DECLINE OF THE *POSIDONIA OCEANICA* SEAGRASS MEADOW AT ITS LOWER LIMIT IN A PRISTINE MEDITERRANEAN LOCALITY

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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).

Tab. 1. Change over timeofshoot density (mean number of shoots per m^2) of the *P. oceanica* meadow.

Year	Shoot density near markers LP1-LP10. La Palud site										Mean
	LP1	LP2	LP3	LP4	LP5	LP6	LP7	LP8	LP9	LP10	
2002	75	100	150	150	108	83	175	150	117	108	123
2005	42	92	104	67	42	40	115	110	67	83	76
2008	58	58	117	8	33	17	58	33	58	42	48
	Shoot density near markers VT1-VT10. Vaisseau-Tuf site										
	VT1	VT2	VT3	VT4	VT5	VT6	VT7	VT8	VT9	VT10	
2006	67	108	83	83	200	133	67	117	92	108	106
2008	67	100	92	67	125	142	67	125	108	133	103

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

Year	Cover near markers LP1-LP10. La Palud site										Mean
	LP1	LP2	LP3	LP4	LP5	LP6	LP7	LP8	LP9	LP10	
2002	41	35	28	22	17	15	26	19	19	24	24%
2005	24	30	17	24	22	17	17	19	31	11	21%
2008	15	19	11	19	11	15	19	22	26	11	17%
	Cover near markers VT1-VT10. Vaisseau-Tuf site										
	VT1	VT2	VT3	VT4	VT5	VT6	VT7	VT8	VT9	VT10	
2006	22	83	39	48	31	57	54	80	63	57	53%
2008	19	39	26	33	43	44	41	37	30	28	34%

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
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