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Earthworms and ACOs: Determining a Preference for Cover Board Designs in Temperate Forests

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Abstract

Much research is needed to assess the impact of earthworms on temperate forest ecosystems in Pennsylvania. Artificial cover objects (ACOs) have proven beneficial for monitoring soil-dwelling species such as salamanders and frogs. This technique may also be beneficial for earthworm studies.

Introduction

For generations throughout the world, earthworms have been considered beneficial to the health of soil. Their ability to recycle nutrients has long been welcomed by gardeners, and arguably no species transforms organic material into rich fertilizer more efficiently (1). It might appear that these hardworking invertebrates deserve recognition for their contribution to Pennsylvanian forests, but some research now suggests that earthworms could be detrimental to our temperate forests' flora and fauna under certain circumstances (1).

Given the need to study earthworm distribution and abundance, researchers need to develop standardized, repeatable sampling techniques. To date I have found none used for worms. However, much work has been done to test techniques for monitoring salamanders and other ground-dwelling species (2). One method of monitoring is the placement of artificial cover objects (ACOs) in predetermined areas (2). ACOs are made of various materials and placed on the ground in an area of study. They can be repeatedly monitored and do minimal damage to the natural habitat (3). Using ACOs is a noninvasive way of monitoring, and could be appropriate for the study of earthworms.

Accordingly, my project had two related goals: 1) To determine if earthworms are attracted to ACOs, and 2) If yes, which designs would be most effective for long-term monitoring. The diminishing forest floor is a great concern. The more we learn about the earthworm, the sooner we can understand their relationship with the temperate forest.

Methods and Results

Fig. 1: A station in the GNA

- Five transects, or rows, were set up to contain 5 stations in each row
- Each station was composed of 6 different cover board designs arranged in 2 rows of 3
- Standard cover board size was 16" x 16"
- Cover boards varied in thickness (1/4" and 3/8"), and material (plywood, rubber, or a combination of both materials with a ¼" gap in between)
- Cover boards were used to monitor earthworm encounters

Data collected included:

- Transect and station number
- Board type
- Number of worms present
- Worm location under the board
- Approximate worm length

Fig. 2: Two representative worms found in GNA, showing the pigmented dorsal side and the pale ventral side

Fig. 3: Board Design vs. Sample Date

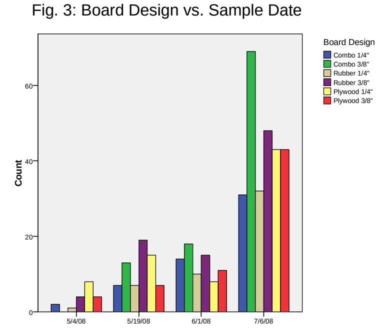

Fig. 4: Number of earthworms per sampling date

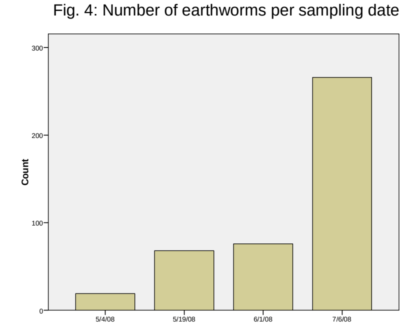

Fig. 5: Number of earthworms per Location

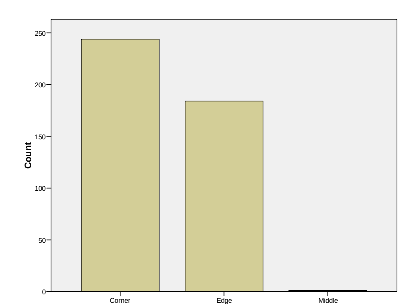

Figure 3: My data indicate a significant interaction between board design and sample date. While all boards were utilized, thicker boards were strongly preferred as the sampling season progressed.

Figure 4: The earthworm encounter rate varied significantly among the four sampling dates. The trend shows an increase in encounters with each subsequent sampling. The last date yielded a disproportionately higher number of earthworms.

Figure 5: The earthworm preference for location under the board differed significantly. The most utilized area was the corners, although edges were also quite popular. Both of these locations were used far more frequently than the middle.

1. Burton, Dennis. "The Trouble with Worms." Schuylkill Center for Environmental Education. http://www.wvnps.org/earthworms.html.
2. Tiebout, Harry. Personal interview. 8 Jan. 2008.
3. "Inventory Methods for Plethodontid Salamanders." Ministry of Environment, Lands and Parks Resources Inventory Branch for the Terrestrial Ecosystems Task Force Resources Inventory Committee. Version 2.0. 1 Mar. 1999

Discussion

Earthworms preferred both the rubber and combo boards of ? " thickness over all other board designs. Further analysis indicated that board thickness was most important in determining this preference.

Thicker boards are heavier, and are more likely to insulate the ground, keeping it cool. The heavier boards trap in more moisture, creating an ideal environment for the worms. Additionally, heavier boards lay flatter on the surface, which worms might prefer. During the June and July samplings (the summer sample dates), the heaviest boards had the most encounters by far (Fig 3). This supports the idea that thicker boards offer a more hospitable environment in the hotter months.

I offer two possible explanations for the sharp increase in worm encounters in July (Fig 4). First, as the worms grew, they were much easier to see and, consequently, count. A second explanation is that, as the temperature increased throughout summer, the worms sought refuge under the ACOs, as leaf litter alone can no longer keep them cool and moist.

Earthworms showed a remarkably strong preference for the outer boundaries of the cover boards (Fig 5). Over the course of the study only one encounter occurred in the middle section. Corners were the most frequented, with a substantial number of encounters occurring under the edges as well. The likely reason for this is that the boundaries are covered with leaf litter and the middle is not. One reoccurring determinant of worm encounters is the presence of moist leaf litter. It is also possible that corners and edges offer the best route of escape, if needed.

Conclusion

Based on my data, I am convinced that cover boards are a sufficient and reliable means for monitoring earthworms in a temperate forest ecosystem. However, the design of the board is important to encourage the greatest earthworm utilization.

I would propose a shape that would maximize corners and edges while maintaining a significant overall mass.

To enhance the number of corners, an initial rectangular design would then have a triangular area cut out of each of the longer sides.

Because mass is critical, the material chosen should be dense. To achieve this, I would choose a design that utilizes ½" plywood on the bottom with ¾" rubber on top, directly attaching the materials rather than leaving a gap.