

Contrasting reproductive strategies in three deep-sea octocorals from eastern Canada: *Primnoa resedaeformis*, *Keratoisis ornata*, and *Anthomastus grandiflorus*

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Abstract Various aspects of reproduction were studied in three deep-sea octocorals belonging to the order Alcyonacea that co-occur at bathyal depths on the continental edge and the slope of eastern Canada. The main goals were to expand knowledge of deep-water heterotrophic corals and ascertain whether reproductive strategies could explain the known patterns of occurrence. *Anthomastus grandiflorus* is a gonochoric species with a female-biased sex ratio that exhibits internal fertilization and brooding of planula larvae. Conversely, *Primnoa resedaeformis* and *Keratoisis ornata* rely on broadcast spawning and external fertilization; their sexuality remains undetermined as spermatozoa were not found. In *P. resedaeformis*, the presence of mixed size classes of oocytes in samples from all months, depths, and locations studied suggests continuous oogenesis or overlapping development of oocyte cohorts, indicative of a gametogenic cycle spanning more than a year. No evidence of periodicity was found in this species, although it could have been masked by the striking bathymetric variation in potential relative fecundity (oocytes polyp^{-1}). The two other octocorals displayed a clear annual breeding pattern. Spawning in *K. ornata* and larval release in *A. grandiflorus* occurred in late summer and fall, respectively, possibly in response to environmental factors, as

supported by shifts in the reproductive peak of *A. grandiflorus* across latitudes. The three species are presumed to share a nonfeeding larval mode, and data on their reproductive potential do not present any striking disparities. Published data on bycatches and video surveys in Atlantic Canada indicate that the gonochoric brooder *A. grandiflorus* is more widely distributed than the two free spawners, *P. resedaeformis* and *K. ornata*, which is contrary to common dispersal potential paradigms.

Keywords Octocorals · Reproduction · Gametogenesis · Spawning · Deep-sea · Cold-water

Introduction

Although the reproduction of deep-sea corals is a key element in determining the level of their vulnerability or resilience to disturbances, very little information exists on their sexual and asexual proliferation and almost nothing is known of the factors that can influence these processes temporally and spatially. Most of the limited information relates to scleractinian (stony) corals of the subclass Hexacorallia (Waller 2005), whereas the subclass Octocorallia is comparatively less studied in the deep ocean. Octocorals include approximately 3,000 extant species subdivided into three main orders (Daly et al. 2007): Pennatulacea (sea pens), Helioporacea (blue corals), and Alcyonacea, the latter representing a morphologically diverse and widespread group of soft corals and sea fans (gorgonians) with numerous representatives in deep ecosystems (Freiwald et al. 2004; Watling and Auster 2005; Wareham and Edinger 2007). Very few data are available on the sexual reproduction of cold-water and deep-water pennatulaceans (Rice et al. 1992; Tyler et al. 1995;

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