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Helminth parasites of the rare endemic catfish, *Liobagrus reini*, in Japan

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Abstract. Examinations of 29 specimens of the catfish *Liobagrus reini* Hilgendorf (Siluriformes: Amblycipitidae), a species endemic to Japan, collected from the Sho River, Toyama Prefecture, in central Honshu, revealed the presence of four species of helminth parasites: *Plagioporus honshuensis* sp. n. (Trematoda), *Rhabdochona coronacauda* Belouss, 1965, *R. japonica* Moravec, 1975 and *Mexiconema liobagri* sp. n. (all Nematoda). The new opecoelid trematode *P. honshuensis* is characterized mainly by the extent of vitelline follicles, the size ratio of the suckers (1 : 1.7-2.1), the situation of testes near the middle of the body and by the structure, size and shape of the cirrus sac. *Allopodocotyle* Pritchard, 1966 is considered a junior synonym of *Plagioporus* Stafford, 1904. The males of *R. japonica* are described for the first time and conspecific females are redescribed; this species is a specific parasite of *L. reini*. The principle hosts of *R. coronacauda* are cyprinids and, therefore, its finding in the catfish may indicate an accidental infection; *L. reini* represents a new host record. *M. liobagri* (only females were found) from the host's abdominal cavity is the second known species of this dracunculoid genus, being characterized by the position of the excretory pore and the number (1) of caudal processes in the female. The recorded helminths are briefly described and illustrated and problems of their systematic status are discussed.

The catfish *Liobagrus reini* Hilgendorf is the only representative of the siluriform family Amblycipitidae in Japan. At present this endemic fish species occurs only rarely in some streams of Honshu, Shikoku, and Kyushu (Miyadi et al. 1976, Hoshino et al. 1996). The parasite fauna of *L. reini* has not yet been studied; the only record of a helminth parasite from this fish is that of Yamaguti (1935), who reported the finding of the nematode *Rhabdochona zacconis* Yamaguti, 1935 (= *R. japonica* Moravec, 1975) from this catfish from Honshu (Nagano Prefecture). Through the courtesy of Mr. Y. Tago of the Toyama Prefectural Fisheries Research Institute, 29 fixed specimens of *L. reini* from the Sho River at Ohta, Toyama Prefecture, central Hoshu, were provided for a helminthological examination. The systematic evaluation of the parasites recorded is presented below.

MATERIALS AND METHODS

Altogether 29 specimens of *Liobagrus reini* (total length 5-11 cm) fixed in 70% ethanol were available; these were caught in the Sho River at Ohta in Toyama Prefecture, central Honshu, on 18 July 1995. The fish specimens were removed from ethanol and placed in tap-water for 24 hrs. Then they were cut open and their internal organs were thoroughly examined for the presence of helminth parasites under the dissecting microscope. The trematodes were first placed in distilled water for 24 hrs and then they were pressed between two glasses and post-fixed in 10% formalin for 24 hrs to keep the body shape; subsequently they were stained with Schuberg's carmine, dehydrated and mounted as permanent preparations in Canada balsam. Nematodes were stored in 4% formalin. For light microscopy they were cleared in glycerine. Eggs of *Rhabdochona japonica* were dissected out from the nematode body in order to study their polar filaments. After examination, the nematodes were either mounted in glycerine-jelly or stored in vials of 70% ethanol. Drawings were made with the aid of a Zeiss microscope drawing attachment. For scanning electron microscopy (SEM), the specimens were postfixed in 1% OsO_4, dehydrated through an ethanol and an acetone series and then subjected to critical point drying. The specimens were coated with gold and examined using a JSM-6300 scanning electron microscope at an accelerating voltage of 15 kV. All measurements are given in micrometres unless otherwise stated. Type and voucher specimens are deposited in the National Science Museum in Tokyo (NSMT) and in the Institute of Parasitology, Academy of Sciences of the Czech Republic (ASCR) at České Budějovice.

REVIEW OF SPECIES

TREMATODA

Family Opecoelidae Ozaki, 1925

Plagioporus honshuensis sp. n. Fig. 1

Description (10 gravid specimens somewhat contrac-ted due to slow fixation *in situ*; measurements of holotype in parentheses): Body oval; forebody distictly tapered. Tegument smooth. Eyespot pigments

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absent. Length of body 952-1,768 (1,700), maximum width 422-748 (625). Oral sucker subterminal, 122-150 × 122-190 (122 × 177). Prepharynx absent. Pharynx large, almost spherical, 95-136 x 109-136 (95 x 136); size ratio of pharynx and oral sucker 1 : 1.10-1.32 (1 : 1.29). Oesophagus short, 14-95 (41). Intestinal bifurcation approximately at level of anterior half of ventral sucker. Caeca end blindly short distance from posterior end of body. Ventral sucker markedly large, 190-286 × 231-340 (245 × 272), situated approximately at border of first and second quarters of body length; size ratio of oral and ventral suckers 1 : 1.73-2.09 (1 : 1.73). Testes transversely oval, tandem, situated near middle of body; anterior testis 68-190 × 218-449 (136 × 449), posterior testis 122-163 × 163-435 (150 × 422). Cirrus sac elongate, 177-272 (204) long and 68-109 (82) wide, containing cirrus, pars prostatica and sinuous seminal vesicle. Genital pore distinctly submedian, situated near posterior end of pharynx. Oval ovary submedian, just anterior to anterior testis, 54-190 × 190-354 (150 × 258). Oötype complex pre-ovarian. Laurer's canal not observed. Uterine seminal receptacle absent. Uterus reaching posteriorly at most to level of ovary. Eggs numerous, oval, thin-shelled, 54-66 (54-63) × 21-36 (24-36). Metraterm well developed, with thick sphincter close to its opening into small genital atrium. Vitelline follicles mostly large, numerous, filling hindbody except in region of gonads and uterus, extending anteriorly to middle of ventricular sucker. Only posterior part of excretory vesicle visible.

T y p e h o s t: *Liobagrus reini* Hilgendorf (Amblycipitidae, Siluriformes) (total length 6-10 cm).

S i t e o f i n f e c t i o n: Intestine.

T y p e l o c a l i t y: Sho River, Toyama Prefecture, central Honshu, Japan (18 July 1995).

O c c u r r e n c e: Prevalence 24% (29 fish examined/ 4 infected), intensity 1-3 (mean 2).

E t y m o l o g y: The specific name *honshuensis* relates to the place of the occurrence of this trematode, i.e. Honshu Island in Japan.

D e p o s i t i o n o f t y p e s : Institute of Parasitology, ASCR, České Budějovice (Cat. No. D-406, holotype and paratypes) and National Science Museum, Tokyo (Cat. Nos. NSMT-Pl-5026, 5027 and 5028, paratypes).

Comments: Adult opecoelids are often difficult to distinguish from allocreadiids, but they differ in the life histories (Yamaguti 1971, Gibson 1996). Therefore, it was difficult to decide whether the specimens of the present material belong to the Opecoelidae Ozaki, 1925 or the Allocreadiidae Stossich, 1903. The key to the families of the Allocreadioidea Looss, 1902 given by Gibson (1996) is based on the characters which do not enable to distinguish unequivocally between these two families. According to Bykhovskaya-Pavlovskaya and Kulakova (1987), adult allocreadiids can be distinguished from opecoelids by the median or submedian position of the genital pore (vs. genital pore usually shifted more laterally from the median line in opecoelids), situation of testes near the middle of body (vs. near posterior end of body) and by blindly ending caeca (vs. caeca may be sometimes fused). Taking into account the position of the genital pore, absence of a uterine seminal receptacle, absence of eyespot pigments and some other features, the present specimens belong to Opecoelidae rather than to Allocreadiidae, even though the situation of testes is more characteristic of the latter. According to keys to the subfamilies of the Opecoelidae given by Skryabin and Petrov (1958), Yamaguti (1971) and Gibson (1996), the present specimens are representatives of the Plagioporinae Manter, 1947, characterized by the presence of a distinct cirrus sac surrounding an internal seminal vesicle and by the absence of a uterine seminal receptacle.

It has been mentioned by Gibson and Bray (1982), Gibson (1996) and others that the systematics of the Plagioporinae, as of all Opecoelidae, is unusually difficult because of a very similar gross morphology of the numerous taxa. During the last two decades, there have been several attempts to revise the taxonomic classification of these trematodes, of which the most important papers are those by Gibson and Bray (1982, 1984), who carried out a reorganization of *Plagioporus* Stafford, 1904 and related genera, with special reference to forms occurring in European waters; they divided *Plagioporus* species into several, either newly defined or newly established genera. However, this classification has not been accepted by Bykhovskaya-Pavlovskaya and Kulakova (1987), recognizing only *Plagioporus sensu lato*. The system of Gibson and Bray (1982, 1984) has recently been used again by Gibson (1996) and it is also recognized by Shimazu (1990a).

However, in spite of these attempts to clarify the systematics of plagioporines, their taxonomic classification remains, in our opinion, by far unsatisfactory. It is mainly due to an inflation of genera in this group, which are sometimes based on the features which can hardly be considered as generic characters (e. g., anterior extent of vitelline follicles or of excretory vesicle, shape of internal seminal vesicle, host types).

The purpose of this paper is not to revise this complicated group of trematodes, but only to place the specimens of the present material in the respective, well-established genus.

According to the key provided by Gibson (1996), the present trematodes should belong to *Allopodocotyle* Pritchard, 1966 mainly because of the vitelline fields restricted to the hindbody and the entire ovary. However, in our opinion, the anterior limits of vitelline follicles cannot be considered a generic feature in this group of trematodes, because there may be a considerable variability in these limits even in a single

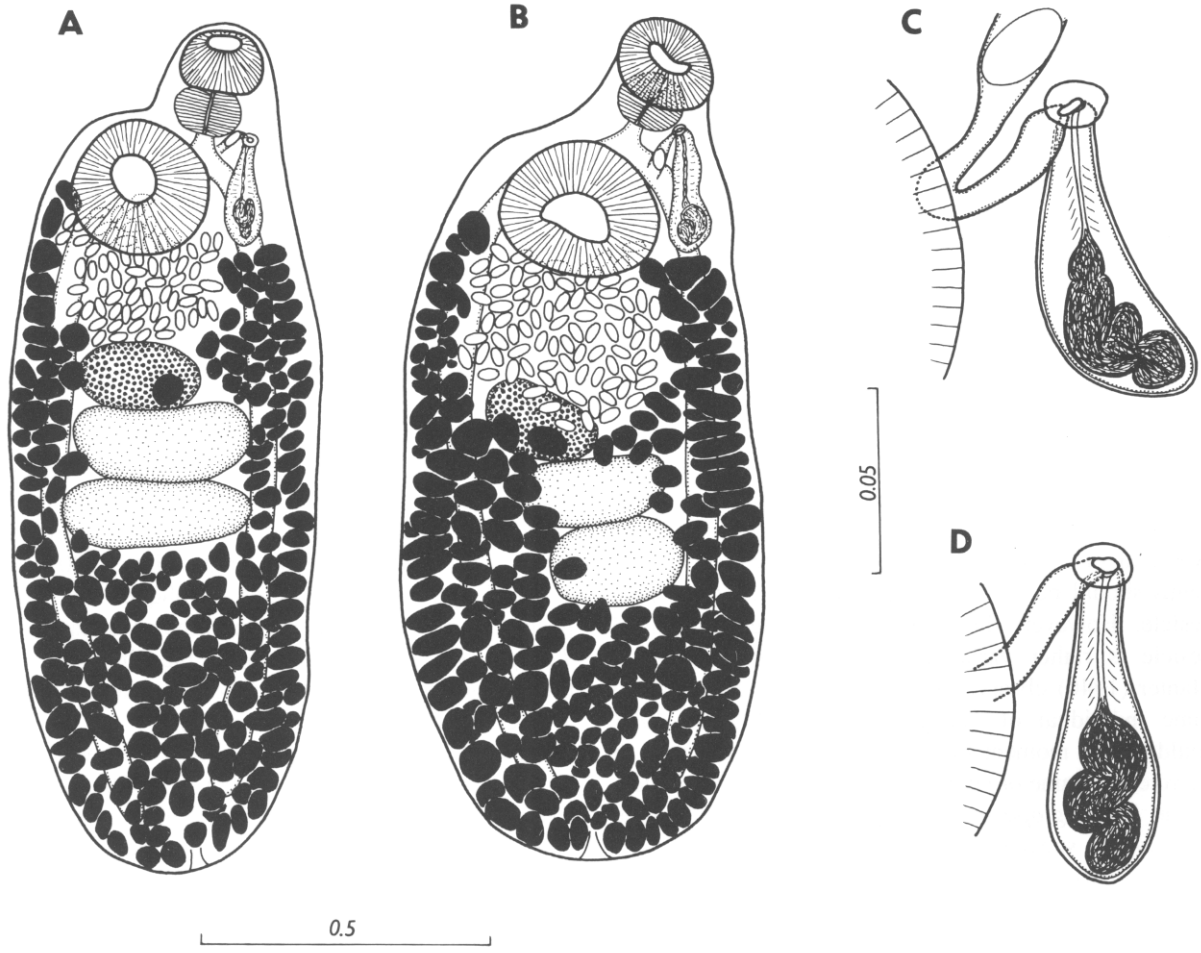

Fig. 1. *Plagioporus honshuensis* sp. n. **A** - holotype; **B** - paratype. **C**, **D** - region of genital pore. Scale bar in mm.

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species as seen, e.g., from the illustrations of *Neoplagioporus ayu* (Takahashi, 1928) given by Shimazu (1990a); in his newly established genus *Neoplagioporus* Shimazu, 1990, there are included both the species with vitelline fields extending into the forebody and that with the vitelline fields currently restricted to the hindbody.

A similar situation is with *Allocreadium* Looss, 1900 of the family Allocreadiidae, including species both with and without vitelline follicles in the forebody (Moravec 1984, Bykhovskaya-Pavlovskaya and Kulakova 1987). Accordingly, *Allopodocotyle* is not considered a valid genus and it should be taken for a junior synonym of *Plagioporus*.

The morphology of *Plagioporus* is very similar to that of *Podocotyle* Dujardin, 1845, which deserves special mention. *Podocotyle* was erected by Dujardin (1845) as a subgenus and later it was raised to generic status by Stossich (1892); Stiles and Hassal (1898) designated as its type *Distoma angulatum* Dujardin, 1845, a species inadequately described from *Anguilla anguilla* (L.) from Morbihan, France. Lühe (1900) considered *P. angulata* a *species inquirenda*; because of the inadequate description of this species, whose type material was lost, Odhner (1905) designated *P. atomon* (Rudolphi, 1802) as the type species of *Podocotyle*. According to Gibson and Bray (1982), *P. angulata* is identical with *P. staffordi* Miller, 1941, being different from *P. atomon*; however, already Szidat (1944) considered the trematodes found from *Anguilla anguilla* from the Baltic to be identical with *Distoma angulatum*; he assigned *D. angulatum* to the genus *Plagioporus sensu lato*.

We agree with Gibson and Bray (1982) that *P. angulata* is the type species of *Podocotyle*, not *P. atomon* as it was reported, for example, by Odhner (1905), Skryabin and Koval (1958) or Yamaguti (1971). Considering the opinion of Szidat (1944) that *D. angulatum* is a member of *Plagioporus*, then *Plagioporus* would be a junior synonym of *Podocotyle*. In fact, the features (anterior extent of vitelline follicles, shape of ovary) by which Gibson and Bray (1982) and Gibson (1996) distinguish both these genera are not, in our opinion, sufficient; the importance of the extent of

vitelline fields has already been discussed above; another distinguishing feature, i. e., an entire ovary in *Plagioporus* and a lobed ovary in *Podocotyle*, is questionable, because, for example, the shape of the ovary may exhibit a considerable intraspecific variability in plagioporines, as observed, e. g., by Shimazu (1990a) in *Neoplagioporus elongatus* (Gato et Ozaki, 1930), where the ovary may be from distinctly trilobed to globular. There have been described many *Podocotyle* species with an entire (unlobed) ovary (Skryabin and Koval 1958). However, for the time being, we refrain from a formal synonymization of *Plagioporus* with *Podocotyle*, because it requires a broader taxonomic revision based on a re-study of type specimens of several related genera. The same concerns *Neoplagioporus* Shimazu, 1990, which may be a junior synonym of *Podocotyle* too; the main feature of this genus should be a short, straight and bipartite seminal vesicle. However, the shape of the internal seminal vesicle is rather variable and, for example, already Manter (1940) observed that the seminal vesicle of the same individual of *Podocotyle pearsi* Manter, 1934 could be in a moment straight or convoluted or coiled in a circle; the same or similar shape of the seminal vesicle as in *Neoplagioporus* was illustrated also for some *Podocotyle* species (*P. californica* Park, 1937, *P. elongata* Park, 1937, *P. endophrysi* Park, 1937).

Because of the above problems, we consider it reasonable to identify trematodes of the present material as a species of *Plagioporus sensu lato*. *P. honshuensis* sp. n. differs from its congeners in the more anterior situation of the testes: whereas these are situated approximately at the middle of body or slightly posterior to it in *P. honshuensis*, the testes of the majority of *Plagioporus* spp. are nearer to the posterior extremity than to the acetabulum. In most species of *Plagioporus,* including those described from freshwater fishes in eastern Asia (*P. elongatus* (Goto et Ozaki, 1930), *P. orientalis* (Yamaguti, 1934), *P. zacconis* Yamaguti, 1934, *P. imanensis* Belouss, 1958, *P. triangulogenitalis* Belouss, 1958, *P. myoxocephalus* Akmmerov, 1961, *P. sichuanensis* Wang, 1985, *P. allovaris* Zhang, 1992 and *P. schizothoraci* Zhang, 1992), the vitelline follicles extend anteriorly up to the level of the pharynx or far anterior to the ventral sucker, whereas they reach only to the level of the middle of ventral sucker in *P. honshuensis*.

In *P. glomeratus* Roytman, 1963, a species described from salmonids of the Amur River basin, the vitelline follicles extend anteriorly to the anterior border of the ventral sucker, but testes are near the posterior end of body and the cirrus sac is situated completely anterior to the ventral sucker.

By its general morphology, especially the size ratio of suckers, large pharynx and the situation of testes, *P. honshuensis* resembles considerably *Dimerosaccus oncorhynchi* (Eguchi, 1931), a parasite of salmonids and cottids in Japan and the only representative of the opecoelid genus *Dimerosaccus* Shimazu, 1980 (see Shimazu 1980, 1988a, Shimazu and Awakura 1993). Unfortunately, the validity of this genus needs confirmation; although Shimazu (1980) characterized it mainly by the structure of the cirrus sac, which should contain an internal seminal vesicle, a prostatic complex and an ejaculatory duct, and by the presence of an external seminal vesicle and gland cells inside a membraneous sac, Shimazu and Awakura (1993) mention that "the cirrus pouch encloses the whole seminal vesicle, though divided". In spite of the question of the validity of *Dimerosaccus*, *D. oncorhynchi* differs from *P. honshuensis* particularly in the structure of the cirrus sac (divided) and its length (580-1,280 μm vs. 177-272 μm) and situation (oblique vs. antero-posterior), but also in the length of the oesophagus (560-720 μm vs. 14-95 μm) and in the situation of the bifurcation of caeca (well anterior to ventral sucker vs. at level of anterior half of ventral sucker).

Of other opecoelids reported from freshwater fishes in Japan (Shimazu 1988a, 1990a,b), only *Neoplagioporus ayu* (Tokahashi, 1928) resembles *P. honshuensis* in the extent of vitelline fields and in the situation of testes; but it distinctly differs in the presence of the trilobed ovary and the bipartite seminal vesicle.

In contrast to *P. honshuensis*, all Japanese species of *Allocreadium* have a median genital pore, the size ratio of suckers is at most 1 : 1.7, and all of them are parasites of cypriniform fishes (Cyprinidae and Cobitidae) (Shimazu 1988b, 1992).

Therefore, we consider specimens of the present material to represent a new species, *P. honshuensis*.

NEMATODA

Family Rhabdochonidae Travassos, Artigas et Pereira, 1928

Rhabdochona japonica Moravec, 1975 Figs. 2-4

Description: Medium sized nematodes with smooth cuticle. Oral aperture hexagonal, surrounded by four small cephalic papillae and two lateral amphids; four small submedian papilla-like structures present on margin of oral aperture. Prostom funnel-shaped, large, elongate; basal teeth absent or only slightly developed. Anterior margin of prostom armed internally with 14 small, forwardly directed teeth (3 dorsal, 3 ventral and 4 on each side, latter forming pairs) (Fig. 4A, B); occasionally some teeth subdivided into two or three (Fig. 4C). Vestibule relatively short, in most specimens somewhat curved (S-shaped). Deirids small, bifurcate, situated near middle of vestibule (Fig. 4F). Tail of both sexes with rounded tip (Fig. 4E).

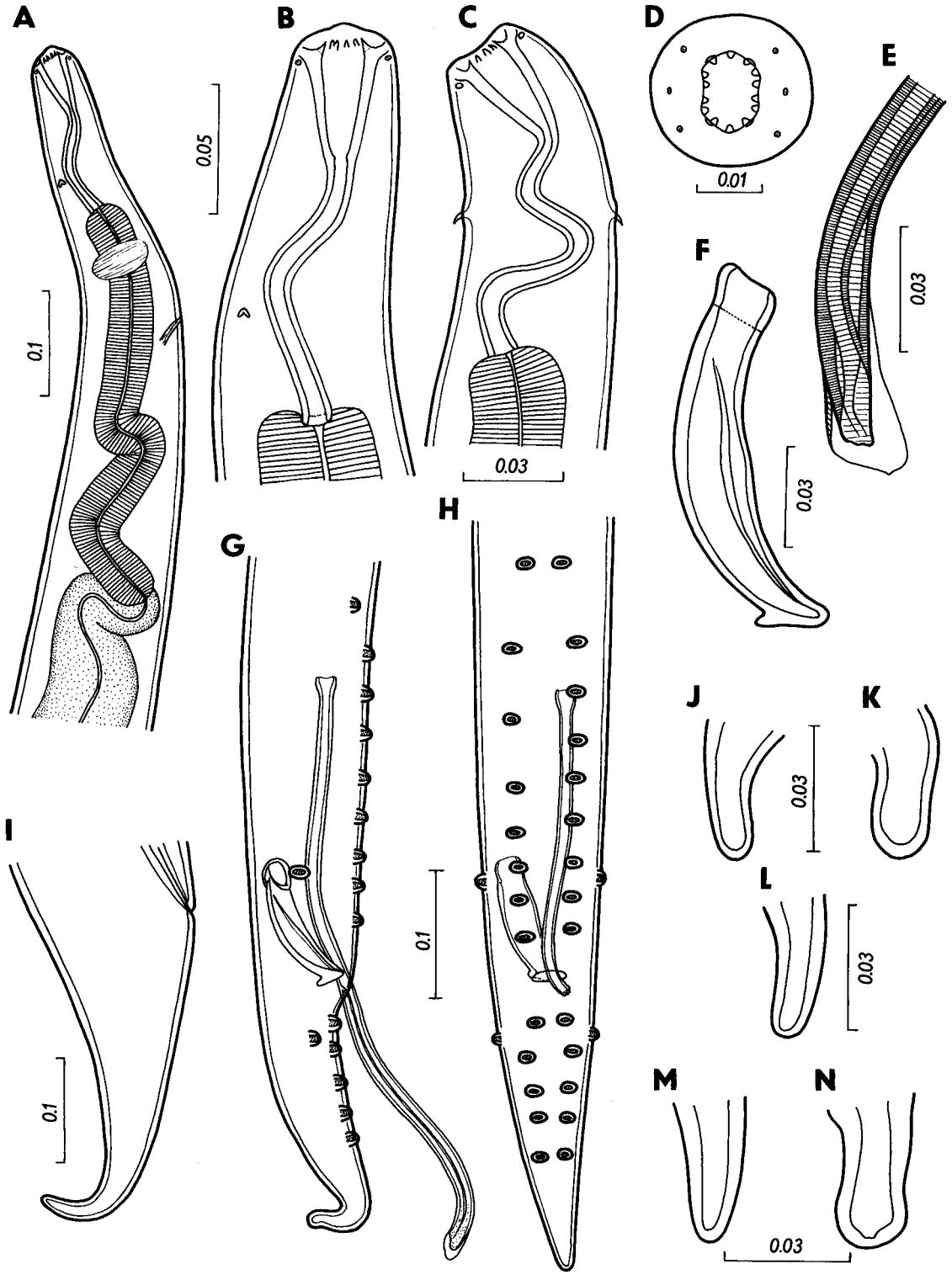

Fig. 2. *Rhabdochona japonica* Moravec, 1975. **A** - anterior end of body; **B-D** - cephalic end, lateral, dorsoventral and apical views; **E** - distal end of left spicule; **F** - right spicule; **G, H** - posterior end of male, lateral and ventral views; **I** - tail of female; **J-L** - tail tip of male; **M, N** - tail tip of female. Scale bars in mm.

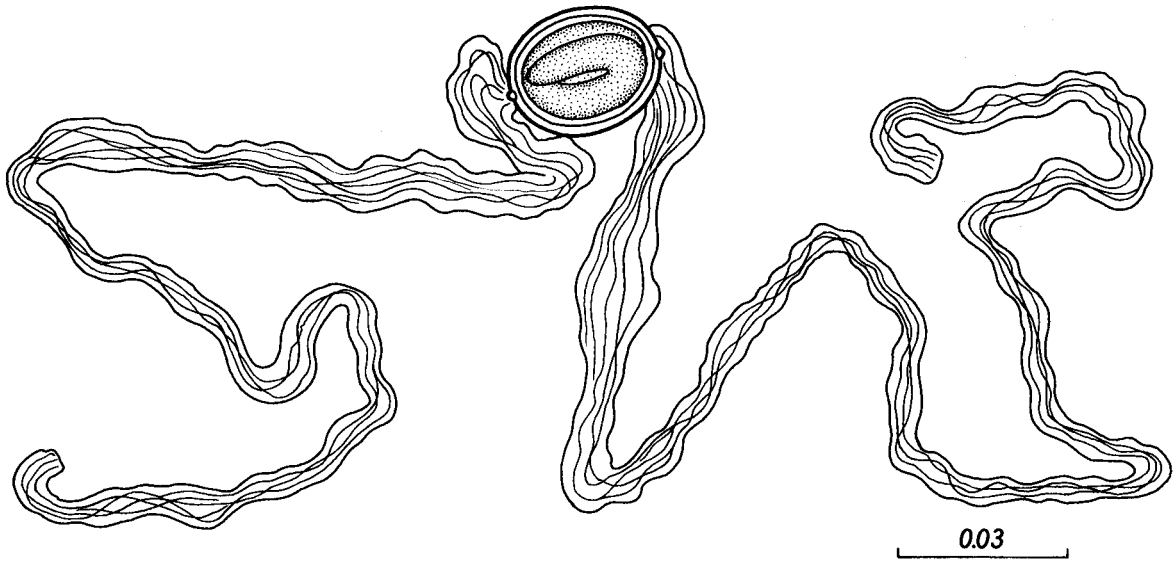

Fig. 3. *Rhabdochona japonica* Moravec, 1975, mature egg. Scale bar in mm.

Male (5 specimens): Length of body 6,501-9,384, maximum width 109-136. Prostom 30-36 long and 18-21 wide in lateral view. Length of vestibule including prostom 144-150 (105-120 in specimens with S-shaped vestibule), of muscular oesophagus 228-345, of glandular oesophagus 2,298-2,978. Nerve ring encircling muscular oesophagus 162-195 from anterior extremity; deirids and excretory pore at 69-102 and 213-270, respectively. Subventral preanal papillae occurring in combinations 8 + 8 and 8 + 9. Additional lateral pair of preanal papillae present between second and third pairs of subventrals (counting from cloacal opening). Of 6 postanal pairs of papillae, second pair lateral, remaining subventral. Longitudinal ventral cuticular ridges (area rugosa) absent. Left spicule long, 549-597; its shaft 282-321, representing 49-56% of entire spicule length; distal tip of protruded spicule obtuse, slightly widened, provided with well-developed cuticular membrane. Right spicule 120-135 long, without dorsal barb at distal tip. Length ratio of spicules 1 : 4.3-4.7. Tail conical, 255-450 long, with distinctly rounded tip.

Female (5 specimens; measurements of type specimens after Moravec (1975) in parentheses): Length of body of gravid females 24,540-25,527 (41,110-43,960), maximum width 190-340 (313-340). Prostom 54-60 (57-60) long and 30 (30) wide in lateral view. Length of vestibule including prostom 120-186 (240), of muscular oesophagus 390-510 (606-705), of glandular oesophagus 3,305-4,665 (7,410-8,160). Nerve ring, excretory pore and deirids at 171-240 (348-381), 231-318 (-) and 75-129 (159), respectively. Tail conical, slender, 265-447 (405-453) long, with rounded tip.

Vulva postequatorial, 9,792-11,832 (16,860) from posterior end of body. Vagina muscular, directed posteriorly from vulva and then anteriorly. Mature eggs small, 33-36 x 24-27 (30-33 x 21-27), oval, larvated; each pole of egg provided with minute protuberance and one long (about 300-350), ribbon-like filament of fibrous structure.

H o s t: *Liobagrus reini* Hilgendorf (total length 5-11 cm).

S i t e o f i n f e c t i o n: Intestine.

L o c a l i t y: Sho River, Toyama Prefecture, central Honshu, Japan (18 July 1995).

O c c u r r e n c e: Prevalence 48% (29 fish examined/ 14 infected), intensity 1-12 (mean 3).

D e p o s i t i o n o f s p e c i m e n s: Institute of Parasitology, ASCR, České Budějovice (Cat. No. N-710) and National Science Museum, Tokyo (Cat. No. NSMT-As-2842).

Comments: Yamaguti (1935) described a new nematode species, *Rhabdochona zacconis*, from the cyprinid *Zacco platypus* (Temminck et Schlegel) (type host) and the catfish *Liobagrus reini* from Japan. Moravec (1975) re-examined the type specimens of this species and found that the nematodes from *L. reini* (2 females only) were, both in morphology and measurements, very different from those (2 males and 2 damaged females) from *Z. platypus* and evidently belonged to a different species. Therefore, he established a new species, *R. japonica*, based on the two available female specimens from *L. reini*, now deposited in the Meguro Parasitological Museum in Tokyo (Cat. No. 22325).

In spite of the fact that females of the present material are somewhat smaller than those described by Moravec (1975), there is no doubt these specimens belong to *R. japonica*. Consequently, this new material enabled a full description of this little-known species, i.e., the first description of the male and a redescription of the female.

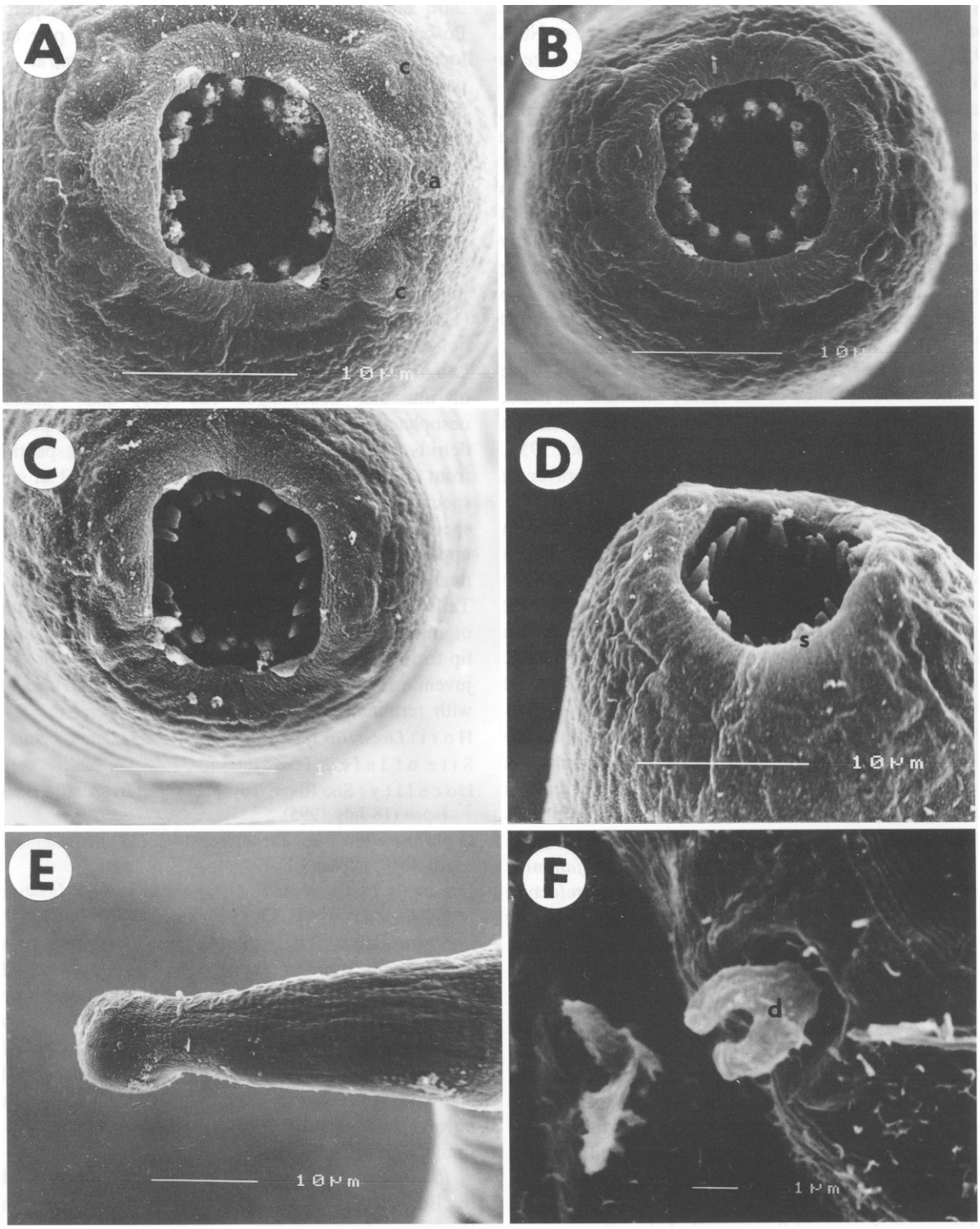

Fig. 4. *Rhabdochona japonica* Moravec, 1975, SEM micrographs. **A, B** - apical views of cephalic ends with prostom armed with typically 14 anterior teeth; **C** - apical view of cephalic end of specimen with some prostomal teeth subdivided; **D** - cephalic end, subventral view; **E** - tip of female tail; **F** - deirid. Abbreviations: a - amphid; c - cephalic papilla; d - deirid; s - submedian papilla-like structure.

Moravec (1975) suggested affinities of *R. japonica* with a morphological group of congeneric species represented by *Rhabdochona anguillae* Spaul, 1927, *R. cotti* Gustafson, 1949, *R. glyptothoracis* Karve et Naik, 1951, *R. longicauda* Dzhalilov, 1964 and *R. ergensi* Moravec, 1968. However, *R. anguillae* has non-filamented eggs (Saraiva and Moravec 1998) and, accordingly, should be excluded from this group; on the

other hand, *R. similis* Moravec, Ali et Abul-Eis, 1991 should be included (Moravec et al. 1991). The group is characterized by species with the prostom armed with 14 anterior teeth, very unequal spicules, a distinctly rounded tip of the tail in both sexes and in having filamented eggs. Whereas *R. cotti* and *R. ergensi* are specific parasites of Nearctic cottids and Palaearctic cobitids, respectively, all the remaining species, *R. glyptothoracis*, *R. longicauda* and *R. similis,* were reported from catfishes of the family Sisoridae in India, Central Asia (Tadjikistan, Afghanistan) and the Middle East (Iraq), respectively (Karve and Naik 1951, Dzhalilov 1964, Moravec and Amin 1978, Moravec et al. 1991).

Rhabdochona cotti differs from *R. japonica* mainly in the absence of the dorsal barb on the right spicule, in having a much smaller prostom, and in a distinctly shorter left spicule, whereas *R. ergensi* has a different type of egg filaments (several thread-like filaments on each pole) and a shorter left spicule. In contrast to *R. japonica*, all three species from catfishes have the right spicule lacking a dorsal barb; moreover, *R. glypto-thoracis* and *R. similis* possess simple (not bifurcate) deirids and the tip of the female tail is somewhat modified, whereas the tip of the tail in *R. longicauda* is provided with an inner refractile formation, which is horseshoe-shaped in lateral view.

Yamaguti's (1935) specimens of *R. japonica* originated from *L. reini* collected in Nagano Prefecture (detailed locality not given). The present finding represents the second record of this parasite in Japan. *R. japonica* seems to be a specific parasite of *L. reini*.

Rhabdochona coronacauda Belouss, 1965 Fig. 5

Description: Small nematodes with smooth cuticle. Wide lateral alae present, extending approximately from level of nerve ring to anus. Prostom small, with marked basal teeth; anterior teeth large, their number not established (8 in number according to Moravec 1975). Vestibule relatively long. Minute deirids simple, located slightly posterior to middle of vestibule length.

Male (1 specimen): Length of body 1,931, maximum width 57. Maximum width of lateral alae 15. Prostom 9 in length and 9 in width. Length of vestibule including prostom 54. Length of muscular oesophagus 105, of glandular oesophagus 240. Nerve ring and excretory pore 90 and 120, respectively, from anterior extremity. Deirids not found. Preanal papillae: 5 pairs subventral and 1 pair lateral; latter pair located between second and third subventral pairs (counting from cloacal aperture). Postanal papillae: 5 pairs subventral and 1 pair lateral located between first and second subventral pairs; papillae of third subventral pair distinctly larger than those of other pairs. Ventral preanal cuticular ridges (area rugosa) absent. Left spicule 363 long, its shaft 213, representing 59% of entire spicule length. Right spicule 75 long, its distal end not readily visible. Ratio of lengths of spicules 1 : 4.8. Tail conical, 93 long, with rounded tip.

Female (1 gravid specimen; measurements of 1 juvenile female in parentheses): Length of body 2,938 (1,333), maximum width 82 (54). Width of lateral alae not established. Prostom 12 (7) long and 12 (6) wide. Length of vestibule including prostom 78 (45). Length of muscular oesophagus 129 (81) and glandular oesophagus 339 (189). Nerve ring, excretory pore and deirids 105 (69), 126 (120) and 48 (-), respectively, from anterior extremity. Vulva postequatorial in gravid specimen and slightly preequatorial in juvenile specimen, 1,618 (625) from posterior end of body. Uteri opposed, containing many eggs. Mature eggs larvated, oval, smooth, without filaments or floats, 33-39 x 21. Tail conical, 102 (84) long, with undetermined number of minute tooth-like processes encircling its truncated tip to form corona; length of tip 3 (3). Posterior end of juvenile female still inside cuticle of fourth-stage larva with terminal crown of cuticular spines.

H o s t : *Liobagrus reini* Hilgendorf (total length 5-7 cm).

S i t e o f i n f e c t i o n : Intestine.

L o c a l i t y : Sho River, Toyama Prefecture, central Honshu, Japan (18 July 1995).

O c c u r r e n c e : Prevalence 14% (29 fish examined/ 4 infected), intensity 1.

D e p o s i t i o n o f s p e c i m e n s : Institute of Parasitology, ASCR, České Budějovice (Cat. No. N-41).

Comments: The morphology of the present specimens is, more or less, in accordance with that of *R. coronacauda* Belouss, 1965, as redescribed by Moravec et al. (1981) from fishes in Japan. The present specimens are somewhat smaller, the male has only five (as compared to six) pairs of subventral preanal papillae, and there is no distinct dorsal barb on the small spicule; however, these differences can be considered as the limits of intraspecific variability.

Rhabdochona coronacauda was originally described by Belouss (1965) from several genera of cyprinids (*Culter*, *Erythroculter*, *Hemibarbus*, *Leuciscus*, *Para-bramis*) and three other genera (*Esox, Hypomesus*, *Salmo*) from the Russian Far East (Primorsk Territory); later, Moravec et al. (1981) found this species in the cyprinid *Opsariichthys uncirostris* (Schlegel) in Japan (Honshu) and redescribed it based on this new material. Undoubtedly, the nematodes from cyprinids (*Culter*, *Erythroculter*, *Parabramis*) reported erroneously by Chen-Chin-Leu (1973) as *R. chodukini* Osmanov, 1957 from China also belonged to *R. coronacauda* (see Moravec and Sey 1988). The finding of *R. coronacauda* in *L. reini* represents a new host record.

It appears that *R. coronacauda* is largely associated with cyprinids of the subfamily Cultrinae, whereas its finding in salmonid, osmerid and esocid fishes may represent accidental infections acquired by these fishes

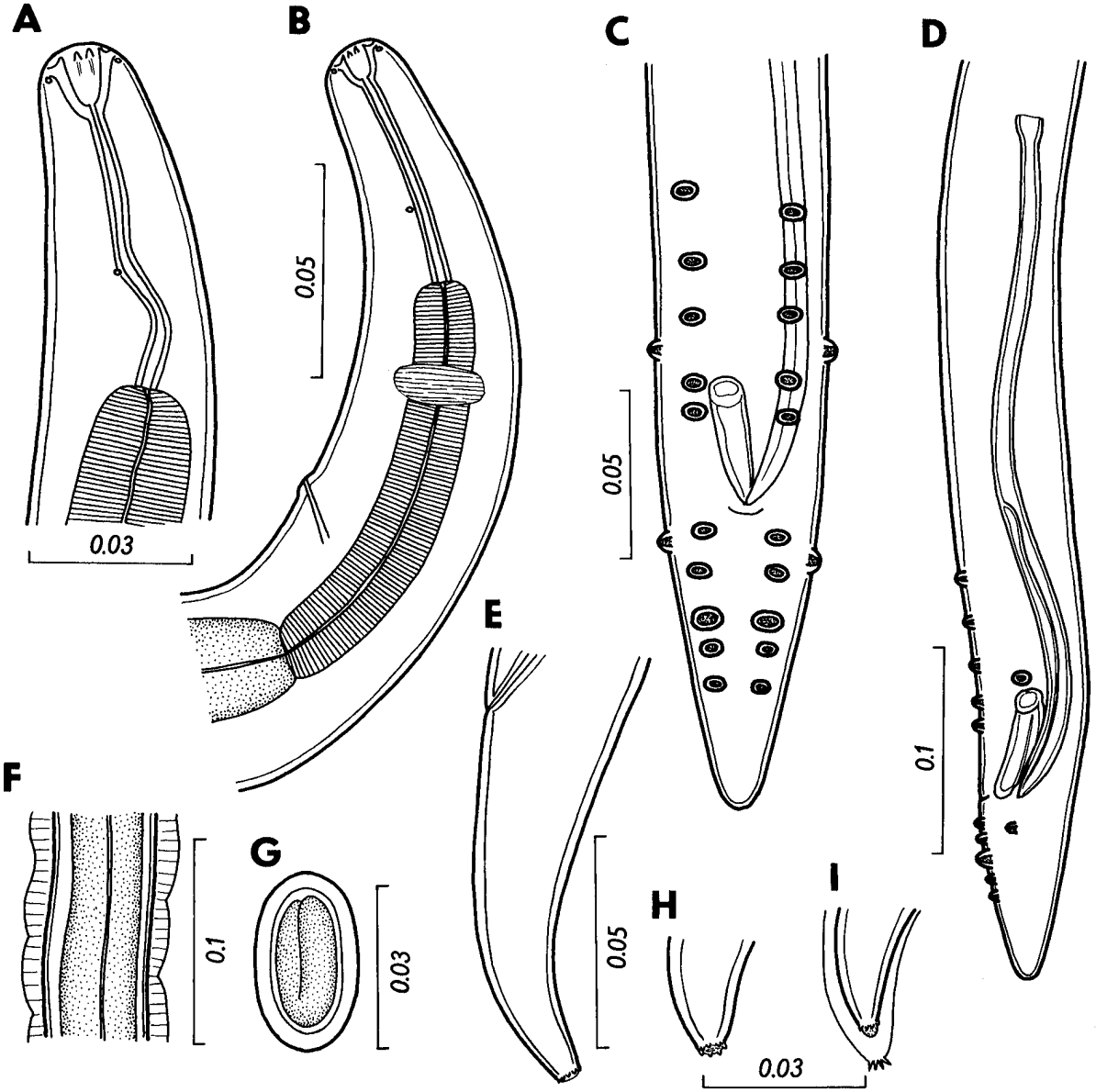

Fig. 5. *Rhabdochona coronacauda* Belouss, 1965. **A** - cephalic end of female; **B** - anterior end of female body; **C**, **D** - posterior end of male, ventral and lateral views; **E** - tail of female; **F** - oesophageal region of body with lateral alae, dorsoventral view; **G** - mature egg; **H** - tail tip of gravid female; **I** - tail tip of juvenile female inside sheathed cuticle of fourth larval stage. Scale bars in mm.

while feeding on infected true definitive hosts (Moravec 1975). However, since *L. reini* feeds only on aquatic insects, it may also be a true definitive host of this parasite. The life cycle of *R. coronacauda* is unknown; infective larvae of this nematode have recently been found in the mayfly *Ephemera japonica* McLachlan in Japan (R. Hirasawa, Nara Women's University, personal communication).

Rhabdochona coronacauda was the only representative of the subgenus *Globochonoides* Moravec, 1975, until Moravec and Sey (1988) established another species, *R. squaliobarbi*, from the cyprinid *Squaliobarbus curriculus* from Vietnam. Its morphology is very similar to that of *R. coronacauda*, differing mainly in the absence of a crown-like formation on the tip of the female tail, a substantially longer (462-561 μm) left spicule and a greater size of the body.

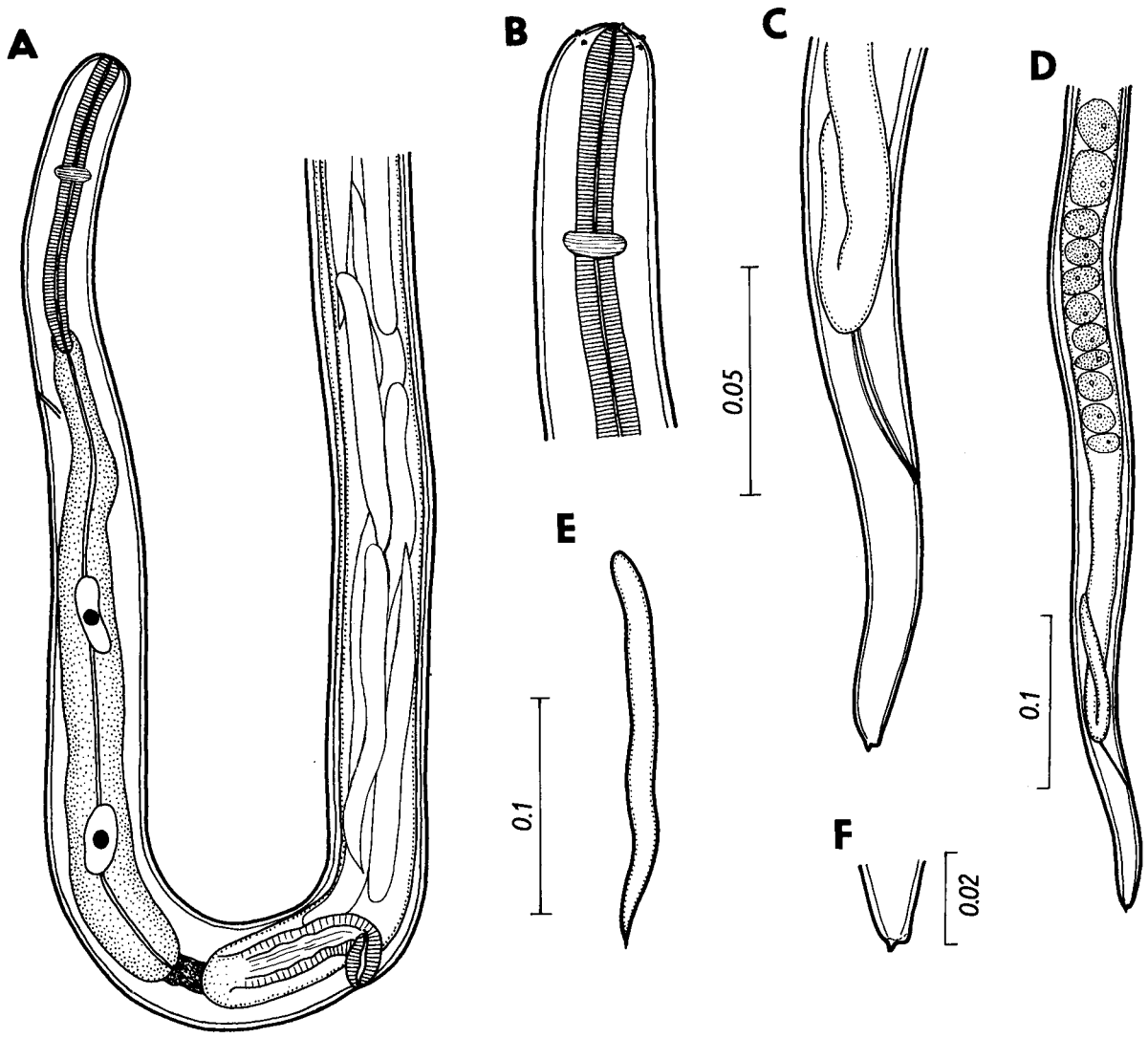

Fig. 6. *Mexiconema liobagri* sp. n., female. **A** - anterior part of body (holotype); **B** - cephalic end (paratype); **C** - tail (paratype); **D** - posterior end of body (paratype); **E** - larva from uterus (holotype); **F** - tip of tail (paratype). Scale bars in mm.

Family Daniconematidae Moravec et Køie, 1987

Mexiconema liobagri sp. n. Fig. 6

Description of female (1 almost complete female with larvae (holotype), 1 complete female without larvae and 2 body fragments (posterior ends); measurements of holotype in parentheses): Fine, thread-like nematodes with thin, smooth cuticle. Head end rounded, 27 (27) wide. Cephalic papillae not readily visible. Length of body of complete paratype specimen 3,427 (body of holotype lacking posterior end 2,856), maximum width at region of posterior end of oesophagus 45 (54). Buccal capsule absent; muscular oesophagus starting im-mediately posterior to below oral opening. Oesophagus divided into short anterior muscular section 216 (156) long and 9 (9) wide, and longer posterior glandular section 279 (363) long and 30 (39) wide. Latter provided with two huge cell nuclei, one near midlength of glandular oesophagus and one near its posterior end; distance of anterior and posterior nuclei from anterior extremity 342 (354) and 453 (423), respectively. Length ratio of muscular and glandular sections of oesophagus 1 : 1.29 (1 : 2.33). Nerve ring encircles muscular oeso-phagus approximately at its middle, 93 (69) from anterior extremity. Excretory pore somewhat posterior to posterior end of muscular oesophagus, 240 (180) from anterior end of body. Deirids not found. Anus functional. Tail conical, 63-72 (-) long, bluntly ended, with one (dorsal) small cuticular process 2 (-) long at tip; any subventral processes not seen. Monodelphic. Single ovary reflected, situated anteriorly to rectum. Uterus long, occupying major part

of nematode body, straight, containing eggs, developing embryos and fully formed larvae in sequence from posterior to anterior end. Vulva well developed, functional, situated 690 (585) from anterior end of body, somewhat posterior to end of oesophagus (distance of vulva from oesophago-intestinal junction 195 (95)); vulval lips not elevated. Vagina first directed posteriorly, then anteriorly from vulva. Fully formed larvae in uterus with sharply pointed tail; length of larvae about (180), width (12).

T y p e h o s t: *Liobagrus reini* Hilgendorf (total length 6-11 cm).

S i t e o f i n f e c t i o n: Abdominal cavity.

T y p e l o c a l i t y: Sho River, Toyama Prefecture, central Honshu, Japan (18 July 1995).

O c c u r r e n c e: prevalence 14% (29 fish examined/ 4 infected), intensity 1.

E t y m o l o g y: The specific name *liobagri* relates to the generic name of the fish host.

D e p o s i t i o n o f t y p e s: Holotype and 1 paratype in the helminthological collection of the Institute of Parasitology, ASCR, in České Budějovice (Cat. No. N-709); 2 paratypes in the National Science Museum, Tokyo (Cat. Nos. NSMT-As-2839 and 2840).

Comments: Although only females of this dracunculoid species were found, their general morphology, particularly the characteristic structure of the oesophagus, shows clearly that they belong to the genus *Mexiconema* Moravec, Vidal et Salgado Maldonado, 1992; the glandular oesophagus provided with two huge cell nuclei is present only in this genus within Dracunculoidea.

Previously, *Mexiconema* was monotypic, containing only *M. cichlasomae* Moravec, Vidal et Salgado Maldonado, 1992, a parasite of the abdominal cavity and some tissues of cichlids (*Cichlasoma*) and poeciliids (*Xiphophorus*) in southern Mexico, but recently has also been recorded from the shark *Ginglystoma cirratum* (secondary infection) from the Gulf of Mexico (Moravec et al. 1992, 1998). The morphology of females from *L. reini* is distinctly different from that of the females of *M. cichlasomae* and there is no doubt that the Japanese nematodes represent a new species. The main differentiating features between these two species is the position of the excretory pore (near the middle of the muscular oesophagus in *M. cichlasomae* and at the level of the anterior end of glandular oesophagus in *M. liobagri*) and the numbers of caudal processes (three in *M. cichlasomae* and one in *M. liobagri*). Furthermore, the larvae of *M. liobagri* are distinctly wider than those of *M. cichlasomae* (9 μm vs. 5-6 μm), and the ovary of *M. liobagri* extends posteriorly to the end of the intestine, whereas that of *M. cichlasomae* to a rather long distance anterior to the end of intestine. Besides morphological features, the host types (Siluriformes vs. Perciformes and Atheriniformes) and the geographical distributions (Japan vs. Mexico) should also be considered.

The life cycles of *Mexiconema* species are unknown. Moravec et al. (1998) have speculated that ectoparasitic, blood-sucking *Argulus* species may serve as the intermediate hosts of *M. cichlasomae*; the same may be true for *M. liobagri*.

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