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RHABDOCHONA LONGLEYI SP. N. (NEMATODA: RHABDOCHONIDAE) FROM BLIND CATFISHES, TROGLOGLANIS PATTERSONI AND SATAN EURYSTOMUS (ICTALURIDAE) FROM THE SUBTERRANEAN WATERS OF TEXAS

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Abstract. A new nematode species, *Rhabdochona longleyi* sp. n. is described from the intestine of two species of blind catfishes, *Trogloglanis pattersoni* Eigenmann (type host) and *Satan eurystomus* Hubbs et Bailey (both fam. Ictaluridae, Siluriformes) from the subterranean waters (artesian wells penetrating San Antonio pool of Edwards Aquifer) of Texas, USA. It is characterized largely by the presence of only six anterior teeth in the prostom, simple deirids, by the shape and length of spicules (0.42 to 0.50 mm and 0.093—0.102 mm), shape of the tail tip (rounded), and by filamented eggs. *R. longleyi* probably adapted to the environment of the aquifer by utilizing available troglobitic crustaceans instead of aquatic insects as an intermediate host.

In spite of the fact that the parasites of insular and relict vertebrates have always been of special interest to parasitologists, there are often fragmentary or no data on the parasites of many relict species and apparently many of them have not yet been examined helminthologically (see e.g. Strunkard 1970). It concerns also the only two troglobitic catfishes known in North America, the toothless blindcat (*T. pattersoni* Eigenmann) and the widemouth blindcat (*S. eurystomus* Hubbs et Bailey); both these fish species are representatives of the monotypic genera *Trogloglanis* and *Satan*.

According to Lee et al. (1980), both *T. pattersoni* and *S. eurystomus* are known from only five artesian wells penetrating San Antonio pool of the Edwards Aquifer (Edwards Limestone, Lower Cretaceous) at the depth of 305—582 m and near San Antonio, Bexar County, in Texas. The only recent information about all aspects of the biology and environment of these subterranean fishes were provided by Longley and Karnei (1978a, b). According to the latter authors these troglobitic fishes are probably restricted to the San Antonio pool of the Edwards Aquifer and it is possible that temperature is important in limiting the distribution of these blindcats to the deep artesian wells in southern Bexar County, where the temperature is near 27 °C. In northern Bexar County where the Edwards Limestone is exposed, the temperature is 24 °C; although numerous caves exist there and many have been explored, no troglobitic fish have ever been recorded from them (see Longley and Karnei 1978a, b). *T. pattersoni* occurs in the same artesian wells as *S. eurystomus*, but only two (possibly three) wells produced both species; population estimates show the ratio of *T. pattersoni* and *S. eurystomus* to be 2 : 1 (Longley and Karnei 1978a, b). No data have so far been published on the parasites of these interesting fishes.

In May 1987, during a short visit of F. M. to Texas, several fixed specimens of *T. pattersoni* and *S. eurystomus* were kindly provided for helminthological dissection

by Dr. Glenn Longley, the director of Edwards Aquifer Research and Data Center, Southwest Texas State University, in San Marcos. From the intestines of both these unique fishes, nematodes of a previously unknown species of the genus *Rhabdochona* Railliet, 1916 were found, and we now assign them to a new species, *R. longleyi* sp n ., which we describe below.

MATERIALS AND METHODS

The nematodes were obtained from the fixed fish specimens collected by Drs. H. Karnei and T. Spinelli, Edwards Aquifer Reseach and Data Center, Southwest Texas State University, San Marcos, in the years 1978 and 1983. A total of 9 specimens of toothless blindcat (*Trogloglanis pattersoni* Eigenmann) and 3 specimens of widemouth blindcat (*Satan eurystomus* Hubbs et Bailey) were obtained for study, but the bodies of 2 *T. pattersoni* proved to be too macerated, preventing thus their utilization for collecting the parasites. All fishes originated from artesian wells in Bexar County near San Antonio, Texas.

The nematode specimens had been fixed *in situ* by 70 % ethanol preservation of their fish hosts. The latter were transferred to distilled water for the period of 24 h and then autopsied. The nematodes recovered were stored in 4 % formaldehyde. For examination they were cleared with glycerine and *en face* views were prepared according to Anderson's (1958) method. The nematode eggs were dissected from the uteri for study. Drawings were made with the aid of a Zeiss microscope drawing attachment. After examination the specimens were stored in 70 % ethanol and deposited in the helminthological collection of the Institute of Parasitology, Czechoslovak Academy of Sciences, České Budějovice; several paratypes are in the US National Helm. Collection, Beltsville, Maryland. All measurements are in mm.

RESULTS

Rhabdochona longleyi sp. n. Figs. 1, 2

Description: Medium sized nematodes, cuticle with fine transverse striation at oesophageal region of body, otherwise smooth. Mouth roughly hexagonal. Two fairly large lateral amphids and four small, submedian cephalic papillae present. Prostom thick-walled, funnel-shaped, with distinct basal teeth in lateral view, in dorsoventral view basal teeth seem to be absent and prostom to be slightly longer than in lateral view. Internally prostom lined with six marked longitudinal ribs extending along whole length of prostom. Near anterior margin of prostom ribs forming relatively big, forwardly directed teeth (one dorsal, one ventral and two lateral on either side). Vestibule relatively long, straight. Deirids small, simple, situated anteriorly to middle of vestibular length. Tail of both sexes conical, with rounded end.

Male (12 specimens; measurements of holotype in brackets): Length of body 7.30—9.70 (7.30), maximum width 0.082—0.136 (0.136). Prostom 0.015—0.018 (0.018) long and 0.012—0.015 (0.015) wide in lateral view. Length of vestibule including prostom 0.093 to 0.120 (0.111), of muscular oesophagus 0.150—0.195 (0.165), of glandular oesophagus 0.456—0.669 (0.600); maximum width of latter 0.039—0.048 (0.045); length ratio of muscular and glandular parts of oesophagus 1 : 2.87—3.85 (1 : 3.64). Length of whole oesophageal region (including vestibule, muscular oesophagus and glandular oesophagus) representing 8.54—12.00 % of whole body length. Nerve ring encircling muscular oesophagus 0.135—0.180 (0.171) from anterior end of body, distance of excretory pore 0.213—0.285 (0.273), of deirids 0.051—0.060 (0.060). Subventral preanal papillae occurred in following combinations: 6 + 8, 8 + 8, 8 + 9, 9 + 9, and 9 + 10 (9 + 10). Additional lateral pair of preanal papillae present at level of third subventral pair (counted from cloacal opening) or slightly more posteriorly. Of 6 postanal pairs of papillae, second pair lateral, remaining subventral. Longitudinal ventral cuticular ridges (area rugosa) absent. Larger (left) spicule well sclerotized, 0.420—0.501 (0.474) long,

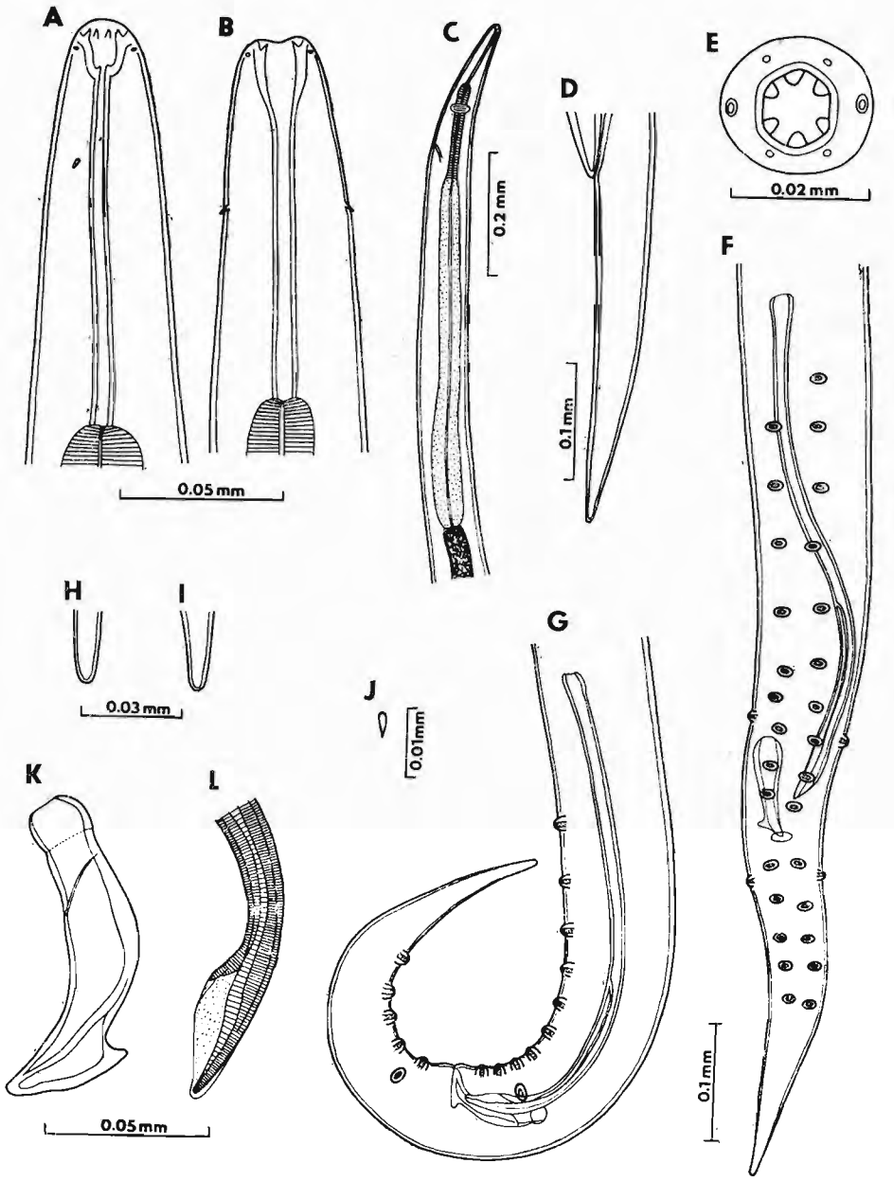

Fig. 1. *Rhabdochona longleyi* sp. n. A, B — anterior end of male, lateral and dorsal views; C — oesophageal part of male body; D — tail of female; E — head end of female, apical view; F, G — posterior end of male, ventral and lateral views; H, I — tip of tail, male and female; J — deirid; K — right spicule; L — distal end of left spicule.

length of its shaft 0.240—0.291 (0.285), representing 54—64 (60) % of whole spicule length, distal tip moderately widened, lanceolate. Smaller (right) spicule 0.093—0.102 (0.099) long, with distinct dorsal barb at distal tip. Length ratio of spicules 1 : 4.35 to 5.06 (1 : 4.79). Tail conical, 0.261—0.390 (0.345) long, with rounded tip.

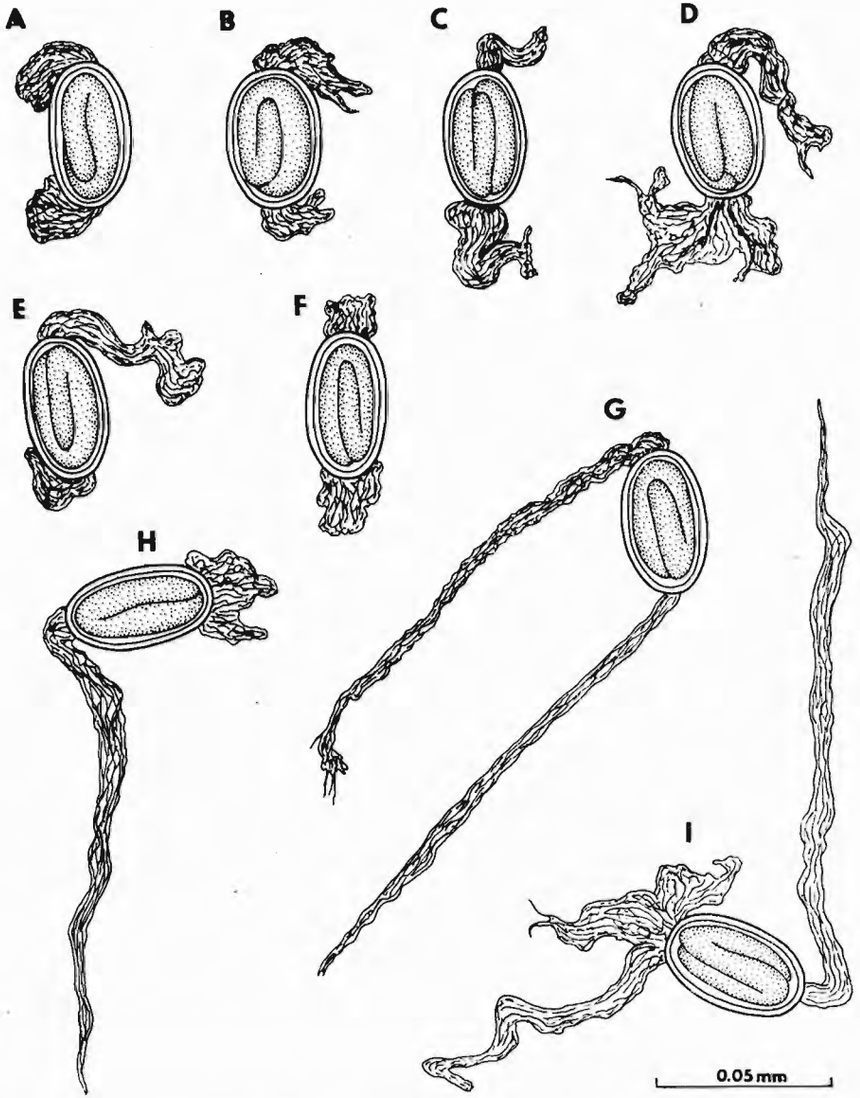

Fig. 2. *Rhabdochona longleyi* sp. n. — mature eggs. (A—F — from *S. eurystomus*, G—I — from *T. pattersoni*.)

Female (8 specimens; measurements of allotype in brackets): Length of body of gravid females 8.62—15.97 (13.40), width 0.109—0.163 (0.122). Prostom 0.015—0.018 (0.018) long and 0.012—0.015 (0.015) wide in lateral view. Length of vestibule including prostom 0.099—0.132 (0.132), of muscular oesophagus 0.147—0.195 (0.156), of glandular oesophagus 0.510—0.720 (0.558); maximum width of latter 0.036—0.066 (0.036); length ratio of muscular and glandular parts of oesophagus 1 : 3.14—4.10 (1 : 3.58). Length of whole oesophageal region representing 6.32—10.61 (6.32) % of whole body length. Distance of nerve ring 0.135—0.165 (0.159), of excretory pore 0.233—0.267 (0.267), of deirids 0.042—0.057 (0.054). Tail conical, 0.264—0.368 (0.309) long, with rounded tip. Vulva postequatorial, 4.86—8.09 (7.59) from posterior end of body. Muscular vagina directed posteriorly. Eggs oval, size 0.039—0.045 × 0.018—0.021 (0.039 to 0.042 × 0.018—0.021); each pole of mature (larvated) egg provided with a wide filament; polar filaments highly variable in length and shape (see Fig. 2), their maximum length being some 0.060—0.075.

Hosts: Toothless blindcat, *Trogloglanis pattersoni* Eigenmann (type host) (body size 7—14 cm), and widemouth blindcat, *Satan eurystomus* Hubbs et Bailey (size 14 cm) (both fam. Ictaluridae, Siluriformes).

Type locality: Artesia Well 4, San Antonio, Bexar County, Texas, USA (Lat. 29°25′ Lon. 98°25′) (holotype and allotype collected from *T. pattersoni* on 11 February 1983; other specimens from *T. pattersoni* and *S. eurystomus* on 4, 13 and 25 March 1978 and in May 1978).

Other locality: Kleberg Ranch, Bexar Co., Texas, USA (2 March 1983).

Prevalence: in 3 out of 7 *T. pattersoni* (intensity 2—8 specimens) and in 2 of 3 *S. eurystomus* (intensity 4—7 specimens) examined from Artesia Well 4, San Antonio, and in 1 of 2 *T. pattersoni* (intensity 5 specimens) from Kleberg Ranch.

Specimens: Holotype (♂), allotype (♀) and paratypes deposited in the helminthological collection of the Institute of Parasitology, Czechoslovak Academy of Sciences, České Budějovice (Coll. No. N-280); several paratypes (2 ♂♂ + 5 ♀♀) in US National Helm. Collection, Beltsville, Maryland (Cat. No. 80 004).

Etymology: This new nematode species has been named in honour of Dr. Glenn Longley, the director of Edwards Aquifer Research and Data Center, Southwest Texas State University, San Marcos, who kindly provided the unique host fishes for helminthological examination. Dr. Longley has been very active in surveying and describing the unusually rich biota of the Edwards Aquifer and is widely recognized for his authoritative contributions in this discipline.

DISCUSSION

The nematode genus *Rhabdochona* Railliet, 1916 comprises many species that are intestinal parasites of freshwater fishes. The parasites may be found on all continents with the exception of the Australian zoogeographical region. Altogether 76 *Rhabdochona* species were listed in the recent paper by Moravec and Coy Otero (1987), but several additional new species have since been described by Wang (1986) from China and by Moravec and Sey (1988) from Vietnam: *R. sichuanensis* Wang, 1986, *R. prosthopori* Wang, 1986, *R. schizothoracalis* Wang, 1986, *R. nemacheili* Wang, 1986, *R. fujianensis* Wang, 1986, *R. vietnamensis* Moravec et Sey, 1988, *R. hakyi* Moravec et Sey, 1988, and *R. squaliobarbi* Moravec et Sey, 1988. Accordingly, at present there are known 84 species of *Rhabdochona* of which 13 species have been reported from American freshwater fishes.

In comparison of *R. longleyi* sp. n. with other American members of *Rhabdochona* (for the key to American species of this genus see Moravec and Coy Otero 1987), it is apparent that by having the rounded tail tip and possessing filamented eggs *R. longleyi* sp. n. resembles only the species *R. cotti* Gustafson, 1949 parasitizing North American cottids; also the size of spicules in both species is rather similar. All remaining American congeneric species are characterized, in addition to other features, by the sharply pointed tip of the tail in both sexes and some of them also by the presence of

nonfilamented mature eggs; thus these species can be easily distinguished from *R. longleyi* sp. n.

Although *R. cotti* is more similar to *R. longleyi* sp. n. than to any of the other American species of *Rhabdochona*, these species differ from each other in many important morphological features. While the prostom of the latter species is provided with well developed basal teeth and armed with 6 anterior teeth, that of *R. cotti* is without basal teeth, and the anterior teeth number 14 (see Gustafson 1949, Moravec and Arai 1971). Although the mean size of the body of *R. cotti* is distinctly greater than that of *R. longleyi* sp. n., the left spicule of the new species is longer (0.309 to 0.370 mm versus 0.420—0.501 mm in *R. longleyi* sp. n.); in contrast to *R. longleyi* sp. n., the dorsal barb on the right spicule is absent in *R. cotti*. *R. longleyi* sp. n. differs from *R. cotti* also by the greater measurements of eggs (0.039—0.045 × 0.018 to 0.021 mm versus 0.032—0.033 × 0.018—0.020 mm), the type of egg filaments, more anterior position of deirids, and conspicuously short glandular oesophagus (0.51—0.72 and 0.46—0.67 mm in females and males, respectively, against 1.46—1.92 and 0.80 to 1.28 mm in *R. cotti*) (by the last named character *R. longleyi* sp. n. differs from the majority of its congeners). Both the species differ as well by their host types: while *R. longleyi* sp. n. parasitizes members of the family Ictaluridae (Siluriformes), *R. cotti* is the parasite of Cottidae (Scorpaeniformes).

The shape of the tail, and some other morphological features of *R. longleyi* sp. n., show affinities of this species with some *Rhabdochona* members parasitizing catfishes (Siluriformes) in Asia and Africa (*R. euchiloglanis*, *R. garuai*, *R. glyptothoracis*, *R. japonica*, *R. longicauda*, *R. mazeedi*, *R. paski*) and with the palaearctic species *R. ergensi*, a parasite of fishes of the genus *Noemacheilus* (Cobitidae, Cypriniformes) (see Moravec 1972a, 1975). However, some of these species (*R. euchiloglanis*, *R. garuai*, *R. mazeedi*, *R. paski*) possess, in contrast to *R. longleyi* sp. n., smooth, nonfilamented mature eggs, and differ also from the latter in other important features, especially in the shape of the right spicule (dorsal barb absent).

All the remaining species which are characterized by the presence of polar filaments on eggs possess a greater number (not less than 12) of anterior teeth in the prostom. In addition, *R. japonica* (hitherto known by females only) and *R. longicauda* have a conspicuously longer glandular oesophagus in females (7.4—8.2 mm and 4.8—5.9 mm versus 0.5—0.7 mm in *R. longleyi* sp. n.) and *R. longicauda* differs also in having quite a different length ratio of spicules (1 : 8.3—11.3 versus 1 : 4.4—5.0). The size of spicules of *R. glyptothoracis* and *R. ergensi* is similar to that of *R. longleyi* sp. n.; but these two can be distinguished from the new species, in addition to the greater number of anterior teeth also by the greater measurements of the prostom, absence of basal teeth, markedly longer glandular oesophagus and different character of polar filaments on eggs; moreover the right spicule of *R. glyptothoracis* bears no dorsal barb, this being well developed in *R. longleyi* sp. n.

A remarkable feature of *R. longleyi* sp. n. is the presence of only 6 anterior teeth in the prostom which can be considered a primitive feature within the genus *Rhabdochona*, as well as the presence of basal teeth (see Moravec 1972b). Of many *Rhabdochona* species in which the number of anterior teeth was observed "*en face*", 6 teeth have hitherto been found in adults only in the species *R. cubensis* and *R. squaliobarbi* (Moravec and Coy Otero 1987, Moravec and Sey 1988); hence *R. longleyi* sp. n. is the third species. Most other species have 14 or 8 anterior teeth, whereas only 6 teeth are present in the conspecific fourth-stage larvae (Moravec 1972b, 1974, 1976). It is still possible that 6 teeth are present in adults in some other species parasitizing catfishes for which the exact number has not hitherto been reported (e.g. *R. garuai*, *R. mazeedi*).

In spite of the presence of less numerous teeth in the prostom, *R. longleyi* sp. n. may be placed in the subgenus *Rhabdochona* as conceived by Moravec (1975).

R. longleyi sp. n. is the second member of *Rhabdochona* described from fishes from the subterranean waters. Another species, *R. kidderi* Pearse, 1936, has been known from caves and cenotes from Yucatan, Mexico, where it was originally found in three subspecies of bagres (*Rhamdia guatemalensis depressa*, *R. g. decolor* and *R. g. stygeae*) (Pimelodidae, Siluriformes) by Pearse (1936) and later reported from there from "*Typhlias*" (*Typlichthys?*) *pearsi* (? Amblyopsidae, Percopsiformes) also by Chitwood (1938). This species differs from *R. longleyi* sp. n. by unusually long (some 1 mm) left spicule, by the sharp tip of the tail, absence of egg filaments and many other features.

The present data show that although the host fishes of *R. longleyi* sp. n. belong to different genera, both *T. pattersoni* and *S. eurystomus* serve as suitable definitive hosts for this nematode and probably there are no substantial differences in the degree of their infestation by this parasite. According to Stunkard (1970), isolation of a population tends to favour speciation, but the parasites have a more stable environment and do not evolve as rapidly as the hosts; the course and results of host-parasite interrelations are controlled by ecological parameters, especially the ability of the parasite to complete the life cycle and maintain the incidence of infection. From this viewpoint there are interesting considerations concerning the life history of *R. longleyi* sp. n. in the environment of the Edwards Aquifer.

According to the present data, only some aquatic insects (principally mayflies, less often also stoneflies and caddisflies) serve as intermediate hosts for *Rhabdochona* species (Gustafson 1939, 1942, 1949, Shtein 1959, Vojtková 1971, Moravec 1972b, 1976, 1977); Weller's (1938) data on the experimental infection of crustaceans with the eggs of *Rhabdochona ovifilamenta* and those of Janiszewska (1960) on the finding of the larvae of *R. barbi* (= *R. hellichi*) in oligochaetes are evidently erroneous because of misidentification of the nematode larvae recovered (see Moravec 1972c, Moravec and Arai 1971). But the list of troglobitic aquatic invertebrates from artesian wells in Bexar County, Texas, provided by Longley and Karnei (1978a) shows that only aquatic crustaceans and gastropods occur there. Therefore, it is highly probable that *R. longleyi* sp. n. adapted to the environment of the subterranean waters by utilizing available crustaceans instead of insects as its intermediate host. Some species of the related fish nematode genus *Spinitectus* can develop through both aquatic insects and crustaceans (Jilek and Crites 1981).

As to the food of host fishes, while *S. eurystomus* is a carnivore feeding on small crustaceans (shrimps, amphipods, isopods) with possible predation on *T. pattersoni*, the stomach contents of *T. pattersoni* failed to reveal what the catfish are foraging on; this form is probably omnivorous, feeding possibly on fungae growths and dead or dying organisms in the aquifer (Longley and Karnei 1978a, b). Most of the fish we examined had been trapped in surface nets for hours prior to being preserved and all traces of food were gone.

The presence of filaments on the surface of mature eggs, as found in *R. longleyi* sp. n., is typical of the *Rhabdochona* species occuring in flowing waters (Moravec 1979); the filaments serve for the attachment of the parasite's eggs to the surface of plants and other objects in flowing water where they are available for the intermediate host.

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RHABDOCHONA LONGLEYI SP. N. (NEMATODA: RHABDOCHONIDAE) — НОВАЯ НЕМАТОДА ОТ СЛЕПЫХ СОМИКОВ *TROGLOGLANIS PATTERSONI* И *SATAN EURYSTOMUS* (ICTALURIDAE) ИЗ ПОДЗЕМНЫХ ВОД ТЕКСАСА

Ф. Моравец и Д. Г. Гуффман

Резюме. Из кишечника двух видов слепых сомиков *Trogloglanis pattersoni* Eigenmann (типовой хозяин) и *Satan eurystomus* Hubbs et Bailey (оба из сем. Ictaluridae, Siluriformes) из подземных вод (артезианские колодцы проникающие в Сан Антонийский омут водоносного слоя Эдвардса (Edwards Aguifer)) Техсаса, США, описан новый вид нематоды — *Rhabdochona longleyi* sp. n. Характерными признаками нового вида являются, главным образом, присутствие только шести передних зубов в простоме, форма и длина спикул (0,42—0,50 мм и 0,093—0,102 мм), форма конца хвоста (закругленный) и яйца с филаментами. Вероятно этот паразит приспособился условиям водоносного слоя и использует здесь в качестве промежуточных хозяев ракообразных вместо водяных насекомых.

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