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Crinoid Cirri as Available Substrata for Polypoid Hydrozoan Species

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Abstract Various polypoid hydrozoan species have been found growing on the cirri of several species of crinoids in seas of Japan. Each hydrozoan colony occupied one cirrus, elongating its stolons over the surface of the cirrus and firmly connecting its segments. Moreover, we found that hydrozoans were able to survive even when growing upon detached, autotomized cirri. Thereafter, hydrozoans growing on detached cirri extended themselves onto adjacent areas utilizing cirri as stepping stones to more substantial substrate.
Key words: cirri, crinoidea, substrata, hydrozoa.

Introduction

Many species of polypoid hydrozoans are epizoic, and their colonies have been observed living on various benthic invertebrates (mainly sponges, cnidarians, molluscs, polychaetes, bryozoans and crustaceans) (His Majesty the Showa Emperor Hirohito, 1988, 1995). Clarification of the association between the epizoic animals and their animal substrates has been a very important subject in biodiversity studies (Rees, 1967; Williams and McDermott, 2004).

Hydrozoans growing on crinoid cirri were also reported even earlier by Hyman (1955). Cirri are important support structures for crinoids while they are attached to rocks and other substrata (Fig. 1). However, crinoid cirri can easily be detached by autotomy (Wilkie, 2001), and these abandoned cirri appear to be unstable substrata for hydrozoans. Recently, during a research project of the National Museum of Nature and Science, entitled "Integrated research on biodiversity of interspecies relationships", several hydrozoan specimens were found growing on crinoid cirri collected from seas of Japan. We studied these newly-collected hydrozoan specimens in an attempt to verify the utility of cirri as substrata.

Materials and Methods

Cirri were randomly sampled from sixteen preserved specimens of crinoidea collected during 2009–2012 from four marine areas of Japan: Sagami Bay, Tosa Bay, the Japan Sea and the East China Sea. Surfaces of the preserved crinoid cirri were examined by binocular microscope to ascertain presence of hydrozoans. Table 1 shows sampling data and species of crinoid cirri inhabited by hydrozoans.

Next, we examined living specimens of crinoids to determine the utility of their cirri as substrata for hydrozoans. Specimens of *Oxycomanthus japonicus* (Müller, 1841) have long been quite successfully raised for *in vivo* biological studies of crinoids at the University of Tokyo's Misaki Marine Biological Station in Miura, Kanagawa Prefecture (Shibata and Oji, 2003). On May 29, 2012, twelve colonies of hydroids found on cirri of these *O. japonicus* were detached, together

Table 1. List of hydrozoan species found on cirri of the preserved specimens of crinoids.

Hydorozoans	Crinoids	Locality	Depth	Date
Order Thecata				
Family Campanulariidae	*Cosmiometra aster* (A. H. Clark, 1907)	Off Jogashima, Miura, Kanagawa Pref.	40 m	11 Nov. 2009
Clytia delicatula	*Cosmiometra aster* (A. H. Clark, 1907)	Off Jogashima, Miura, Kanagawa Pref.	40 m	2 Dec. 2009
(Thornely, 1900)	*Oxycomanthus intermedius* (A. H. Clark, 1916)	Koajiro Bay, Miura, Kanagawa Pref.	8 m	25 Feb. 2010
	Oxycomanthus japonicus (Müller, 1841)	Usa, Tosashimizu, Kochi Pref.		16 Nov. 2010
Campanulariidae gen.	*Tropiometra afra macrodiscus* (Hara, 1895)	Ama, Oki, Shimane Pref.	20 m	14 Dec. 2009
et sp. indet.	*Oxycomanthus pinguis* (A. H. Clark, 1909)	Off Jogashima, Miura, Kanagawa Pref.	40 m	6 Jan. 2010
	Liparometra grandis (A. H. Clark, 1908)	Kagurajima, Kenzaki, Nagasaki, Nagasaki Pref.	6 m	7 Apr. 2010
Family Lafoeidae				
Lafoea dumosa (Fleming, 1820)	*Metacrinus rotundus* Carpenter, 1884	Off Jogashima, Miura, Kanagawa Pref.	90 m	19 Apr. 2012

*All preserved specimens of crinoids were collected by Kohtsuka (one of the authors).

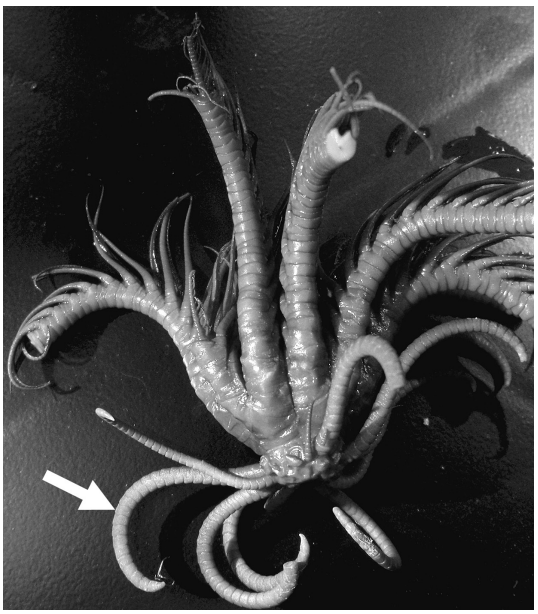

Fig. 1. Side view of *Tropiometra afra macrodiscus*. Cirrus indicated by arrow.

with their substrate cirri, from the crinoid bodies. Living hydrozoan specimens on the separated cirri were brought to the laboratory and kept in culture containers (6 cm in diameter and 3 cm in height) filled with artificial seawater (SEA LIFE: Marine Tech Co., Tokyo) at 20–25°C, and supplied with food (Artemia nauplii). Seawater in culture containers was changed every three days. The status of every specimen of hydrozoan growing on detached cirri was frequently monitored by binocular microscope for five months.

Results and Discussion

In preserved specimens, colonies of two species of Thecata were found on cirri of eight out of sixteen crinoid specimens examined (Table 1). These hydrozoans, however, apparently do not have strict relationships with crinoids as substrata, because they have also been reported colonizing various other substrata, such as algae, bryozoans, and stones (His Majesty the Showa Emperor Hirohito, 1995; Vervoort and Watson, 2003). The newly-collected living specimens of hydrozoans growing on separated *Oxycomanthus japonicus* cirri were identified as belonging to the Bougainvilliidae of the Athecata, because the specimens lacked gonophores, the most important taxonomic character to distinguish species.

Cirri were found occupied by hydrozoans in both a preserved and a living specimen (Fig. 2), in both cases the hydrozoan colonies elongating their stolons all over the cirri surfaces. In experimental conditions, within three months of detachment from crinoid bodies, cirri without any hydrozoans colonizing them eventually broke into pieces and became scattered in the culture containers (Fig. 3). However, the segments of cirri colonized by hydrozoans remained continuously and strongly connected by the hydrozoan stolons (Fig. 4). Moreover, the living hydrozoan specimens enlarged their colonies from their original substrate cirri to the bottoms of the culture containers (Fig. 4). In field conditions, cirri appear to decay after autotomy caused by unexpected conditions. However, hydrozoan

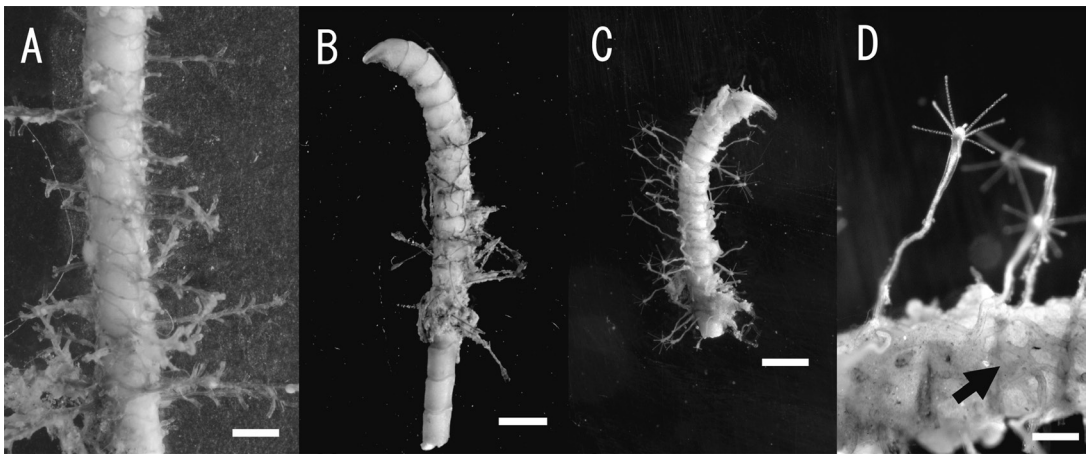

Fig. 2. Hydrozoan specimens growing on crinoid cirri. — A, preserved specimen of *Lafoea dumosa* on a cirrus of *Metacrinus rotundus*; B, preserved specimen of *Clytia delicatula* on a cirrus of *Oxycomanthus japonicus*; C, living specimen of a bougainvilliid species on a cirrus of *O. japonicus*. D, stolons of living bougainvilliid specimens connecting the segments of a cirrus (D is an enlargement of C; the arrow in D indicates the hydrozoan stolon; Scale in D = 0.2 mm). Scale = 1 mm.

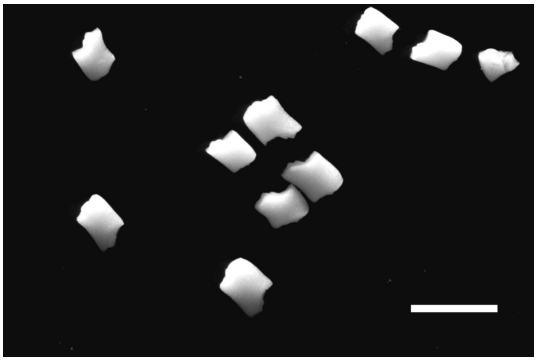

Fig. 3. Fragmented segments of a cirrus of *Oxycomanthus japonicus* three months after separation and rearing in a culture container. Scale = 2 mm.

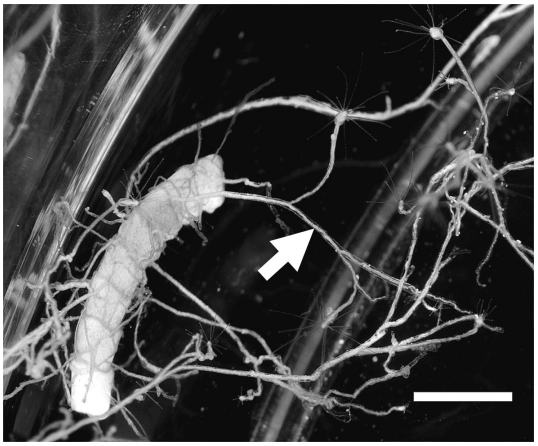

Fig. 4. An expanding colony of a bougainvilliid species three months after the detachment of its substrate cirrus from the host crinoid, *Oxycomanthus japonicus*. The hydrozoan expanded from the cirrus to the bottom of the culture container. The segments of the cirrus were connected continuously with one other by the elongated hydrozoan stolons. The arrow indicates the hydrozoan stolon on the bottom of the culture container. Scale = 2 mm.

species growing on abandoned cirri can survive by protecting the cirri from fragmentation and then expanding their colonies to additional substrata such as rocks. The expansion of colonies from original organic substrata to rocks has already been reported in another athecate hydrozoan, *Coryne uchidai* Stechow, 1931 (Kakinuma, 1960) and thus, our observations cannot be considered to be rare cases. Thus, we speculate that hydrozoan species growing on crinoid cirri achieve success uninfluenced by the condition of the cirri, and utilize those cirri as stepping stones to reach more permanent substrata. Our field

work will be continued to clarify the importance of cirri as substrata for various hydrozoan species.

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