**Supplementary material**

Limited legacy effects of extreme multi-year drought on carbon and nitrogen cycling in a mesic grassland

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*Figure S1.* Precipitation (mm) in (a) 2018 and (b) 2019mm. Each bar represents a single daily precipitation event.



*Figure S2.* Cumulative C enzymes (AG + BG + CB + XYL) in 2018 (a) and 2019 (b). Graphs show the raw enzyme data. Statistics were run with ln transformed data to account for unequal variance. The control treatment is shown in blue, chronic treatment in gray, and intense treatment in orange. The circles represent the average enzyme activity for each treatment. The error bars represent the 95% confidence intervals. No statistical differences among treatments were detected.



*Figure S3.* Cumulative C enzymes (AG + BG + CB + XYL) divided by cumulative N enzymes (LAG + NAP) in 2018 (a) and 2019 (b). Graphs show the raw enzyme data. Statistics were run with ln transformed data to account for unequal variance. The control treatment is shown in blue, chronic treatment in gray, and intense treatment in orange. The circles represent the average enzyme activity for each treatment. The error bars represent the 95% confidence intervals. No statistical differences among treatments were detected.

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*Figure S4.* All individual C enzyme activities in 2018 and 2019. 2018 AB (a), BG (b), CB (c), and XYL (d) are displayed on the left side. 2019 AB (e), BG (f), CB (g), and XYL (g) are displayed on the right side. Graphs show the raw enzyme data. Statistics were run with ln transformed data to account for unequal variance. The control treatment is shown in blue, chronic treatment in gray, and intense treatment in orange. The circles represent the average enzyme activity for each treatment. The error bars represent the 95% confidence intervals. No statistical differences among treatments were detected.

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*Figure S5.* Dissolved organic C and dissolved organic N in 2018 and 2019. 2018 dissolved organic C (a) and 2019 dissolved organic C (b) are displayed on the upper panel. 2018 dissolved organic N (c) and 2019 dissolved organic N (d) are displayed on the lower panel. The control treatment is shown in blue, chronic treatment in gray, and intense treatment in orange. The circles represent the average organic C or N for each treatment. The error bars represent the 95% confidence intervals. No statistical differences were detected.

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*Figure S6.* Net N mineralization in 2018 (a) and 2019 (b). The control treatment is shown in blue, chronic treatment in gray, and intense treatment in orange. The circles represent the average N mineralization for each treatment. The error bars represent the 95% confidence intervals. No statistical differences among treatments were detected.



*Figure S7.* Cumulative N enzymes (LAP + NAP) in 2018 (a) and 2019 (b). Graphs show the raw enzyme data. Statistics were run with ln transformed data to account for unequal variance. The control treatment is shown in blue, chronic treatment in gray, and intense treatment in orange. The circles represent the average enzyme activity for each treatment. The error bars represent the 95% confidence intervals. No statistical differences were detected.



*Figure S8.* All individual N enzyme activities in 2018 and 2019. 2018 NAG (a) and LAP are displayed on the upper panel. 2019 NAG (a) and LAP are displayed on the lower panel. Graphs show the raw enzyme data. Statistics were run with ln transformed data to account for unequal variance. The control treatment is shown in blue, chronic treatment in gray, and intense treatment in orange. The circles represent the average enzyme activity for each treatment. The error bars represent the 95% confidence intervals. No statistical differences were detected.

Supplementary tables:

*Table S1.* ANOVA table of soil moisture.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Measure | Variable | Sum Sq | Mean Sq | Num DF | F value | Pr (>F) |
| 2018 Soil Moisture | Treatment | 164.88 | 82.44 | 2 | 4.25 | 0.018\* |
|  | Date | 2409.88 | 1204.94 | 2 | 62.16 | <<0.001\*\*\* |
|  | Treatment: Date | 152.78 | 38.20 | 4 | 1.97 | 0.11 |
| 2019 Soil Moisture | Treatment | 55.80 | 27.90 | 2 | 1.12 | 0.33 |
|  | Date | 26403.2 | 3300.4 | 8 | 132.67 | <<0.001\*\*\* |
|  | Treatment: Date | 671.7 | 42.0 | 16 | 1.69 | 0.0499\* |

*Table S2.* ANOVA table of C cycling measures.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Measure | Variable | Sum Sq | Mean Sq | Num DF | F value | Pr (>F) |
| 2018 Belowground Respiration | Treatment | 30.44 | 15.22 | 2 | 3.97 | 0.023\* |
|  | Date | 158.72 | 79.36 | 2 | 20.70 | <<0.001\*\*\* |
|  | Soil Moisture | 6.39 | 6.39 | 1 | 1.67 | 0.20 |
|  | Treatment: Date | 34.77 | 8.69 | 4 | 2.27 | 0.071 |
| 2019 Belowground Respiration | Treatment | 12.60 | 6.30 | 2 | 0.26 | 0.77 |
|  | Date | 10633.7 | 1329.21 | 8 | 54.80 | <<0.001\*\*\* |
|  | Soil Moisture | 19.9 | 19.92 | 1 | 0.82 | 0.37 |
|  | Treatment: Date | 114.0 | 7.13 | 16 | 0.29 | 0.99 |
| 2018 Initial Microbial Respiration | Treatment | 9.83 | 4.92 | 2 | 8.084 | <0.001\*\*\* |
|  | Date | 140.81 | 70.41 | 2 | 115.80 | <<0.001\*\*\* |
|  | Treatment: Date | 2.96 | 0.74 | 4 | 1.22 | 0.31 |
| 2019 Initial Microbial Respiration | Treatment | 100.91 | 50.46 | 2 | 1.63 | 0.20 |
|  | Date | 1589.89 | 794.94 | 2 | 25.74 | <<0.001\*\*\* |
|  | Treatment: Date | 100.67 | 25.17 | 4 | 0.81 | 0.52 |
| 2018 C Enzymes | Treatment | 1.23 | 0.65 | 2 | 1.81 | 0.17 |
|  | Date | 8.03 | 4.01 | 2 | 11.16 | <<0.001\*\*\* |
|  | Block | 2.30 | 0.26 | 9 | 0.71 | 0.70 |
|  | Treatment: Date | 1.43 | 0.36 | 4 | 0.997 | 0.42 |
| 2019 C Enzymes | Treatment | 1.97 | 0.99 | 2 | 1.65 | 0.20 |
|  | Date | 16.04 | 8.08 | 2 | 13.42 | <<0.001\*\*\* |
|  | Treatment: Date | 2.97 | 0.74 | 4 | 1.24 | 0.30 |
| 2018 C:N Enzymes | Treatment | 0.18 | 0.088 | 2 | 1.86 | 0.16 |
|  | Date | 0.88 | 0.44 | 2 | 9.3 | 0.00026\*\*\* |
|  | Treatment: Date | 0.018 | 0.0045 | 4 | 0.095 | 0.98 |
| 2019 C:N Enzymes | Treatment | 1.94 | 0.97 | 2 | 2.74 | 0.072 |
|  | Date | 0.97 | 0.48 | 2 | 1.37 | 0.26 |
|  | Treatment: Date | 2.21 | 0.55 | 4 | 1.56 | 0.19 |
| 2018 DOC | Treatment | 1913 | 956 | 2 | 0.59 | 0.55 |
|  | Date | 98701 | 49351 | 2 | 30.68 | <<0.001\*\*\* |
|  | Treatment: Date | 1704 | 426 | 4 | 0.26 | 0.90 |
| 2019 DOC | Treatment | 4600 | 2299.8 | 2 | 0.93 | 0.40 |
|  | Date | 35405 | 17702.7 | 2 | 7.19 | 0.0014\*\* |
|  | Treatment: Date | 8208 | 2052 | 4 | 0.83 | 0.51 |
| 2018 TOC | Treatment | 2.27 | 1.14 | 2 | 18.40 | <0.001\*\*\* |
|  | Date | 0.72 | 0.36 | 2 | 5.80 | 0.0047\*\* |
|  | Treatment: Date | 0.18 | 0.044 | 4 | 0.72 | 0.58 |
| 2019 TOC | Treatment | 2.27 | 1.14 | 2 | 18.40 | <0.001\*\*\* |
|  | Date | 0.72 | 0.36 | 2 | 5.80 | 0.0047\*\* |
|  | Treatment: Date | 0.18 | 0.044 | 4 | 0.72 | 0.58 |

*Table S3.* ANOVA table of N cycling measures.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Measure | Variable | Sum Sq | Mean Sq | Num DF | F value | Pr (>F) |
| 2018 Ammonium | Treatment | 3.77 | 1.88 | 2 | 2.25 | 0.11 |
|  | Date | 44.77 | 22.28 | 2 | 26.75 | <<0.001\*\*\* |
|  | Treatment: Date | 1.15 | 0.29 | 4 | 0.34 | 0.85 |
| 2018 Nitrate | Treatment | 98.07 | 49.03 | 2 | 12.49 | <0.001\*\*\* |
|  | Date | 7.47 | 3.74 | 2 | 0.95 | 0.39 |
|  | Treatment: Date | 3.87 | 0.97 | 4 | 0.25 | 0.91 |
| 2018 Inorganic N | Treatment | 138.10 | 69.05 | 2 | 10.40 | <0.001\*\*\* |
|  | Date | 15.64 | 7.82 | 2 | 1.18 | 0.31 |
|  | Treatment: Date | 5.53 | 1.38 | 4 | 0.21 | 0.93 |
| 2019 Ammonium | Treatment | 84.51 | 42.25 | 2 | 2.07 | 0.13 |
|  | Date | 756.73 | 378.36 | 2 | 18.51 | <<0.001\*\*\* |
|  | Treatment: Date | 77.03 | 19.26 | 4 | 0.94 | 0.45 |
| 2019 Nitrate | Treatment | 4.23 | 2.12 | 2 | 1.83 | 0.17 |
|  | Date | 12.98 | 6.49 | 2 | 5.62 | 0.0056 |
|  | Treatment: Date | 2.97 | 0.74 | 4 | 0.64 | 0.63 |
| 2019 Inorganic N | Treatment | 56.17 | 28.08 | 2 | 1.29 | 0.28 |
|  | Date | 776.86 | 388.43 | 2 | 17.82 | <<0.001\*\*\* |
|  | Treatment: Date | 70.02 | 17.50 | 4 | 0.80 | 0.53 |
| 2018 N min | Treatment | 0.05 | 0.012 | 2 | 0.89 | 0.41 |
|  | Date | 0.19 | 0.097 | 2 | 7.042 | 0.0016\*\* |
|  | Treatment: Date | 0.072 | 0.018 | 4 | 1.30 | 0.28 |
| 2019 N min | Treatment | 0.096 | 0.048 | 2 | 0.77 | 0.47 |
|  | Date | 1.94 | 0.97 | 2 | 15.70 | <<0.001\*\*\* |
|  | Treatment: Date | 0.12 | 0.030 | 4 | 0.48 | 0.75 |
| 2018 TON | Treatment | 0.0080 | 0.0040 | 2 | 11.27 | <0.001\*\*\* |
|  | Date | 0.0019 | 0.00093 | 2 | 2.63 | 0.080 |
|  | Treatment: Date | 0.00042 | 0.0001 | 4 | 0.30 | 0.88 |
| 2019 TON | Treatment | 0.012 | 0.0061 | 2 | 7.78 | <0.001\*\*\* |
|  | Date | 0.033 | 0.016 | 2 | 20.97 | <0.001\*\*\* |
|  | Treatment: Date | 0.0016 | 0.00041 | 4 | 0.53 | 0.72 |
| 2018 N enzymes | Treatment | 1.22 | 0.61 | 2 | 1.59 | 0.21 |
|  | Date | 13.30 | 6.65 | 2 | 17.34 | <<0.001\*\*\* |
|  | Treatment: Date | 0.20 | 0.049 | 4 | 0.13 | 0.97 |
| 2019 N enzymes | Treatment | 2.61 | 1.30 | 2 | 3.86 | 0.026\* |
|  | Date | 7.65 | 3.83 | 2 | 11.33 | <<0.001\*\*\* |
|  | Treatment: Date | 1.02 | 0.25 | 4 | 0.75 | 0.56 |
| 2018 DON | Treatment | 100.7 | 50.35 | 2 | 2.58 | 0.083 |
|  | Date | 682.98 | 341.49 | 2 | 17.53 | <<0.001\*\*\* |
|  | Treatment: Date | 22.76 | 5.69 | 4 | 0.29 | 0.88 |
| 2019 DON | Treatment | 3.34 | 1.67 | 2 | 0.062 | 0.94 |
|  | Date | 292.54 | 146.27 | 2 | 5.40 | 0.0065\*\* |
|  | Treatment: Date | 107.91 | 26.98 | 4 | 0.997 | 0.42 |