

***Actinocleidus fergusonii* (Monogenea: Ancyrocephalidae),
a gill parasite of bluegill (*Lepomis macrochirus*), new to Japan**

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Abstract. Specimens of *Actinocleidus fergusonii* Mizelle, 1938 were collected from the gills of bluegill (*Lepomis macrochirus*) from Budo Reservoir, Hiroshima Prefecture, Japan. This collection represents the first record of *A. fergusonii* from Japan. The species is redescribed based on both the specimens from Japan and paratype material from the U.S.A. The parasite is considered to have been introduced from the central U.S.A. into Japan with live bluegill in 1960.

Key words: *Actinocleidus fergusonii*, Monogenea, *Lepomis macrochirus*, bluegill, redescription, new country record

Introduction

Actinocleidus fergusonii Mizelle, 1938, is a gill parasite of centrarchid fishes (Actinopterygii: Perciformes) in the U.S.A. (Beverley-Burton, 1986). The species was originally described by Mizelle (1938) from bluegill (*Lepomis macrochirus* Rafinesque, 1819) (as *Helioperca macrochira*) in Lake Senachwine, Henry, Illinois, and Boomer Creek, Stillwater, Oklahoma. It has so far been reported from six species of centrarchid fishes, including bluegill, green sunfish (*L. cyanellus* Rafinesque, 1819), warmouth (*L. gulosus* (Cuvier, 1829)), orangespotted sunfish (*L. humilis* (Girard, 1858)), redear sunfish (*L. microlophus* (Günther, 1859)), and largemouth black bass (*Micropterus salmoides* (Lacepède, 1802)), in 14 states (Alabama, Arkansas, California, Florida, Illinois, Kansas, Kentucky, Louisiana, Nebraska, Okla-

homa, Tennessee, Texas, Virginia, Wisconsin), the U.S.A. (see Beverley-Burton, 1986, for the literature between 1938 and 1986; Collins & Janovy, 2003).

Bluegill was introduced into Japan from the central U.S.A. in 1960 and has been established in many localities (Kawamura *et al.*, 2006). Two species of monogeneans, *Onchocleidus ferox* (Muel-ler, 1934) (as *Urocleidus ferox*) and an unidentified ancyrocephalid, have been reported from bluegill in Japan (Muroga *et al.*, 1980). Currently, specimens of monogenean were collected from the gills of bluegill in Hiroshima Prefecture and are identified as *A. fergusonii*. This collection represents the first record of the parasite from Japan as well as from outside the U.S.A. In the present paper, we report on the morphology of *A. fergusonii* based on fresh and stained specimens from Japan and Mizelle's type material from the U.S.A. Seasonal occurrence of *A. fergusonii* infecting bluegill in Japan will be published in a separate paper.

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Materials and Methods

Bluegill (*L. macrochirus*) were collected from Budo Reservoir (34°24'4"N, 132°42'45"E) on the campus of Hiroshima University, Kagamiyama, Higashi-Hiroshima City, Hiroshima Prefecture, Japan, by angling in 2010. Fish were killed 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 in 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 using the original description of Mizelle (1938) and a taxonomic summary and key of Beverley-Burton (1986). The paratype material of *A. fergusonii* (Coll. No. 9141) was borrowed from the United States National Parasite Collection, the United States Department of Agriculture (USDA), Beltsville, Maryland, the U.S.A., for comparison. The morphological terminology follows Beverley-Burton (1986). All measurements (in micrometers) are given for Japanese specimens with the mean and the range in parentheses and for the paratype in square brackets. Parasite voucher specimens from Japan are deposited in the Platyhelminthes (Pl) collection at the National Museum of Nature and Science, Tsukuba (NSMT-Pl 5964–5982). The scientific and common names of fishes are those recommended by Froese & Pauly (2012).

Results

Two species of monogeneans, *A. fergusonii* and *O. ferox*, were collected from the gills of *L. macrochi-*

rus taken in this study. The morphology of *A. fergusonii* is given below.

Actinocleidus fergusonii Mizelle, 1938

(Figs. 1–2)

Redescription (20 and 10 specimens from Japan examined and measured, respectively; 1 paratype material from the U.S.A. examined and measured): Body fusiform, 376 (330–410) [390] long and 56 (45–58) [58] wide. Cephalic lobe with 4 pairs of head organs. Posterior eye spots larger than anterior eye spots. Mouth ventral, leading into spherical pharynx, 23 (15–25) in diameter; intestinal bifurcation posterior to pharynx and confluent posterior to testis. Haptor subcircular, 53 (50–62) [48] long and 71 (55–85) [57] wide, with 2 pairs of hamuli and 7 pairs of larval hooks. Ventral and dorsal hamuli of similar size and shape with reduced deep root and strongly curved blade; ventral hamuli 24 (22–26) [20] long, and dorsal hamuli 23 (21–25) [19] long. Hamulus filament present. Larval hooks II reduced in size, 10 (9–10) [8] long, whereas hooks I and III–VII of same size, 12 (12–13) [9] long. Transverse bars articulating; ventral bar 36 (33–39) [30] in transverse length, with 2 oblique, distal struts, each with notch on posterior margin near distal extremity; dorsal bar 25 (23–27) [20] in transverse length, with 2 oblique, distal struts, each without lateral projection.

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 and filled with dense fine granules. Male copulatory complex sclerotized and situated in a quarter anterior part of body; Penis 22 (20–26) [14] long, with inflated base and curved shaft; accessory piece pointed distally, 24 (23–25) [19] long, with bifid base and triangular knob near middle.

Ovary ovoid, anteroventral to testis. Vagina bulbous and opens on left side of body, 10 (9–10) [10] long and 3 (2–3) [2] wide; subspherical seminal receptacle attached to vagina. Vitelline follicles moder-

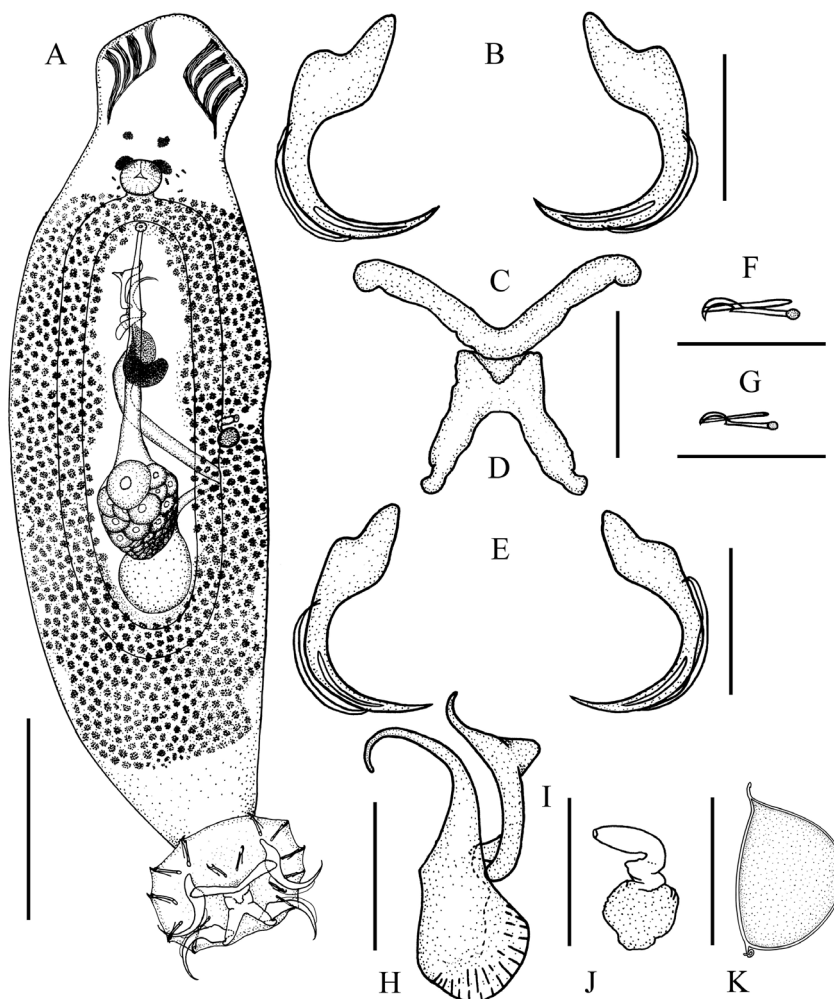


Fig. 1. *Actinocleidus fergusoni* Mizelle, 1938 from *Lepomis macrochirus* Rafinesque, 1819 in Hiroshima Prefecture, Japan, ventral view. A, whole animal; B, ventral hamuli; C, ventral bar; D, dorsal bar; E, dorsal hamuli; F, larval hook I; G, larval hook II; H, penis; I, accessory piece; J, vagina; K, egg. Scale-bars: A, 100 µm; B–K, 20 µm.

ately developed around intestine, extending laterally to body margin. Mehlis' gland not observed. Uterine pore located posterior to intestinal bifurcation. Eggs D-shaped, 88 long and 63 wide, with short stalks at both ends.

Discussion

Mizelle (1938) proposed *A. fergusoni* for mono-

geneans from the gills of *L. macrochirus* taken in Illinois and Oklahoma, the U.S.A. Additional morphological observations of the parasite were made by Mizelle & Brenan (1942) from *L. macrochirus* in Tennessee and Florida and by Mizelle & Regensberger (1945) from the same host species in Wisconsin. Beverley-Burton (1986) reviewed the genus *Actinocleidus* Mueller, 1937 and recognized *A. fergusoni* as valid with illustrations of ventral and

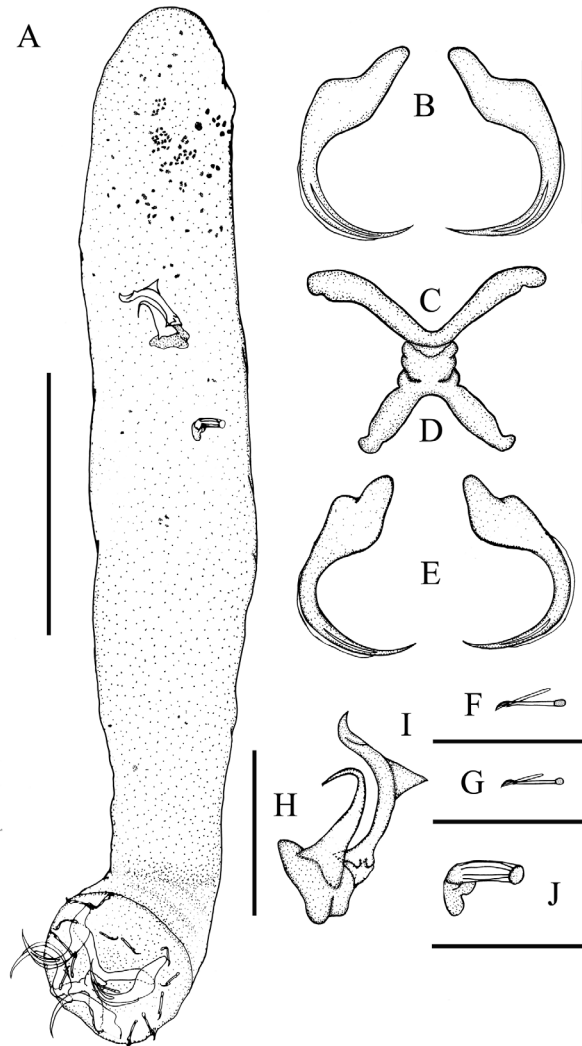


Fig. 2. *Actinocleidus fergusonii* Mizelle, 1938, paratype (Coll. No. 9141 from the United States National Parasite Collection), ventrolateral view. A, whole animal; B, ventral hamuli; C, ventral bar; D, dorsal bar; E, dorsal hamuli; F, larval hook I; G, larval hook II; H, penis; I, accessory piece; J, vagina. Scale-bars: A, 100 µm; B–J, 20 µm.

dorsal hamuli, larval hook, transverse bars, penis and accessory piece, and vagina. The morphology of Japanese specimens of *A. fergusonii* collected in this study is almost identical to that of North American specimens previously described and illustrated (Mizelle, 1938; Mizelle & Brennan, 1942; Mizelle & Regensberger, 1945; Beverley-Burton, 1986) and the paratype material borrowed from the USDA (Fig. 2).

On the other hand, the position of the uterine pore was reported by Mizelle (1938) as being located on the right side of the copulatory organ, but this was not confirmed in the present study. In our Japanese specimens, the uterine pore is located at the posterior end of the bifurcated intestine (Fig. 1). This difference is probably because the paratype was not well preserved and some diagnostic anatomical features

have been lost. In this study, four pairs of the head organs, a subspherical seminal receptacle, and D-shaped eggs with short stalks were also recognized for the first time.

Muroga *et al.* (1980: 30) reported the presence of an unidentified ancyrocephalid species, as well as *O. ferox*, on the gills of bluegill from Chizuka Pond, Hiroshima Prefecture, Japan. Although no specimens of this unidentified ancyrocephalid exist (K. Muroga, personal communication), it appears to be *A. fergusonii*, because only two species of monogeneans so far have been found in Japan (Muroga *et al.*, 1980; this study) and both parasites were found in the same region (Hiroshima Prefecture). Live bluegill were introduced from the central U.S.A. into Japan in 1960 (Kawamura *et al.*, 2006), and both *A. fergusonii* and *O. ferox* are very likely to have been brought into Japan along with those live bluegill.

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