EFFECTS OF *POSIDONIA OCEANICA* (L.) DELILE (1813) FLOWERING ON ELEMENTAL COMPONENTS AND ON TRACES ELEMENTS CONCENTRATIONS

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Abstract

Posidonia oceanica is a magniolophyte endemic to the Mediterranean Sea, in which flowering can vary depending on water temperature and nutrient concentration (C,N,P). Along corsican coast, in the Northwestern Mediterranean Sea, the flowering was unusual but in the last 20 years it flowered regularly. The aim of our study was to determine the effect of the frequency of flowering episode on the shoots by measuring the dynamics of elementary (C, N, P) and the trace element contents (TE) in different tissues (leaves, inflorescences and rhizomes) of flowering and non-flowering shoots. This study also focused on the biometry of these shoots.

Keywords: Posidonia, North-Western Mediterranean, Trace elements, Monitoring, Biometrics

Introduction

In *P.oceanica*, sexual reproduction is less frequent than asexual reproduction [1], even in comparison with other seagrass species. The flowering is not annual, that conduct to a low genetic diversity [2]. In 2003, an intense flowering event was recorded in the Mediterranean Sea with a high percentage of flowering (PF) and flowering intensity (FI) (PF = 0.86 and IF = 0.23 + -0.03 infl./stem [3,4]. This event coincides with the hottest summer recorded [5]. Since 2003, the flowering phenomena are more frequent in Revelatta Bay. The question that arise from these observations is to know what are finally the different consequences of this phenomenon on the morphology and the content (CNP and TE) of *P.oceanica* shoots.

Material and Method

Since 1975, in the Revelatta Bay, *P.oceanica* meadow is monitored [6,7]. From Nov. 2006, Oct. 2012 to Jan. 2013, in Oct. 2017, and from Oct. 2018 to Feb. 2019, 5 flowering and 5 non-flowering shoots were randomly taken at 10m depth. The shoots collected were frozen at -18°C. At each sampling, density counts were performed, the shoot density (number of shoots/m^2), the inflorescence density (number of flowering shoot / m^2) and the flowering index (%) were calculated. All collected shoots were analysed for biometry. The CN elemental composition was determined using an elemental analyser (vario MICRO cube™, Elementar). For the P and ET (Fe, Co, Se, Mo, Cr, Ni, Cu, Zn, Al, Be, Ag, Sn, Sb, Bi, Cd, Pb), analyses were carried out by Inductively Coupled Plasma Mass Spectrometry using Dynamic Reaction Cell technology (ICP-MS ELAN DRC II, PerkinElmer Inc.).

Results and Discussion

In Revellata Bay, flowers (<1%) were reported in 1978 [6]. In 1994, the flowering index was at maximum (IF: 36 ± 25%) and also in 2003 (IF: 20 ± 6%). During theses 2 years, flowering was also observed throughout the Northwestern Mediterranean Sea. It was hypothesized that an increase in the temperature of seawater could explain this phenomenon of intense flowering [3]. In the Revellata Bay (Fig.1), we observe now regular flowering events; in 2006 this event was correlated with an increase of the sea surface temperature. The flowering index recorded in 2013 is lower than that of 1994 but close to that of 2003. This suggests that there would be a cycle of ten years in the intensity of flowering in Revellata Bay (1994, 2003 and 2012) and that maximum flowering intensities would be reached every 10 years on average [8]. These results finally raise the question of whether the increase in flowering is not a factor of weakening the *P. oceanica* meadow, which would therefore pump nutrients into its reserves to allow inflorescence. In addition, flowering has been shown to cause considerable stress in meadow. In our study, after flowering, many fruits and seeds were observed in May 2013 and the presence of patch of flowers was also noted at the same time. Fruit observations were made in 1994 and 2003, while the 1997, 1998 but in 2006 flowers did not produce fruit [7]. This highlights a possible link between intensity of flowering and fruit production correlated with the ten-year cycle. This paper will present the C, N, P contents, the results obtained since 2006 tend to highlight a drying up of the meadow by flowering looking notably at the decrease of N in flowering samples (in juvenile, adults and rhizomes tissues) (Table1) and a modification of the biometry (lower width and higher length in adults leaves).

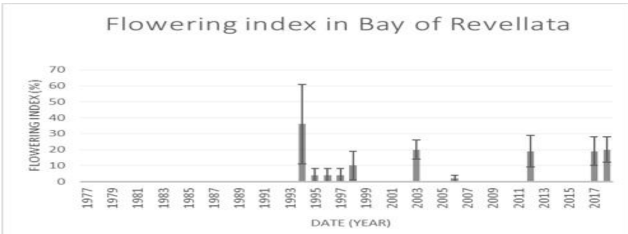

Fig. 1. Evolution of the flowering index in Bay of Revellata from 1978 to 2019.

Tab. 1. Evolution of C,N,P contents of flowering and non-flowering shoots in 2006, 2012 and 2013 in Bay of Revellata.

state / year		Flowering												Not flowering											
		Juv.		Int.		Adult		Shoot		Flow.		Rhiz.		Juv.		Int.		Adult		Shoot		Flow.		Rhiz.	
	value / element	%dw	sd	%dw	sd	%dw	sd	%dw	sd	%dw	sd	%dw	sd	%dw	sd	%dw	sd	%dw	sd	%dw	sd	%dw	sd	%dw	sd
2006	C	**17.6**	0.6	**nd**	nd	**33.2**	0.55	**nd**	nd	**30.6**	1.15	**18.1**	0	**17.1**	0.36	**nd**	nd	**32.6**	0.35	**nd**	nd	**0**	0	**18.1**	0
	N	**0.74**	0.15	**nd**	nd	**1.04**	0.165	**nd**	nd	**1.04**	0.145	**1.39**	0.665	**0.59**	0.055	**nd**	nd	**1.27**	0.27	**nd**	nd	**0**	0	**1.5**	0.31
	P	**nd**	nd	**nd**	nd	**nd**	nd	**nd**	nd	**nd**	nd	**nd**	nd	**nd**	nd	**nd**	nd	**nd**	nd	**nd**	nd	**0**	0	**nd**	nd
2012	C	**20.9**	0.697	**34.1**	0.867	**32.4**	0.932	**32.5**	0.586	**31.3**	0.874	**27.1**	0.69	**29.5**	1.428	**33.3**	1.293	**32.4**	0.888	**32.8**	0.695	**0**	0	**30.8**	0.211
	N	**1.26**	0.243	**1.55**	0.032	**1.03**	0.091	**1.23**	0.106	**1.37**	0.203	**5.46**	0.148	**1.9**	0.478	**1.6**	0.141	**1.09**	0.154	**1.28**	0.134	**0**	0	**1.28**	0.209
	P	**0**	0	**0.11**	0.015	**0.08**	0.011	**0.1**	0.004	**0.2**	0.109	**0.08**	0.007	**0**	0	**0.15**	0.023	**0.09**	0.007	**0.11**	0.011	**0**	0	**0.28**	0.138
2013	C	**35.2**	1.15	**34.4**	1.25	**34**	0.7	**33.1**	0.25	**28.2**	2.3	**35.2**	0.3	**35.7**	0.85	**34.6**	0.4	**33.9**	0.65	**33.2**	0.3	**0**	0	**35.1**	0.35
	N	**2.2**	0.05	**5.45**	0.2	**1.45**	0.35	**1.5**	0.1	**1.1**	0.05	**1.45**	0.2	**1.95**	0.32	**1.85**	0	**1.35**	0.05	**1.5**	0.05	**0**	0	**1.5**	0.05
	P	**0**	0	**0.14**	0.05	**0.1**	0.01	**0.06**	0	**0**	0	**0.06**	0	**0**	0	**0.13**	0	**0.1**	0	**0.12**	0	**0**	0	**0.05**	0.025

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