Gloiopotes huttoni (Copepoda: Caligidae) parasitic on black marlin, *Istiompax indica*, from southern Japan, with a review of the hosts and distribution of *G. huttoni*

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Abstract.—The caligid copepod *Gloiopotes huttoni* (Thomson, 1890) was collected from the body surface of a black marlin, *Istiompax indica* (Cuvier, 1832), in the western North Pacific Ocean off Yonaguni-jima Island, the Ryukyu Islands, southern Japan. This represents the first record of *G. huttoni* from *I. indica* in Japanese waters. This copepod is known to use almost exclusively billfishes as its hosts, but due to the past confused billfish taxonomy, the billfish hosts have been recorded using various scientific names, most of which have recently been relegated to junior synonyms. Thus, based on the current taxonomy of billfishes and the literature published between 1890 and 2019, this paper also reviews the hosts and distribution of *G. huttoni*. Five species of billfishes in two families [black marlin; striped marlin, *Kajikia audax* (Philippi, 1887); blue marlin, *Makaira nigricans* Lacépède, 1802; sailfish, *Istiophorus platypterus* (Shaw, 1792) in the Istiophoridae; and swordfish, *Xiphias gladius* Linnaeus, 1758 in the Xiphiidae] serve as hosts for *G. huttoni* in the Pacific and Indian oceans, but four non-billfish species [bigeye tuna, *Thunnus obesus* (Lowe, 1839); yellowfin tuna, *Thunnus albacares* (Bonnaterre, 1788); wahoo, *Acanthocybium solandri* (Cuvier, 1832); and blue shark, *Prionace glauca* (Linnaeus, 1758)] are regarded as accidental hosts.

Key words: fish parasite, copepod, caligid, billfishes, checklist, bibliography

Introduction

Billfishes (Istiophoridae and Xiphiidae) are important in commercial and recreational fisheries in tropical to temperate waters of the world (Nakamura, 1985; Collette et al., 2006). Five species of the family Istiophoridae and one species of the family Xiphiidae are known to occur in Japanese waters: striped marlin, *Kajikia audax* (Philippi, 1887); blue marlin, *Makaira nigricans* Lacépède, 1802; black marlin, *Istiompax indica* (Cuvier, 1832); sailfish, *Istiophorus platypterus* (Shaw, 1792); shortbill spearfish, *Tetrapturus angustirostris* Tanaka, 1915; and swordfish, *Xiphias gladius* Linnaeus, 1758 (Shimose, 2018).

During a study on the biology and fishery of billfishes in the western North Pacific off southern Japan (e.g., Shimose et al., 2006, 2008, 2009), we collected specimens of the caligid copepod *Gloiopotes huttoni* (Thomson, 1890) from a black marlin. The specimens are reported here as the first record of *G. huttoni* from black marlin in Japanese waters. *Gloiopotes huttoni* has been reported almost exclusively from billfishes caught in the oceans. However, the billfish taxonomy was so confused in the 20th century that different scientific names were used for most of the billfish species, which has made fish parasitologists use various scientific names in recording the billfish hosts. Based on the recent taxonomy of
billfishes (Collette et al., 2006; Froese & Pauly, 2019) and the literature published between 1890 and 2019, this paper also reviews the hosts and distribution of G. huttoni.

**Materials and Methods**

A large black marlin was commercially caught using bait trolling in the western North Pacific off Yonaguni-jima Island, the southern Ryukyu Islands, Okinawa Prefecture, Japan (Locality 20 in Fig. 2) and landed at Kubura Fishing Port of the island on 15 March 2004. The fish was measured for body size and body weight, and then examined by the naked eye for skin parasites. Two of the copepods found were collected, fixed, and later preserved in 70% ethanol. Subsequently, at the Aquaparasitology Laboratory, these copepods were identified, sexed, and measured for body length and greatest width. Voucher specimens of copepods have been deposited in the Crustacea collection of the National Museum of Nature and Science, Tsukuba, Ibaraki Prefecture, Japan (NSMT-Cr 26893). The scientific and common names of billfishes and other fishes mentioned in this paper follow Collette et al. (2006) and Froese & Pauly (2019).

**Results**

The black marlin examined was very large (ca. 315 cm in lower jaw-fork length, ca. 230 kg in body weight without the bill, caudal fin, gills, and viscera) and was found to be heavily infected by copepods on the skin of the anterior body. They were mostly found on the dorsal skin of the head and on the lateral skin immediately posterior to the operculum and the base of the pectoral fin. Two copepods sampled from the head skin consisted of one female and one male, both of which were purple when fresh. Due to limited time, the number of copepods was not counted.

**Female** (Fig. 1A): Body length (excluding setae on caudal rami) 9.1 mm; greatest width (at widest part of cephalothorax) 4.1 mm. Cephalothorax subcircular, longer than wide. Posterior sinuses deep. Dorsal surface of cephalothorax with rows of setules in anterolateral regions and spinules in central region. Fourth pedigerous somite small, with pair of dorsal plates covering anterior portion of genital complex. Genital complex longer than wide, with pair of posterolateral processes: each process bearing spatulate leg 5 ventrolaterally. Abdomen comprising two somites: second somite longer than first. Caudal ramus long and slender.

**Male** (Fig. 1B): Body length (excluding setae on caudal rami) 10.0 mm; greatest width (at widest part of cephalothorax) 3.6 mm. Cephalothorax suborbicular, narrower anteriorly, and longer than wide. Dorsal plates smaller than in female, covering anterolateral corners of genital complex. Genital complex oval without

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**Fig. 1. Gloiopotes huttoni, female (A) and male (B), dorsal view, NSMT-Cr 26893, from a black marlin, Istiompax indica, in the western North Pacific off Yonaguni-jima Island, southern Japan. Ethanol-preserved specimens. Scale bar: 2 mm.**
posterolateral processes present in female; leg 5 arising from posterolateral portion of genital complex. Abdomen with two somites. Caudal ramus long and slender.

Remarks. The copepod specimens collected in this study are identified as *G. huttoni*: they are in accordance with the descriptions of the species by Shiino (1954) from Japanese waters. Since the species has been well redescribed (Yamaguti, 1936, as *Gloiopotes* sp.; Shiino, 1954, as *G. longicaudatus*; Hewitt, 1964; Lewis, 1967; Cressey, 1967), it is not necessary to report here the detailed morphology of the specimens. While the congeneric species *Gloioptes hygomianus* Steenstrup & Lütken, 1861 is known to parasitize wahoo, *Acanthocybium solandri* (Cuvier, 1832), in Japanese waters (Ho & Nagasawa, 2001), the specimens collected are readily distinguished from *G. hygomianus* by the shape and size of the dorsal plates (see Shiino, 1954 for *G. huttoni*; Shiino, 1960; Ho & Lin, 2012; Dojiri & Ho, 2013 for *G. hygomianus*).

*Gloioptes huttoni* was originally described by Thomson (1890) as *Lepeophtheirus huttoni* using specimens from “a swordfish, *Histiophorus herschelii*” in New Zealand. However, Bassett-Smith (1899) placed *L. huttoni* in the genus *Gloioptes* based on material of *L. huttoni* sent to the author. A review of *G. huttoni* and its congeneric species was conducted by Hewitt (1964) and Cressey (1967). The latter author stated that the copepods below are identical as *G. huttoni*: *Gloioptes costatus* Wilson, 1917; *Caligus longicaudatus* Marukawa, 1927; *Gloioptes longicaudatus* (Marukawa, 1927); *Gloioptes* sp. Yamaguti, 1936; and *Gloioptes zeugopteri* Rao, 1951 (Cressey, 1967, see Table 1). Although the genus *Gloioptes* was previously included in the family Euryphoridae (e.g., Shiino, 1954; Lewis, 1967; Cressey, 1967), Dojiri & Ho (2013) have placed the genus in the family Caligidae. The genus consists of five valid species: *G. hygomianus* (type-species), *G. huttoni*, *G. ornatus* Wilson, 1905, *G. watsoni* Kirtisinghe, 1934, and *G. americanus* Cressey, 1967 (Cressey, 1967; Dojiri & Ho, 2013).

In Japan, *G. huttoni* was first described as *Caligus longicaudatus* by Marukawa (1927) in the Illustrated Encyclopedia of the Fauna of Japan. The same description was used in a revised version of the encyclopedia (Marukawa, 1947). Marukawa (1927, 1947) reported that two species of billfishes (*K. audax* and *X. glad-**

![Fig. 2. Collection localities (closed circles) of Gloioptes huttoni in the Pacific and Indian oceans based on the literature published between 1890 and 2019 and this paper. There is no record of the species in the Atlantic Ocean. Detailed information on the collection localities (1–40) is shown in Table 1.](image-url)
| Host | Collection locality | Reference |
|-----------------|---------------------|-----------|
| Makaira nigricans (blue marlin) | Makaira mazara WNP Japan off Kesennuma, Miyagi 24 Shiino (1957, reported as Gloiopotes longicaudatus) | Shiino (1957, reported as Gloiopotes longicaudatus) |
| Makaira mazara | Makaira mazara Japan off Katsuura, Wakayama 22 Ho & Nagasawa (2001) | Ho & Nagasawa (2001) |
| Makaira ampha | Makaira ampha CNP USA off Kona, Hawaii 28 Lewis (1967) | Lewis (1967) |
| Makaira mazara | Makaira mazara Taiwan Keelung 18 Ho (1966, reported as Gloiopotes longicaudatus) | Ho (1966, reported as Gloiopotes longicaudatus) |
| Makaira mazara | Makaira mazara WNP Japan off Kesennuma, Miyagi 24 Shiino (1957, reported as Gloiopotes longicaudatus) | Shiino (1957, reported as Gloiopotes longicaudatus) |
| Makaira mazara | Makaira mazara CNP USA off Kona, Hawaii 28 Lewis (1967) | Lewis (1967) |
| Makaira mazara | Makaira mazara Taiwan Keelung 18 Ho (1966, reported as Gloiopotes longicaudatus) | Ho (1966, reported as Gloiopotes longicaudatus) |
| Makaira mazara | Makaira mazara WNP Japan off Kesennuma, Miyagi 24 Shiino (1957, reported as Gloiopotes longicaudatus) | Shiino (1957, reported as Gloiopotes longicaudatus) |
| Makaira mazara | Makaira mazara CNP USA off Kona, Hawaii 28 Lewis (1967) | Lewis (1967) |
| Makaira mazara | Makaira mazara Taiwan Keelung 18 Ho (1966, reported as Gloiopotes longicaudatus) | Ho (1966, reported as Gloiopotes longicaudatus) |
| Istiompax indica (black marlin) | Istiompax indica WNP Korea Cheong Se Chi, East Sea (Sea of Japan) 27 Vinmathi Maran et al. (2015) | Vinmathi Maran et al. (2015) |
| Istiompax indica | Istiompax indica Japan off Yougani-jima Island, Okinawa 20 This paper | This paper |
| black marlin | black marlin ENP Mexico Socorro Island 33 Shiino (1963, reported as Gloiopotes longicaudatus) | Shiino (1963, reported as Gloiopotes longicaudatus) |
| Istiompax australis | Istiompax australis WSP Australia off Port Jackson, New South Wales 12 Heegaard (1962, reported as Gloiopotes longicaudatus) | Heegaard (1962, reported as Gloiopotes longicaudatus) |
| Istiompax australis | Istiompax australis Australia off Broughton Island, New South Wales 13 Heegaard (1962, reported as Gloiopotes longicaudatus) | Heegaard (1962, reported as Gloiopotes longicaudatus) |
| Makaira indica | Makaira indica Australia Queensland coastal waters 14 Speare (1994, reported as Gloiopotes longicaudatus, 1999) | Speare (1994, reported as Gloiopotes longicaudatus, 1999) |
| Makaira mazara | Makaira mazara New Zealand Bay of Islands 10 Hewitt (1964) | Hewitt (1964) |
| Histiophorus sp.*** | Histiophorus sp.*** IO India Chennai (reported as Madras) 5 Bassett-Smith (1899), Hewitt (1964) | Bassett-Smith (1899), Hewitt (1964) |
| Istiompax indica | Istiompax indica India Andaman and Nicobar waters 8 Nishtar et al. (2018) | Nishtar et al. (2018) |
| Makaira mazara | Makaira mazara — 7°10′S, 72°20′E 1 Shiino (1959, reported as Gloiopotes longicaudatus) | Shiino (1959, reported as Gloiopotes longicaudatus) |

Table 1. Known hosts and collection localities of Gloiopotes huttoni based on the literature published between 1890 and 2019 and the present study. The scientific and common names of billfishes and other fishes follow Collette et al. (2006) and Froese & Pauly (2019). The oceans are divided into the western North Pacific (WNP), the central North Pacific (CNP), the eastern North Pacific (ENP), the western South Pacific (WSP), the eastern South Pacific (ESP), and the Indian Ocean (IO).
| Host | Collection locality | Ocean | Country or region | Site | No. in Fig. 2 | Reference |
|------|---------------------|-------|-------------------|------|---------------|-----------|
| Makoira indicus | — | — | — | — | — | Cressey (1967) |
| Istiophorus platypterus (sailfish) | WNP | Japan | off Katsurara, Wakayama | 22 | Ho & Nagasawa (2001) |
| Istiophorus platypterus | — | Taiwan | Nanfangao Fishing Port | 19 | Ho (1963, reported as Gloiopotes longicaudatus) |
| Istiophorus orientalis | ENP | Panama | Panama Bay | 37 | Wilson (1937, reported as Gloiopotes costatus) |
| Istiophorus greyi | Mexico | Guaymas, Sonora | 30 | Cauney (1960, reported as Gloiopotes costatus) |
| Istiophorus greyi | Mexico | Mazatlán, Sinaloa | 31 | Cauney (1960, reported as Gloiopotes costatus) |
| Istiophorus platypterus | WNP | Japan | off Katsurara, Wakayama | 22 | Ho & Nagasawa (2001) |
| Istiophorus orientalis | — | Taiwan | Nanfangao Fishing Port | 19 | Ho (1963, reported as Gloiopotes longicaudatus) |
| Xiphias gladius (swordfish) | WNP | Japan | off Kamaishi, Iwate | 25 | Ho & Kim (1996) |
| Xiphias gladius swordfish | ENP | USA | Catalina Island, California | 29 | Wilson (1939, reported as Gloiopotes costatus) |
| Xiphias gladius | Peru | Marcona | 38 | Shimo (1963, reported as Gloiopotes longicaudatus) |
| Xiphias zeugopteri | IO | India | Lawson’s Bay | 6 | Rao (1951, reported as Gloiopotes zeugopteri)** |
| Xiphias gladius | India | off Parangipettai | 4 | Rajan et al. (2018) |
| Makaira ampha? | CNP | USA | Hawaiian region | 28 | Lewis (1967) |
| Makaira ampha? or Istiompax marlina | — | USA | Honolulu Fish Market | 28 | Lewis (1967) |
| Makaira sp. marlin | ENP | Mexico | Acapulco, Guerrero | 32 | Cauney (1960, reported as Gloiopotes costatus) |
| Makaira sp. swordfish or marlin | — | Costa Rica | off Cape Velas | 36 | Shimo (1963, reported as Gloiopotes longicaudatus) |
| Makaira sp. swordfish | — | Peru | Marcona | 35 | Shimo (1963, reported as Gloiopotes longicaudatus) |
| Histiophorus herculesii | WSP | New Zealand | — | — | Cressey (1967) |
| Thunnus obesus (bigeye tuna) | WNP | Japan | off Cape Hōzaki, Shizuoka | 24 | Shimo (1954, reported as Gloiopotes longicaudatus) |
| Parathynus sibi | ENP & ESP | 5° N–11° S, 103°–115° W | 31 | Yoshihara & Nagasaki (1973, reported as Gloiopotes longicaudatus) |
| Thunnus albacares (yellowfin tuna) | ENP & ESP | 5° N–11° S, 103°–115° W | 31 | Yoshihara & Nagasaki (1973, reported as Gloiopotes longicaudatus) |
| Acanthocybium solandri (wahoo) | WNP | Taiwan | Cheng-Gong Fishing Port | 17 | Ho & Lin (2012) |
| Acanthocybium solandri | — | — | — | — | — |
| Prionace glauca (blue shark) | Galus glaucus | — | — | — | Shiino (1959, reported as Gloiopotes longicaudatus) |
| — | WNP | Palau | Palau Island | 16 | Shiino (1954, reported as Gloiopotes longicaudatus) |
| — | — | Japan | Sado Island, Sea of Japan | 26 | Homma & Krami (1979, as Gloiopotes longicaudatus) |
| — | — | — | — | — | Shiino (1959, reported as Gloiopotes longicaudatus) |

* Not reported.
** Rajan et al. (2018) suggested that G. zagopteri described by Rao (1951) is not G. huttoni but G. watsoni.
*** Hewitt (1964) reported this fish as “Histiophorus brevirostris”, which is currently regarded as Istiompax indica (see the Discussion section).
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ius) from unknown localities harbored *G. huttoni* on their body surface. Subsequently, the copepod has been reported from the western North Pacific off Iwate, Miyagi, Shizuoka, Wakayama, and Okinawa prefectures (Shiino, 1954, 1957; Ho & Kim, 1996; Ho & Nagasawa, 2001; this paper) and also from the southern Sea of Japan off Niigata Prefecture (Honma & Kitami, 1979) (Table 1, Fig. 2). Shiino (1965b) briefly reported the morphology, host range, geographical distribution of *G. huttoni* (as *G. longicaudatus*) in an encyclopedia of the Japanese fauna.

The hosts previously reported from Japan are four species of billfishes (striped marlin, blue marlin, sailfish, swordfish) and one species of scombrid [bigeye tuna, *Thunnus obesus* (Lowe, 1839), as *Parathynnus sibi* by Shiino (1954)] (Table 1). The black marlin, from which we collected *G. huttoni* in this study, is added here as the fifth billfish host of the parasite in Japanese waters.

In the western North Pacific and adjacent seas, *G. huttoni* has been reported from Indonesia (Yamaguti, 1936), Palau (Shiino, 1954), Taiwan (Ho, 1963, 1966; Ho & Lin, 2012), and Korea (Venmathi Maran *et al.*, 2015) as well (Table 1, Fig. 2). The black marlin, from which we collected *G. huttoni* in this study, is added here as the fifth billfish host of the parasite in Japanese waters.

As shown in Table 1, there are many records of *G. huttoni* from the Indo-Pacific billfishes, which apparently demonstrates that the parasite is specific to the billfishes in the Pacific and Indian oceans. The known billfish hosts are five species in two families: striped marlin, blue marlin, black marlin, sailfish (Istiophoridae), and swordfish (Xiphiidae). To date, there has been no record of *G. huttoni* from shortbill spearfish from these oceans.

The absence of record of *G. huttoni* from the Atlantic Ocean. The copepod occurs only in the Indo-Pacific region.

The northernmost and southernmost limits of the occurrence of *G. huttoni* are off Kamaishi, Japan (39°16′12″N, 141°53′14″E, Locality 25 in Fig. 2) and Batemans Bay, Australia (35°42′52″S, 150°12′19″E, Locality 11 in Fig. 2) in the Northern and Southern hemispheres, respectively (Ho & Kim, 1996; Heegaard, 1962). Thus, the species is expected to have a vast distributional range in tropical to temperate waters of the Indo-Pacific region, which corresponds to the ocean distribution of billfishes.

**Discussion**

As shown in Table 1, there are many records of *G. huttoni* from the Indo-Pacific billfishes, which apparently demonstrates that the parasite is specific to the billfishes in the Pacific and Indian oceans. The known billfish hosts are five species in two families: striped marlin, blue marlin, black marlin, sailfish (Istiophoridae), and swordfish (Xiphiidae). To date, there has been no record of *G. huttoni* from shortbill spearfish from these oceans.

Thomson (1890) originally described *G. hut-
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Ton as Lepeophtheirus huttoni from “a swordfish, Histiothorpus herschelii” collected off New Zealand. Thus, the type host of the copepod is regarded as the “swordfish, Histiothorpus herschelii”. However, based on the current taxonomy of billfishes (Collette et al., 2006; Froese & Pauly, 2019), these names correspond to two species in different families: Xiphius gladius (Xiphidae) and blue marlin, Makaira nigricans (Istiophoridae), respectively. It is, therefore, impossible to designate one of these species as the type host of G. huttoni.

Bassett-Smith (1899) reported G. huttoni from Histiophorus sp. from Chennai (as Madras), India. Later, this billfish was called by Hewitt (1964) as “Histiophorus brevirostris”, although no explanation was given about the reason why he used H. brevirostris. This scientific name has currently been treated as a junior synonym of black marlin, Istiompax indica, which is adopted in this paper (Table 1).

The status of swordfish as the host of G. huttoni has not been well understood (Cressey, 1967: 10), but the fish species is here considered one of the important hosts for the parasite, which has been collected in the Pacific and Indian oceans (Table 1).

Gloioptes huttoni has also been reported from four non-billfish species: bigeye tuna, T. obesus (Shiino, 1954); yellowfin tuna, Thunnus albacares (Bonnaterre, 1788) (Yoshihara & Nagasaki, 1973); wahoo, Acanthocybium solandri (Cuvier, 1832) (Ho & Lin, 2012) (all Scombridae); and blue shark, Prionace glauca (Linnaeus, 1758) (reported as “Galeus glaucus”: Shiino, 1959) (Carcharhinidae). Like billfishes, these four species are oceanic inhabitants, but they cannot be regarded as important hosts for G. huttoni because the blue shark is an elasmobranch which is phylogenetically separated from the billfishes and there is only one record of the parasite each from the three scombrid fishes. Moreover, while Cressey & Cressey (1980) and Zischke et al. (2012) intensively examined the parasitic copepods of scombrids including tunas (Thunnus spp.) from the world and the metazoan parasites of wahoo from the Pacific and Indian oceans, respectively, these authors did not report any occurrence of G. huttoni from their fish samples, which suggests that the copepod is not a parasite of tunas and wahoo. In other words, the infected individuals of bigeye tuna (Shiino, 1954), yellowfin tuna (Yoshihara & Nagasaki, 1973), and wahoo (Ho & Lin, 2012) most probably acquired an accidental infection of G. huttoni.

It is interesting to note that, while the wahoo is not an important host for G. huttoni in the Pacific and Indian oceans, this fish species gets infected by a different species G. hygomianus in the Pacific, Indian, and Atlantic oceans (Shiino, 1960; Lewis, 1967; Cressey, 1967; Cressey & Cressey, 1980; Pillai, 1985; Ho & Nagasawa, 2001; Ho & Lin, 2012).

The previous studies on G. huttoni infecting Japanese billfishes have focused on its taxonomy, thus, no information is available on its prevalence and intensity on these fishes. In our sampling area off Yonaguni-jima Island, four species of billfishes (blue marlin, black marlin, striped marlin, and sailfish) are commercially caught with their catches accounting for 93.3, 6.4, 0.2, and 0.1%, respectively, in 2003–2006, and the black marlin prefers more coastal or shallower waters than the blue marlin (Shimose et al., 2008). For understanding the host utilization of G. huttoni, it is desirable to investigate its occurrence on the four billfish species in coastal and offshore waters around the island.

Acknowledgements

We thank the staff of the Pacific Bluefin Tuna Biology Group at the National Research Institute of Far Seas Fisheries for their cooperation during the study. We are grateful to B. A. Venmathi Maran of the Borneo Marine Research Institute, University of Malaysia Sabah, for providing information on the Korean locality.
We also acknowledge an anonymous reviewer and the editor for their valuable comments on the manuscript of this paper. Part of this work was financially supported by the Fisheries Agency, the Ministry of Agriculture, Forestry and Fisheries of Japan.

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