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***Contracaecum multipapillatum* (= *C. robustum*) from Fishes and Birds in the Northern Gulf of Mexico**

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This note clarifies the taxonomic status of the ascaridoid *Contracaecum robustum* Chandler 1935 based on larval development, investigates the nematode's potential as a public health hazard, and reports the relative prevalence of it and related species along the northern Gulf of Mexico.

Third-stage larvae (L₃'s) of various species of *Contracaecum* Railliet and Henry 1912 have been reported from fishes in the Gulf of Mexico and adjacent waters (Chandler, 1935, Proc. U.S. Natl. Mus. **83**: 123–157; Hutton, 1964, Trans. Am. Microsc. Soc. **83**: 439–447; Nikolaeva and Parukhin, 1968, in Studies of

Central American seas, Z. Yankovskaya [ed.]), but their status is uncertain. Some of these L₃'s probably are not *Contracaecum* sensu stricto (see Deardorff and Overstreet, 1980, Review of *Hysterothylacium* and *Iheringascaris* [both previously = *Thynnascaris*] [Nematoda: Anisakidae] from the northern Gulf of Mexico, Proc. Biol. Soc. Wash. **93**: 1035–1079).

Adult features, and therefore taxonomic status, of *C. robustum* larvae encapsulated in the liver, kidneys, and mesentery of mullets (*Mugil cephalus*, *M. curema*, and probably *Liza ramada* [as *M. capito*] and others) have not

been established. Some consider it to be the larval stage of *C. microcephalum* (Rudolphi 1809) (e.g., Chandler, op. cit.), and others give it specific status (e.g., Nikolaeva and Naidenova, 1964, Tr. Sevastop. Biol. Stn. Akad. Nauk Ukr. SSR 17: 125-158). Araujo (1970, Rev. Farm. Bioquim. Univ. São Paulo 8: 103-113) transferred it to the genus *Cerascaris* Cobb 1929, and Skinner (1975, Bull. Mar. Sci. 25: 318-347) considered specimens of it as *Thynnascaris* sp. The genus *Cerascaris* is based on larval characters, and we agree with Yamaguti (1962, Systema Helminthum, Vol. III. The nematodes of vertebrates, Interscience, New York, 1261 p.) that *Cerascaris* is a junior synonym, probably of *Contracaecum* sensu stricto. Skinner kindly loaned us specimens identified as *Thynnascaris* sp. from cysts in the liver and mesentery of *M. cephalus* in Biscayne Bay, Florida. We did not find the excretory pore located near the level of the nerve ring and consider the specimens identical to those that we, and presumably Chandler, call *C. robustum* from the northern Gulf of Mexico. Because this larva causes some people to discard "wormy" or all mullet, either for esthetic reasons or as an assumed public health hazard (Overstreet, 1978, Marine maladies? Worms, germs, and other symbionts from the northern Gulf of Mexico, Mississippi-Alabama Sea Grant Consortium, Ocean Springs, Mississippi, 140 p.), we sought to identify it and determine if it caused lesions. Related ascaridoid nematodes cause human anisakiasis (Jackson, 1975, J. Milk Food Technol. 38: 769-733).

In order to determine if *C. robustum* would develop in, or harm, a host, we administered worms orally by gavage to one day-old chick, one day-old mallard duckling, and 22 laboratory rats (Charles Rivers Laboratories Crl:COBS®CD®[SD]BR) and surgically by inserting them into either the stomach by way of the abdominal cavity or directly into the cavity of 25 rats, 24 white mice, two hamsters, and two chickens. Of the gavaged rats, 14 received one larva and eight received five; up to 10 larvae were surgically placed into each of the other animals. All nematode specimens given to animals came from the liver and kidneys of the striped mullet, *M. cephalus*, or the mesentery of the red drum, *Sciaenops ocellata*, and allowed to excyst in 0.8% NaCl for 24 hr.

FIGURE 1. *Contracaecum multipapillatum* from *Mugil cephalus*. Posterior end of early L₅ developed in rat showing ventral annular crests and post-anal and para-anal papillae; ventral view.

Contracaecum robustum showed no ability to harm the experimental animals. No individuals penetrated through or into the alimentary tract of any of the five animals tested within 72 hr, at which time all worms had died or had been defecated. However, worms inserted into the abdominal cavity of rats survived for long periods. Three rats examined at 9 mo, each originally given eight worms, had eight, five, and no viable L₃'s encapsulated in the mesentery. Even though the larval nematodes did not cause pathogenic reactions in the animals we tested, *Contracaecum* spp. on occasion caused lesions in the proventriculus of pelicans and other bird hosts (Huizinga, 1971, J. Wildl. Dis. 7: 198-204; Liu and Edward, 1971, J. Wildl. Dis. 7: 266-271), and an immature, unidentified species in Japan caused a granuloma in dogs that ate fish (Kitayama et al., 1967, Jpn. J. Parasitol. 16: 28-35).

Four worms developed to an L₅ stage in the abdominal cavity of rats by day 10. There were a male and female from both the mullet and red drum, and these developed enough to allow an identification. We identified them as *C. multipapillatum* (von Drasche 1882), reducing *C. robustum* to its junior synonym. Specimens were 19 to 25 mm long, with lips slightly longer than wide. The esophagus and spicules were 12 to 14% and 3 to 6% of the body length, respectively. Ratios of the lengths of ventricular appendage to that of esophagus equalled 1:5.6–7.3, of intestinal cecum to esophagus was 1:1.1–1.3, and of intestinal cecum to ventricular appendage was 1:0.1–0.2. As many as 125 pairs of preanal papillae extended along the posterior third of the males, and of the seven postanal papillar pairs, the fifth from the posterior extremity appeared doubled. Three pairs of para-anal papillae occurred slightly posterior to the anus and lateral to it. Minute ventral crests on annules (Fig. 1) extended from near the anus of these males to the anteriormost papillae. In the female, the vagina opened within the anterior 17 to 25% of the body.

Contracaecum multipapillatum infects the proventriculus of numerous amphi-American fish-eating birds (e.g., Lucker, 1941, J. Parasitol. **27**: 505–512; Baruš, 1966, Poeyana Inst. Biol. Habana Ser. A, No. 22, 37 p; Courtney and Forrester, 1974, Proc. Helminthol. Soc. Wash. **41**: 89–93). Unconfirmed reports of larval *C. robustum* in Japan (Fujita, 1940, Jpn. J. Zool. **8**: 377–394) and the Adriatic Sea (Nikolaeva and Niadenova, op. cit.) and unidentified larvae in mullet from Mexico (Salgado-Maldonado, 1978, An. Inst. Biol. Univ. Nal. Autón México Ser. Zool. **49**: 71–82), Peru (Armas, 1979, J. Fish Dis. **2**: 543–547), the Middle East (Baylis, 1923, Parasitology **15**: 1–13; Shamsuddin et al., 1971, Bull. Biol. Res. Cntr. Baghdad **5**: 66–78), and elsewhere suggest a wider occurrence of the parasite, credible because some bird-hosts migrate extensively. Specimens referred to as "*C. robustum*" are apparently restricted to few hosts. We saw few fishes concurrent with mullet and red drum infected with similar appearing larvae. On the other hand, Bangham (1940, Proc. Fl. Acad. Sci. **5**: 289–307) identified larvae from several freshwater fishes in Florida as *C. spiculigerum* (Rudolphi 1809) that may have included *C. multipapillatum* in part. When

Huizinga (1967, J. Parasitol. **53**: 368–375) clarified part of the life cycle of *C. multipapillatum*, he identified his specimens from *Anhinga anhinga leucogaster* on the basis of Lucker's work (op. cit.), the same as we did, but did not relate his material to *C. robustum*. He found that the L₂'s in some copepods exsheathed and, thereby, became able to infect the guppy which in turn were infective to the paratenic largemouth bass. Whether mullet become infected from free-living L₂'s or infected copepods is not known. In any event, the Brown Pelican picks up infections by the time it is 2-wk-old and begins feeding heavily on mullet at fledging (Courtney and Forrester, op. cit.; Humphrey et al., 1978, Wilson Bull. **90**: 587–598).

Prevalence varied according to locality and period examined. We saw heavy infections of adult *C. multipapillatum* in the Double-crested Cormorant, *Phalacrocorax auritus*, from Rockefeller Refuge, Louisiana, where mullet also are heavily infected and fed upon by the cormorant. Along the Mississippi coast, the prevalence of infections in mullets is presently low. At this time, few cormorants live there. A few permanently residing Brown Pelicans live in nearby Mobile Bay and Louisiana. These populations contrast with the large numbers present in 1958 (William Demoran, pers. comm.) when we understand mullet were especially "wormy." Relatively large flocks of both the Brown Pelican and White Pelican presently migrate annually through coastal Mississippi, and two individuals of the White Pelican, *Pelecanus erythrorhynchos*, that died in Mississippi during these migrations plus an examined, resident cormorant, Louisiana Heron, *Hydranassa tricolor*, and Green Heron, *Butorides virescens*, had light infections of *C. multipapillatum*. We examined moderately heavy infections of nematodes from the Brown Pelican, *P. occidentalis*, collected by Courtney (see Courtney and Forrester, op. cit.) and Richard Heard (unpubl.) from various locations in Florida, plus one migrating specimen that died in Mississippi.

Contracaecum rudolphii Hartwich 1964, commonly occurring concurrently with *C. multipapillatum* in pelicans from the southeastern U.S., has been variously identified. Huizinga (1966, Elisha Mitchell Sci. Soc. **82**: 181–195), who studied its life cycle, and

Courtney and Forrester (op. cit.) called it *C. spiculigerum*. Hartwich (1964, Mitt. Zool. Mus. Berlin **40**: 15–53) considered that more than one species went by *C. spiculigerum* and erected *C. rudolphii* for those specimens reported by Huizinga and by others. This name has been accepted by most recent workers (see references listed by Baruš et al., 1978, Helminths of fish-eating birds of the Palaearctic Region I, Nematoda. W. Junk, Publ., Czech. Acad. Sci., Prague, 318 p.), but there are several possible and proposed, older synonyms. In fact, our specimens from the Double-crested Cormorant, White Pelican, Brown Pelican, and Least Bittern, *Ixobrychus exilis*, collected in Mississippi, as well as additional specimens from Louisiana and Florida were identified as *C. microcephalum* (Rudolphi 1809) using the key by Baruš et al. (op. cit). The interlabial tips are rounded in adults, rather than bifurcated as reported for *C. rudolphii*. On the other hand, the 4.7- to 6.2-mm-long spicules in 12 males 21.0 to 34.5 mm long are 18 to 25% of the body length, which fits within the length-range of those reported for *C. rudolphii*, but is a smaller percentage of total body length. The spicule tips are similar to

those of *C. rudolphii*, and apparently, the postanal papillae are similar in the two species.

We have seen a third species represented by a few specimens. *Contracaecum micropapillatum* (Stossich 1890) infected one migrating White Pelican. Oglesby (1960, Auk **77**: 354) reported more than 1,100 specimens identified as “probably *C. micropapillatus*” from a dead White Pelican in Apalachee Bay, Florida.

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