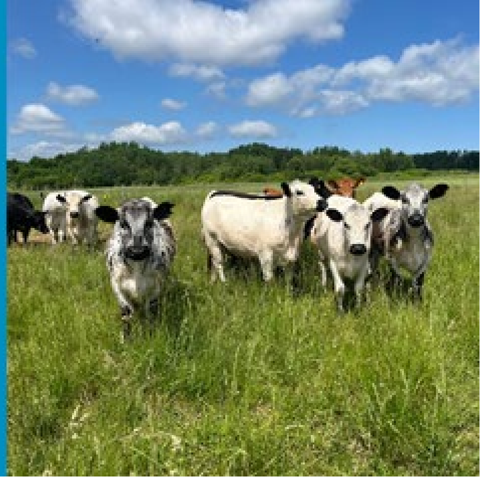
Ecosystem Engineers: Organisms Working for Better Soil Health



Highlights:

· Our land swap turned a horticulture field into a temporary pasture to increase soil health.

· Dung beetles and earthworms are ecosystem engineers, improving soil health and shaping the soil ecosystem

· We did not find a clear increase in dung beetles or earthworms over the 3-year pasture.

Mar 18, 2026

What is an ecosystem engineer?

An ecosystem engineer is a species that significantly impacts their habitat. They can modify, create, or destroy their habitat. Some large examples are elephants, who shape the savannah by tearing down trees and brush. Beavers create ponds and change watercourses as they build dams. But not all ecosystem engineers are so obvious and it is not so easy to see their impacts.

Earthworms have a large impact on the soil environment.

As part of Living Lab - Nova Scotia we are looking at how dung beetles and earthworms are impacted by our land swap beneficial management practice (BMP). This BMP creates a partnership between a horticulture producer and a livestock producer to install a temporary pasture on a horticulture field. We then test how that temporary pasture changes the soil health of the field as it goes back into horticulture production. Dung beetles and earthworms could play a large role in that soil health impact.

Both earthworms and dung beetles tunnel into the soil. As they do this, they draw down organic matter from the surface into the deeper soil layers. They also break down organic matter into more stable forms. When the temporary pasture of the land swap is tilled to prepare the field to go back into horticulture production this more stable, deeper carbon is potentially more protected from loss, helping the field to retain any gains in soil health from the pasture phase.

A dung beetle in the field working on a fresh dung pat.

Horticulture fields tend to have a high level of disturbance, which can negatively impact earthworm populations. They also tend to have low levels of crop residue returned to the field, creating less organic matter for the earthworms to use as a food source. Additionally, there would be no livestock dung in a horticulture field, so dung beetles would have no habitat outside of wildlife dung. For these reasons we expected the pasture to increase the populations of dung beetles and earthworms.

To learn how the land swap BMP impacted populations of dung beetles and earthworms, their populations were monitored from the start of the first pasture year to the end of the third year, before it went back into horticulture production.

How we assessed dung beetles and earthworms

Figure 1. Dung beetle pitfall trap from above, showing the mesh cover.

Dung beetles were captured using pitfall traps placed along the edge of the pasture (Figure 1). A hole was dug in the ground and a cup placed in the hole flush with the soil surface. Wire mesh was then placed over the cup with a piece of fresh dung wrapped in a cheesecloth hanging from the mesh. The dung attracts the dung beetles who would fall through the mesh and get trapped in the cup. Cups were left in the field for 7 days then collected and the number of dung beetles were counted. Sampling occurred from May to September when adult dung beetles are most active from 2023-2025 in temporary pasture fields, and in reference long-term pasture in 2025.

Earthworms were sampled once a year from 2023-2025 in June or July in temporary pasture fields, business-as-usual fields that remained in horticulture, and reference long-term permanent pasture fields in 2025 only. A 0.5 m^2 quadrat was placed on the soil and excavated by shovel to a depth of 10 cm (Figure 2). The soil was placed on a tarp and sifted for any earthworms. A mustard powder solution was then poured into the hole. Mustard is an irritant to earthworms and would cause any burrowed in the soil to come to the surface to be collected. Earthworms were collected for 30 minutes after the mustard solution was added.

Figure 2. Students sampling earthworms by excavating a quadrat and saturating with a mustard solution.

Did our temporary pasture Increase ecosystem engineers?

The most dung beetles were captured during the first year of sampling (Figure 3a). Looking at more detailed data, this was mostly due to high captures in the first month of sampling that year (Figure 3b). This was not what we expected. We expected that the longer the pasture was in place the more dung beetles would colonize the field. The highest value came mostly from a field which had livestock on the farm previously, although not on that field. There could have been enough dung sources for the numbers in the area surrounding our test field to be quite high.

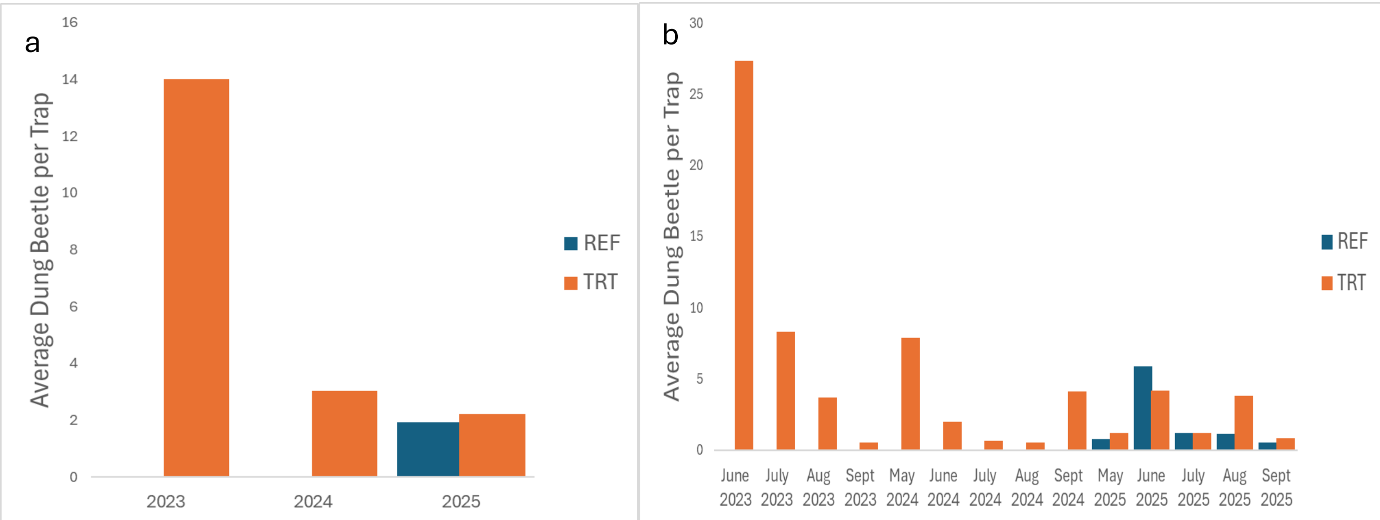


Figure 3a) Average counts of dung beetles collected in pitfall traps from 2023-2025 by year. 3b) Average counts of dung beetles collected by month. REF = long-term pasture, TRT = treatment (temporary pasture).

As to why the numbers were lower in 2024 and 2025, factors such as temperature and precipitation may have come into play. In 2025, when we can compare to a reference field that was a long-term pasture, you can see that there are slightly more dung beetles overall in the temporary pastures for that year.

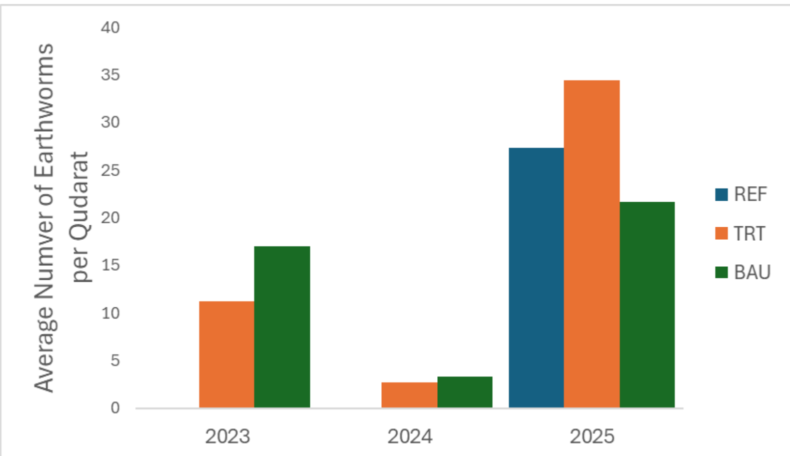


Figure 4. Average number of earthworms collected per quadrat by year from 2023-2025. BAU = business-as-usual (horticulture rotation), TRT = treatment (temporary pasture), REF = long-term pasture.

Earthworm numbers were only higher in the pasture compared to fields remaining in horticulture production in the final year, 2025 (Figure 4). Our temporary pastures also had higher amounts of earthworms compared to the long-term pastures. This could be due to differences in quality of the habitat at the fields. For example, earthworms prefer fine-textured soils over coarse. Overall numbers increased from 2023 to 2025 but only slightly. This could be due to the time it takes earthworms to colonize new areas. Additionally, numbers of earthworms were lower in 2024. This could have been due to temperature and precipitation around the time of sampling. Average soil temperature in 2024 at the time of sampling was 20°C and in 2025 it was 14°C. Earthworms prefer cool, damp conditions and burrow deeper in the soil if conditions are too hot and dry. In 2023 soil temperature averaged 25°C, but sampling was delayed that year until July due to excessive rains in June so earthworms may have acclimated to summer soil temperatures by this time.

How can this research be used?

We did not see increases in dung beetles over time when we converted a horticulture field to a temporary pasture. We did see a small increase in earthworms. This could be because they require more than 3 years to change their population or their numbers could be more influenced by other factors such as soil texture, moisture, or temperature. It is still worth considering these helpful organisms as you decide on field management. Creating low disturbance areas of your farm that have continuous living plants, such as a pasture, or creating wildlife habitats along field margins helps overall biodiversity and protects soil.

Want to Learn More?

For any questions on this research contact Alexandre Loureiro, our Living Lab Coordinator, at aloureiro@nsfa-fane.ca.

Find out more about the Living Lab project at nsfa-fane.ca/livinglabs. Here you can find our other research briefs and additional information resources.

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