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New Observations of *Ophiocnemis marmorata* (Echinodermata: Ophiuroidea) Associated with *Rhopilema esculentum* (Cnidaria: Scyphozoa: Rhizostomeae) in the Philippines and Japan

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Abstract. An ophiotrichid ophiuroid *Ophiocnemis marmorata* (Lamarck) was found epizoic on a rhizostome jellyfish *Rhopilema esculentum* Kishinouye in Palawan Island, the Philippines, and in Kagoshima, Japan. Underwater observation at Palawan showed that one to several individuals of the ophiuroids cling to the oral arms below the bell of one jellyfish. The ophiuroid is widespread in Indo-West Pacific, but this is the first record from Japanese waters. This ophiuroid is usually found on soft substrates, but the association with rhizostome jellyfish has been previously reported by some workers. The association may possibly provide a means of dispersal.
Key words: Ophiuroidea, rhizostome jellyfish, association, dispersal.

Introduction

Ophiuroids are basically benthic living on the sea floor of rocks or sediment. Many species are epizoic and utilize body surface of the other animals as their habitat. They live on the benthic invertebrates, especially sessile organisms like sponges and soft corals, but usually not on pelagic animals. An ophiotrichid brittle star, *Ophiocnemis marmorata* (Lamarck, 1816) is widely distributed in Indian and west Pacific Oceans and usually living on the sandy floor, but is infrequently observed to attach to jellyfishes. No other species has been reported so far to attach to jellyfish nor the other pelagic animals. We recently observed this interesting phenomenon, *Ophiocnemis marmorata* attaching to a jellyfish *Rhopilema esculentum* Kishinouye, 1891 in the Philippines. An additional observation was also made in Kagoshima, Japan. In this short report, we briefly review the association of *Ophiocnemis marmorata* with jellyfishes including our new observations.

Results and Discussion

Taxonomy, geographical distribution, and morphology of *Ophiocnemis marmorata*

The genus *Ophiocnemis* was erected for *Ophiura marmorata* Lamarck, 1816 in the family Ophiotrichidae by Müller and Troschel (1842). Only two species are currently included: *Ophiocnemis marmorata* and *O. cotteaui* Loriol, 1900. The latter one has not been recorded at all since its original description from off Liberia (Loriol, 1900), and its taxonomic status is not clear. *Ophiocnemis marmorata* has been reported rather frequently, and the geographical distribution covers the Indian and western Pacific Oceans (Fig. 1). It is recorded from Kagoshima Prefecture, Japan, in this study as the first report of this species from Japanese waters. Bathymetrical ranges covers from intertidal to about 250 m in depth.

Ophiotrichids have characteristic arm spines. At distal part of arms of *Ophiocnemis marmorata*, the oral-most arm spines are transformed to hooklets (Fig. 2C), which may be helpful to

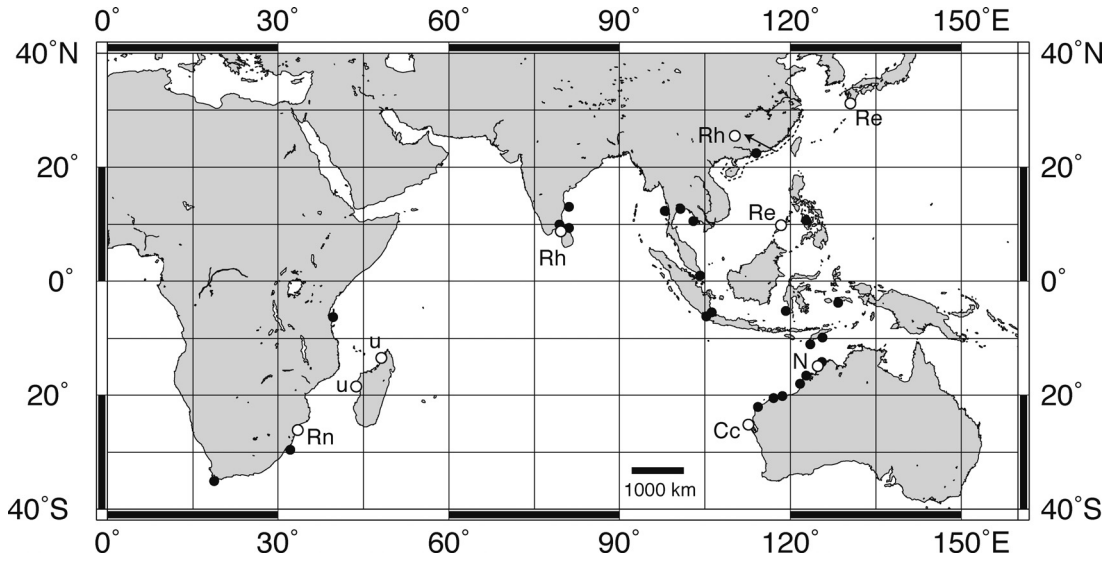

Fig. 1. Geographical distribution of *Ophiocnemis marmorata*. Solid circles denote the localities where the ophiuroid was collected, and open circles denote the localities where the ophiuroid associated with jellyfish was found. A broken line indicates the distribution range of the ophiuroid too, and the association was also observed within the range without the detailed locality data (Liao & A. M. Clark, 1995). Abbreviations: Rn, *Rhopilema nomadica*; Rh, *Rhopilema hispidum*; Re, *Rhopilema esculentum*; Cc, *Cephea cephea*; N, *Netrostoma* sp.; u, unidentified rhizostome jellyfish. Collecting data were obtained from Lyman, 1865, 1874; Ljungman, 1867; Duncan, 1887; Doderlein, 1888; Koehler, 1898, 1905, 1922, 1931; McIntosh, 1910; H. L. Clark, 1915, 1938, 1946; Mortensen, 1934; Boone, 1938; Panikar & Prasad, 1954; A. M. Clark & Courtman-Stock, 1976; Cherbonnier & Guille, 1978; Liao & A. M. Clark, 1995; Rowe & Gates, 1995; Marsh, 1998; and present study.

grasp other organisms. This hooklet arm spines are observed not only in *O. marmorata* but also in other ophiotrichid species. Many ophiotrichids live attached to benthic animals and rocks, but *O. marmorata* is typically living on the sandy floor. *Ophiocnemis marmorata* is distinguished from the other species of the ophiotrichid genera by having many granules on the aboral disk (Fig. 2), though their ecological role is still unclear.

Association of *Ophiocnemis marmorata* with jellyfishes

No other species than *Ophiocnemis marmorata* has been reported so far to attach to pelagic animals like jellyfish. The first report of *O. marmorata* attaching to jellyfish was made by Pannikar and Prasad (1954), and since then four papers have reported the association (Table 1). Marsh (1998) made underwater observation of the association for the first time. Considering the frequency of the observation of this association, usual habitat of the ophiotrichid is probably a sandy bottom and attaching to jellyfish is facultative and not obligate.

In this study, *Ophiocnemis marmorata* attaching to *Rhopilema esculentum* was observed in Japan and the Philippines. In Japan, an individual of *R. esculentum*, collected in October 2002 from Kataura Bay in Minami-satsuma-shi (formerly Kasasa-cho), Kagoshima Prefecture, Kyushu, was associated with *Ophiocnemis marmorata* (Fig. 3). In this bay, *R. esculentum* have been frequently found (M. Chikuchishin, pers. comm.), but attaching ophiuroids had never been found. In the Philippines, many individuals of *R. esculentum* were observed on 6th March 2004 by scuba diving, drifting near the rocky bottom at the depths of about 10–20 m near the mouth of

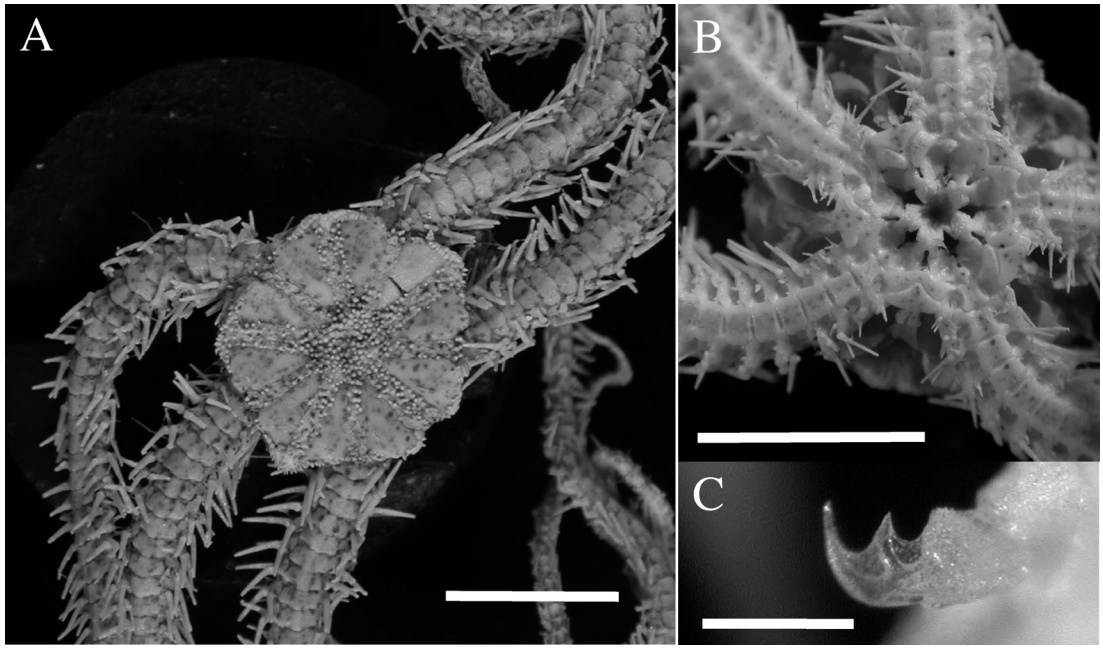

Fig. 2. A specimen (NSMT E-5479) of *Ophiocnemis marmorata* washed up on a beach in Ulgan Bay, Palawan Island, the Philippines. A, aboral view; B, oral view; C, arm spines near the tip of an arm. Scale bars: 5 mm for A and B; 0.2 mm for C.

Table 1. Host rhizostome jellyfishes associated by *Ophiocnemis marmorata*.

Family	Species	Japanese name	Locality	References
Rhizostomatidae	*Rhopilema nomadica* Galil, Spanier & Ferguson, 1990		Inhaca Island, Mozambique	Berggren (1994)
	Rhopilema hispidum (Vanhöffen, 1888)	Hizen-kurage	Southern China	Liao & A. M Clark (1995)
	Rhopilema hispidum	Hizen-kurage	Palk Bay, Sri Lanka	Pannikkar & Prasad (1954)
	Rhopilema esculentum Kishinouye, 1891	Bizen-kurage	Kagoshima, Japan; Palawan Island, the Philippines	Present study
Cepheidae	*Cephea cephea* (Forskål, 1775)	Ibo-kurage	Shark Bay, Western Australia	Marsh (1998)
	Netrostoma sp.		Kimberley, Western Australia	Marsh (1998)
Unidentified	Unidentified rhizostome jellyfish		Madagascar	Cherbonnier & Guille (1978)

Ulgan Bay, Palawan Island. The water temperature was about 27°C. Many of the jellyfishes bore one to several individuals of *O. marmorata* (Fig. 4A, B). There were also large numbers of *R. esculentum* washed up on the beach of Isla Rita at the center of Ulgan Bay, and many of them were attached by one to several *O. marmorata* (Fig. 4C).

Ophiocnemis marmorata has been found from a total of six jellyfish species (including an unidentified one), and all of them belong to families Rhizostomatidae or Cepheidae of Rhizos-

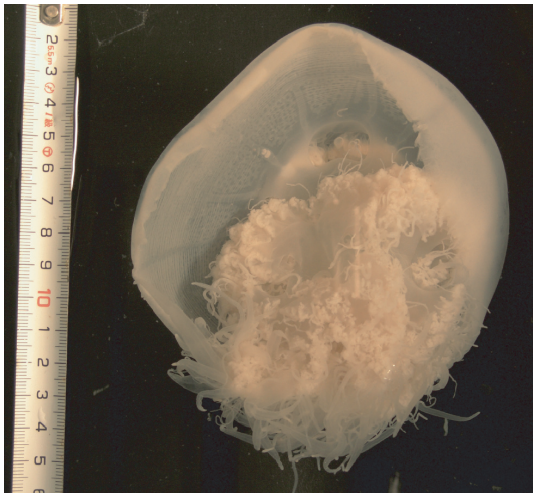

Fig. 3. Formalin specimen (NSMT-CO 1502) of *Rhopilema esculentum* from Kataura Bay, Minami-satsuma-shi, Kagoshima Prefecture, Japan. Scale divisions: 1 mm.

tomeae. General morphological and ecological characteristics of rhizostoms are as follows: 1) rigid gelatinous body; 2) morphologically complicated oral arms; 3) many small, secondary, suctorial mouths present on the oral arms instead of an original central mouth; 4) feeding on small zooplankton by using suctorial mouths and small appendages around them; 5) high swimming ability by well developed circular muscles; 6) living usually near coast but sometimes in open ocean by water currents; 7) vertical movement caused by their daily rhythm or environmental change; and 8) tropical and subtropical inhabitants (see Mayer, 1910; Franc, 1993; Arai, 1997). The stiff body of the jellyfish with complicated form of oral arms (Fig. 3) may be useful for the ophiuroids to attach to the jellyfish. Most of rhizostoms live in shallow bay and may descend close to the sea floor by their habit of vertical movements, and those ecological characteristics cause opportunity for ophiuroids to contact the jellyfish. Food habit of *O. marmorata* was not studied, but it is supposed to be a suspension feeder like most of ophiotrichid ophiuroids (see Warner, 1982). *Ophiocnemis marmorata* may utilize the currents produced by swimming or opening/closing bell movement of host jellyfish to get the foods more efficiently. Marsh (1998) suggested *O. marmorata* may collect their foods by scratching the surface of oral arms of jellyfish.

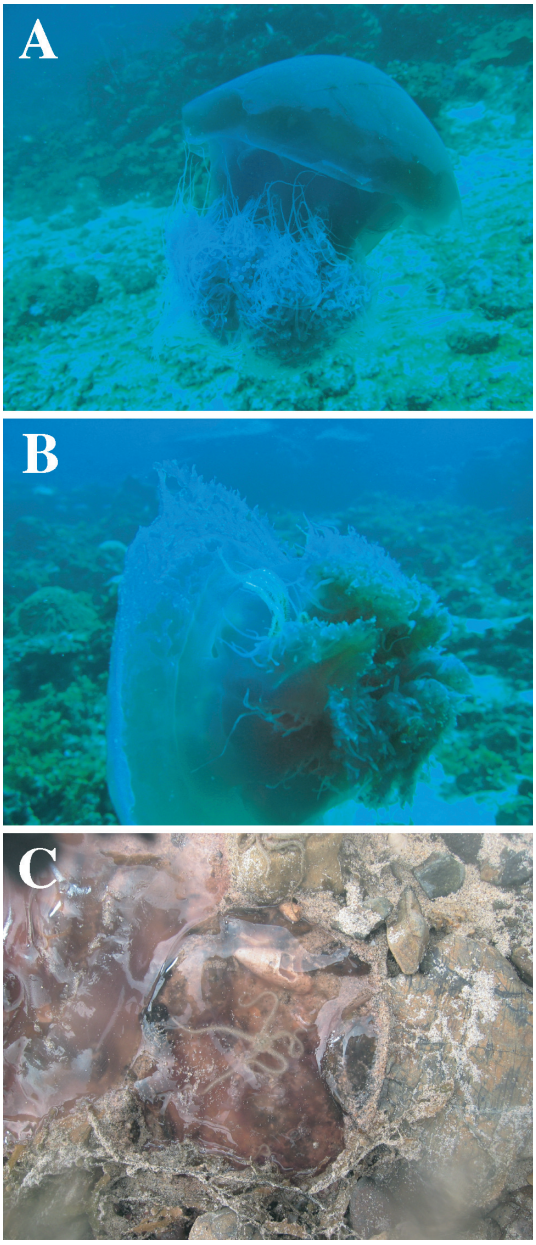

Fig. 4. *Ophiocnemis marmorata* associated with *Rhopilema esculentum*. A, B, underwater photographs; C, washed up specimens on a beach in Ulgan Bay, Palawan Island, the Philippines.

Body size of *Ophiocnemis marmorata* found

on the jellyfishes washed up on the beach in the Philippines were 6.4–8.0 mm (N=7; deposited in the National Science Museum, Tokyo; NSMT E-5479) in disc diameter, and that of the ophiuroid from Kagoshima was 11.8 mm (N=1; NSMT E-5478). The body size of Kagoshima specimen is a little larger than, but those of the Philippine specimens are almost as large as the specimens reported so far: 6.5–9 mm (N=11) from Madagascar (Cherbonnier & Guille, 1978) and 6–8.5 mm (N=7) from western Australia (Marsh, 1998). Only one small individual (2 mm) of this species was reported from Madagascar (Cherbonnier & Guille, 1978). The largest specimen collected from sandy bottom was beyond 20 mm (H. L. Clark, 1938), and thus the individuals found on jellyfishes are relatively small and uniform in size.

Ophiocnemis marmorata has never been found on the sandy bottom around Japanese waters, and the nearest known locality is southern China (Liao & A. M. Clark, 1995) about 1000 km far from Kagoshima. *Nemopilema nomurai* Kishinouye, 1922, another rhizostomatid jellyfish closely related to *Rhopilema esculentum*, is known to move a long distance from the East China Sea to the Kyushu area getting on the Tsushima Current (Yasuda, 2003; Omori & Kitamura, 2004). In Japanese waters, *Rhopilema esculentum* has been reported from Suruga Bay, Seto Inland Sea, Ariake Sea, and off Kagoshima Prefecture (Omori & Kitamura, 2004). This jellyfish has also been found from the Yellow Sea and the East and South China Seas off the coast along China and Korea (Kramp, 1961; Omori & Nakano, 2001; Omori & Kitamura, 2004). *Rhopilema esculentum* may also drift from southern China to Kagoshima. The Kagoshima specimen of *O. marmorata* may originate from the coast of southern China where this ophiuroid is common at 5–100 m deep (Liao & A. M. Clark, 1995). Similar example was reported from western Australia (Rowe & Gates, 1995; March, 1998). The association was observed in Shark Bay at about 450 km far south from the nearest habitat of *O. marmorata* on the sandy bottom in Exmouth Gulf. This association possibly contributes to the dispersion of *O. marmorata*, but future studies, especially on its life cycle and genetics, are required to clarify the dispersion sufficiently.

Rhizosotome jellyfishes also host juvenile clupeoid fishes, portunid crabs, and pontoniine shrimps (Panikkar & Prasad, 1954; Berggren, 1994). The function of these associations is not yet clarified either.

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フィリピンと日本で観察されたビゼンクラゲに乗って移動するクモヒトデ *Ophiocnemis marmorata*

藤田敏彦・並河　洋

トゲクモヒトデ科の *Ophiocnemis marmorata* は，通常砂泥底に棲息しているが，インド・太平洋域で鉢水母のビゼンクラゲ類に付着している姿が稀ながら目撃されていた．最近，フィリピンのパラワン島で，多くのビゼンクラゲ *Rhopilema esculentum* の傘内や口腕に本種が1～数個体付着しているのが潜水によって観察された．また，鹿児島で得られたビゼンクラゲにもこれが付着していることが判明し，ビゼンクラゲ類を分散の手段として利用している可能性が示唆された．

1．クモヒトデ類の浮遊生物への付着現象は *Ophiocnemis marmorata* のみで見られる珍しい現象であり，ビゼンクラゲへの付着を初めて報告した．付着母体となるのがビゼンクラゲ類に限られていることから，ビゼンクラゲ類に特有な強固な体や複雑な口腕といった形態的な特徴や，内湾性で上下運動を行うといった生態的な特徴が，付着母体になりうる要因であると考えられる．

2．*Ophiocnemis marmorata* の鹿児島での出現は本クモヒトデの日本初記録である．日本国内では砂底での分布記録はなく，この個体が遠方よりビゼンクラゲに付着して運ばれた可能性もある．強い遊泳力を持たない海産底生動物の分散は，通常，生活史の一部である浮遊幼生の時期に行われるが，*Ophiocnemis marmorata* のビゼンクラゲ類への付着は，浮遊幼生以外での分散という特殊な役割を持っている可能性がある．