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Distribution of *Anisakis simplex* in fish caught in the Ligurian Sea

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Abstract A total of 822 individuals of 5 fish species were sampled in the western coastal area of the Mediterranean Sea and examined for the presence of *Anisakis simplex* larvae in the body cavity, muscle, and viscera. *A. simplex* mean intensity (mI) and prevalence (Pr) values were very high in the common scad (*Trachurus trachurus*; Pr 80–100%, mI 19.3–36.8) and the blue scad (*T. picturatus*; Pr 80–100%, mI 18.2–70.7), moderate in the blue whiting (*Micromesistius poutassou*), and low in the red mullet (*Mullus barbatus*) and the striped mullet (*M. surmuletus*). The larval burden was strongly related to host length in the common and blue scad.

Introduction

Anisakis simplex is a parasite of commercially important marine fish and its prevalence is of great concern for both human health and economic reasons. The presence of Anisakidae larvae in marine teleosts has been investigated in several studies, and a great number of fish species have been found to be receptive to anisakid infection (Smith 1984; Mattiucci et al. 1996). Furthermore, the infection level of this parasite in host populations is highly variable (Orecchia et al. 1989; Adroher et al. 1996). In this study we compared the infection indices (prevalence and mean intensity) of *A. simplex* in

five host species sampled in the Mediterranean Sea, namely, blue whiting (*Micromesistius poutassou*), common scad (*Trachurus trachurus*), blue scad (*T. picturatus*), red mullet (*Mullus barbatus*), and striped mullet (*M. surmuletus*).

Materials and methods

A total of 822 fish were caught during the period ranging from March 1992 to April 1993 in an area of the western Ligurian Sea (Mediterranean Sea) located at 44°N and 8°E. The total length of each fish was measured.

The body cavity was directly examined for the presence of larvae of *Anisakis simplex*. Viscera and muscles were digested separately (Huang 1990). For each specimen the larvae were counted and identified according to their morphologic features using a light microscope (Petter 1969; Hurst 1984). Larvae were not analyzed for differentiation of A and B *A. simplex* sibling species (Nascetti et al. 1986). The prevalence and the mean intensity of *A. simplex* were calculated as defined by Bush et al. (1997).

Results

Table 1 shows the occurrence of *Anisakis simplex* third-stage larvae according to the fish species sampled. Prevalence (Pr) and mean intensity values presented a wide range of variation, depending on the species and on the time point of sampling. Maximal values were obtained for *Trachurus trachurus* and *T. picturatus*. In both species the highest values were recorded throughout November (Pr 100%). Prevalence levels were moderate in blue whiting and low in striped and red mullet, the exception being fish sampled in March, which showed prevalence values of 55.6% and 24.5%, respectively. The prevalence of *A. simplex* infection was significantly higher in common and blue scad as compared with the other fish species ($P < 0.001$). Furthermore, the mean intensity proved to be highest in common and blue scad and very low in the other fish species. The larval burden was related to host length as determined by Spearman's

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Table 1 Data on *Anisakis simplex* L3 from fish sampled in the coastal area of the Ligurian Sea (ND Not determined)

Host	Sampling month	Fish sampled (n)	Length range (cm)	Age ^a (years)	Prevalence (%)	Mean intensity
<i>Trachurus trachurus</i> (common scad)	March 1992	80	12.0–38.3	ND	95.0	19.3
	June 1992	5	20.0–23.0	ND	80.0	27.5
	November 1992	10	26.0–42.0	ND	100.0	36.8
	April 1993	12	23.0–35.0	ND	91.7	36.4
<i>T. picturatus</i> (blue scad)	June 1992	15	14.5–24.5	ND	80.0	18.2
	November 1992	55	25.0–42.0	ND	100.0	70.7
<i>Micromesistius poutassou</i> (blue whiting)	May 1992	122	15.2–28.3	2–3	43.4	1.5
	September 1992	139	19.0–33.0	2–6	32.4	1.5
	January 1993	84	20.0–27.5	2–5	65.5	2.3
<i>Mullus surmuletus</i> (striped mullet)	March 1992	9	16.6–22.1	4–5	55.6	1.0
	September 1992	44	11.5–14.0	1–2	6.8	1.6
	April 1993	24	11.0–16.0	1–2	8.3	1.5
<i>M. barbatus</i> (red mullet)	March 1992	98	10.6–19.9	1–5	24.5	1.3
	September 1992	59	10.5–15.0	1–4	3.4	1.5
	April 1993	66	10.0–16.0	1–4	4.5	1.3

^a The age of red mullet, striped mullet, and blue whiting only were determined according to the growth index computed by Andaloro and Prestipino Giarritta (1985) and by Wurtz and Matricardi (1986)

correlation coefficient. The larval burden was strongly related to host length in common and blue scad, mainly in fish sampled in November ($P < 0.001$).

Discussion

The study of the ascaridoid population in the five sampled fish species revealed high degrees of prevalence and mean intensity in common and blue scad and low values in red mullet, striped mullet, and blue whiting. The values were significantly different in hosts sampled at the same time. Previous data on fish from southern Europe generally confirm that common and blue scad are the fish species most frequently infected (Carvalho-Varela and Cunha-Ferreira 1984; Huang 1988; Pozzi et al. 1992). However, lower levels of prevalence have been found in common scad in a fish market in Spain (Adroher et al. 1996). In contrast, blue whiting showed a very low infection level as compared with specimens from the North Sea (Smith 1984). This discrepancy could probably be explained by the age of the fish sampled, since the specimens from our survey were younger than those studied by Smith (1984). Indeed, it has been demonstrated that ascaridoid larvae tend to accumulate in herring and Atlantic cod by age because of their long life span and predatory behavior (Smith 1984). Furthermore, it has been shown that third-stage larvae of *A. simplex* live for about 3 years in herrings (Smith 1984). Because of our samples' high degree of heterogeneity we could not evaluate possible relationships of infection prevalence and mean intensity with host age (length) and seasonality. However, Smith (1983) has purported that seasonality might not be expected because *Anisakis* eggs are shed by the final hosts, possibly throughout the year, and they may develop and hatch at any time. Furthermore, the acquisition of infection by euphausiids is nonseasonal (Smith 1983).

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