

The Long-Term Effects of Invasive Earthworms on Plant Community Composition and Diversity in a Hardwood Forest in Northern Minnesota

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Abstract

Non-native European earthworms are invading hardwood forests in the Chippewa National Forest, MN. We applied a model using historic O-horizon soil thickness to classify 41 hardwood sites in the Chippewa National Forest as “long-term wormed” (wormed during the 1989-1996 and 2017 sampling period), “short-term wormed” (unwormed during the 1989-1996 sampling period and wormed in the 2017 sampling period), or “unwormed” (unwormed during the 1989-1996 and 2017 sampling period). We found that graminoids, especially *Carex pensylvanica*, had the greatest abundance in sites that had been wormed for over two decades. The families with the greatest negative change in percent cover after over two decades of earthworm invasion were Asteraceae, Violaceae, and Sapindaceae (specifically *Acer* species). Across all diversity metrics measured, long-term wormed sites had the lowest understory plant species diversity, short-term wormed sites had intermediate diversity, and unwormed sites exhibited the highest diversity. Long-term wormed sites had the lowest species richness at both small and large scales (1 to 1024m²). The greatest within-group compositional dissimilarity occurred at sites that had been wormed for over two decades, indicating that compositional changes in plant communities are still occurring more than two decades since invasion. Sites that had been wormed for over two decades did not appear to have reached a compositionally similar end-state “wormed” community type. If results of this study are indicative of future trends as earthworms become established, it can be expected that understory diversity will decrease as hardwood forest stands become wormed over time.

Full Text

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Figures

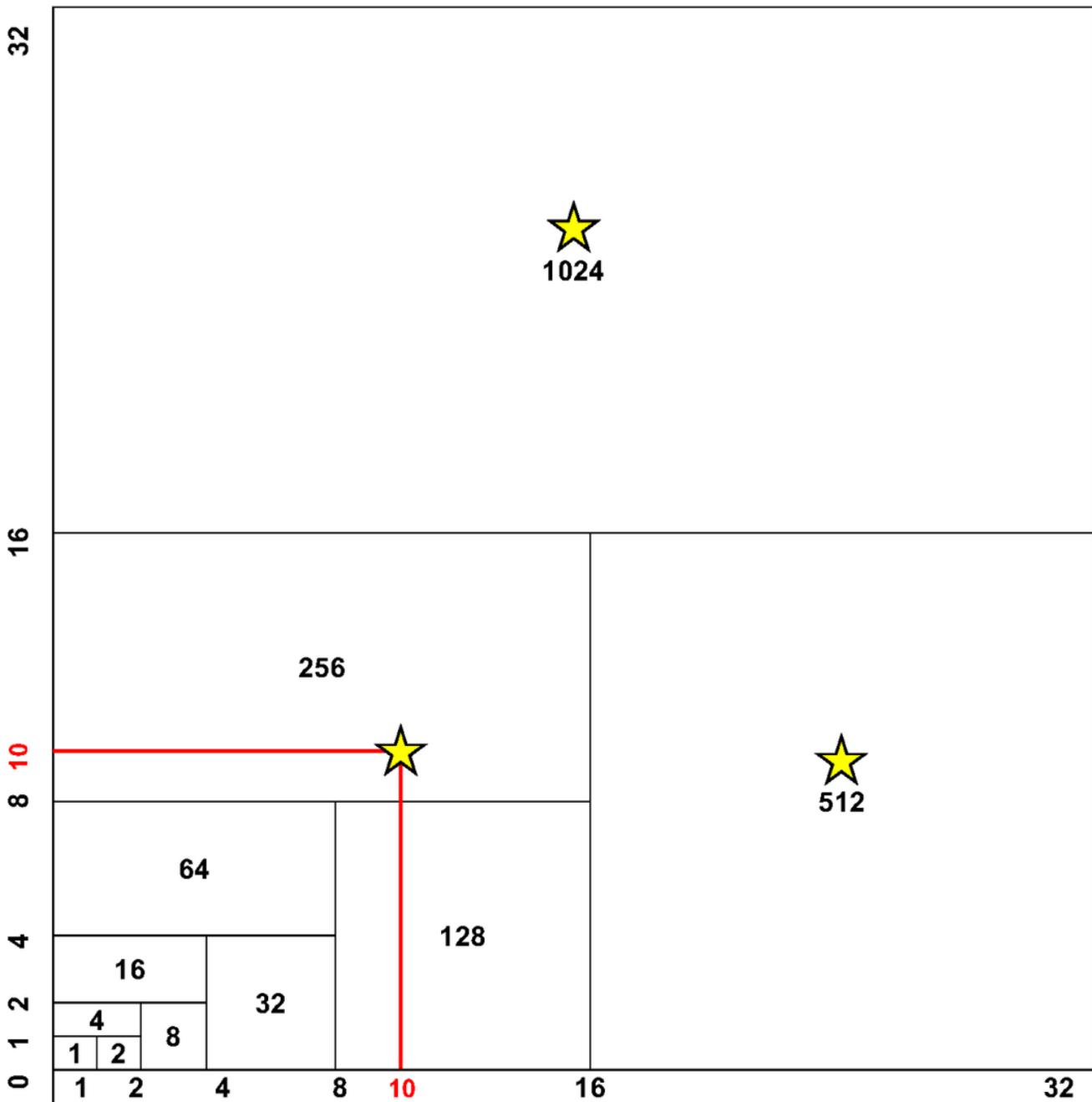


Figure 2

Sampling design for a 32 x 32-meter nested species area plot shown in black. Extent (10 x 10 meters) of a relevé is shown in red. Yellow stars indicate approximate location of earthworm sampling locations.

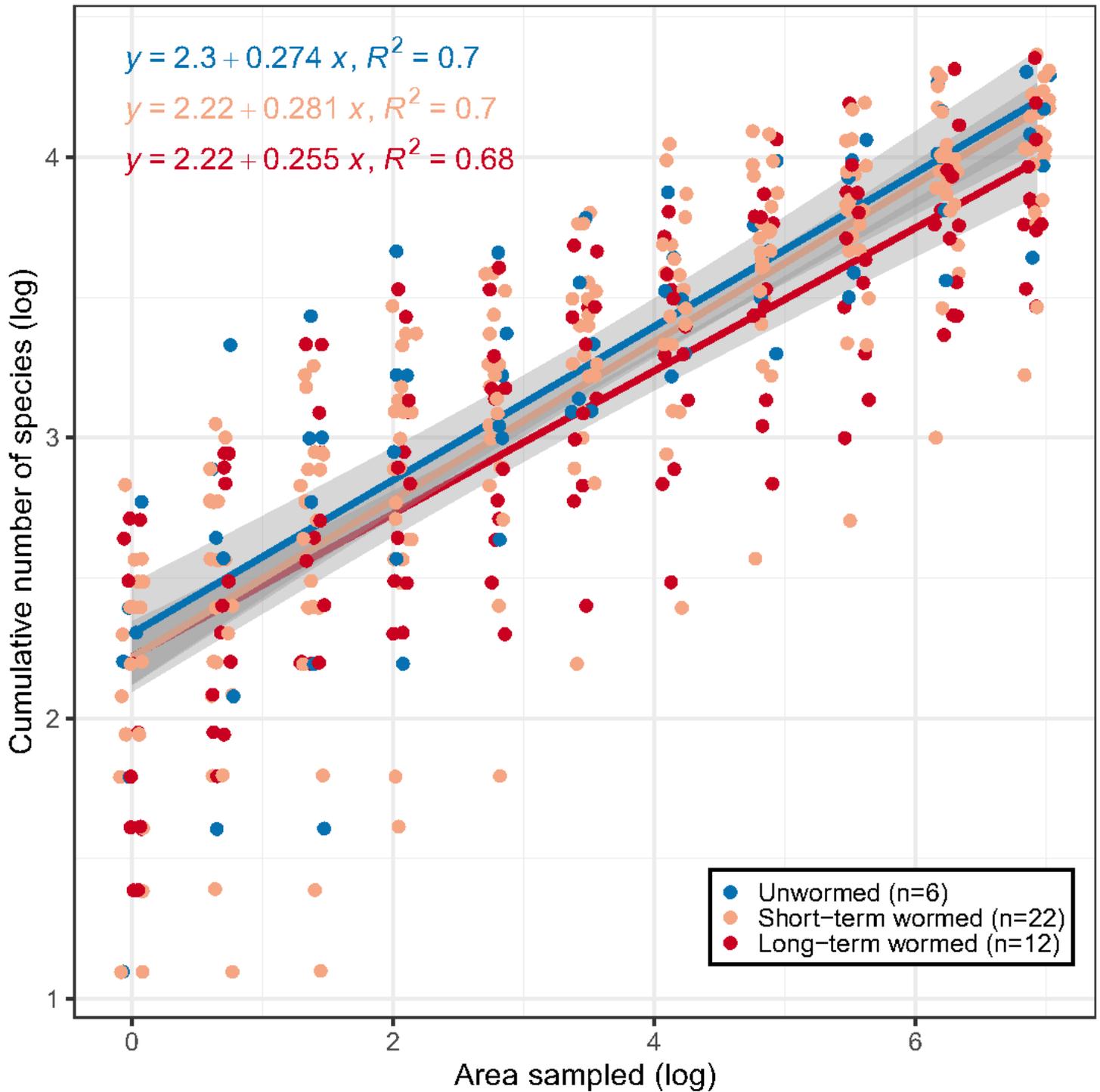


Figure 3

Species accumulation curve for unwormed, short-term wormed, and long-term wormed plant communities from species area plot data collected in hardwood forests of the Chippewa National Forest in 2017. Gray fill indicates 95% confidence interval.

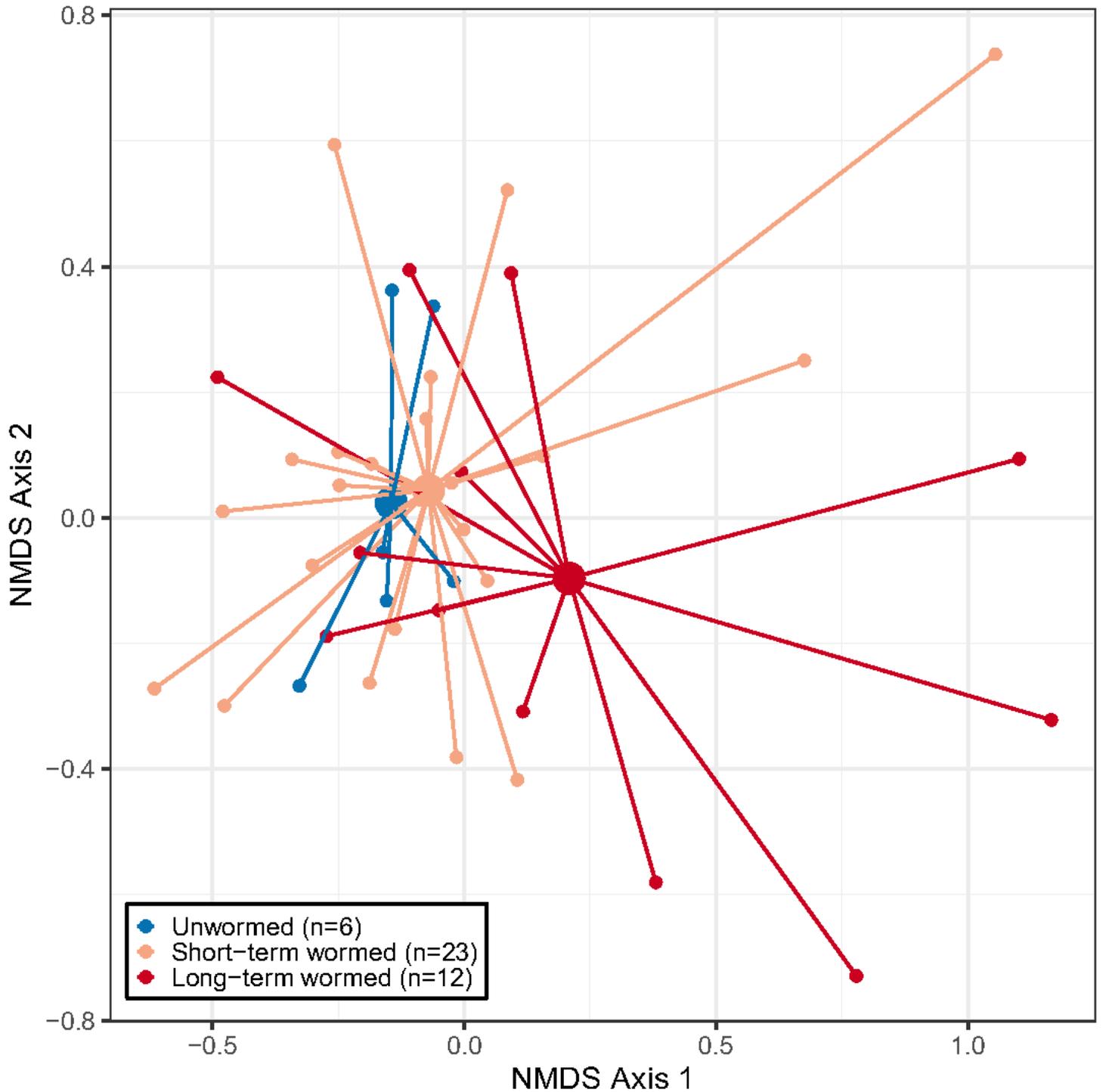


Figure 4

NMS plot for unwormed, short-term wormed, and long-term wormed plant communities from 10 x 10-meter relevé data collected in hardwood forests of the Chippewa National Forest in 2017. Larger circles represent the centroid for each community type. Smaller circles represent individual species area plots. Stress for the NMS ordination was 0.17.