Examining the effects of tree canopy and Japanese Barberry management on Asian Jumping Worms at White Memorial

Naomi Robert[1] and James Fischer[2]

[1]Wamogo Regional High School & [2]The White Memorial Conservation Center, Inc.,

ABSTRACT

Conserving northeastern forests requires handling many challenges. One important task is managing invasive species, such as Japanese barberry (*Berberis thunbergii*) and Asian jumping worms (Megascolescidae). We evaluated how managing Japanese barberry or tree canopy impacted jumping worms. We sampled earthworms in four treatments that varied in canopy cover and management of Japanese Barberry. Abundance and length of worms were recorded in each treatment. Asian Jumping Worms were significantly smaller when tree canopy was removed while worm abundance was not significantly impacted. Japanese Barberry management did not affect the length or abundance of worms. We hypothesize that removing tree canopy impacted the microclimate and amount of leaf litter which in turn impacted earthworm metabolism and food availability. Reduced body size could impact earthworm reproduction. This work continues in the quest for information that improves management of introduced earthworms in northern forest ecosystems.

INTRODUCTION

Introduced earthworms are changing northern forest soils and ecosystem processes. Earthworms have been associated with loss of leaf litter, incorporating organic matter in mineral soil layers, increasing number of invasive species and declining numbers of native plant species and many soil dwelling invertebrates (Bohlen et al., 2004; Nuzzo et al., 2009). Currently, few earthworm management strategies are available for land managers. Managing invasive plants is one potential strategy that has impacted earthworm abundance (Lobe et al., 2014, Madritch and Lindroth, 2009).

To date, management efficacy is primarily evaluated by measuring the impacts on earthworm abundance while other population biology parameters have not been explored i.e. growth, development, survivorship, reproduction, etc. This project explored how experimentally manipulating tree canopy and invasive plant cover impacts earthworm abundance and growth. We explored the biological and ecological interactions that potentially contribute to understanding earthworm population biology.

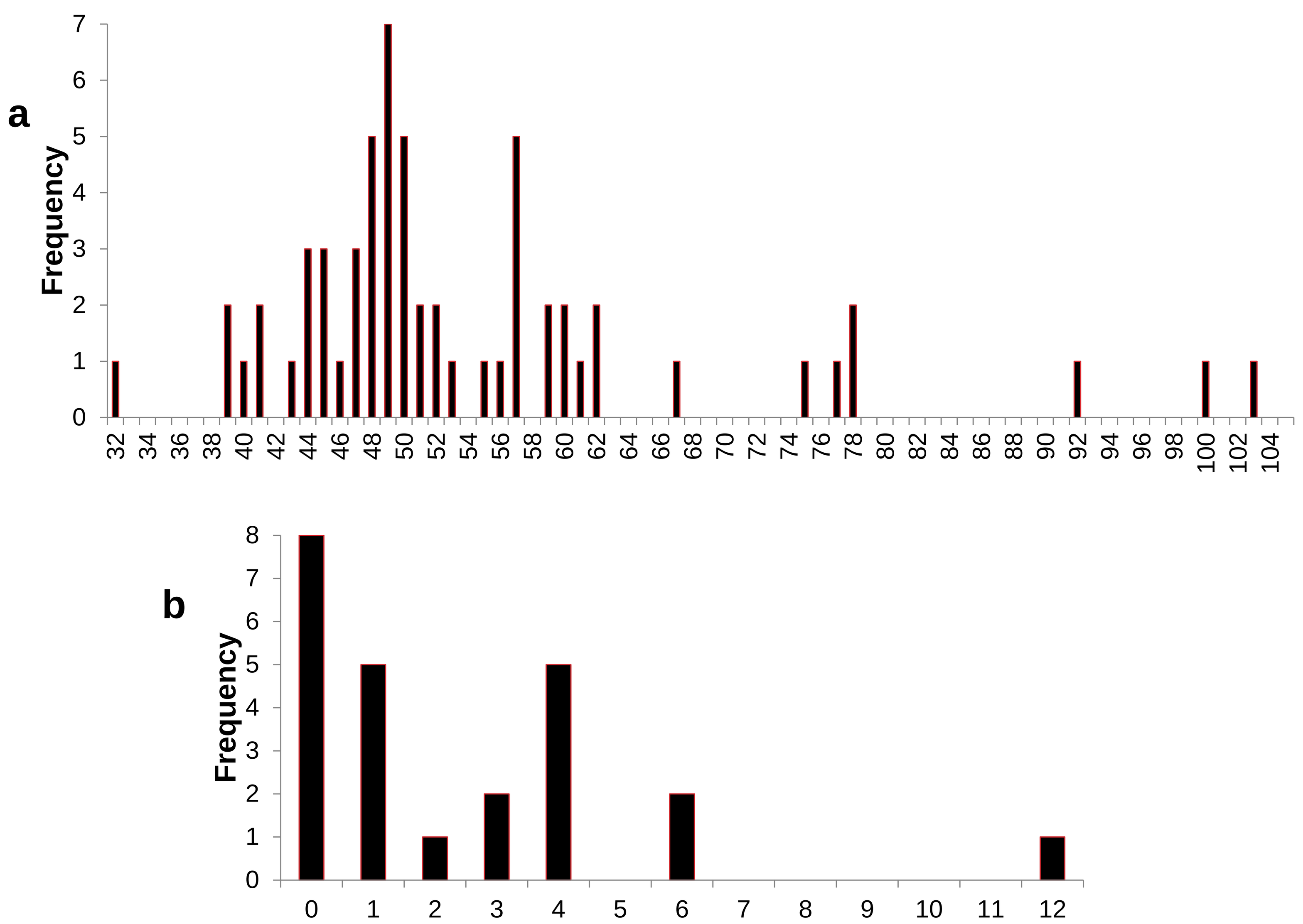

Figure 1. (a) Frequency distributions of earthworm body length and (b) number of worms collected per quadrat sample.

MATERIAL AND METHODS

Study Area and Organism

- Wheeler Hill, The White Memorial Foundation, Inc., Litchfield, CT, USA. (N 41.713652, W -73.228049°).
- Vegetative cover is a second growth mixed hardwoods consisting of red maple (*Acer rubra*) and white ash (*Fraxinus americana*) with a dense understory of Japanese barberry (*Berberis thunbergii*). All vegetation management occurred prior to this project.
- We had a total of 8 plots consisting of 3 quadrat samples/plot.
- A total of 2 plots in each treatment:
  - Tree Canopy & Barberry (Control Plot)
  - Tree Canopy Removed & Barberry Retained
  - Tree Canopy Retained & Barberry Managed
  - Tree Canopy Removed & Barberry Managed.
- We worked only with Asian jumping worms (Megascolecidae).

Data Collection Protocol and Analysis

1. We collected earthworms between September 18 - October 19, 2014.
2. Worms were collected within a 0.25 m^2 quadrat (11 in. X 11 in.).
3. Worms were extracted by pouring 2 - 3 doses of a mixture of 1 gallon of water with 40 grams of ground yellow mustard.
4. Earthworms were counted & preserved in plastic bags with 70% Ethanol.
5. Earthworms were preserved in 10% buffered formalin in petri dishes for at least 4 days.
6. Earthworm length was measured to the nearest millimeter.
7. Species identification was determined under a dissection microscope.
8. Data analysis (calculations and student t-test) was performed in Microsoft Excel.

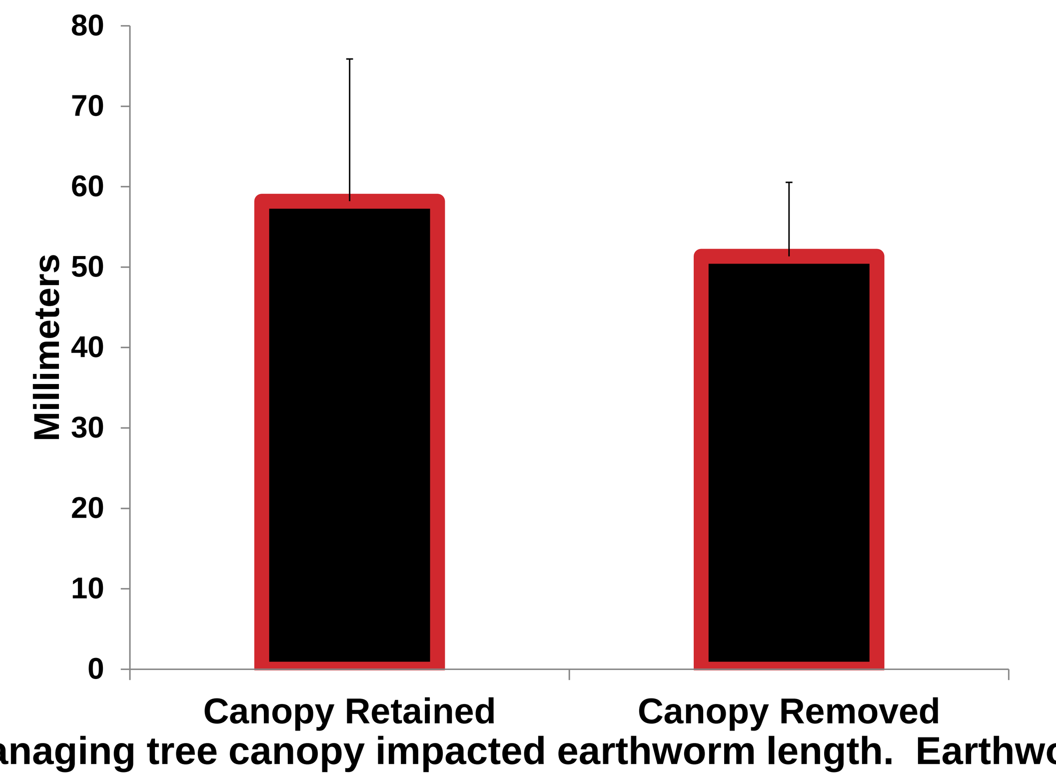

Figure 2. Managing tree canopy impacted earthworm length. Earthworms were statistically significantly smaller when tree canopy was removed than in plots where the tree canopy was retained. (student t-test: p-value = 0.0542, α = 0.10)

RESULTS

Body Size

- Earthworm body length range from 32 mm to 103 mm, averaging 54.26 mm, from a total of 57 worms collected (Figure 1a).
- Earthworms were significantly smaller when tree canopy was removed (Figure 2).
- Body length was not impacted by Japanese Barberry management (Figure 3).

Density

- Average number of earthworms collected per quadrat equaled 2.37, min. =0, max.=12 (Figure 1b).
- Earthworm density was not impacted by either vegetation management scenario (t-stat = 0.5076, p-value = 0.3089).

Biomass

- Earthworm biomass was not impacted by either vegetation management scenario (t-stat = 0.1405, p-value = 0.4465).

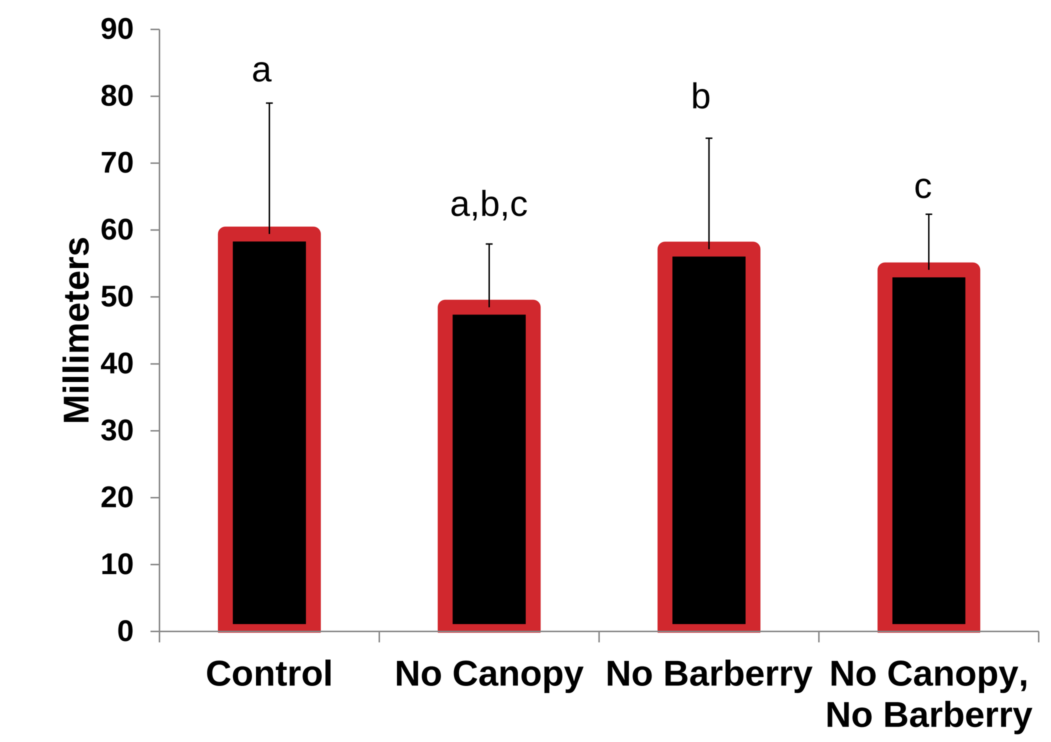

Figure 3. Average length of earthworms (1 S.D.) collected in each treatment, lower-case letters corresponds to statistically significant differences between averages using student t-test (α = 0.10). P-values for each letter pair: a = 0.0548, b = 0.0777, c = 0.0720.

CONCLUSIONS

We learned that removing tree canopy impacts the body length of jumping worms. This could be due to the lack of food because of less available leaf litter. Reduced tree canopy also allows more sunlight to reach the forest floor which creates warmer, drier soil conditions. Earthworms increase their respiration and their overall metabolism when they live in warmer microhabitats (Edwards and Bohlen, 1996). Earthworms might be smaller because there is less food available and they are investing more of their energy into respiration rather than growth. Smaller earthworms are less successful at sexual reproduction, mainly by mate selection. Larger earthworms choose larger mates over smaller mates (Manroy et al., 2005). Smaller worms might mate less often or have fewer offspring.

Currently, no management strategies are available for forest ecosystems influenced by exotic earthworms. This project explores the potential influence of vegetation management as an option for exotic earthworm management. Our observations suggest that vegetation management could influence earthworm growth and reproduction. Much more work is needed.

ACKNOWLEDGEMENTS

I would like to acknowledge my parents for the transportation to the plots, I would like to thank The White Memorial Foundation, Inc. for allowing me to use the property, and I would like to thank Mr. Chris Brittain for completing a recommendation for attending UCONN Natural Resource Conservation Academy.

REFERENCES

Boylen, P. J. et al. 2004. Non-Native invasive earthworms as agents of change in northern temperate forests. Front. Ecol. Environ. 2:427-435.

Edwards, C. A., and P. J. Bohlen. 1996. Biology and Ecology of Earthworms. Chapman and Hall, London, UK. pp. 433.

Madritch, M. D., and R. L. Lindroth. 2009. Removal of invasive shrubs reduces exotic earthworm populations. Biological Invasions 11:663–671.

Manroy, F., M. Aira, A. Velando, J. Dominguez. 2005. Size-assortative mating in the earthworm *Eisenia fetida* (Oligochaeta, Lumbricidae). Journal of Ethology. 23:69-70.

Nuzzo, V. et al. 2009. Earthworm invasion as the driving force behind plant invasion and community change in northeastern North American forests. Conservation Biology 23:966-974.