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Calliobdella lophii (Hirudinea: Piscicolidae) parasitizing white anglerfish *Lophius piscatorius* off the north of Spain

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This paper describes the interaction between two species: white anglerfish *Lophius piscatorius* and its specific leech parasite *Calliobdella lophii* off the north of Spain. Catches of white anglerfish by the Spanish gill-net fleet operating in those waters were sampled monthly in 2001. Abundance, mean intensity and prevalence were used to analyse infestation level by *C. lophii*. Prevalence of leeches and fish length was significantly correlated. Mean intensity was higher on larger white anglerfish. Significant differences were found in the presence of leeches by fish length between areas, with higher values in the western part of the studied area. No significant differences were found in the presence of leeches between sexes or seasons.

INTRODUCTION

Although the class Hirudinea contains over 250 parasite species, they are seldom reported in faunal studies apart from those species related to medical uses such as *Hirudo medicinalis* Linnaeus 1758 and *Haementaria officinalis* Blanchard 1896. The lack of information is more marked in marine leeches, whose biology is poorly known. This is probably due to the limitation on availability of material given that leeches are temporary or semi-permanent parasites and the sampling at sea is difficult and expensive. Furthermore, leeches may go undetected, even when abundance is high (Burreson, 1995).

Though some piscicolid leeches have narrow host specificities and rarely detach from their host during their life cycle, most piscicolid leeches feed on several hosts and do not remain attached after each feeding and reattach following digestion of the blood meal (Sawyer & Hammond, 1973).

References dealing with the population dynamics of marine leeches are scarce (Gibson & Tong, 1969; Sawyer & Hammond, 1973; Khan & Meyer, 1976). Information is particularly meagre for piscicolid leeches that infest deep-sea species. This is the case of *Calliobdella lophii* Van Beneden & Hesse 1863 (Hirudinea: Piscicolidae) that parasitizes anglerfish species (Leigh-Sharpe, 1914). White anglerfish (*Lophius piscatorius* Linnaeus 1758) is a bottom predator species of up to 2 m in total length that lives up to 1000 m deep in the eastern Atlantic. It is a valuable commercial species with landings of about 30,000 tn in the European Atlantic waters in 2001 (ICES, 2004).

There is a previous study on the anatomical description of *C. lophii* (Leigh-Sharpe, 1914) and only a recent study (Karlsbakk, 2005), based on 27 fish analysed, described the infestation of *C. lophii* on white anglerfish in Norway. The present study constitutes, up to date, the first approach in depth on the interaction between *C. lophii* and white anglerfish. The aim was to describe the abundance, intensity and prevalence of the parasite population and to explore some features in the infestation, such as length and sex of the fish, geographical area and season.

MATERIALS AND METHODS

White anglerfish captured by the Spanish gill-net fishery in the north of Spain were sampled monthly onboard fishing vessels in 2001. A total of 921 white anglerfish was examined for *Calliobdella lophii* infestation. Total length and sex of white anglerfish, absence or presence of leeches, number and attachment location, fishing area and depth were recorded. The study area was divided in three subareas (south-eastern Bay of Biscay, International Council for the Exploration of the Sea [ICES] Division VIIIb; Cantabrian Sea, ICES Subdivision VIIIc2; and Northern Galicia, ICES Subdivision VIIIc1) to investigate the effects of geographical location on the infestation levels.

Parasite infestation level was analysed using three of the main quantitative descriptors of parasite populations (Bush et al., 1997): abundance (total number of individuals of the parasite divided by total number of fish studied), mean intensity (number of individuals of the parasite divided by number of infested hosts) and prevalence (proportion of a host population infested by a specific parasite). Fish length-classes of 10 cm were used in the analysis. Catches of the smallest and largest white anglerfish were low and poorly sampled, and were excluded from the analysis. The Spearman's rank correlation coefficient was used to ascertain relationships between host size and prevalence. Presence or absence of parasite by host sex, geographical area and quarter were also analysed by analysis of covariance (ANCOVA) tests using host length as covariable.

Since there was no evidence of differences related to prevalence of infestation between sexes (see Results), the samples were treated collectively.

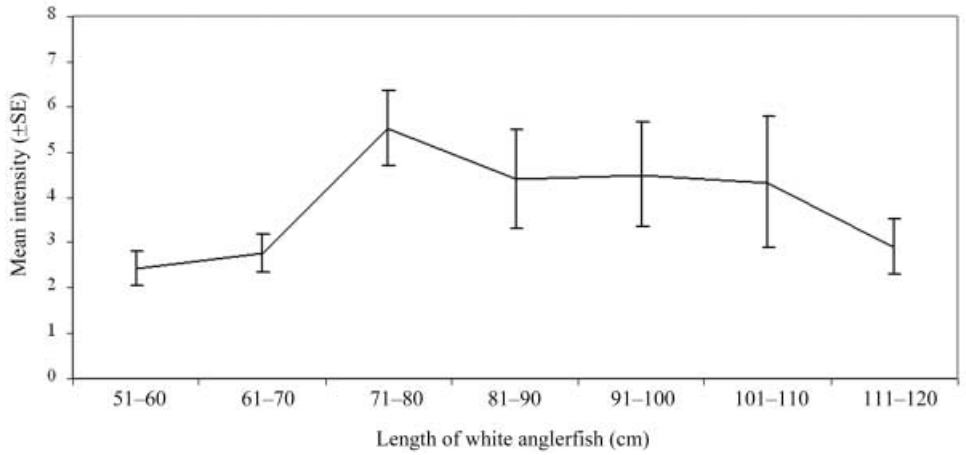

Figure 1. Mean intensity of leeches by length of white anglerfish.

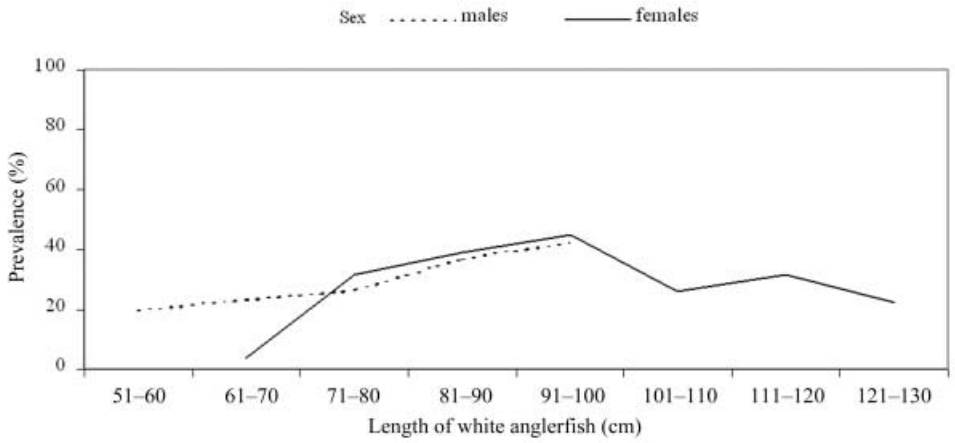

Figure 2. Prevalence of leeches by sex of white anglerfish.

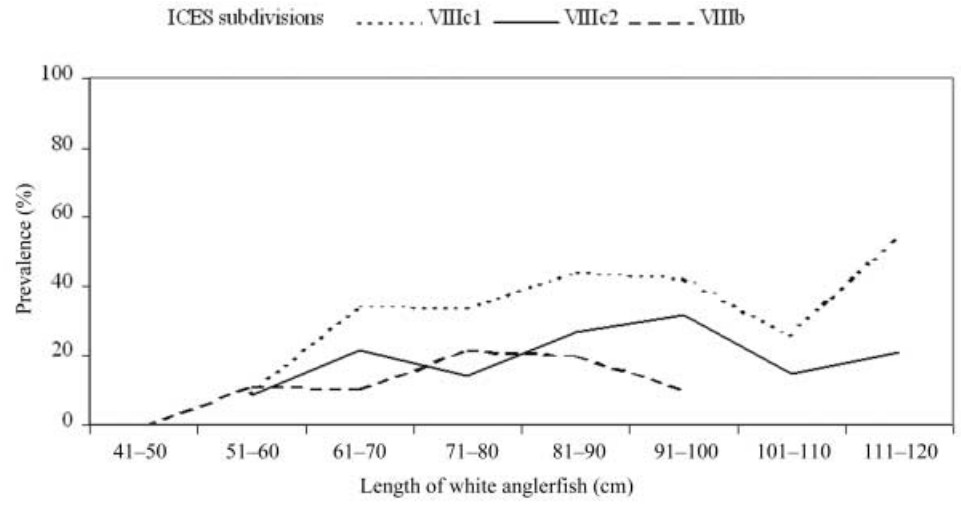

Figure 3. Prevalence of leeches on white anglerfish by geographical area.

RESULTS

White anglerfish sampled ranged from 26 to 127 cm in total length (average 77 cm). Leeches *Calliobdella lophii* were found attached to the skin on the ventral side of the white anglerfish and were seldom on the dorsal side of the head.

A total of 996 leeches was recorded from the 921 white anglerfish examined and 239 parasitized white anglerfish were found, corresponding to a prevalence of 26%. Overall abundance was 1.1 ($\pm$3.5) leeches per fish. The total number of leeches collected per fish varied from zero to 46, resulting in a mean intensity of 4.2 ($\pm$5.8).

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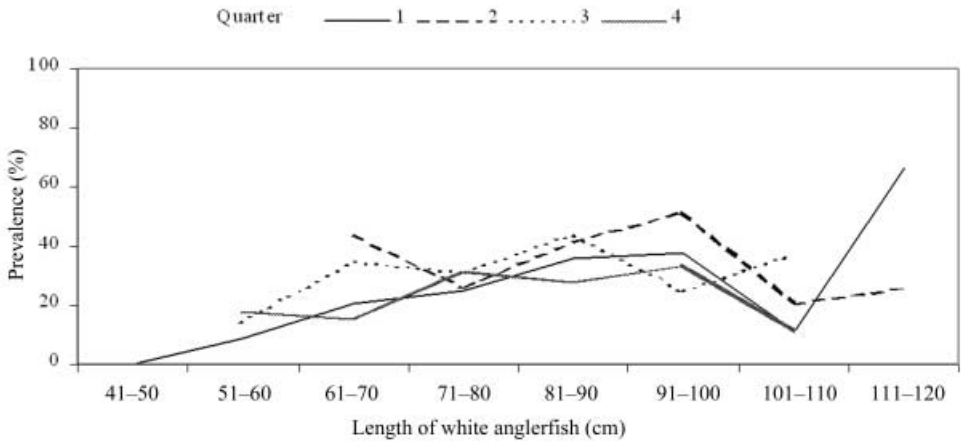

Figure 4. Prevalence of leeches on white anglerfish by season.

The observed frequency distribution of leeches on white anglerfish was of an overdispersed nature in which the parasites were unevenly distributed and the variance was greater than the mean. In detail, 682 white anglerfish were found without any leech, 91 fish had one leech, 43 had two leeches and 105 had three or more leeches.

Leeches were not found attached to fish smaller than 57 cm total length. Prevalence of leeches and white anglerfish total length was significantly correlated (r_s=0.72, $P<0.05$). The number of leeches attached to white anglerfish increased according to length up to length range of 91–100 cm. From this size on, prevalence did not increase and showed more variability.

Mean intensity for fish of 51–70 cm total length (2.7 leeches per fish) was lower than for larger sizes of 71–110 cm (4.7 leeches per fish), although the standard error was greater in these sizes (Figure 1).

No significant differences were found in the presence of leeches between sexes (ANCOVA, $P>0.05$) for the fish length range of 61–100 cm (Figure 2).

Significant differences were found in the presence of leeches by geographical area (ANCOVA, $P<0.01$, Figure 3), corresponding to the major levels of infestation in the samples from Northern Galicia (north-west of Spain, ICES Subdivision VIIIc1) than from the south-eastern Bay of Biscay and Cantabrian Sea (ICES Division VIIIb and Subdivision VIIIc2, respectively).

Leeches were found throughout the year. Temporal analysis of presence of leeches at host size, considering the length range of 61–110 cm, showed no significant differences between quarters (ANCOVA, $P>0.05$) (Figure 4).

DISCUSSION

The marine leech *Calliobdella lophii* was ectoparasitic on the skin of the white anglerfish. The number of leeches per fish followed an overdispersed distribution, where some individuals harboured more parasites and others fewer or no parasites than expected in a random distribution. This is not an unexpected result since the overdispersed distributions, like the negative binomial distributions, are typical of parasite infestations in marine fish (Rohde, 1984).

Calliobdella lophii exhibited in the study area lower infestation intensity and prevalence on white anglerfish than that reported for this species by Karlsbakk (2005) with a small sampling size in more northern and coastal waters.

Seasonal occurrence was stated previously in marine leeches (Gibson & Tong, 1969; Sawyer & Hammond, 1973) and was related to the reproductive cycle of the leeches and the life history of the host. Most blood sucking leeches apparently leave their hosts during the breeding season and either seek a solid substratum for cocoon deposition or deposit their cocoons upon the host, dying shortly after it (Khan & Meyer, 1976). However, our data indicate that *C. lophii* does not present a seasonal occurrence, since its presence was recorded throughout the year. The absence of a significant seasonality in the prevalence of *C. lophii* may be bound up with its supposed life permanently attached to white anglerfish (Leigh-Sharpe, 1914) and the steady conditions of the benthic environment throughout the year (University of Oviedo plankton group, personal communication).

Parasite leech species without seasonality seem to maintain relatively low, but stable, prevalence throughout the year. Thus, the seasonal leech *Oceanobdella blennii* Knight-Jones, 1940 (Gibson & Tong, 1969) showed higher mean infestation intensity, abundance and prevalence than the resulting infestation obtained for *C. lophii* in the present study.

The obtained results indicated that larger white anglerfish harbour more leeches. Similar results were observed in northern waters (Karlsbakk, 2005) and in other species as *Platybdella anarrhichae* (Karlsbakk, 2005) and *Oceanobdella blennii* (Gibson & Tong, 1969) parasitizing *Anarhichas lupus* Linnaeus 1758 and *Blennius pholis* Linnaeus 1758, respectively. A large body size of the hosts will allow leeches to have more space and availability of food for attachment.

The lack of differences in infection between sexes of white anglerfish agrees with other parasite infections in fish hosts. In most cases, no sexual differences were found (Rohde, 1984), although Gibson & Tong (1969) noted that leeches were found more often on male fish.

Parasites have been widely used as biological indicators for several aspects of fish biology but leeches do not meet some of the requirements to be a good candidate for a parasite tag (MacKenzie & Abaunza, 1998), since they are, in most cases, semi-permanent parasites moving about continually looking for blood donors. Moreover, most of the species have a life span of less than one year

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(Gibson & Tong, 1969; Sawyer & Hammond, 1973; Khan & Meyer, 1976). Nevertheless, *C. lophii* seems to be a permanent parasite (Leigh-Sharpe, 1914) and this author enumerated various facts, based on anatomical characteristics, to support the condition of permanent parasite. However, none of the studies are definitive and more conclusive results are required. Little is known on the life span of *C. lophii* neither on its mating behaviour nor on its life cycle. When all this information is available, the consideration of this parasite as a biological tag could be revised, since *C. lophii* parasitizes only on anglerfish and presents geographical differences in prevalence.

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