Jumping worms in Minnesota

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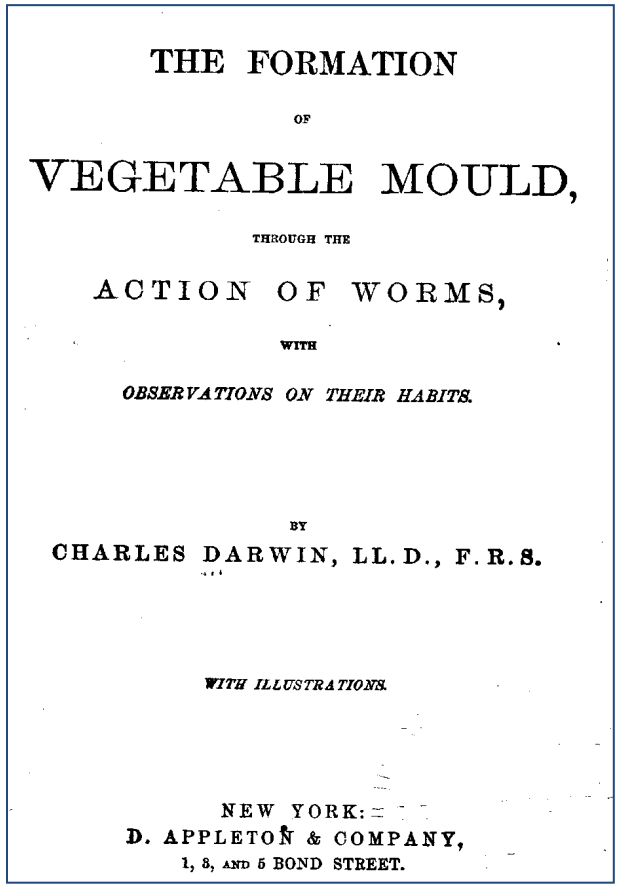
There are over 7000 earthworm species in the world

Giant blue earthworm, Sri Lanka, and Giant Gippsland earthworm, Australia.

Photos: Beverly Van Praagh



THE FORMATION

OF

VEGETABLE MOULD,

THROUGH THE

ACTION OF WORMS,

WITH

OBSERVATIONS ON THEIR HABITS.

BY

CHARLES DARWIN, LL.D., F.R.S.

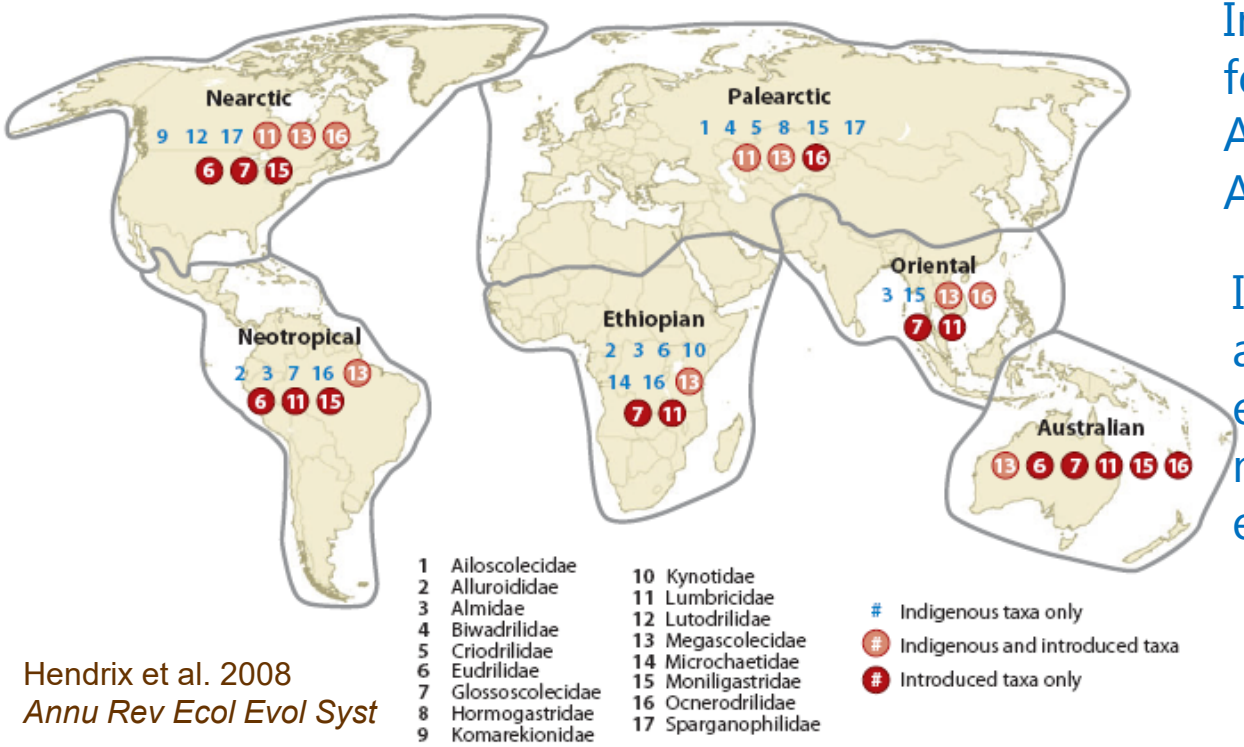
WITH ILLUSTRATIONS.

NEW YORK:
D. APPLETON & COMPANY,
1, 3, AND 5 BOND STREET.

"It may be doubted whether there are many other animals which have played so important a part in the history of the world, as have these lowly organized creatures."

-Charles Darwin, 1881

Global worming



Hendrix et al. 2008
Annu Rev Ecol Evol Syst

Invasive jumping worms are found in North and South America, Europe, Africa and Australia

In Minnesota we have a well established European earthworm invasion, and a new Asian (jumping) earthworm invasion

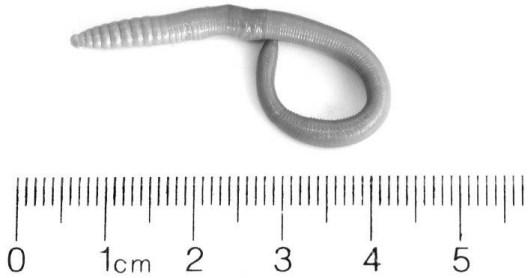
Common European earthworm species and ecological groups

Epigeic: *Dendrobaena octaedra*

Anecic: *Lumbricus terrestris* (nightcrawler)

Jumping worms are epi-endogeic

Epi-endogeic: *Lumbricus rubellus*



Endogeic: *Aporrectodea caliginosa*

Five stages of invasion

Stage 1
Worm free

Stage 2
Epigeic only

Stage 3
Endogeic and epi-endogeic invade

Stage 4
Increasing Biomass and a few *L. terrestris*

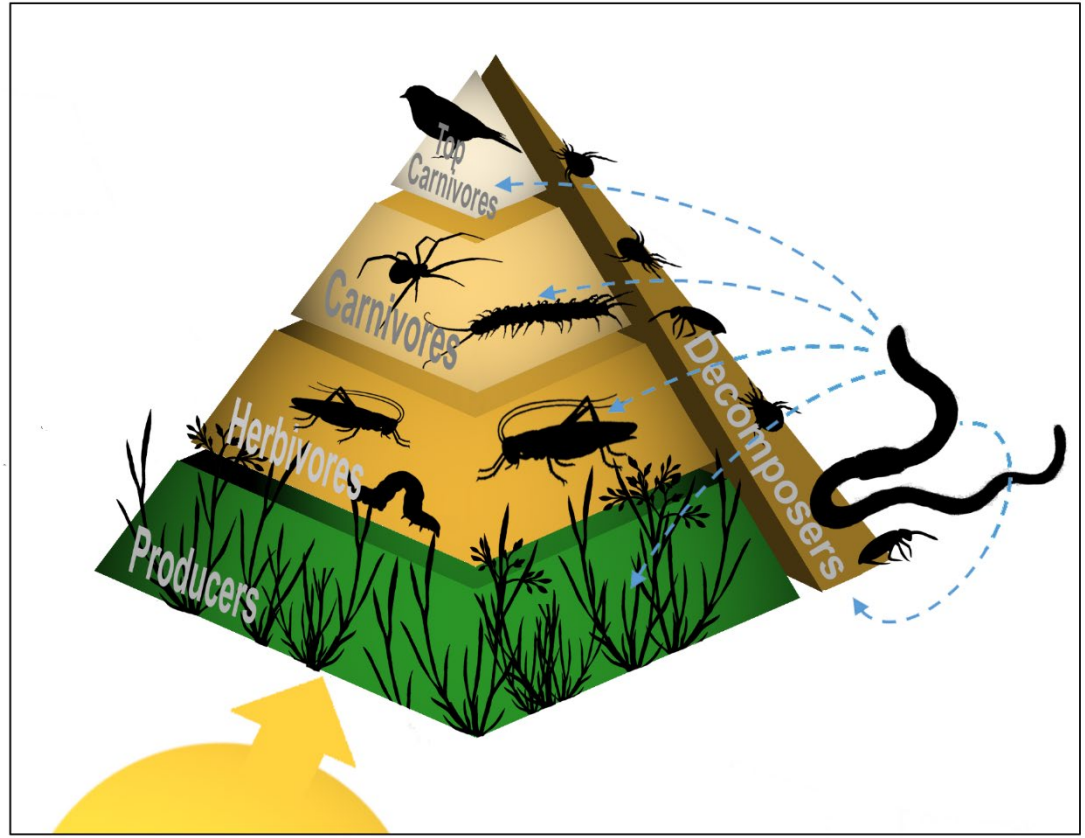
Stage 5
High biomass, *L. terrestris* dominated

Jumping worms fit into stage 5

Loss, Hueffmeier, Frelich, Host, Sjerven and Hale. 2013, *Natural Areas Journal , 33: 21-30*

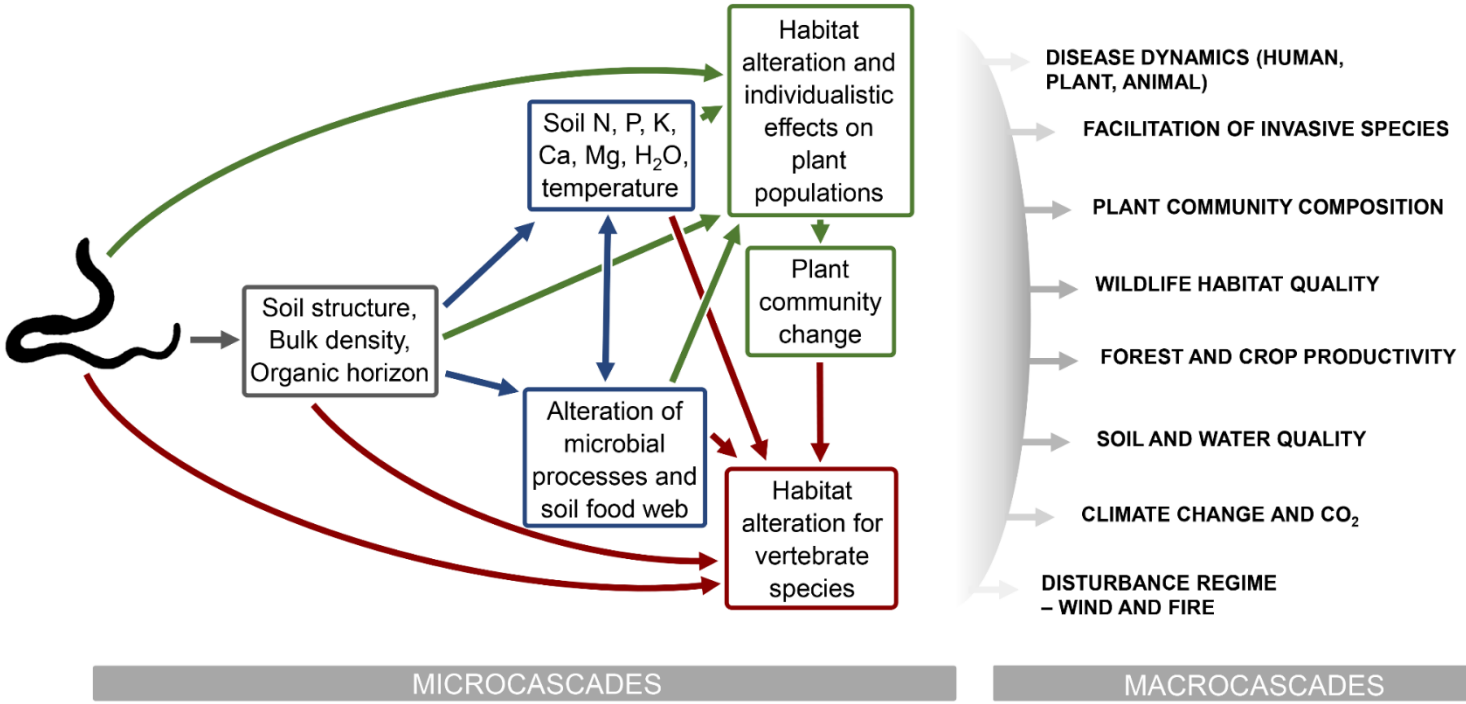
Earthworms in the trophic pyramid

From Frelich et al. 2019, *Frontiers in Ecology and the Environment*



Direct effects of earthworms on soil structure, with cascading impacts on soil function, plant and animal habitat, and issues of concern to society

From Frelich et al. 2019, *Frontiers in Ecology and the Environment*

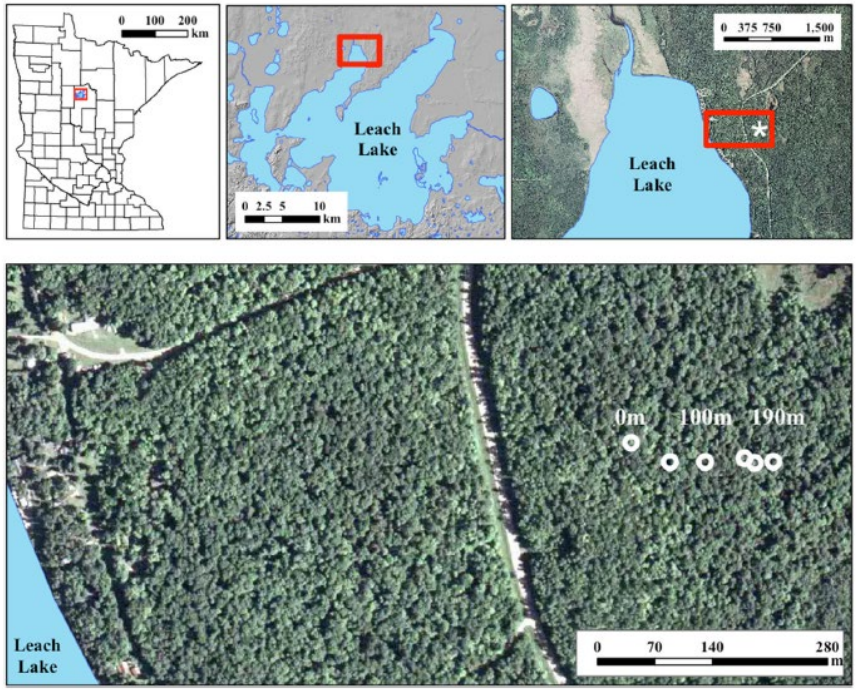


Ecosystems
DOI: 10.1007/s10021-014-9814-0

ECOSYSTEMS

Invasive Earthworms Deplete Key Soil Inorganic Nutrients (Ca, Mg, K, and P) in a Northern Hardwood Forest

Kit Resner,[1] Kyungsoo Yoo,[1]* Stephen D. Sebestyen,[2] Anthony Aufdenkampe,[3] Cindy Hale,[4] Amy Lyttle,[1] and Alex Blum[5]



Jumping worm invasion will likely exacerbate soil erosion caused by European earthworms

Base of a sugar maple showing ca 3-5 inches of erosion since germination

Earthworms were a significant factor in sugar maple dieback in a study of 120 plots in MI, WI, and MN

Bal et al. 2018, *Biological Invasions*

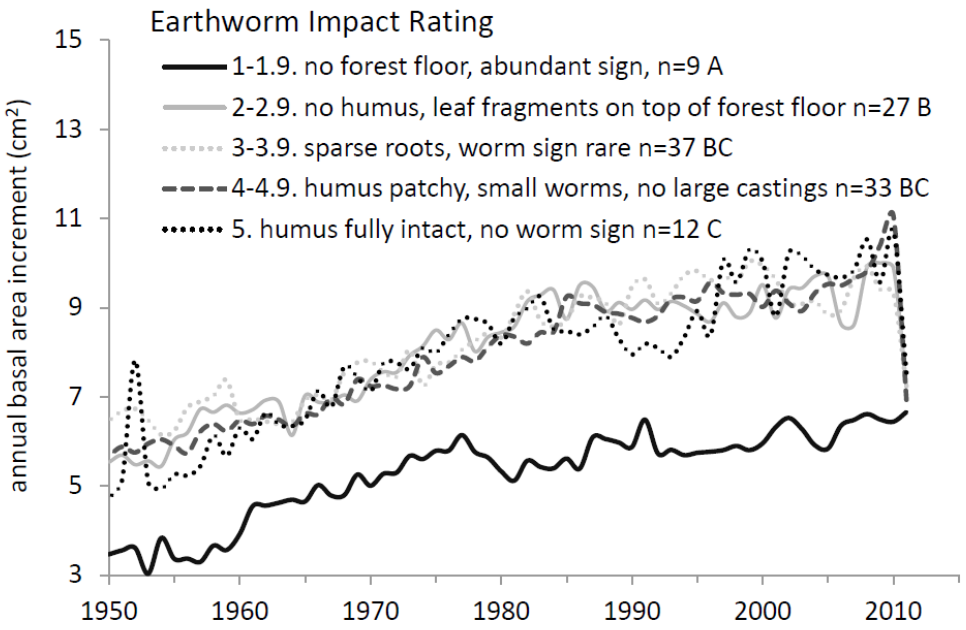


Figure 1.1. Sugar maple crown dieback in Keweenaw County, MI, 2009. Photo by Tara Bal

Earthworm impacts on plants

Winners:

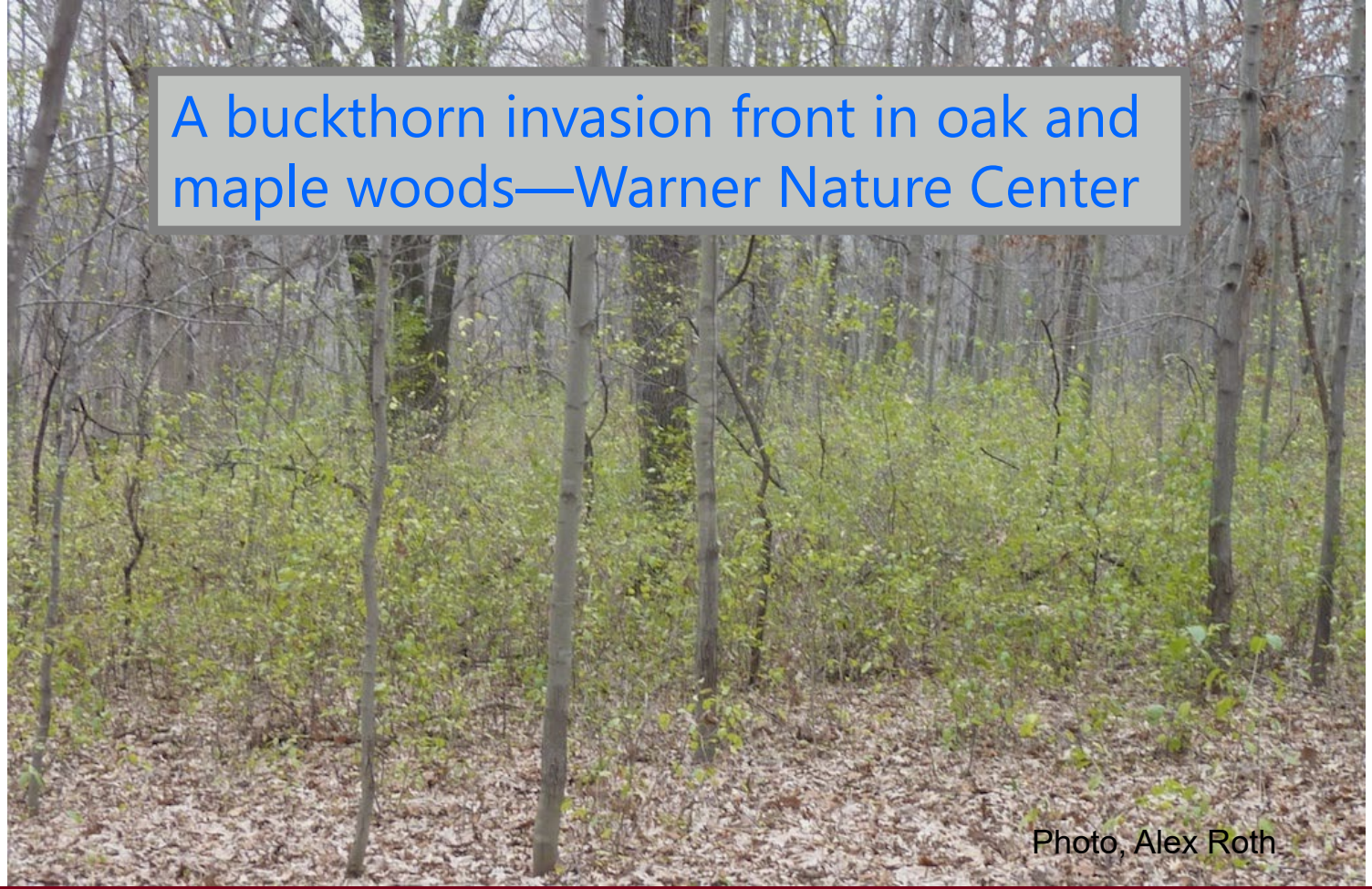
Sedge, grass

Jack-in-the-pulpit

Losers:

Orchids, trillium,
sweet cicely,
yellow violet,
twisted stalk
and others

A buckthorn invasion front in oak and maple woods—Warner Nature Center

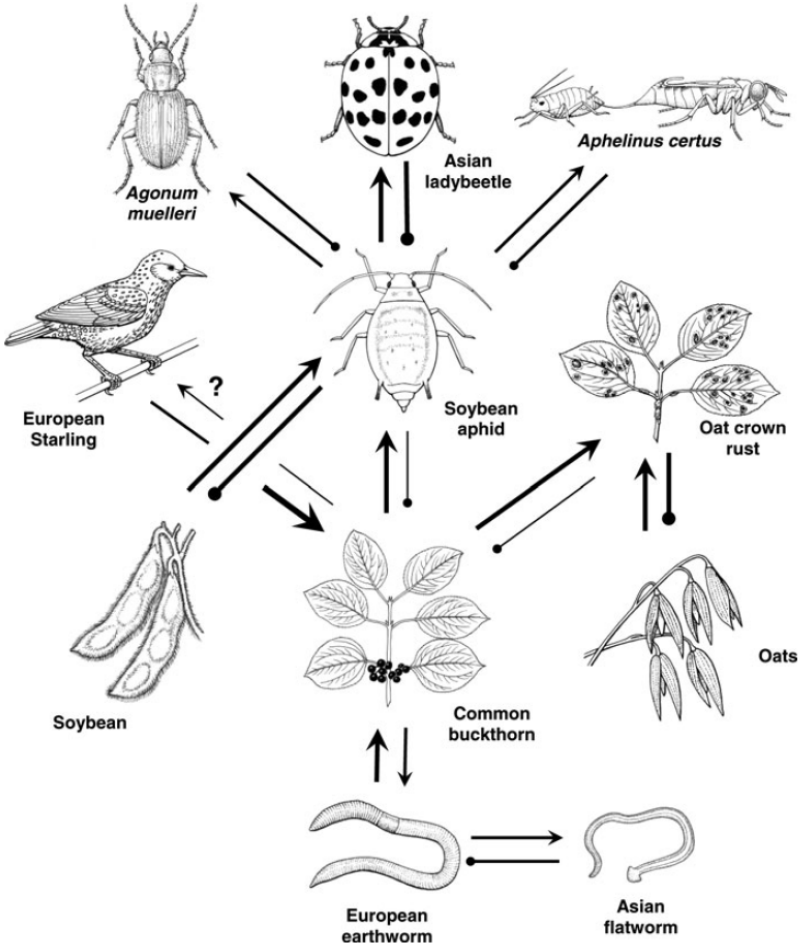


Photo, Alex Roth

A case study of invasional meltdown

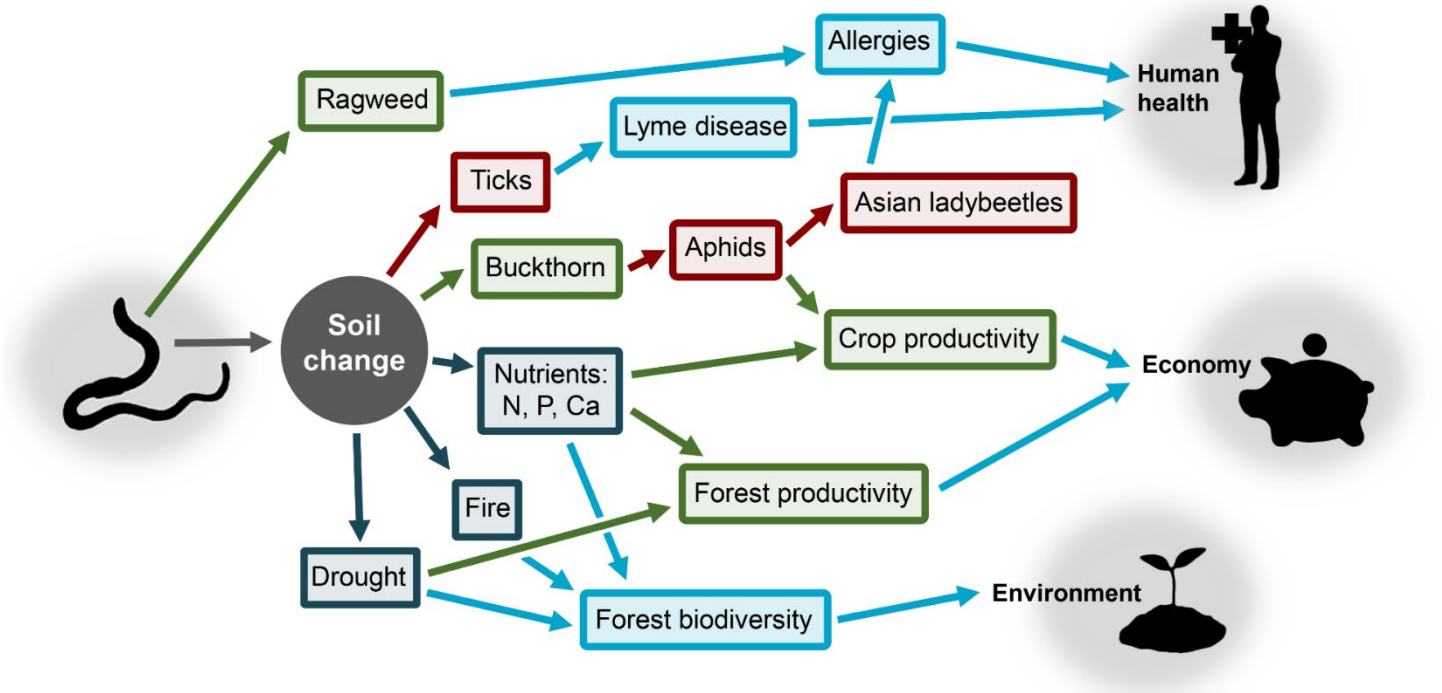
Heimpel, Frelich, Landis, Hopper, Hoelmer, Sezen, Asplen, and Wu, *Biological Invasions*, 2010

Art Work by Julie Martinez



Cascade complexes caused by earthworm invasions affecting human health, the economy and environment

From Frelich et al. 2019, *Frontiers in Ecology and the Environment*



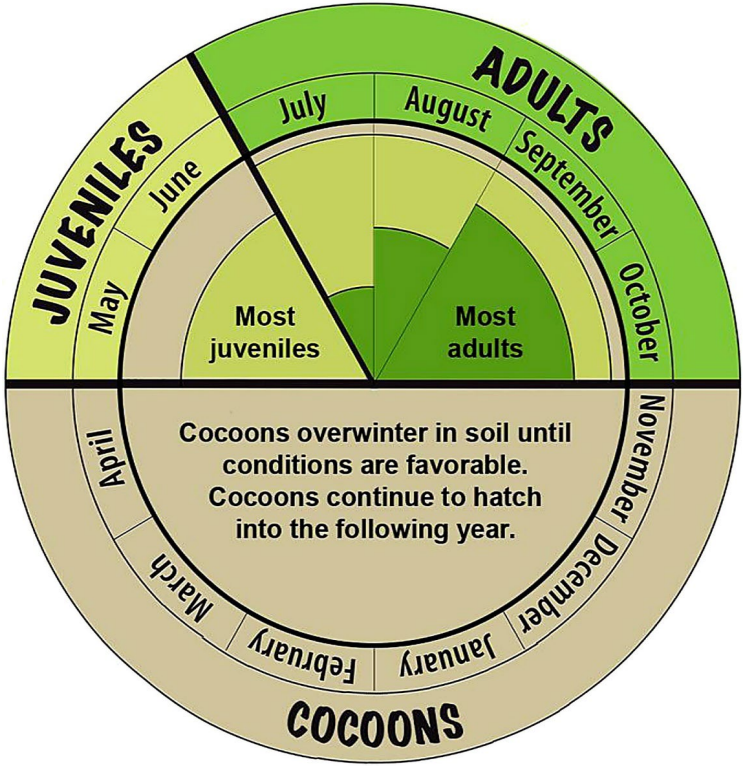
Earthworm invasion will magnify climate warming by:

- Emitting CO_2 into the atmosphere
- Exacerbating drought effects
- Accelerating conversions of boreal forests
- Increasing biodiversity losses
- Facilitating invasive species

Photo: Ken Piehl

Jumping worms

- 14 species in North America
- *Amynthas* and *Metaphire* probably present in MN
- Move around in mulch
- More aggressive than European species
- Mostly annual species—survive winter as eggs/cocoons



Life cycle (McCay et al. 2020 Pedobiologia)

Amynthas agrestis, St.Paul Campus, Oct. 2018

Annular clitellum
vs
Raised clitellum

Clitellum close to head—
start at segment 14 or 15
vs
Further from head,
start at segments 23-32,
depending on species

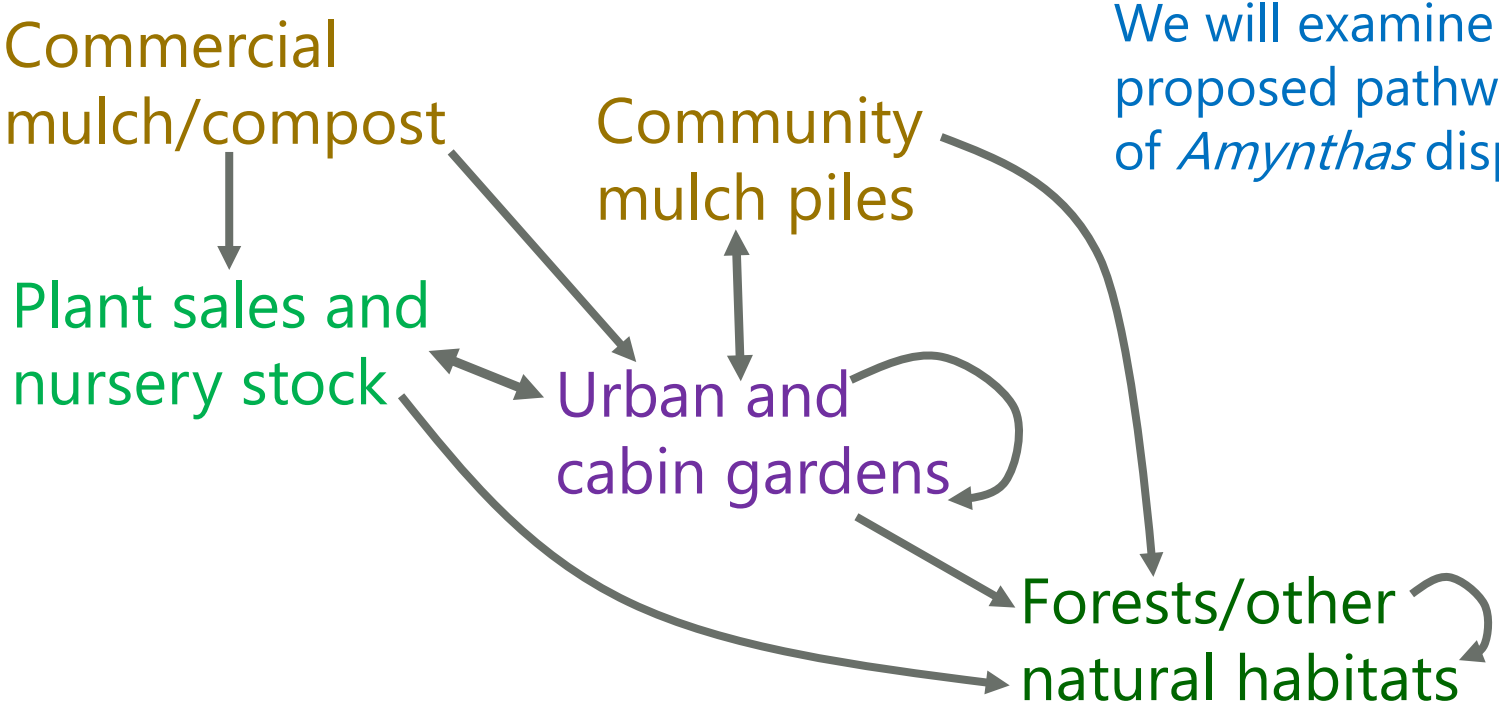
Jumping worms live in the top 2 inches and create a layer of loose granules

Soil granule size depends on species:
Metaphire hilgendorfi > *A. Agrestis* > *A. tokioensis*

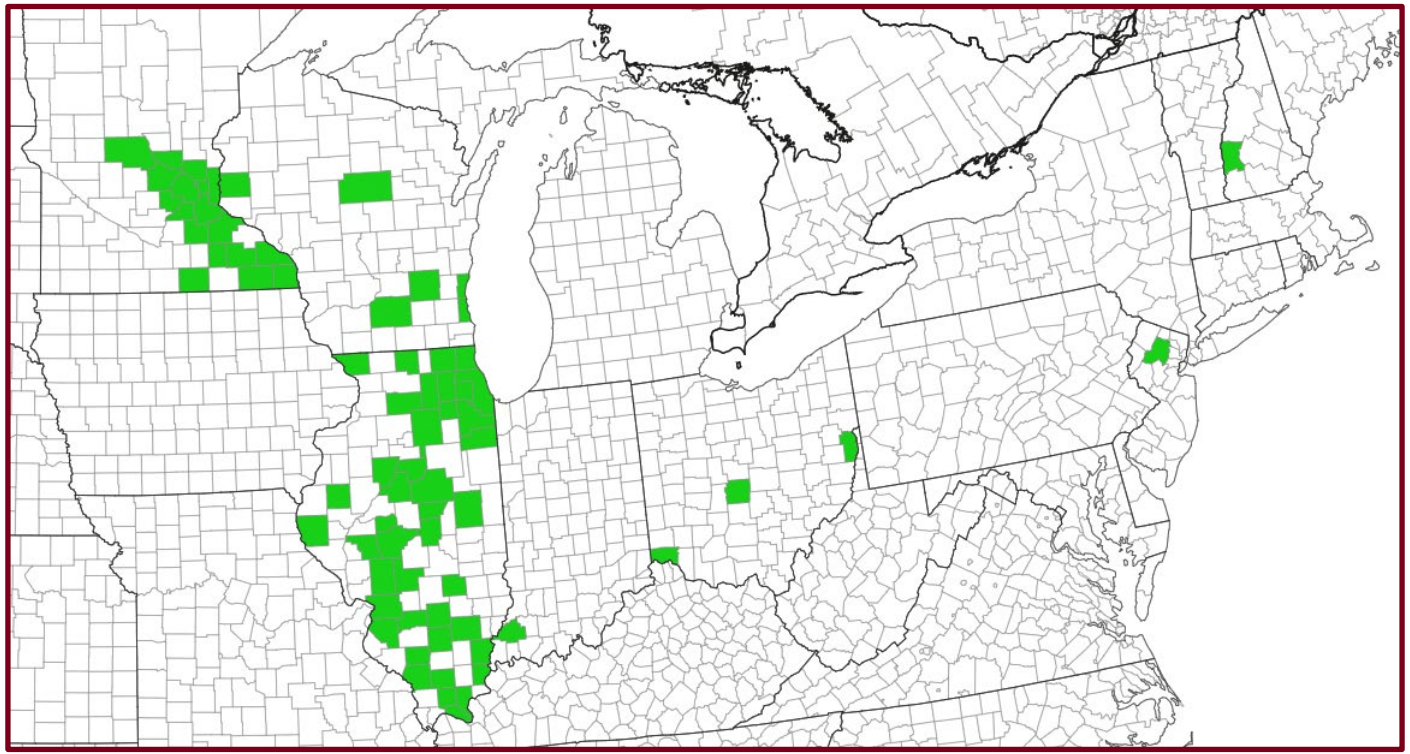
Mulched beds on St.Paul campus are full of *A. agrestis*

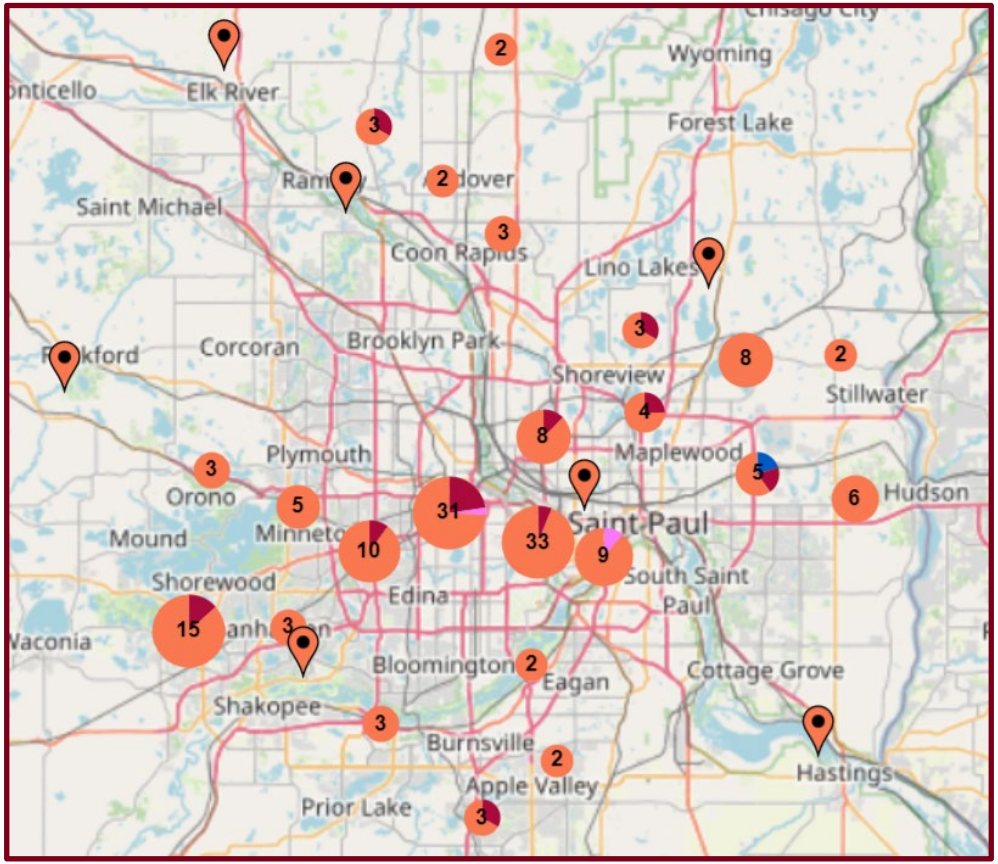
Photo: S. Carlson

Dispersal mechanisms and pathways for *A. agrestis*



Reported distribution of *Amynthas* spp. in the United States – EDDMapS (www.eddmaps.org) as of March 2022

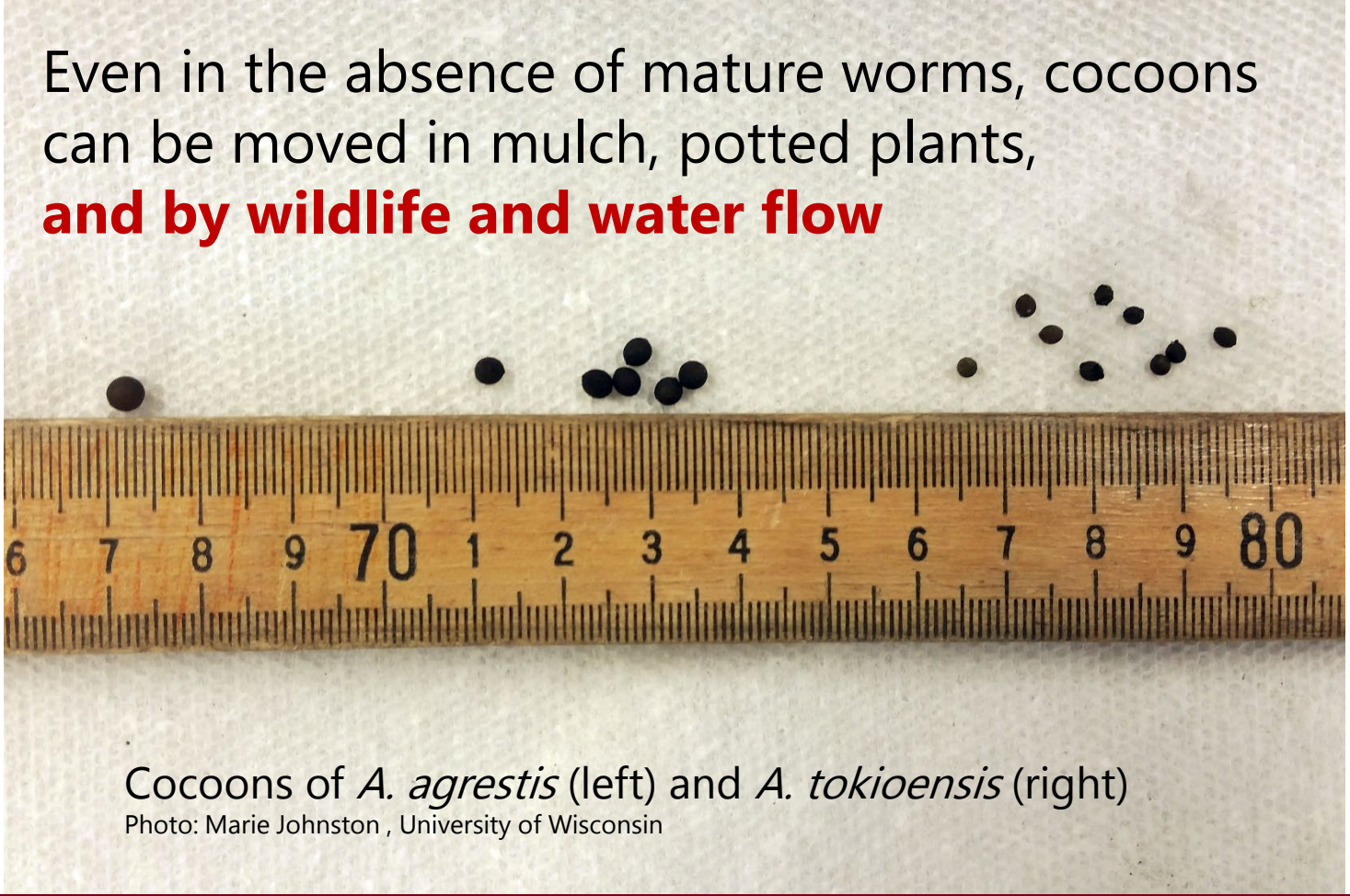




Reported distribution of *Amynthas* spp. in the Twin Cities Metropolitan Area – EDDMapS (www.eddmaps.org) as of March 2022

Approx. 235 reports in the seven-county Twin Cities Metro area

Even in the absence of mature worms, cocoons can be moved in mulch, potted plants,
and by wildlife and water flow



Cocoons of *A. agrestis* (left) and *A. tokioensis* (right)
Photo: Marie Johnston , University of Wisconsin

Temperature-based limits to distribution and invasion susceptibility of Minnesota habitats

We will compare soil temperatures (5-10 cm depths) in habitats where the abundance of *Amynthas* varies—e.g., lawns, mulched gardens, and woodlands

Socially-distanced fieldwork at the UMN Landscape Arboretum

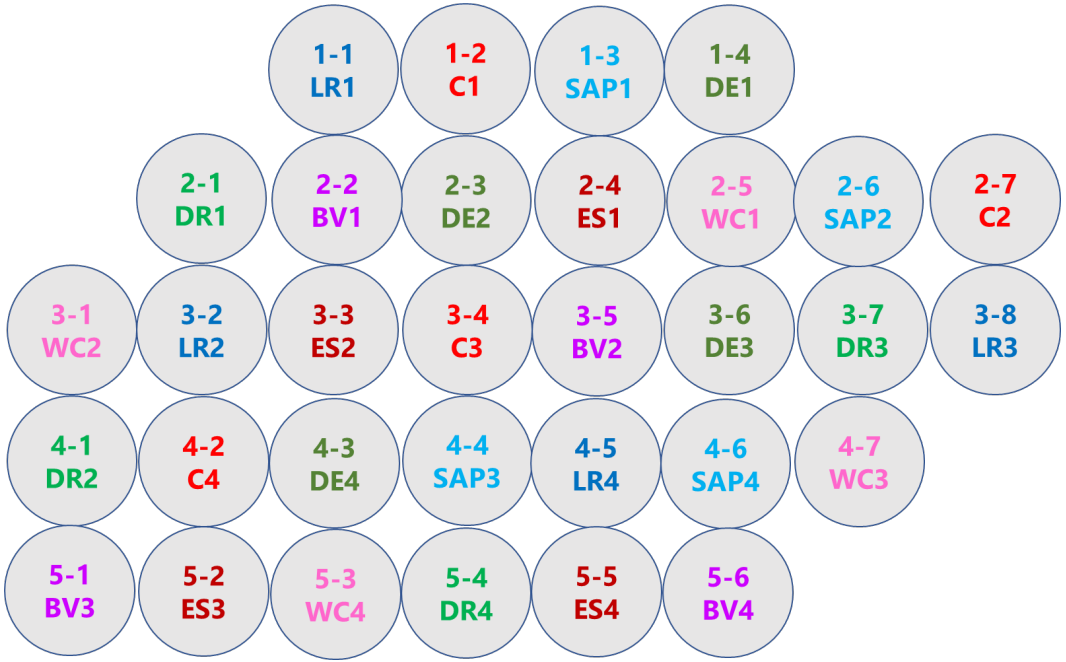
Left to right: Kyungsoo Yoo, Lee Frelich, Shuai Wang and Tyler Baumann

Control of jumping worm (*A. agrestis*) infestation

Study effects of several chemical treatments on viability of eggs, juveniles and mature worms in the field at the arboretum

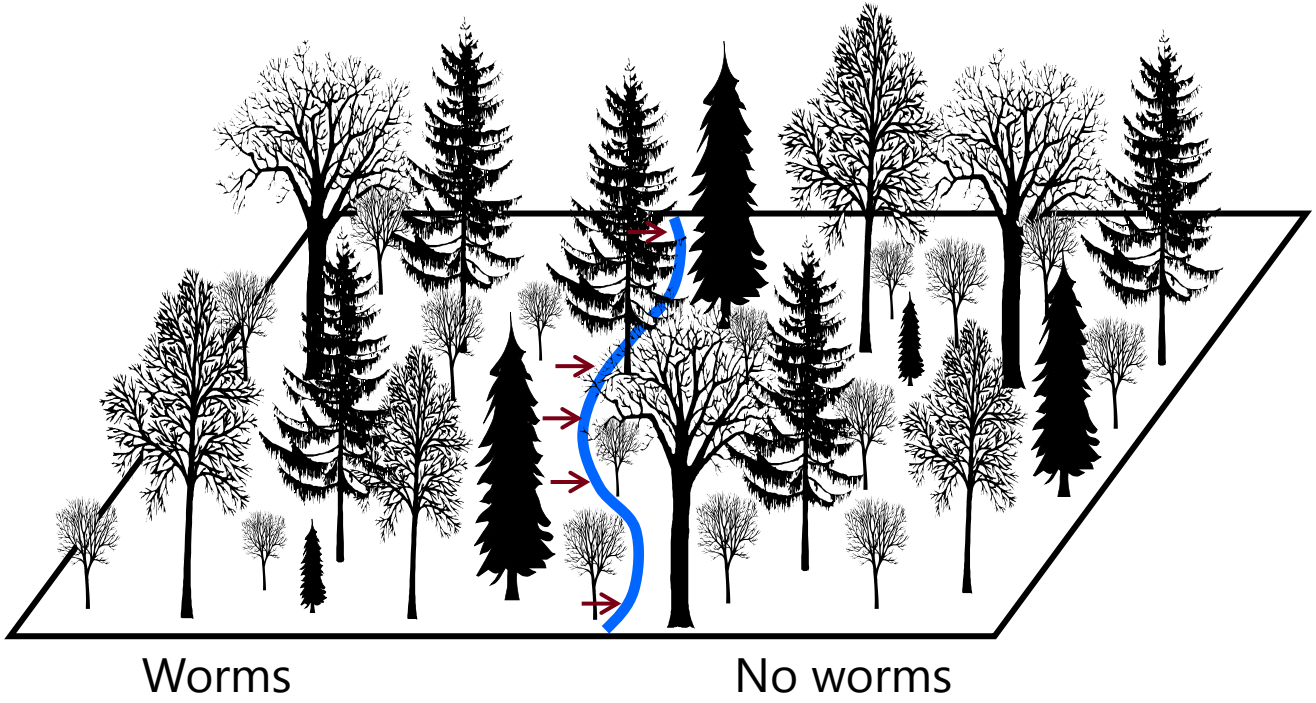
Field site for control experiment at UMN Arboretum July 2021

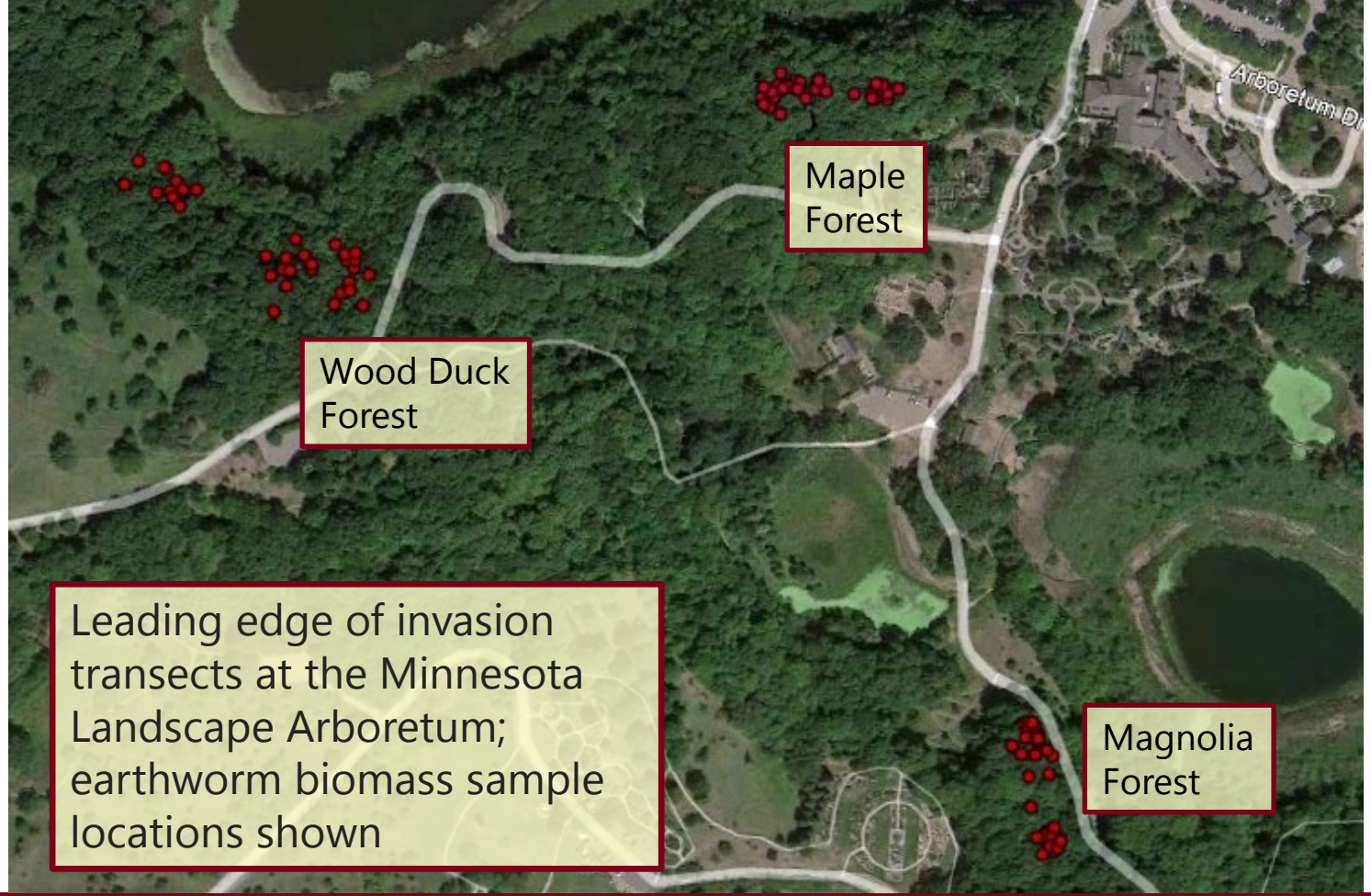
Control of jumping worm (*A. agrestis*) infestation-experimental design



LR: Leaflitter removal
DR: 2x leaf litter
SAP: Saponin
BV: Botanigard (fungal spores)
ES: Elemental Sulfur
DE: Diatomaceous earth
WC: Drought-free control
C: Control

Leading edge of invasion earthworm studies



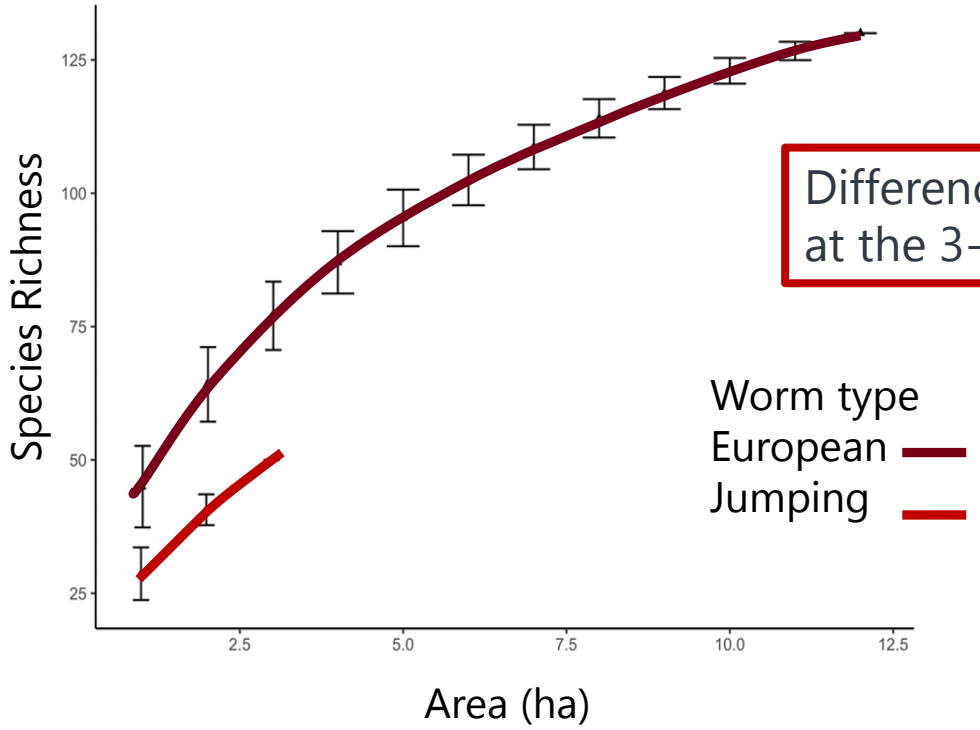


Leading edge of invasion transects at the Minnesota Landscape Arboretum; earthworm biomass sample locations shown

Effects of jumping worms on native forest plant communities

Compare plant communities in infested and un-infested areas at the UM Landscape Arboretum

Native Plant Species Richness Results



Difference of >25 species at the 3-ha (7.5 ac) scale

Jumping worm invasion will likely exacerbate soil erosion caused by European earthworms

Jumping worms create soil texture like cat litter

Test the hypothesis that jumping worms accelerate erosion of surface soils, by comparing erosion rates on both sides of invasion fronts

Jumping worms and European worms compete for the same habitat and food source

Test the hypothesis that jumping worms replace and exclude European earthworms

Funding for this project was provided by:

- The Minnesota Invasive Terrestrial Plants and Pests Center through the Environment and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR).
- The Center for Forest Ecology, through the Wood-Rill Fellowship, and gifts from Darby and Geri Nelson, and the Olseth Family Foundation.

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More information:

Jumping worm project web page, including link to online training:
https://jwp.cfans.umn.edu/jumping-worms-project

MN DNR jumping worm web page:
https://www.dnr.state.mn.us/invasives/terrestrialanimals/jumping-worm/index.html

Minnesota Invasive Terrestrial Plants and Pests Center website, including links to news media coverage:
https://mitppc.umn.edu/project/jumping-worms-minnesota

Questions?

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