

REVIEW

A synopsis of the parasites of medaka (*Oryzias latipes*) of Japan (1929–2017)

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Abstract Information on the protistan and metazoan parasites of medaka, *Oryzias latipes* (Temminck and Schlegel, 1846), from Japan is summarized based on the literature published for 89 years between 1929 and 2017. This is a revised and updated checklist of the parasites of medaka published in Japanese in 2012. The parasites, including 27 nominal species and those not identified to species level, are listed by higher taxa as follows: Ciliophora (no. of nominal species: 6), Cestoda (1), Monogenea (1), Trematoda (9), Nematoda (3), Bivalvia (5), Acari (0), Copepoda (1), and Branchiura (1). For each parasite species listed, the following information is given: its currently recognized scientific name, any original combination, synonym(s), or other previous identification used for the parasite from medaka; site(s) of infection within or on the host; known geographical distribution in Japanese waters; and the published source of each record. A skin monogenean, *Gyrodactylus* sp., has been encountered in research facilities and can be regarded as one of the most important parasites of laboratory-reared medaka in Japan.

Key words: bibliography, medaka, *Oryzias latipes*, parasites, synopsis

INTRODUCTION

Medaka, also known as Japanese rice fish, *Oryzias latipes* (Temminck and Schlegel, 1846), belongs to the family Adrianichthyidae (order Beloniformes) and is a small freshwater fish which is distributed in Asian Far East including Japan, Taiwan, Korea, and China (Kinoshita *et al.*, 2009). In Japan, this species was commonly found in inland waters, but, recently, its wild populations have declined markedly and it has thus been designated as “vulnerable” (Hosoya, 2015). Medaka is also reared in many research facilities in Japan and other countries because the species is an important model animal for biomedical research (*e.g.*, Yamamoto, 1975; Egami *et al.*, 1990; Iwamatsu, 2006; Kinoshita *et al.*, 2009).

A checklist of the parasites of medaka of Japan was published in 2012 based on the literature published between 1929 and 2012 (Nagasawa *et al.*, 2012). This checklist contained the information on both protistan and metazoan parasites reported from medaka in Japan, and 18 nominal species of parasites were listed by higher taxa as follows: Ciliophora (5 spp.), Cestoda (1 sp.), Trematoda (7 spp.), Nematoda (2 spp.), Bivalvia (1 sp.), Copepoda (1 sp.), and Branchiura (1 sp.). The checklist also contained the information on unidentified species of Ciliophora, Trematoda, Monogenea, and Acari. Since the checklist was published in Japanese, it is almost impossible for scientists in countries other than Japan to use it.

The checklist is revised and updated herein based on three sources of the literature: 1) the papers

and books cited by Nagasawa *et al.* (2012); 2) 14 papers overlooked by these authors (Ichioka, 1930; Matsumura, 1933; Okabe, 1936; Mizumoto and Kobayashi, 1956; Ikuyama, 1960a, 1960b; Furukawa *et al.*, 1965; Furukawa and Kobayashi, 1966; Suhama, 1968; Saito and Moriyama, 1993; Ponpornpisit *et al.*, 2000; Miyabe *et al.*, 2007; Beatte *et al.*, 2008; Baba and Urabe, 2011); and 3) five currently published papers (Nagasawa *et al.*, 2012; Ito *et al.*, 2014, 2016a, 2016b; Nitta and Nagasawa, 2017). In this synopsis, the following eight species of parasites are newly added:

1. *Tetrahymena pyriformis* (Ehrenberg, 1830) (Ciliophora);
2. *Dactylogyrus oryziasi* Nitta and Nagasawa, 2017 (Monogenea);
3. *Centrocestus nycitoracis* Izumi, 1935 (Trematoda);
4. *Parabucephalopsis parasiluri* Wang, 1985 (Trematoda);
5. *Cristaria plicata* (Leach, 1815) (Bivalvia);
6. *Hyriopsis schlegeli* (Martens, 1861) (Bivalvia);
7. *Pletholophus tenuis* (Gray in Griffin and Pidgeon, 1833) (Bivalvia); and
8. *Pronodularia japonensis* (Lea, 1859) (Bivalvia).

Information is herein assembled in a *List of the Parasites of Medaka of Japan*. In this list, parasites are arranged by higher taxa in the following order: Ciliophora, Cestoda, Monogenea, Trematoda, Nematoda, Bivalvia, Acari, Copepoda, and Branchiura. Within each higher taxa, genera and species are listed alphabetically. For each species of parasite, the following information is provided:

1) The current **scientific name**, including author(s) and date(s), followed by any previous or other identifications that have been used in establishing records from medaka in Japan. The scientific names of unionid bivalves used in this paper follow those recommended by Kondo (2015).

2) The **Site(s) of infection** of the parasite in or on its host. When the site was not given in the original record, the likely site was determined from other records and is enclosed in square brackets.

3) The **Distribution** of the parasite is indicated by prefecture (boundaries shown in Fig. 1), in geographical order from northeast to southwest in Japan. When no prefectural name was given in the original reports, the distribution is shown by a dash (–).

4) The **Record(s)**. The authors responsible for the records are listed in chronological order. Each reference is followed by the locality or localities given in two parts, first the prefecture and then the detailed collection locality or localities from which the parasite was reported. When no locality record was given, the geographical locality is shown by a dash (–). When all records are from the same prefecture, only the detailed collection locality or localities are listed.

5) Under **Remarks**, comments are given on nomenclature and the infection of the parasite on wild-caught or laboratory-reared medaka.

The **References** section includes works directly cited in a *List of the Parasites of Medaka of Japan*. If only a Japanese title was given by the original author(s), my translation of the title into English is provided in square brackets.

In Japan, *Oryzias sakaizumii* Asai, Senou and Hosoya, 2011, also occurs (Asai *et al.*, 2011) and was previously recognized as medaka of the “Northern Population” occurring along the Sea of Japan coast of the northern half of Honshu Island (Sakaizumi, 1986). A trematode, *Exorchis oviformis*, has been reported from this population (= *O. sakaizumii*) (Saito *et al.*, 1964). Also, glochidia of a unionid bivalve, *Pletholophus tenuis* (reported as *Cristaia tenuis*) can experimentally infect *O. sakaizumii* in tanks (Itoh *et al.*, 2016a). No further published information is available on the parasites of *O. sakaizumii*.

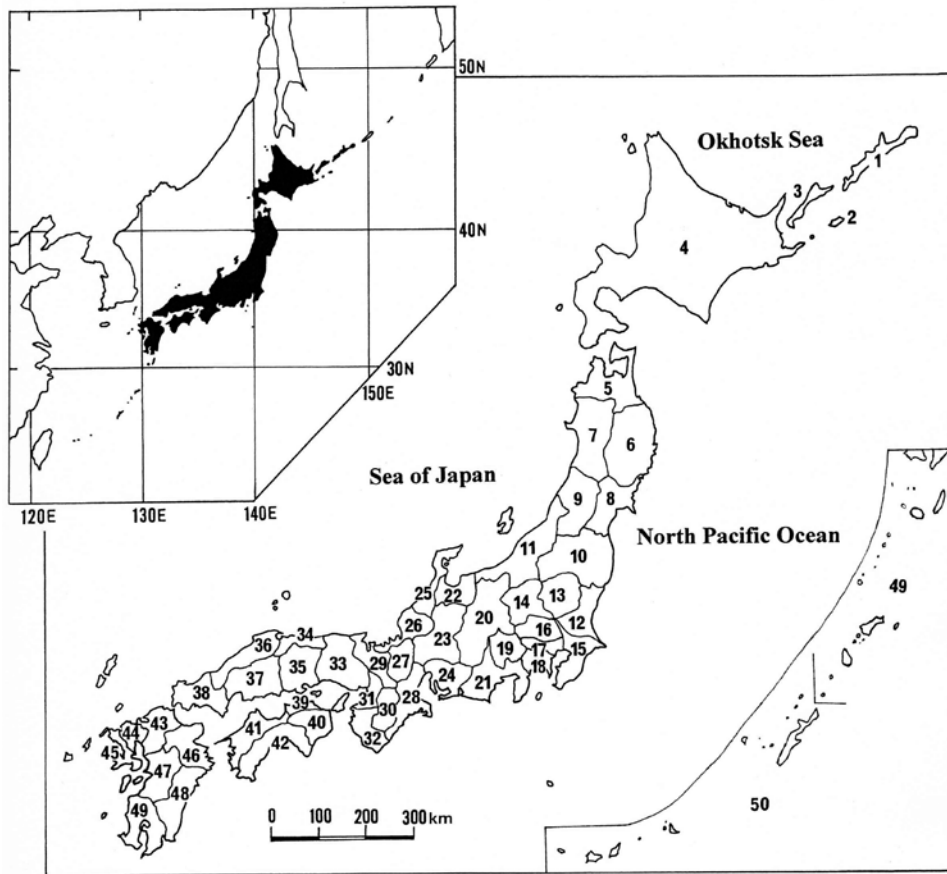


Fig. 1. Map of Japan showing the prefectural boundaries. The following prefectural names are arranged in alphabetical order: Aichi-24; Akita-7; Aomori-5; Chiba-15; Ehime-41; Etorofu Island-1; Fukui-26; Fukuoka-43; Fukushima-10; Gifu-23; Gunma-14; Hiroshima-37; Hokkaido-4; Hyogo-33; Ibaraki-12; Ishikawa-25; Iwate-6; Kagawa-39; Kagoshima-49; Kanagawa-18; Kochi-42; Kumamoto-47; Kunashiri Island-3; Kyoto-29; Mie-28; Miyagi-8; Miyazaki-48; Nagano-20; Nagasaki-45; Nara-30; Niigata-11; Oita-46; Okayama-35; Okinawa-50; Osaka-31; Saga-44; Saitama-16; Shiga-27; Shikotan Island-2; Shimane-36; Shizuoka-21; Tochigi-13; Tokushima-40; Tokyo-17; Tottori-34; Toyama-22; Wakayama-32; Yamagata-9; Yamaguchi-38; and Yamanashi-19.

A LIST OF THE PARASITES OF MEDAKA OF JAPAN

Phylum CILIOPHORA

Chilodonella sp.

Sites of infection: body surface, gills

Distribution: –

Records: Iwamatsu 1993, 1997, 2006 (–)

Remarks: This species induces dyspnoea, and the affected skin looks whitish (Iwamatsu, 1993, 1997, 2006). No taxonomic study has been done using material from medaka.

Ichthyophthirius multifiliis Fouquet, 1876

Including: *Ichthyophthirius* of Kinoshita *et al.*, 2009

Sites of infection: body surface, gills

Distribution: –

Records: Iwamatsu 1993, 1997, 2006 (-); Kinoshita *et al.* 2009 (-)

Remarks: Laboratory-reared medaka get infected by this species, which induces “white spot disease” (Kinoshita *et al.*, 2012). Infected medaka become weakened and finally die (Iwamatsu, 1993, 1997, 2006). No taxonomic study of material from medaka has been conducted.

Tetrahymena pyriformis (Ehrenberg, 1830)

Site of infection: body surface

Distribution: –

Record: Ponpornpisit *et al.* 2000 (-)

Remarks: This species can experimentally infect laboratory-reared medaka (Ponpornpisit *et al.*, 2000).

Trichodina domerguei (Wallengren, 1897)

Previous identification: *Cyclochaeta* (= *Trichodina*) *domerguei* of Sanchez-Bayo and Goka, 2005

Sites of infection: body surface, fins

Distribution: –

Record: Sanchez-Bayo and Goka 2005 (- : a paddy field)

Remarks: An infection of this species has been reported from medaka experimentally reared in paddy fields with a photograph of a heavily infected fry (Sanchez-Bayo and Goka, 2005). Nevertheless, this identification of the species needs verification because it infects marine, brackish-water, and freshwater fishes and is a taxonomically problematic species (*e.g.*, Lom and Laird, 1969; Lom, 1970).

Trichodina fujitai (Suzuki, 1950)

Previous identification: *Cyclochaeta fujitai* of Iwamatsu, 1993, 1997, 2006

Including: *Cyclochaeta* sp. of Suhama (1968)

Sites of infection: body surface, gills

Distribution: Hiroshima

Records: Suhama 1968 (Hiroshima: a pond in Hiroshima University); Iwamatsu 1993, 1997, 2006 (-)

Remarks: This species was originally described as *Cyclochaeta fujitai* by Suzuki (1950) based on material from the fins and gills of three species of freshwater fishes (*Carassius auratus* [as *Cyprinus auratus*], *Cyprinus carpio*, *Tribolodon hakonensis* [as *Leuciscus hakuensis*]) and the gills and branchial chamber of tadpoles of a frog (*Glandirana rugosa* [as *Rana rugosa*]). Recently, Nagasawa *et al.* (2012) transferred the species to the genus *Trichodina*. Like *Chilodonella* sp. and other *Trichodina* spp., this parasite induces dyspnoea (Iwamatsu, 1993, 1997, 2006). The specimens reported as *Cyclochaeta* sp. from the body surface of wild medaka were almost identical as *Cyclochaeta fujitai* (Suhama, 1968), which is currently a junior synonym of *T. fujitai*.

Trichodina gotoi Ariake, 1929

Sites of infection: fins, gills

Distribution: –

Record: Ariake 1929 (–)

Remarks: This species is known to infect crucian carp (*Carassius auratus*), goldfish, and common carp (*Cyprinus carpio*) as well as medaka (Ariake, 1929). No paper has been published on this parasite since its original description.

Trichodina mirabilis Ariake, 1929

Site of infection: [fins]

Distribution: –

Record: Ariake 1929 (–)

Remarks: This species has also been reported from goldfish, crucian carp (*Carassius auratus*), and common carp (*Cyprinus carpio*) (Ariake, 1929). It has not been found since its original description.

***Trichodina* sp.**

Previous identification: *Trichodina* of Iwamatsu, 1993, 1997, 2006; Kinoshita *et al.*, 2009

Sites of infection: body surface, gills, eyes, mouth

Distribution: –

Records: Iwamatsu 1993, 1997, 2006 (–); Kinoshita *et al.* 2009 (–)

Remarks: Various pathological changes are induced by this species in laboratory-reared medaka (Kinoshita *et al.*, 2009). Photographs of the species are shown by Iwamatsu (1993: fig. 35, 1997: fig. 47, 2006: fig. 58) and Kinoshita *et al.* (2009: fig. 2-29).

Phylum PLATYHELMINTHES

Class Cestoda

Schyzocotyle acheilognathi (Yamaguti, 1934)

Previous identification: *Diphyllobothrium* sp. of Nakai, 1930; *Bothriocephalus acheilognathi* of Fukui, 1964

Site of infection: intestine

Distribution: Tokyo, Shizuoka

Records: Nakai 1930 (Tokyo: Suna Town); Fukui 1964 (Shizuoka: Fujieda City)

Remarks: Hoshina *et al.* (1965: 307-309) regarded *Diphyllobothrium* sp. reported by Nakai (1930) as *B. acheilognathi*, which is currently treated as a junior synonym of *S. acheilognathi*.

Class Monogenea

Dactylogyrus oryziasi Nitta and Nagasawa, 2017

Site of infection: gills

Distribution: Tokushima

Record: Nitta and Nagasawa 2017 (an irrigation canal in Tokushima City)

***Gyrodactylus* sp.**

Previous identification: *Gyrodactylus elegans* of Iwamatsu, 1993, 1997, 2006

Including: *Gyrodactylus* of Kinoshita *et al.*, 2009

Sites of infection: body surface, fins, gills

Distribution: –

Records: Iwamatsu 1993, 1997, 2006 (–); Kinoshita *et al.* 2009 (–)

Remarks: The gryrodactylid parasitic on medaka was reported as *G. elegans* by Iwamatsu (1993, 1997, 2006), but since this identification was not based on morphological study using material from medaka, the species is reported herein as *Gyrodactylus* sp. According to Harris *et al.* (2004: 8), “many host records are erroneous.” This monogenean is sometimes heavily found on laboratory-reared medaka in Japan and one of the most important parasites of those medaka (Nitta and Nagasawa, unpublished). Monogeneans including this species have direct a life cycle without using any intermediate host and can easily proliferate in laboratory tanks. An unidentified gryrodactylid-like monogenean is also known to parasitize medaka kept in home aquaria (Nishikawa, 2016a, 2016b, 2017). One and two photographs of gryrodactylid reported as *G. elegans* and *Gyrodactylus* from and on medaka are shown by Iwamatsu (1993: fig. 35, 1997: fig. 47, 2006: fig. 58) and Kinoshita *et al.* (2009: fig. 2-32), respectively.

Class Trematoda

Azygia gotoi (Ariake, 1922)

Site of infection: intestine

Distribution: –

Record: Shimazu 1979 (–)

Remarks: When cercariae of this species are eaten by medaka in an aquarium, they are not encysted but found as juveniles in the host's intestine (Shimazu, 1979). Medaka is regarded as a transport or paratenic host of this parasite (Shimazu, 1979, 2014).

Centrocestus formosanus (Nishigori, 1924)

Sites of infection: gill filaments, spaces between cartilaginous tissues

Distribution: Tokushima

Record: Toyo-oka 1965 (Naruto City)

Remarks: Metacercariae of this species are found encysted in wild medaka (Toyo-oka, 1965).

Centrocestus nycticoracis Izumi, 1935

Sites of infection: –

Distribution: Saga

Record: Ikuyama 1960a (Ōta, Morodomi-chō in Saga City)

Remarks: Metacercariae of this species are found in wild medaka (Ikuyama, 1960a).

Clinostomum sp.

Site of infection: muscle

Distribution: Fukuoka

Record: Ichihara and Takeishi 1998 (Kitakyushu City)

Remarks: Metacercariae of this species are found encysted in wild medaka (Ichihara and Takeishi, 1998).

Diplostomatidae gen. sp.

Previous identification: *Ornithodiplostomum* or *Neodiplostomum* of Toyo-oka and Okada, 1954

Site of infection : body cavity

Distribution: Tokushima

Records: Toyo-oka and Okada 1954 (vicinity of Tokushima City); Toyo-oka 1961 (lower reaches of the Yoshino River)

Remarks: Metacercariae of this species are found unencysted in wild medaka (Toyo-oka and Okada, 1954; Toyo-oka, 1961). When metacercariae removed from medaka are artificially given to a pigeon, they become adults (Toyo-oka and Okada, 1954).

Exorchis oviformis Kobayashi, 1915

Sites of infection: scales, fins, muscle

Distribution: Yamaguchi, Fukuoka

Records: Okabe 1936 (Fukuoka: Katakusu in Fukuoka City); Okabe 1940 (Fukuoka: Umi River); Takabayashi 1953 (Yamaguchi: Yoshida River); Ikuyama 1960b (Fukuoka: Gebayashi in Ōkawa City; Yanagawa City)

Remarks: Metacercariae of this species are found encysted in wild medaka (Okabe, 1936, 1940; Takabayashi, 1953, Ikuyama, 1960b).

Metagonimus miyatai Saito, Chai, Kim, Lee and Rim, 1997

Previous identification: *Metagonimus* Miyata type of Saito, 1984

Site of infection: scales

Distribution: –

Record: Saito 1984 (–)

Remarks: Cercariae of this species can experimentally infect medaka but most of them do not become encysted (Saito, 1984: table 7).

Metagonimus takahashii Suzuki, 1930

Site of infection: scales

Distribution: –

Record: Saito 1984 (–)

Remarks: Like *M. miyatai*, this species can experimentally infect medaka but does not become encysted (Saito and Moriyama, 1973; Saito, 1984: table 7).

Metagonimus yokogawai (Katsurada, 1912)

Sites of infection: scales, fins

Distribution: Toyama, Yamaguchi

Records: Ichioka 1930 (Toyama: Ishizutsumi Village); Takabayashi 1953 (Yamaguchi: Ube City, Yoshida River); Saito and Moriyama 1973 (–); Saito 1984 (–)

Remarks: Metacercariae of this species are found encysted in wild medaka (Ichioka, 1930; Takabayashi, 1953). However, when cercariae of the species experimentally infect laboratory-reared medaka, they do not become encysted (Saito and Moriyama, 1973).

Ornithodiplostomum podicipitis Yamaguti, 1939

Site of infection: surface of visceral organs (liver, kidney, gonads, mesentery, heart, gall bladder)

Distribution: Hiroshima, Tokushima, Ehime

Records: Toyo-oka and Okada 1954 (Tokushima: vicinity of Tokushima City; Ehime: vicinity of Matsuyama City; Hiroshima: vicinity of Hiroshima City); Toyo-oka 1961 (Tokushima: Tokushima City, Naruto City, lower reaches of the Yoshino River)

Remarks: Metacercariae of this species are found encysted in wild medaka. When they are experimentally given to a pigeon, they become adults (Toyo-oka and Okada, 1954).

Parabucephalopsis parasiluri Wang, 1985

Site of infection: [fins]

Distribution: –

Record: Baba and Urabe 2011 (–)

Remarks: Cercariae of this species can experimentally infect laboratory-reared medaka (Baba and Urabe, 2011). Medaka was reported as *Oryzias* sp. by Baba and Urabe (2015).

Unidentified trematodes

***Tetracotyle* sp.**

Previous identification: *Tetracotyle* of Tokyo-oka, 1951, 1961

Site of infection: body cavity

Distribution: Tokushima

Records: Toyo-oka 1957 (near Nikenya Town, Tokushima City); Toyo-oka 1961 (lower reaches of the Yoshino River)

Remarks: Encysted metacercariae of this species are found in wild medaka (Tokyo-oka, 1951, 1961).

Unidentified species

Sites of infection: skin, fins

Distribution: Shimane

Records: Iga 1964, 1965 (Matsue City)

Remarks: Metacercariae of this species are found encysted in wild medaka (Iga, 1964, 1965).

Phylum NEMATODA

Camallanus cotti Fujita, 1927

Site of infection: digestive tract

Distribution: –

Records: Iwamatsu 1993, 1997, 2006 (–)

Remarks: No paper has been published on this species from wild medaka. It is highly likely that the species infects laboratory-reared medaka and can complete its life cycle because “it can proliferate countlessly in tanks” (Iwamatsu, 1993, 1997, 2006).

Gnathostoma nipponicum Yamaguti, 1941

Site of infection: muscle

Distribution: –

Record: Ando *et al.* 1992 (–)

Remarks: Medaka can experimentally get infected by this nematode by eating copepods harboring its larvae (Ando *et al.*, 1992).

Phylum MOLLUSCA

Class Bivalvia

Cristaria plicata (Leach, 1815)

Sites of infection: [fins, gills]

Distribution: Aomori

Record: Itoh *et al.* 2016b (experimental infection)

Remarks: Glochidia of this species can experimentally infect *Oryzias* sp., which is *O. latipes* and/or *O. sakaizumii*, or a hybrid of both species, in tanks (Itoh *et al.*, 2016b).

Hyriopsis schlegeli (Martens, 1861)

Sites of infection: fins, gills

Distribution: Shiga

Records: Mizumoto and Kobayashi 1956 (experimental infection); Furukawa *et al.* 1965 (experimental infection); Furukawa and Kobayashi 1966 (experimental infection)

Remarks: Glochidia of this species can experimentally infect medaka in tanks (Mizumoto and Kobayashi, 1956; Furukawa *et al.*, 1965; Furukawa and Kobayashi, 1966).

Pletholophus tenuis (Gray in Griffin and Pidgeon, 1833)

Previous identification: *Cristaria tenuis* of Itoh *et al.*, 2014, 2016a

Sites of infection: fins, gills

Distribution: Okinawa

Records: Itoh *et al.* 2014 (experimental infection); Itoh *et al.* 2016a (experimental infection)

Remarks: Glochidia of this species can experimentally infect medaka (Itoh *et al.*, 2014, 2016a) and a closely related species, *Oryzias sakaizumii*, in tanks (Itoh *et al.*, 2016a).

Pronodularia japonensis (Lea, 1859)

Previous identification: *Inversidens japonensis* of Miyabe *et al.*, 2007

Sites of infection: fins, gills

Distribution: Chiba

Record: Miyabe *et al.* 2007 (experimental infection)

Remarks: Glochidia of this species can experimentally infect laboratory-reared medaka (Miyabe *et al.*, 2007).

Sinanodonta japonica (Clessin, 1874)

Previous identification: *Anodonta woodiana* of Fukuhara *et al.*, 1986

Site of infection: fins

Distribution: Osaka

Record: Fukuhara *et al.* 1986 (a pond in Toyonaka City)

Remarks: Glochidia of this species can temporally attach to wild medaka because this fish species is not a preferred host (Fukuhara *et al.*, 1986). The pond mussel reported as *Anodonta woodiana* in Japan has recently been separated into two distinct species, *Sinanodonta japonica* (Clessin, 1874) and *Sinanodonta lauta* (Martens, 1877) (Tabe *et al.*, 1994; Kondo *et al.*, 2006; Kondo, 2015), and Fukuhara (2014: 350-351) states that *A. woodiana* reported by Fukuhara *et al.* (1986) might be identical as *A. japonica*, whose scientific name is currently *Sinanodonta japonica*. No glochidia of the species experimentally infect medaka in tanks (Akiyama, 2011).

Phylum ARTHROPODA Class Arachnida, Subclass Acari

Unidentified species

Previous identification: "water mites" of Iwamatsu, 1993, 1997, 2006; Kinoshita *et al.*, 2009

Sites of infection: body surface, fins

Distribution: –

Records: Iwamatsu 1993, 1997, 2006 (–); Kinoshita *et al.* 2009 (–)

Remarks: Water mites are found on laboratory-reared medaka: one and two photographs of water mites are shown by Iwamatsu (1993: fig. 35, 1997: fig. 47, 2006: fig. 58) and Kinoshita *et al.* (2009: fig. 2-31), respectively. No paper has been published on water mites from medaka.

Class Crustacea, Subclass Copepoda

Lernaea cyprinacea Linnaeus, 1758

Previous identification: *Lernaea elegans* of Nakai, 1927; Matsui and Kumada, 1928; Nakai and Koumi, 1931; Suzuki, 1965

Site of infection: head embedded in the host's tissues with body protruding externally

Distribution: Tokyo, Nagano, Shizuoka, Aichi, Nara, Osaka, Fukuoka, Saga

Records: Nakai 1927 (Tokyo: Shimo-ōi Town; –); Matsui and Kumada 1928 (Aichi: vicinity of Toyohashi City: –); Nakai and Koumi 1931 (–); Matsumura 1933 (Shizuoka: canals near Yoshida Fisheries Training Station); Kasahara 1957, 1959 (–); Kasahara 1962 (Nagano: Lake Suwa; Aichi: Toyohashi City, Atsumi Town, Isshiki Town); Suzuki 1965 (–); Tsutsumi 1978 (–); Iwamatsu 1993, 1997, 2006 (–); Beatte *et al.* 2008 (Nagano: a pond in Matsumoto City); Nagasawa *et al.* 2012 (Nara: Ide, Yamato Takada City; Osaka: Tanagawa-nishibata, Misaki Town; Fukuoka: Honjō, Kitakyushu City; Saga: Kōhoku Town)

Remarks: An excellent study on the life cycle of this species using laboratory-reared medaka as its host was made by Kasahara (1962).

Class Crustacea, Subclass Branchiura

Argulus japonicus Thiele, 1900

Previous identification: "fish louse" of Iwamatsu, 1993, 1997, 2006

Site of infection: [body surface]

Distribution: –

Records: Iwamatsu 1993, 1997, 2006 (–)

Remarks: While this species was figured as a parasite of medaka by Iwamatsu (1993: fig. 34, 1997: fig. 46, 2006: fig. 57), this author did not mention its occurrence on laboratory-reared medaka. No published information is available on the species from wild medaka.

ACKNOWLEDGEMENTS

I thank Dr. Masato Nitta, Hiroshima University, for useful comments to improve the manuscript of this paper.

REFERENCES

- Akiyama, Y. B., 2011. Host fish species for glochidia of *Anodonta japonica* inhabiting drainage ditches for rice cultivation in Hikone City. *Venus*, **69**: 207-209.
- Ando, K., Tokura, H., Matsuoka, H., Taylor, D., Chinzei, Y., 1992. Life cycle of *Gnathostoma nipponicum* Yamaguti, 1941. *Journal of Helminthology*, **66**: 53-61.
- Ariake, B., 1929. Five new species of *Trichodina*. *Annotationes Zoologicae Japonenses*, **12**: 285-288.
- Asai, T., Senou, H., Hosoya, K., 2011. *Oryzias sakaizumii*, a new ricefish from northern Japan (Teleostei: Adianichthyidae). *Ichthyological Exploration of Freshwaters*, **22**: 289-299.
- Baba, T., Urabe, M., 2011. Examination methods for the bucephalids which use *Limnoperna fortunei* as the first intermediate host. *Report of Yahagi River Institute*, (15): 97-101. (In Japanese with English title).
- Baba, T., Urabe, M., 2015. Parasites of *Limnoperna fortunei*. In "Limnoperna fortunei: The Ecology, Distribution and Control of a Swiftly Spreading Invasive Fouling Mussel" (ed. by D. Boltovskoy). Springer International Publishing, Switzerland. pp. 55-65.
- Beatte, M., Tanaka, Y., Tojo, K., 2008. On the parasitic copepod *Lernaea cyprinacea* Linnaeus found from a 'biotope' pond in Matsumoto City. *Bulletin of the Shiojiri City Museum of Natural History*, (11): 20-22. (In Japanese with English title).
- Egami, N., Yamagami, K., Shima, A., Eds., 1990. [*Biology of Medaka*]. University of Tokyo Press, Tokyo. vi+315 pp. (In Japanese).
- Fukuhara, S., 2014. [*Anodonta woodiana*, a reservoir inhabitant – life history of a freshwater bivalve]. In "Introduction to Freshwater Fish Study" (ed. by Y. Nagata). Tokai University Press, Hadao. pp. 344-355. (In Japanese).
- Fukuhara, S., Osada, Y., Yamada, T., 1986. Glochidium parasitic period, host-fish and parasitic site of *Anodonta woodiana* in small pond. *Venus*, **45**: 43-52. (In Japanese with English abstract).
- Fukui, T., 1964. [On a tapeworm of medaka]. *Monthly Report of the Meguro Parasitological Museum*, (69): 2-3. (In Japanese).
- Furukawa, M., Kobayashi, Y., 1966. [Studies on the artificial propagation of *Hyriopsis schlegeli*—III. On the hosts]. *Scientific Reports of the Shiga Prefectural Fisheries Experimental Station*, (19): 6-13. (In Japanese).
- Furukawa, M., Kobayashi, Y., Hiratsuka, T., 1965. [Studies on the artificial propagation of *Hyriopsis schlegeli*—II. On the infection of glochidium and its detachment]. *Scientific Reports of the Shiga Prefectural Fisheries Experimental Station*, (18): 59-65. (In Japanese).
- Harris, P. D., Shinn, A. P., Cable, J. Bakke, T. A., 2004. Nominal species of the genus *Gyrodactylus* von Nordmann 1832 (Monogenea: Gyrodactylidae), with a list of principal host species. *Systematic Parasitology*, **59**: 1-27.

- Hoshina, T., Shikama, Y., Egusa, S., 1965. [Fish diseases]. In "[*Introduction to Fish Culture*]" (ed. by N. Kawamoto). Koseisha-Koseikaku, Tokyo. pp. 186-363. (In Japanese).
- Hosoya, K., 2015. *Oryzias latipes* (Temminck & Schlegel, 1846). In "*Red Data Book 2014. Threatened Wildlife of Japan - Volume 4, Pisces - Brackish and Fresh Water Fishes*" (ed. by the Ministry of the Environment). Gyosei Corporation, Tokyo. pp. 166-167. (In Japanese).
- Ichihara, A., Takeishi, M., 1998. [On *Clinostomum* sp. (Clinostomidae) parasitic in the muscle of medaka from Kitakyushu]. *Abstracts of 58th East Japan Meeting of the Japanese Society of Parasitology*. p. 46. (In Japanese).
- Ichioka, S., 1930. [On the distributions of human parasites and *Ligula*-like diphyllbothriid larvae using freshwater fishes as intermediate hosts in Ishizutsumi Village, a newly recognized prevalent area of ricketts, Nishi-tonami County, Toyama Prefecture]. *Byorigaku Kiyo*, **6**: 742-760. (In Japanese).
- Iga, T., 1964. Studies on melanomas induced by trematode [sic] infection on the skin of fresh-water teleosts. I. Physiological properties of the melanoma cells. *Bulletin of Shimane University (Natural Science)*, (14): 85-91.
- Iga, T., 1965. Studies on melanomas induced by trematode infection on the skin of fresh-water teleosts. II. Formation of the dark spot. *Bulletin of Shimane University (Natural Science)*, (15): 89-95.
- Ikuyama, T., 1960a. Studies on *Clonorchis sinensis* in the delta of the Chikugo River. I. The results of *Clonorchis sinensis* - investigation in Saga Prefecture. *Journal of the Kurume Medical Association*, **23**: 2730-2753. (In Japanese with English abstract).
- Ikuyama, T., 1960b. Studies on *Clonorchis sinensis* in the delta of the Chikugo River. II. The results of *Clonorchis sinensis* investigation in Fukuoka Prefecture. *Journal of the Kurume Medical Association*, **23**: 2754-2776. (In Japanese with English abstract).
- Itoh, T., Kitano, T., Toma, M., Fujimoto, H., Sakihara, K., Kohno, H., 2014. Host species for glochidia of the freshwater unionid mussel *Cristaria tenuis* in [sic] Ishigakijima Island, Japan. *Venus*, **72**: 77-87.
- Itoh, T., Kitano, T., Fujimoto, H., Sakihara, K., Kohno, H., 2016a. Record of five new host species for the glochidia of the freshwater unionid mussel *Cristaria tenuis*. *Venus*, **74**: 41-44.
- Itoh, T., Uesugi, S., Kitano, W., 2016b. Host fish species for glochidia of the freshwater unionid mussel *Cristaria plicata* in tanks. *Venus*, **74**: 79-88. (In Japanese with English abstract).
- Iwamatsu, T., 1993. [*The Biology of the Medaka*]. Scientist Press, Tokyo. vii+324 pp. (In Japanese).
- Iwamatsu, T., 1997. *The Integrated Book for the Biology of the Medaka*. University Education Press, Okayama. vi+360 pp. (In Japanese).
- Iwamatsu, T., 2006. *The Integrated Book for the Biology of the Medaka*. University Education Press, Okayama. x+473 pp. (In Japanese).
- Kasahara, S., 1957. [On control effects of dipterex on anchor worm]. *Noyaku Kenkyu*, **4**: 1-6. (In Japanese).
- Kasahara, S., 1959. [On control of anchor worm]. *Suisan Zoshoku*, **6**: 140-148. (In Japanese).
- Kasahara, S., 1962. Studies on the biology of the parasitic copepod *Lernaea cyprinacea* Linnaeus and the methods for controlling this parasite in fish-culture ponds. *Contributions of the Fisheries Laboratory, Faculty of Agriculture, University of Tokyo*, (3): 103-196. (In Japanese with English abstract).
- Kinoshita, M., Murata, K., Naruse, K., Tanaka, M., eds., 2009. *Medaka: Biology, Management, and Experimental Protocols*. Willey-Blackwell, Singapore. xiv+419 pp.
- Kondo, T., 2015. [Illustrations of unionid mussels of Japan]. <http://www.osaka-kyoiku.ac.jp/~kondo/unio/unio.html> (accessed on 20 August 2017).
- Kondo, T., Tabe, M., Fukuhara, S., 2006. Morphological differences of glochidia between two genetic types

- of *Anodonta "woodiana"* (Bivalvia: Unionidae). *Venus*, **65**: 241-245. (In Japanese with English abstract).
- Lom, J., 1970. Observations on trichodinid ciliates from freshwater fishes. *Archive für Protistenkunde*, **112**: 153-177.
- Lom, J., Laird, M., 1969. Parasitic Protozoa from marine and euryhaline fish of Newfoundland and New Brunswick. I. Peritrichous ciliates. *Canadian Journal of Zoology*, **47**: 1367-1380.
- Matsui, Y., Kumada, A., 1928. Studies on fish-diseases. I. "Ikari-mushi" (*Lernaea elegans* Leigh-Sharpe), a new parasitic copepod of Japanese eel. *Journal of the Imperial Fisheries Institute*, **23**: 101-107 (in English), 131-141, 3 pls. (In Japanese).
- Matsumura, A., 1933. [Anchor worm parasitic on fishes in canals of a fisheries training station]. *Yoshoku Kaishi*, **3**: 180-181. (In Japanese).
- Miyabe, T., Takahashi, K., Inoue, M., 2007. Basic research related to artificial multiplication of *Inversidens japonensis*. *Bulletin of the Chiba Prefectural Fisheries Research Center*, (2): 53-60. (In Japanese with English title).
- Mizumoto, S., Kobayashi, Y., 1956. [Studies on the propagation of *Hyriopsis schlegeli*. Part 5]. *Scientific Reports of the Shiga Prefectural Fisheries Experimental Station*, (6): 9-13. (In Japanese).
- Nagasawa, K., Morimoto, S., Asai, T., Kitagawa, T., Hosoya, K., 2012. A checklist of the parasites of medaka (*Oryzias latipes*) of Japan (1929-2012), with new records of *Lernaea cyprinacea* (Copepoda: Lernaeidae) in wild populations of medaka in Japan. *Bulletin of the Biogeographical Society of Japan*, **67**: 1-13. (In Japanese with English abstract).
- Nakai, N., 1927. On the development of a parasitic copepod, *Lernaea elegans* Leigh-Sharpe, infesting on [sic] *Cyprinus carpio* L. *Journal of the Imperial Fisheries Institute*, **23**: 39-59 (in English), 69-88, 3 pls. (In Japanese).
- Nakai, N., 1930. [On *Diphyllobothrium* sp., a tapeworm of medaka (preliminary report)]. *Suisan Butsuri Danwakai Kaiho*, (17): 217-222. (In Japanese).
- Nakai, N., Koumi, E., 1931. On the biological study of a parasitic copepod, *Lernaea elegans* Leigh-Sharpe, infesting on [sic] Japanese fresh water fishes. *Journal of the Imperial Fisheries Experimental Station*, (2): 93-128. (In Japanese with English abstract).
- Nishikawa, H., 2016a. [Disease control of ornamental fishes 126. Monogenean infection of medaka]. *Aqualife*, (442): 72-73. (In Japanese).
- Nishikawa, H., 2016b. [Disease control of ornamental fishes 130. Monogenean infection of medaka and treatment with SUNACE]. *Aqualife*, (446): 116-117. (In Japanese).
- Nishikawa, H., 2017. [Disease control of ornamental fishes 140. Monogenean infection of medaka]. *Aqualife*, (456): 72-73. (In Japanese).
- Nitta, M., Nagasawa, K., 2017. *Dactylogyrus oryziasi* n. sp. (Monogenea: Dactylogyridae) from *Oryzias latipes* (Beloniformes: Adrianichthyidae) in Japan. *Species Diversity*, **22**: 1-5.
- Okabe, K., 1936. [On the life history of *Exorchis oviformis* [sic] Kobayashi (Trematoda)]. *Fukuoka Acta Medica*, **29**: 211-220. (In Japanese).
- Okabe, K., 1940. [Overview of encysted metacercariae of trematodes using freshwater fishes as intermediate hosts in Fukuoka Prefecture]. *Fukuoka Acta Medica*, **33**: 309-335. (In Japanese).
- Ponpornpisit, A., Endo, M., Murata, H., 2000. Experimental infections of a ciliate *Tetrahymena pyriformis* on ornamental fishes. *Fisheries Science*, **66**: 1026-1031.
- Saito, S., 1984. [On differences between species in the genus *Metagonimus*]. *Japanese Society for*

- Systematic Parasitology Circular*, (2): 1-4. (In Japanese).
- Saito, S., Moriyama, N., 1993. Studies on genus *Metagonimus* XIII. The experimental infection to *Oryzias latipes* with both cercariae of *M. takahashii* and *M. yokogawai*. *Japanese Journal of Parasitology*, **22** (supplement): 70. (In Japanese with English title).
- Saito, S., Otsuru, M., Hasegawa, K., Hori, M., 1964. Some observations on metacercariae of trematodes encysted in fresh-water fishes in Niigata Prefecture, Japan. *Niigata Medical Journal*, **78**: 376-386. (In Japanese with English title).
- Sakaizumi, M., 1986. Genetic divergence in wild populations of Medaka, *Oryzias latipes* (Pisces: Oryziatidae) from Japan and China. *Genetica*, **69**: 119-125.
- Sanchez-Bayo, F., Goka, K., 2005. Unexpected effects of zinc pyrethione and imidacloprid on Japanese medaka fish (*Oryzias latipes*). *Aquatic Toxicology*, **74**: 285-293.
- Shimazu, T., 1979. Developmental stages of *Azygia gotoi* (Digenea, Azygiidae). *Bulletin of the National Science Museum, Tokyo, Series A (Zoology)*, **5**: 225-234.
- Shimazu, T., 2014. Digeneans parasitic in freshwater fishes (Osteichthyes) of Japan. III. Azygiidae and Bucephalidae. *Bulletin of the National Museum of Nature and Science, Series A*, **40**: 167-190.
- Suhama, M., 1968. The fine structure of adhesive disc in urceolarid ciliate, *Cyclochaeta* sp. from *Oryzias latipes*. *Bulletin of the Biological Society of Hiroshima University*, (34): 6-12. (In Japanese with English abstract).
- Suzuki, H., 1965. *Lernaea elegans* Leigh-Sharpe, a common parasitic copepoda [sic] found in the skin of the fresh-water fish, *Oryzias latipes* (Temminck et Schlegel). *Researches on Crustacea*, (2): 67-76. (In Japanese with English abstract).
- Suzuki, S., 1950. Studies on the urceolarid ciliates of Japan. *Bulletin of Yamagata University (Natural Sciences)*, (2): 181-218, 6 pls.
- Tabé, M., Fukuhara, S., Nagata, Y., 1994. Genetic differentiation between two types of swan mussel, *Anodonta woodiana*, in Japan. *Venus*, **53**: 29-35. (In Japanese with English abstract).
- Takabayashi, Y., 1953. [Studies on trematodes utilizing fishes as intermediate hosts, with a survey in Yamaguchi Prefecture]. *Acta Scholae Medicinalis in Gifu*, **1**: 219-226. (In Japanese).
- Toyo-oka, R., 1957. [On *Tetracotyle* infecting medaka]. *Jikken Seibutsu Gappo (Tokushima Biological Society)*, **7**: 122. (In Japanese).
- Toyo-oka, R., 1961. [Metacercariae encysted in freshwater fishes in Tokushima Prefecture]. *Kyodo Kenkyu Happyokai Kiyō*, (6-8): 15-26. (In Japanese).
- Toyo-oka, R., 1965. [Human parasites in Naruto City and the distribution of their intermediate hosts]. *Kyodo Kenkyu Happyokai Kiyō*, (11): 120-141. (In Japanese).
- Toyo-oka, R., Okada, K., 1954. Studies on the development of two diplostomatid metacercariae, found in *Oryzias laticeps*, a freshwater fish. *Journal of Gakugei, Tokushima University*, **4**: 55-64.
- Tsusumi, T., 1978. [Treatment of fish diseases at aquaria 7. Anchor worm infecting freshwater fishes and its control]. *Doyaku Kenkyu*, (12): 21-22. (In Japanese).
- Yamamoto, T., 1975. *Medaka (Killifish): Biology and Strains*. Keigaku Publishing, Tokyo. iv+365 pp. 18 pls.

日本産メダカの寄生虫目録（1929-2017年）

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要 旨 1929-2017年に出版された文献を用いて，日本産メダカの寄生虫目録を作成した。本目録は2012年に日本語で出版した同名目録の追補改定版である。本目録では，メダカから報告された各寄生虫の情報を最新の学名，異名，寄生部位，地理的分布，記録（報告書と報告年）に整理した。その結果，2017年までに日本産メダカから27名義種の寄生虫が次の分類群から報告されていたことが明らかになった：絨毛虫類（6種），条虫類（1種），単生類（1種），吸虫類（9種），線形動物（3種），二枚貝類（5種），カイアシ類（1種），エラオ類（1種）。また本目録では，それらに加えて，種まで同定されなかった絨毛虫類，単生類，吸虫類，ダニ類の各種に関する情報も含めた。日本のメダカ研究施設で問題になる寄生虫として，体表に寄生する単生類の1種 *Gyrodactylus* sp. があり，注意を要する。

キーワード：寄生虫，文献集，メダカ，目録