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Helminth infection in *Mugil incilis* from Cartagena de Indias, Colombian Caribbean coast

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Summary

This survey records the occurrence of larvae of *Contracaecum multipapillatum sensu lato* (Von Drasche, 1882) Lucker, 1941 (Nematoda, Anisakidae) and adults of *Floridosentis mugilis* (Machado Filho, 1951) Ward, 1953 (Acanthocephala, Neoechinorhynchidae) in mullet *Mugil incilis* Hancock, 1830 caught in La Boquilla, Cartagena de Indias (Colombian Caribbean coast). The prevalence of *F. mugilis* was 45.7 % and of *C. multipapillatum s.l.* 58.6 %, while 28.6 % of the fish were parasitized by both species. The smallest hosts presented the lowest prevalence of *F. mugilis* but the highest prevalence of *C. multipapillatum s.l.* Prevalence, mean abundance and mean intensity of *C. multipapillatum s.l.* in *M. incilis* were all highest in viscera. The prevalence in fish muscle tissue was low (2.9 %).

Keywords: fish; *Mugil incilis; Floridosentis mugilis; Contracaecum multipapillatum sensu lato;* Colombia; Acanthocephala; Anisakidae

Introduction

Several authors have described the presence of anisakid nematode larvae of the genus Contracaecum Railliet and Henry, 1912 and the acanthocephalan Floridosentis mugilis (Machado Filho, 1951) Ward, 1953 in mullet caught on the coast of the American continent. Bravo-Hollis (1969) found the acanthocephalan F. elongatus Ward, 1953 (= F. *mugilis*) and *F. pacifica* in striped mullet (*Mugil cephalus*) in the Mexican Pacific. Also, from this host on the same coast, Salgado-Maldonado and Barquín-Álvarez (1978) and Iglesias et al. (1998) isolated larvae of Contracaecum sp. and adults of F. elongatus, and Valles-Ríos et al. (2000) only found C. multipapillatum (Von Drasche, 1882) Lucker, 1941 larvae. Also, larvae of Contracaecum sp. were found in striped mullet from Peruvian (Armas, 1979; Pérez et al., 1999) and Chilean (Fernández-Bargiela, 1987) waters. In a study carried out by Galiano and Romero

(1979) on parasites of *M. curema* Valenciennes, 1836 from the Ciénaga Grande de Santa Marta (Colombia), larvae of *Contracaecum* sp. were described in the muscle and many of the fish's organs. Later, Deardorff and Overstreet (1980) found third stage larvae (L3) of *C. multipapillatum* in *M. cephalus* from the Gulf of Mexico, and studied the infectivity of these in various animals. Juárez-Arroyo and Salgado-Maldonado (1989) described in detail the larvae of *Contracaecum* sp. in *M. cephalus* which came from the port of Topolobambo (Sinaloa, Mexico), and the morphological characteristics they found agree with those described by Salgado-Maldonado and Barquín-Álvarez (1978).

This study examines the occurrence of larvae of *C. multi-papillatum sensu lato* and adults of *F. mugilis* in the mullet *M. incilis* Hancock, 1830 from La Boquilla, Cartagena de Indias (northern Colombia).

Materials and methods

A total of 70 specimens of Mugil incilis (mullet) originating from the area of La Boquilla and acquired on ice from a popular fish market in Cartagena de Indias (Colombia) were studied. The length of the fish ranged between 20 and 33 cm, and their height between 4 and 6 cm. Immediately after purchase they were dissected in the laboratory and their viscera and muscle carefully examined for nematodes and acanthocephalans. The parasites obtained were deposited in saline solution for later identification. The parasites collected were fixed in hot 70° alcohol, cleared in lactophenol and stained with a few drops of cotton blue, for two days for acanthocephalans and 7 days for nematodes, prior to morphological identification based on the descriptions of Bullock (1962), Bravo-Hollis (1969), Salgado-Maldonado and Barquin-Álvarez (1978), and Juárez-Arroyo and Salgado-Maldonado (1989) for Floridosentis mugilis and Huizinga (1967) and Deardorff and Overstreet (1980) for *Contracaecum multipapillatum sensu lato.* No molecular identification was carried out. The association between fish length and parasite prevalence was analyzed using Fisher's exact test to compare prevalences and a bootstrap 2-sample t-test to compare mean intensities and abundances, with 95% confidence intervals being determined when possible. These analyses were performed using free "Quantitative Parasitology 3.0" software developed by Reiczigel and Rózsa in 2005, Budapest (theoretical background in Rózsa *et al.* 2000).

Results

Of the 70 mullet analyzed, 24.3 % were males, 41.4 % females and the rest immature. The average length \pm standard deviation of males was 27.7 ± 1.6 cm, of females 28.3 \pm 2.1 cm, and of juveniles 23.8 \pm 2.2 cm. The overall average length was 26.5 ± 2.8 cm. The number of specimens infected was 53 (75.7 %), of which 32 (45.7 %) contained acanthocephalans, 41 (58.6 %) contained nematode larvae, and 20 (28.6 %) harbored both parasites. A total of 288 parasites were collected: 168 acanthocephalans and 120 nematodes. The acanthocephalans were juveniles or adults of Floridosentis mugilis, and were only found in the intestine, preferably in the lumen of the beginning of the second half of the intestinal tract. The parasites were yellowish white in colour, with little movement and were quite fragile. Following the criteria of Bush et al. (1997), the prevalence found for this parasite was 45.7 %, its mean abundance (A) 2.40, mean intensity (I) 5.25, with a range of 1 to 22.

The 120 nematodes studied were isolated from the viscera and muscle. Some parasites, especially in the liver, had formed oval-shaped capsules in which they were coiled in a spiral. When removed from the capsules, they exhibited slow movements and a reddish white colouring. The viscera with the highest parasite burdens were liver and kidney. A burden of up to 7 individuals in the kidney was observed in one fish. All anisakids were in L3 and were identified as *Contracaecum multipapillatum sensu lato*. The total prevalence of *C. multipapillatum s.l.* was 58.6 %, A was 1.73, I = 2.95 with a range of 1 to 9. The muscle was least affected (Table 1).

Table 1. Prevalence (P), mean abundance (A) and mean intensity (I) of *C. multipapillatum* in *M. incilis* according to location

| | N ^a | n ^b | Р 95 % СІ ^с | A 95 % CI | I (range) 95 % CI |
|---------|----------------|----------------|---------------------------|---------------------|-----------------------------|
| Viscera | 41 | 118 | 58.6 46.4 - 69.8 | 1.69 1.26 – 2.20 | 2.88 (1 – 9) 2.37 – 3.54 |
| Muscle | 2 | 2 | 2.9* 0.5 – 9.8 | 0.03* 0.00-0.07 | 1.00* (1 – 1) d |

Statistical comparison: *p<0.001

^aNumber of parasitized hosts

^bNumber of parasites

°95 % confidence interval

^d95 % confidence intervals are uncertain

The prevalence, A and I of *C. multipapillatum s.l.* and *F. mugilis* in relation to the host's size and sex are shown in Tables 2 and 3. The smallest hosts (20 - 24 cm) presented the lowest prevalence of *F. mugilis*, but the highest prevalence of *C. multipapillatum s.l.*

Discussion

We are not aware of any research on *Mugil incilis* from La Boquilla in Cartagena de Indias (Colombia) which studies the acanthocephalan *Floridosentis mugilis* and the nema-tode *Contracaecum multipapillatum sensu lato*. Galiano and Romero (1979), in their study carried out in Ciénaga de Santa Marta (Colombia), identified larvae of *Contracaecum* and several specimens of acanthocephalans (specific identification was not carried out) in the host *M. curema*.

The morphological characteristics of the two parasitic species studied here are similar to those described by Salgado-Maldonado and Barquín-Álvarez (1978) and Iglesias et al. (1998) in M. cephalus. Also, Deardorff and Overstreet (1980) studied the larvae of Contracaecum found in the liver and kidney of *M. cephalus* originating in the Gulf of Mexico, identifying them as C. multipapillatum. They suggested that the larval stages found by Salgado-Maldonado and Barquín-Álvarez (1978) were also C. multipapillatum larvae. However, Juárez-Arrovo and Salgado-Maldonado (1989) consider that they should be denominated Contracaecum sp., adducing the wide geographical distribution of Mugilidae and the geographical amplitude in which larval forms of this nematode have been located. This is due largely to the migratory habits of the ichtyophagous birds - one of their definitive hosts - and, above all, to the great polymorphism presented by the larvae, which could indicate the occurrence of several species of Contracaecum in the same host and geographical area (Juárez-Arroyo & Salgado-Maldonado, 1989). Using molecular tools, it has recently been shown that C. multipa*pillatum* is a complex comprising several species with distinct geographical distributions (Mattiucci et al., 2006; D'Amelio et al., 2007; Mattiucci et al., 2010; Shamsi et al., 2011).

The prevalence of *F. mugilis* was 45.7%, with up to 22 parasites in the intestine of a single host, while intestinal obstructions and even perforations could be observed. This prevalence is lesser than reported by Salgado-Maldonado and Barquín-Álvarez (1978) and Iglesias et al. (1998) in the intestine of *M. cephalus* from the Gulf of Mexico and the Mexican Pacific Ocean, who found a maximum intensity of 33 and 60 acanthocephalans, respectively.

The total prevalence and I obtained for the larvae of *C. multipapillatum s.l.* were 58.6 % and 2.95 respectively, lower than those found by Galiano and Romero (1979), which were 77.5 % and 6.8 respectively, although it should be noted that the mullet species and the habitats were different. The larvae of *C. multipapillatum s.l.* were found not only in viscera, but also in the muscle (Table 1).

As the size (age) of the fish increased, so did the preva-

| Deregite/Figh longth ^a | N^{b} | n ^c | Р | А | I (range) |
|-----------------------------------|---------|----------------|----------------------|-------------|---------------|
| Parasite/Fish length | | | 95 % CI ^d | 95 % CI | 95 % CI |
| C. multipapillatum | | | | | |
| 20 - 24 cm | 17 | 29 | 64.7 | 1.76 | 2.73 (1 – 9) |
| | | | 40.6 - 83.4 | 0.94 - 3.18 | 1.73 - 4.73 |
| 25 – 28 cm | 34 | 68 | 55.9 | 1.94 | 3.47 (1 – 7) |
| | | | 38.1 - 72.4 | 1.26 - 2.71 | 2.74 - 4.32 |
| 29 – 33 cm | 19 | 23 | 52.6 | 1.21 | 2.30(1-4) |
| | | | 31.2 - 74.3 | 0.58 - 1.89 | 1.50 - 2.90 |
| F. mugilis | | | | | |
| 20 - 24 cm | 17 | 26 | 35.3 | 1.53 | 4.33 (1-7) |
| | | | 16.6 - 59.4 | 0.53 - 2.76 | 3.00 - 5.00 |
| 25 - 28 cm | 34 | 92 | 44.1 | 2.71 | 6.17 (1 – 22) |
| | | | 27.6 - 61.9 | 1.29 - 5.26 | 3.47 - 10.93 |
| 29 – 33 cm | 19 | 50 | 57.9 | 2.63 | 4.55 (1 – 11) |
| | | | 34.5 - 77.8 | 1.26 - 4.42 | 2.82 - 6.91 |

Table 2. Prevalence (P), mean abundance (A) and mean intensity (I) of C. multipapillatum and F. mugilis according to host length (M. incilis)

^aStatistical comparison of the data was not significant.

^bNumber of hosts examined.

°Number of parasites collected.

^d95 % confidence intervals

lence of *F. mugilis* (possible accumulative effect with age), whilst for *C. multipapillatum s.l.*, it diminished (Table 2), perhaps due to the mullet changing diet with age. The epidemiological parameters determined for mullet parasitation by *C. multipapillatum s.l.* and *F. mugilis* show no differences between male and female mullet (Table 3).

other hand, Galiano and Romero (1979) pointed out the frequent presence of *Contracaecum* larvae in the muscle of M. *curema*. Furthermore, Vidal-Martínez *et al.* (1994) argued that *C. multipapillatum* larvae may mature and penetrate the alimentary canal of humans. However, the low prevalence of anisakids recorded in fish muscle

Table 3. Relationship between sex of the host (*M. incilis*) and prevalence (P), mean abundance (A) and mean intensity (I) of parasitization by *C. multipapillatum* and *F. mugilis*

| Parasite/Host sex ^a | | N ^b | n ^c | P | A | I (range) |
|--------------------------------|---------|----------------|----------------|-------------|--------------|---------------|
| | | | | Clª | CI | CI |
| C. multipapillatum | | | | | | |
| Malas | 17 | 20 | 41.2 | 1.06 | 2.57 (1 – 4) | |
| | Iviales | 17 | 20 | 19.6 - 65.0 | 0.47 - 1.76 | 1.71 - 3.29 |
| | Famalas | 20 | 43 | 55.2 | 1.52 | 2.75 (1 – 7) |
| | remates | 29 | | 35.7 - 72.8 | 0.93 - 2.24 | 2.06 - 3.50 |
| F. mugilis | | | | | | |
| | Malas | 17 | 37 | 41.2 | 2.18 | 5.29 (1 – 11) |
| | Males | 17 | | 19.6 - 65.0 | 1.00 - 4.18 | 3.43 - 7.86 |
| | Females | 20 | 103 | 62.1 | 3.52 | 5.67 (1 – 22) |
| | | 29 | | 43.0 - 77.9 | 1.83 - 6.14 | 3.33 - 9.11 |

^aStatistical comparison of the data was no significant.

^bNumber of examined hosts.

°Number of collected parasites.

^d95 % confidence intervals

Finally, the L3 of *Contracaecum* have a special significance because of their implication in human anisakidosis (Williams & Jones, 1976; Smith & Wootten, 1978). However, this aspect has been questioned due to the low rate of infestation of larvae in the fish musculature (Huang, 1988; Angot & Brasseur, 1995), although Schaum and Müller (1967) described a case of a human with *C. osculatum*. Iglesias *et al.* (1998) found *C. multipapillatum s.l.* prevalence in the muscle of 5.5 % in *M. cephalus* compared to 2.9 % in *M. incilis* (Table 1) in the present study. On the strongly indicate that the risk of contracting anisakidosis, from consumption of raw or semi-cooked mullet captured from La Boquilla in northern Colombia (SW Caribbean Sea), is very small, if at all.

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