Fukunsral, Kosrae, Micronesia, 19 Jan 2011, Rho HS, by scuba, depth 17 m, deposited in the MABIK, Seocheon, Korea.

**Description.** Thickly encrusting, size up to 22 × 20 × 2–3 cm. Surface smooth with many hole-like pits. Consistency

---

Korean name: ¹⁴바쿠시아겔라스해면 (신청)
firm. Color orange in life. Cavernous interior.

Skeleton. Ectosome consists of a thick membrane with free spicules (mostly acanthoxeas) and mixed fibres. Choanosome consists of a dense network of primary and secondary fibres, not distinct. Primary fibres 50–130 μm in diameter, lightly cored with spicules, echinated and reticulated. Secondary fibres 40–70 μm in diameter, rarely echinated; meshes 50–230 μm in diameter. No tertiary fibres. Choanosome weak cavernous, many spicules.

Spicules. Acanthostyles 150–200 × 8–10 μm, acanthoxeas 140–250 × 6–8 μm. Number of spine whorls, acanthostyles 10–18, acanthoxeas 14.

Etymology. This species name bakusi is named after Dr. Gerald J. Bakus who is a professor in the department of Biological Sciences, University of Southern California, a marine ecologist and a sponge taxonomist.

Fig. 4. *Agelas purpurea* n. sp. A, Entire animals (arrow); B, Associated two sponges (arrow); C, Surface of sponge (arrow); D, Perpendicular section; E, All fibres cored with spicules; F, Spicules (a, Thin acanthostyle; b, Acanthoxea). Scale bar: F=100 μm.
Remarks. This species is similar to *Agelas clathrodes* (Schmidt, 1870) in morphology but it clearly differs in its fibres. Primary fibres of the new species are larger. The mesh in *A. clathrodes* is narrower than that of this new species and the spicules are longer. The new species has numerous acanthoxeas. *Agelas clathrodes* from a Caribbean specimen is strong cavernous in choanosome but this new species has very weak cavernous.

*Agelas vansoesti* n. sp. (Fig. 6)

**Type specimen.** Holotype (MABIK IV00151594), Foko Fukunsral, Kosrae, Micronesia, 19 Jan 2011, Rho HS, by scuba, depth 17 m, deposited in the MABIK, Seocheon, Korea.

**Description.** Flabellate, cup-shaped, size up to $23 \times 10 \times 1.5$ cm. Surface very rough inside but outside smooth with slight protuberances. No oscules. Consistency firm and difficult to tear. Color yellowish brown in life.

Korean name: *벤소스티아겔라스해면* (신칭)
Fig. 6. *Agelas vansoesti* n. sp. A, Entire animal; B, Perpendicular section; C, Skeletal structure; D, Acanthostrongyle; E, Head of acanthostrongyle; F, Acanthoxea; G, Acanthostyle. Scale bars: A=3 cm, D, F=50 μm, E=20 μm, G=100 μm.
Fig. 7. *Agelas incrustans* n. sp. A, Entire animal; B, Underside of sponge; C, Primary and secondary fibres; D, Echinated fibres; E, Acanthostyle; F, Head of acanthostyle; G, Thin acanthostyle; H, Head of thin acanthostyle. Scale bars: A, B=3 cm, E, G=50 μm, F, H=10 μm.
Skeleton. Ectosome a thin membrane, very resilient with cored fibres and free spicules. Choanosome a regular reticulation with loose primary fibres 150 μm in diameter, heavily cored and echinated, primary fibres form a simple fascicle; secondary fibres 60–70 μm in diameter, not cored and rarely echinated; tertiary fibres rarely echinated; secondary fibres 20–30 μm in diameter, not cored and rarely echinated. The secondary fibre mesh is 30–350 μm in diameter.

Spicules. Acanthostyles 180–200 × 8–10 μm, number of spine whorls, 24. Acanthostrongyles 160–200 μm, number of spine whorls 19–24. Acanthoxeas 200–220 μm, number of spine whorls 22–24 (very rare).

Etymology. This species name vansoesti is named after Dr. Rob W.M. van soest, Naturalis Biodiversity Center, Department of Marine Zoology, The Netherlands, a marine sponge taxonomist.

Remarks. The new species is similar to Agelas clathrodes in morphology, but differs in skeletal structure. The new species has primary, secondary and tertiary fibres. Spicules in the new species are longer than that of A. clathrodes. This new species has many acanthostrongyles.

1* Agelas incrustans n. sp (Fig. 7)

Type specimen. Holotype (MABIK IV00151595), Molsron Tukunsru Village, Kosrae, Micronesia, 22 Oct 2012, Rho HS by scuba, depth 17 m, deposited in the MABIK, Seocheon, Korea.

Description. Thick encrusting sponge, size up to 18 × 10 × 2 cm. Surface with many protuberances but smooth. Texture hard. Color light orange in life.

Skeleton regularly arranged, interior not cavernous; many fasciculate, primary fibres with numerous spicule; echinating spicules rare. Mesh variable. Primary fibres 140–150 μm in diameter and make a fascicle complex, spaced at intervals of 400 μm in diameter. Secondary fibres 30–40 μm. Mesh 31–179–238 μm with rare echinating spicules.

Spicule. Acanthostyles 170–210 × 5–10 μm, number of spine whorls 21–23.

Etymology. This species named after the encrusting habit.

Remarks. This species has only one spicule type and shows a very similar range of spicule sizes in all species. Lehnert and Van Soest (1998) stated that the spicule characters of Agelas species are not useful for species discrimination as they exhibit a large variation within each specimen. In most reported papers, there are few details on skeletal structure. Our study was focused on skeletal structure. And we divided the specimens into three group habitat; tuberculate surface with brush-like terminal, repent type and thick incrusting with smooth surface or funnel shape.

These three group show different spicule types. Rough surface with brushed spicules have very distinct verticilliate shape and thick diameter. In repent sponge, spicules have irregular spine of whorls and thinner than brush-like spicules. Thick encrusting or funnel shape sponge has also irregular spine of whorls but thicker than repent sponge.

Although Kosrae is geographically close to Truk, Kosrae has a high diversity of species of Agelas compared with Truk. The genus Agelas has resilient fibres like keratose sponges, but it is difficult to distinguish between primary and secondary fibres. Agelas is also difficult to tear, because it has tougher fibres than those in keratose sponges.

Thirteen species of Indo pacific Agelas (one species from Indonesia) are known but the majority is from the Caribbean (17 spp.) (De Voogde et al., 2008), thirteen species from the Caribbean. Kosrae shows the high diversity of Agelas species.

ACKNOWLEDGMENTS

This research was supported by grants (PM57121 and 2009 B413-GV-R-0101-S000100) from the Marine Biotechnology Program funded by the Ministry of Maritime Affairs of Korean Government. The authors thank Dr. G. J. Bakus in the Department of Biological Sciences, University of Southern California for his review of the manuscript. We thank Kathy Omura, collections manager Marine Biodiversity Processing Center, Natural History Museum of Los Angeles County for preparing Agelas specimens from the Caribbean for study and collection information. We are grateful to the Department of Agricultural and Marine Resources, State of Kosrae, Federated States of Micronesia, for granting marine organism research.

REFERENCES

Alcolado PM, 1984. Nuevas especies de esponjas encontradas en Cuba [New species of sponges from Cuba]. Poeyana, 271: 1–22.

Assmann M, Van Soest RW, Köck M, 2001. Description of...
Agelas cerebrum, a new species and re-description of A. dilatatata (Porifera). Proceedings of the Biological Society of Washington, 114:359-366.

Bergquist PR, 1965. The Sponges of Micronesia, Part I. The Palau Archipelago. Pacific Science, 19:123-204.

Carter HJ, 1883. Contributions to our Knowledge of the Spongida. Annals and Magazine of Natural History, 5, 12:308-329.

De Laubenfels MW, 1954. The sponges of the West-Central Pacific. Oregon State monographs. Studies in Zoology 7:1-10, 1-306.

De Voogd NJ, Parra-Velandia FJ, Van Soest RWM, 2008. A new Agelas (Demospongiae: Agelasida: Agelasidae) from the Thousand Islands, West-Java, Indonesia. Zoologische Mededelingen Leiden, 82:235-243.

Duchassaing De Fonbressin, P, Michelotti G, 1864. Spongiaires de la mer Caraïbe. Natuurkundige verhandelingen van de Hollandsche maatschappij der wetenschappen te Haarlem, 21:1-124.

Hoshino T, 1985. Description of two new species in the genus Agelas (Demospongia) from Zamami Island, the Ryukyus, Japan. Proceedings of the Japanese Society of Systematic Zoology, 30:1-10.

Kelly-Borges M, Valentine C, 1995. The sponges of the tropical island region of Oceanis: a taxonomic status review, In: Marine and coastal biodiversity in the tropical island Pacific region. Vol. 1. Species systematics and information management priorities. Chapter 6. (Eds., Maragos JE, Peterson NMA, Eldredge LG, Bardach JE, Takeuchi HF), Program on Environment, East-West Center, Honolulu, HI, pp. 83-120.

Lehnert H, Van Soest RWM, 1996. North Jamaican deep fore reef sponges. Beaufortia, 46:53-81.

Lehnert H, Van Soest RWM, 1998. Shallow water sponges of Jamaica. Beaufortia, 48:71-103.

Mothes B, Campos M, Lerner C, Carraro JL, Parra-Valandia FJ, 2007. New records of the genus Agelas Duchassaing and Michelotti, 1864 (Porifera, Agelasida) off the Amazon River mouth, Brazil, Southwestern Atlantic. Biota Neotrop, 7:83-90.

Pulitzer-Finali G, 1982. Some shallow-water sponges from Hong Kong. In: The marine flora and fauna of Hong Kong and Southern China. In: Proceedings of 1st International Marine Biology Workshop (Eds., Morton BS, Tseng CK), Hong Kong University, Hong Kong, pp. 97-110.

Pulitzer-Finali G, 1986. A collection of West Indian Demospongiae (Porifera). In appendix, a list of the Demospongiae hitherto recorded from the West Indies. Annali del Museo Civico di Storia Naturale Giacomo Doria, 86:65-216.

Pulitzer-Finali G, 1996. Sponges from the Bismarck Sea. Bollettino dei Musei e degli Istituti Biologici della(R.) Università di Genova, 60-61:101-138.

Schmidt O, 1870. Grundzüge einer Spongien-Fauna des atlantischen Gebietes. Verlag von Wilhelm Engelmann, Leipzig, pp. 1-88.

Schmidt O, 1879. Reports on the dredging under the supervision of Alexander Agassiz, in the Gulf of Mexico, by the USCSS 'Blake’. Die Spongien des Meerbusen von Mexico (Und des caraibischen Meeres). Abtheilung I. Heft 1. Gustav Fischer, Jena, pp. 1-32.

Thomas PA, 1980. Demospongiae of Minicoy Island (Indian Ocean). Part 2. Order Poecilosclerida. Journal of the Marine Biological Association of India, 22:1-7.

Thomas PA, 1981. A second collection of marine Demospongiae from Mahe Island in the Seychelles Bank (Indian Ocean). Annalen. Reeks in 8 - Koninklijk Museum voor Midden-Afrika: zoologische wetenschappen, 233. Koninklijk Museum voor Midden-Afrika: Tervuren, 54 plates pp.

Van Soest RWM, Stentoft N, 1988. Barbados deep-water sponges. Studies on the Fauna of Curacao and other Caribbean Islands, 70:1-175.

Wiedenmayer F, 1977. Shallow-water sponges of the western Bahamas. Experientia Supplementum, 28:1-287.

Wilson HV, 1902 [1900]. The sponges collected in Porto Rico in 1899 by the U.S. Fish Commission Steamer Fish Hawk. Bulletin of the United States Fish Commission, 2:375-411.

Zea S, 1987. Esponjas del Caribe Colombiano. INVEMAR, Bogatá, pp. 1-286.

Received June 18, 2014
Revised July 3, 2014
Accepted July 7, 2014

Six New Agelas from Kosrae Island