[Jap. J. Parasit., Vol. 29, No. 3, 163-168, 1980]

Dimerosaccus gen. nov. (Digenea : Opecoelidae), with a Redescription of its Type Species, *Dimerosaccus oncorhynchi* (Eguchi, 1931) comb. nov.

TAKESHI SHIMAZU

Department of Parasitology, Faculty of Medicine, Shinshu University, Matsumoto, Japan

(Received for publication ; September 3, 1979)

In 1931 Eguchi described *Allocreadium oncorhynchi* (Digenea : Allocreadiidae) as a new species from the digestive tract of the freshwater salmonoid fish, *Oncorhynchus macrostomus* (=*O. rhodurus* f. *macrostomus*), taken in the Nagara River, central Japan. Since then there has been a dispute about its taxonomic position as will be discussed later. This study shows that it represents a new genus of the family Opecoelidae as type species.

Materials and Methods

The trematodes used in this study were newly collected from Japanese fresh-water salmonoid fishes : (1) 10 specimens (deposited in the National Science Museum, Tokyo, Coll. Nos. NSMT—Pl 2169–2172) from the small intestine of *O. rhodurus* f. *macrostomus* from the Nagara River, Gujo-gun, Gifu Prefecture, on 12 September 1975, 20 January 1977 and 31 March 1979 ; (2) 49 (NSMT—Pl 1945–1950 and 2168) from the pyloric ceca and small intestine of *Salvelinus leucomaenis pluvius* from the Samu River, Iiyama, Nagano Prefecture, on 16, 17 and 24 September 1978 and 18 March 1979 ; and (3) 12 (obtained by Mr. Kazuya Nagasawa, deposited in the Meguro Parasitological Museum, Tokyo, MPM Coll. No. 19260) from the small intestine of *O. masou* f. *ishikawai* from the Horei River, Sanriku, Iwate Prefecture, on 19 March 1978. They were found in fresh raw or formalin-preserved fishes, flattened, fixed (or refixed) in Schaudinn's solution or 70% ethanol, stained with Heidenhain's iron hematoxylin or alum carmine, and mounted in Canada balsam. The excretory system was studied in living worms.

Dimerosaccus gen. nov.

Generic diagnosis. Digenea : Opecoelidae : Opecoelinae. Body fairly small, elongate-oval, aspinose, nonoculate. Oral sucker rather small, subterminal. Prepharynx and pharynx present. Esophagus short. Intestinal ceca treminating blindly. Ventral sucker largely pre-equatorial. Ovary pretesticular. Laurer's canal present. Seminal receptacle absent. Ootype complex preovarian. Uterus coiling entirely anterior to ovary. Eggs non-embryonated when laid. Testes tandem, in middle third of body. Vas deferens lacking. A membraneous sac enclosing external seminal vesicle and gland cells. Cirrus pouch small, thick-walled, anterolateral to ventral sucker, containing internal seminal vesicle, prostatic complex and ejaculatory duct. Genital atrium very small. Genital pore submarginal, located in cervical region on left side of body. Vitelline follicles circumcecal, distributed in hindbody. Excretory vesicle I-shaped ; flame cell formula 2[(2+2)+(2+2)]=16, where known. Intestinal par-

asites of fresh-water teleosts.

Type and only species. Dimerosaccus oncorhynchi (Eguchi, 1931) comb. nov.

Dimerosaccus oncorhynchi (Eguchi, 1931) comb. nov.

Figs. 1–7 ; Table 1

Syns. : *Allocreadium oncorhynchi* Eguchi, 1931 ; *Plagioporus oncorhynchi* (Eguchi, 1931) Peters, 1957.

Description. Body elongate-oval, with gland cells scattered in forebody. Cuticle smooth. Pigmented eyespots not seen even in young specimens. Oral sucker subterminal, rather small. Prepharynx short. Pharynx longer than wide. Esophagus short, bifurcating anterior to ventral sucker. Intestinal ceca terminating blindly near posterior end of body. Ventral sucker larger than oral sucker, in posterior part of anterior third of body. Ovary globular or irregularly indented, usually wider than long, median, just pretesticular. Ootype complex preovarian. Laurer's canal rather long, at times with dilatation at its junction with oviduct. Seminal receptacle absent. Uterus forming a few loops between ovary and ventral sucker in flattened specimens, storing spermatozoa in its proximal portion as uterine seminal receptacle ; metraterm short. Eggs light brown, unsegmented when laid. Testes tandem, irregular in outline, in middle third of body. Vasa efferentia coalescing into external seminal vesicle without forming vas deferens. Membraneous sac large, thin-walled, enclosing external seminal vesicle and a large number of gland cells, extending posteriad as far as midlevel of ventral sucker in flattened specimens or slightly beyond

Table 1 Comparison between *Allocreadium oncorhynchi* and the present trematodes in measurements in mm

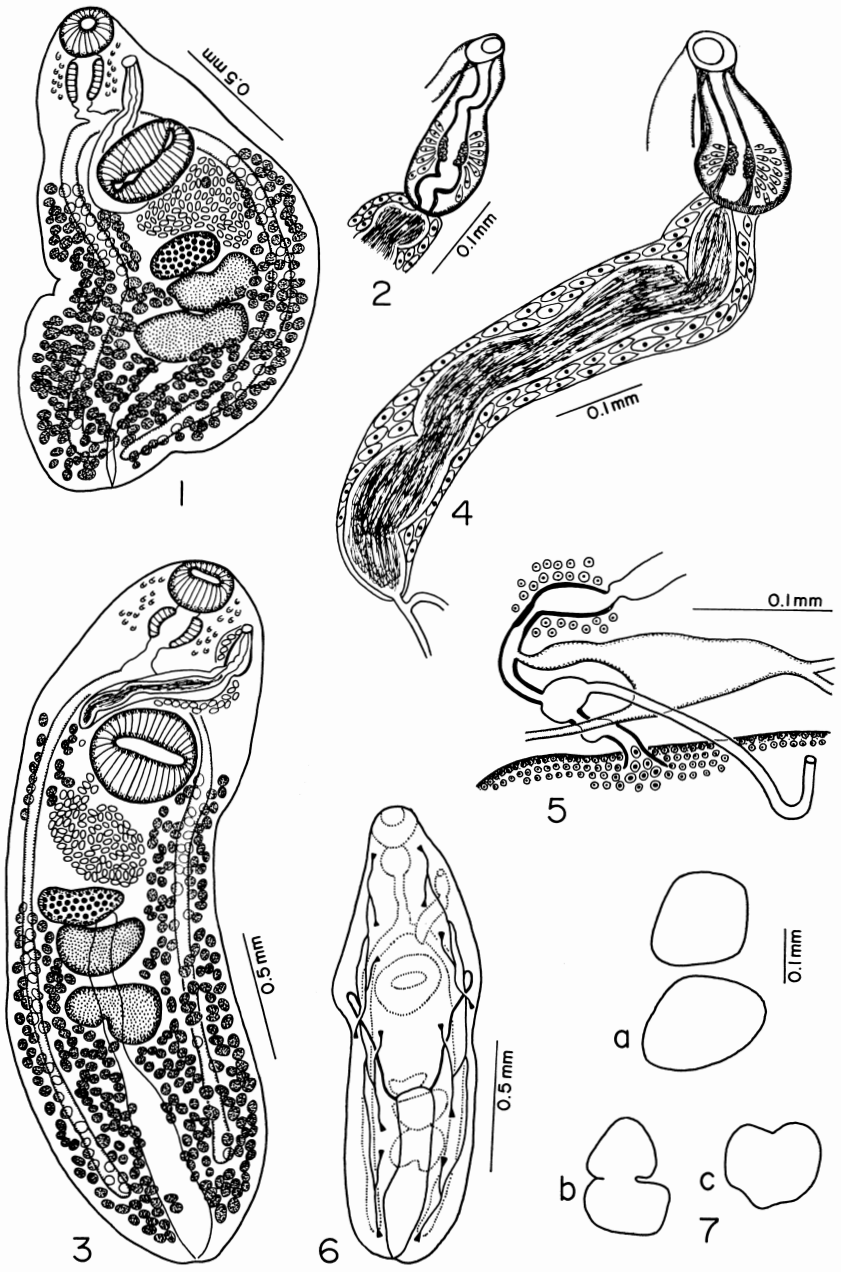
Parasites		*A. oncorhynchi**	The present trematodes		
Hosts†		*O. r. m.*	*O. r. m.*	*S. l. p.*	*O. m. i.*
No. of specimens measured		—	3	10	3
Body	l.‡	2.1 -2.4	1.77 -2.24	3.09 -4.18	2.44 -2.97
	w.§	0.72 -0.9	0.91 -1.02	0.68 -0.92	0.58 -0.63
Oral sucker	l.	0.160-0.194	0.17 -0.20	0.20 -0.25	0.20 -0.22
	w.	0.13 -0.15	0.19 -0.20	0.22 -0.26	0.20 -0.25
Ventral sucker	l.	0.24 -0.27	0.25 -0.29	0.31 -0.43	0.31 -0.35
	w.	0.30 -0.33	0.37 -0.38	0.34 -0.45	0.30 -0.35
Sucker width ratio		—	1 : 1.76-2.00	1 : 1.50-1.82	1 : 1.40-1.59
Pharynx	l.	0.13 -0.15	0.17 -0.18	0.16 -0.20	0.12 -0.16
	w.	0.105-0.12	0.12	0.12 -0.24	0.14 -0.17
Ovary	l.	0.135-0.18	0.15 -0.20	0.14 -0.32	0.11 -0.18
	w.	0.16 -0.24	0.24 -0.31	0.18 -0.33	0.15 -0.22
Testes	l.	0.16 -0.285	0.18 -0.28	0.20 -0.48	0.18 -0.22
	w.	0.30 -0.285	0.32 -0.44	0.30 -0.46	0.20 -0.28
Cirrus pouch	l.	—	0.16 -0.20	0.16 -0.20	0.18 -0.20
	w.	—	0.08	0.08 -0.12	0.08 -0.09
Membraneous sac	l.	—	—	0.44 -0.61	0.40 -0.45
Eggs		0.0575× 0.0335	0.052-0.059× 0.031-0.033	0.044-0.057× 0.028-0.031	0.054-0.065× 0.033-0.038

* According to Eguchi (1931, 1932).

† *O. r. m.*, *Oncorhynchus rhodurus* f. *macrostomus* ; *S. l. p.*, *Salvelinus leucomaenis pluvius* ; *O. m. i.*, *O. masou* f. *ishikawai.*

‡ Length.

§ Width.



Explanation of Figures

Figs. 1–7 *Dimerosaccus oncorhynchi* (Eguchi, 1931) comb. nov.

Figs. 1 and 2 Specimen from *Oncorhynchus rhodurus* f. *macrostomus*.
1, entire worm, slightly shrinking, ventral view; and 2, cirrus pouch, ventral view.

Figs. 3–6 Specimens from *Salvelinus leucomaenis pluvius*. 3, entire worms, flattened, ventral view; 4, male terminalia, ventral view; 5, ovarian complex, dorsal view; and 6, excretory system in another young specimen, flattened, ventral view.

Fig. 7 Outline drawings of testes in specimens from *O. masou* f. *ishikawai*. a, normal testes; b, incompletely divided one; and c, very little divided one.

ventral sucker in unflattened ones; external seminal vesicle large, somewhat sinuous, thin-walled. Cirrus pouch elongate pear-shaped, thick-walled, small, never reaching ventral sucker, including internal seminal vesicle, prostatic complex and ejaculatory duct; internal seminal vesicle tubular, thick-walled, short; pars prostatica oval, small, accompanied by prostatic cells; ejaculatory duct muscular, short. Genital atrium very small. Genital pore submarginal at level of prepharynx on left side of body. Vitelline glands follicular, circumcecal, distributed from midlevel of ventral sucker to posterior end of body. Excretory vesicle tubular, reaching to ovary; main collecting canals of mesostomate type, ciliated, dividing near ventral sucker; flame cell formula 2[(2+2)+(2+2)]=16; pore terminal. Table 1 compares the measurements of the present material with those of *A. oncorhynchi* given by Eguchi (1931, 1932).

Notes. The internal seminal vesicle (Fig. 2) of the worms from *O. rhodurus* f. *macrostomus* was longer and more winding than those (Fig. 4) of the others. In some of the flukes from *O. masou* f. *ishikawai* were observed incompletely differentiated testes. Figure 7 illustrates one case of the normally formed testes (a) and two cases of incompletely divided testes (b and c).

Discussion

All of the present trematodes may be identified as *A. oncorhynchi*, although there are slight morphological differences between them and Eguchi's (1931, 1932) descriptions of this species. For the present the species must rest only on his descriptions. No detailed studies nor additional records of the species have appeared since his papers. Moreover, his original specimens have been missing (his personal communication dated 7 September 1977). Eguchi (1932) described (pp. 26–27): "It [the cirrus or membraneous sac] . . . is made up of very thin walls. Vesicula seminalis [externa] makes one or two involutions, ... Anterior to this part it becomes slender and turns into the prostate part of the ductus ejaculatorius. These parts are encircled by glandular cells which are filling up the cirrus sac. . . . . The ejaculatory part is made of tubules of small inside diameter, but the wall is well developed and thick, . . . the border line between the cirrus sac . . . and ejaculatory part is strongly constricted." Despite this description, however, he illustrated (Figs. 1, 2 and 5) the male terminal apparatus closely similar to that of the present material, in which as described above, the membraneous sac surrounded the external seminal vesicle and gland cells, and the true cirrus pouch included the internal seminal vesicle, prostatic complex and ejaculatory duct. This suggests his misinterpretation of the structural details of the apparatus. Yamaguti (1958), examining Eguchi's syntype, claimed that the membraneous sac was absent and that the true cirrus pouch contained only the terminal portion of the male duct. This is untenable. Eguchi observed a long vas deferens and the seminal receptacle formed independently of the Laurer's canal. The present material lacked these organs. In some specimens, the junction of the Laurer's canal with the oviduct was dilated (Fig. 5), but spermatozoa were seen not in the dilatation but in the uterine seminal receptacle. He described the prepharynx as being absent and the excretory vesicle as being Y-shaped and dividing at about the level of the anterior testis. The present material had a short prepharynx and a tubular vesicle reaching to the ovary. Presumably these differences are due to his erroneous observations.

Eguchi (1931, 1932) assigned his new species to the genus *Allocreadium* Looss, 1900, as *A. oncorhynchi*, the family Allocreadiidae. Later, Peters (1957), who examined one of Eguchi's specimens, "tentatively" transferred it to the genus *Plagioporus* Stafford, 1904, as *P. oncorhynchi*, the family Opecoelidae. He noted that its cirrus pouch differed from that of other species of this genus but did not explained further the detailed structure of the pouch. Yamaguti

(1958, 1971) disagreed with each of them and stated that it should be reffered to another opecoelid genus on account of different characters of its male terminal organs. The organs described above are distinct from those of *Allocreadium* and *Plagioporus*, both of which possess the thin-walled cirrus pouch enclosing the seminal vesicle, prostatic complex and cirrus or ejaculatory duct, but lack the external seminal vesicle (Yamaguti, 1971). This excludes the species from each of the two genera.

According to Cable (1956) and Yamaguti (1971, 1975), its morphological features, particularly the flame cell formula in its adult stage, 2[(2+2)+(2+2)]=16, indicates that the species belongs to the family Opecoelidae. Its characteristic male terminalia readily separate it from all known genera of the family. As defined above, therefore, a new genus, *Dimerosaccus*, is proposed to include it as type species, *Dimerosaccus oncorhynchi* (Eguchi, 1931) comb. nov. Morphologically this new genus appears related to the genera *Opecoelus* Ozaki, 1925, *Opecoelina* Manter, 1934, *Opegaster* Ozaki, 1928, and *Ozakia* Wisniewski, 1933, of the subfamily Opecoelinae, although it is distinguishable from all of them by the membraneous sac and blindly ending ceca. It may be that it is a member of the subfamily.

As already discussed, the present observations have made some corrections and additions to Eguchi's original description of the species. Accordingly, the specific diagnosis is partially emended: prepharynx present; seminal receptacle absent; vas deferens lacking; external seminal vesicle and gland cells enclosed in membraneous sac; cirrus pouch thick-walled, small, containing internal seminal vesicle, prostatic complex and ejaculatory duct; excretory vesicle tubular, reaching to ovary; and flame cell formula 2[(2+2)+(2+2)]=16.

Summary

Dimerosaccus gen. nov. (Digenea: Opecoelidae: Opecoelinae) is erected to include *Dimerosaccus oncorhynchi* (Eguchi, 1931) comb. nov. [syns.: *Allocreadium oncorhynchi* Eguchi, 1931; *Plagioporus oncorhynchi* (Eguchi, 1931) Peters, 1957] as type and only species. It differs from all known genera of the family Opecoelidae in having the membraneous sac surrounding the external seminal vesicle and gland cells. The species is redescribed from specimens newly obtained from the pyloric ceca and small intestine of the Japanese fresh-water salmonoid fishes, *Oncorhynchus rhodurus* f. *macrostomus*, *O. masou* f. *ishikawai* and *Salvelinus leucomaenis pluvius*. The specific diagnosis is emended.

Acknowledgments

The author is grateful to Mr. Jiro Shirataki, Hachiman, Gifu Prefecture, for providing the fish from the Nagara River. He thanks also Mr. Kazuya Nagasawa, Faculty of Agriculture, University of Tokyo, Tokyo, and Mr. Shunya Kamegai, Meguro Parasitological Museum, Tokyo, for permitting him to study the specimens deposited in the Museum.

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Addendum

After the manuscript went to the editor, another specimen (NSMT—Pl 2173) of the species was found in the author's collection. It was obtained from the small intestine of *S. leucomaenis pluvius* fished in the Hime River, Hakuba, Nagano Prefecture, on 13 July 1979.

新属 *Dimerosaccus* (Digenea : Opecoelidae), および模式種 *Dimerosaccus oncorhynchi* (Eguchi, 1931) comb. nov. の再記載

嶋津　武
（信州大学医学部寄生虫学教室）

Allocreadium oncorhynchi Eguchi, 1931 (Allocreadiidae 科) に同定すべき吸虫を，アマゴ *Oncorhynchus rhodurus* f. *macrostomus* (岐阜県郡上郡長良川)，ヤマメ *O. masou* f. *ishikawai* (岩手県三陸町甫嶺川)，イワナ *Salvelinus leucomaenis pluvius* (長野県飯山市寒川) の幽門垂と小腸から見出して，種を再記載した．分類学的検討の結果，本種は，形態的諸形質，とりわけ成虫期における 2[(2+2)+(2+2)]=16 という炎細胞式からみて，Opecoelidae 科の Opecoelinae 亜科に新属 *Dimerosaccus* を設けて，模式種として所属させるべきものとの結論をえた．本新属は，外貯精嚢とそれを取り巻く腺細胞とを包囲する薄い被膜のある点を特徴とする．本吸虫の所属が変つたので，種名は *Dimerosaccus oncorhynchi* (Eguchi, 1931) comb. nov. となつた．*A. oncorhynchi* と *Plagioporus oncorhynchi* (Eguchi, 1931) Peters, 1957 とは同物異名である．上記標本の観察結果から，江口 (1931) と Eguchi (1932) の原記載中に，不正確なあるいは誤つた個所を認めたので，種の標徴を部分的に修正した．