# IMPACTS OF EXOTIC EARTHWORMS ON THE TAXONOMIC DIVERSITY AND ABUNDANCE OF ARTHROPODS

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## 1. ABSTRACT

The recent invasion of exotic earthworms into northern forests has had large climatic and biotic impacts. This study examined the effects of exotic earthworms on arthropods. Pitfall traps were established at 16 study sites in the Huron Mountains of Northern Michigan's Upper Peninsula in two ecosystems, eastern hemlock dominated and sugar maple dominated.

The arthropods were identified and quantified. At higher densities of earthworms, the numbers of individuals of the arthropod taxa collembola (spring tails), opiliones (daddy long legs), rhapidophoridae (camel crickets), hymenoptera (bees, wasps, etc.), hemiptera (true bugs), and curculionidae (weevils) increased, while scarabaeidae and other coleopterans (beetles) decreased. The taxonomic diversity of all taxa studied indicated a decrease in diversity at higher densities of earthworms in sugar maple stands.

## 2. INTRODUCTION

- Recently there has been an invasion of exotic earthworm species into northern U.S. forests (McLaren and Pedlarchuk 1987, Hendrix and Bohlen 2002, Bohlen, et al. 2004 ).
- This invasion has caused alterations including elimination of organic soil horizon (Alban and Berry 1994, Bohlen, et al. 2004) and disruption of nutrient cycling (Bohlen, et al. 2004).
- Impacts of these earthworms on microarthropod communities have also been studied in their native setting and in labs (Seyferth&Rusek and Hendrix 1988, McLaren and Pedlarchuk 2005, Bohlen et al. 2004, Salamon et al. 2006), however, further studies are needed in non-native field settings.
- Since arthropods are important ecological indicators, it is pertinent to understand how they are impacted.

## 3. METHODS

- Sixteen 20x20m plots with a 5m buffer zone were established with half of the plots in sugar maple and half in hemlock stands. Within each stand type there were high, medium, and low density earthworm plots as determined by observation.

- Five plastic cup pitfalls placed at each plot location stratified sampling within a 5m buffer buffered 50% propylene glycol solution was used as bait, and a styrofoam cover was used to decrease disturbance.

- Two rounds of sampling were performed. The first traps were installed on June 10, 2005 and the second on July 7th, 2005 and specimens collected after 7 days.
- Specimens collected were identified at least to order. Once identified specimens were placed in 70% ethanol.
- Diversity was calculated using Shannon's Index of Diversity and ANOVA was performed on data using Microsoft Excel and Statistix 8.

## 4. RESULTS: Single Factor Influence

- When looking at the single factor of earthworm density Curculionidae, Hemiptera, and Collembolan are classified to family all increased with an increase in earthworm density.

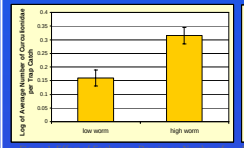


Figure 1: Effect of Earthworm Density on Number of Curculionidae Trapped, p=0.0003

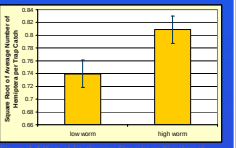


Figure 2: Effect of Earthworm Density on Number of Hemiptera Trapped, p=0.0231

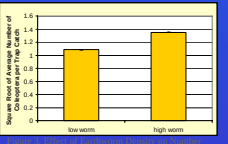


Figure 3: Effect of Earthworm Density on Number of Other Coleoptera Trapped, p<0.0001

## 5. RESULTS: 2-way Interaction Influence

•When single factor interactions couldn't be analyzed 2 way interactions between earthworm density and either round or forest type was. The average number of Scarabaeidae trapped in round 2 was higher in low density earthworm plots but Opiliones and Rhapidophoridae was lower.

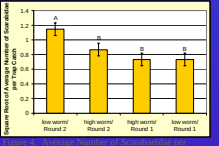


Figure 4: Average Number of Scarabaeidae per Trap with Earthworm Density x Round Interactions as Factor, p=0.0128

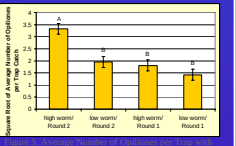


Figure 5: Average Number of Opiliones per Trap with Earthworm Density x Round Interactions as Factor, p=0.0023

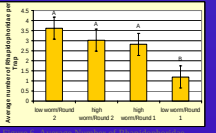


Figure 6: Average Number of Rhapidophoridae per Trap with Earthworm Density x Round Interactions as Factor, p=0.0046.

## 6. RESULTS: 3-way Interaction Analyzed by Round.

•For Collembola the data was analyzed separately by round. In round 1 there was a larger average number trapped in high earthworm density hemlock plots, but in round 2 there was a larger average number trapped in high density earthworm sugar maple plots.

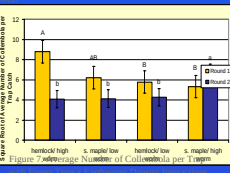


Figure 7: Average Number of Collembola per Trap with Earthworm Density x Forest Type x Round Interactions as Factor, Round 1, p=0.0153 Round 2, p=0.0020

•As earthworm density increased, overall diversity decreased in sugar maple stands of Round 2.

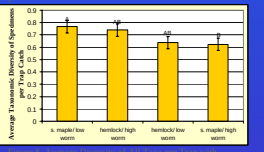


Figure 8: Average Diversity of All Taxa per Trap with Forest Type x Earthworm Density Interactions as Factor, p=0.0099

## 7. CONCLUSION

•Curculionidae, Hemiptera, Opiliones, Rhapidophoridae, Collembola, and other Coleoptera increased in number as earthworm density increased.

• Scarabidae decreased in number as earthworm density increased.

• However, in spite of more individual taxa positively correlating with earthworm density, overall taxonomic diversity decreased as earthworm density increased in sugar maple plots.

## 8. ACKNOWLEDGEMENTS

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