

Heteromorphic Polyps Discovered in *Cytaeis uchidae* Rees, 1962 (Hydrozoa; Cytaeidae) from Japan

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Abstract Laboratory observations revealed that colonies of the athecate hydroid *Cytaeis uchidae* Rees, 1962 on a gastropod host, *Niotha livescens* (Philippi), possessed heteromorphic polyps, characterized by highly elastic tentacles that were absent in normal polyps. Such tentacles were armed with huge basitrichous isorhiza-type nematocysts that did not occur in normal filiform tentacles. The tips of the highly elastic tentacles, in which abundant basitrichous isorhizas were concentrated, had the swollen appearance of capitate tentacles, such being characteristic of the suborder Capitata. Furthermore, the heteromorphic polyps were most frequently present on the periphery of the colonies along the aperture of the gastropod host.

Key words: Hydrozoa, *Cytaeis uchidae*, heteromorphic polyps, highly elastic tentacles, nematocysts.

Introduction

Cytaeis uchidae Rees, 1962, an athecate hydroid, is so far known only from Sagami Bay (the type locality) and Asamushi, Mutsu Bay, Japan (Rees, 1962; Hirai & Kakinuma, 1973; Hirohito, 1988). According to previous studies of colonies of the species, polyps were represented by a single morphotype, having only filiform tentacles (Komai, 1931; Rees, 1962; Hirohito, 1988). In 1998, however, examination of a series of specimens collected anew from the type locality, revealed additional heteromorphic polyps with tentacles armed with a type of nematocysts absent in normal tentacles. The presence of heteromorphic polyps was confirmed in follow-up investigations on specimens subsequently collected from the type and other localities, as well as on museum specimens. The polyp seemed to be highly heterogeneous, occurring only in athecate hydroids with filiform tentacles (viz, suborder Filifera). Therefore, the morphology of the heteromorphic polyps is described here as a first step in clarifying their function and the environmental conditions under which they developed.

Materials and Methods

A total of 208 living colonies of *Cytaeis uchidae* Rees, 1962 collected from the type and other localities were examined, together with 33 preserved specimens collected from the type locality and deposited in the Showa Memorial Institute, National Science Museum, Tokyo. Collection data of the specimens examined are listed in Table 1. The localities of specimens collected included the coasts of Miura peninsula, Sagami Bay (type locality), Asamushi, Mutsu Bay, and Shimoda, Izu Peninsula, Sagami Sea (new locality record).

All colonies of the species were found exclusively on shells of live gastropods, collected using baited (dead fish) traps set on sandy-mud bottoms and immediately transported to the laboratory. The host gastropod was subsequently identified as *Niotha livescens* (Philippi, 1849), following Cernohorsky (1984) and Tsuchiya (2001). Living hydroid specimens on the host gastropods were kept without food in artificial sea water (SEA LIFE: Marine Tech Co., Tokyo) during the laboratory observations. Those col-

Table 1. *Cytaeis uchidae*. Number of colonies in which heteromorphic polyps exist.

Localities and date of collections	Number of colonies examined	Number of colonies in which heteromorphic polyps exist (%)	Status of specimens examined
Miura peninsula, Sagami Bay			
Aburatsubo			
1948/03/23	1	1 (100)	Deposited specimen (NSMT-Hy R713)
1960/03/30	7	5 (71.4)	Deposited specimen (NSMT-Hy R3506)
1960/06/28	5	4 (80.0)	Deposited specimen (NSMT-Hy R3562)
1961/06/06	2	2 (100)	Deposited specimen (NSMT-Hy R3678)
1964/07/09	17	11 (64.7)	Deposited specimen (NSMT-Hy R3801)
1998/06/10	141	124 (87.9)	Living materials newly collected in this study
Hayama			
1931/05/21	1	1 (100)	Deposited specimen (NSMT-Hy R715)
Shimoda of Izu peninsula, Sagami Sea			
2003/11/06	15	8 (53.3)	Living materials newly collected in this study
2003/11/07	8	5 (62.5)	Living materials newly collected in this study
2004/01/29	7	6 (85.7)	Living materials newly collected in this study
2004/01/28	21	13 (61.9)	Living materials newly collected in this study
2004/03/11	4	2 (50.0)	Living materials newly collected in this study
Asamushi of Mitsu Bay			
1999/07/25	2	2 (100)	Living materials presented by Prof. Numakunai
2004/09/15	10	10 (100)	Living materials presented by Ms Takeda
Total	241	194 (80.5)	

lected in 1998 were returned to their collection locality at the conclusion of the initial laboratory observations. Other materials were maintained in the laboratory for further examinations of polyp function.

The morphology and distribution of heteromorphic polyps were observed under a binocular microscope in 241 specimens (208 living and 33 preserved).

Nematocyst composition in the living specimens was examined using a microscope with phase-contrast optics.

To clarify unequivocally the origin of the heteromorphic polyps, the connections between the latter and normal polyps via hydrorhizas were checked. Colonies were detached from the decalcified surface of shells by 5% formic acid solution, three specimens collected from Asamushi on 15 September 2004 being subsequently examined under binocular microscope. The detached specimens were thereafter preserved in 75% ethanol and deposited in the National Science Museum, Tokyo (NSMT-Co 1436).

Results

The study demonstrated that each host shell was encrusted with a single colony of *Cytaeis uchidae*, based on observations of links between the detached hydrorhizas. Consequently, the heteromorphic polyps clearly originated from the established colony.

Morphology of heteromorphic polyps

The heteromorphic polyps had highly elastic tentacles that were absent in normal polyps (Fig. 1). Otherwise, the morphology of body of each polyp type was similar (Fig. 2A, B). Maximum length of the highly elastic tentacles was 4.5 mm, compared with 2 mm for normal tentacles.

Although of similar appearance to normal polyps in fixed museum-held specimens, the highly elastic tentacles could be determined owing to their obesity, even in contracted condition (Fig. 2C).

The nematocyst composition of *Cytaeis uchidae* includes three types of microbasic euryteles,

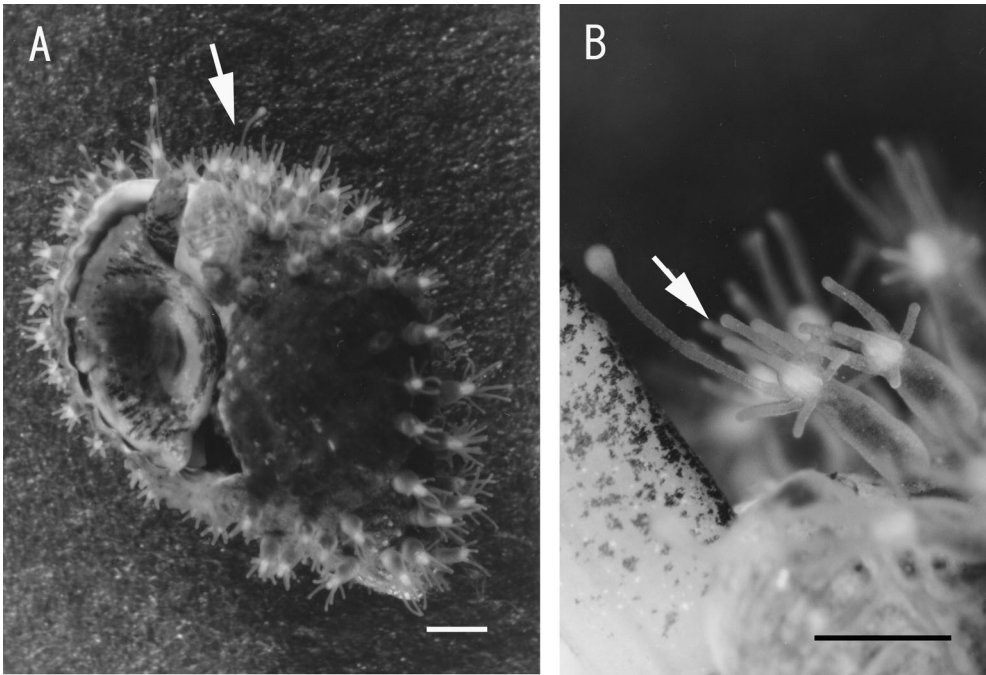


Fig. 1. Heteromorphic polyps in a living colony of *Cytaeis uchidae* on a host gastropod *Niotha livescens*. A: Entire colony. White arrow indicates the heteromorphic polyp enlarged in B. B: Heteromorphic polyp with a highly elastic tentacle. Scale=1 mm.

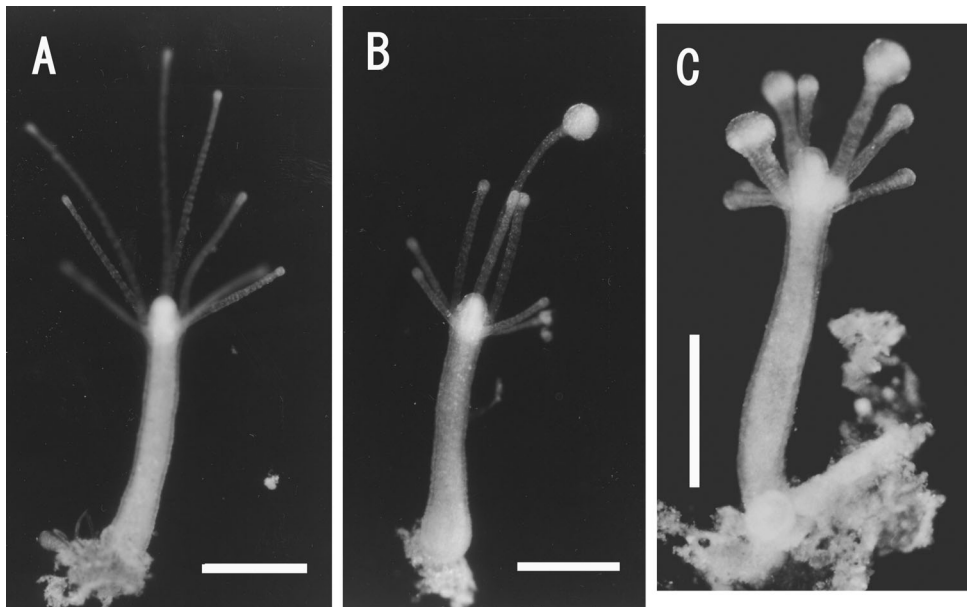


Fig. 2. Polyps detached from a living colony of *Cytaeis uchidae*. A: Normal polyp. B: Heteromorphic polyp with a highly elastic tentacle (tip swollen to resemble a capitate tentacle.) C: heteromorphic polyp with contracted highly elastic tentacles. Scale=0.5 mm.

Table 2. *Cytaeis uchidae*. Dimensions (mean \pm SD, (range)) of each type of nematocysts (μm).

	N	Length	Width
Colony			
Desmonemes	30	8.10 \pm 0.37 (7.5–9.2)	4.78 \pm 0.23 (4.6–5.0)
Mirobasic euryteles	30	9.82 \pm 0.43 (9.2–10.8)	4.49 \pm 0.45 (4.2–4.6)
Basitrichous isorhizas	30	19.34 \pm 0.88 (18.0–21.0)	10.68 \pm 0.61 (10.0–12.0)
Medusa			
Desmonemes	30	6.77 \pm 0.38 (6.4–7.6)	4.16 \pm 0.32 (3.6–4.2)
Mirobasic euryteles (type I)	30	8.25 \pm 0.39 (8.0–9.2)	3.64 \pm 0.40 (3.0–4.2)
Mirobasic euryteles (type II)	30	9.14 \pm 0.53 (8.0–10.0)	6.10 \pm 0.39 (5.6–6.2)

N: number of nematocysts (Colony: each type of nematocysts examined randomly in 3 heteromorphic polyps, medusa: both desmonemes and mirobasic euryteles (type I) in tentacles of 3 medusae, mirobasic euryteles (type II) in manubrium of 3 medusae).

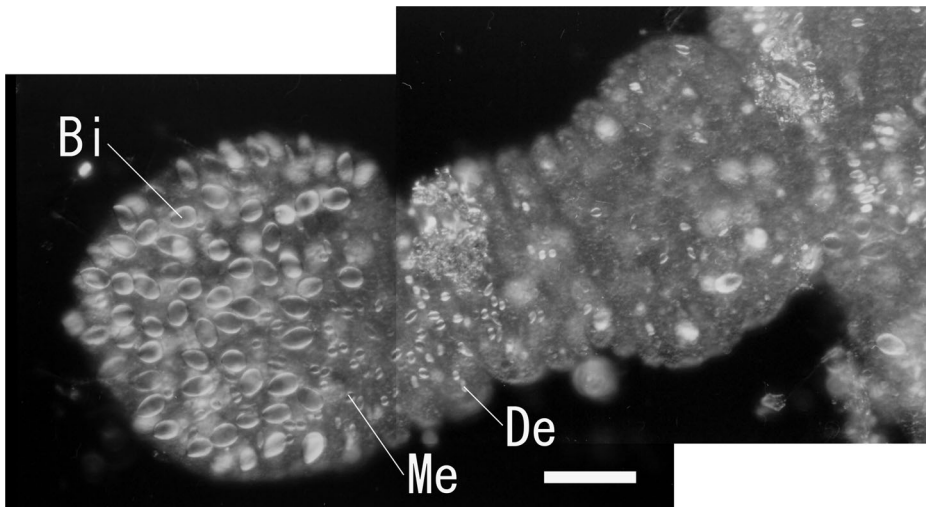


Fig. 3. A highly elastic tentacle in which abundant nematocysts are concentrated. Abbreviations. Bi: basitrichous isorhizas, Me: microbasic euryteles, De: desmonemes. Scale=0.05 mm.

desmonemes and basitrichous isorhizas (Table 2). The tips of the highly elastic tentacles were armed with a large number of huge basitrichous isorhizas, hypertrophied as that of capitate tentacles (Fig. 3).

Distribution of heteromorphic polyps

Heteromorphic polyps were found in about 80% of colonies examined (Table 1), one to eight heteromorphic polyps being observed per colony, regardless of colony size (Tables 3, 4). The heteromorphic polyps were found frequently at the periphery of the colony, along the aperture of the host gastropod shell (Fig. 1, Table 5).

Discussion

The present study revealed that colonies of *Cytaeis uchidae* have heteromorphic polyps, characterized by 1) the presence of highly elastic tentacles armed with huge nematocysts of basitrichous isorhizas, and 2) a distribution confined to that part of the colony which bordered the periphery of the aperture of the host. However, few heteromorphic polyps were evident in each colony, which may explain their having been overlooked in previous studies.

Why do heteromorphic polyps exist? Heteromorphic polyps were found in fixed specimens

Table 3. *Cytaeis uchidae*. Relationship between the sizes of host gastropods and the numbers of colonies in which heteromorphic polyps exist.

Shell length of host gastropod	Total number of colonies examined	Number of colonies in which heteromorphic polyps exist
5–6 mm	7	6
6–7 mm	12	10
7–8 mm	9	9
8–9 mm	15	14
9–10 mm	14	12
10–11 mm	13	13
11–12 mm	11	11
12–13 mm	13	11
13–14 mm	14	11
14–15 mm	4	3
15–16 mm	6	5
16–17 mm	5	4
17–18 mm	3	2
18–19 mm	4	2
19–20 mm	6	6
20–21 mm	3	3
21–22 mm	1	1
22–23 mm	1	1
Total	141	124

Colonies examined were obtained from Aburatsubo on 10 June 1998.

Table 4. *Cytaeis uchidae*. Number of heteromorphic polyps of each colony.

Number of heteromorphic polyps per colony	Number of colonies examined*
0	17
1	45
2	50
3	20
4	5
5	0
6	1
7	2
8	1
Total	141

*: Total of 141 colonies examined were obtained from Aburatsubo on 10 June 1998.

collected from Sagami Bay (type locality) about 40 years ago, as well as in living colonies collected recently from Sagami Bay and Asamushi, Mutsu Bay (ca. 600 Km distant from the former).

Table 5. Intracolony distribution of 253 heteromorphic polyps observed in 141 colonies of *Cytaeis uchidae* obtained from Aburatsubo on 10 June 1998.

Position of heteromorphic polyps observed	Number of heteromorphic polyps
Margin of colonies along aperture of host gastropod shells	249
Inner part of colonies	4
Total	253

Clearly, the morphological variations found have not resulted from environmental influences, as heteromorphic polyps occurred widely in colonies, regardless of the age of their host gastropods. Therefore, heteromorphic polyps must be considered as having some special function.

What is the role of the relatively poorly-represented heteromorphic polyps in each colony? In Cnidaria, “nematocyst-based effector systems” specialized so as to repel the competitors in living space and foods, have been reported (reviewed in Buss, 1990). Possibly, the occurrence of huge nematocysts in the highly elastic tentacles also has a defensive function against potential competitors.

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