Aquatic Animals

水生動物 第2025巻
令和7年5月

Host records for fish parasite family Cymothoidae (Crustacea: Isopoda) at four locations on Pacific coast of western Japan

Yuzumi Okumura[1,2*]・Hiroki Fujita[1]

[1]Seto Marine Biological Laboratory, Field Science Education and Research Center, Kyoto University, 459 Shirahama, Wakayama 649-2211, Japan. [2]Graduate School of Science, Kyoto University, Sakyo-ku, Kyoto 606-8502, Japan.

*Corresponding author, e-mail: okumura.yuzumi.73x@st.kyoto-u.ac.jp, Tel: +81-739-42-3515.

Abstract

Cymothoid isopods are fish-parasitic crustaceans, with 47 genera and 391 species recorded worldwide. In this study, we collected fishes to investigate the cymothoid fauna at four localities in Japan: Sakihama (Muroto City, Kochi Prefecture), Kashiwajima Island (Otsuki Town, Kochi Prefecture), Sakurajima Island (Kagoshima City, Kagoshima Prefecture), and Yakushima Island (Yakushima Town, Kagoshima Prefecture). A total of 526 fish specimens belonging to 65 genera and 83 species were examined for cymothoid isopod prevalence. Parasites were found in only three species: *Diodon holocanthus* from Kashiwajima Island, *Chilomycterus reticulatus,* and *Prionurus scalprum* from Yakushima Island. Five individuals of *Cymothoa pulchrum* were collected from the buccal cavities of *C. reticulatus* and *D. holocanthus*, and one individual of *Anilocra prionuri* was obtained from the body surface of *P. scalprum*. This study constitutes the first record of *C. pulchrum* and *A. prionuri* from Yakushima Island. Given the generally low prevalence of cymothoids, a combination of different sampling methods and continuous data accumulation is needed to elucidate host-parasite relationships.

Key words: *Cymothoa pulchrum*; *Anilocra prionuri*; cymothoid; parasite fauna; prevalence

Introduction

The family Cymothoidae Leach, 1814 is a group of isopod crustaceans that parasitize the body surface, buccal cavity, opercular cavity, and burrow into the host body–creating a pocket-like shape (with a small hole) in the host fish (Smit et al. 2014). To date, 47 genera and 391 species have been recorded worldwide (Boyko et al. 2025). A total of 16 genera and 45 species of parasitic isopods have been identified in Japan to date, including several recently described species such as *Cinusa nippon* Nagasawa, 2021, which parasitizes the buccal cavity of the vermiculated puffer, *Takifugu snyderi* (Abe, 1988), the panther puffer, *T. pardalis* (Temminck & Schlegel, 1850), and the fine patterned puffer, *T. flavipterus* Matsuura, 2017 off Murotsushita, Shimonoseki, Yamaguchi Prefecture; *Mothocya kaorui* Kawanishi, Miyazaki & Satoh, 2023, which inhabits the opercular cavity of the keeled needlefish, *Platybelone argalus platyura* (Bennett, 1832) from Bayonnaise Rocks Island and Hachijojima Island in the Izu Islands; and *Anilocra harazakii* Uyeno and Tsujii, 2023, which parasitizes the body surface of Marr's fusilier, *Pterocaesio marri* Schultz, 1953 along the coasts of Yakushima Island and Takeshima in Mishima Village, Kagoshima Prefecture; *Elthusa phoenix* Aneesh, Helna & Ohtsuka, 2024, which parasitizes the opercular cavity of the sohachi flounder, *Cleisthenes pinetorum* Jordan and Starks, 1904 from Sado Island (Yamauchi 2016; Nunomura and Shimomura 2020; Kawanishi and Ohashi 2020; Nagasawa, 2021; Fujita 2023; Kawanishi et al. 2023; Helna et al. 2023; Uyeno and Tsujii 2023; Aneesh et al. 2024a,b; Umeda et al. 2025). Cymothoid isopods parasitize diverse taxa of actinopterygian fishes, while some species also parasitize Chondrichthyes (Hata et al. 2017; Kawanishi and Ohashi 2020). The species diversity of these parasites is known to be particularly high in tropical regions (Smit et al. 2014). However, the limited collection records from temperate areas may be attributed more to insufficient research efforts rather than actual distribution patterns (Smit et al. 2014). Comprehensive surveys targeting a wide range of fish species are necessary to better understand cymothoid fauna. Although numerous records exist on cymothoid isopods and their hosts, there is limited information on which fish species they parasitize and which they do not.

In this study, to investigate the cymothoid fauna, fishes were collected over short survey periods (2–9 days) from Sakihama in Muroto and Kashiwajima Island in Kochi Prefecture, as well as from Sakurajima Island and Yakushima Island in Kagoshima Prefecture. Unused fishes caught in fixed shore nets were examined, and additional specimens were collected using bait fishing, brail nets, casting nets, and fish spears to comprehensively survey a wide range of fish species for cymothoid infestation.

Materials and Methods

The surveys were conducted at Sakihama Fishing Port in Sakihama Town, Muroto City, Kochi Prefecture, from February 20 to February 27, 2023; at Kashiwajima Island in Otsuki Town, Hata District, Kochi Prefecture, from October 2 to October 5, 2024; at Sakurajima Island in Kagoshima City, Kagoshima Prefecture, from October 6 to October 7, 2024; and at Yakushima Town, Kumage District, Kagoshima Prefecture, from October 8 to October 16, 2024 (Fig. 1, Table 1). Each survey was conducted over a short period of 2 to 9 days, depending on the site. At Sakihama Fishing Port, cymothoid prevalence of unused fishes caught in fixed shore nets was examined. Fishes were collected at the other survey sites (Kashiwajima Island, Sakurajima Island, and Yakushima Island) using bait fishing, brail nets (700 mm length, 30 mm mesh size), casting nets (5 mm mesh size), and fish spears. Within each site, a wide range of areas was surveyed to maximize the diversity of collected specimens. Each fish was promptly examined on-site to check for the presence of cymothoids. The body surface was visually inspected for external parasites, and the presence of holes indicating possible infestation in the body cavity was also noted. Subsequently, the buccal and opercular cavities were carefully examined using forceps. As the fish were intended to be released alive, examinations were conducted as quickly as possible, and standard measurements such as total length were not recorded.

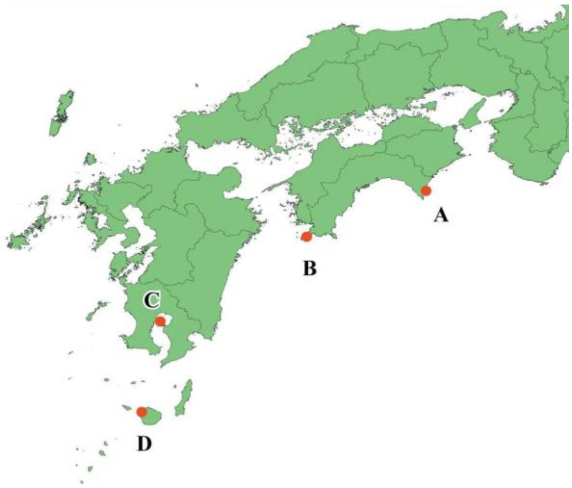

Fig. 1. Sampling sites: A. Sakihama Fishing Port in Sakihama Town, Muroto City, Kochi Prefecture. B. Kashiwajima Island in Otsuki Town, Hata Distinct, Kochi Prefecture. C. Sakurajima Island, Kagoshima City, Kagoshima Prefecture. D. Yakushima Island, Kumage Distinct, Kochi Prefecture.

The collected parasites were initially preserved in 99.5 % ethanol in the field, transported to the laboratory, and stored at -20 °C. Fish specimens were identified to the species level whenever possible; those identified only to the family or genus level were nevertheless included in the total species count, following Nakabo (2013), while cymothoid species were identified based on Nunomura and Shimomura (2020, 2021a,c), Martin et al. (2016), and Fujita and Ohnaka (2025).

Cymothoid photographs were captured under a stereomicroscope SMZ18 (Nikon, Tokyo, Japan) using the real-time EDF function in NIS-Elements Documentation (version 5.30.00) (Nikon), and the photographs were combined using Photoshop 2025 (version 26.4.1) (Adobe, San Jose, CA, USA).

Table 1. Species and number of fish collected at each collection site.

Collection Site	Order	Family	Genus	Species	No.
Sakihama, Muroto City, Kochi prefecture	Anguilliformes	Congridae	*Conger*	*Conger japonicus*	4
		Muraenidae	-	Muraenidae sp.	1
		Ophichthidae	*Ophisurus*	*Ophichthus urolophus*	1
				Ophisurus macrurhynchus	1
	Clupeiformes	Clupeidae	*Sardinops*	*Sardinops melanostictus*	2
	Gasterosteiformes	Fistulariidae	*Fistularia*	*Fistularia melanostictus*	1
	Lophiiformes	Lophiidae	*Lophiomus*	*Lophimus setigerus*	1
	Myctophiformes	Myctophidae	-	Myctophidae sp.	2
	Myliobatiformes	Dasyatidae	*Hemitrygon*	*Hemitrygon akajei*	2
		Gymnuridae	*Gymnura*	*Gymnura japonic*	2
	Perciformes	Acropomatidae	*Doederleinia*	*Doederleinia berycoides*	1
		Carangidae	*Decapterus*	*Decapterus akaadsi*	43
			-	*Decapterus* sp.1	1
			-	*Decapterus* sp.2	1
			Trachurus	*Trachurus japonicus*	12
		Centrolophidae	*Hyperoglyphe*	*Hyperoglyphe* sp.	1
			Psenopsis	*Psenopsis* sp.	1
		Cepolidae	*Acanthocepola*	*Acanthocepola limbata*	1
		Emmelichthyidae	*Erythrocle*	*Erythrocles schlegelii*	9
		Gempylidae	*Sphyraena*	*Sphyraena japonica*	3
		Haemulidae	*Parapristipoma*	*Parapristipoma trilineatum*	1
		Labridae	*Choerodon*	*Choerodon azurio*	1
		Latridae	*Goniistius*	*Goniistius zonatus*	2
		Microcanthidae	*Microcanthus*	*Microcanthus strigatus*	11
		Mullidae	*Parupeneus*	*Parupeneus ciliatus*	2
		Scombridae	*Sarda*	*Sarda orientalis*	3
			Scomber	*Scomber japonicus*	16
		Scombropidae	*Scombrops*	*Scombrops boops*	7
		Scorpaenidae	*Pterois*	*Pterois lunulata*	2
			-	*Pteriois* sp.	3
		Sparidae	*Pagrus*	*Pagrus major*	1
		Sphyraenidae	*Promethichthys*	*Promethichthys prometheus*	30
			Sphyraena	*Sphyraena* sp.	37
		Trichiuridae	-	Trichiuridae sp.	3
	Pleuronectiformes	Pleuronectidae	*Pseudopleuronectes*	*Pseudopleuronectes herzensteini*	1
	Tetraodontiformes	Molidae	*Mola*	*Mola mola*	3
		Tetraodontidae	*Arothron*	*Arothron firmamentum*	2
			Lagocephalus	*Lagocephalus* sp.	2
			-	Tetradonidae sp.	1
		Total	34	39	218

Morphological observations were made with an SMZ800 stereomicroscope (Nikon).

Results

A total of 526 fish individuals representing 83 species across 65 genera were examined for cymothoid isopod prevalence at the four survey sites (Table 1). At Sakihama Fishing Port, 218 individuals of 34 genera and 40 species were collected. At Kashiwajima Island, 198 individuals from 18 genera and 21 species were collected. At Sakurajima Island, 34 individuals from 5 genera and 5 species were collected. At Yakushima Island, 57 individuals from 19 genera and 26 species were collected. Parasites were found in only three fish species: longspined porcupinefish, *Diodon holocanthus* Linnaeus, 1758 from Kashiwajima Island; and spotfin burrfish, *Chilomycterus reticulatus* (Linnaeus, 1758) and scalpel sawtail, *Prionurus scalprum* Valenciennes, 1835 from Yakushima Island (Fig. 2, Table 2). Five individuals of *Cymothoa pulchrum* Lanchester, 1902 were collected from the buccal cavities of *Chilomycterus reticulatus* and

Table 1. continued.

Collection Site	Order	Family	Genus	Species	No.
Kashiwajima Island, Kochi Prefecture	Gasterosteiformes	Aulostomidae	*Aulostomus*	*Aulostomus chinensis*	1
	Perciformes	Epinephelidae	*Epinephelus*	*Epinephelus fasciatus*	9
		Kyphosidae	*Girella*	*Girella* sp.	5
			Kyphosu	*Kyphosus vaigiensis*	1
		Labridae	*Parajulis*	*Parajulis poecilepterus*	8
			Pseudolabrus	*Pseudolabrus eoethinus*	1
			Thalassoma	*Thalassoma cupido*	1
			-	*Thalassoma lunare*	9
		Microcanthidae	*Microcanthus*	*Microcanthus strigatus*	8
		Mullidae	*Parupeneus*	*Parupeneus multifasciatus*	1
		Pomacentridae	*Abudefduf*	*Abudefduf bengalensis*	4
			-	*Abudefduf vaigiensis*	45
			Amphiprion	*Amphiprion clarkii*	10
			Chromis	*Chromis notata*	55
			Dascyllus	*Dascyllus trimaculatus*	11
			Pomacentrus	*Pomacentrus coelestis*	21
		Scorpaenidae	*Sebastiscus*	*Sebastiscus marmoratus*	1
	Tetraodontiformes	Porcupinefish	*Chilomycterus*	*Chilomycterus reticulatus*	2
			Diodon	*Diodon holocanthus*	3
		Tetraodontidae	*Canthigaster*	*Canthigaster rivulata*	1
			Takifugu	*Takifugu snyderi*	1
		Total	19	21	198
Sakurajima Island, Kagoshima Prefecture	Atheriniformes	Atherinidae	-	Atherinidae sp.	1
	Perciformes	Apogonidae	*Ostorhinchus*	*Ostorhinchus notatus*	21
		Pomacentridae	*Amphiprion*	*Amphiprion clarkii*	1
			Chromis	*Chromis notata*	7
	Tetraodontiformes	Tetraodontidae	*Takifugu*	*Takifugu alboplumbeus*	4
		Total	5	5	34
Yakushima Island, Kagoshima Prefecture	Beloniformes	Belonidae	-	Belonidae sp.	1
	Perciformes	Acanthuridae	*Prionurus*	*Prionurus scalprum*	1
		Apogonidae	*Ostorhinchus*	*Ostorhinchus doederleini*	1
		Blenniidae	-	Blenniidae sp.	1
		Caesionidae	*Caesio*	*Caesio caerulaurea*	1
			Pterocaesio	*Pterocaesio marri*	2
			-	*Pterocaesio tile*	1
		Chaetodontidae	*Chaetodon*	*Chaetodon auripes*	1
		Ephippidae	*Platax*	*Platax teira*	1
		Kyphosidae	*Kyphosus*	*Kyphosus cinerascens*	4
			-	*Kyphosus vaigiensis*	6
		Labridae	*Hologymnosus*	*Hologymnosus doliatus*	1
			Thalassoma	*Thalassoma lunare*	1
		Lutjanidae	*Lutjanus*	*Lutjanus fulvus*	8
			-	*Lutjanus* sp.1	11
			-	*Lutjanus* sp.2	1
		Mullidae	*Parupeneus*	*Parupeneus multifasciatus*	1
		Pomacentridae	*Abudefduf*	*Abudefduf vaigiensis*	8
			Chromis	*Chromis chrysura*	8
		Scaridae	*Scarus*	*Scarus festivus*	1
			-	*Scarus forsteni*	2
			-	*Scarus ghobban*	3
			-	*Scarus* sp.1	6
		Sparidae	*Acanthopagrus*	*Acabthopagrus shlegelii*	2
	Tetraodontiformes	Balistidae	*Balistoides*	*Balistoides viridescens*	1
		Porcupinefish	*Chilomycterus*	*Chilomycterus reticulatus*	2
		Total	19	26	76

Diodon holocanthus, including two females (TL: 26.3 mm and 27.0 mm), two males (TL: 13.9 mm and 19.7 mm), and three transitional individuals (TL: 29.4 mm), (TL: 21.4 mm) (SMBL-V0853), and (TL: 14.6 mm)

Fig. 2. (A) *Cymothoa pulchrum* (transitional stage, TL: 21.4mm) (SMBL-V0853) collected from the buccal cavity of the spotfin burrfish, *Chilomycterus reticulatus* collected in Yakushima Island, Kagoshima Prefecture. (B) *Anilocra prionuri* (aegathoid stage, TL: 11.4 mm) (SMBL-V855) on the body surface of *Prionurus scalprum* collected in Yakushima Island, Kagoshima Prefecture. Scale bars: 3 mm.

(SMBL-V0854). In addition, one individual of *Anilocra prionuri* Williams & Bunkley-Williams, 1986 (aegathoid stage, TL: 11.4 mm) (SMBL-V0855) was collected from the body surface of *Prionurus scalprum*. No cymothoids were found in other fish species, including those known to be hosts to these cymothoids.

Cymothoa pulchrum female and transitional in this study were generally consistent with the characteristics in Martin et al. (2016)–subparallel body, widest at pereonite 3–5, cephalon deeply immersed in pereonite 1, anterior border of pereonite 1 subtruncate, coxae almost visible in dorsal view, posterior margin of pleotelson round, basis of pereopod 1 with large carina, uropodal endopod rami reaching half of pleotelson.

Anilocra prionuri aegathoid stage in this study has the characteristics generally consistent with Fujita and Ohnaka (2025)–pleopod 1 and 2 peduncle with 4 and 3 coupling hooks, without plumose seta, uropodal exopod longer than endopod, and triangular uropodal exopod, a few swimming setae on uropodal rami.

Discussion

In this study, we conducted a comprehensive survey investigating cymothoid prevalence in various fish species. However, most of the examined fishes were not infested with cymothoids. No infestations were observed in previously recorded host species of Cymothoidae, including members of Beloniformes, Myctophidae, Pomacentridae, blackthroat seaperch, *Doederleinia berycoides* (Hilgendorf, 1879), grey-spotted puffer, *Takifugu snyderi*, red seabream, *Pagrus major* (Temminck & Schlegel, 1843), *Pterocaesio marri*, blackhead seabream, *Acabthopagrus shlegelii* (Bleeker, 1854), pacific sardine, *Sardinops*

Table 2. Number and species of cymothoid per sampling site, host fish species, attachment sites, and developmental stages of isopods.

Location	Host fish	Sampling Date	Fish ID	Cymothoid Species	Attachment site	Cymothoid stage
Sakihama Fishing Port Kochi Prefecture	-	-	-	-	-	-
Kashiwajima Island Kochi Prefecture	*Diodon holocanthus*	October 4–5, 2024	K1	*Cymothoa pulchrum*	buccal cavity	1 female (TL 26.321mm), 1 male (TL 13.929mm)
	Diodon holocanthus	October 4–5, 2024	K2	*Cymothoa pulchrum*	buccal cavity	1 female (TL 26.970mm)
	Diodon holocanthus	October 4–5, 2024	K3	*Cymothoa pulchrum*	buccal cavity	1 transitional stage (TL 29.421mm), 1 male (TL 19.720mm
Sakurajima Island Kagoshima Prefecture	-	-	-	-	-	-
Yakushima Island Kagoshima Prefecture	*Chilomycterus reticulatus*	10-Oct-24	Y1	*Cymothoa pulchrum*	buccal cavity	1 transitional stage (TL 21.4mm) (SMBL-V0853)
	Chilomycterus reticulatus	10-Oct-24	Y2	*Cymothoa pulchrum*	buccal cavity	1 transitional stage (TL 14.6mm) (SMBL-V0854)
	Prionurus scalprum	10-Oct-24	Y3	*Anilocra prionuri*	body surface	1 aegathoid stage (TL 11.4mm) (SMBL-V0855)

melanostictus (Jenyns, 1842), ocean sunfish, *Mola mola* (Linnaeus, 1758), Japanese jack mackerel, *Trachurus japonicus* (Temminck & Schlegel, 1844) (Yamauchi 2016; Hata et al. 2017; Uyeno and Tsujii 2023; Nagasawa 2021; Fujita et al. 2023). Because only one individual of some fish species can be collected, more samples are needed to assess prevalence accurately. Except for certain species such as *Mothocya parvostis* Bruce, 1986, the prevalence of cymothoids is generally under 30 %; for example, *Ceratothoa oxyrrhynchaena* Koelbel, 1879, which parasitizes *Sacura margaritacea* (Hilgendorf, 1879), has a prevalence of 2.9 %; *Cymothoa eremita* Brünnich, 1783, which parasitizes fork-tailed threadfin bream, *Nemipterus furcosus* (Valenciennes, 1830), has an 7.0 % prevalence; *Paracymothoa astyanaxi* Lemos de Castro, 1955, found on *Deuterodon intermedius* (Eigenmann, 1908), shows a prevalence rate approximately 14 %; and *Anilocra nemipterid* Bruce, 1987, which infest two-lined monocle bream, *Scolopsis bilineata* (Bloch, 1793), reaches a maximum of 28 % (Gomiero et al. 2012; Roche et al. 2012; Saito et al. 2022; Martin et al. 2024). In contrast, *M. parvostis*, which parasitizes the Japanese halfbeak, *Hyporhamphus sajori* (Temminck & Schlegel, 1846), exhibits a significantly higher prevalence, ranging from 41.6 % to 74.4 % (Kawanishi et al. 2016). These differences in the prevalence of cymothoids are likely influenced by various factors, including differences in the ecology, life history, behavior, and population structure of host fish, as well as the ecology and life history of the cymothoid species themselves (Kawanishi et al. 2016). Moreover, since cymothoid prevalence may vary depending on the sampling period and the size of the host fish, it is desirable to collect host specimens of various sizes throughout the year (Bakenhaster et al. 2006.; Ohtani et al. 2021).

Cymothoa pulchrum is distributed across the Pacific and Indian Oceans (Nagasawa and Uyeno 2012; Martin et al. 2016). Recorded host species include *C. reticulatus*, *D. holocanthus*, *D. liturosus* Shaw, 1804, *Diodon hystrix* Linnaeus, 1758, *Arothron stellatus* (Bloch and Schneider, 1801), *Arothron meleagris* (Lacepède, 1798), *Calotomus japonicus* (Valenciennes, 1840), *Siganus spinus* (Linnaeus, 1758), and *Caranx* sp. (See Yamauchi and Hoshino 2021). Nagasawa and Uyeno (2012) noted that *C. pulchrum* has not been recorded in the East China Sea and the Sea of Japan, suggesting a possible relationship with the Kuroshio Current. This species has been recorded in Japanese waters from the Ryukyu Islands, Tanegashima Island, and the Pacific coasts of Honshu (the main island in Japan) and Shikoku region. In this study, *C. pulchrum* was collected from *D. holocanthus* on Kashiwajima Island and *C. reticulatus* on Yakushima Island. These findings align with previous records of the species' distribution and host range (Nagasawa and Uyeno 2012). While this represents the first record of *C. pulchrum* from the coastal waters of Yakushima Island, a previous record exists from *C. reticulatus* along the coast of Tanegashima Island, approximately 61 km from our collection site (Nagasawa and Uyeno 2012). The morphology of *C. pulchrum* observed in this study was generally consistent with the redescriptions provided by Martin et al. (2016).

Anilocra prionuri has been recorded exclusively from Japanese waters, with records from Izu Islands (Shikine Island, Miyake Island), Kii Peninsula, Wakayama Prefecture (Kushimoto, Shirahama), and Kuchinoerabu-jima Island (Williams and Bunkley-Williams 1986; Hata et al. 2017; Nagasawa and Fujimoto 2018). This species parasitizes *P. scalprum*, largescale blackfish, *Girella punctata* Gray, 1835, and threadsail filefish, *Stephanolepis cirrhifer* (Temminck & Schlegel, 1850) (Williams and Bunkley-Williams, 1986). Like *C. pulchrum*, the distribution of *A. prionuri* is believed to be influenced by the Kuroshio Current (Nagasawa and Fujimoto 2018). While this study presents the first record of *A. prionuri* from Yakushima Island, a previous record exists from *P.*

scalprum in the neighboring Kuchinoerabu-jima Island (Nagasawa and Fujimoto 2018).

At Kashiwajima Island, cymothoids have been recorded to parasitize the buccal cavity of adult yellowtail clownfish, *Amphiprion clarkii* (Bennett, 1830) (Wada and Saito 2017). No cymothoids were found in any of the 10 *A. clarkii* specimens collected in this study. Anemonefishes have a symbiotic relationship with sea anemones and typically form groups consisting of a dominant breeding pair and several immature individuals, so they rarely move away from their host (Ross 1978; Fautin 1991; Hattori 1991). Wada and Saito (2017) observed adult *A. clarkii* parasitized by cymothoids at dive sites. This suggests that cymothoid isopods may only infest anemonefish populations that inhabit specific, localized areas. In Japan, cymothoid isopods parasitizing the buccal cavity of *A. clarkii* have been recorded from Izu Oshima Islands as well as Kashiwajima Island, where Cymothoidae sp. juveniles have been found in the buccal cavity of juvenile *A. clarkii*. (Saito and Hoshino 2015). Additionally, in Lembeh Island, Indonesia, adult cymothoids have been recorded in the buccal cavities of five species of Anemonefishes: *A. clarkii*, pink anemonefish, *Amphiprion perideraion* Bleeker, 1855, clown anemonefish, *A. ocellaris* Cuvier, 1830, yellow clownfish, *A. sandaracinos* Allen, 1972, and spinecheek anemonefish, *Premnas biaculeatus* (Bloch, 1790) (Wada and Saito 2017). Although buccal-attaching isopods have been observed in anemonefish, their species remain unknown. Further collection of anemonefishes is necessary to clarify species of cymothoid and host-parasite relationships.

Immature individuals of isopods, different from those infested juvenile anemonefish, have been observed in the buccal cavity of juvenile neon damselfish, *Pomacentrus coelestis* Jordan & Starks, 1901 at Izu Oshima Island (Saito and Hoshino 2015). However, in this study, no cymothoids were detected in any of the 21 specimens of *P. coelenstis* collected from Kashiwajima Island, Kochi Prefecture. *Mothocya parvostis* uses juvenile *Acanthopagrus schlegelii* as an optional intermediate host (Fujita et al. 2020). Because only juveniles of *P. coelenstis* and *A. clarkii* with cymothoid infestation have been observed on Izu Oshima Island, it is possible that these provisional fishes also function as optional intermediate hosts. Further investigation of adult *P. coelenstis* and *A. clarkii* is needed to clarify this possibility.

In this study, 526 fish individuals were collected through fishing and local markets to investigate the presence of cymothoids. However, given the generally low average prevalence of cymothoids, it is unlikely that the full range of host species can be comprehensively identified in a short survey period. Furthermore, previous studies have utilized fish specimens from museum collections for parasite investigations (Welicky et al. 2019). To elucidate the host-parasite relationships of cymothoid isopods, it is essential to integrate various sampling methods and continuously accumulate data over time.

Acknowledgment

We sincerely thank Hiroki Hata, Ecology Laboratory, Ehime University, for his research assistance. We also thank Takuya Matsuo and Tsukasa Kido, fishermen from Sakihama Fishing Port, Sakihama Town, Muroto City, Kochi Prefecture, as well as Takumi Maki, a fishing guide from Yakushima Town, Kagoshima Prefecture, for their invaluable assistance in specimen collection for this study. We are deeply grateful to two anonymous reviewers for their helpful comments and suggestions.

References

Aneesh, P. T., Bruce, N., Helna, A. K., Kumar, A. B. (2024a). Description of *Sandythoa* gen. nov., a fish parasitic branchial cymothoid (Crustacea: Isopoda: Cymothoidae) from the Indian Ocean, with five species including one new species. Syst. Parasitol. 101: 50. doi:10.1007/s11230-024-10163-2

Aneesh, P. T., Helna, A. K., Ohtsuka, S. (2024b). *Elthusa phoenix* sp. nov. (Crustacea: Isopoda:

Cymothoidae), a branchial fish parasitic isopod, from the Sohachi flounder, *Cleisthenes pinetorum* Jordan and Starks, 1904 from off Sado Island, Japan. Mar. Biol. Res. 20: 102–113. doi:10.1080/17451000.2024.2323720.

Bakenhaster, M. D., McBride, R. S., Price, W. W. (2006). Life history of *Glossobius hemiramphi* (Isopoda: Cymothoidae): development, reproduction, and symbiosis with its host *Hemiramphus brasiliensis* (Pisces: Hemiramphidae). J. Crust. Biol. 26: 283–294. doi:10.1651/c-2573.1.

Boyko, C. B., Bruce, N. L., Hadfield, K. A., Merrin. K. L., Ota, Y., Poore, G. C. B., Taiti, S. (Eds.) (2025). World marine, freshwater and terrestrial isopod crustaceans database. Cymothoidae Leach, 1814. Accessed through: World Register of Marine Species. https://www.marinespecies.org/aphia.php?p=taxdetails&id=118274 on 2025-01-12.

Fautin, D. G. (1991). The anemonefish symbiosis: what is known and what is not. Symbiosis 10: 23–46.

Fujita, H., Kawai, K., Taniguchi, R., Tomano, S., Sanchez, G., Kuramochi, T., Umino, T. (2020). Infestation of the parasitic isopod *Mothocya parvostis* on juveniles of the black sea bream *Acanthopagrus schlegelii* as an optional intermediate host in Hiroshima Bay. Zool. Sci. 37: 544–553.

Fujita, H. (2023). Morphological and molecular study of the fish parasitic crustaceans *Cymothoa indica* and *Mothocya collettei* (Isopoda: Cymothoidae), with new distribution records. Diversity 15: 969. doi:10.3390/d15090969.

Fujita, H., Saito, N., Okuno, J., Moritaki, T., Yamauchi, T. (2023). New distribution record of the fish parasitic crustacean *Cinusa nippon* (Isopoda: Cymothoidae), with a description of the manca. Jpn. J. Appl. Entomol. Zool. 67: 37–45. (In Japanese with English abstract). doi: 10.1303/jjaez.2023.37.

Fujita, H., Ohnaka, T. (2025). First description of life stages of *Anilocra prionuri* Williams and Bunkley-Williams, 1986 (Isopoda: Cymothoidae) and growth-associated morphological changes. Zool. Stud. 64: 15.

Gomiero, L. M., Souza, U. P., Braga, F. M. S. (2012). Condition factor of *Astyanax intermedius* Eigenmann, 1908 (Osteichthyes, Characidae) parasitised by *Paracymothoa astyanaxi* Lemos de Castro, 1955 (Crustacea, Cymothoidae) in the Grande River, Serra do Mar State Park–Santa Virgínia Unit, São Paulo, Brazil. Braz. J. Biol. 72: 379−388.

Hata, H., Sogabe, A., Tada, S., Nishimoto, R., Nakano, R., Kohya, N., Takeshima, H., 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. Mar. Biol. 164: 105. doi: 10.1007/s00227-017-3138-5.

Hattori, A. (1991). Socially controlled growth and size-dependent sex change in the Anemonefish *Amphiprion frenatus* in Okinawa, Japan. Jpn. J. Ichthyol. 38: 165−177.

Helna, A. K., Aneesh, P. T., Kumar, A. B., Ohtsuka, S. (2023). Morphological description and molecular characterisation of *Glyptothoa* gen. nov., a fish parasitic deep-sea cymothoid (Crustacea: Isopoda) from the Indian Ocean, with four species, including one new species. Zool. Stud. 62: 51. doi:10.6620/ZS.2023.62-51.

Kawanishi, R., Sogabe, A., Nishimoto, R., Hata, H. (2016). Spatial variation in the parasitic isopod load of the Japanese halfbeak in western Japan. Dis. Aquat. Organ. 122: 13–19. doi: 10.3354/dao03064.

Kawanishi, R., Ohashi, S. (2020). First record of the rare parasitic isopod *Elthusa splendida* (Cymothoidae) from the Pacific Ocean, based on a specimen found in a museum shark collection. Species Divers. 25: 343–348. doi: 10.12782/SPECDIV.25.343.

Kawanishi, R., Miyazaki, Y., Satoh, T. P. (2023). *Mothocya kaorui* n. sp. (Crustacea: Isopoda: Cymothoidae), a fish-parasitic isopod with unique antennules from the Izu Islands, Japan. Syst. Parasitol. 100: 231–244. doi: 10.1007/s11230-023-10083-7.

Martin, M. B., Bruce, N. L., Nowak, B. F. (2016). Review of the fish-parasitic genus *Cymothoa* Fabricius, 1793 (Crustacea: Isopoda: Cymothoidae) from Australia. Zootaxa 4119: 1–72. doi: 10.11646/zootaxa.4119.1.1.

Martin, M. B., Yusoff, M. A. M., Hashin, N. S., Do, T. D., Amin, N. M., Shaharom-Harrison, F., Sung, Y. Y., Min, W., Yantao, L., Asaduzzaman, M., Wong, L. L. (2024). Morphological and molecular characterisation of *Cymothoa eremita* (Brunnich, 1783) (Isopoda: Cymothoidae) from the South China Sea. Reg. Stud. Mar. Sci. 71: 103372. doi: 10.1016/j.rsma.2024.103372.

Nagasawa, K., Uyeno, D, (2012). Geographical distribution affected by the Kuroshio of the fish parasite *Cymothoa pulchra* (Isopoda: Cymothoidae) in Japanese waters. Biogeography 14:151–153.

Nagasawa, K., Fujimoto, M. (2018). *Anilocra prionuri* (Isopoda: Cymothoidae), a marine fish ectoparasite, from the northern Ryukyu Islands, southern Japan, with a note on a skin wound of infected fish. Crust. Res. 47: 29–33. doi: 10.18353/crustacea.47.0_29.

Nagasawa, K. (2021). *Cinusa nippon* n. sp. (Isopoda: Cymothoidae) parasitic in the buccal cavity of coastal puffer (Tetradontiformes: Tetradontidae) from Japan, with the first specimen-based record of the isopod genus from the pacific region. Zool. Sci. 38: 359–369. doi: 10.2108/zs210009.

Nakabo, T. (ed.) (2013). Fishes of Japan with Pictorial Keys to the Species. 3rd ed. Tokai University Press, Hadano. Xlix+xxxii+xvi+2428 pp.

Nunomura, N., Shimomura, M. (2020). Isopoda from Japan (66) Suborder Cymothoida Family Cymothoidae, genera *Anilocra* and *Pleopodias*. Aquabiology 251: 579–584. (In Japanese with English abstract).

Nunomura, N., Shimomura, M. (2021a). Isopoda from Japan (67) Suborder Cymothoida Family Cymothoidae, genera *Nerocila* and *Renocila*. Aquabiology 252: 80–87. (In Japanese with English abstract).

Nunomura, N., Shimomura, M. (2021b). Isopoda from Japan (68) Suborder Cymothoida Family Cymothoidae, genera *Ceratothoa*. Aquabiology 253: 195–201. (In Japanese with English abstract).

Nunomura, N., Shimomura, M. (2021c). Isopoda from Japan (69) Suborder Cymothoida Family Cymothoidae, genera *Glossobius*, *Cterissa*, *Ryukyua* and *Cymothoa*. Aquabiology 254: 327–333. (In Japanese with English abstract).

Ohtani, T., Kawamoto, I., Chiba, M., Kurono, N., Matsuoka, S., Ogawa, K. (2021). *Ceratothoa verrucosa* (Isopoda: Cymothoidae) infection in the buccal cavity of red seabream caught in Iyo-nada, western Japan, with some notes on its co-infection with *Choricotyle elongata* (Monogenea: Diclidophoridae). Fish Pathol. 56: 43–52. doi:10.3147/jsfp.56.43.

Roche, D. G., Strong, L. E., Binning, S. A. (2012). Prevalence of the parasitic cymothoid isopod *Anilocra nemipteri* on its fish host at Lizard Island, Great Barrier Reef. Aust. J. Zool. 60: 330−333.

Ross, R. M. (1978). Territorial behavior and ecology of the anemonefish *Amphiprion rnelanoptcs* on Guam. Z. Tierpsychol. 36: 71–83.

Saito, N., Hoshino, O. (2015). Descriptions of immature stages of Cymothoidae (Crustacea: Isopoda) collected from Izu-Ohshima, Pacific coast of central Japan. Cancer 24: 53–62. (In Japanese with English abstract).

Saito, N., Fujita, H., Aiba, S. (2022). First host record of Ceratothoa oxyrrhynchaena (Isopoda: Cymothoidae) infesting the serranid fish, *Sacura margaritacea* (Perciformes: Serranidae). TAXA, Proc. Japan. Soc. Syst. Zool. 53: 59–63. (In Japanese with English abstract).

Smit, N. J., Bruce, N. J., Hadfield, K. A. (2014). Global diversity of fish parasitic isopod crustaceans of the family Cymothoidae. Int. J. Parasitol. Parasites Wildl. 3: 188–197.

Umeda, K., Nitta, M., Takano, T., Kumon, K., Eba, T., Matsuura, Y., Matsuyama, T. (2025). Identification of cymothoid isopods probably responsible for mass mortality of hatchery-reared Pacific bluefin tuna *Thunnus orientalis* juveniles after transfer to sea cages. Aquaculture 91: 109–120. doi: 10.1007/s12562-024-01823-9.

Uyeno, D., Tosuji, H. (2023). Two new species of the genus *Anilocra* Leach, 1818 (Isopoda: Cymothoidae) parasitic on reef fishes from the western Pacific. Parasitol. Int. 95: 102752. doi: 10.1016/j.parint.2023.102752.

Wada, T., Saito, N. (2017). Amphiprioninae and Cymothoidae (Crustacea: Isopoda) in Lembeh [translated from Japanese "Lembeh no kumanomi rui to sono uonoe (kokaku amon: tokyaku moku)"]. Umiushi-tsusin 97: 6–7. (In Japanese).

Welicky, R. L., Malherbe, W., Hadfield, K. A., Smit, N. J. (2019). Understanding growth relationships of African cymothoid fish parasitic isopods using specimens from museum and field collections. Int. J. Parasitol. Parasites Wildl. 8: 182–187. doi: 10.1016/j.ijppaw.2019.02.002.

Williams, E. H., Bunkley-Williams, L. (1986). The first *Anilocra* and *Pleopodias* isopods (Crustacea: Cymothoidae) parasitic on Japanese fishes, with three new species. Proc. Biol. Soc. Wash. 99: 647–657.

Yamauchi, T. (2016). Cymothoid isopods (Isopoda: Cymothoidae) from fishes in Japanese waters. Cancer 25: 113–119. (In Japanese).

Yamauchi, T., Hoshino, O. (2021). Ovigerous females of *Cymothoa pulchra* (Crustacea: Isopoda: Cymothoidae) collected from the Japanese parrotfish *Calotomus japonicus* (Perciformes: Scaridae) at Izu Oshima Island, Japan. Hum. Nat. 31: 69−72.

Received: 5 April 2025 | Accepted: 4 May 2025 | Published: 8 May 2025