

Epizoic Anthoathecate Species (Cnidaria, Hydrozoa) Growing on Eroded Shells of Live Gastropods (*Nassarius festivus*) in Japan

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Abstract In addition to polyps of the anthoathecate hydroid *Koellikerina bouilloni* previously reported exclusively on old, eroded shells of live gastropods (*Nassarius festivus*) in Ibaraki Prefecture, Japan, the polyps of three additional epizoic anthoathecate hydroid species (*Dicoryne conybearei*, *Stylactaria misakiensis* and *Leuckartiara* sp.) were found on similar condition *N. festivus* shells in different localities in Japan. Because polyps of these hydroid species were not found on fresh shells, it is suggested that *N. festivus* could avoid colonization by the hydroids whilst occupying fresh shells, but not older eroded ones, the latter therefore providing a suitable substrate for the hydroid polyps.

Key words: Epizoic anthoathecate hydroid, *Dicoryne conybearei*, *Leuckartiara* sp. *Stylactaria misakiensis*, *Nassarius festivus*, host gastropod, eroded shells, substrate selection.

Introduction

The polyps of hydroid species often live attached to the shells of living gastropods (Rees, 1967). These include polyps of the anthoathecate hydroid *Koellikerina bouilloni* Kawamura and Kubota, 2005, recently discovered on old eroded shells of live gastropods, *Nassarius festivus* (Powys, 1835), in Isozaki, Ibaraki Pref., Japan (Namikawa and Kawamura, 2021). Subsequent observations of *N. festivus* shell surfaces collected from other regions of Japan, found the polyps of three additional epizoic anthoathecate hydroid species (*Dicoryne conybearei* (Allman, 1864), *Stylactaria misakiensis* (Iwasa, 1934) and *Leuckartiara* sp.) on similar condition shells from those locations. Conversely, no hydroid specimens were found on fresh *N. festivus* shells, suggesting that only the older eroded shells of this gastropod species were suitable substrata for these hydroid species. Because the accumulation

of suitable substrate data for each hydroid species is important basic information, not only for hydrozoan biology, but also from an industrial perspective, since hydroid species have often been implicated as fouling organisms (e.g., Dürr and Watson, 2010), the present findings are presented below.

Materials and Methods

A total of 125 live *Nassarius festivus* shells were randomly collected from baited traps set in the seagrass beds at Kisarazu, Chiba Pref. on 22 April 2019 (N=40), Torinosu, Shirahama, Wakayama Pref. on 30 July 2019 (N=39) and Koajiro, Miura, Kanagawa Pref. on 7 August 2019 (N=46) in Japan (Fig. 1). At Torinosu and Koajiro, a second gastropod species, *Nassarius livescens* (Philippi, 1849), was also collected in the same baited traps (as bycatch). All gastropod specimens collected were conveyed alive to the Department of Zoology, the National Museum of Nature and Science, Tsukuba, where their shell

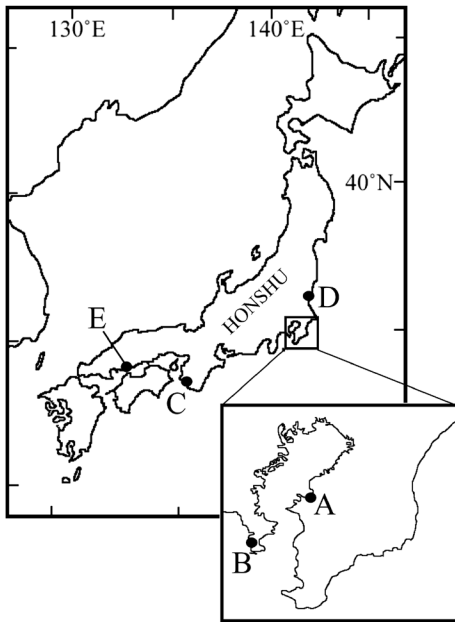


Fig. 1. Sampling locations of shells of living *Nassarius festivus* bearing epizoic hydroid polyps. A. Kisarazu, Chiba Pref. (*Stylactaria misakiensis*), B. Koajiro, Kanagawa Pref. (*Dicoryne conybearei*), C. Torinosu, Shirahama, Wakayama Pref. (*Leuckartiara* sp.), D. Isozaki, Ibaraki Pref. (*Koellikerina bouilloni* in Namikawa and Kawamura, 2021), E. Takehara, Hiroshima Pref. (*Leuckartiara* sp. in Kondo *et al.*, 2020).

surface was examined under a binocular stereomicroscope to ascertain presence or absence of hydroid species.

The hydroid specimens found on *N. festivus* shells were identified from the morphology of their reproductive organs (viz, gonophore or medusa). Immature specimens growing on the shells were maintained in culture containers (6 cm in diameter, 3 cm in height) filled with artificial seawater (Marine Art SF-1: Osakayakken. Co. Ltd, Osaka) at 20–25°C until mature enough for the development of reproductive organs. During rearing, the hydroid specimens were fed once each week with *Artemia* sp. nauplii and their host gastropods, with ornamental fish food flakes. Seawater in the culture containers was renewed approximately daily.

Results and Discussion

Namikawa and Kawamura (2021) defined “fresh shells” of living *Nassarius festivus* as those having well-defined grooves and sculptures, without attrition (Fig. 2A–B). Old eroded shells of this species are shown in Fig. 2C–E. In the present study, all of the hydroid specimens observed on the *N. festivus* shells collected from each locality occurred on the old eroded shells (Table 1). How-

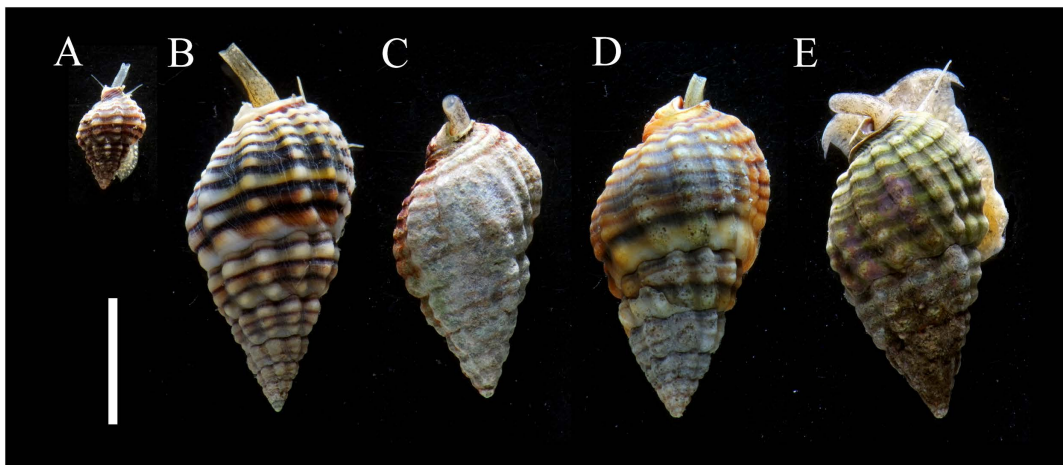


Fig. 2. *Nassarius festivus* collected from Torinosu, Shirahama, Wakayama Pref., showing erosion of older shells. A–B. fresh shells; C–E. old eroded shells. Scale = 5 mm.

Table 1. Utilization of gastropod shells by hydroid species at each collection locality.

Localities	Total no. of shells collected	Condition of shell surface of <i>Nassarius festivus</i>	
		Fresh	Old eroded
		No. of shells with hydrozoa/examined (Percentage of association (%))	No. of shells with hydrozoa/examined (Percentage of association (%))
Kisarazu	40	0/8 (0%)	14/32 (44%)
Koajiro	46	0/21 (0%)	16/25 (64%)
Torinosu	39	0/12 (0%)	8/27 (30%)



Fig. 3. Hydroid species found on old eroded shells of *N. festivus* in each collection locality. A. polyps of *Dicoryne conybearei* (Koajiro); B. gonophores of *D. conybearei*; C. polyps of *Stylactaria misakiensis* (Kisarazu); D. gonophores of *S. misakiensis*; E. polyps of *Leuckartiara* sp. (Torinosu); F. a medusa of *Leuckartiara* sp. The yellow arrows indicate the polyps of each hydroid species. Scales = 5 mm (A, C, E), 0.5 mm (D, F), 0.1 mm (B).

ever, the identities of the hydroid species varied depending on the locality, as follows: *Dicoryne conybearei* (Koajiro), *Stylactaria misakiensis* (Kisarazu) and *Leuckartiara* sp. (Torinosu) (Fig. 3).

All three hydroid species have been previously recorded as epizoid fauna encrusting gastropod shells. *Dicoryne conybearei* has been found on the shells of living gastropods or those inhabited by hermit crabs (Hirohito, 1988; Bouillon *et al.*, 2004; Schuchert, 2007; Fernandez-Leborans, 2010). *Stylactaria misakiensis* (= *S. inabai*) is a substrate specific hydroid, growing on the shells of living *Nassarius japonicus* (A. Adams, 1852), and subsequently on *N. japonicus* shells when inhabited by hermit crabs (following death of the gastropod), in every locality investigated on Honshu (main island of Japan) (Hirohito, 1988; Namikawa, 2012; Kondo *et al.*, 2020; and unpublished data). A report of a single specimen

of *S. misakiensis* growing on the shell of *N. festivus* from Sagami Bay did not refer to the condition of the shell surface (Hirohito, 1988). *Leuckartiara* sp. has been reported on the shells of living *N. festivus* collected at Takehara, Hiroshima Pref., Japan (Kondo *et al.*, 2020), although no specimens of the former were found on the smaller *N. festivus* shells. This was considered as supporting evidence that *Leuckartiara* sp. could not grow on fresh shells of this host gastropod (even at Takehara), although the report did not refer to the relationship between presence/absence of hydroid specimens and gastropod shell surface condition. The above findings indicated that the old eroded shells of *N. festivus* were likely to be a favored substrate of the four anthoathecate hydroid species (including *Koellikerina bouilloni*), depending on the locality. Conversely, they suggested that *N. festivus* has the ability to avoid colonization by these

epizoic hydroid species whilst occupying fresh shells, but lose that ability in old eroded ones.

On the other hand, not every epizoic anthoathecate hydroid species specifically chose old eroded *N. festivus* shells as favored substrate. *Cytaeis uchidae* Rees, 1962, also an epizoic anthoathecate hydroid, occurs only on the shells of *Nassarius livescens*, with strong substrate specificity in Japan (Kondo *et al.*, 2020). At Torinosu and Koajiro, *C. uchidae* polyps were found growing on the shells of *N. livescens*, but not on any of the living *N. festivus* shells collected together with the latter.

As described above, the relationships between the epizoic anthoathecate hydroids and *Nassarius festivus* are considered extremely interesting from the viewpoint of substrate selection, with further investigations necessary to clarify the environmental factors implicated in such selection.

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