The slide features decorative botanical illustrations. On the left side, there is a vertical illustration of a plant stem with small, dense clusters of flowers or fruits. On the right side, there are several illustrations of seed heads or fruits, some of which appear to be dispersing seeds, shown in various orientations.

Going the distance: investigating dispersal across scales

Joe Dauer
Michigan State University
Department of Plant Biology

KBS K-12 Partnership
December 5, 2012

Outline of Talk

- Long-distance seed dispersal in the atmosphere
- Plant dispersal through soil
- Kazoo experiential learning activities

Investigative Ecology



Plant Dispersal

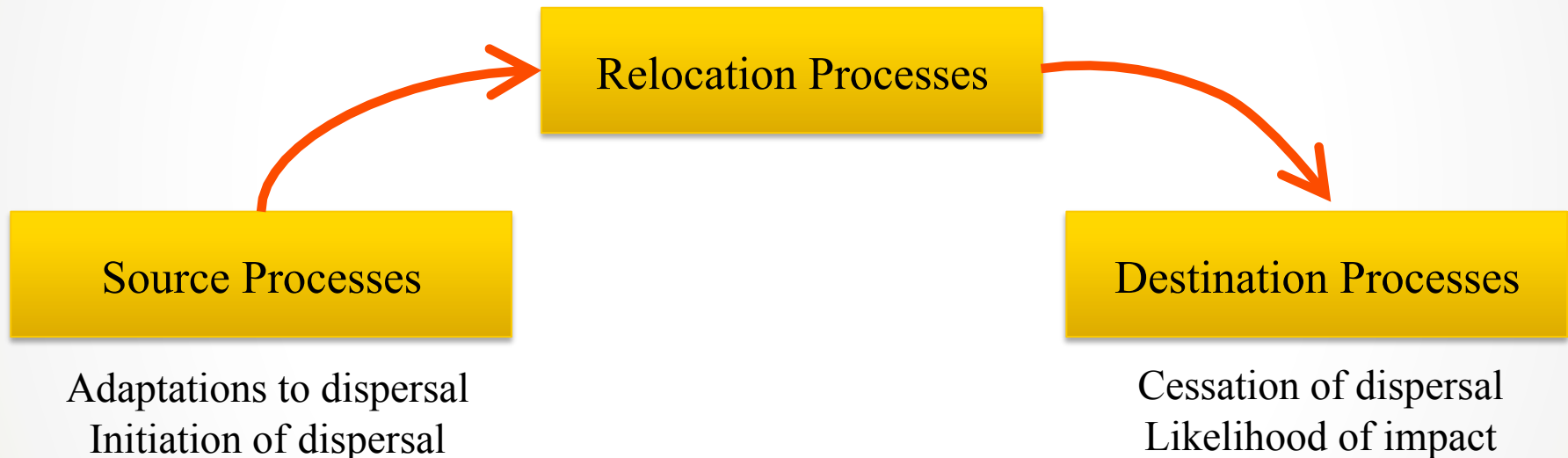
Dispersal – the movement of organisms away from their source (Nathan 2001)

- Superspreaders in epidemiology
- Connectivity and corridors in restoration ecology and biodiversity
- Management of species

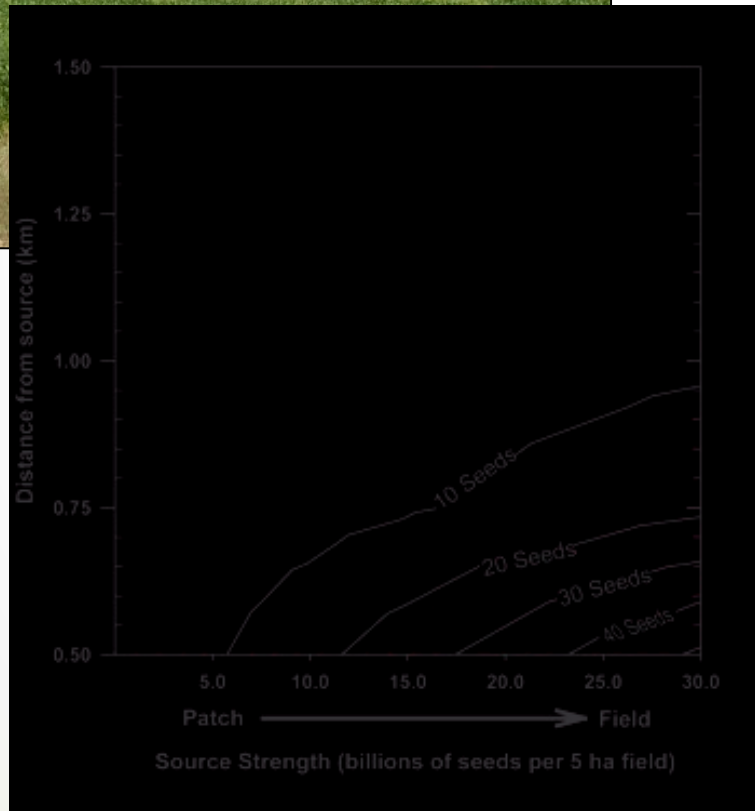
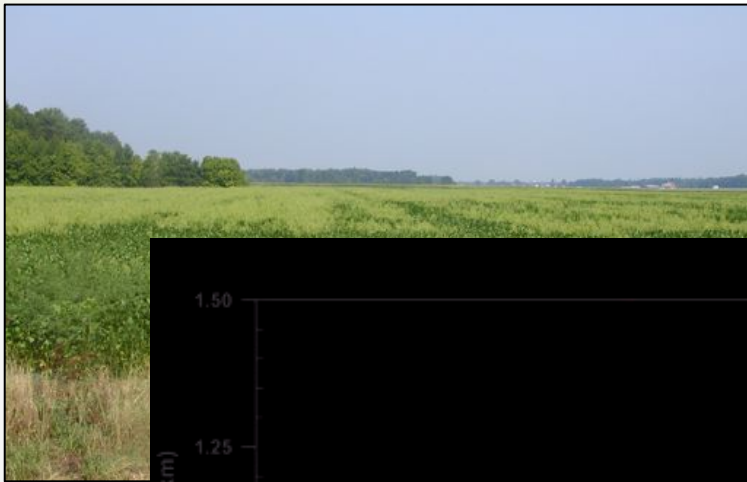
Why plant ecologists care about dispersal

- Not a behavioral response, passively distributed
- The major driver of plant invasions

Dispersal Framework



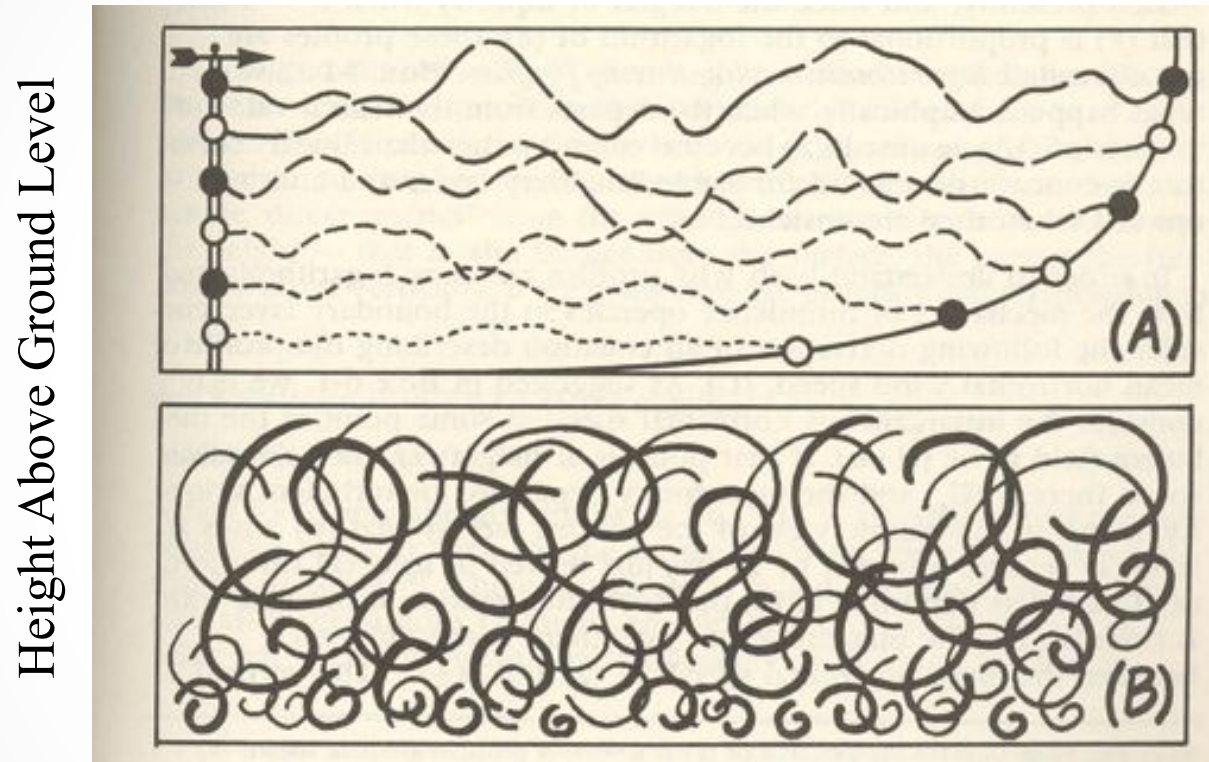
Looking up



Daniel et al. 2007. J. Appl. Ecol.

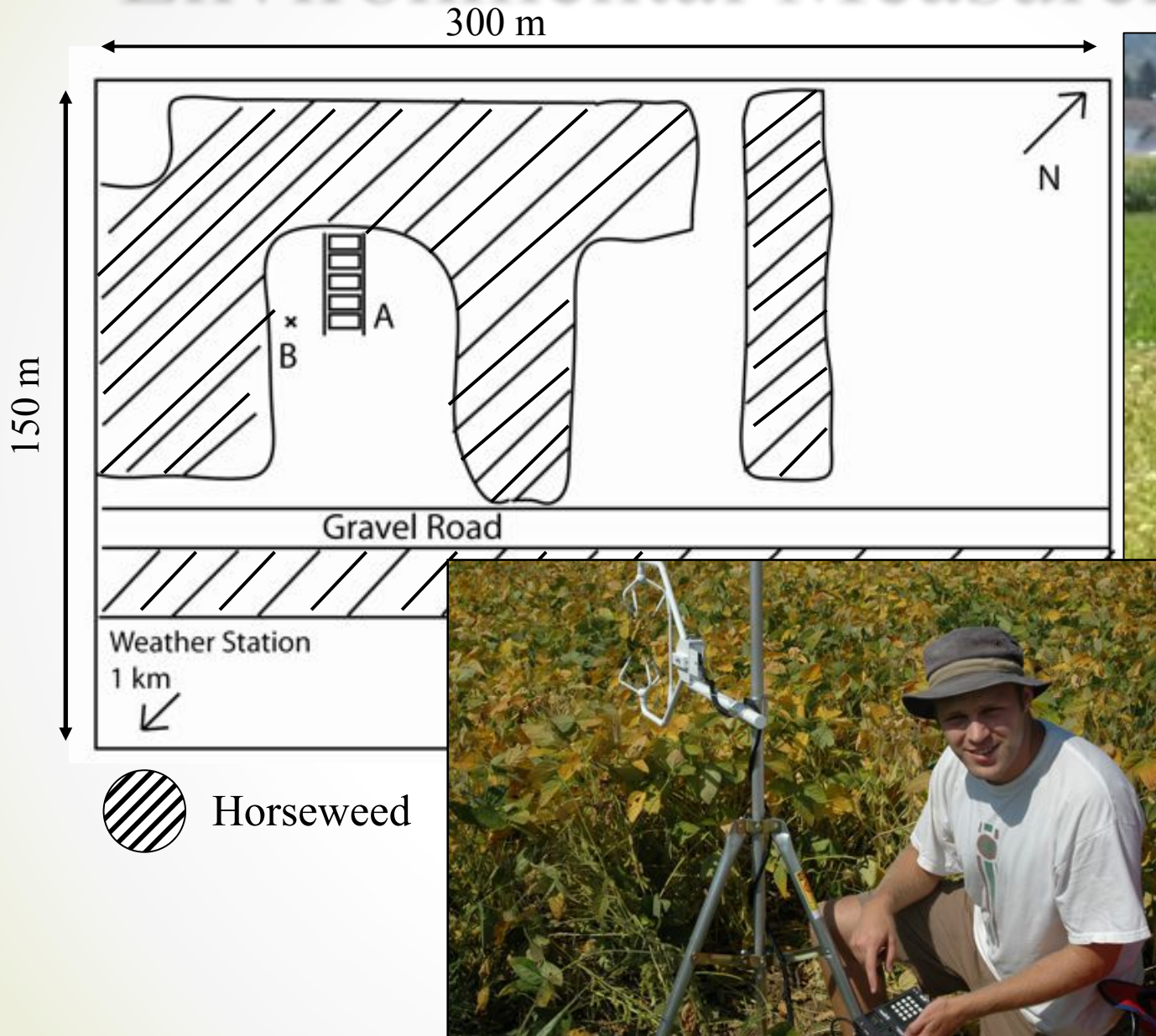
- An important agricultural weed which has evolved resistance to the most common herbicide (RoundUp)
- Produces 100,000 small wind dispersed seeds
- Motivating question: How are seeds traveling and how far?

What is the structure of the lower atmosphere?

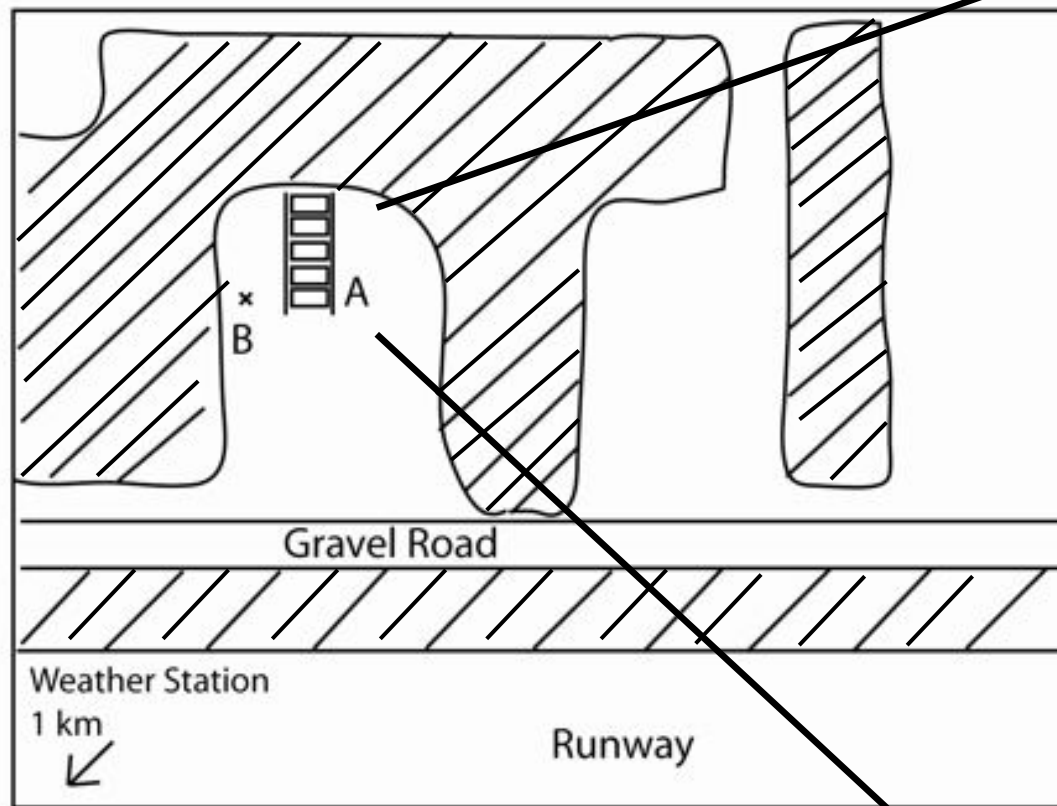


1. Wind speed increases at greater heights
2. Air flow is more laminar at greater heights

Environmental Measurements



Seed Collection – near plant canopy



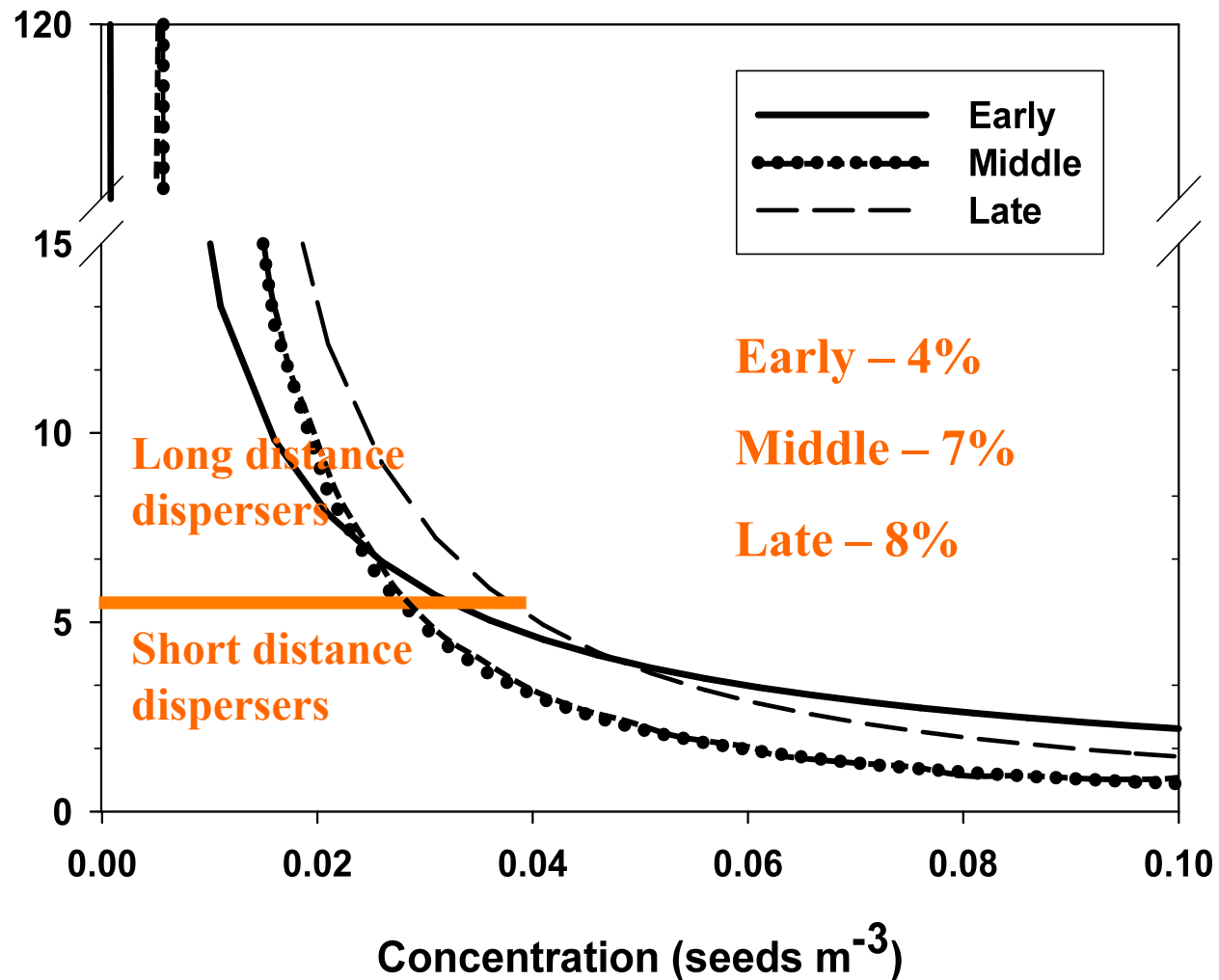
 Horseweed



Seed Collection – in atmosphere



Daily Seed Movement



Aerobiology Conclusions

- There are a lot of plants that use the atmosphere to disperse long distances
- Measuring the mechanism of seed dispersal yields greater information on how to manage biological invasions (Dauer et al. 2009 Landscape Ecol.)
- The atmosphere is largely unexplored

Outline of Talk

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Perennial Weeds



Reproduces vegetatively and via seed

May reproduce once or multiple times



Vegetative Reproduction



Rhizomes (modified underground stems)

Stolons (runners)



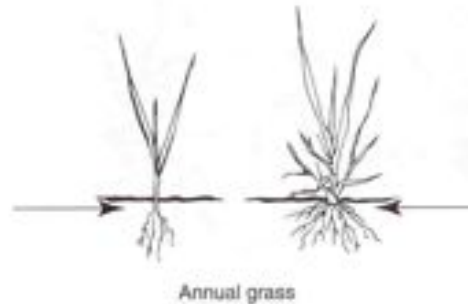
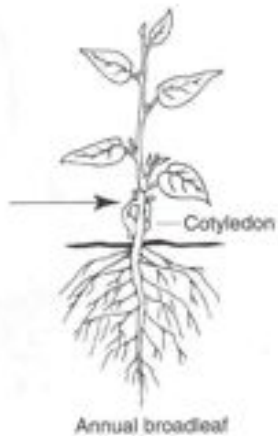
Perennials can also reproduce by:

- Stem tubers = enlarged rhizomes or stolons, also called nutlets
- Fragments

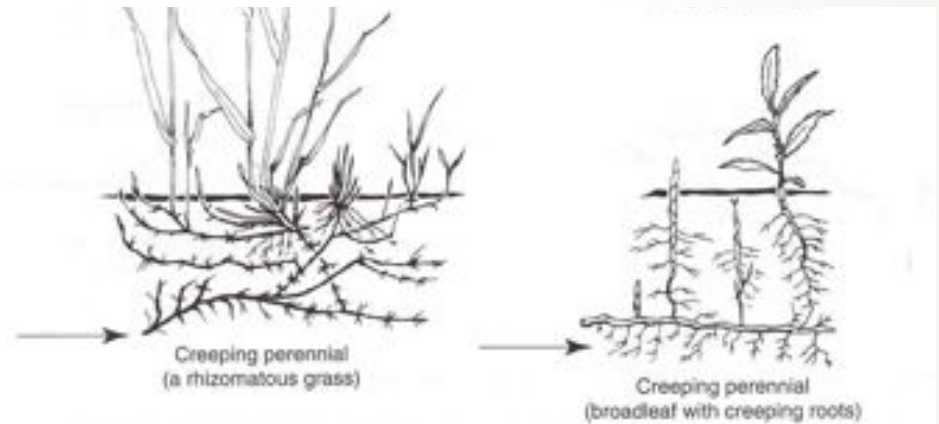


Growing points

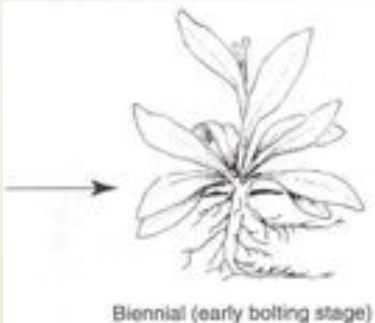
Annuals



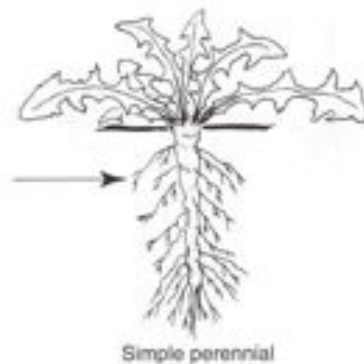
Creeping Perennials



Biennials

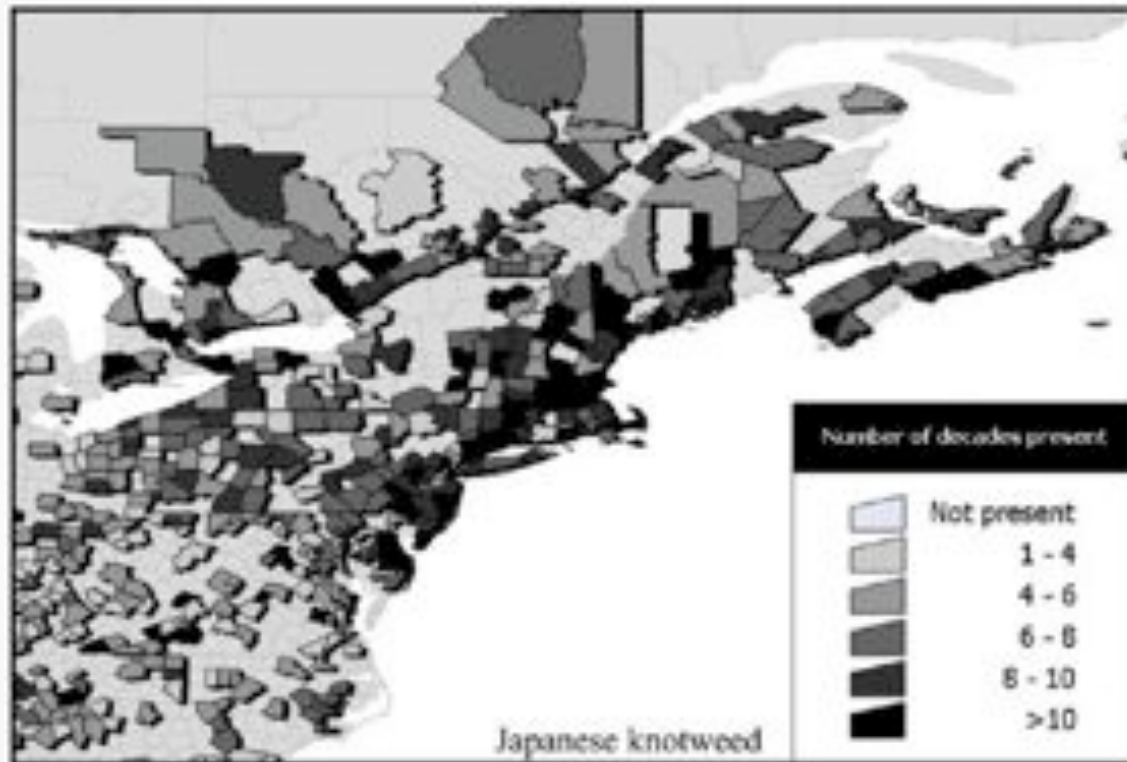


Simple Perennials



Arrows indicate lowest position on the plant from which new shoots can regenerate

Japanese Knotweed Background



Barney et al. 2006





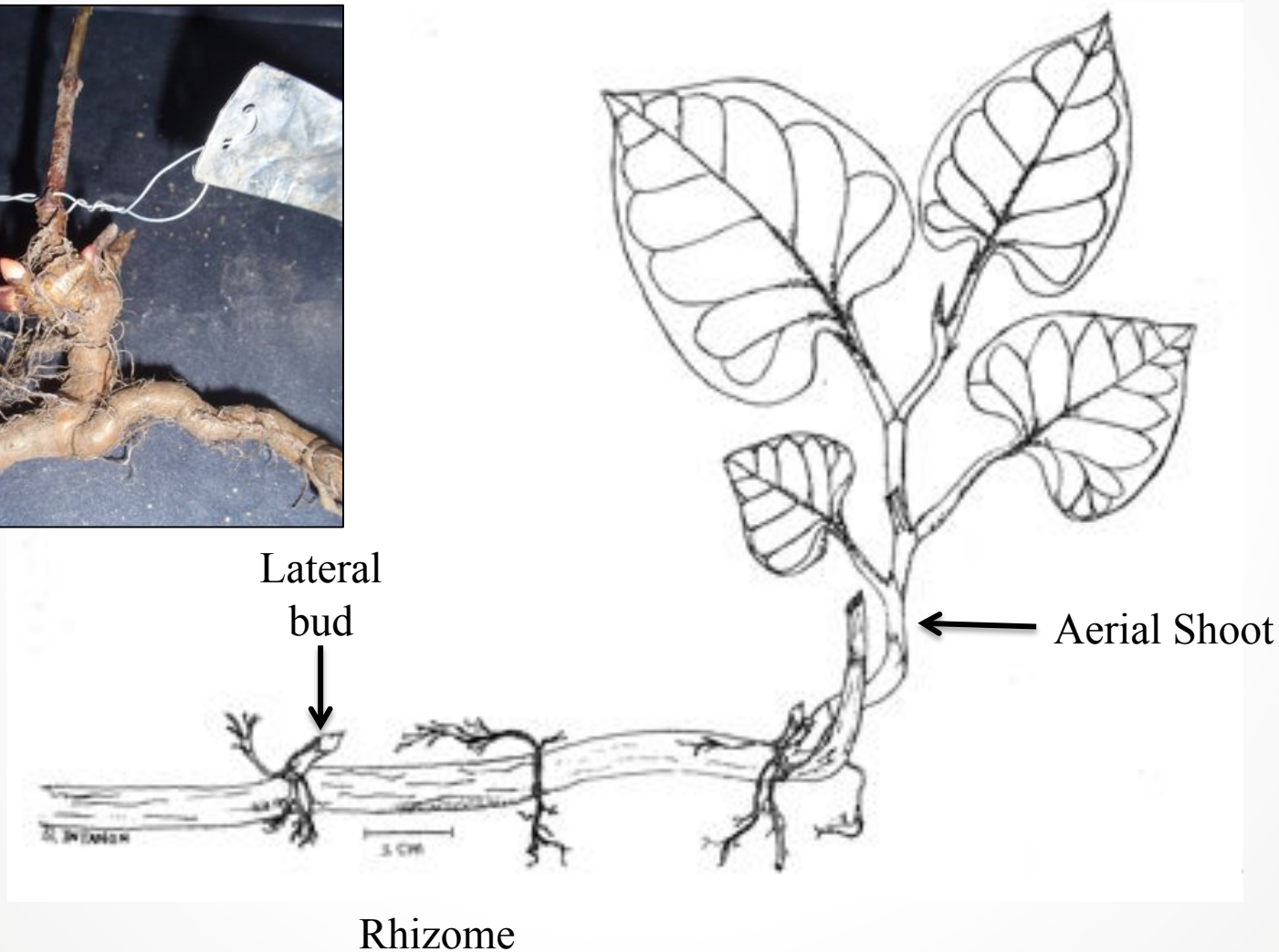
Japanese knotweed
(*Polygonum cuspidatum*)



Structure & Reproduction



Terminal
bud

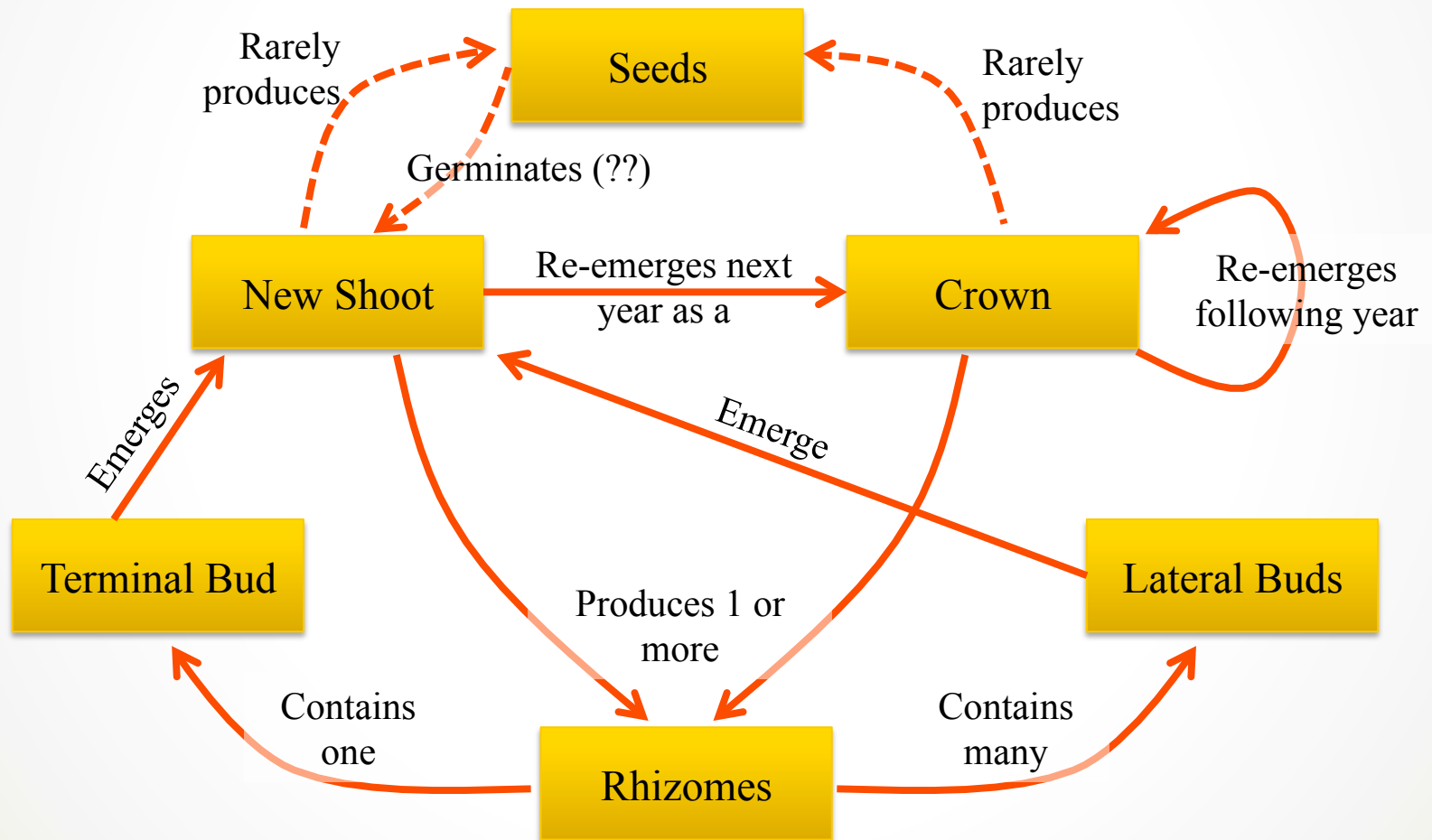


Research Question

What is Japanese knotweed rhizome morphology in a new infestation and how does it change in time and space?



Japanese knotweed life cycle and dispersal



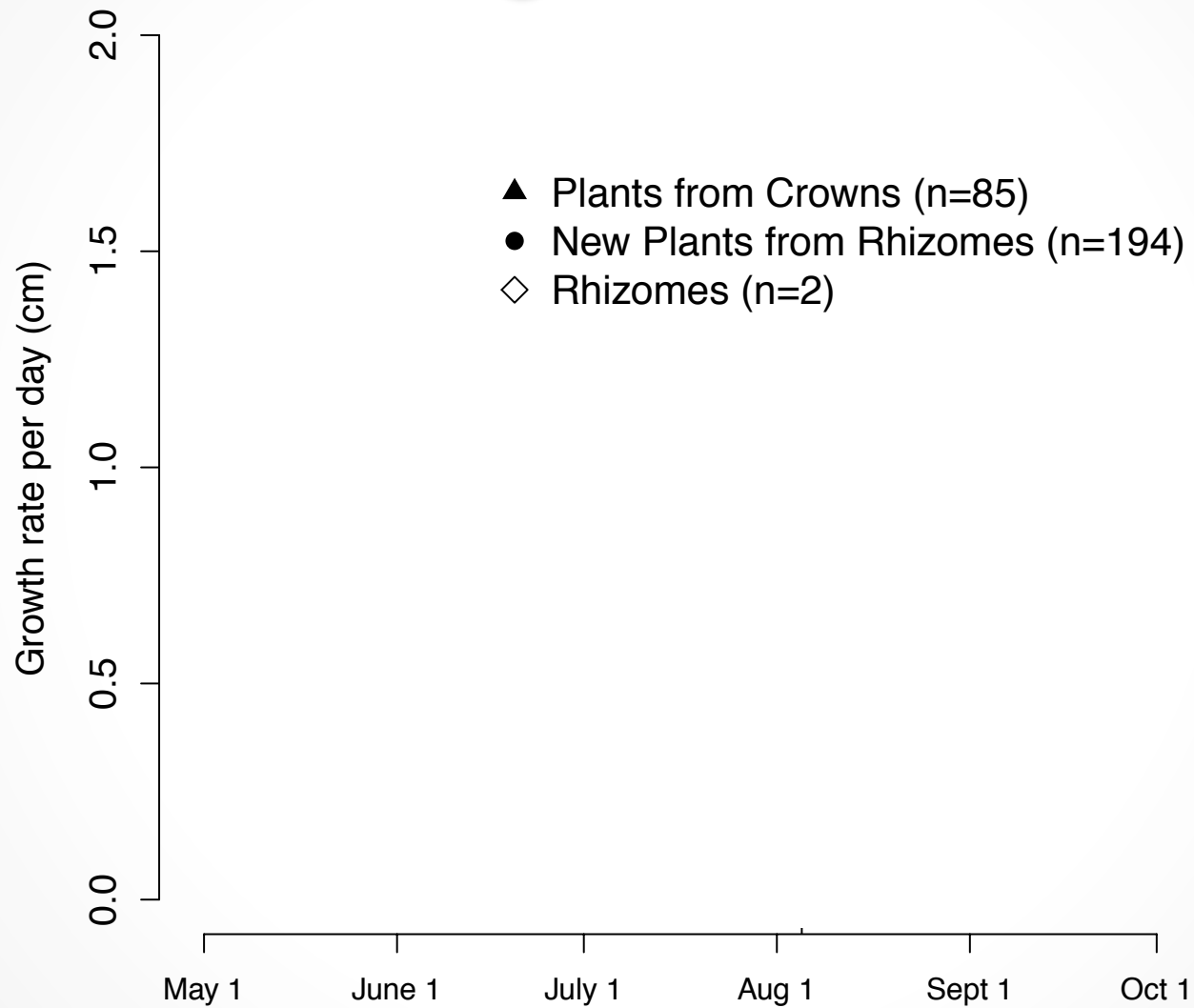
Mapping knotweed shoots and rhizomes

Philomath, OR

Maybury State Park, Northville, MI



Timing of Growth



Rhizome Growth



Knotweed Conclusions

- Underground rhizome growth is the primary way an infestation of Japanese knotweed expands
- Eventually Japanese knotweed patches can reach hundreds of stems in a few square meters
- Improve management by identifying vulnerabilities in the knotweed life cycle

Outline of Talk

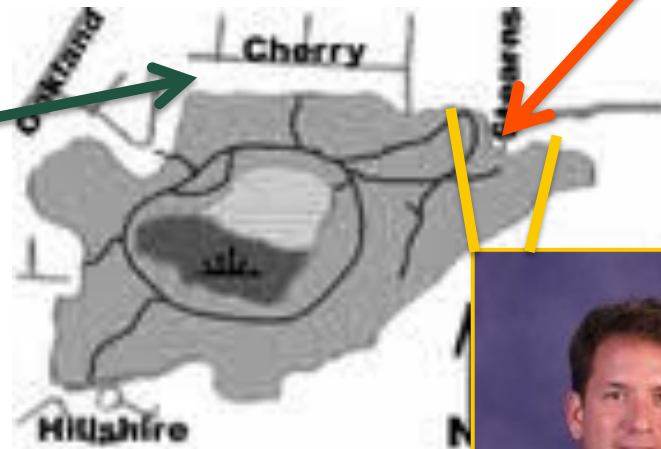
- Long-distance seed dispersal in the atmosphere
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Kazoo Collaboration



4th and 5th Grade Students

Kleinstuck Nature Preserve



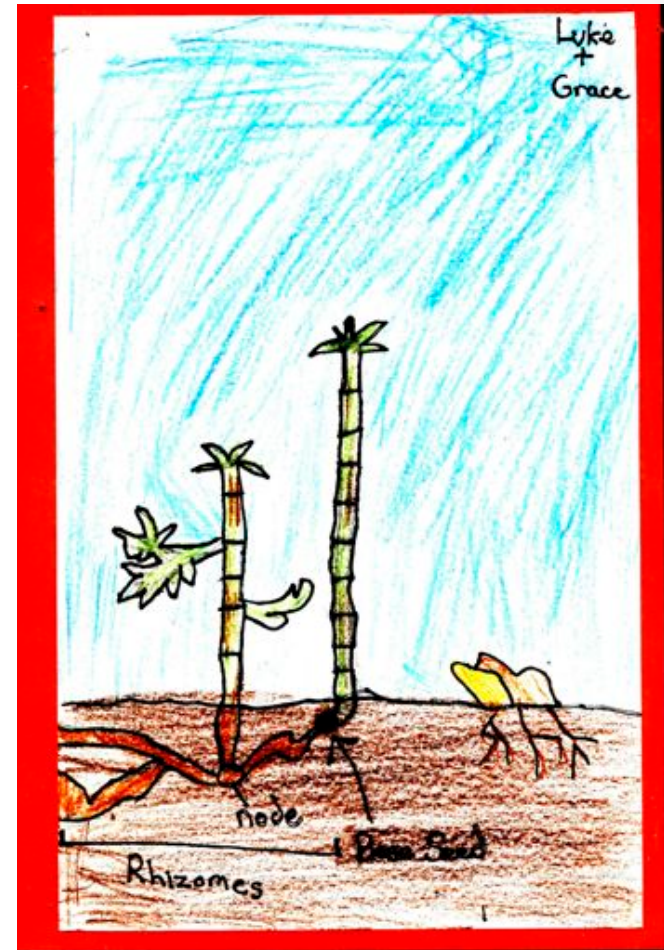
Objectives for Collaboration

- Engage the students in real research on plants they would encounter in their backyard
- Learn about plants outside of a textbook
- Consider humans role in plant invasions

Getting to know the plant

What is a Rhizome?

A Rhizome is a horizontal stem of a plant that sends out roots from its nodes. A node is the part of a plant stem from which one or more leaves form. Nodes are located under-ground about a foot from the surface. Nodes usually form a swelling or knob in the Rhizome.



Exploring Rhizome Morphology

- Built 1.5 inch wide rhizotrons to observe rhizome growth
- Long term project
- Repeated with different treatments
 - Soil and Sand
 - Organic and Synthetic fertilizers







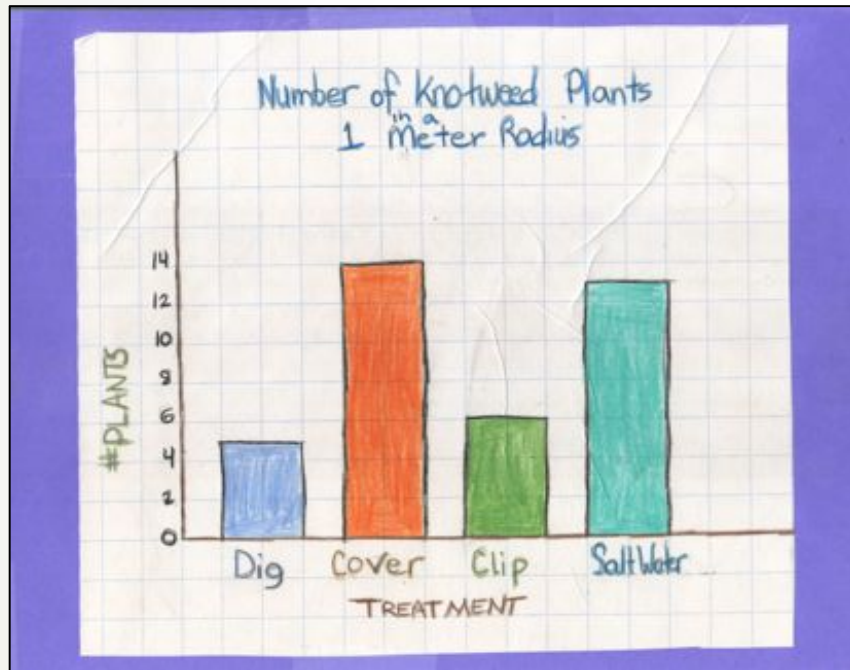
Using our backyard



Start with what we know –
where the plants are
located.

Use science notebooks to
record process

Student-driven research



Students decided on treatments:

1. Dig out the rhizomes
2. Cover the plants through spring
3. Cut the knotweed at the ground level
4. Cut the knotweed and add a strong salt solution to the crown.

Connecting with Scientists

Sap-sucking louse (psyllid) that feeds only on Japanese knotweed

Released in 2010 in England as biological control

Was the release of the psyllid successful?

Can the lice overpopulate?

How long does it take to eat one plant?

How long will it take for the lice to make a difference?

How long will it take for the lice to become part of our ecosystem?

When are the lice coming to the US?



Informing the Public

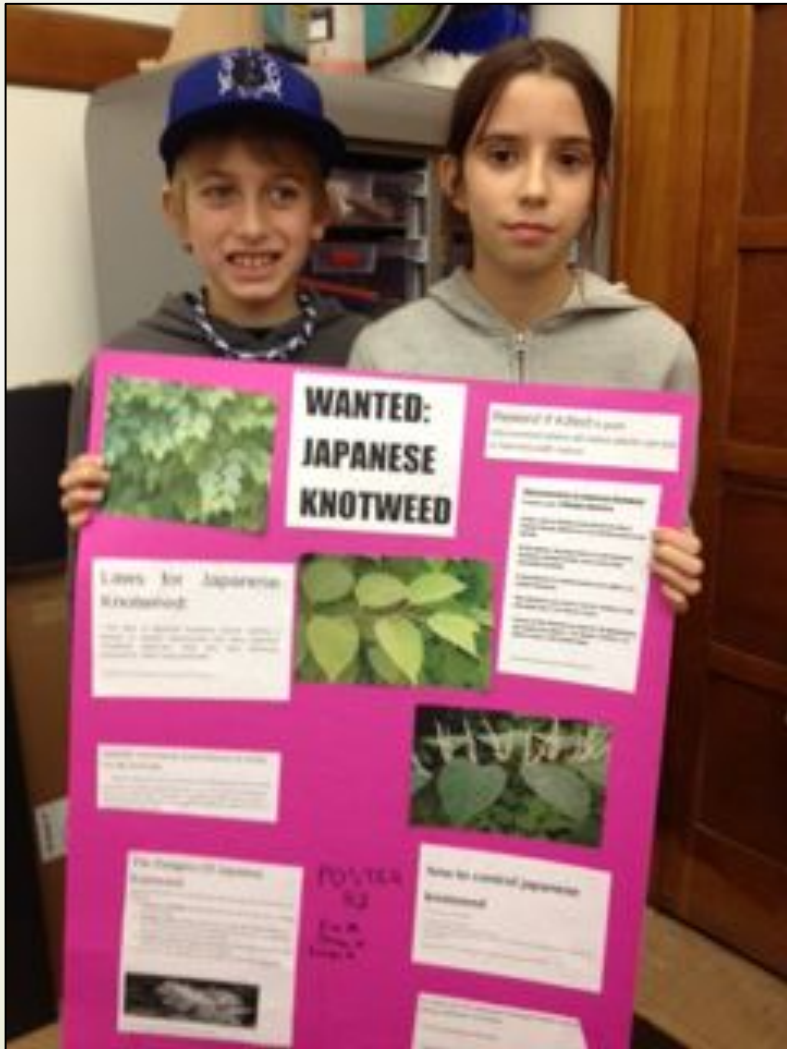


Presenting the work at
Kleinstuck Preserve Field Day



Continuing Outreach

1. Inform their school mates
2. Connect with students at other schools
3. Work with Dept. Natural Resources to inform public at nature reserves



Acknowledgements

- Carol Mallory-Smith and Andy Hulting
- Melody Rudenko, Jessica Haavisto, Megan Gustafson, Etiowo Usoro
- The landowners
- MI Department of Natural Resources and Vern Stephens
- Derek Strine and Nicole Chinigo
- All the Kazoo students



United States Department of Agriculture
National Institute of Food and Agriculture

