**Goussia cruciata** (Thelohan, 1892) a hepatic coccidian parasite of the horse mackerel *Trachurus trachurus* (Linnaeus, 1758) from the Mediterranean coasts of northern Morocco

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**Abstract**

To determine the parasite load of fishes on the north Moroccan Mediterranean coasts, six species belonging to five families that predominate in the zone were examined. These included: 2 species of the family Sparidae, *Boops boops* and *Pagellus bograveo*; 1 species of the family Mugilidae, *Mugil ramada*; 1 species of the family Clupeidae, *Sardina pilchardus*; 1 species of the family Scombridae, *Scromber scombrus*; and 1 species of the family Carangidae, *Trachurus trachurus*. Examination of these fish revealed that despite the presence of parasites in some species of fish sample, the horse mackerel *T. trachurus* was the only species which was infected by *Goussia cruciata* (Coccidia, Apicomplexa) in significant prevalence and high abundance.

**Introduction**

Parasites of land mammals in Morocco have been reported by various authors (Cabaret, 1979; Ait Talab, 1987; Laouali, 1992; Berrag et al., 1995). In contrast, few studies have been concerned with marine parasites and none focussed on fish coccidia of the Moroccan Mediterranean coasts despite the enormous economic value of fish in this region. The evidence of the pathological effects caused by many of fish coccidians studied elsewhere, makes such a study in Morocco worthwhile. According to a recent review of fish (Duszynsky et al., 1999), *G. cruciata* has been reported as the main hepatic parasite of *T. trachurus* only twice (Kalfa-Papaioannou and Athanassopoulou-Raptopoulou, 1984; Daoudi, 1987). These two studies evaluated the parasite in the north Aegean Sea, and on the west coasts of France and Kotor Bay, Yugoslavia. The aim in the present paper is to provide data on the coccidian *G. cruciata* in the Mediterranean coasts of Northern Morocco where we found it in sufficient abundance to merit detailed parasitological study.

**Materials and Methods**

Ninety-eight fish belonging to six different species were captured along the Mediterranean coasts of northern Morocco in the winter period of 1998. Fish were captured in collaboration with local and traditional fishermen using small ships and fishing nets. The zone of capture stretched approximately twenty kilometres starting from Ristinga to Martil (two seaside stations of the north Mo-
roccan Mediterranean coasts). After capture, fish were brought immediately to the laboratory to be identified and then examined macroscopically. They were then dissected and their organs were placed in glass containers and examined carefully. Fresh smears of the intestinal wall were prepared on slides for microscopic observation. Similar smears were prepared from swim bladder, liver, gall bladder, pyloric caeca, kidneys, heart and gonads. Finally, fish were skinned to allow examination of muscle blocks. Parasite measurements were made with an ocular micrometer incorporated into the light microscope.

Results

Examination of the fish permitted detection of three different species of parasites in the studied samples. These parasites were found in two among the six examined species of fishes (Tab. 1). One nematode was encountered in the muscles of 1 of 16 S. pilchardus examined, and 18 of 22 T. trachurus had oocysts of G. cruciata in their hepatic tissue. One of these 18 parasitized T. trachurus was also infected with a great number of cysts of a myxosporidan of the genus Kudoa. The examination of the other four fish species did not reveal parasites.

Table 1 shows that both the nematode and the myxosporidan had a low prevalence (6.25% and 4.54% respectively) which did not allow further analysis of the two infections. By contrast, parasitism with G. cruciata was characterised by high prevalence (82%) and the parasite was particularly abundant in liver samples. To describe this parasite further, 50 oocysts were examined in detail and their dimensions taken. The oocysts were spherical with a diameter of 24.3(22.1-26.0)μm. Each oocyst contained four egg-shaped sporocysts

<table>
<thead>
<tr>
<th>Fish species</th>
<th>No. examined</th>
<th>No. infected</th>
<th>Parasite (Prevalence)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Boops boops</em></td>
<td>14</td>
<td>0</td>
<td>Nematode (6.25%)</td>
</tr>
<tr>
<td><em>Pagellus bograveo</em></td>
<td>12</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td><em>Sardina pilchardus</em></td>
<td>16</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><em>Mugil ramada</em></td>
<td>20</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td><em>Scomber scombrus</em></td>
<td>14</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td><em>Trachurus trachurus</em></td>
<td>22</td>
<td>18</td>
<td>G. cruciata (82.0%) and Kudoa sp (4.54%)</td>
</tr>
</tbody>
</table>

Table 1. Parasitary infection in the six examined fish species.

<table>
<thead>
<tr>
<th>No. examined</th>
<th>Prevalence</th>
<th>Oocysts</th>
<th>Sporocysts</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>26</td>
<td>38.5%</td>
<td>19.8 (17.0-22.5)μm</td>
<td>8.5 (7.0-9.5) x 6.5 (6.0-7.0)μm</td>
<td>(Daoudi, 1987)</td>
</tr>
<tr>
<td>22</td>
<td>82%</td>
<td>24.3 (22.1-26.0)μm</td>
<td>10.1 (9.1-11.0) x 7.8 (7.8-8.4)μm</td>
<td>Present study</td>
</tr>
</tbody>
</table>

Table 2. Comparison of G. cruciata dimensions obtained from two different studies.
which were disposed in a characteristic cross-shaped form and each sporocyst measured 10.1(9.1-11.0) x 7.8(7.8-8.4) µm (Table 2 and Fig. 1). Every sporocyst contained two worm-shaped sporozoites. The sporocyst envelope comprised two valves separated by a longitudinal suture line.

Discussion

This work represents an initial study of fish parasites in the Mediterranean coasts of Northern Morocco. The rarity of parasites detected in fish sample needs further studies to confirm this is the norm within this zone of study. The period of sampling and the number of examined fishes must be extended to improve parasite research. Two of the three detected parasites, a nematode and Kudoa sp could not be studied for their low prevalence. In contrast, the third parasite G. cruciata which is the principal hepatic parasite infecting the horse mackerel T. trachurus manifested a relatively large presence in the region. Thus, we decided to study this parasite in a first attempt to examine a fish coccidian in the Mediterranean coasts of Northern Morocco. A study of G. cruciata in the North Aegean Sea (Kalfa-Papaioannou and Athanassopoulou-Raptopoulou, 1984) examined the pathological effects of the parasite on its fish hosts, whereas in another study (Daoudi, 1987) in Yugoslavia and Banyuls sur Mer, France, a detailed description of the parasite was given. To identify G. cruciata in the locality of the present study, we compared the results of our description with those of Daoudi (Table 2). But according to our description, the similarities between G. cruciata and G. clupearum (Daoudi, 1987) are very striking. Nevertheless, two main details can help to distinguish between the two species. One of these details is the arrangement of the four sporocysts in the parasitic oocyst. G. cruciata sporocysts have a cross-shaped disposition (see results), whereas for G. clupearum the sporocysts are arranged in a random way without any precise order. The other distinctive detail is the parasite host specificity: G. cruciata is reported as a hepatic parasite infecting only two fish species of the genus Trachurus, T. trachurus and T. mediterraneus. In contrast, G. clupearum, infests 12 known hosts belonging to different genera other than the genus Trachurus which provides is host to G. cruciata.

As it appears in our results, the above mentioned Daoudi’s description confirms that the parasite which we had examined in the Mediterranean coasts of Morocco is certainly G. cruciata. But our measurements showed that the dimensions of the parasite as well as its prevalence were expressed in higher values in comparison with the same parameters which were reported in the previous work (Table 2) (Daoudi, 1987). Daoudi reported a
prevalence of 38.5%, whereas in the present study the prevalence reached 82%. A difference of size between oocysts belonging to the same species of coccidians can be due to various factors including the freshness of the samples: the fresher the biological material, the more the oocysts are likely to conserve their characteristic size (Costa et al., 1991). The observed difference in the prevalence could be statistically insignificant, as it can be a consequence of artefacts introduced during sampling. The number of hosts, their age and, perhaps, their sex should be proportional between the two studies in order to allow an interpretative comparison. Alvarez-Pellitero and Gonzalez-Lanza (1986) showed a clear increase in the prevalence of *Eimeria baueri* in parallel with the age of fish hosts, and Fournie and Solangi (1980) reported that the prevalence of *E. funduli* was slightly, but constantly, higher in male fish of the host species *Fundulus grandis* in comparison with the value calculated in female fish. The prevalence as well as the parasitary burden can be affected by the season in which a study is carried out (Blanc et al., 1986). For these reasons there are insufficient data presented here to compare the differences observed between our results and those of the previous study. However, the present data are sufficient to support the presence of *G. cruciata* in the Mediterranean coasts of Northern Morocco and these data enlarge considerably the hitherto known area where this parasite has been reported.

It is worth mentioning that when the nematode *Anguillicola crassus* had enlarged its area of repartition enough to reach the European waters, this parasite became very pathogenic towards the European eel *Anguilla anguilla*, whereas in Japan from where the nematode originates it does not cause any pathological effects on its habitual host *Anguilla japonica* (Van Banning and Haenen, 1990). Thus, it would be interesting to verify whether in a given locality *G. cruciata* can recruit new hosts other than *T. trachurus* or becomes more or less pathogenic toward the latter.

Environmental factors are likely to have an influence on the evolution of any host-parasite system, and above all these factors may undergo deep changes along the numerous localities of the large area where the presence of the parasite has been already confirmed. Therefore, supplementary data related to the subject are needed to determine if a variation of one or several environmental factors between different localities of study can have an impact on the interaction between *G. cruciata* and *T. trachurus*. In this context, basic information on the population dynamics of the parasite, such as those presented here, and on its own potential pathological effects on the host tissues will be of a great importance.

References


