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Records of the bird capillariid nematode *Ornithocapillaria appendiculata* (Freitas, 1933) n. comb. from freshwater fishes in Mexico, with remarks on *Capillaria patzcuarensis* Osorio-Sarabia et al., 1986

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Abstract

Re-examination of capillariid specimens collected from the freshwater fish *Chirostoma estor* Jordan from Lake Pátzcuaro in 1985–1986 and deposited as paratypes of *Capillaria patzcuarensis* Osorio-Sarabia, Pérez-Ponce de León & Salgado-Maldonado, 1986 showed that their morphology was in contradiction with the description of this species and, in fact, they could be identified as the species originally described as *C. appendiculata* Freitas, 1933 from cormorants *Phalacrocorax brasilianus* (Gm.) in Brazil; conspecific capillariid specimens were later recorded from *Chirostoma estor* and *Cyprinus carpio* L. from the same locality. This species and two others are transferred to *Ornithocapillaria* Baruš & Sergeeva, 1990 as *O. appendiculata* (Freitas, 1933) n. comb., *O. carbonis* (Dubinin & Dubinina, 1940) n. comb., and *O. phalacrocoraxi* (Borgarenko, 1975) n. comb. This is the first record of *O. appendiculata* in Mexico. Its occurrence in fishes suggests that these nematodes may be acquired by their fish hosts accidentally while feeding on cormorant excrement containing mature nematodes. A female capillariid collected from one of 110 *Chirostoma estor* examined from this locality in April, 1998 was identified as *Capillaria patzcuarensis*. Both capillariid species are briefly described and illustrated.

Introduction

An examination of the type-specimens of *Capillaria patzcuarensis* Osorio-Sarabia, Pérez-Ponce de León & Salgado-Maldonado, 1986 (Nematoda: Capillariidae), carried out during April, 1998, revealed that the specimens designated as "paratypes" (cat. no. 2255 [F]), originating from the intestine of the freshwater fish *Chirostoma estor* Jordan from Lake Pátzcuaro, Michoacán, Mexico, differed considerably in their morphology from the original description of *C. patzcuarensis*, evidently representing a different species. Undoubtedly conspecific female nematodes were found in the material collected by one of us (DO-S) in the same locality (Lake Pátzcuaro) in 1991 and 1993, being recorded from *Chirostoma estor* and *Cyprinus carpio* L. A closer examination of all of these nematodes has shown that they are the species originally described as *Capillaria appendiculata* Freitas, 1933, an intestinal parasite of cormorants in Brazil.

Since the holotype of *C. patzcuarensis* has been lost and other paratypes (except for those mentioned above) have not been deposited in the National Helminthological Collection in Mexico, an attempt was recently made to collect new specimens of this species from its type-host and type-locality: despite a large number (110) of *Chirostoma estor* examined by GS-M and FM from Lake Pátzcuaro during April, 1998, only one damaged female nematode of this species was found.

This paper presents the results of these findings.

Materials and methods

Material studied

Type-specimens of *Capillaria patzcuarensis*: 2 vials (cat. no. 2254 [F]) designated as the holotype male and the allotype female: no specimens were found in these vials; one vial (cat. no. 2255 [F]) designated as paratypes: one posterior end of male and 10 females (some of them in fragments) originating from the intestine of *Chirostoma estor* Jordan, Lake Pátzcuaro, Mexico, 1985–1986.

One female capillariid from the intestine of *C. estor* from Lake Pátzcuaro, collected by D. Osorio-Sarabia on 19 January, 1991.

One female capillariid from the intestine of *Cyprinus carpio* L. from Lake Pátzcuaro, collected by D. Osorio-Sarabia on 2 June, 1993.

One female capillariid from *C. estor* from Lake Pátzcuaro, collected by B. Salgado-Maldonado and F. Moravec on 26 April, 1998.

Type-specimens (syntypes) of *Capillaria appendiculata* deposited in the Instituto Oswaldo Cruz in Rio de Janeiro: one vial (cat. no. 7469) containing several body fragments (including one male posterior end) in poor condition, conserved in ethanol; fragments black or dark brown; specimens were collected from *Phalacrocorax brasiliensis* [= *P. brasilianus* (Gm.)] in Brazil by Travassos on 20 August, 1921 and subsequently determined by Freitas.

The nematodes were fixed either in hot 4% formalin or hot 70% ethanol. Museum specimens have been stored in 70% ethanol. For light microscopical examination, they were cleared in glycerine. Drawings were made with the aid of a Zeiss microscope drawing attachment. All measurements are given in millimetres unless otherwise stated. The specimens have been deposited in the National Helminthological Collection, Institute of Biology, National Autonomous University of Mexico (UNAM), Mexico City, and in the Institute of Parasitology, Academy of Sciences of the Czech Republic, in České Budějovice.

***Ornithocapillaria appendiculata* (Freitas, 1933) n. comb.** (Figure 1)

Syn. *Capillaria appendiculata* Freitas, 1933

Description

General. Body comparatively long. Two distinct lateral bacillary bands extending along almost entire body length. Head end narrow, rounded; oral papillae indistinct in lateral view. Muscular oesophagus long, gradually expanded posteriorly; nerve-ring situated approximately at border of first and second fifths of length of muscular oesophagus. Stichosome formed by single row of stichocytes provided with markedly large nuclei, each with several distinct nucleoli; stichocytes rather long, subdivided into numerous transverse annuli. Two medium-sized, wing-like cells present at oesophago-intestinal junction.

Male (posterior part of body of one specimen from *Chirostoma estor*). Length of body fragment 9.25, maximum width 0.048. Width of lateral bacillary bands 0.024. Only short part of oesophageal portion of body present, containing 5 posterior-most stichocytes. Spicule well sclerotised, smooth; proximal end expanded; distal end rounded; length of spicule 2.31; its width at anterior end, in middle and at posterior end 0.012, 0.009 and 0.007, respectively. Proximal end of spicule in cloacal tube. Spicular sheath nonspiny, invaginated. Caudal end rounded, somewhat bifurcate in ventral view, provided with markedly large membranous bursa supported by 2 wide ventro-lateral lobes not reaching to posterior margin of bursa; each lobe provided with small ventral projection bearing papilla. Bursa tripartite, consisting of 2 large oval ventro-lateral wings and small dorsal interconnecting lobe; length of wings 0.051, their width 0.021. Cloacal aperture 0.030 from posterior ends of caudal lobes.

Female (based on 6 specimens from *C. estor*; measurements of one specimen from *Cyprinus carpio* in parentheses): Body length of gravid females 14.88–22.13 (21.83), maximum width 0.060–0.081 (0.075). Width of lateral bacillary bands 0.027–0.036 (0.024). Length of entire oesophagus 4.54–6.11 (4.78) [27–41% (22%) of body length], of muscular oesophagus 0.315–0.435 (0.399), of stichosome 4.21–5.79 (4.39); stichocytes 40–45 (39) in number. Distance of nerve-ring from anterior end 0.084–0.153 (0.111). Vulva situated 0.093–0.171 (0.081) posterior to oesophago-intestinal junction or 8.62–14.95 (17.00) from poste-

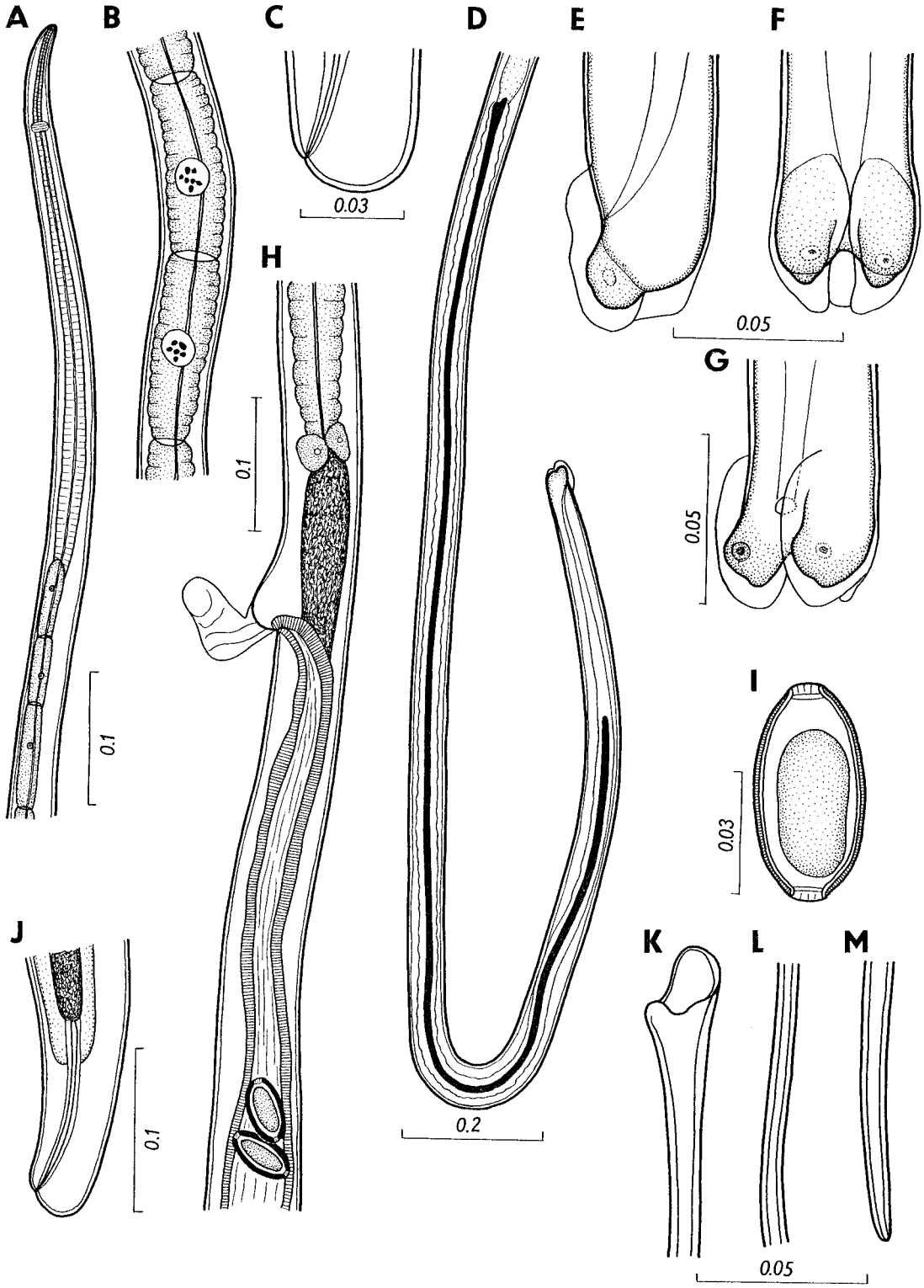

Figure 1. Ornithocapillaria appendiculata (Freitas) from *Chirostoma estor*. A, anterior end of female; B, stichocytes in middle region of stichosome; C, tail of female; D, posterior end of male; E,F,G, caudal end of male, lateral, ventral and subventral views; H, region of vulva; I, fully developed egg; J, caudal end of female; K,L,M, proximal end, middle part and distal end of spicule. Scale-bars in mm.

rior end of body, being provided with marked vulvar appendage 0.081–0.090 (0.078) long and 0.030–0.036 (0.048) wide; appendage absent in smallest specimen (body length 14.88) with uterus containing only immature eggs. Eggs arranged in one row in region near vulva, more distant eggs in 2 rows. Mature eggs oval, thick-walled, 0.057–0.060 × 0.027. Egg-wall bi-layered, 0.003 (0.003) thick; inner layer thin, hyaline; outer layer slightly thicker, with almost smooth surface; polar plugs not protruding, length 0.003–0.004 (0.004), width 0.006–0.007 (0.007). Contents of mature eggs uncleaved. Ovary reaching level of rectum posteriorly. Anus subterminal; tail rounded, 0.009–0.012 (0.009) long.

Hosts (accidental): Freshwater fishes, *Chirostoma estor* Jordan (Atherinidae, Atheriniformes) and *Cyprinus carpio* Linnaeus (Cyprinidae, Cypriniformes).
Site of infection: Intestine.
Locality: Lake Pátzcuaro, Michoacán, central Mexico (collected 19 January, 1991 and 2 June, 1993).

Capillaria patzcuarensis Osorio-Sarabia, Pérez-Ponce de León & Salgado-Maldonado, 1986

(Figure 2)

Description

Female (based on 1 incomplete specimen). Length of body fragment (major part of oesophageal portion missing) 4.03, maximum width 0.075. Lateral bacillary bands readily visible. Stichosome uniformly light in colour; stichocytes elongate, with inconspicuous nuclei, subdivided into several transverse annuli. Two rather small wing-like cells present at oesophago-intestinal junction. Vulva situated at level of oesophago-intestinal junction, 3.28 from posterior end of body; vulval lips not elevated; vulval appendage absent. Eggs arranged in one row in region near vulva, more distant eggs in 2 rows. Fully-developed eggs rather large, oval, thick-walled; their polar plugs almost not protruding; size including polar plugs 0.072–0.081 × 0.030–0.033. Egg-wall bi-layered, 0.003 thick; inner layer thin, hyaline; outer layer slightly thicker, with distinct sculpture on surface (stippled). Contents of fully-developed eggs uncleaved. Incompletely-developed eggs have thin, smooth, one-layered shell and markedly protruding polar plugs. Ovary reaches posteriorly approximately to middle of rectum. Anus subterminal; tail rounded, 0.009 long.

Host: Freshwater fish, *Chirostoma estor* Jordan (Atherinidae, Atheriniformes).
Site of infection: Intestine.
Locality: Lake Pátzcuaro, Michoacán, central Mexico (collected 26 April, 1998).

Discussion

In 1986, Osorio-Sarabia et al. inadequately described a new capillariid species, *Capillaria patzcuarensis*, from the intestine of the freshwater atherinid fish *Chirostoma estor* from Lake Pátzcuaro, Michoacán, central Mexico. Their description was based on three males and ten females. Later the same species was reported from this locality by Salgado & Osorio-Sarabia (1987), who recorded it from *C. estor*, *Goodea atripinnis* Jordan (Goodeidae, Cypriniformes) and *Cyprinus carpio* (Cyprinidae, Cypriniformes). In Lake Pátzcuaro, *C. patzcuarensis* was also reported by Pérez-Ponce de León et al. (1994) from *Chirostoma attenuatum* Meek. Pérez-Ponce de León et al. (1996) also mentioned several unpublished records of this parasite from Lake Pátzcuaro [including a new host record from *Algansea lacustris* Steindachner (Cyprinidae)] and from *C. carpio* from the Aquaculture Centre "La Rosa", Coahuila. In spite of all these findings, the only existing description and illustrations of *C. patzcuarensis* are those given in the original paper (Osorio-Sarabia et al., 1986).

A recent examination of the type material of *C. patzcuarensis* deposited in the National Helminthological Collection in Mexico showed that no specimens were present in the vials labelled as the holotype and the allotype (cat. no. 2254 [F]); on the other hand, the only available paratypes of *C. patzcuarensis* from the vial designated with cat. no. 2255 (F), originating from the host *C. estor* from Lake Pátzcuaro (see Lamothe-Argumedo et al., 1997), all proved to be representatives of another capillariid genus and species, which differed considerably from the original description of *C. patzcuarensis*. While the body length of *C. patzcuarensis* was reported to be about 2 mm and 4 mm for males and females, respectively, the "paratypes" examined are considerably larger, with the length of the females ranging from 14 to 22 mm. Other important differences are the length of the spicule (0.32 *vs* 2.31 mm), the nature of the spicule sheath (spiny *vs* non-spiny) and the size of the eggs (0.068–0.070 × 0.028–0.030 *vs* 0.057–0.060 × 0.027 mm). Although the male cau-

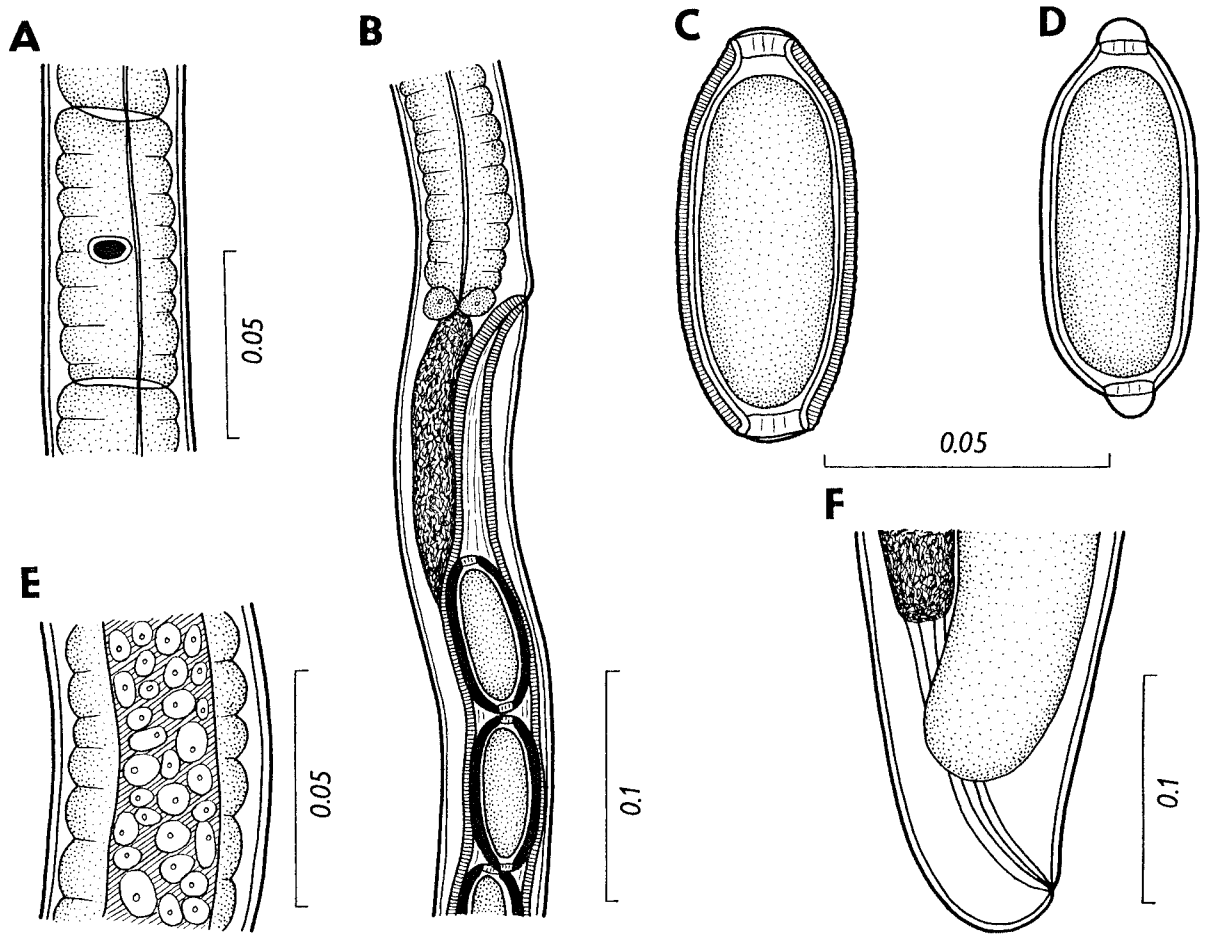

Figure 2. Capillaria patzcuarensis Osorio-Sarabia, Pérez-Ponce de León & Salgado-Maldonado, 1986, female from *Chirostoma estor*. A, stichocyte in middle region of stichosome; B, region of vulva; C, fully-developed egg; D, not fully-developed egg; E, part of oesophageal region with marked lateral bacillary band; F, caudal end. Scale-bars in mm.

dal end of *C. patzcuarensis* is inadequately described, it is reported to lack any lobes, whereas that of the only available "paratype" male is provided with two large ventro-lateral lobes supporting a large membranous bursa, which is not mentioned in the description of *C. patzcuarensis*. The general morphology of these nematodes designated as "paratypes", particularly the structure of the male caudal extremity with its large bursa, shows that they belong to a morphological group of capillariids represented by species originally described as *Capillaria appendiculata* Freitas, 1933, *C. carbonis* Dubinin & Dubinina, 1940 and *C. phalacrocoraxi* Borgarenko, 1975, all intestinal parasites of cormorants (*Phalacrocorax* spp.). All these were later provisionally transferred to *Baruscapillaria* Moravec, 1982 by Moravec (1982) and Moravec et al. (1994), which was accepted by Baruš & Sergejeva (1990b). However, the presence of the vulval appendage and the morphology of the male caudal extremity suggest that they should be listed in the recently established genus *Ornithocapillaria* Baruš & Sergeeva, 1990 [type-species *O. ovopunctata* (Linstow, 1873)] (see Baruš & Sergeeva, 1990a) rather than in *Baruscapillaria*; therefore, we transfer them to this genus as *Ornithocapillaria appendiculata* (Freitas, 1933) n. comb., *O. carbonis* (Dubinin & Dubinina, 1940) n. comb., and *O. phalacrocoraxi* (Borgarenko, 1975) n. comb. It has previously been pointed out by Baruš & Sergejeva (1990a) that *C. phalacrocoraxi* may belong to *Ornithocapillaria*.

The three above-mentioned species are closely related and, because their descriptions are in most cases wanting, it is difficult to make a detailed comparison with the present specimens. *O. phalacrocoraxi*,

a parasite described from the bursa Fabricii and the cloaca of *Phalacrocorax pygmeus* (Pallas) in Tajikistan (Central Asia) (Baruš & Sergejeva, 1990b), can be differentiated by a longer spicule (3.08–3.30 *vs* 2.31 mm), smaller eggs (0.044–0.045 × 0.022–0.023 *vs* 0.051–0.081 × 0.027–0.033 mm) and geographical distribution. Moravec et al. (1994) showed that the numerous records of *Capillaria carbonis* (Rudolphi, 1819) [*nomen nudum*] from different hosts in Europe and Asia probably included more than one species; they validated this name by changing its authority, considering the description of specimens originating from *Phalacrocorax carbo* (Linnaeus) in Russia, given by Dubinin & Dubinina (1940), to be the original for this species. A more detailed redescription of this species, under the invalid name *C. carbonis* (Rudolphi, 1819) [*nomen nudum*], was provided by Okulewicz (1989) on the basis of specimens collected from *P. carbo* in Poland. In contrast to the present specimens from Mexico, *O. carbonis* has a slightly different shape of the male caudal bursa which is supported by two large, well-separated lobes on either side, the eggs are somewhat smaller (0.048–0.054 × 0.023–0.024 mm) and the vulval appendage is distinctly shorter (0.020–0.021 *vs* 0.078–0.090 mm).

The morphology of the present Mexican specimens is most similar to that of *O. appendiculata*; taking into account the fact that it is the only species of this group occurring in the New World, we consider our specimens to belong to this species. Although the type-specimens of *O. appendiculata* were in such a poor condition that most morphological features could not be studied, the structure of the only preserved male caudal extremity and that of eggs proved to be identical with those in the present material from Mexico. *O. appendiculata* was described from the large intestine of *Phalacrocorax brasiliensis* [= *P. brasilianus* (Gm.)] from Brazil and it has not been recorded since (Freitas, 1933; Vicente et al., 1995). This is the second record of this species and the first one from Mexico.

The original description of *O. appendiculata* is inadequate, being based on two fragmented males and one female; accordingly, the present data extend our knowledge concerning the morphology of this species. Moreover, the present material confirms that the characteristic vulval appendage is present in females with fully-developed eggs in the uterus, whereas it is absent from conspecific females containing only eggs which are not fully-developed (apparently, it appears only after the start of oviposition). This should be taken into account, because the presence or absence of the vulval appendage is considered by some authors to be an important diagnostic feature in capillariids (Sergeeva,1979), even though the validity of this character for the systematics of these nematodes was questioned by others (Justine, 1992).

It is rather difficult to explain the records of this bird capillariid (*O. appendiculata*) in fishes of Lake Pátzcuaro. The only explanation seems to be that fishes have acquired these parasites accidentally while feeding on cormorant excrement containing mature nematodes. The nematodes live in the large intestine and probably also in the cloaca of their bird hosts, from where they may be accidentally expelled with faeces to the external environment. Lake Pátzcuaro is a large, shallow lake inhabited by large populations of water birds, including cormorants. No cormorants from this locality have so far been examined for parasites.

Pérez-Ponce de León et al. (1996) remark that the only capillariid species present in fishes of Lake Pátzcuaro is *C. patzcuarensis*. However, considering reports of this species from fishes of different orders (Atheriniformes, Cyprinodontiformes and Cypriniformes) (Pérez-Ponce de León et al. 1996) and confirmed occasional findings of bird capillariids from fishes (present study), it is apparent that more than one capillariid species occurs in fishes in this locality.

Unfortunately, the type-specimens relating to the original description of *C. patzcuarensis* were lost, as indicated above, and, at present, no other specimens of this species are available which originate from the type-host, *Chirostoma estor*; probably the only specimen of this species now available is the female capillariid reported in this study, collected from one of 110 *C. estor* examined (prevalence c. 1%) from Lake Pátzcuaro in April, 1998. The rare occurrence of this parasite in *C. estor* in this locality has previously been indicated by Salgado & Osorio-Sarabia (1987), who reported the prevalence to be c. 2%. Although the present study gives some additional data on the female morphology of *C. patzcuarensis*, a detailed redescription of this species based on newly collected material is highly desirable.

Acknowledgements

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sion to examine the type-material of *C. patzcuarensis* and to Dr Anna Kohn from the Instituto Oswaldo Cruz, Rio de Janeiro, for her kind assistance in obtaining type-specimes of *C. appendiculata* from the helminthological collection of that institute. The authors' thanks are also due to Mrs Irena Husáková, Institute of Parasitology, AS CR, České Budějovice, for her help in preparing the drawings. This study was supported by grant 524/97/0009 from the Grant Agency of the Czech Republic.

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Nomenclatural note

Since *Terranova diazungriai* Moravec, 1998 (*Nematodes of freshwater fishes of the Neotropical Region*. Academia, Prague, 464 pp.) was found to be a homonym to *T. diazungriai* Vado, 1972 (*Bulletin du Museum National d'Histoire Naturelle*, 3 sér., Zoologie, **34**, 477–498) described from Venezuela, a new name, *T. incognita* nom. nov., is now proposed for the former species.

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