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Original article

The influence of white seabream (*Diplodus sargus*) production on macrobenthic colonization patterns

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ABSTRACT

The present work evaluates the influence of fish production on macrobenthic colonization over large areas (approximately 700 m^2), where the colonizing populations are not nearby the disturbed area. Sampling was undertaken within newly created aquaculture earthen ponds under two contrasting conditions: white seabream (*Diplodus sargus*) production and no production (control). Macrobenthic and geochemical samples were collected 7, 23, 54, 93 and 180 days after filling the earthen ponds with seawater pumped from a water reservoir for the first time. The water reservoir was also sampled, and is used as a reference for the colonizing populations. Macrobenthic colonization rate in the ponds was low, probably due to the isolation of the disturbed habitat, to the large size of the defaunated area, and possibly to geochemical constraints. Initial colonization was by insect larvae (mainly chironomids), the bivalves *Cerastoderma* spp., the polychaetes *Pseudopolydora paucibranchiata* and *Hydrodoides elegans*, and nemerteneans. The number of species was similar in control and production ponds, even though under production higher total abundance values were observed. Although well represented in the water reservoir, the amphipod *Microdeutopus gryllotalpa* was only observed within the new ponds after 6 months. Preliminary results suggest that macrobenthic colonization patterns were influenced by fish production, as assemblages were significantly different among ponds. Higher food availability due to fish production may explain the results obtained, but ecological reasons, such as predation, may also contribute for shaping the macrobenthic communities.

1. Introduction

Aquaculture is a traditional activity in Portugal, practiced either within specific aquaculture ponds or saltpan reservoirs. Due to economic constraints, saltpans have progressively been abandoned or converted into aquaculture farms or rice production areas (Amaral and Costa, 1999). Nowadays, more than 95% of the marine fish farming is undertaken within

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earthen ponds under semi-intensive conditions. However, to set up an aquaculture farm from an old saltpan it is often necessary the excavation of the crystallization tanks, changing the geochemical characteristics of the substrata. In the newly created fish farm from the Portuguese Institute for Fisheries Research (IPIMAR) crystallization tanks were excavated in order to increase depth by 20–30 cm.

Recruitment has long been recognised as one of the key ecological processes shaping the distribution patterns and abundances of many organisms (Connell, 1985; Menge, 1991). Recruits may arrive into disturbed areas by one of several ways: settlement of pelagic larvae from the water column; reproduction within the area by species with benthic development; or immigration of benthic juveniles and adults from surrounding sediments (Levin, 1984). The immigration of infaunal benthos may occur either by crawling over or through the sediment or by leaving the sediment to swim or drift through the water column (Santos and Simon, 1980). Therefore, active dispersers are more likely to find suitable sites for colonization and should be more widespread than passive dispersers (Rundle et al., 2002).

Soft bottom macrobenthic colonization and succession patterns have been extensively analysed. Nevertheless, information on this subject plays a crucial role in documenting impacts and assessing ecological responses to human-induced disturbance (Zajac et al., 1998). Most studies have been focused on spatial and temporal changes of benthic communities in relation to organic enrichment (Pearson and Rosenberg, 1978; Tsutsumi et al., 1991; Morris and Keough, 2003), oxygen conditions (Santos and Simon, 1980; Diaz-Castañeda and Safran, 1988; Rosenberg et al., 2002), crude oil (Gray, 1982; Berge, 1990), and dredging operations (see review by Newell et al., 1998).

To date, most studies of infaunal colonization have, however, focused on small-scale disturbance (see review by Hall, 1994), particularly where the colonizing population is in the vicinity of the defaunated area. The aim of the present work is the analysis of the influence of fish production on macrobenthic colonization of large areas (newly created earthen production ponds) where the source of colonizing populations is not in the proximity of the disturbed area.

2. Study area and methods

The study was conducted at the Olhão Fish Culture Experimental Station located in the Ria Formosa lagoon (Fig. 1). Sampling was performed under two contrasting conditions, a pond with white seabream (*Diplodus sargus*) production and a pond with no production (control). The ponds have a surface area of $\sim$700 m^2 and a water depth of 1.5 m. In both ponds, the daily water turnover rate varied between 20% and 40%, depending on water temperature and fish biomass. Fish from the production pond were fed for 15 minutes with dry pellets every hour, between the sunrise and sunset, using an automatic feeder. In opposition no food was added to the control pond. During the period of construction the ponds were left without water in order to avoid the existence of animal life before the beginning of the experiments. Within each pond, the water entrance is located at one end of the pond and the water exit and the automatic feeder are positioned at the opposite end. All ponds are filled with seawater pumped from a water reservoir, a main tank that receives water directly from the lagoon during spring tides. This tank was also sampled and served as a reference for the species available for pond colonization. Samples were taken at 7, 23, 54, 93 and 180 days after the ponds were filled with water for the first time (26th May, 2003). The water reservoir, however, had already been filled for six months. Between the two first sampling surveys 3000 fish (weight: 9.0 ± 3.0 g; total length: 7.6 ± 1.3 cm) were introduced in the production pond. Within each sampling period, three sites were chosen randomly and three macrofaunal samples were collected using a corer of 20 cm depth (0.02 m^2 per site). Water quality parameters (water temperature and dissolved oxygen) from all ponds were measured in mid-water column once a week in the morning using a probe YSI, model 55.

The macrofaunal samples were washed through a 0.5 mm square mesh sieve, and the retained material was preserved in 4% buffered formalin stained with Rose Bengal. In the laboratory, animals were sorted into major taxonomic groups, identified to the lowest practical taxonomic level and counted.

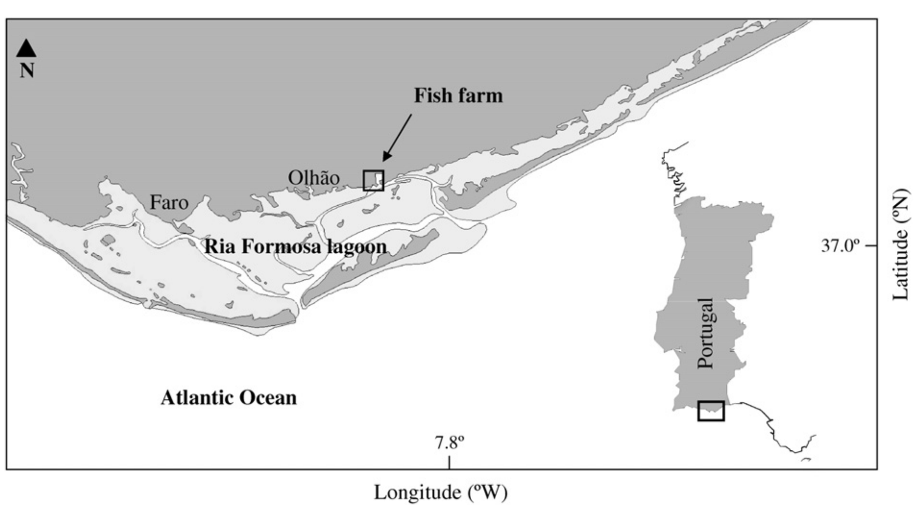

Fig. 1 – Ria Formosa lagoon. Location of the study area.