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Monitoring of *Posidonia oceanica* meadows in Telašćica Nature Park (Croatia)

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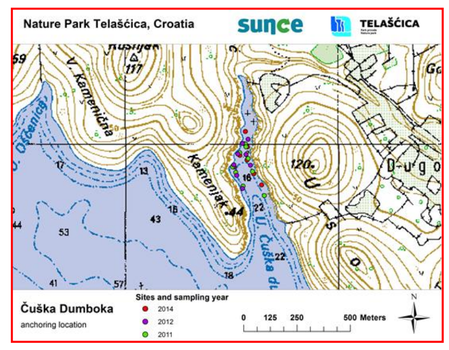
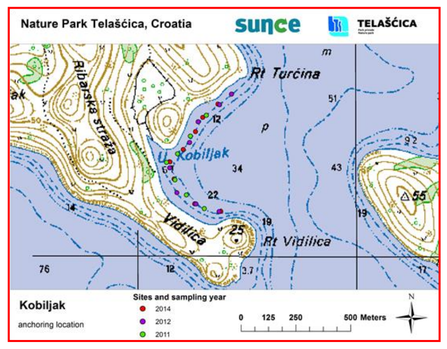
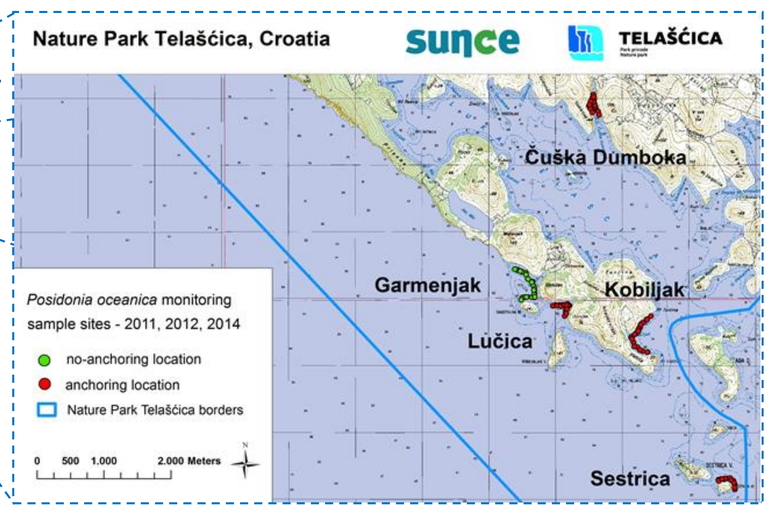
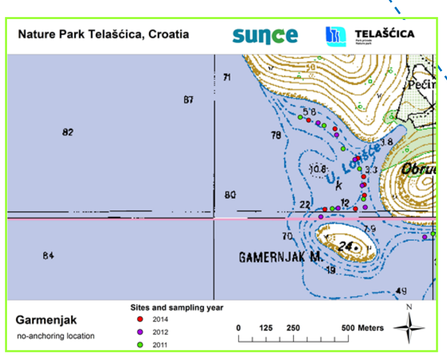
Introduction

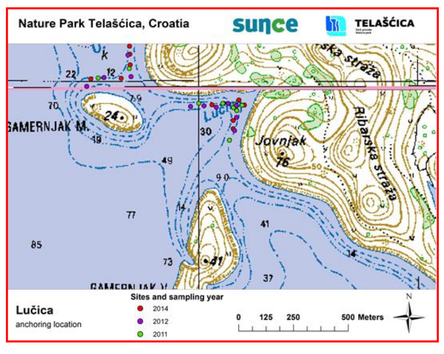
The Telašćica Nature Park (Croatia) has recently undertaken the monitoring of marine priority habitats in compliance with the management plan developed within the MedPAN South project. Assessment of health conditions of *Posidonia oceanica* meadows has been implemented in 2011, 2012 and 2014, in five locations with different conditions of anthropogenic pressure. The monitoring was mainly aimed to highlight any conditions of disturbance in locations highly frequented by recreational boaters.

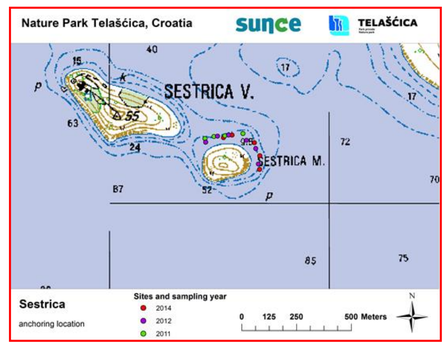












Methods

On the base an empirical assessment of boat frequentation, meadows were defined as “anchoring” (four locations - Čuška Dumboka, Kobiljak, Lučica, Sestrica - supposed to be subjected to high pressure of boat frequentation) or “no-anchoring” (one location - Garmenjak - where frequentation is considered negligible because it is not known as preferential boater’s destinations). Structural descriptors of the meadows (i.e. shoot density, % cover of *P. oceanica* and dead *matte*) were assessed in different sites at each location, by means of direct surveys in SCUBA diving.

Shoot Density SD

Classification of *Posidonia oceanica* meadows according to SD and depth (UNEP-RAC/SPA, 2011 modified)

depth (m)	High	Good	Moderate	Poor	Bad
1	> 1133	1133 to 930	930 to 727	727 to 524	< 524
2	> 1067	1067 to 863	863 to 659	659 to 456	< 456
3	> 1005	1005 to 808	808 to 612	612 to 415	< 415
4	> 947	947 to 757	757 to 567	567 to 377	< 377
5	> 892	892 to 709	709 to 526	526 to 343	< 343
6	> 841	841 to 665	665 to 489	489 to 312	< 312
7	> 792	792 to 623	623 to 454	454 to 284	< 284
8	> 746	746 to 584	584 to 421	421 to 259	< 259
9	> 703	703 to 547	547 to 391	391 to 235	< 235
10	> 662	662 to 513	513 to 364	364 to 214	< 214
11	> 624	624 to 481	481 to 338	338 to 195	< 195
12	> 588	588 to 451	451 to 314	314 to 177	< 177
13	> 554	554 to 423	423 to 292	292 to 161	< 161
14	> 522	522 to 397	397 to 272	272 to 147	< 147
15	> 492	492 to 372	372 to 253	253 to 134	< 134
16	> 463	463 to 349	349 to 236	236 to 122	< 122

Conservation Index **CI = P/(P+D)**

(Moreno et al., 2001; Montefalcone et al., 2006)

P = % live *P. oceanica* — CI = 0 minimum state of conservation
D = % dead *matte* — CI = 1 maximum state of conservation

For both SD and CI, and each location, the variation during the three years of monitoring was calculated as $(P_x-P_y)/P_x$

P_x = mean value (of both SD and CI) of first or the second survey
P_y = mean values of the following monitoring campaigns

Summary of sampling effort in the three monitoring campaigns

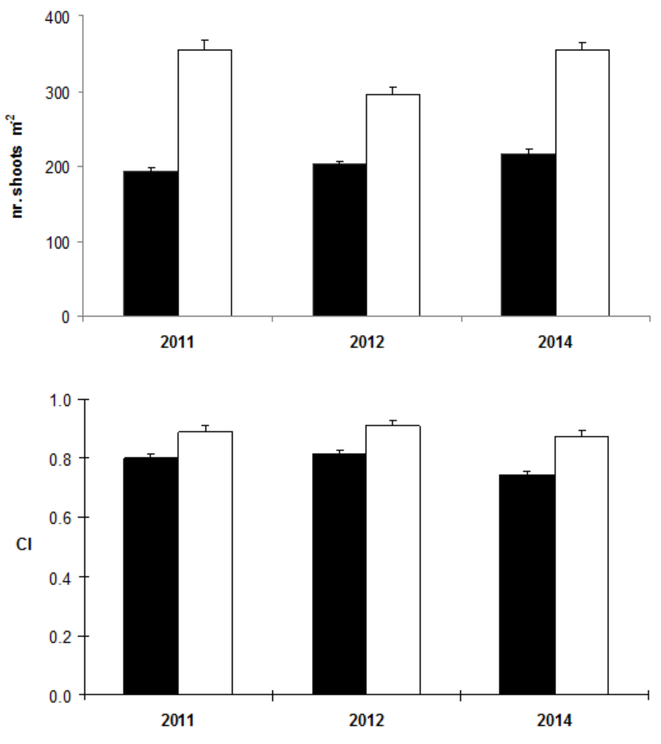
Locations	pressure	2011			2012			2014		
		sites	quadrats	LITs	sites	quadrats	LITs	sites	quadrats	LITs
Čuška Dumboka	anchoring	9	78	36	8	64	32	8	64	32
Kobiljak	anchoring	7	80	27	8	64	32	8	64	32
Lučica	anchoring	7	58	28	7	56	28	7	56	28
Sestrica	anchoring	4	35	16	6	48	24	6	48	24
Garmenjak	no-anchoring	6	52	23	7	56	28	8	64	32
		33	**303**	**130**	**36**	**288**	**144**	**37**	**296**	**148**

Results

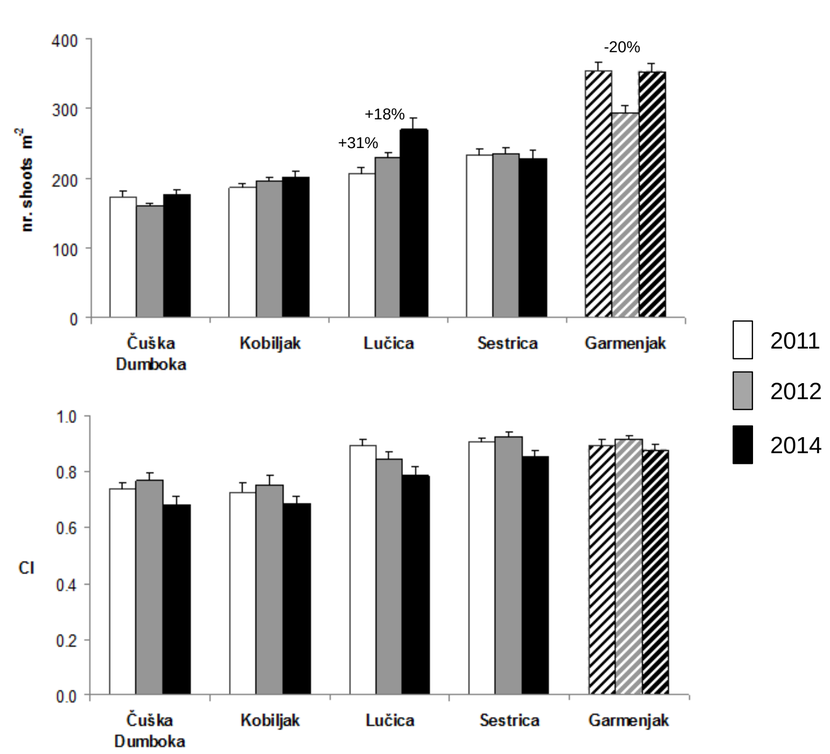
Overall, shoot density in "no-anchoring" sites had higher values than "anchoring" sites, from 31 to 45%, in the three years of investigations. Changes in Conservation Index were smaller, 10 to 15% higher in “no-anchoring” than "anchoring" sites. Among the “anchoring” locations, Čuška Dumboka and Kobiljak showed the lowest values of shoot density and Conservation Index (as a consequence of the highest abundance of dead matte), over the three years of monitoring.

Classification of *Posidonia oceanica* meadows at each location and for each times of monitoring according to the rating suggested by UNEP-RAC/SPA (2011)

Location	pressure	2011	2012	2014
Čuška Dumboka	anchoring	BAD	BAD	BAD
Kobiljak	anchoring	BAD	POOR	POOR
Lučica	anchoring	BAD	POOR	POOR
Sestrica	anchoring	POOR	POOR	POOR
Garmenjak	no anchoring	MODERATE	POOR	MODERATE



Mean values (+se) of SD (above) and CI (below) at each time for each pressure conditions



Mean values (+se) of the SD (above) and CI (below) at each location for each time. Solid and striped bars are anchoring and no-anchoring locations, respectively. % changes are indicated in the event of significant differences among times

Conclusions

Results indicate clear signs of deterioration in the locations supposed to be subjected to high pressure of anchoring.

The combined use of the two descriptors seems to be effective to get information on the conditions of the meadows and strengthens the a priori assumption that mechanical disturbance of anchors affects *P. oceanica* enhancing regression processes of the meadows.

The management authority is now implementing a series of actions to reduce human pressures and promote a more sustainable approach to nautical tourism. Monitoring of boat frequentation (number and size of boats, anchor type), is recommended to assess the effective pressure of anchoring and understand if the different conditions of meadows under pressure correspond to different level of disturbance or if other factors work along with the anchoring.

References

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