

Supplementary material

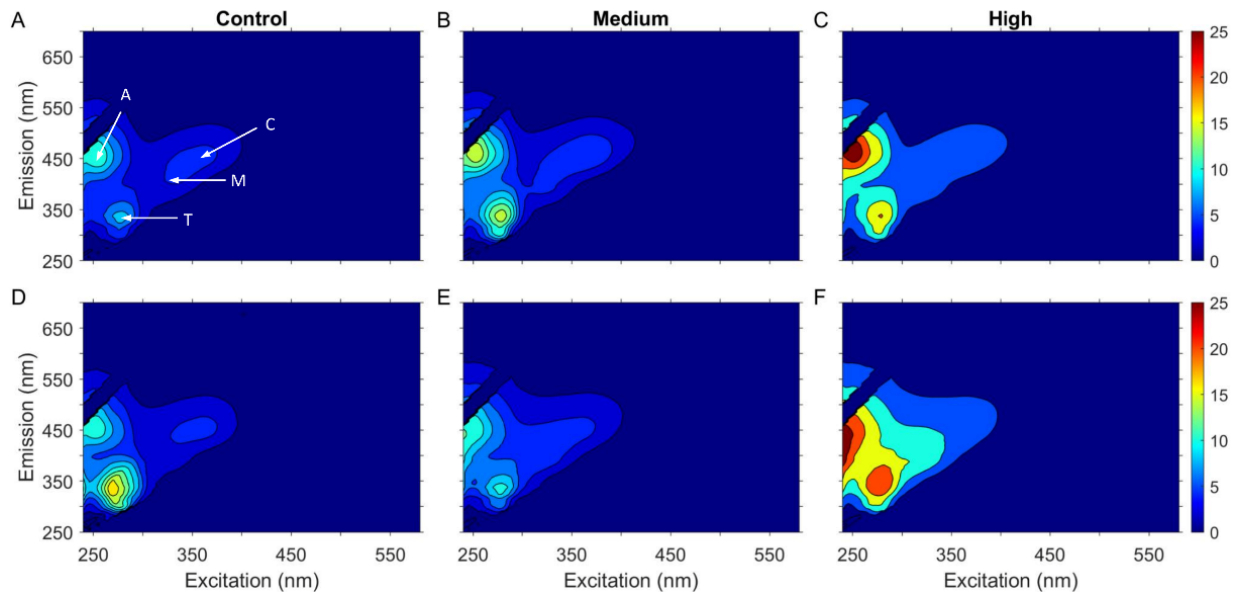


Figure S1: 3D excitation-emission matrices (EEM) of porewater DOM at 0 – 2 cm (top row: A, B, C) and 5 – 7 cm (bottom row: D, E, F) sediment depth as a function of nutrient enrichment treatment (A and D = control; B and E = medium; C and F = high). Each EEMs plot represents an average of 3 replicates at 6 sites ($n = 18$) during the summer sampling period. Peak features have been added to panel A for reference, as described by Coble (2007).

Table S1: 3D EEMs fluorescence peaks as described by Coble (2007).

Component	Peak name	Excitation/emission (nm)	Source
Humic-like	A	260 / 400–460	Terrestrial, allochthonous. Bulk of DOM export.
Humic-like	C	320–360 / 420–460	Terrestrial, agriculture.
Marine humic-like	M	290–310 / 370–410	Anthropogenic wastewater and agriculture, marine.
Protein-like (tryptophan)	T	275 / 340	Autochthonous.

Table S2: Sediment properties and univariate indices of macrofaunal communities as a function of sediment nutrient enrichment and season. Data are median with the range in parenthesis (n = 9 – 18).

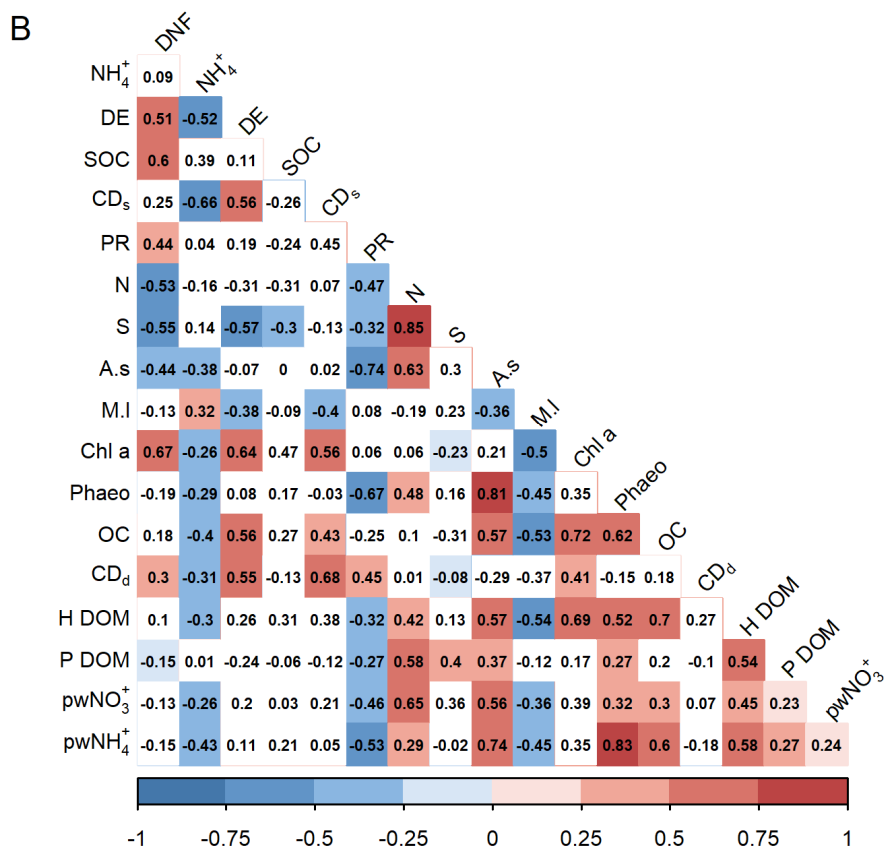
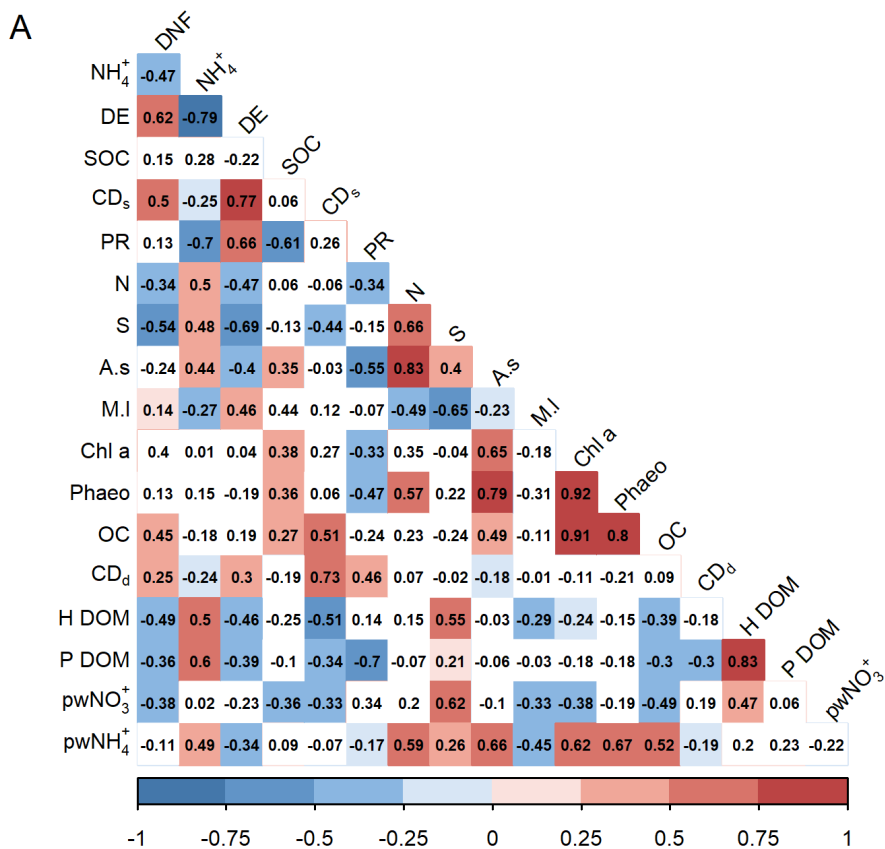
	Control		Medium		High	
	Winter	Summer	Winter	Summer	Winter	Summer
Sediment properties						
OC (%)	2.15 (1.19–3.38)	2.00 (0.97–4.36)	2.40 (1.18–3.18)	2.82 (1.14–4.18)	2.40 (1.19–3.45)	2.07 (1.06–4.70)
Mud (%)	14 (3.20–27)	6.82 (0.94–24)	12 (2.58–25)	6.55 (2.40–28)	13 (3.91–25)	10 (2.51–27)
MGS (µm)	154 (115–205)	196 (117–256)	156 (115–205)	194 (112–245)	153 (117–204)	193 (113–243)
MPB						
Chlorophyll <i>a</i> (µg g ⁻¹ DW)	11 (7.34–17)	8.36 (4.76–20)	18 (12–21)	15 (8.02–22)	13 (6.33–14)	12 (3.89–17)
Phaeopigments (µg g ⁻¹ DW)	3.78 (2.94–9.99)	4.36 (2.18–13)	6.94 (4.75–15)	6.61 (3.51–13)	6.64 (2.48–14)	6.85 (3.28–25)
PR *	0.95 (–0.17–2.63)	0.75 (0.05–2.05)	0.80 (0.25–1.74)	0.71 (–0.04–1.44)	1.10 (–0.03–1.82)	0.89 (0.02–2.16)
Macrofauna (per core)						
Total abundance	-	125 (29–343)	-	90 (28–296)	-	60 (2–225)
Taxa richness	-	19 (10–25)	-	14 (7–27)	-	11 (2–22)
Shannon diversity	-	2.4 (1.7–2.9)	-	2.0 (1.1–2.7)	-	1.8 (0.4–2.5)
<i>A. stutchburyi</i> (>10 mm)	1 (0–24)	6 (0–57)	1 (0–25)	11 (0–49)	2 (0–29)	4 (0–56)
<i>M. liliana</i> (>10 mm)	3 (3–9)	3 (1–6)	1 (0–4)	1 (0–6)	0 (0–1)	0 (0–4)
DOM fluorescence						
Humic-like (0–2 cm)	-	211 (148–469)	-	285 (139–570)	-	451 (177–1233)
Humic-like (5–7 cm)	-	185 (92–703)	-	209 (98–589)	-	408 (124–1788)
Protein-like (0–2 cm)	-	73 (26–228)	-	111 (42–549)	-	195 (84–579)
Protein-like (5–7 cm)	-	80 (28–1351)	-	107 (48–258)	-	218 (37–1080)
Porewater (µmol N L ⁻¹)						
NO ₃ ⁻ (0–2 cm)	1.23 (0.65–3.99)	1.40 (0.25–2.97)	5.68 (0.95–47)	7.21 (3.97–31)	41 (3.64–104)	28 (2.96–186)
NO ₃ ⁻ (5–7 cm)	1.31 (0.56–79)	1.30 (0.50–7.59)	6.09 (1.08–34)	27 (2.43–180)	81 (45–135)	151 (35–583)
NH ₄ ⁺ (0–2 cm)	2.19 (0.09–77)	12 (3.65–133)	602 (17–4425)	261 (12–4563)	1947 (202–13512)	4359 (371–18526)
NH ₄ ⁺ (5–7 cm)	45 (7.96–111)	37 (9.24–175)	6808 (125–12831)	2398 (26–18871)	65425 (1975–91593)	35472 (274–99917)

OC = organic content; Mud = mud content; MGS = median grain size; DW = dry weight; PR = photosynthesis respiration ratio

* Data from {Mangan, 2020 #366@-author-year}

Table S3: Results of one-way PERMANOVAs to determine treatment effects on sediment and macrofauna properties, DOM fluorescence and porewater nutrient concentrations. Repeated measures two-way PERMANOVAs are used to compare summer and winter values. Significant effects ($p < 0.05$) are given in bold and post-hoc pairwise tests are shown for significant interactions. Nutrient enrichment treatments have been further abbreviated to C = control, M = medium, H = high, and winter and summer to W and S, respectively.

		Term	df	Pseudo-	p	Post-hoc pairwise tests	
						Treatment	Time
Summer							
Sediment characteristics	Treatment	2	0.13	0.947			
Chlorophyll <i>a</i>	Treatment	2	7.28	0.002	(C = H) < M		
Phaeopigments	Treatment	2	1.57	0.236			
Macrofauna							
Total abundance	Treatment	2	2.83	0.072			
Taxa richness	Treatment	2	7.45	0.001	(C = M) > H		
Shannon diversity	Treatment	2	6.94	0.002	C > (M = H)		
<i>A. stutchburyi</i> (>10 mm)	Treatment	2	0.14	0.868			
<i>M. liliana</i> (>10 mm)	Treatment	2	15.63	0.001	C > (M = H)		
DOM fluorescence							
Humic-like (0–2 cm)	Treatment	2	12.92	0.001	(C = M) < H		
Humic-like (5–7 cm)	Treatment	2	8.52	0.001	(C = M) < H		
Protein-like (0–2 cm)	Treatment	2	6.08	0.004	C < (M = H)		
Protein-like (5–7 cm)	Treatment	2	1.96	0.142			
Porewater							
NO ₃ ⁻ (0–2 cm)	Treatment	2	10.81	0.001	C < M < H		
NO ₃ ⁻ (5–7 cm)	Treatment	2	17.69	0.001	C < M < H		
NH ₄ ⁺ (0–2 cm)	Treatment	2	22.02	0.001	C < M < H		
NH ₄ ⁺ (5–7 cm)	Treatment	2	16.16	0.001	C < M < H		
Seasonal							
Sediment characteristics	Treatment	2	0.17	0.988			
	Time	1	31.12	0.001		W ≠ S	
	Treatment X Time	2	0.49	0.646			
Chlorophyll <i>a</i>	Treatment	2	5.97	0.015	(C = H) < M		
	Time	1	1.25	0.260			
	Treatment X Time	2	0.85	0.477			
Phaeopigments	Treatment	2	1.03	0.389			
	Time	1	4.96	0.027		W > S	
	Treatment X Time	2	2.69	0.085			
Macrofauna							
<i>A. stutchburyi</i> (>10 mm)	Treatment	2	0.11	0.884			
	Time	1	1.65	0.194			
	Treatment X Time	2	0.19	0.839			
<i>M. liliana</i> (>10 mm)	Treatment	2	26.83	0.001	C > (M = H)		
	Time	1	0.62	0.439			
	Treatment X Time	2	1.35	0.292			
Porewater							
NO ₃ ⁻ (0–2 cm)	Treatment	2	12.07	0.001	C < M < H		
	Time	1	1.19	0.282			
	Treatment X Time	2	1.87	0.161			
NO ₃ ⁻ (5–7 cm)	Treatment	2	22.20	0.001			
	Time	1	6.74	0.007			
	Treatment X Time	2	8.51	0.001	S, C < M < H; C, M, S = W		
NH ₄ ⁺ (0–2 cm)	Treatment	2	8.93	0.001	C < M < H		
	Time	1	0.04	0.848			
	Treatment X Time	2	0.10	0.921			
NH ₄ ⁺ (5–7 cm)	Treatment	2	14.88	0.001	C < M < H		
	Time	1	0.74	0.382			
	Treatment X Time	2	0.32	0.727			



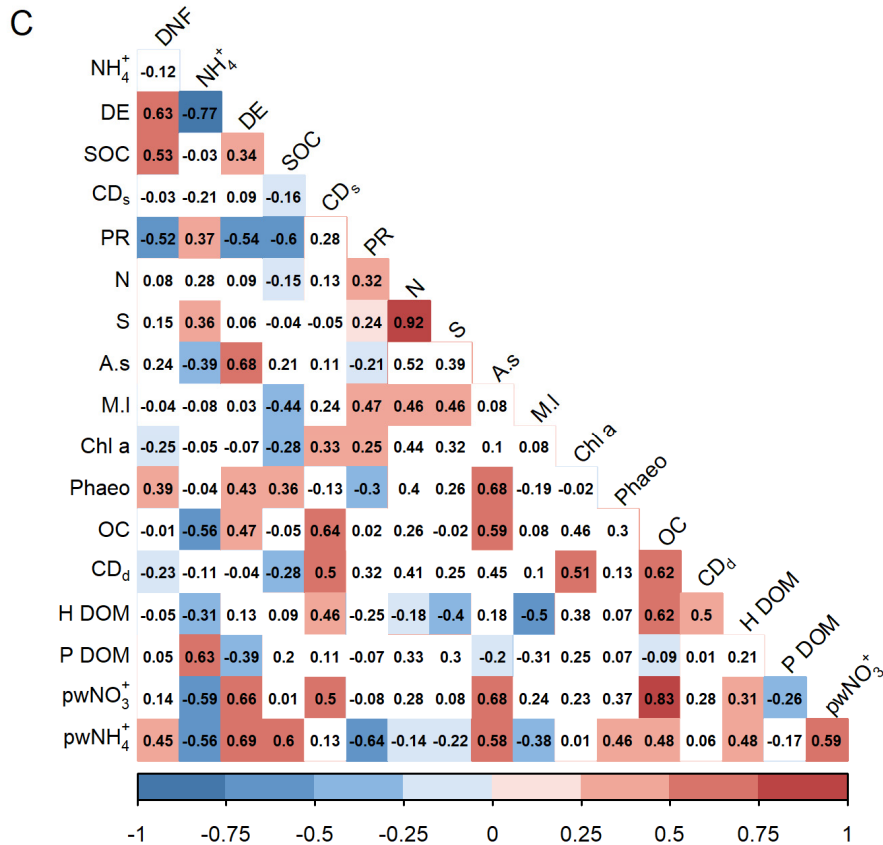


Figure S2: Pearson's correlation coefficients between summer N and C cycling parameters, environmental variables and univariate indices of macrofaunal communities under A) no (control), B) medium and C) high nutrient enrichment (n = 18). Correlations with p -values < 0.05 are coloured in shades of blue for negative and red for positive correlations. Parameters are ordered as N cycling, C cycling, univariate macrofaunal indices, environmental variables and porewater concentrations. DNF = net denitrification rate; NH₄⁺ = NH₄⁺ efflux; DE = denitrification efficiency; SOC = sediment oxygen consumption; CD₅ = carbon degradation rate at the sediment surface; PR = photosynthesis respiration ratio; N = total abundance; S = species richness; A.s = adult *Austrovenus stutchburyi*; M.I = adult *Macomona liliana*; Chl a = sediment chlorophyll a; Phaeo = phaeopigment content; OC = sediment organic content; CD_d = carbon degradation rate at 5 – 7 cm; H DOM = humic-like fluorescence; P DOM = protein-like fluorescence; pw NO₃⁺ = porewater nitrate concentration; pw NH₄⁺ = porewater ammonium concentration. Both fluorescence intensities and porewater concentrations are an averaged of data collected at 0 – 2 cm and 5 – 7 cm sediment depth.