

A new species of *Stylaster* (Cnidaria: Hydrozoa: Stylasteridae) from the Arabian Sea, off Oman

Author(s): Stephen D. Cairns and Kaveh Samimi-Namin

Source: Proceedings of the Biological Society of Washington, 128(4):209-215.

Published By: Biological Society of Washington

DOI: <http://dx.doi.org/10.2988/0006-324X-128.4.209>

URL: <http://www.bioone.org/doi/full/10.2988/0006-324X-128.4.209>

BioOne (www.bioone.org) is a nonprofit, online aggregation of core research in the biological, ecological, and environmental sciences. BioOne provides a sustainable online platform for over 170 journals and books published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Web site, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at www.bioone.org/page/terms_of_use.

Usage of BioOne content is strictly limited to personal, educational, and non-commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

A new species of *Stylaster* (Cnidaria: Hydrozoa: Stylasteridae) from the Arabian Sea, off Oman

Stephen D. Cairns* and Kaveh Samimi-Namin

(SDC) Department of Invertebrate Zoology, National Museum of Natural History, Smithsonian Institution, Washington DC, USA (cairnss@si.edu)

(KS-N) Department of Marine Zoology, Naturalis Biodiversity Center, P.O. Box 9517, 2300 RA Leiden, The Netherlands (kaveh.samimi@naturalis.nl)

Abstract.—A new species of *Stylaster* (Group A, previously known as *Allopora*) is described from the southern coast of Oman, Arabian Sea. This region is known for its complex hydrography, which leads to a high diversity of marine life in shallow-water habitats. *Stylaster omanensis* n. sp. differs from all other described species of the genus in lacking dactylostyles.

Keywords: Stylasteridae, *Stylaster*, Oman, Dhofar region, Arabian Sea, new species

The Stylasteridae, one of 78 families of hydroids, is a very diverse and ecologically successful family, having the second highest number of species in the class, i.e., 314 Recent species and 29 Recent genera (Cairns 2015). Stylasterids are ubiquitous in marine environments, known from the Arctic Circle to off continental Antarctica at depths of 0–2789 m, but are most abundant between 200–1200 m (Cairns 2011) and tend to concentrate in insular regions, avoiding the coasts of large continental landmasses (Cairns 1992b). They are exclusively sessile, benthic, and colonial organisms that require a hard substrate for original settlement and subsequent anchorage. Their calcareous skeleton is a synapomorphy for the family but is not unique among the hydroid families, Milleporidae and some genera of the Hydractiniidae also having calcareous skeletons. But, the Stylasteridae is the only hydroid family to both have a predominantly deep-water distribution and to be calcified, which may explain its unique niche and resultant high diversity (Cairns

2015). The species described herein, *S. omanensis*, belongs to the most species-rich genus in the family, *Stylaster*, which contains 95 species and is found worldwide at depths of 0–1485 m. The genus has been divided into three species groups (Cairns 1983) to aid in identification. *S. omanensis* belongs to Group A (*sensu* Cairns 1983), none of which had previously been reported from the Indian Ocean. *S. omanensis* is an exception to many of the generalities described above, in that it is a shallow-water species that occurs off a large continental land mass. It is also unique within its genus in lacking dactylostyles, although one other undescribed species from Indonesia (Puce et al. 2011) also apparently lacks dactylostyles.

The number of coral studies in the western Arabian Sea and Dhofar region is very limited (see Sheppard & Salm 1988; Sheppard & Sheppard 1991, Sheppard et al. 2000), and coral communities of this region is not sufficiently described and documented. Preliminary studies on few groups of cnidarians such as octocorals, and scleractinians suggest very high diversity compare to northern parts of the

* Corresponding author.

DOI: 10.2988/0006-324X-128.4.209

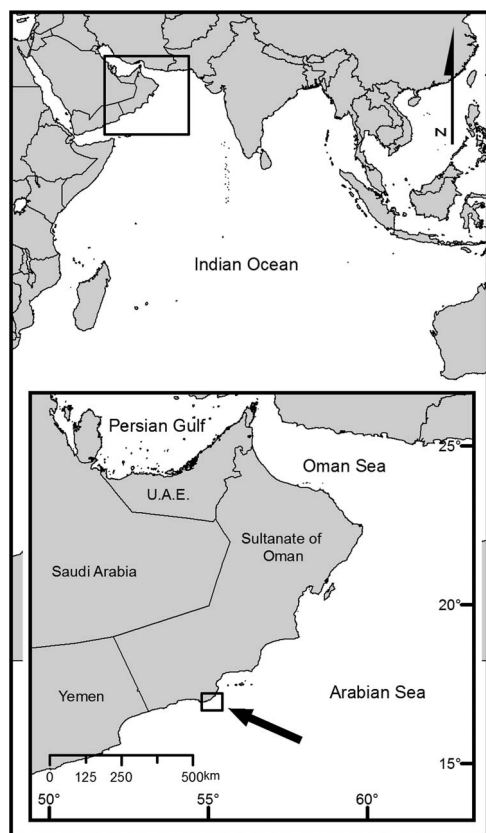


Fig 1. Type Locality of *Stylaster omanensis* in Dhofar governorate, south of Oman.

Arabian Sea, Gulf of Oman, and the Persian Gulf (unpublished data). Together with Hallaniyat Islands, this area is considered as one of the major sources of coral larvae and therefore an important area for coral recruitment and conservation efforts (Claereboudt, pers. comm.). It is generally known that Dhofar region has a very complex hydrography, and supports diverse marine habitats. This is mainly due to the significant changes in the marine environment of this region during monsoonal seasons. The summer southwest monsoon generates one of the five largest upwelling areas of the world (Bakun et al. 1998), whereas the winter northeast monsoon reverses the circulation pattern and increases the biological production of the whole Northern Indian Ocean (Burkill

1999, Wilson 2000). The upwelling caused by southwest monsoon affects the hydrography to a depth of about 400 m (Brock et al. 1992), resulting to displacement of warm surface waters by cold nutrient-rich waters, and leading to an increase in productivity and diversity within the intertidal and shallow subtidal areas (Savidge et al. 1990, Ormond & Banajmoon 1994, Schils & Coppejans 2003).

Although, the existence of *Stylaster* colonies has been reported from Dhofar region and Mirbat (Coles et al. 1996, Sheppard & Salm 1988, Claereboudt, pers. comm.); it has never been studied in detail until now. So far there is no record of *Stylaster* on the Yemen coastline of the Arabian Sea (Benzoni, pers. comm.). In this paper we describe a new species of the stylasterid genus *Stylaster* from this rich and diverse area.

Material and Methods

In situ observations and material collection were made in 2011–2013 during several field trips along the coast of the Arabian Sea, from Mirbat, Dhofar governorate, in the south of Oman (Fig. 1). *In situ* photographs were taken using a small compact underwater camera and the depth recorded using a dive computer. Colonies of *S. omanensis* were sampled using hammer and chisel. In total, three colonies were collected, two of which kept in ethanol and the third one was dried. For scanning electron microscopy, a small fragment of skeleton was mounted on a stub with double-sided carbon tape, then coated with gold-palladium (AuPd), and examined using a Jeol 6480LV SEM operated at 10 kV at NBCSEM specimen preparation follows the methodology discussed by Cairns (1983). All specimens are deposited at the Naturalis Biodiversity Center, Leiden, the Netherlands (formerly Rijksmuseum van Natuurlijke Historie, Leiden, the Netherlands).

Definitions of the morphological terminology can be found in the illustrated glossary of Cairns (2011).

The following abbreviations are used in the text: NBC, Naturalis Biodiversity Center; RMNH, Rijksmuseum van Natuurlijke Historie, prefacing acronym for specimens deposited at the Naturalis Biodiversity Center, Leiden; SEM, Scanning Electron Microscope stub number; USNM, National Museum of Natural History, Smithsonian Institution, Washington D.C., United States

Genus *Stylaster* Gray, 1831

Stylaster Gray, 1831: 37 (in part).—Boschma, 1956: F99; 1957: 2.—Cairns, 1983: 476–479 (Groups A–C, full synonymy and discussion).

Allopora Ehrenberg, 1834: 303, 371.—Boschma, 1956: F99–F100; 1957: 18.

Diagnosis.—Colonies usually uniplanar, but may be bushy or lamellar; coenosteal color variable. Gastro- and dactylopores arranged in cyclosystems arranged exclusively on branch edges (Group C, 43 species), uniformly on all branch surfaces (Group A, 27 species), or irregularly on three sides of the branches (Group B, 24 species). Gastropore tube single-chambered but may be partitioned by an annular or diffuse ring palisade or sphincter; gastrostyles always present. Dactylostyles usually present, sometimes as dactyloglossae. Ampullae usually superficial with lateral or apical efferent pores, but may be primarily internal.

Type Species.—*Madrepora rosea* Pallas, 1766.

Discussion.—As implied above in the Diagnosis (including eight exclusively fossil species, the new species described herein, and an additional unclassified species), there are 95 species known in the genus (Cairns & Schuchert 2015), making it one of the largest in the phylum, only exceeded in number of species by: *Sertularella* (130 species), *Acropora* (120

species), and *Symplectoscyphus* (105 species). In order to facilitate comparisons among the species, Cairns (1983) divided the genus into three groups based on the arrangement of their cyclosystems (see Diagnosis). *Stylaster omanensis* is the first described species in this genus found to lack dactylostyles, although an undescribed species is known (Puce et al. 2011).

Distribution.—Cosmopolitan, 0–1485 m (Cairns, 1992a).

Stylaster omanensis, new species
Figs. 2–3

Types.—Holotype: Mirbat, Dhofar region, RMNH Coel. 42028 (in ethanol), and SEM stubs 2016 and 2294 (USNM). Paratypes: Mirbat, Dhofar region, two specimens, RMNH Coel. 42029 (dry), RMNH Coel. 42031 (in ethanol).

Zoobank Registration Number.—736732A5-587F-4140-ADC6-5989EAD01DBC

Type Locality.—Oman, Arabian Sea, Dhofar region, Mirbat, 16.940367°N, 54.808095°E 18 m, collected by K. Samimi-Namin, 19–23 May 2013.

Description.—Colonies are uniplanar (Fig. 3A–B, D), robust, and moderately branched, the holotype (Fig. 3A) measuring 51 mm in height and 72 mm in width, with a basal branch diameter of 12.1 mm. The larger paratype is 105 mm in height and 26 mm in basal branch diameter, but irregularly branched. Branching is roughly dichotomous, but not regular, the blunt branch tips somewhat flattened and 1–3 mm in diameter. There are no commensal polychaetes. The coenosteal texture is reticulate-granular (Fig. 2G–I), the strips ranging from 45–77 µm in width, each covered with small (3–4 µm in diameter) granules. Nematopores or isolated dactylopores not observed. The colonies are rose-colored (Fig. 3A–D) to white.

Cyclosystems are uniformly arranged (Fig. 2A–C) on all branch surfaces (*Stylaster* Group A), circular to slightly irregular in outline (Fig. 2E–F), and 0.45–0.75 mm in diameter; cyclosystems flush to only slightly raised above coenosteal

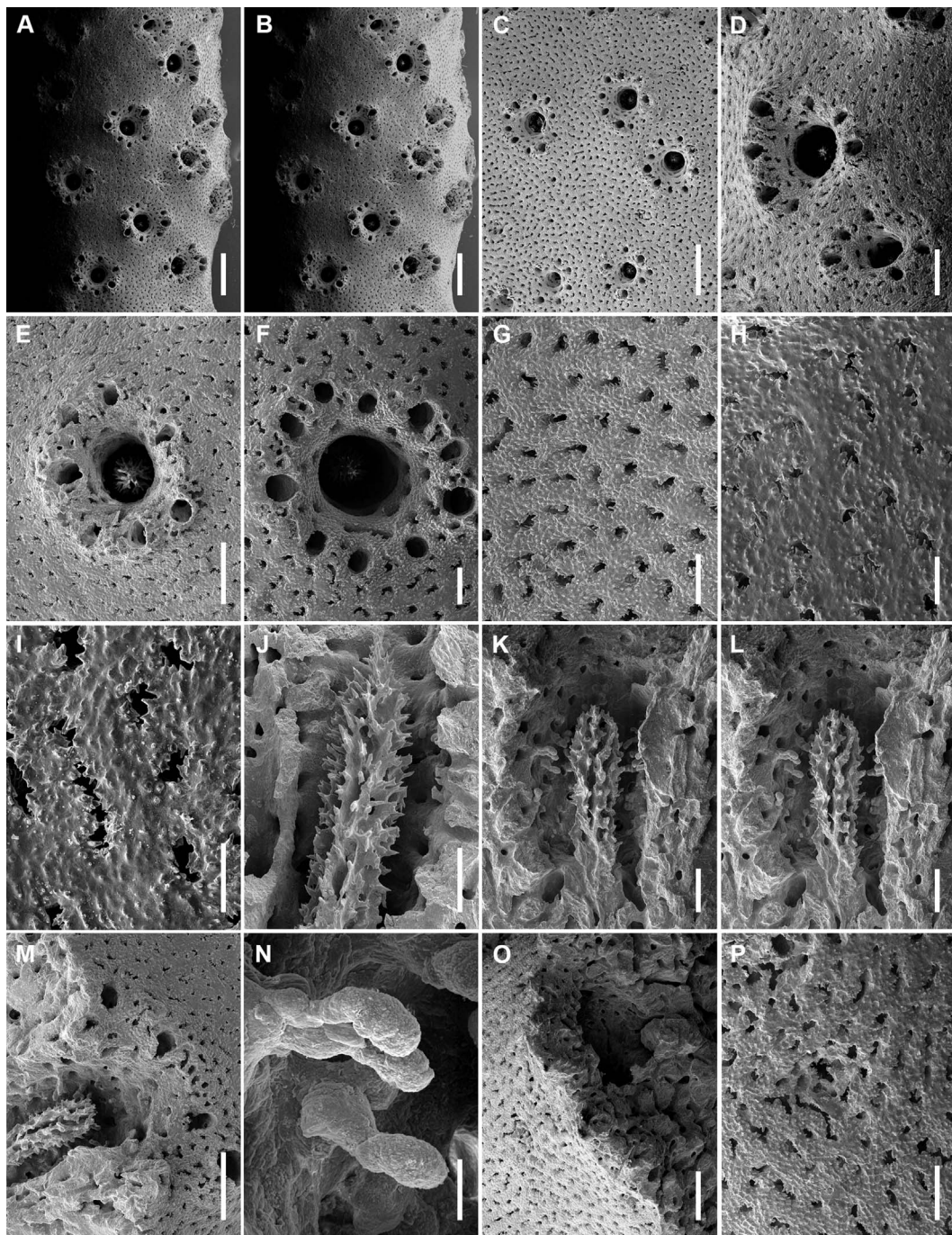


Fig. 2. *Styaster omanensis*. A–B, stereo pair of distal branch showing randomly arranged cyclosystems; C, several cyclosystems; D–F, various cyclosystems; G–I, reticulate-granular coenosteal texture at progressively larger magnifications; J, a gastrostyle; K–L, stereo view of a gastrostyle and surrounding ring palisade; M, a gastrostyle and gastropore cavity from above; N, ring palisade elements; O, cross section of a primarily internal male ampullar cavity; P, efferent pore of male ampulla in a shallow depression. Scale bars: A, B, C = 500 μ m; D, E, M, O = 200 μ m; F, G, J, K, L, P = 100 μ m; H, I = 50 μ m; N = 20 μ m. C, F, G, J are from paratype RMNH Coel. 42029, the rest are from holotype.

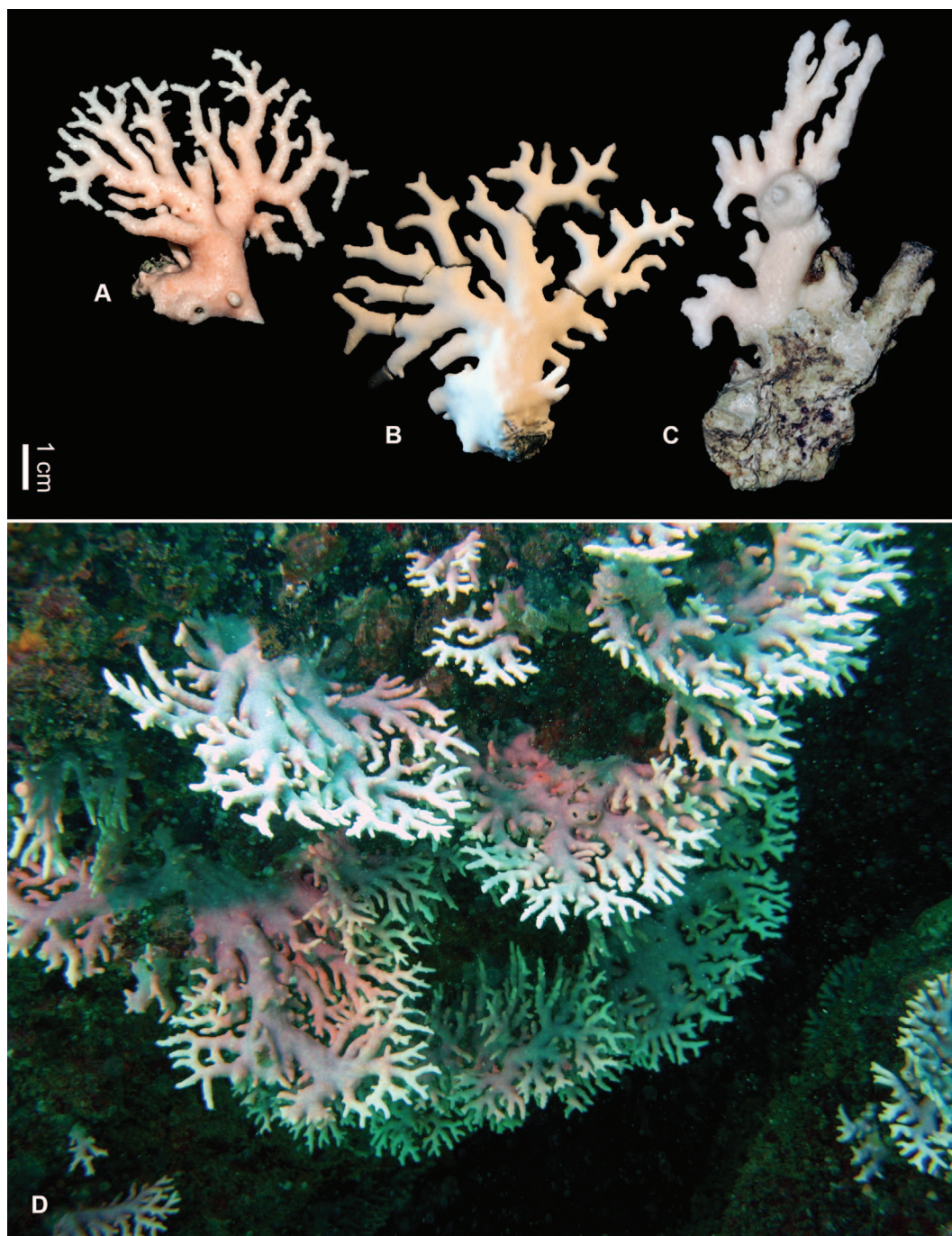


Fig. 3. Underwater pictures and photographs of the holotype and paratypes of *Stylaster omanensis*. A, holotype RMNH Coel. 42028; B, paratype RMNH Coel. 42029; C, paratype RMNH Coel. 42031; D, *in situ* photographs of *S. omanensis* at 18 m depth.

surface (Fig. 2D). Based on 50 cyclo-systems, the range of dactylopores per cyclo-system is 5–10; the average is 7.54 ($\sigma = 1.27$); and the modal number is 8. Diastemas are rare.

The gastropore is circular (0.21–0.29 mm in diameter), and the gastropore tube is cylindrical for most of its length (Fig. 2J–M), broadening slightly near the coenosteal surface. The gastrostyle is cylindrical to lanceolate (Fig. 2J–M), 0.28–0.46 mm in length and about 0.13–0.25 mm in greatest diameter. Its tip is blunt and its lateral surface is covered with tall, longitudinally arranged, spinose ridges that are separated by deep channels; the ridges bear elongate spines up to 40 μm in length. A diffuse ring palisade (Fig. 2K–L) occurs near the tip of the gastrostyle, the elements cylindrical to slightly clavate in shape (Fig. 2N), each up to 60 μm in length and about 18 μm in diameter. The dactylotomes are thin (about 55 μm in width) and do not open to the gastropore tube (Fig. 2M). There appear to be no dactylostyles of any kind.

The male ampullae are primarily internal (Fig. 2O), showing as slight bulges on the coenosteal surface, with an internal diameter of 0.45–0.55 mm. The efferent pore is small, 30–35 μm in diameter, that sits in the center of a shallow depression (Fig. 2P) about 0.18 mm in diameter adjacent to a cyclo-system. Female ampullae are not known.

Remarks.—*Stylaster omanensis* clearly falls into *Stylaster* Group A, as defined by Cairns (1983). Although species of *Stylaster* are known from throughout the Indian Ocean, no species from Group A have been reported from that ocean except for four species off South Africa (Cairns & Zibrowius 2013: Table 1). Stylasterids have remarkably small distributional ranges (Cairns, 1992b, 2005), and thus it would be unusual for a species known from off South Africa to be conspecific with one from off Oman approximately 6200 km to the north.

Nonetheless, *S. omanensis* differs from those species, as well as all other described species in the genus, by lacking dactylostyles, although one other undescribed species from Indonesia (Puce et al. 2011) also apparently lacks dactylostyles.

Stylaster omanensis also differs from those species by having quite small cyclo-systems.

Etymology.—The species is named for the country from which was first collected.

Distribution.—Known only from the type locality.

Acknowledgments

We would like to thank B. W. Hoeksema, L.P. van Ofwegen, and K. van Egmond (NBC, Leiden) for support and curatorial assistance. The second author is grateful to the Ministry of Environment and climate affair, Oman, M.R. Claereboudt (Sultan Qaboos University, Muscat) for their support. He also thanks S.C. Wilson, R. Baldwin, O. Taylor, A. Willson, I. Benson, E. Looker (Five Oceans Environmental Services, Muscat), F. Al-Abdali (Sultan Qaboos University, Muscat) for support. The second author's research at the NBC and part of the field work was supported by Schure-Beijerinck-Poppingfonds, Alida Buitendijkfonds, Jan Joost ter Pelkwijkfonds, and a Martin-Fellowship. The Alfred P. Sloan Foundation and the Census of Marine Life are gratefully acknowledged for the research grant provided to the second author; also in this regard, M.R. Claereboudt (Sultan Qaboos University, Muscat), N. D'Adamo (UNESCO-IOC, Perth), J.H. Ausubel (Rockefeller University) are greatly appreciated for their continued support.

Literature Cited

- Boschma, H. 1956. Milleporina and Stylasterina. Pp F90–F106 in Moore, R. C., ed., *Treatise on Invertebrate Paleontology*, Lawrence, Kansas, Geological Society of America.

- Boschma, H. 1957. List of the described species of the order Stylasterina. *Zoologische Verhandlungen* 33:1–72.
- Bakun, A., C. Roy, & S. Lluch-Cota. 1998. Coastal upwelling and other processes regulating ecosystem productivity and fish production in the western Indian Ocean. Pp. 103–141 in Okemwa E., M. Ntiba, & K. Sherman, eds., *Large Marine Ecosystems of the Indian Ocean: Assessment, Sustainability, and Management*, Blackwell Science Inc. Malden, Massachusetts.
- Brock, J. C., C. R. McClain, & W. W. Hay. 1992. A southwest monsoon hydrographic climatology for the northwestern Arabian Sea. *Journal of Geophysical Research: Oceans* 97:9455–9465.
- Burkill, P. H. 1999. ARABESQUE: UK JGOFS process studies in the Arabian Sea. *Deep Sea Research II* 46:529–863.
- Cairns, S. D. 1983. A generic revision of the Stylasterina (Coelenterata: Hydrozoa). Part 1. Description of the genera. *Bulletin of Marine Science* 33(2):427–508.
- Cairns, S. D. 1992a. A generic revision of the Stylasteridae (Coelenterata: Hydrozoa). Part 3. Keys to the genera. *Bulletin of Marine Science* 49(1–2):538–545.
- Cairns, S. D. 1992b. Worldwide distribution of the Stylasteridae (Cnidaria: Hydrozoa). *Scientia Marina* 56(2–3):125–130.
- Cairns, S. D. 2005. Revision of the Hawaiian Stylasteridae (Cnidaria: Hydrozoa: Athecata). *Pacific Science* 59(3):439–451.
- Cairns, S. D. 2011. Global diversity of the Stylasteridae (Cnidaria: Hydrozoa: Athecata). *PLoS ONE* 6(7):1–13.
- Cairns, S. D. 2015. Stylasteridae (Cnidaria: Hydrozoa: Anthoathecata) of the New Caledonian Region. *Mémoires du Muséum national d'Histoire naturelle* 207:1–361.
- Cairns, S. D. & P. Schuchert. Stylasteridae. *World Register of Marine Species (WoRMS)* at <http://www.marinespecies.org/aphia.php?p=taxdetails&id=22805> on 2015-08-05-28.
- Cairns, S. D. & H. Zibrowius. 2013. Stylasteridae (Cnidaria, Hydrozoa, Filifera) from South Africa. *Zootaxa* 3691(1):1–57.
- Coles, S. L., R. Keech, A. Y. Samdani, & R. V. Salm. 1996. *Corals of Oman*. Muscat Printing Press.
- Ehrenberg, C. G. 1834. Beiträge zur physiologischen Kenntniss der Corallenthiere im alleg-meinen, und besonders des Rothen Meeres, nebst einem Versuch zur physiologischen Systematik derselben. *Physikalische-Mathematische Abhandlungen der Königlichen Akademie der Wissenschaften zu Berlin* (1832) 1:225–380.
- Gray, J. E. 1831. Description of a new genus (*Stylaster*) of star-bearing corals. *Zoological Miscellany*: 36–37.
- Pallas, P. S. 1766. *Elenchus Zoophytorum*. Hagae Comitum: P. van Cleef, 28 + 451 pp.
- Ormond, R. & S. Banaimoon. 1994. Ecology of intertidal macroalgal assemblages on the Hadramout Coast of Southern Yemen, an area of seasonal upwelling. *Marine Ecology-Progress Series* 105: 105–120.
- Puce, S., D. Pica, L. Mancini, F. Brun, A. Peverelli, & G. Bavestrello. 2011. Three-dimensional analysis of the network of an Indonesian *Stylaster* (Cnidaria, Hydrozoa, Stylasteridae) by means of X-ray computed tomography. *Zoomorphology* 130:85–95.
- Savidge, G., J. Lennon, & A. J. Matthews. 1990. A shore-based survey of upwelling along the coast of Dhofar region, southern Oman. *Continental Shelf Research* 10:259–275.
- Schils, T. & E. Coppejans. 2003. Phytogeography of upwelling areas in the Arabian Sea. *Journal of Biogeography* 30(9):1339–1356.
- Sheppard, C. R. & A. S. Sheppard. 1991. Corals and coral communities of Arabia. In: *Fauna of Saudi Arabia*, vol 12. Natural History Museum, Basle.
- Sheppard, C. R. C., S. C. Wilson, R. V. Salm, & D. Dixon. 2000. Reefs and coral communities of the Arabian Gulf and Arabian Sea. Pp. 257–293 in McClanahan, C. R. C. Sheppard & D. O. Obura, eds., *Coral reefs of the Indian Ocean, their ecology and conservation*. Oxford University Press, New York.
- Sheppard, C. R. C. & R.V. Salm. 1988. Reef and coral communities of Oman, with a description of a new coral species (Order Scleractinia, genus *Acanthastrea*). *Journal of Natural History* 22:263–279.
- Wilson, S. C. 2000. Northwest Arabian Sea and Gulf of Oman. Pp. 17–33 in Sheppard C. R. C., ed., *Seas at millennium: an environmental evaluation*. Pergamon, Amsterdam.

Associate Editor: Rick Hochberg