



Digeneans Found in Freshwater Fishes of the Uji River at Uji, Kyoto Prefecture, and the Takami River at Higashiyoshino, Nara Prefecture, Japan

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宇治川(京都市宇治市)と高見川(奈良市県東吉野村)の淡水魚類の二生類
Digeneans Found in Freshwater Fishes of the Uji River at Uji, Kyoto
Prefecture, and the Takami River at Higashiyoshino, Nara Prefecture, Japan

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Abstract: Freshwater fishes of 20 species collected in the Uji River at Uji, Kyoto Prefecture, and the Takami River at Higashiyoshino, Nara Prefecture, in 1999 and 2000 were examined for helminth parasites. Digenans of eight species (seven identified and one unidentified) in seven genera in four families found are described and illustrated. The life cycle and host and locality records of each of them are discussed. *Genarchopsis anguillae* Yamaguti, 1938 (Derogenidae) is regarded as a synonym of *G. goppo* Ozaki, 1925.

Key words: digeneans, freshwater fishes, Uji River, Takami River, Kyoto Prefecture, Nara Prefecture, Japan

Introduction

Freshwater fishes collected in the Uji River at Uji, Kyoto Prefecture, and the Takami River at Kotsugawa, Higashiyosino, Nara Prefecture, were examined for helminth parasites. This paper aims to report digeneans of eight species found. Cestodes, nematodes, and acanthocephalans found will be dealt with elsewhere.

Urabe (2003) and Shinagawa *et al.* (1999) had examined snails of *Semisulcospira* species (Pleuroceridae) collected in the Uji River at Uji and the Takami River at Kotsugawa for cercariae, respectively. Nakamura *et al.* (2000) had examined fishes caught in the latter place for parasites. The life cycle and host and locality records of each of the eight species are also discussed. For its previous host and locality records in Japan, readers are referred to Shimazu (2003).

Materials and Methods

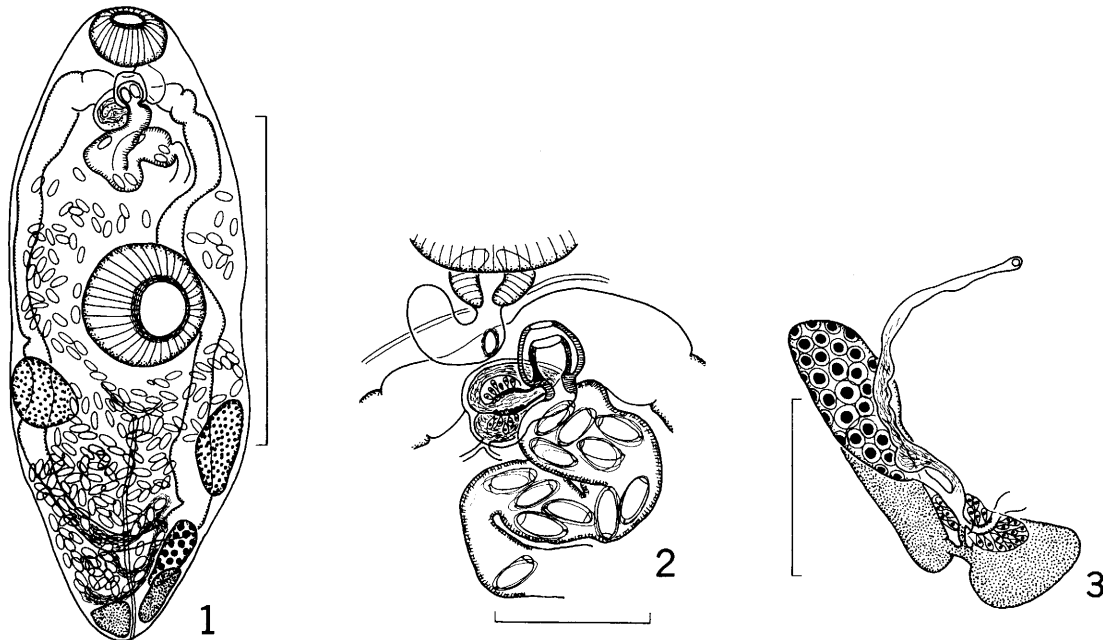
Freshwater fishes were collected in the Uji River at Uji, Kyoto Prefecture, on 30 April and 2 May 1998; and in the Takami River at Kotsugawa, Higashiyoshino, Nara Prefecture, on 25 July–1 August 1999, 9 October 1999, 25–26 December 1999, and 11–17 August 2000. They were examined fresh for helminth parasites under a stereoscopic microscope. The fishes examined were: *Zacco platypus* (Temminck and Schlegel) (number of fish examined, 10; standard body length of fish examined, 80–145 mm), *Sarcocheilichthys variegatus variegatus* (Temminck and Schlegel)(2; 95–130), *Pseudogobio esocinus esocinus* (Temminck and Schlegel) (2; 85–120), *Hemibarbus barbus* (Temminck and Schlegel) (4; 335–420), *Squalidus chankaensis biwae* (Jordan and Snyder)(12; 60–70)(Cyprinidae), *Plecoglossus altivelis altivelis* Temminck and Schlegel (1; 125) (Plecoglossidae), *Lepomis macrochirus* Rafinesque(5; 90–130), *Micropterus salmoides* (Lecepede) (2; 110–120)(Centrarchidae), *Gymnogobius urotaenia* (Hilgendorf) (1; 85), *Rhinogobius* sp. OR (tou-yosinobori in the common Japanese name) (22; 30–50), and *Tridentiger brevispinis* Katsuyama, Arai, and Nakamura (10; 50–75) (Gobiidae) from the Uji River; and *Z. platypus* (5; not measured), *Z. temminckii* (Temminck and Schlegel) (32; 63–130), *Phoxinus oxycephalus jouyi*

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Figs. 1-3. *Genarchopsis goppo* found in *Rhinogobius flumineus* from the Takami River.

1. Entire gravid worm, ventral view.
2. Terminal genitalis, ventral view.
3. Ovarian complex, dorsal view.

(Scale bars: 1 mm in Fig. 1; 0.2 mm in Figs. 2 and 3.)

(Jordan and Snyder) (15; 47-92), *Tribolodon hakonensis* (Günther) (13; 72-140), *Pungtungia herzi* Herzenstein (1; 59), *P. esocinus esocinus* (1; 115), *H. longirostris* (Regan) (1; 125) (Cyprinidae), *Cobitis biwae* Jordan and Snyder (16; 70-120) (Cobitidae), *Pseudobagrus nudiceps* Sauvage (2; 210-250) (Bagridae), *Liobagrus reini* Hilgendorf (59; 50-90) (Amblycipitidae), *Pl. altivelis altivelis* (5; 155-195), and *Rhinogobius flumineus* (Mizuno) (47; 30-55) (Gobiidae) from the Takami River. Prevalence and intensity of infection of each parasite species in each host species at each locality were not determined.

Digenean worms found were slightly flattened, fixed with AFA, and stained with either Heidenhain's iron hematoxylin or Grenacher's alum carmine, and mounted in Canada balsam. Drawings were made with the aid of a drawing tube. Measurements (length by width) are given in millimeters unless otherwise stated.

The specimens studied have been deposited in the National Science Museum, Tokyo (NSMT).

Family Derogenidae

Genarchopsis goppo Ozaki, 1925

Syn. *Progonus goppo* (Ozaki, 1925) Srivastava, 1933; *G. anguillae* Yamaguti, 1938, n. syn.; *G. gigi* Yamaguti, 1939; *Genarches goppo* (Ozaki, 1925) Skryabin and Gushanskaya, 1955; *Ge. anguillae* (Yamaguti, 1938) Skryabin and Gushanskaya, 1955; *Ge. gigi* (Yamaguti, 1939) Skryabin and Gushanskaya, 1955.

Occurrence. A total of 10 mature worms were found in the stomach of *Rhinogobius flumineus* from the Takami River.

Specimens. NSMT-Pl 5254-5256.

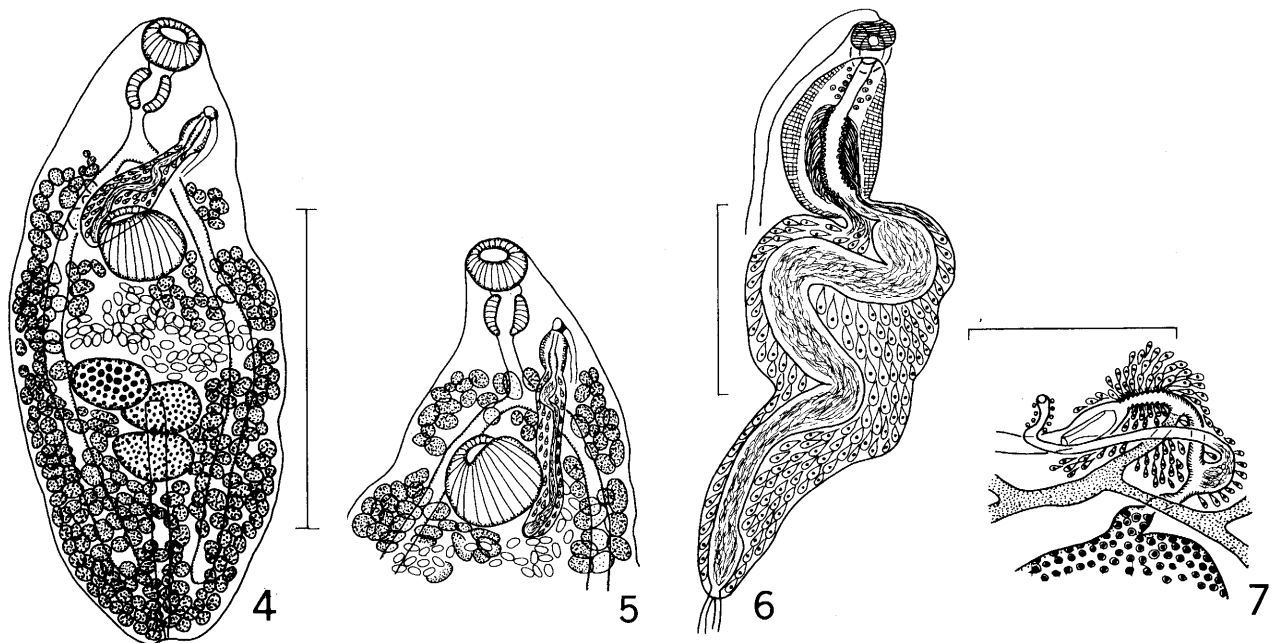
Description (Figs. 1-3). Based on 9 gravid specimens. Body spindle-shaped with bluntly pointed ends, 1.44-2.64 by 0.50-1.04; forebody 0.74-1.40 long, occupying 48-53% of total body

length. Preoral lobe present (not illustrated). Tegument smooth. Oral sucker subterminal, 0.15–0.24 by 0.17–0.31, with a well-developed sphincter. Prepharynx absent. Pharynx 0.05–0.10 by 0.08–0.15. Esophagus very short, with a small oval posteroventral pouch. “Drüsenmargen” small. Intestines winding, fusing to form a cyclocoel anteriorly to vitellaria. Ventral sucker large, about equatorial, 0.30–0.56 by 0.27–0.57, with a well-developed sphincter; sucker width ratio 1: 1.51–1.82. Testes globular to elliptical, slightly diagonal, lateral to or overlapping intestine on each side of body, between ventral sucker and ovary, 0.13–0.37 by 0.11–0.20. Sinus-sac thin walled, posterior to esophagus, 0.08–0.23 by 0.08–0.15, enveloping a retort-shaped convoluted seminal vesicle, a well-developed prostatic complex, and a short ejaculatory duct opening into base of sinus-organ dorsally to metraterm, and apparently distal part of metraterm. Hermaphroditic duct present only in sinus-organ. Sinus-organ permanent, muscular, cylindrical, thick, short, projecting into genital atrium. Genital atrium thick walled, dome-shaped. Genital pore almost median, ventral to pharynx. Ovary globular to elliptical, dextro- or sinistro-submedian, just anterior to vitellaria, 0.11–0.31 by 0.06–0.15. Ootype-complex median or submedian, anterior to vitellaria. Laurer’s canal long, storing a small number of spermatozoa, opening dorsally between ovary and testes. Seminal receptacle absent. Mehlis’ gland massive, enclosed by a membranous sheath. Uterus much coiled between vitellaria and sinus-sac, mostly medial to intestines; metraterm well differentiated, much longer than sinus-sac, with a well-developed sphincter at its anterior end, leading to base of sinus-organ; uterine seminal receptacle well developed. Eggs numerous, elongate-oblong, slightly reniform,

operculate, fully embryonated when laid, 60–84 by 32–42 μm , with a long anopercular filament. Vitellaria consisting of 2 elliptical symmetrical or diagonal masses measuring 0.11–0.25 by 0.07–0.14, near posterior end of body. Excretory vesicle Y-shaped, running anteriorly in ventral parenchyma, bifurcating between testes and ventral sucker, with arms uniting dorsally to pharynx or esophagus; excretory pore posteroterminal.

Discussion. *Genarchopsis goppo* and *G. anguillae* differ from each other in egg size (Shimazu, 1995). In *G. goppo* the eggs are smaller, measuring 51–72 by 21–35 μm (combined) in Japanese specimens (Shimazu, 1995), 57–64 by 22–26 μm in Japanese ones (Urabe, 2001), and 66–75 by 27–30 μm in Chinese ones (Moravec *et al.*, 2003). In *G. anguillae* the eggs are larger, measuring 69–78 by 30–36 μm in the holotype and a voucher specimen (Yamaguti, 1938, 1942) or 67–80 by 28–34 μm in the holotype (Shimazu, 1995). The present specimens had rather large eggs measuring 60–84 by 32–42 μm . This range of egg size is wide and overlaps the above-mentioned ranges of egg size of the two species. It is unreasonable to distinguish the two species solely by egg size. It is concluded that the two species are the same species, as suggested by Shimazu (1995) and Moravec *et al.* (2003).

Urabe (2001) experimentally elucidated the life cycle of *G. goppo* using cystophorous cercariae shed from naturally infected snails of *S. libertina* (Gould) from Nara; copepods, *Mesocyclops leuckarti* (Claus), *Thermocyclops hyalinus* (Rehberg), and *Eucyclops serrulatus* (Fischer), as experimental second intermediate hosts; and *Rhinogobius* sp. OR as an experimental final host. The cercariae were morphologically similar to *Cercaria yoshidae* Cort and



Figs. 4–7. *Dimerosaccus oncorhynchi* found in *Liobagrus reini* and *Rhinogobius flumineus* from the Takami River.

4. Entire gravid worm, ventral view.
5. Forebody of gravid worm, ventral view.
6. Terminal genitalia, dorsal view.
7. Ovarian complex, dorsal view.

(Scale bars: 0.3 mm in Figs. 4 and 5; 0.2 mm in Figs. 6 and 7.)

Nichols, 1920. It may be possible that the cercaria named *C. yoshidae* is composed of morphologically similar cercariae of more than one species of at least two genera developing in *Semisulcospira* spp. (see Shimazu, 1995, 2003). In *G. goppo*, according to Urabe (2001), the intestinal ceca end blindly in the cercarial stage, but they become united with each other posteriorly to form a cyclocoel in the metacercarial stage as seen in the already described adult stage. Shinagawa *et al.* (1999) recorded *C. yoshidae* from *S. libertina* collected in the Takami River at Kotsugawa. Their cercaria must have been the cercaria of *G. goppo*. The copepod host there is unknown. *Rhinogobius flumineus* is a final host there (Nakamura *et al.*, 2000; this paper).

Family Opecoelidae

Dimerosaccus oncorhynchi (Eguchi, 1931)

Shimazu, 1980

Syn. *Allocreadium oncorhynchi* Eguchi, 1931; *Plagioporus oncorhynchi* (Eguchi, 1931) Peters, 1957; *P. honshuensis* Moravec and Nagasawa, 1998.

Occurrence. Worms were found in the intestine of fishes of two species from the Takami River: 1 immature and 21 mature worms in *Liobagrus reini* and 1 immature and 10 mature in *Rhinogobius flumineus*.

Specimens. NSMT-PI 5257 and 5258 from *L. reini* and 5259 and 5260 from *R. flumineus*.

Description (Figs. 4–7). Based on 10 larger gravid specimens. Body lanceolate-oblong to

ovate, not oculate, 2.60–4.86 by 1.00–1.50; forebody 0.86–1.20 long, occupying 20–30% of total body length. Tegument smooth. Oral sucker subterminal, 0.19–0.25 by 0.19–0.29. Prepharynx very short. Pharynx 0.14–0.19 by 0.12–0.20. Esophagus 0.18–0.28 long, bifurcating between pharynx and ventral sucker; intestinal ceca extending to near posterior end of body. Ventral sucker sessile, located slightly anterior to junction of anterior and middle thirds of body, 0.27–0.44 by 0.31–0.54; sucker width ratio 1: 1.54–2.00. Testes transversely elongated, entire, median, tandem, contiguous, in middle third of hindbody, 0.19–0.52 by 0.27–0.54. Cirrus pouch distinctly bipartite; anterior portion thick walled, muscular, small, 0.15–0.31 by 0.09–0.14, enclosing a small distalmost part of seminal vesicle, a small pars prostatica surrounded by a small number of prostatic cells, and a short ejaculatory duct (cirrus) surrounded by small gland cells; posterior portion thin walled, membranous, long, 0.31–0.86 by 0.09–0.31, extending posteriorly usually beyond ventral sucker or sometimes not, enclosing an undulating tubular greater part of seminal vesicle and a large number of prostatic cells. Genital atrium small. Genital pore sinistrosubmedian at pharyngeal level. Ovary transversely reniform, just dextroanterior to anterior testis, 0.19–0.31 by 0.27–0.48. Laurer's canal proximally slightly dilated to contain a small number of spermatozoa as a seminal receptacle(?), running transversely to open dorsally to left of median line of body. Ootype-complex anterior or anterolateral to ovary. Mehlis' gland well developed. Uterus folded a few times between anterior testis, ovary, and ventral sucker, almost intercecal; metraterm nearly as long as anterior portion of cirrus pouch, with a crescent sphincter at its anterior

end; uterine seminal receptacle present. Eggs fairly numerous, not embryonated, operculate, 66–70 by 40–46 μm (collapsed). Vitelline follicles extending anteriorly to slightly postbifurcal level to middle level of esophagus and posteriorly to posterior end of body, anteriorly separate, posteriorly confluent. Excretory vesicle I-shaped, reaching anteriorly to ovary; excretory pore posteroterminal.

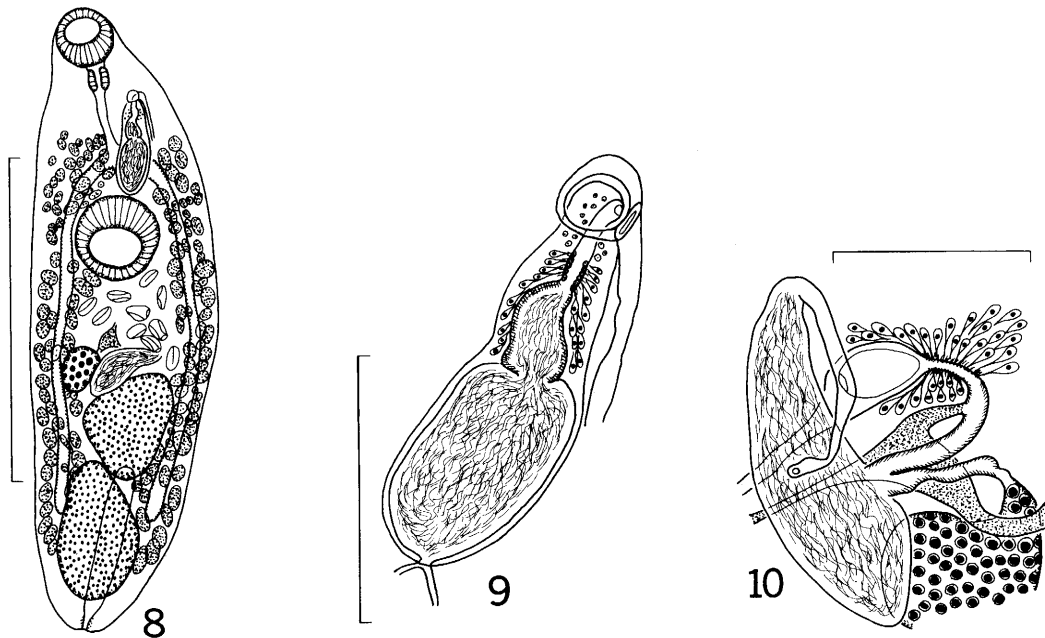
Discussion. In *D. oncorhynchi*, there have been known two morphological forms in Japan: the anterior limit of the vitelline follicles is posterior to the bifurcal level (Honshu form) but anterior to it (Hokkaido form) (see Shimazu, 2000). Both forms were observed in the present specimens (Figs. 4 and 5). Evidently, the difference in anterior limit of the vitelline follicles alone cannot separate species. The cirrus pouch extends posteriorly at most to the middle level of the ventral sucker in the specimens described by Shimazu (2000). In the present specimens, however, sometimes so it did (Fig. 4), but usually it extended posteriorly beyond the ventral sucker (Fig. 5).

This digenean was found in *L. reini* and *R. flumineus* from the Takami River at Kotsugawa in the present examination. Nakamura *et al.* (2000) obtained it from *R. flumineus* but not from *L. reini* at the same locality. Shinagawa *et al.* (1999) did not obtain any cercariae of cotylomicrocercous type, which are considered cercariae of opecoelid digeneans, from the snail *S. libertina* collected at the same place.

Neoplagioporus elongatus

(Goto and Ozaki, 1930) Shimazu, 1990

Syn. *Lebouria elongata* Goto and Ozaki, 1930; *Caudotestis orientalis* Yamaguti, 1934; *C. gnathopogonis* Yamaguti, 1934; *Plagioporus elongatus* (Goto and Ozaki, 1930) Price,



Figs. 8-10. *Neoplagioporus elongatus* found in *Sarcocheilichthys variegatus variegatus* and *Tridentiger brevispinis* from the Uji River.

8. Entire gravid worm, ventral view.

9. Terminal genitalia, ventral view.

10. Ovarian complex, dorsal view.

(Scale bars: 1 mm in Fig. 8; 0.2 mm in Figs. 9 and 10.)

1934; *P. (C.) elongatus* (Goto and Ozaki, 1930) Yamaguti, 1954; *P. (C.) gnathopogonis* (Yamaguti, 1934) Yamaguti, 1954; *P. (C.) orientalis* (Yamaguti, 1934) Yamaguti, 1954; *P. (P.) elongatus* (Goto and Ozaki, 1930) Skryabin and Koval', 1958; *P. (P.) orientalis* (Yamaguti, 1934) Skryabin and Koval', 1958; *Neolebouria elongatus* (Goto and Ozaki, 1930) Gibson, 1976.

Occurrence. Worms were found usually in the intestine and rarely in the rectum of fishes of six species from the Uji River: 1 immature and 34 mature worms in intestine of *Sarcocheilichthys variegatus variegatus*, 11 immature and 201 mature in intestine of *Hemibarbus barbus*, 9 mature in intestine of *Squalidus chankaensis biwae*, 1 immature and 4 mature in intestine of *Gymnogobius urotaenia*, 3 mature in rectum of *Rhinogobius* sp. OR, and 38 mature in intestine and rectum of *Tridentiger brevispinis*.

Specimens. NSMT-P1 5261 from *S. variegatus*

variegatus, 5262 and 5263 from *H. barbus*, 5264 from *Sq. chankaensis biwae*, 5265 from *G. urotaenia*, 5266 from *Rhinogobius* sp. OR, and 5267 from *T. brevispinis*.

Description (Figs. 8-10). Based on 10 larger gravid specimens. Body elongate-oblong, not oculate, 2.10-3.20 by 0.70-0.86; forebody 0.80-1.20 long, occupying 31-41% of total body length. Tegument smooth. Oral sucker subterminal, 0.19-0.26 by 0.20-0.25. Prepharynx very short. Pharynx barrel-shaped, 0.08-0.12 by 0.07-0.11. Esophagus 0.16-0.31, bifurcating posteriorly to middle level between pharynx and ventral sucker; intestinal ceca ending at middle level of testicular region. Ventral sucker at about junction of anterior and middle thirds of body, 0.27-0.38 by 0.28-0.36; sucker width ratio 1: 1.30-1.46. Testes entire, slightly diagonal, contiguous or slightly separate, in posterior

half of hindbody; anterior testis 0.27–0.47 by 0.31–0.35, posterior 0.31–0.54 by 0.31–0.47. Cirrus pouch claviform, anterior to or slightly overlapping ventral sucker, 0.31–0.52 by 0.08–0.12. Seminal vesicle internal, distinctly divided into two portions; posterior portion elliptical, thin walled, larger than anterior; anterior ovate, thick walled. Pars prostatica small, globular, surrounded by prostatic cells. Ejaculatory duct (cirrus) short, surrounded by small gland cells. Genital atrium small. Genital pore sinistrosubmedian, slightly posterior to pharyngeal level. Ovary almost globular, dextrorsubmedian, usually intercecal, pretesticular, 0.15–0.23 by 0.12–0.23. Seminal receptacle club-shaped, lying obliquely between ovary and anterior testis, 0.42–0.69 by 0.08–0.15, connecting to oviduct at border of middle and posterior thirds. Laurer's canal usually passing posteriorly to open dorsally near seminal receptacle. Ootype-complex anterior to ovary and seminal receptacle. Mehlis' gland well developed. Uterus coiled a few times between anterior testis and ventral sucker, intercecal; metraterm about half length of cirrus pouch. Eggs fairly numerous, not embryonated, 94–110 by 54–68 μm . Vitelline follicles distributed along intestinal ceca, anteriorly to middle level of esophagus, posteriorly to postcecal level at about middle level of posterior testis but rarely slightly into posttesticular region, separate. Excretory vesicle I-shaped, reaching merely to anterior testis; excretory pore posteroterminal.

Discussion. These specimens correspond well in morphology and measurements with *N. elongatus* as described by Shimazu (1990b). In the Uji River at Uji, a cercaria of cotylomicrocercous type, *Cercaria incerta* Faust, 1924, lives in *S. habei* Davis, *S. nakasekoe* Kuroda, and *S. reiniana* (Brot) (Urabe, unpublished

data; see also Urabe, 2003). This cercaria is considered the cercaria of an opecoelid species. It is still unknown what species the cercaria belongs to. For *N. elongatus*, *Sq. chankaensis biwae*, *G. urotaenia*, *Rhinogobius* sp. OR, and *T. brevispinis* are new host records, and the Uji River at Uji is a new locality record (see Shimazu, 1990b, 2003).

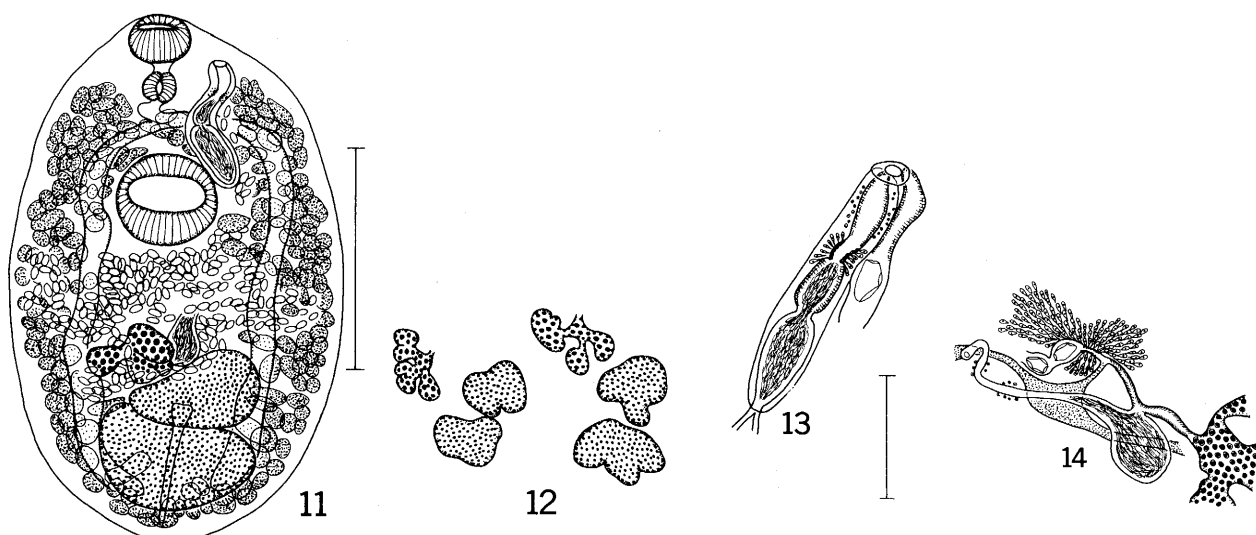
N. zacconis (Yamaguti, 1934) Shimazu, 1990

Syn. *Caudotestis zacconis* Yamaguti, 1934; *Plagioporus* (C.) *zacconis* Yamaguti, 1954; *P. (P.) zacconis* (Yamaguti, 1934) Skryabin and Koval', 1958.

Occurrence. Worms were found in the intestine of fishes of three species: 4 immature and 29 mature worms from *Zacco platypus* from the Uji River; and 22 mature from *Z. temminckii* and 1 immature and 14 mature from *Liobagrus reini* from the Takami River.

Specimens. NSMT-P1 5257, 5268, and 5269 from *Z. platypus*, 5270 from *Z. temminckii*, and 5271 from *L. reini*.

Description (Figs. 11–14): Based on 10 larger gravid specimens. Body oval, broadest at middle level of body, not oculate, 2.38–4.17 by 1.44–1.95; forebody 0.97–1.83 long, occupying 40–46% of total body length. Tegument smooth. Oral sucker subterminal, 0.24–0.35 by 0.30–0.37. Prepharynx short. Pharynx barrel-shaped, 0.13–0.21 by 0.15–0.21. Esophagus 0.27–0.39 long, bifurcating about halfway between two suckers; intestinal ceca extending usually to about middle level of posterior testis but rarely into posttesticular region. Ventral sucker slightly preequatorial, 0.44–0.72 by 0.45–0.66; sucker width ratio 1: 1.52–1.77. Testes globular to transversely elongated, entire or indented, median, tandem or slightly oblique,



Figs. 11-14. *Neoplagioporus zacconis* found in *Zacco platypus* from the Uji River and *Z. temminckii* and *Liobagrus reinii* from the Takami River.

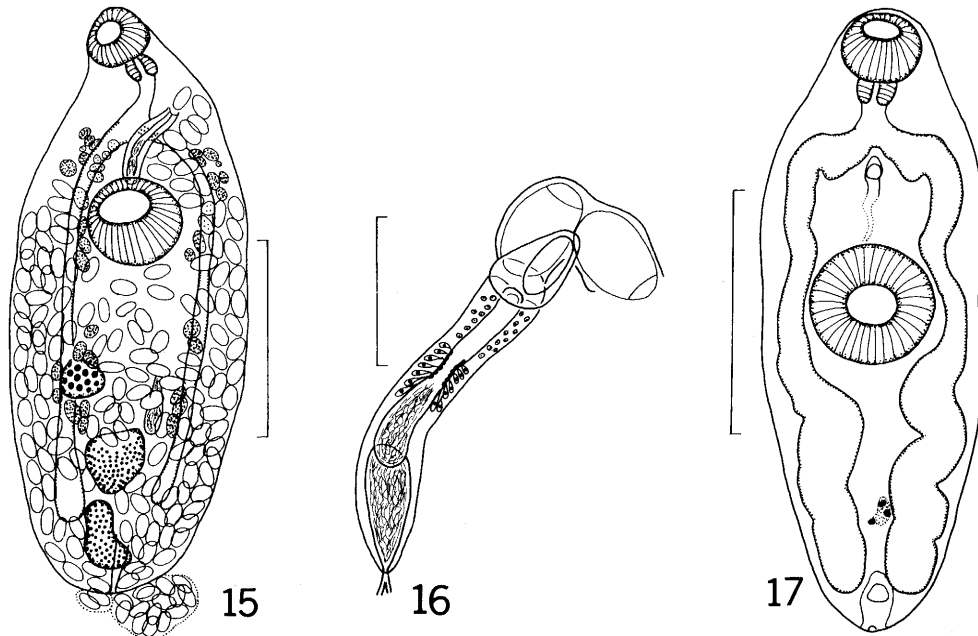
11. Entire gravid worm, ventral view.
12. Ovary and testes in two specimens, ventral view.
13. Terminal genitalia, ventral view.
14. Ovarian complex, dorsal view.

(Scale bars: 1 mm in Figs. 11 and 12; 0.3 mm in Figs. 13 and 14.)

contiguous, in posterior half of hindbody, anterior testis larger than posterior, 0.39-0.78 by 0.39-0.94. Cirrus pouch claviform, extending posteriorly to middle level of ventral sucker, 0.62-1.00 by 0.13-0.22. Seminal vesicle internal, distinctly bipartite; posterior portion oblong, thin walled, larger than anterior; anterior oval, thick walled. Pars prostatica small, surrounded by prostatic cells. Ejaculatory duct (cirrus) short, eversible, surrounded by small gland cells. Genital atrium small. Genital pore sinistrosubmedian, at pharyngeal level. Ovary deeply trilobed, lobes rarely further lobed, usually dextroanterior but rarely anterior to anterior testis, 0.20-0.43 by 0.39-0.86. Seminal receptacle medial to ovary, 0.32-0.54 by 0.12-0.19, connecting to oviduct at about middle level. Laurer's canal running transversely or obliquely to left, opening dorsally to left intestinal cecum. Ootype-complex anterior to ovary

and seminal receptacle. Mehlis' gland well developed. Uterus coiled usually between testes and ventral sucker, rarely extending anteriorly to middle level of ventral sucker and farther between testes, usually inter- and extra-cecal; metraterm well developed. Eggs fairly numerous, not embryonated when laid, 80-86 by 48-54 μm . Vitelline follicles distributed along intestinal ceca, anteriorly extending to pharyngeal level and separate, posteriorly entering posttesticular region and confluent, absent from peripheral fields of body. Excretory vesicle I-shaped, reaching to middle level of anterior testis; excretory pore posterosubterminal.

Discussion. These specimens correspond well in morphology and measurements with *N. zacconis* as described by Shimazu (1990b). As mentioned already, the cercaria of an opoecelid digenean, *C. incerta*, occurs in *S. habei*, *S. nakasekoe*, and *S. reiniana* in the Uji River at



Figs. 15 and 16. *Urorchis* sp. found in *Rhinogobius flumineus* from the Takami River.

15. Entire gravid worm, ventral view.

16. Terminal genitalia, ventral view.

Fig. 17. *Isoparorchis hypselobagri* found in *Tridentiger brevispinis* from the Uji River, entire immature worm, ventral view.

(Scale bars: 1 mm in Fig. 17; 0.5 mm in Fig. 15; 0.1 mm in Fig. 16.)

Uji (Urabe, unpublished data; see also Urabe, 2003). However, it is unknown what species this cercaria belongs to. For *N. zacconis*, *L. reini* is a new host record, and the Uji River is a new locality record (see Shimazu, 1990b, 2003). Nakamura *et al.* (2000) found this species in *Pungtungia herzi* as well as *Z. platypus* and *Z. temminckii* from the Takami River at Kotsugawa. Shinagawa *et al.* (1999) did not obtain any cercariae of cotylomicrocercous type from *S. libertina* collected at the same place.

Kim *et al.* (1998) described *N. zacconis* from *Z. platypus* from Korea. The ovary is usually bilobed but rarely trilobed in their specimens, but it is distinctly trilobed in Japanese ones (Shimazu, 1990b; this paper, Figs. 11 and 12). They attribute this difference in shape of the ovary to a geographical phenotypic variation.

Urorchis sp.

Occurrence. A single mature worm was found in the intestine of *Rhinogobius flumineus* from the Takami River.

Specimen. NSMT-P1 5272.

Description (Figs. 15 and 16). Based on 1 gravid worm. Body elongate-oval, not oculate, 1.87 by 0.74; forebody 0.68 long, occupying 36% of total body length. Tegument smooth. Oral sucker subterminal, 0.17 by 0.20. Prepharynx not seen. Pharynx barrel-shaped, 0.08 by 0.12. Esophagus 0.14 long, bifurcating about midway between two suckers; intestinal ceca extending to middle level of testicular region. Ventral sucker at about junction of anterior and middle thirds of body, 0.28 by 0.30; sucker width ratio 1: 1.50. Testes irregular in outline,

median, tandem, separate, in center of posterior half of hindbody, 0.20–0.21 by 0.17–0.18. Cirrus pouch clavate, curved, slightly overlapping ventral sucker posteriorly, 0.28 by 0.06. Seminal vesicle internal, bipartite; pars prostatica small, surrounded by prostatic cells; ejaculatory duct (cirrus) short, surrounded by small gland cells. Genital atrium small. Genital pore sinistrosubmedian, located at middle level of esophagus. Ovary deltoid, dextrosubmedian, pretesticular, 0.12 by 0.14. Ovarian complex not worked out. Uterus folded in all available space posterior to anterior border of ventral sucker; metraterm well developed in forebody. Eggs numerous, fully embryonated, 86–96 by 46–60 μm . Vitelline follicles sparse, surrounding intestinal ceca, between bifurcal level and anterior testis, separate. Excretory vesicle not worked out; excretory pore posteroterminal.

Discussion. This specimen is more similar in general morphology to *U. acheilognathi* Yamaguti, 1934 than *U. goro* Ozaki, 1927 as described by Shimazu (1990a). The ejaculatory duct (cirrus) is short. In this respect the specimen resembles *U. goro* rather than *U. acheilognathi*. Nakamura *et al.* (2000) did not find any specimens of *Urorchis* in the fishes from the Takami River at Kotsugawa. Accordingly, the present specimen remains unidentified until further specimens are available.

Family Isoparorchidae

Isoparorchis hypselobagri (Billet, 1898)

Ejmont, 1932

Syn. *Leptolecithum eurytremum* Kobayashi, 1915; *Isoparorchis eurytremus* (Kobayashi, 1915) Travassos, 1922.

Occurrence. Only two immature worms were found in the peritoneal cavity of *Tridentiger*

brevispinis from the Uji River.

Specimens. NSMT-P1 5273.

Description (Fig. 17). Based on 2 immature specimens. Body elongate-oblong, 3.26–3.56 by 1.14–1.16; forebody 1.54–1.60 long, occupying 47–49% of total body length. Tegument smooth. Oral sucker subterminal, 0.35 by 0.40–0.41. Prepharynx absent. Pharynx 0.10–0.12 by 0.19–0.21. Esophagus very short, 0.02–0.05 long, bifurcating at about middle level of forebody; intestinal ceca winding, reaching to near posterior end of body. Ventral sucker 0.60–0.62 in diameter, slightly anterior to middle level of body; sucker width ratio 1: 1.48–1.57. Genital organs very weakly developed, median, postbifurcal and near posterior end of body. Enlarged part of excretory vesicle seen posterior to genital organs; excretory pore posteroterminal.

Discussion. *Isoparorchis hypselobagri* is parasitic in the air bladder of the catfish *Silurus asotus* Linnaeus (Siluridae) in Japan (see Shimazu, 2003). *Tridentiger brevispinis* may serve as a second intermediate host or a paratenic host for the parasite. Urabe (2003) found *Cercaria introverta* Faust, 1924 in *S. nakasekoe* collected in the Uji River at Uji. Possibly, this cercaria is the larva of *I. hypselobagri* (see Shimazu, 2003).

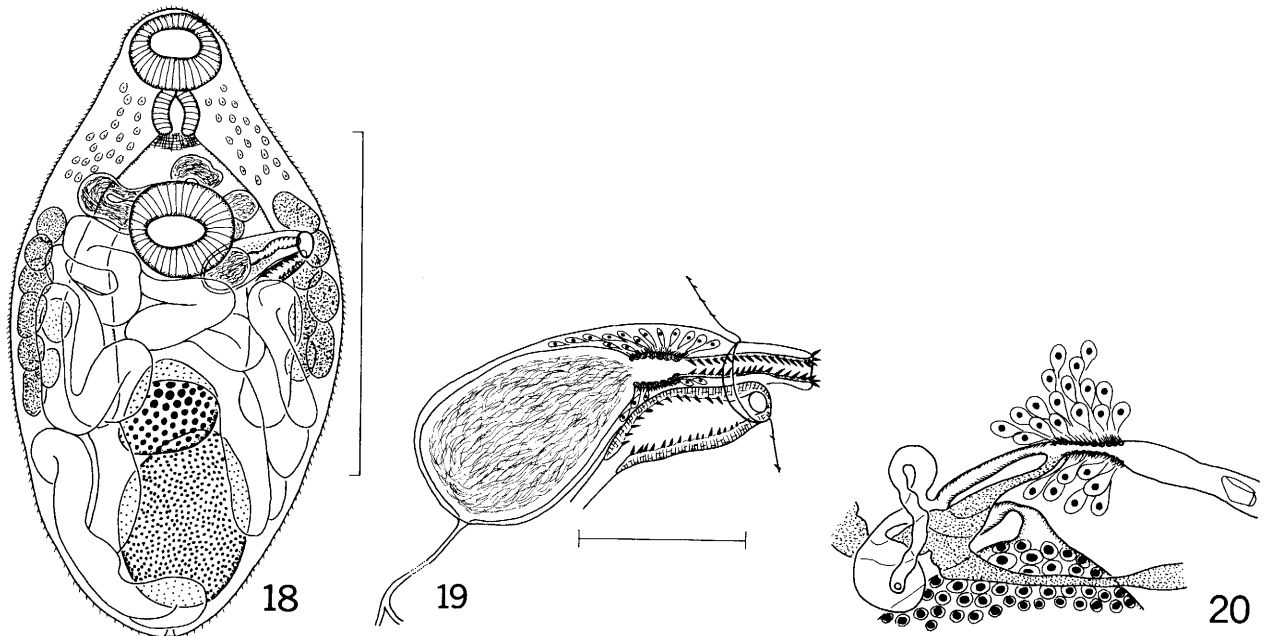
Family Lissorchiidae

Asymphylogora macrostoma Ozaki, 1925

Syn. *Parasymphylogora macrostoma* (Ozaki, 1925) Szidat, 1943; *Orientotrema macrostoma* (Ozaki, 1925) Tang, 1962.

Occurrence. A total of 1 immature and 45 mature worms were found in the intestine of *Tribolodon hakonensis* from the Takami River.

Specimens. NSMT-P1 5274 and 5275.



Figs. 18-20. *Asymphylogdora macrostoma* found in *Tribolodon hakonensis* from the Takami River.

18. Entire gravid worm, ventral view.

19. Terminal genitalia, ventral view.

20. Ovarian complex, dorsal view.

(Scale bars: 0.6 mm in Fig. 18; 0.1 mm in Figs. 19 and 20.)

Description (Figs. 18-20). Based on 10 larger gravid specimens. Body ovate, pointed more toward anterior end than toward posterior, 1.16-1.30 by 0.64-0.70; forebody 0.44-0.50, occupying 34-39% of total body length. Tegumental spines like scale, especially larger in several rows around periphery of orifice of ventral sucker. Gland cells seen in forebody. Oral sucker sub-terminal, large, 0.15-0.17 by 0.18-0.22. Prepharynx very short. Pharynx oblong, 0.08-0.11 by 0.08-0.10. Esophagus short, enlarged, 0.04-0.05 long, bifurcating just anterior to ventral sucker; intestinal ceca extending to middle level of hindbody. Ventral sucker located at about junction of anterior and middle thirds of body, 0.17-0.21 by 0.21-0.23; sucker width ratio 1: 1.04-1.30. Testis single, oblong, median, lying near posterior end of body 0.31-0.37 by 0.23-0.31. Sperm ducts double; common

sperm duct single, long. Cirrus pouch clavate, slightly curved, lying obliquely across left intestinal cecum, not reaching median line of body, 0.21-0.28 by 0.08-0.10. Seminal vesicle internal, almost spherical. Pars prostatica globular, small, surrounded by prostatic cells. Ejaculatory duct (cirrus) eversible, internally lined heavily by spines in posterior two-thirds. Genital atrium shallow. Genital pore sinistro-lateral or -sublateral at level of ventral sucker. Ovary almost round, median, just pretesticular, 0.15-0.21 by 0.15-0.22. Ootype-complex between ventral sucker and ovary. Laurer's canal present. Seminal receptacle present, empty (functionless) or containing only a small number of spermatozoa. Uterus much folded in all available space of hindbody even in posttesticular region; its proximal part folded dorsally and slightly anteriorly to ventral sucker, acting as a uterine

seminal receptacle; metraterm well developed, internally armed heavily with spines in posterior two-thirds, about half length of cirrus pouch. Eggs numerous, 26–30 by 14–18 μm , fully embryonated when laid. Vitelline follicles large, numbering 6 to 10 on each side of body, lateral, lying longitudinally along intestinal cecum in middle third of body. Excretory vesicle I-shaped, extending to ovary (not illustrated); excretory pore posteroterminal.

Discussion. These specimens agree in general morphology with *A. macrostoma* as described by Shimazu (1992). They are characterized by that the proximal loops of the uterus are located more anterior, or as farther as between the intestinal ceca and the ventral sucker.

Cercaria innominata (Faust, 1924) Ito, Mochizuki, and Noguchi, 1959 (originally spelt *innominatum*, Ito *et al.*, 1959), or *Cercariaeum innominatum* Faust, 1924, has been found in *S. nakasekoe* collected in the Uji River at Uji (Urabe, unpublished data; see also Urabe, 2003) and in *S. libertina* collected in the Takami River at Kotsugawa (Shinagawa *et al.*, 1999). This cercaria is the cercaria of *A. macrostoma* (Shimazu, unpublished data). *Tribolodon hakonensis* is a final host of this species in the Takami River at Kotsugawa (Nakamura *et al.*, 2000; this paper).

***Palaeorchis diplorchis* (Yamaguti, 1936)**

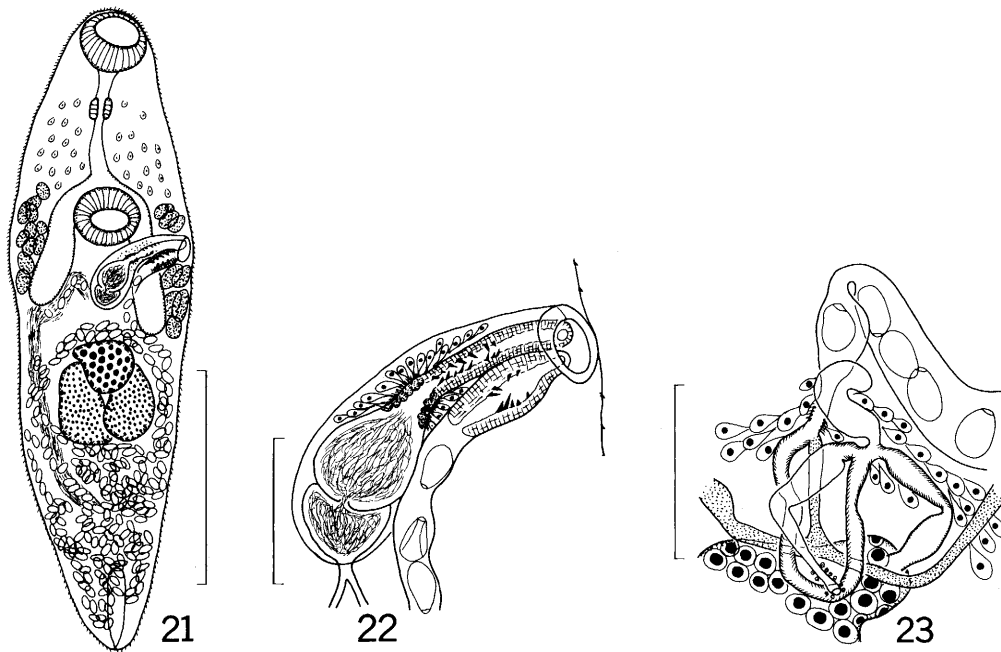
Szidat, 1943

Syn. *Asymphyllodora diplorchis* Yamaguti, 1936; *Steganoerma kamatukae* Takeuti, 1936.

Occurrence. A total of 38 mature worms were found in the intestine of *Pseudogobio esocinus esocinus* from the Uji River.

Specimens. NSMT-P1 5276 and 5277.

Description (Figs. 21–23). Based on 10 larger gravid specimens. Body elongate-oblong, 1.50–1.94 by 0.42–0.52; forebody 0.50–0.66, occupying 29–37% of total body length. Tegument spinose. Gland cells seen in forebody. Oral sucker subterminal, 0.15–0.18 by 0.18–0.19. Prepharynx present. Pharynx pyriform, 0.06–0.07 by 0.06. Esophagus 0.15–0.31 long, bifurcating just anteriorly to ventral sucker; intestinal ceca short, posteriorly terminating between ventral sucker and ovary. Ventral sucker median, located at about junction of anterior and middle thirds of body, 0.16–0.18 by 0.16–0.19; sucker width ratio 1: 0.84–1.04. Testes double, longitudinally elongated, median, symmetrical, contiguous, at about middle level of hindbody, 0.18–0.29 by 0.12–0.15. Sperm ducts double; common sperm duct absent. Cirrus pouch clavate, curved, lying obliquely across left intestinal cecum and posteriorly to ventral sucker, reaching median line of body, 0.23–0.31 by 0.06–0.12. Seminal vesicle internal, distinctly bipartite. Pars prostatica globular, small, surrounded by prostatic cells. Ejaculatory duct (cirrus) ever-sible, internally spined in posterior half. Genital atrium shallow. Genital pore sinistrolateral, at level of ventral sucker or slightly posterior to it. Ovary globular to deltoid, median, between anterior halves of testes, 0.15–0.19 by 0.12–0.23. Ootype-complex between ventral sucker and ovary. Laurer's canal present. Seminal receptacle present, empty (functionless) or containing only a small number of spermatozoa. Uterus much coiled in all available space posterior to cirrus pouch in hindbody, acting as a uterine seminal receptacle in proximal part; metraterm well developed, internally armed with spines in posterior half, about half length of cirrus pouch. Eggs numerous, 42–48 by 24–28 μm . Vitelline follicles small,



Figs. 21-23. *Palaeorchis diplorchis* found in *Pseudogobio esocinus esocinus* from the Uji River.

21. Entire gravid worm, ventral view.

22. Terminal genitalia, ventral view.

23. Ovarian complex, dorsal view.

(Scale bars: Fig. 0.5 mm in Fig. 21; 0.2 mm in Fig. 22; 0.1 mm in Fig. 23.)

numbering about 10, distributed laterally to intestinal cecum on each side of body. Excretory vesicle I-shaped, short, reaching posterior third of posttesticular region; excretory pore posteroterminal.

Discussion. These specimens correspond well in morphology and measurements with *P. diplorchis* as described by Shimazu (1992). Urabe (2001) found Cercaria D, which is morphologically similar to but different from *C. incognita* (Faust, 1924) Ito, 1962 (originally spelt *incognitum*, Ito, 1962), or *Cercariaeum incognitum* Faust, 1924, in *S. nakasekoe* from the Uji River at Uji. These tailless cercariae are morphologically similar to *C. innominata*, but they have shorter intestinal ceca which end at the level of the ventral sucker (Ito, 1962). It seems

likely that either Cercaria D or *C. incognita* is the cercaria of *P. diplorchis*. For *P. diplorchis*, the Uji River at Uji is a new locality record (see Shimazu, 1992, 2003).

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