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**Supporting Information for**

**Fire transforms effects of terrestrial subsidies on aquatic ecosystem structure and function**

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Supporting text

Figures S1 to S13

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Supporting Information Text

**Supplementary Results**

*Dissolved oxygen percent*

Dissolved oxygen (DO as % O2) measurements showed consistent patterns among replicate dawn measurements (separated by 24 h) in each time point (Fig. S6), although % O2 showed considerable change over time. At Day-10, dawn and dusk % O2 was consistently < 50 % in tanks receiving more than 100 g of plant material, with treatments > 200 g plant material showing hypoxic conditions (< 10 % O2). Significant non-linear relationships between % O2 and plant biomass were observed in all time points, with treatment-specific intercepts for a global smoother at Day-10 and significant non-linear relationships that varied by treatment for dawn-and-dusk measurements at Days-31 and 59 (*SI Appendix*, Tables S5 and S6). Measurements on Days-31 and 59 also showed significantly higher % O2 in mid-range burned tanks (100-200g) compared to unburned, however, % O2 was consistently lower in burned treatments at 400 g compared to unburned tanks (*SI Appendix*, Fig. S7). By Day-89, treatment effects were minimal although % O2 remained higher in tanks receiving less plant materials (*SI Appendix*, Fig. S6).

*Isotope labeling*

Nitrogen isotope labeling (15N) substantially increased the δ15N isotope values of pooled burned-and-unburned sage leaf materials (mean ± SD; 296 ± 53 ‰) relative to willow (13 ± 0.3 ‰) (*p*<0.001) (Fig. S9, Table S9A).  Burning treatment did not affect leaf δ15N values for sage (*p*=0.423) or willow (*p*=0.485).  C:N values were higher in burned relative to unburned sage (*p*=0.001), driven by higher C:N values (~ 70) in sage subjected to longer fire treatment (i.e., very-burned sage), but equivalent between burned and unburned willow (*p*=0.061) (*SI Appendix*, Fig. S9 and Table S9A).  δ15N values did not differ between burned and unburned sage (*p*=0.423) or willow (*p*=0.485). Using pooled burned and unburned leaves, sage had C:N values slightly higher than willow (mean 49 and 47) (*p*=0.014) (*SI Appendix*, Fig. S9B).  Plankton δ15N values were slightly lower than those in the plankton (11 vs. 13 ‰) (*p*=0.001), and plankton C:N was significantly lower than willow (mean 5.8) (*p*<0.001) (*SI Appendix*, Fig. S9B and Table S9A).

Plankton δ15N was used in isotope mixing models to determine the percent of sage-15N incorporated into plankton biomass. Raw δ15N values are reported in (*SI Appendix*, Fig. S9C, D).  GAM models fit to raw δ15N values can be found in (*SI Appendix*, Table S11).

The positive relationship between plankton nitrogen and carbon concentrations was similar among burned and unburned treatments (*SI Appendix*, Fig. S11) that did not differ across time or among plankton size fractions.  Plankton C:N ratios showed significant nonlinearity across the plant-biomass gradient at Day-10 and Day-31 (*p*≤0.038) (*SI Appendix*, Table S11), with burned treatment plankton C:N being lower in mid-range tanks (100-150 g) at Day-10 and higher in high plat-biomass treatments (400 g) at Day-10 and Day-31 (*SI Appendix*, Fig. S12).

Fig. S1. Elemental analysis of burned and unburned plant material (leaves and stem) from sage and willow prior to being added to experimental treatments. Significant post-hoc comparisons (*p*<0.05) of burned effects within a Plant:Tissue type are shown with *black asterisks*. *Red asterisks* indicate significant overall treatment effects and the direction of these effects for either sage or willow in the absence of interactions.



Fig. S2. Model effects from GAMs with differences between smoothers for DOC concentration across time in treatments receiving burned and unburned plant material. Shaded regions are the confidence interval for ‘the difference smooth,’ which is the difference between burned and unburned treatment smoothers. Significant differences between treatment-level smoothers are noted in regions that do not include zero ± model confidence intervals and are shaded in pink.



**Fig. S3.** Total dissolved nitrogen (TDN) concentration across time in treatments receiving burned and unburned plant material. Lines represent best-fit generalized additive models (GAMs) with treatment-level 95% confidence intervals. Black lines with gray confidence intervals indicate global smoothers across all data points; solid (*burned*) and dotted (*unburned*) black lines together represent treatment-level intercepts with global smoothers; colored lines indicate factor-smooths that vary between treatments.

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**Fig. S4.** Model effects from GAMs with differences between smoothers for TN across time in treatments receiving burned and unburned plant material. Shaded regions are the confidence interval for ‘the difference smooth,’ which is the difference between burned and unburned treatment smoothers. Significant differences between treatment-level smoothers are noted in regions that do not include zero ± model confidence intervals and are shaded in pink.

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**Fig. S5. (A)** Total phosphorus concentration in water from burned and unburned treatments at Day-31, and **(B)** the difference between burned and unburned treatment smoothers. Lines in *A* represent best-fit generalized additive models (GAMs) with treatment-level 95% confidence intervals. Lines in *B* represent differences between treatment-level smoothers, where significant differences (shaded in pink) are noted in regions that do not include zero ± model confidence intervals.

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**Fig. S6.** **(A-D)** Changes in dissolved oxygen concentration (%) at dawn and dusk across the four experimental period. Data here were used to calculate net ecosystem production and respiration. Lines represent best-fit generalized additive models (GAMs) with treatment-level 95% confidence intervals. Black lines with gray confidence intervals indicate global smoothers across all data points; solid (*burned*) and dotted (*unburned*) black lines together represent treatment-level intercepts with global smoothers; colored lines indicate factor-smooths that vary between treatments.

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**Fig. S7.** (**A-D**) Model effects from GAMs with differences between smoothers for oxygen concentration (% O2) across four experimental time points in treatments receiving burned and unburned plant material. Shaded regions are the confidence interval for ‘the difference smooth,’ which is the difference between burned and unburned treatment smoothers. Significant differences between treatment-level smoothers are noted in regions that do not include zero ± model confidence intervals and are shaded in pink.

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**Fig. S8.** Model effects from GAMs with differences between smoothers for (**A**) NPP and (**B**) R across time in treatments receiving burned and unburned plant material. Shaded regions are the confidence interval for ‘the difference smooth,’ which is the difference between burned and unburned treatment smoothers. Significant differences between treatment-level smoothers are noted in regions that do not include zero ± model confidence intervals and are shaded in pink.

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**Fig. S9. (A)** Nitrogen isotope values and **(B)** C:N ratio for experimental controls (tin blanks), stock plankton, and burned or unburned plant material (willow, sage). **(C, D)** Nitrogen isotope values of plankton fractions in burned and unburned treatments at Day-10 (Time-1) and Day-31 (Time-2). Lines in the bottom panel represent GAMs fit to data with 95% confidence intervals.

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**Fig. S10.** Model effects from GAMs with differences between smoothers for % sage-derived 15N at Day-10 and Day-31 in tanks receiving burned and unburned plant material. Significant differences between treatment-level smoothers are noted in regions that do not include zero ± model confidence intervals and are shaded in pink.

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**Fig. S11. (A)** Relationship between plankton total nitrogen and total carbon, and **(B)** C:N of plankton fractions in treatment tanks receiving burned and unburned plant material at Day-10 and Day-31. Lines represent linear regression (*top*) and GAMs (*bottom*) with treatment-level 95% confidence intervals.

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**Fig. S12.** Difference in plankton C:N (pooled across size fractions) from treatment tanks receiving burned and unburned plant material at Day-10 and Day-31. Lines represent linear regression (*top*) and GAMs (*bottom*) with treatment-level 95% confidence intervals.

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**Fig. S13.** Model effects from GAMs with differences between smoothers for greenhouse gasses **(A)** carbon dioxide (CO2) and **(B)** methane (CH4) in tanks receiving burned and unburned plant material at the beginning of the experiment and during three experimental time points. Significant differences between treatment-level smoothers are noted in regions that do not include zero ± model confidence intervals and are shaded in pink.

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| **Table S1**. Linear models testing the influence of treatment (burned vs. unburned) plant material (leaf, stem) on sage biomass prior to addition to aquatic mesocosms. Factor interactions were excluded*,* except for their three-way interaction, which allowed for *a priori* contrasts of burning effects within plant tissue types in a single species. | | | | | |
| *Sage biomass* | *Effect* | *SS* | *df* | *F* | *p-value* |
| Nitrogen (%N) | Treatment | 0.028 | 1 | 8.663 | **0.019** |
|  | Type | 0.260 | 1 | 80.525 | **<0.001** |
|  | Treatment:Type | 0.071 | 1 | 21.810 | **0.002** |
|  | Residual | 0.026 | 8 |  |  |
|  |  |  |  |  |  |
| Phosphorus (%P) | Treatment | 0.001 | 1 | 1.968 | 0.198 |
|  | Type | 0.008 | 1 | 19.306 | **0.002** |
|  | Treatment:Type | 0.0001 | 1 | 0.144 | 0.714 |
|  | Residual | 0.003 | 8 |  |  |
|  |  |  |  |  |  |
| Potassium (%K) | Treatment | 0.256 | 1 | 7.616 | **0.025** |
|  | Type | 0.180 | 1 | 5.357 | **0.049** |
|  | Treatment:Type | 0.074 | 1 | 2.188 | 0.177 |
|  | Residual | 0.269 | 8 |  |  |
|  |  |  |  |  |  |
| Sulfur (%S) | Treatment | 0.0001 | 1 | 0.132 | 0.726 |
|  | Type | 0.112 | 1 | 141.389 | **<0.001** |
|  | Treatment:Type | 00004 | 1 | 0.489 | 0.504 |
|  | Residual | 0.006 | 8 |  |  |
|  |  |  |  |  |  |
| Zinc (Zn ppm) | Treatment | 3,073 | 1 | 2.336 | 0.165 |
|  | Type | 3,281 | 1 | 2.494 | 0.153 |
|  | Treatment:Type | 1,236 | 1 | 0.940 | 0.361 |
|  | Residual | 10,524 | 8 |  |  |
| ANOVA table generated from Type-III sum of squares using *car* package in R. *SS* = sum of squares; *df* = degrees of freedom; *MS* = mean sum of squares. Significant effects (p<0.05) are in bold. | | | | | |

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| **Table S2**. Linear models testing the influence of treatment (burned vs. unburned) plant material (leaf, stem) on willow biomass prior to addition to aquatic mesocosms. Factor interactions were excluded*,* except for their three-way interaction, which allowed for *a priori* contrasts of burning effects within plant tissue types in a single species. | | | | | |
| *Willow biomass* | *Effect* | *SS* | *df* | *F* | *p-value* |
| Nitrogen (%N) | Treatment | 0.082 | 1 | 6.019 | **0.044** |
|  | Type | 1.454 | 1 | 107.153 | **<0.001** |
|  | Treatment:Type | 0.044 | 1 | 3.212 | 0.116 |
|  | Residual | 0.095 | 7 |  |  |
|  |  |  |  |  |  |
| Phosphorus (%P) | Treatment | 0.006 | 1 | 18.283 | **0.004** |
|  | Type | 0.007 | 1 | 20.670 | **0.003** |
|  | Treatment:Type | 0.001 | 1 | 2.513 | 0.157 |
|  | Residual | 0.002 | 7 |  |  |
|  |  |  |  |  |  |
| Potassium (%K) | Treatment | 0.068 | 1 | 8.034 | **0.025** |
|  | Type | 0.264 | 1 | 31.358 | **<0.001** |
|  | Treatment:Type | 0.002 | 1 | 0.173 | 0.690 |
|  | Residual | 0.059 | 7 |  |  |
|  |  |  |  |  |  |
| Sulfur (%S) | Treatment | 0.003 | 1 | 22.303 | **0.002** |
|  | Type | 0.042 | 1 | 374.819 | **<0.001** |
|  | Treatment:Type | 0.001 | 1 | 11.985 | **0.011** |
|  | Residual | 0.001 | 7 |  |  |
|  |  |  |  |  |  |
| Zinc (Zn ppm) | Treatment | 22,363 | 1 | 35.304 | **<0.001** |
|  | Type | 21,956 | 1 | 34.663 | **<0.001** |
|  | Treatment:Type | 5,340 | 1 | 8.431 | **0.023** |
|  | Residual | 4,434 | 7 |  |  |
| ANOVA table generated from Type-III sum of squares using *car* package in R. *SS* = sum of squares; *df* = degrees of freedom; *MS* = mean sum of squares. Significant effects (p<0.05) are in bold. | | | | | |

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| **Table S3**. Model selection for percent dissolve organic carbon (DOC), total dissolved nitrogen (TDN), and total dissolved phosphorus (TDP) with candidate GAM models\* assessed in each time point, corresponding to 0, 10, 31, 59, and 89 days post addition of burned or unburned plant material to experimental mesocosms. TDP was only measured at Day-31. | | | | | | |
| *Metric* | *Time* | *Model* | | *df* | *AIC* | *ΔAIC* |
| **DOC** | Day-0 | | ~Treatment + s(plant material, by= Treatment) | 5.5 | 3.2 |  |
|  |  | | ~Treatment + s(plant material) | 4.0 | 1.0 |  |
|  |  | | ~s(plant material) | 3.1 | **-0.8** | 0.0 |
|  | Day-10 | | ~Treatment + s(plant material, by= Treatment) | 10.9 | **146.8** | -15.2 |
|  |  | | ~Treatment + s(plant material) | 6.6 | 157.8 |  |
|  |  | | ~s(plant material) | 5.5 | 162.0 |  |
|  | Day-31 | | ~Treatment + s(plant material, by= Treatment) | 12.5 | **117.7** | -40.3 |
|  |  | | ~Treatment + s(plant material) | 6.3 | 160.0 |  |
|  |  | | ~s(plant material) | 5.3 | 158.0 |  |
|  | Day-59 | | ~Treatment + s(plant material, by= Treatment) | 8.2 | **64.0** | -12.1 |
|  |  | | ~Treatment + s(plant material) | 4.0 | 69.7 |  |
|  |  | | ~s(plant material) | 3.0 | 76.1 |  |
|  | Day-89 | | ~Treatment + s(plant material, by= Treatment) | 6.3 | 110.9 |  |
|  |  | | ~Treatment + s(plant material) | 5.4 | 109.3 |  |
|  |  | | ~s(plant material) | 4.4 | **108.6** | 0.0 |
|  |  | |  |  |  |  |
| **TDN** | Day-0 | | ~Treatment + s(plant material, by= Treatment) | 5.0 | **-85.1** | -0.6 |
|  |  | | ~Treatment + s(plant material) | 4.0 | -83.4 |  |
|  |  | | ~s(plant material) | 3.0 | -84.5 |  |
|  | Day-10 | | ~Treatment + s(plant material, by= Treatment) | 8.9 | -7.8 |  |
|  |  | | ~Treatment + s(plant material) | 6.2 | -10.6 |  |
|  |  | | ~s(plant material) | 5.3 | **-12.6** | 0.0 |
|  | Day-31 | | ~Treatment + s(plant material, by= Treatment) | 6.3 | -11.7 |  |
|  |  | | ~Treatment + s(plant material) | 6.9 | **-18.1** | -3.0 |
|  |  | | ~s(plant material) | 5.5 | -15.0 |  |
|  | Day-59 | | ~Treatment + s(plant material, by= Treatment) | 11.3 | **-39.6** | -13.6 |
|  |  | | ~Treatment + s(plant material) | 6.1 | -26.2 |  |
|  |  | | ~s(plant material) | 5.1 | -26.0 |  |
|  | Day-89 | | ~Treatment + s(plant material, by= Treatment) | 7.0 | **-23.7** | -6.4 |
|  |  | | ~Treatment + s(plant material) | 4.8 | -20.6 |  |
|  |  | | ~s(plant material) | 3.6 | -17.4 |  |
|  |  | |  |  |  |  |
| **TDP** | Day-31 | | Treatment + s(plant material, by=Treatment) | 9.9 | **100.1** | -16.8 |
|  |  | | Treatment + s(plant material) | 5.9 | 117.9 |  |
|  |  | | s(plant material) | 4.8 | 116.9 |  |
| *\*Treatment +* *s(plant material, by= Treatment)* GAM has parametric terms (*Treatment*) and separate smoothers for each treatment. *Treatment + s(plant material)* GAM has a global smoother allowing for off-set intercepts according to treatments. The *s(plant material)* GAM fits a global smoother to all data. *Bold* represents the selected models. Delta AIC (*ΔAIC*) is the difference between the selected model and the global smoother model. | | | | | | |

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| **Table S4**. Generalized additive models (GAM) testing treatment (burned vs. unburned) and factor-smooth interaction effects on dissolved organic carbon (DOC) and total dissolved nitrogen (TDN) at five time points and total phosphorous (TP) at one time point. Separate smoothers were fit for burned and unburned data, and anova tables were generated by *anova.gam*(). | | | | | |
| **Dissolved organic carbon (DOC mg/L)** | |  |  |  |  |
|  | *Effect* | *df /edf* | *Ref.df* | *F* | *p-value* |
| Day-0 | s(plant material) | 1.040 | 1.080 | 1.341 | 0.240 |
|  |  |  |  |  |  |
| Day-10 | Treatment | 1 | – | 9.571 | **0.005** |
|  | s(plant material) : burned | 3.623 | 4.412 | 119.7 | **<0.001** |
|  | s(plant material) : unburned | 3.151 | 3.853 | 149.1 | **<0.001** |
|  |  |  |  |  |  |
| Day-31 | Treatment | 1 | – | 0.035 | 0.853 |
|  | s(plant material) : burned | 6.482 | 7.532 | 34.39 | **<0.001** |
|  | s(plant material) : unburned | 1.568 | 1.929 | 59.34 | **<0.001** |
|  |  |  |  |  |  |
| Day-59 | Treatment | 1 | – | 12.32 | **0.002** |
|  | s(plant material) : burned | 2.051 | 2.532 | 94.00 | **<0.001** |
|  | s(plant material) : unburned | 2.202 | 2.714 | 56.55 | **<0.001** |
|  |  |  |  |  |  |
| Day-89 | s(plant material) | 1.928 | 2.385 | 29.80 | **<0.001** |
|  |  |  |  |  |  |
| **Total dissolved nitrogen (TDN mg/L)** | |  |  |  |  |
| Day-0 | Treatment | 1 | – | 0.879 | 0.357 |
|  | s(plant material) : burned | 1.000 | 1.000 | 0.009 | 0.927 |
|  | s(plant material) : unburned | 1.000 | 1.000 | 6.303 | **0.019** |
|  |  |  |  |  |  |
| Day-10 | s(plant material) | 2.848 | 3.492 | 5.720 | **0.003** |
|  |  |  |  |  |  |
| Day-31 | Treatment | 1 | – | 4.122 | 0.053 |
|  | s(plant material) | 3.207 | 3.921 | 4.870 | **0.004** |
|  |  |  |  |  |  |
| Day-59 | Treatment | 1 | – | 3.500 | 0.075 |
|  | s(plant material) : burned | 4.359 | 5.269 | 23.03 | **<0.001** |
|  | s(plant material) : unburned | 2.457 | 3.022 | 10.52 | **<0.001** |
|  |  |  |  |  |  |
| Day-89 | Treatment | 1 | – | 6.231 | **0.020** |
|  | s(plant material) : burned | 2.417 | 2.973 | 3.613 | **0.032** |
|  | s(plant material) : unburned | 1.000 | 1.000 | 0.531 | 0.473 |
|  |  |  |  |  |  |
| **Total phosphorus (TP μmol/L)** | |  |  |  |  |
| Day-31 | Treatment | 1 | – | 1.329 | 0.267 |
|  | s(plant material) : burned | 2.924 | 3.525 | 154.7 | **<0.001** |
|  | s(plant material) : unburned | 2.930 | 3.371 | 124.6 | **<0.001** |
| *Treatment* indicates the parametric term in GAM, *s(plant material)* is the smooth term for either burned or unburned treatments. *df / edf* column indicates either *df* (degrees of freedom) for parametric terms or *edf* (effective degrees of freedom) for smoother terms; *Ref.df* = reference degree of freedom, where dashes indicate NA for parametric terms. Significant effects (p<0.05) are in bold. | | | | | |

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| **Table S5**. Model selection for percent dissolved oxygen (DO as % O2) with candidate GAM models\* assessed in each time point, corresponding to Days-10, 31, 59, and 89 post addition of burned or unburned plant material to experimental mesocosms. Dawn and dusk measurements represent discrete back-to-back measurements over a 24 h period. | | | | | | | | | | | |
| *Metric* | *Time* | *Model* | | *df* | | | | *AIC* | | *ΔAIC* | |
| % O2 | Day-10 | dawn-1 | ~Treatment + s(plant material, by= Treatment) | | 9.7 | | | | 226.4 | |  |
|  |  |  | ~Treatment + s(plant material) | | | 6.7 | | | **221.5** | | -3.9 |
|  |  |  | ~s(plant material) | | | 5.6 | | | 225.4 | |  |
|  |  | dusk-1 | ~Treatment + s(plant material, by= Treatment) | | | 9.3 | | | 258.5 | |  |
|  |  |  | ~Treatment + s(plant material) | | | 6.5 | | | **254.3** | | -3.1 |
|  |  |  | ~s(plant material) | | | 5.4 | | | 257.4 | |  |
|  |  | dawn-2 | ~Treatment + s(plant material, by= Treatment) | | | 9.9 | | | 230.6 | |  |
|  |  |  | ~Treatment + s(plant material) | | | 6.8 | | | **228.9** | | -4.7 |
|  |  |  | ~s(plant material) | | | 5.6 | | | 233.6 | |  |
|  | Day-31 | dawn-1 | ~Treatment + s(plant material, by= Treatment) | | | | 8.4 | | **231.2** | | -4.8 |
|  |  |  | ~Treatment + s(plant material) | | | | 4.0 | | 237.8 | |  |
|  |  |  | ~s(plant material) | | | | 3.0 | | 236.0 | |  |
|  |  | dusk-1 | ~Treatment + s(plant material, by= Treatment) | | | | 8.2 | | **246.9** | | -4.3 |
|  |  |  | ~Treatment + s(plant material) | | | | 4.0 | | 251.7 | |  |
|  |  |  | ~s(plant material) | | | | 3.0 | | 251.2 | |  |
|  |  | dawn-2 | ~Treatment + s(plant material, by= Treatment) | | | | 8.8 | | **229.5** | | -7.4 |
|  |  |  | ~Treatment + s(plant material) | | | | 4.0 | | 238.5 | |  |
|  |  |  | ~s(plant material) | | | | 3.0 | | 237.0 | |  |
|  | Day-59 | dawn-1 | ~Treatment + s(plant material, by= Treatment) | | | | 10.0 | | **198.3** | | -22.8 |
|  |  |  | ~Treatment + s(plant material) | | | | 6.5 | | 222.3 | |  |
|  |  |  | ~s(plant material) | | | | 5.5 | | 221.1 | |  |
|  |  | dusk-1 | ~Treatment + s(plant material, by= Treatment) | | | | 12.4 | | **215.3** | | -22.9 |
|  |  |  | ~Treatment + s(plant material) | | | | 6.9 | | 237.2 | |  |
|  |  |  | ~s(plant material) | | | | 5.9 | | 238.2 | |  |
|  |  | dawn-2 | ~Treatment + s(plant material, by= Treatment) | | | | 10.2 | | **195.7** | | -25.4 |
|  |  |  | ~Treatment + s(plant material) | | | | 6.6 | | 221.4 | |  |
|  |  |  | ~s(plant material) | | | | 5.5 | | 221.1 | |  |
|  | Day-89 | dawn-1 | ~Treatment + s(plant material, by= Treatment) | | | | 6.5 | | 208.2 | |  |
|  |  |  | ~Treatment + s(plant material) | | | | 5.0 | | 208.2 | |  |
|  |  |  | ~s(plant material) | | | | 4.1 | | **206.3** | | 0.0 |
|  |  | dusk-1 | ~Treatment + s(plant material, by= Treatment) | | | | 7.1 | | **229.0** | | -2.0 |
|  |  |  | ~Treatment + s(plant material) | | | | 5.6 | | 232.5 | |  |
|  |  |  | ~s(plant material) | | | | 4.7 | | 231.0 | |  |
|  |  | dawn-2 | ~Treatment + s(plant material, by= Treatment) | | | | 6.0 | | 198.5 | |  |
|  |  |  | ~Treatment + s(plant material) | | | | 4.0 | | 196.6 | |  |
|  |  |  | ~s(plant material) | | | | 3.1 | | **195.0** | | 0.0 |
| *\*Treatment +* *s(plant material, by= Treatment)* GAM has parametric terms (*Treatment*) and separate smoothers for each treatment. *Treatment + s(plant material)* GAM has a global smoother allowing for off-set intercepts according to treatments. The *s(plant material)* GAM fits a global smoother to all data. *Bold* represents the selected models. Delta AIC (*ΔAIC*) is the difference between the selected model and the global smoother model. | | | | | | | | | | | |

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| **Table S6**. Generalized additive models (GAM) testing treatment (burned vs. unburned) and factor-smooth interaction effects on dissolved oxygen measured at dawn, dusk, and dawn over a 24 h period. Separate smoothers were fit for burned and unburned data, and anova tables were generated by *anova.gam*(). | | | | | | | |
| **Dissolved oxygen (% O2)** | | |  | |  |  |  |
|  | | *Effect* | | *df /edf* | *Ref.df* | *F* | *p-value* |
| Day-10 | dawn-1 | Treatment | | 1 | – | 5.467 | **0.028** |
|  |  | s(plant material) | | 3.516 | 4.287 | 127.7 | **<0.001** |
|  | dusk-1 | Treatment | | 1 | – | 4.718 | **0.040** |
|  |  | s(plant material) | | 3.225 | 3.942 | 73.89 | **<0.001** |
|  | dawn-2 | Treatment | | 1 | – | 6.333 | **0.019** |
|  |  | s(plant material) | | 3.481 | 4.245 | 114.0 | **<0.001** |
|  |  |  | |  |  |  |  |
| Day-31 | dawn-1 | Treatment | | 1 | – | 0.309 | 0.584 |
|  |  | s(plant material) : burned | | 1.844 | 2.282 | 32.91 | **<0.001** |
|  |  | s(plant material) : unburned | | 2.508 | 3.083 | 14.25 | **<0.001** |
|  | dusk-1 | Treatment | | 1 | – | 1.887 | 0.182 |
|  |  | s(plant material) : burned | | 2.026 | 2.503 | 25.65 | **<0.001** |
|  |  | s(plant material) : unburned | | 2.190 | 2.699 | 10.07 | **<0.001** |
|  | dawn-2 | Treatment | | 1 | – | 0.744 | 0.397 |
|  |  | s(plant material) : burned | | 2.289 | 2.818 | 27.35 | **<0.001** |
|  |  | s(plant material) : unburned | | 2.411 | 2.966 | 10.64 | **<0.001** |
|  |  |  | |  |  |  |  |
| Day-59 | dawn-1 | Treatment | | 1 | – | 1.656 | 0.212 |
|  |  | s(plant material) : burned | | 4.970 | 5.958 | 23.28 | **<0.001** |
|  |  | s(plant material) : unburned | | 1.000 | 1.000 | 52.88 | **<0.001** |
|  | dusk-1 | Treatment | | 1 | – | 6.275 | **0.021** |
|  |  | s(plant material) : burned | | 5.038 | 6033 | 24.8 | **<0.001** |
|  |  | s(plant material) : unburned | | 2.753 | 3.377 | 14.67 | **<0.001** |
|  | dawn-2 | Treatment | | 1 | – | 3.860 | **0.062** |
|  |  | s(plant material) : burned | | 5.166 | 6.175 | 22.80 | **<0.001** |
|  |  | s(plant material) : unburned | | 1.000 | 1.000 | 38.78 | **<0.001** |
|  |  |  | |  |  |  |  |
| Day-89 | dawn-1 | s(plant material) | | 1.667 | 2.061 | 9.333 | **<0.001** |
|  | dusk-1 | Treatment | | 1 | – | 0.506 | 0.483 |
|  |  | s(plant material) : burned | | 2.575 | 3.163 | 5.636 | **0.004** |
|  |  | s(plant material) : unburned | | 1.000 | 1.000 | 2.538 | 0.124 |
|  | dawn-2 | s(plant material) | | 1.041 | 1.081 | 15.09 | **<0.001** |
| *Treatment* indicates the parametric term in GAM, *s(plant material)* is the smooth term for either burned or unburned treatments. *df* = degrees of freedom for parametric terms; *edf* = effective degrees of freedom for smoother terms; *Ref.df* = reference degree of freedom, where dashes indicate NA for parametric terms. Significant effects (p<0.05) are in bold. | | | | | | | |

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| **Table S7**. Model selection for net primary productivity (NPP) and respiration (R) with candidate GAM models\* assessed at 4 time points post addition of burned or unburned plant material to experimental mesocosms. | | | | | | |
| *Metric* | *Time* | *Model* | *df* | *AIC* | *ΔAIC* | |
| NPP | Day-10 | ~Treatment + s(plant material, by= Treatment) | 8.1 | 214.2 | -0.9 | |
|  |  | ~Treatment + s(plant material) | 6.1 | **213.5** |  | |
|  |  | ~s(plant material) | 5.0 | 214.4 |  | |
|  | Day-31 | ~Treatment + s(plant material, by= Treatment) | 6.4 | 177.5 | -9.3 | |
|  |  | ~Treatment + s(plant material) | 7.7 | **176.3** |  | |
|  |  | ~s(plant material) | 4.2 | 185.6 |  | |
|  | Day-59 | ~Treatment + s(plant material, by= Treatment) | 11.0 | 175.7 | -6.0 | |
|  |  | ~Treatment + s(plant material) | 7.3 | **175.2** |  | |
|  |  | ~s(plant material) | 6.1 | 181.2 |  | |
|  | Day-89 | ~Treatment + s(plant material, by= Treatment) | 7.4 | **187.4** | -5.2 | |
|  |  | ~Treatment + s(plant material) | 5.8 | 192.2 |  | |
|  |  | ~s(plant material) | 4.8 | 192.5 |  | |
|  |  |  |  |  |  | |
| R | Day-10 | ~Treatment + s(plant material, by= Treatment) | 8.0 | 207.9 |  | |
|  |  | ~Treatment + s(plant material) | 6.1 | 203.6 |  | |
|  |  | ~s(plant material) | 5.1 | **203.3** | 0.0 | |
|  | Day-31 | ~Treatment + s(plant material, by= Treatment) | 5.0 | 189.6 |  | |
|  |  | ~Treatment + s(plant material) | 9.6 | **173.3** | -6.4 | |
|  |  | ~s(plant material) | 8.3 | 179.7 |  | |
|  | Day-59 | ~Treatment + s(plant material, by= Treatment) | 11.6 | **164.9** | -5.8 | |
|  |  | ~Treatment + s(plant material) | 7.4 | 167.6 |  | |
|  |  | ~s(plant material) | 6.3 | 170.8 |  | |
|  | Day-89 | ~Treatment + s(plant material, by= Treatment) | 7.5 | **196.9** | -7.0 | |
|  |  | ~Treatment + s(plant material) | 6.0 | 202.9 |  | |
|  |  | ~s(plant material) | 4.9 | 203.9 |  | |
| *\*Treatment +* *s(plant material, by= Treatment)* GAM has parametric terms (*Treatment*) and separate smoothers for each treatment. *Treatment + s(plant material)* GAM has a global smoother allowing for off-set intercepts according to treatments. The *s(plant material)* GAM fits a global smoother to all data. *Bold* represents the selected models. Delta AIC (*ΔAIC*) is the difference between the selected model and the global smoother model. | | | | | |
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| **Table S8**. Generalized additive models (GAM) testing treatment (burned vs. unburned) and factor-smooth interaction effects on net primary productivity (NPP) and respiration (R) at 4 time points following the addition of plant material to experimental mesocosm. Separate smoothers were fit for burned and unburned data, and ANOVA tables were generated by *anova.gam*(). | | | | | |
| **Net primary productivity (NPP Δ % O2)** | |  |  |  |  |
|  | *Effect* | *df /edf* | *Ref.df* | *F* | *p-value* |
| Day-10 | Treatment | 1 | – | 2.626 | 0.117 |
|  | s(plant material) | 2.552 | 3.136 | 15.760 | **<0.001** |
|  |  |  |  |  |  |
| Day-31 | Treatment | 1 | – | 8.479 | **0.007** |
|  | s(plant material) | 3.867 | 4.699 | 4.856 | **0.006** |
|  |  |  |  |  |  |
| Day-59 | Treatment | 1 | – | 7.304 | **0.012** |
|  | s(plant material) | 3.719 | 4.525 | 8.277 | **<0.001** |
|  |  |  |  |  |  |
| Day-89 | Treatment | 1 | – | 2.620 | 0.118 |
|  | s(plant material) : burned | 2.757 | 3.382 | 3.717 | **0.020** |
|  | s(plant material) : unburned | 1.000 | 1.000 | 1.002 | 0.327 |
|  |  |  |  |  |  |
| **Respiration (R Δ % O2)** | |  |  |  |  |
| Day-10 | Treatment | 1 | – | 1.520 | 0.229 |
|  | s(plant material) | 2.533 | 3.113 | 13.000 | **<0.001** |
|  |  |  |  |  |  |
| Day-31 | Treatment | 1 | – | 6.443 | **0.019** |
|  | s(plant material) | 5.710 | 6.758 | 10.000 | **<0.001** |
|  |  |  |  |  |  |
| Day-59 | Treatment | 1 | – | 5.669 | **0.027** |
|  | s(plant material) : burned | 3.762 | 4.576 | 13.144 | **<0.001** |
|  | s(plant material) : unburned | 3.274 | 4.000 | 7.775 | **<0.001** |
|  |  |  |  |  |  |
| Day-89 | Treatment | 1 | – | 3.380 | 0.078 |
|  | s(plant material) : burned | 2.927 | 3.587 | 5.293 | **0.004** |
|  | s(plant material) : unburned | 1.000 | 1.000 | 0.002 | 0.965 |
| *Treatment* indicates the parametric term in GAM, *s(plant material)* is the smooth term for either burned or unburned treatments. *df* = degrees of freedom for parametric terms; *edf* = effective degrees of freedom for smoother terms; *Ref.df* = reference degree of freedom, where dashes indicate NA for parametric terms. Significant effects (p<0.05) are in bold. | | | | | |

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| **Table S9**. Non-parametric Mann-Whitney *U*-test and linear models testing effects of treatments (burned vs. unburned) and sample types (15N-labeled sage, non-labeled willow, and plankton stock) on nitrogen isotope values (δ15N) and C:N ratios prior to the start of the experiment (Day-0). | | | | | | | | | | | | | | | | | |
| **Mann-Whitney *U-*tests** | | | | | | | | | | | | | | | | | |
| *Metric* | | | | | *Material* | | *Contrast* | | | | | | *U* | | | *p-value* | |
| δ15N | | | Leaf material | | | | willow *vs*. sage | | | | | | 315 | | | **<0.001** | |
| C:N |  | |  | | | | | | | | | | 160 | | | **0.014** | |
|  |  | | | |  | | | | | | | |  |  | | |  |
| δ15N | Willow, plankton | | | | | | willow *vs*. plankton stock | | | | | | 28 | | | **0.001** | |
| C:N |  | | | |  | | | | | | | | 28 | | | **0.001** | |
|  |  | | | |  | | | | |  |  | | | | |  | |
| **Linear models** | | | | |  | | | | |  |  | | | | |  | |
| *Metric* | | | | *Material* | | *Effect* | | *df* | *SS* | | | *MS* | | | *F* | *p-value* | |
| sage-δ15N | | Leaf material | | | | Treatment | | 2 | 5,178 | | | 2,589 | | | 0.913 | 0.423 | |
|  |  | | | | | Residual | | 15 | 42,461 | | | 2,837 | | |  |  | |
|  |  | | | | |  | |  |  | | |  | | |  |  | |
| sage-C:N |  | | | | | Treatment | | 2 | 3,011 | | | 1,505 | | | 11.320 | **0.001** | |
|  |  | | | | | Residual | | 13 | 1729 | | | 133 | | |  |  | |
|  |  | | | | |  | |  |  | | |  | | |  |  | |
| willow-δ15N |  | | | | | Treatment | | 1 | 0.050 | | | 0.050 | | | 0.554 | 0.485 | |
|  |  | | | | | Residual | | 6 | 0.538 | | | 0.090 | | |  |  | |
|  |  | | | | |  | |  |  | | |  | | |  |  | |
| willow-C:N |  | | | | | Treatment | | 1 | 14.773 | | | 14.773 | | | 5.279 | 0.061 | |
|  |  | | | | | Residual | | 6 | 16.789 | | | 2.798 | | |  |  | |
| Sample size is *n*=7 (plankton), *n*=18 (sage), *n*=8 (willow). | | | | | | | | | | | | | | | | | |

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| **Table S10**. Model selection using plankton of two size classes (< 63 and >63 μm) and measuring the trophic transfer efficiency (percent of 15N-labeled sage) in plankton biomass determined using a two-member mixing model, their stable isotope values (δ15N), and carbon:nitrogen (C:N) molar ratios. Candidate GAM models\* were assessed in two each time points post addition of burned or unburned plant material to experimental mesocosms. | | | | | |
| *Metric* | *Time* | *Model* | *df* | *AIC* | *ΔAIC* |
| % sage-15N | Day-10 | Treatment + Type + s(plant material, by=Treatment) | 12.9 | **354.1** | -26.7 |
|  |  | Treatment + Type + s(plant material) | 8.7 | 359.8 |  |
|  |  | s(plant material) | 6.0 | 380.8 |  |
|  | Day-31 | Treatment + Type + s(plant material, by=Treatment) | 12.8 | **367.5** | -24.1 |
|  |  | Treatment + Type + s(plant material) | 8.2 | 385.6 |  |
|  |  | s(plant material) | 6.1 | 391.6 |  |
|  |  |  |  |  |  |
| δ15N | Day-10 | Treatment + Type + s(plant material, by=Treatment) | 12.9 | **479.4** | -26.7 |
|  |  | Treatment + Type + s(plant material) | 8.7 | 485.1 |  |
|  |  | s(plant material) | 6.0 | 506.1 |  |
|  | Day-31 | Treatment + Type + s(plant material, by=Treatment) | 12.8 | **492.7** | -24.1 |
|  |  | Treatment + Type + s(plant material) | 8.2 | 510.8 |  |
|  |  | s(plant material) | 6.1 | 516.8 |  |
|  |  |  |  |  |  |
| C:N | Day-10 | Treatment + Type + s(plant material, by=Treatment) | 8.1 | **287.0** | -2.9 |
|  |  | Treatment + Type + s(plant material) | 7.0 | 291.3 |  |
|  |  | s(plant material) | 5.0 | 289.9 |  |
|  | Day-31 | Treatment + Type + s(plant material, by=Treatment) | 12.6 | **223.7** | -59.9 |
|  |  | Treatment + Type + s(plant material) | 8.4 | 261.2 |  |
|  |  | s(plant material) | 6.0 | 283.6 |  |
| *\** *Treatment + Type* represent parametric terms that provide offsets for either separate smoothers for each treatment *s(plant material, by=Treatment* or global smoothers *s(plant material). Bold* represents the selected models. Delta AIC (*ΔAIC*) is the difference between the selected model and the global smoother model. | | | | | |
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| **Table S11**. Generalized additive models (GAM) testing treatment (burned vs. unburned) and type (< 63 μm, > 63 μm) and factor-smooth interaction effects on trophic transfer efficiency (TTE, plankton percent sage-15N) calculated from a two-member mixing model and plankton C:N. Separate smoothers were fit for burned and unburned data, and ANOVA tables were generated by *anova.gam*(). | | | | | |
| **TTE, Plankton % sage-15N** | |  |  |  |  |
|  | *Effect* | *df / edf* | *Ref.df* | *F* | *p-value* |
| Day-10 | Treatment | 1 | – | 31.261 | **<0.001** |
|  | Type | 1 | – | 1.721 | 0.196 |
|  | s(plant material) : burned | 3.560 | 4.338 | 136.8 | **<0.001** |
|  | s(plant material) : unburned | 3.921 | 4.762 | 173.6 | **<0.001** |
|  |  |  |  |  |  |
| Day-31 | Treatment | 1 | – | 13.082 | **<0.001** |
|  | Type | 1 | – | 1.004 | 0.321 |
|  | s(plant material) : burned | 4.669 | 5.621 | 79.45 | **<0.001** |
|  | s(plant material) : unburned | 3.34 | 4.082 | 125.45 | **<0.001** |
|  |  |  |  |  |  |
| **Plankton C:N** | |  |  |  |  |
| Day-10 | Treatment | 1 | – | 0.716 | 0.401 |
|  | Type | 1 | – | 1.870 | 0.177 |
|  | s(plant material) : burned | 2.655 | 3.260 | 3.495 | **0.019** |
|  | s(plant material) : unburned | 1.000 | 1.001 | 4.532 | **0.038** |
|  |  |  |  |  |  |
| Day-31 | Treatment | 1 |  | 2.615 | 0.112 |
|  | Type | 1 |  | 56.713 | **<0.001** |
|  | s(plant material) : burned | 5.031 | 6.026 | 19.885 | **<0.001** |
|  | s(plant material) : unburned | 2.050 | 2.532 | 5.331 | **0.004** |
| *Treatment* indicates the parametric term in GAM, *s(plant material)* is the smooth term for either burned or unburned treatments. *df / edf* column indicates either *df* (degrees of freedom) for parametric terms or *edf* (effective degrees of freedom) for smoother terms; *Ref.df* = reference degree of freedom, where dashes indicate NA for parametric terms. Significant effects (p<0.05) are in bold. | | | | | |

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| **Table S12**. Model selection for greenhouse gas concentrations – carbon dioxide (CO2 μM) and methane (CH4 nM) – with candidate GAM models\* assessed in before and 3 time point after the addition of burned or unburned plant material to experimental mesocosms. | | | | | | | |
| *Metric* | *Time* | *Model* | | *df* | *AIC* | *ΔAIC* | |
| CO2 | Day-0 | | Treatment +s(plant material, by=Treatment) | 8.9 | **161.3** | -20.3 | |
|  |  | | Treatment + s(plant material) | 4.0 | 176.0 |  | |
|  |  | | s(plant material) | 3.0 | 181.6 |  | |
|  | Day-10 | | Treatment +s(plant material, by=Treatment) | 9.2 | **271.2** | -8.1 | |
|  |  | | Treatment + s(plant material) | 6.6 | 272.9 |  | |
|  |  | | s(plant material) | 5.4 | 279.3 |  | |
|  | Day-31 | | Treatment +s(plant material, by=Treatment) | 10.2 | **269.6** | -14.1 | |
|  |  | | Treatment + s(plant material) | 4.0 | 285.4 |  | |
|  |  | | s(plant material) | 3.0 | 283.7 |  | |
|  | Day-59 | | Treatment +s(plant material, by=Treatment) | 7.2 | **268.0** | -8.8 | |
|  |  | | Treatment + s(plant material) | 5.4 | 277.1 |  | |
|  |  | | s(plant material) | 4.3 | 276.8 |  | |
|  |  | |  |  |  |  | |
| CH4 | Day-0 | | Treatment +s(plant material, by=Treatment) | 5.0 | 132.5 | -0.2 | |
|  |  | | Treatment + s(plant material) | 4.0 | **131.1** |  | |
|  |  | | s(plant material) | 3.0 | 131.3 |  | |
|  | Day-10 | | Treatment +s(plant material, by=Treatment) | 9.3 | **159.3** | -5.3 | |
|  |  | | Treatment + s(plant material) | 6.0 | 166.3 |  | |
|  |  | | s(plant material) | 5.1 | 164.6 |  | |
|  | Day-31 | | Treatment +s(plant material, by=Treatment) | 5.9 | 197.8 |  | |
|  |  | | Treatment + s(plant material) | 4.0 | 196.3 |  | |
|  |  | | s(plant material) | 3.0 | **194.9** | 0.0 | |
|  | Day-59 | | Treatment +s(plant material, by=Treatment) | 5.0 | 227.5 |  | |
|  |  | | Treatment + s(plant material) | 7.1 | **223.5** | -2.3 | |
|  |  | | s(plant material) | 5.9 | 225.8 |  | |
| *\*Treatment +* *s(plant material, by= Treatment)* GAM has parametric terms (*Treatment*) and separate smoothers for each treatment. *Treatment + s(plant material)* GAM has a global smoother allowing for off-set intercepts according to treatments. The *s(plant material)* GAM fits a global smoother to all data. *Bold* represents the selected models. Delta AIC (*ΔAIC*) is the difference between the selected model and the global smoother model. | | | | | | |
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| **Table S13**. Generalized additive models (GAM) testing treatment (burned vs. unburned) and factor-smooth interaction effects on carbon dioxide (CO2) and methane (CH4) emissions from experimental mesocosms. Separate smoothers were fit for burned and unburned data, and ANOVA tables were generated by *anova.gam*(). | | | | | |
| **Carbon dioxide (μM)** | |  |  |  |  |
|  | *Effect* | *df /edf* | *Ref.df* | *F* | *p-value* |
| Day-0 | Treatment | 1 | – | 14.980 | **<0.001** |
|  | s(plant material) : burned | 1.000 | 1.000 | 10.566 | **0.004** |
|  | s(plant material) : unburned | 4.022 | 4.880 | 3.383 | **0.024** |
|  |  |  |  |  |  |
| Day-10 | Treatment | 1 | – | 9.403 | **0.005** |
|  | s(plant material) : burned | 2.047 | 2.527 | 155.7 | **<0.001** |
|  | s(plant material) : unburned | 2.966 | 3.633 | 144.2 | **<0.001** |
|  |  |  |  |  |  |
| Day-31 | Treatment | 1 | – | 0.427 | 0.520 |
|  | s(plant material) : burned | 2.499 | 3.072 | 52.20 | **<0.001** |
|  | s(plant material) : unburned | 3.422 | 4.176 | 22.47 | **<0.001** |
|  |  |  |  |  |  |
| Day-59 | Treatment | 1 | – | 2.341 | 0.140 |
|  | s(plant material) : burned | 2.744 | 3.366 | 11.86 | **<0.001** |
|  | s(plant material) : unburned | 1.000 | 1.000 | 28.09 | **<0.001** |
|  |  |  |  |  |  |
| **Methane (nM)** | |  |  |  |  |
| Day-0 | Treatment | 1 | – | 2.038 | 0.166 |
|  | s(plant material) | 1.000 | 1.000 | 0.718 | 0.405 |
|  |  |  |  |  |  |
| Day-10 | Treatment | 1 | – | 0.266 | 0.611 |
|  | s(plant material) : burned | 1.813 | 2.244 | 0.890 | 0.427 |
|  | s(plant material) : unburned | 3.346 | 4.086 | 6.530 | **0.001** |
|  |  |  |  |  |  |
| Day-31 | s(plant material) | 1 | 1.001 | 0.190 | 0.667 |
|  |  |  |  |  |  |
| Day-59 | Treatment | 1 | – | 3.645 | 0.068 |
|  | s(plant material) | 3.381 | 4.127 | 2.038 | 0.113 |
| *Treatment* indicates the parametric term in GAM, *s(plant material)* is the smooth term for either burned or unburned treatments. *df* = degrees of freedom for parametric terms; *edf* = effective degrees of freedom for smoother terms; *Ref.df* = reference degree of freedom, where dashes indicate NA for parametric terms. Significant effects (p<0.05) are in bold. | | | | | |