

Table S1: Temperature and salinity, as well as initial dissolved ammonium (NH_4^+) and combined nitrate-nitrite (NO_x) concentrations for each sediment incubation. All values are reported as mean \pm standard error. N = 3 for every measurement for each incubation.

Incubation Date	Site	Temp	Salinity	NH_4^+ (μM)	NO_x (μM)
Aug. 9, 2016	Town Pond	26.1 \pm 0.1	31.4 \pm 0.0	3.59 \pm 0.86	0.99 \pm 0.05
Aug. 11, 2016	Bissel Cove	23.5 \pm 0.1	31.6 \pm 0.0	2.95 \pm 0.90	0.48 \pm 0.03
Aug. 18, 2016	Allen Harbor	24.7 \pm 0.1	31.2 \pm 0.1	2.68 \pm 0.78	0.44 \pm 0.04
Oct. 7, 2016	Town Pond	21.2 \pm 0.1	30.8 \pm 0.1	1.93 \pm 1.27	1.72 \pm 0.06
Oct. 15, 2016	Bissel Cove	15.9 \pm 0.1	30.6 \pm 0.3	4.37 \pm 1.80	1.79 \pm 0.03
Oct. 18, 2016	Allen Harbor	19.5 \pm 0.1	30.9 \pm 0.0	2.33 \pm 0.83	0.51 \pm 0.02
Apr. 20, 2017	Town Pond	12.8 \pm 0.1	18.5 \pm 0.2	2.84 \pm 0.52	42.41 \pm 4.34
Apr. 25, 2017	Bissel Cove	12.9 \pm 0.0	24.1 \pm 0.0	3.05 \pm 0.95	1.24 \pm 0.01
Apr. 29, 2017	Allen Harbor	13.3 \pm 0.0	26.9 \pm 0.0	5.62 \pm 3.71	0.61 \pm 0.01
July 7, 2017	Allen Harbor	23.4 \pm 0.1	27.5 \pm 0.2	4.21 \pm 0.75	0.19 \pm 0.03
July 7, 2017	Bissel Cove	23.2 \pm 0.0	26.6 \pm 0.0	3.96 \pm 0.66	0.31 \pm 0.07
Jul 18, 2017	Town Pond	23.1 \pm 0.0	28.1 \pm 0.0	7.38 \pm 5.27	0.25 \pm 0.06

Table S2: Seasonal patterns of sediment properties (0-1 cm depth) at each sampling site. N=3 per measurement unless otherwise noted.

Incubation Date	Site	%OM (LOI)	Chl-a ($\mu\text{g m}^{-2}$)	Pheo ($\mu\text{g m}^{-2}$)	%C	%N	C:N (mol/mol)	Density (g L^{-1})	Porosity (%)
Aug. 9, 2016	Town Pond	5.56 ± 1.78	2333.2 ± 805.1	6368.2 ± 2062.2	3.25 ± 0.83	0.16 ± 0.03	22.9 ± 2.7	1.14 ± 0.07	0.48 ± 0.07
Aug. 11, 2016	Bissel Cove	2.42 ± 0.69	1124.2 ± 157.2	1519.6 ± 379.7	1.24 ± 0.30	0.08 ± 0.02	19.9 ± 1.2	1.72 ± 0.03	0.47 ± 0.06
Aug. 18, 2016	Allen Harbor	1.18 ± 0.06	5021.4 ± 2257.8	1981.7 ± 662.4	0.53 ± 0.02	0.02 ± 0	31.1 ± 2.2	1.82 ± 0.06	0.44 ± 0.03
Oct. 7, 2016	Town Pond	6.19 ± 0.93	1396.3 ± 1014.7 ^a	4873.6 ± 3425.0 ^a	2.78 ± 0.63	0.18 ± 0.03	19.8 ± 6.7	1.44 ± 0.09	0.66 ± 0.05
Oct. 15, 2016	Bissel Cove	--	1324.9 ± 394.5 ^a	3709.2 ± 2747.5 ^a	--	--	--	1.51 ± 0.13	0.66 ± 0.6
Oct. 18, 2016	Allen Harbor	1.11 ± 0.23	3710.9 ± 490.0	3075.9 ± 177.3	0.62 ± 0.08	0.02 ± 0	46.7 ± 8.9	1.72 ± 0.05	0.45 ± 0.03
Apr. 20, 2017	Town Pond	7.61 ± 0.02	2719.1 ± 554.0	8724.3 ± 971.7	2.40 ± 0.29	0.25 ± 0.04	11.5 ± 0.6	1.14 ± 0.02	0.68 ± 0.02
Apr. 25, 2017	Bissel Cove	4.41 ± 0.83	6253.7 ± 452.9 ^a	7137.5 ± 380.6 ^a	1.82 ± 0.16	0.14 ± 0.02	15.2 ± 0.6	1.41 ± 0.09	0.61 ± 0.01
Apr. 29, 2017	Allen Harbor	1.11 ± 0.14	2601.1 ± 367.4	1090.5 ± 222.6	0.57 ± 0.05	0.02 ± 0	30.6 ± 8.7	1.86 ± 0.05	0.45 ± 0.01
July 7, 2017	Allen Harbor	1.04 ± 0.06	5379.9 ± 516.0	2051.8 ± 257.2	0.50 ± 0.06	0.02 ± 0	35.1 ± 2.2	1.70 ± 0.03	0.65 ± 0.18
July 7, 2017	Bissel Cove	2.09 ± 0.74	1838.3 ± 302.3	2271.3 ± 723.9	0.94 ± 0.24	0.06 ± 0.03	28.2 ± 11.0	1.46 ± 0.04	0.43 ± 0.03
Jul 18, 2017	Town Pond	4.16 ± 2.11	941.6 ± 354.3	2324.1 ± 1042.8	1.79 ± 0.75	0.16 ± 0.09	15.4 ± 2.2	1.83 ± 0.18	0.47 ± 0.01

^a Only two cores were sampled for sediment chlorophyll-*a* and pheophytin during these incubations due to the large number of shell pieces in the sediment.

^b No samples were collected for analysis of %OM, %C, or %N during this incubation due to the large number of shell pieces in the sediment.

Table S3: Results of linear regressions estimating the ability to predict mean sediment fluxes using water column pigment concentrations (Chl-*a*: chlorophyll-*a*, Pheo: pheophytin, Pigments: chlorophyll-*a* + pheophytin) over various time lags (Prev.: previous).

Flux	Previous Week Chl- <i>a</i>	Previous Week Pheo	Previous Week Pigments	Previous Month Chl- <i>a</i>	Previous Month Pheo	Previous Month Pigments	Prev. 3 Months Chl- <i>a</i>	Prev. 3 Months Pheo	Prev. 3 Months Pigments
O₂	R ² = 0 p = 0.92	R ² = 0 p = 0.91	R ² = 0 p = 0.89	R ² = 0 p = 0.64	R ² = 0 p = 0.47	R ² = 0 p = 0.46	R ² = 0.03 p = 0.27	R ² = 0.08 p = 0.19	R ² = 0.16 p = 0.11
PO₄³⁻	R ² = 0 p = 0.64	R ² = 0 p = 0.83	R ² = 0 p = 0.83	R ² = 0 p = 0.97	R ² = 0 p = 0.61	R ² = 0 p = 0.79	R ² = 0.01 p = 0.32	R ² = 0 p = 0.59	R ² = 0.03 p = 0.28
ΣN	R ² = 0.06 p = 0.23	R² = 0.25 p = 0.05	R² = 0.26 p = 0.05	R ² = 0 p = 0.64	R² = 0.51 p = 0.01	R ² = 0.21 p = 0.07	R ² = 0 p = 0.48	R ² = 0 p = 0.55	R ² = 0 p = 0.80
N₂-N	R ² = 0 p = 0.33	R ² = 0.01 p = 0.31	R ² = 0 p = 0.90	R ² = 0.12 p = 0.14	R ² = 0 p = 0.52	R ² = 0 p = 0.53	R ² = 0 p = 0.78	R ² = 0.06 p = 0.23	R ² = 0 p = 0.70
NH₄⁺	R ² = 0 p = 0.44	R ² = 0.04 p = 0.26	R ² = 0.04 p = 0.25	R ² = 0.20 p = 0.08	R ² = 0.07 p = 0.20	R² = 0.30 p = 0.04	R ² = 0.03 p = 0.28	R ² = 0 p = 0.38	R ² = 0.09 p = 0.18
NO_x	R ² = 0 p = 0.75	R ² = 0 p = 0.93	R ² = 0 p = 0.78	R ² = 0 p = 0.65	R ² = 0.09 p = 0.18	R ² = 0 p = 0.68	R ² = 0 p = 0.51	R ² = 0.04 p = 0.25	R ² = 0 p = 0.95

Table S4: Results of linear regressions between sediment fluxes and sediment properties (0-1 cm depth; %OM: percent organic matter, Chl-*a*: chlorophyll-*a*, Pheo: pheophytin, Total Pigments: chlorophyll-*a* + pheophytin). Statistically significant ($p \leq 0.05$) relationships are bolded, and R^2 values indicate the adjusted R^2 .

	ΣN Flux	O_2 Flux	PO_4^{3-} Flux	N_2-N Flux	NH_4^+ Flux	NO_x Flux
%OM	$R^2 = 0.02$	$R^2 = 0$	$R^2 = 0.04$	$R^2 = 0$	$R^2 = 0$	$R^2 = 0.04$
	$p = 0.21$	$p = 0.56$	$p = 0.16$	$p = 0.43$	$p = 0.58$	$p = 0.16$
Chl-<i>a</i>	$R^2 = 0$	$R^2 = 0$	$R^2 = 0$	$R^2 = 0$	$R^2 = 0$	$R^2 = 0$
	$p = 0.77$	$p = 0.91$	$p = 0.79$	$p = 0.61$	$p = 0.36$	$p = 0.83$
Pheo	$R^2 = 0.12$	$R^2 = 0$	$R^2 = 0.09$	$R^2 = 0.21$	$R^2 = 0$	$R^2 = 0.07$
	$p = 0.03$	$p = 0.92$	$p = 0.06$	$p < 0.01$	$p = 0.77$	$p = 0.08$
Total	$R^2 = 0.03$	$R^2 = 0$	$R^2 = 0.02$	$R^2 = 0.13$	$R^2 = 0$	$R^2 = 0.03$
Pigments	$p = 0.17$	$p = 0.99$	$p = 0.21$	$p = 0.02$	$p = 0.78$	$p = 0.17$