Impact of Perkinsus sp. on Manila clam Ruditapes philippinarum beds

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ABSTRACT—Three million Manila clams (Ruditapes philippinarum, Adams & Reeve 1850) were sown in 3 sets: A, B and P (0.65, 0.66 and 0.79 g per clam respectively) in intertidal beds of the Eo estuary (Asturias, N Spain). In January 1994 Perkinsus sp. was detected in set P. Growth, survival and prevalence of Perkinsus sp. were periodically examined during a 2 yr period. Clam growth and survival were unaffected by the parasites in all sets, probably due to the low prevalence of Perkinsus sp. (which ranged from 2 to 9%). This low prevalence, in turn, may have been due to the fact that water temperature remained below 20°C. We suggest that, in most cases, clam mortality associated with Perkinsus sp. may be minimized with adequate management of clam beds. The disease could be controlled if stressful growing conditions such as high densities, harvesting, or overcrowding in depuration plants are avoided during the warmer months. Additionally, we recommend 2 prophylactic measures: the removal of sets with parasitized clams and the introduction of unparasitized seed in clam culture areas.

KEY WORDS: Perkinsus sp. · Ruditapes philippinarum · Manila clam · Management · Eo estuary

INTRODUCTION

Parasitic protozoa of the genus Perkinsus (Apicomplexa, Perkinsea) are common in molluscs. Perkins (1993) reported Perkinsus spp. in 63 species of bivalves which ranged from temperate to tropical waters. Perkinsus spp. have historically been associated with high mortalities in cultured species, including Crassostrea virginica in the USA (Andrews & Hewatt 1957), Tridacna gigas in Australia (Goggin & Lester 1987), and Ruditapes decussatus in Portugal (Ruano & Cachola 1986) and Italy (Da Ros & Canzonier 1985). In Spain the disease was first detected in R. decussatus in 1985 (González et al. 1987), and later in both R. philippinarum and R. decussatus (Villalba & Navas 1988, Figueras et al. 1992).

Since the introduction of the Manila clam Ruditapes philippinarum in France (1972), England and Spain (1980) and in Italy (1982) (Breber 1985, Flasch & Leborgne 1992), its culture has been widely developed in European waters. At present, Perkinsus sp. is not included in the legislation of the European Union as a ‘pathogen of obligatory declaration’ (93/54/EU), and therefore transplantations of Manila clams throughout European countries have resulted in the introduction of Perkinsus sp. to most clam culture areas.

The presence of Perkinsus sp. could endanger both cultured clams and clams harvested in natural beds. However, the effects of parasites on clam populations are not well known. In this study, the relationship of Perkinsus sp. to growth and survival of Manila clam beds was examined over a 2 yr period.

MATERIALS AND METHODS

In June 1993, 3 sets, A, B and P, of 1 million clams each, of Manila clam spat (0.65, 0.66 and 0.79 g per clam respectively) from 3 different hatcheries were planted in intertidal beds of CULTIMAR S.A. in the Eo estuary (N Spain) (Fig. 1). The sets were planted in sand-gravel beds and covered with plastic netting (6 mm mesh size) at densities of approximately 260 clams m⁻².
RESULTS

Initial and final weights, survival of Manila clams and prevalence of Perkinsus sp. in sets A, B and P are shown in Table 1. The growth rates of unparasitized clams in sets A and B were similar to the growth rates of clams in set P, which were infected with the parasite (Fig. 3). Similarly, no significant differences ($p > 0.2$) were found in clam survival among sets (Fig. 4) at the end of the culture (summer 1995), indicating that there were no effects due to the parasite at the prevalences observed. As a prophylactic measure, a large number of parasitized clams (set P) were harvested in October–November 1994, and during this period a moderate mortality increase (14%) was observed (Fig. 4). All sets were harvested totally during summer 1995.

Water temperature in the Eo estuary (Fig. 2) varied from 12°C in December 1992 to 20°C in September 1994, always below the 25°C optimum for Perkinsus sp. (Vigario & Ruano 1992).

DISCUSSION

During the 27 mo of our experiment, both growth and survival of Manila clams showed similar patterns in sets A, B and P. As usual, commercial clams (13 to 16 g per clam) were harvested after 2 yr of culture (Fig. 3), which indicates that clam growth was not affected by Perkinsus sp. at the prevalences observed during this study (never greater than 9%) (Fig. 4). Moreover, survival was similar in the 3 sets and only a moderate increase in mortality was observed following partial harvesting in set P (October–November 1994).

![Fig. 1. Eo estuary. Culture took place in La Linera inlet](image)

![Fig. 2. Temperature (°C) and salinity (‰) of Eo estuary](image)
Table 1. Survival (S), weight (W) and prevalence of Perkinsus sp. (P) in Manila clam sets. Numbers represent the mean value (± 1 SD) in percentage (survival, prevalence) and grams (weight) during the period June 1993—August 1995.

<table>
<thead>
<tr>
<th>Set</th>
<th>S_initial</th>
<th>S_final</th>
<th>W_initial</th>
<th>W_final</th>
<th>P_initial</th>
<th>P_final</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>100</td>
<td>53.8 (8.4)</td>
<td>0.65 (0.11)</td>
<td>14.1 (3.06)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>B</td>
<td>100</td>
<td>55.6 (12.6)</td>
<td>0.96 (0.25)</td>
<td>13.3 (2.51)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>P</td>
<td>100</td>
<td>53.4 (9.4)</td>
<td>0.79 (0.19)</td>
<td>15.5 (3.33)</td>
<td>7</td>
<td>7</td>
</tr>
</tbody>
</table>

Possibly, this mortality was due to harvesting, a phenomenon which has frequently been observed by the shellfish industry. Since the parasite was not observed in clams from set A or B, prevailing conditions of temperature, salinity and density (always below 2 kg m⁻²) during this experiment may have prevented successful transmission of the parasite to the closest clams in set A or B in the Eo estuary. Furthermore, Perkinsus sp. was not found in the natural populations of Ruditapes decussatus in the Eo estuary (C. Rodriguez unpubl. data). Apparently the source of Perkinsus sp. infections in the clams in set P was the hatchery stock from which they were derived, since other clams from the hatchery were found to be parasitized by the parasite as well (September 1994).

In contrast to other reports, Perkinsus sp. prevalence and clam mortality in our study showed no significant increases during high summer temperatures despite the fact that Perkinsus sp. is more active then. Vigario & Ruano (1992) demonstrated that infection and development of Perkinsus sp. in Ruditapes decussatus are favoured by water temperatures near 25°C, and temperatures below 15°C prevent parasite reproduction. Santmarti et al. (1995) reported variable mortalities (10 to 90%) of Manila clams during summer 1990 in the Ebro Delta (Spain) associated with high prevalences of Perkinsus sp. (83 to 100%).

Clam mortality attributed to Perkinsus sp. is usually associated with stress due to environmental factors (e.g. high temperature, since 25°C is the upper thermal threshold of Ruditapes philippinarum; Bernard 1983) and/or inadequate culture management (e.g. high clam densities). Although the lethality of Perkinsus sp. is clear (Villalba et al. 1993), disease develops only under optimal conditions. For example, F. Ruano (pers. comm.) in Portugal observed high prevalences of Perkinsus sp. in R. decussatus and high mortalities in dense beds (8 kg m⁻²) when temperatures reached 25°C. Stress due to high temperatures and crowding facilitated the development of disease. Furthermore, high losses of clams were attributed to Perkinsus sp. in a Spanish clam depuration plant, while no mortalities were detected in natural beds with low parasite prevalences (Figuera et al. 1992). This difference in mortality may be explained by the lower prevalence of the parasite in natural beds and the lack of stressors such as the process of harvesting or/and holding in the plant. Similarly, McLaughlin & Farley (1995) suggested that Mya arenaria mortality due to Perkinsus sp. may occur when clams are heavily infected and/or stressed by other diseases and environmental factors.
Since temperature appears to be the main environmental factor in mortalities associated with *Perkinsus* sp., management techniques may be developed for 2 types of culture zones, according to temperature. Firstly, in areas where summer temperatures are below 20°C, the disease could be controlled if stressful growing conditions such as high densities, harvesting, and overcrowding in depuration plants are avoided. Secondly, in areas where maximum temperatures are near 25°C, the best technique, besides the above-mentioned precautions, would be to harvest all of the clam population before the temperature reaches 25°C and very heavy *Perkinsus* sp. pressure registered. In both zones we recommended 2 prophylactic measures: the total harvesting of sets with parasited clams and the introduction of unparasitized seed in the culture areas.

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**LITERATURE CITED**


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