

# Supplementary Information for “Temperature mediates insect herbivore impact on element cycling in broadleaved forests” (Hwang et al. 2024)

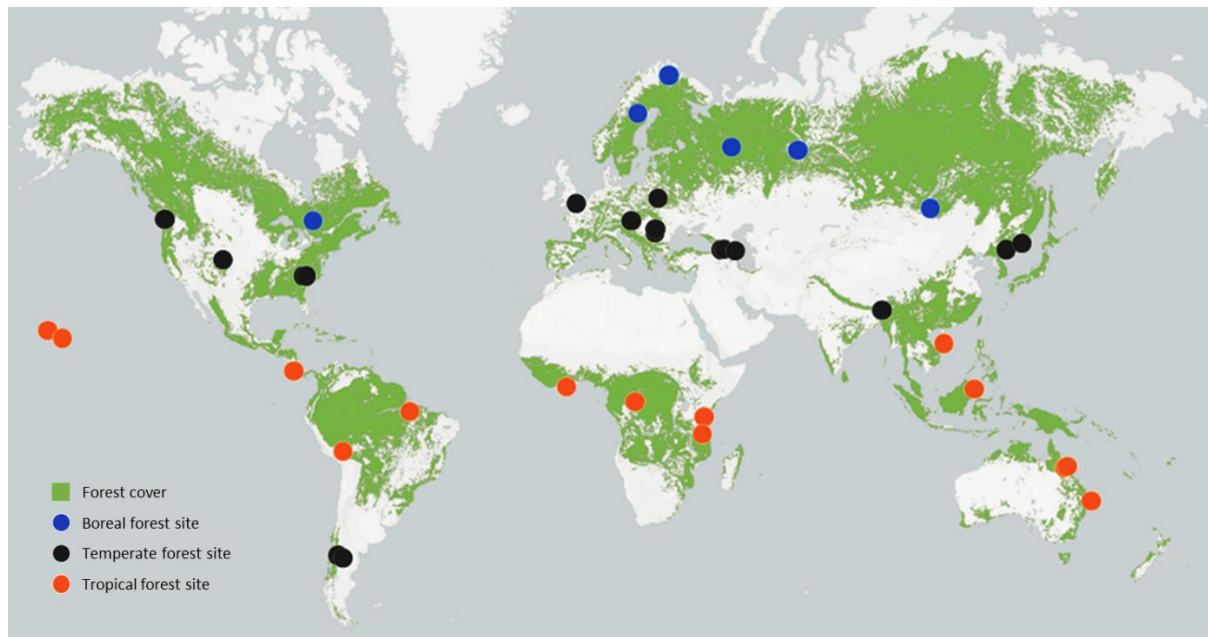
## Supplementary Table 1. Acronyms and equations

Acronyms (Fig. 1) and equations used for herbivory-related calculations are patterned after Metcalfe et al<sup>1</sup>.

| Description                                                                                                                   | Acronym  | Unit                            | Equation                                              |
|-------------------------------------------------------------------------------------------------------------------------------|----------|---------------------------------|-------------------------------------------------------|
| Element C, N, P, or Si                                                                                                        | E        | NA                              | NA                                                    |
| Green leaf concentration of E                                                                                                 | $F_E$    | proportion                      | NA                                                    |
| Leaf litter concentration of E                                                                                                | $B_E$    | proportion                      | NA                                                    |
| Foliar production                                                                                                             | FP       | $\text{g m}^{-2} \text{y}^{-1}$ | $L_H / (1 - H)$                                       |
| Herbivory as proportion of leaf litter area removed (folivory)                                                                | H        | proportion                      | NA                                                    |
| E consumed by insect folivores (gross input of E by insect folivores)                                                         | $H_c E$  | $\text{g m}^{-2} \text{y}^{-1}$ | $FP \times F_E \times H$                              |
| Additional E input from insect folivores due to green leaf consumption before resorption (net input of E by insect folivores) | $H_i E$  | $\text{g m}^{-2} \text{y}^{-1}$ | $L_{EH} + H_c - L_E$                                  |
| Foliar input of E to soil without H (litter-mediated input of E)                                                              | $L_E$    | $\text{g m}^{-2} \text{y}^{-1}$ | $(FP \times F_E) \times (1 - RE_E)$                   |
| Foliar input of E to soil with H                                                                                              | $L_{EH}$ | $\text{g m}^{-2} \text{y}^{-1}$ | $L_H \times L_E \times (1 - RE_E)$                    |
| Annual broadleaved litterfall with H                                                                                          | $L_H$    | $\text{g m}^{-2} \text{y}^{-1}$ | Total annual dry weight of leaf litter / area of trap |
| Global mass correction factor due to leaf senescence (Vergutz et al., 2012)                                                   | Q        | proportion                      | NA                                                    |
| Resorption of E                                                                                                               | $RE_E$   | proportion                      | $1 - (L_E / F_E \times Q)$                            |
| Soil concentration of E                                                                                                       | $S_E$    | proportion                      | NA                                                    |

### Supplementary Fig. 1. Site distribution

Green shading represents forest cover<sup>2</sup>. Circles indicate locations of mature, undisturbed broadleaved boreal (blue), temperate (black), and tropical (orange) forest stands included in this study. Altogether, the network was comprised of 74 forest plots in 40 sites. Base map adapted from Google Maps.



## Supplementary Table 2. Global means, minimums, and maximums across broadleaved forest plots

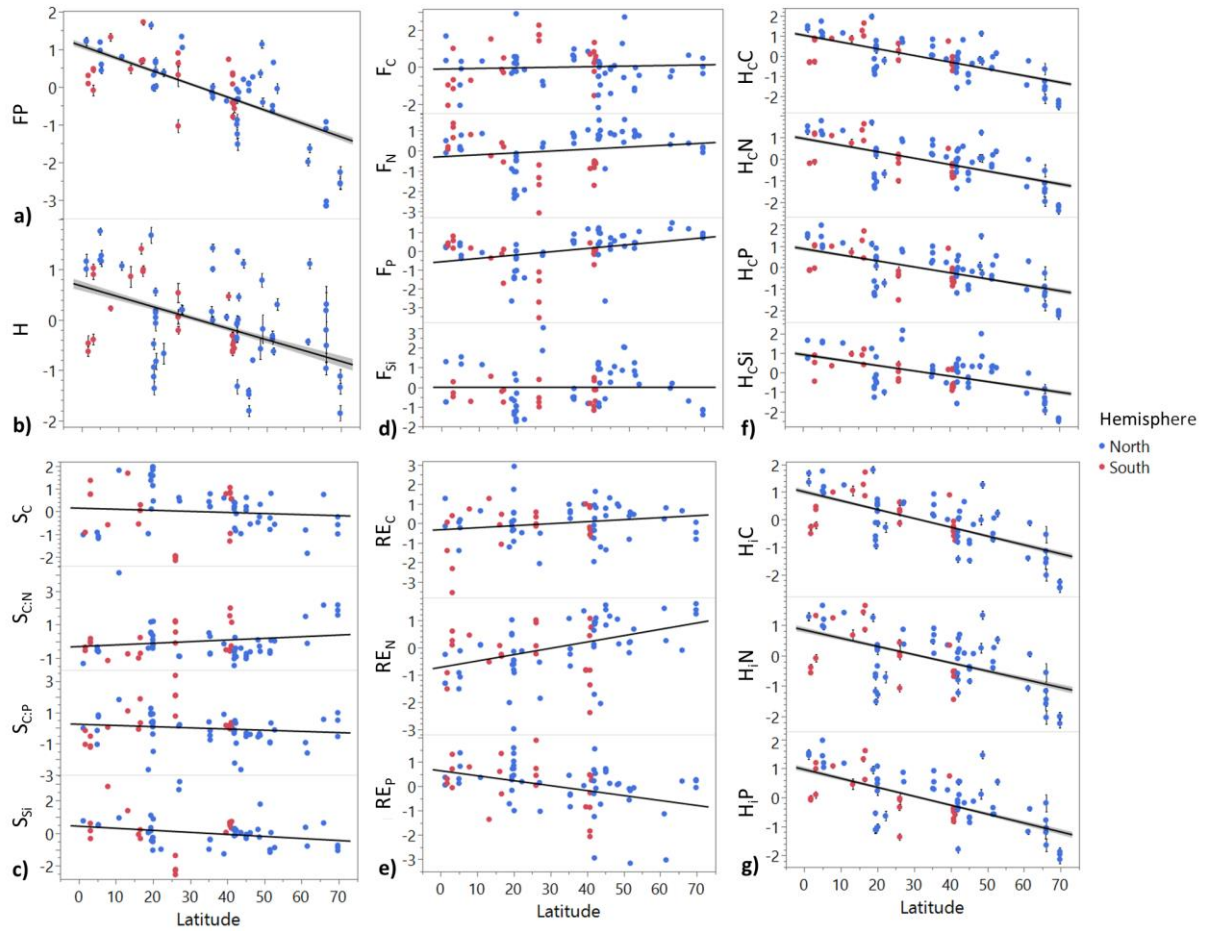
Global means, minimums, and maximums of ecological characteristics across all plots and gradients with standard error (74 plots, 9-25 litter traps per plot). Source data are provided as a Source Data file.

| Variable                                   | Unit                              | Mean            | Minimum         | Maximum       |
|--------------------------------------------|-----------------------------------|-----------------|-----------------|---------------|
| Mean annual temperature (MAT)              | °C                                | 12.0            | -1.4            | 26.9          |
| Mean annual precipitation (MAP)            | mm                                | 1792.1          | 434             | 5500          |
| Potential evapotranspiration (PET)         | mm                                | 974.5           | 246.4           | 1648.9        |
| Water stress ratio (PET/MAP)               | ratio                             | 0.6             | 0.2             | 1.3           |
| Latitude                                   | decimal degrees                   | 17.6            | -41.2           | 69.8          |
| Absolute latitude                          | decimal degrees                   | 31.5            | 1.2             | 69.8          |
| Elevation                                  | m                                 | 844.8           | 7               | 2981          |
| Foliar production (FP)                     | g m <sup>-2</sup> y <sup>-1</sup> | 381.1 ± 6.6     | 43.5 ± 3.9      | 1174.0 ± 64.8 |
| Foliar herbivory (H)                       | % leaf area removed               | 4.12 ± 0.97     | 0.63 ± 0.08     | 13.58 ± 0.77  |
| Solar radiation (SR)                       | MWh m <sup>-2</sup>               | 1.30 ± 0.04     | 0.73            | 1.98          |
| Soil C (S <sub>C</sub> )                   | % dry weight                      | 8.2 ± 0.8       | 0.8             | 27.2          |
| Soil N (S <sub>N</sub> )                   | % dry weight                      | 0.49 ± 0.05     | 0.04            | 1.81          |
| Soil P (S <sub>P</sub> )                   | % dry weight                      | 0.0771 ± 0.0076 | 0.0004          | 0.2785        |
| Soil Si (S <sub>Si</sub> )                 | % dry weight                      | 2.6 ± 0.5       | 0.1             | 24.7          |
| Green leaf C (F <sub>C</sub> )             | % dry weight                      | 47.8 ± 0.3      | 42.6            | 55.7          |
| Green leaf N (F <sub>N</sub> )             | % dry weight                      | 1.91 ± 0.06     | 0.6             | 3.1           |
| Green leaf P (F <sub>P</sub> )             | % dry weight                      | 0.13 ± 0.01     | 0.02            | 0.24          |
| Green leaf Si (F <sub>Si</sub> )           | % dry weight                      | 0.7 ± 0.1       | 0.1             | 7.5           |
| Litter C (B <sub>C</sub> )                 | % dry weight                      | 49.1 ± 0.3      | 41.7            | 55.4          |
| Litter N (B <sub>N</sub> )                 | % dry weight                      | 1.14 ± 0.04     | 0.41            | 2.03          |
| Litter P (B <sub>P</sub> )                 | % dry weight                      | 0.067 ± 0.005   | 0.009           | 0.233         |
| Litter Si (B <sub>Si</sub> )               | % dry weight                      | 1.1 ± 0.1       | 0.1             | 4.6           |
| C resorption efficiency (RE <sub>C</sub> ) | %                                 | 19.7 ± 0.4      | 9.3             | 32.5          |
| N resorption efficiency (RE <sub>N</sub> ) | %                                 | 51.5 ± 1.6      | 15.7            | 72.9          |
| P resorption efficiency (RE <sub>P</sub> ) | %                                 | 61.5 ± 1.4      | 22.9            | 81.7          |
| Litter flux of C (L <sub>C</sub> )         | g m <sup>-2</sup> y <sup>-1</sup> | 179.3 ± 3.05    | 21.7            | 555.9         |
| Litter flux of N (L <sub>N</sub> )         | g m <sup>-2</sup> y <sup>-1</sup> | 4.4 ± 0.1       | 0.3             | 14.6          |
| Litter flux of P (L <sub>P</sub> )         | g m <sup>-2</sup> y <sup>-1</sup> | 0.215 ± 0.04    | 0.01            | 0.73          |
| Litter flux of Si (L <sub>Si</sub> )       | g m <sup>-2</sup> y <sup>-1</sup> | 4.92 ± 0.21     | 0.06            | 38.31         |
| H <sub>c</sub> of C (H <sub>cC</sub> )     | g m <sup>-2</sup> y <sup>-1</sup> | 9.1 ± 0.4       | 0.2 ± 0.1       | 71.7 ± 44.2   |
| H <sub>c</sub> of N (H <sub>cN</sub> )     | g m <sup>-2</sup> y <sup>-1</sup> | 0.36 ± 0.01     | 0.0071 ± 0.0001 | 2.0 ± 1.2     |
| H <sub>c</sub> of P (H <sub>cP</sub> )     | g m <sup>-2</sup> y <sup>-1</sup> | 0.022 ± 0.001   | 0.0007 ± 0.0001 | 0.15 ± 0.01   |
| H <sub>c</sub> of Si (H <sub>cSi</sub> )   | g m <sup>-2</sup> y <sup>-1</sup> | 0.15 ± 0.01     | 0.0005 ± 0.0001 | 1.9 ± 0.2     |
| H <sub>i</sub> of C (H <sub>iC</sub> )     | g m <sup>-2</sup> y <sup>-1</sup> | 1.7 ± 0.1       | 0.03 ± 0.01     | 10.9 ± 0.5    |
| H <sub>i</sub> of N (H <sub>iN</sub> )     | g m <sup>-2</sup> y <sup>-1</sup> | 0.17 ± 0.02     | 0.005 ± 0.001   | 0.8 ± 0.1     |
| H <sub>i</sub> of P (H <sub>iP</sub> )     | g m <sup>-2</sup> y <sup>-1</sup> | 0.014 ± 0.001   | 0.0004 ± 0.0001 | 0.10 ± 0.01   |

**Supplementary Table 3. Ecological characteristics of broadleaved forests across latitude zones.** Means of ecological characteristics across tropical (33), temperate (32) and boreal (9) forests with standard errors. Different letters following means indicate significant differences based on two-sided Kruskal-Wallis and Dunn-Bonferroni post-hoc tests (95% CI). Source data are provided as a Source Data file.

| Variable                                        | Units                             | Tropical                      | Temperate                     | Boreal                      | $\chi^2$ | DF | P       |
|-------------------------------------------------|-----------------------------------|-------------------------------|-------------------------------|-----------------------------|----------|----|---------|
| Mean annual temperature (MAT)                   | °C                                | 19.47 ± 0.51 <sup>a</sup>     | 7.76 ± 0.51 <sup>b</sup>      | -0.28 ± 0.33 <sup>c</sup>   | 58.02    | 2  | < 0.001 |
| Mean annual precipitation (MAP)                 | mm                                | 2426.91 ± 129.75 <sup>a</sup> | 1388.81 ± 129.75 <sup>b</sup> | 559.44 ± 45.31 <sup>c</sup> | 34.77    | 2  | < 0.001 |
| Potential evapotranspiration (PET)              | mm                                | 1317.09 ± 17.78 <sup>a</sup>  | 775.85 ± 17.78 <sup>b</sup>   | 424.76 ± 51.32 <sup>c</sup> | 59.89    | 2  | < 0.001 |
| Dryness or climate ratio                        | ratio                             | 0.63 ± 0.05                   | 0.66 ± 0.05                   | 0.59 ± 0.05                 | 0.28     | 2  | 0.869   |
| Foliar biomass production (FP)                  | g m <sup>-2</sup> y <sup>-1</sup> | 513.0 ± 10.2 <sup>a</sup>     | 321.6 ± 7.3 <sup>b</sup>      | 231.9 ± 17.5 <sup>c</sup>   | 32.05    | 2  | < 0.001 |
| Foliar herbivory (H)                            | % leaf area                       | 5.4 ± 0.2 <sup>a</sup>        | 3.3 ± 0.1 <sup>b</sup>        | 2.4 ± 0.2 <sup>b</sup>      | 8.49     | 2  | 0.014   |
| Soil C                                          | % dry weight                      | 10.33 ± 0.56                  | 7.31 ± 0.56                   | 4.05 ± 0.92                 | 3.86     | 2  | 0.145   |
| Soil C : N                                      | ratio                             | 17.74 ± 0.67 <sup>ab</sup>    | 15.47 ± 0.67 <sup>b</sup>     | 22.19 ± 2.31 <sup>a</sup>   | 10.73    | 2  | 0.005   |
| Soil C : P                                      | ratio                             | 275.74 ± 8.25 <sup>a</sup>    | 107.83 ± 8.25 <sup>b</sup>    | 106.71 ± 28.1 <sup>b</sup>  | 6.12     | 2  | 0.047*  |
| Soil Si                                         | % dry weight                      | 2.47 ± 0.87                   | 3.13 ± 0.87                   | 1.24 ± 0.9                  | 3.72     | 2  | 0.155   |
| Foliar C                                        | % dry weight                      | 48.38 ± 0.41                  | 47.69 ± 0.41                  | 47.51 ± 0.66                | 1.29     | 2  | 0.525   |
| Foliar N                                        | % dry weight                      | 1.64 ± 0.09 <sup>a</sup>      | 0.021 ± 0.001 <sup>b</sup>    | 0.022 ± 0.001 <sup>b</sup>  | 11.73    | 2  | 0.003   |
| Foliar P                                        | % dry weight                      | 0.10 ± 0.01 <sup>a</sup>      | 0.14 ± 0.01 <sup>b</sup>      | 0.18 ± 0.01 <sup>c</sup>    | 26.80    | 2  | < 0.001 |
| Foliar Si                                       | % dry weight                      | 0.47 ± 0.25                   | 1.01 ± 0.25                   | 0.55 ± 0.16                 | 5.27     | 2  | 0.072   |
| Litter C                                        | % dry weight                      | 50.08 ± 0.33 <sup>a</sup>     | 48.7 ± 0.33 <sup>b</sup>      | 48.77 ± 0.58 <sup>ab</sup>  | 11.93    | 2  | 0.003   |
| Litter N                                        | % dry weight                      | 1.12 ± 0.06                   | 1.19 ± 0.06                   | 1.07 ± 0.12                 | 0.23     | 2  | 0.893   |
| Litter P                                        | % dry weight                      | 0.04 ± 0.01 <sup>a</sup>      | 0.08 ± 0.01 <sup>b</sup>      | 0.10 ± 0.02 <sup>b</sup>    | 36.18    | 2  | < 0.001 |
| Litter Si                                       | % dry weight                      | 1.00 ± 0.18 <sup>a</sup>      | 1.36 ± 0.18 <sup>b</sup>      | 0.69 ± 0.21 <sup>ac</sup>   | 6.96     | 2  | 0.031*  |
| C resorption                                    | proportion                        | 0.19 ± 0.01                   | 0.20 ± 0.01                   | 0.20 ± 0.01                 | 1.20     | 2  | 0.549   |
| N resorption                                    | proportion                        | 0.47 ± 0.03 <sup>a</sup>      | 0.53 ± 0.03 <sup>ab</sup>     | 0.62 ± 0.03 <sup>b</sup>    | 12.07    | 2  | 0.002   |
| P resorption                                    | proportion                        | 0.67 ± 0.02 <sup>a</sup>      | 0.58 ± 0.02 <sup>b</sup>      | 0.55 ± 0.05 <sup>b</sup>    | 14.05    | 2  | < 0.001 |
| Gross insect-mediated C flux                    | g m <sup>-2</sup> y <sup>-1</sup> | 15.87 ± 0.90 <sup>a</sup>     | 5.41 ± 0.90 <sup>b</sup>      | 1.65 ± 0.58 <sup>b</sup>    | 24.37    | 2  | < 0.001 |
| Gross insect-mediated N flux                    | g m <sup>-2</sup> y <sup>-1</sup> | 0.600 ± 0.038 <sup>a</sup>    | 0.231 ± 0.038 <sup>b</sup>    | 0.082 ± 0.029 <sup>b</sup>  | 14.21    | 2  | < 0.001 |
| Gross insect-mediated P flux (H <sub>c</sub> P) | g m <sup>-2</sup> y <sup>-1</sup> | 0.034 ± 0.003 <sup>a</sup>    | 0.016 ± 0.003 <sup>b</sup>    | 0.006 ± 0.002 <sup>b</sup>  | 12.17    | 2  | 0.003   |
| Gross insect-mediated Si flux                   | g m <sup>-2</sup> y <sup>-1</sup> | 0.178 ± 0.076 <sup>a</sup>    | 0.178 ± 0.76 <sup>ab</sup>    | 0.029 ± 0.012 <sup>b</sup>  | 7.04     | 2  | 0.030   |
| H <sub>c</sub> C : Litter C                     | ratio                             | 0.055 ± 0.007 <sup>a</sup>    | 0.035 ± 0.005 <sup>b</sup>    | 0.026 ± 0.009 <sup>b</sup>  | 9.62     | 2  | 0.008   |
| H <sub>c</sub> N : Litter N                     | ratio                             | 0.084 ± 0.010                 | 0.061 ± 0.009                 | 0.051 ± 0.014               | 5.68     | 2  | 0.058   |
| H <sub>c</sub> P : Litter P                     | ratio                             | 0.136 ± 0.016 <sup>a</sup>    | 0.072 ± 0.013 <sup>b</sup>    | 0.042 ± 0.008 <sup>b</sup>  | 17.68    | 2  | < 0.001 |
| H <sub>c</sub> Si : Litter Si                   | ratio                             | 0.035 ± 0.004                 | 0.031 ± 0.008                 | 0.024 ± 0.010               | 5.83     | 2  | 0.054   |

\* No significant differences between latitude zones in Dunn test after Bonferroni-Holm adjustment.



## Supplementary Fig. 2. Potential explanatory variables for insect-mediated element

**fluxes in broadleaved forests along latitude gradient.** Insect-mediated element fluxes and potential explanatory variables along a global latitudinal gradient. a) Foliar biomass production ( $FP$ ,  $g\ m^{-2}\ y^{-1}$ ), b) foliar herbivory rate ( $H$ , % leaf area removed  $y^{-1}$ ), c) soil nutrients or stoichiometry ( $S_C$ ,  $S_{C:N}$ ,  $S_{C:P}$ ,  $S_{Si}$ ; %), d) foliar concentration of element  $E$  ( $F_E$ , %), e) resorption efficiency of  $E$  ( $RE_E$ , %), f) gross insect-mediated element flux ( $H_C$ ,  $g\ m^{-2}\ y^{-1}$ ), and g) net insect-mediated element flux ( $H_i$ ,  $g\ m^{-2}\ y^{-1}$ ) plotted against absolute latitude.

Response variables were log and logit transformed as necessary and (Z) standardized before regressing. Blue circles represent forests in the Northern Hemisphere, red circles represent forests in the Southern Hemisphere. Circles for a), b), f) and g) depict means within a forest plot (74 plots), bars represent  $\pm 1$  SE (9-25 traps per plot), and lines represent best-fitted lines. Source data are provided as a Source Data file.

**Supplementary Table 4. Relative contributions of abiotic variables on insect-mediated element fluxes in broadleaved forests globally**

Mean annual temperature (MAT, °C), dryness ratio (potential evaporation/mean annual precipitation), and soil element concentration or stoichiometric ratio (C, C:N, C:P, Si) relative contributions to gross ( $H_c$ ,  $g\ m^{-2}\ y^{-1}$ ) and net ( $H_i$ ,  $g\ m^{-2}\ y^{-1}$ ) insect herbivore element fluxes. Linear mixed-effect modeling results are based on log and logit transformations of variables as appropriate, followed by z standardization. Site:plot was set as a random factor. Coefficients (COEF) indicate direction and magnitude of change, and the lower and upper ends of the 95% confidence intervals (CI) describe the uncertainty surrounding the estimates. Source data are provided as a Source Data file.

|         | MAT   |            | PET/MAP |             | Soil C, C:N, C:P, or Si |              |
|---------|-------|------------|---------|-------------|-------------------------|--------------|
| Flux    | COEF  | CI         | COEF    | CI          | COEF                    | CI           |
| $H_cC$  | 0.59* | 0.42, 0.77 | 0.04    | -0.15, 0.21 | 0.09                    | -0.09, 0.27  |
| $H_cN$  | 0.44* | 0.27, 0.62 | 0.05    | -0.12, 0.22 | -0.35*                  | -0.53, -0.19 |
| $H_cP$  | 0.51* | 0.32, 0.71 | 0.01    | -0.18, 0.19 | -0.29*                  | -0.47, -0.11 |
| $H_cSi$ | 0.36* | 0.15, 0.56 | 0.07    | -0.10, 0.24 | 0.29*                   | 0.10, 0.48   |
| $H_iC$  | 0.59* | 0.39, 0.77 | 0.05    | -0.13, 0.26 | 0.09                    | -0.09, 0.28  |
| $H_iN$  | 0.38* | 0.21, 0.56 | 0.12    | -0.05, 0.28 | -0.31*                  | -0.48, -0.14 |
| $H_iP$  | 0.52* | 0.34, 0.71 | -0.00   | -0.18, 0.18 | -0.22*                  | -0.41, -0.05 |

\*Indicates significant explanatory power after 1000 bootstrapping simulations (95% CIs do not overlap with zero).

# **Supplementary Table 5. Relative contributions of abiotic variables on insect-mediated element fluxes in broadleaved forests within latitude zones**

Relative contributions of mean annual temperature (MAT), dryness (potential evapotranspiration/mean annual precipitation), and soil nutrient content to gross insect-mediated nitrogen ( $H_cN$ ) and phosphorus ( $H_cP$ ) fluxes in tropical (33 plots), temperate (32 plots) and boreal forests (9 plots). Linear mixed-effect modeling results are based on log and logit transformations of variables as appropriate, followed by z standardization. Site was set as a random factor. Coefficients (COEF) indicate direction and magnitude of change and the lower and upper ends of the 95% confidence intervals (CI) describe the uncertainty surrounding the estimates. Source data are provided as a Source Data file.

| Tropical  | Abiotic variable | COEF  | CI            |
|-----------|------------------|-------|---------------|
| $H_cN$    | MAT*             | 0.60  | 0.28, 0.93    |
|           | PET/MAP*         | 0.13  | 0.03, 0.22    |
|           | Soil C:N*        | -0.31 | -0.46, -0.16  |
| $H_cP$    | MAT*             | 0.40  | 0.04, 0.75    |
|           | PET/MAP*         | 0.13  | 0.03, 0.24    |
|           | Soil C:P*        | -0.33 | -0.43, -0.25  |
| Temperate |                  |       |               |
| $H_cN$    | MAT              | -0.18 | -0.43, 0.10   |
|           | PET/MAP*         | -0.15 | -0.26, -0.05  |
|           | Soil C:N*        | -0.18 | -0.27, -0.08  |
| $H_cP$    | MAT              | 0.28  | -0.004, 0.539 |
|           | PET/MAP          | 0.01  | -0.08, 0.11   |
|           | Soil C:P*        | 0.22  | 0.12, 0.31    |
| Boreal    |                  |       |               |
| $H_cN$    | MAT*             | 3.22  | 0.67, 5.84    |
|           | PET/MAP          | -0.09 | -1.18, 0.90   |
|           | Soil C:N         | -0.27 | -0.64, 0.13   |
| $H_cP$    | MAT              | 3.48  | -1.46, 7.68   |
|           | PET/MAP          | -0.07 | -1.36, 1.36   |
|           | Soil C:P         | -0.11 | -0.47, 0.25   |

\*Indicates significant explanatory power after 1000 bootstrapping simulations (95% CIs do not overlap with zero).

**Supplementary Table 6. Relative contributions of biotic variables to insect-mediated element fluxes in broadleaved forests globally**

Foliar biomass production (FP, g m<sup>-2</sup> y<sup>-1</sup>), foliar herbivory rate (H, % leaf area removed y<sup>-1</sup>), green leaf element concentration (FE<sub>E</sub>, %), and resorption efficiency (RE<sub>E</sub>, %) relative contributions to gross (H<sub>C</sub>) and net (H<sub>i</sub>) insect herbivore element fluxes. Linear mixed-effect modeling results are based on log and logit transformations of variables as appropriate, followed by z standardization. Site:plot was set as a random factor. Coefficients (COEF) indicate direction and magnitude of change, and the lower and upper ends of the 95% confidence intervals (CI) describe the uncertainty surrounding the estimates. Source data are provided as a Source Data file.

|                   | Foliar biomass production |              | Herbivory rate |              | Foliar element concentration |              | Resorption efficiency |              |
|-------------------|---------------------------|--------------|----------------|--------------|------------------------------|--------------|-----------------------|--------------|
| Flux              | COEF                      | CI           | COEF           | CI           | COEF                         | CI           | COEF                  | CI           |
| H <sub>C</sub> C  | 0.57                      | 0.571, 0.573 | 0.64           | 0.644, 0.646 | 0.04                         | 0.035, 0.039 | NA                    | NA           |
| H <sub>C</sub> N  | 0.58                      | 0.547, 0.549 | 0.66           | 0.616, 0.618 | 0.35                         | 0.245, 0.249 | NA                    | NA           |
| H <sub>C</sub> P  | 0.58                      | 0.582, 0.585 | 0.66           | 0.656, 0.658 | 0.35                         | 0.347, 0.352 | NA                    | NA           |
| H <sub>C</sub> Si | 0.44                      | 0.434, 0.436 | 0.49           | 0.489, 0.491 | 0.44                         | 0.527, 0.530 | NA                    | NA           |
| H <sub>i</sub> C  | 0.57                      | 0.571, 0.574 | 0.65           | 0.644, 0.646 | 0.37                         | 0.139, 0.145 | 0.14                  | 0.139, 0.145 |
| H <sub>i</sub> N  | 0.57                      | 0.572, 0.574 | 0.65           | 0.644, 0.647 | 0.25                         | 0.246, 0.264 | 0.23                  | 0.222, 0.238 |
| H <sub>i</sub> P  | 0.56                      | 0.562, 0.565 | 0.63           | 0.634, 0.636 | 0.37                         | 0.365, 0.383 | 0.21                  | 0.209, 0.221 |

1 **Supplementary references**

- 2 <sup>1</sup>Metcalfe, D. B., Asner, G. P., Martin, R. E., Silva Espejo, J. E., Huasco, W. H., Farfán  
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