

Biodiversity loss and turnover in alternative states in the Mediterranean Sea: a case study on meiofauna

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LIST OF SUPPLEMENTARY INFORMATION

Supplementary Table S1. PERMANOVA and pairwise output to test differences among areas in OM, meiofaunal and nematode variables.

Supplementary Table S2. Results of PERMANOVA main test to test differences between alternative states and sites in OM, meiofaunal and nematode variables.

Supplementary Table S3. Results of DistLM forward carried out to ascertain the role of different environmental variables (OM quantity, biochemical composition and nutritional quality) on meiofaunal abundance, biomass, richness of taxa and nematode species richness. F=F statistic; *** = $P < 0.001$; ** = $P < 0.01$; * = $P < 0.05$; ns = not significant.

Supplementary Figure S1. Output of PERMDISP on OM variables.

Supplementary Figure S2. Output of PERMDISP on meiofaunal and nematode variables.

Supplementary Figure S3. Forest plots showing the negative effect (red dots) of barrens on OM biochemical compounds concentration at all investigated areas (round symbol) and cumulatively for all areas (square symbol). Bars represent the standard error.

Table S1. PERMANOVA and pairwise output to test differences among Areas in OM biochemical compounds contents and biochemical composition (a), meiofaunal abundance, biomass and taxonomic composition (b) and nematode species composition (c). df=degree of freedom, MS=means of squares; F= variance ratio, P= significance level, ns=not significant, *=P<0.05, **=P<0.01, ***=P<0.001, Min=Minorca, Sar=Sardinia, Tus=Tuscany, Sic=Sicily, Cro=Croatia and Mon=Montenegro.

		Source	df	MS	F	P	Pairwise	
a)	Total phytopigment	Barren Area	5	3.1	4.8	**	Cro>Mon>Min,Sar,Tus>Sic	
		Residual	30	0.6				
	Meadow	Area	5	6.1	42.9	***	Min>Sar,Tus>Sic,Cro>Mon	
		Residual	30	0.1				
	Protein	Barren	Area	5	1.4	1.6	ns	ns
			Residual	30	0.9			
		Meadow	Area	5	4.4	10.0	***	Sic>Sar>Tus,Cro,Mon>Min
			Residual	30	0.4			
	Carbohydrate	Barren	Area	5	4.4	9.9	***	Cro,Mon>Sar,Tus,Min,Sic
			Residual	30	0.4			
		Meadow	Area	5	1.8	2.1	ns	ns
			Residual	30	0.9			
	Lipid	Barren	Area	5	3.9	7.5	***	Sar>Tus,Sic,Cro,Mon>Min
			Residual	30	0.5			
		Meadow	Area	5	1.0	1.0	ns	ns
			Residual	30	1.0			
	Biopolymeric C	Barren	Area	5	4.0	8.0	***	Cro,Mon>Sar,Tus>Min,Sic
			Residual	30	0.5			
Meadow		Area	5	1.8	2.1	ns	ns	
		Residual	30	0.9				
Biochemical composition	Barren	Area	5	16.6	5.4	***	Min≠Sar≠Tus≠Sic≠Cro≠Mon	
		Residual	30	3.1				
	Meadow	Area	5	19.5	7.5	***	Min≠Sar,Sic≠Tus≠Cro,Mon	
		Residual	30	2.6				
Nutritional quality	Barren	Area	5	2011.4	11.0	***	Min≠Sar,Tus≠Sic≠Cro≠Mon	
		Residual	30	182.1				
	Meadow	Area	5	1885.0	3.8	**	Min,Tus≠Sar≠Sic≠Cro,Mon	
		Residual	30	491.7				
b)	Meiofaunal abundance	Barren	Area	5	3837.5	5.0	***	Min,Tus,Cro,Mon>Sar>Sic
			Residual	54	762.9			
		Meadow	Area	5	3580.1	6.3	***	Cro>Min,Sar,Tus,Sic,Mon
			Residual	54	572.7			
	Meiofaunal biomass	Barren	Area	5	3756.2	3.8	***	Cro,Min,Tus>Sar,Mon>Sic
			Residual	54	992.4			
		Meadow	Area	5	3758.4	4.6	***	Sar,Cro>Tus,Mon>Min,Sic
			Residual	54	811.7			
	Meiofaunal taxonomic composition	Barren	Area	5	4080.0	4.5	***	Min≠Sar,Sic≠Tus,Cro,Mon
			Residual	54	910.4			
		Meadow	Area	5	5097.2	7.4	***	Min,Tus,Cro,Mon≠Sar,Sic
			Residual	54	686.0			
c)	Nematode species composition	Barren	Area	5	7924.0	3.0	***	Min≠Sar≠Sic≠Cro≠Tus,Mon
			Residual	54	2616.0			
		Meadow	Area	5	7973.4	5.2	***	Min≠Sar≠Tus≠Sic≠Cro≠Mon
			Residual	54	1527.4			

Table S2. Results of PERMANOVA main test to test differences between alternative states and sites on OM biochemical compounds contents and biochemical composition (a), meiofaunal abundance, biomass and taxonomic composition (b) and nematode species composition (c). F= variance ratio, P= significance level, %var=% of explained variance, ns=not significant, *=P<0.05, **=P<0.01, ***=P<0.001; S1=Site1, S2=Site2).

	Minorca				Sardinia				Tuscany				Sicily				Croatia				Montenegro			
	Source	F	P	%var	Source	F	P	%var	Source	F	P	%var	Source	F	P	%var	Source	F	P	%var	Source	F	P	%var
a) Total phytopygment	State	18.4	*	85.1	State	2.3	ns	38.4	State	20.1	ns	71.8	S1 State	300.3	***	99.0	State	0.7	ns	0.0	State	19.0	*	80.0
	Site(State)	3.8	ns	7.2	Site(State)	36.5	***	56.8	Site(State)	0.8	ns	0.0	Residual	1.0			Site(State)	6.2	*	63.5	Site(State)	1.6	ns	3.4
	Residual			7.7	Residual			4.8	Residual			28.2	S2 State	213.2	***	98.6	Residual			36.5	Residual			16.6
Protein	S1 State	11.1	*	77.0	State	79.3	*	96.2	S1 State	119.0	**	97.5	S1 State	138.3	***	97.9	State	4.5	ns	57.2	State	0.9	ns	0.0
	Residual			23.0	Site(State)	3.6	ns	1.8	Residual			2.5	Residual			2.1	Site(State)	6.6	*	27.8	Site(State)	35.1	***	91.9
	S2 State	11.9	*	78.3	Residual			2.0	S2 State	30.0	**	90.6	S2 State	35.1	**	91.9	Residual			14.9	Residual			8.1
Carbohydrate	S1 State	23.5	**	88.2	S1 State	87.2	**	96.6	S1 State	1275.	***	99.8	S1 State	104.0	**	97.2	S1 State	18.1	*	85.1	S1 State	234.	***	98.7
	Residual			11.8	Residual			3.4	Residual			0.2	Residual			2.8	Residual			14.9	Residual			1.3
	S2 State	40.7	**	93.0	S2 State	6.7	ns	65.7	S2 State	17.8	*	84.9	S2 State	1636.	***	99.8	S2 State	20.7	*	86.8	S2 State	61.2	**	95.3
Lipid	S1 State	312.4	***	99.0	S1 State	0.0	ns	0.0	State	0.8	ns	0.0	S1 State	123.4	***	97.6	S1 State	66.9	**	95.6	State	0.3	ns	0.0
	Residual			1.0	Residual			100.0	Site(State)	43.2	***	93.4	Residual			2.4	Residual			4.4	Site(State)	59.7	***	95.1
	S2 State	191.5	***	98.4	S2 State	49.2	**	94.1	Residual			6.6	S2 State	18.3	*	85.2	S2 State	400.1	***	99.3	Residual			4.9
Biopolymeric C	S1 State	15.8	*	83.2	S1 State	13.8	*	81.0	State	0.0	ns	0.0	S1 State	1484.	***	99.8	S1 State	17.7	*	84.8	S1 State	129.	***	97.7
	Residual			16.8	Residual			19.0	Site(State)	43.5	**	93.4	Residual			0.2	Residual			15.2	Residual			2.3
	S2 State	39.7	**	92.8	S2 State	8.3	*	70.8	Residual			6.6	S2 State	126.0	**	97.7	S2 State	1.0	ns	0.0	S2 State	30.2	**	90.7
Biochemical composition	S1 State	33.4	**	91.5	S1 State	12.7	**	79.6	State	2.846	ns	43.0	S1 State	125.6	***	97.6	S1 State	13.3	**	80.4	State	2.0	ns	29.6
	Residual			8.5	Residual			20.4	Site(State)	8.858	***	41.3	Residual			2.4	Residual			19.6	Site(State)	10.6	***	53.7
	S2 State	25.8	**	89.2	S2 State	19.7	**	86.2	Residual			15.8	S2 State	50.4	**	94.3	S2 State	12.3	**	79.0	Residual			16.7
Nutritional quality	State	10.0	*	76.3	S1 State	273.	***	98.9	S1 State	15.9	ns	83.2	S1 State	61.8	**	95.3	State	42.0	**	91.7	S1 Ha	26.7	**	89.6
	Site(State)	5.0	*	13.6	Residual			1.1	Residual			16.8	Residual			4.7	Site(State)	2.4	ns	2.6	Res			10.4
	Residual			10.1	S2 State	1217	***	99.8	S2 State	0.5	ns	0.0	S2 State	1.3	ns	10.0	Residual			5.7	S2 Ha	95.7	**	96.9
b) Meiofaunal abundance	State	8.7	*	56.2	State	13.6	*	72.8	State	20.9	**	74.8	State	173.9	***	50.0	State	69.4	***	90.1	State	63.7	**	88.1
	Site(State)	2.0	ns	7.3	Site(State)	3.0	*	7.6	Site(State)	1.7	ns	3.1	Site(State)	0.2	ns	0.0	Site(State)	1.4	ns	0.8	Site(State)	1.2	ns	0.5
	Residual			36.4	Residual			19.6	Residual			22.1	Residual			50.0	Residual			9.1	Residual			11.4
Meiofaunal biomass	State	10.6	*	51.1	State	6.7	*	54.9	State	23.6	**	74.6	State	63.2	***	67.0	State	207.4	***	91.0	State	52.2	***	81.0
	Site(State)	1.1	ns	1.0	Site(State)	3.0	*	12.7	Site(State)	1.4	ns	1.9	Site(State)	0.3	ns	0.0	Site(State)	0.5	ns	0.0	Site(State)	0.8	ns	0.0
	Residual			47.9	Residual			32.4	Residual			23.6	Residual			33.0	Residual			9.0	Residual			19.0
Meiofaunal taxonomic composition	State	9.0	*	52.0	State	14.1	**	69.0	State	16.0	**	70.4	State	68.8	**	74.5	State	36.1	**	86.2	State	56.6	***	85.3
	Site(State)	1.5	ns	4.3	Site(State)	2.1	ns	5.4	Site(State)	1.9	ns	4.4	Site(State)	0.4	ns	0.0	Site(State)	2.2	ns	2.7	Site(State)	1.1	ns	0.2
	Residual			43.7	Residual			25.6	Residual			25.2	Residual			25.5	Residual			11.2	Residual			14.5
c) Nematode species composition	State	1.5	ns	11.9	S1 State	2.9	ns	38.9	S1 State	1.3	ns	7.9	S1 State	7.0	*	66.6	S1 State	4.3	*	52.1	State	2.7	*	25.2
	Site(State)	1.9	ns	20.9	Residual			61.1	Residual			92.1	Residual			33.4	Residual			47.9	Site(State)	1.3	ns	7.0
	Residual			67.2	S2 State	3.6	*	46.7	S2 State	2.5	ns	33.6	S2 State	2.9	ns	39.2	S2 State	2.7	ns	36.0	Residual			67.9
				Residual			53.3	Residual			66.4	Residual			60.8	Residual			64.0					

Table S3. Results of DistLM forward carried out to ascertain the role of different environmental

variables (OM quantity, biochemical composition and nutritional quality) on the observed

variability in meiofaunal abundance, biomass, richness of taxa and nematode species richness. F=F

statistic; *** = P < 0.001; ** = P < 0.01; * = P < 0.05; ns = not significant.

	Variable	Meiofaunal abundance			Meiofaunal biomass			Richness of meiofaunal taxa			Nematode Species Richness				
		F	P	%Explained variance	F	P	%Explained variance	F	P	%Explained variance	F	P	%Explained variance		
A)	Minorca	% barren	4.4	*	86.6	3.0	ns	83.5	6.8	*	97.8	9.5	*	73.0	
		biopolymeric C	0.5	ns	13.4	0.5	ns	16.5	0.1	ns	2.2	2.2	ns	27.0	
	Sardinia	% barren	9.5	**	93.4	4.6	*	93.2	6.2	*	64.3	7.2	**	98.0	
		biopolymeric C	0.4	ns	6.6	0.2	ns	6.8	2.7	ns	35.7	0.1	ns	2.0	
	Tuscany	% barren	23.1	***	82.5	22.2	***	83.2	10.0	*	96.4	6.5	**	90.4	
		biopolymeric C	1.7	ns	17.5	1.6	ns	16.8	0.2	ns	3.6	0.4	ns	9.6	
	Sicily	% barren	18.0	**	62.7	13.0	**	63.9	13.5	**	66.1	16.3	**	58.6	
		biopolymeric C	6.2	*	37.3	4.7	*	36.1	4.2	*	33.9	7.8	*	41.4	
	Croatia	% barren	47.5	**	72.0	64.8	**	75.3	20.4	**	76.0	51.7	***	61.0	
		biopolymeric C	4.7	*	28.0	4.0	ns	24.7	2.7	ns	24.0	11.5	**	39.0	
	Montenegro	% barren	29.4	**	61.8	25.5	**	61.8	5.2	*	67.6	27.0	**	50.4	
		biopolymeric C	8.6	**	38.2	8.0	*	38.2	2.0	ns	32.4	25.5	**	49.6	
	B)	Minorca	% barren	4.4	*	22.8	3.0	ns	22.2	6.8	*	27.7	9.5	**	18.2
			Chlorophyll-a	2.6	ns	15.6	2.0	ns	16.0	4.4	ns	20.8	7.9	*	16.4
Phaeopigment			2.3	ns	14.2	1.8	ns	14.8	3.8	ns	18.9	7.1	*	15.5	
Protein			1.3	ns	8.5	1.4	ns	12.2	0.1	ns	0.9	0.3	ns	1.1	
Carbohydrate			0.3	ns	2.4	0.3	ns	2.9	0.1	ns	0.8	2.6	ns	7.8	
Lipid			0.1	ns	0.5	0.1	ns	0.5	0.3	ns	2.2	2.5	ns	7.6	
Chla to BPC %			7.8	**	32.7	3.9	*	27.4	5.6	*	24.5	3.5	ns	9.8	
Protein to BPC %			0.1	ns	1.1	0.2	ns	1.5	0.3	ns	2.3	4.0	ns	10.7	
Protein to carbohydrate			0.3	ns	2.1	0.3	ns	2.4	0.3	ns	1.9	5.3	*	12.9	
Sardinia			% barren	9.5	**	11.2	4.6	*	10.2	6.2	*	11.2	7.2	*	11.0
		Chlorophyll-a	13.0	***	12.9	10.4	***	16.4	13.9	**	17.1	7.7	**	11.4	
		Phaeopigment	5.7	*	8.3	5.2	*	11.0	13.4	***	16.8	2.5	ns	5.3	
		Protein	34.0	***	17.7	12.2	***	17.7	15.3	**	17.8	21.4	**	17.9	
		Carbohydrate	1.8	ns	3.4	0.6	ns	1.8	0.2	ns	0.6	2.1	ns	4.5	
		Lipid	4.7	*	7.3	2.8	ns	7.0	8.1	**	13.1	3.1	ns	6.3	
		Chla to BPC %	14.2	**	13.4	7.6	**	13.9	4.4	ns	9.0	11.3	***	13.9	
		Protein to BPC %	21.5	**	15.6	7.4	**	13.7	5.5	*	10.5	19.7	***	17.4	
		Protein to carbohydrate	7.9	**	10.1	3.4	*	8.1	1.5	ns	3.8	8.7	**	12.2	
		Tuscany	% barren	23.1	***	21.5	22.2	***	20.5	10.0	*	44.0	6.5	**	30.5
Chlorophyll-a			2.3	ns	5.8	3.1	ns	7.1	0.1	ns	1.1	0.7	ns	5.3	
Phaeopigment			4.7	*	9.9	5.7	*	10.8	0.7	ns	6.1	1.6	ns	10.6	
Protein			3.0	ns	7.1	3.3	ns	7.3	0.4	ns	3.2	1.1	ns	7.4	
Carbohydrate			5.9	*	11.4	5.4	*	10.5	1.0	ns	8.2	0.9	ns	6.6	
Lipid			3.6	ns	8.2	2.9	ns	6.7	1.0	ns	8.1	0.7	ns	5.2	
Chla to BPC %			5.0	*	10.3	6.3	*	11.5	0.8	ns	6.2	1.2	ns	8.4	
Protein to BPC %			6.3	*	11.9	6.6	**	11.9	1.2	ns	9.4	1.7	ns	11.1	
Protein to carbohydrate			8.2	**	13.9	8.7	**	13.8	1.8	ns	13.6	2.4	ns	15.0	
Sicily			% barren	18.0	**	23.0	13.0	***	20.7	13.5	**	23.8	16.3	***	21.7
		Chlorophyll-a	12.5	**	19.9	10.1	**	18.4	8.3	*	18.7	11.5	***	18.8	
		Phaeopigment	8.2	**	16.2	6.0	**	13.7	5.4	*	14.6	9.9	***	17.5	
		Protein	11.7	**	19.3	8.1	**	16.4	9.1	*	19.8	12.0	**	19.1	
		Carbohydrate	4.3	ns	10.8	3.6	*	9.8	2.5	ns	8.3	5.8	*	12.8	
		Lipid	0.5	ns	1.8	0.7	ns	2.5	0.2	ns	0.7	1.1	ns	3.5	
		Chla to BPC %	0.1	ns	0.2	0.2	ns	0.6	0.0	ns	0.1	0.2	ns	0.6	
		Protein to BPC %	2.3	ns	6.7	4.2	*	10.9	4.2	*	12.3	0.9	ns	2.9	
		Protein to carbohydrate	0.6	ns	2.0	2.4	ns	7.0	0.4	ns	1.7	0.9	ns	2.9	
	Croatia	% barren	47.5	**	17.9	64.8	**	18.2	20.4	**	18.8	51.7	***	16.3	
Chlorophyll-a		14.5	**	12.8	13.3	**	12.0	6.3	*	10.8	39.5	***	15.5		
Phaeopigment		0.1	ns	0.3	0.1	ns	0.1	0.1	na	0.1	0.9	ns	1.6		
Protein		8.0	*	9.6	9.7	**	10.3	5.2	*	9.6	5.8	*	7.1		
Carbohydrate		8.9	**	10.1	7.8	**	9.2	5.1	*	9.4	20.8	***	13.1		
Lipid		0.3	ns	0.7	0.6	ns	1.2	1.3	ns	3.3	0.0	ns	0.1		
Chla to BPC %		21.6	**	14.8	27.0	***	15.3	9.4	**	13.6	26.3	***	14.1		
Protein to BPC %		32.8	**	16.6	36.4	***	16.4	13.7	**	16.2	48.9	***	16.1		
Protein to carbohydrate		40.3	***	17.3	48.8	***	17.4	18.0	**	18.0	48.4	**	16.1		
Montenegro		% barren	29.4	**	21.4	25.5	**	20.5	5.2	ns	12.6	27.0	***	21.6	
	Chlorophyll-a	0.8	ns	2.2	1.0	ns	2.6	0.5	ns	1.6	2.5	ns	5.9		
	Phaeopigment	11.9	***	15.6	11.0	**	15.0	2.7	ns	7.8	7.8	*	13.0		
	Protein	3.6	*	7.7	4.0	*	8.1	9.5	**	17.8	1.1	ns	2.9		
	Carbohydrate	14.7	**	17.1	13.8	**	16.6	4.2	ns	10.9	34.1	***	22.9		
	Lipid	0.9	ns	2.3	1.0	ns	2.5	0.5	ns	1.8	3.6	ns	7.8		
	Chla to BPC %	1.4	ns	3.6	1.7	ns	4.2	2.9	ns	8.2	0.4	ns	1.2		
	Protein to BPC %	13.4	***	16.4	13.8	***	16.6	13.3	**	21.0	7.4	*	12.6		
	Protein to carbohydrate	9.0	**	13.6	9.8	**	14.1	9.9	**	18.3	6.9	*	12.1		

Figure S1. Average (\pm SE) multivariate dispersion (PERMDISP) based on dissimilarity matrices of sedimentary organic matter biochemical compounds and composition at the scales of area and state.

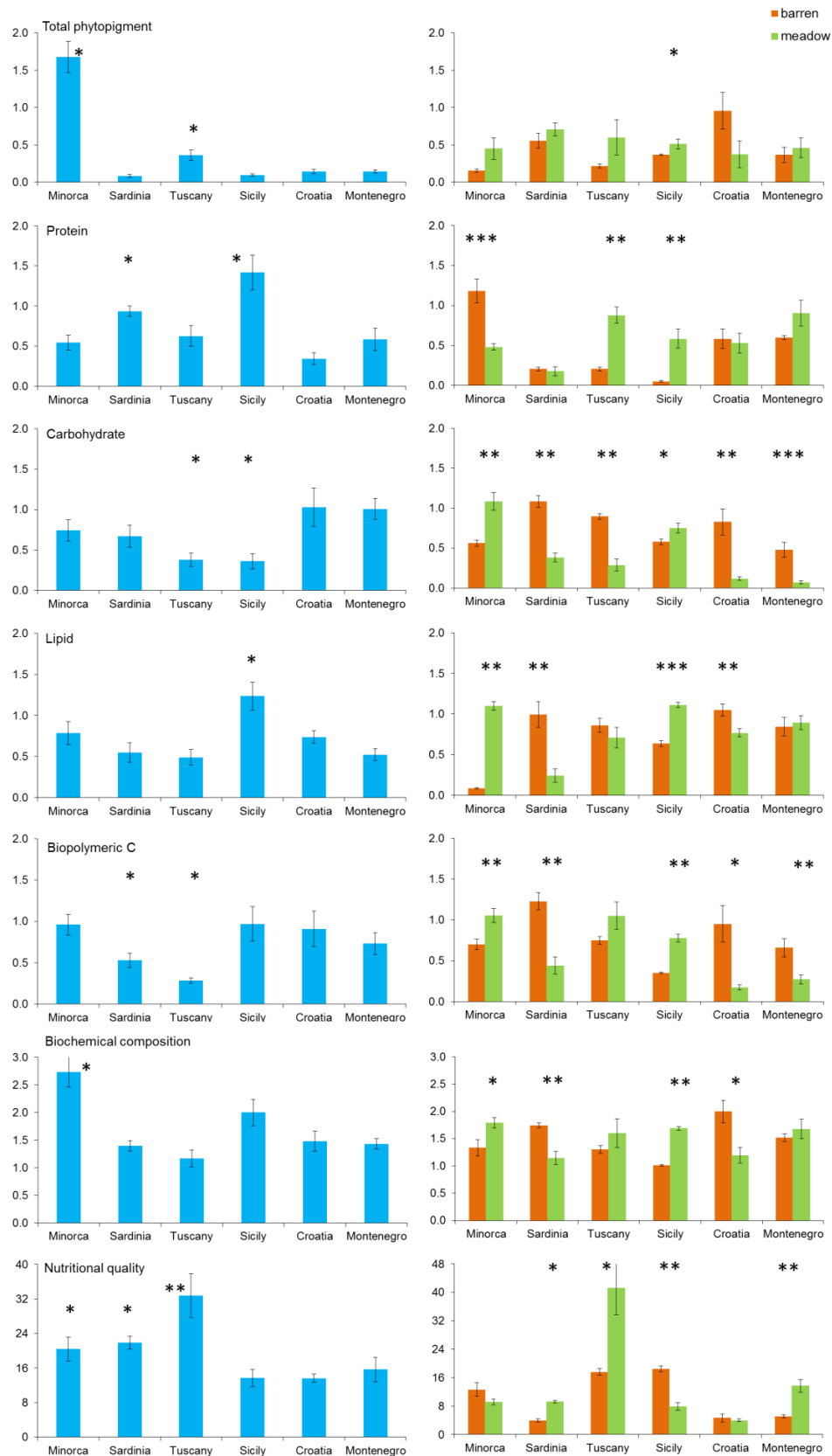


Figure S2. Average (\pm SE) multivariate dispersion (PERDISP) based on dissimilarity matrices of meiofaunal abundance, biomass, taxonomic composition and nematode species composition at the scales of area and state.

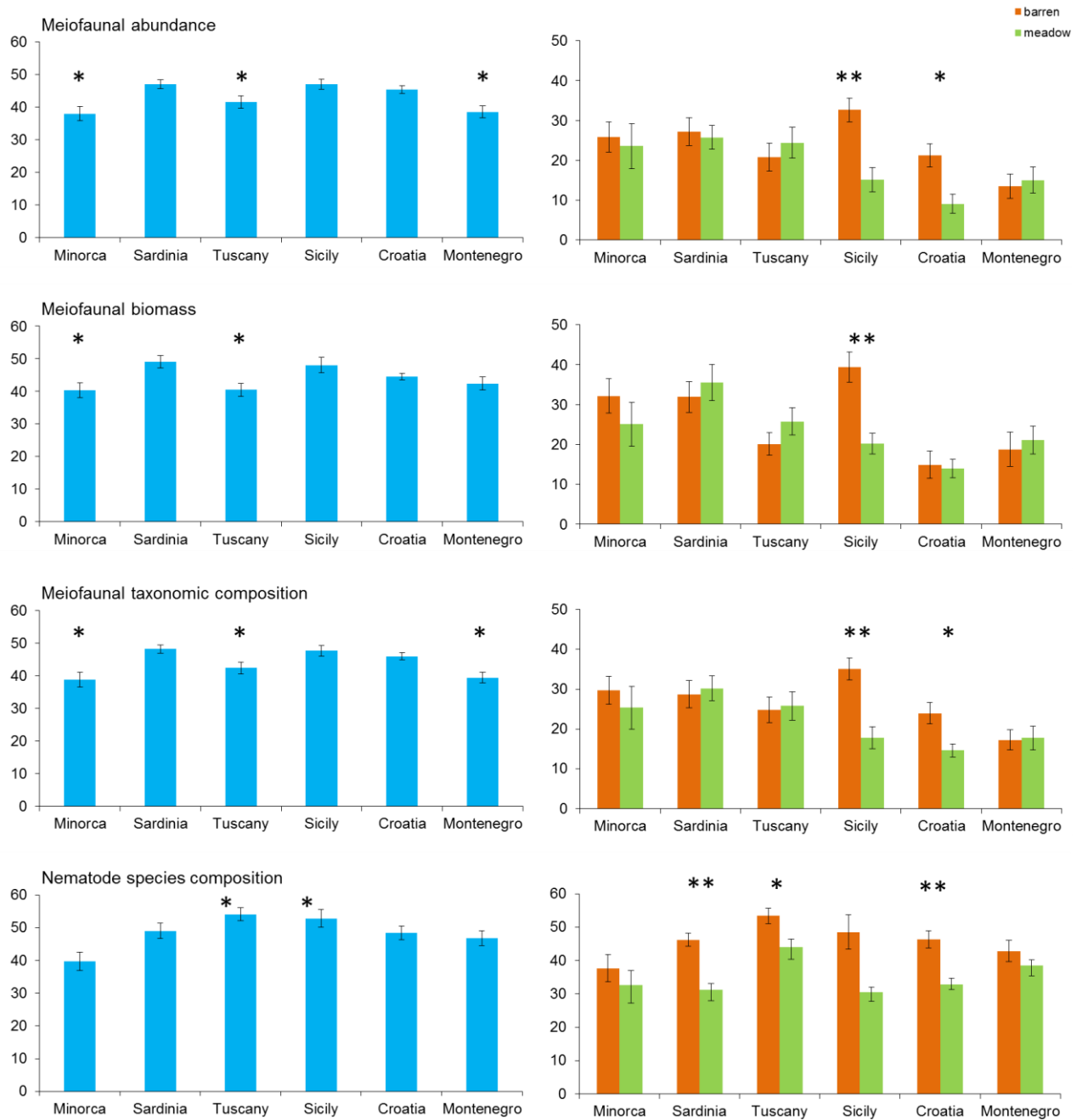


Figure S3. Effect of the presence of barrens on the concentration of sedimentary organic matter biochemical compounds.

