

Two Korean Digenetic Trematodes : *Orientocreadium koreanum* sp. nov. and *O. pseudobagri* Yamaguti, 1934 (Orientocreadiidae) from Freshwater Fishes

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One new and one the first recording digenetic trematodes are described from Korean freshwater fishes : *Orientocreadium koreanum* sp. nov. from *Liobagrus andersoni* Regan (Korean torrent catfish) and *O. pseudobagri* Yamaguti, 1934 from *Pseudobagrus fulvidraco* (Richardson) (Korean bullhead). The problems of the family Orientocreadiidae and the major identifying characters of *O. koreanum* are discussed.

Key words : Digenetic trematodes, *Orientocreadium koreanum* sp. nov., *O. pseudobagri*, Freshwater fish, Taxonomy, Korea

The family Orientocreadiidae is a digenean group which parasitises in intestine of freshwater fishes. In the palearctic region, *Orientocreadium pseudobagri* Yamaguti, 1934, *O. siluri* (Bychovskii et Dubinina, 1954) and *O. chaenogobii* Shimazu, 1990 were recorded. Little is known concerning the adult platyhelminth parasites of the fish of Korea. There are few reports about fish helminths in Korea since Park (1938, 1939a, b, c) had reported several digenean species from the fish of Korea. Undoubtedly, no species of orientocreadiids are known to inhabit Korean freshwater fishes.

During a study to document more fully the species of adult platyhelminths infecting Korea fishes, two species of Digenea were recovered including one new species, *Orientocreadium koreanum*, from Korean torrent catfish and one the

first recording species, *O. pseudobagri*, from Korean bullhead.

Materials and methods

One individual of Korean torrent catfish was collected at Yangpyung Gun, Kyongki-Do in October 1994 and 10 individuals of Korean bullheads were purchased at Kyongdong fish market, Seoul in the year 1994 and were examined for parasites.

The recovered worms were placed in a solution of normal saline and fixed in hot AFA, then stored in 70% ethanol, stained with Semichon's acetocarmine and mounted in Canada balsam. Mounted specimens were measured and observed with light microscope and were illustrated with the aid of a camera lucida.

Results

Orientocreadium koreanum sp. nov.

Description (Fig. 1). This description is based upon 2 whole-mounted mature worms. The dimensions of this worm are given in Table 1.

These worms have an elongate subcylindrical body-shape, dorsoventrally flattened. The widest point of the body may occur at the level of the ovary. The body-surface bears spines which reach to the posterior region, becoming more widely spaced posteriorly.

The subterminal, globular oral sucker is same or slightly smaller than the globular ventral sucker, the ratio being 1 : 1.0–1.17. The center of the ventral sucker lies at about one-third of the body length from the anterior end. There is a distinct prepharynx which leads into a subglobular

pharynx which has 4 anterior muscular protuberances, and this in turn leads into an short oesophagus. The caeca terminate about posterior end zone.

The testes lie in tandem in the hind body and are separated by uterine coils. Their shape is oval and margins are smooth. The length of the post-testicular region is relatively short. The posterior testis is usually larger than anterior one. The size of the testes is considerably larger than that of the ovary, the ratio of the anterior testis : ovary is 1 : 0.64–0.68 and the posterior testis : ovary 1 : 0.55–0.59. The cirrus-sac is a large, slightly curved clavate structure and reaches to a point between a level anterior region of the ventral sucker and a level posterior zone of the ventral sucker. It contains a oval internal seminal vesicle of small size, a tubular pars prostatica and a long cirrus. The proximal portion of cirrus

Table 1. Dimensions of *Orientocreadium koreanum* n. sp.

Items	Specimens	
	Holotype	Paratype
Hosts	<i>Liobagrus andersoni</i>	<i>Liobagrus andersoni</i>
Locality	Korea	Korea
Length(mm)	1.03	1.29
Breadth(mm)	0.25	0.25
Oral sucker(mm)	0.10×0.095	0.115×0.113
Ventral sucker(mm)	0.12×0.11	0.113×0.115
Sucker ratio	1 : 1.17	1 : 1.00
Prepharynx(mm)	0.030	0.070
Pharynx(mm)	0.063×0.055	0.075×0.065
Oesophagus(mm)	0.030	—
Cirrus sac(mm)	0.21×0.06	0.26×0.06
Testes(mm)	0.16×0.12(upper) 0.14×0.18(lower)	0.14×0.14(upper) 0.14×0.19(lower)
Ovary(mm)	0.11×0.08	0.08×0.10
Eggs(um)	35×20	35×22

sac is connected with large, voluminous external seminal vesicle which reaches to the anterior margin of the ovary. The distal portion of the cirrus sac forms an well developed sphincter structure.

The internal seminal vesicle and the pars prostatica are densely surrounded by numerous prostatic gland cells. The genital pore lies medially and just in front of the ventral sucker.

The subglobular to oval ovary lies about half-way between the anterior testis and the ventral sucker. There is no seminal receptacle. The oviduct and the initial coils of the uterus contain small amount of sperms. Mehlis' gland lies just posteriorly to the ovary. Laurer's canal was not clearly seen.

The uterus, which contains several tens of smooth-shelled, operculate eggs, reaches to or close to the posterior extremity. The ascending uterine coil initially passes the right side of the posterior testis and coils between testes, then it again ascends the right side of the anterior testis and passes ovarian region. The uterus does not pass to the left of the gonads.

The well-developed metraterm lies along the cirrus pouch. The internal side of the metraterm has numerous spines. The vitellarium consists of numerous and relatively large follicles in two symmetrical lateral fields between the level of the ovary and the vicinity of the posterior extremity of the body. The exact anterior limits of the vitellium in paratype specimen are, however, somewhat above the anterior margin of the ovary.

Etymology : The epithet is derived from Latin name for Korea.

Host : *Liobagrus andersoni* Regan

Infection site : Intestine

Type locality : Yangpyun Gun, Kyongki-Do, a branch stream of the Han River

Holotype : NFUP Helm. Coll. No. 174; Paratype 174-1

Orientocreadium pseudobagri Yamaguti, 1934

Description(Fig. 2). This description is based upon 5 whole-mounted mature worms. The dimensions of this worm are given in Table 2.

The worm is of an elongate subcylindrical shape, dorsoventrally flattened. The widest point of the body may occur at the level of the ovary. The body-surface, except for the posterior extremity, bears spines which reach to the posterior region, becoming more widely spaced posteriorly.

The subterminal, globular oral sucker is same or slightly smaller than globular ventral sucker, the ratio being 1 : 1.0-1.1. In young specimens which bears no eggs, the oral sucker is slightly larger than ventral sucker, the ratio being 1 : 0.9 and the ventral sucker is situated at about one-second of the body-length from the anterior end, but in older specimens it becomes more anteriorly situated as the hindbody grows allometrically. There is a distinctive prepharynx which leads into a subglobular pharynx which has 4 anterior muscular protuberances, and this in turn leads into an short oesophagus. The caeca terminate about posterior end zone.

The testes lie in the posterior half of the body in tandem arrangement. In young specimens the two testes are attached each other, but in older worms they are separated by uterus. Their shape is oval and margins are smooth or slightly indented. The posterior testis is usually larger than anterior one. The cirrus-sac is a large, curved

Table 2. Dimensions of *Orientocreadium pseudobagri* from the present material and from the literature

Items	Authority		
	Yamaguti (1934)	Shimazu (1990)	Present study
Hosts	<i>Pseudobagrus surantiacus</i>	<i>Pelteobagrus nudiceps</i> <i>Silurus lithophilus</i>	<i>Pseudobagrus fulvidraco</i>
Locality	Japan	Japan	Korea
Length(mm)	1.16–1.49	1.10–2.84	1.35–2.36
Breadth(mm)	0.22–0.34	0.23–0.55	0.25–0.41
Oral sucker(mm)	0.1–0.15 in diameter	0.09–0.17× 0.10–0.19	0.11–0.16× 0.12–0.17
Ventral sucker (mm)	0.1–0.13 in diameter	0.09–0.15× 0.11–0.18	0.11–0.17× 0.12–0.18
Sucker ratio	1 : 0.85–1.07	1 : 0.82–1.00	1 : 1.00–1.06
Prepharynx(mm)	0.084	0.05–0.09	0.07–0.18
Pharynx(mm)	0.063–0.084× 0.063–0.095	0.08–0.12× 0.05–0.12	0.08–0.11× 0.07–0.10
Oesophagus(mm)	0.03–0.04	0.04–0.10	0.04–0.07
Cirrus sac(mm)	0.16–0.26× 0.05–0.06	0.16–0.40× 0.04–0.12	0.24–0.40× 0.06–0.10
Testes(mm)	0.07–0.09× 0.10–0.12	0.06–0.28× 0.07–0.30	0.11–0.15× 0.10–0.17(upper) 0.10–0.15× 0.12–0.19(lower)
Ovary(mm)	0.075–0.12 in diameter	0.08–0.16× 0.09–0.20	0.10–0.13× 0.11–0.16
Eggs(µm)	27–33×18–21	30–44×18–22	30–34×20–22.5

clavate structure and reaches to a point between a level anterior region of the ventral sucker and a level posterior zone of the ventral sucker.

It contains a oval internal seminal vesicle of small size, a tubular pars prostatica and a long cirrus. The proximal portion of cirrus sac is connected with large, voluminous external seminal vesicle which reaches to the anterior margin of the ovary. The distal portion of the cirrus sac forms an well developed sphincter structure. The int-

ernal seminal vesicle and the pars prostatica are densely surrounded by numerous prostatic gland cells. The cirrus is straight or sinuous and its distal region can be protracted externally. The genital pore lies medially and just in front of the ventral sucker.

The subglobular ovary lies about half-way between the anterior testis and the ventral sucker. There is no seminal receptacle. The oviduct and the initial coils of the uterus contain small amount

of sperms. Mehlis' gland lies just posteriorly to the ovary. Laurer's canal was not clearly seen, but apparently opens dorsally at the level of the ovary. The uterus, which contains numerous smooth-shelled, operculate eggs, occupies most of the post-testicular region of the hindbody, coils between testes and fills the post-acetabular region. The well-developed metraterm lies along the cirrus pouch or opposite side. The internal side of the metraterm has numerous spines. The vitellarium consists of two lateral fields extending from the ovarian level to some distance in front of the caecal termination.

Discussion

In the family Orientocreadiidae, many genera were proposed by several authors. Tubangui(1931) erected *Orientocreadium* as a new genus of the family Allocreadiidae and reported one new species, *O. batrachooides*, as the genotype. He distinguished it from other genera in Allocreadiidae by following characters: "the position of its seminal vesicle outside of the cirrus sac, the presence of a prepharynx, the shortness of the oesophagus, vitellaria extending to posterior end of body". Chaterji(1933) proposed a new genus *Ganada* with *G. clariae* as the type species. He included the genus in the family Lepodermatidae, which is synonymized as Plagiorchiidae, and distinguished it from the other genera(except *Leptophallus*) by the presence of an external seminal vesicle. Dayal(1938a) established a new genus *Neoganada* with *N. barabankiae* as the type species. According to his description, *Neoganada* differs from *Ganada* in the relative size of suckers, in having lobed testes, in the presence of seminal receptacle, in

the arrangement of uterine coils, in the presence of a muscular metraterm. And it differs from *Leptophallus* in the extent of intestine caeca, in having lobed testes, in the structure and relative position of cirrus sac, in the distribution of vitelline glands, in the arrangement of uterine coils, in the presence of a muscular metraterm. Dayal(1938b) erected a new genus *Nizamia* with *N. hyderabadii* as the type species. He mentioned that *Nizamia* was closely related to *Leptophallus*, *Ganada* and *Neoganada*, but differs from all of them in the possession of a long prepharynx and a short oesophagus, in having external seminal vesicle divided into two portions, in the possession of deeply lobed testes and trilobed ovary, and in having operculated eggs. In addition, he distinguished it from *Leptophallus* and *Neoganada* by the absence of seminal receptacle. Dayal(1949) erected a new genus *Ganadotrema* with *G. indica* as the type species. According to his description, *Ganadotrema* is closely related to *Leptophallus*, *Ganada*, *Neoganada* and *Nizamia*, but differs from all of them in the possession of a long spiny cirrus, in the shape of external seminal vesicle and in the shape of the ovary. Gupta(1951) erected a genus *Macrotrema* with *M. macroni* as the type species. He distinguished it from the closely related genera, *Leptophallus*, *Ganada*, *Neoganada*, *Nizamia*, *Ganadotrema* by the following characters: the absence of pars prostatica, the possession of a long oesophagus, the relative position of the two testes which lie diagonally one behind the other, the ovary larger than the testes, the extension of vitelline glands which commence from ventral sucker and extend upto a little anterior to the posterior end of the body. Bykhovskii et Dubinina(1954) proposed a new genus *Paratormopsolus* with

P. siluri as the type species and included the genus in the family Acanthocolpidae.

These morphologically closely related genera were classified belonging to three families, Allocreadiidae, Plagiorchiidae, Acanthocolpidae, according to authors. Because each author did not refer to the other author's papers, this family category problem was arosed. From the analysis of each author's generic description, it is reasonable that the above genera, except *Leptophallus*, are classified into one separate group. As the genus *Leptophallus* is a parasite of snakes and has a definite seminal receptacle, it can not be included in the above group. Dayal(1938a) described the presence of a small seminal receptacle in his new genus *Neoganada*. However, it is suggested that what he called the seminal receptacle is not a true one but a chamber made of the distal portion of the oviduct and the proximal portion of Laurer's canal(Shimazu, 1990). Yamaguti(1958) classified these genera into one subfamily Orientocreadiinae belonging to the family Allocreadiidae. Later, Skrjabin and Kobal(1960) proposed the family Orientocreadiidae. The common conspicuous characters of these genera(the presence of prepharynx and external seminal vesicle) appear enough to separate them from other digenean families. Therefore it is appropriate that these genera classified into one separate family Orientocreadiidae.

According to the morphology of the excretory bladder, the above seven genera can be divided into two groups, i.e., I-shaped excretory bladder(*Orientocreadium*, *Paratormopsolus*) and Y-shaped excretory bladder(*Ganada*, *Neoganada*, *Nizamia*, *Ganadotrema*, *Macrotrema*). There are no differences between *Orientocreadium* and *Paratormo-*

psolus in generic characters. Therefore it is proper that *Paratormopsolus* is synonymized with *Orientocreadium*. As the described generic characters of the five genera having Y-shaped excretory bladder are considered as minor characters, it is appropriate that those characters should be treated as the species characters rather than the generic characters. Therefore the genera *Neoganada*, *Nizamia*, *Ganadotrema*, *Macrotrema* should be treated as a synonym of the genus *Ganada*. These synonymization scheme was adopted by Fischthal and Kuntz(1963). However, Yamaguti(1971) synonymized the later six genera with *Orientocreadium*, recognizing only one genus in the family. Generally, the shape of excretory vesicle is considered to be a very significant in classifying higher taxa of digeneans, even though Y-shaped excretory vesicle is frequently confused with I-shaped one, especially, when the proximal arms of Y are very short. Consequently, the family Orientocreadiidae is divided into two genera, *Orientocreadium* and *Ganada*, according to the shape of excretory bladder.

Orientocreadium koreanum sp.nov. most closely resembles *O. pseudobagri* Yamaguti 1934 and *O. siluri*(Bychovskii et Dubinina 1954). *O. koreanum* differs from *O. pseudobagri* by the ratio between the testes and the ovary. The former species has that the sizes of the testes are much larger than that of the ovary. Another major distinguishing character between the two species is the location of the testes. *O. koreanum* has testes with postequatorial location rather than equatorial location in hindbody. *O. koreanum* is distinguished from *O. siluri* by following characters : the anterior extent of the vitellaria is not the posterior border of the acetabulum but the ovarian level and the

location of the testes is postequatorial in hindbody. Recently, Shimazu(1990) reported *Orientocreadium chaenogobii* as a new species. *O. koreanum* is distinguished from that species by the anterior extent of the vitellaria, the ratio between the testes and the ovary, and the location of the testes.

The ratio between the testes and the ovary in some digenean species may be considered as a variation according to the developmental stages. The sizes of the testes in *O. pseudobagri* from small young adults to large completely matured adults, however, showed equal or slightly larger than those of the ovary consistently. Therefore this character appears to be stable as a specific character in this taxon. The location of the testes, also, may be considered as a variation according to growing stages in some species. In many digenean species which have uterine coils in the region of the behind testes, the locations of the testes in young adults are more posterior than in old adults due to the poor development of the uterus. The specimens of *O. koreanum*, however, are fully matured with a completely developed uterus and many eggs. So this character can be adopted as a specific identifying character of *O. koreanum*.

Orientocreadium pseudobagri is distinguished with *O. siluri* and *O. chaenogobii* by the anterior limit of the vitellaria.

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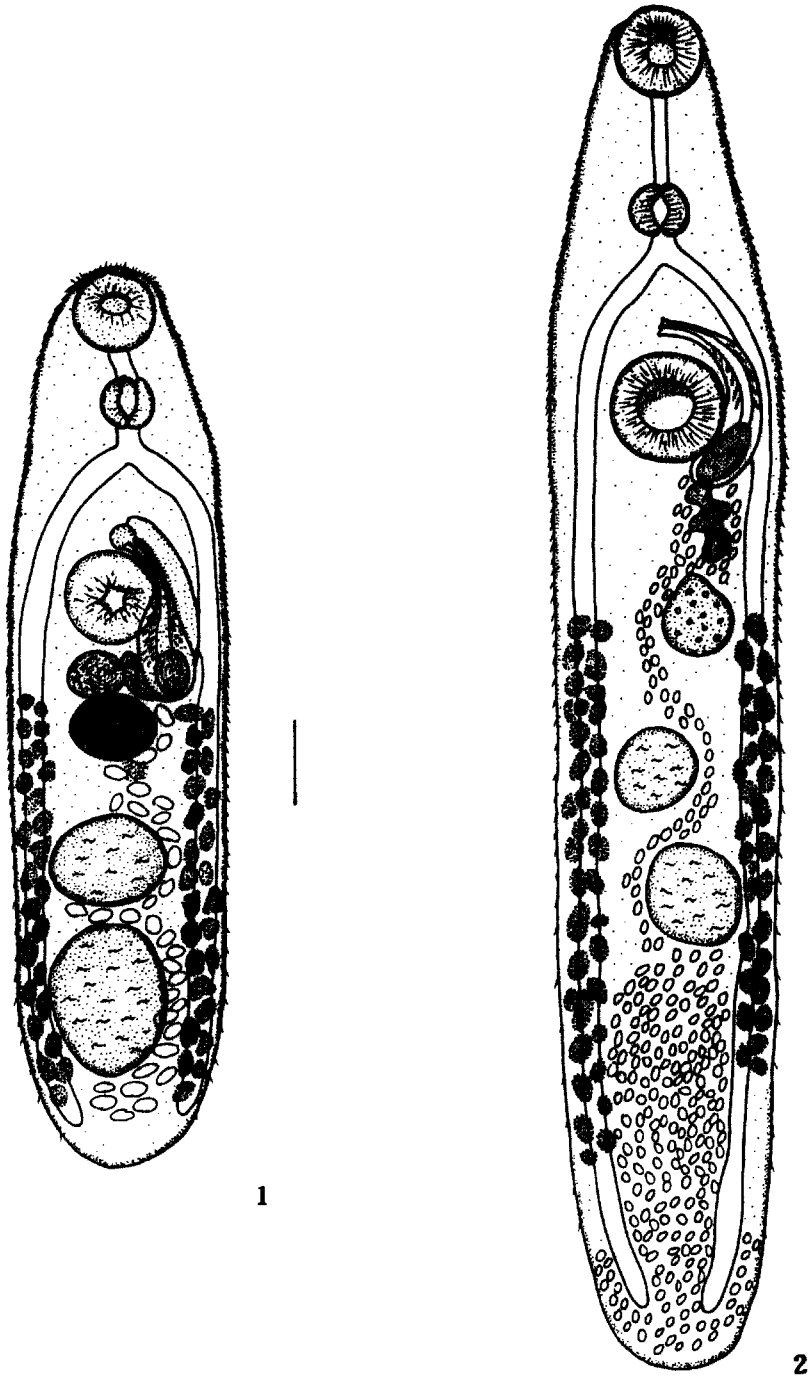


Fig. 1. *Orientocreadium koreanum* sp. nov. (NFUP Helm. Coll. No. 174)

Fig. 2. *Orientocreadium pseudobagri* Yamaguti, 1934 (NFUP Helm. Coll. No. 188) (Scale bar for Figs. 1 & 2 : 0.1 mm)

한국산 민물어류에 기생하는 *Orientocreadium* 속 흡충류 :
Orientocreadium koreanum sp. nov. 및 *O. pseudobagri* Yamaguti, 1934

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한국산 민물어류에 기생하는 연충류를 조사하기 위해 본 연구를 시행하였으며, 본 논문에서는 2 종류의 흡충류를 동정, 분류하였다. *Orientocreadium koreanum* n. sp.는 통가리의 장에서 검출된 신종이며, *O. pseudobagri* Yamaguti, 1934는 동자개의 장에서 검출된 한국산 미기록 종이였다. *Orientocreadiidae* 과의 분류학적 문제점들에 관해 고찰하였으며, 분류된 2종에 대해 기존의 기록종들과의 차이점들을 상세히 논하였다.

Key words : Digenetic trematodes, *Orientocreadium koreanum* sp. nov., *O. pseudobagri*, Freshwater fish, Taxonomy, Korea