

New Records of Parasitic Copepoda from the Offshore Pelagic Fishes of Japan

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Six species of parasitic Copepoda were recovered from seven species of offshore pelagic fishes caught off Katsuura, Wakayama Prefecture in July, 1992-1994. They are: *Anthosoma crassum* (Abildgaard) on *Isurus oxyrinchus* Rafinesque; *Caligus coryphaenae* Steenstrup & Lütken on *Acanthocybium solandri* (Cuvier) and *Thunnus albacares* (Bonnaterre); *Gloiopotes huttoni* (Thomson) on *Makaira mazara* (Jordan & Snyder), *Tetrapturus audax* (Philippi), and *Istiophorus platypterus* (Shaw & Nodder); *G. hygomianus* Steenstrup & Lütken on *A. solandri*; *Pandarus satyrus* Dana on *I. oxyrinchus*; and *Pennella filosa* (Linnaeus) on *M. mazara* and *Tetrapturus angustirostris* Tanaka. Except for the findings of *A. crassum* on *I. oxyrinchus* and *G. huttoni* on *M. mazara* and *T. audax*, all of the remaining records are new to the hosts in Japan. *Pennella filosa* is recorded for the first time from *M. mazara* and *T. angustirostris* in the world.

Key words: parasitic copepods, offshore pelagic fishes, Japan

Introduction

So far as we are aware, more than 300 species of parasitic Copepoda have been recovered and described from the marine fishes of Japan. However, a great majority of them were reported from the coastal and/or demersal fishes and those occurring on the offshore, pelagic gamefishes were not equally treated. For instance, the billfishes (Istiophoridae) are a typical family of offshore gamefishes and there are five species known from the waters of Japan. However, only two of those five species of billfishes, the Indo-Pacific blue marlin [*Makaira mazara* (Jordan & Snyder)] and the striped marlin [*Tetrapturus audax* (Philippi)], have been reported to carry one species of copepod parasite - *Gloiopotes longicaudatus* (Marukawa, 1925) - by Shiino (1954, 1957).

Recently, we had an opportunity to examine 26 lots of parasitic copepods collected by Dr. Izumi Nakamura of Kyoto University from the large, offshore gamefishes taken off Katsuura in Wakayama Prefecture (Table 1). The fishes were caught by sports fishermen using trolling during the Katsuura Billfish Tournament, and the copepod parasites were found on three species of billfishes and one species each of swordfish, wahoo, tuna, and shark.

Six species of parasitic copepods were identified from those 26 samples. To our surprise, each of these six species of parasites constitutes the new record for the host(s) from the waters of Japan. Furthermore, one record becomes the first discovery of the parasite for two species of billfishes in the world. This paper deals with these new records.

Materials and Methods

The copepod parasites in the 26 lots received from Dr. Izumi Nakamura of Kyoto University were removed from the pelagic fishes caught in July of 1992, 1993, and 1994 during the fishing tournaments taken place off Katsuura in Wakayama Prefecture (Table 1). They were fixed in 10% formalin and stored in 70% alcohol. In the laboratory, the preserved parasites were soaked in lactic acid for 10 to 15 minutes before the removal of their appendages under a dissection microscope. To examine closely the structures of the removed appendages, the hanging drop method devised by Humes and Gooding (1964) was employed. The appendages were studied under the compound microscope with a series of magnification up to $\times 1,500$.

Results

Six species of siphonostomatoid copepods in five genera of five families were identified. It comprises two species of *Gloiopotes* (Euryphoridae) and one species each of the following four genera: *Anthosoma* (Dichelethiidae), *Caligus* (Caligidae), *Pandarus* (Pandaridae), and *Pennella* (Pennellidae) (Table 1). Below, given in alphabetical order, are these six species of parasites accompanied with a brief note about their occurrence:

Anthosoma crassum (Abildgaard) (Dichelethiidae) - found in the oral cavity of the shortfin mako (*Isurus oxyrinchus* Rafinesque).

A. crassum has been reported from the shortfin mako caught off Massachusetts (Wilson, 1922), Mediterranean Sea (Delamare-Deboutteville & Nunes-Ruivo, 1954), Angola (Nunes-Ruivo,

Table 1. Parasitic copepods on fishes caught during the fishing tournaments off Katsuura, Wakayama Prefecture.

Fish	Date	Parasite (number)	Site of attachment
<i>Makaira mazara:</i>			
No. 1	7-19-92	<i>Gloiopotes huttoni</i> (3 , 2)	base of bill
		<i>Gloiopotes huttoni</i> (7 , 3)	gill cavity, near gill arch
		<i>Gloiopotes huttoni</i> (1 , 1)	base of bill
No. 2	7-17-93	<i>Gloiopotes huttoni</i> (4 , 1)	dorsal side of body
		<i>Pennella filosa</i> (1)	isthmus
No. 3	7-18-93	<i>Gloiopotes huttoni</i> (1 , 2)	first dorsal fin base
		<i>Gloiopotes huttoni</i> (1 , 3)	body surface
No. 4	7-15-94	<i>Gloiopotes huttoni</i> (4 , 4)	base of first dorsal fin
		<i>Gloiopotes huttoni</i> (5 , 6)	base of anal fin
No. 5	7-15-94	<i>Gloiopotes huttoni</i> (4 , 4)	base of first dorsal fin
No. 6	7-15-94	<i>Gloiopotes huttoni</i> (12 , 17)	body surface
No. 7	7-15-94	<i>Gloiopotes huttoni</i> (8 , 4)	body surface
No. 8	7-16-94	<i>Gloiopotes huttoni</i> (6 , 6)	head
		<i>Gloiopotes huttoni</i> (2)	body surface
		<i>Pennella filosa</i> (1)	base of first dorsal fin
No. 9	7-16-94	<i>Gloiopotes huttoni</i> (5 , 2)	head
		<i>Gloiopotes huttoni</i> (1 , 1)	caudal fin
<i>Tetrapturus audax:</i>			
No. 10	7-17-92	<i>Gloiopotes huttoni</i> (49 , 63)	base of anal fin
No. 11	7-19-92	<i>Gloiopotes huttoni</i> (4 , 3)	body surface
<i>Tetrapturus angustirostris:</i>			
No. 12	7-15-94	<i>Pennella filosa</i> (2)	by anal fin
<i>Istiophorus platypterus:</i>			
No. 13	7-15-94	<i>Gloiopotes huttoni</i> (1 , 1)	body surface
<i>Acanthocybium solandri:</i>			
No. 14	7-19-92	<i>Gloiopotes hygomianus</i> (4 , 2)	by anal fin
		<i>Gloiopotes hygomianus</i> (1 , 1)	base of anal fin
		<i>Caligus coryphaenae</i> (1)	base of anal fin
<i>Thunnus albacares:</i>			
No. 15	7-19-92	<i>Caligus coryphaenae</i> (4 , 2)	caudal fin
<i>Isurus oxyrinchus:</i>			
No. 16	7-16-93	<i>Anthosoma crassum</i> (2)	oral cavity
		<i>Pandarus satyrus</i> (6)	oral cavity

1956), Indian Ocean (Cressey, 1967), New Zealand (Hewitt, 1968), India (Pillai, 1985), and southern Brazil (Montu, 1996). This is the second record of *A. crassum* on the shortfin mako from the western North Pacific. In Japan this parasite was reported from the shortfin mako [note: called *Isoropsis glauca* (Müller & Henle)], the blue shark [*Prionace glauca* (Linnaeus)] and the sharpnose sevengill shark [*Heptranchias perlo* (Bonnaterre)] by Shiino (1955), and from the salmon shark [*Lamna ditropis* Hubbs & Follett, note: called *Isurus nasus* (Bonnaterre)" and *Lamna nasus* (Bonnaterre)" in the works of Yamaguti (1936b) and Shiino (1955)]. It is interesting to point out that 13 species of copepod parasites have been reported from the shortfin mako from various parts of the world. Thus, in Japan, the chances of finding parasitic copepods other than *A. crassum* is high.

Caligus coryphaenae Steenstrup & Lütken (Caligidae) - recovered from the base of the anal fin of the wahoo [*Acanthocybium solandri* (Cuvier)] and on the caudal fin of the yellowfin tuna [*Thunnus albacares* (Bonnaterre)].

Ten species of copepods have been reported from the wahoo from various parts of the world, but in Japan only *Brachiella thynni* Cuvier is known from this host. It was found on the wahoo caught off Owase in Mie Prefecture (Shiino, 1956). Although seven species of parasitic copepods are known from the yellowfin tuna, none of them was reported from Japan. *Caligus coryphaenae* is a fairly common parasite found chiefly on the pelagic fishes of the Carangidae and Scombridae. Therefore, finding it on the wahoo and yellowfin tuna from Japan is not unexpected. In Japan *C. coryphaenae* has been reported from the common dolphinfish (*Coryphaena hippurus* Linnaeus) by Yamaguti (1936a) and Shiino (1960a), and from the skipjack tuna [*Katsuwonus pelamis* (Linnaeus)] by Shiino (1960a).

Gloiopotes huttoni (Thomson) (Euryporidae) - on the Indo-Pacific blue marlin [*Makaira mazara* (Jordan & Snyder)] at the base of the bill, dorsal fin, anal fin, in the gill cavity by the gill arch as well as on the head and body surface. Also found on the body surface of the Indo-Pacific sailfish [*Istiophorus platypterus* (Shaw & Nodder)] and striped marlin [*Tetrapturus audax* (Philippi)].

In 1954 and 1957 Shiino reported the occurrence of *Gloiopotes longicaudatus* (Marukawa, 1925)" on the striped marlin (*T. audax*) and Indo-Pacific blue marlin (*M. mazara*) from Japan. But according to Cressey (1967) that name of the parasite is synonymous with *G. huttoni*. Also, the unspecified species of euryporid copepod, *Gloiopotes* sp.", reported by Yamaguti (1936) from the striped marlin (*T. audax*) was confirmed by Shiino (1954a) to be identical with *Gloiopotes longicaudatus* (Marukawa)." Consequently, there is but one species of *Gloiopotes* from the billfishes of Japan.

Cressey (1967) claimed that *G. huttoni* is specific to the billfishes and swordfish of the Indian and Pacific Oceans.

Gloiopotes hygomianus Steenstrup & Lütken (Euryphoridae) - on the body surface of the wahoo (*A. solandri*) found near the anal fin.

Five species of *Gloiopotes* are currently known. While *G. hygomianus* is found on the wahoo, the remaining four species [*G. americanus* Cressey, *G. huttoni* (Thompson), *G. ornatus* Wilson, and *G. watsoni* Kirtisinghe] are specific to the billfishes (Istiophoridae) and swordfish (Xiphiidae) (Cressey, 1967). As many as ten species of parasitic copepods have been reported from the wahoo and the occurrence of *G. hygomianus* on this fish is known from Cocos Islands (Shiino, 1960b), Hawaii (Lewis, 1967), Indian Ocean (Lewis et al., 1969), western North Atlantic (Cressey and Cressey, 1980), India (Pillai, 1985), and Brazil (Boxshall and Montu, 1997).

Pandarus satyrus Dana (Pandaridae) - in the oral cavity of the shortfin mako (*I. oxyrinchus*).

Parasitic copepods of the genus *Pandarus* are host specific to sharks. There are three species occurring on the shortfin mako, they are *P. smithii* Rathbun and *P. katoi* Cressey in addition to *P. satyrus*. So far, *P. satyrus* is known to parasitize the shortfin mako in the Indian Ocean and the western Atlantic (Cressey, 1968). According to Cressey (1968), *P. cranchii* reported by Hewitt (1967) from the shortfin mako of New Zealand is a misidentification and should be synonymized with the present species. In Japan *P. satyrus* is so far known from three species of sharks: the blue shark (*P. glauca*) (Yamaguti, 1936b; Shiino, 1954b), smooth hammerhead [*Sphyrna zygaena* (Linnaeus)] (Shiino, 1954b), and an unspecified shark (Shiino, 1960a).

Pennella filosa (Linnaeus) (Pennellidae) - inserted into the isthmus of the Indo-Pacific blue marlin (*M. mazara*) and by the anal fin of the shortbill spearfish (*Tetrapturus angustirostris* Tanaka).

So far as we are aware, no copepod parasite has been reported from the shortbill spearfish. As to the Indo-Pacific blue marlin, only two species of *Gloiopotes* have been reported. Kabata (1979) claimed that the hosts of *P. filosa* comprises tunas (*Thunnus*) and sunfishes (*Mola*), but it is also known to occur on the Indo-Pacific sailfish (*I. platypterus*) (Causey, 1960) and swordfish (*Xiphias gladius* Linnaeus) (Brian, 1906; Wilson, 1917; Delamare-Deboutville, 1954; Kabata, 1988).

The specimens of parasitic copepods have been deposited in the National Science Museum, Tokyo. Their catalogue numbers are: NSMT-Cr 13640 for *Gloiopotes huttoni* and NSMT-Cr 13641 for *Pennella filosa* from *Makaira mazara*; NSMT-Cr 13642 for *G. huttoni* from *Tetrapturus audax*; NSMT-Cr 13643 for *P. filosa* from *T. angustirostris*; NSMT-Cr 13644 for *Gloiopotes huttoni* from *Istiophorus platypterus*; NSMT-Cr 13645 for *G. hygomianus* from *Acanthocybium solandri*; NSMT-Cr 13646 for *C. coryphaenae* from *Thunnus albacares*; and

NSMT-Cr 13647 for *Anthosoma crassum* and NSMT-Cr 13648 for *Pandarus satyrus* from *Isurus oxyrinchus*. The female *Caligus coryphaenae* obtained from *Acanthocybium solandri* was not deposited because it was dissected for close study.

Discussion

Based on the notes given above under each species of parasitic Copepoda it is apparent that the occurrence of those six species of copepod parasites on their respective hosts are all new to Japan, except for the records of *A. crassum* from the shortfin mako (*I. oxyrinchus*) and *G. huttoni* from the Indo-Pacific blue marlin (*M. mazara*) and the striped marlin (*T. audax*). However, inasmuch as no copepod parasite is known from the Indo-Pacific sailfish (*I. platypterus*) of Japan, the finding of *G. huttoni* in Dr. Nakamura's collections still makes the new record for Japan.

The seven species of gamefishes dealt with in this report are widely distributed in the tropical and subtropical waters of the world. Therefore, it is not surprising to find several species of copepod parasites occurring them from various parts of the world. Consequently, most of the parasites new to the hosts caught in Japan are already known from the same host taken in the other parts of the world. Nevertheless, it is interesting to note that the present new record for Japan also sets a new record for the Indo-Pacific blue marlin (*M. mazara*) in the world. So far, only two species of copepod parasites are known to occur on this species of billfish, *G. huttoni* from Taiwan (Ho, 1966) and India (Pillai, 1985), in addition to Japan (Shiino, 1957), and *G. watsoni* Kirtisinghe from India (Pillai, 1985). Thus, the finding of *P. filosa* on *M. mazara* is a new discovery for that host in the world.

Also, the discovery of *P. filosa* on the shortbill spearfish (*T. angustirostris*) of Japan sets the first record of the copepod parasite for this species of billfish. So far, no copepod parasite has been reported from *T. angustirostris*, even though it is known as a highly migratory species living in both Pacific and Indian Oceans. This is an indication that how little we know about the copepod parasites of the fishes of the world.

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References

- Brian, A. G. G. 1906: Copepoda parassiti dei pesci d'Italia. Genova, 191 pp., 21 pls.
- Boxshall, G. A., and M. A. Montu. 1997: Copepods parasitic on Brazilian coastal fishes; a handbook. *Nauplius*, 5: 1-225.
- Causey, D. 1960: Parasitic Copepoda from Mexican coastal fishes. *Bulletin of Marine Science of the Gulf and Caribbean*, 10: 323-337.
- Cressey, R. F. 1967: Genus *Gloioptotes* and a new species with notes on host specificity and intraspecific variation (Copepoda; Caligoida). *Proceedings of the United States National Museum*, 122 (3688): 1-21.
- Cressey, R. F., and H. B. Cressey. 1980: Parasitic copepods of mackerel- and tuna-like fishes (Scombridae) of the world. *Smithsonian Contributions to Zoology*, 311: 1-186.
- Delamare-Deboutteville, C., and L. Nunes-Ruivo. 1954: Copepodes parasites des poissons mediterraneens. *Vie et Milieu*, 4: 203-218.
- Hewitt, G. C. 1967: Some New Zealand parasitic Copepoda of the family Pandaridae. *New Zealand Journal of Marine and Freshwater Research*, 1: 180-264.
- Hewitt, G. C. 1968: Some New Zealand parasitic Copepoda of the family Anthosomidae. *Zoological Publications of Victoria University, Wellington*, 47: 1-31.
- Ho, J.-S. 1963: On five species of Formosan parasitic copepods belonging to the suborder Caligoida. *Crustaceana*, 5: 81-98.
- Humes, A. G., and R. U. Gooding. 1964: A method for studying the external anatomy of copepods. *Crustaceana*, 6: 238-240.
- Kabata, Z. 1979: Parasitic Copepoda of British fishes. Ray Society, London. 468 pp., 199 pls.
- Kabata, Z. 1988: Copepoda and Branchiura. In: L. Margolis and Z. Kabata eds. Guide to the parasites of fishes of Canada. Part II - Crustacea," Canadian Special Publication of Fisheries and Aquatic Sciences 101, 184 pp.
- Lewis, A. G. 1967: Copepod crustaceans parasitic on teleost fishes of the Hawaiian Islands. *Proceeding of the United States National Museum*, 121 (3574): 1-204.
- Lewis, A. G., J. Dean, and E. Gilfillan III. 1969: Taxonomy and host associations of some parasitic copepods (Crustacea) from pelagic teleost fishes. *Pacific Science*, 23: 414-437.
- Montu, M. A. 1996: Records of parasitic copepods of sharks from the southwestern Atlantic. *Nauplius*, 4: 179-180.
- Nunes-Ruivo, L. 1956: Copepodes parasites des peixes dos mares de Angola. *Anais da Junta de Investig. do Ultramar.*, 9: 8-44.
- Pillai, K. N. 1985: Fauna of India: Parasitic copepods of marine fishes. Calcutta: Technical and General Press, pp. 1-900.
- Shiino, S. M. 1954a: Copepods parasitic on Japanese fishes. 4. The family Euryphoridae. *Report of*

- the Faculty of Fisheries, Prefectural University of Mie*, **1**: 273-290.
- Shiino, S. M. 1954b: Copepods parasitic on Japanese fishes. 5. Five species of the family Pandaridae. *Report of the Faculty of Fisheries, Prefectural University of Mie*, **3**: 291-332.
- Shiino, S. M. 1955: Copepods parasitic on Japanese fishes. 8. The Anthosomidae. *Report of Faculty of Fisheries, Prefectural University of Mie*, **2**: 50-69.
- Shiino, S. M. 1956: Copepods parasitic on Japanese fishes. 12. Family Lernaepodidae. *Report of Faculty of Fisheries, Prefectural University of Mie*, **2**: 269-311.
- Shiino, S. M. 1957: Copepods parasitic on Japanese fishes. 13. Parasitic copepods collected off Kesennuma, Miyagi Prefecture. *Report of the Faculty of Fisheries, Prefectural University of Mie*, **2**: 359-376.
- Shiino, S. M. 1958: Parasitic copepods from fishes collected in the Indian Ocean. *Report of Faculty of Fisheries, Prefectural University of Mie*, **2**: 98-119.
- Shiino, S. M. 1960a: Copepods parasitic on the fishes collected on the coast of Province Shima, Japan. *Report of Faculty of Fisheries, Prefectural University of Mie*, **3**: 471-500.
- Shiino, S. M. 1960b: Parasitic copepods of fishes from the eastern Pacific. *Report of Faculty of Fisheries, Prefectural University of Mie*, **3**: 527-541.
- Wilson, C. B. 1917: North American parasitic copepods belonging to the family Lernaepodidae, with a revision of the entire family. *Proceedings of the United States National Museum*, **53** (2914): 1-50.
- Yamaguti, S. 1936a: Parasitic copepods from fishes of Japan. Part 2. Caligoida I. Published by author, pp. 1-22.
- Yamaguti, S. 1936b: Parasitic copepods from fishes of Japan. Part 3, Caligoida II. Published by author, pp. 1-21.

大型表層性魚類からの寄生性カイアシ類の新記録

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摘 要

和歌山県勝浦沖で開催されたKatsuura Billfish Tournamentの際に漁獲された大型表層性魚類から、以下の寄生性カイアシ類6種を得たので、宿主名とともに報告する：ハナガタムシ *Anthosoma crassum* (Abildgaard) [宿主：アオザメ]、シイラジラミ *Caligus coryphaenae* Steenstrup & Lütken [宿主：カマスサワラ、キハダ]、カジキジラミ *Gloiopotes huttoni* (Thomson)(= *G. longicaudatus*)[宿主：クロカジキ、マカジキ、バショウカジキ]、カマスサワラジラミ (新称) *Gloiopotes hygomianus* Steenstrup & Lutken [宿主：カマスサワラ]、サメジラミ *Pandarus satyrus* Dana [宿主：アオザメ]、マグロヒジキムシ (新称) *Pennella filosa* (Linnaeus) [宿主：クロカジキ、フウライカジキ]。アオザメからのハナガタムシおよびクロカジキとマカジキからのカジキジラミを除いて、他種はすべてわが国における新宿主からの記録である。マグロヒジキムシは、今回、世界で初めてクロカジキとフウライカジキから記録された。

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