

## Relationship between functional diversity and benthic secondary production in a disturbed estuary

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### Supplement 1.

**Table S1.** Trait values of the studied species

Taxonomic group	Species	Size class (mg AFDM)	Life span (months)	Living position in the sediment	Mobility	Feeding guild	Reproduction frequency
Amphipoda	<i>Ampithoe valida</i>	0.28	9	Epifauna	Fixed tube dweller	Herbivore	Annual protracted
Amphipoda	<i>Melita palmata</i>	0.33	7	Epifauna	Limited movement	Deposit/Grazer	Annual protracted
Bivalvia	<i>Cerastoderma edule</i>	7.33	62	Up to 2 cm	Limited movement	Suspension/Deposit	Annual protracted
Bivalvia	<i>Scrobicularia plana</i>	15.5	62	Below 5 cm	Limited movement	Suspension/Deposit	Annual protracted
Decapoda	<i>Carcinus maenas</i>	8.83	62	Epifauna	Free movement via burrow system	Omnivore	Annual protracted
Gastropoda	<i>Gibbula umbilicalis</i>	7.98	28	Epifauna	Slow, free movement through the sediment matrix	Deposit/Grazer	Annual episodic
Gastropoda	<i>Haminoea hydatis</i>	4.19	18	Epifauna	Slow, free movement through the sediment matrix	Herbivore	Annual episodic
Gastropoda	<i>Littorina littorea</i>	60	62	Epifauna	Slow, free movement through the sediment matrix	Herbivore	Annual episodic
Gastropoda	<i>Littorina saxatilis</i>	4.85	62	Epifauna	Slow, free movement through the sediment matrix	Herbivore	Annual episodic
Gastropoda	<i>Peringia ulvae</i>	0.74	20	Epifauna	Slow, free movement through the sediment matrix	Deposit/Grazer	Annual protracted

Taxonomic group	Species	Size class (mg AFDM)	Life span (months)	Living position in the sediment	Mobility	Feeding guild	Reproduction frequency
Isopoda	<i>Cyathura carinata</i>	4.25	24	Epifauna	Limited movement	Omnivore	Annual protracted
Oligochaeta	Oligochaeta	0.14	24	2 to 5 cm	Slow, free movement through the sediment matrix	Strictly deposit	Annual protracted
Oligochaeta	<i>Tubificoides</i> sp.	0.1	24	2 to 5 cm	Slow, free movement through the sediment matrix	Strictly deposit	Annual protracted
Polychaeta	<i>Alkmaria romijni</i>	0.04	18	Up to 2 cm	Limited movement	Strictly deposit	Annual protracted
Polychaeta	<i>Capitella capitata</i>	0.37	18	Up to 2 cm	Limited movement	Strictly deposit	Annual protracted
Polychaeta	<i>Chaetozone setosa</i>	0.22	18	Up to 2 cm	Limited movement	Strictly deposit	Annual episodic
Polychaeta	<i>Eteone</i> spp.	1.4	18	Up to 2 cm	Slow, free movement through the sediment matrix	Omnivore	Annual protracted
Polychaeta	<i>Glycera trydactila</i>	18.91	48	Up to 2 cm	Slow, free movement through the sediment matrix	Omnivore	Annual protracted
Polychaeta	<i>Hediste diversicolor</i>	10.11	36	Below 5 cm	Free movement via burrow system	Omnivore	Semelparous
Polychaeta	<i>Heteromastus filiformis</i>	0.61	18	2 to 5 cm	Limited movement	Strictly deposit	Annual protracted
Polychaeta	<i>Mediomastus fragilis</i>	0.24	18	Up to 2 cm	Limited movement	Suspension/ Deposit	Annual episodic
Polychaeta	<i>Nephtys hombergi</i>	7.6	48	Up to 2 cm	Slow, free movement through the sediment matrix	Omnivore	Annual protracted
Polychaeta	<i>Pygospio elegans</i>	0.06	18	Up to 2 cm	Fixed tube dweller	Suspension/ Deposit	Annual protracted
Polychaeta	<i>Streblospio shrubsolii</i>	0.16	18	Up to 2 cm	Limited movement	Suspension/ Deposit	Annual protracted

**Table S2.** Spearman rank correlations between the community-weighted mean for each trait category combinations. The dominant trait categories in the community are in bold. \*Quantitative traits, with categories in grey to provide a trait identity for the life-history groups.

		2 to 5 cm	<2 cm	>5 cm	Epifauna	Deposit (SSDF-SDF)	Deposit/ Grazer	Herbivore	Omnivore	Suspension/ Deposit	Free movement	Limited movement	Slow free movement	Tube dweller
Living depth	2 to 5cm		0.12	-0.2	0.2	0.58	0.17	-0.02	0.33	-0.29	0.13	-0.1	0.15	0.55
	<b>&lt;2 cm</b>	0.12		-0.44	0.36	0.56	0.51	0.43	-0.49	-0.46	-0.27	-0.66	0.5	0.3
	<b>&gt;5 cm</b>	-0.2	-0.44		<b>-0.99</b>	-0.39	<b>-0.88</b>	-0.61	0.4	0.96	0.51	0.85	-0.89	-0.44
	Epifauna	0.2	0.36	-0.99		0.33	<b>0.9</b>	0.61	-0.41	-0.94	-0.55	-0.84	0.91	0.47
Feeding	Deposit (SSDF-SDF)	0.58	0.56	-0.39	0.33		0.31	0.25	-0.06	-0.44	-0.1	-0.36	0.29	0.43
	<b>Deposit/Grazer</b>	0.17	0.51	-0.88	0.9	0.31		0.79	-0.68	-0.82	-0.68	-0.94	0.99	0.42
	Herbivore	-0.02	0.43	-0.61	0.61	0.25	0.79		-0.74	-0.51	-0.59	-0.82	0.8	0.08
	<b>Omnivore</b>	0.33	-0.49	0.4	-0.41	-0.06	-0.68	-0.74		0.26	0.84	0.67	-0.68	0.02
	<b>Suspension/Deposit</b>	-0.29	-0.46	0.96	-0.94	-0.44	-0.82	-0.51	0.26		0.33	0.82	-0.83	-0.51
Mobility	Free movement	0.13	-0.27	0.51	-0.55	-0.1	-0.68	-0.59	0.84	0.33		0.53	-0.69	-0.06
	<b>Limited movement</b>	-0.1	-0.66	0.85	-0.84	-0.36	-0.94	-0.82	0.67	0.82	0.53		-0.95	-0.42
	<b>Slow free movement</b>	0.15	0.5	-0.89	0.91	0.29	0.99	0.8	-0.68	-0.83	-0.69	-0.95		0.42
	Tube dweller	0.55	0.3	-0.44	0.47	0.43	0.42	0.08	0.02	-0.51	-0.06	-0.42	0.42	
Reproduction	Annual episodic	-0.02	0.6	-0.58	0.56	0.42	0.75	0.95	-0.76	-0.5	-0.57	-0.82	0.77	0.17
	<b>Annual protracted</b>	0.14	-0.47	0.1	-0.03	-0.36	-0.17	-0.58	0.39	0.14	0.02	0.4	-0.2	0.18
	Semelparous	0.27	-0.27	0.62	-0.65	0.01	-0.78	-0.78	0.84	0.45	0.85	0.7	-0.8	-0.06
Size	<b>Size*</b>	-0.1	-0.52	0.98	-0.96	-0.38	-0.92	-0.7	0.54	0.93	0.58	0.92	-0.93	-0.39
	<0.5 mg	-0.07	0.72	-0.39	0.35	0.41	0.42	0.44	-0.51	-0.37	-0.4	-0.55	0.41	0.13
	>15 mg	-0.31	-0.45	0.95	-0.93	-0.46	-0.8	-0.49	0.24	1	0.32	0.8	-0.81	-0.51
	0.5 to 1.5 mg	0.17	0.6	-0.89	0.89	0.39	0.99	0.79	-0.67	-0.83	-0.65	-0.96	0.98	0.46
	5 to 15 mg	0.15	-0.54	0.48	-0.5	-0.04	-0.75	-0.57	0.87	0.37	0.71	0.71	-0.73	-0.2
Life span	<b>Life span*</b>	-0.14	-0.5	0.99	-0.97	-0.4	-0.89	-0.65	0.46	0.96	0.52	0.88	-0.91	-0.4
	<2 yr	0.13	0.6	-0.89	0.89	0.39	0.98	0.81	-0.69	-0.83	-0.66	-0.96	0.99	0.43
	>5 yr	-0.32	-0.44	0.94	-0.92	-0.49	-0.78	-0.46	0.22	0.99	0.34	0.77	-0.79	-0.48
	2 to 5 yr	0.44	-0.37	0.38	-0.4	0.1	-0.66	-0.77	0.93	0.24	0.7	0.66	-0.67	0.05

**Table S2 continued.** Spearman rank correlations between the community weighted mean for each trait category combinations. The dominant trait categories in the community are in bold. \*Quantitative traits, with categories in grey to provide the trait identity for the life-history groups.

	Annual episodic	Annual protracted	Semelparous	Size*	<0.5 mg	>15 mg	0.5 to 1.5 mg	5 to 15 mg	Life span*	<24 mo. (<2yrs)	>60mo. (>5yrs)	24 to 60mo. (2 to 5yrs)
2 to 5cm	-0.02	0.14	0.27	-0.1	-0.07	-0.31	0.17	0.15	-0.14	0.13	-0.32	0.44
<b>&lt;2 cm</b>	0.6	-0.47	-0.27	-0.52	0.72	-0.45	0.6	-0.54	-0.5	0.6	-0.44	-0.37
<b>&gt;5 cm</b>	-0.58	0.1	0.62	0.98	-0.39	0.95	-0.89	0.48	0.99	-0.89	0.94	0.38
Epifauna	0.56	-0.03	-0.65	-0.96	0.35	-0.93	0.89	-0.5	-0.97	0.89	-0.92	-0.4
Deposit (SSDF-SDF)	0.42	-0.36	0.01	-0.38	0.41	-0.46	0.39	-0.04	-0.4	0.39	-0.49	0.1
<b>Deposit/Grazer</b>	0.75	-0.17	-0.78	-0.92	0.42	-0.8	0.99	-0.75	-0.89	0.98	-0.78	-0.66
Herbivore	0.95	-0.58	-0.78	-0.7	0.44	-0.49	0.79	-0.57	-0.65	0.81	-0.46	-0.77
<b>Omnivore</b>	-0.76	0.39	0.84	0.54	-0.51	0.24	-0.67	0.87	0.46	-0.69	0.22	0.93
<b>Suspension/Deposit</b>	-0.5	0.14	0.45	0.93	-0.37	1.00	-0.83	0.37	0.96	-0.83	0.99	0.24
Free movement	-0.57	0.02	0.85	0.58	-0.4	0.32	-0.65	0.71	0.52	-0.66	0.34	0.7
<b>Limited movement</b>	-0.82	0.4	0.7	0.92	-0.55	0.8	-0.96	0.71	0.88	-0.96	0.77	0.66
<b>Slow free movement</b>	0.77	-0.2	-0.8	-0.93	0.41	-0.81	0.98	-0.73	-0.91	0.99	-0.79	-0.67
Tube dweller	0.17	0.18	-0.06	-0.39	0.13	-0.51	0.46	-0.2	-0.4	0.43	-0.48	0.05
Annual episodic		-0.67	-0.74	-0.69	0.52	-0.48	0.79	-0.58	-0.64	0.81	-0.46	-0.77
<b>Annual protracted</b>	-0.67		0.18	0.21	-0.4	0.15	-0.23	0.11	0.19	-0.27	0.13	0.39
Semelparous	-0.74	0.18		0.71	-0.33	0.43	-0.75	0.72	0.65	-0.78	0.41	0.88
Size*	-0.69	0.21	0.71						0.99			
<0.5 mg	0.52	-0.4	-0.33			-0.37	0.48	-0.41		0.5	-0.36	-0.34
>15 mg	-0.48	0.15	0.43		-0.37		-0.81	0.34		-0.82	0.99	0.21
0.5 to 1.5 mg	0.79	-0.23	-0.75		0.48	-0.81		-0.74		0.99	-0.79	-0.65
5 to 15 mg	-0.58	0.11	0.72		-0.41	0.34	-0.74			-0.72	0.31	0.82
Life span*	-0.64	0.19	0.65	0.99	-0.45	0.95	-0.9	0.5				
<2 yr	0.81	-0.27	-0.78		0.5	-0.82	0.99	-0.72			-0.8	-0.67
>5 yr	-0.46	0.13	0.41		-0.36	0.99	-0.79	0.31		-0.8		0.18
2 to 5 yr	-0.77	0.39	0.88		-0.34	0.21	-0.65	0.82		-0.67	0.18	

## Supplement 2

Statistical tests between functional diversity components *versus* the factors Site (Seagrass and Sandflat) and Period (PRE: 1993-1996, POST 1: 1999-2002, POST 2: 2003-2006)

### Life Strategy 1

(small epifauna, with short life span, free movement, grazers or/and deposit feeders)

Homogeneity, but Normality failed

ANOSIM

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BETWEEN Site (across all Period groups):	Global R: 0.89, p-value: 0.001
BETWEEN Period GROUPS (across all Site groups):	Global R: 0.241, p-value: 0.034

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#### Pairwise Tests

Groups	R Statistic	Significance Level %	Possible Permutations	Actual Permutations	Number >= Observed
PRE vs. POST1	<b>0.439</b>	<b>2.3</b>	525	525	12
PRE vs. POST2	0.188	11.2	525	525	59
POST1 vs. POST2	0.146	16.7	1225	999	166

### Life Strategy 2

(large long-lived burrowing species, with limited movement, suspension or/and deposit feeders)

Homogeneity, but Normality failed

ANOSIM

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BETWEEN Site (across all Period groups):	Global R: 1, p-value 0.001
BETWEEN Period GROUPS (across all Site groups):	Not significant (p-value 0.14)

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### Life Strategy 3

(Omnivores, with intermediate size and life span)

Homogeneity, but Normality failed

ANOSIM

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BETWEEN Site (across all Period groups):	Global R: 0.667, p-value: 0.001
BETWEEN Period GROUPS (across all Site groups):	Global R: 0.384, p-value: 0.003

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#### Pairwise Tests

Groups	R Statistic	Significance Level %	Possible Permutations	Actual Permutations	Number >= Observed
PRE vs. POST1	<b>0.705</b>	<b>0.2</b>	525	525	1
PRE vs. POST2	0.249	8.8	525	525	46
POST1 vs. POST2	0.276	6.3	1225	999	62

### Functional Richness

Homogeneity, Normality verified

ANOVA

	df	Sum Sq	Mean Sq	F value	Pr(>F)
Site	1	7.7648e-23	7.7648e-23	21.9509	0.0002483 ***
Period	2	5.9404e-23	2.9702e-23	8.3967	0.0032112 **
Period:Site	2	1.1272e-22	5.6359e-23	15.9327	0.0001559 ***
Residuals	16	5.6598e-23	3.5370e-24		

Multiple R-squared: 0.8153, Adjusted R-squared: 0.7575

Comparisons	
Sandflat PRE vs. Seagrass:PRE, Seagrass:POST1, Seagrass:POST2	p<0.001
Sandflat POST1 vs. Seagrass:PRE, Seagrass:POST1, Seagrass:POST2	Non-significant
Sandflat POST2 vs. Seagrass:PRE, Seagrass:POST1, Seagrass:POST2	Non-significant
Seagrass: PRE vs POST1, POST2	p<0.001
Seagrass: POST1 vs. POST2	Non-significant
Sandflat: PRE vs. POST1 vs. POST2	Non-significant

### Functional Evenness

Homogeneity, but Normality failed

*ANOSIM*

BETWEEN Site (across all Period groups):	Not significant (p-value 0.379)
BETWEEN Period GROUPS (across all Site groups):	Not significant (p-value 0.745)

### Functional Divergence

Homogeneity, but Normality failed

*ANOSIM*

BETWEEN Site (across all Period groups):	Global R: 0.381, p-value 0.008
BETWEEN Period GROUPS (across all Site groups):	Global R: 0.361, p-value 0.003

### Pairwise Tests

Groups	R Statistic	Significance Level %	Possible Permutations	Actual Permutations	Number >= Observed
PRE vs. POST1	<b>0.778</b>	<b>0.2*</b>	525	525	1
PRE vs. POST2	<b>0.321</b>	<b>5.1*</b>	525	525	27
POST1 vs. POST2	0.13	19.3	1225	999	192

### Functional Dispersion

Homogeneity, Normality verified

*ANOVA*

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Period	2	0.015034	0.0075172	5.8449	0.0124280 *
Site	1	0.004733	0.0047329	3.6800	0.0730920 .
Period:Site	2	0.032553	0.0162764	12.6555	0.0005063 ***
Residuals	16	0.020578	0.0012861		

Multiple R-squared: 0.7177, Adjusted R-squared: 0.6295

### Comparisons

Sandflat PRE vs. Seagrass:PRE, Seagrass:POST1, Seagrass:POST2	p<0.01
Sandflat POST1 vs. Seagrass:PRE, Seagrass:POST1, Seagrass:POST2	Non-significant
Sandflat POST2 vs. Seagrass:PRE, Seagrass:POST1, Seagrass:POST2	Non-significant
Seagrass: PRE vs POST1, POST2	p<0.01
Seagrass: POST1 vs. POST2	Non-significant
Sandflat: PRE vs. POST1, POST2	p<0.01
Sandflat: POST1 vs. POST2	Non-significant