The effects of a marine fish-farm on the species richness and abundance of molluscs, decapods and echinodermes associated with a Posidonia oceanica meadow in Malta (Central Mediterr...
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THE EFFECTS OF A MARINE FISH-FARM ON THE SPECIES RICHNESS AND
ABUNDANCE OF MOLLUSCS, DECAPODS AND ECHINODERMS ASSOCIATED WITH A
POSIDONIA OCEANICA MEADOW IN MALTA (CENTRAL MEDITERRANEAN).

Abstract

The composition of the echinoderm, mollusc and decapod assemblages
associated with a Posidonia oceanica meadow located close to a fish-
farm-varied with distance from the cages. Three ecological zones were
identified. The intermediate zone II (40-160m from the cages) had a
higher species richness and abundance than either zones I (nearest the
cages) and III (320m from the cages), probably due to the higher
production resulting from a moderate level of nutrient enrichment at
intermediate distances from the source of pollution.

Key-words: Fish-farms, Invertebrates, Mediterranean, Posidonia
oceanica, Pollution.

Introduction

Fish-farming generates considerable waste organic matter in the form
of uneaten food and faecal pellets. In sheltered localities, most of
this waste settles below and in the vicinity of the cages (Hevia et
al., 1996) where it can have a profound influence on the structure of
the benthic communities originally present (Johannessen et al., 1994).
Although the diversity of macroinvertebrates below the cages usually
decreases (Brown et al., 1987), species richness and biomass further
away from the cages may increase due to the enhanced food supply
(Brown et al., 1987; ).

In the Mediterranean, aquaculture has developed mainly in lagoons and
sheltered embayments. Such localities often support extensive meadows
of the endemic seagrass Posidonia oceanica (L.) Delile above which the
fish-farm cages are frequently located. Despite the increase of
aquaculture in the Mediterranean (Mendez et al., 1997) and the
ecological importance of P. oceanica meadows (Mazzella et al., 1992),
studies of the impact of fish-farms on this community type are
lacking.

The present work studies the effects of organic waste generated by
fish-farm cages on the species richness and abundance of molluscs,
decapods and echinoderms associated with a Posidonia oceanica meadow
in a Maltese embayment.

Material and Methods

The study area was located in St Paul’s Bay on the northwestern coast
of the island of Malta (Central Mediterranean) (Fig 1), where a fish-
farm has been producing Sparus aurata since 1991. The marine unit
consists of eight cages and is located above Posidonia oceanica
meadows in waters 12–16 m deep. No P. oceanica is now present directly
below the cages, however, a meadow of this seagrass starts 10m from
the periphery of the cages.
Three replicate samples per station were collected by SCUBA diving using a corer (internal diameter 35 cms, length 50 cms) to which a 0.5 mm mesh net was attached. During sample collection, the corer was pushed over *P. oceanica* leaves and into the matte down to a depth of c. 10 cms. All the sampling stations were located at the same depth (12m) but at increasing distances from the cages as follows: 10m, 30m, 50m, 90m, 170m, 330m (Fig 1). Samples were collected during August 1998. In the laboratory, the samples were passed through a 0.5mm mesh sieve and the retained fauna were sorted, identified and counted. 

Sediment from a single sample collected from each station using a small PVC corer (internal diameter 10cm, length 10cm) was analysed for grain size and organic content (Walkley & Black titration method) according to the procedures in Buchanan (1984).

The macrofaunal abundance data were analysed by non-metric multidimensional scaling after double square-root transformation and calculation of the Bray-Curtis similarity measure (Clarke and Warwick, 1994). Analysis of similarities (ANOSIM) was used to test for any differences in faunal composition between stations (Clarke and Warwick, 1994).

**Results**

The sediment at all six stations was predominantly sandy, however, the gravel fraction was relatively low in the two stations closest to the farm and was highest in station F (Table 1). The percent organic carbon in the sediment showed an overall decrease with distance from the cages, except for station E where it was anomalously high (Table 1).

**Table 1. Relative abundance of gravel, sand and mud (silt + clay) and the percent organic carbon (as determined by the Walkley & Black method) for each of the six stations.**

<table>
<thead>
<tr>
<th>Station</th>
<th>Distance (m)</th>
<th>Gravel (%)</th>
<th>Sand (%)</th>
<th>Silt &amp; Clay (%)</th>
<th>Organic carbon (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>10</td>
<td>0.97</td>
<td>82.21</td>
<td>16.82</td>
<td>2.30</td>
</tr>
<tr>
<td>B</td>
<td>30</td>
<td>0.80</td>
<td>85.58</td>
<td>13.62</td>
<td>1.60</td>
</tr>
<tr>
<td>C</td>
<td>50</td>
<td>2.19</td>
<td>83.20</td>
<td>14.62</td>
<td>1.58</td>
</tr>
<tr>
<td>D</td>
<td>90</td>
<td>2.04</td>
<td>84.08</td>
<td>13.88</td>
<td>1.54</td>
</tr>
<tr>
<td>E</td>
<td>170</td>
<td>1.52</td>
<td>82.18</td>
<td>16.30</td>
<td>2.56</td>
</tr>
<tr>
<td>F</td>
<td>330</td>
<td>3.61</td>
<td>88.21</td>
<td>8.18</td>
<td>0.57</td>
</tr>
</tbody>
</table>

Macrofaunal abundance (Fig 2a) and species richness (Fig 2b) reached a peak value 90m from the cages.
The observed zonation is similar to that described by Brown et al., (1987) for the distribution of macrobenthos near a fish-farm in a Scottish sea loch. These authors found four distinct zones: (i) an azoic zone under the cages; (ii) a highly enriched zone from the edge
to ~8m; (iii) a slightly enriched “transitional” zone at <25m; and (iv) a clean zone at distance >25m.

Our study shows that in Maltese coastal waters, waste generated by fish cages influences the composition of the macrobenthic invertebrate assemblages present below and in the vicinity of the cages and results in distinct ecological zones that differ in species richness and abundance. The width of these zones is expected to vary with amount of waste generated, current regime and depth.

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**Bibliography**


