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Demosponges from Ascension Island with a description of nine new species

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Original Article

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Abstract

We surveyed the shallow-water sponges of Ascension Island using scuba diving. In total, we collected 58 sponge specimens from 17 locations at depths of 0.5–30 m. In addition, we compiled historical records of sponges. We describe nine species new to science: *Niphates verityae* sp. nov., *Petrosia* (*Petrosia*) *ernesti* sp. nov., *Monanchora downesae* sp. nov., *Svenzea weberorum* sp. nov., *Erylus williamsae* sp. nov., *Ircinia nolanae* sp. nov., *Ircinia richardsoni* sp. nov., *Ircinia simae* sp. nov. and *Chondrosia browningorum* sp. nov. We provide molecular sequences for three of the new species. We have added 50% to the number of known species and added two new genera and one family to the known Ascension Island sponge fauna. Twenty-six species, from 16 genera, and 13 families, are now reported from Ascension's shallow waters. Many of these may be endemic to the island. We discuss the biogeographic affinities of Ascension Island and emphasize the need for additional survey of the sponge fauna of remote islands such as Ascension.

Introduction

Ascension Island is a small, isolated volcanic island, part of the Mid-Atlantic Ridge region, which lies at 07°57′S 14°22′W in the tropical south Atlantic. It is one of the most remote islands in the world; the nearest landmass is St Helena Island, 1200 km to the south. It is 2300 km away from Brazil and 1500 km from the west coast of Africa. This isolation, combined with Ascension's comparative geological youth (~1.5 million years old) (Evangelidis *et al.*, 2004), is thought to have in part contributed to a relatively depauperate shallow marine fauna (Brickle *et al.*, 2017).

There has been limited research on the sponge fauna of Ascension Island (Table 1). The first specimen collected from Ascension Island was a shore-collected dry specimen in 1902 collected by the German South Polar expedition; however, the first specimens known to have originated on Ascension Island were collected by the R.R.S. *Discovery* between 1925 and 1929 (Burton, 1932). Sponges were collected by scuba in 1985 during a British Joint Services' Survey expedition (Taylor & Irving, 1985; Irving, 1989); 67 specimens were collected, which were estimated to represent 47 different species. These were deposited at the Zoological Museum Amsterdam, now part of the Naturalis Biodiversity Center (Naturalis BioPortal, 2021). Identifications for the majority of these specimens have not yet been finalised or formally published. However, those that have, represent several species new to science (Van Soest, 1990; Van Soest *et al.*, 2013, 2014).

Ascension Island shallow-water fauna appears to have a broadly Mid-Atlantic Ridge faunal composition, with affinities to the tropical and sub-tropical western and eastern Atlantic regions (Floeter *et al.*, 2008). These affinities could be due to the proximal ancient Gondwana origins of the west African and northern South American continents (Rosen, 1975). However, these dispersal patterns are likely now maintained by large-scale oceanic gyre currents in the Atlantic Ocean, which enable the dispersal of shallow-water organisms to the remote shelf of Ascension Island (Den Hartog, 1989; Zibrowius *et al.*, 2014; Reimer *et al.*, 2017). For fish, Ascension Island has a stronger biogeographic connection with the Brazilian province than with the Tropical Eastern Atlantic Province, whereas nearby, but far older, St Helena has near equal affiliations with the Brazilian and Tropical Eastern Atlantic provinces (Briggs & Bowen, 2012). Ascension Island zoantharians are found to have phylogeographic affinities with the western Atlantic and Caribbean regions (Reimer *et al.*, 2017). In contrast, shallow-water Ascension Island scleractinian corals appear to have broader amphi-Atlantic distributions (Zibrowius *et al.*, 2014).

Ascension Island has been found to have a high level of endemism, likely due to its remote position in the Atlantic Ocean, which has enabled vicariance in many types of marine

Table 1. Prior species-level sponge records from Ascension Island

Species	Source	Location	Depth/substrate/collection method	Notes/wider distribution
Ircinia variabilis (Schmidt, 1862) – NOTE record likely to be inaccurate	Hentschel (1914)	Ascension, location not given	0 m, washed up on a beach	The specimen was 'poorly preserved and severely abraded by the sea'. It is not certain this specimen came from Ascension as it could have drifted in from elsewhere. While it is probably an *Ircinia*, species-level identification would be difficult from such a damaged specimen. Van Soest *et al*. (2021) note the record is inaccurate. It was not included in our species totals.
Mycale (*Arenochalina*) *incrustans* (Burton, 1932)	Burton (1932)	Station 2, Clarence Bay, Ascension Island, Catherine's Point and Collier Point	Shore. Attached to a buoy	No anisochelae, so not certainly a *Mycale* species.
Spongia (*Spongia*) *officinalis* Linnaeus, 1759	Burton (1932)	Station 1. Clarence Bay, Ascension Island	16–27 m Coralline sand and shell. Rectangular net	This record needs validation, given the advances in taxonomy of keratose sponges and the distance from the type locality in the Mediterranean.
Dysidea fragilis (Montagu, 1814)	Burton (1932)	Station 1. Clarence Bay, Ascension Island	16–27 m. Coralline sand and shell. Rectangular net	Burton notes that the specimens were thinly encrusting but resembled the European forms closely in structure. He believed the species to be cosmopolitan. This species is currently thought to be restricted to the Atlantic coasts of Europe (Van Soest *et al*., 2021). This record requires validation.
Clathria (*Microciona*) *ascensionis* Van Soest, Beglinger & De Voogd, 2013	Van Soest *et al*. (2013)	North Point (site nr. 6), 7.8833°S 14.3833°W	18 m. Thinly encrusting dead bivalve shell. Scuba	Collected by R. Irving, Operation Origin 1985. Holotype (ZMA Por. 20827). Currently only known from the type locality.
Clathria (*Microciona*) *calloides* Van Soest, Beglinger & De Voogd, 2013	Van Soest *et al*. (2013)	Catherine Point (site no. 12), Ascension Island	10 m. Scuba	Collected by R. Irving, Operation Origin 1985. The holotype is from the Cape Verde Islands.
Clathria (*Thalysias*) *minutoides* Van Soest, Beglinger & De Voogd, 2013	Van Soest *et al*. (2013)	West of Coast Red Nipple (site no. 24), near Crystal Bay, Ascension Island	3–6 m. Encrusting on barnacles. Scuba	ZMA Por. 14001 and 21366, Collected by R. Irving, Operation Origin 1985. Holotype is from the Cape Verde Islands.
Mycale (*Arenochalina*) *africamucosa* Van Soest, Beglinger & De Voogd, 2014	Van Soest *et al*. (2014)	Ascension Island, 7.92°S 14.41°W	Scuba	ZMA Por. 16297. Collected by R. Irving, Operation Origin 1985. Described from Cape Verde Islands, wider distribution Ascension, St Helena, possibly Gulf of Guinean islands.
Mycale (*Carmia*) *senegalensis* Lévi, 1952	Van Soest *et al*. (2014)	Ascension. Field no. 310 – no position info	Thin crust on volcanic rock and limestone concretion. Scuba	ZMA Por. 20835. Collected by R. Irving, Operation Origin 1985. Ascension, Senegal, Tenerife, possibly Eastern Mediterranean.
Monanchora stocki Van Soest, 1990	Van Soest (1990)	Ascension Operation Origin sites: Pyramid Point (site 11) and South East Head (site 29)	16 m, 33 m. One specimen encrusting algae on vertical wall. Scuba	ZMA POR 7608, ZMA POR 7609. Collected by R. Irving, Operation Origin 1985. Holotype from Cape Verde Islands.
Ascandra atlantica (Thacker, 1908)	Naturalis BioPortal (2021)	Ascension. Operation Origin site: West (site 1). S of SW bay off Rocket Launcher (50 m offshore) in 1980.	Depths unknown	ZMA POR 21091, ZMA POR 20839, ZMA POR P 1011, ZMA POR P 1020, ZMA POR P 1021, collected by R. Irving, 1985, Operation Origin. One fragment and specimen collected by M.B.L Grice, 1980. Type locality is Cape Verde, present in NE/SE Brazil. Potential specimen from Japan.
Arturia canariensis (Miklucho-Maclay, 1868)	Naturalis BioPortal (2021)	Ascension. Operation Origin sites: Boatswainbird Island (site 14).	30 m	ZME POR 20841, ZMA POR P 1027, ZMA POR P 1040, ZMA POR P 1035, collected by R. Irving, 1985. Type locality is the Azores, Canaries, Madeira, and Cape Verde. Potential distributions found in the Southern European Atlantic.

Clathrina clathrus (Schmidt, 1864)	Naturalis BioPortal (2021)	Ascension. Operation Origin site: W of Coast Red Nipple (site 24).	26 m	ZMA POR 21367, ZMA POR P 1052, ZMA POR P 1053, ZMA P 1054, collected by R. Irving, 1985. Type locality is the Adriatic and the Azores, Canaries, Madeira and Cape Verde. Potential distributions found in the southern European Atlantic.
Clathrina primordialis (Haeckel, 1872)	Naturalis BioPortal (2021)	Ascension. Operation Origin sites: North Point (site 9) and Spire Rock (site 31).	25–33 m	ZMA POR 21368, ZMA POR P 1122, ZMA POR 20840, ZMA POR P 1120. Collected by R. Irving, Operation Origin 1985. Type locality European waters, Adriatic, southern Norway, western Mediterranean, and South European Atlantic Shelf.
Geodia gibberosa Lamarck, 1815	Naturalis BioPortal (2021)	Ascension. Station GMBL-80–36 in 1980.	Depths unknown	ZMA POR 9792, ZMA POR P 3456, collected by M.B.L Grice, 1980. Type locality is the Caribbean Sea, Brazil, Venezuela, Suriname, Caribbean part of Mexico, Bermuda, Bahamas and Gulf of Guinea Islands.
Mycale (*Arenochalina*) *laxissima* (Duchassaing and Michelotti, 1864)	Naturalis BioPortal (2021)	Ascension. Operation Origin. Station unknown, collected 1985.	Depths unknown	ZMA POR P 11947, collected by R. Irving, 1985. Type locality in Eastern Caribbean, Bahamas and Brazil.
Mycale (*Carmia*) *microsigmatosa* Arndt, 1927	Naturalis BioPortal (2021)	Ascension. Operation Origin. Station unknown, collected 1985.	Depths unknown	ZMA POR P 12128, collected by R. Irving, 1985. Type locality is in the southern Caribbean, Bermuda, Trindade and Martin Vaz Islands, and Brazil.
Pione vastifica (Hancock, 1849)	Naturalis BioPortal (2021)	Ascension. Operation Origin. Stations: English Bay (site 00) and Catherine Point (site 12).	4–17 m	ZMA POR 20829, ZMA POR P 4352, ZMA POR 20834, ZMA POR P 4534, collected by R. Irving, 1985. Type locality is the Azores, Canaries and Madeira, as well as Cape Verde, Sahelian upwelling, western Mediterranean, and the southern Atlantic Shelf.

organisms (Floeter *et al.*, 2008). Both Ascension and St Helena Islands, separately, have the two highest levels of endemism in reef fishes, for all oceanic islands in the Atlantic Ocean, despite limited shelf habitat diversity and area and relatively young geological ages (Floeter *et al.*, 2008). Briggs (1974, 1995) originally proposed that Ascension and St Helena should be combined as an independent biogeographic province based on fish, which has been reiterated by more recent studies of the biogeography of shelf and coastal ecoregions (Spalding *et al.*, 2007). However, later studies indicate that both Ascension and St Helena have sufficient endemism to be regarded as separate biogeographic provinces of the Eastern Atlantic Region (Floeter *et al.*, 2008; Briggs & Bowen, 2012).

Materials and methods

Specimen collection

Sponges were collected during August–September 2012 and July 2015 as part of a larger expedition to generate baseline data on Ascension Island's marine habitats (Brickle *et al.*, 2017). In total, 58 sponge specimens were collected by scuba diving from 17 locations (Table 2, Figure 1) and at depths of 0.5–30 m. Due to the lack of a recompression chamber, diving depth was usually limited to <20 m. However, during the 2012 survey, several deeper dives were possible as a portable recompression chamber was present on the island for a commercial diving project.

Sponges were selected by eye: the divers attempted to sample species that looked different from those previously sampled during the dive. The aim was to sample as many different species as possible rather than gaining any quantitative information. Once selected, three photographs of each specimen were taken *in situ* using housed digital SLR cameras (Nikon D70 and Nikon D90 in Ikelite housings with Ikelite DS125 substrobe both with 60 mm macro lenses). A small piece (~1 cm^2 of tissue) was then removed.

Laboratory methodology

After collection, notes were made on colour, sponge texture, and any presence of any smell or slime. The samples were transferred to 95% ethanol for storage. Tissue slides were prepared by sectioning a very thin portion of tissue at a 90° angle through the sample. The tissue was then dehydrated in absolute ethanol for 4 min and placed in clove oil for a further 4 min to clarify the tissue before being mounted on a microscope slide in Canada balsam. A coverslip was then placed on the slide. To isolate spicules for examination, pieces of sponge were placed in undiluted household bleach overnight to remove tissue, then rinsed four times in distilled water and cleaned in two washes of 95% ethanol. Spicules were allowed to settle for at least 15 min between rinses, and then the upper layer of liquid was pipetted off, leaving the spicules undisturbed. Cleaned spicules were dried on glass slides, mounted in Canada balsam and imaged on a compound microscope (Olympus BX43). For scanning electron microscopy (SEM), cleaned spicules were placed on metal stubs, coated with gold and viewed with a JEOL 6400 SEM (UNB, Fredericton). Spicule measurements (N = 20, unless otherwise noted) were made using an Olympus SC50 camera and Olympus cellSens standard 1.16 software. Measurements are reported as minimum (mean) maximum.

Histology

Histology was undertaken at the Microscopy and Microanalysis Facility at the University of New Brunswick. Histological

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Table 2. Sampling sites, see also Figure 1

Site number	Site name	Latitude	Longitude	Depth
1	The Arches	−7.91812	−14.4195	5 m
2	Pan Am	−7.96962	−14.4124	6.5–10.5 m
3	Pyramid Point	−7.90617	−14.4052	18 m
4	Comfortless Cove	−7.91023	−14.4035	4.4–10.2 m
5	Shelly Beach	−7.99183	−14.3949	0.5 m
7	Red Rock	−7.89435	−14.3948	8–14.7 m
8	Two Hooks round to English Bay	−7.89292	−14.3868	13 m
9	Red Rock Archway	−7.89423	−14.3946	30 m
10	Wigan Pier	−7.89397	−14.3835	6.2–13 m
11	Darby Wreck	−7.89192	−14.3814	5 m
12	Soudan Wreck	−7.8876	−14.3762	8 m
13	Lady's Loo	−7.89522	−14.3649	16 m
14	Porpoise Point	−7.8981	−14.3513	13 m
15	Boatswain Bird Island	−7.93677	−14.3081	6 m
16	Boatswain Bird Island	−7.93498	−14.308	16–18 m
17	South East Bay	−7.95443	−14.3079	12–15 m

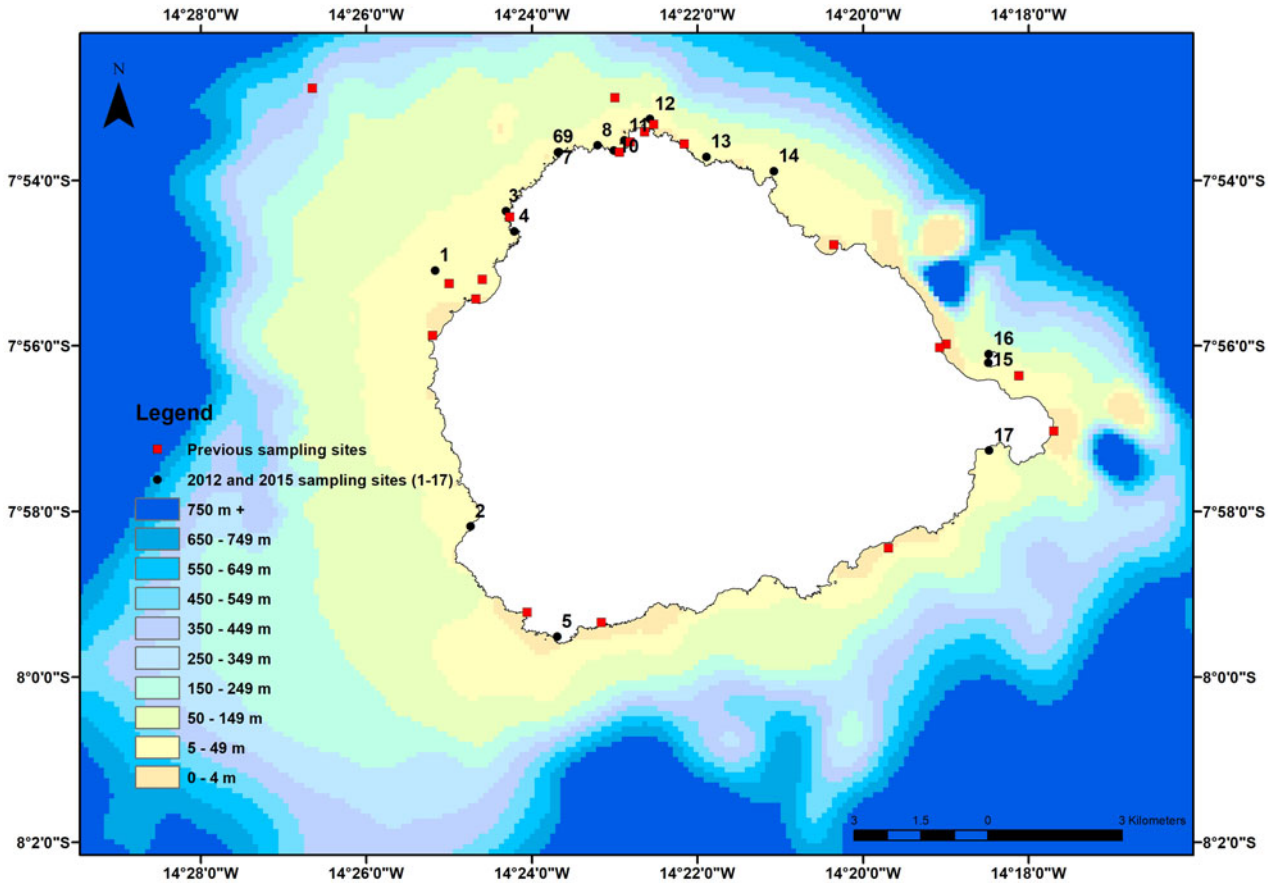

Fig. 1. Location of sponge records from Ascension Island. This includes species level records from this survey and Table 1. In addition, records for *Crambe* sp., Demosponges 1–3, and *Halicona* sp. Barnes (2017), Porifera × 2 (Irving, 1989), and Porifera × 3 (Manning & Chace, 1990). Bathymetric data supplied by Ascension Island Government.

processing of samples was based on a previously incompletely documented protocol (as acknowledged in Eerkes-Medrano *et al.*, 2014). The full modified protocol is as follows. Sponge samples preserved in 70% ethanol were dissected into embeddable pieces no bigger than 1.5 cm cubed. These pieces were rehydrated to water before being fixed in 4% paraformaldehyde overnight and then rinsed in phosphate-buffered saline (PBS) and dehydrated again through an ethanol series back to 70% ethanol. Specimens were separately desilicified overnight in 4% hydrofluoric acid (in 70% ethanol) to remove spicules and decalcified overnight in

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undiluted cal-ex decalcifier to remove coral using the same rehydration to water, treatment, PBS rinse, and dehydration through an ethanol series as the fixation step. Specimens were then processed by hand using the following steps: dehydrated to 100% ethanol with two 30 min washes of 95% ethanol and three 10 min washes of 100% ethanol, all at room temperature, cleared in toluene with one 30 min wash of 1:1 ethanol: toluene at room temperature and two 30 min washes of toluene at 60°C, and infiltrated with paraffin wax overnight after two 4 h washes of paraffin all at 60°C before embedding the next day. Embedded samples were cut in 7 µm sections for choanocyte chambers, and 12 µm sections for skeletal structures using a Leica rotary microtome and sections were dried on slides using Haupt's adhesive. Slides were stained with Masson's trichrome with the following times for the stains: 1 min and 20 s with Gill III Hematoxylin, 3 min Ponceau Acid Fuchsin, and 4 min Acetic Aniline Blue with 5 min differentiation step with 1% phosphomolybdic acid after the Ponceau Acid Fuchsin and Acetic Aniline Blue staining steps.

Sequencing

Sequencing was done by the Canadian Rivers Institute Genomics Laboratory, University of New Brunswick, Saint John. DNA was extracted from sponge samples using E.N.Z.A. Tissue DNA Kit by Omega BioTek according to the manufacturer's directions. A 20–30 µg piece of tissue was ground in the lysis buffer in a MixerMill at 25.0 freq 1/s for 3 min and then was left to incubate overnight at 55°C. The C2-D2 region of 28S (Chombard *et al.*, 1998), and CO1 (Meyer *et al.*, 2005) were amplified by polymerase chain reaction following the thermal regime used by Erpenbeck *et al.* (2016). Clean up and sequencing of PCR products were performed by Génome Québec, Montréal, QC. Sequences were submitted to GenBank (Clark *et al.*, 2016); accession numbers are provided for the four specimens from three different species where sequencing was successful (*Monanchora downesae* sp. nov.; *Chondrosia browningorum* sp. nov.; and two specimens of *Ircinia simae* sp. nov.).

Type specimens

The majority of the type material is in the Atlantic Reference Centre Museum, New Brunswick, Canada (ARC). One paratype is in Ulster Museum Belfast (BELUM). Information on extant species was obtained from the World Porifera Database (Van Soest *et al.*, 2021). The publication and species names were registered in ZooBank: publication urn:lsid:zoobank.org:pub:FD98928F-BEF3-45D5-A6D3-F612A7D5C9B9.

Results

Systematics

Phylum PORIFERA Grant, 1836
Class DEMOSPONGIAE Sollas, 1885
Subclass HETEROSCLEROMORPHA Cárdenas, Pérez & Boury-Esnault, 2012
Order HAPLOSCLERIDA Topsent, 1928
Family NIPHATIDAE Van Soest, 1980
Genus *Niphates* Duchassaing & Michelotti, 1864
Niphates verityae Goodwin & Downey, 2021 sp. nov.
urn:lsid:zoobank.org:act:9D46D0C2–77B7-4EBD-AE43-4BE7DA54CB9F
(Figure 2A–E)

Type Material

Holotype: ARC 81586, Pan Am, Ascension Island, −7.96962° −14.4124°, depth 6.5–10.5 m, 14 July 2015, collected by Rob Mrowicki.

Paratype: ARC 81549, Wigan Pier, Ascension Island, −7.89397° −14.3835°, depth 6.2 m, 25 August 2012, collected by Judith Brown.

Diagnosis

Niphates with an encrusting form and pale green colour *in vivo*. Relatively short oxea (168(176)185 × 5(6)9 µm) compared with other species in the region.

Etymology

Named after Verity Goodwin, daughter of author Claire Goodwin, who was born shortly after the initial fieldwork expedition.

External Appearance

In vivo (Figure 2A): Pale green, thickly encrusting sponge forming a low mound on bedrock. Holotype around 5 cm in diameter and up to 1 cm thick. Skeletal mesh and apertures between it are visible through the surface, giving the sponge a delicate, lacy appearance. The sponge surface is slightly conulose due to the protruding ends of the primary choanosomal fibres. Some small oscules (up to 5 mm in diameter) are visible on the sponge surface.

Preserved: Buff in ethanol with firm but compressible texture.

Skeleton

Choanosomal skeleton (Figure 2B, C): Formed of a meshwork of fibres, most of which have thick spongin sheaths. The primary ascending fibres are 97–190 µm in diameter and cored by 6–12 spicules. The ascending fibres subdivide and diverge as they get towards the ectosome. They are joined by secondary fibres 23–66 µm in diameter cored by 2–6 spicules. The meshes formed between the fibres are irregular in shape and size. The larger meshes are 239–450 µm in diameter and the smaller 84–133 µm in diameter.

Ectosomal skeleton (Figure 2D): Paratangential (three-dimensional) ectosomal skeleton formed of two sizes of irregular mesh. The larger meshes are 426–660 µm in diameter and formed from primary fibres 46–96 µm in diameter and cored by 8–12 spicules. These large meshes are subdivided into smaller meshes 169–382 µm in diameter by secondary fibres 27–47 µm in diameter and cored by 4–8 spicules. The ends of the primary skeletal fibres of the choanosome protrude through the ectosome, creating a conulose surface.

Spicules (Figure 2E)

Oxea which abruptly taper to fine points 168(176)185 × 5(6)9 µm.

Remarks

We assign this specimen to *Niphates* rather than *Callyspongia* due to the three-dimensional ectosomal skeleton and the irregular nature of the meshes in its choanosomal skeleton (Van Soest & Hooper, 2002). There are 22 valid species in the genus *Niphates*. Eight species are known from the tropical Atlantic and Caribbean (reviewed in Van Soest, 1980 and Santos *et al.*, 2014). These can all be distinguished from *Niphates verityae* sp. nov. by their form, colour or spiculation. *Niphates alba* Van Soest, 1980, *Niphates arenata* Rützler *et al.*, 2014, and *Niphates lutea* Lehnert & Van Soest, 1999 possess strongyle rather than oxeote megascleres. *Niphates luizae* Santos, Docio & Pinheiro, 2014 differs from *Niphates verityae* sp. nov, and all other regional *Niphates*, in possessing very robust oxea (270 × 18 µm). *Niphates*

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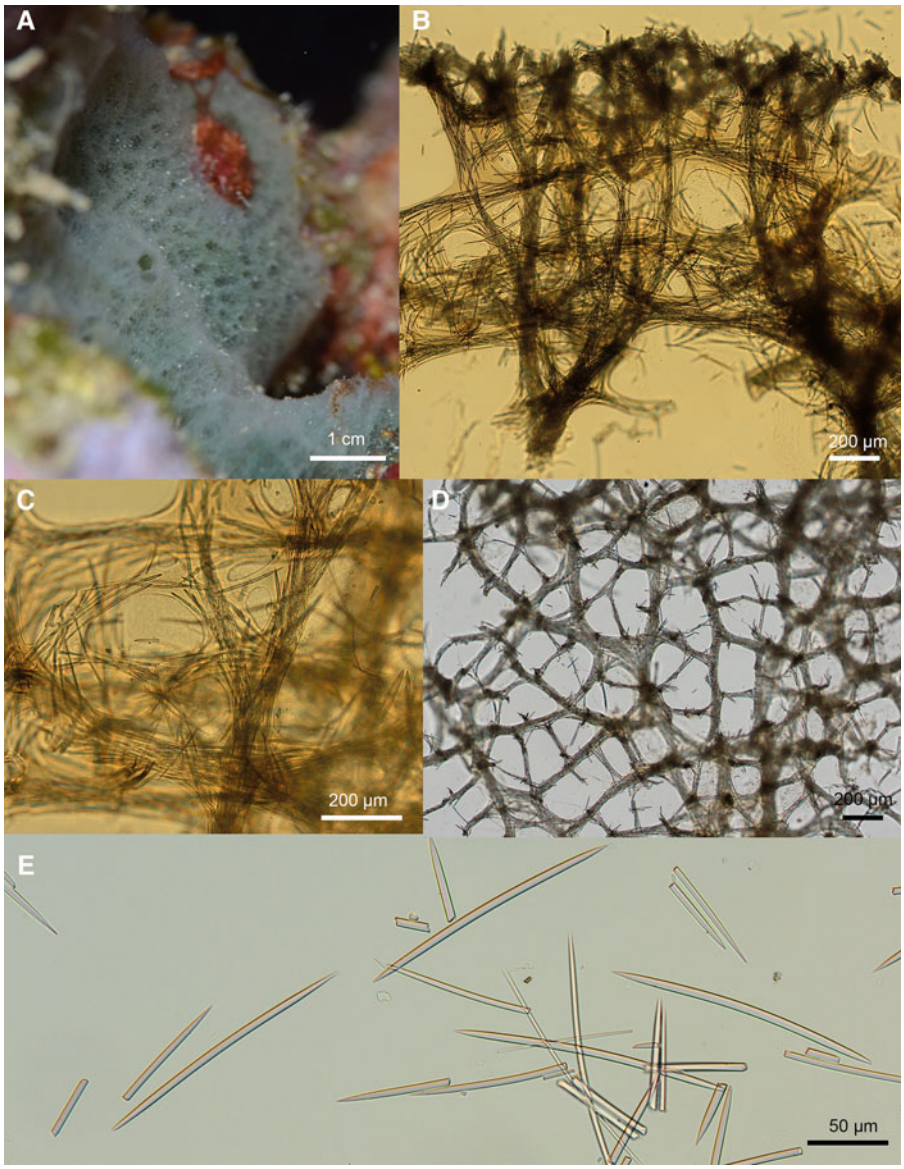

Fig. 2. *Niphates verityae* sp. nov. ARC 81586. (A) *In vivo* appearance. (B) Choanosomal skeleton. (C) Choanosomal fibres. (D) Ectosomal skeleton. (E) Oxea.

amorpha Van Soest, 1980 has a similar encrusting form but possesses larger oxea (183–252 × 4–7 µm), may have sigmata (12–18 µm) and is purplish-grey when alive. *Niphates caycedoi* (Zea & Van Soest, 1986) has larger oxea (199–285 × 5–19 µm), possesses toxa, and is a vivid blue to violet colour. *Niphates digitalis* (de Lamarck, 1814) differs in having a cup-shaped rather than encrusting form and may possess sigmata. *Niphates erecta* Duchassaing & Michelotti, 1864 has larger oxea (154–232 × 2.5–9 µm), may have sigmata, and has a ramose form with solid branches.

This species is found in Ascension Island's north and south-western sectors, encrusting on volcanic bedrock and boulders.

Family PETROSIIDAE Van Soest, 1980
Genus *Petrosia* Vosmaer, 1885
Subgenus Petrosia (Petrosia) Vosmaer, 1885
Petrosia (*Petrosia*) *ernesti* Goodwin & Downey, 2021 sp. nov.
urn:lsid:zoobank.org:act:
C29AD1FF-6496-46EA-A87A-9C5DBBCB8E88
(Figure 3A–E)

Type Material

Holotype: ARC 81579, Red Rock Archway, −7.89423° −14.3946°, depth 30 m, 6 September 2012, collected by Judith Brown.

Diagnosis

Petrosia with four spicule categories comprising of strongyle megascleres (187–262 and 65–134 µm) and strongyle (18–32 µm) and oxea (25–38 µm) microscleres.

Etymology

Named after Ernest Goodwin, son of author Claire Goodwin, who was born shortly after the initial fieldwork expedition.

External Appearance

In vivo (Figure 3A): Thickly encrusting beige sponge with a smooth surface. Holotype formed a very large patch – over 1 m in diameter. The sponge was inside a small cave under the 'Archway'. Preserved: Thin crust with a glassy smooth ectosome. The ectosome does detach but not in flakes.

Skeleton

Choanosomal skeleton (Figure 3B): A reticulation of fibres 50–90 µm in diameter (around 5–10 spicules thick). There is no distinction between primary and secondary fibres. Fibres are echinated by the smallest styles and strongyles.

Ectosomal skeleton (Figure 3C, D): Meshwork of fibres 30–60 µm (around 2–5 spicules) thick, echinated by the smallest styles and strongyles.

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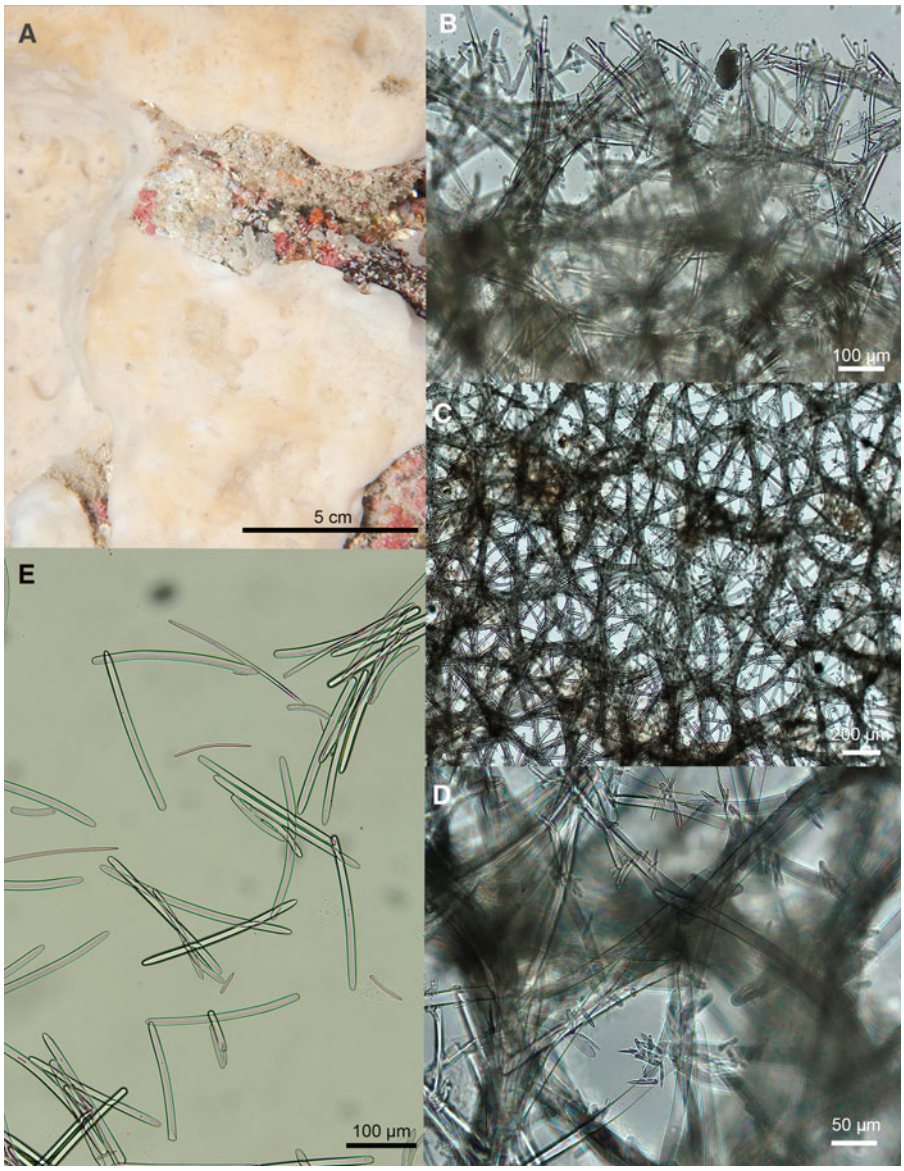

Fig. 3. *Petrosia* (*Petrosia*) *ernesti* sp. nov. ARC 81579. (A) *In vivo* appearance. (B) Choanosomal skeleton. (C) Ectosomal skeleton. (D) Close up of ectosomal fibres showing clusters of microscleres at nodes. (E) Spicules.

Spicules (Figure 3E)

Large strongyles: 187(237)262 × 13(15)18 µm. Ends are variable. Some are both rounded. In others one other is slightly pointed, giving an almost style or oxea-like appearance (although the points are not sharp enough to be true styles or oxeas). The majority are curved.

Medium strongyles: 65(97)134 × 7(14)21 µm. Most with rounded ends, although a few variants as above. The majority are curved.

Small strongyles: 18(25)32 × 3(5)6 µm.

Small stylote oxea: 25(32)38 × 3(5)8 µm. One rounded end, similar to the strongyles. The other end comes to an abrupt point.

Remarks

We assign this species to *Petrosia* (*Petrosia*) rather than *Petrosia* (*Strongylophora*) as its ectosomal skeleton is reticulate network rather than a dense irregular tangential reticulation of free microxeas and strongyles (Desqueyroux-Faúndez & Valentine, 2002). Ten species are known from the Atlantic and Caribbean (Van Soest *et al.*, 2021; Table 3). Only *Petrosia* (*Petrosia*) *ficiformis* (Poiret, 1789) and *Petrosia* (*Petrosia*) *weinbergi* Van Soest, 1980 have more than two categories of spicules. *Petrosia* (*Petrosia*) *ficiformis* has 2–3 categories of spicules, but these are oxea, which in some cases may be modified to strongyles. Its smallest category of spicules is 45–65 µm, considerably larger than the small styles and strongyles found in our specimen (information on spicule dimensions from de Weerdt & Van Soest, 1986). *Petrosia* (*Petrosia*) *weinbergi* is a green sponge. It also has oxea tending to strongyles rather than mainly strongyles, and its smallest category of spicules has a broader size range than those found in our specimen (29–58 × 1.5–4 µm). None of the known species possesses the style-like microscleres (presumably modified oxea) found in our specimen.

This species was found in a rocky environment in the northern sector of Ascension Island.

Order POECILOSCLERIDA Topsent, 1928
Family CRAMBEIDAE Lévi, 1963
Genus *Monanchora* Carter, 1883
Monanchora downesae Goodwin & Downey, 2021 sp. nov.
urn:lsid:zoobank.org:
act:61054234-9CD3-4032-9CF6-FA9277BED72B
(Figure 4A–H)

Type Material

Holotype: ARC 81596, Red Rock, Ascension Island, −7.89435° −14.39475°, depth 14.7 m, 19 July 2015, collected by Paul Brickle and Stevie Cartwright.

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Table 3. *Petrosia* (*Petrosia*) species from the Atlantic and Caribbean

Species	Spicules (μm)	Type locality/Distribution/Appearance
Petrosia (*Petrosia*) *ernesti* sp. nov.	Large strongyles: 187(237)262 xx 13(15)18 Medium strongyles: 65(97)134 × 7(14)21 Small strongyles: 18(25)32 × 3(5)6 Small styles: 25(32)38 × 3(5)8	Ascension Island. 30 m. Beige, thickly encrusting.
Petrosia (*Petrosia*) *canariensis* de Weerdt & Van Soest, 1986	Small strongyles: 135 × 8 (mainly in ectosome) Large strongyles: 290 × 24	Canary Islands, 200–1000 m on volcanic rock. Club-shaped.
Petrosia (*Petrosia*) *clavata* (Esper, 1794)	Large oxea 203 × 6 Small oxea 160 × 5	Mediterranean. Azores. Branched sponge. Branches club-shaped. Smooth surface and large round oscules. Spicule measurements from Bavastrello *et al*. (1994). *P. clavata* (Type A).
Petrosia (*Petrosia*) *crassa* (Carter, 1876)	Large oxea: 200–300 × 17 Small oxea: 80–170	Faroe Islands. Massive lobate sponges. Pale yellow. Spicule sizes from Lundbeck (1902). de Weerdt and Van Soest (1986) note that Topsent's (1904, 1928) specimens from the Azores and mid-Atlantic are probably *P. ficiformis*. *P. crassa* differs in having a coarser structure, larger oscules, and larger and thicker spicules. However, this species has recently been recorded from the Gulf of Cadiz (Sitjà *et al*., 2019).
Petrosia (*Petrosia*) *cretacea* (Schmidt, 1870)	'nadeln' 145	Florida, Gulf of Mexico. Crust, 23 cm in diameter and around 8 cm thick. Irregularly wavy surface. Dry colour white. No further information on spicules in the type description.
Petrosia (*Petrosia*) *ficiformis* (Poiret, 1789)	2–3 size categories, oxeas, in some specimens modified to strongyles. Small oxea (ectosome): 45–65 × 1–5 Medium oxea: 120–200 × 1.5–2.5 Large oxea: 240 × 10–15	Mediterranean, Azores, Canary Islands, Cape Verde. Form variable. Knolls, plates or fused branches. On volcanic rock from 5–125 m. Information from de Weerdt & Van Soest (1986).
Petrosia (*Petrosia*) *incrustata* (Alcolado & Gotera, 1986)	Strongyles: 60–435 × 7–17 Styles: 270–440 × 3–14	Cuba. 30 m. Purple, encrusting sponge 1 cm thick.
Petrosia (*Petrosia*) *massiva* Lehnert & Van Soest (1996)	Large strongyles: 90–250 × 6–9 Small strongyles: 21–28 × 2–3 Smaller in ectosome. Both categories often oxeote.	Jamaica. 70.1 m. Massive yellow sponge 3–4 cm thick and 25 cm maximum diameter.
Petrosia (*Petrosia*) *pellasarca* (de Laubenfels, 1934)	Oxeas: 165–240 × 8–10	Puerto Rico 36–73 m. Lamellate, encrusting 1 × 5 × 8 cm. Brown.
Petrosia (*Petrosia*) *raphida* Boury-Esnault, Pansini & Uriz, 1994	Strongyles: 354–499 × 26–36.4 Raphides: 81–108 × 1–1.35	Mediterranean – near the coast of Gibraltar, 580 m. Spherical with narrowed base.
Petrosia (*Petrosia*) *weinbergi* Van Soest, 1980	Oxea to strongyles. Small: 29–58 × 1.5–4 Medium: 76–151 × 4–12 Large 222–254 × 7.5–14.5	Curaçao 500 m, Puerto Rico. Stony mass encrusting corals, green, 1–2 cm thick.

Paratype: BELUM Mc6222, English Bay, Ascension Island, −7.89292°, −14.3868°, depth 5–11.5 m, 3 December 2009, collected by Claire Goodwin.

Other specimens: BELUM Mc6234, BELUM Mc6235, BELUM Mc6236, One Hook, English Bay, Ascension Island, −7.98292°, −14.3868°, depth 8–20 m, 8 December 2009, collected by Claire Goodwin.

GenBank accession number for ARC 81596: MW488272.

Diagnosis

Monanchora lacking microscleres. Spicules ectosomal tylostyles 217(271)294 × 4(5)6 μm and basal styles 288(311)343 × 6(7)9 μm. Bright orange-red colour *in vivo*, prominent stellate channels surround oscules but not of a contrasting colour.

Etymology

Named for Kate Downes, a young, bright, talented scientist whose precious life sadly ended in 2020. Kate's passion for Ascension drove her work on the island and continued after she left to pursue a PhD on yellowfin tuna that utilize this unique tropical ecosystem. Kate's sad passing has left large voids in her family, friends and colleagues' lives. We are honoured to name this common beautiful sponge species in her cherished memory.

External Appearance

In vivo (Figure 4A, B): Red thinly encrusting (up to 1 cm thick) sponge forming patches up to 10 cm in diameter. Large pore sieves, often slightly elevated. Stellate subsurface channels radiate from the pore sieves. The area between the channels is punctate.

Preserved: Thin red crust.

Skeleton (Figure 4D)

A basal layer of large styles echinates the substrate. Ascending columns of up to 15 of the smaller ectosomal tylostyles ascend to the surface.

Spicules (Figure 4C)

Ectosomal tylostyles (Figure 4E, H): 217(271)294 × 4(5)6 μm. Head can be slightly tylote, forming an oval swelling. Taper to a fine point.

Basal styles (Figure 4F, G): 288(311)343 × 6(7)9 μm. Head not tylote. Fairly straight-sided then terminating in an abrupt point.

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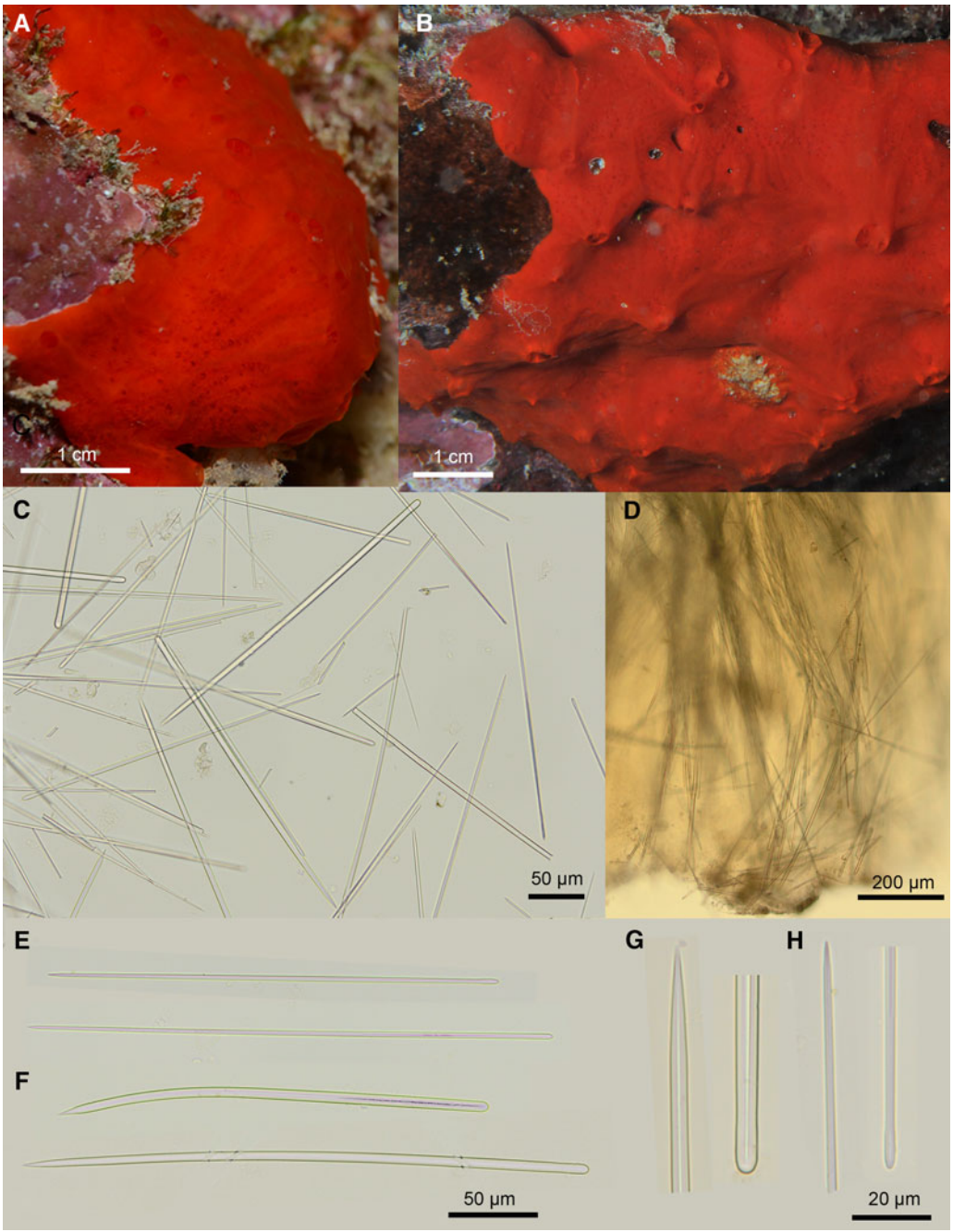

Fig. 4. *Monanchora downesae* sp. nov. (A) *In vivo* appearance ARC81596. (B) *In vivo* appearance Mc6222, (C) Spicules. (D) Choanosomal skeleton. (E) Ectosomal tylostyles. (F) Basal styles. (G) Basal style ends. (H) Ectosomal tylostyle ends.

Remarks

Seventeen species of *Monanchora* are currently regarded as valid (Van Soest *et al.*, 2021). Of these, six are known from the Atlantic: *Monanchora arbuscula* (Duchassaing & Michelotti, 1864), *Monanchora bahamensis* Esteves *et al.*, 2018, *Monanchora brasiliensis* Esteves *et al.*, 2012, *Monanchora coccinea* Esteves *et al.*, 2018, *Monanchora megasigma* Esteves *et al.*, 2018, and *Monanchora stocki* Van Soest, 1990.

Monanchora stocki Van Soest 1990 was described from the Cape Verde Islands and Ascension Island. It has styles of only a slightly shorter size range (ectosomal 175–263 by 2–3.5 µm and basal 161–362 by 4–7 µm) and is also a red crust. However, it also has isochelae 16–24 µm, and although we did search carefully, we could not find any in any of our specimens. Although both *Monanchora* (Esteves *et al.*, 2018) and the related genus *Crambe* (Van Soest, 2002) are known to lose microscleres in some specimens, we feel it is unlikely that this would occur in all the specimens collected. Additionally, the large styles of *M. stocki* have a pronounced tylote head, and both categories are thinner and can be much shorter than those in our specimen.

Esteves *et al.* (2018), in their review of tropical western Atlantic *Monanchora*, note that *Monanchora arbuscula* can have very rare or absent microscleres, unlike the other species present in the region. *M. arbuscula* also can take a red encrusting form. However, as the name suggests, other specimens can be erect and ramified. They measured a large number of specimens they categorized as *M. arbuscula*. Some of these, particularly those from Fernando de Noronha had very similar-sized styles to our specimens (223–339 µm) and lacked microscleres, as did specimens from Rio Grande do Norte in Brazil. Their specimens from Abrolhos, Brazil were very similar in appearance to ours, being a red crust without veins. However, they had sigmoid

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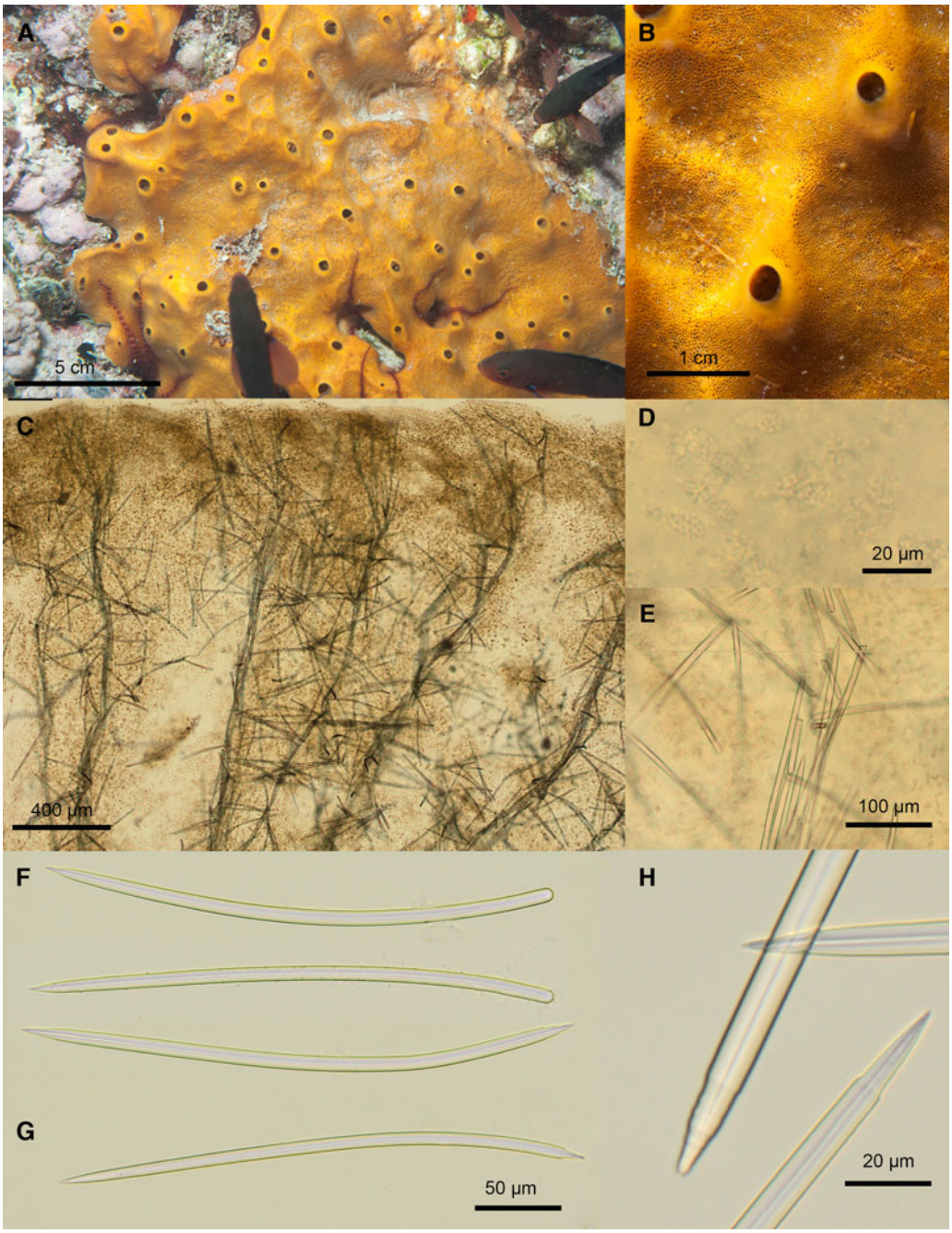

Fig. 5. *Svenzea weberorum* sp. nov. ARC 81544. (A) *In vivo* appearance. (B) Close up of surface. (C) Choanosomal skeleton. (D) Granular cells. (E) Close up of choanosomal skeleton showing granular cells. (F) Styles. (G) Oxea. (H) Close up of ends of spicules.

chelae, which our specimens lack. Additionally, specimens of *M. arbuscula* that lack chelae also lack two categories of megascleres, having just the thinner category (Esteves pers. comm.). This indicates that our specimens are probably a distinct species. There was also only 93% alignment with 28S sequences from our specimen (ARC 81596, GenBank MW488272) and a specimen of *M. arbuscula* (GenBank KC869447.1, Thacker *et al.*, 2013).

The genus *Crambe* has species with a similar appearance and also often has a reduced spicule complement, lacking microscleres. However, sequences of *Crambe crambe* (GenBank KX688742.1, Idan *et al.*, 2018) had only 83% similarity with our sequenced specimen so we feel our species is unlikely to belong in this genus.

This species was very abundant on volcanic bedrock in the shallow water around northern and western Ascension Island.

Order SCOPALINIDA Morrow & Cárdenas, 2015
Family SCOPALINIDAE Morrow, Picton, Erpenbeck, Boury-Esnault, Maggs & Allcock, 2012
Genus Svenzea Alvarez, Van Soest & Rützler, 2002
Svenzea weberorum Goodwin & Downey, 2021 sp. nov.
urn:lsid:zoobank.org:act:15D06575-04EB-4880-BE3D-4B4CBAA03FE6
(Figure 5A–H)

Type Material

Holotype: ARC 81544, Wigan Pier, Ascension Island, −7.89397° −14.3835°, depth 6 m, 25 August 2012, collected by Judith Brown.

Paratype: ARC 81600, Pyramid Point, Ascension Island, −7.90617° −14.40522°, depth 18 m, 22 July 2015, collected by Emma Nolan and Jerry Pierce.

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Other specimens: ARC 81591, Red Rock, Ascension Island, −7.89435°, −14.39475°, depth 14.7 m, 19 July 2015, collected by Paul Brickle and Stevie Cartwright.

ARC 81588, Red Rock, Ascension Island, −7.89423° −14.3946°, depth 16 m, 18 July 2015, collected by Paul Brewin and Jerry Pierce.

ARC 81555, Porpoise Point, Ascension Island, −7.8981° −14.35125°, depth 13 m, 29 August 2012, collected by Judith Brown.

Diagnosis

Svenzea with massively encrusting form and yellow-orange colour *in vivo*. Spicules are styles 260–318 × 6–12 µm and oxeas 236–348 × 7–11 µm.

Etymology

Named for Drs Nicola and Sam Weber; two scientists who have spent many years on Ascension Island. They were instrumental in generating a biodiversity baseline and environmental management, which ultimately led to the creation of the island's Marine Protected Area. Sam and Nicola continue to work closely with Ascension Island Government's Conservation Department and were critical to this project's success.

External Appearance

In vivo (Figure 5A, B): Thickly encrusting yellow-orange sponge. The holotype is around 30 cm in diameter and up to 5 cm thick, but this species often forms larger patches. Oscules up to 5 mm across are irregularly scattered over its surface; they are slightly raised and surrounded by a ring of solid, non–punctate tissue. The rest of the ectosome is punctate, with the ectosomal mesh visible through the surface.

Preserved: Cream in ethanol. Holds its form but fairly soft and compressible. Oscules have a smooth area around them, distinct from the rest of the sponge's punctate surface.

Skeleton

Choanosomal skeleton (Figure 5C): Reticulate. Ascending columns of 3–6 spicules are irregularly joined by either single spicules or short bundles of up to 3 spicules. Columns are surrounded by a spongin sheath which is obvious on some tissue sections. Granular cells (9(12)17 µm in diameter) are very abundant in the tissue and sometimes obscure the skeleton when viewed on the light microscope (Figure 5D, E). They form a particularly dense layer in the ectosome. There is no distinct ectosomal skeleton, but there is a translucent layer of tissue at the surface which can be peeled off. This has very abundant granular cells in it.

Spicules

The majority of the spicules are styles (Figure 5F). These are usually curved, sometimes smoothly, but sometimes with one or more angular bends. The point is fairly abrupt and can be smooth but is often telescoped (Figure 5H). Styles measure 267(289)318 × 9(10)12 µm in the holotype (ARC 81544) and 266(284)295 × 6(8)10 µm in the paratype (ARC 81600). Oxea, presumably modifications of the styles, are also present but much less abundant than the styles (Figure 5G). These are of a similar form to the styles but usually slightly longer. Oxea measured 278(321)348 × 7(9)11 µm in the holotype (ARC 81544) and 236(297)343 × 7(9)11 µm in the paratype (ARC 81600). There are occasional very thin styles (1–2 µm thick present), presumably modifications of the other styles.

Remarks

This sponge was very common in the shallow waters around Ascension. It is eaten by turtles.

The other specimens listed here, but not as holotypes or paratypes, do vary in some characters, and therefore we have not assigned them as type specimens. However, all of these had similar skeletal forms and granules, so we think they are the same species. Additional sampling will help determine the level of variation in spiculation that occurs in *Svenzea weberorum* sp. nov.

ARC 81555 is very similar in appearance to the type specimens but is brown rather than orange in colour and has slightly shorter and narrower styles (228(264)284 × 7(8)9 µm). While oxea were present, they were scarce. ARC 81591 is yellow (a good photograph of external appearance was not available). It has a similar size range of styles (276(298)328 × 11(14)17 µm), but oxeas do not seem to be present. ARC 81588 also has styles of a similar, but slightly longer, length (290(316)348 × 9(11)14 µm), but while oxea were present, they were very rare. This specimen was not photographed.

There are six valid species of Svenzea (Van Soest *et al.*, 2021; Table 4). Of these *Svenzea zeai* (Alvarez *et al.*, 1998), *Svenzea cristinae* Alvarez *et al.*, 2002 (Lehnert and Van Soest, 1999), *Svenzea germanyanezi* Gómez and Calderón-Gutiérrez, 2020 and *Svenzea tubulosa* (Alcolado & Gotera, 1986) have been recorded from the Atlantic or Caribbean. *S. tubulosa* can be distinguished by its tubular form and much larger styles. *S. flava* has 'styloid' spicules, mostly with two blunt ends, rather than true styles, and these are larger than found in our specimens (310–395 × 12–15 µm). *S. cristinae* has much larger styles (320–460 × 4–11 µm). *S. germanyanezi* is a small, cone-shaped, cave-dwelling sponge, with two categories of oxea, both of which are considerably larger than those of *S. weberorum* sp. nov. (390–490 × 9–10.6 µm and 325–410 × 1.8–5.5 µm). *S. zeai* has shorter styles and oxea and is a purple-brown sponge with volcano-shaped, oscular mounds up to 6 cm high.

This species is found in the north-eastern and western sectors of the island, on volcanic bedrock, boulders, and on the under hangs of vertical rocks.

Order TETRACTINELLIDA Marshall, 1876
Suborder ASTROPHORINA Sollas, 1887
Family GEODIIDAE Gray, 1867
Subfamily ERYLINAE Sollas, 1888
Genus Erylus Gray, 1867
Erylus williamsae Goodwin & Downey, 2021 sp. nov.
urn:lsid:zoobank.org:act:22A91166-24FB-4960-BB99-84806CDE1717
(Figure 6A–H)

Type Material

Holotype: ARC 81577, Red Rock Archway, Ascension Island, −7.89423° −14.3946°, depth 30 m, 6 September 2012, collected by Judith Brown.

Diagnosis

Erylus with oxeas 483(578)662 µm long. Microscleres include strongylasters 9(13)16 µm and microrhabds/microxea 38(47)54 × 3(4)6 µm.

Etymology

Named for Natasha Williams, Conservation Assistant for Ascension Island Government's Conservation Department who has been with the department since she left school on Ascension Island. Natasha played an important role in facilitating this study.

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Table 4. Comparison of currently valid *Svenzea* species. Information from original descriptions and Zea *et al.* (2014)

Species	Styles (μm)	Oxeas (μm)	Skeleton	Distribution/Appearance
Svenzea weberorum sp. nov.	267(289) 318 × 9(10)12	278(321) 348 × 7(9)11	Choanosomal skeleton reticulate. Ascending columns of 3–6 spicules are irregularly joined by either single spicules or short bundles of up to 3 spicules. Many granular cells present.	Very common in the shallow waters around Ascension Island. It is eaten by turtles. Thickly encrusting yellow-orange sponge. The holotype is around 20 cm in diameter and up to 5 cm high, but it can form larger patches. Oscules up to 5 mm across are irregularly scattered over its surface. They are slightly raised and surrounded by a ring of solid, non-punctate tissue.
Svenzea zeai (Alvarez, Van Soest & Rützler, 1998)	205(238) 270 × 7(9)12	210(276) 320 × 7(9)12	Ectosomal reticulation of spicules obscured by granular cells. Choanosome, ascending spicule tracts with 1–3 spicules (generally unispicular), connected by single spicules, also obscured by granular cells.	Widely distributed through the Caribbean area. recorded from Florida to Puerto Rico, the Virgin Islands, Tobago, the Atlantic coast of Colombia, Curaçao and Belize, between 20 and 40 m depth. Thick encrustations to masses with low to high to globular, volcano-shaped oscular mounds. Specimens can reach 1 m in diameter and 20 cm in thickness. Specimens from the southern Caribbean coast of Colombia and some from Panama tend to form creeping branches, up to about 5–8 cm in diameter and reaching 1 m or more in length. Colour dark brown exterior and creamy interior, but there are also lighter brown to grey specimens.
Svenzea cristinae Alvarez, Van Soest & Rützler, 2002	320–460 × 4–11	60–340 × 4–10, may be absent	Disorganized unispicular reticulation with loose spicules forming triangular or polygonal meshes with very little spongin at the nodes; granular cells obscuring most of the skeleton.	Known from Belize, Jamaica, Panama, Columbia. Thickly encrusting. Surface brown-yellow, purple or brown with pinkish areas; smooth; pierced with minute pores less than 1 mm diameter, aggregated in shallow depressions Irregular encrustations, up to 2–3 cm thick, following the contours of the substratum, and reaching tens of cm in diameter (sometimes up to 1 m). The surface is generally uneven, micro-rugose, but can be smooth, but always having many low mounds and irregular lobes; sometimes lobes grow upwards and ramify. Oscules up to about 5 mm, scattered, located either on top of elevations or in depressions. Colour usually light to dark purple or golden brown; shallow-water specimens are dull golden yellow.
Svenzea devoogdae Alvarez, Van Soest & Rützler, 2002	130–270 × 6–14	130–290 × 8–13	Disorganized reticulation of uni- or pauci-spicular spicule tracts connected at the nodes with very little spongin and obscured by granular cells.	Massive with lobes and oscular mounds. Maroon-black externally, beige choanosome. Surface smooth, infested with small black zoanthids. Oscula up to 1 cm in diameter on top of lobes and mounds. Sulawesi, Bali, Indonesia; 11–20 m
Svenzea flava (Lehnert & Van Soest, 1999)	244–380 × 2–11 'styloids' with one end tapering but mostly blunt	Not present	Long ascending polyspicular tracts 50–160 μm in diameter and 80–250 μm apart. Connected by single spicules and sometimes short tracts.	Jamaica 76 m. Yellow massive sponge with a smooth surface, 8 × 6 × 4 cm.
Svenzea tubulosa (Alcolado & Gotera, 1986)	Styles 310–395 × 12–15	Not present	More or less isotropic with spicule tracts 100–130 μm in diameter.	Cuba, 20–30 m. Tubular sponge 15 cm in height and 2 cm in diameter. Beige.

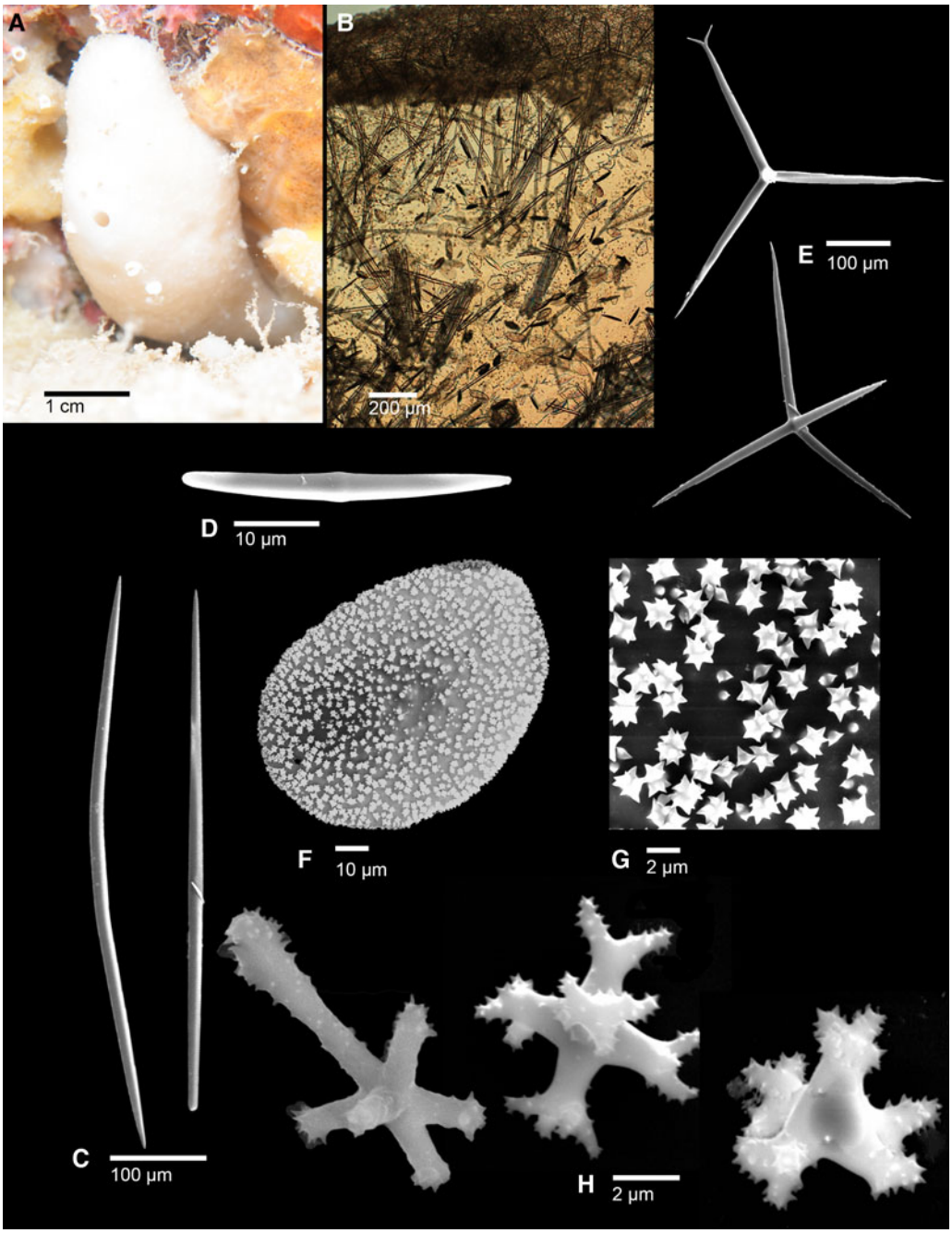

Fig. 6. *Erylus williamsae* sp. nov. ARC 81577. (A) *In vivo* appearance. (B) Skeleton. (C) Oxea. (D) Microrhabd. (E) Orthotriaenes/Dichotriaenes. (F) Aspidaster. (G) Aspidaster surface. (H) Strongylasters.

External Appearance

In vivo (Figure 6A): Small white lobe around 4 cm in length, 2.5 cm in width and 2 cm in height. Smooth surface with a single oscule on its apex.

Preserved: White in ethanol. Very firm texture.

Skeleton (Figure 6B)

Columns of oxeas in cortex 300–500 µm thick. Composed of orthotriaenes which join the ends of the columns of oxeas, interspersed with a dense layer of aspidasters.

Spicules

Large oxeas (Figure 6C): 483(578)662 × 12(17)25 µm. Some are true oxea, some strongylote (rounded ends), and occasionally there are stylote forms.

Orthotriaenes/Dichotriaenes (Figure 6E): Clades 200(242)284 µm, rhabdome 145(191)251 µm. In some one or more clades are bifurcate.

Microrhabds/microxea (Figure 6D): 38(47)54 × 3(4)6 µm. Rounded ends. Often centrotylote.

Aspidasters (Figure 6F, G): 80(111)146 × 4(62)69 µm. Uneven ovals. Some have slightly pointed ends, tending towards diamond shaped.

Strongylasters (Figure 6H): 9(13)16 µm. Seem to take two forms, both with 5–6 uneven rays. In one form rays are usually not branched, and one ray is significantly longer than the others. In the other form, the rays are shorter in comparison to the centrum, and each ray is divided into 2–5 segments at its end. There are also intermediate forms.

Remarks

This species can be distinguished from most other *Erylus* species, of which there are 68, based on its smaller megascleres and differing combinations of microscleres (see Vieira *et al.*, 2010) for a review, and Lehnert & Stone (2019) and Van Soest (2017) for

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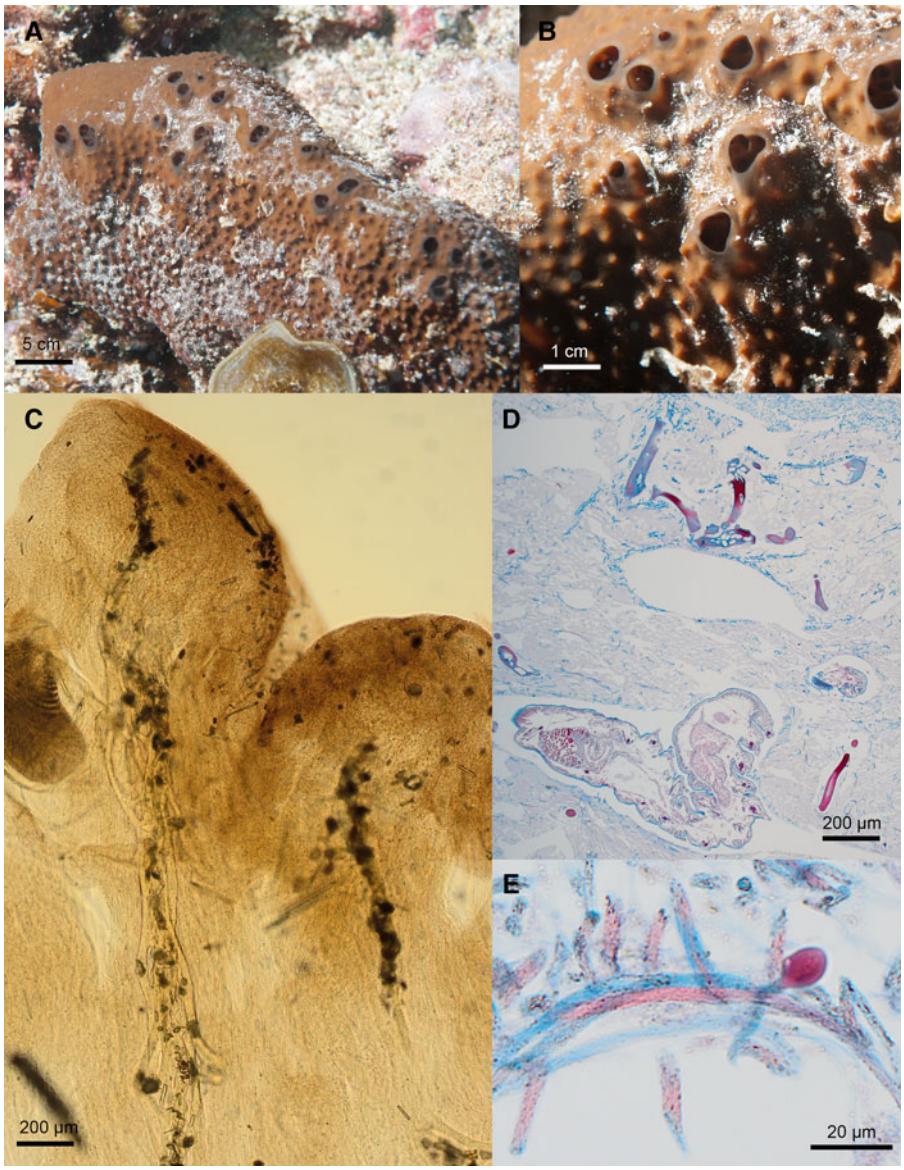

Fig. 7. *Ircinia nolanae* sp. nov. ARC 81543. (A) *In vivo* appearance. (B) Close up of surface. (C) Choanosomal skeleton. (D) Stained section of choanosome. (E) Ircinid filaments.

subsequent descriptions of *E. imperator* Lehnert & Stone, 2019, *E. rhabdocoronatus*, Van Soest, 2017 and *E. surinamensis* Van Soest, 2017. Those with similar spicule combinations are *E. bahamensis* Pulitzer-Finali, 1986, and *E. corneus* Boury-Esnault, 1973. *Erylus bahamensis* has larger oxeas (530–850 × 6–15 µm) and its asterose microscleres are tylasters which can be twice the size of those found in our specimen (15–28 µm). *Erylus corneus* can be distinguished as it has oxyasters (with pointed tips) rather than strongylasters. This species was found in a rocky environment in the northern sector of the island.

Subclass KERATOSA Grant, 1861
Order DICTYOCERATIDA Minchin, 1900
Family IRCINIDAE Gray, 1867
Genus *Ircinia* Nardo, 1833
Ircinia nolanae Goodwin & Downey, 2021 sp. nov.
urn:lsid:zoobank.org:
act:47C13975-9EC1-4D8E-9B25-377033DA2E73
(Figure 7A–E)

Type Material

Holotype: ARC 81543, The Arches, Ascension Island, −14.41951667° −7.918116667°, depth 5 m, 25 August 2012, collected by Judith Brown.

Paratype: ARC 81595, Red Rock, Ascension Island, −7.89435° −14.39475°, depth 14.7 m, 19 July 2015, collected by Paul Brickle and Stevie Cartwright.

Diagnosis

Massively encrusting *Ircinia* which is reddish-brown *in vivo* and takes the form of a massive (up to 1 metre in length) encrusting lobe. Large, fasciculate, primary fibres (100–160 µm width) cored with debris. Sparse secondary fibres (around 30–40 µm in width) with no or little debris.

Etymology

Named for Dr Emma Nolan, a marine scientist on the Ascension Island Marine Sustainability Project. Emma took part in the SMSG/SAERI Surveys and helped with the logistics.

External Appearance

In vivo (Figure 7A, B): Very large sponge forming massive lobes around 50 −100 cm in length and 5 −15 cm high. The form is typically an elongate, thickly encrusting lobe with a central ridge along which large oscules (up to 75 mm in diameter) are arranged. The colour is reddish-brown on the outside. The interior of the sponge, when cut, is beige. The surface of the sponge is covered with closely spaced, rounded conules up to 10 mm high.

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Preserved: Firm but compressible lobe. Wrinkled, slightly shiny, exterior layer with obvious conules. The exterior is dark brown on the top and cream on the bottom of the sponge. Cream interior.

Skeleton (Figure 7C–E)

Large, fasciculate, primary fibres (100–160 µm width) cored with debris. Sparse secondary fibres (around 30–40 µm in width) with no or little debris join them at intervals. Spongin filaments are very abundant, especially in the ectosome. They are 3(4)5 µm in width on the shaft and have oval heads 6(7)10 µm wide. There is a light crust of debris in the ectosome.

Remarks

Many of the other species of *Ircinia* present in the region can be distinguished based on form, being globular: *Ircinia strobilina* (de Lamarck, 1816), cup-shaped *Ircinia campana* (de Lamarck, 1814); ramose: *Ircinia dickinsoni* (de Laubenfels, 1936), *Ircinia repens* Sandes & Pinheiro, 2014, *Ircinia reteplana* (Topsent, 1923); or thinly encrusting: *Ircinia hummelincki* Van Soest, 1978 (Table 5). *Ircinia ectofibrosa* (George & Wilson, 1919) is white *in vivo*. Those with similar thickly encrusting/lobular forms and, where known, a brown colour, are *Ircinia felix* (Duchassaing & Michelotti, 1864), *Ircinia pauciarenaria* Boury-Esnault, 1973; and *Ircinia sergipana* Sandes & Pinheiro, 2014 (Table 5). *Ircinia pauciarenaria* Boury-Esnault, 1973 has much larger primary fascicular fibres (570–760 µm) and secondary fibres (lower width of 96 µm). In *Ircinia sergipana* Sandes & Pinheiro, 2014 both the primary and secondary fibres are cored, and it has thinner filaments (2.5–5 µm with heads 5–7.5 µm). *Ircinia felix* (Duchassaing & Michelotti, 1864) is a common species in the Caribbean, known colloquially as the stinker sponge. It is typically globular or cake shaped rather than an elongate lobe, and has pronounced white conules linked with pale webbing, whereas the surface of our specimens is uniform in colour. *Ircinia richardsoni* sp. nov. is similar in form to this species but differs in having strongly cored secondary fibres and is black rather than brown.

This species is common on bedrock in the shallow waters around the north and north-western side of Ascension.

Ircinia richardsoni Goodwin & Downey, 2021 sp. nov.
urn:lsid:zoobank.org:act:
A99F0D6A-1B3E-49D7-A063-B51EEA7F16D8
(Figure 8A–E)

Type Material

Holotype: ARC 81552, Soudan Wreck, Ascension Island; −7.8876° −14.37621667°; depth 8 m, 27 August 2012; collected by Judith Brown.

Paratypes: ARC 81599 and ARC 81590 Red Rock, Ascension Island; −7.894233° −14.3946°; depth 8 m, 20 July 2015, collected by Stevie Cartwright.

Diagnosis

Ircinia with a massively encrusting form, black external colour *in vivo*, and small surface conules. Primary fibres (100–170 µm width) fasciculate and heavily cored with debris. Secondary fibres (40–60 µm wide) are also debris cored.

Etymology

Named for Dr Andrew (Andy) Richardson who was the Senior Marine and Fisheries Scientist on Ascension Island until 2019. Andy helped with surveys and sample collections and was significant in driving the AIMS (Ascension Island Marine Sustainability) Project.

External Appearance

In vivo (Figure 8A, B): Large sponge forming massive lobes up to 50 cm in length and 20 cm high. The form is typically an elongate lobe with a central ridge along which oscules (up to 50 mm diameter) are arranged. The colour is black on the outside. The interior of the sponge, when cut, is beige. The sponge's surface is covered with very small conules that appear only as slight bumps on the surface (unlike the more pronounced conules found in other species of the genus).

Preserved: In ethanol, dark brown exterior with conulose surface. Cream interior. Texture fairly soft and compressible.

Skeleton (Figure 8C, D)

Large, fasciculate, primary fibres (100–170 µm width) heavily cored with debris. Secondary fibres (40–60 µm wide) join them; these are also fairly heavily cored and, due to this, the distinction between primary and secondary fibres is not always clear. Spongin filaments (Figure 8E) are very abundant, especially in the ectosome. They are 3(3)4 µm in width on the shaft and have oval heads 5(6)7 µm wide. There is a light crust of debris in the ectosome.

Remarks

Many of the other species of *Ircinia* present in the region can be distinguished based on form, being globular, cup-shaped, or ramose (Table 5), see summary for *Ircinia nolanae* sp. nov. above. Those with similar thickly encrusting/lobular forms and, where known, a black or dark brown colour are *Ircinia felix* (Duchassaing & Michelotti, 1864), *Ircinia pauciarenaria* Boury-Esnault, 1973, and *Ircinia sergipana* Sandes & Pinheiro, 2014. *Ircinia pauciarenaria* Boury-Esnault, 1973 has much larger primary fascicular fibres (570–760 µm) and secondary fibres (lower width of 96 µm). *Ircinia felix* (Duchassaing & Michelotti, 1864) is typically globular or cake shaped rather than an elongate lobe. It has pronounced white conules linked with pale webbing, whereas the surface of our specimens is uniform in colour. *Ircinia sergipana* Sandes & Pinheiro, 2014 is similar in that both its primary and secondary fibres are cored. However, it is much more strongly conulose than our specimens with conules up to 5 mm high. It is also a much smaller sponge; the type specimen is only 8 cm in width. *Ircinia nolanae* sp. nov. is similar in form to this species but differs in having uncored secondary fibres, being brown rather than black, and having much larger conules.

This species has been found on rocky environments in the northern sector of Ascension Island.

Ircinia simae Goodwin & Downey, 2021 sp. nov.
urn:lsid:zoobank.org:
act:7B551BC9-C91C-43DC-8F9C-B9B484C4C8F7
(Figure 9A–G)

Type Material

Holotype: ARC 81559, Boatswain Bird Island, Ascension Island, −14.3081° −7.936766667°; depth 6 m, 1 September 2012, collected by Steve Brown.

Paratype: ARC 81561 Boatswain Bird Island, Ascension Island, −7.936766667° −14.3081°; depth 6 m, 1 September 2012, collected by Steve Brown.

Other specimens: ARC 81560; ARC 81564 and ARC 81562, Boatswain Bird Island, Ascension Island, −7.936766667° −14.3081°; depth 6 m, 1 September 2012, collected by Steve Brown.

ARC 81580, Red Rock Archway, Ascension Island, −7.894233333° −14.3946°; depth 30 m, 6 September 2012, collected by Judith Brown.

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Table 5. Comparison of currently valid *Ircinia* species from the Atlantic and Caribbean. Information from type descriptions except where stated otherwise

Species	Colour/Form	Fibre (measurements in μm)	Type locality/Distribution/Notes
Ircinia simae sp. nov.	Sponge is white but has pink patches (or in some cases is entirely pink), presumably due to symbiotic algae. Massively encrusting forming patches or low mounds, often in caves. A few large oscules, often on apex of mounds or ridges. Surface conulose with thin, hispid conules, and in some places the sub-ectosomal network is visible as a mesh.	Primary fibres 120–240, fasciculate. Secondary fibres 40–80, uncored, sometimes fasciculate. Filaments 4(4)5 on the shaft and 5(7)8 on the head.	Seems to be common in shallow water around Ascension, particularly in caves and under overhangs.
Ircinia nolanae sp. nov.	Very large reddish-brown sponge forming massively encrusting lobes up to 60 cm in length and 20 cm high. Central ridge bears large oscules. Surface covered with rounded conules.	Primary fibres, cored, fasciculate 100–160. Secondary fibres, uncored, 30–40. Filaments shaft 3–5, head 6–10.	Ascension. Present in shallow water.
Ircinia richardsoni sp. nov.	Large black sponge forming massively encrusting lobes up to 50 cm in length and 20 cm high. Central ridge bears large oscules. Surface covered with very small conules.	Primary fibres, heavily cored, fasciculate 100–170. Secondary fibres, cored, 40–60. Filaments 3–4 on shaft, 5–7 on head.	Ascension. Present in shallow water.
Ircinia campana (Lamarck, 1814) *sensu* Van Soest (1978)	Reddish-brown (*in vivo*), greyish–brown (ethanol). Cup-shaped 7.5–50 cm high, 8.5–40 cm diameter. Strongly conulose with conules 2–8 mm high and 3–10 mm apart.	Primary fibres fasciculate 300–700. Secondary fibres 30–150. Filaments 3–6, knobs 9–10.	Common on reefs and rocky lagoon bottoms. Type locality in Caribbean Sea. Caribbean, Florida, Gulf of Mexico, Mexico, Brazil.
Ircinia dickinsoni (de Laubenfels, 1936) as *Hircinia ramosa*	Drab (*in vivo*). Cylindrical and ramose.	Primary fibres 170. Filaments 3.	Puerto Rico. 59–72 m.
Ircinia ectofibrosa (George & Wilson, 1919)	Light white to purple (*in vivo*). Plate shaped base with lobed or sub–cylindrical projections.	Primary fibres 100–100. Secondary fibres 40–50. Filaments 3–6.	North Carolina.
Ircinia felix (Duchassaing & Michelotti, 1864)	Brown (*in vivo*), beige to brown (ethanol). Typically, globular or cake shaped with a maximum diameter of 12–14 cm. But may be encrusting, lamellar, or ramose. Conulose, conules 1 mm high and 2–3 mm apart. Oscules typically have a large, blackish purple rim. The original description describes it as rounded or lobed with cross–linked hard and rigid spiniform processes. Various variations in morphology have been recorded including lobate, branching and massive and it is not clear if these are all the same species; see Zea *et al.* (2014) and Messing *et al.* (2020).	Primary fibres 80–170, moderately cored, forming fasciculate columns 200–550. Secondary fibres 15–100, sparsely cored. Filaments 3–5, knob 8–10, at least 1500 long. Dermis loaded with sand grains. Messing *et al.* (2020) note a surface reticulation of foreign material with apertures 60–190.	Type locality Eastern Caribbean. Also known from Florida, the Gulf of Mexico and Brazil (Van Soest *et al.*, 2021). Recorded from the Trindade and Martim Vaz Islands (Moraes *et al.*, 2006), 1000 km off the coast of Brazil. Except where stated information from Van Soest (1978), including re-description of lectotype.
Ircinia hummelincki Van Soest, 1978	Beige brown (ethanol). Thinly encrusting on coral debris with one cylindrical branch projecting. Fine conules 0.5 mm high and 1 mm apart.	Primary fibres 200–250. Secondary fibres (30–40). Filaments 15–29.	Barbados. 100 m. Distinguished by its extremely coarse filaments which do not terminate in a rounded knob.
Ircinia oros (Schmidt, 1864)	Grey (*in vivo*). Massive, lobate (20–30 cm diameter and 10–15 cm in height). Each lobe usually bears a large oscule (30–60 mm in diameter), sometimes at the end of a short funnel (1 cm high). Surface covered by a slim layer of very fine and regular mineral sediment engulfed in a slender regular network showing a lighter colour. Conules (1–2 mm in height) regularly distributed, 24 mm apart.	Primary 200–250. Secondary 100–200. Filaments 9–13, oval knob 15–22.	Type locality Adriatic Sea. Widespread in Mediterranean. Also recorded Canaries. Information from Manconi *et al.* (2013).
Ircinia pauciarenaria Boury-Esnault, 1973	Black or dark maroon interior white. Massive lobed (type specimens 14 × 3 × 3 cm and 15 × 10 × 4 cm).	Fibres 96–280 forming fascicules 570–760. Filaments 3–5 with head 10.	Pernambuco, Brazil. 14–51 m. Distinguished from other species by its very thin filaments and by the sparse coring of its fibres.
Ircinia repens Sandes & Pinheiro, 2014	Light to dark brown (in ethanol). Ramose shaped, composed of repent branches with pointed ends (Figure 3A). The largest specimen is 18 × 2 cm (length × width). Conulose surface, with conules less than 1 mm high, 0.5–2 mm apart	Primary fibres 125–288. Secondary fibres 35–112. Primary fibres cored more heavily than	North-eastern Brazil 20–30 m.

	from each other. The oscular projections are up to 10 mm high (Figure 3B) and irregularly distributed over the surface. The oscules are 2 mm in diameter.	secondary. Filaments 2.5–5 on shaft, 5–6.3 at head.	
Ircinia reteplana (Topsent, 1923)	Flabellate with anastomosing, flattened, branches. Largest specimen 17 × 37 × 1 cm.	Primary fibres, cored, 140–210. Secondary fibres, mostly uncored, 25–100. Filaments shaft 3–6, head 10–12.	Eastern Caribbean.
Ircinia sergipana Sandes & Pinheiro, 2014	Beige (ethanol). Massive lobed in shape, single specimen, 8 × 7.5 cm (width × height). Conulose surface with projections up to 10 mm high and region between conules perforated by oscules smaller than 1 mm in diameter. The conules are 1–5 mm high, 3–5 mm apart.	Fibres 35–130 (both primary and secondary are cored). Filaments 2.5–5 with heads 5–7.5.	Type locality north-eastern Brazil.
Ircinia strobilina (Lamarck, 1816) *sensu* Van Soest (1978)	Blackish grey on upper surface, yellow grey near base (*in vivo*), grey (ethanol). Globular, oval, cake-shaped. Up to 20 cm high and 23 in diameter. Strongly conulose. Conules 2–15 mm high and 5–15 mm apart.	Primary fibres 200–1000. Secondary fibres up to 80. Filaments 1–6 with knobs 5–12. Dermis thickly loaded with sand.	Common on reefs. Caribbean, Guyanan shelf, Bermuda, Florida. Van Soest (1978) states that specimens with long conules and those with rounded conules might be separate groups.
Ircinia variabilis (Schmidt, 1862)	Thickly encrusting. Conulose. Colour very variable – whitish to pink, greenish to blackish. Up to 70 cm in diameter and 20 cm thick but usually much smaller. Vacelet (1959) notes it is common under shallow rocky overhangs. De Laubenfels (1950) notes that it is common in the Bahamas. These specimens were grey-blue or violet blue rather than white, fine grained and small with inconspicuous oscules.	Primary fibres (cored) 100–250. Secondary fibres 40–70 (no inclusions). Filaments 2–8 with knobs 5–11. Ectosome strengthened by sand grains which may form a coat or reticulation.	Type locality Adriatic. Widespread in the Mediterranean and around Spain, found on vertical cliffs between 7 and 25 m. Also recorded from several oceanic Atlantic locations including the Canaries, Cape Verde (Topsent, 1928), Gulf of Guinea (Burton, 1956). Also recorded from Bermuda (de Laubenfels, 1950). Information from Van Soest *et al.* (2021). Images of the lectotype selected by Schulze are figured in Pronzato *et al.* (2004).

Species in '*incertae sedis*' have not been included: *Ircinia marginalis* (Duchassaing and Michelotti, 1864); *Ircinia procumbens* (Poléjaeff, 1884), *Ircinia tintinnabula* (Duchassaing and Michelotti, 1864), *Ircinia tristis* (Duchassaing and Michelotti, 1864).

ARC 81594, Red Rock, Ascension Island, −7.89435° −14.39475°; depth 14.7 m, 19 July 2015, collected by Paul Brickle and Stevie Cartwright.

ARC 81589, Red Rock, Ascension Island, −7.894233° −14.3946°; depth 16 m, 18 July 2015, collected by Paul Brewin and Jerry Pierce.

GenBank accession number for ARC 81559 MW488269; for ARC 81561 MW488270.

Diagnosis

Ircinia with white colour *in vivo*, strongly conulose surface, and massively encrusting form. Primary fibres are cored and strongly fasciculate with a width of 120–240 µm. Secondary fibres 40–80 µm and always uncored.

Etymology

Named for Jolene Sim who is the Conservation Officer at Ascension Island Government's Conservation Department. Jolene was instrumental in helping with the logistics of the SMSG/SAERI surveys that enabled the collection of these samples. Jolene has also done a phenomenal amount of work for conservation on Ascension Island.

External Appearance

In vivo (Figure 9A, B, F): Thickly encrusting white sponge forming patches up to 15 cm in diameter and 10 cm thick. In some specimens, the form is that of a low lobe. The surface is covered with dense, spiky conules, which often come to a fine point, giving it a hispid appearance. Occasional large oscules are scattered over the surface, sometimes on the apex of low mounds. In some specimens, the surface is tinged bright purple-pink, presumably due to symbiotic algae; this may be patchy or cover the entirety. In some specimens, the surface reticulation is visible, giving the sponge a webbed appearance when viewed closely.

Preserved: Cream with conulose surface. Texture soft and compressible.

Skeleton

Choanosome (Figure 9C, G): Primary fibres are strongly fasciculate with a width of 120–240 µm. The central core takes up around a third of the column. The secondary fibres join the primary columns at regular intervals; the fibres branch dendritically where they join the columns. They are also often fasciculate along their length, although less strongly than the primaries. They are much narrower than the primary fibres (40–80 µm) and always uncored.

Ectosome (Figure 9D): The ectosome has a thick crust of debris. In some patches, this forms meshes with uneven apertures. Spongin filaments (Figure 9E) are very dense, especially in the ectosome. They measure 4(4)5 µm on the shaft and 5(7)8 µm on the head.

Remarks

Very few other species of Atlantic and Caribbean *Ircinia* are pale coloured; the majority, where *in vivo* colour is known, are dark brown or black (Table 5). *Ircinia ectofibrosa* (George & Wilson, 1919) is light *in vivo* but is plate-shaped with cylindrical projections. The *in vivo* colours of *Ircinia hummelincki* Van Soest, 1978, *Ircinia procumbens* (Poléjaeff, 1884), *Ircinia reteplana* (Topsent, 1923), *Ircinia sergipana* Sandes & Pinheiro, 2014, and *Ircinia repens* Sandes & Pinheiro, 2014 are not known, but they all differ in form.

The closest species seems to be *Ircinia variabilis* (Schmidt, 1862) which is also thickly encrusting and often a white or pinkish colour, although it has also been recorded as yellow, brown, purple or greenish (Van Soest *et al.*, 2021). The type locality of

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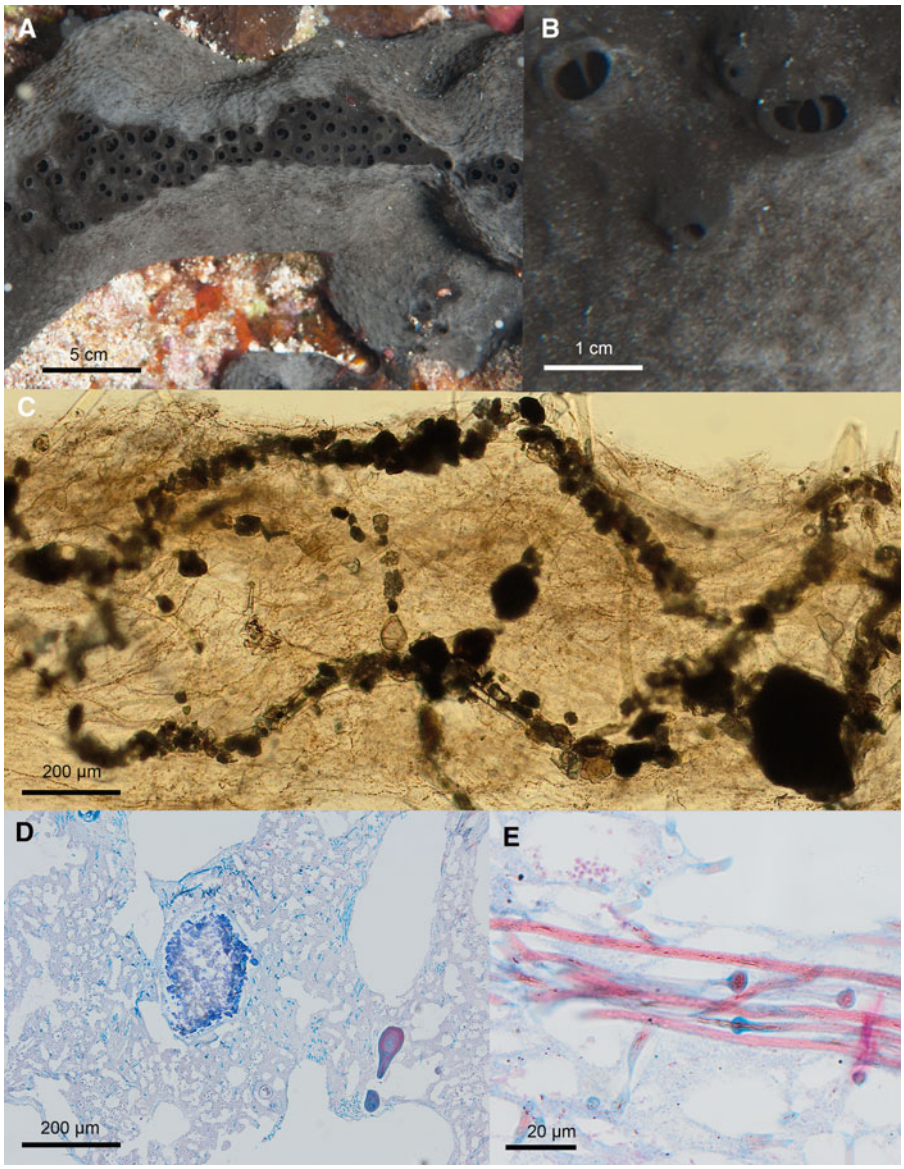

Fig. 8. *Ircinia richardsoni* sp. nov. ARC 81543. (A) *In vivo* appearance. (B) Close up of surface. (C) Choanosomal skeleton. (D) Stained section of choanosome. (E) Ircinid filaments.

this species is in the Adriatic, and it is widespread in the Mediterranean and on southern European coasts. It has also been recorded from several oceanic Atlantic locations, including the Canaries, Cape Verde (Topsent, 1928) Gulf of Guinea (Burton, 1956). It has been recorded from the Bahamas (de Laubenfels, 1950), but these specimens differ in being an underlying blue-grey colour rather than white, and further investigation is needed to determine if they are conspecific. Images of Mediterranean specimens indicate that it appears to have a more strongly mounded form than our specimens with strong lobes with prominent terminal oscules that are often white ringed (Parco Nazionale Cinque Terre, 2019). Comparison with the lectotype figured in Pronzato *et al.* (2004) shows that the primary fibres are less fasciculate and narrower than those found in our specimens with the core taking up a greater part of the fibre. The filaments are also wider than those found in our specimens (2–8 µm on shaft and 5–11 µm on their head). Comparison of our specimen (ARC 8155, GenBank MW488269) with a sequence from *Ircinia variabilis* from the Mediterranean (GenBank KX688725.1 (Idan *et al.*, 2018)) showed only 92.56% similarity; our specimens were more similar (98.72%) to *Ircina campana* (GenBank KC869531 (Thacker *et al.*, 2013)).

This species was common in both the east and northern sectors of Ascension Island, under boulders and in a sea cave.

Subclass VERONGIMORPHA Erpenbeck, Sutcliffe, De Cook, Dietzel, Maldonado, Van Soest, Hooper & Wörheide, 2012
Order CHONDROSIA Boury-Esnault & Lopes, 1985
Family CHONDROSIIDAE Schulze, 1877
Genus Chondrosia Nardo, 1847
Chondrosia browningorum Goodwin & Downey, 2021 sp. nov.
urn:lsid:zoobank.org:act:
EA4CF59E-1919-4632-8F75-ECACD8B4472C
(Figure 10A–E)

Type Material

Holotype: ARC 81575, Red Rock Archway, Ascension Island, −7.89423° −14.3946°; depth 30 m, 6 September 2012, collected by Judith Brown.

Paratypes: ARC 81545, ARC 81550 and ARC 81547 Wigan Pier, Ascension Island, 7.89397° −14.3835°; depth 6.5–12 m, 25 August 2012, collected by Judith Brown.

GenBank accession number for ARC 81575: MW488271.

Diagnosis

An Atlantic species of *Chondrosia* with a cortex around 600–700 µm thick without inclusions, sphaerulous cells 1.2(1.6)1.7 µm in diameter and oval choanocyte chambers 30–40 µm in length and 17–23 µm in diameter.

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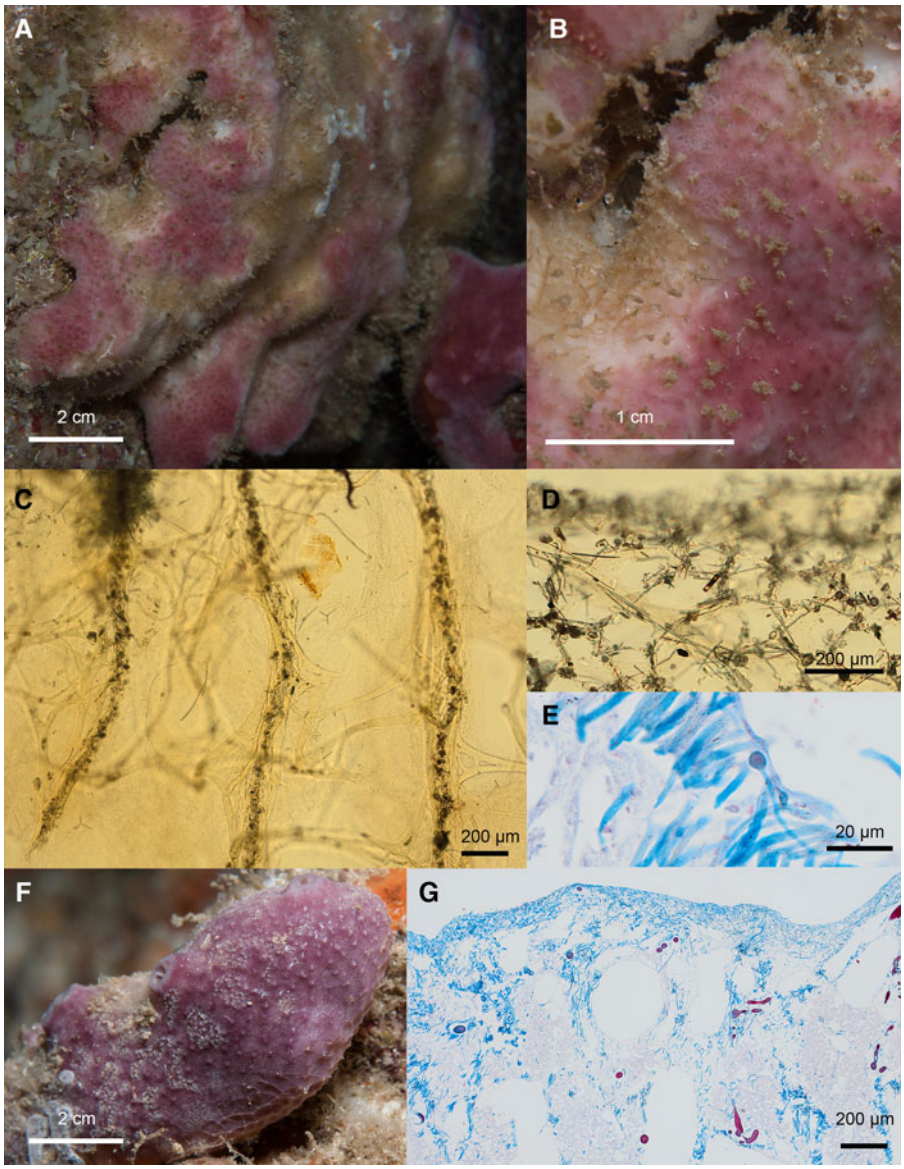

Fig. 9. *Ircinia simae* sp. nov. (A) *In vivo* holotype ARC 81559. (B) Close up of ectosome ARC 81559 (note surface reticulation seen in upper half). (C) Choanosomal skeleton ARC 81559. (D) Ectosomal skeleton Paratype ARC 81561. (E) Ircinid filaments ARC 81559. (F) Paratype ARC 81561 *In vivo*. (G) Stained choanosomal section ARC 81559.

Etymology

Named for Sarah Browning and Lt Col. Simon Browning (retd). Simon and Sarah are long-term members of SMSG and participated in all the SMSG/SAERI surveys to Ascension Island and collected material for this study. Simon was also instrumental with regards to the logistics for the surveys through the facilitation of shipping of dive gear, compressors and sample equipment on the MOD Atlantic airbridge.

External Appearance

In vivo: The holotype (Figure 10A) is light grey with patches of darker grey. It has prominent, slightly raised, oscules irregularly scattered over its surface. It forms a large patch up to 20 cm in diameter and 5 cm thick. The paratypes (Figure 10B) are smaller patches (around 5 cm maximum diameter and 2 cm thick) that are dark black. Presumably, as with other species of *Chondrosia* this difference can be attributed to light exposure, with specimens exposed to light becoming darker (Boury-Esnault, 2002). The texture of this sponge was very firm and rubbery, very tough to cut. The holotype was taken from an archway without much light exposure.

Preserved: Crust with a very smooth surface. In specimens that were black *in vivo* this colour is retained in the surface layer, the interior is grey. Texture very hard.

Skeleton (Figure 10C–E)

The cortex is around 600–700 µm thick with upper and basal layers of around 40–50 µm (Figure 10C). The sphaerulous cells (Figure 10D) are slightly more abundant in the cortex's upper layer but are also fairly numerous through the other cortex layers and in the choanosome. They occur in clusters of up to 11 but usually around 5–9. They are 1.2(1.6)1.7 µm in diameter. The choanocyte chambers (Figure 10E) are oval, 30–40 µm in length and 17–23 µm in diameter.

Remarks

Three species of *Chondrosia* have been recorded from the Atlantic or Caribbean: *Chondrosia plebeja* Schmidt, 1868; *Chondrosia collectrix* (Schmidt, 1870) and *Chondrosia reniformis* Nardo, 1847 (Van Soest *et al.*, 2021). *C. reniformis* is a massively encrusting species that can reach 30 cm in diameter. It is black when exposed to light and white when not exposed. It has a cortex 1–3 mm thick without inclusions (Lazoski *et al.*, 2001). Its sphaerulous cells contain about 20 spherules of about 3 µm in diameter, and it has choanocyte chambers 40 µm in diameter (Boury-Esnault, 2002). Boury-Esnault (2002) notes that only *Chondrosia reniformis* from the Mediterranean Sea, and the nearest Atlantic coasts (Spain, Portugal and Morocco) belong to this species. Specimens from localities outside the Mediterranean vary

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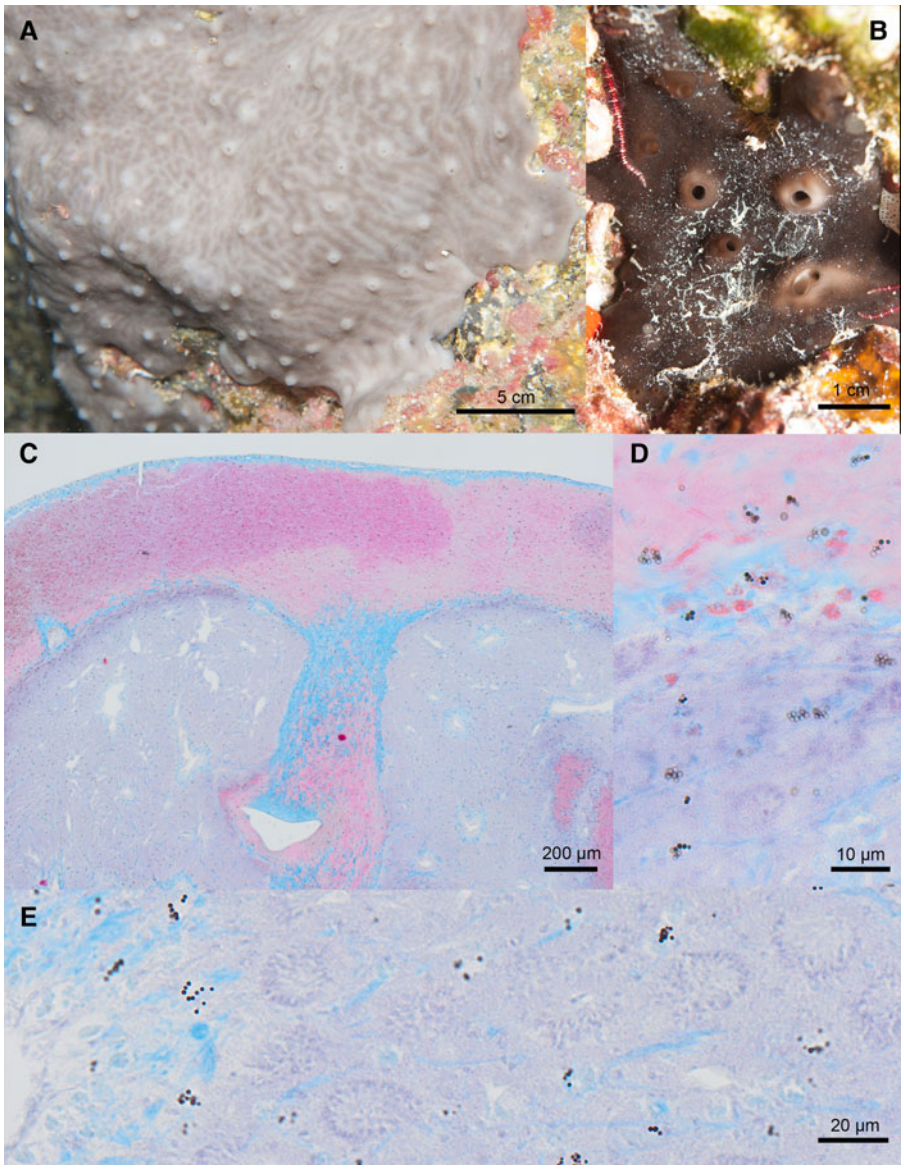

Fig. 10. *Chondrosia browningorum* sp. nov. (A) ARC 81575 *In vivo*. (B) ARC 81545 *In vivo*. (C) ARC 81575 Stained section showing cortex and choanosome. (D) ARC 81575 Sphaerulous cells. (E) ARC 81575 Choanocyte chambers.

principally in the localization and abundance of foreign materials and sphaerulous cells and are certainly different species (Lazoski *et al.*, 2001). Our specimens differ in having a much thinner cortex and smaller sphaerulous cells.

C. plebeja was initially described from the coast of Algiers. It was re-described by Kirkpatrick from specimens from St Helena. Schmidt distinguished *C. plebeja* from *C. reniformis* on account of *C. plebeja*'s irregular surface and the presence of foreign bodies on the surface and in the interior (Kirkpatrick, 1910). Kirkpatrick's specimen was mug shaped (14.5 × 13.5 × 3.5 cm), and in life, specimens were buff coloured with reddish-brown patches. The surface is irregular and deeply pitted due to the incorporation of foreign material. It has a very thin, delicate cortical layer. It has pear-shaped choanocyte chambers (30 × 24 µm) and a dendritic canal system in which the terminal axes end in numerous 'bristle' canals. Stephens (1915) also noted this species from St Helena, also with a cup-shaped form and with abundant foreign material. Sphaerulous cells are not abundant. Wiedenmayer (1977) believed *C. plebeja* was a synonym of *C. reniformis*, but Kirkpatrick's, and Stephens (1915) specimens appeared to be distinct. Our specimens lack foreign material in their choanosome and lack the distinctive choanocyte chambers described by Kirkpatrick.

Chondrosia collectrix (Schmidt, 1870) was described from Florida and is known from Bermuda, the Caribbean and Brazil. It has an irregular cortex 250 µm thick. Inclusions are sometimes present in its cortex and choanosome (Lazoski *et al.*, 2001). Wiedenmayer (1977) describes it as cushion-shaped and up to 15 cm wide and 1.5 cm thick with a purplish brown to black colour. The colour can be obscured by large quantities of sand in the cortex. Our specimens differ from *C. collectrix* in having a much thicker cortex, without inclusions. A sequence of 28S from our specimen ARC 81575 only shows 93% similarity with *Chondrosia collectrix* from Panama GenBank specimen KC869640.1 (Thacker *et al.*, 2013).

A further undescribed species is noted by Lazoski *et al.* (2001) with a smooth cortex 1–2 mm thick, with no inclusions. Specimens were taken from Brazil and Bermuda.

This species was found in rocky areas in the northern sector of Ascension Island.

Discussion

Before this investigation, taxonomic knowledge about shallow-water Ascension Island sponge fauna was limited and patchy (Hentschel, 1914; Burton, 1932; Van Soest, 1990; Van Soest

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et al., 2013, 2014). Before 2012, a total of 17 species from 10 genera, and eight families, had been fully described for Ascension Island (previously identified species in the genera: *Clathria, Dysidea, Monanchora*, *Ascandra*, *Arturia*, *Clathrina*, *Geodia*, *Pione*, *Mycale* and *Spongia*). Hentschel's (1914) record of *Ircinia variabilis* (Schmidt, 1862) is not included in this total as it was a drift specimen and therefore, this record is believed to be inaccurate (Van Soest *et al*., 2021). Some of the species-level identifications, specifically for *Dysidea fragilis*, and *Spongia* (*Spongia*) *officinalis*, are not yet confirmed as definitive Ascension Island sponge fauna. Therefore, these broadly Atlantic-distributed species, will need future work to determine their exact identity.

Many previously collected specimens have been preliminarily identified to genera, which include *Crambe*, *Eurete*, *Aplysilla*, *Batzella*, *Callyspongia*, *Chalinula*, *Chelonaplysilla*, *Chondrosia*, *Cinachyrella*, *Clathrina*, *Cliona*, *Darwinella*, *Dendrilla*, *Halichondria*, *Hippospongia*, *Holopsamma*, *Hymeniacidon*, *Ircinia*, *Leucandra*, *Leucosolenia*, *Niphates*, *Penares*, *Plakina*, *Siphonodictyon*, *Spirastrella*, *Stronglyacidon*, *Svenzea*, *Sycon*, *Tedania*, *Terpios*, *Tethya* and *Haliclona*, which adds 29 genera and 16 families to this pre-2012 list (Barnes, 2017; OBIS, 2021). In addition to this, there are many remaining specimen records that are only identified to Class or Phylum (Taylor & Irving, 1985; Irving, 1989; Manning & Chace, 1990; Barnes, 2017; OBIS, 2021). Operation Origin (Taylor & Irving, 1985; Irving, 1989) collected 67 specimens which they hypothesized represented 47 different species, but only a limited number of these identifications for this material have been finalized and published (Van Soest, 1990; Van Soest *et al*., 2013, 2014; BioPortal Naturalis, 2021; R. Van Soest, pers. comm. 2021).

This new investigation has identified nine additional new species, added two new genera, and one new family to what we previously knew about Ascension Island sponge fauna. Twenty-six species, plus additional higher taxonomic level records, from the shallow waters have now been described, and these occur in 45 genera and 29 families. Most records are from the Demospongiae Class; however, nine records are from the Calcarea Class, which represents four described species, and in totality, with genera level records, seven genera, and five families. One record represents the genus *Eurete*, which is in the Hexactinellida class, and one genus level record, *Plakina*, represents the Homoscleromorpha Class. This new investigation has more than doubled the number of previously known species for Ascension Island. Currently, at least 10 species are classed as endemics, including the nine described herein, and the species *Mycale* (*Microciona*) *ascensionis*. This means that close to 40% of the sponge species currently known from Ascension Island, are potentially found nowhere else in the world. Previous studies of Ascension Island's shallow marine fauna have generally found very low levels of endemic species (5–20%), such as in shrimps (Chace & Manning, 1972), molluscs (Rosewater, 1975), echinoderms (Pawson, 1978) and fish (Lubbock, 1980). The limited number of endemics is believed to be caused by the island's young age, isolation, and the impact of competition and predation in sub-littoral environments (Irving, 2013). However, the diversity and endemism of sponges could be due to their relative unpalatability and the large number of crevices and overhangs in shallow-water environments (Irving, 2013).

Few Ascension Island sponge species have broad distributions that have been substantiated, with only five species in the World Porifera Database (Van Soest *et al*., 2021) verified by taxonomic experts. These broad ranging species from Ascension Island, have been found, although rarely, at the islands of St Helena, Cape Verde Islands, Azores, and the Senegalese coast. However, records of identified species from Bioportal Naturalis, which add an additional eight described species, indicate that many of these sponges have type localities at the islands of Cape Verde, Tenerife, the Azores, the Senegalese and Gulf of Guinean coast, and Mediterranean Sea (R. Van Soest pers. comm.; WoRMS, 2021). Two species (*Mycale* (*Arenochalina*) *laxissima* and *M.* (*Carmia*) *microsigmatosa*) have type localities around the islands, seas, and coasts of Brazil, the Caribbean, the island of Bermuda, and the remote islands of Trindade and Martim Vaz Islands, and two species (*Geodia gibberosa* and *Ascandra atlantica*) are distributed on both sides of the mid-Atlantic. These broader-ranging species generally place shallow-water sponges of Ascension Island into a stronger biogeographic affinity with the eastern tropical/sub-tropical side of the Atlantic Ocean. Ascension Island's oceanographic position indicates that it should be more greatly influenced by the westward-flowing Southern Equatorial Current from the western side of the African continent. However, only one sponge species, *Clathria* (*Microciona*) *ascensionis* Van Soest *et al*., 2013, is found at both the islands of St Helena and Ascension, that could have been enabled by this current. The limited connectivity between these two islands has also been found in the distributions of shallow-water Scleractinia corals (Zibrowius *et al*., 2014). Our results indicate a stronger affinity of Ascension Island to fauna found in the North Atlantic gyre, which could be due to the mixing of the cooler Canary Island current, and the Southern Equatorial Counter-Current in the mid-Atlantic Ocean (Den Hartog, 1989). Currently, Ascension Island sponge distributions appear to be at the southerly limit of this eastern subtropical North Atlantic distribution. Four species indicate, however, an affinity with the western Atlantic and Caribbean, which was found to be important for the biogeography of Ascension Island shallow-water zoantharians and scleractinians (Zibrowius *et al*., 2014; Reimer *et al*., 2017). This has been posited to be caused by either the presence of more species in the Brazilian coastal regions, compared to the west African, or the Atlantic Equatorial undercurrent, which flows from west to east to depths of less than 100 m, enabling population connectivity (Zibrowius *et al*., 2014; Reimer *et al*., 2017). The sponge biodiversity in many of these remote islands in the Atlantic Ocean is poorly known. Further research is needed on sponges from surrounding mid-Atlantic islands and South American and West African coastlines to determine biogeographic affinities with Ascension Island (Floeter *et al*., 2008).

Burton (1932) hypothesized that the presence of *Spongia officinalis* at Ascension Island demonstrated how oceanic islands might act as stepping stones in the colonization of new areas by sponges, as it explained the presence of species found in both Australia and the West Indies. He accepted wide variation in spicule sizes and forms within species resulting in much synonymization and belief that many sponge species were cosmopolitan (Burton, 1932). With the advantages of *in situ* imagery and molecular analysis now available to us, it is becoming apparent that there is much undiscovered sponge biodiversity including many cryptic species (Klautau *et al*., 1999; Xavier *et al*., 2010). Populations of species separated by a wide geographic range are unlikely due to (when known), the often short-lived existence of lecithotrophic larvae in sponge species, which limits their dispersal capabilities (Maldonado, 2006). Burton's specimens of *Spongia officinalis* should be re-examined, and their identification evaluated.

Limited knowledge of sponge fauna from the closest oceanic island, St Helena, has restricted our biogeographic understanding of how these islands' fauna is potentially connected. Preliminary surveys do indicate that the sponge faunas differ. Several of the St Helena species are new to science, indicating this area may also have endemic species (Authors' unpublished data; Brown 2014). The St Helena sponge fauna could be more influenced by the

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cooler Benguela Current from the South Atlantic gyre; this could explain limited faunal connectivity between these two islands. Currently, most sampling of Ascension Island has been in the northern sector. Therefore, future sampling in the south of the island could also improve our understanding of biogeographic connections with St Helena, other mid-Atlantic oceanic islands, and coastal regions in the South Atlantic's eastern sector.

Our findings indicate that more research is needed on Ascension Island sponge fauna due to the very high incidence of new species from the relatively small number of samples collected in this study. This should be undertaken at St. Helena too, to improve our knowledge base of Mid-Atlantic shallow-water sponge fauna. A more detailed comparison between sponge fauna from these two isolated oceanic islands would determine the biogeographic affinities and extent of endemism of the phylum. The entire Exclusive Economic Zone (EEZ) of Ascension Island was designated as a Marine Protected Area in 2019 (Ascension Island Government, 2020). Continued work will aid better management of risks to marine biodiversity in Ascension Island and the wider Mid-Atlantic region.

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References

Alcolado PM and Gotera GG (1986) Nuevas adiciones a la fauna de poriferos de Cuba. *Poeyana* **331**, 1–19.

Alvarez B, Van Soest RWM and Rützler K (1998) A revision of axinellidae (Porifera: Demospongiae) in the Central West Atlantic Region. *Smithsonian Contribution to Zoology* **598**, 1–47.

Alvarez B, Van Soest RWM and Rützler K (2002) Svenzea, a new genus of Dictyonellidae (Porifera: Demospongiae) from tropical reef environments, with description of two new species. *Contributions to Zoology* **71**, 171–176.

Ascension Island Government (2020) *The Ascension Island Marine Protected Area Management Plan 2021–2026.*

Barnes DKA (2017) Marine colonisation and biodiversity at Ascension Island and remote islands. *Journal of the Marine Biological Association of the United Kingdom* **97**, 771–782.

Bavastrello G, Pansini M and Sarà M (1994) The variability and taxonomic status of different *Petrosia*-like sponges in the Mediterranean Sea. In Van Soest RWM, Van Kempen TMG and Braekman J-C (eds), *Sponges in Time and Space: Biology, Chemistry, Paleontology*. Rotterdam: Balkema, pp. 83–92.

Boury-Esnault N (1973) Résultats Scientifiques des Campagnes de la Calypso. Campagne de la Calypso au large des côtes atlantiques de l'Amérique du Sud (1961–1962). I. Spongiaires. *Annales de l'Institut Océanographique* **49**, 263–295.

Boury-Esnault N (2002) Order Chondrosida Boury-Esnault & Lopès, 1985. Family Chondrillidae Gray, 1872. In Hooper JNA and Van Soest RWM (eds), *Systema Porifera: A Guide to the Classification of Sponges*. New York, NY: Kluwer Academic/Plenum Publishers, pp. 291–299.

Boury-Esnault N, Pansini M and Uriz MJ (1994) Spongiaires bathyaux de la mer d'Alboran et du golfe ibéro-marocain. *Mémoires Du Muséum National d'Histoire Naturelle* **160**, 1–174.

Brickle P, Brown J, Küpper FC and Brewin PE (2017) Biodiversity of the marine environment around Ascension Island, South Atlantic. *Journal of the Marine Biological Association of the United Kingdom* **97**, 643–646.

Briggs JC (1974) *Marine Zoogeography*. New York, NY: McGraw-Hill.

Briggs JC (1995) *Global Biogeography. Developments in Paleontology and Stratigraphy 14*. Amsterdam: Elsevier.

Briggs JC and Bowen BW (2012) A realignment of marine biogeographic provinces with particular reference to fish distributions. *Journal of Biogeography* **39**, 12–30.

Burton M (1932) Sponges. *Discovery Reports* **6**, 237–392, pls 48–57.

Burton M (1956) *The Sponges of West Africa*. Atlantide Report (Scientific Results of the Danish Expedition to the Coasts of Tropical West Africa, 1945–1946, Copenhagen) **4**, pp. 111–147.

Chace FJ and Manning R (1972) Two new Caridean shrimps, one representing a new family, from marine pools on Ascension Island (Crustacea: Decapoda: Natantia). *Smithsonian Contributions to Zoology* **131**, 1–18.

Chombard C, Boury-Esnault N and Tillier S (1998) Reassessment of homology of morphological characters in tetractinellid sponges based on molecular data. *Systematic Biology* **47**, 351–366.

Clark K, Karsch-Mizrachi I, Liman D, Ostell J and Sayers E (2016) GenBank. *Nucleic Acids Research* **44**, 67–72.

de Lamarck JB (1814) Sur les polypiers empâtés. *Annales du Museum national d'Histoire naturelle* **20**, 294–312, 370–386; 432–458.

de Lamarck JB (1816) *Histoire naturelle des animaux sans vertèbres*, Tome second. Paris: Verdière, 568 pp.

De Laubenfels MW (1934) New sponges from the Puerto Rican deep. *Smithsonian Miscellaneous Collections* **91**, 1–28.

De Laubenfels MW (1936) *A Discussion of the Sponge Fauna of the Dry Tortugas in Particular and the West Indies in General, with Material for a Revision of the Families and Orders of the Porifera*. Carnegie Institute of Washington Publication 467 (Tortugas Laboratory Paper 30), pp. 1–225.

De Laubenfels MW (1950) The Porifera of the Bermuda archipelago. *Transactions of the Zoological Society of London* **27**, 1–154.

De Weerdt WH and Van Soest RWM (1986) Marine shallow-water Haplosclerida (Porifera) from the south-eastern part of the North Atlantic Ocean. *Zoologische Verhandelingen* **225**, 1–49.

Den Hartog JC (1989) Herinneringen aan een reis naar Sint-Helena. *Dieren* **6**, 114–120.

Desqueyroux-Faúndez R and Valentine C (2002) Family Petrosiidae Van Soest, 1980. In Hooper JNA and Van Soest RWM (eds), *Systema Porifera: A Guide to the Classification of Sponges*. New York, NY: Kluwer Academic/Plenum Publishers, pp. 906–917.

Duchassaing de Fonbressin P and Michelotti G (1864) Spongiaires de la mer Caraibe. *Natuurkundige Verhandelingen Van de Hollandsche Maatschappij Der Wetenschappen Te Haarlem*.

Eerkes-Medrano D, Feehan C and Leys SP (2014) Sponge cell aggregation: checkpoints in development indicate a high level of organismal complexity. *Invertebrate Biology* **134**, 1–18.

Erpenbeck D, Voigt O, Al-Aidaroos AM, Berumen ML, Büttner D, Cantania D, Guirguis AN, Paulay G, Schätzle S and Wörheide G (2016) Molecular biodiversity of Red Sea demosponges. *Marine Pollution Bulletin* **105**, 507–514.

Esteves EL, Lerner C, Lôbo-Hajdu G and Hajdu E (2012) *Monanchora brasiliensis* sp. nov. (Poecilosclerida: Demospongiae), new crambeid from the Brazilian coast, southwestern Atlantic, with monodentate anchorate chelae. *Journal of the Marine Biological Association of the United Kingdom* **92**, 869–876.

Esteves EL, Paula TSD, Lerner C, Lôbo-Hajdu G and Hajdu E (2018) Morphological and molecular systematics of the '*Monanchora arbuscula* complex' (Poecilosclerida: Crambeidae), with the description of five new

https://doi.org/10.1017/S0025315421000709 Published online by Cambridge University Press

species and a biogeographic discussion of the genus in the Tropical Western Atlantic. *Invertebrate Systematics* **32**, 457–503.

Evangelidis CP, Minshull TA and Henstock TJ (2004) Three-dimensional crustal structure of Ascension Island from active source seismic tomography. *Geophysical Journal International* **159**, 311–325.

Floeter SR, Rocha LA, Robertson DR, Joyeux JC, Smith-Vaniz WF, Wirtz P, Edwards AJ, Barreiros JP, Ferreira CEL, Gasparini JL, Brito A, Falcón JM, Bowen BW and Bernardi G (2008) Atlantic reef fish biogeography and evolution. *Journal of Biogeography* **35**, 22–47.

George WC and Wilson HV (1919) Sponges of Beaufort (N.C.) Harbor and Vicinity. *Bulletin of the Bureau of Fisheries, Washington*.

Gómez P and Calderón-Gutiérrez F (2020) Anchialine cave-dwelling sponge fauna (Porifera) from La Quebrada, Mexico, with the description of the first Mexican stygobiont sponges. *Zootaxa* **4803**, 125–151.

Hentschel E (1914) Monaxone Kieselschwämme und Hornschwämme der Deutschen Südpolar-Expedition 1901–1903. *Deutsche Südpolar-Expedition*, 1901–03 15, 35–141.

Idan T, Shefer S, Feldstein T, Yahel R, Huchon D and Ilan M (2018) Shedding light on an East-Mediterranean mesophotic sponge ground community and the regional sponge fauna. *Mediterranean Marine Science* **19**, 84–106.

Irving R (1989) A preliminary investigation of the sublittoral habitats and communities of Ascension Island, South Atlantic. *Progress in Underwater Science* **13**, 65–78.

Irving R (2013) Ascension Island's hermatypic but non-reef building corals. In Sheppard C (ed.), *Coral Reefs of the United Kingdom Overseas Territories. Coral Reefs of the World, Vol. 4*. Dordrecht: Springer, pp. 213–221.

Kirkpatrick R (1910) Hydrozoa and Porifera. In Cunningham JT (ed.), *On the Marine Fishes and Invertebrates of St Helena. Proceedings of the Zoological Society of London* 1910, 86–131.

Klautau M, Russo C, Lazoski C, Boury-Esnault N, Thorpe J and Solé-Cava AM (1999) Does cosmopolitanism result from overconservative systematics? A case study using the marine sponge *Chondrilla nucula*. *Evolution* **53**, 1414–1422.

Lazoski C, Solé-Cava A, Boury-Esnault N, Klautau M and Russo CAM (2001) Cryptic speciation in a high gene flow scenario in the oviparous marine sponge *Chondrosia reniformis*. *Marine Biology* **139**, 421–429.

Lehnert H and Stone RP (2019) Two new species of Geodiidae (Porifera, Demospongiae, Astrophorina) from the Emperor Seamounts, North Pacific Ocean. *Zootaxa* **4671**, 381–395.

Lehnert H and Van Soest RWM (1996) North Jamaican deep fore-reef sponges. *Beaufortia* **46**, 53–81.

Lehnert H and Van Soest RWM (1999) More North Jamaican deep fore-reef sponges. *Beaufortia* **49**, 141–169.

Lubbock R (1980) The shore fishes of Ascension Island. *Journal of Fish Biology* **17**, 283–303.

Lundbeck W (1902) Porifera. (Part I.) Homorrhaphidae and Heterorrhaphidae. In *The Danish Ingolf-Expedition*. **6**(1). Copenhagen: Bianco Luno, pp. 1–108.

Maldonado M (2006) The ecology of the sponge larva. *Canadian Journal of Zoology* **84**, 175–194.

Manconi R, Cadeddu B, Ledda F and Pronzato R (2013) An overview of the Mediterranean cave-dwelling horny sponges (Porifera, Demospongiae). *ZooKeys* **281**, 1–68.

Manning RB and Chace Jr FA (1990) Decapod and stomatopod crustacea from the Ascension Island, South Atlantic Ocean. *Smithsonian Contributions to Zoology* **503**, 1–91. https://doi.org/10.5479/si.00810282.503.

Messing CG, Bangalore PV, Diaz MC, Freeman CJ, Kohler KE, Reed JK, Ruetzler K, Thacker RW, Van Soest RWM, Wulff JL and Zea S (2020) *South Florida Sponges: A Guide to Identification*. Available at https://guide.poriferatreeoflife.org/index.html/ Accessed online 24 January 2021.

Meyer CP, Geller JB and Paulay G (2005) Fine scale endemism on coral reefs: archipelagic differentiation in turbinid gastropods. *Evolution* **59,** 113–125.

Moraes FC, Ventura M, Klautau M, Hajdu E and Muricy G (2006) Biodiversidade de esponjas das ilhas oceânicas brasileiras. In Alves RJV and Castro JWA (eds), *Ilhas Oceânicas Brasileiras – da pesquisa ao manejo*. Brasília: Ministério do Meio Ambiente, Secretaria de Biodiversidade e Florestas, pp. 147–178.

Naturalis BioPortal (2021) Naturalis Biodiversity Center. Available at http://bioportal.naturalis.nl.

OBIS (2021) *Ocean Biodiversity Information System*. Intergovernmental Oceanographic Commission of UNESCO. Available at www.obis.org.

Parco Nazionale Cinque Terre (2019) L'Area Marina Protetta delle Cinque Terre. Available at https://cinqueterre.macisteweb.com/dborganismi/plominо_documents/caaf3a4e52614a4caaf3cfa784a35df8. Accessed online 24 January 2021.

Pawson DL (1978) The echinoderm fauna of Ascension Island, South Atlantic Ocean. *Smithsonian Contributions to Marine Science* **2**, 1–31.

Poléjaeff N (1884) Report on the Keratosa collected by H.M.S. Challenger during the years 1873–1876. *Report on the Scientific Results of the Voyage of H.M.S. Challenger, Zoology* **11**, 1–88.

Pronzato R, Malva R and Manconi R (2004) The taxonomic status of *Ircinia fasciculata*, *Ircinia felix*, and *Ircinia variabilis* (Dictyoceratida, Irciinidae). In Pansini M, Pronzato R, Bavestrello G, Manconi R and Sarà M (eds), *Sponge Science in the New Millennium*. Papers con. Bollettino Dei Musei e Degli Istituti Biologici Della Univertità Di Genova 68, pp. 553–563.

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. Genova: Montotipia Erred, 65–216.

Reimer JD, Lorion J, Irei Y, Hoeksema BW and Wirtz P (2017) Ascension Island shallow-water Zoantharia (Hexacorallia: Cnidaria) and their zooxanthellae (Symbiodinium). *Journal of the Marine Biological Association of the United Kingdom* **97**, 695–703.

Rosen DE (1975) A Vicariance model of Caribbean biogeography. *Systematic Zoology* **24**, 431–464.

Rosewater J (1975) An annotated list of the marine mollusks of Ascension Island, South Atlantic Ocean. *Smithsonian Contributions to Zoology* **189**, 1–41.

Rützler K, Piantoni C, Van Soest RWM and Díaz MC (2014) Diversity of sponges (Porifera) from cryptic habitats on the Belize barrier reef near Carrie Bow Cay. *Zootaxa* **3805**, 1–129.

Sandes J and Pinheiro U (2014) Dictyoceratida (Porifera: Demospongiae) from Tropical Southwestern Atlantic (Northeastern Brazil, Sergipe State) and the description of three new species. *Zootaxa* **3838**, 445–461.

Santos GG, Docio L and Pinheiro U (2014) Two new species of the family Niphatidae Van Soest, 1980 from Northeastern Brazil (Haplosclerida: Demospongiae: Porifera). *Zootaxa* **3774**, 265–274.

Schmidt O (1862) *Die Spongien des adriatischen Meeres*. Leipzig: Wilheim Engelmann.

Schmidt O (1864) *Supplement der Spongien des adriatischen Meeres. Enthaltend Die Histologie Und Systematische Ergänzungen*. Leipzig: Wilheim Engelmann.

Schmidt O (1870) *Grundzüge einer Spongien-Fauna des qtlantischen Gebietes*. Leipzig: Wilheim Engelmann.

Sitjà C, Maldonado M, Farias C and Rueda JL (2019) Deep-water sponge fauna from the mud volcanoes of the Gulf of Cadiz (North Atlantic, Spain). *Journal of the Marine Biological Association of the United Kingdom* **99**, 807–831.

Spalding MD, Fox HE, Allen GR, Davidson N, Ferdaña ZA, Finlayson M, Halpern BS, Jorge MA, Lombana A, Lourie SA, Martin KD, McManus E, Molnar J, Recchia CA and Robertson J (2007) Marine ecoregions of the world: a bioregionalisation of coastal and shelf areas. *Bioscience* **57**, 573–583.

Stephens J (1915) Atlantic sponges collected by the Scottish National Antarctic Expedition. *Transactions of the Royal Society of Edinburgh* **50**, 423–467.

Taylor J and Irving R (1985) *Operation Origin Ascension Island 1985 Final report Vol. 1*.

Thacker RW, Hill AL, Hill MS, Remond NE, Collins AG, Morrow CC, Spicer L, Carmack CA, Zappe ME, Pohlmann D, Hall C, Diaz MC and Bangalore PV (2013) Nearly complete 28S rRNA gene sequences confirm new hypotheses of sponge evolution. *Integrative and Comparative Biology* **53**, 373–387.

Topsent E (1904) Spongiaires des Açores. Plate 17. *Résultats des campagnes scientifiques accomplies par le Prince Albert I. Monaco* **25**, 1–280.

Topsent E (1923) Sur une *Hircinia* de forme caractéristique: *Hircinia* (*Euricinia*) *reteplana* n. sp. du Musée Zoologique de Strasbourg. *Bulletin de l'Association Philomathique d'Alsace et de Lorraine* **6**, 231–235.

Topsent E (1928) Spongiaires de l'Atlantique et de la Méditerranée provenant des croisières du Prince Albert ler de Monaco. *Résultats Des Campagnes Scientifiques Accomplies Par Le Prince Albert I. Monaco* **74**, 1–376.

Vacelet J (1959) Répartition générale des éponges et systématique des éponges cornées de la région de Marseille et de quelques stations méditerranéennes. *Recueil Des Travaux de La Station Marine d'Endoume* **16**, 39–101.

https://doi.org/10.1017/S0025315421000709 Published online by Cambridge University Press

Van Soest RWM (1978) Marine sponges from Curaçao and other Caribbean localities. Part I. Keratosa. In Hummelinck PW and Van der Steen LJ (eds), *Uitgaven Van de Natuurwetenschappelijke Studiekring voor Suriname en de Nederlandse Antillen. No. 94. Studies on the Fauna of Curaçao and Other Caribbean Islands* 56. Utrecht: Foundation for Scientific Research in Surinam and the Netherlands Antilles, pp. 1–94.

Van Soest RWM (1980) Marine sponges from Curaçao and other Caribbean localities. Part II. Haplosclerida. In Hummelinck PW and Van der Steen LJ (eds), *Uitgaven Van de Natuurwetenschappelijke Studiekring voor Suriname en de Nederlandse Antillen. No. 104. Studies on the Fauna of Curaçao and Other Caribbean Islands* 62. Utrecht: Foundation for Scientific Research in Surinam and the Netherlands Antilles, pp. 1–173.

Van Soest RWM (1990) *Monanchora stocki* n. sp. (Porifera, Poecilosclerida) from the Mid-Atlantic Islands. *Bijdragen Tot de Dierkunde* **60**, 249–255.

Van Soest RWM (2017) Sponges of the Guyana shelf. *Zootaxa* **4217**, 1–225.

Van Soest RWM and Hooper JNA (2002). Suborder Haplosclerina Topsent, 1928. In Hooper JNA and Van Soest RWM (eds), *Systema Porifera: A Guide to the Classification of Sponges*. New York, NY: Kluwer Academic/Plenum Publishers, pp. 291–299.

Van Soest RWM, Picton BE and Morrow CC (2000) Sponges of the NE Atlantic. In *World Biodiversity Database CD-ROM Series*, Windows/Mac version 1.0. Amsterdam: ETI Bioinformatics, University of Amsterdam.

Van Soest RWM, Beglinger EJ and de Voogd NJ (2013) Microcionid sponges from Northwest Africa and the Macaronesian Islands (Porifera, Demospongiae, Poecilosclerida). *Zoölogische Mededelingen Leiden* **87**, 275–404.

Van Soest RWM, Beglinger EJ and de Voogd NJ (2014) *Mycale* species (Porifera: Poecilosclerida) of Northwest Africa and the Macaronesian Islands. *Zoölogische Mededelingen Leiden* **88**, 59–109.

Van Soest RWM, Boury-Esnault N, Hooper JNA, Rützler K, de Voogd NJ, Alvarez B, Hajdu E, Pisera AB, Manconi R, Schönberg C, Klautau M, Kelly M, Vacelet J, Dohrmann M, Diaz MC, Cárdenas P, Carballo JL, Ríos P, Downey RV and Morrow CC (2021) *World Porifera Database*. Available at http://www.marinespecies.org/porifera. Accessed online 24 January 2021.

Vieira WF, Cosme B and Hajdu E (2010) Three new *Erylus* (Demospongiae, Astrophorida, Geodiidae) from the Almirante Saldanha Seamount (off SE Brazil), with further data for a tabular review of worldwide species and comments on Brazilian seamount sponges. *Marine Biology Research* **6**, 437–460.

Wiedenmayer F (1977) Shallow-water sponges of the western Bahamas. *Experientia Supplementum* **28**, 145–147.

Xavier J, Rachello-Dolmen P, Parra-Velandia FJ, Schönberg C, Breeuwer J and Van Soest RWM (2010) Molecular evidence of cryptic speciation in the "cosmopolitan" excavating sponge *Cliona celata* (Porifera, Clionaidae). *Molecular Phylogenetics and Evolution* **56**, 13–20.

Zea S, Henkel TP and Pawlik JR (2014) *The Sponge Guide: A Picture Guide to Caribbean Sponges*. 2nd Edition. Available at https://spongeguide.uncw.edu/2ndedition.

Zibrowius H, Wirtz P, Nunes F, Hoeksema BW and Benzoni F (2014) Shallow-water scleratinian corals of Ascension Island, Central South Atlantic. *Journal of the Marine Biological Association of the United Kingdom* **97**, 713–725.

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