# Recent monitoring data of *Posidonia oceanica* meadows distributed along the Apulian coasts (Eastern- Central Mediterranean Sea) according to the 2000/60 EC Directive



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## Introduction

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*Posidonia oceanica* (L.) Delile is an endemic species of the Mediterranean Sea, widely recognized as key species in infralitoral habitats (Hemminga and Duarte, 2000). Caused by the increase in anthropogenic pressure on marine ecosystems and the associated water quality decline, the European Union has engaged a strategy, the Water Framework Directive (WFD), with the aim to preserve and recover the ecological quality of the marine environment. For this purpose, according to the WFD, a specific monitoring of *Posidonia oceanica* meadows was carried out along the Apulian coasts by the Regional Agency for the Environmental Prevention and Protection (ARPA Puglia).

### **Material and Methods**

A total of 17 sites, 11 in the Southern Adriatic Sea and 6 in the Northern Ionian Sea were investigated during two consecutive monitoring cycles (2009-2011 and 2012-2014) (Fig.1). Sampling procedures as well as laboratory analyses (phenology and lepidochronology) were carried out according to a common methodological protocol shared at Italian national level (D.M. 260/2010) for the final ecological classification (*sensu* WFD) using the PREI index (Box 1; Gobert *et al.*, 2009). In each *Posidonia* meadow, two sampling stations were investigated by scuba divers at the fixed depth of 15 m and in correspondence of the lower bathymetric distribution limit (Tab. 1). For each station, 9 shoots counting (40x40 cm square), 3 covering estimates (around 5 m of radius) and 18 shoots sampling were carried out.



SITE	STANDARD STATION	depth (m)	LOWER LIMIT STATION	depth (m)			
	(Coord. ° lat. N long. E - WGS84)		(Coord. ° lat. N long. E - WGS84)				
Trèmiti Islands	N42.11725 E15.49774	15	N42.11700 E15.49817	20			
Bari (Balice) *	N41.15258 E16.80531	10.5					
Bari (Trullo)*	N41.12670 E16.90391	10.5	n.p.				
Mola di Bari *	N41.06969 E17.09167	13					
Monopoli	N40.95770 E17.30872	15	N40.95946 E17.30963	18			
Forcatelle	N40.84731 E17.48616	15	N40.84962 E17.48929	18			
Villanova	N40.79709 E17.59126	15	N40.79825 E17.59264	18			
Torre Guaceto	N40.72706 E17.79389	15	N40.72656 E17.79683	18			
San Cataldo	N40.39811 E18.31799	15	N40.39967 E18.31885	22			
Cesine	N40.37215 E18.34770	15	N40.37326 E18.34999	17			
Foce Alimini	N40.20692 E18.47262	15	N40.20712 E18.47528	23			
Ugento	N39.87788 E18.11008	15	N39.87356 E18.10669	24			
S. Maria al Bagno	N40.11158 E18.00083	15	N40.11136 E17.99469	27			
Porto Cesareo	N40.20596 E17.90834	15	N40.20422 E17.89340	29			
Campomarino	N40.28711 E17.55322	15	N40.27922 E17.55606	24			
Gàndoli - Lido Silvana	N40.37599 E17.29647	15	N40.37363 E17.29277	25			
Chèradi Islands	N40.45008 E17.13319	15	N40.44750 E17.12653	18			
* n. p. : the sampling station is not planned as coinciding with the standard station							

San Cataldo



S. Maria al Bagn

Fig. 1 Distribution of the sampling sites of *Posidonia oceanica* along the coastline of the Puglia Region.

Box 1		Where	PREI range	CLASSIFICATION	
		where:	1 - 0.775	high	
		N density = meas. value-0/refer. value-0; (0 = worst value for the density).	0.774 - 0.550	good	
EQK = (EQK)	(1 + 0.11)/(1 + 0.10) = PKEI	$\mathbf{N}$ leaf surface area = meas, value-0/refer, value-0 $\mathbf{\cdot}$ (0 = worst value for the leaf surface area).		moderate	
		• It fear sufface and $-$ meas, value offerer, value of, ( $0 - 0$ of st value for the fear sufface area).		poor	
EOP' N density   N los	fourface area i N/E (I) i N lower limit	$(E/L) = [1 - (Epiphyte Biomass/Leaf Biomass)] \times 0.5.$	<0.1	bad	
EQR = IN defisitly + IN feat surface area + IN(E/L) + IN fower filling3.5		N lower limit = (N'-12)/(refer. value -12); (12 m = worst lower limit for <i>Posidonia</i> meadows); N'= depth of lower limit measured on the field + $\lambda$ , where $\lambda = 0$ (stable limit); $\lambda = 3$ (progressive limit); $\lambda = -3$ (regressive limit).		REFERENCE VALUE	
				599 shoots.m <sup>-2</sup>	
				310 cm <sup>2</sup> .shoot <sup>-1</sup>	
				0	
			Lower limit	38 m	

#### Result – Evaluation of Ecological Status from 2009 to 2014

In the first cycle of monitoring the values of the PREI Index varied from 0.295 (Mola di Bari) to 0.701 (S. Maria al Bagno). In the second cycle of monitoring (15 sites) the PREI Index ranged from 0.333 (Bari Balice) to 0.723 (Porto Cesareo) (Fig.2). The results showed that in the first cycle of monitoring (2009-2011) 29% of sites were classified "GOOD", were classified 59% as as "MODERATE" and the remaining 12% as "POOR" while in the second cycle (2012-2014) there is a general slight improvement of the classification (71% classified as "MODERATE", 29% as "GOOD") (Fig.3).

In the second monitoring cycle (2012-2014) the sites of Ugento and S. Maria al Bagno weren't sampled because the water bodies (*sensu* WFD) whose they belong to, were classified in a *Good* status in the first cycle (2009-2011).



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Fig. 2 PREI Index values estimated in the two monitoring cycles.

#### Result – Effect of water column transparency on PREI Index

Among the environmental factors that affect and limit the distribution and the ecological status of *Posidonia* oceanica, the transparency of water column is considerable and is related to the minimum light requirement of this seagrass (Dennison et al., 1993). Over the past hundred years, the reduction of water transparency was caused by human activities such as poor land and maritime management practices resulting into increased surface run-off, dredging operations, coastal urbanization and engineering, marine farming, etc (Ralph et al., 2007). Fig.4 shows the positive relation ( $R^2$  0.53, p=0.002) between mean water transparency and values of PREI Index for the second cycle of monitoring. Fig. 5 underlines that the reduction in water transparency could be related, other than to the natural oceanographic features different for the Adriatic and for the Ionian Sea (Barbone et al., 2014), to the population density, and consequently to an higher rate of human activities, of the coasts of Puglia Region.



Fig. 4 Relation between PREI Index (2012-2014) and water transparency

Fig. 5 Population density of coastal municipalities of Puglia. The numbers in the circles represent the position of sampling sites of *Posidonia* meadows (see Fig.4 for the names).

#### Conclusions

Although the ecological quality status of the Apulian *Posidonia oceanica* meadows (summarized by the PREI index values) reflects the distribution of anthropic pressures on the coast (harbours, industrial and urbanized areas, river's outlets) along a latitudinal gradient, the classification based on the rules (reference conditions and EQR boundaries for the PREI index) reported in the Italian law (D.M.

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