

Supporting Information for

Coordination between bioelements induce more stable macroelements than microelements in wetland plants

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Supplementary Appendixes 1-5;

Supplementary Figures 1-19;

Supplementary Tables 1-8.

Supplementary Texts in Methods

Appendix S1 Field sampling and laboratory analysis

We conducted a large-scale investigation of wetland plant communities across the western China during the growing season (July and August) in 2018 and 2019 using a uniform protocol. We focused on three main life-forms of wetland plants (emergent plants, floating-leaved plants and submerged plants). In each site, we collected plant samples as many species as possible. For emergent plants and floating-leaved plants, 3-5 fully expanded and intact leaves were sampled randomly from each individual. For submerged plants, we collected 3-5 segments of plant shoots (20 cm from the tips) from each individual, and then picked off all the leaves. About 10 individuals were chosen and thus 30-50 leaves or segments in total were collected in each site. All 30-50 leaves or segments from the same species in a site were mixed as the plant sample of this species in the site. The plant samples were oven-dried at 70 °C for 72 h and then ground into fine powder passing through a 0.25 mm mesh sieve. Based on habitat accessibility, we collected 84 plant species (28 emergent, 5 floating-leaved and 51 submerged species) from 232 wetland sites in western China, for a total of 1058 samples (species-site combinations, 475, 40 and 543 samples for the three plant life forms). Of the 84 species, 21 appeared only once (21 samples), while the other 63 species constituted the other 1037 samples.

In terms of habitat types, we investigated wetland types including shallow areas (no deeper than 1.5 m) of lakes, rivers, and marshes, as well as streams, ponds, and channels, while ephemeral water bodies were excluded. Specifically, of the 1058 plant leaf samples collected from 232 sites, 154 samples were from 45 lakes, 270 samples were from 54 rivers, 148 samples were from 31 marshes, 130 samples were from 29 streams, 242 samples were from 47 ponds, and 114 samples were from 26 channels.

Before sampling, the pH and salinity of the undisturbed water were measured *in situ* with a handheld multiparameter meter (PROPLUS, YSI, USA). Then, 500ml water samples were collected from midway between the water surface and the soil substrate. Three samples from the upper 0-20 cm of sediments were collected randomly at each site and then mixed, air dried, the roots and rocks removed, and then ground and sieved through a 0.15 mm mesh for further analysis. The pH and electrical conductivity (EC) of the sediments were measured by dissolving samples into a mass-based soil-water ratio of 1:5.

The total nitrogen (N) contents of water were analyzed using a multiparameter portable colorimeter (DR900, HACH, USA) with a digestion solution, while the total SO_4^{2-} contents of water were determined by ion chromatography (ICS-1000, DIONEX, USA). Total carbon (C), N and sulfur (S) concentrations of both plants and sediments were measured from powdered samples by an elemental analyzer (UNICUBE, Elementar, Germany). The concentrations of the other 14 bioelements (phosphorus, P; potassium, K; calcium, Ca; magnesium, Mg; sodium, Na;

aluminum, Al; iron, Fe; manganese, Mn; zinc, Zn; copper, Cu; nickel, Ni; cobalt, Co; silicon, Si; boron, B) of plants, sediments and water were measured by inductively coupled plasma mass spectrometry (ICP-MS-2030, Shimadzu, Japan).

Appendix S2 Detection of phylogenetic signal

As defined by Blomberg et al. (2003), phylogenetic signal is the pattern that evolutionarily related species tend to resemble each other for traits of organisms. Blomberg's K value was calculated to quantify the amount of phylogenetic signal for each trait (bioelements in this study), and then to compare the strength of phylogenetic signal across traits - higher Blomberg's K value indicating stronger phylogenetic conservatism for the trait. Statistical significance of Blomberg's K value was tested by comparing the obtained trait data with a set of data permuted the trait values randomly across the tips of a phylogenetic tree (Blomberg et al., 2003). Phylogenetic signal analyses were conducted on all 84 species, which belonged to 40 genera, 23 families and 11 orders. All species names were confirmed using The World Flora Online (www.worldfloraonline.org). Angiosperm order and family assignments were based on the Angiosperm Phylogeny Group IV classification (APG 2016). The “*phytools*” (Revell 2012) and “*S.PhyloMaker*” package (Qian & Jin 2016) in *R* were used to construct a phylogenetic tree (Figure S2). Blomberg's K values and its statistical significance were calculated using the “*Picante*” package in *R* (Kembel et al., 2010). A significant phylogenetic signal ($P < 0.05$) indicated that the bioelemental concentrations was constrained by phylogeny (Blomberg et al., 2003).

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Appendix S3 Leaf element network (LEN) analysis

With reference to plant trait network (He et al., 2020), we introduced LEN to clarify the complex relationships between bioelements and further assess the variations in the synergies of bioelements across environmental gradients. Low temperature and high salinity are common stressors in western China (Wang et al., 2015; Zuo et al., 2022). We divided our data into three temperature gradients according to the GST range in this study area (low-GST, 0-10°C; middle-GST, 10-20°C and high-GST, 20-30°C). Similarly, according to the classification standards of the International Limnology Society and Previous study (Zuo et al., 2022), combining with the salinity range in this study area, the water salinity was divided into four gradients (fresh water, 0-0.5‰; brackish water, 0.5-2‰; moderate saline water, 2-5‰ and saline water, >5‰).

All the 17 bioelements were included in network analysis. Each bioelement and bivariate correlation were considered as node and edge in network, respectively. First, we built bivariate correlations of the 17 bioelements for all data and each temperature and salinity level, and calculated the Pearson correlation coefficient (r) and statistical significance (P). Then, a threshold ($|r| > 0.2$ and $P < 0.05$) was set to define the meaningful bivariate correlations (Kleyer et al., 2019), and an adjacency matrix $A = [a_{ij}]$ where $a_{ij} \in [0,1]$ was calculated by assigning 0 to the correlations with $|r| < 0.2$ and $P > 0.05$, and 1 to the correlations with $|r| > 0.2$ and $P < 0.05$ (He et al., 2020). The adjacency matrixes were visualized using *Cytoscape* 3.9.1 to build LENs (Shannon et al., 2003), and the connections between bioelements in LENs were weighted by $|r|$.

Each LEN consists of six overall network parameters (edge density, average path length, diameter, average clustering coefficient, modularity and vulnerability) and five node parameters (degree, weighted degree, closeness, betweenness and clustering coefficient, Table S2 for detailed information). Briefly, the edge density, diameter and average path length quantify the “connectivity” of LEN, the average clustering coefficient and modularity quantify the “complexity” (He et al., 2020; Rao et al., 2023), and the vulnerability quantify the “stability” (Yuan et al., 2021). LENs with lower edge density, or higher diameter and average path length are “looser” and “less connected”, that is, more independence between bioelements. LENs with higher average clustering coefficient signify a lower network complexity. High modularity of LEN means that the network is separated into more modules to perform different functions. LENs with higher vulnerability indicate a lower network stability.

To describe the importance of each bioelement in LEN, the degree, weighted degree and closeness are used to assess the “connectedness”, and the betweenness and clustering coefficient to assess the “centrality” of bioelements. Bioelement with the highest degree and weighted degree are regarded as “hub trait”, which has an important regulatory role in the whole elementome of plants. Bioelements with high closeness are closely connected to other bioelements, and those have high betweenness serving as “mediator” of bioelemental

connections within LEN. Additionally, bioelements with higher clustering coefficient serve as a center of a functional module within LEN. The overall network parameters and node parameters were calculated using “igraph” package in R (Csárdi & Nepusz 2006).

We further tested the stability of the five node parameters for the 17 bioelements in different conditions, to explore the consistency of the importance of each bioelement across environmental gradients (Li et al., 2022). Stability of a certain node parameter for a given bioelement was calculated by dividing the mean value of the node parameters at all environmental levels, for example the three GST levels, by the standard deviations (*i.e.*, Mean/SD). If a certain bioelement with high importance (*e.g.*, high degree in LEN) also has high stability, it means that such bioelements always play central roles in different environmental conditions (Li et al., 2022; Rao et al., 2023), and *vice versa*. Furthermore, we also tested the variations in the importance of each bioelement by comparing the shifts of the node parameters across environmental gradients.

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Appendix S4 Calculation of Euclidean distance of leaf element networks between paired environmental gradients

Based on a Euclidean distance approach (Collins et al., 2000), we used interval analysis to explore the effects of environmental gradient differences on the leaf element networks (LENs). The environmental gradient interval matrix (*i.e.*, the independent variable) was represented by paired environmental gradient differences (*e.g.*, middle-GST vs low-GST). In this study, there were three temperature gradient differences and six salinity gradient differences. The change in LENs (*i.e.*, the dependent variable) was represented by the Euclidean distance (ED) of bioelements as follows:

$$ED = \sqrt{\sum_{i=1}^T (x_{ij} - x_{ik})^2}$$

where x_{ij} is the concentration of i th bioelement at the j th environmental level, and x_{ik} is the concentration of i th bioelement at the k th environmental level, and T is the total number of bioelements (17 in this study). A larger Euclidean distance represents a larger change (or difference) in LENs between paired environmental gradients.

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Appendix S5 Calculation of leaf structural C (C_s) of plants

Because leaf proteins comprising most organic N (predominant form of N) also contain C, and given that proteins contain more carbon (53.5%, Vertregt & Penning de Vries 1987) than leaves on average (around 50%, Ma et al., 2018). We calculated the concentrations of leaf protein-free C (structural C, C_s) with the following equation:

$$C_s = \frac{C - 6.25 N \times \frac{53.5}{100}}{1 - \frac{6.25 N}{1000}}$$

where *C* and *N* are the leaf C and N concentrations, respectively; 6.25 converts N concentrations to protein concentrations; and 53.5% is the carbon percentage of proteins (Fleck et al., 2003; Niinemets & Tamm, 2005; Xing et al., 2021).

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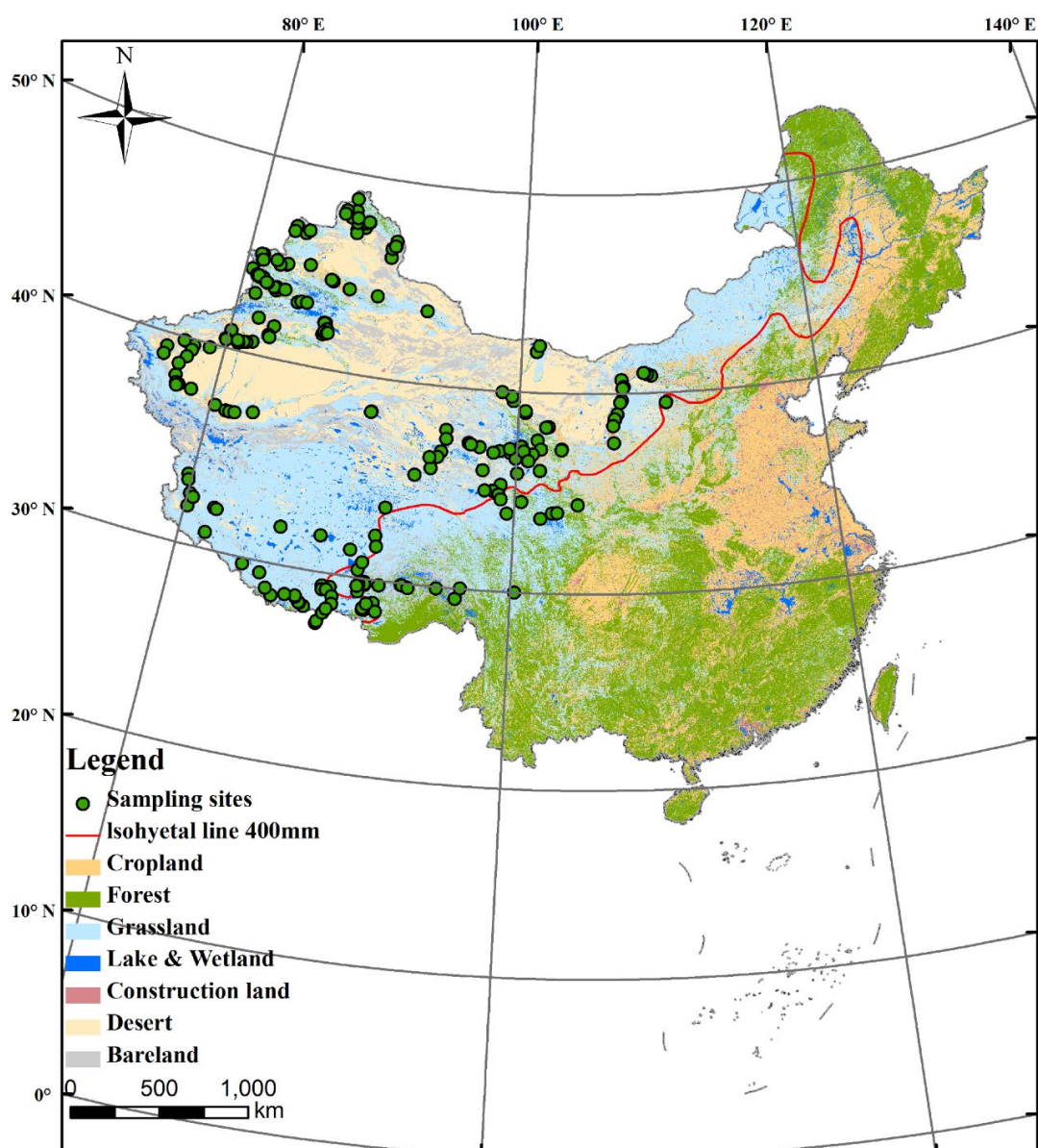


Figure S1. Sampling sites in this study. Two hundred and thirty-two wetlands were selected for samples collecting in alpine and arid regions of western China. The raw data for the base map were the Spatial Distribution Data of China Terrestrial Ecosystem Types (2015) that downloaded from the Resource and Environment Science and Data Center.

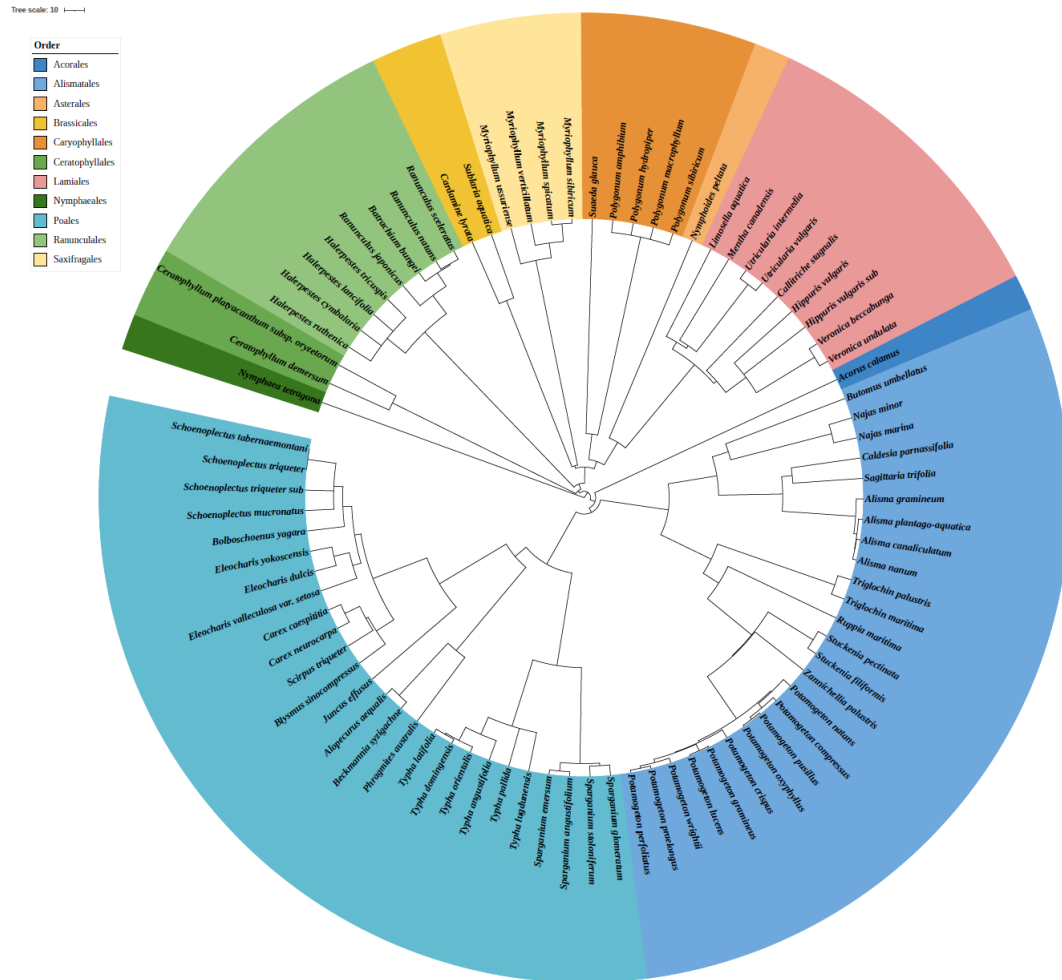


Figure S2. Phylogenetic tree of species in this study. The 84 wetland plant species belonging to 40 genera, 23 families and 11 orders. The different colors correspond to different orders in the legend.

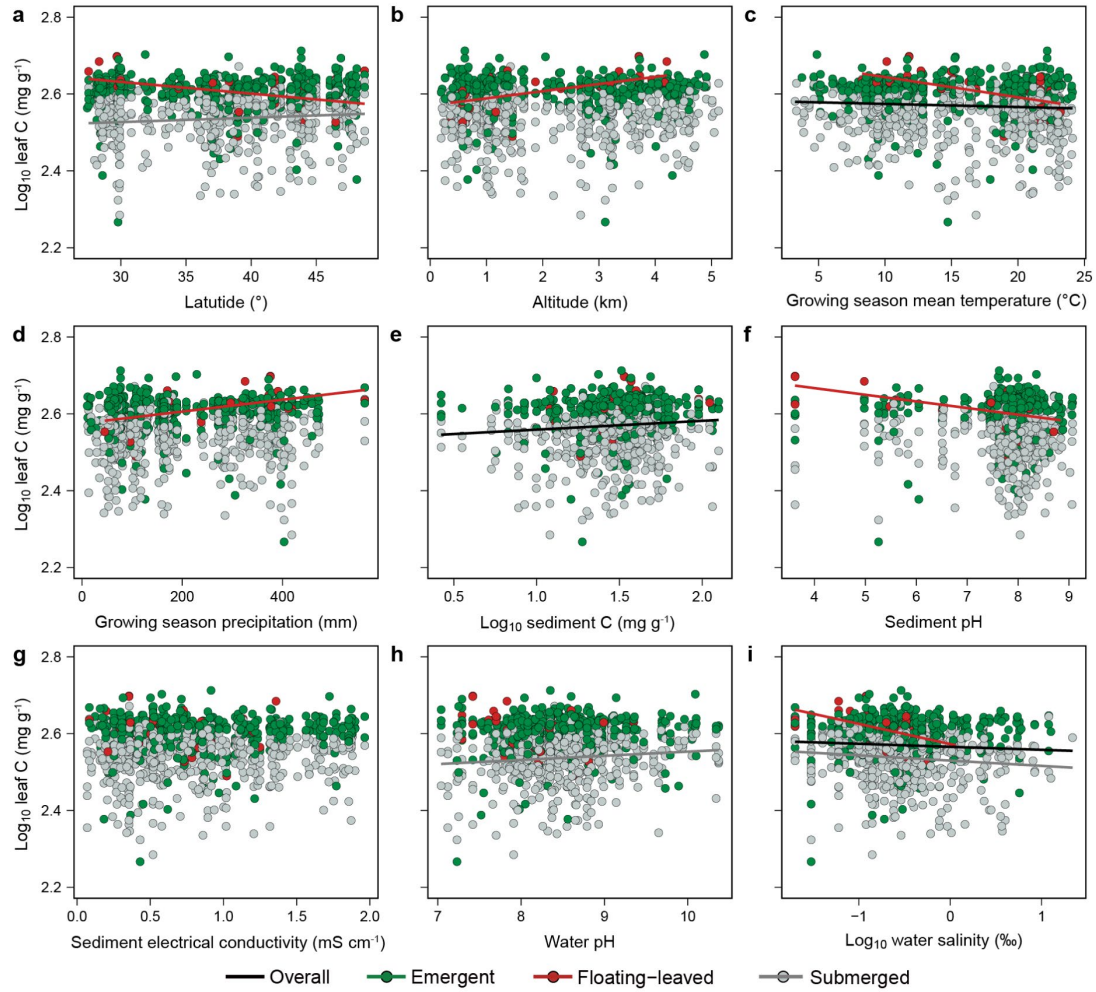


Figure S3. Patterns of leaf C along geographic, climatic and environmental gradients of wetland plants. (a) latitude ($^{\circ}$); (b) altitude (km); (c) growing season mean temperature (GST, $^{\circ}\text{C}$); (d) growing season precipitation (GSP, mm); (e) sediment C concentrations (mg g^{-1}); (f) sediment pH; (g) sediment electrical conductivity (mS cm^{-1}); (h) water pH; (i) water salinity (‰). Solid lines represent significant fits ($P < 0.05$). Overall observations ($n = 1058$) and different life-forms (submerged plants: $n = 543$; emergent plants: $n = 475$; floating-leaved plants: $n = 40$) of wetland plants are shown in different colors. Statistical summaries for regression models are shown in Table S4.

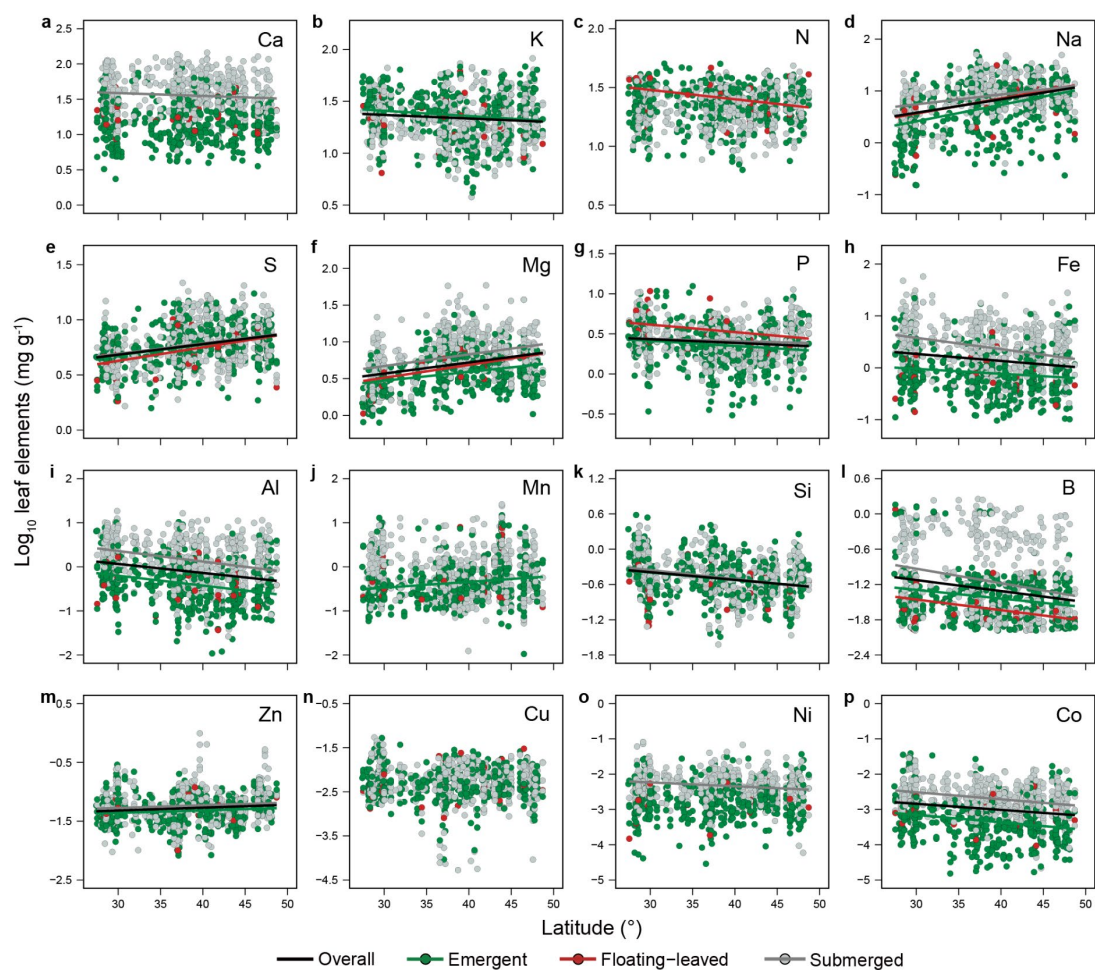


Figure S4. Relationships between leaf bioelements and latitude of wetland plants. Solid lines represent significant fits ($P < 0.05$). Overall observations ($n = 1058$) and different life-forms (submerged plants: $n = 543$; emergent plants: $n = 475$; floating-leaved plants: $n = 40$) of wetland plants are shown in different colors. Statistical summaries for regression models are shown in Table S4.

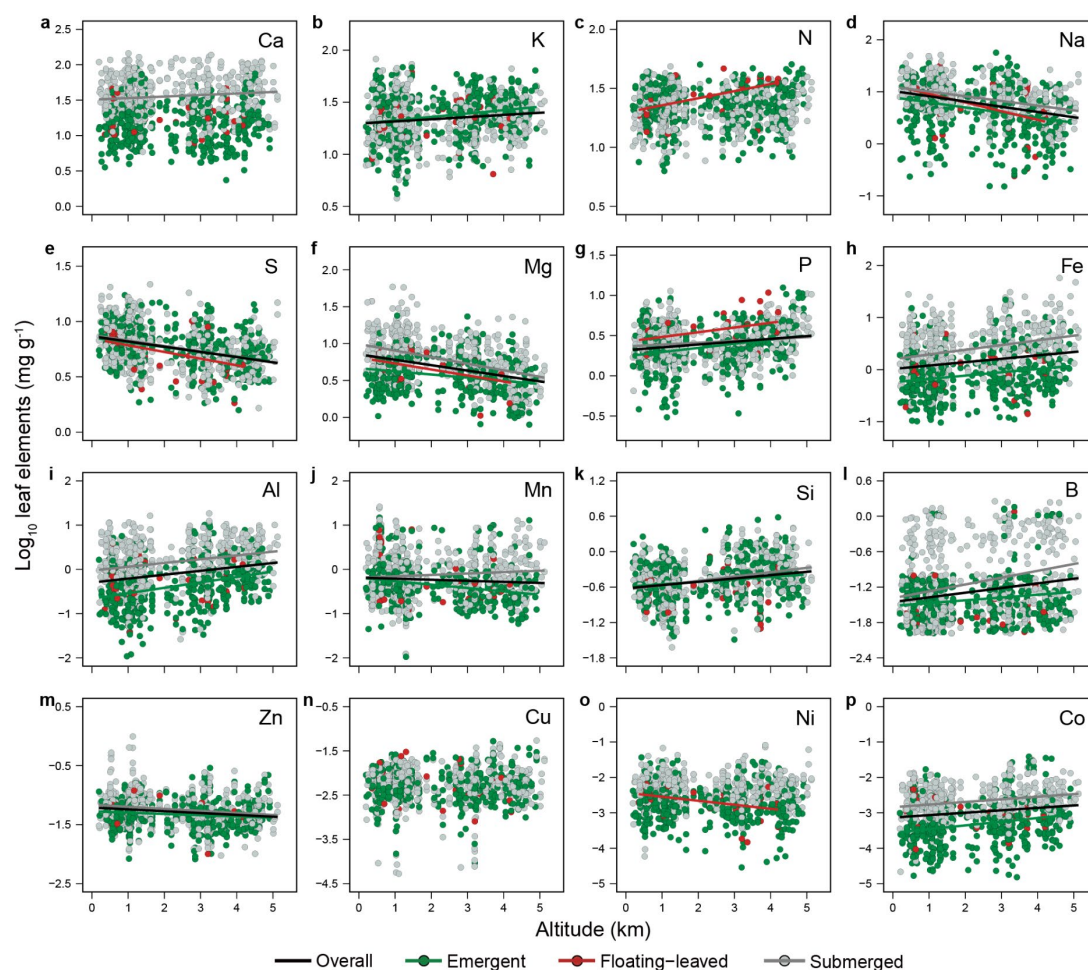


Figure S5. Relationships between leaf bioelements and altitude of wetland plants. Solid lines represent significant fits ($P < 0.05$). Overall observations ($n = 1058$) and different life-forms (submerged plants: $n = 543$; emergent plants: $n = 475$; floating-leaved plants: $n = 40$) of wetland plants are shown in different colors. Statistical summaries for regression models are shown in Table S4.

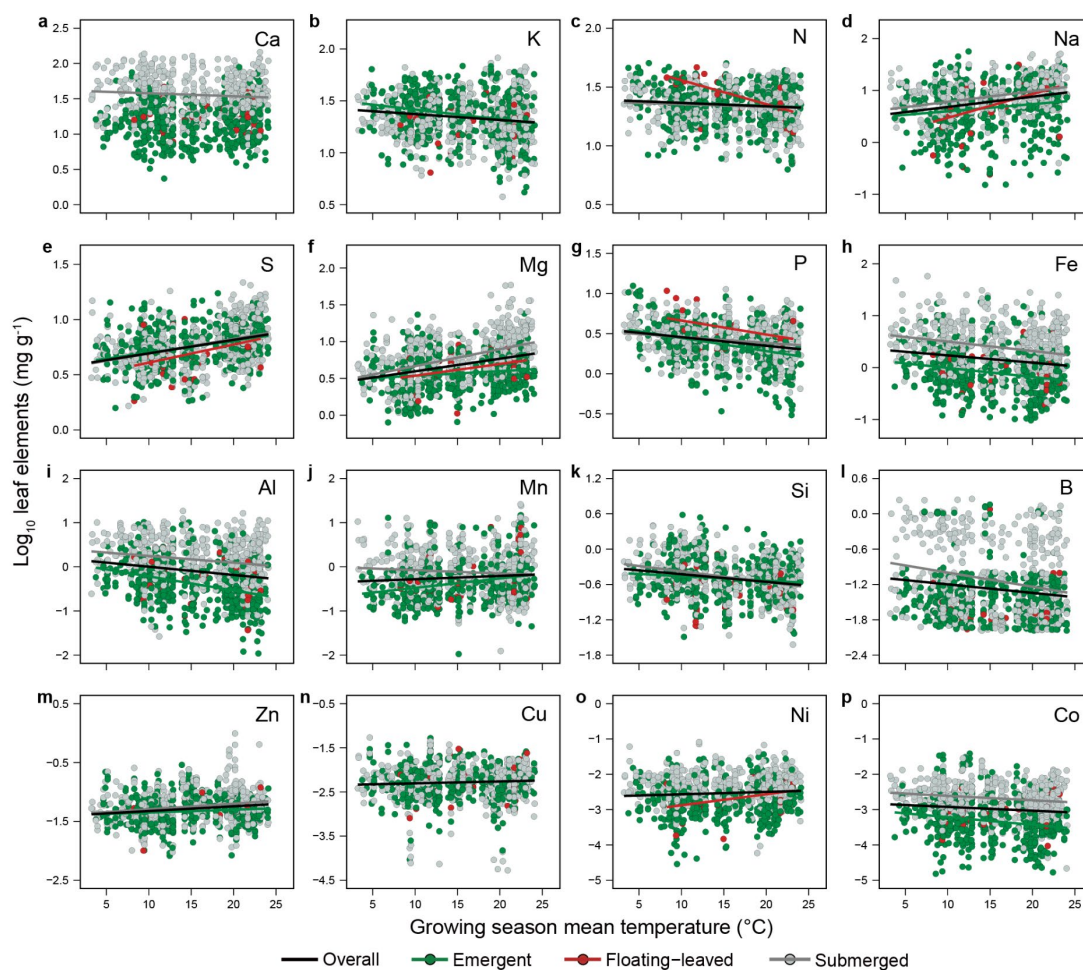


Figure S6. Relationships between leaf bioelements and growing season mean temperature (GST) of wetland plants. Solid lines represent significant fits ($P < 0.05$). Overall observations ($n = 1058$) and different life-forms (submerged plants: $n = 543$; emergent plants: $n = 475$; floating-leaved plants: $n = 40$) of wetland plants are shown in different colors. Statistical summaries for regression models are shown in Table S4.

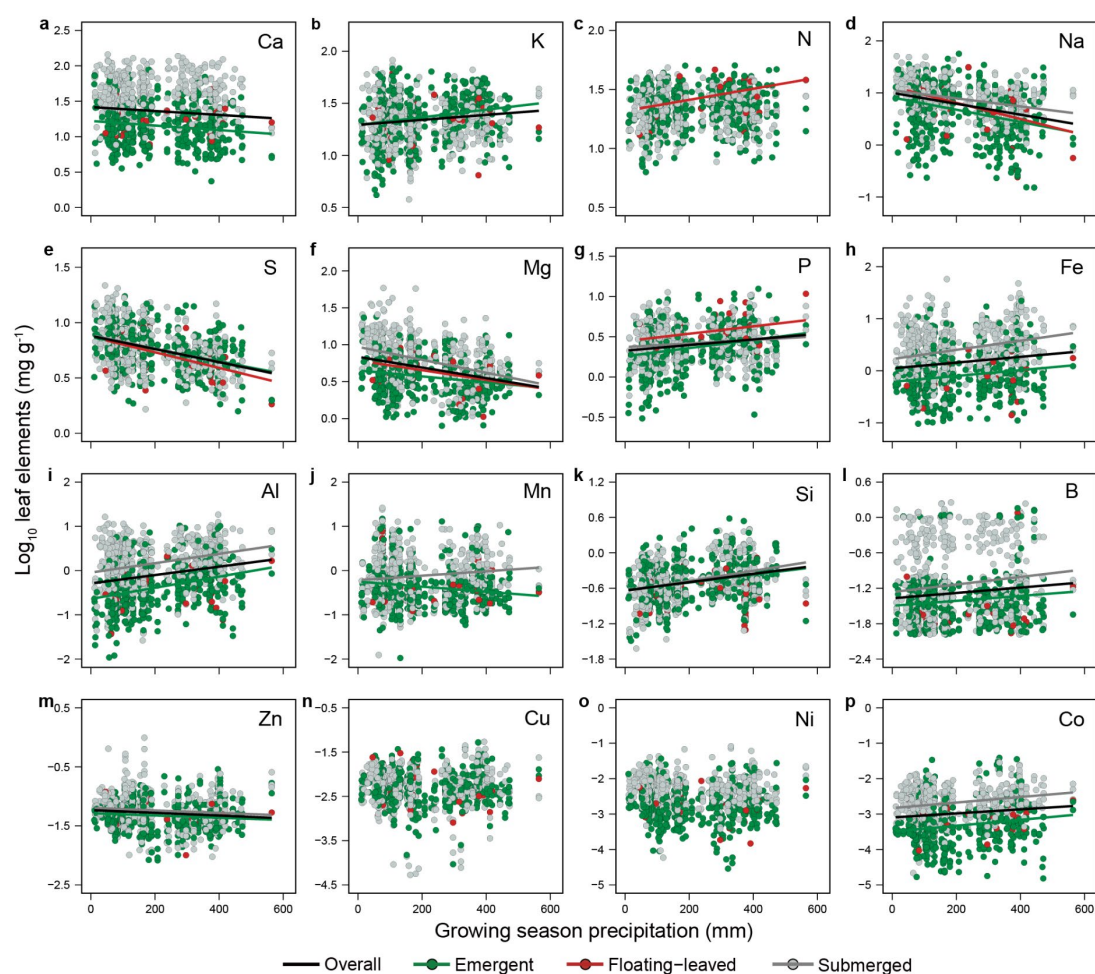


Figure S7. Relationships between leaf bioelements and growing season precipitation (GSP) of wetland plants. Solid lines represent significant fits ($P < 0.05$). Overall observations ($n = 1058$) and different life-forms (submerged plants: $n = 543$; emergent plants: $n = 475$; floating-leaved plants: $n = 40$) of wetland plants are shown in different colors. Statistical summaries for regression models are shown in Table S4.

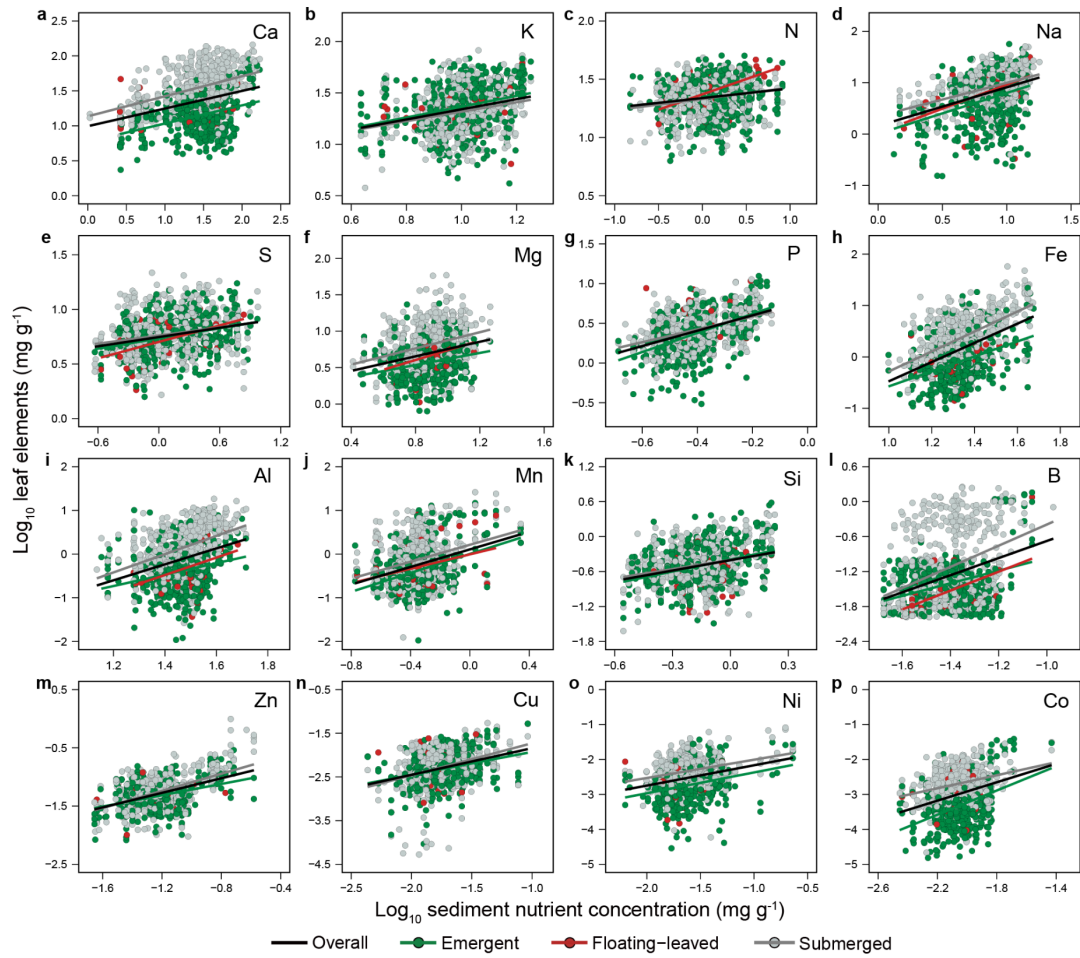


Figure S8. Relationships between leaf bioelements and sediment nutrient concentrations of wetland plants. Solid lines represent significant fits ($P < 0.05$). Overall observations ($n = 1058$) and different life-forms (submerged plants: $n = 543$; emergent plants: $n = 475$; floating-leaved plants: $n = 40$) of wetland plants are shown in different colors. Statistical summaries for regression models are shown in Table S4.

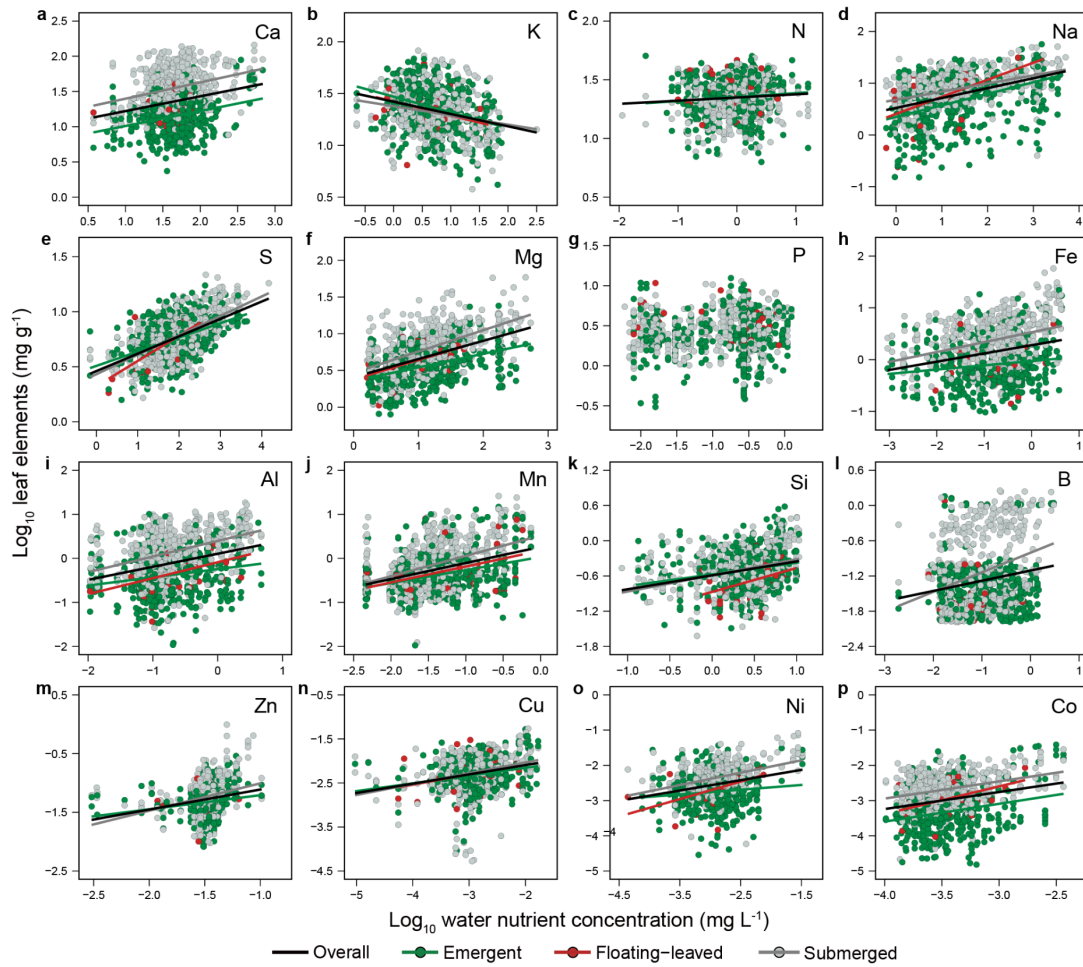


Figure S9. Relationships between leaf bioelements and water nutrient concentrations of wetland plants. Solid lines represent significant fits ($P < 0.05$). Overall observations ($n = 1058$) and different life-forms (submerged plants: $n = 543$; emergent plants: $n = 475$; floating-leaved plants: $n = 40$) of wetland plants are shown in different colors. Statistical summaries for regression models are shown in Table S4.

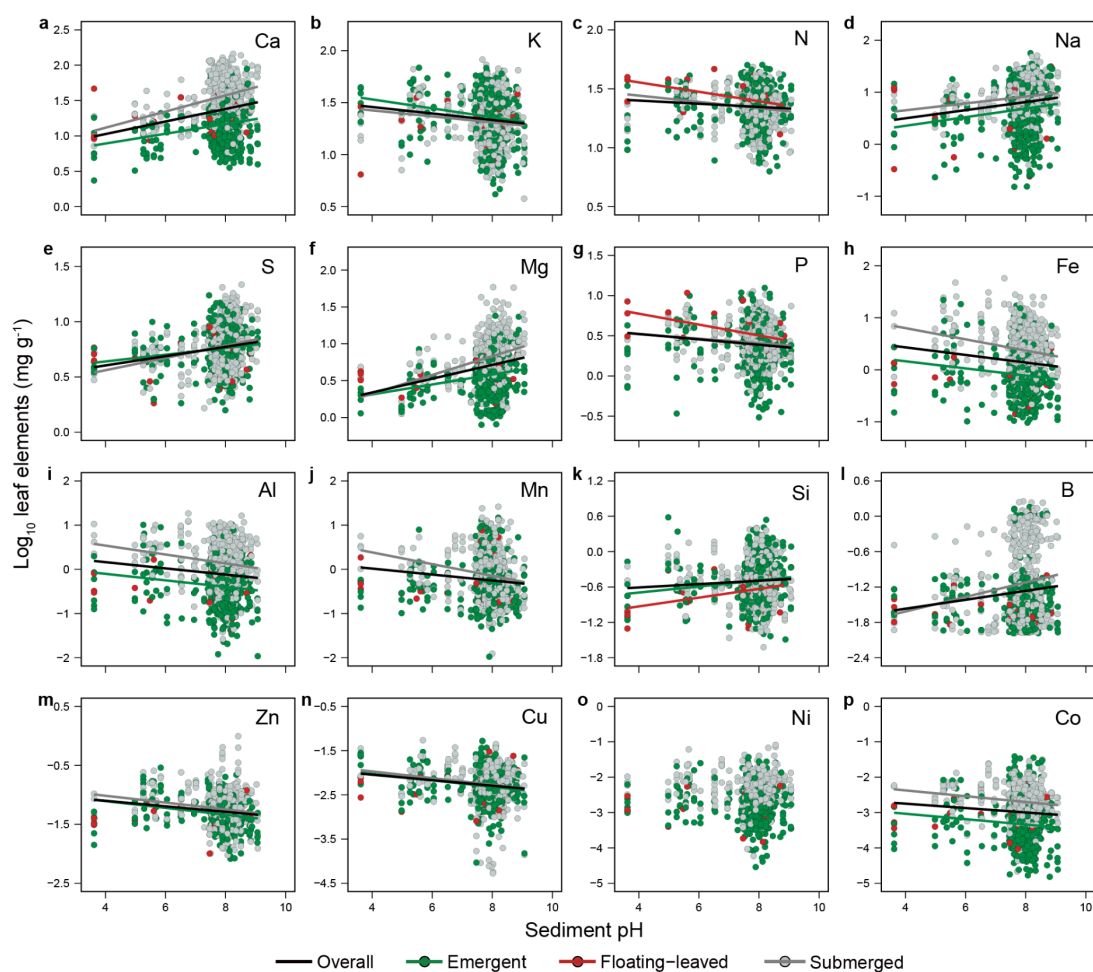


Figure S10. Relationships between leaf bioelements and sediment pH of wetland plants.

Solid lines represent significant fits ($P < 0.05$). Overall observations ($n = 1058$) and different life-forms (submerged plants: $n = 543$; emergent plants: $n = 475$; floating-leaved plants: $n = 40$) of wetland plants are shown in different colors. Statistical summaries for regression models are shown in Table S4.

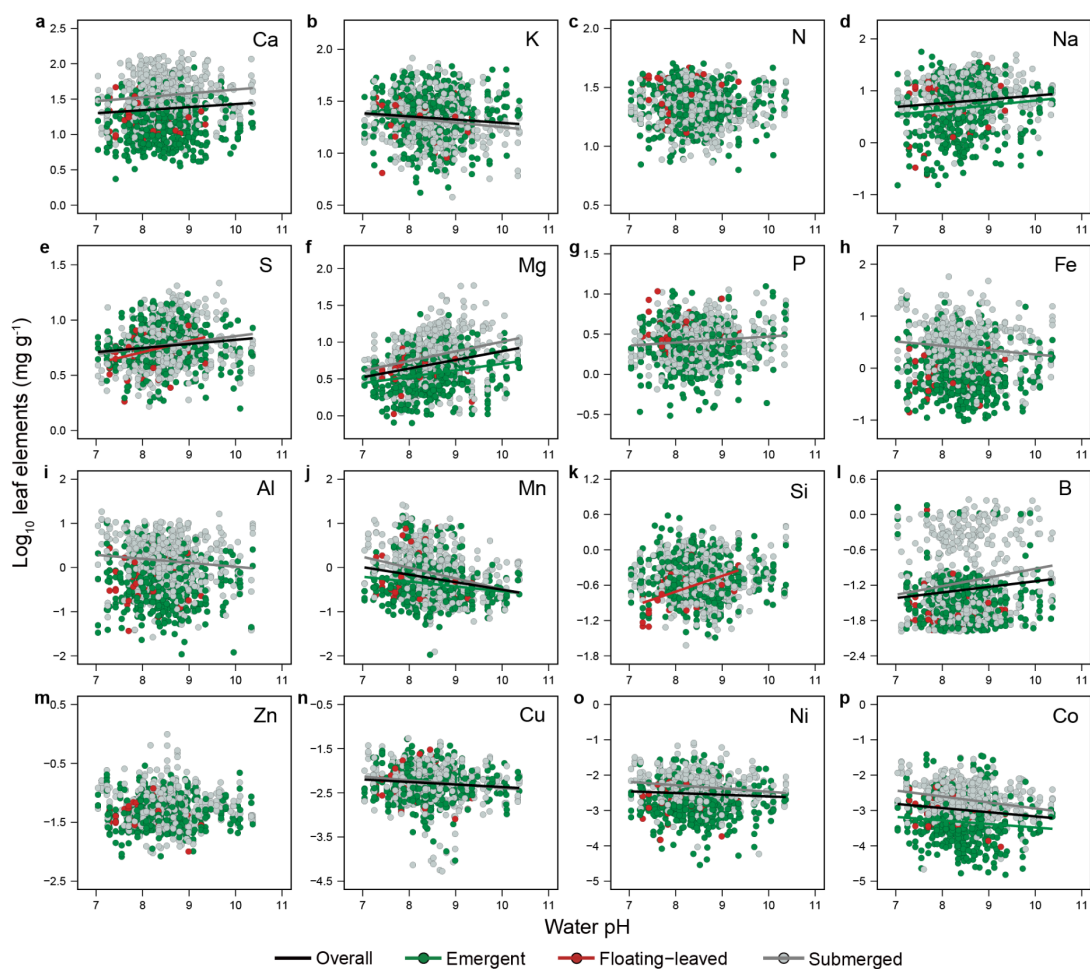


Figure S11. Relationships between leaf bioelements and water pH of wetland plants. Solid lines represent significant fits ($P < 0.05$). Overall observations ($n = 1058$) and different life-forms (submerged plants: $n = 543$; emergent plants: $n = 475$; floating-leaved plants: $n = 40$) of wetland plants are shown in different colors. Statistical summaries for regression models are shown in Table S4.

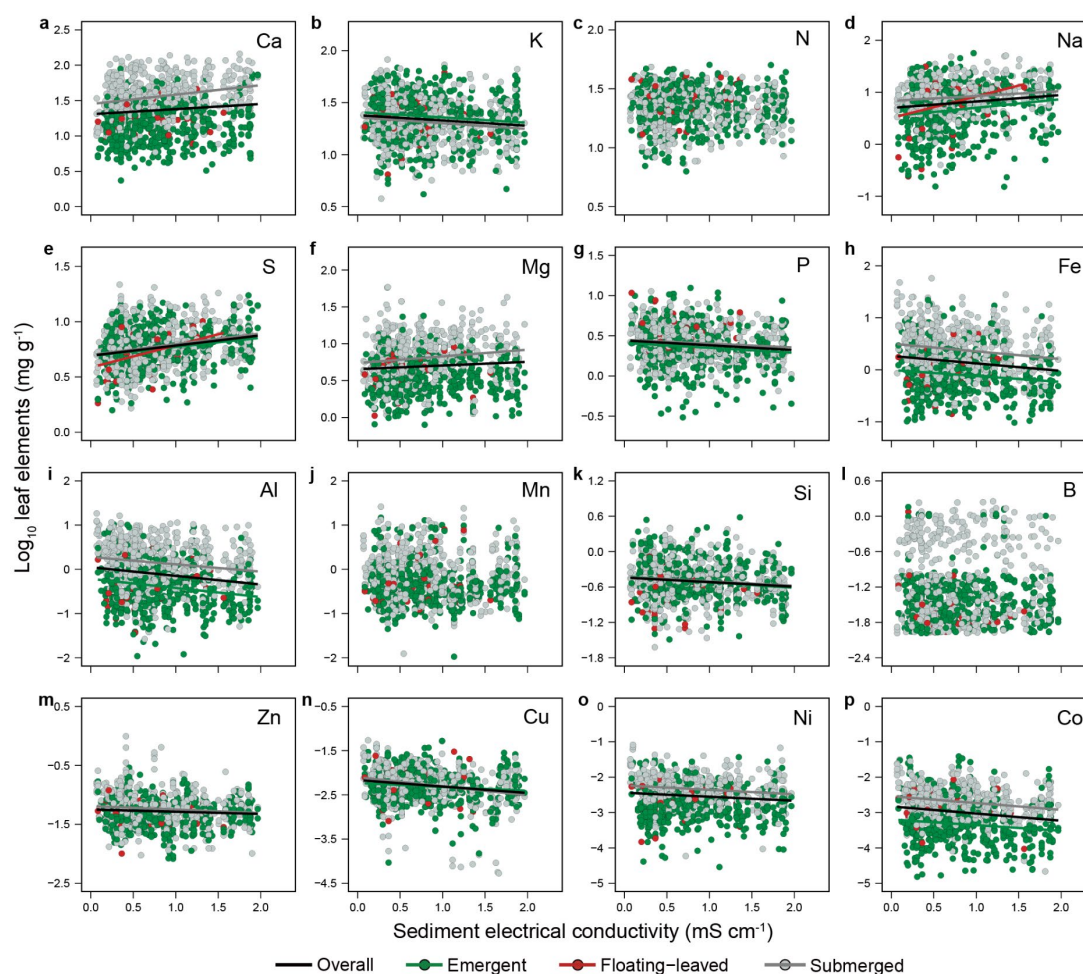


Figure S12. Relationships between leaf bioelements and sediment electrical conductivity of wetland plants. Solid lines represent significant fits ($P < 0.05$). Overall observations ($n = 1058$) and different life-forms (submerged plants: $n = 543$; emergent plants: $n = 475$; floating-leaved plants: $n = 40$) of wetland plants are shown in different colors. Statistical summaries for regression models are shown in Table S4.

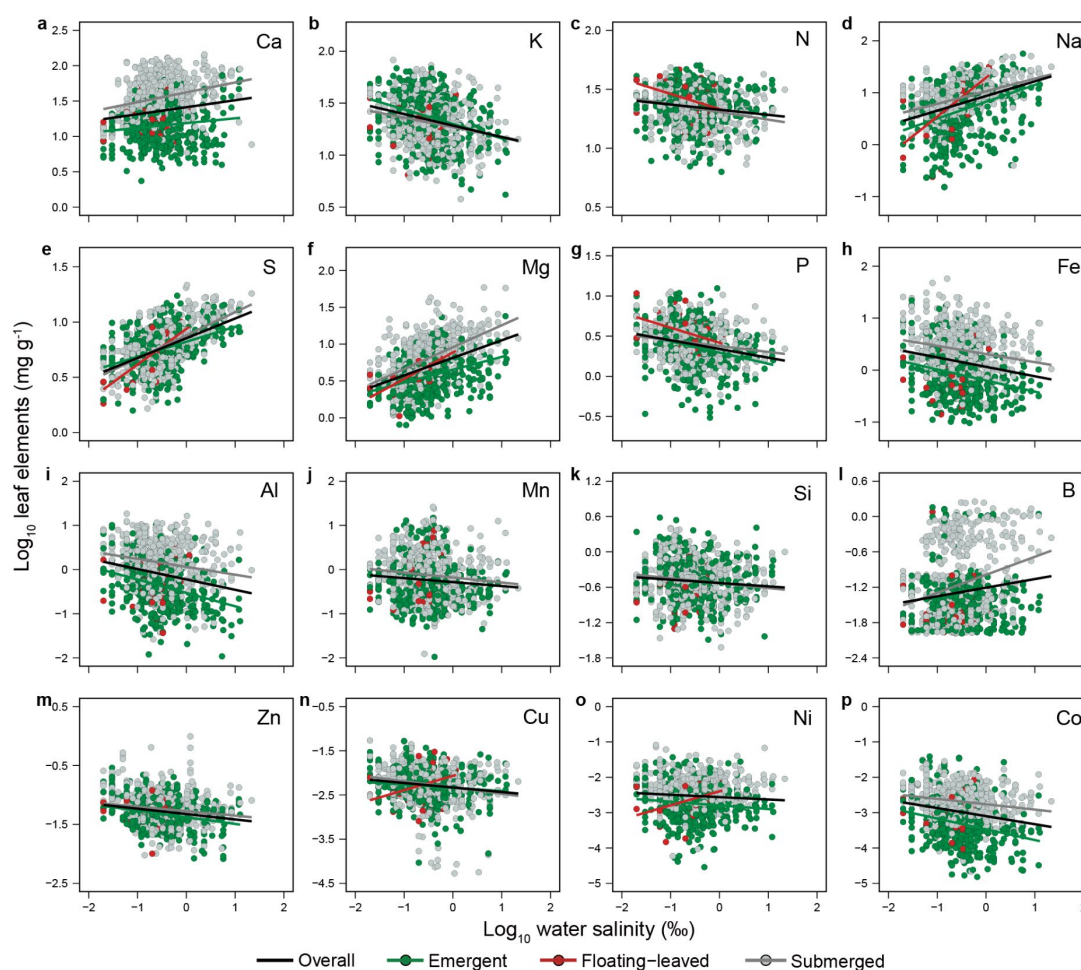


Figure S13. Relationships between leaf bioelements and water salinity of wetland plants. Solid lines represent significant fits ($P < 0.05$). Overall observations ($n = 1058$) and different life-forms (submerged plants: $n = 543$; emergent plants: $n = 475$; floating-leaved plants: $n = 40$) of wetland plants are shown in different colors. Statistical summaries for regression models are shown in Table S4.

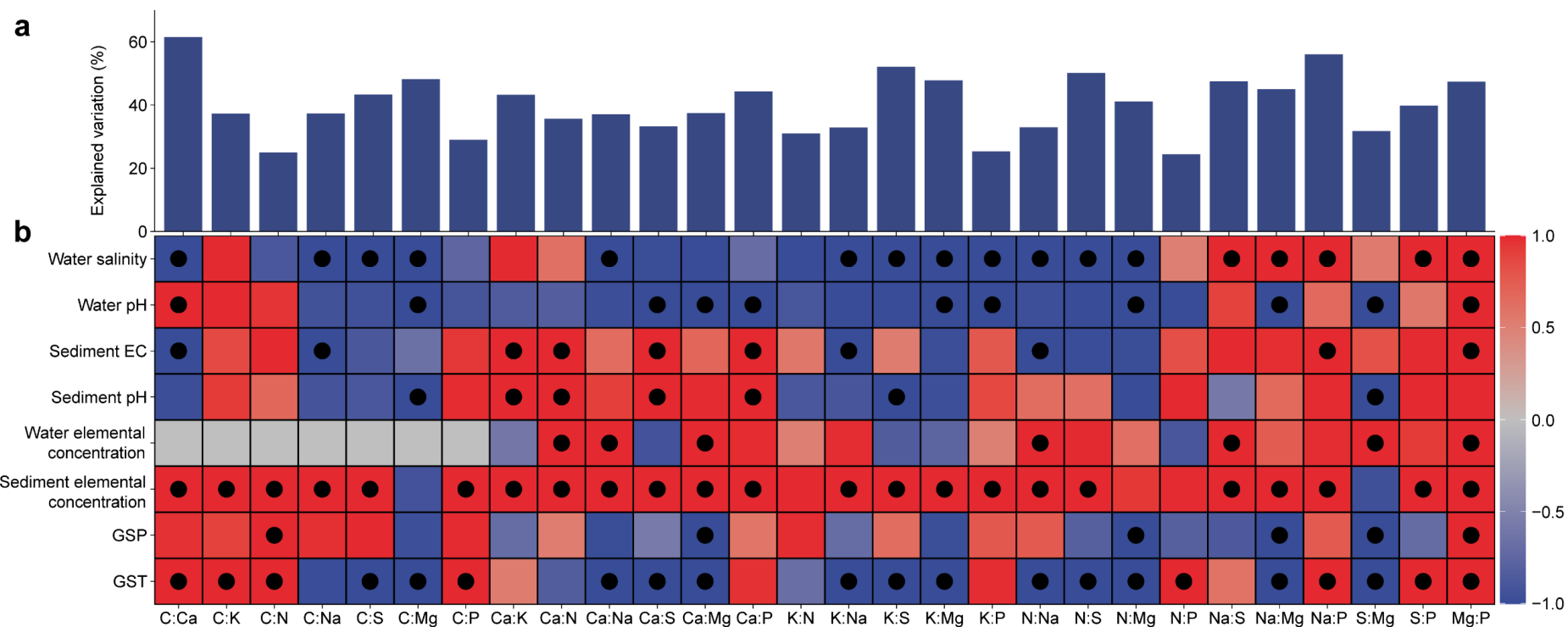


Figure S14. Environmental drivers of stoichiometric ratios of wetland plants. Heat map of the relationships between stoichiometric ratios and environmental variables based on Bayesian phylogenetic linear mixed models. Colours indicate the probability of direction of the posterior distributions of the relationship between pairs of variables, where red and blue indicate positive and negative relationships respectively. Black dots indicate Bayes factors > 1. Twenty-eight stoichiometric ratios between macroelements (C, Ca, K, N, Na, S, Mg and P) were selected to analyze the effects of environmental variables on stoichiometric ratios.

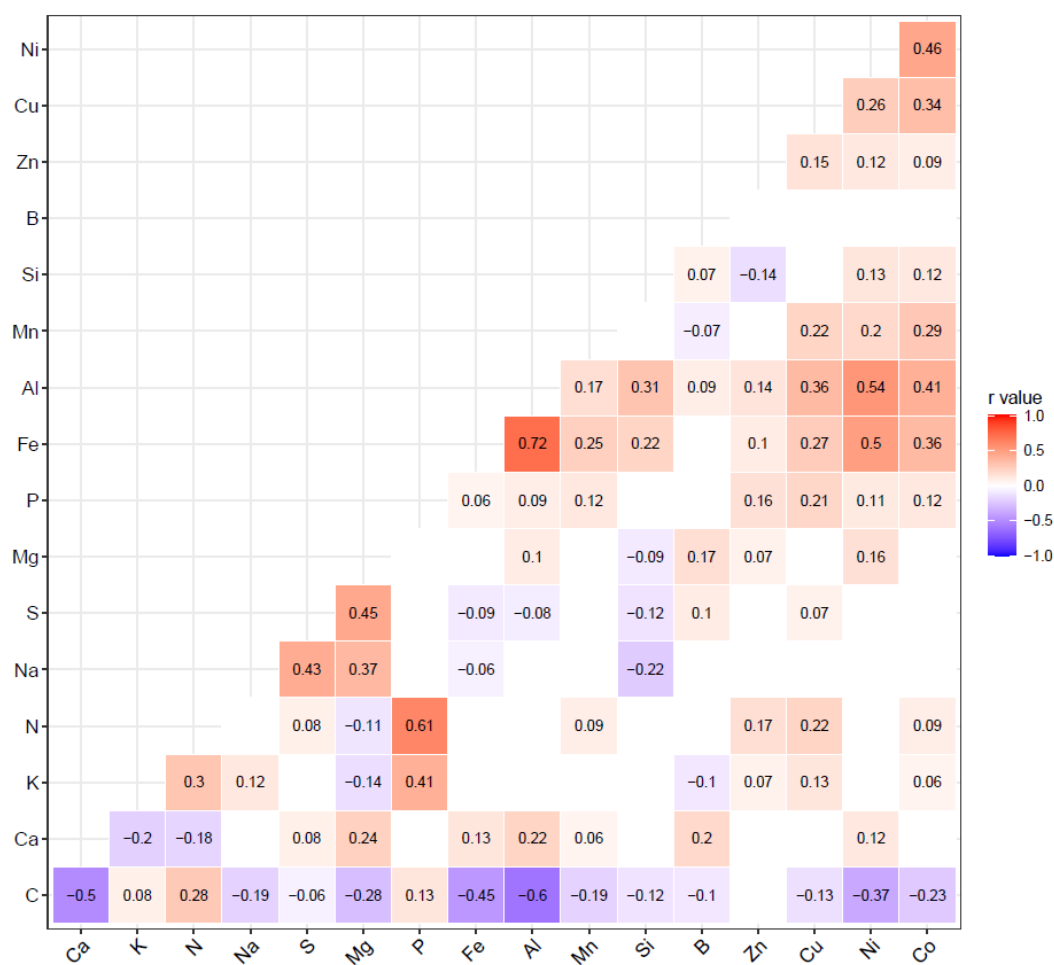


Figure S15. The Pearson's correlation coefficients (r) for 17 bioelements of wetland plants ($n = 1058$). Correlation significant test at $P < 0.05$ level, and blank blocks represent non-significant correlations between the two bioelements.

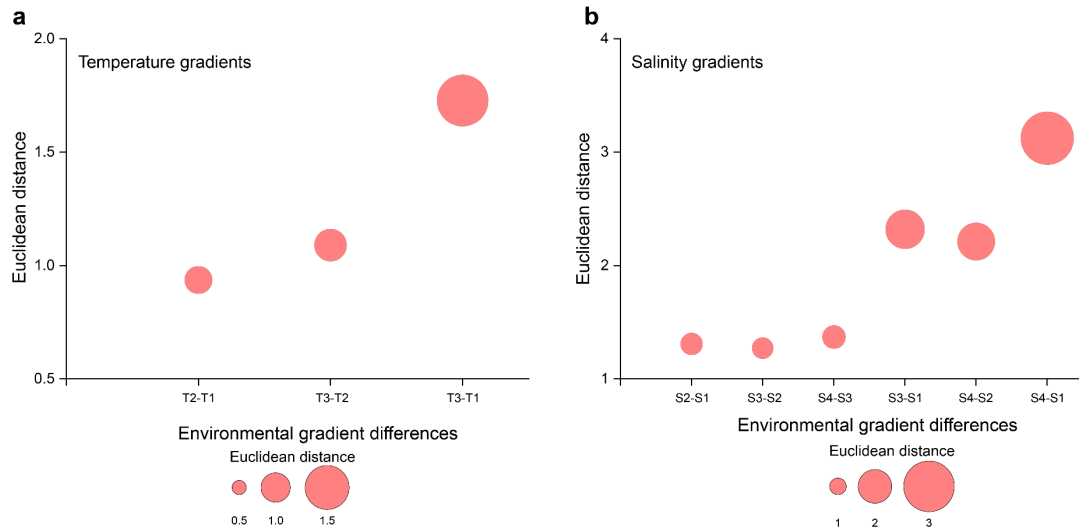


Figure S16. Variations and differences of leaf element networks (LENs) along environmental gradients. (a) and (b) show the effects of environmental gradient differences on the LENs based on Euclidean distance along temperature and salinity gradients, respectively. T1, T2 and T3 represent low-GST, middle-GST and high-GST, respectively. S1, S2, S3 and S4 represent fresh water, brackish water, moderate saline water and saline water, respectively.

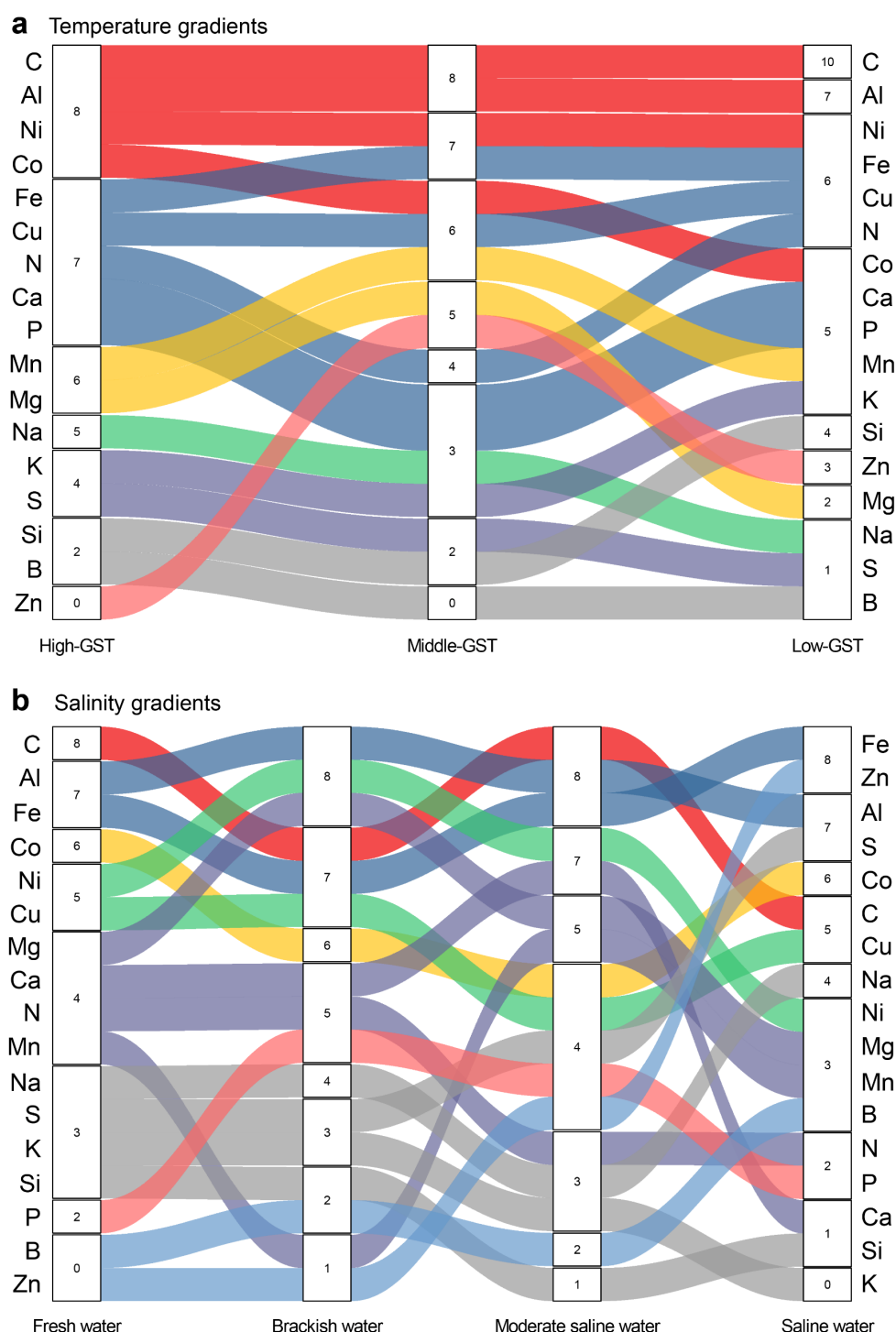


Figure S17. Variations in bioelement degree of leaf element networks at different temperature (a) and salinity gradients (b). “Degree” is the number of significant correlations of given element within networks. Element with high “degree” is regarded as “hub trait”, which has an important interconnect function among elements. The number adjacent to each node is the degree value of corresponding element. Each curve with different colors represents an element, and the curvature reflects the variation of node degree across temperature and salinity gradients. The greater the curvature, the greater the difference for the degree at different temperature and salinity levels.

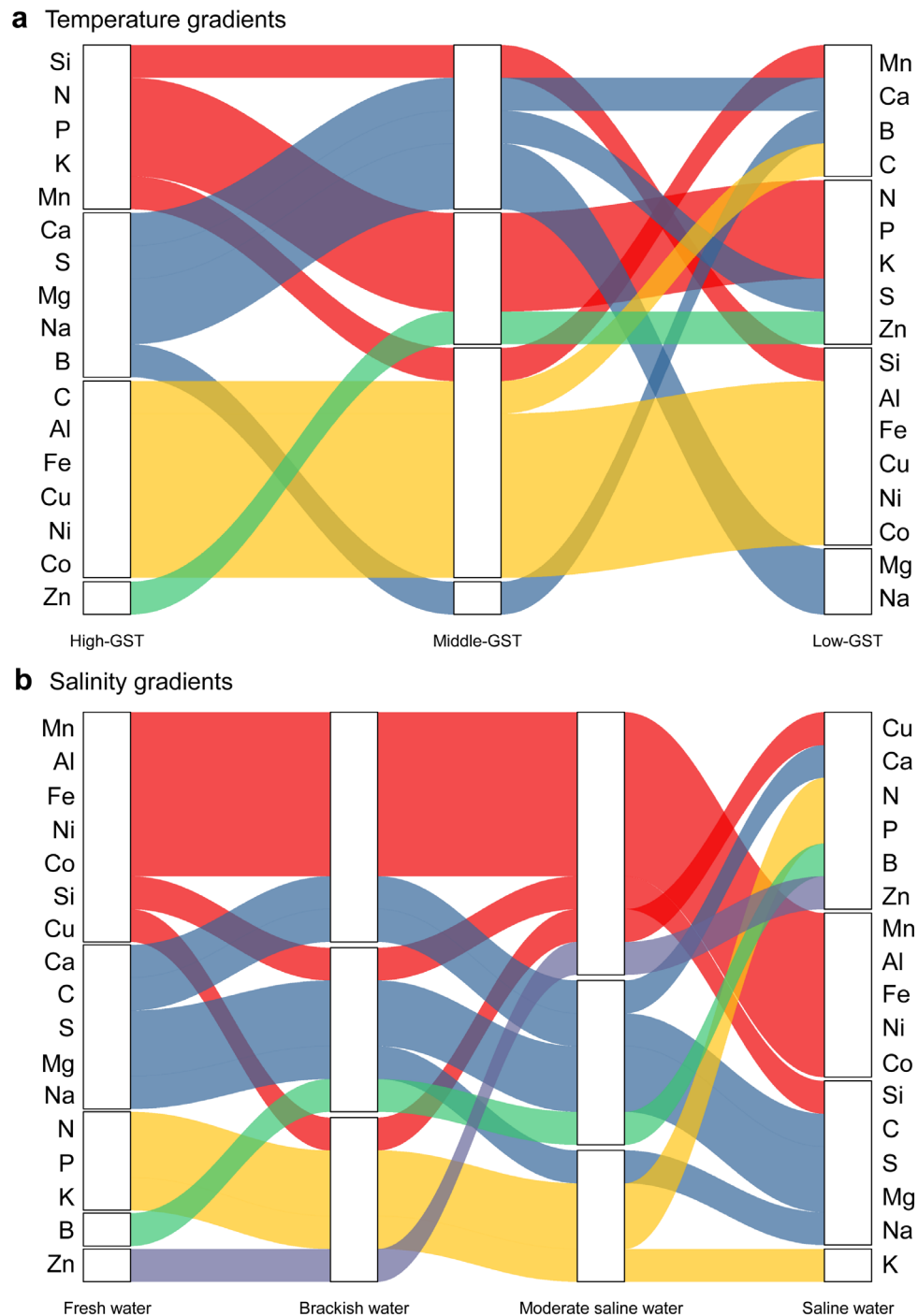


Figure S18. Variations in module composition of leaf element networks at different temperature (a) and salinity gradients (b). Elements in the same module are represented by the same color. Each curve represents an element, and the curvature reflects the variation of module composition across temperature and salinity gradients.

Element modules are groups of traits that interact more strongly among themselves than with other elements, and tend to perform a common function (Flores-Moreno et al., 2019). That is, modules are similar to trait dimensions/axes (Díaz et al., 2016; Kleyer et al., 2019). For example, in Fig. S18, N, P, and K remained within the same module across environmental

gradients (except in saline water), and these elements play essential roles in plant photosynthesis, osmoregulation, and biomolecule synthesis (Ågren & Weih, 2012; Marschner, 2012; Sardans & Peñuelas, 2015). Similarly, metallic micronutrients (e.g., Al, Fe, Ni and Co) were in the same module in all environments, consistent with their important implications in redox systems and enzyme activities (Marschner, 2012; Grusak et al., 2016; Lilay et al., 2024). Meanwhile, some elements might be classified differentially in different environments or different studies (Ågren & Weih, 2012). This may be because some elements have multiple functions (Ågren & Weih, 2012; Marschner, 2012), as well as plant bioelemental stoichiometry is plastic across environmental gradients (Sistla & Schimel, 2012; Peñuelas et al., 2019).

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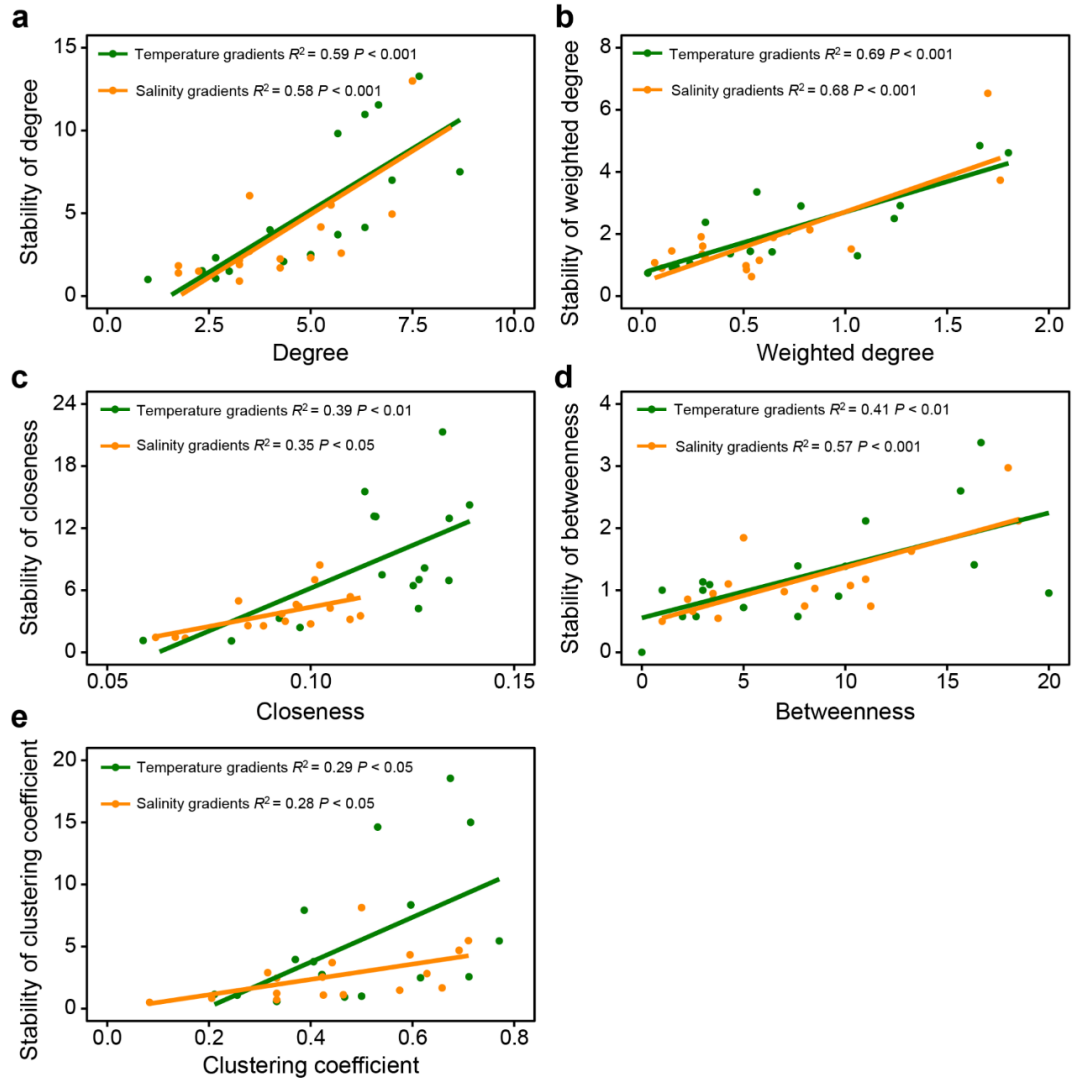


Figure S19. Relationships between five node parameters and their stability of the leaf element networks along environmental gradients. a-e, Relationships between degree, weighted degree, closeness, betweenness, clustering coefficient and their stability along temperature and salinity gradients ($n = 17$), respectively. Significant regressions ($P < 0.05$) are shown by solid lines.

Table S1. Statistical summary of geographic and environmental factors of the 232 sampling sites in alpine and arid wetlands. Geographic factors include latitude, longitude and altitude; climatic factors include growing season mean temperature (GST) and growing season precipitation (GSP); sediment properties include sediment nutrient concentrations of 17 elements, sediment pH and electrical conductivity (EC); water properties include water nutrient concentrations of 16 elements, water pH and salinity. CV = SD / Mean.

Group	Parameter	Unit	Mean	SD	CV	Min	Max
Geography	Latitude	degree	37.95	5.95	0.16	27.42	48.72
	Longitude	degree	90.16	8.55	0.09	76.16	109.76
	Altitude	m	2260.18	1478.96	0.65	194.70	5127.20
Climate	GST	°C	15.61	6.14	0.39	3.24	24.10
	GSP	mm	193.06	134.49	0.70	10.54	564.00
Sediment properties	C	mg g ⁻¹	33.10	18.11	0.55	2.65	125.63
	Ca	mg g ⁻¹	42.64	32.43	0.76	1.07	169.05
	K	mg g ⁻¹	10.34	2.65	0.26	4.32	17.84
	N	mg g ⁻¹	1.59	1.28	0.81	0.15	8.18
	Na	mg g ⁻¹	7.86	3.25	0.41	1.33	17.96
	S	mg g ⁻¹	1.70	1.59	0.93	0.23	9.45
	Mg	mg g ⁻¹	8.09	2.75	0.34	2.58	18.38
	P	mg g ⁻¹	0.39	0.11	0.28	0.21	0.74
	Fe	mg g ⁻¹	22.73	7.56	0.33	9.96	47.34
	Al	mg g ⁻¹	30.61	6.80	0.22	13.65	51.99
	Mn	mg g ⁻¹	0.48	0.24	0.47	0.17	2.20
	Si	mg g ⁻¹	0.75	0.27	0.36	0.28	1.70
	B	mg g ⁻¹	0.04	0.01	0.31	0.02	0.11
	Zn	mg g ⁻¹	0.07	0.04	0.53	0.02	0.26
	Cu	mg g ⁻¹	0.020	0.01	0.54	0.004	0.092
	Ni	mg g ⁻¹	0.028	0.03	0.90	0.006	0.230
	Co	mg g ⁻¹	0.009	0.003	0.37	0.004	0.037
	pH		7.89	0.75	0.10	3.62	9.07
	EC	mS cm ⁻¹	0.75	0.48	0.64	0.07	1.97
Water properties	Ca	mg L ⁻¹	71.53	85.40	1.19	3.73	685.00
	K	mg L ⁻¹	11.68	24.80	2.12	0.23	317.00
	N	mg L ⁻¹	1.56	1.79	1.15	0.01	16.10
	Na	mg L ⁻¹	314.54	740.89	2.36	0.61	5080.57
	S	mg L ⁻¹	372.67	1127.33	3.03	0.70	14711.36
	Mg	mg L ⁻¹	45.62	81.30	1.78	1.61	540.00
	P	mg L ⁻¹	0.23	0.20	0.88	0.01	1.24
	Fe	mg L ⁻¹	0.50	0.78	1.55	0.001	4.32
	Al	mg L ⁻¹	0.50	0.81	1.62	0.01	4.69
	Mn	mg L ⁻¹	0.08	0.11	1.34	0.005	0.74
	Si	mg L ⁻¹	3.10	2.29	0.74	0.09	10.67
	B	mg L ⁻¹	0.26	0.38	1.49	0.002	3.01
	Zn	µg L ⁻¹	33.48	10.78	0.32	3.03	102.67
	Cu	µg L ⁻¹	2.08	2.62	1.26	0.01	16.78
	Ni	µg L ⁻¹	2.34	4.09	1.75	0.04	32.83
	Co	µg L ⁻¹	0.44	0.46	1.04	0.10	3.66
	pH		8.50	0.63	0.07	7.04	10.37
	Salinity	‰	1.02	2.33	2.28	0.02	21.84

Table S2. Glossary of network parameters and definitions applied to this study

Network parameters	Parameters quantified	Definition	Ecological meaning
Node		Each trait in the network; here, represent 17 element traits of wetland plant leaves (He et al., 2020)	Different characteristics and functions of elements are related to plant growth and adaptation
Edge		Positive (or negative) correlation between two nodes and its weight (i.e., significant Pearson correlation coefficient) (He et al., 2020)	Presence of a synergy (or trade-off) between two traits of plants
Edge density (<i>ED</i>)	Connectivity	Proportion of actual edges among traits from all possible edges in the trait network (He et al., 2020)	Higher <i>ED</i> indicates stronger connectivity and synergy among traits of plants, that may be beneficial for plant to acquire and transport the external resources across the whole plant efficiently
Average path length (<i>AL</i>)	Connectivity	Mean shortest path distance between any pair of connected traits within the network (He et al., 2020)	Higher <i>AL</i> implies stronger independence among traits of plants
Diameter (<i>D</i>)	Connectivity	Maximum shortest path distance between any pair of connected traits within the network (He et al., 2020)	Higher <i>D</i> indicates stronger independence among traits of plants
Average clustering coefficient (<i>AC</i>)	Complexity	Clustering coefficients of all node traits averaged across the network (He et al., 2020)	Higher <i>AC</i> indicates stronger connectivity and synergy among traits of plants, that may be beneficial for plant to acquire and transport the external resources across the whole plant to cope with changing environments
Modularity (<i>M</i>)	Complexity	Strength of the separation of trait network into modules (Felipe-Lucia et al., 2020; He et al., 2020)	High <i>M</i> means that the modules composed of specific traits perform specific functions, giving the plants more freedom and flexibility to respond to harsh environments
Vulnerability (<i>V</i>)	Stability	The vulnerability of a node measures the relative contribution of the node to the global efficiency. The vulnerability of a network is indicated by the maximal vulnerability of nodes in network (Yuan et al., 2021)	High <i>V</i> means a low stability of network
Degree (<i>k</i>)	Connectedness	Number of significant correlations of node trait <i>i</i> (Felipe-Lucia et al., 2020)	Strength of a trait associated with other traits. Node traits with higher <i>k</i> favor the efficient use and acquisition of resources

Weighted degree (<i>WD</i>)	Connectedness	A parameter that considers both the trait degree and the absolute correlation strength of between traits (1) $WD = k \times EW_i$, where EW_i is the absolute mean weight of all edges of node trait i (2) $EW_i = \sum r / (n - 1)$, where $ r $ are the absolute correlation coefficients of node trait i and n is the number of traits of the network (Felipe-Lucia et al., 2020)	Node traits with largest k and WD are considered as “hub traits”. Hub traits are the most connected traits in the network and of high importance to the whole plant phenotype
Closeness (C)	Connectedness	The reciprocal of the mean shortest path between a focal node trait and all other nodes in the network (He et al., 2020)	Node traits with higher C indicates closer connection of this trait with other traits in the network
Betweenness (B)	Centrality	The number of shortest paths going through a focal node trait (He et al., 2020)	Node traits with higher B serve as “mediator” of trait connections within the network, environmental filtering of this trait can greatly influence the coordination between multiple functional modules or subnetworks
Clustering coefficient (CC)	Centrality	The traits connected to a focal node trait are the neighboring traits, and the clustering coefficient is the probability of connection between neighboring traits (He et al., 2020)	Node traits with higher CC serve as a center of a functional module of the network, which plays an important role in realizing a specific function

377 Note: Among the above parameters, degree, weighted degree, closeness, betweenness and clustering coefficient are network node parameters, and edge density,
378 average path length, diameter, average clustering coefficient, modularity and vulnerability are network overall topological parameters.

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386 **Table S3. Stoichiometric characteristics of 17 bioelements for overall observations and different life-forms of wetland plants.** Different lowercase letters
387 denote significant differences in leaf bioelements among different plant life-forms at $P < 0.05$.

Element (mg g ⁻¹)	Submerged plants			Emergent plants			Floating-leaved plants			Overall			Mix	Max
	Mean	SD	CV [†]	Mean	SD	CV	Mean	SD	CV	Mean	SD	CV		
C	347.25 ^b	43.84	12.63	403.84 ^a	37.98	9.41	407.58 ^a	41.29	10.13	374.93	50.05	13.35	184.80	515.90
Ca	43.13 ^a	26.88	62.32	17.52 ^c	12.57	71.75	20.48 ^b	9.91	48.40	30.77	24.62	80.01	2.347	114.673
K	23.06 ^b	11.35	49.21	26.41 ^a	12.70	48.08	23.98 ^{ab}	9.82	40.93	24.59	12.02	48.89	3.778	82.126
N	23.17 ^b	7.51	32.39	24.01 ^b	8.22	34.24	27.60 ^a	8.80	31.87	23.71	7.92	33.42	6.300	50.500
Na	10.00 ^a	6.97	69.73	7.75 ^b	7.32	94.52	9.00 ^{ab}	6.00	66.60	8.94	7.18	80.25	0.152	56.442
S	6.55 ^a	3.15	48.01	6.18 ^a	2.54	41.05	5.67 ^a	2.07	36.43	6.35	2.86	45.00	1.580	21.660
Mg	8.12 ^a	6.51	80.11	4.41 ^c	2.87	65.17	4.86 ^b	1.94	39.96	6.33	5.38	84.99	0.796	58.722
P	2.92 ^b	1.52	52.13	2.74 ^c	1.72	62.82	3.86 ^a	1.99	51.40	2.88	1.65	57.36	0.305	12.456
Fe	4.08 ^a	5.28	129.32	1.43 ^b	2.27	157.53	1.22 ^b	1.06	87.03	2.78	4.29	154.17	0.096	57.520
Al	2.49 ^a	2.59	103.88	0.85 ^b	1.34	157.13	0.77 ^b	0.79	102.44	1.69	2.22	131.46	0.011	18.375
Mn	1.57 ^a	2.58	164.44	0.89 ^b	1.756	197.00	1.16 ^b	1.94	167.55	1.25	2.25	179.80	0.011	26.048
Si	0.43 ^a	0.37	85.52	0.43 ^a	0.41	96.25	0.26 ^b	0.16	63.35	0.42	0.39	90.92	0.024	3.816
B	0.21 ^a	0.33	152.95	0.10 ^b	0.24	244.92	0.06 ^c	0.19	326.04	0.16	0.29	187.71	0.010	1.792
Zn	0.073 ^a	0.074	101.34	0.055 ^b	0.035	62.57	0.054 ^b	0.022	40.38	0.064	0.059	91.07	0.008	0.987
Cu	0.0075 ^a	0.006	81.78	0.0068 ^b	0.006	92.48	0.0074 ^{ab}	0.007	88.20	0.0072	0.006	86.63	0.0001	0.054
Ni	0.0067 ^a	0.008	115.25	0.0033 ^b	0.005	140.95	0.0031 ^b	0.002	76.84	0.0050	0.007	131.11	2.873E-05	0.082
Co	0.0032 ^a	0.004	110.92	0.0016 ^c	0.004	274.74	0.0016 ^b	0.002	106.44	0.0024	0.004	163.86	0.0000152	0.039
C _s [‡]	315.95 ^b	46.76	14.79	380.48 ^a	44.43	11.68	382.34 ^a	45.31	11.85	347.43	55.93	16.10	155.64	509.21
Percentage of C _s	90.77% ^b	0.036	3.99	94.012% ^a	0.033	3.491	93.666% ^a	0.026	2.794	93.33%	0.038	4.11	78.55%	98.70%

388 [†] The coefficient of variation (CV, %) was calculated by dividing the standard deviation (SD) by arithmetic mean value (Mean), representing the variability in
389 leaf bioelemental concentrations.

390 [‡] C_s represents the leaf structural C concentrations. Percentage of C_s represents the proportion of leaf C_s concentrations to total C concentrations.

Table S4. Statistical summary of biogeographic patterns of 17 bioelements for overall observations and different life-forms of wetland plants. Geographic factors include latitude and altitude; climatic factors include growing season mean temperature (GST) and growing season precipitation (GSP); sediment factors include sediment nutrient concentrations, pH and electrical conductivity (EC); water factors include water nutrient concentrations, pH and salinity. The data of leaf bioelemental concentrations were log-transformed.

Element	Life-forms	North latitude				Altitude			
		Slope	Intercept	R^2	P	Slope	Intercept	R^2	P
C	Overall	0.0002	2.561		>0.05	0.0012	2.567		>0.05
	Emergent	4.41E-05	2.602		>0.05	-0.0001	2.604		>0.05
	Floating-leaved	-0.003	2.723	0.18	<0.01	0.0186	2.570	0.29	<0.001
	Submerged	0.0011	2.492	0.01	<0.01	-0.0014	2.540		>0.05
Ca	Overall	-1.93E-05	1.364		>0.05	0.0039	1.355		>0.05
	Emergent	0.0009	1.122		>0.05	0.0049	1.144		>0.05
	Floating-leaved	0.0046	1.091		>0.05	-0.0259	1.317		>0.05
	Submerged	-0.0041	1.710	0.01	<0.05	0.0216	1.507	0.01	<0.01
K	Overall	-0.0035	1.473	0.01	<0.01	0.0207	1.295	0.02	<0.001
	Emergent	-0.0051	1.561	0.02	<0.01	0.0327	1.293	0.04	<0.001
	Floating-leaved	-0.0069	1.605		>0.05	0.0186	1.306		>0.05
	Submerged	-0.0014	1.370		>0.05	0.0088	1.297		>0.05
N	Overall	0.0006	1.328		>0.05	0.0055	1.337		>0.05
	Emergent	0.0005	1.332		>0.05	0.0055	1.340		>0.05
	Floating-leaved	-0.0080	1.718	0.11	<0.05	0.0601	1.296	0.29	<0.001
	Submerged	0.0014	1.285		>0.05	0.0020	1.336		>0.05
Na	Overall	0.0259	-0.196	0.15	<0.001	-0.1010	1.016	0.12	<0.001
	Emergent	0.0318	-0.540	0.16	<0.001	-0.0978	0.894	0.08	<0.001
	Floating-leaved	0.0291	-0.310	0.13	<0.05	-0.1659	1.126	0.19	<0.01
	Submerged	0.0189	0.175	0.15	<0.001	-0.0904	1.095	0.19	<0.001
S	Overall	0.0096	0.395	0.10	<0.001	-0.0471	0.866	0.13	<0.001
	Emergent	0.0094	0.396	0.11	<0.001	-0.0429	0.854	0.11	<0.001
	Floating-leaved	0.0122	0.261	0.19	<0.01	-0.0603	0.845	0.19	<0.01
	Submerged	0.0094	0.409	0.09	<0.001	-0.0497	0.877	0.14	<0.001
Mg	Overall	0.0151	0.116	0.10	<0.001	-0.0734	0.854	0.12	<0.001
	Emergent	0.0121	0.108	0.08	<0.001	-0.0428	0.666	0.05	<0.001
	Floating-leaved	0.0175	-0.014	0.31	<0.001	-0.0811	0.811	0.27	<0.001
	Submerged	0.0158	0.196	0.11	<0.001	-0.0889	0.994	0.18	<0.001
P	Overall	-0.0046	0.571	0.01	<0.001	0.0351	0.318	0.04	<0.001
	Emergent	-0.0064	0.604	0.02	<0.01	0.0519	0.243	0.07	<0.001
	Floating-leaved	-0.0093	0.894	0.08	<0.05	0.0589	0.423	0.15	<0.01
	Submerged	-0.0029	0.523	0.01	<0.05	0.0231	0.364	0.02	<0.001
Fe	Overall	-0.0135	0.672	0.03	<0.001	0.0651	0.013	0.03	<0.001
	Emergent	-0.0094	0.262	0.02	<0.01	0.0636	-0.242	0.04	<0.001
	Floating-leaved	-0.0009	-0.015		>0.05	0.0043	-0.057		>0.05
	Submerged	-0.0218	1.232	0.09	<0.001	0.0905	0.200	0.09	<0.001
Al	Overall	-0.0204	0.678	0.05	<0.001	0.0882	-0.297	0.05	<0.001
	Emergent	-0.0225	0.474	0.07	<0.001	0.1226	-0.663	0.11	<0.001
	Floating-leaved	-0.0058	-0.092		>0.05	0.0369	-0.385		>0.05
	Submerged	-0.0239	1.076	0.08	<0.001	0.0855	-0.027	0.06	<0.001

Mn	Overall	0.0040	-0.392	>0.05	-0.0241	-0.186	0.004	<0.05
	Emergent	0.0132	-0.869	0.03 <0.001	-0.0768	-0.192	0.05	<0.001
	Floating-leaved	0.0054	-0.495	>0.05	-0.0555	-0.178		>0.05
	Submerged	-0.0059	0.105	>0.05	0.0316	-0.189	0.01	<0.05
Si	Overall	-0.0130	-0.001	0.06 <0.001	0.0561	-0.623	0.06	<0.001
	Emergent	-0.0127	-0.016	0.05 <0.001	0.0416	-0.594	0.03	<0.001
	Floating-leaved	0.0075	-0.959	>0.05	-0.0349	-0.604		>0.05
	Submerged	-0.0153	0.104	0.08 <0.001	0.0737	-0.643	0.11	<0.001
B	Overall	-0.0188	-0.562	0.04 <0.001	0.0789	-1.454	0.04	<0.001
	Emergent	-0.0147	-0.850	0.04 <0.001	0.0474	-1.519	0.02	<0.01
	Floating-leaved	-0.0181	-0.913	0.08 <0.05	0.0755	-1.750		>0.05
	Submerged	-0.0246	-0.193	0.05 <0.001	0.1158	-1.388	0.06	<0.001
Zn	Overall	0.0049	-1.465	0.01 <0.001	-0.0311	-1.211	0.03	<0.001
	Emergent	0.0043	-1.489	0.01 <0.05	-0.0218	-1.275	0.01	<0.01
	Floating-leaved	0.0066	-1.553	>0.05	-0.0402	-1.222		>0.05
	Submerged	0.0046	-1.413	0.01 <0.05	-0.0349	-1.163	0.03	<0.001
Cu	Overall	-0.0028	-2.171	>0.05	0.0004	-2.281		>0.05
	Emergent	-0.0045	-2.131	>0.05	0.0100	-2.327		>0.05
	Floating-leaved	0.0145	-2.833	>0.05	-0.0673	-2.148		>0.05
	Submerged	-0.0031	-2.139	>0.05	-0.0014	-2.256		>0.05
Ni	Overall	-0.0018	-2.458	>0.05	-0.0100	-2.506		>0.05
	Emergent	0.0032	-2.865	>0.05	-0.0164	-2.707		>0.05
	Floating-leaved	0.0181	-3.346	>0.05	-0.1135	-2.432	0.11	<0.05
	Submerged	-0.0109	-1.908	0.03 <0.001	0.0189	-2.368		>0.05
Co	Overall	-0.0172	-2.326	0.03 <0.001	0.0684	-3.134	0.03	<0.001
	Emergent	-0.0212	-2.519	0.04 <0.001	0.1047	-3.565	0.06	<0.001
	Floating-leaved	0.0039	-3.137	>0.05	-0.0527	-2.884		>0.05
	Submerged	-0.0200	-1.914	0.08 <0.001	0.0740	-2.841	0.06	<0.001

397

Continued Table S4

Element	Life-forms	GST				GSP			
		Slope	Intercept	R ²	P	Slope	Intercept	R ²	P
C	Overall	-0.0008	2.582	0.004	<0.05	1.84E-05	2.566		>0.05
	Emergent	9.87E-07	2.604		>0.05	3.88E-06	2.603		>0.05
	Floating-leaved	-0.0053	2.697	0.31	<0.001	0.0002	2.575	0.23	<0.01
	Submerged	-0.0004	2.544		>0.05	-2.02E-05	2.541		>0.05
Ca	Overall	0.0003	1.358		>0.05	-0.0003	1.417	0.01	<0.001
	Emergent	-0.0008	1.167		>0.05	-0.0003	1.221	0.02	<0.001
	Floating-leaved	0.0068	1.149		>0.05	-0.0002	1.304		>0.05
	Submerged	-0.0042	1.619	0.01	<0.05	-2.61E-05	1.557		>0.05
K	Overall	-0.0056	1.429	0.02	<0.001	0.0002	1.293	0.02	<0.001
	Emergent	-0.0094	1.510	0.05	<0.001	0.0004	1.293	0.04	<0.001
	Floating-leaved	-0.0014	1.368		>0.05	0.0002	1.306		>0.05
	Submerged	-0.0022	1.352		>0.05	0.0001	1.295		>0.05
N	Overall	-0.0029	1.394	0.01	<0.001	4.70E-05	1.340		>0.05
	Emergent	-0.0026	1.392	0.01	<0.05	-2.39E-06	1.353		>0.05
	Floating-leaved	-0.0203	1.761	0.45	<0.001	0.0005	1.318	0.20	<0.01
	Submerged	-0.0022	1.376	0.01	<0.05	4.00E-05	1.333		>0.05
Na	Overall	0.0198	0.484	0.07	<0.001	-0.0010	1.001	0.10	<0.001
	Emergent	0.0137	0.462	0.02	<0.001	-0.0012	0.913	0.09	<0.001

S	Floating-leaved	0.0458	0.015	0.19	<0.01	-0.0016	1.120	0.19	<0.01
	Submerged	0.0204	0.576	0.15	<0.001	-0.0008	1.050	0.11	<0.001
	Overall	0.0122	0.571	0.14	<0.001	-0.0006	0.880	0.17	<0.001
	Emergent	0.0108	0.592	0.11	<0.001	-0.0006	0.870	0.16	<0.001
Mg	Floating-leaved	0.0164	0.446	0.19	<0.01	-0.0007	0.873	0.33	<0.001
	Submerged	0.0132	0.560	0.15	<0.001	-0.0006	0.887	0.17	<0.001
	Overall	0.0171	0.425	0.10	<0.001	-0.0007	0.836	0.10	<0.001
	Emergent	0.0063	0.473	0.02	<0.01	-0.0004	0.652	0.04	<0.001
P	Floating-leaved	0.0160	0.377	0.13	<0.05	-0.0007	0.786	0.20	<0.01
	Submerged	0.0230	0.437	0.20	<0.001	-0.0009	0.971	0.15	<0.001
	Overall	-0.0108	0.564	0.06	<0.001	0.0003	0.326	0.03	<0.001
	Emergent	-0.0163	0.609	0.11	<0.001	0.0005	0.257	0.06	<0.001
Fe	Floating-leaved	-0.0174	0.836	0.18	<0.01	0.0005	0.445	0.10	<0.05
	Submerged	-0.0073	0.530	0.04	<0.001	0.0002	0.371	0.02	<0.01
	Overall	-0.0140	0.374	0.02	<0.001	0.0006	0.046	0.02	<0.001
	Emergent	-0.0174	0.167	0.05	<0.001	0.0006	-0.212	0.03	<0.001
Al	Floating-leaved	-0.0029	0.001		>0.05	-1.19E-06	-0.048		>0.05
	Submerged	-0.0180	0.680	0.05	<0.001	0.0009	0.225	0.07	<0.001
	Overall	-0.0186	0.187	0.03	<0.001	0.0009	-0.291	0.04	<0.001
	Emergent	-0.0318	0.101	0.11	<0.001	0.0013	-0.641	0.09	<0.001
Mn	Floating-leaved	-0.0118	-0.111		>0.05	0.0002	-0.362		>0.05
	Submerged	-0.0153	0.399	0.03	<0.001	0.0011	-0.045	0.07	<0.001
	Overall	0.0074	-0.355	0.01	<0.01	-0.0001	-0.221		>0.05
	Emergent	0.0213	-0.690	0.06	<0.001	-0.0006	-0.250	0.02	<0.001
Si	Floating-leaved	0.0227	-0.674		>0.05	-0.0006	-0.165		>0.05
	Submerged	-0.0075	-0.002	0.01	<0.05	0.0005	-0.216	0.01	<0.01
	Overall	-0.0131	-0.296	0.05	<0.001	0.0007	-0.644	0.08	<0.001
	Emergent	-0.0076	-0.384	0.01	<0.01	0.0007	-0.636	0.06	<0.001
B	Floating-leaved	0.0050	-0.759		>0.05	-0.0003	-0.607		>0.05
	Submerged	-0.0183	-0.198	0.10	<0.001	0.0009	-0.658	0.12	<0.001
	Overall	-0.0145	-1.053	0.02	<0.001	0.0005	-1.371	0.01	<0.001
	Emergent	-0.0062	-1.317		>0.05	0.0004	-1.497	0.01	<0.01
Zn	Floating-leaved	-0.0140	-1.361		>0.05	0.0007	-1.742		>0.05
	Submerged	-0.0241	-0.756	0.04	<0.001	0.0006	-1.264	0.01	<0.01
	Overall	0.0080	-1.405	0.03	<0.001	-0.0002	-1.233	0.01	<0.001
	Emergent	0.0048	-1.398	0.01	<0.05	-0.0002	-1.286	0.01	<0.05
Cu	Floating-leaved	0.0109	-1.487		>0.05	-0.0003	-1.229		>0.05
	Submerged	0.0095	-1.389	0.04	<0.001	-0.0002	-1.197	0.01	<0.05
	Overall	0.0043	-2.348	0.003	<0.05	-0.0001	-2.260		>0.05
	Emergent	0.0014	-2.325		>0.05	-1.35E-05	-2.301		>0.05
Ni	Floating-leaved	0.0167	-2.567		>0.05	-0.0007	-2.127		>0.05
	Submerged	0.0055	-2.347		>0.05	-0.0001	-2.240		>0.05
	Overall	0.0067	-2.634	0.01	<0.01	-0.0001	-2.506		>0.05
	Emergent	0.0047	-2.816		>0.05	-0.0001	-2.727		>0.05
Co	Floating-leaved	0.0312	-3.189	0.11	<0.05	-0.0008	-2.482		>0.05
	Submerged	0.0019	-2.360		>0.05	0.0002	-2.360		>0.05
	Overall	-0.0107	-2.816	0.01	<0.01	0.0006	-3.097	0.01	<0.001
	Emergent	-0.0216	-2.998	0.04	<0.001	0.0008	-3.497	0.03	<0.001
	Floating-leaved	0.0217	-3.357		>0.05	-0.0003	-2.922		>0.05
	Submerged	-0.0125	-2.484	0.03	<0.001	0.0008	-2.832	0.05	<0.001

Element	Life-forms	Sediment element concentration				Water element concentration			
		Slope	Intercept	R^2	P	Slope	Intercept	R^2	P
C	Overall	0.0229	2.536	0.01	<0.01				
	Emergent	0.0109	2.588		>0.05				
	Floating-leaved	0.0420	2.544		>0.05				
	Submerged	0.0154	2.514		>0.05				
Ca	Overall	0.2528	0.994	0.08	<0.001	0.2100	1.012	0.04	<0.001
	Emergent	0.2600	0.773	0.12	<0.001	0.2127	0.797	0.07	<0.001
	Floating-leaved	0.0336	1.216		>0.05	0.0536	1.176		>0.05
	Submerged	0.2871	1.136	0.17	<0.001	0.2312	1.166	0.08	<0.001
K	Overall	0.4937	0.847	0.07	<0.001	-0.1188	1.421	0.07	<0.001
	Emergent	0.5254	0.841	0.08	<0.001	-0.1516	1.470	0.10	<0.001
	Floating-leaved	0.3367	1.010		>0.05	-0.1354	1.423	0.10	<0.01
	Submerged	0.4610	0.856	0.06	<0.001	-0.0889	1.378	0.05	<0.001
N	Overall	0.0823	1.338	0.03	<0.001	0.0270	1.349	0.01	<0.05
	Emergent	0.0410	1.346		>0.05	0.0336	1.352	0.01	<0.05
	Floating-leaved	0.2619	1.370	0.37	<0.001	-0.0299	1.416		>0.05
	Submerged	0.0971	1.331	0.05	<0.001	0.0278	1.340		>0.05
Na	Overall	0.7511	0.158	0.15	<0.001	0.1907	0.523	0.19	<0.001
	Emergent	0.7941	0.005	0.12	<0.001	0.2230	0.348	0.19	<0.001
	Floating-leaved	0.9347	0.026	0.17	<0.01	0.3294	0.407	0.28	<0.001
	Submerged	0.6483	0.348	0.21	<0.001	0.1570	0.680	0.25	<0.001
S	Overall	0.1414	0.747	0.07	<0.001	0.4604	0.158	0.31	<0.001
	Emergent	0.1559	0.733	0.09	<0.001	0.1294	0.508	0.21	<0.001
	Floating-leaved	0.2511	0.702	0.22	<0.01	0.2295	0.323	0.44	<0.001
	Submerged	0.1242	0.761	0.05	<0.001	0.1765	0.433	0.39	<0.001
Mg	Overall	0.4996	0.255	0.06	<0.001	0.2477	0.408	0.22	<0.001
	Emergent	0.4141	0.205	0.05	<0.001	0.1851	0.356	0.17	<0.001
	Floating-leaved	0.6681	0.070	0.15	<0.01	0.2654	0.377	0.35	<0.001
	Submerged	0.5560	0.319	0.08	<0.001	0.2900	0.467	0.33	<0.001
P	Overall	0.9667	0.793	0.18	<0.001	-0.0025	0.393		>0.05
	Emergent	1.1991	0.857	0.22	<0.001	-0.0008	0.361		>0.05
	Floating-leaved	0.2270	0.630		>0.05	-0.0848	0.476		>0.05
	Submerged	0.8084	0.746	0.17	<0.001	0.0038	0.416		>0.05
Fe	Overall	1.8685	-2.343	0.21	<0.001	0.1590	0.278	0.06	<0.001
	Emergent	1.4558	-2.028	0.14	<0.001	0.0824	-0.028	0.02	<0.01
	Floating-leaved	0.7894	-1.092		>0.05	0.0926	0.018		>0.05
	Submerged	1.9429	-2.226	0.32	<0.001	0.1905	0.528	0.10	<0.001
Al	Overall	1.8253	-2.791	0.09	<0.001	0.2962	0.104	0.08	<0.001
	Emergent	1.3072	-2.300	0.05	<0.001	0.1856	-0.246	0.04	<0.001
	Floating-leaved	1.9944	-3.272	0.15	<0.01	0.3615	-0.089	0.22	<0.01
	Submerged	2.0899	-2.928	0.15	<0.001	0.3544	0.397	0.14	<0.001
Mn	Overall	1.0053	0.107	0.11	<0.001	0.3653	0.259	0.12	<0.001
	Emergent	1.0840	0.003	0.16	<0.001	0.2961	0.030	0.10	<0.001
	Floating-leaved	0.8234	-0.007	0.09	<0.05	0.3611	0.175	0.11	<0.05
	Submerged	0.9685	0.213	0.09	<0.001	0.4618	0.518	0.18	<0.001
Si	Overall	0.5933	-0.405	0.08	<0.001	0.2372	-0.590	0.07	<0.001
	Emergent	0.6898	-0.393	0.12	<0.001	0.1980	-0.574	0.05	<0.001

B	Floating-leaved	0.5387	-0.604	>0.05	0.4062	-0.871	0.15	<0.01
	Submerged	0.5273	-0.400	0.07 <0.001	0.2755	-0.590	0.10	<0.001
	Overall	1.4705	0.796	0.11 <0.001	0.1737	-1.108	0.03	<0.001
	Emergent	1.0852	0.118	0.10 <0.001	0.0229	-1.389		>0.05
Zn	Floating-leaved	1.6218	0.744	0.30 <0.001	-0.1453	-1.764		>0.05
	Submerged	1.8187	1.426	0.13 <0.001	0.3335	-0.805	0.09	<0.001
	Overall	0.6251	-0.523	0.20 <0.001	0.3409	-0.771	0.04	<0.001
	Emergent	0.4842	-0.734	0.13 <0.001	0.2401	-0.968	0.02	<0.001
Cu	Floating-leaved	0.1360	0.199	>0.05	0.0239	-1.267		>0.05
	Submerged	0.7342	-0.358	0.27 <0.001	0.4659	-0.541	0.06	<0.001
	Overall	0.6098	-1.232	0.10 <0.001	0.2111	-1.672	0.06	<0.001
	Emergent	0.5261	-1.402	0.09 <0.001	0.1765	-1.802	0.05	<0.001
Ni	Floating-leaved	-0.0238	-2.326	>0.05	0.2400	-1.580	0.08	<0.05
	Submerged	0.7338	-0.995	0.12 <0.001	0.2455	-1.544	0.08	<0.001
	Overall	0.5808	-1.587	0.06 <0.001	0.2927	-1.689	0.06	<0.001
	Emergent	0.5949	-1.778	0.06 <0.001	0.1346	-2.355	0.01	<0.05
Co	Floating-leaved	0.1531	-2.408	>0.05	0.4956	-1.222	0.21	<0.01
	Submerged	0.5225	-1.486	0.08 <0.001	0.3514	-1.330	0.13	<0.001
	Overall	1.3180	-0.280	0.08 <0.001	0.4821	-1.312	0.05	<0.001
	Emergent	1.7312	0.228	0.15 <0.001	0.5044	-1.579	0.06	<0.001
	Floating-leaved	0.8175	-1.306	>0.05	0.7836	-0.247	0.22	<0.01
	Submerged	0.9321	-0.774	0.08 <0.001	0.4885	-0.989	0.10	<0.001

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Continued Table S4

Element	Life-forms	Sediment pH			Water pH		
		Slope	Intercept R^2	P	Slope	Intercept R^2	P
C	Overall	-0.0016	2.582	>0.05	0.0023	2.550	>0.05
	Emergent	0.0022	2.587	>0.05	0.0013	2.593	>0.05
	Floating-leaved	-0.0173	2.736	0.25 <0.001	-0.0236	2.800	>0.05
	Submerged	0.0007	2.531	>0.05	0.0108	2.445	0.01 <0.01
Ca	Overall	0.0888	0.672	0.05 <0.001	0.0430	1.000	0.01 <0.01
	Emergent	0.0692	0.616	0.04 <0.001	0.0044	1.118	>0.05
	Floating-leaved	0.0178	1.133	>0.05	-0.0513	1.682	>0.05
	Submerged	0.1145	0.658	0.10 <0.001	0.0549	1.086	0.01 <0.01
K	Overall	-0.0311	1.583	0.01 <0.001	-0.0310	1.602	0.01 <0.01
	Emergent	-0.0430	1.703	0.02 <0.001	-0.0144	1.490	>0.05
	Floating-leaved	0.0160	1.225	>0.05	-0.0430	1.694	>0.05
	Submerged	-0.0289	1.541	0.01 <0.05	-0.0427	1.678	0.02 <0.01
N	Overall	-0.0135	1.454	0.004 <0.05	-0.0067	1.405	>0.05
	Emergent	0.0084	1.287	>0.05	0.0018	1.337	>0.05
	Floating-leaved	-0.0399	1.714	0.11 <0.05	-0.0363	1.713	>0.05
	Submerged	-0.0266	1.549	0.02 <0.01	-0.0079	1.408	>0.05
Na	Overall	0.0780	0.188	0.02 <0.001	0.0725	0.183	0.01 <0.001
	Emergent	0.0830	0.023	0.02 <0.01	0.0911	-0.098	0.01 <0.01
	Floating-leaved	0.0976	0.066	>0.05	0.2019	-0.852	>0.05
	Submerged	0.0661	0.389	0.03 <0.001	0.0370	0.592	>0.05
S	Overall	0.0420	0.436	0.03 <0.001	0.0371	0.450	0.02 <0.001
	Emergent	0.0305	0.518	0.02 <0.01	0.0120	0.654	>0.05
	Floating-leaved	0.0258	0.531	>0.05	0.1009	-0.098	0.08 <0.05
	Submerged	0.0557	0.338	0.05 <0.001	0.0536	0.319	0.03 <0.001

Mg	Overall	0.0936	-0.035	0.07	<0.001	0.1173	-0.297	0.06	<0.001
	Emergent	0.0673	0.044	0.05	<0.001	0.0885	-0.178	0.05	<0.001
	Floating-leaved	0.0414	0.340		>0.05	0.0820	-0.020		>0.05
	Submerged	0.1270	-0.185	0.11	<0.001	0.1311	-0.305	0.08	<0.001
P	Overall	-0.0337	0.657	0.01	<0.001	0.0188	0.236		>0.05
	Emergent	-0.0263	0.566		>0.05	0.0090	0.285		>0.05
	Floating-leaved	-0.0679	1.046	0.21	<0.01	-0.0444	0.904		>0.05
	Submerged	-0.0280	0.631	0.01	<0.05	0.0376	0.094	0.01	<0.01
Fe	Overall	-0.0729	0.723	0.01	<0.001	-0.0316	0.422		>0.05
	Emergent	-0.0686	0.438	0.02	<0.01	-0.0280	0.139		>0.05
	Floating-leaved	-0.0179	0.085		>0.05	0.1067	-0.916		>0.05
	Submerged	-0.1078	1.232	0.03	<0.001	-0.0828	1.092	0.01	<0.01
Al	Overall	-0.0704	0.444	0.01	<0.001	-0.0487	0.307		>0.05
	Emergent	-0.0737	0.193	0.01	<0.01	-0.0581	0.108		>0.05
	Floating-leaved	-0.0058	-0.267		>0.05	0.0565	-0.770		>0.05
	Submerged	-0.1006	0.939	0.02	<0.001	-0.0898	0.914	0.01	<0.05
Mn	Overall	-0.0673	0.285	0.01	<0.001	-0.1703	1.200	0.05	<0.001
	Emergent	-0.0240	-0.181		>0.05	-0.1096	0.557	0.02	<0.001
	Floating-leaved	-0.0037	-0.263		>0.05	-0.1860	1.222		>0.05
	Submerged	-0.1324	0.912	0.04	<0.001	-0.2447	1.953	0.09	<0.001
Si	Overall	0.0284	-0.722	0.004	<0.05	0.0227	-0.694		>0.05
	Emergent	0.0515	-0.900	0.01	<0.01	0.0068	-0.556		>0.05
	Floating-leaved	0.0744	-1.227	0.10	<0.05	0.2674	-2.850	0.23	<0.001
	Submerged	-0.0129	-0.388		>0.05	0.0136	-0.608		>0.05
B	Overall	0.0757	-1.871	0.01	<0.001	0.0950	-2.084	0.01	<0.001
	Emergent	0.0270	-1.622		>0.05	0.0120	-1.512		>0.05
	Floating-leaved	-0.0001	-1.595		>0.05	-0.0948	-0.826		>0.05
	Submerged	0.1232	-2.108	0.02	<0.001	0.1471	-2.393	0.02	<0.001
Zn	Overall	-0.0468	-0.914	0.02	<0.001	-0.0020	-1.262		>0.05
	Emergent	-0.0577	-0.876	0.04	<0.001	0.0125	-1.430		>0.05
	Floating-leaved	0.0384	-1.588		>0.05	-0.0040	-1.271		>0.05
	Submerged	-0.0578	-0.785	0.03	<0.001	-0.0215	-1.054		>0.05
Cu	Overall	-0.0621	-1.796	0.02	<0.001	-0.0571	-1.797	0.01	<0.01
	Emergent	-0.0734	-1.732	0.03	<0.001	-0.0310	-2.042		>0.05
	Floating-leaved	0.0422	-2.598		>0.05	-0.0344	-2.005		>0.05
	Submerged	-0.0755	-1.669	0.02	<0.001	-0.0859	-1.530	0.02	<0.01
Ni	Overall	-0.0254	-2.330		>0.05	-0.0481	-2.121	0.003	<0.05
	Emergent	-0.0490	-2.362		>0.05	-0.0406	-2.402		>0.05
	Floating-leaved	0.0598	-3.107		>0.05	0.0604	-3.154		>0.05
	Submerged	-0.0334	-2.067		>0.05	-0.0935	-1.535	0.02	<0.001
Co	Overall	-0.0618	-2.503	0.01	<0.01	-0.1182	-1.985	0.01	<0.001
	Emergent	-0.0765	-2.729	0.01	<0.05	-0.1002	-2.480	0.01	<0.05
	Floating-leaved	0.0440	-3.317		>0.05	-0.2115	-1.271		>0.05
	Submerged	-0.0815	-2.049	0.02	<0.001	-0.1686	-1.255	0.06	<0.001

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Continued Table S4

Element	Life-forms	Sediment EC				Water salinity			
		Slope	Intercept	R ²	P	Slope	Intercept	R ²	P
C	Overall	0.0047	2.566		>0.05	-0.0078	2.566	0.003	<0.05
	Emergent	0.0056	2.600		>0.05	-0.0003	2.604		>0.05

Ca	Floating-leaved	-0.0179	2.620	>0.05	-0.0526	2.573	0.18	<0.01
	Submerged	0.0004	2.537	>0.05	-0.0137	2.530	0.01	<0.01
	Overall	0.0725	1.307	0.01 <0.001	0.0990	1.413	0.02	<0.001
	Emergent	0.0437	1.120	>0.05	0.0682	1.188	0.01	<0.01
K	Floating-leaved	0.0271	1.246	>0.05	0.0700	1.311		>0.05
	Submerged	0.1332	1.451	0.05 <0.001	0.1395	1.624	0.07	<0.001
	Overall	-0.0511	1.380	0.01 <0.001	-0.1104	1.285	0.07	<0.001
	Emergent	-0.0510	1.409	0.01 <0.05	-0.1396	1.301	0.10	<0.001
N	Floating-leaved	-0.0689	1.391	>0.05	-0.0308	1.323		>0.05
	Submerged	-0.0551	1.358	0.02 <0.01	-0.0921	1.269	0.06	<0.001
	Overall	-0.0159	1.361	>0.05	-0.0439	1.327	0.02	<0.001
	Emergent	-0.0092	1.360	>0.05	-0.0123	1.347		>0.05
Na	Floating-leaved	0.0269	1.400	>0.05	-0.1294	1.331	0.09	<0.05
	Submerged	-0.0230	1.358	>0.05	-0.0648	1.307	0.05	<0.001
	Overall	0.1236	0.699	0.02 <0.001	0.2820	0.937	0.12	<0.001
	Emergent	0.1638	0.539	0.03 <0.001	0.3238	0.827	0.12	<0.001
S	Floating-leaved	0.4158	0.505	0.08 <0.05	0.7502	1.290	0.33	<0.001
	Submerged	0.0939	0.834	0.02 <0.001	0.2424	1.029	0.19	<0.001
	Overall	0.0920	0.692	0.06 <0.001	0.1787	0.853	0.26	<0.001
	Emergent	0.0821	0.690	0.05 <0.001	0.1362	0.822	0.16	<0.001
Mg	Floating-leaved	0.2002	0.586	0.17 <0.01	0.3221	0.938	0.49	<0.001
	Submerged	0.0971	0.699	0.06 <0.001	0.2094	0.880	0.34	<0.001
	Overall	0.0497	0.655	0.01 <0.01	0.2381	0.814	0.17	<0.001
	Emergent	0.0220	0.551	>0.05	0.1742	0.653	0.13	<0.001
P	Floating-leaved	0.1432	0.549	>0.05	0.3593	0.887	0.45	<0.001
	Submerged	0.0907	0.738	0.02 <0.001	0.2973	0.959	0.29	<0.001
	Overall	-0.0600	0.441	0.01 <0.001	-0.1086	0.340	0.06	<0.001
	Emergent	-0.0616	0.411	0.01 <0.05	-0.1385	0.295	0.07	<0.001
Fe	Floating-leaved	-0.1061	0.615	>0.05	-0.1867	0.418	0.12	<0.05
	Submerged	-0.0476	0.449	0.01 <0.05	-0.0729	0.376	0.03	<0.001
	Overall	-0.1438	0.267	0.02 <0.001	-0.1813	0.064	0.04	<0.001
	Emergent	-0.1150	-0.004	0.02 <0.01	-0.2140	-0.200	0.06	<0.001
Al	Floating-leaved	0.1334	-0.139	>0.05	0.1752	0.069		>0.05
	Submerged	-0.1485	0.503	0.02 <0.001	-0.1566	0.310	0.03	<0.001
	Overall	-0.1951	0.047	0.03 <0.001	-0.2349	-0.223	0.04	<0.001
	Emergent	-0.2052	-0.217	0.04 <0.001	-0.3033	-0.528	0.09	<0.001
Mn	Floating-leaved	0.2094	-0.453	>0.05	0.1016	-0.242		>0.05
	Submerged	-0.1656	0.278	0.02 <0.001	-0.1781	0.062	0.03	<0.001
	Overall	-0.0010	-0.238	>0.05	-0.0899	-0.284	0.01	<0.01
	Emergent	-0.0025	-0.365	>0.05	-0.0674	-0.400		>0.05
Si	Floating-leaved	0.1013	-0.360	>0.05	0.2393	-0.131		>0.05
	Submerged	0.0153	-0.134	>0.05	-0.1131	-0.180	0.01	<0.01
	Overall	-0.0790	-0.441	0.01 <0.001	-0.0694	-0.537	0.01	<0.001
	Emergent	-0.0962	-0.422	0.02 <0.01	-0.0438	-0.520		>0.05
B	Floating-leaved	0.1531	-0.780	>0.05	0.1643	-0.566		>0.05
	Submerged	-0.0790	-0.432	0.01 <0.01	-0.1073	-0.547	0.03	<0.001
	Overall	-0.0103	-1.273	>0.05	0.1463	-1.208	0.02	<0.001
	Emergent	-0.0313	-1.386	>0.05	-0.0310	-1.426		>0.05
	Floating-leaved	-0.2303	-1.439	>0.05	-0.2074	-1.735		>0.05
	Submerged	0.0321	-1.170	>0.05	0.3058	-0.989	0.06	<0.001

Zn	Overall	-0.0379	-1.249	0.004	<0.05	-0.0913	-1.324	0.03	<0.001
	Emergent	-0.0088	-1.318		>0.05	-0.1126	-1.379	0.06	<0.001
	Floating-leaved	-0.0160	-1.292		>0.05	0.0535	-1.268		>0.05
	Submerged	-0.0593	-1.191	0.01	<0.05	-0.0768	-1.275	0.02	<0.001
Cu	Overall	-0.1455	-2.167	0.03	<0.001	-0.1019	-2.331	0.02	<0.001
	Emergent	-0.0868	-2.234	0.01	<0.01	-0.0720	-2.339	0.01	<0.05
	Floating-leaved	-0.0063	-2.281		>0.05	0.3252	-2.068	0.08	<0.05
	Submerged	-0.2039	-2.104	0.06	<0.001	-0.1416	-2.331	0.03	<0.001
Ni	Overall	-0.1138	-2.439	0.01	<0.001	-0.0671	-2.562	0.005	<0.05
	Emergent	-0.0784	-2.681		>0.05	-0.1044	-2.795	0.01	<0.05
	Floating-leaved	0.1065	-2.736		>0.05	0.3980	-2.397	0.11	<0.05
	Submerged	-0.1258	-2.233	0.02	<0.001	-0.0414	-2.350		>0.05
Co	Overall	-0.2024	-2.827	0.03	<0.001	-0.2286	-3.099	0.04	<0.001
	Emergent	-0.1594	-3.197	0.01	<0.01	-0.3041	-3.472	0.07	<0.001
	Floating-leaved	-0.1188	-2.910		>0.05	0.0857	-2.933		>0.05
	Submerged	-0.1922	-2.540	0.04	<0.001	-0.1516	-2.763	0.03	<0.001

401

Table S5. Results of the phylogenetic signal analyses using Blomberg's K value with the corresponding P value of 17 elements of wetland plants. Significant values ($P < 0.05$) are marked in bold.

Element	Blomberg's K	P
C	0.160	0.001
Ca	0.103	0.008
K	0.223	0.001
N	0.130	0.001
Na	0.117	0.028
S	0.089	0.020
Mg	0.077	0.201
P	0.106	0.011
Fe	0.122	0.024
Al	0.134	0.003
Mn	0.107	0.014
Si	0.117	0.011
B	0.081	0.260
Zn	0.095	0.007
Cu	0.089	0.040
Ni	0.170	0.006
Co	0.094	0.032

406 **Table S6. Variance partitioning analysis of 17 bioelements using phylogenetic linear mixed effect model.** The model including phylogenetic levels
407 (hierarchically nested structures were expressed as order level; order/family level and order/family/species level), environmental effects (site level) and residual.
408 Conditional R^2 represents model fit parameters of model.

Element	Variance components (%)					Family level and above	Species level and above	Conditional R^2
	Order	Order/family	Order/family/species	Site	Residual			
C	15.32	25.00	16.13	7.26	36.29	40.32	56.45	0.64
Ca	9.09	9.09	11.11	23.23	47.47	18.18	29.29	0.52
K	4.31	22.41	19.83	15.52	37.93	26.72	46.55	0.62
N	1.87	8.41	14.95	25.23	49.53	10.28	25.23	0.50
Na	6.78	21.19	12.71	25.42	33.90	27.97	40.68	0.66
S	0.97	0.00	10.68	47.57	40.78	0.97	11.65	0.59
Mg	8.25	0.00	11.34	42.27	38.14	8.25	19.59	0.62
P	9.43	0.00	11.32	33.02	46.23	9.43	20.75	0.54
Fe	5.45	10.91	10.00	24.55	49.09	16.36	26.36	0.51
Al	7.21	9.01	9.91	31.53	42.34	16.22	26.13	0.57
Mn	10.68	0.00	3.88	36.89	48.54	10.68	14.56	0.51
Si	0.00	11.32	2.83	44.34	41.51	11.32	14.15	0.59
B	0.00	2.56	11.54	48.72	37.18	2.56	14.10	0.63
Zn	1.87	0.00	1.87	56.07	40.19	1.87	3.74	0.60
Cu	5.50	0.00	1.83	54.13	38.53	5.50	7.34	0.61
Ni	2.78	6.94	9.03	53.47	27.78	9.72	18.75	0.72
Co	3.77	2.83	1.89	42.45	49.06	6.60	8.49	0.51
Mean of 17 elements	5.49	7.63	9.46	35.98	41.44	13.12	22.58	
Mean of macroelements	7.00	10.76	13.51	27.44	41.28	17.77	31.28	
Mean of microelements	4.14	4.84	5.86	43.57	41.58	8.98	14.85	

409

410 **Table S7. Results of phylogenetically controlled linear mixed models using a Bayesian framework.**

411 1. Model formula

Response variables	Model formula	Family
C	$C \sim \text{GST} + \text{GSP} + S_C + S_pH + S_EC + W_pH + W_salt + (\text{random} = \text{species} + \text{phylogeny})$	lognormal
Ca	$Ca \sim \text{GST} + \text{GSP} + S_Ca + W_Ca + S_pH + W_pH + S_EC + W_salt + (\text{random} = \text{phylogeny} + \text{species})$	lognormal
K	$K \sim \text{GST} + \text{GSP} + S_K + W_K + S_pH + W_pH + S_EC + W_salt + (\text{random} = \text{phylogeny} + \text{species})$	lognormal
N	$N \sim \text{GST} + \text{GSP} + S_N + W_N + S_pH + W_pH + S_EC + W_salt + (\text{random} = \text{phylogeny} + \text{species})$	lognormal
Na	$Na \sim \text{GST} + \text{GSP} + S_Na + W_Na + S_pH + W_pH + S_EC + W_salt + (\text{random} = \text{phylogeny} + \text{species})$	lognormal
S	$S \sim \text{GST} + \text{GSP} + S_S + W_S + S_pH + W_pH + S_EC + W_salt + (\text{random} = \text{phylogeny} + \text{species})$	lognormal
Mg	$Mg \sim \text{GST} + \text{GSP} + S_Mg + W_Mg + S_pH + W_pH + S_EC + W_salt + (\text{random} = \text{phylogeny} + \text{species})$	lognormal
P	$P \sim \text{GST} + \text{GSP} + S_P + W_P + S_pH + W_pH + S_EC + W_salt + (\text{random} = \text{phylogeny} + \text{species})$	lognormal
Fe	$Fe \sim \text{GST} + \text{GSP} + S_Fe + W_Fe + S_pH + W_pH + S_EC + W_salt + (\text{random} = \text{phylogeny} + \text{species})$	lognormal
Al	$Al \sim \text{GST} + \text{GSP} + S_Al + W_Al + S_pH + W_pH + S_EC + W_salt + (\text{random} = \text{phylogeny} + \text{species})$	lognormal
Mn	$Mn \sim \text{GST} + \text{GSP} + S_Mn + W_Mn + S_pH + W_pH + S_EC + W_salt + (\text{random} = \text{phylogeny} + \text{species})$	lognormal
Si	$Si \sim \text{GST} + \text{GSP} + S_Si + W_Si + S_pH + W_pH + S_EC + W_salt + (\text{random} = \text{phylogeny} + \text{species})$	lognormal
B	$B \sim \text{GST} + \text{GSP} + S_B + W_B + S_pH + W_pH + S_EC + W_salt + (\text{random} = \text{phylogeny} + \text{species})$	lognormal
Zn	$Zn \sim \text{GST} + \text{GSP} + S_Zn + W_Zn + S_pH + W_pH + S_EC + W_salt + (\text{random} = \text{phylogeny} + \text{species})$	lognormal
Cu	$Cu \sim \text{GST} + \text{GSP} + S_Cu + W_Cu + S_pH + W_pH + S_EC + W_salt + (\text{random} = \text{phylogeny} + \text{species})$	lognormal

Ni	$\text{Ni} \sim \text{GST} + \text{GSP} + \text{S_Ni} + \text{W_Ni} + \text{S_pH} + \text{W_pH} + \text{S_EC} + \text{W_salt} + (\text{random} = \text{phylogeny} + \text{species})$	lognormal
Co	$\text{Co} \sim \text{GST} + \text{GSP} + \text{S_Co} + \text{W_Co} + \text{S_pH} + \text{W_pH} + \text{S_EC} + \text{W_salt} + (\text{random} = \text{phylogeny} + \text{species})$	lognormal
C:Ca	$\text{C:Ca} \sim \text{GST} + \text{GSP} + \text{S_C:Ca} + \text{S_pH} + \text{W_pH} + \text{S_EC} + \text{W_salt} + (\text{random} = \text{phylogeny} + \text{species})$	lognormal
C:K	$\text{C:K} \sim \text{GST} + \text{GSP} + \text{S_C:K} + \text{S_pH} + \text{W_pH} + \text{S_EC} + \text{W_salt} + (\text{random} = \text{phylogeny} + \text{species})$	lognormal
C:N	$\text{C:N} \sim \text{GST} + \text{GSP} + \text{S_C:N} + \text{S_pH} + \text{W_pH} + \text{S_EC} + \text{W_salt} + (\text{random} = \text{phylogeny} + \text{species})$	lognormal
C:Na	$\text{C:Na} \sim \text{GST} + \text{GSP} + \text{S_C:Na} + \text{S_pH} + \text{W_pH} + \text{S_EC} + \text{W_salt} + (\text{random} = \text{phylogeny} + \text{species})$	lognormal
C:S	$\text{C:S} \sim \text{GST} + \text{GSP} + \text{S_C:S} + \text{S_pH} + \text{W_pH} + \text{S_EC} + \text{W_salt} + (\text{random} = \text{phylogeny} + \text{species})$	lognormal
C:Mg	$\text{C:Mg} \sim \text{GST} + \text{GSP} + \text{S_C:Mg} + \text{S_pH} + \text{W_pH} + \text{S_EC} + \text{W_salt} + (\text{random} = \text{phylogeny} + \text{species})$	lognormal
C:P	$\text{C:P} \sim \text{GST} + \text{GSP} + \text{S_C:P} + \text{S_pH} + \text{W_pH} + \text{S_EC} + \text{W_salt} + (\text{random} = \text{phylogeny} + \text{species})$	lognormal
Ca:K	$\text{Ca:K} \sim \text{GST} + \text{GSP} + \text{S_Ca:K} + \text{W_Ca:K} + \text{S_pH} + \text{W_pH} + \text{S_EC} + \text{W_salt} + (\text{random} = \text{phylogeny} + \text{species})$	lognormal
Ca:N	$\text{Ca:N} \sim \text{GST} + \text{GSP} + \text{S_Ca:N} + \text{W_Ca:N} + \text{S_pH} + \text{W_pH} + \text{S_EC} + \text{W_salt} + (\text{random} = \text{phylogeny} + \text{species})$	lognormal
Ca:Na	$\text{Ca:Na} \sim \text{GST} + \text{GSP} + \text{S_Ca:Na} + \text{W_Ca:Na} + \text{S_pH} + \text{W_pH} + \text{S_EC} + \text{W_salt} + (\text{random} = \text{phylogeny} + \text{species})$	lognormal
Ca:S	$\text{Ca:S} \sim \text{GST} + \text{GSP} + \text{S_Ca:S} + \text{W_Ca:S} + \text{S_pH} + \text{W_pH} + \text{S_EC} + \text{W_salt} + (\text{random} = \text{phylogeny} + \text{species})$	lognormal
Ca:Mg	$\text{Ca:Mg} \sim \text{GST} + \text{GSP} + \text{S_Ca:Mg} + \text{W_Ca:Mg} + \text{S_pH} + \text{W_pH} + \text{S_EC} + \text{W_salt} + (\text{random} = \text{phylogeny} + \text{species})$	lognormal
Ca:P	$\text{Ca:P} \sim \text{GST} + \text{GSP} + \text{S_Ca:P} + \text{W_Ca:P} + \text{S_pH} + \text{W_pH} + \text{S_EC} + \text{W_salt} + (\text{random} = \text{phylogeny} + \text{species})$	lognormal
K:N	$\text{K:N} \sim \text{GST} + \text{GSP} + \text{S_K:N} + \text{W_K:N} + \text{S_pH} + \text{W_pH} + \text{S_EC} + \text{W_salt} + (\text{random} = \text{phylogeny} + \text{species})$	lognormal
K:Na	$\text{K:Na} \sim \text{GST} + \text{GSP} + \text{S_K:Na} + \text{W_K:Na} + \text{S_pH} + \text{W_pH} + \text{S_EC} + \text{W_salt} + (\text{random} = \text{phylogeny} + \text{species})$	lognormal
K:S	$\text{K:S} \sim \text{GST} + \text{GSP} + \text{S_K:S} + \text{W_K:S} + \text{S_pH} + \text{W_pH} + \text{S_EC} + \text{W_salt} + (\text{random} = \text{phylogeny} + \text{species})$	lognormal

K:Mg	$K:Mg \sim GST + GSP + S_K:Mg + W_K:Mg + S_pH + W_pH + S_EC + W_salt + (random = phylogeny + species)$	lognormal
K:P	$K:P \sim GST + GSP + S_K:P + W_K:P + S_pH + W_pH + S_EC + W_salt + (random = phylogeny + species)$	lognormal
N:Na	$N:Na \sim GST + GSP + S_N:Na + W_N:Na + S_pH + W_pH + S_EC + W_salt + (random = phylogeny + species)$	lognormal
N:S	$N:S \sim GST + GSP + S_N:S + W_N:S + S_pH + W_pH + S_EC + W_salt + (random = phylogeny + species)$	lognormal
N:Mg	$N:Mg \sim GST + GSP + S_N:Mg + W_N:Mg + S_pH + W_pH + S_EC + W_salt + (random = phylogeny + species)$	lognormal
N:P	$N:P \sim GST + GSP + S_N:P + W_N:P + S_pH + W_pH + S_EC + W_salt + (random = phylogeny + species)$	lognormal
Na:S	$Na:S \sim GST + GSP + S_Na:S + W_Na:S + S_pH + W_pH + S_EC + W_salt + (random = phylogeny + species)$	lognormal
Na:Mg	$Na:Mg \sim GST + GSP + S_Na:Mg + W_Na:Mg + S_pH + W_pH + S_EC + W_salt + (random = phylogeny + species)$	lognormal
Na:P	$Na:P \sim GST + GSP + S_Na:P + W_Na:P + S_pH + W_pH + S_EC + W_salt + (random = phylogeny + species)$	lognormal
S:Mg	$S:Mg \sim GST + GSP + S_S:Mg + W_S:Mg + S_pH + W_pH + S_EC + W_salt + (random = phylogeny + species)$	lognormal
S:P	$S:P \sim GST + GSP + S_S:P + W_S:P + S_pH + W_pH + S_EC + W_salt + (random = phylogeny + species)$	lognormal
Mg:P	$Mg:P \sim GST + GSP + S_Mg:P + W_Mg:P + S_pH + W_pH + S_EC + W_salt + (random = phylogeny + species)$	lognormal

412 Growing season mean air temperature (GST), growing season precipitation (GSP), sediment pH (S_pH); sediment electrical conductivity (S_EC), water pH
413 (W_pH), water salinity (S_salt), S_Ca and W_Ca represent Ca concentrations in sediment and water, respectively, as do other elements.

Model	Fixed variables statistics											Model statistics				
C		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5
	Intercept	5.95	0.04	5.87	6.03	1.00	16940	21659	1.000	0.000	2.94E+178	R^2c	0.49	0.02	0.45	0.52
	GST	-0.01	0.01	-0.03	0.00	1.00	49911	32727	0.971	0.059	0.02	R^2m	0.03	0.01	0.01	0.04
	GSP	-0.01	0.01	-0.02	0.01	1.00	50174	31746	0.809	0.382	0.005					
	S_C	0.01	0.00	0.00	0.01	1.00	61144	33678	0.922	0.156	0.005					
	S_pH	0.00	0.00	-0.01	0.00	1.00	69766	32005	0.759	0.482	0.002					
	S_EC	0.00	0.00	-0.01	0.01	1.00	68879	33148	0.603	0.795	0.002					
	W_pH	0.01	0.00	0.00	0.02	1.00	66011	33181	0.984	0.033	0.02					
	W_salt	-0.01	0.00	-0.02	0.00	1.00	66538	31295	0.985	0.030	0.022					
Ca		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5
	Intercept	2.91	0.17	2.56	3.25	1.00	11180	17650	1.000	0.000	1.21E+13	R^2c	0.50	0.02	0.46	0.54
	GST	-0.07	0.03	-0.12	-0.01	1.00	36818	32172	0.993	0.003	1.309	R^2m	0.11	0.04	0.05	0.20
	GSP	-0.03	0.03	-0.08	0.02	1.00	36173	31753	0.878	0.244	0.027					
	S_Ca	0.18	0.02	0.14	0.21	1.00	49025	32261	1.000	0.000	1.76E+09					
	W_Ca	0.06	0.02	0.02	0.11	1.00	40889	33043	0.996	0.009	0.358					
	S_pH	0.11	0.02	0.07	0.14	1.00	48753	32209	1.000	0.000	1.01E+04					
	S_EC	0.07	0.02	0.03	0.10	1.00	55256	30922	1.000	0.000	8.73					
	W_pH	-0.04	0.02	-0.07	0.00	1.00	50391	32077	0.983	0.034	0.083					
W_salt	0.00	0.02	-0.05	0.05	1.00	38249	31040	0.509	0.982	0.012						
K		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5
	Intercept	3.15	0.16	2.84	3.46	1.00	8106	14659	1.000	0.000	1.13E+18	R^2c	0.52	0.02	0.47	0.56
	GST	-0.07	0.02	-0.11	-0.03	1.00	31340	31092	0.999	0.001	2.02	R^2m	0.13	0.04	0.07	0.22
	GSP	-0.03	0.02	-0.07	0.01	1.00	30695	30383	0.917	0.166	0.026					
	S_K	0.11	0.01	0.09	0.13	1.00	55572	31862	1.000	0.000	4.23E+06					
	W_K	-0.07	0.02	-0.11	-0.04	1.00	36433	32040	1.000	0.000	100.46					

	S_pH	-0.01	0.01	-0.03	0.02	1.00	51609	32359	0.735	0.530	0.008					
	S_EC	-0.03	0.01	-0.05	0.00	1.00	49916	30988	0.984	0.032	0.065					
	W_pH	-0.02	0.01	-0.04	0.01	1.00	46960	31400	0.903	0.193	0.015					
	W_salt	0.00	0.02	-0.03	0.03	1.00	36333	31628	0.547	0.905	0.008					
N		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5
	Intercept	3.17	0.08	3.02	3.32	1.00	20876	24256	1.000	0.000	2.90E+41	R^2c	0.28	0.02	0.23	0.32
	GST	-0.06	0.02	-0.10	-0.02	1.00	45311	32682	0.998	0.003	1.04	R^2m	0.05	0.02	0.02	0.08
	GSP	-0.05	0.02	-0.08	-0.01	1.00	47388	32836	0.996	0.008	0.337					
	S_N	0.03	0.01	0.01	0.06	1.00	56476	32559	0.997	0.007	0.249					
	W_N	0.01	0.01	-0.01	0.03	1.00	77317	31937	0.814	0.373	0.008					
	S_pH	-0.01	0.01	-0.03	0.01	1.00	66236	31553	0.794	0.413	0.008					
	S_EC	-0.03	0.01	-0.05	-0.01	1.00	71978	32677	0.994	0.013	0.121					
	W_pH	-0.01	0.01	-0.03	0.01	1.00	66547	32416	0.761	0.478	0.007					
	W_salt	0.00	0.01	-0.02	0.03	1.00	69373	33631	0.652	0.697	0.006					
Na		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5
	Intercept	1.82	0.31	1.20	2.43	1.00	13043	19462	1.000	0.000	4.10E+03	R^2c	0.64	0.02	0.61	0.67
	GST	0.11	0.04	0.04	0.18	1.00	47855	33523	0.998	0.004	1.26	R^2m	0.39	0.09	0.18	0.53
	GSP	-0.02	0.04	-0.09	0.05	1.00	44624	31334	0.717	0.566	0.021					
	S_Na	0.22	0.02	0.18	0.27	1.00	71652	31130	1.000	0.000	7.57E+09					
	W_Na	0.11	0.04	0.03	0.18	1.00	48463	32870	0.998	0.004	1.24					
	S_pH	0.05	0.02	0.00	0.09	1.00	65227	33157	0.978	0.044	0.091					
	S_EC	0.07	0.02	0.03	0.11	1.00	66600	31651	0.999	0.001	1.63					
	W_pH	0.04	0.02	0.00	0.08	1.00	62802	33024	0.965	0.071	0.059					
	W_salt	0.10	0.04	0.03	0.18	1.00	44482	31598	0.995	0.009	0.612					
S		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5
	Intercept	1.67	0.06	1.53	1.78	1.00	19273	17811	1.000	0.000	2.44E+22	R^2c	0.53	0.02	0.48	0.56
	GST	0.10	0.02	0.06	0.13	1.00	41343	32439	1.000	0.000	2.30E+03	R^2m	0.39	0.04	0.31	0.47
	GSP	-0.06	0.02	-0.09	-0.02	1.00	41393	33965	0.999	0.001	1.73					

	S_S	0.03	0.01	0.01	0.06	1.00	51555	32153	0.996	0.008	0.214					
	W_S	0.04	0.02	0.00	0.08	1.00	35726	30952	0.962	0.077	0.051					
	S_pH	0.00	0.01	-0.02	0.02	1.00	53584	31632	0.565	0.870	0.006					
	S_EC	0.03	0.01	0.00	0.05	1.00	50560	33236	0.981	0.038	0.053					
	W_pH	0.03	0.01	0.01	0.05	1.00	57587	32623	0.997	0.007	0.246					
	W_salt	0.10	0.02	0.06	0.14	1.00	36692	31248	1.000	0.000	70.17					
Mg		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5
	Intercept	1.63	0.11	1.42	1.84	1.00	25428	25770	1.000	0.000	1.02E+12	R^2c	0.52	0.03	0.47	0.57
	GST	0.22	0.03	0.17	0.28	1.00	52425	33090	1.000	0.000	1.04E+09	R^2m	0.22	0.04	0.14	0.31
	GSP	0.05	0.03	0.00	0.10	1.00	50038	32267	0.980	0.040	0.102					
	S_Mg	0.05	0.02	0.02	0.08	1.00	80611	31151	1.000	0.001	1.5					
	W_Mg	0.11	0.02	0.07	0.15	1.00	53597	33330	1.000	0.000	294.6					
	S_pH	0.05	0.02	0.01	0.08	1.00	72129	31546	0.998	0.004	0.463					
	S_EC	0.02	0.02	-0.01	0.05	1.00	81889	30473	0.917	0.166	0.02					
	W_pH	0.15	0.02	0.11	0.18	1.00	68102	32171	1.000	0.000	2.88E+07					
	W_salt	0.05	0.02	0.01	0.10	1.00	52563	32908	0.992	0.017	0.206					
P		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5
	Intercept	0.93	0.11	0.72	1.15	1.00	17664	22079	1.000	0.000	3.20E+04	R^2c	0.40	0.02	0.35	0.45
	GST	-0.10	0.03	-0.15	-0.05	1.00	45148	32233	1.000	0.000	34.7	R^2m	0.20	0.04	0.12	0.29
	GSP	-0.03	0.02	-0.07	0.02	1.00	43566	32828	0.876	0.248	0.023					
	S_P	0.17	0.01	0.14	0.20	1.00	76613	31221	1.000	0.000	1.68E+10					
	W_P	0.03	0.01	0.01	0.06	1.00	83461	30665	0.993	0.013	0.148					
	S_pH	-0.02	0.02	-0.05	0.01	1.00	67575	32602	0.887	0.226	0.016					
	S_EC	-0.04	0.01	-0.07	-0.01	1.00	65154	30914	0.996	0.008	0.22					
	W_pH	0.03	0.02	0.01	0.06	1.00	64054	31179	0.989	0.021	0.113					
	W_salt	0.02	0.02	-0.01	0.05	1.00	68250	32105	0.858	0.283	0.014					
Fe		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5
	Intercept	0.26	0.24	-0.23	0.74	1.00	13786	19381	0.866	0.268	0.083	R^2c	0.53	0.04	0.44	0.61

	GST	-0.08	0.04	-0.16	0.00	1.00	38093	31616	0.968	0.065	0.116	R^2_m	0.12	0.06	0.04	0.27
	GSP	-0.05	0.04	-0.13	0.03	1.00	36359	31807	0.902	0.196	0.047					
	S_Fe	0.37	0.03	0.31	0.44	1.00	45632	34145	1.000	0.000	1.89E+14					
	W_Fe	0.06	0.03	0.00	0.12	1.00	47323	33222	0.976	0.048	0.112					
	S_pH	-0.01	0.03	-0.06	0.05	1.00	53196	32619	0.615	0.771	0.014					
	S_EC	-0.05	0.03	-0.10	0.00	1.00	58263	30799	0.972	0.057	0.086					
	W_pH	-0.05	0.03	-0.10	0.00	1.00	52930	33343	0.962	0.075	0.064					
	W_salt	0.05	0.03	0.00	0.11	1.00	55336	32909	0.976	0.048	0.102					
Al		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5
	Intercept	-0.34	0.28	-0.91	0.21	1.00	16093	22348	0.898	0.204	0.115	R^2_c	0.55	0.02	0.49	0.59
	GST	-0.04	0.05	-0.14	0.07	1.00	42125	32706	0.759	0.482	0.034	R^2_m	0.19	0.09	0.06	0.39
	GSP	0.11	0.05	0.01	0.21	1.00	40061	32239	0.984	0.032	0.264					
	S_Al	0.26	0.03	0.19	0.33	1.00	52376	33605	1.000	0.000	6.24E+06					
	W_Al	0.22	0.03	0.16	0.29	1.00	53898	33024	1.000	0.000	8.16E+04					
	S_pH	-0.07	0.03	-0.14	0.00	1.00	51786	31578	0.981	0.037	0.155					
	S_EC	-0.07	0.03	-0.13	0.00	1.00	62427	32164	0.982	0.036	0.142					
	W_pH	-0.03	0.03	-0.10	0.03	1.00	53818	31905	0.837	0.327	0.026					
	W_salt	0.01	0.03	-0.06	0.08	1.00	57769	32162	0.627	0.745	0.018					
Mn		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5
	Intercept	-0.57	0.24	-1.07	-0.11	1.00	17448	20795	0.991	0.019	0.865	R^2_c	0.43	0.04	0.34	0.49
	GST	-0.06	0.05	-0.16	0.04	1.00	43529	33305	0.872	0.257	0.049	R^2_m	0.28	0.09	0.11	0.44
	GSP	-0.06	0.05	-0.16	0.04	1.00	42040	32098	0.892	0.215	0.053					
	S_Mn	0.24	0.04	0.16	0.31	1.00	49025	34127	1.000	0.000	2.62E+04					
	W_Mn	0.23	0.04	0.16	0.31	1.00	48705	32123	1.000	0.000	1.51E+05					
	S_pH	-0.11	0.03	-0.18	-0.05	1.00	62415	32455	1.000	0.000	5.56					
	S_EC	-0.04	0.03	-0.10	0.02	1.00	68278	30790	0.905	0.189	0.037					
	W_pH	-0.16	0.03	-0.22	-0.09	1.00	62642	33334	1.000	0.000	244.26					
	W_salt	0.06	0.03	-0.01	0.12	1.00	64883	32278	0.952	0.095	0.067					

Si		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5
	Intercept	-1.24	0.13	-1.51	-0.99	1.00	17632	20857	1.000	0.000	3.59E+06	R^2c	0.46	0.04	0.39	0.52
	GST	-0.04	0.03	-0.10	0.03	1.00	42149	31821	0.866	0.267	0.031	R^2m	0.28	0.06	0.16	0.41
	GSP	0.20	0.03	0.13	0.26	1.00	40397	32981	1.000	0.000	3.19E+03					
	S_Si	0.10	0.02	0.06	0.14	1.00	58957	33103	1.000	0.000	975.13					
	W_Si	0.25	0.02	0.21	0.29	1.00	61774	32909	1.000	0.000	1.29E+14					
	S_pH	0.08	0.02	0.04	0.12	1.00	58092	33224	1.000	0.000	9.3					
	S_EC	-0.02	0.02	-0.06	0.02	1.00	62103	31676	0.848	0.304	0.017					
	W_pH	0.06	0.02	0.02	0.10	1.00	61464	32036	0.997	0.007	0.482					
	W_salt	0.04	0.02	0.00	0.08	1.00	62493	32196	0.961	0.077	0.053					
B		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5
	Intercept	-3.30	0.19	-3.69	-2.94	1.00	20818	21898	1.000	0.000	2.80E+13	R^2c	0.54	0.02	0.49	0.58
	GST	0.10	0.05	0.00	0.21	1.00	41133	32767	0.973	0.053	0.176	R^2m	0.02	0.01	0.01	0.04
	GSP	0.13	0.05	0.03	0.23	1.00	39223	32201	0.994	0.012	0.665					
	S_B	0.36	0.03	0.30	0.42	1.00	58385	31028	1.000	0.000	6.58E+09					
	W_B	0.14	0.04	0.07	0.21	1.00	54675	33590	1.000	0.000	28.44					
	S_pH	-0.03	0.03	-0.10	0.03	1.00	57572	31429	0.846	0.308	0.028					
	S_EC	0.00	0.03	-0.06	0.06	1.00	64397	32372	0.515	0.969	0.015					
	W_pH	0.01	0.03	-0.06	0.07	1.00	59247	32983	0.570	0.861	0.016					
	W_salt	0.02	0.04	-0.05	0.09	1.00	52811	31860	0.688	0.624	0.021					
Zn		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5
	Intercept	-2.92	0.07	-3.06	-2.77	1.00	19819	23185	1.000	0.000	1.02E+30	R^2c	0.46	0.04	0.38	0.53
	GST	0.11	0.03	0.06	0.16	1.00	39420	32849	1.000	0.000	4.28	R^2m	0.41	0.05	0.30	0.50
	GSP	-0.11	0.03	-0.16	-0.06	1.00	39903	31972	1.000	0.000	0.094					
	S_Zn	0.26	0.02	0.23	0.29	1.00	52417	32385	1.000	0.000	1.09E+15					
	W_Zn	0.10	0.02	0.07	0.13	1.00	57022	32926	1.000	0.000	9.01E+03					
	S_pH	-0.05	0.02	-0.09	-0.02	1.00	54519	33014	0.999	0.001	1.42					
	S_EC	-0.05	0.02	-0.08	-0.02	1.00	57385	30007	1.000	0.001	2.05					

	W_pH	0.04	0.02	0.01	0.08	1.00	53376	32394	0.997	0.007	0.351					
	W_salt	0.01	0.02	-0.02	0.04	1.00	59455	31565	0.745	0.510	0.01					
Cu		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5
	Intercept	-5.23	0.11	-5.45	-5.02	1.00	19022	22233	1.000	0.000	1.75E+47	R^2c	0.39	0.04	0.32	0.46
	GST	0.10	0.04	0.02	0.18	1.00	35151	32167	0.991	0.017	0.369	R^2m	0.31	0.05	0.20	0.41
	GSP	-0.17	0.04	-0.25	-0.09	1.00	36364	31049	1.000	0.000	71.92					
	S_Cu	0.17	0.03	0.11	0.23	1.00	44912	32944	1.000	0.000	2.22E+03					
	W_Cu	0.16	0.03	0.10	0.23	1.00	44523	33448	1.000	0.000	6.83E+03					
	S_pH	-0.09	0.03	-0.14	-0.04	1.00	56340	32196	1.000	0.001	3.33					
	S_EC	-0.21	0.03	-0.25	-0.16	1.00	53889	32726	1.000	0.000	1.03E+07					
	W_pH	0.00	0.03	-0.05	0.06	1.00	53185	33733	0.567	0.866	0.013					
	W_salt	0.04	0.03	-0.01	0.09	1.00	58757	32078	0.925	0.150	0.036					
Ni		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5
	Intercept	-5.74	0.19	-6.11	-5.36	1.00	23840	24820	1.000	0.000	1.41E+23	R^2c	0.53	0.03	0.44	0.57
	GST	0.19	0.05	0.09	0.28	1.00	44572	33389	1.000	0.000	17.87	R^2m	0.42	0.08	0.23	0.54
	GSP	0.02	0.05	-0.07	0.11	1.00	42874	33340	0.642	0.716	0.024					
	S_Ni	0.14	0.04	0.07	0.21	1.00	49782	33465	1.000	0.000	67.23					
	W_Ni	0.20	0.03	0.13	0.27	1.00	50905	33432	1.000	0.000	6.41E+03					
	S_pH	-0.06	0.03	-0.11	0.00	1.00	65259	32324	0.969	0.061	0.085					
	S_EC	-0.07	0.03	-0.13	-0.02	1.00	66847	32312	0.996	0.009	0.479					
	W_pH	-0.05	0.03	-0.10	0.01	1.00	64886	33199	0.941	0.117	0.049					
	W_Salt	0.05	0.03	-0.01	0.11	1.00	68149	32317	0.955	0.090	0.062					
Co		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5
	Intercept	-6.95	0.32	-7.59	-6.34	1.00	13024	18611	1.000	0.000	3.74E+23	R^2c	0.52	0.03	0.44	0.57
	GST	-0.06	0.05	-0.16	0.04	1.00	35752	32504	0.873	0.255	0.05	R^2m	0.35	0.14	0.10	0.59
	GSP	-0.08	0.05	-0.18	0.02	1.00	35284	31616	0.937	0.126	0.082					
	S_Co	0.26	0.03	0.20	0.33	1.00	52481	33149	1.000	0.000	2.51E+07					
	W_Co	0.26	0.03	0.19	0.32	1.00	49183	32216	1.000	0.000	9.42E+05					

	S_pH	-0.05	0.03	-0.11	0.02	1.00	54776	32577	0.915	0.171	0.043					
	S_EC	-0.08	0.03	-0.14	-0.02	1.00	56478	29339	0.996	0.007	0.545					
	W_pH	-0.18	0.03	-0.24	-0.12	1.00	55375	33619	1.000	0.000	1.49E+03					
	W_salt	0.04	0.03	-0.03	0.10	1.00	54229	32067	0.863	0.275	0.031					
C:Ca		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5
	Intercept	3.03	0.21	2.62	3.45	1.00	10855	18072	1.000	0.000	5.45E+12	R^2c	0.61	0.02	0.58	0.65
	GST	0.10	0.03	0.03	0.16	1.00	34822	30723	0.999	0.003	1.34	R^2m	0.13	0.05	0.06	0.24
	GSP	0.06	0.03	0.00	0.12	1.00	35298	31678	0.973	0.053	0.1					
	S_C:Ca	0.13	0.03	0.07	0.19	1.00	33821	31358	1.000	0.000	95.74					
	S_pH	-0.06	0.03	-0.12	0.00	1.00	31941	30621	0.976	0.047	0.107					
	S_EC	-0.09	0.02	-0.12	-0.05	1.00	50438	30314	1.000	0.000	36.68					
	W_pH	0.07	0.02	0.03	0.10	1.00	55330	31485	1.000	0.001	3.41					
	W_salt	-0.11	0.02	-0.15	-0.07	1.00	45018	30758	1.000	0.000	520.6					
C:K		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5
	Intercept	2.78	0.16	2.46	3.10	1.00	8522	14004	1.000	0.000	2.35E+15	R^2c	0.37	0.02	0.33	0.41
	GST	0.09	0.02	0.05	0.14	1.00	34557	29866	1.000	0.000	61.99	R^2m	0.06	0.02	0.03	0.10
	GSP	0.03	0.02	-0.01	0.07	1.00	33528	30388	0.900	0.200	0.024					
	S_C:K	0.09	0.01	0.07	0.12	1.00	52224	32305	1.000	0.000	5.00E+04					
	S_pH	0.02	0.01	-0.01	0.05	1.00	54904	32868	0.936	0.127	0.021					
	S_EC	0.01	0.01	-0.01	0.04	1.00	53351	31516	0.858	0.284	0.011					
	W_pH	0.04	0.01	0.01	0.06	1.00	52348	33413	0.999	0.002	0.719					
	W_salt	0.04	0.01	0.01	0.06	1.00	44159	31956	0.996	0.008	0.26					
C:N		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5
	Intercept	2.77	0.08	2.62	2.92	1.00	19529	24332	1.000	0.000	4.97E+33	R^2c	0.25	0.02	0.21	0.29
	GST	0.05	0.02	0.02	0.09	1.00	46561	33233	0.999	0.002	1.33	R^2m	0.02	0.01	0.01	0.04
	GSP	0.06	0.02	0.02	0.09	1.00	45003	33433	1.000	0.001	2.49					
	S_C:N	0.04	0.01	0.02	0.06	1.00	73272	33411	1.000	0.000	4.16					
	S_pH	0.01	0.01	-0.02	0.03	1.00	67487	30511	0.684	0.633	0.006					

	S_EC	0.03	0.01	0.01	0.05	1.00	72792	32371	0.998	0.003	0.383					
	W_pH	0.02	0.01	0.00	0.04	1.00	70420	32933	0.959	0.082	0.023					
	W_salt	-0.01	0.01	-0.03	0.01	1.00	74460	32330	0.890	0.219	0.011					
C:Na		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5
	Intercept	4.09	0.35	3.40	4.78	1.00	8691	14561	1.000	0.000	2.33E+09	R^2c	0.37	0.05	0.28	0.47
	GST	-0.09	0.04	-0.16	-0.01	1.00	36024	31407	0.987	0.027	0.238	R^2m	0.02	0.01	0.00	0.05
	GSP	0.08	0.04	0.00	0.15	1.00	36646	31934	0.979	0.042	0.151					
	S_C:Na	0.12	0.02	0.07	0.16	1.00	58274	32217	1.000	0.000	1.71E+03					
	S_pH	-0.04	0.02	-0.08	0.01	1.00	51880	31513	0.931	0.139	0.036					
	S_EC	-0.08	0.02	-0.12	-0.03	1.00	51432	31310	1.000	0.001	2.33					
	W_pH	-0.04	0.02	-0.08	0.01	1.00	53735	31835	0.946	0.107	0.044					
	W_salt	-0.25	0.03	-0.30	-0.20	1.00	46572	32514	1.000	0.000	8.57E+07					
C:S		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5
	Intercept	4.28	0.09	4.11	4.46	1.00	16727	20397	1.000	0.000	1.36E+25	R^2c	0.43	0.02	0.39	0.48
	GST	-0.10	0.02	-0.13	-0.06	1.00	42098	32281	1.000	0.000	483.12	R^2m	0.28	0.04	0.21	0.36
	GSP	0.05	0.02	0.02	0.09	1.00	43016	33230	0.998	0.003	0.675					
	S_C:S	0.06	0.01	0.04	0.09	1.00	52988	33833	1.000	0.000	101.58					
	S_pH	-0.02	0.01	-0.04	0.01	1.00	58414	33168	0.893	0.214	0.013					
	S_EC	-0.02	0.01	-0.04	0.01	1.00	58618	32224	0.897	0.205	0.014					
	W_pH	-0.02	0.01	-0.04	0.00	1.00	63964	32068	0.950	0.099	0.021					
	W_salt	-0.14	0.01	-0.16	-0.11	1.00	60793	32098	1.000	0.000	2.08E+09					
C:Mg		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5
	Intercept	4.32	0.13	4.06	4.57	1.00	19689	23797	1.000	0.000	1.14E+40	R^2c	0.48	0.02	0.44	0.52
	GST	-0.26	0.03	-0.32	-0.21	1.00	40523	33022	1.000	0.000	6.58E+06	R^2m	0.15	0.04	0.09	0.23
	GSP	-0.05	0.03	-0.11	0.00	1.00	42414	31994	0.975	0.050	0.097					
	S_C:Mg	-0.03	0.02	-0.06	0.01	1.00	62484	32857	0.940	0.120	0.031					
	S_pH	-0.06	0.02	-0.10	-0.03	1.00	69969	31889	1.000	0.000	12.72					
	S_EC	-0.01	0.02	-0.04	0.03	1.00	65573	33086	0.662	0.675	0.01					

	W_pH	-0.15	0.02	-0.18	-0.12	1.00	63344	31920	1.000	0.000	2.18E+06					
	W_salt	-0.15	0.02	-0.18	-0.11	1.00	65435	31693	1.000	0.000	2.41E+06					
C:P		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5
	Intercept	4.98	0.13	4.72	5.23	1.00	12528	18384	1.000	0.000	1.63E+38	R^2c	0.29	0.02	0.24	0.34
	GST	0.16	0.03	0.11	0.21	1.00	36166	33019	1.000	0.000	3.89E+04	R^2m	0.04	0.01	0.02	0.07
	GSP	0.06	0.02	0.01	0.11	1.00	37171	33395	0.992	0.016	0.23					
	S_C:P	0.09	0.02	0.06	0.12	1.00	59784	32013	1.000	0.000	4.18E+03					
	S_pH	0.04	0.02	0.01	0.07	1.00	53560	32703	0.991	0.018	0.12					
	S_EC	0.03	0.02	0.00	0.06	1.00	57223	32246	0.950	0.100	0.029					
	W_pH	-0.02	0.02	-0.05	0.01	1.00	55844	30657	0.918	0.164	0.02					
	W_salt	-0.01	0.02	-0.04	0.02	1.00	54067	32169	0.762	0.477	0.01					
Ca:K		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5
	Intercept	-0.24	0.23	-0.71	0.21	1.00	12581	19081	0.854	0.292	0.075	R^2c	0.43	0.03	0.38	0.48
	GST	0.00	0.04	-0.07	0.08	1.00	38858	31773	0.534	0.933	0.019	R^2m	0.08	0.04	0.03	0.17
	GSP	-0.02	0.04	-0.09	0.05	1.00	39732	32491	0.700	0.600	0.02					
	S_Ca:K	0.24	0.02	0.19	0.29	1.00	51190	33292	1.000	0.000	3.20E+09					
	W_Ca:K	-0.01	0.02	-0.05	0.04	1.00	61165	28827	0.609	0.781	0.011					
	S_pH	0.13	0.02	0.08	0.18	1.00	51858	31938	1.000	0.000	6.25E+03					
	S_EC	0.09	0.02	0.05	0.14	1.00	53549	31657	1.000	0.000	43.1					
	W_pH	-0.02	0.02	-0.07	0.02	1.00	51553	32911	0.858	0.284	0.02					
W_salt	0.07	0.02	0.02	0.11	1.00	49491	32430	0.996	0.009	0.422						
Ca:N		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5
	Intercept	-0.23	0.19	-0.61	0.13	1.00	13313	20803	0.899	0.202	0.076	R^2c	0.36	0.03	0.30	0.41
	GST	-0.04	0.04	-0.11	0.03	1.00	39386	32978	0.840	0.320	0.03	R^2m	0.07	0.03	0.03	0.14
	GSP	0.00	0.03	-0.06	0.07	1.00	40794	33470	0.530	0.940	0.017					
	S_Ca:N	0.15	0.02	0.10	0.20	1.00	53353	33126	1.000	0.000	3.94E+04					
	W_Ca:N	0.10	0.02	0.06	0.14	1.00	56097	33313	1.000	0.000	47.9					
	S_pH	0.14	0.02	0.10	0.19	1.00	55976	32684	1.000	0.000	1.54E+04					

	S_EC	0.14	0.02	0.10	0.18	1.00	59265	32702	1.000	0.000	7.12E+05					
	W_pH	-0.02	0.02	-0.07	0.02	1.00	51508	34355	0.832	0.337	0.018					
	W_salt	0.01	0.03	-0.04	0.06	1.00	48164	31426	0.618	0.764	0.013					
Ca:Na		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5
	Intercept	1.12	0.20	0.68	1.49	1.00	19808	16832	1.000	0.000	74.24	R^2c	0.37	0.05	0.27	0.45
	GST	-0.19	0.05	-0.29	-0.10	1.00	44844	32927	1.000	0.000	50.91	R^2m	0.18	0.07	0.06	0.33
	GSP	-0.11	0.05	-0.20	-0.02	1.00	41446	32737	0.990	0.020	0.389					
	S_Ca:Na	0.30	0.03	0.24	0.35	1.00	65495	33582	1.000	0.000	6.24E+10					
	W_Ca:Na	0.24	0.03	0.18	0.30	1.00	68193	30043	1.000	0.000	2.16E+07					
	S_pH	0.04	0.03	-0.02	0.10	1.00	54149	33179	0.914	0.172	0.04					
	S_EC	0.01	0.03	-0.05	0.07	1.00	62113	31546	0.651	0.699	0.015					
	W_pH	-0.06	0.03	-0.12	0.00	1.00	62782	33907	0.980	0.040	0.12					
	W_salt	-0.13	0.03	-0.20	-0.07	1.00	62548	32594	1.000	0.000	114.36					
Ca:S		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5
	Intercept	1.28	0.16	0.96	1.59	1.00	18165	21996	1.000	0.000	7.25E+04	R^2c	0.33	0.03	0.28	0.38
	GST	-0.18	0.03	-0.25	-0.11	1.00	40718	32462	1.000	0.000	5.15E+03	R^2m	0.06	0.02	0.03	0.12
	GSP	-0.01	0.03	-0.07	0.06	1.00	39691	31878	0.565	0.870	0.017					
	S_Ca:S	0.19	0.02	0.14	0.23	1.00	51156	33225	1.000	0.000	2.32E+08					
	W_Ca:S	-0.03	0.02	-0.07	0.01	1.00	68181	31841	0.940	0.121	0.033					
	S_pH	0.10	0.02	0.05	0.14	1.00	51840	33110	1.000	0.000	29.89					
	S_EC	0.12	0.02	0.08	0.17	1.00	56423	31740	1.000	0.000	3.65E+03					
	W_pH	-0.08	0.02	-0.12	-0.04	1.00	61835	32916	1.000	0.000	8.53					
	W_salt	-0.05	0.02	-0.09	-0.01	1.00	56435	31093	0.989	0.023	0.147					
Ca:Mg		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5
	Intercept	1.34	0.14	1.04	1.60	1.00	21697	22791	1.000	0.000	2.23E+07	R^2c	0.37	0.04	0.30	0.44
	GST	-0.27	0.04	-0.34	-0.19	1.00	41317	30351	1.000	0.000	7.41E+05	R^2m	0.17	0.05	0.09	0.28
	GSP	-0.11	0.04	-0.18	-0.04	1.00	41729	31709	0.999	0.003	1.72					
	S_Ca:Mg	0.23	0.02	0.19	0.28	1.00	66173	33952	1.000	0.000	2.12E+10					

	W_Ca:Mg	0.15	0.02	0.11	0.20	1.00	65536	31718	1.000	0.000	2.59E+04					
	S_pH	0.06	0.02	0.01	0.11	1.00	57239	33697	0.994	0.011	0.298					
	S_EC	0.01	0.02	-0.03	0.06	1.00	57436	33349	0.692	0.617	0.013					
	W_pH	-0.17	0.02	-0.22	-0.13	1.00	59134	31902	1.000	0.000	1.20E+06					
	W_salt	-0.06	0.02	-0.11	-0.02	1.00	55069	31306	0.996	0.009	0.396					
Ca:P		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5
	Intercept	1.99	0.19	1.59	2.35	1.00	15576	20121	1.000	0.000	9.36E+05	R^2c	0.44	0.03	0.38	0.50
	GST	0.07	0.04	0.00	0.15	1.00	40105	32347	0.967	0.065	0.105	R^2m	0.16	0.06	0.06	0.29
	GSP	0.01	0.04	-0.06	0.08	1.00	38561	32181	0.589	0.822	0.019					
	S_Ca:P	0.30	0.02	0.25	0.35	1.00	55577	32960	1.000	0.000	1.58E+11					
	W_Ca:P	0.05	0.02	0.01	0.09	1.00	76502	30077	0.991	0.017	0.187					
	S_pH	0.13	0.03	0.08	0.18	1.00	54114	31179	1.000	0.000	403.13					
	S_EC	0.10	0.02	0.06	0.15	1.00	56988	30642	1.000	0.000	101.89					
	W_pH	-0.07	0.02	-0.12	-0.02	1.00	55300	31305	0.999	0.003	1.08					
	W_salt	-0.01	0.03	-0.06	0.04	1.00	52721	32448	0.698	0.604	0.015					
K:N		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5
	Intercept	-0.01	0.13	-0.27	0.24	1.00	13966	19981	0.545	0.911	0.022	R^2c	0.31	0.03	0.26	0.36
	GST	-0.01	0.03	-0.06	0.04	1.00	38459	31951	0.678	0.644	0.014	R^2m	0.03	0.01	0.02	0.06
	GSP	0.05	0.02	0.01	0.10	1.00	40003	33082	0.985	0.029	0.13					
	S_K:N	0.05	0.02	0.02	0.08	1.00	58142	32245	0.999	0.002	0.864					
	W_K:N	0.00	0.01	-0.03	0.03	1.00	62071	32191	0.510	0.979	7.00E-03					
	S_pH	-0.02	0.02	-0.05	0.01	1.00	59761	32206	0.892	0.217	0.017					
	S_EC	0.00	0.01	-0.03	0.03	1.00	61313	31499	0.575	0.851	0.008					
	W_pH	-0.02	0.01	-0.05	0.01	1.00	60403	33674	0.906	0.188	0.017					
	W_salt	-0.05	0.02	-0.08	-0.01	1.00	52333	33006	0.998	0.005	0.449					
K:Na		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5
	Intercept	1.31	0.32	0.68	1.94	1.00	8410	15141	1.000	0.000	58.63	R^2c	0.33	0.05	0.25	0.43
	GST	-0.20	0.04	-0.27	-0.12	1.00	36994	32026	1.000	0.000	570.49	R^2m	0.11	0.07	0.03	0.28

	GSP	-0.02	0.04	-0.10	0.06	1.00	35411	32418	0.701	0.599	0.023					
	S_K:Na	0.28	0.03	0.23	0.33	1.00	53840	33027	1.000	0.000	7.69E+09					
	W_K:Na	0.05	0.02	0.01	0.10	1.00	53519	32604	0.988	0.024	0.157					
	S_pH	-0.03	0.03	-0.08	0.02	1.00	49332	31818	0.910	0.181	0.031					
	S_EC	-0.08	0.02	-0.13	-0.03	1.00	55436	30121	1.000	0.001	2.19					
	W_pH	-0.07	0.02	-0.11	-0.02	1.00	50616	33097	0.996	0.007	0.431					
	W_salt	-0.27	0.03	-0.32	-0.21	1.00	47697	33098	1.000	0.000	1.10E+09					
K:S		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5
	Intercept	1.52	0.18	1.16	1.88	1.00	9629	15985	1.000	0.000	7.82E+05	R ² c	0.52	0.02	0.48	0.56
	GST	-0.18	0.03	-0.23	-0.13	1.00	33146	30931	1.000	0.000	1.37E+05	R ² m	0.34	0.07	0.21	0.47
	GSP	0.01	0.03	-0.04	0.06	1.00	31915	30057	0.641	0.717	0.013					
	S_K:S	0.16	0.02	0.12	0.20	1.00	36502	31533	1.000	0.000	4.98E+08					
	W_K:S	-0.02	0.02	-0.05	0.01	1.00	49531	32758	0.852	0.295	0.013					
	S_pH	-0.05	0.02	-0.09	-0.02	1.00	46507	32787	1.000	0.001	1.96					
	S_EC	0.00	0.02	-0.03	0.04	1.00	43896	32029	0.534	0.931	0.009					
	W_pH	-0.05	0.02	-0.08	-0.02	1.00	46840	32999	0.999	0.003	0.826					
	W_salt	-0.16	0.02	-0.20	-0.13	1.00	46009	32438	1.000	0.000	8.11E+07					
K:Mg		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5
	Intercept	1.54	0.15	1.24	1.83	1.00	21979	24370	1.000	0.000	4.96E+07	R ² c	0.48	0.02	0.43	0.52
	GST	-0.30	0.04	-0.37	-0.23	1.00	43478	32722	1.000	0.000	4.64E+06	R ² m	0.25	0.05	0.15	0.37
	GSP	-0.07	0.04	-0.14	0.00	1.00	42615	30580	0.981	0.037	0.151					
	S_K:Mg	0.13	0.02	0.09	0.18	1.00	69945	31847	1.000	0.000	806.66					
	W_K:Mg	-0.02	0.02	-0.06	0.03	1.00	71460	29872	0.769	0.462	0.013					
	S_pH	-0.05	0.02	-0.09	0.00	1.00	56954	33319	0.971	0.057	0.072					
	S_EC	-0.04	0.02	-0.09	0.00	1.00	64484	31210	0.979	0.042	0.09					
	W_pH	-0.18	0.02	-0.23	-0.14	1.00	59962	30316	1.000	0.000	3.36E+08					
	W_salt	-0.17	0.02	-0.22	-0.13	1.00	64341	33131	1.000	0.000	2.76E+06					
K:P		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5

	Intercept	2.21	0.12	1.95	2.45	1.00	15428	19875	1.000	0.000	1.33E+41	R^2c	0.25	0.02	0.21	0.30
	GST	0.06	0.03	0.01	0.11	1.00	42604	33823	0.988	0.024	0.175	R^2m	0.06	0.02	0.03	0.11
	GSP	0.02	0.02	-0.03	0.07	1.00	41989	33080	0.777	0.446	0.017					
	S_K:P	0.13	0.01	0.10	0.16	1.00	71162	31810	1.000	0.000	4.78E+06					
	W_K:P	0.00	0.02	-0.03	0.03	1.00	67599	31031	0.503	0.995	0.008					
	S_pH	0.02	0.02	-0.01	0.05	1.00	61238	33098	0.870	0.259	0.015					
	S_EC	0.01	0.02	-0.02	0.04	1.00	65874	31240	0.778	0.444	0.01					
	W_pH	-0.06	0.02	-0.09	-0.02	1.00	60105	32131	1.000	0.001	2.88					
	W_salt	-0.06	0.02	-0.09	-0.03	1.00	57329	31991	1.000	0.001	3.18					
N:Na		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5
	Intercept	1.33	0.35	0.63	2.03	1.00	11214	17660	1.000	0.001	28.73	R^2c	0.33	0.05	0.24	0.43
	GST	-0.12	0.04	-0.20	-0.04	1.00	48779	32953	0.998	0.004	1.59	R^2m	0.02	0.02	0.00	0.07
	GSP	0.03	0.04	-0.05	0.10	1.00	48885	33246	0.761	0.478	0.024					
	S_N:Na	0.16	0.03	0.10	0.21	1.00	62453	32657	1.000	0.000	8.41E+03					
	W_N:Na	0.07	0.02	0.03	0.12	1.00	68526	30936	0.999	0.002	1.22					
	S_pH	0.01	0.03	-0.04	0.06	1.00	60792	31495	0.639	0.722	0.014					
	S_EC	-0.09	0.02	-0.14	-0.04	1.00	62832	33447	1.000	0.000	9.47					
	W_pH	-0.05	0.02	-0.10	0.00	1.00	63276	32225	0.974	0.052	0.083					
	W_salt	-0.23	0.03	-0.29	-0.18	1.00	61432	33468	1.000	0.000	6.68E+06					
N:S		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5
	Intercept	1.47	0.08	1.34	1.65	1.00	14344	18233	1.000	0.000	1.10E+15	R^2c	0.50	0.02	0.46	0.54
	GST	-0.14	0.02	-0.18	-0.10	1.00	41429	32286	1.000	0.000	1.02E+04	R^2m	0.34	0.04	0.27	0.42
	GSP	-0.02	0.02	-0.06	0.02	1.00	40707	32828	0.812	0.376	0.015					
	S_N:S	0.10	0.02	0.07	0.14	1.00	58053	32006	1.000	0.000	3.17E+05					
	W_N:S	0.03	0.01	0.01	0.05	1.00	71473	29898	0.995	0.009	0.174					
	S_pH	0.00	0.01	-0.03	0.02	1.00	61597	32479	0.627	0.747	0.007					
	S_EC	-0.03	0.01	-0.06	0.00	1.00	54386	33734	0.988	0.025	0.081					
	W_pH	-0.04	0.01	-0.06	-0.01	1.00	63102	32453	0.998	0.005	0.33					

	W_salt	-0.12	0.01	-0.15	-0.10	1.00	61775	33141	1.000	0.000	1.70E+07					
N:Mg		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5
	Intercept	1.55	0.10	1.35	1.74	1.00	27674	25323	1.000	0.000	1.02E+11	R ² c	0.41	0.02	0.37	0.45
	GST	-0.29	0.03	-0.36	-0.22	1.00	44642	32543	1.000	0.000	7.14E+07	R ² m	0.21	0.04	0.14	0.28
	GSP	-0.09	0.03	-0.16	-0.03	1.00	47942	33332	0.998	0.003	1.4					
	S_N:Mg	0.04	0.03	-0.01	0.09	1.00	50057	32083	0.945	0.111	0.045					
	W_N:Mg	0.01	0.02	-0.03	0.04	1.00	68750	30860	0.626	0.749	0.01					
	S_pH	-0.06	0.02	-0.11	-0.02	1.00	56206	32911	0.996	0.008	0.397					
	S_EC	-0.05	0.02	-0.09	-0.01	1.00	65997	32543	0.990	0.019	0.153					
	W_pH	-0.16	0.02	-0.20	-0.12	1.00	68382	32774	1.000	0.000	4.44E+05					
	W_salt	-0.13	0.02	-0.17	-0.09	1.00	70911	31858	1.000	0.000	3.35E+03					
N:P		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5
	Intercept	2.20	0.09	2.03	2.38	1.00	16327	20566	1.000	0.000	3.91E+24	R ² c	0.24	0.02	0.20	0.29
	GST	0.07	0.02	0.03	0.12	1.00	38681	32753	0.999	0.003	1.29	R ² m	0.05	0.01	0.02	0.06
	GSP	-0.02	0.02	-0.06	0.02	1.00	40401	32987	0.812	0.376	0.015					
	S_N:P	0.04	0.01	0.01	0.07	1.00	50292	33864	0.994	0.012	0.184					
	W_N:P	-0.02	0.01	-0.04	0.01	1.00	70217	31771	0.900	0.200	0.014					
	S_pH	0.04	0.01	0.01	0.07	1.00	61695	32503	0.997	0.006	0.338					
	S_EC	0.01	0.01	-0.01	0.04	1.00	63486	31166	0.828	0.344	0.01					
	W_pH	-0.04	0.01	-0.07	-0.02	1.00	63827	32861	0.999	0.002	0.955					
	W_salt	0.00	0.01	-0.03	0.03	1.00	63295	32728	0.514	0.971	0.007					
Na:S		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5
	Intercept	0.21	0.29	-0.36	0.79	1.00	12510	18789	0.779	0.441	0.071	R ² c	0.47	0.03	0.41	0.53
	GST	0.01	0.04	-0.07	0.08	1.00	42193	31717	0.601	0.798	0.02	R ² m	0.21	0.09	0.07	0.41
	GSP	-0.04	0.04	-0.11	0.03	1.00	42392	30331	0.877	0.247	0.035					
	S_Na:S	0.11	0.03	0.06	0.16	1.00	53893	32170	1.000	0.000	84.46					
	W_Na:S	0.15	0.02	0.10	0.19	1.00	65173	29790	1.000	0.000	2.98E+05					
	S_pH	-0.01	0.02	-0.05	0.04	1.00	56545	33244	0.584	0.832	0.013					

	S_EC	0.08	0.03	0.02	0.13	1.00	50009	30484	0.998	0.004	0.915						
	W_pH	0.03	0.02	-0.02	0.08	1.00	59753	31301	0.901	0.199	0.026						
	W_salt	0.11	0.03	0.06	0.16	1.00	55924	32084	1.000	0.000	50.64						
Na:Mg		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5	
	Intercept	0.22	0.20	-0.19	0.61	1.00	18796	19483	0.878	0.244	0.083		R ² c	0.45	0.03	0.40	0.50
	GST	-0.12	0.04	-0.19	-0.05	1.00	41367	32404	1.000	0.001	6.16		R ² m	0.11	0.04	0.04	0.21
	GSP	-0.10	0.03	-0.17	-0.04	1.00	40120	32307	0.999	0.002	2.42						
	S_Na:Mg	0.16	0.02	0.12	0.20	1.00	59227	30678	1.000	0.000	2.70E+05						
	W_Na:Mg	0.01	0.02	-0.03	0.05	1.00	62898	32482	0.751	0.498	0.012						
	S_pH	0.01	0.02	-0.04	0.05	1.00	52155	32762	0.665	0.669	0.012						
	S_EC	0.05	0.02	0.00	0.09	1.00	55902	32166	0.984	0.032	0.104						
	W_pH	-0.12	0.02	-0.16	-0.07	1.00	55420	33115	1.000	0.000	547.49						
	W_salt	0.10	0.02	0.05	0.14	1.00	55581	32446	1.000	0.000	69.69						
Na:P		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5	
	Intercept	0.87	0.34	0.20	1.54	1.00	12894	17792	0.993	0.014	1.72		R ² c	0.56	0.02	0.52	0.60
	GST	0.24	0.04	0.15	0.32	1.00	45291	31721	1.000	0.000	3.02E+03		R ² m	0.35	0.10	0.13	0.51
	GSP	0.03	0.04	-0.05	0.11	1.00	43681	31984	0.760	0.480	0.026						
	S_Na:P	0.28	0.03	0.23	0.34	1.00	65117	31066	1.000	0.000	4.85E+10						
	W_Na:P	0.06	0.03	0.01	0.11	1.00	62450	33042	0.988	0.024	0.182						
	S_pH	0.07	0.03	0.02	0.12	1.00	62888	31229	0.995	0.010	0.387						
	S_EC	0.11	0.02	0.06	0.16	1.00	60313	33256	1.000	0.000	37.86						
	W_pH	0.01	0.03	-0.04	0.06	1.00	60062	33139	0.669	0.663	0.014						
	W_salt	0.14	0.03	0.08	0.20	1.00	51011	30838	1.000	0.000	54.05						
S:Mg		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF		Estimate	Est.Error	Q2.5	Q97.5	
	Intercept	0.04	0.12	-0.20	0.27	1.00	23954	24478	0.667	0.665	0.023		R ² c	0.32	0.02	0.27	0.36
	GST	-0.13	0.03	-0.19	-0.08	1.00	52190	33981	1.000	0.000	229.34		R ² m	0.05	0.02	0.03	0.09
	GSP	-0.10	0.03	-0.15	-0.04	1.00	50929	32630	1.000	0.000	5						
	S_S:Mg	-0.04	0.02	-0.07	0.00	1.00	60907	33823	0.963	0.074	0.048						

	W_S:Mg	0.07	0.02	0.04	0.11	1.00	83560	30800	1.000	0.000	49.17					
	S_pH	-0.08	0.02	-0.11	-0.04	1.00	72734	33621	1.000	0.000	13.16					
	S_EC	0.02	0.02	-0.02	0.06	1.00	58057	32581	0.820	0.359	0.015					
	W_pH	-0.13	0.02	-0.17	-0.10	1.00	73813	32937	1.000	0.000	1.30E+05					
	W_salt	0.00	0.02	-0.04	0.03	1.00	78850	31815	0.547	0.906	0.009					
S:P		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF	Estimate	Est.Error	Q2.5	Q97.5	
	Intercept	0.69	0.13	0.42	0.94	1.00	18139	20671	1.000	0.000	208.03	R ² c	0.40	0.03	0.35	0.45
	GST	0.24	0.03	0.18	0.29	1.00	42678	32297	1.000	0.000	1.74E+07	R ² m	0.22	0.06	0.12	0.37
	GSP	-0.01	0.03	-0.07	0.04	1.00	43784	33454	0.712	0.575	0.016					
	S_S:P	0.09	0.02	0.05	0.13	1.00	56738	32136	1.000	0.000	171.45					
	W_S:P	0.03	0.02	-0.01	0.06	1.00	58906	32712	0.932	0.137	0.027					
	S_pH	0.05	0.02	0.02	0.09	1.00	63744	33600	0.999	0.002	1					
	S_EC	0.05	0.02	0.01	0.08	1.00	57412	33027	0.992	0.015	0.194					
	W_pH	0.00	0.02	-0.04	0.03	1.00	65385	32380	0.568	0.863	8.00E-03					
	W_salt	0.10	0.02	0.06	0.14	1.00	56220	33229	1.000	0.000	255.84					
Mg:P		Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	PD	p_val	BF	Estimate	Est.Error	Q2.5	Q97.5	
	Intercept	0.66	0.09	0.48	0.85	1.00	22267	24497	1.000	0.000	379.62	R ² c	0.47	0.02	0.42	0.51
	GST	0.35	0.04	0.28	0.42	1.00	37523	30477	1.000	0.000	1.25E+10	R ² m	0.26	0.05	0.18	0.37
	GSP	0.10	0.03	0.03	0.17	1.00	40206	32614	0.998	0.003	1.15					
	S_Mg:P	0.18	0.02	0.14	0.22	1.00	60883	31716	1.000	0.000	4.47E+06					
	W_Mg:P	0.08	0.02	0.03	0.12	1.00	59663	29495	1.000	0.000	5.82					
	S_pH	0.06	0.02	0.02	0.11	1.00	55872	32891	0.996	0.007	0.425					
	S_EC	0.07	0.02	0.03	0.11	1.00	60345	29724	0.999	0.002	1.41					
	W_pH	0.11	0.02	0.07	0.16	1.00	53895	32999	1.000	0.000	1.47E+03					
	W_salt	0.07	0.02	0.03	0.12	1.00	52660	32614	0.999	0.002	1.2					

415 R^2_c = Percentage of variance explained by all the model (fixed + random), R^2_m = Percentage of variance explained by fixed factors, probability of direction (PD),
416 p-value (pval), Bayes factor (BF).

417 **Table S8. Results of partial least squares path modeling (PLS-PM) for macroelement and microelements, respectively.** In the PLS-PM, the observation
418 variables were classified as four latent variables - latitude, longitude and altitude into geography, GST and GSP into climate, sediment pH, electrical conductivity
419 (EC) and nutrient concentrations into sediment properties, and water pH, salinity and nutrient concentrations into water properties. Goodness of fit index (GoF),
420 R^2 , path coefficients (standardized direct effects) and standardized indirect effects were used to estimate model performance and compare the effects of different
421 latent variables on the patterns of elements.

A. PLS-PM for macroelements								
1. Summary inner model								
	Type	R^2		Block Communality	Mean Redundancy	AVE		
Geography	Exogenous	0.000		0.674	0.000	0.674		
Climate	Endogenous	0.803		0.881	0.707	0.881		
Sediment properties	Endogenous	0.274		0.254	0.069	0.254		
Water properties	Endogenous	0.280		0.698	0.195	0.698		
Macroelements	Endogenous	0.455		0.356	0.162	0.356		
2. Goodness of fit	0.472							
3. Correlations between latent variables								
	Geography	Climate		Sediment properties	Water properties	Macroelements		
Geography	1.000	-0.896		-0.406	-0.170	-0.389		
Climate	-0.896	1.000		0.510	0.275	0.468		
Sediment properties	-0.406	0.510		1.000	0.516	0.554		
Water properties	-0.170	0.275		0.516	1.000	0.562		
Macroelements	-0.389	0.468		0.554	0.562	1.000		
4. Standardized effects								
Relationships			Direct	SE	P	Indirect	Total	
Geography	→	Climate	-0.896	0.014	<0.001	0.000	-0.896	
Geography	→	Sediment properties	0.260	0.059	<0.001	-0.666	-0.406	
Geography	→	Water properties	0.264	0.060	<0.001	-0.434	-0.170	
Geography	→	Macroelements				-0.378	-0.378	
Climate	→	Sediment properties	0.743	0.059	<0.001	0.000	0.743	

Climate	→	Water properties	0.263	0.063	<0.001	0.363	0.626
Climate	→	Macroelements	0.244	0.026	<0.001	0.410	0.654
Sediment properties	→	Water properties	0.489	0.031	<0.001	0.000	0.489
Sediment properties	→	Macroelements	0.237	0.030	<0.001	0.182	0.419
Water properties	→	Macroelements	0.373	0.027	<0.001	0.000	0.373
5. Outer model							
	Weight	Loading	Communality	Redundancy			
\$Geography							
Latitude	0.444	0.950	0.903	0.000			
Longitude	0.195	0.452	0.204	0.000			
Altitude	0.512	0.957	0.916	0.000			
\$Climate							
GST	0.504	0.932	0.868	0.697			
GSP	0.561	0.945	0.893	0.718			
\$Sediment properties							
Sediment P	0.236	0.526	0.276	0.076			
Sediment S	0.234	0.481	0.232	0.063			
Sediment K	0.272	0.503	0.253	0.069			
Sediment Ca	0.246	0.625	0.391	0.107			
Sediment Mg	0.214	0.398	0.159	0.043			
Sediment Na	0.326	0.456	0.208	0.057			
Sediment pH	0.247	0.508	0.258	0.071			
Sediment EC	0.227	0.502	0.252	0.069			
\$Water properties							
Water S	0.190	0.896	0.803	0.225			
Water K	0.190	0.760	0.578	0.162			
Water Ca	0.194	0.738	0.544	0.152			
Water Mg	0.230	0.810	0.655	0.183			
Water Na	0.197	0.844	0.712	0.199			
Water salinity	0.201	0.948	0.898	0.251			
\$Macroelements							

P	0.251	0.334	0.112	0.051			
S	0.464	0.776	0.603	0.275			
K	0.208	0.328	0.108	0.049			
Mg	0.343	0.719	0.517	0.236			
Na	0.362	0.664	0.441	0.201			
B. PLS-PM for microelements							
1. Summary inner model							
	Type	R ²	Block Communality	Mean Redundancy	AVE		
Geography	Exogenous	0.000	0.668	0.000	0.668		
Climate	Endogenous	0.782	0.880	0.689	0.880		
Sediment properties	Endogenous	0.184	0.302	0.056	0.302		
Water properties	Endogenous	0.363	0.417	0.151	0.417		
Microelements	Endogenous	0.332	0.409	0.136	0.409		
2. Goodness of fit	0.430						
3. Correlations between latent variables							
	Geography	Climate	Sediment properties	Water properties	Microelements		
Geography	1.000	0.884	0.422	0.242	0.219		
Climate	0.884	1.000	0.337	0.209	0.180		
Sediment properties	0.422	0.337	1.000	0.601	0.524		
Water properties	0.242	0.209	0.601	1.000	0.507		
Microelements	0.219	0.180	0.524	0.507	1.000		
4. Standardized effects							
Relationships			Direct	SE	P	Indirect	Total
Geography	→	Climate	0.884	0.014	<0.001	0.000	0.884
Geography	→	Sediment properties	0.566	0.060	<0.001	-0.144	0.422
Geography	→	Water properties	-0.085	0.055	0.120	0.327	0.242
Geography	→	Microelements				0.219	0.219
Climate	→	Sediment properties	-0.163	0.060	<0.01	0.006	-0.163
Climate	→	Water properties	0.078	0.053	0.138	-0.010	-0.021
Climate	→	Microelements	0.002	0.027	0.941	-0.062	-0.060

Sediment properties	→	Water properties	0.611	0.027	<0.001	0.000	0.611
Sediment properties	→	Microelements	0.343	0.033	<0.001	0.184	0.526
Water properties	→	Microelements	0.301	0.032	<0.001	0.000	0.301
5. Outer model							
	Weight	Loading	Communality	Redundancy			
\$Geography							
Latitude	0.488	0.965	0.932	0.000			
Longitude	0.104	0.372	0.138	0.000			
Altitude	0.507	0.967	0.935	0.000			
\$Climate							
GST	0.499	0.930	0.866	0.677			
GSP	0.566	0.946	0.895	0.700			
\$Sediment properties							
Sediment Fe	0.312	0.637	0.406	0.077			
Sediment Al	0.244	0.489	0.239	0.044			
Sediment Si	0.165	0.222	0.049	0.009			
Sediment B	0.211	0.445	0.198	0.036			
Sediment Zn	0.153	0.323	0.104	0.019			
Sediment Cu	0.239	0.608	0.370	0.068			
Sediment Ni	0.250	0.674	0.454	0.083			
Sediment Co	0.244	0.774	0.599	0.110			
\$Water properties							
Water Fe	0.280	0.638	0.407	0.148			
Water Al	0.197	0.693	0.480	0.174			
Water Zn	0.224	0.398	0.158	0.057			
Water Cu	0.357	0.733	0.537	0.195			
Water Ni	0.281	0.683	0.467	0.169			
Water Co	0.210	0.673	0.453	0.164			
\$Microelements							
Fe	0.238	0.763	0.582	0.193			
Al	0.257	0.827	0.684	0.227			

Mn	0.029	0.308	0.095	0.032
Si	0.208	0.406	0.165	0.055
Cu	0.198	0.534	0.286	0.095
Ni	0.226	0.720	0.519	0.173
Co	0.334	0.731	0.535	0.178