Threat Mitigation and Soil Hydrology for the Giant Gippsland Earthworm

Hidden underground: how soil moisture supports this remarkable species

WHAT IS THE GIANT GIPPSLAND EARTHWORM?

The Giant Gippsland Earthworm (GGE) is one of the world's most well-known earthworms, yet despite being discovered over 120 years ago, much about this remarkable species remains unknown.

Living deep beneath the soil in South and West Gippsland Victoria, these earthworms can grow over a metre long and are rarely seen, but they can often be heard. When the soil is moist, their movement through water-filled burrows creates a distinctive "gurgling" sound in response to external stimuli.

For many years, observations of where these earthworms occur, typically in deep, moist clay soils, often along creeklines and soaks, have shown that soil moisture is essential for their survival. However, while we know moisture is important, the specific soil and hydrological conditions that support healthy populations are not well understood.

Changes to natural water movement in the landscape are considered one of the greatest threats to the species. Activities such as urban development, altered drainage, dams, and even dense revegetation can dry out or flood soils, making them unsuitable for the earthworms. Climate change is also likely to increase these pressures over time.

This project "*Threat Mitigation and Soil Hydrology in Giant Gippsland Earthworm Habitat*", funded by the Australian Government under the Saving Native Species Program, set out to better understand how soil moisture and hydrology influence GGE habitat, and to support landholders in protecting this unique species.

WHY DOES SOIL MOISTURE MATTER?

Earthworms rely on water in the soil to breathe, move and feed. They exchange oxygen and carbon dioxide through their skin which requires a thin film of moisture. If they dry out, worms cannot breathe.

💧 *Earthworms need moisture to breathe, move and feed*

WHAT DID THIS PROJECT DO?

📍 **Project area:** Arawata- South Gippsland

This project examined the role of soil hydrology in sustaining GGE colonies. A long-term monitoring program was established to measure soil moisture, temperature and oxygen at depth, together with rainfall and earthworm activity (gurgling) over a two -year period (2024-2026). The aim was to identify how moisture conditions vary through the soil profile and how these changes influence earthworm presence and activity across weather conditions.

A pilot hydrology study was undertaken at Arawata in partnership with Water Technology.

Soil probes (Figure 1) were installed to monitor conditions at multiple depths (10–80 cm) across four locations on a south-east facing slope:

- two areas with active GGE colonies
- one area with no earthworms (comparison site)
- one revegetated area within an earthworm colony

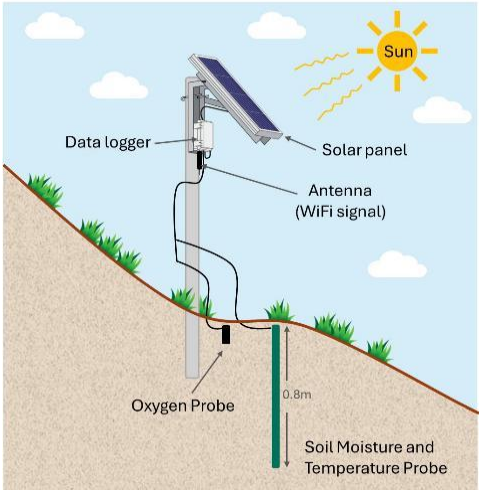

Figure 1 Conceptual diagram of soil moisture probe

This project received grant funding from the Australian Government Saving Native Species Program

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The sites were monitored over time to track changes in soil moisture and earthworm activity. Earthworm activity was measured using regular gurgle counts, allowing us to better understand the relationship between soil moisture and earthworm behaviour.

Monitoring captured conditions during an exceptionally dry period in 2025, providing insight into how earthworms respond to low soil moisture conditions.

WHAT DID WE FIND?

Soil moisture varied strongly throughout the year and was the key driver of earthworm activity. Levels were generally highest during winter and spring, and lowest during late summer and early autumn.

Soil moisture patterns

Soil moisture is matters — but not just at the surface

Surface soils were found to dry quickly during hot and dry conditions. In contrast, deeper clay soils remained more stable and retained moisture for longer periods. Deeper soils require sustained rainfall to recharge, rather than short, isolated rain events (Figure 2).

Even when the surface soils appeared dry, moisture was still present deeper in the soil profile, providing important refuge conditions for earthworms during dry periods. Monitoring showed that deeper soils often retained moderate to high moisture levels (around 50–70%) even during dry periods.

Earthworm Activity

Earthworms follow moisture, not seasons

Earthworm activity, measured by “gurgle” counts, closely followed soil moisture conditions. More gurgles were recorded during wetter periods when soils were moist, while few or no gurgles were detected during dry conditions, particularly over summer. This does not mean earthworms were absent, but rather that they were likely deeper underground and less detectable.

GGEs do not move large distances unless suitable habitat is continuous and they do not become dormant like many other earthworms. Instead, they rely on moving up and down within the soil profile to find moisture.

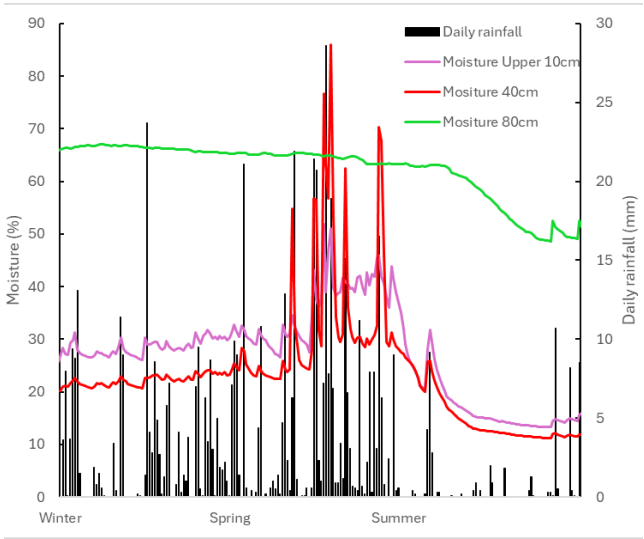
Monitoring indicates that gurgle activity is most commonly recorded when soil moisture levels are approximately 60–80% within the deeper soil profile (40–80 cm), with a narrower range of around 60–70% observed at 80 cm depth.

Key insight

Earthworms can’t just move somewhere else

GGEs don’t move far or go dormant — they survive dry conditions by moving deeper into moist soil. This means short-term rainfall may not immediately improve habitat conditions, making sustained soil moisture critical for their survival.

Figure 2. Soil moisture response to rainfall



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Rainfall and activity - sustained rainfall matters

The monitoring showed a strong relationship between rainfall and earthworm activity (Figure 3), with rainfall influencing soil moisture conditions that in turn drive earthworm activity (see Figure 2),

Initial monitoring during a high rainfall period in May 2024 recorded 52 gurgles. In contrast, monitoring during drier conditions in 2025 (e.g. May 2025) and over summer 2026 recorded substantially lower activity, with no gurgles detected during summer.

Despite rainfall in October 2025, gurgle activity remained relatively low, likely reflecting very dry soil conditions prior to this rainfall and limited recharge of deeper soil layers following the prolonged drought.

Monitoring also recorded low oxygen levels in deeper soils during saturated conditions. Excessively wet soils can flood burrows, forcing earthworms closer to the surface or out of their burrows (Figure 4). This highlights the importance of well-drained soils that maintain a balance between moisture and oxygen conditions.

Sustained soil moisture, rather than short-term rainfall, is essential for maintaining suitable habitat conditions.

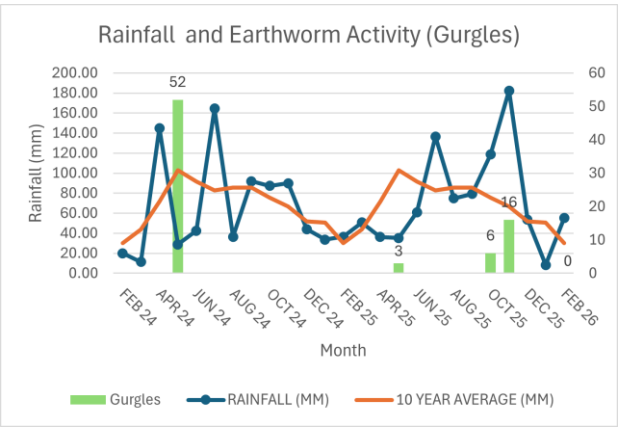

Figure 3 Rainfall patterns influence soil moisture and earthworm activity, with higher activity during wetter periods and little or no activity during dry conditions.

Surface soils respond rapidly to rainfall but dry quickly. Deeper soils respond more slowly and remain more stable, requiring sustained rainfall to recharge.

Figure 4. GGE are most likely to be seen when flooded out of their burrows. Saturated soils reduce oxygen levels forcing worms toward the surface. Image is for illustrative purposes only and not from the study.

Why some areas don't support GGEs

At one monitoring site where no GGEs were present, soil moisture declined significantly at depth during summer, falling below 35%. Unlike the earthworm habitat sites, this area did not retain moisture in deeper soil layers during dry periods.

This shows that the ability of soils to retain moisture at depth is a key factor in where GGEs can survive. Deep, clay-rich soils provide a stable underground environment that buffers earthworms from short-term changes in weather.

These soils retain moisture for longer, recharge more slowly, and maintain more consistent temperatures at depth.

In contrast, shallow soils — particularly on north-facing or steep slopes — dry out more quickly, experience greater temperature fluctuations, and do not retain moisture at depth.

These conditions reduce their suitability for sustaining earthworm populations.
GGE are rarely found in shallow soils or on north-facing slopes.

Adapted to life in deep soils

The GGE is adapted to life in deep clay soils, with a strong, muscular head that allows it to construct extensive and permanent burrow systems. It also has a high capacity to carry oxygen in its blood, enabling it to function in deeper soils where oxygen levels are often lower.

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Its large size is supported by these moist, stable conditions, but also limits its ability to move or relocate when conditions change. These adaptations allow the species to survive in deep soils but also make it highly dependent on consistent soil moisture, particularly in deeper soil layers

Soil temperature and reproduction

GGE typically lay their cocoons in the upper soil layers (within approximately 40 cm of the surface) (Figure 5). Monitoring showed that soil temperature fluctuates most near the surface (around 10 cm), while deeper soils remain more stable, with pasture and soil layers acting as a buffer.

In addition to moisture, soil temperature is likely to influence survival and reproduction, including cocoon development and hatching. Surface soils are more exposed to temperature extremes, particularly during hot and dry conditions, which may increase the vulnerability of cocoons.

Deeper soil layers provide a more buffered environment, maintaining more stable moisture and temperature conditions. This highlights the importance of deeper soil environments that buffer both moisture and temperature conditions.

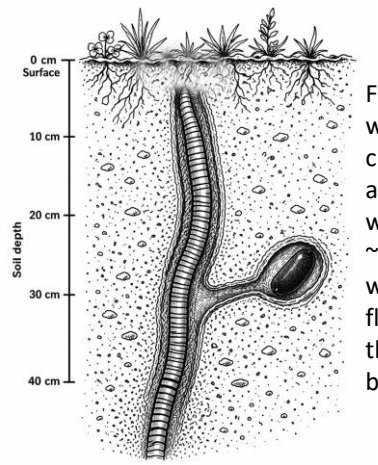

Figure 5 Egg cocoon within a side chamber . Cocoons are typically laid within the upper ~40 cm of soil, where temperature fluctuates more than in deeper, buffered soil layers.

Threats to soil moisture

Changes to natural water movement, such as drainage alteration, development, or changes in vegetation, can affect soil moisture and potentially impact earthworm habitat. Climate change may also increase the frequency of dry conditions.

Understanding how soil moisture behaves through the soil profile helps guide better management of GGE habitat, particularly during dry periods and under changing climate conditions.

Vegetation and soil moisture

Monitoring identified differences between revegetated and pasture sites. At the revegetated site, soil moisture at depth (80 cm) was lower during summer and extended dry conditions. In the following year, deep soil moisture did not recover to the levels observed at other sites (approximately 60–70%).

This suggests that vegetation can influence how soil moisture is retained and recharged at depth. Dense planting may increase water use and reduce the recharge of deeper soil layers, particularly during dry periods.

Careful revegetation design is therefore important to maintain the soil moisture conditions required to support GGE habitat.

Protecting soil moisture means protecting the Giant Gippsland Earthworm — and the hidden ecosystems it supports.

Looking Ahead

This project is just the beginning of understanding how soil moisture influences GGE habitat.

Future work will focus on expanding monitoring to more sites, tracking how earthworms respond to dry and wet periods, and improving our understanding of the conditions needed to support healthy populations. Investigating methods such as devices that track GGE movement by acoustic monitoring will improve our understanding of worm movement in response to change. This will help guide better management of habitat into the future in the face of climate change and changing land use.

This project was delivered through a collaborative partnership between the Gippsland Threatened Species Action Group, Bass Coast and South Gippsland Landcare Networks, Oates Environmental Consulting, Invert-Eco Terrestrial Invertebrate Consulting, and Water Technology.

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