Pulse Amplitude Modulated (PAM) fluorometry to study *Posidonia oceanica* (L.) Delile, 1813 photosynthetic dynamics

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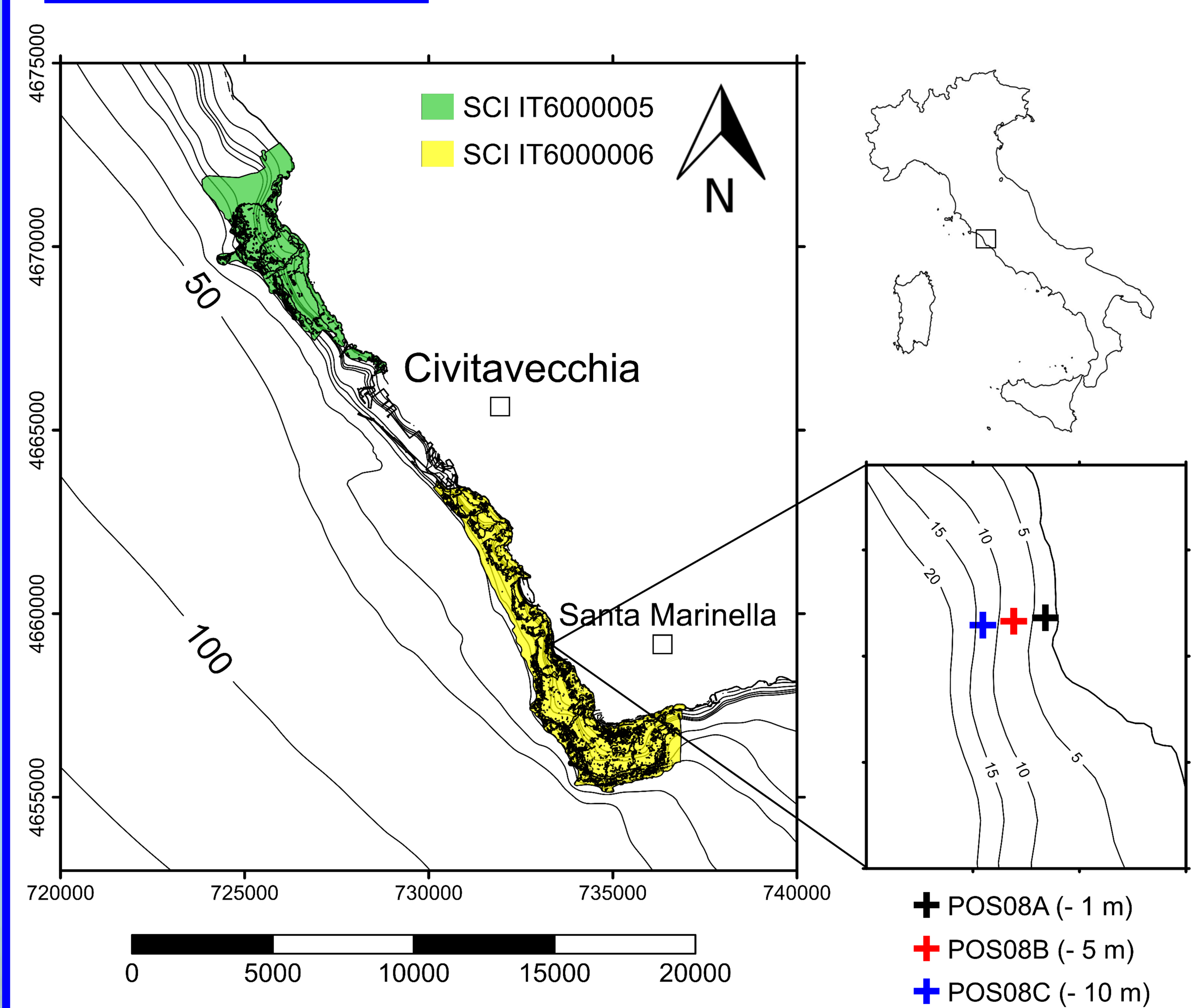
1. INTRODUCTION

Seagrass photosynthesis, and thereby, their productivity is directly regulated by underwater irradiance (Dennison et al., 1993). Numerous studies have shown that seagrass regression is also caused by reductions of underwater light, mainly due to the increase of turbidity as a consequence of anthropogenic activities.

In this context, Pulse Amplitude Modulated (PAM) fluorometry has recently been recognized as an efficient technique for the study of photosynthetic dynamics of marine plants. The emerging use of PAM fluorometry is linked to the possibility to carry out rapid, non-destructive and accurate *in situ* measures.

The aim of this study was to investigate the response of *Posidonia oceanica* to different light environments through fluorometric (Fv/Fm, Y(II), ETR) and photosynthetic (Pmax, α, β, Ek) parameters, as measured by PAM fluorometry.

2. STUDY AREA

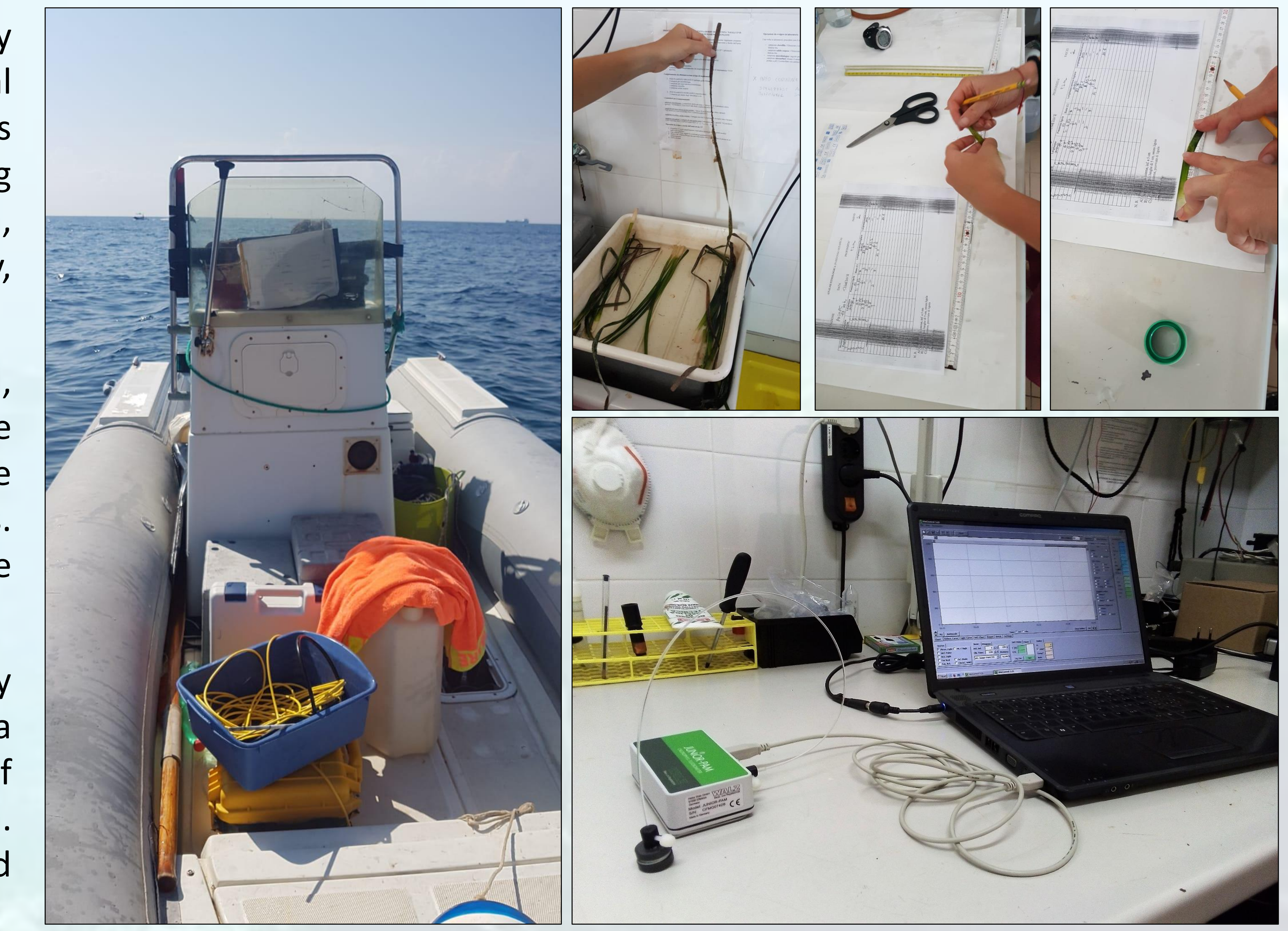


3. MATERIALS and METHODS

In June 2018 (POSI_PAM1), a first sampling survey was organized to develop an optimal operational protocol. In August 2018 (POSI_PAM2), operations were replicated and with the purpose of showing the plant response to daily light variation, samplings were repeated three times a day, respectively at 9:00, 12:00 and 15:00 UTC.

In each occasion, three shoots were collected and, after being acclimated to dark for 15 minutes, the first two intermediate leaves of each shoot were subjected to SAT Pulse and RLC Analysis. Morphometric analysis was realized to obtain the Leaf Area Index per shoot.

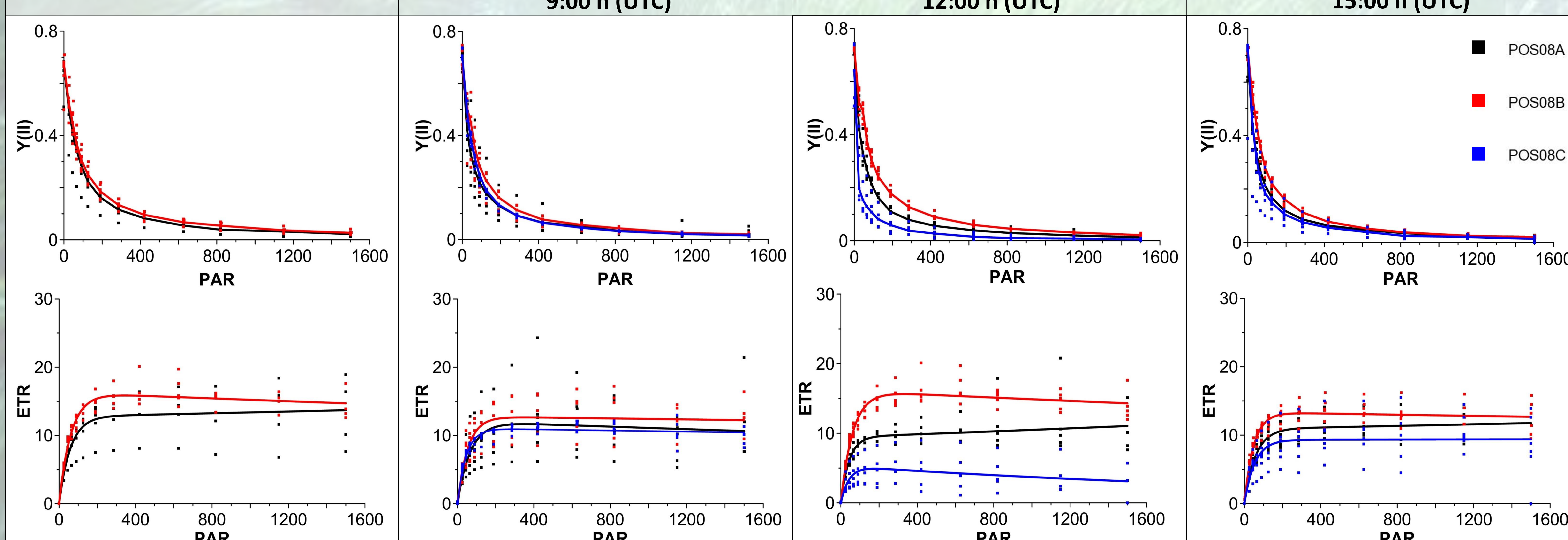
Besides the values of temperature and conductivity of water, aerial PAR was measured by a meteorological station, while a sensor of underwater PAR was positioned inside the patch. Statistical analysis of results concerned ANOVA and Kruskall-Wallis test.



4. RESULTS

Flurometric parameters

POSI_PAM1	POSI_PAM2		
	9:00 h (UTC)	12:00 h (UTC)	15:00 h (UTC)



Abbreviations: ETR, Electron transport rate (μmol electrons/(m^2 · s)); PAR, Photosynthetic active radiation (μmol photons · m^{-2} · s^{-1}); UTM, Coordinated universal time; Y(II), Photochemical quantum yield of photosystem II.

Photosynthetic parameters

Sampling survey	Time	Sampling station	Pmax	α	β	Ek	R^2
POSI_PAM1	11:00	POS08A	12.7	- 0.217	- 6.03 10^{-4}	58.8	0.717
	12:00	POS08B	15.8	0.253	1.29 10^{-3}	62.7	0.832
POSI_PAM2	9:00	POS08A	11.1	0.196	1.05 10^{-3}	56.7	0.543
		POS08B	12.8	0.234	3.85 10^{-4}	54.6	0.675
		POS08C	11.1	0.239	4.27 10^{-4}	46.1	0.916
	12:00	POS08A	9.47	0.221	-9.77 10^{-4}	42.8	0.673
		POS08B	16.2	0.257	1.29 10^{-3}	62.7	0.924
		POS08C	5.32	0.126	1.91 10^{-3}	42.1	0.292
	15:00	POS08A	10.9	0.187	-5.52 10^{-4}	58.2	0.806
		POS08B	13.3	0.271	4.54 10^{-4}	49.1	0.878
		POS08C	9.32	0.171	-4.45 10^{-4}	54.6	0.509

Leaf Area Index per shoot (cm^2)

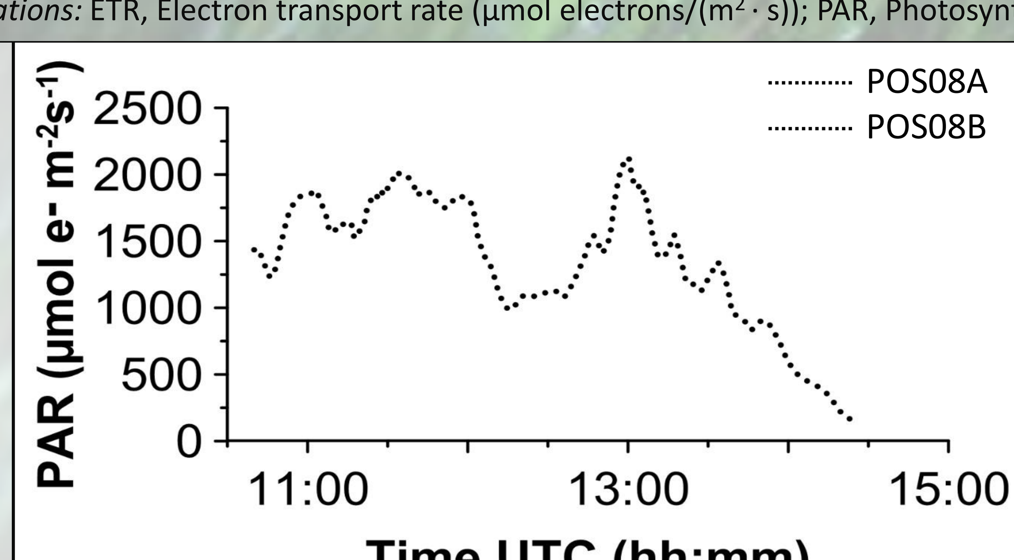
POSI_PAM1	POS08A	3.6
	POS08B	6.2
POSI_PAM2	POS08A	0.96
	POS08B	3.9
	POS08C	3.5

Fv/Fm

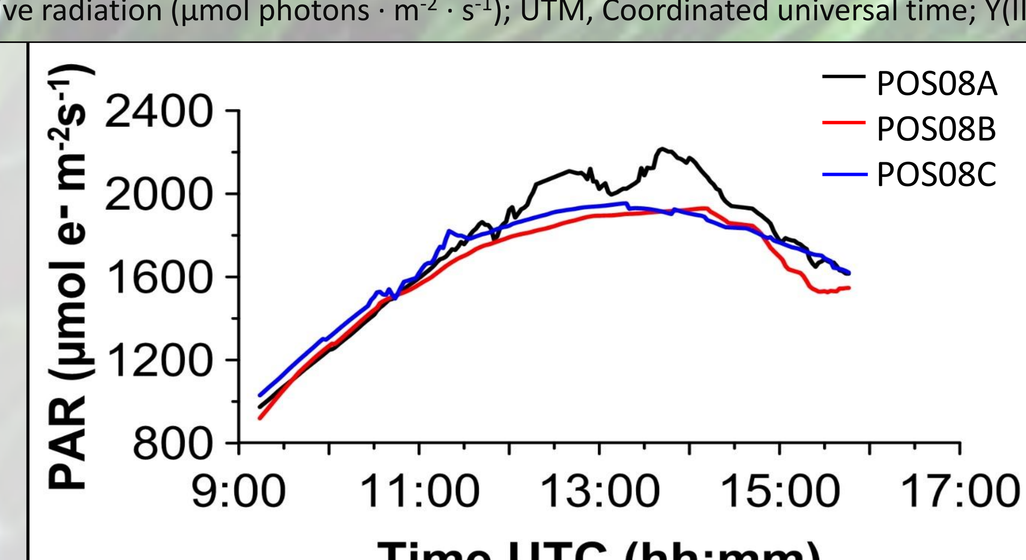
POSI_PAM1	POS08A	0.66
	POS08B	0.66
POSI_PAM2	POS08A	0.72
	POS08B	0.72
	POS08C	0.72

Abbreviations: Pmax, maximum electron transport rate (μmol electrons/(m2 · s); α, quantum efficiency of photosynthesis (electrons/photons); β, photoinhibition parameter; Ek, minimum saturating irradiance; Fv/Fm, maximum photochemical quantum yield of PSII.

POSI_PAM1



POSI_PAM2



5. CONCLUSIONS

Results from both surveys show that POS08B has the highest fluorometric and photosynthetic parameters. This suggests that those patches could have better photosynthetic efficiency and capacity of photoacclimation. This hypothesis is sustained by the Leaf Area Index per shoot obtained for POS08B, thus indicating that leaves have an adequate area for catching the light. We can deduce that plants at 5 meters depth find all necessary conditions to develop a better photosynthetic system than other stations, even if they present the same level of photoadaptation, as shown by the equal Fv/Fm results, obtained for all stations in both surveys.

6. REFERENCES

Dennison, W., Orth, R.J., Moore, K.A., Stevenson, J.C., (1993). *Assessing water quality with submersed Aquatic Vegetation.* Bioscience, Vol. 43,2: 86-94.

Platt, T., Gallegos, C.L., Harrison W.G., (1980). *Photoinhibition of photosynthesis in natural assemblages of marine phytoplankton.* Journal Marine Research, 38: 687-701.