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Infection with *Peniculus minuticaudae* (Copepoda: Pennellidae) on Threadsail Filefish (*Stephanolepis cirrhifer*) and Black Scrapper (*Thamnaconus modestus*) Cultured in Japan

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Abstract Female adult specimens of the pennellid copepod *Peniculus minuticaudae* Shiino, 1956 were collected from the fins of two species of monacanthid fishes, threadsail filefish (*Stephanolepis cirrhifer*) and black scrapper (*Thamnaconus modestus*), cultured in floating cages in Japan. These collections represent the first records of *P. minuticaudae* from farmed marine fishes as well as the first records of this copepod species from farmed *S. cirrhifer* and *T. modestus*. The finding of *P. minuticaudae* in this study is also the second record of pennellid copepods from maricultured fishes. Both the pectoral fins and the second dorsal fin were most heavily infected, followed by the caudal fin and the anal fin.

Key words: aquaculture, black scrapper, Copepoda, fish parasite, *Peniculus minuticaudae*, *Stephanolepis cirrhifer*, *Thamnaconus modestus*, threadsail filefish

INTRODUCTION

Peniculus minuticaudae Shiino, 1956 is a poorly studied parasitic copepod of marine teleost fishes in Japanese waters. The species was originally described by Shiino (1956) based on female specimens from the fins of threadsail filefish (*Stephanolepis cirrhifer* (Temminck and Schlegel), recorded as *Monacanthus cirrhifer*) landed at Shirahama on the Pacific coast of Wakayama Prefecture, central Japan. Recently, Okawachi *et al.* (2012) found this copepod species infecting the fin rays of three species, unicorn leatherjacket filefish (*Aluterus monoceros* (Linnaeus)), hairfined leatherjacket (*Paramonacanthus japonicus* (Tilesius, 1809)) and brown-banded butterflyfish (*Roa modesta* (Temminck and Schlegel)), held at a public aquarium in Kagoshima Prefecture, southern Japan. These authors also found developmental stages of *P. minuticaudae* parasitic on *P. japonicus* and suggested that the life cycle of the parasite was completed in the tanks at the aquarium.

Two species of monacanthid fishes, threadsail filefish and black scrapper (*Thamnaconus modestus* (Günther, 1877)), are currently cultured in coastal waters of Japan. Despite their increasing importance in aquaculture, only little information is available on the parasites and parasitic diseases of these fish species farmed in Japan. This note reports on infections with *P. minuticaudae* on *S. cirrhifer* and *T. modestus* cultured in Japan.

MATERIALS AND METHODS

In this study, only fish infected with *P. minuticaudae* were examined. Eleven *S. cirrhifer* were collected at two sites: one fish (fish size not measured, 630g body weight [BW]) was collected on 7 December 2005 from a floating cage at a fish farm in the western North Pacific off Minami-Ise (34° 14'40"N, 136°30'20"E), Mie Prefecture, Honshu, while ten fish (22.4-27.2 [mean 25.4] cm total length, 274-603 [467] g BW) were sampled on 28 November 2008 from a floating cage in the Bungo Channel off Kamiura (33°2'47"N, 131°56'10"E), Saiki, Oita Prefecture, Kyushu. Also, two *T. modestus* (fish size not measured, 168-203 [186] g BW) were collected on 11 August 2011 from a floating cage in the Bungo Channel (Nyutsu Bay) off Kamae (32°49'54"N, 131°58'31"E), Saiki, Oita Prefecture. These fish were brought to the laboratory, where copepods were removed from the fish, fixed in 10% formalin or 70% ethanol, and then preserved in 70% ethanol. For identification, some of the copepods from two host species were soaked in lactophenol and examined using the wooden slide procedure of Humes and Gooding (1964). Representative specimens are deposited in the crustacean collection at the National Museum of Nature and Science, Tokyo (NSMT-Cr 21852 from *S. cirrhifer* from Oita Prefecture; and NSMT-Cr 21853 from *T. modestus* from Oita Prefecture).

RESULTS AND DISCUSSION

Copepod specimens were collected from the fins (Fig. 1A). They were adult females, and total length (excluding the egg sacs) of 10 specimens from *S. cirrhifer* sampled in Oita Prefecture was 2.30-2.85 (mean 2.48) mm. The morphology of the specimens (Fig. 1B) well corresponded to the original description and recent redescription of *P. minuticaudae* given by Shiino (1956) and Okawachi *et al.* (2012), respectively. The present collections represent the first records of *P. minuticaudae* from farmed fishes as well as the first records of the species from cultured *S. cirrhifer* and *T. modestus*. Moreover, only one pennellid species, *Haemobaphes disphaerocephalus*, has been so far reported to accidentally infect farmed Atlantic salmon (*Salmo salar* L.) in Canada (Kent *et al.*, 1997; Johnson *et al.*, 2004). Thus, our finding of *P. minuticaudae* in this study is also the second documented record of pennellid copepods from commercially cultured fishes.

One *S. cirrhifer* from Mie Prefecture harbored 99 copepods. Ten *S. cirrhifer* from Oita Prefecture were individually infected with 4 to 80 (mean 31.1) copepods. Also, two *T. modestus* carried each 47 and 123 copepods. All of these copepods were found attached to the fin rays (Fig. 1A), as previously reported by Shiino (1956). In the 10 *S. cirrhifer* from Oita Prefecture, copepods were most abundantly found on both the pectoral fins (n=128, 41.2%) and the second dorsal fin (98, 31.5%), followed by the caudal fin (56, 18.0%) and the anal fin (29, 9.3%), which suggests that *P. minuticaudae* females prefer the pectoral and second dorsal fins of the fish. The first dorsal fin has only spines and thus was not infected.

The membrane of the fins heavily infected with *P. minuticaudae* was usually damaged, and the distal part of some of the fin rays was exposed to the water. Okawachi *et al.* (2012) observed a similar fin damage in aquarium fishes. Since much remains unknown about the pathogenicity of *P. minuticaudae*, it is desirable to study its impact on the host fish.

Peniculus minuticaudae has been reported so far to infect four species of teleost fishes in Japanese waters (Shiino, 1956; Okawachi *et al.*, 2012). Among those species, *R. modesta* is classified in the family Chaetodontidae (order Perciformes), while three other species (*S. cirrhifer*, *A. monoceros* and *P. japonicus*) belong to the family Monacanthidae (order Tetraodontiformes). In this study, another

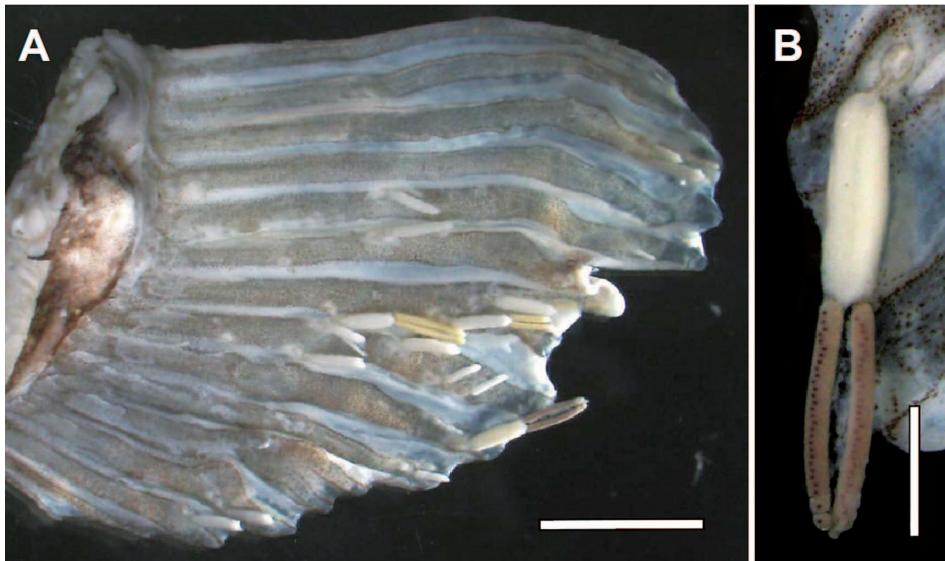


Fig. 1. Females of *Peniculus minuticaudae* infecting the pectoral fin of threadsail filefish (*Stephanolepis cirrhifer*). The fish was sampled from a floating cage in the Bungo Channel off Kamiura, Saiki, Oita Prefecture, Japan. Alcohol-preserved specimen. A. Females attached to the fin rays, B. An ovigerous female with a pair of egg sacs, dorsal view. Scale bars: 5 mm in A and 1 mm in B.

monacanthid (*T. modestus*) is added as a new host for *P. minuticaudae*, which implies that the monacanthid fishes are preferred hosts for this species of pennellid. In addition, it has been reported that *S. cirrhifer* and *T. modestus* farmed in Oita Prefecture were infected with unidentified copepods of *Peniculus* (Fukuda, 1999: 57). These copepods may be identical with *P. minuticaudae* because the sampling locality and hosts were the same as those in the present study.

Pennellid copepods need two hosts to complete their life cycle, which comprises two free-swimming nauplius stages, one infective copepodid stage, four chalimus stages, and the adult stage (Kabata, 1981; Brooker *et al.*, 2007). Both invertebrate and vertebrate hosts, such as cephalopods (Rose and Hamon, 1953), gastropods (Ho, 1966; Perkins, 1983) and teleosts (Schram, 1979; Brooker *et al.*, 2007), are known to serve as the hosts for juvenile pennellids. On the other hand, Okawachi *et al.* (2012) currently suggested, based on their observations made at an aquarium, that *P. minuticaudae* can complete its life cycle using only a single host (a monacanthid, *P. japonicus*). If this is the case at farming sites, individuals of cage-cultured *S. cirrhifer* and *T. modestus* may serve as the hosts for juvenile and adult *P. minuticaudae*. We need to examine both farmed fish and those occurring near the floating cages to detect developmental stages of the parasite.

The mass seed production has not yet been successful for *S. cirrhifer* and *T. modestus* in Japan, where wild-caught young fish are used for farming. However, as nothing is known about the parasites of those young fish, we need to examine them for the prevalence and intensity of various parasites including *P. minuticaudae*.

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養殖カワハギとウマヅラハギに寄生していたカイアシ類 *Peniculus minuticaudae*

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要 旨 三重県南伊勢町地先の北太平洋で養殖されていたカワハギ *Stephanolepis cirrhifer* および大分県佐伯市上浦地先と蒲江地先の豊後水道でそれぞれ養殖されていたカワハギとウマヅラハギ *Thamnaconus modestus* の鱗から寄生性カイアシ類 *Peniculus minuticaudae* Shiino, 1956の雌成虫を採集した。これは本寄生虫の養殖魚類および養殖カワハギ・ウマヅラハギからの初記録であるとともに、養殖魚類にペンネラ科カイアシ類の寄生を認めた2度目の事例である。本寄生虫は胸鱗と第2背鱗に多く見られ、次いで尾鱗と臀鱗の順に多く寄生していた。

キーワード: ウマヅラハギ, カイアシ類, カワハギ, 魚類寄生虫, 水産養殖, *Peniculus minuticaudae*, *Stephanolepis cirrhifer*, *Thamnaconus modestus*