

Lernaea cyprinacea (Copepoda: Lernaeidae) infecting a rock flagtail, *Kuhlia rupestris* (Kuhliidae), in a subtropical river, southern Japan

Kazuya Nagasawa^{1,2} and Hirotaka Katahira³

¹Graduate School of Integrated Sciences for Life, Hiroshima University, 1-4-4 Kagamiyama,
Higashi-Hiroshima, Hiroshima 739-8523, Japan

²Aquaparasitology Laboratory, 365-61 Kusanagi, Shizuoka 424-0886, Japan

³Department of Environmental Science, School of Life and Environmental Science,
Azabu University, 1-17-71 Fuchinobe, Chuo-ku, Sagami-hara, Kanagawa 252-5201, Japan

■ Abstract

A metamorphosed adult female of *Lernaea cyprinacea* Linnaeus, 1758 was found to parasitize a rock flagtail, *Kuhlia rupestris* (Lacepède, 1802), in the Miyara River on Ishigaki-jima Island, one of the Ryukyu Islands, southern Japan. This represents the first record of *L. cyprinacea* from Ishigaki-jima Island. *Kuhlia rupestris* is a new host record for *L. cyprinacea*.

■ Introduction

The lernaeid copepod *Lernaea cyprinacea* Linnaeus, 1758 is one of the parasites that are commonly found on freshwater fishes in Japan, where more than 40 fish species and subspecies are known as its hosts (Nagasawa et al., 2007, 2019a). The species has been studied mainly on the four largest main islands (Honshu, Hokkaido, Kyushu, and Shikoku), but little information is available on the species occurring on small islands and islets (Nagasawa et al., 2013).

The Ryukyu Islands are located in southern Japan and consist of 198 islands, which form a chain extending ca. 1,100 km from Kyushu Island southwestward to Taiwan. The climate of the Ryukyu Islands is subtropical, which is different from that of the four main islands of Japan. To date, only a few studies have been made on the freshwater fish parasites of the Ryukyu Islands, and two species of parasitic copepods are known from two islands: *L. cyprinacea* from Kume-jima Island

(reported as Kume Island) and Okinawa-jima Island (Uyeno et al., 2011; Shimadzu, 2016; Nagasawa et al., 2019b) and *Neoergasilus japonicus* (Harada, 1930) (Ergasilidae) from Okinawa-jima Island (Nagasawa and Uyeno, 2012).

Recently, we collected *L. cyprinacea* from a rock flagtail, *Kuhlia rupestris* (Lacepède, 1802), in a river on Ishigaki-jima Island, which is reported herein.

■ Materials and Methods

A single individual of *K. rupestris* was collected using hook and line with earthworm bait in the upper reaches of the Miyara River (Fig. 1A, 24°24'56"N, 124°13'34"E) at Miyara on Ishigaki-jima Island, Okinawa Prefecture, on 14 May 2010. Immediately after capture, this fish was brought alive to the Yaeyama Laboratory of the Seikai National Fisheries Research Institute (SNFRI) at Fukai-Ohta on the same island, where, after its identification was confirmed based on Nakabo (2000), it was measured for standard length (SL) and examined for metazoan parasites. When *L. cyprinacea* was found, it was carefully removed from the fish using forceps and fixed in 70% ethanol. Later, in the Aquaparasitology Laboratory, the specimen of *L. cyprinacea* was observed for its external morphology, measured for body length, and photographed using a camera attached to an Olympus stereo microscope (SZX10). The specimen is retained by the senior author (KN) for a morphological study of *L. cyprinacea* from various localities of Japan and will be later deposited in the Crustacea collection of the National Museum of Nature and Science, Tsukuba, Ibaraki Prefecture, Japan. The scientific names of fishes mentioned in this paper are those recommended in Hosoya (2015).

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✉ KN: e-mail: ornatus@hiroshima-u.ac.jp

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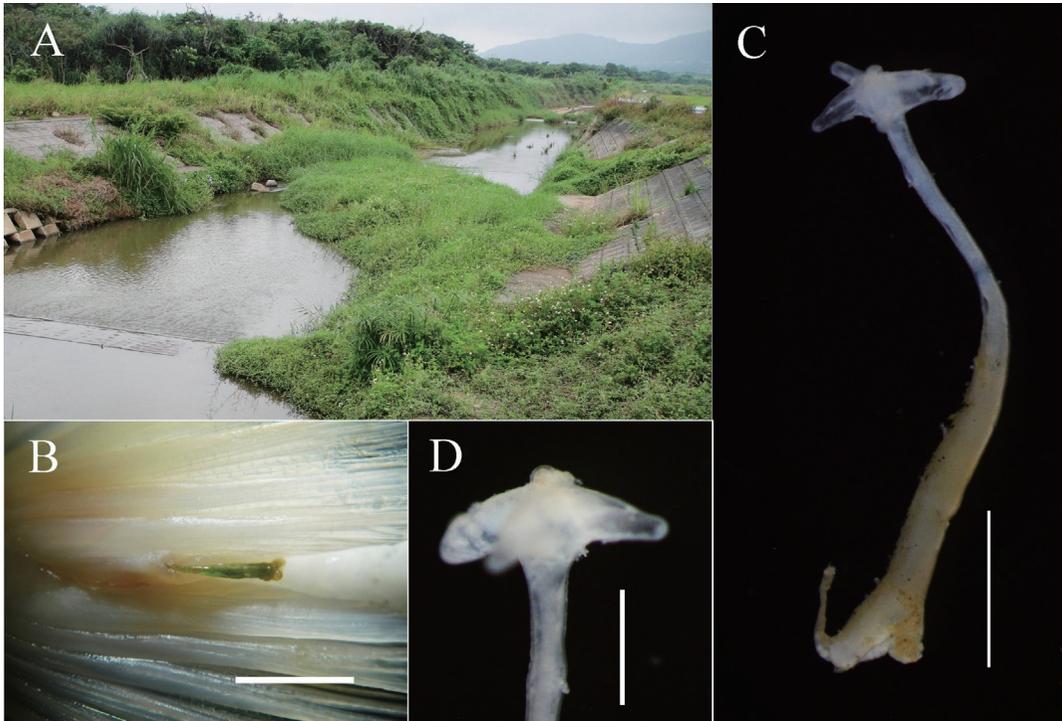


Fig. 1. A, sampling site of *Kuhlia rupestris* infected with *Lernaean cyprinacea* in the upper reaches of the Miyara River, Ishigaki-jima Island, Okinawa Prefecture, Japan (14 May 2010); B, metamorphosed adult female of *L. cyprinacea* found between the bases of the ventral fins of *K. rupestris*, fresh specimen; C, metamorphosed adult female of *L. cyprinacea*, ethanol-preserved specimen, lateral view; D, head and anterior part of neck of metamorphosed adult female of *L. cyprinacea*, ethanol-preserved specimen, lateral view. Scale bars: B, 5 mm; C, 2 mm; D, 1 mm.

■ Results

A single individual of *L. cyprinacea* was found on the ventral surface between the bases of the ventral fins of *K. rupestris* examined (150 mm SL). The anterior part of the body of *L. cyprinacea* was embedded in the host tissue, whereas the posterior part of the body protruded externally (Fig. 1B). The specimen of *L. cyprinacea* is a metamorphosed adult female (7.5 mm long), which is characterized by the cephalic holdfast comprising a pair of ventral processes and a pair of larger dorsal processes; the neck being cylindrical; the trunk tapering gradually from the junction with the neck towards the maximum width; the abdomen being short and conical; and a pair of genital swellings located on the ventral surface of the abdomen (Fig. 1C–D). A pair of regressed egg sacs, each containing 15 and 2 eggs, was also found near the posterior extremity of the body.

■ Discussion

There are three records of *L. cyprinacea* from the Ryukyu Islands. Uyeno et al. (2011) described the species from guppy, *Poecilia reticulata* Peters, 1859, and kuro-yoshinobori, *Rhinogobius brunneus*

(Temminck and Schlegel, 1845) (reported as *Rhinogobius* sp. DA), from Kume-jima Island. Recently, Shimadzu (2016) and Nagasawa et al. (2019b) found *L. cyprinacea* infecting Ryukyu ayu, *Plecoglossus altivelis ryukyuensis* Nishida, 1988, and *R. brunneus*, respectively, from Okinawa-jima Island. The morphology of our specimen corresponds to the description of *L. cyprinacea* given by Uyeno et al. (2011). The present paper represents the first record of *L. cyprinacea* from Ishigaki-jima Island.

Much remains unstudied on the parasitic copepods of freshwater fishes of the Ryukyu Islands. In addition to *L. cyprinacea* (Uyeno et al., 2011; Nagasawa et al., 2019b; this paper), only one species of parasitic copepod, *Neoergasilus japonicus*, has been reported from this region (Nagasawa and Uyeno, 2012). Until 2013, as many as 678 species of fishes in 110 families and 20 orders were recorded from inland waters of the Ryukyu Islands (Yoshigou, 2014). More work is needed to clarify the fauna of parasitic copepods of freshwater fishes of the Ryukyu Islands.

Kuhlia rupestris occurs in fresh waters in a wide area from East Africa in the west to Samoa in the

east, and its northernmost limit of distribution is the Ryukyu Islands (Froese and Pauly, 2019). Despite such a wide distribution of the species, our knowledge of its parasite fauna is very limited. There has been no record of *L. cyprinacea* from *K. rupestris* so far, and this fish species is a new host record for *L. cyprinacea*.

The reproduction of *L. cyprinacea* is strongly affected by water temperatures: the species stops spawning during a cold-water (winter) period in the temperate region of Japan (Kasahara, 1962). However, the specimen of the species had a pair of egg sacs in late January on Okinawa-jima Island (Nagasawa et al., 2019b) and our specimen from Ishigaki-jima Island almost finished spawning in mid-May. These facts suggest that the species can spawn for a longer period, even in winter, in the subtropical region than in the northern (temperature and subarctic) regions of Japan. It is desirable to study the life cycle and ecology of *L. cyprinacea* in different climate zones of Japan, where the species occurs in a wide region from the subarctic Hokkaido Island through the temperate Honshu, Shikoku, and Kyushu islands to the subtropical Ryukyu Islands (Nagasawa et al., 2007; Uyeno et al., 2011; Nagasawa and Urawa, 2019).

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