Metazoan parasite community of a European eel (*Anguilla anguilla*) population from an estuary in Portugal

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Abstract

Over an 11-month period, the gills, digestive tract, and swimbladder of eels from the Ria de Aveiro were examined for the presence of parasites. Fifteen metazoan parasite species were found: one myxosporean (*Myxidium giardi*), one monogenean (*Pseudodactylogyrus anguillae*), five digeneans (*Deropristis inflata*, *Lecithochirium rufoviride*, *Helicometra fasciata*, *Podocotyle* spp., and *Lecithochirium* sp. metacercariae), two cestodes (*Proteocephalus* sp. and *Bothriocephalus claviceps*), two nematodes (*Anguillicola crassus* and *Contracaecum* sp. larvae), two acanthocephalans (*Acanthocephalus clavula* and *Pomphorhynchus laevis*), and two crustaceans (*Ergasilus gibbus* and *Gnathiidae* gen. sp.). The parasite species *D. inflata*, *L. rufoviride*, *Lecithochirium* sp. metacercariae, *H. fasciata*, *Proteocephalus* sp., *Contracaecum* sp. larvae, *P. laevis*, and *Gnathiidae* gen. sp. are recorded in Portugal for the first time in this host. Although the eels from Ria de Aveiro presented a very rich parasite community, several species occur very rarely. The low diversity observed in the intestinal infracommunity of the Ria de Aveiro eels reflects the high proportion of eels that were not parasitized or harboured only one helminth species.

Introduction

The European eel, *Anguilla anguilla* L., is an economically important fish whose geographical distribution includes all European waters and the Mediterranean basin. The EU production of the European eel was estimated in 10 thousand tones per year. Most of this production occurs in freshwater but small quantities are also produced in marine and brackish waters (Cross, 2003). Ria de Aveiro is the most important brackish water lagoon in the Portuguese coast where several fish species, including the European eel, are extensively produced.

Several studies on the parasite communities of the European eel have been conducted in Portugal (Carvalho-Varela et al., 1984; Saraiva & Chubb, 1989; Saraiva & Eiras, 1996; Saraiva et al., 2005), but none was done in brackish or saltwater environments and only one comprehensively analysed eel parasite communities (Saraiva et al., 2005).

The main aim of this work is to study a brackish water eel parasite community from Portugal and, since the Portuguese coast is a transitional area between the Mediterranean and the Northeast Atlantic, to compare this community with those observed in other European coasts.

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Materials and methods

During an eleven-month period, 134 live eels (total length: 36.1 ± 6.3, weight: 85.1 ± 54.6 g) from the Ria de Aveiro, estuarine bay of the River Vouga, were acquired from local fishermen. The eels were transported live to the laboratory where they were killed, dissected, and the gills, digestive tract and swimbladder examined for the presence of metazoan parasites. The prevalence, intensity, mean intensity, and mean abundance were determined according to Bush et al. (1997).

The characterization of the parasite community structure was done at component community and intestinal helminth infracommunity levels (Bush et al., 1997), using the total number of parasite species (species richness), the Simpson’s reciprocal index (1/D), the Shannon-Wiener index (H’) and its Evenness (Pielou’s index) (E), the Berger-Parker Dominance index (d), the mean number of parasites and species per eel and the Brillouin’s index (HB). All these indices were adopted in order to facilitate comparisons with results from other authors and calculated in accordance with Magurran (1989) and Krebs (1999). Component species were defined as species presenting prevalences of 10% or greater (Kennedy, 1993).

Table 1. Infected organ, total number of parasites (TN), prevalence (P), mean intensity (I) ± standard deviation (SD), (minimum – maximum ), and mean abundance (A) ± standard deviation (SD) of eel parasites from Ria de Aveiro. * Number of cysts.

<table>
<thead>
<tr>
<th>Parasite species</th>
<th>Infected organ</th>
<th>TN</th>
<th>P (%)</th>
<th>I ± SD (min-max)</th>
<th>A ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Myxidium giardi</em></td>
<td>Gills</td>
<td>2189*</td>
<td>38.8</td>
<td>42.1 ± 91.94 (1-552)</td>
<td>16.34 ± 60.84</td>
</tr>
<tr>
<td><em>Pseudodactylogyrus anguillae</em></td>
<td>Gills</td>
<td>255</td>
<td>31.3</td>
<td>6.1 ± 7.4 (1-45)</td>
<td>1.90 ± 5.05</td>
</tr>
<tr>
<td><em>Deropristis infulta</em></td>
<td>Stomach and intestine</td>
<td>2075</td>
<td>47.0</td>
<td>32.9 ± 94.99 (1-732)</td>
<td>15.49 ± 67.17</td>
</tr>
<tr>
<td><em>Lechitochirium rafuoidre</em></td>
<td>Stomach</td>
<td>46</td>
<td>7.5</td>
<td>4.6 ± 6.39 (1-23)</td>
<td>0.34 ± 2.12</td>
</tr>
<tr>
<td><em>Lechitochirium sp. metacercariae</em></td>
<td>Gills</td>
<td>8</td>
<td>0.8</td>
<td>8.0</td>
<td>0.06</td>
</tr>
<tr>
<td><em>Podocotyle sp.</em></td>
<td>Intestine</td>
<td>254</td>
<td>9.7</td>
<td>19.5 ± 27.01 (1-106)</td>
<td>1.90 ± 10.21</td>
</tr>
<tr>
<td><em>Helicometra fasciata</em></td>
<td>Intestine</td>
<td>50</td>
<td>3.7</td>
<td>10.0 ± 17.02 (1-44)</td>
<td>0.37 ± 3.79</td>
</tr>
<tr>
<td><em>Proteocephalus sp.</em></td>
<td>Intestine</td>
<td>10</td>
<td>5.2</td>
<td>1.4 ± 0.49 (1-2)</td>
<td>0.07 ± 0.34</td>
</tr>
<tr>
<td><em>Bothrioccephalus clariceps</em></td>
<td>Intestine</td>
<td>5</td>
<td>2.2</td>
<td>1.7 ± 0.94 (1-3)</td>
<td>0.04 ± 4.97</td>
</tr>
<tr>
<td><em>Anguillicola crassus</em></td>
<td>Swim bladder</td>
<td>228</td>
<td>32.8</td>
<td>5.2 (± 8.84) (1-24)</td>
<td>1.70 ± 4.14</td>
</tr>
<tr>
<td><em>Contraecum sp. larvae</em></td>
<td>Intestinal wall</td>
<td>417</td>
<td>13.4</td>
<td>23.2 ± 71.00 (1-311)</td>
<td>3.11 ± 27.20</td>
</tr>
<tr>
<td><em>Acanthocephalus clavula</em></td>
<td>Intestine</td>
<td>2</td>
<td>1.5</td>
<td>1.0</td>
<td>0.01</td>
</tr>
<tr>
<td><em>Pomphorhynchus laevis</em></td>
<td>Intestine</td>
<td>1</td>
<td>0.8</td>
<td>1.0</td>
<td>0.01</td>
</tr>
<tr>
<td><em>Ergasilus gibbus</em></td>
<td>Gills</td>
<td>76</td>
<td>9.7</td>
<td>5.9 ± 6.36 (1-25)</td>
<td>0.57 ± 2.63</td>
</tr>
<tr>
<td><em>Gnathiidae gen. sp.</em></td>
<td>Gills</td>
<td>9</td>
<td>3.7</td>
<td>1.8 ± 1.17 (1-4)</td>
<td>0.07 ± 0.41</td>
</tr>
</tbody>
</table>
Results

Composition of the parasite community

A total of 121 eels (90.3%) were infected with one to six parasite species. Fifteen metazoan parasite species were detected in the studied eels: one myxosporean (*Myxidium giardi*), one monogenean (*Pseudodactylogyrus anguillae*), five digeneans (*Deropristis inflata*, *Lecithochirium rufoviride*, *Helicometra fasciata*, *Podocotyle* spp., and *Lecithochirium* sp. metacercariae), two cestodes (*Proteocephalus* sp. and *Bothriocephalus claviceps*), two nematodes (*Anguillicola crassus* and *Contracaecum sp. larvae*), two acanthocephalans (*Acanthocephalus clavula* and *Pomphorhynchus laevis*), and two crustaceans (*Ergasilus gibbus* and *Gnathiidae gen. sp.*). The infection levels observed are presented in Table 1.

Only five parasite species occurred in eels all year round (*M. giardi*, *D. inflata*, *L. rufoviride*, *A. crassus*, and *Contracaecum* sp.) Two gill parasites, *P. anguillae* and *E. gibbus*, were not

<table>
<thead>
<tr>
<th>Portugal</th>
<th>Spain</th>
<th>France</th>
<th>Italy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aveiro</td>
<td>Outeiral et al., 2003/2002</td>
<td>Maillol et al., 2005</td>
<td>Termeño et al., 2005</td>
</tr>
<tr>
<td>Present study</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Component community structure of the Aveiro eel population and other European brackish water eel populations (D. i. = *Deropristis inflata*, P. a. = *Pseudodactylogyrus anguillae*, B. c. = *Bothriocephalus claviceps*, E. s. = *Ergasilus sieboldi*; *values calculated from data given by the authors; ‡ helminth parasites only).
detected in the summer, and *Podocotyle* sp., *H. fasciata*, and *Proteocephalus* sp. occurred in only two seasons. The remainder five species occurred just in one season with very low prevalence values.

**Component community structure**

Data on the eel metazoan (excluding Myxosporea) parasite community structure observed in the present study as well as those reported from previous studies in brackish or marine European waters are presented in Table 2.

In the present study the species richness and the number of component species of the eel parasite community were high. The Shannon-Wiener index was also relatively high, while the Simpson’s index and Pielou’s evenness were lower when compared to other brackish water communities. The trematode *D. inflata* was the dominant species with a Berger-Parker dominance index of 0.60.

**Infracommunity structure**

Data on the eel intestinal helminth infracomunity are presented in Table 3. Most eels (84%) were uninfected or harboured only one intestinal parasite species. A maximum of 3 intestinal helminth species per eel was found. Although the mean number of parasites per eel was high the mean number of helminth species per eel and the Brillouin’s index (all eels and infected eels only) were low.

**Discussion**

Eight out of the fifteen parasite species observed were detected for the first time in eels from Portugal (*D. inflata, L. rufoviride, Lecithochirium* sp. metacercariae, *H. fasciata, Proteocephalus* sp., *Contracaecum* sp. larvae, *P. laevis* and Gnathiidae gen. sp.) probably because this is the first study in brackish environments in this country. All these parasites have been observed in eels from brackish or saltwater environments (Seyda, 1973; Vaes, 1978; Reimer, 1987; Keie, 1988; Pilcher & Moore, 1993; Orecka-Grabda & Wierzbicka, 1994; Reimer et al., 1994; Wierzbicka & Orecka-Grabda, 1994; Dezfulli et al., 1997; Kennedy et al., 1997; Outeiral et al., 2001, 2002; Maíllo et al., 2005; Ternengo et al., 2005) and all but *P. laevis* were previously found in eels from the neighbour Galicia, Spain. (Outeiral et al., 2001, 2002). Six of the parasite species detected are eel specialists
(M. giardi, P. anguillae, D. inflata, B. claviceps, A. crassus, and E. gibbus) and these species are the most prevalent.

Although the number of parasite species observed in the present study was lower than that reported by Outeiral et al. (2001, 2002) in Galicia, the number of component species, diversity, and evenness detected were generally higher. The Pielou’s evenness values detected by several authors were usually higher than those observed in the Ria de Aveiro which indicate more stable communities. It is interesting to observe that while freshwater parasite communities were usually dominated by a nematode species (Saraiva et al., 2005) the studies in brackish or saltwater environments indicate that the dominant species was usually the specialist digenetic D. inflata.

Although most of the parasite species detected in the present study were observed in the intestine this organ was never infected with more than three species. The low diversity observed in the intestinal infracommunity of the Ria de Aveiro eels reflects the high proportion of eels that were not parasitized or harboured only one helminth species.

References


