

Short communication

Selecting parasites for use in biological tagging of the Atlantic swordfish (*Xiphias gladius*)

J.A. Castro-Pampillón^a, M. Soto-Búa^b, H. Rodríguez-Domínguez^b,
J. Mejuto-García^c, C. Arias-Fernández^b, J.M. García-Estévez^{b,*}

^aInstituto Español de Oceanografía, Centro Costero de Vigo, Aptdo 1552, E-36280 Vigo, Spain

^bCátedra de Parasitología, Laboratorio de Parasitología Marina, Facultad de Ciencias del Mar, Universidad de Vigo, Vigo, Spain

^cInstituto Español de Oceanografía, Centro Costero de la Coruña, Muelle de Animas s/n, E-15001 A Coruña, Spain

Received 9 November 2000; received in revised form 27 November 2001; accepted 17 December 2001

Abstract

Sampling 125 swordfish in the Gulf of Guinea has provided a parasitofauna profile. By comparing the results with those obtained by other authors in other Atlantic areas, the parasites involved can be assessed for their potential use in tagging. The presence of cestode plerocercoids, *Tentacularia coryphaenae*, only in the South Atlantic and the nematode *Anisakis simplex* as well as the copepod, *Penella filosa*, in the North Atlantic, means that they are particularly suitable to be used as biological tags. © 2002 Elsevier Science B.V. All rights reserved.

Keywords: Parasites; Biological tags; Swordfish; *Xiphias gladius*

1. Introduction

The swordfish (*Xiphias gladius* L.) is a highly important commercial species in many countries (Anonymous, 1997). In order to assess any fishing resource scientifically for its management, its stocks must be delimited.

The International Commission for the Conservation of the Atlantic Tuna (ICCAT) has, for management purposes, defined three separate stocks: the Mediterranean, and the North and South Atlantic divided at 5°N (Miyake, 1990). The Commission has always

been concerned about checking that these divisions do indeed correspond to biological criteria, undertaking different research projects. So, while findings for catch and larvae distribution as well as the possible existence of a common spawning ground, support the theory of a single Atlantic stock (Farber, 1988), results from tagging programs and genetic tests contradict this (Mejuto, 1997).

Using parasites as biological tags may provide data relevant to different types of studies, such as differentiating stocks and determining trophic-reproductive and recruitment migrations as well as information about the host's diet and feeding habits (Williams et al., 1992). The successful use of parasites as biological tags in recent years (Hemmingsen et al., 1991; Jones, 1991; Speare, 1995), has led us to compare the parasitofauna of swordfish in the Gulf of Guinea and North Atlantic.

* Corresponding author. Tel.: +34-986-812-394;
fax: +34-986-812-565.
E-mail address: jestevez@uvigo.es (J.M. García-Estévez).

2. Swordfish parasites

Most studies of the swordfish in the North Atlantic and Mediterranean have used small number of samples and focussed only on some of its parasites (Euzet and Quignard, 1961; Guitart-Manday, 1964; Iles, 1971; Gómez Cabrera, 1987). Hogans et al. (1983, 1985) carried out a detailed study of the parasitofauna of the swordfish in the NW Atlantic based on 303 samples.

A total of 125 swordfish specimens was collected from the Gulf of Guinea waters between August and November 1996. Of these, 46 were male and 79 female, ranging in size from 70 to 260 cm of furcal length. The study enumerated 10 species of metazoans: one Monogenea, one Digenea, five Cestoda, one Nematoda and two Crustacea (Table 1). The parasite species *Sphyricephalus viridis*, *Pelichnibothrium speciosum* and *Caligus coryphaenae* were recorded for the first time on this host (Castro-Pampillón et al., 2002).

2.1. Infestation levels in different areas

The guidelines followed in order to select a parasite as a potential tag are those put forward by Kabata (1963), Sindermann (1983), MacKenzie (1987), Lester (1990), Moser (1991) and MacKenzie and Abaunza (1999). Two main criteria govern parasite selection: first, infestation levels of the species must be significantly different in the areas to be compared, and second, the parasites, or their past presence, should be detectable in their host throughout the time-scale of study.

As regards the first criterion, we must rule out *Fistulicola plicatus*, *Hepatoxylon squali* (= *H. attenuatus*) the non-encapsulated form of *Tentacularia coryphaenae* and *Maricostula incurva* (= *Hysterothylacium incurvum*). These are common in the NW Atlantic and the Gulf of Guinea and have similar infestation levels in both regions (Kabata, 1963; Sindermann, 1983; MacKenzie, 1987; Williams et al., 1992).

Species present in one area but absent in the other as well as common species (present in both areas) which have different infestation levels in different areas could be used together as biological tags. Thus *P. speciosum*, *S. viridis*, *C. coryphaenae* and the encapsulated form of *T. coryphaenae* appear in the

Table 1

Relation between parasite species found in the Gulf of Guinea swordfish (own data) and in the NW Atlantic (Hogans et al., 1983)

Species	P (%)
Gulf of Guinea	
Trematoda, Monogenea	
<i>Tristoma</i> spp.	60.0
Trematoda, Digenea	
<i>Hirudinella</i> sp.	6.4
Cestoda, Pseudophyllidea	
<i>F. plicatus</i>	96.0
Cestoda, Tetraphyllidea	
<i>P. speciosum</i>	4.8
Cestoda, Trypanorhyncha	
<i>H. squali</i>	68.0
<i>T. coryphaenae</i>	6.4
<i>T. coryphaenae</i> ^a	100.0
<i>S. viridis</i>	17.6
Nematoda, Ascaroidea	
<i>M. incurva</i>	84.8
Crustacea, Copepoda	
<i>Pennella instructa</i>	24.0
<i>C. coryphaenae</i>	24.0
NW Atlantic	
Trematoda, Monogenea	
<i>Tristoma coccineum</i> ^b	87.1
<i>T. integrum</i> ^b	44.4
Trematoda, Digenea	
<i>Hirudinella ventricosa</i>	20.3
<i>O. dimidia</i>	0.3
Cestoda, Pseudophyllidea	
<i>F. plicatus</i>	91.8
Cestoda, Tetraphyllidea	
<i>Ceratobothrium xantocephalum</i>	36.9
<i>P. delphini</i>	49.5
<i>S. polymorphus</i>	91.5
Cestoda, Trypanorhyncha	
<i>Hepatoxylon attenuatus</i>	58.6
<i>T. coryphaenae</i>	6.1
<i>D. varioucinatus</i>	3.4
<i>N. lamontae</i>	51.5
Nematoda, Ascaroidea	
<i>H. incurvum</i>	94.2
<i>H. aduncum</i>	8.5
<i>H. corrugatum</i>	68.8
<i>H. reliquens</i>	4.7
<i>A. simplex</i>	20.7
Nematoda, Spirurida	
<i>O. melanocephala</i>	4.4

Table 1 (Continued)

Species	P (%)
Acanthocephala	
<i>R. pristis</i>	1.3
Crustacea, Copepoda	
<i>Pennella</i> spp. (<i>P. filosa</i> + <i>P. instructa</i>) ^c	60.1

^a Encapsulated parasite.^b Iles (1971).^c Hogans et al. (1985) along with their prevalence (P).

Gulf of Guinea but are absent in the NW Atlantic. However, *Opisthodena dimidia*, *Dasyrhynchus variouuncinnatus*, *Rhadinorhynchus pristis*, *Onchophora melanocephala*, *Hysterothylacium aduncum*, *H. reliquens*, *H. corrugatum*, *Ceratobothrium xanthocephalum*, *Phyllobothrium delphini*, *Scolex polymorphus*, *Nybelinia lamontae*, *Anisakis simplex* and *Pennella filosa* were present in the NW Atlantic but did not appear in the sampling from the Gulf of Guinea.

The parasite infestation level must be high enough to be representative of the host stock so that it may be used in biological tagging. Therefore, species with prevalence levels lower than 10% are ruled out.

2.2. Permanent and semi-permanent parasites

The second criterion is the duration of the parasite in the host. Lester et al. (1985) distinguished between permanent parasites, which survive for more than 1 year, and semi-permanent ones, which do not. Temporary parasites have a short life span and move freely between different hosts. An example of this is the copepod, *C. coryphaenae*, which should therefore also be ruled out as a potential tag.

Monogeneans and digeneans are considered semi-permanent. Monogeneans have a single host life-cycle and are mainly ectoparasitic, which suggests that they may be more sensitive to unfavourable changes in the environment (Tripathi, 1959). Adult digeneans, usually with a molluscan intermediate host and several larval stages are generally short-lived.

Larval and adult nematodes which are free in the lumen of the intestine or stomach generally have relatively short life spans in marine fish (Margolis, 1970).

Trypanorhynchs, whose plerocercoids can live for several years (Chubb, 1980; MacKenzie, 1990) are considered permanent, as their transmission forces them through the food chain over long periods until they reach their definitive host (Speare, 1995).

According to Lester (1990), the permanent nature of encapsulated forms makes them particularly suitable for use as biological tags. Such is the case of the plerocercoids of *T. coryphaenae* in the South Atlantic swordfish, and the copepod *P. filosa* and larvae of the nematode *A. simplex* in swordfish in North Atlantic waters.

3. Conclusions

Parasites with different infestation levels in the Gulf of Guinea and the NW Atlantic waters may be considered on the whole as potential biological tags of Atlantic swordfish stocks. From among these species, the encapsulated forms of *T. coryphaenae*, *A. simplex* and *P. filosa* present themselves as ideal biological tags due to their permanent nature.

References

- Anonymous, 1997. Swordfish Detailed Report. ICCAT Standing Committee of Research and Statistics. Halifax Meeting, Canada.
- Castro-Pampillón, J.A., Rodríguez-Domínguez, H., Soto-Búa, M., Mejuto-García, J., Arias-Fernández, C., García-Estévez, J.M., 2002. Parasites of swordfish from the Gulf of Guinea. J. Parasitol. 88, in press.
- Chubb, J.C., 1980. Seasonal occurrence of helminths in freshwater fishes. Part III. Larval cestoda and nematoda. Adv. Parasitol. 18, 1–120.
- Euzet, L., Quignard, J.P., 1961. Sur deux parasites des *Xiphias gladius* L. Commission International de l'Exploration Scientifique del Mediterrane 16, 321–323.
- Farber, M.I., An overview of available information pertinent to interpreting possible stock structure of swordfish in the Atlantic Ocean. Collective Volume of Scientific Papers 27. ICCAT, Madrid, 1988, pp. 240–255.
- Gómez Cabrera, S., 1987. Céstodos parásitos de *Xiphias gladius* L. (Peces: Xiphiidae) de las costas españolas. Rev. Iber. Parasitol. 47, 347.
- Guitart-Manday, D., 1964. Biología pesquera del emperador o pez de espada, *Xiphias gladius* Linnaeus (Telostomi: Xiphiidae) en las aguas de Cuba. Poeyana Ser. B 1, 37.
- Hemmingsen, W., Lombardo, I., MacKenzie, K., 1991. Parasites as biological tags for cod, *Gadus morhua* L., in northern Norway: a pilot study. Fish. Res. 12, 365–373.

- Hogans, W.E., Bratney, J., Uhazy, L.S., Hurley, P.C., 1983. Helminth parasites of swordfish (*Xiphias gladius* L.) from the northwest Atlantic ocean. J. Parasitol. 69, 1178–1179.
- Hogans, W.E., Bratney, J., Hurlbutt, T.R., 1985. *Pennella filosa* and *P. instructa* (Copepoda: Pennellidae) on swordfish (*Xiphias gladius*) from NW Atlantic. J. Parasitol. 71, 111–112.
- Iles, C., 1971. *Fistulicola plicatus* (Cestoda) and *Tristoma* spp. (Trematoda) on swordfish from the northwest Atlantic. J. Fish. Res. Board Can. 28, 31–34.
- Jones, J.B., 1991. Movements of albacore tuna (*Thunnus alalunga*) in the south Pacific: evidence from parasites. Mar. Biol. 111, 1–9.
- Kabata, Z., 1963. Parasites as biological tags. International Commission for the Northwest Atlantic Fisheries (ICNAF). Special Publication 4, pp. 31–37.
- Lester, R.J.G., 1990. Reappraisal of the use of parasites for fish stock identification. Aust. J. Mar. Freshwat. Res. 41, 855–864.
- Lester, R.J.G., Barnes, A., Habib, G., 1985. Parasites of skipjack tuna *Katsuwonus pelamis*: fishery implications. Fish. Bull. US 83, 343–356.
- MacKenzie, K., 1987. Parasites as indicators of host populations “Parasitology—Quo Vadit?” In: Proceedings of the Sixth International Congress on Parasitology, Brisbane, Australia. Inter. J. Parasitol. 17, 345–352.
- MacKenzie, K., 1990. Cestode parasites as biological tags for mackerel (*Scomber scombrus* L.) in the northeast Atlantic. J. Cons. Int. Explor. Mer. 46, 155–166.
- MacKenzie, K., Abaunza, P., 1999. Parasites as biological tags for stock discrimination of marine fish: a guide to procedures and methods. Fish. Res. 38, 45–56.
- Margolis, L., 1970. Nematode diseases of marine fishes. In: Snieszko, S.F. (Ed.), A Symposium on Diseases of Fishes and Shellfishes. Am. Fish. Soc. Spec. Publs 5, pp. 190–208.
- Mejuto, J., 1997. A contribution to the definition of swordfish (*Xiphias gladius*) population structure using mtDNA. Final Report on the UE Project DGXIV. MED93-013.
- Miyake, M., 1990. Manual de operaciones para estadísticas y muestreo de los túnidos y especies afines en el Océano Atlántico. ICCAT, Madrid, 188 pp.
- Moser, M., 1991. Parasites as biological tags. Parasitol. Today 7, 182–185.
- Sindermann, C.J., 1983. Parasites as natural tags for marine fish: a review. NAFO Sci. Coun. Stud. 6, 63–71.
- Speare, P., 1995. Parasites as biological tags for sailfish *Istiophorus platypterus* from east coast Australian waters. Mar. Ecol. Prog. Ser. 118, 43–50.
- Tripathi, Y.R., 1959. Monogenetic trematodes from fishes of India. Ind. J. Helminthol. 9, 1–49.
- Williams, H.H., MacKenzie, K., McCarthy, A.M., 1992. Parasites as biological indicators of the population biology, migrations, diet and phylogenetics of fish. Rev. Fish Biol. Fish. 2, 144–176.