Gastric helminths in the swordfish *Xiphias gladius* collected off the coast of central-south Chile

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Abstract

This study reports the parasites found in the stomach of five individuals of swordfish, collected off the central-south coast of Chile during 2011. A total of 3,936 parasites was found; a few (n= 14) were cestodes (*Tentacularia coryphaenae* Bosc, 1797), while most (n= 3,922) were nematodes (*Hyterothylacium* spp.). Only some of the nematodes were identified as *H. incurvum* (= *Maricostula incurva* Bruce & Canon 1989). These parasitological findings are not new, however, the great abundance, the different developmental stages, and the fact that several nematode larvae were attached to muscles and scales of the fish prey (*Cubiceps* sp.), allow us to suggest that this fish is the intermediate host for *Hyterothylacium* spp. The cephalopods (e.g. *Dosidicus gigas* which was another prey item) might transmit larval cestodes to the swordfish.

Introduction

The knowledge about parasite richness for large pelagic fish can be scarce due to difficulties in obtaining samples. This is the situation for the swordfish, *Xiphias gladius* Linnaeus 1758, which is a migratory oceanic fish that can reach up to 4.5 m in length. Beside this, there are some studies focused on trophic habits, population structure and parasites. However, most parasitological studies have been done on samples from the north hemisphere, especially the Atlantic Ocean (Castro-Pampillón et al. 2002a, Mattiuci et al. 2005, Garcia et al. 2008), the Gulf of Guinea (Castro-Pampillón et al. 2002b) and the Mediterranean Sea (Merella et al. 2003, Mattiuci et al. 2005).

The swordfish has a wide distribution between 50°N and 50°S latitude, in all oceans of the world. There are studies about fisheries (Yañez et al. 2008, Espindola et al. 2011) and diet (Ibañez et al. 2004, Castillo et al. 2007) in samples caught in the Pacific Ocean, specifically off the coast of Chile. However, there is no record of its parasites in this area. Therefore, the objective of this study was to determine the parasite species from stomach samples of the swordfish collected off the coast of central Chile.

Materials and methods

Five stomachs of the swordfish were obtained from industrial fisheries, which collected the fish from off the central zone of Chile (33-38°S, 75-77°W), during 2011. The stomachs were frozen up to the moment of the dissection.

The stomachs were dissected and parasites and diet prey were separated and preserved in 10% formalin. Prevalence and mean abundance of parasites were calculated according to Bush et al. (1997). The prey items were taxonomically determined and the frequency of occurrence of each item (FO) was calculated as the percentage of stomachs that had a certain prey item.

For taxonomical identification, some nematode specimens were selected at random; 20 specimens were measured under light microscopy and 10 specimens were observed under electron microcopy (SEM), whereas cestodes were cleared with lactophenol in order to observe internal structures.

Results

A total of 3,936 parasites corresponding to 2 parasite taxa was found in the five stomachs. Most (n= 3,922) were nematodes belonging to *Hysterothylacium* spp. (mean abundance= 783.6 ± 372.0). A few cestodes (n= 14), were also found, which belonged to *Tentacularia coryphaenae* Bosc, 1797 (mean abundance 2.8 ± 5.2) (Table 1). The nematodes

occurred as both larval and adult stages and were both attached to the mucosa or free in the lumen of the stomach. The cestodes larval stages were encysted in the stomach walls.

Table 1: *Prevalence (PREV, %), range of intensity (INT) and mean abundance of parasites ± standard deviation (X ABU ± S.D.) found in five stomachs of swordfish collected off central coast of Chile.*

	PREV	INT	X ABU ± S.D.
NEMATODA			
Hysterothylacium sp.			
Adults	100	100-485	235.6 ± 143.7
Larvae	100	0-985	548.0 ± 366.3
CESTODA			
Tentacularia coryphaenae	40	2-12	2.8 ± 5.2
TOTAL			790.6 ± 317.7

Even though only 20 nematode specimens were analyzed morphometrically and morphologically, most of the nematodes (ca. 3500) had prominent dorsal lips, which is a characteristic of *Hysterothylacium* genus and can be easily observed under optical microscopy (Fig. 1 A-D). Some specimens were identified as *Hysterothylacium incurvum* (= *Maricostula incurva*) (Fig. 1 A-H), following Bruce and Cannon (1989). Nematode lengths were highly variable: males reach up to 75.0 mm and females reach up to 120.6 mm. However, some of the analyzed specimens had different features, such as a pre-equatorial vulva position in females and an additional dorsal pair of caudal papillae in males, so possibly there may be other *Hysterothylacium* species in the swordfish.

Although all swordfish specimens had food content in the stomachs, some of them had small digested pieces of fish and cephalopods (FO= 40%). However, those prey which were in sufficiently good condition to be identified, were determined as the cephalopod *Dosidicus gigas* (FO= 80%) and the oceanic fish *Cubiceps* sp. (FO= 60%).

It is important to note that many larval nematodes were attached to muscles and scales of fish prey. Including a copepod (*Sarcotretes* sp.) attached to the *Cubiceps* sp. was found.

Conclusions

The parasitological findings achieved in this study are not new, because *Hysterothylacium* spp. and *T. coryphaenae* have already been found in other studies (Castro-Pampillón et al. 2002b, Mattiuci et al. 2005, Garcia et al. 2008). Even though a small sample of stomachs of the swordfish was obtained, we recovered a great abundance of *Hysterothylacium* spp. (783.6 nematodes/host) which is greater than other records. For example, a range of 16.6-47.8 nematodes was recorded by Castro-Pampillón et al. (2002b), a mean abundance of 40.1 nematodes was found by Garcia et al. (2008), whereas Mattiuci et al. (2005) reported the highest mean abundance of 65 nematodes in the largest fish (> 145 cm).

Fish prey (*Cubiceps* sp.) was infected with nematodes which suggest that this fish is the intermediate host for *Hysterothylacium* species. This fish species has been recorded as prey of the swordfish off Chile, but in a low frequency of occurrence (Castillo et al. 2007), therefore, the high abundance of nematodes in the swordfish could be explained if the abundance of nematodes is high in *Cubiceps* sp. or if these nematodes have long life span to be accumulated in the definitive host. *Dosidicus gigas* is a common prey in the swordfish from the Pacific Ocean (Ibañez et al. 2004, Castillo et al. 2007) that might transmit larval cestodes to the swordfish (Pardo-Gandarillas et al. 2009). There is no information about parasites in *Cubiceps* in any part of the world. Thus, the present study has additionally contributed to know some parasites in this fish (*Sarcotretes* sp. and *Hysterothylacium* spp.).

Nematode identification was difficult because of the great abundance of the nematodes, so a small sample was analyzed and identified (as *H. incurvum*). Moreover, the large body size of adult nematodes makes observation of the internal organs difficult too. Therefore, molecular analysis may be necessary to elucidate the number of *Hysterothylacium* present in swordfish in the Pacific Ocean.

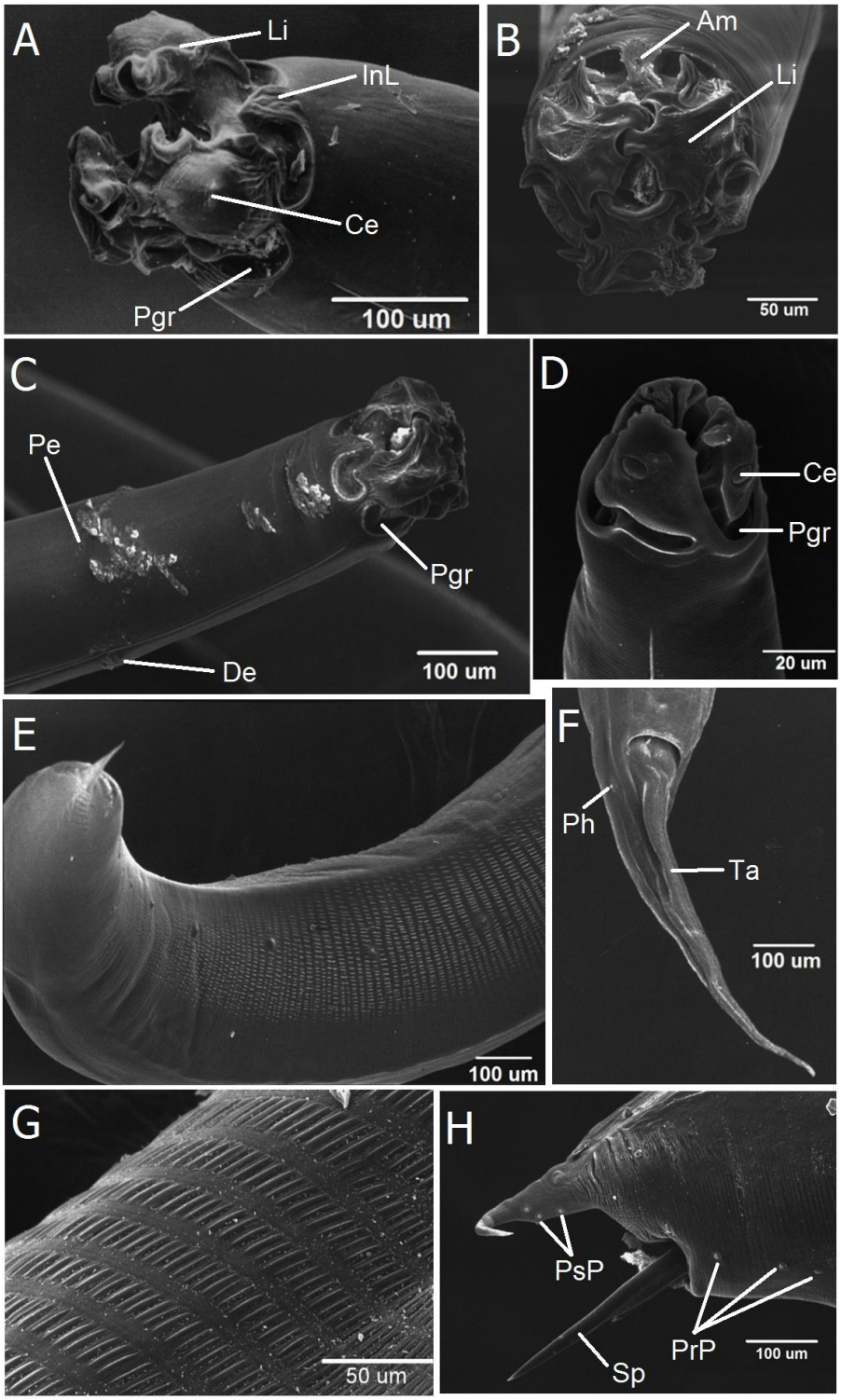

Fig. 1: SEM micrographs of *Hysterothylacium incurvum*: A) Apical view of a open mouth; B) Apical view of a closed mouth, C) anterior region of the body, D) cephalic region of a juvenile female, E) posterior region of the male body, F) female tail, G) area rugosa, H) tail of a male.

Abbreviations: **Li**: lip; **InL**: subventral interlabium; **Pgr**: postlabial groove; **Ce**: Cephalic papillae; **Am:** Anphid; **Pe:** Excretor pore; **De:** Deirid; **Sp:** Spicule; **PrP:** Preanal papilla; **PsP:** Postanal papilla; **Ta:** Tail; **Ph:** phasmid.

References

BRUCE NL, CANNON LRG. *Hysterothylacium, Iheringascaris* and *Maricostula* new genus, nematodes (Ascaridoidea) from Australian pelagic marine fishes. J Nat Hist 23: 1397-1441, 1989.

BUSH AO, LAFFERTY KD, LOTZ JM, SHOSTAK AW. Parasitology meets ecology on its own terms, Margolis et al. revisited. J Parasitol 83: 575-583, 1997.

CASTILLO K, IBAÑEZ C, GONZALEZ C, CHONG J. Dieta del pez espada *Xiphias gladius* Linnaeus, 1758 en distintas zonas de pesca frente a Chile central durante el otoño de 2004". Rev Biol Mar Oceanogr 42: 149-156, 2007.

CASTRO-PAMPILLÓN JA, RODRÍGUEZ-DOMÍNGUEZ H, SOTO-BÚA M, MEJUTO-GARCÍA J, ARIAS-FEMÁNDEZ C, GARCÍA-ESTÉVEZ JM. Parasites of swordfish from the Gulf of Guinea. J Parasitol 88: 188-189, 2002.

ESPÍNDOLA F, YÁÑEZ E, BARBIERI MA. El Niño Southern Oscillation and spatial-temporal variability of the nominal performances of swordfish (*Xiphias gladius*) in the southeastern Pacific. Rev Biol Mar Oceanogr 46: 231-242, 2011.

GARCIA A, SANTOS MN, DAMIANO S, NASCETTI G, MATTUCCI S. The metazoan parasites of swordfish from Atlantic tropical–equatorial waters. J Fish Biol 73: 2274-2287, 2008.

IBAÑEZ CM, GONZÁLEZ C, CUBILLOS L. Dieta del pez espada *Xiphias gladius* Linnaeus, 1758, en aguas oceánicas de Chile central en invierno de 2003. Invest Mar 32(2): 113-120, 2004.

MATTIUCI S, FARINA V, GARCIA A, SANTOS MN, MARINIELLO L, NASCETTI G. Metazoan parasitic infections of swordfish (X*iphias gladius* L., 1758) from the Mediterranean Sea and Atlantic Gibraltar waters: implications for stock assessment. Col Vol Sci Pap 58: 1470-1482, 2005.

MERELLA P, ZUCCA D, GARIPPA G. Contribution to the knowledge of the ectoparasites of swordfish *Xiphias Gladius* Linnaeus, 1758 from the western Mediterranean. Rev Iber Parasitol 63: 117-120, 2003.

PARDO-GANDARILLAS MC, LOHRMANN KB, VALDIVIA AL, IBÁÑEZ CM. First record of parasites of *Dosidicus gigas* (d' Orbigny, 1835) (Cephalopoda: Ommastrephidae) from the Humboldt Current system off Chile. Rev Biol Mar Oceanogr 44: 397-408, 2009.

YÁÑEZ E, VEGA R, SILVA C, LETELIER J, BARBIERI MA, ESPÍNDOLA F. An integrated conceptual approach to study the swordfish (*Xiphias gladius*) fishery in the eastern South Pacific. . Rev Biol Mar Oceanogr 43: 641-652, 2008.