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First record of *Onchocleidus dispar* (Monogenea: Ancyrocephalidae), a gill parasite of bluegill (*Lepomis macrochirus*), from Japan

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Abstract. Specimens of *Onchocleidus dispar* Mueller, 1936 were collected from the gills of bluegill (*Lepomis macrochirus*) caught in Budo Reservoir, Hiroshima Prefecture, Japan. This is the first record of *O. dispar* from Japan and Asia. The species is very likely to have been brought along with the bluegill from the central U.S.A. to Japan in 1960.

Key words: *Onchocleidus dispar*, Monogenea, *Lepomis macrochirus*, bluegill, invasive species

Introduction

Onchocleius dispar Mueller, 1936 is a gill parasite of centrarchid fishes (Actinopterygii: Perciformes: Centrarchidae) in North America (Beverley-Burton & Suriano, 1980; Beverley-Burton, 1984; Wheeler & Beverley-Burton, 1989). The species was originally described by Mueller (1936) from the gills of pumpkinseed (*Lepomis gibbosus* (Linneaus, 1758), as *Eupomotis gibbosus*) collected in Constantia, central New York. It has so far been reported, using different generic names (i.e., *Haplocleidus, Urocleidus* and *Cleidodiscus*), from 10 species of centrarchid fishes, including pumpkinseed, Sacramento perch (*Archoplites interruptus* (Girard, 1854)), redbreast sunfish (*L. auritus* (Linnaeus, 1758)), green sunfish (*L. cyanellus* Rafinesque, 1819), warmouth (*L. gulosus* (Cuvier, 1829)), orange-spotted sunfish (*L. humilis* (Girard, 1858)), bluegill (*L. macrochirus* Rafinesque, 1819), longear sunfish (*L. megalotis* (Rafinesque, 1820)), smallmouth bass (*Micropterus dolomieui* Lacepède, 1802), and largemouth black bass (*M. salmoides* (Lacepède, 1802)) from the U.S.A. and Canada (Beverley-Burton & Suriano, 1980; Beverley-Burton, 1984; Wheeler & Beverley-Burton, 1989). It also has been reported from bluegill in Cuba (Mendoza-Franco *et al*., 2006) and from pumpkinseed in some European countries (Lambert, 1977; Hoffman, 1999; Moravec, 2001; Galli *et al*., 2003; Sterud & Jørgensen, 2006; Hockley *et al*., 2011).

Bluegill were introduced into Japan from the central U.S.A. in 1960 and have become established in many localities of Japan (Kawamura *et al*., 2006). Two species of gill monogeneans, *Onchocleidus ferox* (Mueller, 1934) and *Actinocleidus fergusoni* (Mizelle, 1938), were reported from those bluegill established in Japanese waters (Muroga *et al*., 1980; Grygier & Urabe, 2003; Ogawa, 2011; Maneepitaksanti & Nagasawa, 2012). Recently, specimens of monogeneans were found on the gills of bluegill collected from a reservoir in Hiroshima Prefecture, western Japan, and are herein identified as *O. dis-*

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par. This collection represents the first record of the parasite from Japan and Asia. In this paper, the morphology of *O. dispar* using the fresh and stained specimens from Japan is reported. Ecological aspects of the species infecting bluegill in Japan will be reported in a separate article.

Materials and Methods

Eight bluegill (*L. macrochirus*) were collected by angling from Budo Reservoir (34°24′4″N, 132°42′45″E) within the Hiroshima University campus at Kagamiyama in Higashi-Hiroshima, Hiroshima Prefecture, Japan, on 22 March 2010. Fish were killed instantaneously by piercing the head and examined for gill parasites. Monogeneans were removed from the gills, and the reproductive ducts of living material subjected to cover-slip pressure were observed under an Olympus BX51 compound microscope. Sclerotized components of the haptor and the copulatory complex were studied based on permanent mounts of specimens fixed in ammonium picrate-glycerin (Ergens, 1969). Internal anatomy was studied using specimens fixed in 5% formalin on slide glasses with slight cover-slip pressure, stained in Heidenhain's iron hematoxylin or alum carmine, dehydrated through a graded ethanol series, cleared in xylene, and mounted in Canada balsam. Drawings were made with the aid of a drawing tube attached to an Olympus BX51 compound microscope. Identification was made based on Mueller (1936), Beverley-Burton & Suriano (1980) and Wheeler & Beverley-Burton (1989). The morphological terminology follows that used by Wheeler & Beverley-Burton (1989), except larval hooks, for which marginal hooks are used in this paper. All measurements (in micrometers) are given with the mean and the range in parentheses. Voucher specimens studied are deposited in the Platyhelminthes (Pl) collection housed at the National Museum of Nature and Science (NSMT-Pl 5983–5992) in Tsukuba, Ibaraki Prefecture, Japan. The scientific and common names of fishes follow those recommended by Froese & Pauly (2013).

Results

Four (50.0%) of the eight bluegill examined (75–120 [mean 98] mm standard length) were infected by a total of 10 *O. dispar* (0–7 worms per host, 2.5 worms per infected host).

Onchocleidus dispar Mueller, 1936

(Fig. 1)

Description (10 freshly-killed and 10 stained specimens were examined and measured): Body fusiform, 389 (360–420) long and 108 (95–120) wide. Cephalic lobe with 3 pairs of head organs. Posterior eye spots larger than anterior eye spots. Spherical pharynx, 27 (25–30) in diameter; intestinal bifurcation posterior to pharynx and confluent posterior to testis. Haptor wedge-shaped, 71 (68–75) long and 42 (39–44) wide, with 2 pairs of hamuli and 7 pairs of larval hooks. Ventral and dorsal hamuli are similar in shape but dissimilar in size. Dorsal hamuli distinctively larger than ventral hamuli with reduced deep root, elongated superficial root and strongly curved blade; dorsal hamuli 70 (67–75) long. Ventral hamuli have similar shape with dorsal hamuli except the superficial root is not as long as the dorsal hamuli and with tapering at the terminal end; ventral hamuli 38 (35–40) long. Hamulus filament present. All marginal hooks are similar in shape and size, 16 (14–18) long. Dorsal bar straight with dilated terminal ends, 25 (24–26) in transverse length and 3 (2-4) width; ventral bar bow shaped 17 (13–19) in transverse length and 5 (4-6) width.

Testis ovoid, dorsoposterior to ovary. Vas deferens looping dorsoventrally around left intestinal caecum, passes anteromedially to dilatation forming seminal vesicle, and opens into base of penis. Two prostatic reservoirs located posterior to copulatory complex. Male copulatory complex sclerotized and situated in one-third from anterior part of body; Slender, funnel shaped penis tube 26 (25–28) long, with spiral filament; pincer-like accessory piece, 20 (19–22) long.

Ovary ovoid, anteroventral to testis. Unsclerotized vagina opens on right side of body; the semi-

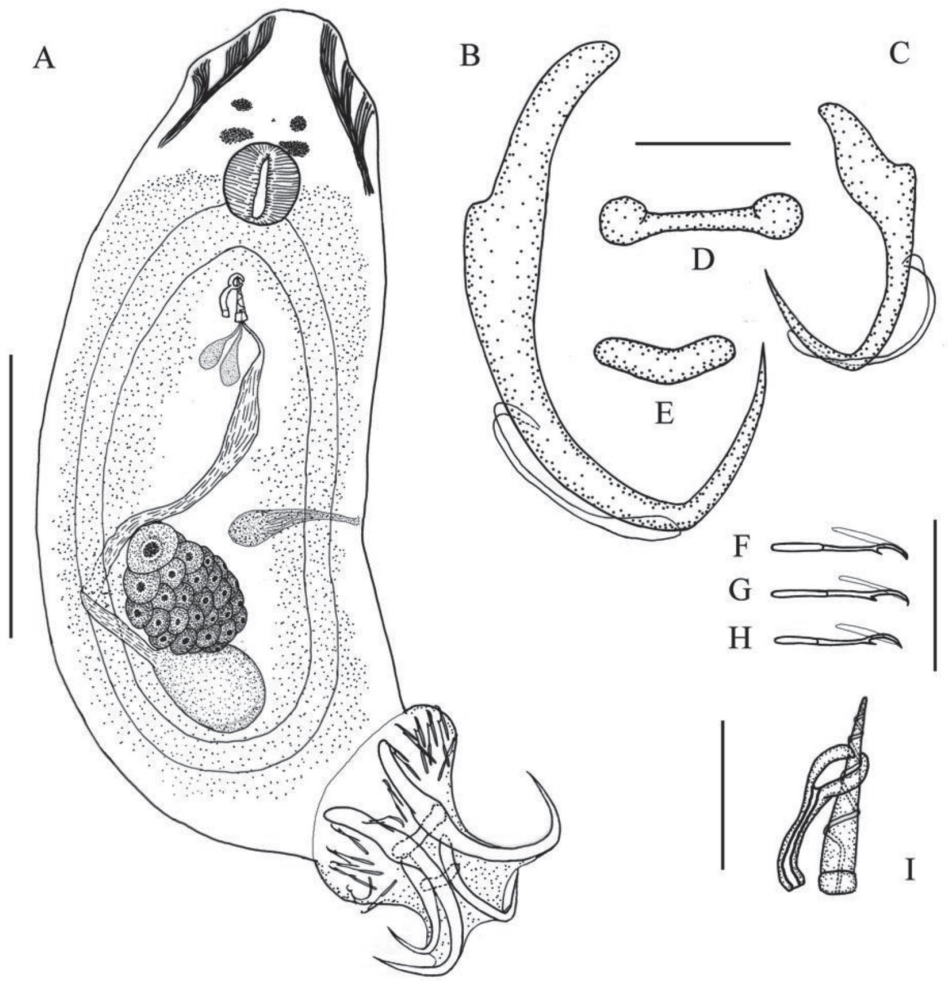

Fig. 1. *Onchocleidus dispar* Mueller, 1936 from *Lepomis macrochirus* in Hiroshima Prefecture, Japan. A, whole animal, dorsal view; B, dorsal hamulus; C, ventral hamulus; D, dorsal bar; E, ventral bar; F, marginal hook I; G, marginal hook II; H, marginal hook III; I, penis and accessory piece. Scale-bars: A, 100 μm; B–I, 20 μm.

nal receptacle attached to vagina. Vitelline follicles moderately developed around intestine, extending laterally to body margin. Mehlis' gland and uterus not observed.

Host: Bluegill *Lepomis macrochirus* Rafinesque, 1819 (Perciformes: Centrarchidae).

Site of attachment: Gills.

Locality: Budo Reservoir (34°24′4″N, 132°42′45″E) within the Hiroshima University campus at Kagamiyama in Higashi-Hiroshima, Hiroshima Prefecture, Japan.

Discussion

Mueller (1936) originally described *Onchocleidus dispar* from the gills of *Lepomis gibbosus* (as *Eupomotis gibbosus*) collected in central New York, the U.S.A. However, due to the morphological confusion of the haptor, the species was placed in different genera, such as *Haplocleidus, Urocleidus*, and *Cleidodiscus*, but, currently, it has been considered to be a member of *Onchocleidus* (Wheeler & Beverley-Burton, 1989). Wheeler & Beverley-Burton

(1989) reviewed the genus *Onchocleidus* Mueller, 1936 and recognized 24 species as valid, including the species.

Detailed morphological observations of *O. dispar* (as *H. dispar*) were made by Beverley-Burton & Suriano (1980) using specimens from *L. gibbosus* collected in Ontario, Canada. The morphology of our Japanese specimens of *O. dispar* examined in this study is almost identical to that of the North American specimens previously described and illustrated (Beverley-Burton & Suriano, 1980; Wheeler & Beverley-Burton, 1989), except the haptoral shape. According to the original diagnosis of *Onchocleidus* by Mueller (1936), the shape of the haptor is wedge-shaped, but Beverley-Burton & Suriano (1980) showed it in a different shape. The wedge-shaped haptor observed in this study was identical with that in the original description. Hence, it gives justification to recognize the species in *Onchocleidus*.

Onchocleidus dispar is originally distributed in the U.S.A. and Canada (Beverley-Burton, 1984; Wheeler & Beverley-Burton, 1989). It has been reported as an alien parasite from Cuba (Mendoza-Franco *et al*., 2006) in North America and from France (Lambert, 1977), Romania (see Hoffman, 1999), the Slovak Republic (see Moravec, 2001), Italy (Galli *et al*., 2003), Norway (Sterud & Jørgensen, 2006) and the U.K. (Hockley *et al*., 2011) in Europe. The present finding of *O. dispar* in Japan constitutes a new country record and the first record of the species from Asia.

In Japan, before our finding of *O. dispar* in this study, two species of monogeneans had been found from the gills of bluegill: *Onchocelidus ferox* in Hiroshima and Shiga prefectures (Muroga *et al*., 1980; Grygier & Urabe, 2003; Ogawa, 2011; Maneepitaksanti & Nagasawa, 2012) and *Actinocleidus fergusoni* in Hiroshima Prefecture (Maneepitaksanti & Nagasawa, 2012). The three monogeneans are specific to centrarchid fishes of North American origin (Beverley-Burton, 1986; Wheeler & Beverley-Burton, 1989), and, in 1960, bluegill were introduced from the central U.S.A. to Japan (Kawamura *et al*., 2006). Therefore, as suggested by Maneepitaksanti & Nagasawa (2012) for *A. fergusoni* and *O. ferox*, it is considered that *O. dispar* was also brought along with the bluegill from the U.S.A. to Japan.

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