NEW OBSERVATIONS ON *MEXICONEMA CICHLASOMAE* (NEMATODA: DRACUNCULOIDEA) FROM FISHES IN MEXICO

MORAVEC F.**, JIMÉNEZ-GARCÍA M.I.*** & SALGADO-MALDONADO G.***

Summary :

The dracunculoid nematode *Mexiconema cichlasomae* Moravec, Vidal et Salgado Maldonado, 1992, originally described from the abdominal cavity and viscera of *Cichlasoma* spp. from Mexico, was recorded from the abdominal cavity of the poeciliid *Xiphophorus helleri* Heckel in Lake Catemaco and its small tributary Arroyo Agrio, Veracruz and from the intestine of the nurse shark *Ginglystoma cirratum* (Bonnaterre) off the southern coast of the Gulf of Mexico in Campeche; both these findings represent new host records. The nematode specimens from these hosts are briefly described and illustrated. Whereas *X. helleri* evidently served as the true definitive host of this parasite, *G. cirratum* probably acquired *Mexiconema* infection accidentally while feeding on fish definitive hosts in the brackish or salt-water environment. The ability of *M. cichlasomae* to utilize fishes of different orders (Perciformes and Cyprinodontiformes) as definitive hosts is rather exceptional among dracunculoid nematodes.

KEY WORDS : *Mexiconema*, dracunculoid nematode, parasite, *Xiphophorus*, *Ginglystoma*, fish, Mexico.

Résumé : NOUVELLES OBSERVATIONS SUR *MEXICONEMA CICHLASOMAE* (NEMATODA: DRACUNCULOIDEA) CHEZ DES POISSONS DU MEXIQUE

Le nématode dracunculoïde *Mexiconema cichlasomae* Moravec, Vidal et Salgado Maldonado, 1992, a été originellement décrit à partir de la cavité abdominale et des viscères de *Cichlasoma* spp. du Mexique. Il a été retrouvé dans la cavité abdominale du poeciliidé *Xiphophorus helleri* du lac Catemaco et de son affluent Arroyo Agrio, Veracruz, ainsi que dans l'intestin du requin *Ginglystoma cirratum* (Bonnaterre) au large de la côte sud du Golfe du Mexique, à Campeche; *Xiphophorus helleri* et *Ginglystoma cirratum* représentent des hôtes nouveaux pour ce parasite. Les spécimens du nématode obtenus chez ces hôtes sont brièvement décrits et illustrés. Alors que *X. helleri* constitue manifestement le véritable hôte définitif du parasite, *G. cirratum* a probablement été infesté par *Mexiconema* de manière accidentelle, en se nourrissant du poisson hôte définitif, dans l'environnement d'eau saumâtre ou salée. La capacité de *M. cichlasomae* à utiliser des poissons d'ordres différents (Perciformes et Cyprinodontiformes) comme hôtes définitifs est assez exceptionnelle parmi les nématodes dracunculoides.

MOTS CLÉS : *Mexiconema*, dracunculoid nematode, parasite, *Xiphophorus*, *Ginglystoma*, poisson, Mexique.

Dracunculoids represent a very interesting group of fish nematodes parasitic in the tissues, cavities, etc. of the host. Mainly because of the small size of some fish dracunculoids and due to their adaptation to life within tissues, this group is little-known. During recent years, several new forms with an unusual morphology, representing several new genera (e.g., *Daniconema* Moravec & Køie, 1987; *Travassosnema* Costa, Moreira & Oliveira, 1991; *Mexiconema* Moravec, Vidal & Salgado Maldonado, 1992; *Lucionema* Moravec, Molnár & Székely, 1998), have

been described from freshwater and brackish-water fishes in different parts of the world (Moravec & Køie, 1987; Costa *et al.*, 1991; Moravec *et al.*, 1992, 1998).

One of these parasites, *Mexiconema cichlasomae* Moravec, Vidal & Salgado Maldonado, 1992 was described from four species of *Cichlasoma* (Cichlidae, Perciformes) from the Yucatan Peninsula, southeastern Mexico. In the present study, morphologically similar nematodes from the abdominal cavity of the poeciliid *Xiphophorus helleri* Heckel from Lake Catemaco (freshwater) and its small tributary stream Arroyo Agrio in Veracruz and from the intestine of the nurse shark *Ginglystoma cirratum* (Bonnaterre) off the southern coast of the Gulf of Mexico in Campeche are described. The new observations are related to previous data.

MATERIALS AND METHODS

The nematodes from Veracruz were collected by junior authors (M.I. J.G. & G. S.M.) from *Xiphophorus helleri* Heckel from Lake Catemaco

* Institute of Parasitology, Academy of Sciences of the Czech Republic, Branišovská 31, 370 05 České Budějovice, Czech Republic.

** Laboratory of Parasitology, Centre for Research and Advanced Studies, National Polytechnic Institute (CINVESTAV-IPN), Mérida Unit, Carretera Antigua a Progreso Km 6, A. P. 73 « Cordemex », C. P. 97310 Mérida, Yucatán, Mexico.

*** Institute of Biology, National Autonomous University of Mexico, A. P. 70-153, 04510 Mexico, D.F., Mexico.

Correspondence: F. Moravec.

Tel. : (420) 38 7775432 – Fax: (420) 38 47743.

E-mail: <moravec@paru.cas.cz>

(23 fish specimens examined) and its tributary Arroyo Agrio (13 specimens) in June 1996, whereas those from Campeche were collected by the senior author (F. M.) from the shark *Ginglystoma cirratum* (Bonnaterre) bought from local fishermen on 4 July 1995. In addition, seventeen *X. helleri* specimens from Lake Catemaco, 17 March 1996, were found not to be infected with *Mexiconema*. The nematode specimens obtained were washed in physiological saline (0.9 % NaCl) and were subsequently fixed with hot mixture of 40 % formalin and saline (1:9). The nematodes were stored in 4 % formalin or 70 % ethanol. For examination the specimens were cleared with glycerine. Drawings were made with the aid of a camera lucida. The specimens have been deposited in vials with 70 % ethanol in the Institute of Parasitology, Academy of Sciences of the Czech Republic (Helm. Coll. No. N-573), České Budějovice. All measurements are given in micrometres unless otherwise stated.

RESULTS

MEXICONEMA CICHLASOMAE

MORAVEC, VIDAL & SALGADO MALDONADO,
1992 (Fig. 1)

Description (based on specimens from *X. helleri* and *G. cirratum*): Fine, thread-like nematodes with almost smooth cuticle. Cephalic end rounded, dome-shaped in lateral view and somewhat expanded. In dorso-ventral view, region of oral opening depressed. Eight cephalic papillae and a pair of lateral amphids present. Buccal capsule absent. Oesophagus divided into anterior shorter muscular section and posterior longer glandular section provided with two huge cell nuclei, one near mid-length of glandular oesophagus and one near its posterior end. Tail conical, ending in three small spike-like or digital cuticular processes.

Male (five specimens from *X. helleri*; measurements of three specimens from *G. cirratum* in parentheses): Length of body 4,580-4,870 (3,890-4,410), maximum width 63-87 (42-57). Length of muscular oesophagus 285-390 (324-390), its maximum width 15-21 (12-15); glandular oesophagus 390-570 (525-720), maximum width 45-51 (24-39). Distance of anterior oesophageal cell nucleus from anterior extremity 435-503 (625-680), that of posterior nucleus 694-735 (898-993). Length ratio of muscular and glandular sections of oesophagus 1 : 1.13-2.00 (1 : 1.38-1.92). Nerve ring 126-186 (165-183) and excretory pore 147-216 (210-237) from anterior extremity. Caudal end bearing only four pairs of sessile papillae, all located near cloacal opening: 1 adanal and 2 postanal subventral pairs and 1 lateral

pair usually situated at level of first subventral pair or, sometimes, slightly more posteriorly to it. Preanal papillae absent. Spicules and gubernaculum absent. Unpaired sclerotized copulatory plate present, adhering to anterior wall of cloacal duct, elongate in lateral view, straight or posteriorly bent; its complete length being 33-45 (30-36), length of its broader distal part 18-30 (18-24), its maximum width 3 (3). Genital cone usually well-developed, 15-24 (18-21) high and 12-15 (12-15) wide. Tail 84-99 (72-81) long, with three mucrons 4-5 (3-4) long at tip.

Female (five gravid specimens from *X. helleri*; measurements of three young specimens from *G. cirratum* in parentheses): Length of body 12,440-16,590 (5,250-6,050), maximum width 163-190 (68-92). Length of muscular oesophagus 360-444 (339-408), its maximum width 21-24 (15-21); glandular oesophagus 405-450 (549-645), maximum width 60 (42-54). Distance of anterior oesophageal cell nucleus from anterior extremity 571-707 (612-680), that of posterior nucleus 721-857 (843-938). Length ratio of muscular and glandular sections of oesophagus 1 : 1.01-1.22 (1 : 1.17-1.62). Nerve ring 195-225 (159-198) and excretory pore 240-279 (186-240) from anterior extremity. Tail 99-129 (63-108) long, bluntly ended, with three small cuticular mucrons 3-5 (3-5) long at tip. Monodelphic. Single ovary situated at some distance anterior to rectum. Uterus long, containing eggs, developing embryos and fully formed larvae in sequence from posterior to anterior end (only eggs present in specimens from *G. cirratum*). Larvae in uterus about 100 (-) long and 9 (-) wide. Vulva situated 1,120-1,330 (993-1,088) from anterior end of body, somewhat posterior to end of oesophagus (distance of vulva from oesophagus end 231-517 [45-114]). Vagina muscular, directed posteriorly.

Hosts: *Xiphophorus helleri* Heckel (Poeciliidae, Cyprinodontiformes) (body length 7.2-9.2 cm) and *Ginglystoma cirratum* (Bonnaterre) (Orectolobidae: Lamniformes) (body length 119 cm).

Site of infection: Abdominal cavity in *X. helleri* and intestine = spiral valves (secondary, accidental) in *G. cirratum*.

Localities: Lake Catemaco and its tributary Arroyo Agrio (*X. helleri*), Veracruz (17 June and 26 June 1996, respectively) and Bay of Campeche, southern Gulf of Mexico, Campeche (4 July 1995), both southern Mexico.

Occurrence: Lake Catemaco: in 2 out of 23 *X. helleri* examined (prevalence 8.7 %, intensity 1 and 2 nematodes per fish); the stream Arroyo Agrio opening in L. Catemaco: in 12 of 13 *X. helleri* (prevalence 92.3 %, intensity 1-51 [mean 11]); Bay of Campeche: in a single *G. cirratum* (intensity 6).

Fig. 1. – *Mexiconema cichlasomae* Moravec, Vidal & Salgado Maldonado, 1992. A-H: specimens from *Xiphophorus helleri* (A: anterior end of female; B: female cephalic end; C: posterior end of female; D: larva from uterus; E, F: tail of male; G: tail of female; H: tail of male). I-R: specimens from *Ginglystoma cirratum* (I, J: female cephalic end, lateral and dorsoventral views; K: anterior end of female; L: tail of male, ventral view; M: region of male genital cone, lateral view; N: posterior end of female; O: tail of male; P: tail of female; R: copulatory plate, ventral view). Scale bars in mm.

DISCUSSION

Moravec *et al.* (1992) described *Mexiconema cichlasomae* from the abdominal cavity and viscera, and rarely from the skin beneath scales, of four species of cichlids, *Cichlasoma urophthalmus* (Günther) (type host), *C. belleri* (Steidachner), *C. motaguense* (Günther) and *C. pearsei* (Hubbs), from freshwater, brackish-water and marine localities of the Yucatan Peninsula, southeastern Mexico. Despite the fact that the nematodes of the present material originated from phylogenetically distant fish hosts (Cyprinodontiformes and Laimniformes vs. Perciformes), we were unable to find any substantial morphological or biometrical differences between them and those from *Cichlasoma* spp. The measurements of both males and females from all host types are similar (only young females with eggs in uterus were found in *G. cirratum* and, therefore, they are smaller than those from other hosts) and all taxonomically important morphological features (e.g., number and distribution of male caudal papillae, shape of the copulatory plate, structure of the mouth and the oesophagus) are the same.

Moravec *et al.* (1992) reported the length of larvae from the uterus to be about 180 µm, whereas those measured in the present material from *Xiphophorus* were only about 100 µm; however, there may be a high degree of intraspecific variability in the length of larvae from uterus in dracunculoids, as recently observed in *Philonema oncorhynchi* Kuitunen-Ekbaum, 1933 (see Moravec & Nagasawa, 1998a).

The presence of a genital cone was not mentioned in the original description of *M. cichlasomae*. However, a recent re-examination of one paratype specimen from the helminthological collection of the Institute of Parasitology, ASCR, in České Budějovice (Cat. No. N - 573) confirmed the presence of this organ. The size and the shape of the genital cone in males of the present material were highly variable (see Fig. 1 E and 1 H), but this was present in all specimens examined. Consequently, we consider all specimens of the present material to be conspecific with *M. cichlasomae*. The presence of gravid *M. cichlasomae* females with larvae in the abdominal cavity of *X. belleri* confirms that this fish serves as a true definitive host of this parasite, as defined by Odening (1976). This is very interesting, because dracunculoids usually exhibit a rather high degree of host specificity. On the other hand, the site of infection (intestinal lumen) and the fact that only very young living *M. cichlasomae* females were found in the shark *G. cirratum* suggest that this is only an accidental, probably postcyclic host, which acquired infection secondarily while feeding on infected true definitive hosts (e.g., some cichlids or other fishes) in the marine or brackish-water environment. According

to Böhlke & Chaplin (1993), these sharks feed chiefly on invertebrates (squids, shrimps, sea urchins, spiny lobsters), but they take fish as well. The findings of *M. cichlasomae* in *X. belleri* and *G. cirratum* represent new host records.

The true definitive hosts of *M. cichlasomae*, cichlids (*Cichlasoma*) and poeciliids (*Xiphophorus*), include both fresh and brackish water forms and, accordingly, it is likely that also the life cycle of this parasite can be completed in both freshwater and brackish-water environments. For example, some *Cichlasoma* species, e.g., *C. urophthalmus*, are highly tolerant to water salinity and can be found in both purely freshwater bodies (rivers, lakes, sinkholes) and brackish-water coastal lagoons. Moravec *et al.* (1992) reported *M. cichlasomae* from *Cichlasoma* spp. from different freshwater, brackish-water and even marine localities. The life cycle of *Mexiconema* is not known, but it may be similar to that of skrjabianids, utilizing ectoparasitic branchiurids (*Argulus* spp.) as intermediate hosts (Tikhomirova, 1975, 1980; Tikhomirova & Rudometova, 1975; Moravec, 1985, 1994). This is suggested by heavy infection of *C. urophthalmus* population with *Argulus* sp. in the coastal lagoon Celestun (mostly salt-water), Yucatan, the type locality of *M. cichlasomae*, observed by the first author (F. M.) in autumn 1994.

Initially *Mexiconema cichlasomae* was the only known species of the genus. However, a second congeneric species was recently recorded from the endemic catfish in Japan (Moravec & Nagasawa, 1998b), which indicates a wide geographical distribution of species within the genus *Mexiconema*.

ACKNOWLEDGEMENTS

Thanks are due to Raúl Simá-Alvarez and Gregory Torres-Arjona from CINVESTAV-IPN, Mérida, for their help during the field work in Campeche, to Guillermina Cabañas-Carranza, Juan Manuel Caspeta-Mandujano, Rafael Báez-Valé and Elizabeth Mazen-Peña from UNAM for help in the field work in Veracruz, and to Irena Husáková, Institute of Parasitology, ASCR, in České Budějovice for her technical assistance in preparing the illustrations. This work was partly supported by grant no. 4689-N9406 from the Consejo Nacional de la Ciencia y Tecnología (CONACyT), Mexico.

REFERENCES

- BÖHLKE J.E. & CHAPLIN C.C.G. Fishes of the Bahamas and adjacent tropical waters. Second edition. University of Texas Press, Austin, 1993, 771 p.

- COSTA H.M.A., MOREIRA N.I.B. & OLIVEIRA C.L. de. *Travassosnema* gen. n. with the description of *T. travassosi* sp. n. (Dracunculoidea, Guyanemidae) parasite of *Acestrorhynchus lacustris* Reinhardt, 1874 (Characidae) from Tres Marias Reservoir, MG, Brazil. *Memórias do Instituto Oswaldo Cruz*, 1991, 86, 437-439.
- MORAVEC F. Occurrence of the endoparasitic helminths in tench (*Tinca tinca*) from the Mácha Lake fishpond system. *Acta Societatis Zoologicae Bohemoslovacae*, 1985, 49, 32-50.
- MORAVEC F. Parasitic nematodes of freshwater fishes of Europe. Academia and Kluwer Academic Publishers, Praha and Dordrecht, Boston, London, 1994, 473 pp.
- MORAVEC F. & KØIE M. *Daniconema anguillae* gen. et sp. n., a new nematode of a new family Daniconematidae fam. n. parasitic in European eels. *Folia Parasitologica*, 1987, 34, 335-340.
- MORAVEC F., MOLNÁR K. & SZÉKELY C. *Lucionema balatonense* gen. et sp. n., a new nematode of a new family Lucionematidae fam. n. from the swimbladder of the European pikeperch, *Stizostedion lucioperca* (Pisces). *Folia Parasitologica*, 1998, 45, 57-61.
- MORAVEC F. & NAGASAWA K. New data on the morphology of *Philonema oncorhynchi* (Nematoda: Dracunculoidea) from the abdominal cavity of Pacific salmon (*Oncorhynchus* spp.). *Systematic Parasitology*, 1998a, in press.
- MORAVEC F. & NAGASAWA K. Helminth parasites of the rare endemic catfish *Liobagrus reini* in Japan. *Folia Parasitologica*, 1998b, in press.
- MORAVEC F., VIDAL V. & Salgado Maldonado G. *Mexiconema cichlasomae* gen. et sp. n. (Nematoda: Daniconematidae) from *Cichlasoma* spp. (Pisces) from Mexico. *Folia Parasitologica*, 1992, 39, 33-40.
- ODENING K. Conception and terminology of hosts in parasitology. *Advances in Parasitology*, 1976, 14, 1-93.
- TIKHOMIROVA V.A. Life cycles of nematodes of the family Skrjabillanidae. in: Voprosy ekologii zhivotnykh, Part 2, Kalinin, 1975, pp. 100-113. (In Russian.)
- TIKHOMIROVA V.A. On nematodes of the family Skrjabillanidae (Nematoda: Camallanata). *Parazitologiya*, 1980, 14, 258-262. (In Russian.)
- TIKHOMIROVA V.A. & RUDOMETOVA N.K. A new nematode species, *Skrjabillanus schigini* sp. n. (Camallanata: Skrjabillanidae) from *Ctenopharyngodon idella*. *Parazitologiya*, 1975, 9, 547-549. (In Russian.)

Reçu le 17 décembre 1997

Accepté le 11 juin 1998