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## Taxonomy and distribution of sea anemones (Cnidaria: Actiniaria and Corallimorpharia) from deep water of the northeastern Pacific

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## Abstract

Sea anemones *sensu lato* (members of cnidarian orders Actiniaria and Corallimorpharia) occurring in water of the northeastern Pacific Ocean greater than 1,000 m (to the abyssal plain) are poorly known. Based on the literature and specimens we examined in the four largest collections of animals from this area, we estimate that approximately 35 species occur in these deep-water habitats and fewer than half have been documented there. Of the largest and most abundant epibenthic species, based on morphology, we identified two species of Corallimorpharia (both previously known) and 12 of Actiniaria (three new). Half the sea anemone species are widely distributed: *Actinauge verrillii* McMurrich, 1893, *Actinoscyphia groendyki* n. sp., *Actinostola faeculenta* (McMurrich, 1893), *BathypHELLIA australis* Dunn, 1983, *Liponema brevicorne* (McMurrich, 1893), *Metridium farcimen* (Brandt, 1835), and *Monactis vestita* (Gravier, 1918). The others are known only from the northeastern Pacific Ocean: *Corallimorphus pilatus* Fautin, White, and Pearson, 2002, *Corallimorphus denhartogi* Fautin, White, and Pearson, 2002, *Anthosactis nomados* White, Wakefield Pagels, and Fautin, 1999, *Bolocera kensmithi* n. sp., *Paraphelliactis pabista* Dunn, 1982, *Sagartiogeton californicus* (Carlgren, 1940) (for which we designate a neotype), and *Sicyonis careyi* n. sp. A naturally occurring oxygen minimum zone (OMZ) off Oregon is expanding, and the marine life living within its virtually anoxic areas is threatened. Nine of the species we examined occur within the current depth range of the OMZ and may be threatened if the OMZ continues to strengthen and expand.

**Key words:** Biogeography, Coelenterata, Hexacorallia, Bathyal, Abyssal

## Introduction

Animals belonging to cnidarian orders Actiniaria and Corallimorpharia (sea anemones *sensu lato*) in deep waters of the northeastern Pacific Ocean are poorly known. By contrast, the intertidal and shallow subtidal fauna of the area has been well studied; about 30 species have been documented in shallow habitats (e.g. Gotshall 1994; Fautin & Hand 2007). We used morphological characters to identify specimens previously collected on the continental slope and abyssal plain. We estimate, based on the literature and the four largest museum collections of these animals, that about 35 species of anemones occur from southern California to northern British Columbia at 1,000 m and deeper. We provide an inventory of the 14 largest and most abundant epibenthic species: 12 actinarians, three of which we describe as new species, and two corallimorpharians. In addition, as part of our consideration of *Sicyonis*, we move from that genus the species now properly known as *Parasicyonis biotrans* (Riemann-Zürneck, 1991).

Aside from contributing to basic knowledge of marine biodiversity (Cressey 2010), this inventory may be useful in assessing the impact of the oxygen minimum zone (OMZ) off the coast of Oregon that is expanding in space and time (Chan *et al.* 2008; Gewin 2010). Because many of the specimens on which it is based were collected in the 1970s and 1980s, before the expansion of the OMZ, this inventory of the anemones of the deep northeastern Pacific Ocean can be used as a baseline for comparison in future biotic inventories in the OMZ to determine if expansion of the OMZ has affected sea anemones.

Ekman (1953) reported that many deep-sea taxa are widely distributed. Vinogradova (1959) refined that generalization by considering taxonomic rank; she discovered in an analysis of 1,031 species from around the world at deeper than 2,000 m that at the generic level faunas are similar, but endemism is high at the species level. Similarly, Rodríguez *et al.* (2007) found that all 31 families of anemones in the Southern Ocean (including the Sub-Antarctic [Deacon 1982; Rodríguez *et al.* 2007]), as well as 75% of the genera, have representatives elsewhere in the world, but 75% of the species are endemic. The wide distribution of higher taxa in the deep sea is likely due to connectivity of the waters due to thermohaline circulation, termed by Broecker (1991) the great ocean conveyor.

We found that all families, as well as 92% of the genera (all except *Paraphelliactis* Carlgren, 1928b), have representatives outside the Pacific Ocean, but that 71% of the species are endemic to the North Pacific. Of the new species of Actiniaria we identified, *Bolocera kensmithi* n. sp. and *Sicyonis careyi* n. sp. are known only from the northeastern Pacific Ocean, and *Actinoscyphia groendyki* n. sp. is found in both the North Pacific and Southern Oceans. In addition to the northeastern Pacific, *Actinauge verrillii* McMurrich, 1893, and *BathypHELLIA australis* Dunn, 1983, have been recorded in the Southern Ocean, and *Monactis vestita* (Gravier, 1918) has been recorded in the Atlantic. The remaining species are known only from the North Pacific. Three occur on both the east and west sides of that ocean basin: *Actinostola faeculenta* (McMurrich, 1893), *Liponema brevicorne* (McMurrich, 1893), and *Metridium farcimen* (Brandt, 1835). All others are endemic to the northeastern Pacific Ocean: *Corallimorphus denhartogi* Fautin, White, and Pearson, 2002, *Corallimorphus pilatus* Fautin, White, and Pearson, 2002,