# Appendix S2 for ‘Linked disturbance in the temperate forest: Earthworms, deer, and canopy gaps’

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# Section S1 – Model outputs showing the effect of fencing and canopy gap treatments on MOSS total earthworm density & biomass

**MOSS Total Earthworm Biomass**

| | sumsq | meansq | NumDF | DenDF | F-value | p.value |
|---|---|---|---|---|---|---|
| **Fence** | 0.12 | 0.12 | 1 | 63.00 | 5.54 | **0.021** |
| **Canopy Gap** | 0.21 | 0.21 | 1 | 61.28 | 9.36 | **0.003** |
| **Fence x Canopy Gap** | 0.06 | 0.06 | 1 | 63.00 | 2.50 | 0.120 |

**MOSS Total Earthworm Density**

| | $\chi^2$ | df | p.value |
|---|---|---|---|
| **Intercept** | 17.90 | 1.00 | **2.33E-05** |
| **Fence** | 4.58 | 1.00 | **0.03** |
| **Canopy Gap** | 0.33 | 1.00 | 0.56 |
| **Fence x Canopy Gap** | 0.50 | 1.00 | 0.47 |

# Section S2 – Model outputs showing the effect of fencing and canopy gap treatments on MOSS genera-specific earthworm biomass

| | MOSS *Aporrectodea* Biomass | | |
|---|---|---|---|
| | $\chi^2$ | df | p.value |
| **Intercept** | 14.53 | 1 | **1.38E-04** |
| **Canopy Gap** | 0.13 | 1 | 0.71 |
| **Fence** | 4.20 | 1 | **0.040** |
| **Canopy Gap x Fence** | 2.00 | 1 | 0.16 |

| | MOSS *Dendrobaena* Biomass | | | | | |
|---|---|---|---|---|---|---|
| | sumsq | meansq | NumDF | DenDF | F-value | p.value |
| **Canopy Gap** | 0.043 | 0.043 | 1.00 | 61.18 | 4.77 | **0.03** |
| **Fence** | 0.002 | 0.002 | 1.00 | 63.00 | 0.21 | 0.64 |
| **Canopy Gap x Fence** | 0.0003 | 0.0003 | 1.00 | 63.00 | 0.03 | 0.87 |

| | MOSS *Lumbricus* Biomass | | | | | |
|---|---|---|---|---|---|---|
| | sumsq | meansq | NumDF | DenDF | F-value | p.value |
| **Canopy Gap** | 0.20 | 0.20 | 1 | 61.6 | 7.85 | **0.006** |
| **Fence** | 0.16 | 0.16 | 1 | 63 | 5.99 | **0.020** |
| **Canopy Gap x Fence** | 0.05 | 0.05 | 1 | 63 | 1.86 | 0.18 |

# Section S3 – Model outputs showing the effect of fencing and canopy gap treatments on MOSS genera-specific earthworm density

| | Aporrectodea Density | | |
|---|---|---|---|
| | $\chi^2$ | df | p.value |
| **Intercept** | 0.12 | 1 | 0.73 |
| **Canopy Gap** | 0.16 | 1 | 0.68 |
| **Fence** | 4.13 | 1 | **0.04** |
| **Canopy Gap x Fence** | 3.69 | 1 | **0.05** |

| | Dendrobaena Density | | |
|---|---|---|---|
| | $\chi^2$ | df | p.value |
| **Intercept** | 8.83 | 1 | **0.003** |
| **Canopy Gap** | 1.42 | 1 | 0.23 |
| **Fence** | 1.34 | 1 | 0.25 |
| **Canopy Gap x Fence** | 0.68 | 1 | 0.41 |

| | Lumbricus Density | | |
|---|---|---|---|
| | $\chi^2$ | df | p.value |
| **Intercept** | 14.44 | 1 | **1.40E-03** |
| **Canopy Gap** | 4.82 | 1 | **0.028** |
| **Fence** | 2.07 | 1 | 0.15 |
| **Canopy Gap x Fence** | 0.33 | 1 | 0.55 |

# Section S4 – Model outputs showing the effect of year, fencing, and canopy gap location on earthworm density from 2006 to 2019 in the FE

**FE Earthworm Density Over 13 Years Under Canopy Gap**

| | $\chi^2$ | df | p.value |
|---|---|---|---|
| **(Intercept)** | 1216.77 | 1 | **2E-16** |
| **Year** | 212.32 | 1 | **2E-16** |
| **Gap Location** | 7.32 | 3 | 0.06 |
| **Year x Gap Location** | 100.46 | 3 | **2E-16** |

**FE Earthworm Density Over 13 Years In Fence**

| | $\chi^2$ | df | p.value |
|---|---|---|---|
| **(Intercept)** | 175.67 | 1 | **2E-16** |
| **Year** | 60.83 | 1 | **6.22E-15** |
| **Fencing** | 0.15 | 1 | 0.7 |
| **Fencing x Year** | 26.03 | 1 | **3.30E-07** |

# Section S5 –Pairwise comparison of earthworm density in gap location by year

| | | FE Pairwise Comparison Earthworm Density By Location & Year | | | | |
|---|---|---|---|---|---|---|
| **gap location** | **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** |
| *location = NG* | *2006/2019* | 0.15 | 0.04 | 64 | -0.60 | 0.55 |
| *location = NB* | *2006/2019* | -0.48 | 0.03 | 64 | -14.57 | **<0.0001** |
| *location = NT* | *2006/2019* | -0.32 | 0.03 | 64 | -9.87 | **<0.0001** |
| *location = ST* | *2006/2019* | -0.29 | 0.04 | 64 | -6.90 | **<0.0001** |

# Section S6 – Model outputs showing the effect of fencing and canopy gap location on 2019 earthworm biomass and density in the FE

| | FE Total Biomass | | | | | |
|---|---|---|---|---|---|---|
| | **Sum Sq** | **Mean Sq** | **NumDF** | **DenDF** | **F value** | **Pr(>F)** |
| **Fencing** | 0.09 | 0.09 | 1 | 8 | 1.89 | 0.21 |
| **Gap Location** | 0.27 | 0.07 | 4 | 32 | 1.34 | 0.27 |
| **Fencing x Gap Location** | 0.17 | 0.04 | 4 | 32 | 0.86 | 0.49 |

| | FE Earthworm Density | | |
|---|---|---|---|
| | $\chi^2$ | **df** | **p.value** |
| **(Intercept)** | 93.6 | 1.00 | **2E-16** |
| **Fencing** | 10.6 | 1.00 | **0.001** |
| **Gap Location** | 17.3 | 4.00 | **0.002** |
| **Fencing x Gap Location** | 11.5 | 4.00 | **0.02** |

# Section S7 – Pairwise analysis of earthworm density in fenced and unfenced canopy gap locations

| | | 2019 FE Pairwise Comparison of Earthworm Density by Gap Location | | | | |
|---|---|---|---|---|---|---|
| **Gap Location** | **Contrast (In Fence / Outside Fence)** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** |
| *Center* | *in-out* | -0.83 | 0.26 | 39 | -3.26 | **0.002** |
| *North Buffer* | *in-out* | -0.11 | 0.22 | 39 | -0.47 | 0.64 |
| *North Gap* | *in-out* | -0.04 | 0.23 | 39 | -0.17 | 0.86 |
| *North Transition* | *in-out* | -0.25 | 0.23 | 39 | -1.10 | 0.28 |
| *South Transition* | *in-out* | -0.15 | 0.23 | 39 | -0.67 | 0.51 |

# Section S8 – Model outputs showing the effect of fencing and canopy gap treatments on FE genera-specific earthworm density

| | FE *Aporrectodea* Density | | |
|---|---|---|---|
| | $\chi^2$ | df | p.value |
| **(Intercept)** | 0.20 | 1 | 0.66 |
| **Fencing** | 3.98 | 1 | **0.046** |
| **Gap Location** | 14.24 | 4 | **0.0066** |
| **Fencing x Gap Location** | 6.70 | 4 | 0.152 |

| | FE *Lumbricus* Density | | |
|---|---|---|---|
| | $\chi^2$ | df | p.value |
| **(Intercept)** | 19.52 | 1 | **0.00001** |
| **Fencing** | 9.25 | 1 | **0.002** |
| **Gap Location** | 11.94 | 4 | **0.02** |
| **Fencing x Gap Location** | 14.98 | 4 | **0.005** |

| | FE *Dendrobaena* Density | | |
|---|---|---|---|
| | $\chi^2$ | df | p.value |
| **(Intercept)** | 1.14 | 1 | 0.29 |
| **Fencing** | 0.24 | 1 | 0.62 |
| **Gap Location** | 7.46 | 4 | 0.11 |
| **Fencing x Gap Location** | 4.55 | 4 | 0.34 |