DECLINE OF THE POSIDONIA OCEANICA SEAGRASS MEADOW AT ITS LOWER LIMIT IN A PRISTINE MEDITERRANEAN LOCALITY
P. Bonhomme 1, D. Bonhomme 1, C. F. Boudouresque 1, G. Cadiou 1, E. Charbonnel 3 and S. Ruitton 2
1 Centre d'océanologie de Marseille, Université de la Méditerranée - charles.boudouresque@univmed.fr
2 GIS posidonie, Université de la Méditerranée
3 Parc marin de la Côte Bleue

Abstract
The lower limit (31-34 m deep) of the Posidonia oceanica meadow was monitored (2002 through 2008) at Port-Cros Island (Provence, France, Mediterranean Sea), a national park where the biota and communities are considered to be in pristine condition. Both shoot density and cover conspicuously declined at the seagrass limit.

Keywords: Posidonia, Monitoring, Phanerogams, Temperature

Introduction
Posidonia oceanica seagrass meadows are utilized as a biological indicator which allows an overall assessment of the quality of the marine environment and an evaluation of the efficiency of management policies. Within the Port-Cros Island national park (Provence, France, Mediterranean), biota and communities are considered to be in pristine condition. As a result, the P. oceanica lower limit is expected to be stable, in contrast with many other Mediterranean localities [1].

Material and Methods
Two sets of 10 cement markers were laid down at the lower limit of the P. oceanica meadow, i.e. at the boundary between the meadow and the dead matte or the coastal detritic community (sand) which extends downwards and offshore. The first monitoring site is localized near La Palud Cove (34 m deep), on the northern coast of Port-Cros Island. The second one is localized on the southeastern coast, between Pointe du Vaisseau and Pointe du Tuf (31-34 m deep). They were established in fall 2002 and 2006 respectively, and then monitored in fall 2005 and 2008. The P. oceanica shoot density was measured in the vicinity of each marker by means of a 20 cm x 20 cm frame randomly placed (three replicates). Shoots were counted within the frame. The cover is the mean percentage of substrate covered by the P. oceanica meadow (whatever the shoot density within the meadow or within patches of P. oceanica); cover was measured according to the method described by Boudouresque et al. [2].

Results and Discussion
The mean shoot density of the Posidonia oceanica meadow declined from 123 to 48 shoots/m² between 2002 and 2008 at La Palud (Wilcoxon signed-rank test, p = 0.005; Table 1), at a mean annual rate of reduction of 14%. The bottom cover declined at an annual rate of 7% at La Palud (2002-2008; p = 0.03; Table 2) and 20% at Vaisseau-Tuf (2006-2008; p = 0.01; Table 2). According to Pergent et al. (1995) these values fall within the range of “normal densities” for a pristine meadow at the depths considered (61-285 shoots/m² at 31 m depth, 38-262 at 34 m).

The decline of shoot density constitutes a harbinger for the withdrawal of the seagrass meadow limit [3]. The steady retreat of most deep P. oceanica limits in the northwestern Mediterranean [3], including those of meadows in supposedly pristine localities, is a worrying feature, the cause of which is unclear.

References

Tab. 1. Change over time of shoot density (mean number of shoots per m²) of the P. oceanica meadow.

<table>
<thead>
<tr>
<th>Year</th>
<th>Shoot density near markers LP1-LP10, La Palud Cove</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>75 150 150 150 150 63 175 175 175 175 123</td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>42 92 104 67 42 40 115 115 67 83 76</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>58 58 117 8 32 17 58 32 32 58 48</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shoot density near markers VT1-VT10, Vaisseau-Tuf'de</td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>67 138 63 63 230 133 67 117 92 108 106</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>67 138 92 67 125 142 67 125 108 133 103</td>
<td></td>
</tr>
</tbody>
</table>

Tab. 2. Change over time of bottom cover (%) of the P. oceanica meadow.

<table>
<thead>
<tr>
<th>Year</th>
<th>Cover near markers LP1-LP10, La Palud Cove</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>41 33 28 22 17 13 26 19 19 24 25%</td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>24 30 17 24 22 17 17 21 21 23%</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>14 19 17 19 17 19 22 26 26 17%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cover near markers VT1-VT10, Vaisseau-Tuf'de</td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>22 83 39 48 31 67 54 60 83 67 63%</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>19 39 26 33 43 44 41 37 30 28 34%</td>
<td></td>
</tr>
</tbody>
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