

SUPPLEMENTARY INFORMATION FOR

Nitrogen deposition reveals global patterns in plant and animal stoichiometry

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Supplementary Tables

Supplementary Table 1. Effects of absolute latitude, environmental drivers (temperature, radiation, N deposition, labile P), realms (freshwater vs. terrestrial), and trophic groups (autotroph vs. heterotroph) on organismal N and P content, and N:P ratios. Values are slope coefficients (\pm SE) describing relationships between elemental content and environmental predictors. “Overall” denotes the relationship between a predictor and a given element (N, P, or N:P) across all habitats and trophic groups. The symbol “-” indicates contrasts between slopes. Both original *P* values and Benjamini-Hochberg-corrected *P* values (*P* - B&H) are reported, with statistically significant effects after correction shown in bold. *P* values are based on two-sided tests with permuted t-statistics.

Models / Effects	Slopes	SE	<i>P</i>	<i>P</i> - B&H
MODELS WITH ABSOLUTE LATITUDE				
Model N content				
ABSOLUTE LATITUDE				
overall	3.0e-03	4.3e-04	0.008	0.060
freshwater	3.6e-03	7.8e-04	0.065	0.190
terrestrial	2.5e-03	3.2e-04	0.027	0.101
freshwater - terrestrial	1.1e-03	8.2e-04	0.727	0.991
autotroph	4.5e-03	5.9e-04	0.013	0.065
heterotroph	1.6e-03	4.4e-04	0.307	0.512
autotroph - heterotroph	3.0e-03	6.0e-04	0.188	0.352

freshwater autotroph	5.0e-03	9.0e-04	0.076	0.190
terrestrial autotroph	4.0e-03	4.7e-04	0.007	0.060
freshwater heterotroph	2.1e-03	7.5e-04	0.122	0.261
terrestrial heterotroph	1.0e-03	4.0e-04	0.627	0.941
freshwater autotroph - terrestrial autotroph	1.1e-03	8.2e-04	1.000	1.000
freshwater autotroph - freshwater	3.0e-03	6.0e-04	1.000	1.000
heterotroph				
terrestrial autotroph - terrestrial heterotroph	3.0e-03	6.0e-04	1.000	1.000
freshwater heterotroph - terrestrial	1.1e-03	8.2e-04	1.000	1.000
heterotroph				
Model P content				
ABSOLUTE LATITUDE				
overall	6.5e-03	8.5e-04	0.014	0.052
freshwater	4.1e-03	1.6e-03	0.265	0.442
terrestrial	9.0e-03	1.1e-03	<0.001	<0.001
freshwater - terrestrial	-5.0e-03	2.1e-03	0.209	0.392
autotroph	1.0e-02	1.3e-03	0.002	0.010
heterotroph	3.0e-03	1.4e-03	0.299	0.448
autotroph - heterotroph	7.2e-03	2.0e-03	0.065	0.191
freshwater autotroph	7.6e-03	2.2e-03	0.086	0.191
terrestrial autotroph	1.3e-02	8.6e-04	<0.001	<0.001
freshwater heterotroph	4.8e-04	1.6e-03	0.917	1.000
terrestrial heterotroph	5.4e-03	1.9e-03	0.089	0.191

freshwater autotroph - terrestrial autotroph	-5.0e-03	2.1e-03	1.000	1.000
freshwater autotroph - freshwater	7.2e-03	2.0e-03	1.000	1.000
heterotroph				
terrestrial autotroph - terrestrial heterotroph	7.2e-03	2.0e-03	1.000	1.000
freshwater heterotroph - terrestrial	-5.0e-03	2.1e-03	1.000	1.000
heterotroph				
Model N:P ratio				
ABSOLUTE LATITUDE				
overall	-5.6e-03	8.5e-04	0.057	0.171
freshwater	-2.0e-03	1.6e-03	0.614	1.000
terrestrial	-9.2e-03	1.1e-03	<0.001	<0.001
freshwater - terrestrial	7.1e-03	2.2e-03	0.151	0.378
autotroph	-6.5e-03	1.3e-03	0.031	0.135
heterotroph	-4.7e-03	1.4e-03	0.187	0.401
autotroph - heterotroph	-1.8e-03	2.1e-03	0.724	1.000
freshwater autotroph	-2.9e-03	2.2e-03	0.567	1.000
terrestrial autotroph	-1.0e-02	8.5e-04	<0.001	<0.001
freshwater heterotroph	-1.2e-03	1.5e-03	0.850	1.000
terrestrial heterotroph	-8.3e-03	2.0e-03	0.036	0.135
freshwater autotroph - terrestrial autotroph	7.1e-03	2.2e-03	1.000	1.000
freshwater autotroph - freshwater	-1.8e-03	2.1e-03	1.000	1.000
heterotroph				
terrestrial autotroph - terrestrial heterotroph	-1.8e-03	2.1e-03	1.000	1.000

freshwater heterotroph - terrestrial	7.1e-03	2.2e-03	1.000	1.000
heterotroph				
MODELS WITH ENVIRONMENTAL DRIVERS				
Model N content				
TEMPERATURE				
overall	-4.6e-03	1.0e-03	0.111	0.476
freshwater	-3.5e-03	1.8e-03	0.533	1.000
terrestrial	-5.6e-03	9.7e-04	0.175	0.656
freshwater - terrestrial	2.2e-03	2.0e-03	0.820	1.000
autotroph	-1.0e-02	1.6e-03	0.059	0.354
heterotroph	9.6e-04	1.1e-03	0.850	1.000
autotroph - heterotroph	-1.1e-02	1.8e-03	0.148	0.592
freshwater autotroph	-9.0e-03	2.3e-03	0.295	0.805
terrestrial autotroph	-1.1e-02	1.3e-03	0.010	0.067
freshwater heterotroph	2.0e-03	1.6e-03	0.516	1.000
terrestrial heterotroph	-1.1e-04	1.4e-03	0.987	1.000
freshwater autotroph - terrestrial autotroph	2.2e-03	2.0e-03	1.000	1.000
freshwater autotroph - freshwater	-1.1e-02	1.8e-03	1.000	1.000
heterotroph				
terrestrial autotroph - terrestrial heterotroph	-1.1e-02	1.8e-03	1.000	1.000
freshwater heterotroph - terrestrial	2.2e-03	2.0e-03	1.000	1.000
heterotroph				
RADIATION				

overall	-1.2e-03	9.0e-03	0.957	1.000
freshwater	3.7e-03	1.5e-02	0.939	1.000
terrestrial	-6.0e-03	9.2e-03	0.872	1.000
freshwater - terrestrial	9.7e-03	1.7e-02	0.901	1.000
autotroph	2.5e-02	1.5e-02	0.609	1.000
heterotroph	-2.7e-02	9.0e-03	0.503	1.000
autotroph - heterotroph	5.2e-02	1.7e-02	0.453	1.000
freshwater autotroph	3.0e-02	2.1e-02	0.682	1.000
terrestrial autotroph	2.0e-02	1.3e-02	0.621	1.000
freshwater heterotroph	-2.3e-02	1.3e-02	0.377	0.943
terrestrial heterotroph	-3.2e-02	1.2e-02	0.680	1.000
freshwater autotroph - terrestrial autotroph	9.7e-03	1.7e-02	1.000	1.000
freshwater autotroph - freshwater	5.2e-02	1.7e-02	1.000	1.000
heterotroph				
terrestrial autotroph - terrestrial heterotroph	5.2e-02	1.7e-02	1.000	1.000
freshwater heterotroph - terrestrial	9.7e-03	1.7e-02	1.000	1.000
heterotroph				
N DEPOSITION				
overall	9.7e-02	7.0e-03	<0.001	<0.001
freshwater	1.9e-01	1.1e-02	<0.001	<0.001
terrestrial	-9.5e-05	7.9e-03	0.998	1.000
freshwater - terrestrial	1.9e-01	1.3e-02	0.005	0.038
autotroph	2.2e-01	1.3e-02	<0.001	<0.001

heterotroph	-2.1e-02	6.9e-03	0.519	1.000
autotroph - heterotroph	2.4e-01	1.5e-02	<0.001	<0.001
freshwater autotroph	3.1e-01	1.7e-02	<0.001	<0.001
terrestrial autotroph	1.2e-01	1.1e-02	0.001	0.009
freshwater heterotroph	7.6e-02	8.9e-03	<0.001	<0.001
terrestrial heterotroph	-1.2e-01	1.0e-02	0.096	0.476
freshwater autotroph - terrestrial autotroph	1.9e-01	1.3e-02	1.000	1.000
freshwater autotroph - freshwater	2.4e-01	1.5e-02	1.000	1.000
heterotroph				
terrestrial autotroph - terrestrial heterotroph	2.4e-01	1.5e-02	1.000	1.000
freshwater heterotroph - terrestrial	1.9e-01	1.3e-02	1.000	1.000
heterotroph				
LABILE P				
overall	-1.2e-02	1.1e-02	0.713	1.000
freshwater	4.3e-02	1.8e-02	0.447	1.000
terrestrial	-6.7e-02	1.3e-02	0.204	0.710
freshwater - terrestrial	1.1e-01	2.2e-02	0.258	0.737
autotroph	6.5e-02	2.0e-02	0.333	0.869
heterotroph	-8.8e-02	1.2e-02	0.080	0.436
autotroph - heterotroph	1.5e-01	2.4e-02	0.105	0.476
freshwater autotroph	1.2e-01	2.6e-02	0.229	0.723
terrestrial autotroph	9.9e-03	1.8e-02	0.852	1.000
freshwater heterotroph	-3.4e-02	1.4e-02	0.243	0.729

terrestrial heterotroph	-1.4e-01	1.7e-02	0.213	0.710
freshwater autotroph - terrestrial autotroph	1.1e-01	2.2e-02	1.000	1.000
freshwater autotroph - freshwater	1.5e-01	2.4e-02	1.000	1.000
heterotroph				
terrestrial autotroph - terrestrial heterotroph	1.5e-01	2.4e-02	1.000	1.000
freshwater heterotroph - terrestrial	1.1e-01	2.2e-02	1.000	1.000
heterotroph				
Model P content				
TEMPERATURE				
overall	-1.0e-02	1.9e-03	0.120	0.600
freshwater	-5.5e-03	3.8e-03	0.564	1.000
terrestrial	-1.5e-02	3.4e-03	0.072	0.535
freshwater - terrestrial	9.3e-03	6.2e-03	0.471	1.000
autotroph	-5.3e-03	3.5e-03	0.588	1.000
heterotroph	-1.5e-02	3.8e-03	0.078	0.535
autotroph - heterotroph	9.7e-03	6.2e-03	0.469	1.000
freshwater autotroph	-6.5e-04	6.2e-03	0.955	1.000
terrestrial autotroph	-9.9e-03	2.1e-03	0.218	0.770
freshwater heterotroph	-1.0e-02	3.1e-03	0.331	1.000
terrestrial heterotroph	-2.0e-02	6.1e-03	0.092	0.535
freshwater autotroph - terrestrial autotroph	9.3e-03	6.2e-03	1.000	1.000
freshwater autotroph - freshwater	9.7e-03	6.2e-03	1.000	1.000
heterotroph				

terrestrial autotroph - terrestrial heterotroph	9.7e-03	6.2e-03	1.000	1.000
freshwater heterotroph - terrestrial heterotroph	9.3e-03	6.2e-03	1.000	1.000
RADIATION				
overall	3.3e-02	1.8e-02	0.598	1.000
freshwater	2.5e-02	3.5e-02	0.810	1.000
terrestrial	4.1e-02	2.8e-02	0.536	1.000
freshwater - terrestrial	-1.6e-02	5.2e-02	0.889	1.000
autotroph	2.8e-02	3.1e-02	0.774	1.000
heterotroph	3.8e-02	3.0e-02	0.565	1.000
autotroph - heterotroph	-1.1e-02	4.9e-02	0.931	1.000
freshwater autotroph	1.9e-02	5.2e-02	0.872	1.000
terrestrial autotroph	3.6e-02	2.3e-02	0.654	1.000
freshwater heterotroph	3.0e-02	2.9e-02	0.794	1.000
terrestrial heterotroph	4.6e-02	4.7e-02	0.627	1.000
freshwater autotroph - terrestrial autotroph	-1.6e-02	5.2e-02	1.000	1.000
freshwater autotroph - freshwater heterotroph	-1.1e-02	4.9e-02	1.000	1.000
N DEPOSITION				
overall	-8.7e-02	1.4e-02	0.072	0.535

freshwater	-1.0e-01	3.0e-02	0.176	0.754
terrestrial	-7.1e-02	3.2e-02	0.355	1.000
freshwater - terrestrial	-3.2e-02	5.5e-02	0.778	1.000
autotroph	1.9e-02	3.0e-02	0.790	1.000
heterotroph	-1.9e-01	3.2e-02	0.003	0.090
autotroph - heterotroph	2.1e-01	5.5e-02	0.079	0.535
freshwater autotroph	3.4e-03	5.4e-02	0.977	1.000
terrestrial autotroph	3.5e-02	2.1e-02	0.670	1.000
freshwater heterotroph	-2.1e-01	1.9e-02	0.001	0.060
terrestrial heterotroph	-1.8e-01	5.6e-02	0.087	0.535
freshwater autotroph - terrestrial autotroph	-3.2e-02	5.5e-02	1.000	1.000
freshwater autotroph - freshwater	2.1e-01	5.5e-02	1.000	1.000
heterotroph				
terrestrial autotroph - terrestrial heterotroph	2.1e-01	5.5e-02	1.000	1.000
freshwater heterotroph - terrestrial	-3.2e-02	5.5e-02	1.000	1.000
heterotroph				
LABILE P				
overall	2.3e-02	2.2e-02	0.738	1.000
freshwater	-1.5e-01	4.7e-02	0.231	0.770
terrestrial	2.0e-01	5.0e-02	0.098	0.535
freshwater - terrestrial	-3.5e-01	8.7e-02	0.054	0.535
autotroph	-1.1e-01	4.5e-02	0.405	1.000
heterotroph	1.5e-01	5.3e-02	0.219	0.770

autotroph - heterotroph	-2.6e-01	8.8e-02	0.196	0.770
freshwater autotroph	-2.8e-01	8.4e-02	0.151	0.697
terrestrial autotroph	6.9e-02	2.6e-02	0.494	1.000
freshwater heterotroph	-2.3e-02	3.5e-02	0.846	1.000
terrestrial heterotroph	3.3e-01	9.1e-02	0.051	0.535
freshwater autotroph - terrestrial autotroph	-3.5e-01	8.7e-02	1.000	1.000
freshwater autotroph - freshwater	-2.6e-01	8.8e-02	1.000	1.000
heterotroph				
terrestrial autotroph - terrestrial heterotroph	-2.6e-01	8.8e-02	1.000	1.000
freshwater heterotroph - terrestrial	-3.5e-01	8.7e-02	1.000	1.000
heterotroph				

Model N:P ratio

TEMPERATURE

overall	3.4e-03	2.0e-03	0.661	1.000
freshwater	2.1e-03	4.2e-03	0.855	1.000
terrestrial	4.7e-03	4.2e-03	0.639	1.000
freshwater - terrestrial	-2.6e-03	7.4e-03	0.879	1.000
autotroph	-8.7e-03	4.0e-03	0.433	1.000
heterotroph	1.5e-02	4.5e-03	0.171	1.000
autotroph - heterotroph	-2.4e-02	7.6e-03	0.179	1.000
freshwater autotroph	-1.0e-02	7.4e-03	0.565	1.000
terrestrial autotroph	-7.3e-03	2.5e-03	0.414	1.000
freshwater heterotroph	1.4e-02	3.1e-03	0.294	1.000

terrestrial heterotroph	1.7e-02	7.6e-03	0.290	1.000
freshwater autotroph - terrestrial autotroph	-2.6e-03	7.4e-03	1.000	1.000
freshwater autotroph - freshwater	-2.4e-02	7.6e-03	1.000	1.000
heterotroph				
terrestrial autotroph - terrestrial heterotroph	-2.4e-02	7.6e-03	1.000	1.000
freshwater heterotroph - terrestrial	-2.6e-03	7.4e-03	1.000	1.000
heterotroph				
RADIATION				
overall	2.7e-02	2.0e-02	0.710	1.000
freshwater	5.1e-02	3.8e-02	0.606	1.000
terrestrial	3.6e-03	3.3e-02	0.978	1.000
freshwater - terrestrial	4.7e-02	5.9e-02	0.723	1.000
autotroph	1.1e-01	3.6e-02	0.276	1.000
heterotroph	-5.5e-02	3.4e-02	0.529	1.000
autotroph - heterotroph	1.7e-01	5.8e-02	0.222	1.000
freshwater autotroph	1.3e-01	6.0e-02	0.333	1.000
terrestrial autotroph	8.6e-02	2.7e-02	0.388	1.000
freshwater heterotroph	-3.2e-02	3.0e-02	0.793	1.000
terrestrial heterotroph	-7.9e-02	5.6e-02	0.511	1.000
freshwater autotroph - terrestrial autotroph	4.7e-02	5.9e-02	1.000	1.000
freshwater autotroph - freshwater	1.7e-01	5.8e-02	1.000	1.000
heterotroph				
terrestrial autotroph - terrestrial heterotroph	1.7e-01	5.8e-02	1.000	1.000

freshwater heterotroph - terrestrial	4.7e-02	5.9e-02	1.000	1.000
heterotroph				
N DEPOSITION				
overall	1.8e-01	1.5e-02	0.003	0.060
freshwater	2.8e-01	3.1e-02	0.001	0.030
terrestrial	6.9e-02	3.6e-02	0.426	1.000
freshwater - terrestrial	2.1e-01	6.0e-02	0.088	0.880
autotroph	1.3e-01	3.3e-02	0.150	1.000
heterotroph	2.2e-01	3.4e-02	0.018	0.270
autotroph - heterotroph	-8.3e-02	5.9e-02	0.555	1.000
freshwater autotroph	2.4e-01	5.8e-02	0.067	0.804
terrestrial autotroph	2.7e-02	2.5e-02	0.773	1.000
freshwater heterotroph	3.2e-01	1.8e-02	<0.001	<0.001
terrestrial heterotroph	1.1e-01	6.1e-02	0.375	1.000
freshwater autotroph - terrestrial autotroph	2.1e-01	6.0e-02	1.000	1.000
freshwater autotroph - freshwater	-8.3e-02	5.9e-02	1.000	1.000
heterotroph				
terrestrial autotroph - terrestrial heterotroph	-8.3e-02	5.9e-02	1.000	1.000
freshwater heterotroph - terrestrial	2.1e-01	6.0e-02	1.000	1.000
heterotroph				
LABILE P				
overall	9.7e-02	2.4e-02	0.315	1.000
freshwater	1.2e-01	4.8e-02	0.349	1.000

terrestrial	7.1e-02	5.6e-02	0.643	1.000
freshwater - terrestrial	5.2e-02	9.3e-02	0.813	1.000
autotroph	1.2e-01	4.8e-02	0.351	1.000
heterotroph	7.3e-02	5.8e-02	0.640	1.000
autotroph - heterotroph	4.8e-02	9.4e-02	0.832	1.000
freshwater autotroph	1.5e-01	8.8e-02	0.484	1.000
terrestrial autotroph	9.5e-02	3.3e-02	0.444	1.000
freshwater heterotroph	9.9e-02	3.6e-02	0.518	1.000
terrestrial heterotroph	4.7e-02	9.9e-02	0.833	1.000
freshwater autotroph - terrestrial autotroph	5.2e-02	9.3e-02	1.000	1.000
freshwater autotroph - freshwater	4.8e-02	9.4e-02	1.000	1.000
heterotroph				
terrestrial autotroph - terrestrial heterotroph	4.8e-02	9.4e-02	1.000	1.000
freshwater heterotroph - terrestrial	5.2e-02	9.3e-02	1.000	1.000
heterotroph				

Supplementary Table 2. Summary of marginal and conditional variance explained by the linear mixed-effect models. R^2 values represent variance explained by fixed effects alone (marginal) and by both fixed and random effects (conditional).

Models	Marginal R^2	Conditional R^2
Main models:		
Absolute Latitude - N content	0.76	0.94
Absolute Latitude - P content	0.68	0.93
Absolute Latitude -: N:P content	0.14	0.82
Environmental drivers - N content	0.69	0.91
Environmental drivers - P content	0.64	0.93
Environmental drivers - N:P content	0.14	0.87
Models with species elemental content averaged within locations:		
Absolute Latitude - N content	0.82	0.94
Absolute Latitude - P content	0.62	0.90
Absolute Latitude - N:P content	0.12	0.73
Environmental drivers - N content	0.84	0.94
Environmental drivers - P content	0.67	0.88
Environmental drivers - N:P content	0.10	0.70
Models excluding Radiation:		
Environmental drivers - N content	0.69	0.91
Environmental drivers - P content	0.64	0.93

Environmental drivers - N:P content	0.14	0.87
Models excluding Temperature:		
Environmental drivers - N content	0.69	0.91
Environmental drivers - P content	0.63	0.93
Environmental drivers - N:P content	0.12	0.87
Model with additional interactions among predictors:		
Temperature:N deposition and N deposition:labile P		
Environmental drivers - N content	0.69	0.91

Supplementary Table 3. Partial variance explained by each predictor in the main models (see Supplementary Table 1). Semi-partial R^2 values were estimated using the `mergeR2()` function from the *partR2*-package⁶³.

Predictors	Response in %N		Response in %P		Response in N:P	
	Partial R^2	CI (lower / upper)	Partial R^2	CI (lower / upper)	Partial R^2	CI (lower / upper)
Full model	6.8e-01	(6.7e-01 / 6.9e-01)	6.4e-01	(6.3e-01 / 6.6e-01)	1.1e-01	(9.2e-02 / 1.1e-01)
Realm	5.2e-05	(0.0e+00 / 2.3e-02)	5.3e-02	(2.6e-02 / 8.0e-02)	4.1e-02	(2.5e-02 / 5.0e-02)
Trophic	5.5e-01	(5.4e-01 / 5.5e-01)	2.5e-01	(2.2e-01 / 2.7e-01)	2.2e-04	(0.0e+00 / 1.0e-02)
Temperature	8.8e-03	(5.5e-04 / 3.1e-02)	5.7e-03	(0.0e+00 / 3.5e-02)	0.0e+00	(0.0e+00 / 7.6e-03)
Radiation	6.5e-05	(0.0e+00 / 2.3e-02)	0.0e+00	(0.0e+00 / 2.9e-02)	0.0e+00	(0.0e+00 / 9.5e-03)
N deposition	0.0e+00	(0.0e+00 / 2.2e-02)	3.4e-03	(0.0e+00 / 3.2e-02)	2.2e-02	(6.8e-03 / 3.2e-02)
Labile P	0.0e+00	(0.0e+00 / 2.2e-02)	1.3e-03	(0.0e+00 / 3.0e-02)	0.0e+00	(0.0e+00 / 6.8e-03)
Temperature: Realm	6.8e-04	(0.0e+00 / 2.0e-02)	0.0e+00	(0.0e+00 / 2.6e-02)	3.7e-06	(0.0e+00 / 9.6e-03)

Radiation:	4.6e-03	(0.0e+00 /	0.0e+00	(0.0e+00 /	3.0e-03	(0.0e+00 /
Realm		2.4e-02)		2.6e-02)		1.3e-02)
Labile P:	0.0e+00	(0.0e+00 /	0.0e+00	(0.0e+00 /	0.0e+00	(0.0e+00 /
Realm		1.7e-02)		2.4e-02)		5.8e-03)
N deposition:	2.0e-05	(0.0e+00 /	2.1e-03	(0.0e+00 /	0.0e+00	(0.0e+00 /
Realm		1.9e-02)		2.8e-02)		3.0e-03)
Temperature:	1.7e-03	(0.0e+00 /	2.0e-03	(0.0e+00 /	3.8e-03	(0.0e+00 /
Trophic		2.1e-02)		2.8e-02)		1.4e-02)
Radiation:	1.2e-02	(4.2e-03 /	4.3e-03	(0.0e+00 /	0.0e+00	(0.0e+00 /
Trophic		3.1e-02)		3.0e-02)		7.3e-03)
Labile P:	0.0e+00	(0.0e+00 /	1.9e-03	(0.0e+00 /	2.3e-03	(0.0e+00 /
Trophic		1.7e-02)		2.8e-02)		1.2e-02)
N deposition:	6.8e-03	(1.2e-04 /	0.0e+00	(0.0e+00 /	5.8e-03	(0.0e+00 /
Trophic		2.6e-02)		2.5e-02)		1.6e-02)
Realm:	0.0e+00	(0.0e+00 /	0.0e+00	(0.0e+00 /	6.6e-03	(0.0e+00 /
Trophic		1.8e-02)		1.9e-02)		1.6e-02)

Supplementary Table 4. Overall effects of interacting environmental drivers (Temperature x N deposition, N deposition x labile P) on organismal N content. Values are slope coefficients (\pm SE) describing the relationship between organismal N content and N deposition at four levels of the interacting predictor (temperature in $^{\circ}\text{C}$ or labile P in log-transformed $\text{g P} / \text{m}^2$): 2.5th percentile, mean - 1 SD, mean + 1 SD, 97.5th percentile. Both original *P* values and Benjamini-Hochberg-corrected *P* values (*P* - B&H) are reported, with statistically significant effects after correction shown in bold. *P* values are based on two-sided tests with permuted t-statistics.

Interacting predictors	Values along the distribution	Slopes	SE	<i>P</i>	<i>P</i> - B&H
Temperature:					
Percentile 2.5	3	6.8e-02	1.1e-02	0.136	0.155
Mean - SD	6.5	7.4e-02	9.7e-03	0.031	0.050
Mean + SD	22.7	1.1e-01	9.7e-03	0.005	0.020
Percentile 97.5	26.7	1.1e-01	1.2e-02	0.018	0.048
Labile P:					
Percentile 2.5	2	4.9e-02	2.0e-02	0.579	0.579
Mean - SD	2.7	7.4e-02	1.2e-02	0.122	0.155
Mean + SD	3.6	1.1e-01	7.6e-03	<0.001	<0.001
Percentile 97.5	4.3	1.3e-01	1.4e-02	0.028	0.050

Supplementary Table 5. Sensitivity analysis testing the effects of removing radiation or temperature from the main models (see Supplementary Table 1). Models evaluate the effects of environmental predictors (temperature or radiation, N deposition, labile P), realm (freshwater vs. terrestrial), and trophic group (autotroph vs. heterotroph) on organismal N and P content, and N:P ratios. Values are slope coefficients (\pm SE) describing the relationship between elemental content and environmental drivers. “Overall” denotes the relationship between a predictor and a given element across realms and trophic groups. The symbol “-” indicates contrasts between slope coefficients. Both original *P* values and Benjamini-Hochberg-corrected *P* values (*P* - B&H) are reported, with statistically significant effects after correction shown in bold. Letters in parentheses indicate gain (g) or loss (l) of significant relationships compared to the main models (with both temperature and radiation included). *P* values are based on two-sided tests with permuted t-statistics.

Effects	Slopes	SE	<i>P</i>	<i>P</i> - B&H
MODELS EXCLUDING RADIATION				
Model N content				
TEMPERATURE				
overall	-4.7e-03	9.1e-04	0.083	0.267
freshwater	-2.8e-03	1.6e-03	0.601	1.000
terrestrial	-6.6e-03	7.4e-04	0.043	0.193
freshwater - terrestrial	3.8e-03	1.7e-03	0.635	1.000
autotroph	-8.4e-03	1.4e-03	0.070	0.267
heterotroph	-9.5e-04	9.1e-04	0.820	1.000

autotroph - heterotroph	-7.4e-03	1.4e-03	0.225	0.533
freshwater autotroph	-6.5e-03	2.0e-03	0.397	0.812
terrestrial autotroph (g)	-1.0e-02	1.1e-03	0.005	0.025
freshwater heterotroph	9.6e-04	1.5e-03	0.766	1.000
terrestrial heterotroph	-2.9e-03	9.1e-04	0.671	1.000
freshwater autotroph - terrestrial autotroph	3.8e-03	1.7e-03	1.000	1.000
freshwater autotroph - freshwater heterotroph	-7.4e-03	1.4e-03	1.000	1.000
terrestrial autotroph - terrestrial heterotroph	-7.4e-03	1.4e-03	1.000	1.000
freshwater heterotroph - terrestrial heterotroph	3.8e-03	1.7e-03	1.000	1.000
N DEPOSITION				
overall	9.3e-02	6.6e-03	<0.001	<0.001
freshwater	1.8e-01	1.1e-02	<0.001	<0.001
terrestrial	1.5e-03	7.3e-03	0.960	1.000
freshwater - terrestrial	1.8e-01	1.3e-02	0.003	0.017
autotroph	2.0e-01	1.2e-02	<0.001	<0.001
heterotroph	-1.7e-02	6.7e-03	0.572	1.000
autotroph - heterotroph	2.2e-01	1.4e-02	<0.001	<0.001
freshwater autotroph	2.9e-01	1.6e-02	<0.001	<0.001
terrestrial autotroph	1.1e-01	1.0e-02	<0.001	<0.001
freshwater heterotroph	7.4e-02	8.9e-03	<0.001	<0.001
terrestrial heterotroph	-1.1e-01	9.5e-03	0.083	0.267
freshwater autotroph - terrestrial autotroph	1.8e-01	1.3e-02	1.000	1.000

freshwater autotroph - freshwater heterotroph	2.2e-01	1.4e-02	1.000	1.000
terrestrial autotroph - terrestrial heterotroph	2.2e-01	1.4e-02	1.000	1.000
freshwater heterotroph - terrestrial heterotroph	1.8e-01	1.3e-02	1.000	1.000
LABILE P				
overall	-1.7e-02	1.1e-02	0.600	1.000
freshwater	3.2e-02	1.7e-02	0.570	1.000
terrestrial	-6.7e-02	1.3e-02	0.198	0.524
freshwater - terrestrial	9.9e-02	2.1e-02	0.298	0.639
autotroph	5.6e-02	2.0e-02	0.415	0.812
heterotroph	-9.1e-02	1.1e-02	0.076	0.267
autotroph - heterotroph	1.5e-01	2.4e-02	0.133	0.374
freshwater autotroph	1.1e-01	2.6e-02	0.285	0.639
terrestrial autotroph	6.9e-03	1.8e-02	0.893	1.000
freshwater heterotroph	-4.1e-02	1.3e-02	0.127	0.374
terrestrial heterotroph	-1.4e-01	1.7e-02	0.216	0.533
freshwater autotroph - terrestrial autotroph	9.9e-02	2.1e-02	1.000	1.000
freshwater autotroph - freshwater heterotroph	1.5e-01	2.4e-02	1.000	1.000
terrestrial autotroph - terrestrial heterotroph	1.5e-01	2.4e-02	1.000	1.000
freshwater heterotroph - terrestrial heterotroph	9.9e-02	2.1e-02	1.000	1.000
Model P content				
TEMPERATURE				

overall	-9.1e-03	1.8e-03	0.148	0.474
freshwater	-5.2e-03	3.6e-03	0.583	1.000
terrestrial	-1.3e-02	3.1e-03	0.083	0.412
freshwater - terrestrial	7.7e-03	5.7e-03	0.555	1.000
autotroph	-4.8e-03	3.2e-03	0.591	1.000
heterotroph	-1.3e-02	3.5e-03	0.077	0.412
autotroph - heterotroph	8.5e-03	5.7e-03	0.506	1.000
freshwater autotroph	-9.2e-04	5.8e-03	0.935	1.000
terrestrial autotroph	-8.7e-03	2.0e-03	0.255	0.604
freshwater heterotroph	-9.5e-03	3.0e-03	0.358	0.805
terrestrial heterotroph	-1.7e-02	5.6e-03	0.098	0.412
freshwater autotroph - terrestrial autotroph	7.7e-03	5.7e-03	1.000	1.000
freshwater autotroph - freshwater heterotroph	8.5e-03	5.7e-03	1.000	1.000
terrestrial autotroph - terrestrial heterotroph	8.5e-03	5.7e-03	1.000	1.000
freshwater heterotroph - terrestrial heterotroph	7.7e-03	5.7e-03	1.000	1.000
N DEPOSITION				
overall	-9.7e-02	1.3e-02	0.026	0.234
freshwater	-9.9e-02	2.5e-02	0.148	0.474
terrestrial	-9.5e-02	2.5e-02	0.110	0.412
freshwater - terrestrial	-3.4e-03	4.4e-02	0.973	1.000
autotroph	1.4e-02	2.5e-02	0.850	1.000
heterotroph (g)	-2.1e-01	2.6e-02	<0.001	<0.001

autotroph - heterotroph	2.2e-01	4.4e-02	0.023	0.234
freshwater autotroph	1.2e-02	4.4e-02	0.912	1.000
terrestrial autotroph	1.6e-02	1.7e-02	0.813	1.000
freshwater heterotroph (g)	-2.1e-01	1.9e-02	<0.001	<0.001
terrestrial heterotroph	-2.1e-01	4.4e-02	0.011	0.165
freshwater autotroph - terrestrial autotroph	-3.4e-03	4.4e-02	1.000	1.000
freshwater autotroph - freshwater heterotroph	2.2e-01	4.4e-02	1.000	1.000
terrestrial autotroph - terrestrial heterotroph	2.2e-01	4.4e-02	1.000	1.000
freshwater heterotroph - terrestrial heterotroph	-3.4e-03	4.4e-02	1.000	1.000
LABILE P				
overall	2.3e-02	2.2e-02	0.759	1.000
freshwater	-1.5e-01	4.7e-02	0.238	0.595
terrestrial	2.0e-01	5.0e-02	0.106	0.412
freshwater - terrestrial	-3.5e-01	8.7e-02	0.061	0.392
autotroph	-1.1e-01	4.5e-02	0.403	0.864
heterotroph	1.5e-01	5.3e-02	0.204	0.540
autotroph - heterotroph	-2.6e-01	8.8e-02	0.197	0.540
freshwater autotroph	-2.8e-01	8.4e-02	0.158	0.474
terrestrial autotroph	6.6e-02	2.6e-02	0.513	1.000
freshwater heterotroph	-2.1e-02	3.5e-02	0.879	1.000
terrestrial heterotroph	3.3e-01	9.1e-02	0.047	0.352
freshwater autotroph - terrestrial autotroph	-3.5e-01	8.7e-02	1.000	1.000

freshwater autotroph - freshwater heterotroph	-2.6e-01	8.8e-02	1.000	1.000
terrestrial autotroph - terrestrial heterotroph	-2.6e-01	8.8e-02	1.000	1.000
freshwater heterotroph - terrestrial heterotroph	-3.5e-01	8.7e-02	1.000	1.000

Model N:P ratio

TEMPERATURE

overall	5.0e-03	1.9e-03	0.515	1.000
freshwater	4.5e-03	4.1e-03	0.719	1.000
terrestrial	5.5e-03	4.1e-03	0.589	1.000
freshwater - terrestrial	-1.1e-03	7.2e-03	0.943	1.000
autotroph	-4.3e-03	3.8e-03	0.711	1.000
heterotroph	1.4e-02	4.4e-03	0.210	1.000
autotroph - heterotroph	-1.9e-02	7.3e-03	0.306	1.000
freshwater autotroph	-4.8e-03	7.1e-03	0.789	1.000
terrestrial autotroph	-3.7e-03	2.3e-03	0.665	1.000
freshwater heterotroph	1.4e-02	3.1e-03	0.315	1.000
terrestrial heterotroph	1.5e-02	7.4e-03	0.381	1.000
freshwater autotroph - terrestrial autotroph	-1.1e-03	7.2e-03	1.000	1.000
freshwater autotroph - freshwater heterotroph	-1.9e-02	7.3e-03	1.000	1.000
terrestrial autotroph - terrestrial heterotroph	-1.9e-02	7.3e-03	1.000	1.000
freshwater heterotroph - terrestrial heterotroph	-1.1e-03	7.2e-03	1.000	1.000

N DEPOSITION

overall (g)	1.6e-01	1.4e-02	0.002	0.030
freshwater	2.4e-01	2.6e-02	0.002	0.030
terrestrial	7.1e-02	2.9e-02	0.337	1.000
freshwater - terrestrial	1.7e-01	4.8e-02	0.099	0.844
autotroph	7.6e-02	2.7e-02	0.337	1.000
heterotroph (g)	2.4e-01	2.8e-02	0.004	0.045
autotroph - heterotroph	-1.6e-01	4.8e-02	0.141	0.844
freshwater autotroph	1.6e-01	4.7e-02	0.150	0.844
terrestrial autotroph	-1.1e-02	2.1e-02	0.913	1.000
freshwater heterotroph	3.3e-01	1.8e-02	<0.001	<0.001
terrestrial heterotroph	1.5e-01	4.9e-02	0.140	0.844
freshwater autotroph - terrestrial autotroph	1.7e-01	4.8e-02	1.000	1.000
freshwater autotroph - freshwater heterotroph	-1.6e-01	4.8e-02	1.000	1.000
terrestrial autotroph - terrestrial heterotroph	-1.6e-01	4.8e-02	1.000	1.000
freshwater heterotroph - terrestrial	1.7e-01	4.8e-02	1.000	1.000
heterotroph				
LABILE P				
overall	9.1e-02	2.4e-02	0.333	1.000
freshwater	1.2e-01	4.8e-02	0.373	1.000
terrestrial	6.1e-02	5.6e-02	0.705	1.000
freshwater - terrestrial	6.2e-02	9.3e-02	0.783	1.000
autotroph	1.1e-01	4.8e-02	0.393	1.000
heterotroph	7.2e-02	5.7e-02	0.628	1.000

autotroph - heterotroph	3.8e-02	9.4e-02	0.850	1.000
freshwater autotroph	1.4e-01	8.8e-02	0.498	1.000
terrestrial autotroph	8.0e-02	3.2e-02	0.528	1.000
freshwater heterotroph	1.0e-01	3.6e-02	0.517	1.000
terrestrial heterotroph	4.1e-02	9.8e-02	0.841	1.000
freshwater autotroph - terrestrial autotroph	6.2e-02	9.3e-02	1.000	1.000
freshwater autotroph - freshwater heterotroph	3.8e-02	9.4e-02	1.000	1.000
terrestrial autotroph - terrestrial heterotroph	3.8e-02	9.4e-02	1.000	1.000
freshwater heterotroph - terrestrial heterotroph	6.2e-02	9.3e-02	1.000	1.000

MODELS EXCLUDING TEMPERATURE

Model N content

RADIATION

overall	-2.8e-02	8.1e-03	0.259	0.691
freshwater	-2.0e-02	1.4e-02	0.665	1.000
terrestrial	-3.5e-02	7.2e-03	0.260	0.691
freshwater - terrestrial	1.6e-02	1.4e-02	0.808	1.000
autotroph	-2.9e-02	1.3e-02	0.532	0.921
heterotroph	-2.6e-02	7.4e-03	0.469	0.921
autotroph - heterotroph	-2.5e-03	1.4e-02	0.979	1.000
freshwater autotroph	-2.1e-02	1.8e-02	0.763	1.000
terrestrial autotroph	-3.7e-02	1.2e-02	0.338	0.801
freshwater heterotroph	-1.8e-02	1.2e-02	0.456	0.921

terrestrial heterotroph	-3.4e-02	8.0e-03	0.556	0.927
freshwater autotroph - terrestrial autotroph	1.6e-02	1.4e-02	1.000	1.000
freshwater autotroph - freshwater heterotroph	-2.5e-03	1.4e-02	1.000	1.000
terrestrial autotroph - terrestrial heterotroph	-2.5e-03	1.4e-02	1.000	1.000
freshwater heterotroph - terrestrial heterotroph	1.6e-02	1.4e-02	1.000	1.000
N DEPOSITION				
overall	8.2e-02	6.8e-03	<0.001	<0.001
freshwater	1.8e-01	1.1e-02	<0.001	<0.001
terrestrial	-1.5e-02	7.5e-03	0.633	1.000
freshwater - terrestrial	1.9e-01	1.3e-02	0.001	0.006
autotroph	1.9e-01	1.2e-02	<0.001	<0.001
heterotroph	-2.3e-02	6.7e-03	0.463	0.921
autotroph - heterotroph	2.1e-01	1.4e-02	<0.001	<0.001
freshwater autotroph	2.8e-01	1.6e-02	<0.001	<0.001
terrestrial autotroph	8.9e-02	1.1e-02	0.008	0.045
freshwater heterotroph	7.5e-02	8.8e-03	<0.001	<0.001
terrestrial heterotroph	-1.2e-01	9.5e-03	0.072	0.360
freshwater autotroph - terrestrial autotroph	1.9e-01	1.3e-02	1.000	1.000
freshwater autotroph - freshwater heterotroph	2.1e-01	1.4e-02	1.000	1.000
terrestrial autotroph - terrestrial heterotroph	2.1e-01	1.4e-02	1.000	1.000
freshwater heterotroph - terrestrial heterotroph	1.9e-01	1.3e-02	1.000	1.000

LABILE P				
overall	-2.1e-02	1.1e-02	0.504	0.921
freshwater	3.6e-02	1.8e-02	0.520	0.921
terrestrial	-7.9e-02	1.3e-02	0.173	0.691
freshwater - terrestrial	1.2e-01	2.2e-02	0.248	0.691
autotroph	4.6e-02	2.0e-02	0.511	0.921
heterotroph	-8.9e-02	1.2e-02	0.104	0.468
autotroph - heterotroph	1.4e-01	2.4e-02	0.189	0.691
freshwater autotroph	1.0e-01	2.6e-02	0.326	0.801
terrestrial autotroph	-1.1e-02	1.8e-02	0.831	1.000
freshwater heterotroph	-3.1e-02	1.4e-02	0.261	0.691
terrestrial heterotroph	-1.5e-01	1.7e-02	0.226	0.691
freshwater autotroph - terrestrial autotroph	1.2e-01	2.2e-02	1.000	1.000
freshwater autotroph - freshwater heterotroph	1.4e-01	2.4e-02	1.000	1.000
terrestrial autotroph - terrestrial heterotroph	1.4e-01	2.4e-02	1.000	1.000
freshwater heterotroph - terrestrial heterotroph	1.2e-01	2.2e-02	1.000	1.000
Model P content				
RADIATION				
overall	1.1e-03	1.7e-02	0.983	1.000
freshwater	9.9e-03	3.3e-02	0.916	1.000
terrestrial	-7.6e-03	2.6e-02	0.906	1.000
freshwater - terrestrial	1.7e-02	4.9e-02	0.865	1.000

autotroph	6.9e-03	2.9e-02	0.930	1.000
heterotroph	-4.6e-03	2.8e-02	0.941	1.000
autotroph - heterotroph	1.2e-02	4.6e-02	0.907	1.000
freshwater autotroph	1.6e-02	4.9e-02	0.892	1.000
terrestrial autotroph	-1.8e-03	2.2e-02	0.986	1.000
freshwater heterotroph	4.1e-03	2.8e-02	0.972	1.000
terrestrial heterotroph	-1.3e-02	4.4e-02	0.868	1.000
freshwater autotroph - terrestrial autotroph	1.7e-02	4.9e-02	1.000	1.000
freshwater autotroph - freshwater heterotroph	1.2e-02	4.6e-02	1.000	1.000
terrestrial autotroph - terrestrial heterotroph	1.2e-02	4.6e-02	1.000	1.000
freshwater heterotroph - terrestrial heterotroph	1.7e-02	4.9e-02	1.000	1.000
N DEPOSITION				
overall	-9.4e-02	1.4e-02	0.055	0.667
freshwater	-1.1e-01	3.0e-02	0.196	0.968
terrestrial	-8.1e-02	3.2e-02	0.301	0.968
freshwater - terrestrial	-2.6e-02	5.5e-02	0.841	1.000
autotroph	-1.5e-03	3.0e-02	0.988	1.000
heterotroph	-1.9e-01	3.1e-02	0.006	0.135
autotroph - heterotroph	1.8e-01	5.5e-02	0.135	0.827
freshwater autotroph	-1.4e-02	5.4e-02	0.900	1.000
terrestrial autotroph	1.1e-02	2.0e-02	0.884	1.000
freshwater heterotroph (g)	-2.0e-01	1.9e-02	<0.001	<0.001

terrestrial heterotroph	-1.7e-01	5.6e-02	0.086	0.667
freshwater autotroph - terrestrial autotroph	-2.6e-02	5.5e-02	1.000	1.000
freshwater autotroph - freshwater heterotroph	1.8e-01	5.5e-02	1.000	1.000
terrestrial autotroph - terrestrial heterotroph	1.8e-01	5.5e-02	1.000	1.000
freshwater heterotroph - terrestrial heterotroph	-2.6e-02	5.5e-02	1.000	1.000
LABILE P				
overall	1.7e-02	2.2e-02	0.833	1.000
freshwater	-1.4e-01	4.7e-02	0.290	0.968
terrestrial	1.7e-01	5.0e-02	0.147	0.827
freshwater - terrestrial	-3.1e-01	8.6e-02	0.080	0.667
autotroph	-9.6e-02	4.5e-02	0.465	1.000
heterotroph	1.3e-01	5.3e-02	0.282	0.968
autotroph - heterotroph	-2.3e-01	8.8e-02	0.257	0.968
freshwater autotroph	-2.5e-01	8.4e-02	0.220	0.968
terrestrial autotroph	5.8e-02	2.6e-02	0.593	1.000
freshwater heterotroph	-2.4e-02	3.5e-02	0.861	1.000
terrestrial heterotroph	2.8e-01	9.1e-02	0.089	0.667
freshwater autotroph - terrestrial autotroph	-3.1e-01	8.6e-02	1.000	1.000
freshwater autotroph - freshwater heterotroph	-2.3e-01	8.8e-02	1.000	1.000
terrestrial autotroph - terrestrial heterotroph	-2.3e-01	8.8e-02	1.000	1.000
freshwater heterotroph - terrestrial heterotroph	-3.1e-01	8.6e-02	1.000	1.000

Model N:P ratio				
RADIATION				
overall	1.9e-02	1.9e-02	0.801	1.000
freshwater	4.8e-02	3.7e-02	0.685	1.000
terrestrial	-1.0e-02	3.2e-02	0.903	1.000
freshwater - terrestrial	5.8e-02	5.8e-02	0.683	1.000
autotroph	7.9e-02	3.3e-02	0.436	1.000
heterotroph	-4.1e-02	3.4e-02	0.646	1.000
autotroph - heterotroph	1.2e-01	5.6e-02	0.391	1.000
freshwater autotroph	1.1e-01	5.8e-02	0.474	1.000
terrestrial autotroph	5.0e-02	2.4e-02	0.610	1.000
freshwater heterotroph	-1.2e-02	3.0e-02	0.935	1.000
terrestrial heterotroph	-7.0e-02	5.5e-02	0.562	1.000
freshwater autotroph - terrestrial autotroph	5.8e-02	5.8e-02	1.000	1.000
freshwater autotroph - freshwater heterotroph	1.2e-01	5.6e-02	1.000	1.000
terrestrial autotroph - terrestrial heterotroph	1.2e-01	5.6e-02	1.000	1.000
freshwater heterotroph - terrestrial heterotroph	5.8e-02	5.8e-02	1.000	1.000
N DEPOSITION				
overall	1.6e-01	1.5e-02	0.011	0.165
freshwater (l)	2.7e-01	3.1e-02	0.003	0.068
terrestrial	4.1e-02	3.5e-02	0.632	1.000
freshwater - terrestrial	2.3e-01	6.0e-02	0.073	0.657

autotroph	1.2e-01	3.2e-02	0.203	1.000
heterotroph	2.0e-01	3.3e-02	0.024	0.270
autotroph - heterotroph	-7.6e-02	5.9e-02	0.574	1.000
freshwater autotroph	2.4e-01	5.8e-02	0.090	0.675
terrestrial autotroph	3.5e-03	2.3e-02	0.968	1.000
freshwater heterotroph	3.1e-01	1.8e-02	<0.001	<0.001
terrestrial heterotroph	7.9e-02	6.1e-02	0.546	1.000
freshwater autotroph - terrestrial autotroph	2.3e-01	6.0e-02	1.000	1.000
freshwater autotroph - freshwater heterotroph	-7.6e-02	5.9e-02	1.000	1.000
terrestrial autotroph - terrestrial heterotroph	-7.6e-02	5.9e-02	1.000	1.000
freshwater heterotroph - terrestrial heterotroph	2.3e-01	6.0e-02	1.000	1.000
LABILE P				
overall	8.2e-02	2.4e-02	0.415	1.000
freshwater	1.2e-01	4.8e-02	0.376	1.000
terrestrial	4.4e-02	5.6e-02	0.745	1.000
freshwater - terrestrial	7.5e-02	9.3e-02	0.735	1.000
autotroph	1.2e-01	4.8e-02	0.396	1.000
heterotroph	4.8e-02	5.8e-02	0.752	1.000
autotroph - heterotroph	6.7e-02	9.4e-02	0.771	1.000
freshwater autotroph	1.5e-01	8.8e-02	0.472	1.000
terrestrial autotroph	7.8e-02	3.2e-02	0.527	1.000
freshwater heterotroph	8.6e-02	3.6e-02	0.588	1.000

terrestrial heterotroph	1.1e-02	9.8e-02	0.964	1.000
freshwater autotroph - terrestrial autotroph	7.5e-02	9.3e-02	1.000	1.000
freshwater autotroph - freshwater heterotroph	6.7e-02	9.4e-02	1.000	1.000
terrestrial autotroph - terrestrial heterotroph	6.7e-02	9.4e-02	1.000	1.000
freshwater heterotroph - terrestrial heterotroph	7.5e-02	9.3e-02	1.000	1.000

Supplementary Table 6. Effects of absolute latitude, environmental predictors (temperature, radiation, N deposition, labile P), realm (freshwater vs. terrestrial), and trophic group (autotroph vs. heterotroph) on organismal N and P content, and N:P ratios, averaged for each taxon within locations. Values are slope coefficients (\pm SE) describing relationships between elemental content and environmental predictors. “Overall” denotes the relationship between a predictor and a given element (N, P, or N:P) across realms and trophic groups. The symbol “-” indicates contrasts between slope coefficients. Both original *p* values and Benjamini-Hochberg-corrected *P* values are reported (*P* - B&H), with statistically significant effects after correction shown in bold. Letters in parentheses indicate gain (g) or loss (l) of significant relationships compared to the main models (see Supplementary Table 1), which include intraspecific variability. Averaging elemental content within taxa and locations (thereby reducing intraspecific variability) resulted in eleven additional and five fewer significant relationships between predictors and organismal stoichiometry, mainly among freshwater autotrophs (Supplementary Table 1). Despite changes in magnitude and significance, the direction of significant relationships remained consistent between main and species-averaged models, and most relationships were unchanged (214 of 225 tested across six models). Explained variance in species-averaged models was not consistently higher than in main models that retained intraspecific variability (Supplementary Table 2). *P* values are based on two-sided tests with permuted t-statistics.

Effects	Slopes	SE	<i>P</i>	<i>P</i> - B&H
MODELS WITH ABSOLUTE LATITUDE				
Model N content				

ABSOLUTE LATITUDE				
overall (g)	2.8e-03	4.7e-04	0.004	0.030
freshwater (g)	3.6e-03	8.7e-04	0.007	0.030
terrestrial	1.9e-03	3.3e-04	0.038	0.081
freshwater - terrestrial	1.7e-03	9.2e-04	0.279	0.465
autotroph (g)	4.9e-03	6.3e-04	0.004	0.030
heterotroph	6.3e-04	4.9e-04	0.505	0.758
autotroph - heterotroph	4.3e-03	6.3e-04	0.020	0.050
freshwater autotroph (g)	5.7e-03	9.9e-04	0.010	0.030
terrestrial autotroph (g)	4.1e-03	4.8e-04	0.008	0.030
freshwater heterotroph	1.5e-03	8.5e-04	0.059	0.111
terrestrial heterotroph	-2.1e-04	4.3e-04	0.880	1.000
freshwater autotroph - terrestrial autotroph	1.7e-03	9.2e-04	1.000	1.000
freshwater autotroph - freshwater heterotroph	4.3e-03	6.3e-04	1.000	1.000
terrestrial autotroph - terrestrial heterotroph	4.3e-03	6.3e-04	1.000	1.000
freshwater heterotroph - terrestrial	1.7e-03	9.2e-04	1.000	1.000
heterotroph				
Model P content				
ABSOLUTE LATITUDE				
overall (g)	7.3e-03	9.0e-04	<0.001	<0.001
freshwater	5.7e-03	1.7e-03	0.075	0.161
terrestrial	9.0e-03	1.1e-03	<0.001	<0.001
freshwater - terrestrial	-3.2e-03	2.2e-03	0.370	0.555

autotroph	1.2e-02	1.3e-03	<0.001	<0.001
heterotroph	2.6e-03	1.4e-03	0.319	0.532
autotroph – heterotroph (g)	9.6e-03	2.0e-03	0.003	0.009
freshwater autotroph (g)	1.1e-02	2.3e-03	0.006	0.015
terrestrial autotroph	1.4e-02	8.8e-04	<0.001	<0.001
freshwater heterotroph	9.5e-04	1.6e-03	0.816	1.000
terrestrial heterotroph	4.2e-03	1.9e-03	0.156	0.292
freshwater autotroph - terrestrial autotroph	-3.2e-03	2.2e-03	1.000	1.000
freshwater autotroph - freshwater heterotroph	9.6e-03	2.0e-03	1.000	1.000
terrestrial autotroph - terrestrial heterotroph	9.6e-03	2.0e-03	1.000	1.000
freshwater heterotroph - terrestrial	-3.2e-03	2.2e-03	1.000	1.000
heterotroph				

Model N:P ratio

ABSOLUTE LATITUDE

overall (g)	-5.6e-03	8.9e-04	0.013	0.049
freshwater	-2.6e-03	1.7e-03	0.442	0.663
terrestrial	-8.6e-03	1.1e-03	<0.001	<0.001
freshwater - terrestrial	6.1e-03	2.3e-03	0.136	0.340
autotroph (g)	-8.0e-03	1.3e-03	0.002	0.010
heterotroph	-3.2e-03	1.4e-03	0.282	0.470
autotroph - heterotroph	-4.8e-03	2.1e-03	0.214	0.422
freshwater autotroph	-5.0e-03	2.3e-03	0.225	0.422
terrestrial autotroph	-1.1e-02	8.6e-04	<0.001	<0.001

freshwater heterotroph	-1.9e-04	1.6e-03	0.964	1.000
terrestrial heterotroph	-6.3e-03	2.0e-03	0.078	0.234
freshwater autotroph - terrestrial autotroph	6.1e-03	2.3e-03	1.000	1.000
freshwater autotroph - freshwater heterotroph	-4.8e-03	2.1e-03	1.000	1.000
terrestrial autotroph - terrestrial heterotroph	-4.8e-03	2.1e-03	1.000	1.000
freshwater heterotroph - terrestrial heterotroph	6.1e-03	2.3e-03	1.000	1.000

MODELS WITH ENVIRONMENTAL DRIVERS

Model N content

TEMPERATURE

overall	-5.2e-03	1.2e-03	0.097	0.448
freshwater	-6.3e-03	2.3e-03	0.192	0.678
terrestrial	-4.1e-03	1.3e-03	0.439	1.000
freshwater - terrestrial	-2.2e-03	2.9e-03	0.801	1.000
autotroph	-1.2e-02	1.8e-03	0.048	0.288
heterotroph	1.2e-03	1.7e-03	0.834	1.000
autotroph - heterotroph	-1.3e-02	2.5e-03	0.173	0.649
freshwater autotroph	-1.3e-02	3.0e-03	0.161	0.649
terrestrial autotroph	-1.1e-02	1.3e-03	0.025	0.180
freshwater heterotroph	5.8e-05	2.2e-03	0.983	1.000
terrestrial heterotroph	2.3e-03	2.2e-03	0.833	1.000
freshwater autotroph - terrestrial autotroph	-2.2e-03	2.9e-03	1.000	1.000
freshwater autotroph - freshwater heterotroph	-1.3e-02	2.5e-03	1.000	1.000

terrestrial autotroph - terrestrial heterotroph	-1.3e-02	2.5e-03	1.000	1.000
freshwater heterotroph - terrestrial heterotroph	-2.2e-03	2.9e-03	1.000	1.000
RADIATION				
overall	6.3e-03	1.1e-02	0.814	1.000
freshwater	9.8e-03	2.1e-02	0.827	1.000
terrestrial	2.7e-03	1.3e-02	0.968	1.000
freshwater - terrestrial	7.0e-03	2.6e-02	0.942	1.000
autotroph	1.4e-02	1.8e-02	0.788	1.000
heterotroph	-2.0e-03	1.5e-02	0.973	1.000
autotroph - heterotroph	1.6e-02	2.4e-02	0.876	1.000
freshwater autotroph	1.8e-02	2.8e-02	0.835	1.000
terrestrial autotroph	1.1e-02	1.4e-02	0.806	1.000
freshwater heterotroph	1.6e-03	1.9e-02	0.933	1.000
terrestrial heterotroph	-5.5e-03	2.1e-02	0.956	1.000
freshwater autotroph - terrestrial autotroph	7.0e-03	2.6e-02	1.000	1.000
freshwater autotroph - freshwater heterotroph	1.6e-02	2.4e-02	1.000	1.000
terrestrial autotroph - terrestrial heterotroph	1.6e-02	2.4e-02	1.000	1.000
freshwater heterotroph - terrestrial heterotroph	7.0e-03	2.6e-02	1.000	1.000
N DEPOSITION				
overall	8.0e-02	9.8e-03	0.001	0.012
freshwater	1.4e-01	1.8e-02	<0.001	<0.001

terrestrial	1.9e-02	9.3e-03	0.603	1
freshwater - terrestrial (l)	1.2e-01	2.1e-02	0.065	0.325
autotroph	1.8e-01	1.5e-02	<0.001	<0.001
heterotroph	-2.3e-02	1.1e-02	0.543	1.000
autotroph - heterotroph (l)	2.1e-01	1.7e-02	0.006	0.051
freshwater autotroph	2.4e-01	2.3e-02	<0.001	<0.001
terrestrial autotroph	1.2e-01	1.2e-02	0.002	0.020
freshwater heterotroph (l)	3.8e-02	1.7e-02	0.027	0.180
terrestrial heterotroph	-8.4e-02	1.4e-02	0.171	0.649
freshwater autotroph - terrestrial autotroph	1.2e-01	2.1e-02	1.000	1.000
freshwater autotroph - freshwater heterotroph	2.1e-01	1.7e-02	1.000	1.000
terrestrial autotroph - terrestrial heterotroph	2.1e-01	1.7e-02	1.000	1.000
freshwater heterotroph - terrestrial	1.2e-01	2.1e-02	1.000	1.000
heterotroph				
LABILE P				
overall	-4.2e-02	1.4e-02	0.234	0.780
freshwater	-3.0e-02	2.4e-02	0.557	1.000
terrestrial	-5.4e-02	1.6e-02	0.414	1.000
freshwater - terrestrial	2.3e-02	3.1e-02	0.814	1.000
autotroph	2.1e-02	2.3e-02	0.785	1.000
heterotroph	-1.0e-01	1.7e-02	0.055	0.300
autotroph - heterotroph	1.3e-01	3.0e-02	0.266	0.840
freshwater autotroph	3.3e-02	3.4e-02	0.762	1.000

terrestrial autotroph	9.2e-03	2.0e-02	0.888	1.000
freshwater heterotroph (g)	-9.3e-02	2.2e-02	<0.001	<0.001
terrestrial heterotroph	-1.2e-01	2.4e-02	0.292	0.876
freshwater autotroph - terrestrial autotroph	2.3e-02	3.1e-02	1.000	1.000
freshwater autotroph - freshwater heterotroph	1.3e-01	3.0e-02	1.000	1.000
terrestrial autotroph - terrestrial heterotroph	1.3e-01	3.0e-02	1.000	1.000
freshwater heterotroph - terrestrial heterotroph	2.3e-02	3.1e-02	1.000	1.000

Model P content

TEMPERATURE

overall	-1.2e-02	2.8e-03	0.185	1.000
freshwater	-6.4e-03	5.2e-03	0.607	1.000
terrestrial	-1.7e-02	4.2e-03	0.059	0.990
freshwater - terrestrial	1.0e-02	7.6e-03	0.490	1.000
autotroph	-8.8e-03	4.1e-03	0.326	1.000
heterotroph	-1.4e-02	5.4e-03	0.252	1.000
autotroph - heterotroph	5.5e-03	7.7e-03	0.707	1.000
freshwater autotroph	-3.6e-03	7.5e-03	0.791	1.000
terrestrial autotroph	-1.4e-02	2.4e-03	0.066	0.990
freshwater heterotroph	-9.1e-03	5.2e-03	0.614	1.000
terrestrial heterotroph	-1.9e-02	7.7e-03	0.149	1.000
freshwater autotroph - terrestrial autotroph	1.0e-02	7.6e-03	1.000	1.000
freshwater autotroph - freshwater heterotroph	5.5e-03	7.7e-03	1.000	1.000

terrestrial autotroph - terrestrial heterotroph	5.5e-03	7.7e-03	1.000	1.000
freshwater heterotroph - terrestrial heterotroph	1.0e-02	7.6e-03	1.000	1.000
RADIATION				
overall	1.8e-02	3.0e-02	0.842	1.000
freshwater	-4.3e-02	5.3e-02	0.730	1.000
terrestrial	8.0e-02	3.7e-02	0.303	1.000
freshwater - terrestrial	-1.2e-01	7.0e-02	0.367	1.000
autotroph	-2.9e-02	3.9e-02	0.759	1.000
heterotroph	6.5e-02	5.0e-02	0.581	1.000
autotroph - heterotroph	-9.4e-02	6.7e-02	0.458	1.000
freshwater autotroph	-9.0e-02	7.0e-02	0.507	1.000
terrestrial autotroph	3.3e-02	2.7e-02	0.708	1.000
freshwater heterotroph	3.5e-03	5.6e-02	0.988	1.000
terrestrial heterotroph	1.3e-01	6.6e-02	0.289	1.000
freshwater autotroph - terrestrial autotroph	-1.2e-01	7.0e-02	1.000	1.000
freshwater autotroph - freshwater heterotroph	-9.4e-02	6.7e-02	1.000	1.000
terrestrial autotroph - terrestrial heterotroph	-9.4e-02	6.7e-02	1.000	1.000
freshwater heterotroph - terrestrial heterotroph	-1.2e-01	7.0e-02	1.000	1.000
N DEPOSITION				
overall	6.2e-02	2.6e-02	0.434	1.000
freshwater	7.8e-02	4.7e-02	0.497	1.000

terrestrial	4.7e-02	4.0e-02	0.592	1.000
freshwater - terrestrial	3.1e-02	7.0e-02	0.815	1.000
autotroph	7.3e-02	3.8e-02	0.397	1.000
heterotroph	5.2e-02	5.0e-02	0.708	1.000
autotroph - heterotroph	2.2e-02	7.2e-02	0.893	1.000
freshwater autotroph	8.9e-02	6.8e-02	0.535	1.000
terrestrial autotroph	5.8e-02	2.4e-02	0.486	1.000
freshwater heterotroph	6.7e-02	4.8e-02	0.649	1.000
terrestrial heterotroph	3.6e-02	7.2e-02	0.804	1.000
freshwater autotroph - terrestrial autotroph	3.1e-02	7.0e-02	1.000	1.000
freshwater autotroph - freshwater heterotroph	2.2e-02	7.2e-02	1.000	1.000
terrestrial autotroph - terrestrial heterotroph	2.2e-02	7.2e-02	1.000	1.000
freshwater heterotroph - terrestrial heterotroph	3.1e-02	7.0e-02	1.000	1.000
LABILE P				
overall	1.4e-01	3.3e-02	0.191	1.000
freshwater	-1.7e-02	6.0e-02	0.908	1.000
terrestrial	2.9e-01	6.2e-02	0.028	0.990
freshwater - terrestrial	-3.1e-01	1.0e-01	0.130	1.000
autotroph	7.8e-03	5.4e-02	0.945	1.000
heterotroph	2.7e-01	7.2e-02	0.132	1.000
autotroph - heterotroph	-2.6e-01	1.1e-01	0.212	1.000
freshwater autotroph	-1.5e-01	9.9e-02	0.446	1.000

terrestrial autotroph	1.6e-01	3.5e-02	0.155	1.000
freshwater heterotroph	1.1e-01	5.8e-02	0.541	1.000
terrestrial heterotroph	4.2e-01	1.1e-01	0.040	0.990
freshwater autotroph - terrestrial autotroph	-3.1e-01	1.0e-01	1.000	1.000
freshwater autotroph - freshwater heterotroph	-2.6e-01	1.1e-01	1.000	1.000
terrestrial autotroph - terrestrial heterotroph	-2.6e-01	1.1e-01	1.000	1.000
freshwater heterotroph - terrestrial heterotroph	-3.1e-01	1.0e-01	1.000	1.000

Model N:P ratio

TEMPERATURE

overall	2.6e-03	3.1e-03	0.788	1.000
freshwater	1.0e-03	5.7e-03	0.945	1.000
terrestrial	4.2e-03	4.7e-03	0.644	1.000
freshwater - terrestrial	-3.1e-03	8.5e-03	0.845	1.000
autotroph	-4.8e-03	4.6e-03	0.637	1.000
heterotroph	1.0e-02	5.9e-03	0.483	1.000
autotroph - heterotroph	-1.5e-02	8.6e-03	0.391	1.000
freshwater autotroph	-6.4e-03	8.4e-03	0.701	1.000
terrestrial autotroph	-3.3e-03	2.8e-03	0.710	1.000
freshwater heterotroph	8.4e-03	5.6e-03	0.666	1.000
terrestrial heterotroph	1.2e-02	8.6e-03	0.461	1.000
freshwater autotroph - terrestrial autotroph	-3.1e-03	8.5e-03	1.000	1.000
freshwater autotroph - freshwater heterotroph	-1.5e-02	8.6e-03	1.000	1.000

terrestrial autotroph - terrestrial heterotroph	-1.5e-02	8.6e-03	1.000	1.000
freshwater heterotroph - terrestrial heterotroph	-3.1e-03	8.5e-03	1.000	1.000
RADIATION				
overall	7.8e-03	3.5e-02	0.947	1.000
freshwater	1.1e-01	6.2e-02	0.488	1.000
terrestrial	-9.1e-02	4.7e-02	0.314	1.000
freshwater - terrestrial	2.0e-01	8.6e-02	0.179	0.950
autotroph	1.6e-01	4.7e-02	0.157	0.950
heterotroph	-1.4e-01	6.1e-02	0.314	1.000
autotroph - heterotroph	3.0e-01	8.4e-02	0.051	0.950
freshwater autotroph	2.6e-01	8.4e-02	0.115	0.950
terrestrial autotroph	5.7e-02	3.2e-02	0.563	1.000
freshwater heterotroph	-4.1e-02	6.4e-02	0.850	1.000
terrestrial heterotroph	-2.4e-01	8.3e-02	0.093	0.950
freshwater autotroph - terrestrial autotroph	2.0e-01	8.6e-02	1.000	1.000
freshwater autotroph - freshwater heterotroph	3.0e-01	8.4e-02	1.000	1.000
terrestrial autotroph - terrestrial heterotroph	3.0e-01	8.4e-02	1.000	1.000
freshwater heterotroph - terrestrial heterotroph	2.0e-01	8.6e-02	1.000	1.000
N DEPOSITION				
overall	-7.9e-03	2.8e-02	0.919	1.000
freshwater (l)	7.0e-02	5.2e-02	0.574	1.000

terrestrial	-8.6e-02	4.7e-02	0.356	1.000
freshwater - terrestrial	1.6e-01	8.1e-02	0.262	0.986
autotroph	1.1e-01	4.3e-02	0.263	0.986
heterotroph	-1.3e-01	5.7e-02	0.344	1.000
autotroph - heterotroph	2.4e-01	8.3e-02	0.146	0.950
freshwater autotroph	1.9e-01	7.9e-02	0.190	0.950
terrestrial autotroph	3.3e-02	2.8e-02	0.713	1.000
freshwater heterotroph (l)	-4.9e-02	5.1e-02	0.768	1.000
terrestrial heterotroph	-2.0e-01	8.4e-02	0.183	0.950
freshwater autotroph - terrestrial autotroph	1.6e-01	8.1e-02	1.000	1.000
freshwater autotroph - freshwater heterotroph	2.4e-01	8.3e-02	1.000	1.000
terrestrial autotroph - terrestrial heterotroph	2.4e-01	8.3e-02	1.000	1.000
freshwater heterotroph - terrestrial	1.6e-01	8.1e-02	1.000	1.000
heterotroph				
LABILE P				
overall	-1.6e-01	3.9e-02	0.206	0.951
freshwater	-8.4e-02	6.7e-02	0.620	1.000
terrestrial	-2.4e-01	7.6e-02	0.130	0.950
freshwater - terrestrial	1.5e-01	1.2e-01	0.488	1.000
autotroph	1.8e-02	6.1e-02	0.888	1.000
heterotroph	-3.4e-01	8.7e-02	0.107	0.950
autotroph - heterotroph	3.6e-01	1.3e-01	0.171	0.950
freshwater autotroph	9.5e-02	1.1e-01	0.662	1.000

terrestrial autotroph	-5.8e-02	4.3e-02	0.664	1.000
freshwater heterotroph	-2.6e-01	6.6e-02	0.235	0.986
terrestrial heterotroph	-4.2e-01	1.3e-01	0.091	0.950
freshwater autotroph - terrestrial autotroph	1.5e-01	1.2e-01	1.000	1.000
freshwater autotroph - freshwater heterotroph	3.6e-01	1.3e-01	1.000	1.000
terrestrial autotroph - terrestrial heterotroph	3.6e-01	1.3e-01	1.000	1.000
freshwater heterotroph - terrestrial heterotroph	1.5e-01	1.2e-01	1.000	1.000

Supplementary Table 7. Sensitivity analysis testing of evaluating the effects of removing 5% of either taxa or locations on estimates of the main models (Supplementary Table 1).

Models evaluate the effects of absolute latitude, environmental predictors (temperature, radiation, N deposition, labile P), realm (freshwater vs. terrestrial), and trophic group (autotroph vs. heterotroph) on organismal N and P content, and N:P ratios. “Overall” denotes the relationship between a predictor and a given element (N, P, or N:P) across realms and trophic groups. The symbol “-” indicates contrast between slope coefficients. Both original *P* values and Benjamini-Hochberg-corrected *P* values (*P* - B&H) are reported, with statistically significant effects after correction shown in bold. Significant effects indicate sensitivity of the original estimates to the removal of taxa or locations. Original slope estimates are provided in Supplementary Table 1. Distributions of slopes after removals are not shown (see Methods for details on *p-value* calculations). *P* values are based on two-sided tests with permuted t-statistics.

Effects	5% taxa removed		5% locations removed	
	<i>P</i>	<i>P</i> - B&H	<i>P</i>	<i>P</i> - B&H
MODELS WITH ABSOLUTE LATITUDE				
Model N content				
ABSOLUTE LATITUDE				
overall	0.279	0.660	0.413	0.729
freshwater	0.356	0.660	0.477	0.729
terrestrial	0.387	0.660	0.355	0.729
freshwater - terrestrial	0.396	0.660	0.544	0.742

autotroph	0.272	0.660	0.436	0.729
heterotroph	0.472	0.708	0.335	0.729
autotroph - heterotroph	0.266	0.660	0.485	0.729
freshwater autotroph	0.317	0.660	0.486	0.729
terrestrial autotroph	0.229	0.660	0.403	0.729
freshwater heterotroph	0.393	0.660	0.440	0.729
terrestrial heterotroph	0.671	0.915	0.373	0.729
freshwater autotroph - terrestrial autotroph	1.000	1.000	1.000	1.000
freshwater autotroph - freshwater heterotroph	1.000	1.000	1.000	1.000
terrestrial autotroph - terrestrial heterotroph	1.000	1.000	1.000	1.000
freshwater heterotroph - terrestrial	1.000	1.000	1.000	1.000
heterotroph				

Model P content

ABSOLUTE LATITUDE

overall	0.317	0.672	0.361	0.720
freshwater	0.448	0.672	0.404	0.720
terrestrial	0.146	0.672	0.320	0.720
freshwater - terrestrial	0.400	0.672	0.450	0.720
autotroph	0.226	0.672	0.356	0.720
heterotroph	0.444	0.672	0.341	0.720
autotroph - heterotroph	0.313	0.672	0.480	0.720
freshwater autotroph	0.358	0.672	0.400	0.720
terrestrial autotroph	0.073	0.672	0.296	0.720

freshwater heterotroph	0.587	0.800	0.570	0.777
terrestrial heterotroph	0.380	0.672	0.328	0.720
freshwater autotroph - terrestrial autotroph	1.000	1.000	1.000	1.000
freshwater autotroph - freshwater heterotroph	1.000	1.000	1.000	1.000
terrestrial autotroph - terrestrial heterotroph	1.000	1.000	1.000	1.000
freshwater heterotroph - terrestrial heterotroph	1.000	1.000	1.000	1.000

Model N:P ratio

ABSOLUTE LATITUDE

overall	0.332	0.707	0.362	0.699
freshwater	0.488	0.732	0.430	0.699
terrestrial	0.179	0.707	0.288	0.699
freshwater - terrestrial	0.398	0.707	0.423	0.699
autotroph	0.289	0.707	0.387	0.699
heterotroph	0.424	0.707	0.340	0.699
autotroph - heterotroph	0.409	0.707	0.627	0.855
freshwater autotroph	0.417	0.707	0.466	0.699
terrestrial autotroph	0.083	0.707	0.305	0.699
freshwater heterotroph	0.571	0.779	0.461	0.699
terrestrial heterotroph	0.355	0.707	0.308	0.699
freshwater autotroph - terrestrial autotroph	1.000	1.000	1.000	1.000
freshwater autotroph - freshwater heterotroph	1.000	1.000	1.000	1.000
terrestrial autotroph - terrestrial heterotroph	1.000	1.000	1.000	1.000

freshwater heterotroph - terrestrial	1.000	1.000	1.000	1.000
heterotroph				
MODELS WITH ENVIRONMENTAL DRIVERS				
Model N content				
TEMPERATURE				
overall	0.329	0.789	0.466	0.827
freshwater	0.416	0.789	0.538	0.828
terrestrial	0.371	0.789	0.397	0.827
freshwater - terrestrial	0.508	0.789	0.404	0.827
autotroph	0.310	0.789	0.456	0.827
heterotroph	0.449	0.789	0.459	0.827
autotroph - heterotroph	0.319	0.789	0.431	0.827
freshwater autotroph	0.368	0.789	0.505	0.827
terrestrial autotroph	0.240	0.789	0.417	0.827
freshwater heterotroph	0.477	0.789	0.429	0.827
terrestrial heterotroph	0.833	1.000	0.812	1.000
freshwater autotroph - terrestrial autotroph	1.000	1.000	1.000	1.000
freshwater autotroph - freshwater heterotroph	1.000	1.000	1.000	1.000
terrestrial autotroph - terrestrial heterotroph	1.000	1.000	1.000	1.000
freshwater heterotroph - terrestrial	1.000	1.000	1.000	1.000
heterotroph				
RADIATION				
overall	0.703	1	0.814	1.000

freshwater	0.547	0.800	0.675	0.988
terrestrial	0.476	0.789	0.524	0.827
freshwater - terrestrial	0.513	0.789	0.500	0.827
autotroph	0.489	0.789	0.501	0.827
heterotroph	0.430	0.789	0.359	0.827
autotroph - heterotroph	0.453	0.789	0.439	0.827
freshwater autotroph	0.481	0.789	0.515	0.827
terrestrial autotroph	0.511	0.789	0.479	0.827
freshwater heterotroph	0.486	0.789	0.438	0.827
terrestrial heterotroph	0.461	0.789	0.377	0.827
freshwater autotroph - terrestrial autotroph	1.000	1.000	1.000	1.000
freshwater autotroph - freshwater heterotroph	1.000	1.000	1.000	1.000
terrestrial autotroph - terrestrial heterotroph	1.000	1.000	1.000	1.000
freshwater heterotroph - terrestrial	1.000	1.000	1.000	1.000
heterotroph				
N DEPOSITION				
overall	0.242	0.789	0.350	0.827
freshwater	0.247	0.789	0.295	0.827
terrestrial	0.974	1.000	0.990	1.000
freshwater - terrestrial	0.290	0.789	0.311	0.827
autotroph	0.147	0.789	0.308	0.827
heterotroph	0.394	0.789	0.513	0.827
autotroph - heterotroph	0.169	0.789	0.340	0.827

freshwater autotroph	0.179	0.789	0.291	0.827
terrestrial autotroph	0.216	0.789	0.427	0.827
freshwater heterotroph	0.508	0.789	0.354	0.827
terrestrial heterotroph	0.266	0.789	0.365	0.827
freshwater autotroph - terrestrial autotroph	1.000	1.000	1.000	1.000
freshwater autotroph - freshwater heterotroph	1.000	1.000	1.000	1.000
terrestrial autotroph - terrestrial heterotroph	1.000	1.000	1.000	1.000
freshwater heterotroph - terrestrial heterotroph	1.000	1.000	1.000	1.000
LABILE P				
overall	0.428	0.789	0.439	0.827
freshwater	0.459	0.789	0.463	0.827
terrestrial	0.359	0.789	0.435	0.827
freshwater - terrestrial	0.409	0.789	0.462	0.827
autotroph	0.447	0.789	0.521	0.827
heterotroph	0.313	0.789	0.475	0.827
autotroph - heterotroph	0.373	0.789	0.511	0.827
freshwater autotroph	0.413	0.789	0.489	0.827
terrestrial autotroph	0.546	0.800	0.665	0.988
freshwater heterotroph	0.349	0.789	0.461	0.827
terrestrial heterotroph	0.361	0.789	0.499	0.827
freshwater autotroph - terrestrial autotroph	1.000	1.000	1.000	1.000
freshwater autotroph - freshwater heterotroph	1.000	1.000	1.000	1.000

terrestrial autotroph - terrestrial heterotroph	1.000	1.000	1.000	1.000
freshwater heterotroph - terrestrial heterotroph	1.000	1.000	1.000	1.000
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Model P content				
TEMPERATURE				
overall	0.349	0.913	0.430	0.908
freshwater	0.453	0.913	0.531	0.908
terrestrial	0.314	0.913	0.383	0.908
freshwater - terrestrial	0.421	0.913	0.415	0.908
autotroph	0.437	0.913	0.512	0.908
heterotroph	0.365	0.913	0.395	0.908
autotroph - heterotroph	0.473	0.913	0.408	0.908
freshwater autotroph	0.674	0.963	0.820	1.000
terrestrial autotroph	0.294	0.913	0.428	0.908
freshwater heterotroph	0.438	0.913	0.461	0.908
terrestrial heterotroph	0.383	0.913	0.382	0.908
freshwater autotroph - terrestrial autotroph	1.000	1.000	1.000	1.000
freshwater autotroph - freshwater heterotroph	1.000	1.000	1.000	1.000
terrestrial autotroph - terrestrial heterotroph	1.000	1.000	1.000	1.000
freshwater heterotroph - terrestrial heterotroph	1.000	1.000	1.000	1.000
RADIATION				
overall	0.492	0.913	0.469	0.908

freshwater	0.530	0.913	0.519	0.908
terrestrial	0.432	0.913	0.465	0.908
freshwater - terrestrial	0.502	0.913	0.648	0.948
autotroph	0.429	0.913	0.429	0.908
heterotroph	0.498	0.913	0.519	0.908
autotroph - heterotroph	0.562	0.913	0.730	1.000
freshwater autotroph	0.492	0.913	0.562	0.908
terrestrial autotroph	0.417	0.913	0.459	0.908
freshwater heterotroph	0.617	0.925	0.590	0.908
terrestrial heterotroph	0.440	0.913	0.505	0.908
freshwater autotroph - terrestrial autotroph	1.000	1.000	1.000	1.000
freshwater autotroph - freshwater heterotroph	1.000	1.000	1.000	1.000
terrestrial autotroph - terrestrial heterotroph	1.000	1.000	1.000	1.000
freshwater heterotroph - terrestrial	1.000	1.000	1.000	1.000
heterotroph				
N DEPOSITION				
overall	0.567	0.913	0.457	0.908
freshwater	0.500	0.913	0.469	0.908
terrestrial	0.539	0.913	0.456	0.908
freshwater - terrestrial	0.469	0.913	0.491	0.908
autotroph	0.578	0.913	0.522	0.908
heterotroph	0.597	0.918	0.445	0.908
autotroph - heterotroph	0.562	0.913	0.432	0.908

freshwater autotroph	0.786	1.000	0.833	1.000
terrestrial autotroph	0.418	0.913	0.503	0.908
freshwater heterotroph	0.781	1.000	0.584	0.908
terrestrial heterotroph	0.572	0.913	0.449	0.908
freshwater autotroph - terrestrial autotroph	1.000	1.000	1.000	1.000
freshwater autotroph - freshwater heterotroph	1.000	1.000	1.000	1.000
terrestrial autotroph - terrestrial heterotroph	1.000	1.000	1.000	1.000
freshwater heterotroph - terrestrial heterotroph	1.000	1.000	1.000	1.000
LABILE P				
overall	0.412	0.913	0.551	0.908
freshwater	0.508	0.913	0.468	0.908
terrestrial	0.409	0.913	0.502	0.908
freshwater - terrestrial	0.426	0.913	0.487	0.908
autotroph	0.503	0.913	0.474	0.908
heterotroph	0.421	0.913	0.475	0.908
autotroph - heterotroph	0.446	0.913	0.514	0.908
freshwater autotroph	0.464	0.913	0.484	0.908
terrestrial autotroph	0.385	0.913	0.535	0.908
freshwater heterotroph	0.652	0.954	0.646	0.948
terrestrial heterotroph	0.435	0.913	0.497	0.908
freshwater autotroph - terrestrial autotroph	1.000	1.000	1.000	1.000
freshwater autotroph - freshwater heterotroph	1.000	1.000	1.000	1.000
















terrestrial autotroph - terrestrial heterotroph	1.000	1.000	1.000	1.000
freshwater heterotroph - terrestrial heterotroph	1.000	1.000	1.000	1.000
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Model N:P ratio				
TEMPERATURE				
overall	0.446	0.953	0.471	0.818
freshwater	0.473	0.953	0.555	0.818
terrestrial	0.442	0.953	0.468	0.818
freshwater - terrestrial	0.542	0.953	0.546	0.818
autotroph	0.495	0.953	0.428	0.818
heterotroph	0.447	0.953	0.395	0.818
autotroph - heterotroph	0.453	0.953	0.384	0.818
freshwater autotroph	0.479	0.953	0.444	0.818
terrestrial autotroph	0.518	0.953	0.466	0.818
freshwater heterotroph	0.467	0.953	0.415	0.818
terrestrial heterotroph	0.457	0.953	0.416	0.818
freshwater autotroph - terrestrial autotroph	1.000	1.000	1.000	1.000
freshwater autotroph - freshwater heterotroph	1.000	1.000	1.000	1.000
terrestrial autotroph - terrestrial heterotroph	1.000	1.000	1.000	1.000
freshwater heterotroph - terrestrial heterotroph	1.000	1.000	1.000	1.000
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RADIATION				
overall	0.482	0.953	0.498	0.818

freshwater	0.415	0.953	0.430	0.818
terrestrial	0.809	1.000	0.834	1.000
freshwater - terrestrial	0.434	0.953	0.464	0.818
autotroph	0.435	0.953	0.472	0.818
heterotroph	0.450	0.953	0.477	0.818
autotroph - heterotroph	0.424	0.953	0.461	0.818
freshwater autotroph	0.403	0.953	0.470	0.818
terrestrial autotroph	0.473	0.953	0.492	0.818
freshwater heterotroph	0.569	0.953	0.595	0.83
terrestrial heterotroph	0.419	0.953	0.474	0.818
freshwater autotroph - terrestrial autotroph	1.000	1.000	1.000	1.000
freshwater autotroph - freshwater heterotroph	1.000	1.000	1.000	1.000
terrestrial autotroph - terrestrial heterotroph	1.000	1.000	1.000	1.000
freshwater heterotroph - terrestrial	1.000	1.000	1.000	1.000
heterotroph				
N DEPOSITION				
overall	0.390	0.953	0.404	0.818
freshwater	0.310	0.953	0.359	0.818
terrestrial	0.573	0.953	0.470	0.818
freshwater - terrestrial	0.316	0.953	0.371	0.818
autotroph	0.318	0.953	0.393	0.818
heterotroph	0.618	0.953	0.475	0.818
autotroph - heterotroph	0.730	1.000	0.539	0.818

freshwater autotroph	0.270	0.953	0.360	0.818
terrestrial autotroph	0.521	0.953	0.508	0.818
freshwater heterotroph	0.729	1.000	0.538	0.818
terrestrial heterotroph	0.651	0.953	0.521	0.818
freshwater autotroph - terrestrial autotroph	1.000	1.000	1.000	1.000
freshwater autotroph - freshwater heterotroph	1.000	1.000	1.000	1.000
terrestrial autotroph - terrestrial heterotroph	1.000	1.000	1.000	1.000
freshwater heterotroph - terrestrial heterotroph	1.000	1.000	1.000	1.000
LABILE P				
overall	0.569	0.953	0.433	0.818
freshwater	0.562	0.953	0.453	0.818
terrestrial	0.564	0.953	0.443	0.818
freshwater - terrestrial	0.488	0.953	0.559	0.818
autotroph	0.504	0.953	0.475	0.818
heterotroph	0.609	0.953	0.464	0.818
autotroph - heterotroph	0.467	0.953	0.587	0.830
freshwater autotroph	0.451	0.953	0.469	0.818
terrestrial autotroph	0.563	0.953	0.453	0.818
freshwater heterotroph	0.634	0.953	0.501	0.818
terrestrial heterotroph	0.638	0.953	0.548	0.818
freshwater autotroph - terrestrial autotroph	1.000	1.000	1.000	1.000
freshwater autotroph - freshwater heterotroph	1.000	1.000	1.000	1.000

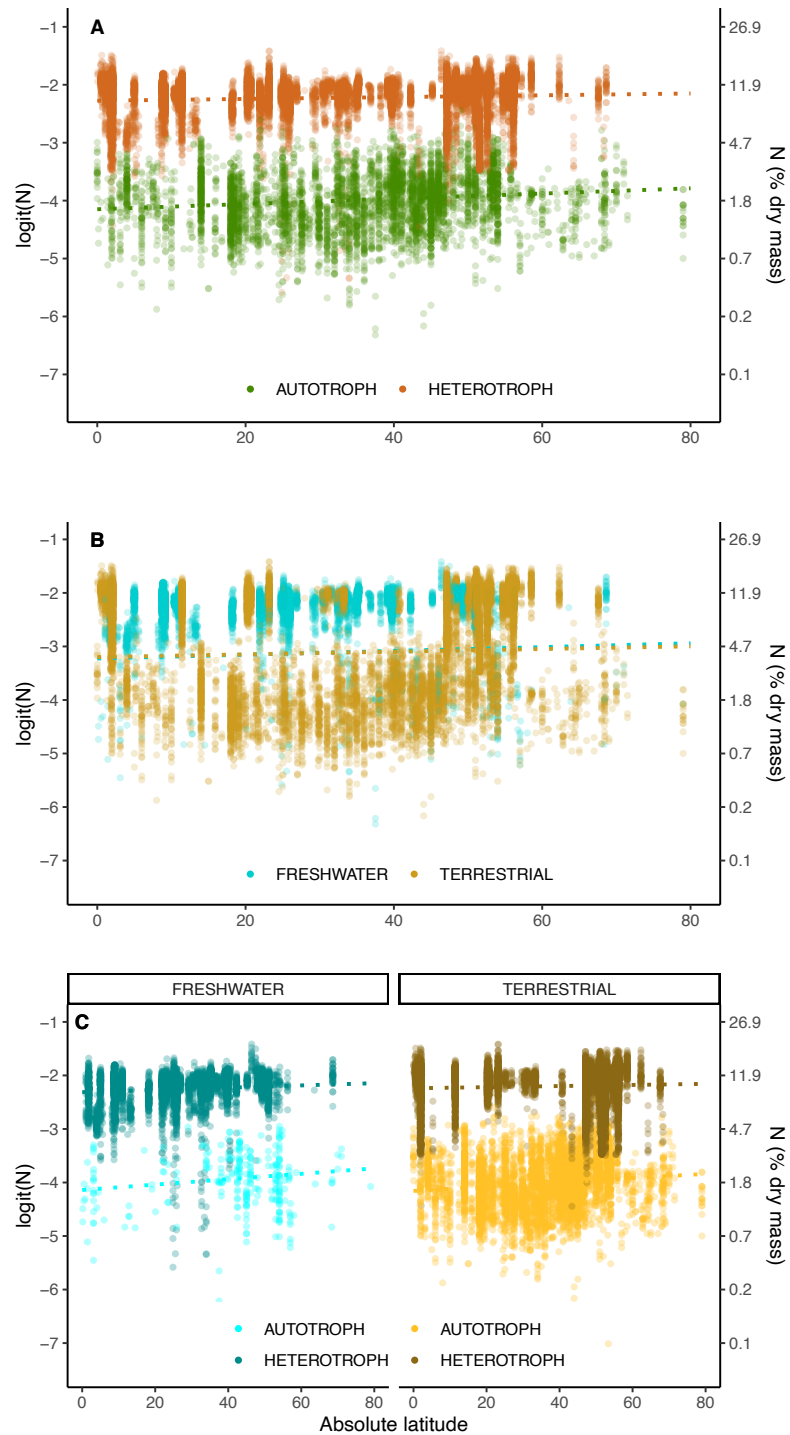
terrestrial autotroph - terrestrial heterotroph	1.000	1.000	1.000	1.000
freshwater heterotroph - terrestrial heterotroph	1.000	1.000	1.000	1.000

Supplementary Figures

		Elemental Body Composition	HYPOTHESES / PREDICTIONS				RESULTS													
			Hypothesis	Alternative Hypothesis					Main Effect											
Temperature			G_T Hotter is better	T_T Metabolic cold adaptation	T_T Trophic-dependent temperature sensitivity	R_T Realm-dependent temperature sensitivity														
	N		↗				—	—	—	—	—	—	—	—	—	—	—	—	—	—
	P		↘				—	—	—	—	—	—	—	—	—	—	—	—	—	—
	NP		↗↘				—	—	—	—	—	—	—	—	—	—	—	—	—	—
Radiation			G_R Growing season length	T_R UV-dependent	T_R Trophic-dependent UVR tolerance	R_R Realm-dependent UVR tolerance														
	N		↗				—	—	—	—	—	—	—	—	—	—	—	—	—	—
	P		↘				—	—	—	—	—	—	—	—	—	—	—	—	—	—
	NP		↗↘				—	—	—	—	—	—	—	—	—	—	—	—	—	—
Nutrients			G_N Stoichiometric plasticity	T_N Trophic-dependent nutrient content	R_N Realm-dependent nutrient content															
	Nitrogen	N		↗			↗	↗	—	—	↗	↗	↗	↗	↗	↗	↗	↗	—	—
		P		↘				—	—	—	—	—	—	—	—	—	—	—	—	—
		NP		↗↘				—	—	—	—	↗	—	—	—	—	↗	—	—	—
	Phosphorus	N		↗				—	—	—	—	—	—	—	—	—	—	—	—	—
		P		↘				—	—	—	—	—	—	—	—	—	—	—	—	—
		NP		↗↘				—	—	—	—	—	—	—	—	—	—	—	—	—

Supplementary Figure 1. Summary of hypotheses, predictions, and results on how environmental predictors affect organismal elemental content. Three mechanisms were tested: (i) Temperature-Dependent Physiology (Temperature; G_T), encompassing the *hotter is better* and the *metabolic cold adaptation* hypotheses; (ii) Radiation-Dependent Physiology (Radiation; G_R), via the *growing season length* and *UV-dependent* hypotheses; and (iii) Nutrient-

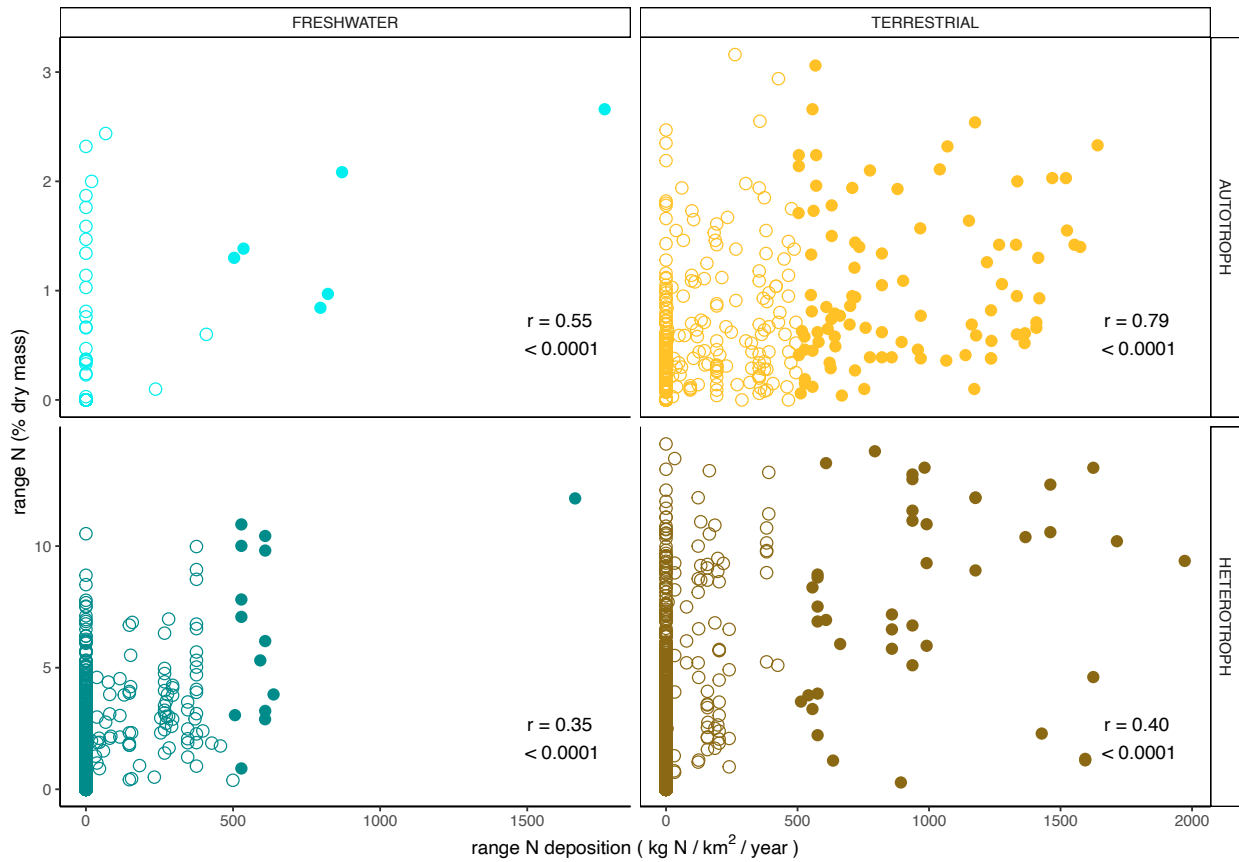
Dependent Physiology (Nutrients; G_N), through *stoichiometric plasticity* and *stoichiometric homeostasis* hypotheses. Arrows in the “Predictions” panel indicate effect directions. General hypotheses ($G_{T^o, R, \text{ or } N}$) are further specified by trophic group ($T_{T^o, R, \text{ or } N}$; insect and leaf symbols for animals and plants) or realm ($R_{T^o, R, \text{ or } N}$; water and mountain icons for freshwater and terrestrial organisms). Dark gray cells denote stronger predicted responses for a trophic group or realm than lighter gray. In the “Results” panel, dashes indicate no significant response; arrows indicate significant responses and their direction. Colored arrows highlight significant contrasts: freshwater > terrestrial organisms (light green) and autotrophs > heterotrophs (dark green; Supplementary Table 1).



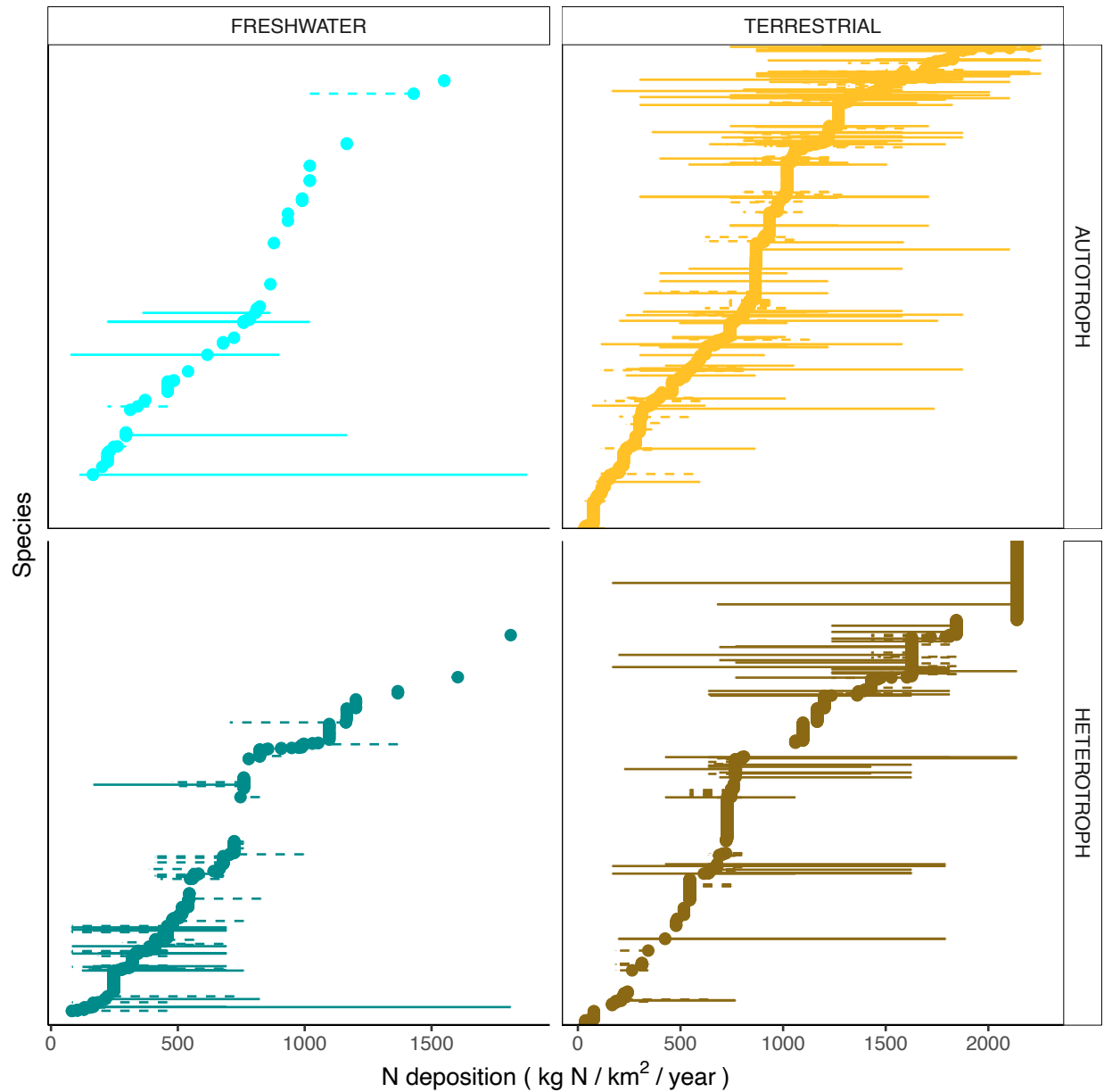
Supplementary Figure 2. Estimated marginal effects of latitude on organismal N content.

(A) Latitudinal patterns for autotrophs vs. heterotrophs, pooled across realms. (B) Latitudinal patterns for freshwater vs. terrestrial organisms, pooled across trophic groups. (C) Latitudinal

patterns for freshwater vs. terrestrial autotrophs vs. heterotrophs. Model fit lines indicate significant (solid; $P < 0.05$) or non-significant (dotted; $P > 0.05$) relationships from linear mixed-effect models. Elemental content data points and estimates are shown on the logit scale and back-transformed to % dry mass. See Supplementary Table 1 for slope coefficients and exact P values, and Supplementary Table 2 for explained variance.

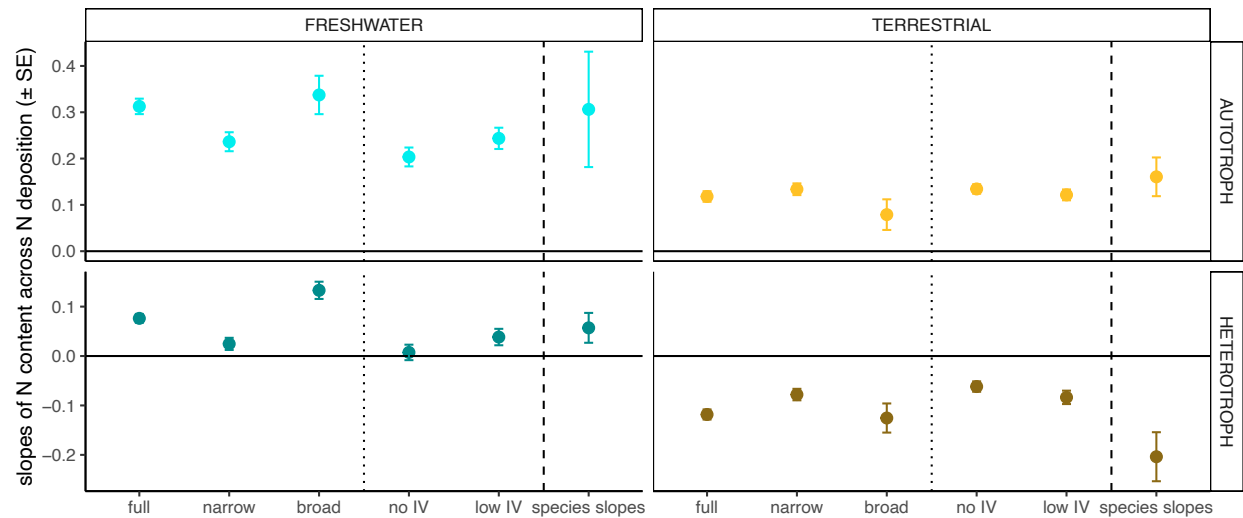


Supplementary Figure 3. Correlations between species-level ranges in N content and N deposition across realms (freshwater vs. terrestrial) and trophic groups (autotroph vs. heterotroph). Open circles represent species experiencing narrow variation in N deposition (< 500 kg N km⁻² y⁻¹), while closed circles represent species experiencing broad variation (> 500 kg N km⁻² y⁻¹). When species with zero range in N deposition are excluded, only the correlation for freshwater autotrophs becomes non-significant (two-sided Spearman's $r = 0.24$; $P = 0.514$). Significant correlations persist for freshwater heterotrophs ($r = 0.39$; $P < 0.0001$), terrestrial autotrophs ($r = 0.27$; $P < 0.0001$), and terrestrial heterotrophs ($r = 0.25$; $P = 0.007$).

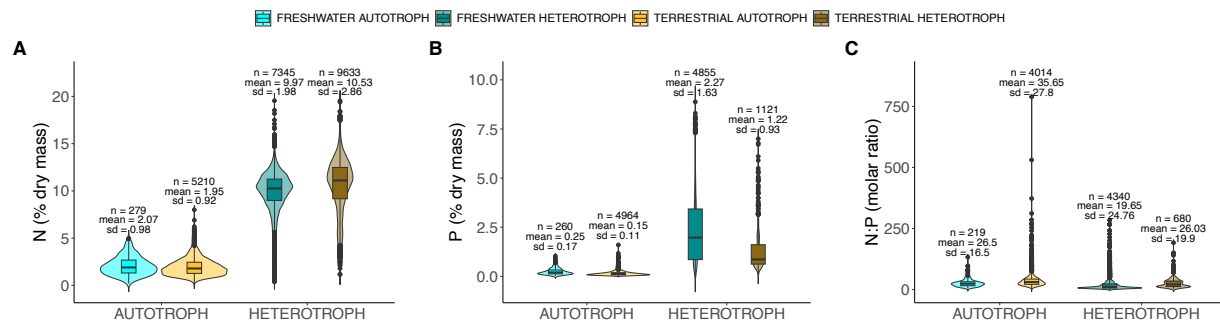


Supplementary Figure 4. Species distribution along the gradient in N deposition within realms (freshwater vs. terrestrial) and trophic groups (autotroph vs. heterotroph). Species are ordered by increasing median values of their N deposition range. Segments indicate species ranges in N deposition with dashed lines representing narrow ranges (< 500 kg N km⁻² y⁻¹) and solid lines representing broad ranges (> 500 kg N km⁻² y⁻¹). Species turnover across the N deposition gradient is relatively high, as most species occupy a small proportion of the total

gradient (min. - max. = 33.0 - 2256.1 kg N km⁻² y⁻¹): freshwater autotrophs, 3.6% ± 13.7; freshwater heterotrophs, 2.4% ± 7.6; terrestrial autotrophs, 4.3% ± 11.9; terrestrial heterotrophs, 1.8% ± 8.8 (mean ± SD). The proportion of species spanning broad ranges in N deposition (i.e., > 500 kg N km⁻² y⁻¹; indicating lower turnover) was low across groups, ranging from 2.0% to 7.7%, depending on realm and trophic group (see Supplementary Figure 2).



Supplementary Figure 5. Distributions of slopes between organismal N content and N deposition across six *scenarios*: (i) all data (“full”; Supplementary Table 1); species experiencing (ii) narrow (“narrow”; $< 500 \text{ kg N km}^{-2} \text{ y}^{-1}$) or (iii) broad (“broad”; $> 500 \text{ kg N km}^{-2} \text{ y}^{-1}$) variation in N deposition; (iv) species-averaged N content (no intraspecific variation, “no IV”); (v) species-averaged within locations (“low IV”); and (vi) individual species slopes (“species slopes”), limited to species with \geq four distinct N deposition values. The dotted line separates mixed-effect models with species as random effects (left) from generalized linear models (right). The dashed line separates models including (left) vs. excluding (right) other environmental predictors (temperature, radiation, labile P). These scenarios differ in the relative influence of species intraspecific variation and species turnover on slope estimates. Despite differences in slope magnitude, results showed consistent slope direction across realms, trophic groups, and scenarios compared with the main models (“full”; Supplementary Table 1).



Supplementary Figure 6. Distribution of elemental content in autotrophs and heterotrophs from freshwater and terrestrial realms: (A) N content, (B) P content, and (C) N:P ratios. Boxplots show medians, interquartile ranges, minima, maxima, and outliers. Means and standard deviations (SD) are also reported for each trophic group (autotroph, heterotroph) within each realm (freshwater, terrestrial).