Northward range extension of the cymothoid isopod *Ceratothoa oxyrrhynchaena*, a buccal cavity parasite of marine demersal fishes, in Japan

Kazuya Nagasawa[1,2] and Masafumi Kodama[3]

[1]Graduate School of Integrated Sciences for Life, Hiroshima University,
1–4–4 Kagamiyama, Higashi-Hiroshima, Hiroshima 739–8528, Japan

[2]Aquaparasitology Laboratory, 365–61 Kusanagi, Shizuoka 424–0886, Japan

[3]International Coastal Research Center, Atmosphere and Ocean Research Institute, The University of Tokyo,
1–19–8 Akahama, Otsuchi, Iwate 028–1102, Japan

Abstract

A pair of a gravid female and a male of *Ceratothoa oxyrrhynchaena* Koelbel, 1878 (Isopoda: Cymothoidae) were collected from the buccal cavity of a blackthroat seaperch, *Doederleinia berycoides* (Hilgendorf, 1879) (Perciformes: Acropomatidae), in the western North Pacific Ocean off Kinkasan Island, Miyagi Prefecture, northeastern Japan. This expands the geographical distribution range of *C. oxyrrhynchaena* from off Onahama (ca. 37°N), Fukushima Prefecture, northward to off Kinkasan Island (38°17′N) and represents the first record of the species from the southern subarctic waters. Based on the previous and present records of *C. oxyrrhynchaena* from Japan, the species is suggested to occur in a wide area ranging from the subtropical through temperate to southern subarctic waters.

Introduction

The cymothoid isopod *Ceratothoa oxyrrhynchaena* Koelbel, 1878 is a buccal cavity parasite of marine demersal fishes in the Northern and Southern Hemispheres. The species was originally described using material from Japan (Koelbel, 1878) and has since been reported from the Mediterranean Sea (Italy, France, Tunisia, Algeria, Croatia, Turkey, Lebanon), the northeast Atlantic Ocean (Mauritania), Gulf of Suez, and the Coral Sea (Australia) (see Horton, 2000; Bariche and Trilles, 2005; Martin et al., 2013, 2015; Öktener et al., 2018 for the literature). Three records exist of the species from China (Bruce, 1982; Yu and Li, 2003a, b), but Yamauchi (2009) stated that the cymothoid reported is different from *C. oxyrrhynchaena*.

Recently, *C. oxyrrhynchaena* has been regarded as the valid name of the species (Horton, 2000; Yamauchi, 2009; Martin et al., 2013, 2015; Hadfield et al., 2016). In Japan, due to confused taxonomy or misunderstanding of the scientific name of *C. oxyrrhynchaena*, various names were used in the past for the species, including *Ceratothoa oxyrrhynchæna* (Schioedte and Meinert, 1883), *Meinertia oxyrrhynchaena* (Thielemann, 1910; Nierstrasz, 1915; Gurjanova, 1936; Yamaguchi and Baba, 1993), *Meinertia oxyrhynchaena* (Komai, 1927; Iwasa, 1947), *Conodophilus oxyrhynchaenus* (Nierstrasz, 1931; Shiino, 1965; Saito et al., 2000; Tatsu, 2002), and *Codonophilum oxyrhynchaenus* (Nunomura, 2011). The species reported by Iwasa (1947) and Shiino (1965) has been suggested to differ from *C. oxyrrhynchaena* (Yamauchi, 2009).

Our knowledge of *C. oxyrrhynchaena* is still limited in Japan, especially its geographical distribution. To date, the species has been reported from western and central Japan, but no information is available on its occurrence in northern Japan. In July 2019, two individuals of crustacean parasite, which are herein reported as *C. oxyrrhynchaena*, were collected from the buccal cavity of a blackthroat seaperch, *Doederleinia berycoides* (Hilgendorf, 1879), caught in the western North Pacific off Kinkasan Island, Miyagi Prefecture, northeastern Japan. This expands the geographical distribution range of *C. oxyrrhynchaena* from off Onahama, Fukushima Prefecture (Yamauchi, 2009), northward to off Kinkasan Island. The latter locality is seasonally affected by a subarctic water current, the Oyashio, and the collection also represents the first record of *C. oxyrrhynchaena* from the southern subarctic waters.

Nature of Kagoshima 47: 21–25.
KN, e-mail: ornatus@hiroshima-u.ac.jp
Received: 26 May 2020; published online: 1 June 2020; http://journal.kagoshima-nature.org/archives/NK_047/047-004.pdf

Fig. 1. A blackthroat seaperch, *Doederleinia berycoides*, infected by *Ceratothoa oxyrrhynchaena* in the buccal cavity. Only a female isopod is seen in this picture. The fish was caught using bottom gillnets at about 120 m in depth in the western North Pacific Ocean off Kinkasan Island, Miyagi Prefecture, northeastern Japan, on 20 July 2019. The photograph was taken by Kaito Fukuda. Scale bar: 3 cm.

Materials and Methods

The specimens of *C. oxyrrhynchaena* were collected from the buccal cavity of the blackthroat seaperch (ca. 32 cm in total length) after the fish was landed at Ishinomaki Fishing Port, Miyagi Prefecture, on 20 July 2019. Demersal fishes including the infected one were commercially caught using bottom gillnets at about 120 m in depth about 1.8 km off the east coast of Kinkasan Island (38°17′23″N, 141°35′59″E) on the same day and immediately transported on ice to the port. The specimens of the isopod collected were deeply frozen and given to us for identification. The specimens were thawed and fixed in 85% ethanol at the laboratory of the International Coastal Research Center, Atmosphere and Ocean Research Institute, Otsuchi, Iwate Prefecture. Later, at the Aquaparasitology Laboratory, Shizuoka Prefecture, they were examined using an Olympus SZX10 stereo microscope and identified as *C. oxyrrhynchaena*. Drawings of pereopods 6–7 dissected from the female specimen were made with the aid of a drawing tube fitted on the stereo microscope. Voucher specimens of the isopod have been deposited in the Crustacea collection of the National Museum of Nature and Science, Tsukuba, Ibaraki Prefecture, Japan (NSMT-Cr 27471). The scientific and common names of fishes mentioned in this paper follow Froese and Pauly (2019).

Results

When the female of *C. oxyrrhynchaena* was discovered, it was recognized as a large strange white parasite occurring in the buccal cavity of the blackthroat seaperch (Fig. 1). It was firmly attached on the fish tongue with its cephalon being oriented anteriorly. The male of *C. oxyrrhynchaena* was found as a smaller white parasite, which was located in the posterior portion of the buccal cavity.

The female possessed the brood pouch which held many larvae (Fig. 2A), measuring 47.4 mm body length (BL) and 21.1 mm body width (BW) (2.2 times as long as greatest width). This female is characterized by a stout body (Fig. 2A, C), acute anterolateral projections on pereonite 1 (Fig. 2E), uropods being shorter than the pleotelson (Fig. 2 F), and a large carina on the basis of pereopods 6–7, especially that on the basis of pereopod 7 (Fig. 3). The male (Fig. 2B, D) was much smaller than the female: the body is oblong, measuring 22.0 mm BL and 8.6 mm BW (2.6 times as long as wide).

Discussion

In Japan, *C. oxyrrhynchaena* has been collected from the western North Pacific Ocean, the East China Sea, and the Sea of Japan (Fig. 4). The known northern limit of distribution of the species is off Onahama, Fukushima Prefecture (locality 2 in Fig. 4, 36°59.6′–37°00.5′N, 141°17.4′–141°17.7′E, Yamauchi, 2009). In this study, *C. oxyrrhynchaena* was collected off Kinkasan Island, Miyagi Prefecture (locality 1 in Fig. 4), which represents a new northernmost locality record for the species in Japan.

Based on the previous records of *C. oxyrrhynchaena* from Japan, Nagasawa (2020a) suggested that the species occurs in the subtropical and temperate waters of Japan. However, the present collection locality is seasonally affected by a subarctic cold current, the Oyashio, which indicates that the species occurs in a wider area than previously suggested, ranging from the subtropical through temperate to southern subarctic waters of Japan. This wide distribution range of *C. oxyrrhynchaena* is caused by the fact that the species parasitizes demersal fishes (see below), whose habitats are not strongly affected by shallow water temperatures.

Ceratothoa oxyrrhynchaena is not a host-specific parasite. In Japan, the species has been found from seven species of demersal fishes in five families of three orders: blackthroat seaperch (Perciformes: Acropomatidae) (Yamauchi, 2009; Yamauchi and Nunomu-

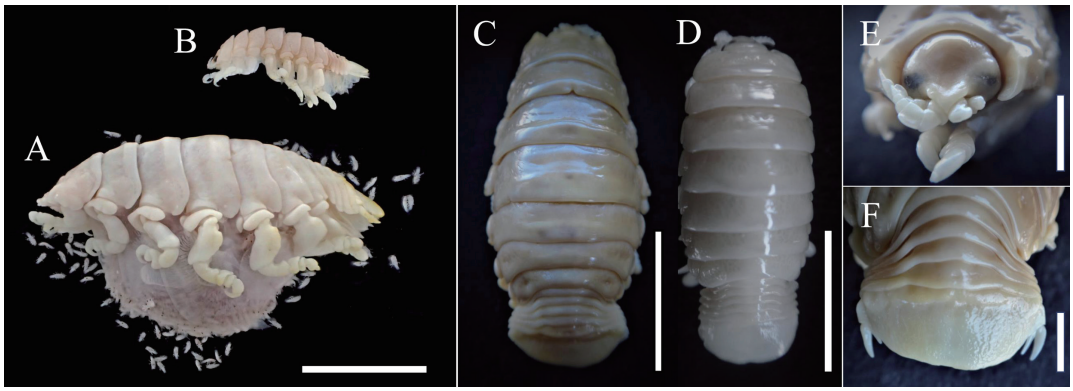

Fig. 2. *Ceratothoa oxyrrhynchaena*, female (A, C, E, F) and male (B, D), NSMT-Cr 27471. Some larvae from the brood pouch of the female are found (A). Frozen-thawed (A, B) and ethanol-preserved (C–F) and specimens, lateral (A, B), dorsal (C, D), anterior (E), and posterior (F) views. Scale bars: A, B, C, 20 mm; D, 10 mm; E, F, 5 mm.

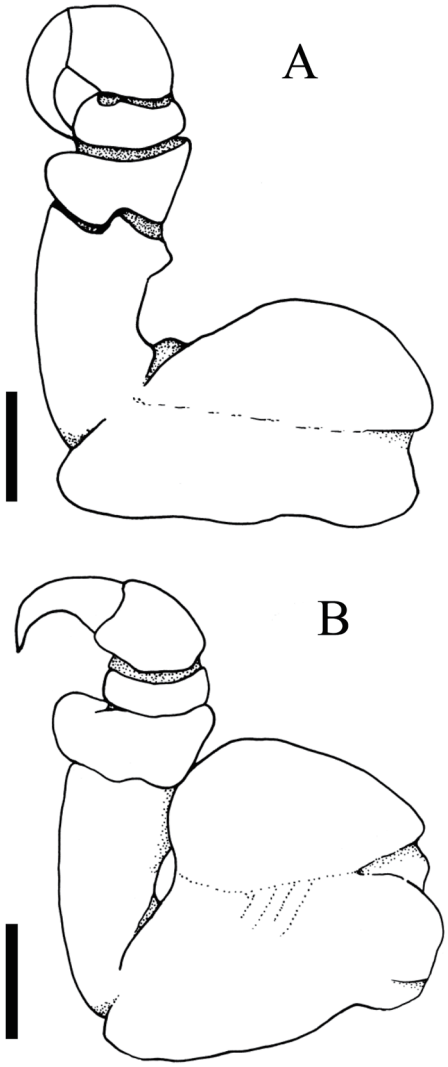

Fig. 3. *Ceratothoa oxyrrhynchaena*, female, NSMT-Cr 27471. A, pereopod 6; B, pereopod 7. Scale bars: A, B, 20 mm.

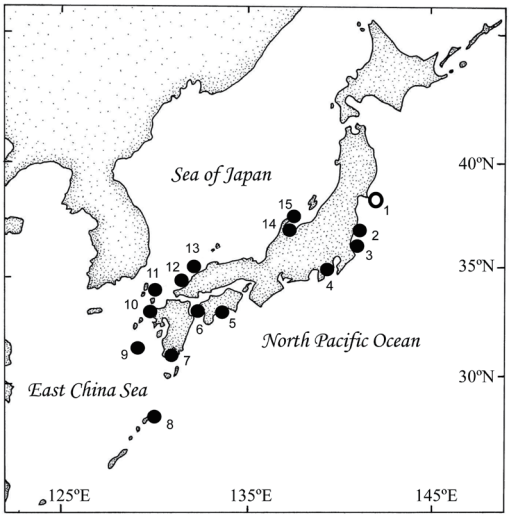

Fig. 4. Map of the Japanese Archipelago, showing the collection localities of *Ceratothoa oxyrrhynchaena* in the previous (closed circles) and present (open circle) studies. 1, off Kinkasan Island, Miyagi Prefecture (this paper); 2, off Onahama, Fukushima Prefecture (Yamauchi, 2009); 3. Kashima-nada Sea off Ibaraki Prefecture (Nagasawa et al., 2020); 4, Sagami Bay, Kanagawa Prefecture (Thielemann, 1910; Nunomura, 2006; Hata et al., 2017); 5, Tosa Bay, Kochi Prefecture (Nagasawa, 2020a); 6, off Ehime Prefecture (Hata et al., 2017); 7, Kagoshima Bay, Kagoshima Prefecture (Hata et al., 2017); 8, off Amami Island, Kagoshima Prefecture (Hata et al., 2017); 9, East China Sea (Hata et al., 2017); 10, off Nagasaki Prefecture (Yamauchi and Kashio, 2018); 11. off the Tsushima Islands, Nagasaki Prefecture (Nagasawa, 2020b); 12, off Yamaguchi Prefecture (Okamoto, 2011); 13, off Shimane Prefecture (Yamauchi and Kashio, 2018); 14, Toyama Bay, Toyama Prefecture (Yamauchi and Nunomura, 2010); 15, off Uchiura, Ishikawa Prefecture (Tatsu, 2002).

ra, 2010; Okamoto, 2011; Nunomura, 2011; Hata et al., 2017; Yamauchi and Kashio, 2018; Nagasawa et al., 2020; this paper); yellowback sea-bream, *Dentex hypselosomus* Bleeker, 1854 (Perciformes: Sparidae)

(Hata et al., 2017; Yamauchi and Kashio, 2018; Nagasawa, 2020a, b); yellowfin sea bream, *Dentex abei* Iwatsuki, Akazaki and Taniguchi, 2007 (Perciformes: Sparidae) (Hata et al., 2017); royal escolar, *Rexea prometheoides* (Bleeker, 1856) (Perciformes: Gempylidae) (Hata et al., 2017); ara, *Niphon spinosus* Cuvier, 1828 (Perciformes: Serranidae) (Hata et al., 2017); deep-sea smelt, *Glossanodon semifasciatus* (Kishinouye, 1904) (Osmeriformes: Argentinidae) (Hata et al., 2017); and Aome-eso, *Chlorophthalmus albatrossis* Jordan and Starks, 1904 (Aulopiformes: Chlorophthalmidae) (Hata et al., 2017). Among these hosts, blackthroat seaperch and yellowback sea-bream are commercially important in various regions of Japan and have often been reported to harbor the isopod. In particular, blackthroat seaperch are caught as far north as the subarctic waters off Aomori Prefecture and Hokkaido, northeastern Japan (Yamada et al., 2007). It is thus desirable to examine those fish in order to clarify the geographical distribution of *C. oxyrrhynchaena* in Japanese waters.

There is no record of *C. oxyrrhynchaena* from Korea (Kwon, 2012). However, the species has been reported from western Japan near Korea (localities 10–13 in Fig. 4), and blackthroat seaperch are commercially captured off southern Korea (Huh et al., 2011; Choi et al., 2012), which implies that *C. oxyrrhynchaena* occurs in Korean waters as well.

Acknowledgments

We thank Kaito Fukuda of the FUKUDA MARINE RESEARCH DIVING, Ishinomaki, for his various helps during the study, including taking a photograph used in this paper and arrangements of the specimens for us. We are also grateful to Seiji Abe, the captain of the fishing vessel *Eiryo Maru*, for providing us with information on the infected fish.

References

Bariche, M. and Trilles, J. P. 2005. Preliminary check-list of cymothoids (Crustacea: Isopoda) parasitic on marine fishes from Lebanon. Zoology in the Middle East, 34: 53–60.

Bruce, N. L. 1982. On a small collection of marine Isopoda (Crustacea) from Hong Kong. Pp. 315–324 in Morton, B. S. and Tseng, C. K. (eds.) Proceedings of the First International Marine Biological Workshop: The Marine Flora and Fauna of Hong Kong and Southern China, Hong Kong, 1980. Hong Kong University Press, Hong Kong.

Choi, J. H., Choi, S. H., Kim, Y.-H., Lee, D. W. and Ryu, D. K. 2012. Age and growth of blackthroat seaperch *Doederleinia berycoides* in the south sea of Korea. Korean Journal of Fisheries and Aquatic Sciences, 45: 246–252. (In Korean with English abstract).

Froese, R. and Pauly, D. (eds.) 2019. FishBase. World Wide Web electronic publication. www.fishbase.org, version (12/2019). Accessed 8 March 2020.

Gurjanova, E. F. 1936. Isopodes des Mers Orientales. Institut Zoologique de l'Academie des Sciences de l'URRS, Nouvelle Série 6, Crustacées, 7(3): i–xii, 1–278. (In Russian with German abstract).

Hadfield, K. A., Bruce, N. L. and Smith, N. J. 2016. Redescription of poorly known species of *Ceratothoa* Dana, 1852 (Crustacea, Isopoda, Cymothoidae), based on original type material. ZooKeys, 592: 39–91.

Hata, H., Sogabe, A., Tada, S., Nishimoto, R., Nakano, R., Kohya, N., Takeshima, H. and Kawanishi, R. 2017. Molecular phylogeny of obligate fish parasites of the family Cymothoidae (Isopoda, Crustacea): evolution of the attachment mode to host fish and the habitat shift from saline water to freshwater. Marine Biology, 164: 105. DOI 10.1007/s00227-017-3138-5

Horton, T. 2000. *Ceratothoa steindachneri* (Isopoda: Cymothoidae) new to British waters with a key to north-east Atlantic and Mediterranean Ceratothoa. Journal of the Marine Biological Association of the United Kingdom, 80: 1041–1052.

Huh, S.-H., Oh, H. S., Park, J. M. and Baeck, G. W. 2011. Feeding habits of the blackthroat seaperch *Doederleinia berycoides* in the southern sea of Korea. Korean Journal of Fisheries and Aquatic Sciences, 44: 284–289. (In Korean with English abstract).

Iwasa, M. 1947. *Meinertia oxyrhynchaena* (Koelbel). P. 816 and fig. 2351 in Uchida, S. (ed.) Revised and Enlarged Illustrated Encyclopedia of the Fauna of Japan. Hokuryukan, Tokyo. (In Japanese).

Koelbel, C. 1878. Über einige neue Cymothoiden. Sitzungsberichte der Mathematisch-Naturwissenschaftlichen Klasse der Kaiserlichen Akademie der Wissenschaften, 78: 401–416.

Komai, T. 1927. *Meinertia oxyrhynchaena* Koelbel. P. 1148 and fig. 2215 in Uchida, S. (ed.) Illustrated Encyclopedia of the Fauna of Japan. Hokuryukan, Tokyo. (In Japanese).

Kwon, D.-H. 2012. Invertebrate fauna of Korea. Vol. 21, Number 13. Isopods I. National Institute of Biological Resources, Incheon. 93 pp.

Martin, M. B., Bruce, N. L. and Nowak, B. F. 2013. Redescription of *Ceratothoa carinata* (Bianconi, 1869) and *Ceratothoa oxyrrhynchaena* Koelbel, 1878 (Crustacea: Isopoda: Cymothoidae), buccal-attaching fish parasites new to Australia. Zootaxa, 3683: 395–410.

Martin, M. B., Bruce, N. L. and Nowak, B. F. 2015. Review of the fish-parasitic genus *Ceratothoa* Dana, 1852 (Crustacea: Isopoda: Cymothoidae) from Australia, with description of two new species. Zootaxa, 3963: 251–294.

Nagasawa, K. 2020a. *Ceratothoa oxyrrhynchaena* (Isopoda: Cymothoidae) parasitic on yellowback sea-bream, *Dentex hypselosomus*, from Tosa Bay, western Japan, with a summary of the biology of the isopod in Japan. Nature of Kagoshima, 46: 329–334. (In Japanese with English abstract).

Nagasawa, K. 2020b. Body length variation in the marine fish ectoparasite *Ceratothoa oxyrrhynchaena* (Isopoda: Cymothoidae) in relation to host body size. Crustacean Research, 49: 57–60.

Nagasawa, K., Kurihara, M. and Uematsu, Y. 2020. The cymothoid isopod *Ceratothoa oxyrrhynchaena* parasitic on blackthroat seaperch, *Doederleinia berycoides*, from Pacific waters off Ibaraki Prefecture, central Japan. Nature of Kagoshima, 46: 531–534. (In Japanese with English abstract).

Nierstrasz, H. E. 1915. Die Isopoden-Sammlung im Naturhistorischen Reichsmuseum zu Leiden – I. Cymothoidae. Zoologische Mededelingen (Leiden), 1: 71–108, 2 pls.

Nierstrasz, H. E. 1931. Isopoda genuina. II. Flabellifera. Pp. 123–233 and 2 pls. in Weber, M. and De Beaufort, L. F. (eds.) Die Isopoden der Siboga-Expedition. Siboga Expeditie, 32c. E. J. Brill, Leiden.

Nunomura, N. 2006. Marine isopod crustaceans in the Sagami Sea, central Japan. Memoirs of the National Science Museum, Tokyo, 41: 7–42.

Nunomura, N. 2011. Crustaceans No. 2 (Isopoda). Special Publication of the Toyama Science Museum, 24: 1–133. (In Japanese with English title).

Okamoto, M. 2011. The parasites of fishes and shellfishes caught in the south-western Sea of Japan off Shimane Prefecture. Report of Shimane Prefectural Fisheries Technology Center, 3: 55–68. (In Japanese with English abstract).

Öktener, A., Türker, D. and Alaş, A. 2018. First record of *Ceratothoa oxyrrhynchaena* (Isopoda: Cymothoidae) from Turkish marine waters. Annales: Series Historia Naturalis, 28: 7–14.

Saito, N., Itani, G. and Nunomura, N. 2000. A preliminary check list of isopod crustaceans in Japan. Bulletin of the Toyama Science Museum, 23: 11–107. (In Japanese with English abstract).

Schioedte, J. C. and Meinert, F. R. 1883. Symbolæ ad monographium Cymothoarum crustaceorum isopodum familæ. III. Saophridæ. IV. Ceratothoinæ. Naturhistorisk Tidsskrift, 13: 281–378.

Shiino, S. M. 1965. *Conodophilus oxyrhynchaenus* (Koelbel). P. 544 and unnumbered figure in Okada, Y., Uchida, S. and Uchida, T. (eds.) New Illustrated Encyclopedia of the Fauna of Japan. Part 2. Hokuryukan, Tokyo. (In Japanese).

Tatsu, K. 2002. Arthropoda specimens deposited in the Noto Marine Center, Ishikawa Prefecture. Report of the Noto Marine Center, 8: 39–46. (In Japanese with English title).

Thielemann, M. 1910. Beiträge zur Kenntnis der Naturgechichte Ostasiens. Herausgegeben von F. Doflein. Band II. No. 9. Beiträge zur Kenntnis der Isopodenfauna Ostasiens. Abhandlungen der Matemathetisch-Naturwissenschaftlichen Klasse der K. Bayer. Akademie der Wissenschaften (Suppl.-Bd.), 2: 1–109, 2 Taf.

Yamada, U., Tokimura, M., Horikawa, H. and Nakabo, T. 2007. Fishes and Fisheries of the East China and Yellow Seas. Tokai University Press, Hadano. lxxiv + 1262 pp. (In Japanese with English title).

Yamaguchi, T. and Baba, K. 1993. Crustacean specimens collected in Japan by Ph. F. von Siebold and H. Bürger and held by the Nationaal Natuurhistorisch Museum in Leiden and other museums. Pp. 145–535 in Yamaguchi, T. (ed.) Ph. F. von Siebold and Natural History of Japan: Crustacea. The Carcinological Society of Japan, Tokyo. (In Japanese with English abstract).

Yamauchi, T. 2009. Deep-sea cymothoid isopods (Crustacea: Isopoda: Cymothoidae) of Pacific coast of northern Honshu, Japan. Pp. 467–481 in Fujita, T. (ed.) Deep-Sea Fauna and Pollutants off Pacific Coast of Northern Japan. National Museum of Nature and Science Monographs, Vol. 39. National Museum of Nature and Science, Tsukuba.

Yamauchi, T. and Kashio, S. 2018. Cymothoid isopods (Crustacea) preserved in Natural History Museum, Kishiwada City, Japan. Bulletin of the Natural History Museum, Kishiwada City, 5: 55–57. (In Japanese with English abstract).

Yamauchi, T. and Nunomura, N. 2010. Cymothoid isopods (Crustacea: Isopoda) collected by Dr. Y. Kano in Toyama Bay of the Sea of Japan. Bulletin of the Toyama City Museum, 33: 71–76.

Yu, H. and Li, X. 2003a. Study on the Cymothoidae from Chinese waters. Studia Marina Sinica, 45: 223–238. (In Chinese with English abstract).

Yu, H. and Li, X. 2003b. Further report of the Flabellifera of Hainan Island, South China Sea. Studia Marina Sinica, 45: 260–272. (In Chinese with English abstract).