



Everything you probably never wanted to know about

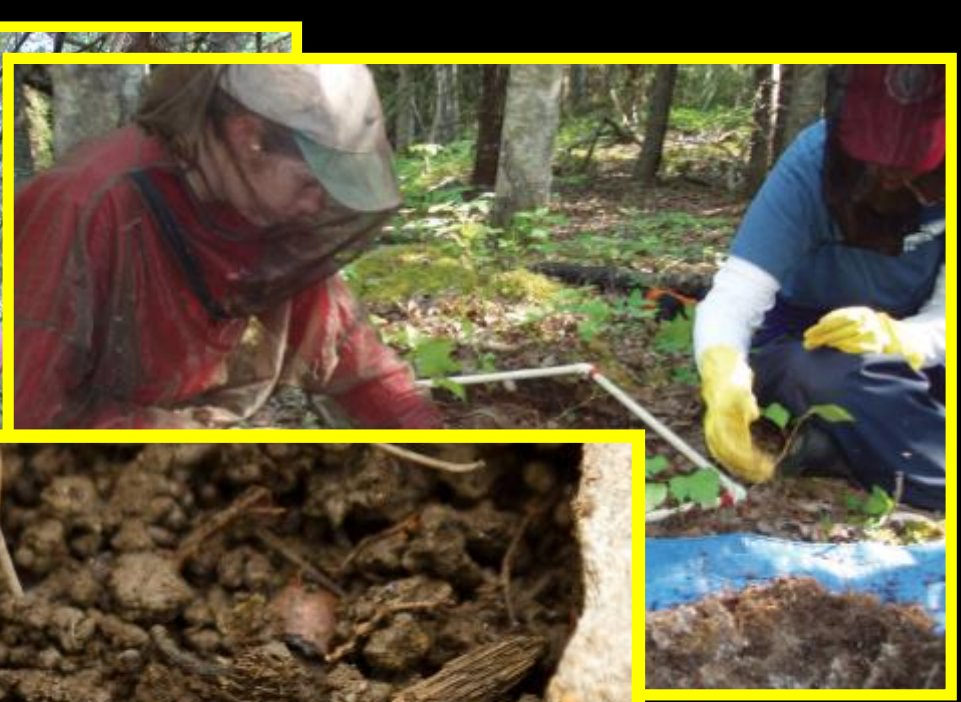
**WORMS!**











# Why do you think you like earthworms?

A photograph of a robin bird in a grassy field. The bird is facing right, looking down. A large yellow banner with black text is overlaid diagonally across the image. Several smaller text boxes are also overlaid on the image.

**Earthworms are just all round super COOL!**

**Earthworms can compost waste.**

**Earthworms provide food for birds and other animals.**

**Earthworms recycle other organic material.**

**Earthworms provide fertilizer.**

# Why you might want to reconsider how you feel about earthworms.

A close-up photograph of a mole's hand, which is pinkish and has small claws, holding a large, dark brown earthworm. The mole is in a grassy field, and a mound of dark soil is visible in the background.

Earthworms are an invasive species.

Earthworms upset soil chemistry.

Earthworms make it more difficult for native plants and insects to thrive.

Earthworms can damage forests.

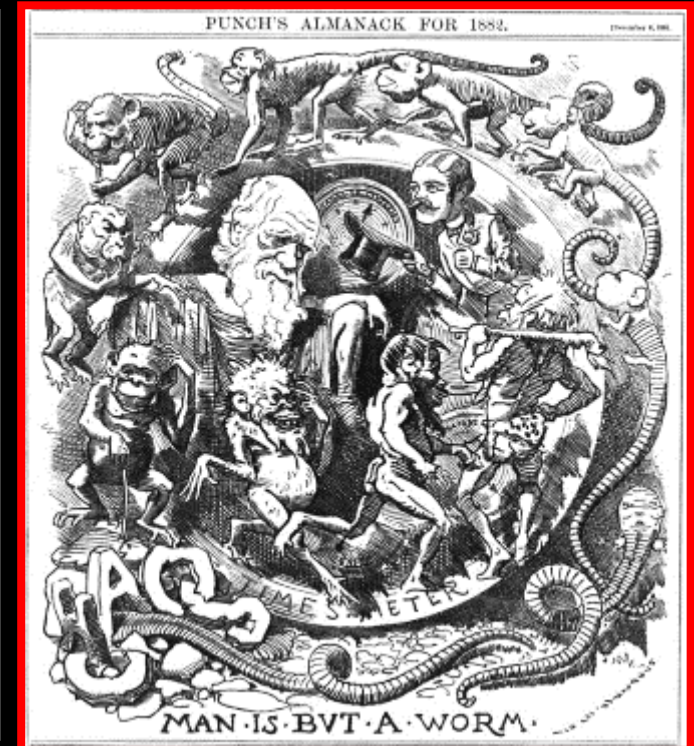
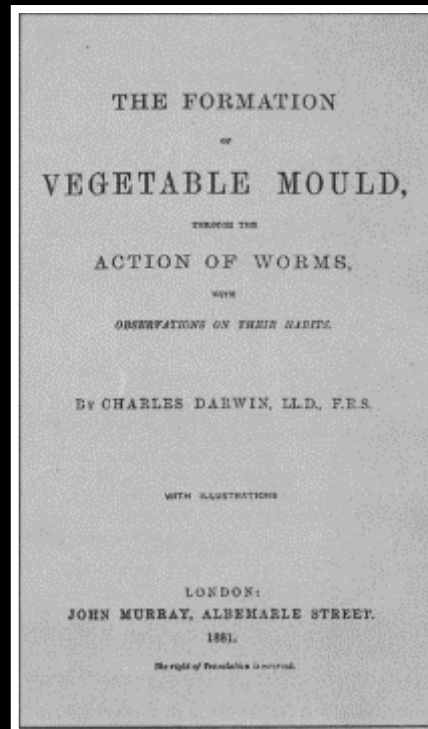
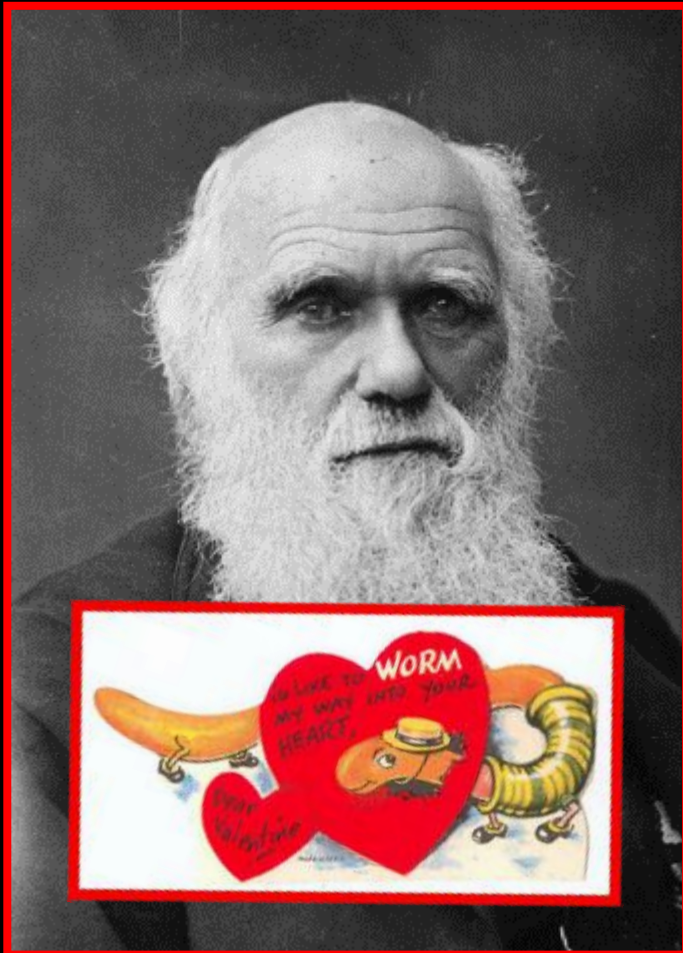


# WHO OPENED THE CAN?



In his last botanical work, *The Formation of Vegetable Mould, Through the Action of Worms*, which was published 6 months before his death in 1881. Charles Darwin demonstrated the service that worms perform in digesting leaves and recalculating organic matter.

Charles Darwin considered the earthworm the most influential creature on the planet.



**They are ubiquitous in all but the driest of regions of the world. There are about 9000 species of worms both aquatic and terrestrial although only a few species are commonly known.**





**ANNELIDS** are segmented or ringed worms

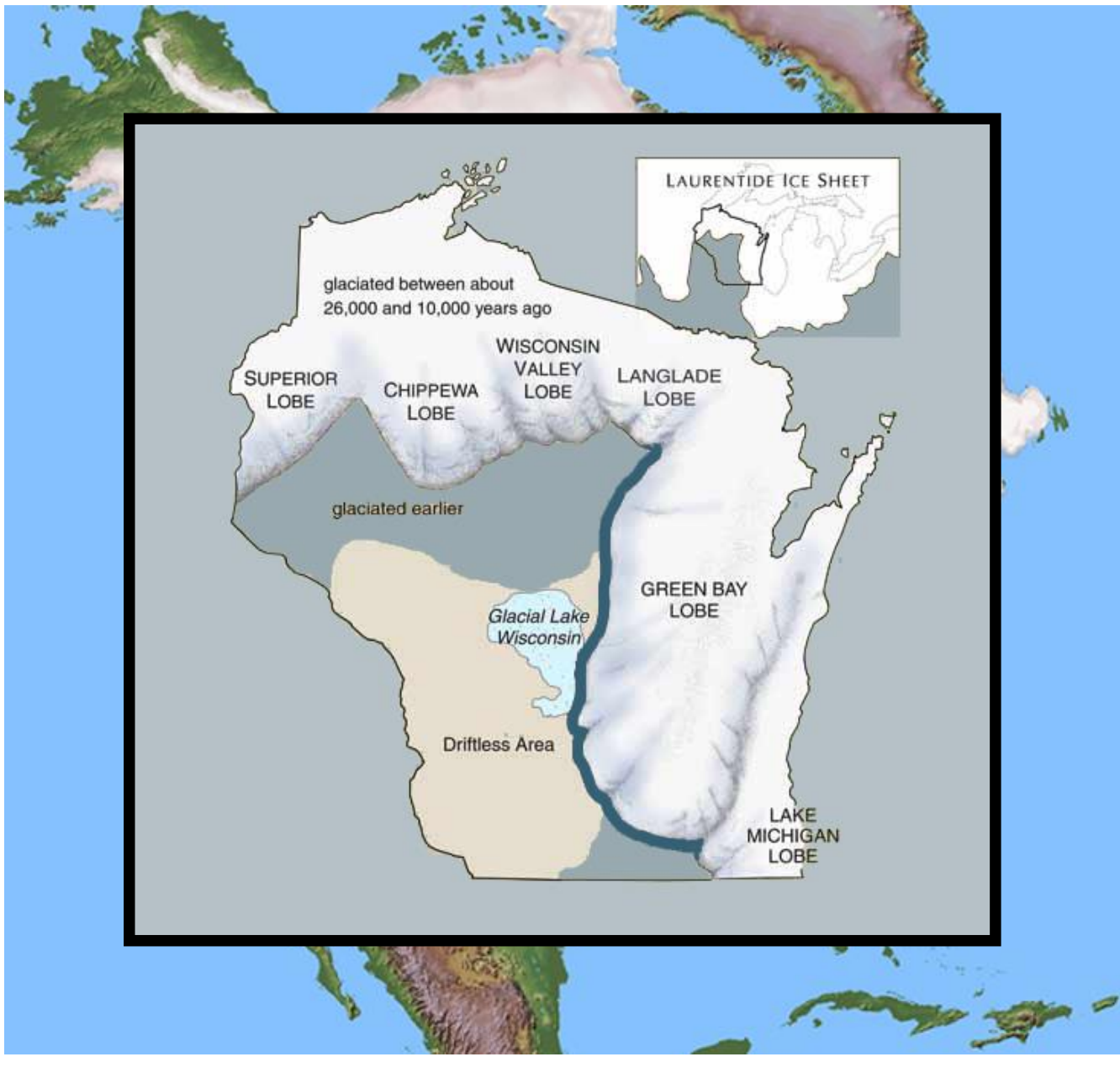
They are amongst the most ancient of terrestrial animals, their ancestors emerging in the pre-Cambrian some 600 to 700 million years ago.

They pre-date the invasion of fungi, land plants, insects (400 to 500 million years)

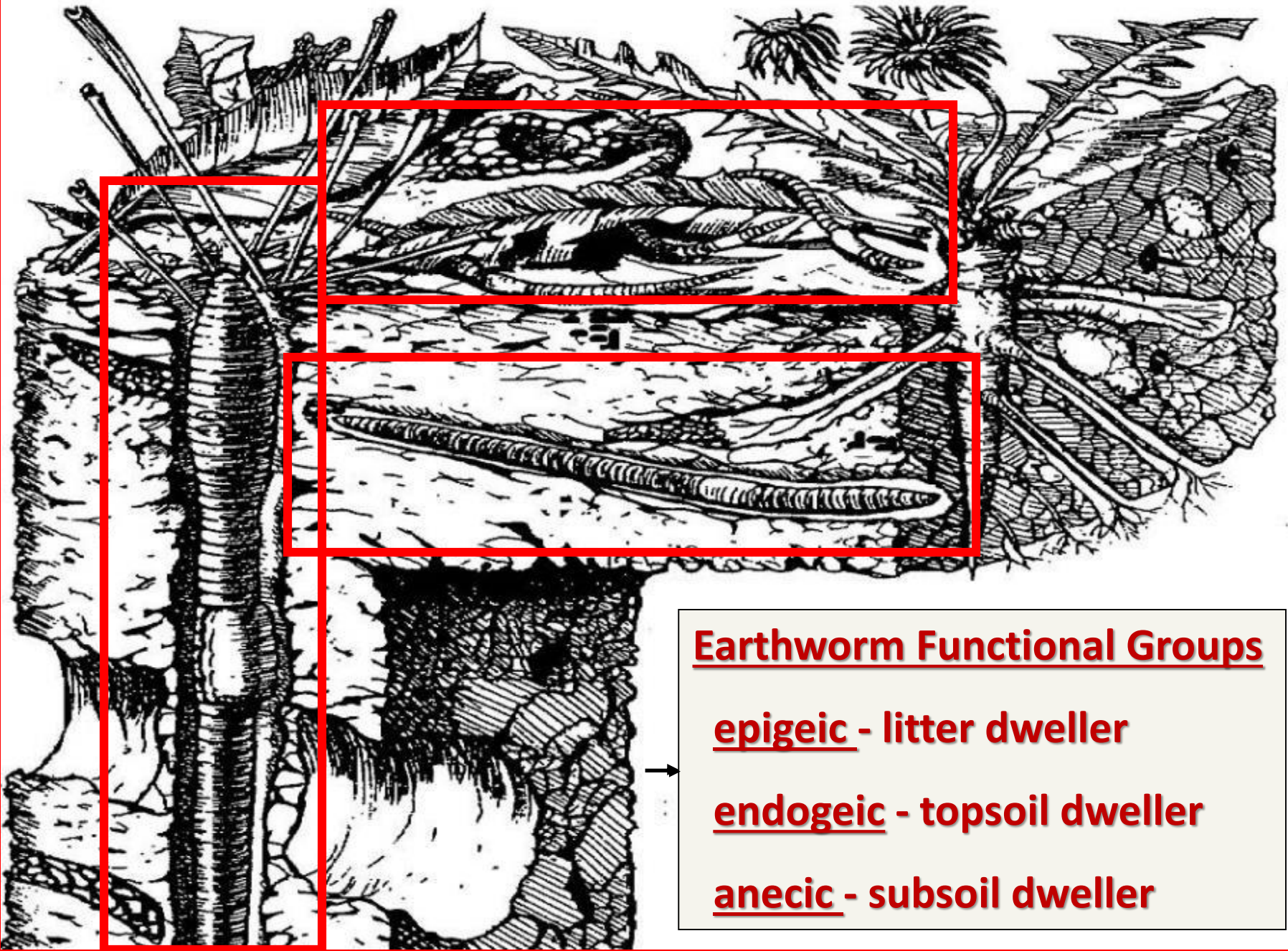
Dinosaurs and mammals (200 million years)

Hominids (4 million years)

**Worms in WISCONSIN...**



**Few native earthworms exist in the northern-most reaches of the continental United States. Most species were forced south in the last major glaciation, which ended 10,000 years ago.**



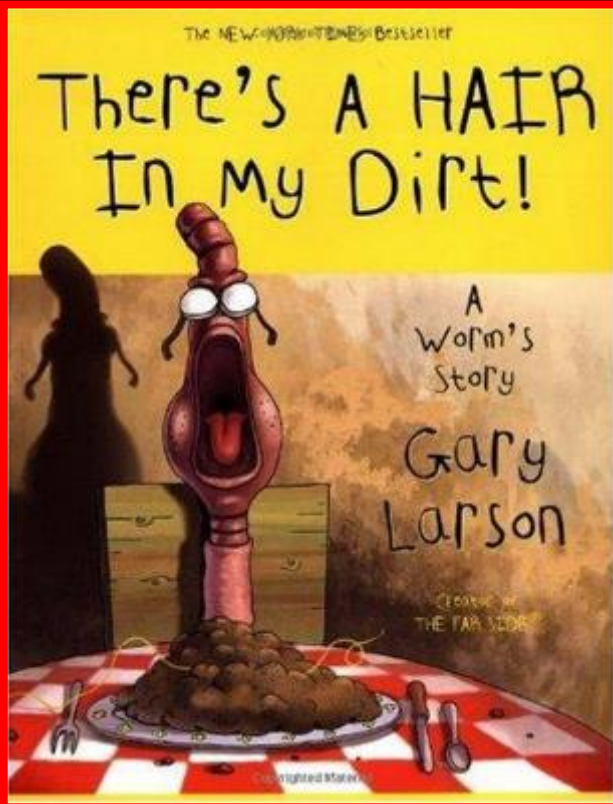
**Earthworm Functional Groups**

**epigeic - litter dweller**

**endogeic - topsoil dweller**

**anecic - subsoil dweller**

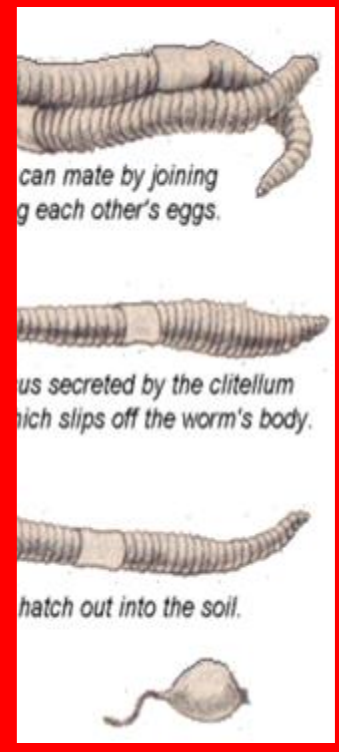
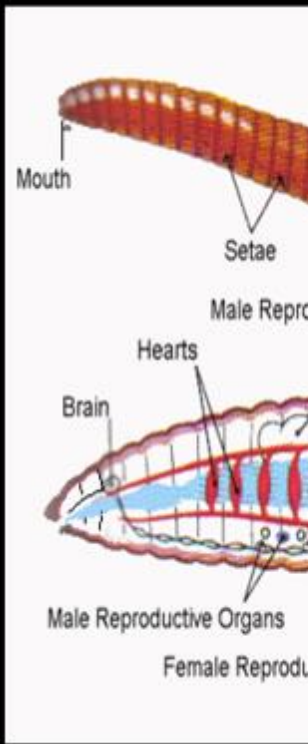
# Earthworm Ecology



**Worms eat dirt. They are detritivorous where they feed on decaying organic matter (leaf litter) and geophageous (dirt) and feed mainly in the soil layers.**



# Earthworm Biology



**Earthworms are promiscuous, polygamous, hermaphrodites but some can reproduce parthenogenetically.**

# Lumbricus terrestris

Night crawler



# Lumbricus rubellus

Leaf worm



# Aporrectodea caliginosa

Pink nosed worm



# Eisenia fetida

Red wiggler



# Dendrobaena spp.

Small leaf worm

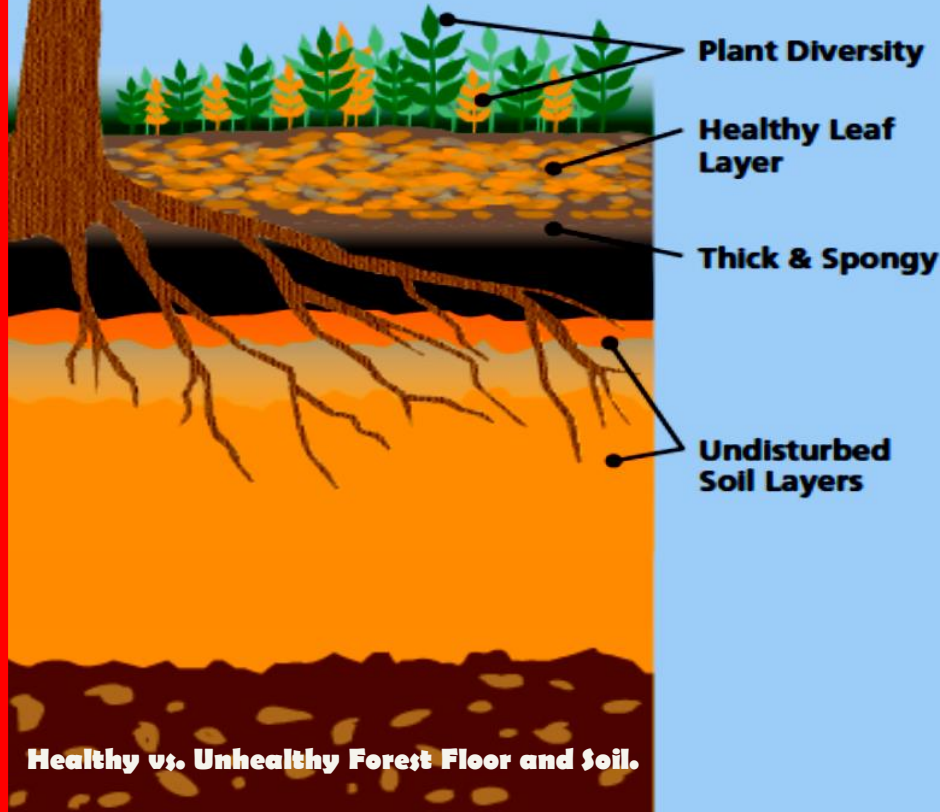


**If they are widespread why are they a problem?**

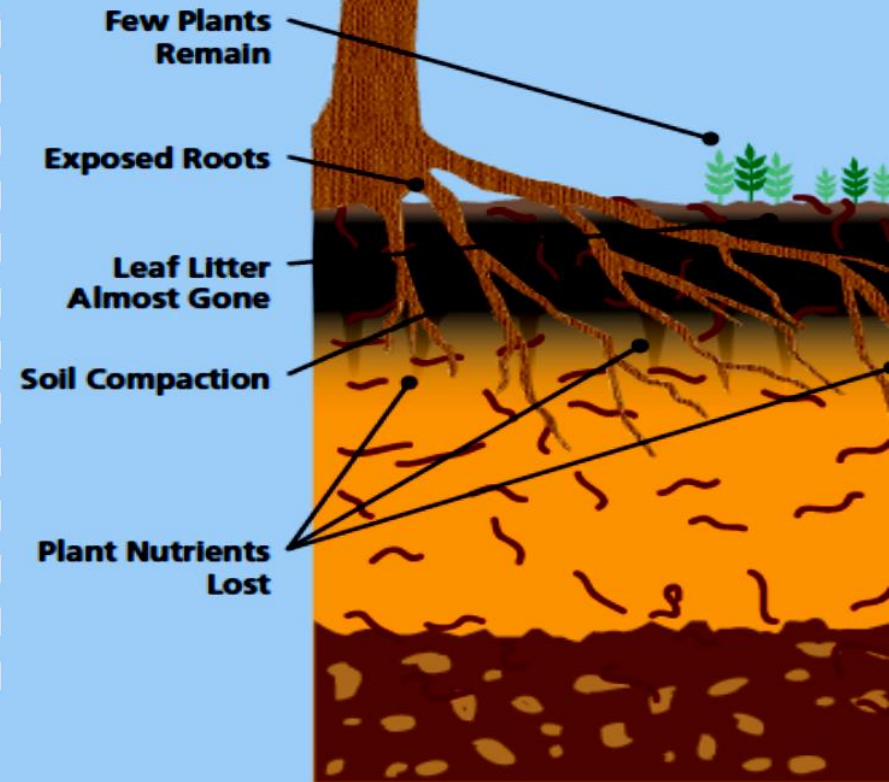


# What Happens to the Woods?

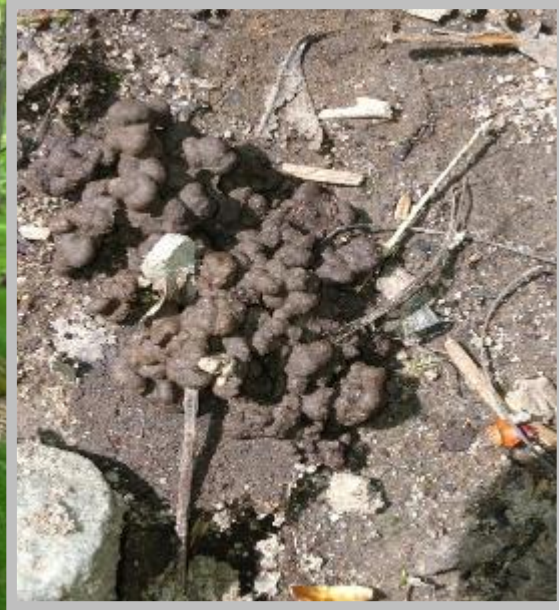
## Lightly Infested



## Heavily Infested



Earthworms have considerable capacity to change the nature of their environment to suit their survival. Ecological requirements (moisture, temperature, and food supply) greatly influence the rates of reproduction and growth.



**When a forest becomes heavily infested with earthworms the leaf litter is depleted and the soil is vulnerable to invasive species which in turn causes a decrease in the diversity of native plants and animals.**

E is for  
Earthworm

I know you agree... there is nothing more EXCITING!





**What about those  
other WORMS...**

# Amynthas spp.

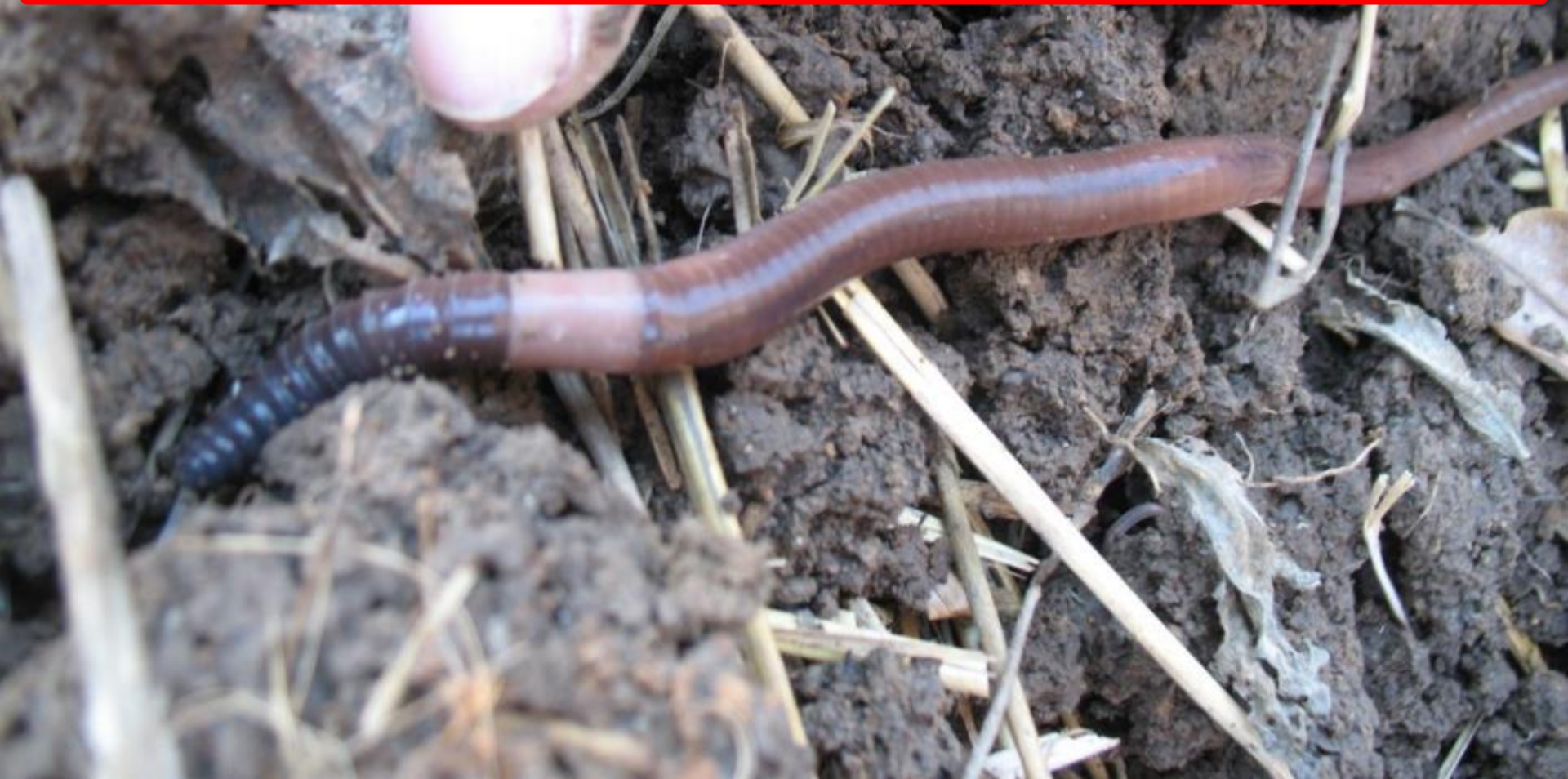
Jumping worm, Crazy Worm, Snake Worm, Alabama Jumper

- They are a **RESTRICTED** species in Wisconsin under Invasive Species Rule NR 40.  
[dnr.wi.gov/topic/invasives/classification.html](http://dnr.wi.gov/topic/invasives/classification.html)
- The first population was identified in 2013.





**Jumping worms in the genus *Amyntas* are currently invading areas around the globe, including North America, Central America, Europe and now WISCONSIN.**





While the invasion of European earthworms into North America is recognized and studied in the United States, the secondary invasion of Asian species have been little realized, detected or studied until recently and currently are not at all well understood.

# Amynthas spp.

Jumping Worm, Crazy Worm, Snake Worm, Alabama Jumper

## Characteristics

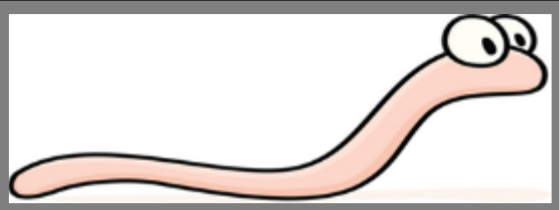
- Darker in color – appearing almost gray
- Glossy smooth skin
- Light milky white clitellum smooth to the body
- Very active, thrashing and jumping
- Moves like a snake
- Sheds its tail when handled
- Parthenogenic – asexual reproduction so it only takes one worm to start a family.

# Biology & Ecology

**WHY IT'S GOING TO BE A PROBLEM?**

- Reaches maturity in 60 days much faster than Lumbricidae species at 120 days – thus allowing for 2 hatches a season.
- Voracious appetites
- Highly adaptive to temperature changes
- Cocoons winter over
- Adaptive, non-particular to habitat types
- Produces a unique soil signature
- Outcompetes /pushes out, infects, poisons?  
Non-native European species of earthworms.





# Earthworm Comparison

*Amyntas* spp.



- Length:** 7 to 20 cm
- Life Cycle:** Annual; over-winters as cocoon
- Skin:** Darker dorsally than ventrally, slightly rigid
- Clitellum:** Milky white, annular, smooth
- Clitellum from segments** 14-16
- Behavior:** Very active, snake like
- Casts:** “Coffee grounds” soil signature
- Loses its tail** when handled roughly

*Lumbricus rubellus*



- Length:** 2 to 8 cm
- Burrows into soil** during winter
- Color:** Reddish-brown
- Clitellum:** Raised, pink/red, “saddle” shape
- Clitellum from segments** 26-32
- Behavior:** Less active, “wiggly”
- Casts:** Dispersed casts
- Will not drop tail**



**A single Jumping worm or cocoon stowed away in a potted plant can go home with a customer and start a new infestation.**

**Moving soil from one place to another, the horticultural trade can facilitate the passive spread of invasive earthworms.**

# STORIES TO H SPELLB

MAY

IT'S FOUND US!

IT'S THE WORM!

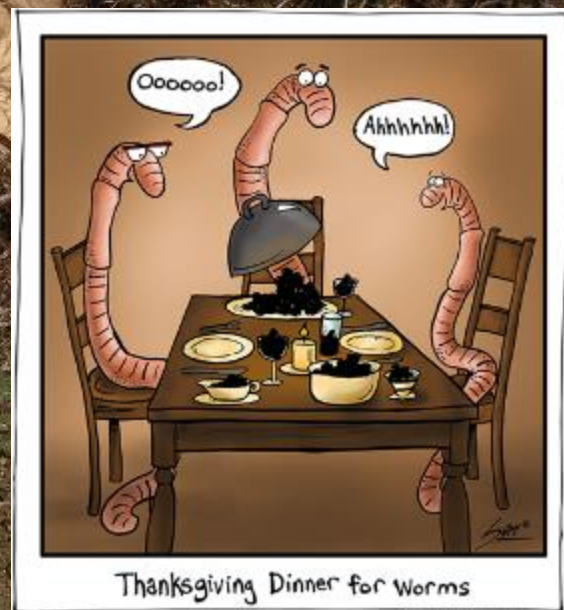


# HOW ARE THEY SPREADING?

Earthworms in the genus *Amyntas* appear to be closely associated with horticulture.







Thanksgiving Dinner for Worms

PLANT  
Sale  
→





**Dispose of Bait Worms in the Trash**

**Contain Your CRAWLERS!**



[dnr.wi.gov/invasives](http://dnr.wi.gov/invasives)

**Keep Worms OUT of Wisconsin's Woods!**

FR-494a-2012





## Why should we be concerned?

The effect of European earthworms on forest ecosystems has been well studied and include:

- Significant reduction to litter layer in deciduous forests
  - Loss of native plant diversity and increase in exotic, invasive plant species.
- Changes in soil nutrient dynamics
  - We think the effects of *Amyntas* spp. will be similar, but more dramatic.
- Parthenogenic and easily spread



# What can we do?

## Best Management Practices (BMP's)

1. Watch for jumping worms and signs of their presence.
2. Educate yourself and others to recognize jumping worms.
3. Only use, sell, plant, purchase, trade landscape and gardening materials and plants that appear to be free of jumping worms.
4. Only sell, purchase or trade compost that was heated to appropriate temperatures and duration following protocols for reduction in pathogens (PFRP's-detailed under NR 502.12).
5. Arrive clean, leave clean. Clean soil and debris from vehicles, equipment and personal gear before moving to and from a work or recreational area.

Stop the Spread!



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# GREEN INDUSTRY CRAZY WORM REASONABLE PRECAUTIONS

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Developed for nursery, garden center and landscape contractor professions.

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## 1. PROPAGATION AREAS

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- Remove leaf debris from facilities and dispose of at a specified holding/compost site.
- Dispose of culled plants at the proper site- compost, bury or burn.
- Clean soil from all tools, boots and gloves before entering the propagation facility or moving from one site to another.
- Inspect all incoming plant material, place in quarantine area for acceptable time before introducing into general population.
- Clean large equipment and trucks as needed before returning from an offsite location.

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## 2. CONTAINER GROWING AREAS

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- Only use properly prepared compost in container mixes.
- Keep soil media mixing site and media bins free of debris, clean as necessary.
- Clean all equipment between mix batches. Only allow mix equipment, authorized trucks and personnel in mixing areas.
- Inspect all mix ingredient purchases.
- Dispose of culled plants in proper location.
- Produce container plants between an air gap or effective barrier between container and soil surface.

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## 3. FIELD GROWING AREAS

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- Do not accept or spread clean leaf debris or yard waste from outside sources in growing fields unless it has been properly composted.
- Clean equipment and trucks before entering new farms to care for plant nursery stock.
- Inspect all plant material for organisms before planting, during the growing season and before harvest.
- Scout and monitor soil for organisms on an annual basis.

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## 4. SHIPPING/RECEIVING AREAS

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- Quarantine all incoming plant material until inspected.
- Clean debris from trucks and dispose of in authorized location.
- Heal balled stock in gravel, properly composted material, or wrap balls in plastic or leave exposed to open air to discourage pests.
- All plants should be stored and held using an air gap between the soil and plant/container or on an effective surface barrier limiting soil contact.
- Inspect all plants before shipping off site.

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## 1. CULL PILES AND SITES

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- Locate cull piles in separate/isolated areas and always away from sensitive naturalized areas. Always use specified waste sites when disposing of materials (burn pile, burying or composting).
- Do not accept yard waste from outside sources.
- Cull piles should be separated/isolated from all other areas of the facility such as growing areas, and clean media mix components. Take precautions to prevent cull materials from being inadvertently dispersed or moved from the localized cull site. (e.g. wind, rain, etc.)
- Landscape waste must be disposed of at proper cull sites.

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## 2. BIOSECURITY (PRODUCTION AREAS EXCLUDING PUBLIC RETAIL AREAS)

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- All visitors must check in to main office before entering any of the production areas.
- Employees must clean soil from clothes, gloves and shoes before moving from one designated production area to another.
- Visitors must observe company policy when entering into areas of production. (foot and vehicular traffic)
- All visiting vehicles should report to an entry specific site before going to deliver or load and should be inspected for contaminants.
- Tarp all loads that represent risk in spreading potential threats.
- Educate and train all personnel of potential risks to nursery production areas (pests, disease, etc.).

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## 3. RE-USE OR RECYCLING CONTAINERS AND BARRIERS

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- Recycle-Remove excess soil from containers and place soil in cull pile.
- Re-use-Clean and inspect materials before re-use. Properly dispose of nonrecycled materials according to local ordinances.

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## 4. GENERAL LANDSCAPE CONSTRUCTION PRECAUTIONS

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- Landscape waste must be disposed of at proper cull sites.
- Clean soil from all tools, boots and gloves before entering the propagation facility or moving from one site to another.
- Clean large equipment and trucks as needed before returning from an offsite location or in the designated cull pile site.
- Inspect all incoming plant material, place in quarantine area for acceptable time before introducing into general population.
- Heal balled stock in gravel, properly composted material, or wrap balls in plastic or leave exposed to open air to discourage pests.
- All plants should be stored and held using an air gap between the soil and plant/container or on an effective surface barrier limiting soil contact.
- Inspect all plants before shipping off site.



# Research at the UW-Arboretum

Biol Invasions  
DOI 10.1007/s10530-016-1264-5



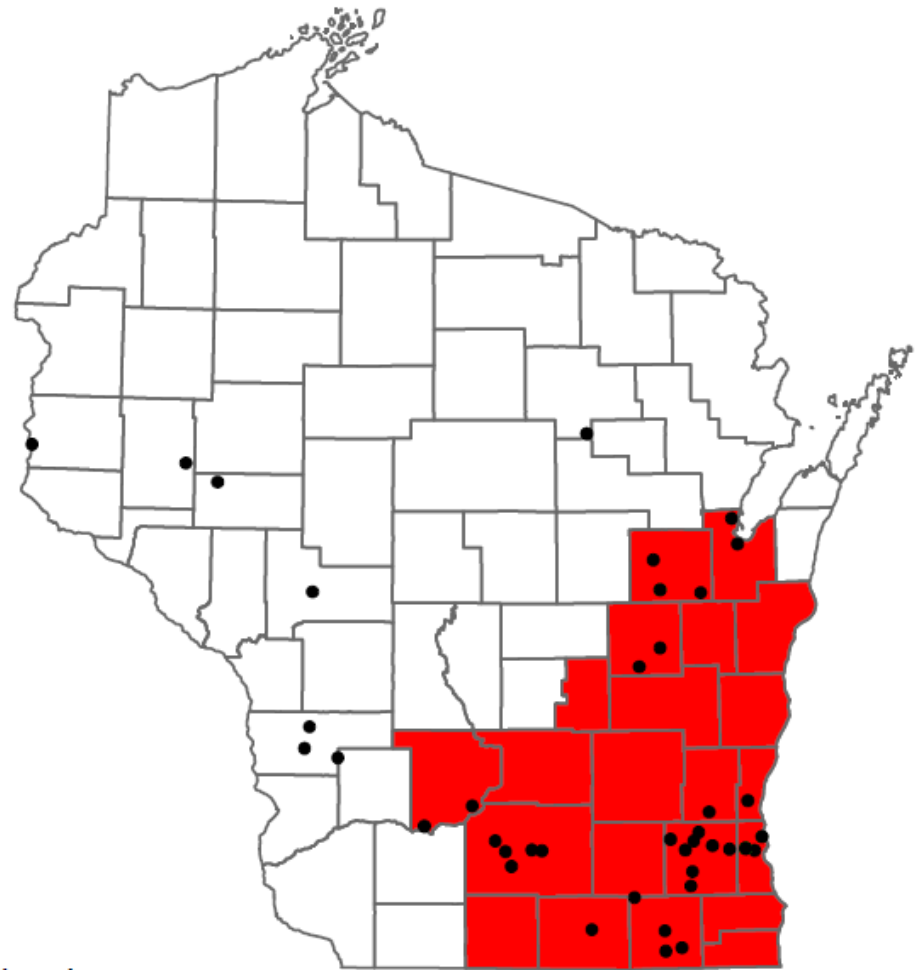
ORIGINAL PAPER

## Effects of non-native Asian earthworm invasion on temperate forest and prairie soils in the Midwestern US

Jiangxiao Qiu  · Monica G. Turner

- *A. agrestis* and *A. tokioensis* substantially reduced leaf litter, and increased total carbon, total N, and avail. P from 0-5cm.
- Increased inorganic N and TOC from 0-25cm.
- Effects were observed in both forest and prairie soil, with stronger effects in forests.
- Depletion of litter layer and rapid mineralization of nutrients may make ecosystems more susceptible to nutrient losses.

# WHERE ARE THEY?



## Legend

- *Amynthus* spp. County Reports 2015
- *Amynthus* spp City Reports 2016



# CAN WE KILL THEM?

We're working on that...



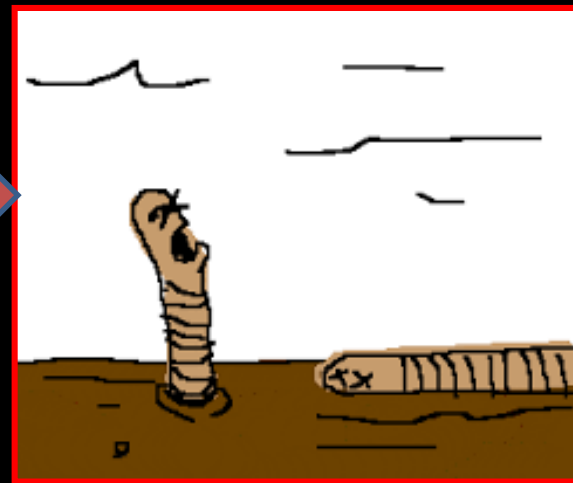
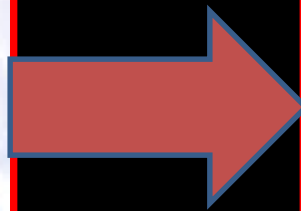


# Research at the UW-Arboretum

- Effects of *Amyntas* spp. on woodland herbs and woody seedlings and saplings – *Katie Laushman*
- Interaction between *Amyntas* spp. and buckthorn litter – *Carly Ziter*
- Abiotic controls to cocoon hatching – *Marie Johnston*
- Effect of an organic fertilizer on *Amyntas* spp. and soil arthropods - *Herrick*



**Biochar is charcoal used as a soil amendment. Biochar is a stable solid, rich in carbon, and can endure in soil for thousands of years. Like most charcoal, biochar is made from biomass via pyrolysis. Biochar is under investigation as an approach to carbon sequestration.**



# Does anything eat them?



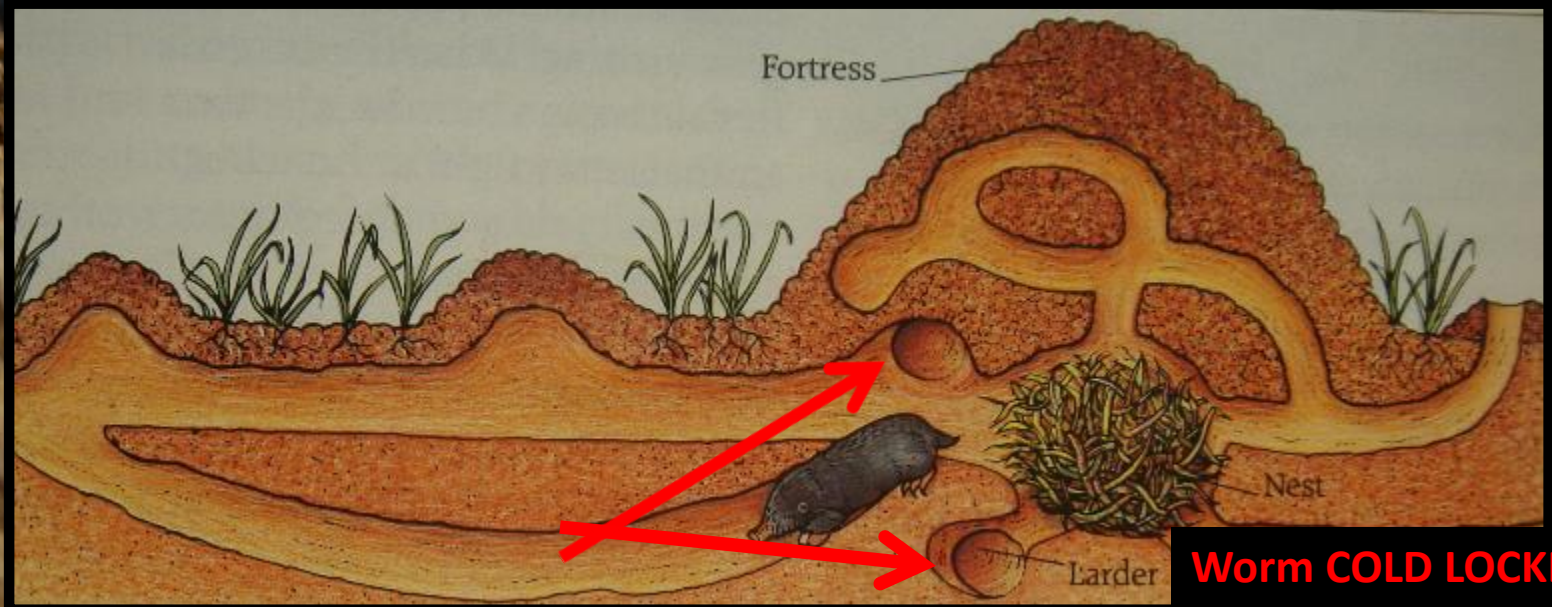
The early bird  
ate too many worms  
and died



# There are other options...

## The Common mole

*Scalopus aquaticus*



**Worm COLD LOCKER**



**CLOSING  
WORM  
THOUGHTS...**





# Questions?

