The following appendices accompany the article

Selection of multiple seagrass indicators for environmental biomonitoring

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Appendix 1. Partition of the variance of each physiological and biochemical level descriptor into their different spatial components (between sites, between sampling zones, and within sampling zones), as a percentage of the total variance calculated from sum of squares using 2-way ANOVA. Sources of variation statistically significant are shown in **bold** and marked *($p < 0.05$) or **($p < 0.005$). The degrees of freedom (df) show that some descriptors were measured in 4 shallow meadows and some of them only in 3 shallow meadows (without Torr 5 m) due to analytical constraints; and that leaf samples of some zones within Jugadora 5 m and 15 m were contaminated with some metals (Fe, Ni and Cr) during laboratory procedures, and consequently eliminated from the analyses

Descriptor Source of variability	Deep locations df	Deep locations Variance (%)	Shallow locations df	Shallow locations Variance (%)
%C leaf2				
between sites	7	17.28	4	**74.36** **
between zones	16	50.48	10	15.11
withinzones	16	32.24	10	10.53
%N leaf2				
between sites	7	**67.52** **	4	**78.32** **
between zones	16	13.06	10	**15.28** *
withinzones	16	19.42	10	6.4
%P leaf2				
between sites	7	31.27	4	**45.44** *
between zones	16	44.61	10	32.34
withinzones	16	24.13	10	22.22
%P rhizome				
between sites	7	**48.15** **	4	**60.90** **
between zones	16	21.96	10	20.52
withinzones	16	29.9	10	18.58
δ^{13}C leaf2				
between sites	7	**52.82** *	3	**89.37** **
between zones	16	28.5	8	5.31
withinzones	16	18.67	8	5.31
δ^{13}C scales1				
between sites	7	**69.82** **	3	**79.10** **
between zones	16	14.4	8	11.03
withinzones	16	15.78	8	9.87
δ^{13}C scales5				
between sites	7	**54.31** **	3	**83.09** **
between zones	16	23.77	8	1.83
withinzones	16	21.92	8	15.08
δ^{15}N leaf2				
between sites	7	**68.27** **	3	**89.46** **
between zones	16	16.84	8	4.63
withinzones	16	14.9	8	5.91
δ^{15}N scales1				
between sites	7	**65.75** **	3	28.66
between zones	16	17.04	8	**50.09** *
withinzones	16	17.21	8	21.24
δ^{15}N scales5				
between sites	7	39.93	3	18.66
between zones	16	**40.73** *	8	**69.06** **
withinzones	16	19.34	8	12.28
δ^{34}S leaf2				
between sites	7	32.61	3	8.46
between zones	16	42.66	8	**69.39** *
withinzones	16	24.73	8	22.16
δ^{34}S scales1				
between sites	7	**58.73** *	3	**57.70** *
between zones	16	**28.71** *	8	**32.76** *
withinzones	16	12.56	8	9.53
δ^{34}S scales5				
between sites	7	40.42	3	28.35
between zones	16	36.36	8	42.37
withinzones	16	23.22	8	29.28
Fe leaf2				
between sites	6	**54.21** *	4	**74.51** **
between zones	14	**30.86** *	10	11.62
withinzones	14	14.92	10	13.87
Zn leaf2				
between sites	7	**82.69** **	4	**76.72** **
between zones	16	**12.40** *	10	15.11
withinzones	16	4.91	10	8.17
Ni leaf2				
between sites	6	36.88	4	**68.17** **
between zones	14	**47.00** **	10	10.96
withinzones	14	16.12	10	20.88
Mn leaf2				
between sites	7	**66.24** **	4	**60.01** *
between zones	16	18.14	10	22.16
withinzones	16	15.62	10	17.83
Cr leaf2				
between sites	6	**51.96** *	4	**68.97** **
between zones	14	**35.98** **	10	10.53
withinzones	14	12.06	10	20.51
Pb leaf2				
between sites	7	**79.05** **	4	**73.93** **
between zones	16	**14.32** *	10	**21.71** **
withinzones	16	6.63	10	4.36
As leaf2				
between sites	7	**65.09** **	4	**67.52** **
between zones	16	17.76	10	20.9
withinzones	16	17.16	10	11.58

Appendix 1 (continued)

Descriptor / Source of variability	Deep locations df	Deep locations Variance (%)	Shallow locations df	Shallow locations Variance (%)
Cu leaf2				
between sites	7	**84.73****	4	**59.16****
between zones	16	8.76	10	16.12
withinzones	16	6.51	10	24.72
Fe rhizome				
between sites	7	**59.04****	4	**58.03***
between zones	16	14.37	10	24.21
withinzones	16	26.59	10	17.76
Zn rhizome				
between sites	7	31.73	4	**54.26***
between zones	16	27.35	10	**36.03****
withinzones	16	40.92	10	9.71
Ni rhizome				
between sites	7	22.1	4	25.32
between zones	16	**53.09***	10	49.74
withinzones	16	24.82	10	24.94
Mn rhizome				
between sites	7	**35.98***	4	**51.75***
between zones	16	22.56	10	24.71
withinzones	16	41.46	10	23.54
Cr rhizome				
between sites	7	**41.01***	4	**56.23****
between zones	16	31.24	10	16.07
withinzones	16	27.75	10	27.7
Pb rhizome				
between sites	7	28.43	4	**60.96****
between zones	16	45.18	10	16.66
withinzones	16	26.39	10	22.38
As rhizome				
between sites	7	26.56	4	48.10*
between zones	16	30.85	10	18.87
withinzones	16	42.6	10	33.03
Cu rhizome				
between sites	7	**59.18****	4	**76.27****
between zones	16	22.18	10	12.29
withinzones	16	18.64	10	11.44
Sucrose				
between sites	7	**66.69****	4	**63.78****
between zones	16	10.25	10	14.45
withinzones	16	23.07	10	21.77

Descriptor / Source of variability	Deep locations df	Deep locations Variance (%)	Shallow locations df	Shallow locations Variance (%)
FAA				
between sites	7	67.6	3	60.92
withinsites	7	32.4	3	39.08
Asn				
between sites	7	74.39*	3	72.24
withinsites	7	25.61	3	27.76
Arg				
between sites	7	51.73	3	26.99
withinsites	7	48.27	3	73.01
Gln				
between sites	7	63.95	3	57.82
withinsites	7	36.05	3	42.18
Ala				
between sites	7	**72.94***	3	72.94
withinsites	7	27.06	3	27.06
Asp				
between sites	7	70.13	3	**83.33***
withinsites	7	29.87	3	16.67
Val				
between sites	7	55.53	3	58.48
withinsites	7	44.47	3	41.52
Ser				
between sites	7	**81.49***	3	72.04
withinsites	7	18.51	3	27.96
Lys				
between sites	7	55.8	3	60.17
withinsites	7	44.2	3	39.83
His				
between sites	7	67.8	3	45.11
withinsites	7	32.2	3	54.89
Thr				
between sites	7	71.72	3	29.88
withinsites	7	28.28	3	70.12
Pro				
between sites	7	**84.66****	3	62.76
withinsites	7	15.34	3	37.24
Glu				
between sites	7	59.31	3	77.58
withinsites	7	40.69	3	22.42
Cit				
between sites	7	40.96	3	**85.62***
within sites	7	59.04	3	14.38

Appendix 2. Partition of the variance of each individual, population and community level descriptor into their different spatial components (between sites, between sampling zones, and within sampling zones), as a percentage of the total variance calculated from sum of squares using 2-way ANOVA. Sources of variation statistically significant are shown in **bold** and marked *(p < 0.05) or **(p < 0.005). The degrees of freedom (df) show that some descriptors were measured in 4 shallow meadows and some of them only in 3 shallow meadows (without Torr 5 m) due to analytical constraints

Descriptor	Deep meadows			Shallow meadows		
Source of variability	df	Variance (%)	p-level	df	Variance (%)	p-level
Total number of leaves per shoot						
between sites	7	31.22	0.117	4	37.22	0.164
between zones	16	35.43	0.414	10	**45.54***	**0.022**
within zones	16	33.35		10	17.24	
Maximal leaf length						
between sites	7	**55.71***	**0.009**	4	**82.66****	**0.000**
between zones	16	**30.96***	**0.013**	10	11.84	0.055
within zones	16	13.33		10	5.50	
Average leaf width						
between sites	7	**51.61***	**0.006**	4	**76.74****	**0.000**
between zones	16	26.27	0.312	10	12.14	0.402
withinzones	16	22.12		10	11.12	
Broken leaves						
between sites	7	**40.76****	**0.028**	4	42.96	0.087
between zones	16	29.86	0.457	10	38.80	0.058
withinzones	16	29.38		10	18.24	
Shoot necrosis						
between sites	7	**73.47****	**0.000**	3	**68.65***	**0.007**
between zones	16	13.62	0.420	8	21.67	0.061
withinzones	16	12.90		8	9.68	
Shoot biomass						
between sites	7	**57.03***	**0.006**	3	41.28	0.143
between zones	16	**29.09***	**0.025**	8	**45.79***	**0.008**
withinzones	16	13.88		8	12.93	
Shoot density						
between sites	7	**75.68****	**0.000**	4	52.59	0.058
between zones	16	12.53	0.406	10	**39.99****	**0.000**
withinzones	16	11.79		10	7.42	
Meadow cover						
between sites	7	**67.08****	**0.002**	4	**71.07****	**0.001**
between zones	16	**25.89****	**0.000**	10	14.11	0.489
withinzones	16	7.03		10	14.82	
Rhizome baring						
between sites	7	**67.06****	**0.001**	3	13.90	0.564
between zones	16	**23.55****	**0.005**	8	50.92	0.211
withinzones	16	9.39		8	35.18	
Rhizome growth type						
between sites	7	**56.90***	**0.018**	3	18.97	0.564
between zones	16	**37.17****	**0.000**	8	**69.54****	**0.000**
withinzones	16	5.93		8	11.49	
Epiphyte biomass						
between sites	7	**64.03****	**0.002**	4	24.06	0.330
between zones	16	**25.59***	**0.008**	10	45.84	0.185
withinzones	16	10.38		10	30.10	
%C epiphytes						
between sites	7	**72.96****	**0.000**	4	**57.41***	**0.032**
between zones	16	**20.04****	**0.002**	10	**35.18****	**0.001**
withinzones	16	6.99		10	7.40	
%N epiphytes						
between sites	7	**74.26****	**0.000**	4	**78.61****	**0.000**
between zones	16	**18.51***	**0.006**	10	13.47	0.132
withinzones	16	7.23		10	7.92	
Fish bite marks						
between sites	7	**51.53****	**0.001**	4	**56.76***	**0.019**
between zones	16	16.69	0.920	10	29.03	0.068
withinzones	16	31.79		10	14.21	
Sea urchin bite marks						
between sites	7	24.71	0.466	4	**65.70****	**0.001**
between zones	16	**56.47****	**0.002**	10	13.09	0.786
withinzones	16	18.82		10	21.21	

Appendix 3. Factor loadings within the first 2 principal components of the PCA performed using ANOVA-selected descriptors. Descriptors showing the highest correlation with each component ($r \leq 0.70$) are highlighted in bold. Descriptors exceptionally included due to their ecological relevance or sensitivity to specific anthropogenic disturbances are underlined ($0.60 < r > 0.70$). Asterisks denote descriptors highly correlated with component I but without significant variation among deep meadows based on ANOVA results

Descriptor	Component I	Component II
Asparagine content in rhizomes (Asn)	**0.84**	0.23
Alanine content in rhizomes (Ala)	0.64	−0.05
Aspartic acid content in rhizomes (Asp)	**0.78***	−0.08
Serine content in rhizomes (Ser)	**0.79**	0.04
Proline content in rhizomes (Pro)	−0.10	−0.63
Citosine content in rhizomes (Cit)	0.39	−0.45
Carbon content in leaf2 (C leaf)	−0.24	0.62
Nitrogen content in leaf2 (N leaf)	0.36	−0.02
Phosphorus content in leaf2 (P leaf)	**0.85***	0.16
Phosphorus content in rhizomes (N rhi)	**0.87**	−0.06
$\delta^{34}S$ signature in 1 year old scales (dS scal1)	**0.71**	0.16
$\delta^{13}C$ signature in leaf 2 (dC leaf)	0.01	0.59
$\delta^{13}C$ signature in 1 year old scales (dC scal1)	0.20	0.31
$\delta^{13}C$ signature in 5 year old scales (dC scal5)	0.16	0.37
$\delta^{15}N$ signature in leaf 2 (dN leaf)	0.13	0.51
$\delta^{15}N$ signature in 1 year old scales (dN scal1)	0.39	0.20
Carbon content in leaf epiphyte (C epi)	−0.13	−0.14
Nitrogen content in leaf epiphyte (N epi)	0.10	0.47
Iron content in leaf 2 (Fe leaf)	**0.73**	−0.23
Zinc content in leaf 2 (Zn leaf)	0.64	0.59
Nickel content in leaf 2(Ni leaf)	**0.70***	−0.18
Manganese content in leaf 2 (Mn leaf)	0.47	0.03
Chromium content in leaf 2 (Cr leaf)	0.47	−0.25
Lead content in leaf 2 (Pb leaf)	**0.89**	−0.04
Arsenic content in leaf 2 (As leaf)	0.67	−0.05
Copper content in leaf 2 (Cu leaf)	0.68	0.47
Iron content in rhizomes (Fe rhi)	**0.74**	−0.08
Zinc content in rhizomes (Zn rhi)	0.65	−0.16
Manganese content in rhizomes (Mn rhi)	0.67	−0.09
Chromium content in rhizomes (Cr rhi)	−0.06	−0.29
Lead content in rhizomes (Pb rhi)	0.08	−0.03
Arsenic content in rhizomes (As rhi)	0.55	−0.22
Copper content in rhizomes (Cu rhi)	0.61	0.55
Sucrose content in rhizomes (Sucrose)	**−0.78**	−0.21
Maximum leaf length (Lmax)	−0.10	**−0.77**
Leaf width (Width)	−0.33	−0.65
Fish bite marks (Fish)	−0.39	**0.74**
Sea urchin bite marks (Sea urchin)	−0.08	0.60
Broken leaves (Broken)	0.54	−0.41
Shoot necrosis (Necrosis)	**0.79**	−0.37
Shoot biomass (B shoot)	−0.40	−0.48
Epiphyte biomass (B epi)	0.40	−0.06
Shoot density (Density)	**−0.70**	0.56
Meadow cover (Cover)	−0.63	0.37
Rhizome baring (Baring)	−0.32	−0.38
Rhizome growth type (Growth rhi)	**0.91**	0.12
% variance	31.6	14.2
Cumulative variance	31.6	45.8

	Component I	Component II	Component III	Component IV
% variance	31.6	14.2	12.8	10.8

Appendix 4. Three-way nested ANOVA results including environmental status (healthy, intermediate, and unhealthy; fixed factor), and sampling site (random factor, nested in status) and zone (random factor, nested in site). p-values < 0.05 are shown in bold

Indicator		df effect	MS effect	df error	MS error	*F*	p-level
Shoot density	Status	2	170872.0	5.0	41163.4	4.2	0.086
	Site	5	41642.6	15.6	5836.9	7.1	**0.001**
	Zone	16	5832.5	69.0	5487.7	1.1	0.406
Meadow cover	Status	2	12786.8	5.0	1670.8	7.7	**0.030**
	Site	5	1670.8	16.0	818.6	2.0	0.127
	Zone	16	818.6	192.0	222.2	3.7	**0.000**
Rhizome growth type	Status	2	4.3	5.3	0.1	32.8	**0.001**
	Site	5	0.1	15.9	0.4	0.3	0.886
	Zone	16	0.4	67.0	0.1	6.3	**0.000**
Shoot necrosis	Status	2	3286.5	5.0	459.6	7.1	**0.034**
	Site	5	459.6	16.0	102.8	4.5	**0.010**
	Zone	16	102.8	48.0	97.4	1.1	0.420
Sucrose in rhizomes	Status	2	104.2	4.9	12.0	8.7	**0.024**
	Site	5	11.9	15.5	2.5	4.7	**0.008**
	Zone	16	2.6	45.0	5.8	0.4	0.960
Asn in rhizomes	Status	2	13700.9	5.0	672.9	20.4	**0.004**
	Site	5	672.9	16.0	1512.9	0.4	0.811
Ser in rhizomes	Status	2	5.1	5.0	4.0	1.3	0.355
	Site	5	4.0	16.0	1.0	4.1	**0.014**
P in rhizomes	Status	2	0.2	5.0	0.0	11.7	**0.013**
	Site	5	0.0	14.5	0.0	1.4	0.275
	Zone	16	0.0	44.0	0.0	0.7	0.745
Mn in rhizomes	Status	2	11.3	5.0	17.8	0.6	0.567
	Site	5	17.7	14.0	4.0	4.4	**0.013**
	Zone	16	4.1	44.0	7.6	0.5	0.907
Fe in rhizomes	Status	2	194195.5	5.0	20205.7	9.6	**0.020**
	Site	5	20139.2	14.0	7810.4	2.6	0.074
	Zone	16	8056.9	44.0	14914.8	0.5	0.910
Fe in leaf	Status	2	177151.0	4.0	159937.5	1.1	0.414
	Site	4	159217.8	13.9	44483.4	3.6	**0.033**
	Zone	14	44240.2	40.0	21389.3	2.1	**0.037**
Zn in leaves	Status	2	30809.0	5.0	5193.1	5.9	**0.048**
	Site	5	5209.8	15.9	763.6	6.8	**0.001**
	Zone	16	758.5	46.0	300.3	2.5	**0.007**
Pb in leaves	Status	2	373.4	5.0	16.0	23.3	**0.003**
	Site	5	16.1	15.8	9.6	1.7	0.198
	Zone	16	9.5	46.0	4.4	2.2	**0.021**
As in leaves	Status	2	0.7	5.0	0.5	1.3	0.347
	Site	5	0.5	15.7	0.1	7.8	**0.001**
	Zone	16	0.1	46.0	0.1	1.0	0.441
Cu in leaves	Status	2	1599.3	5.0	72.3	22.1	**0.003**
	Site	5	72.5	15.7	23.8	3.0	**0.041**
	Zone	16	23.8	46.0	17.7	1.3	0.212
$\delta^{34}S$ in 1 year old scales	Status	2	12.6	5.0	5.8	2.2	0.210
	Site	5	5.8	16.0	1.7	3.5	**0.025**
	Zone	16	1.7	48.0	0.7	2.3	**0.014**