

Maine Lakes Conference
June 13th, 2025



DEPARTMENT OF
Agriculture, Conservation & Forestry



NATURAL AREAS



Facilitates Conservation of Maine's Biodiversity

Collecting, tracking, and providing data

- Landowners
- Developers
- Resource managers
- Towns
- State agencies
- Various conservation partners

Invasive Plant Initiatives

At-risk species



Exemplary Natural
Communities



Wildlife Habitat



Ecological
Reserves



Invasive Plants





Collect Data

- Survey, map, and monitor EDRR species
- Identify, confirm & map invasive plant records throughout the state

Produce Management Plans

- Develop plans to manage invasives that threaten ecologically important habitats
- Plan and conduct management for

Treatment

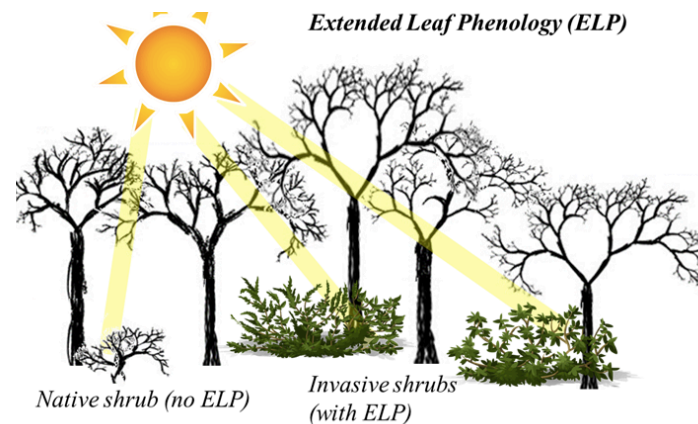
- Aid in mechanical, biological, cultural & chemical treatment (IPM)
- Provide access to licensed herbicide

Education and Outreach

- Educate communities and natural resource staff on invasive plant identification, management, and ways to slow their spread

- Highly Competitive!
- Aggressive growth (above ground and below ground)
- Extended leaf phenology
 - A Great Time to Survey!
- Enemy release
 - No need for defense = better competitors
- Habitat alterations
 - E.g., Allelopathy
- Abundant (and fast) reproduction
- More efficient resource use!

(Levine et al. 2003; Vila and Weiner 2004; Richardson et al 2007, Murrell et al. 2011; Abgrall et al. 2018; Cygan 2018)

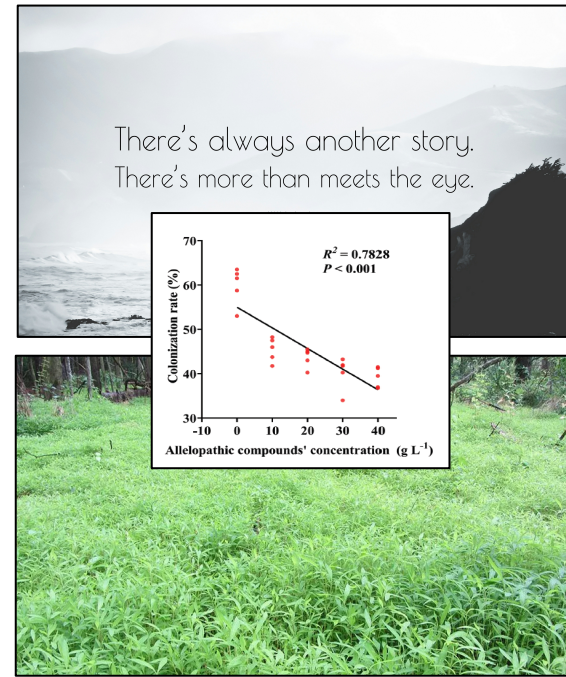


(USA National Phenology Network)

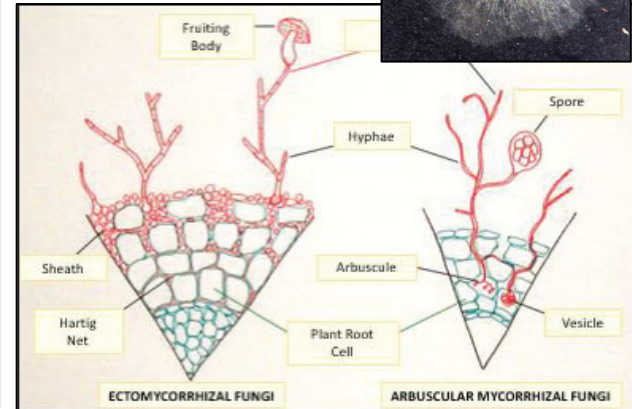
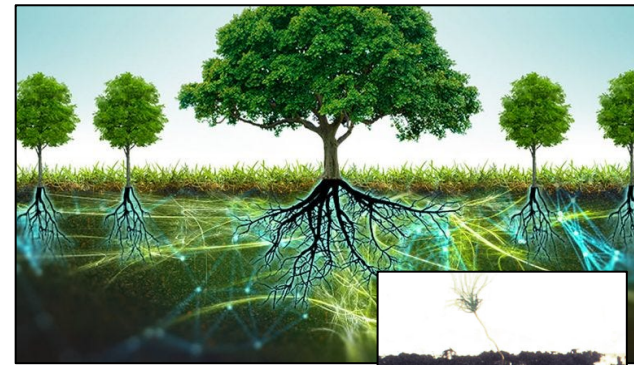


DEPARTMENT OF
Agriculture, Conservation & Forestry

- **Reduce regeneration**, health and vigor of other plants
- Suppress colonization of mycorrhizal fungal communities
 - ↓ mutualistic associations
- Reduce soil microbes and **soil health/development**
- Lasting effects (3-7 years after removal)
- Many plants release these chemicals, but...
 - scale/density/quantity matters
 - evolutionary history matters



- **Hyphae “latch” onto plant roots and.....**
 - Increase surface area
 - Nutrient uptake
 - Access to water
 - Health & vigor
- **Plants provide sugars/carbohydrates**
- **Increases forest health and functioning**
 - Carbon sequestration
 - **Nutrient cycling**
 - **Soil formation**
 - Resilient/resistant to stressors and disease
 - Assists with seedling development
 - **Regeneration/succession**





Native Species Being Outcompeted

- ***Displaced native species***
- ***Reduced seed sources***
- ***Reduced regeneration***
- ***Loss of important trees***
- ***Loss of functional diversity***
- ***Reduction of biomass***

Ecosystem Degradation

Changes to:

- Soil health & development
- Forest structure
- Forest succession
- Organic inputs
- Biodiversity

Impairment of Ecosystem Services

- Carbon sequestration
- Loss of habitat
- Food web dynamics
- Water filtration
- Bank stabilization
- Erosion control



Native Species Being Outcompeted

- Displaced native species
- Reduced seed sources
- Reduced regeneration
- Loss of important trees
- Loss of functional diversity
- Reduction of biomass

Ecosystem Degradation

Changes to:

- ***Soil health & development***
- ***Forest structure***
- ***Forest succession***
- ***Organic inputs***
- ***Biodiversity***

Impairment of Ecosystem Services

- Carbon sequestration
- Loss of habitat
- Food web dynamics
- Water filtration
- Bank stabilization
- Erosion control



Native Species Being Outcompeted

- Displaced native species
- Reduced seed sources
- Reduced regeneration
- Loss of important trees
- Loss of functional diversity
- Reduction of biomass



Ecosystem Degradation

Changes to:

- Soil health & development
- Forest structure
- Forest succession
- Organic inputs
- Biodiversity



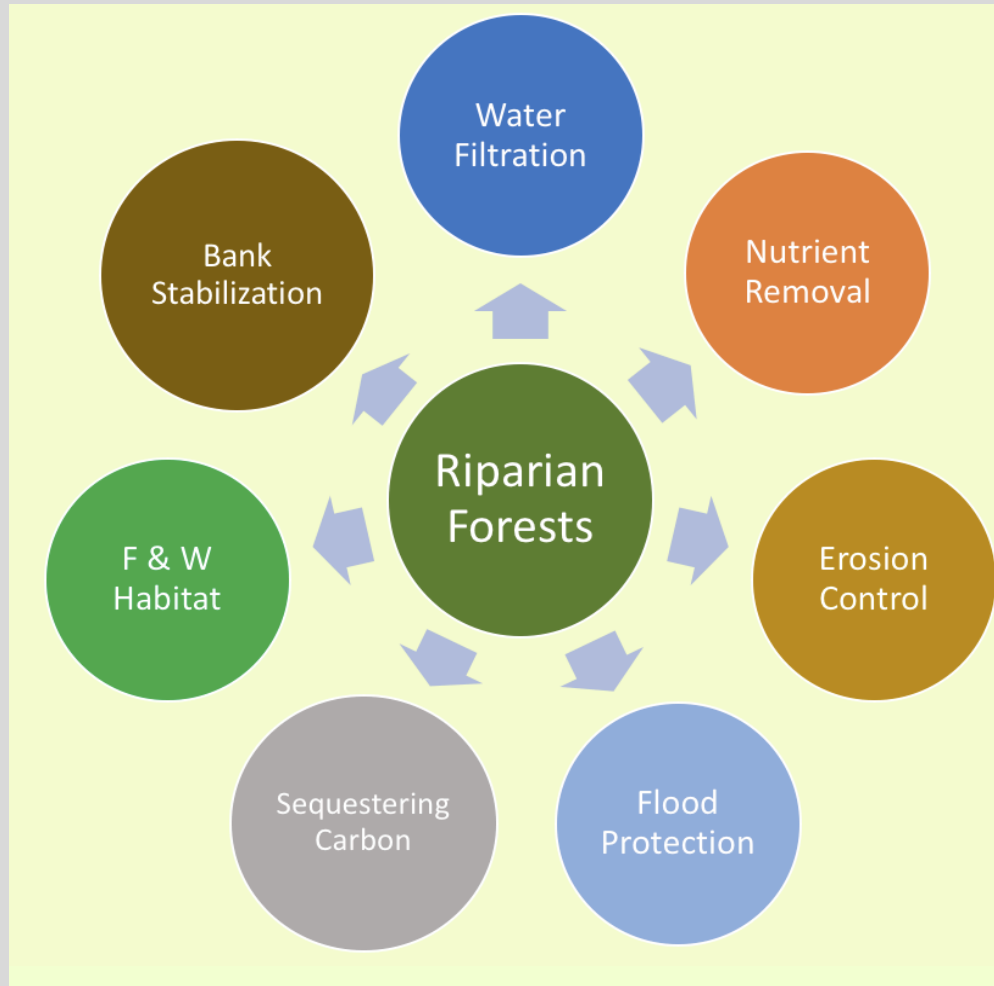
Impairment of Ecosystem Services

- ***Carbon sequestration***
- ***Loss of habitat***
- ***Food web dynamics***
- ***Water filtration***
- ***Bank stabilization***
- ***Erosion control***

Vital to many organisms and the waterbody!

- Provide ecosystem services!
- Increase habitat complexity
- Increase available resources
- Vegetation community and soil development

Lake water quality and ecosystem health is strongly influenced by what drains from the land into the rivers and streams



Riparian Soils

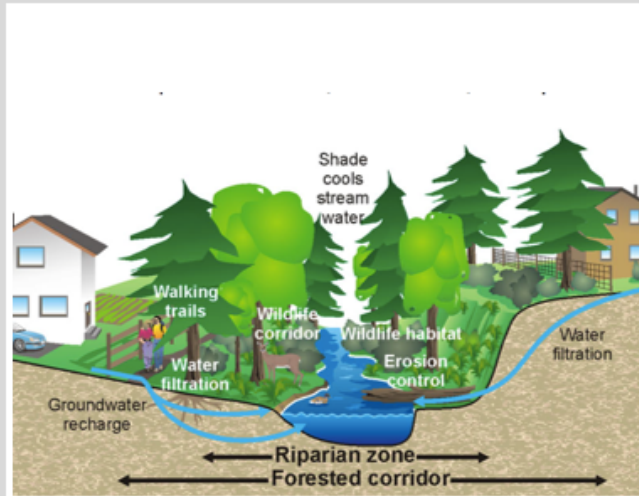
Regulate the transfer of nutrients and sediment into waterways

(Wilkerson et al. 2006)

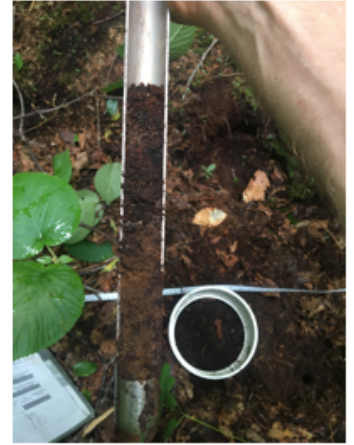
Organic material in soils can:

- Increase infiltration rates
- Reduce runoff and overland flow
- Reduce sedimentation
- Reduce excess nutrients and eutrophication

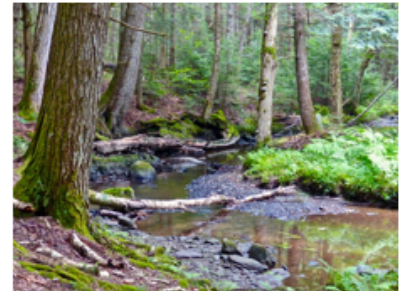
(USDA-NRCS 2014; Sun et al. 2018)



(www.caenarchive.org)



(www.troutunlimited.org)



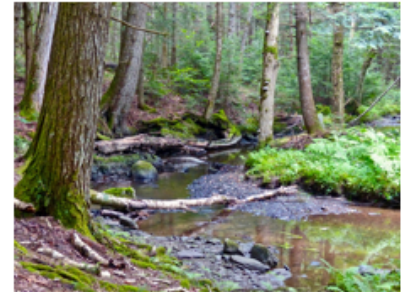
Forest Structure

- Distribution of horizontal and vertical layers in a forest
- Composition of trees and shrubs
- Forest floor
 - Ground cover
 - Litter layer
 - Coarse woody debris

(Good forestry in the Granite State 2010)



www.eschooltoday.com

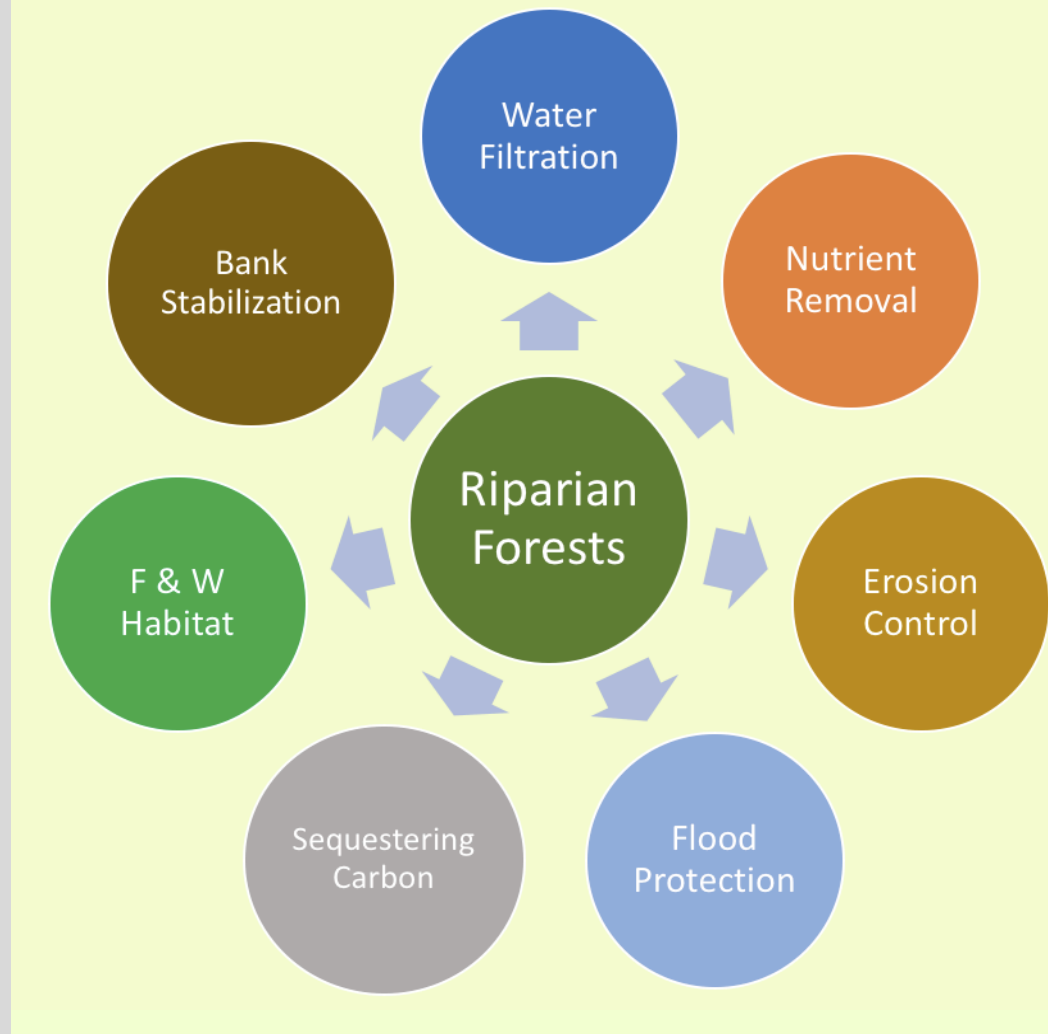


**Dependent on properly
functioning ecosystems & plant
community composition!**

(Levine et al. 2003; Vila and Weiner 2004)

**Changes to species composition
and diversity can hinder
ecosystem processes and
functioning**

(Richardson et al. 2007)

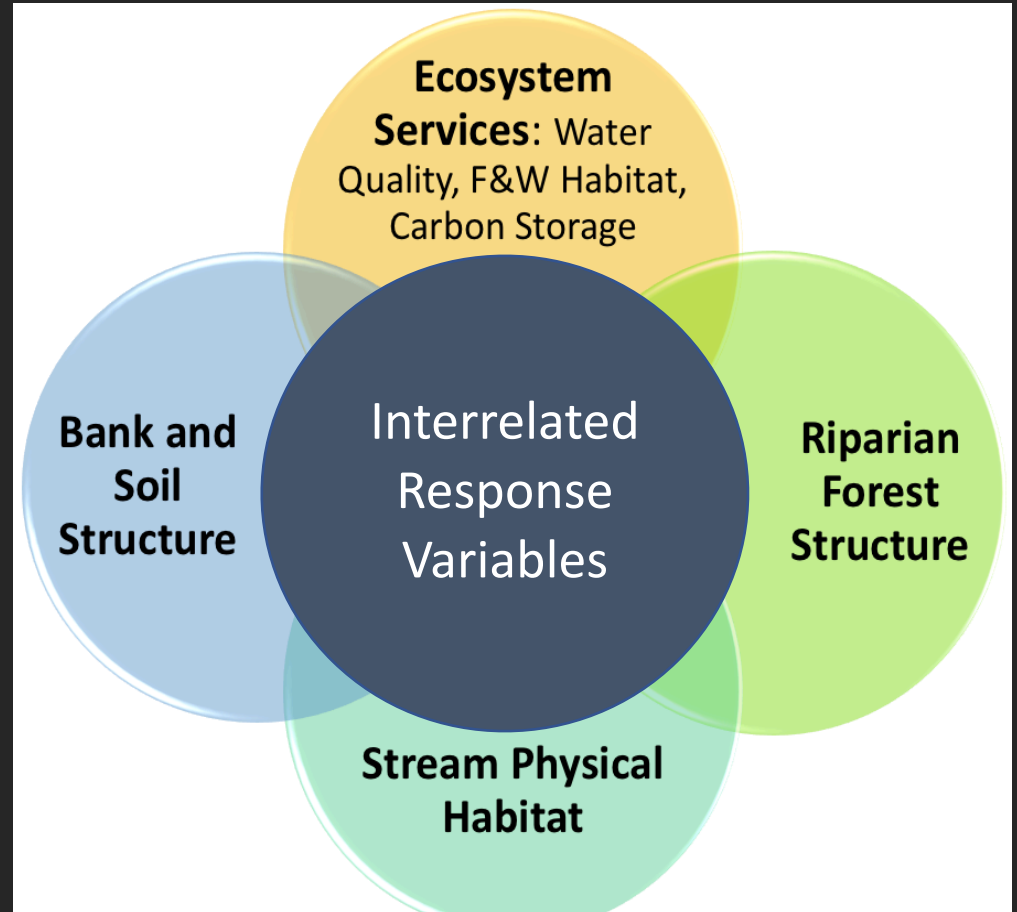
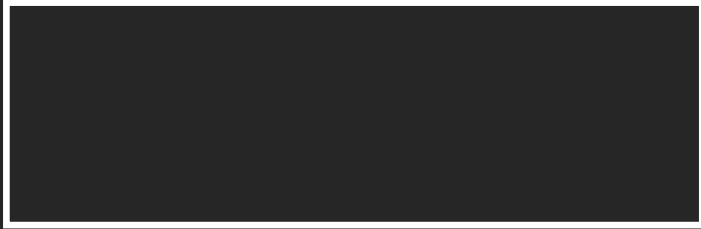




- ***Proficient dispersal***
- ***Abundant (and fast) reproduction***
- ***Aggressive growth (above ground and below ground)***
- ***High environmental tolerance***
- ***Phenotypical plasticity***
 - Monocultures
- Extended leaf phenology
- Enemy release
 - No need for defense = better competitors
- Habitat alterations
 - E.g., Allelopathy

(Levine et al. 2003; Vila and Weiner 2004; Richardson et al 2007, Murrell et al. 2011; Abgrall et al. 2018; Cygan 2018)





325 Occurrences over 30 km
15,173 m²
3.2% of lower watershed

Japanese Knotweed

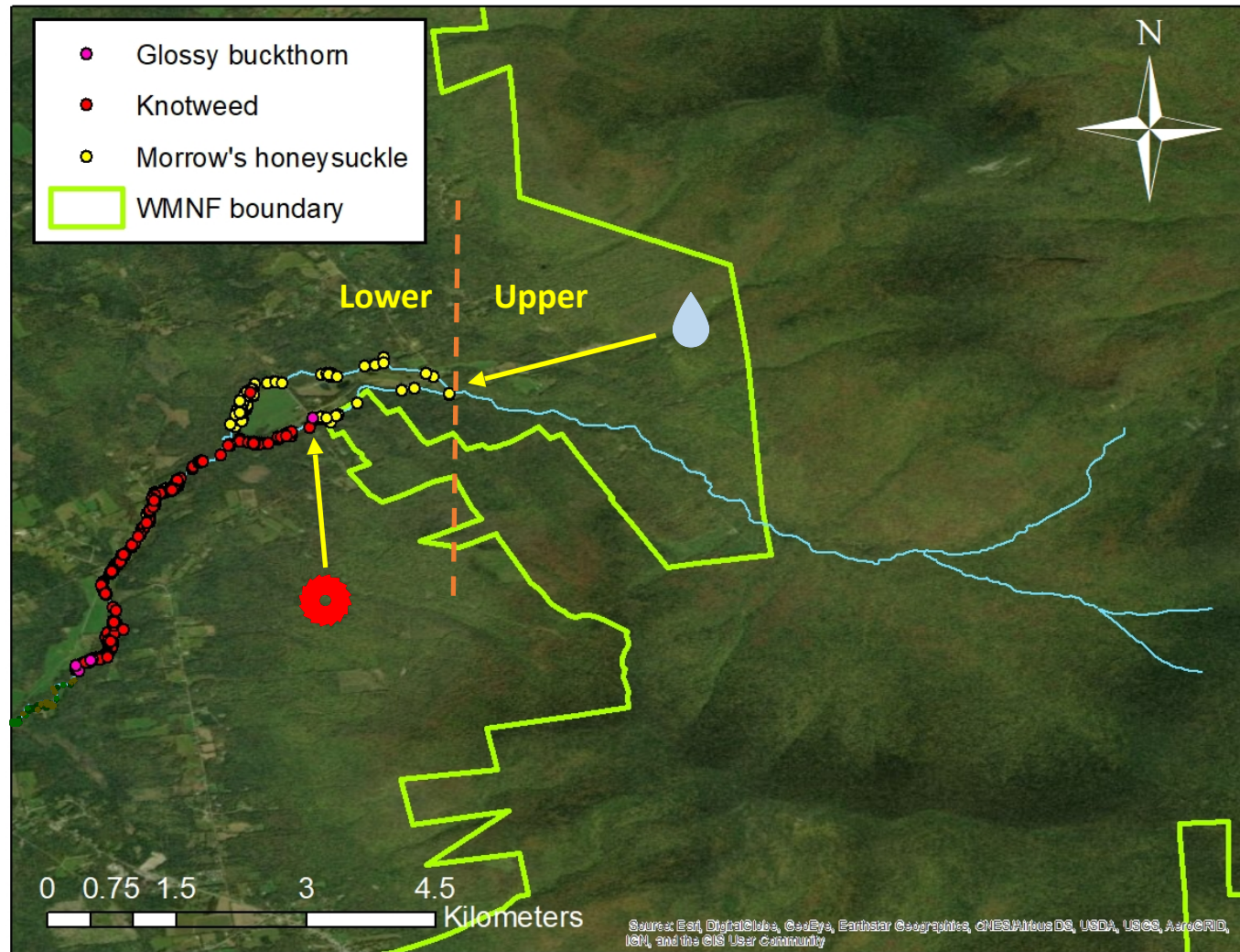
176 occurrences
Largest: 3000 m²
 $\bar{x}$: 78.2 m²
Total size: 13,763 m²

Morrow's Honeysuckle

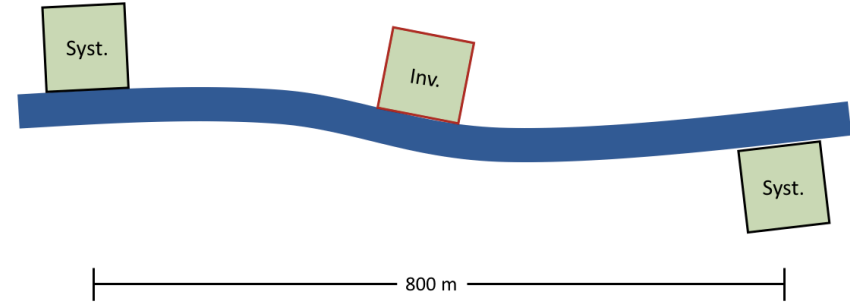
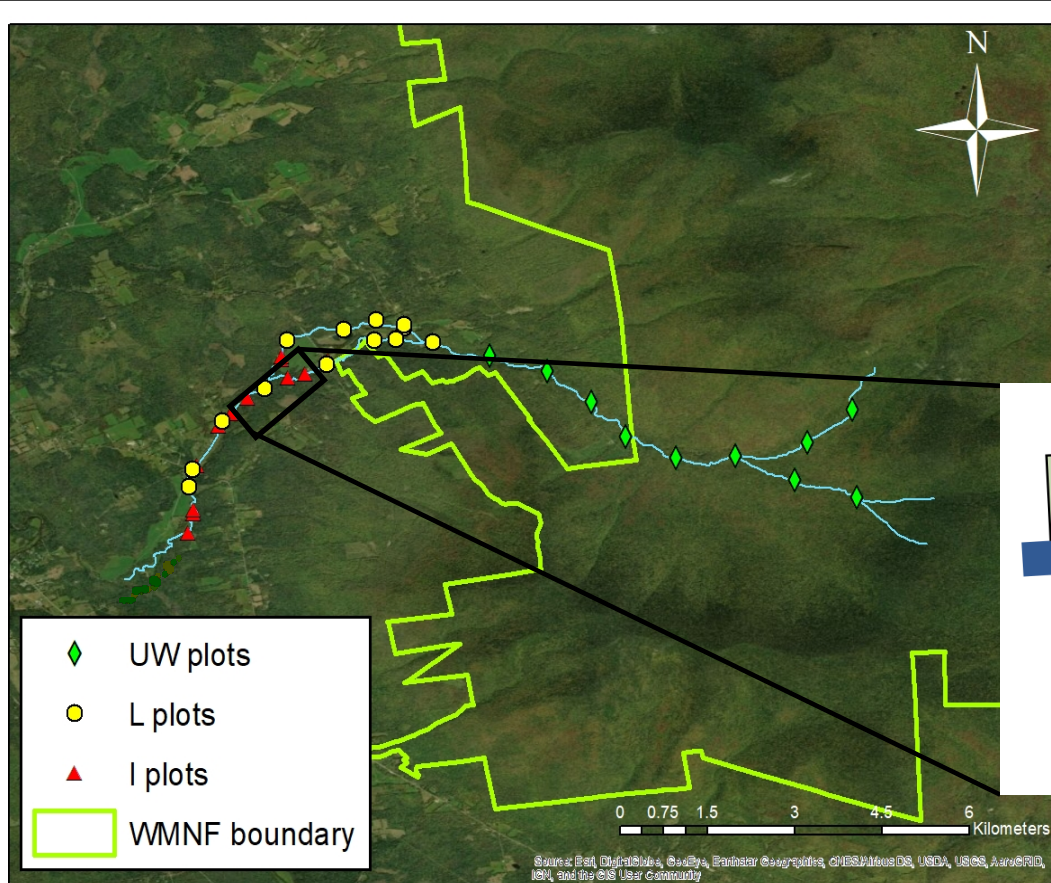
140 occurrences
Largest: 440 m²
 $\bar{x}$: 78.2 m²
Total size: 1,336 m²

Glossy Buckthorn

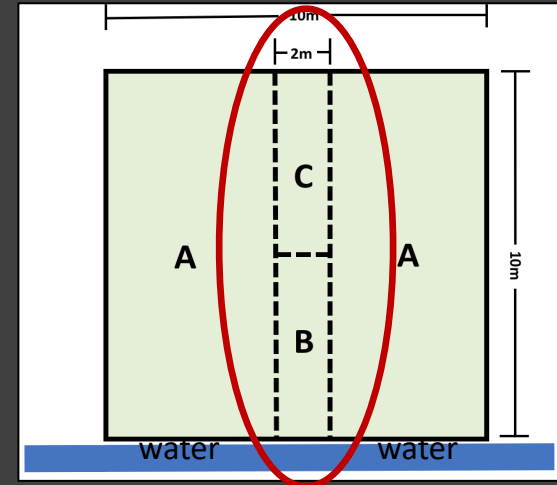
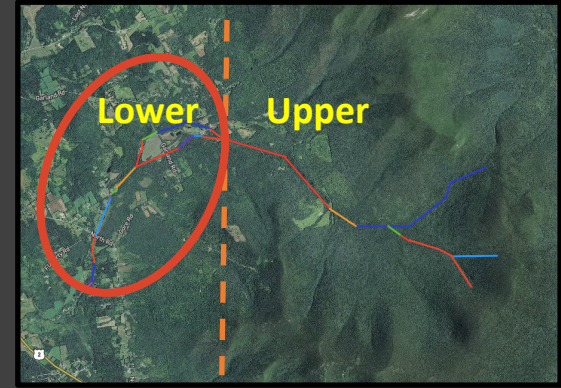
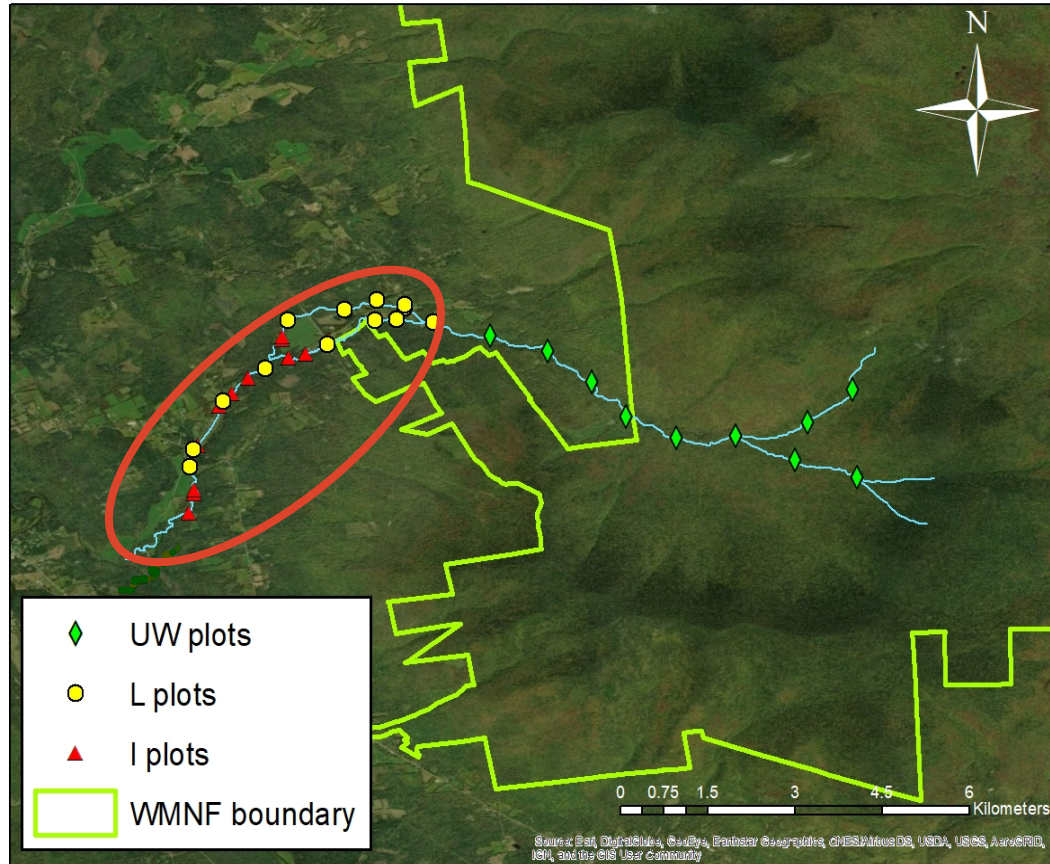
19 occurrences
Largest: 18 m²
 $\bar{x}$: 78.2 m²
Total size: 73.5 m²



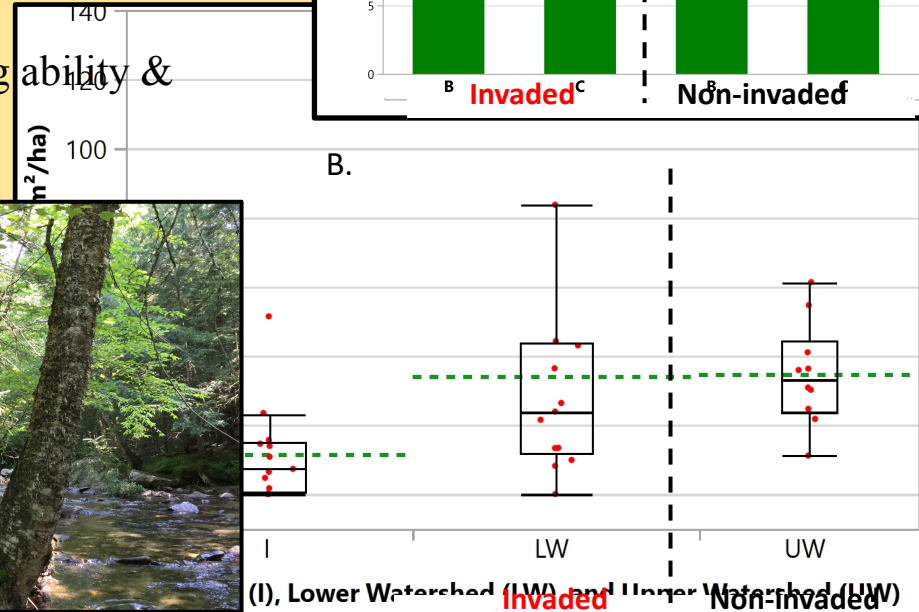
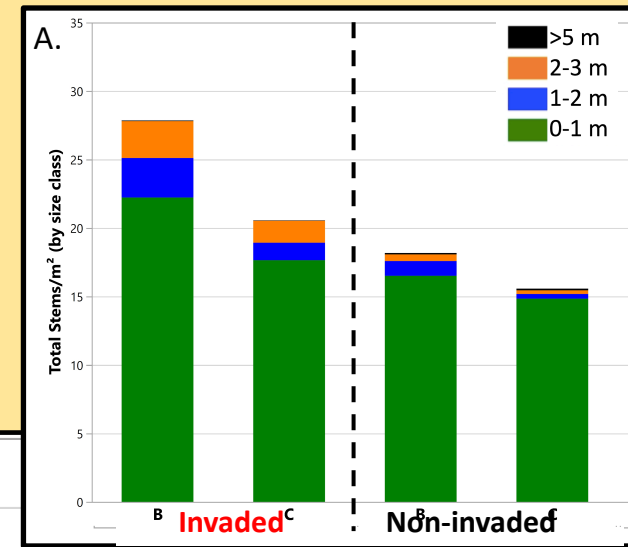
Experimental Design: Plot layout



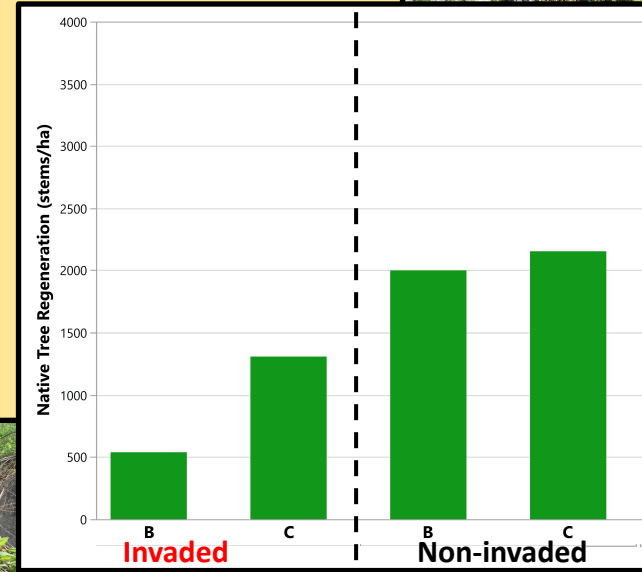
Experimental Design: Plot layout



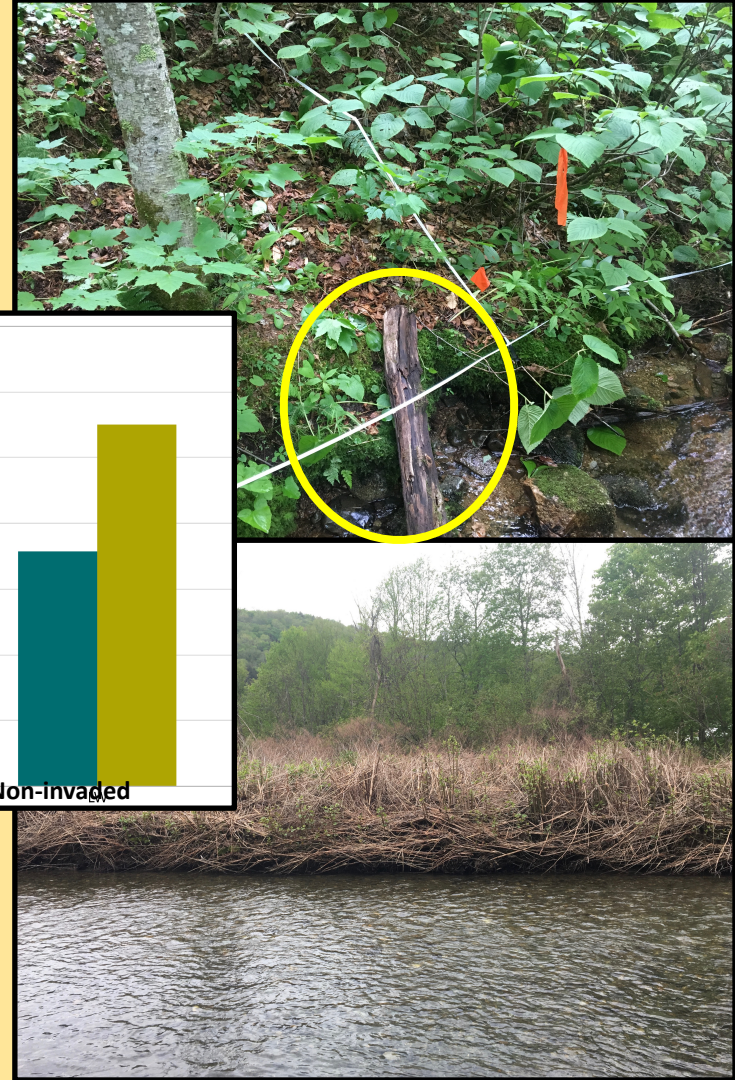
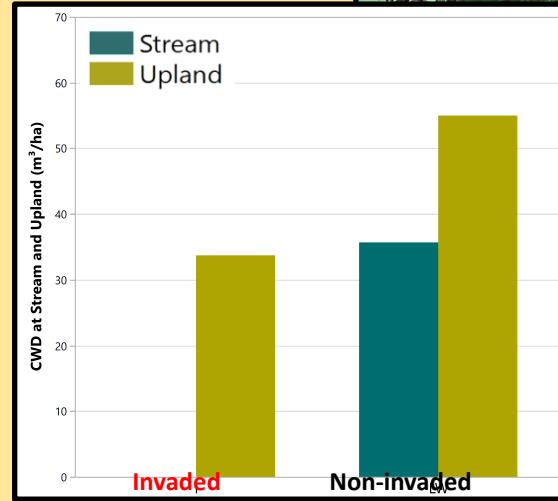
- **Invaded stands had a higher density of small stems (0 – 2m) and less large stems (> 5 m) (A.)**
- **66% reduction in basal area in invaded stands (B.)**
- **↓ C storage, CWD, structural complexity, shading ability & bank stability**



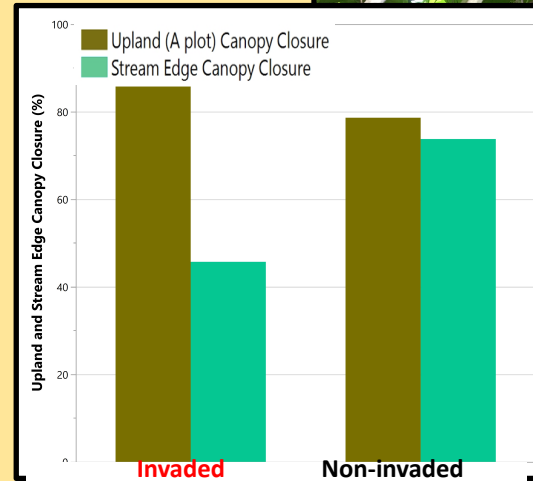
- **Invaded plots had 69% less regeneration of native trees**
 - Aggressive growth, dense shade and allelopathy
 - Invasive plants strongly hindered succession & forest development



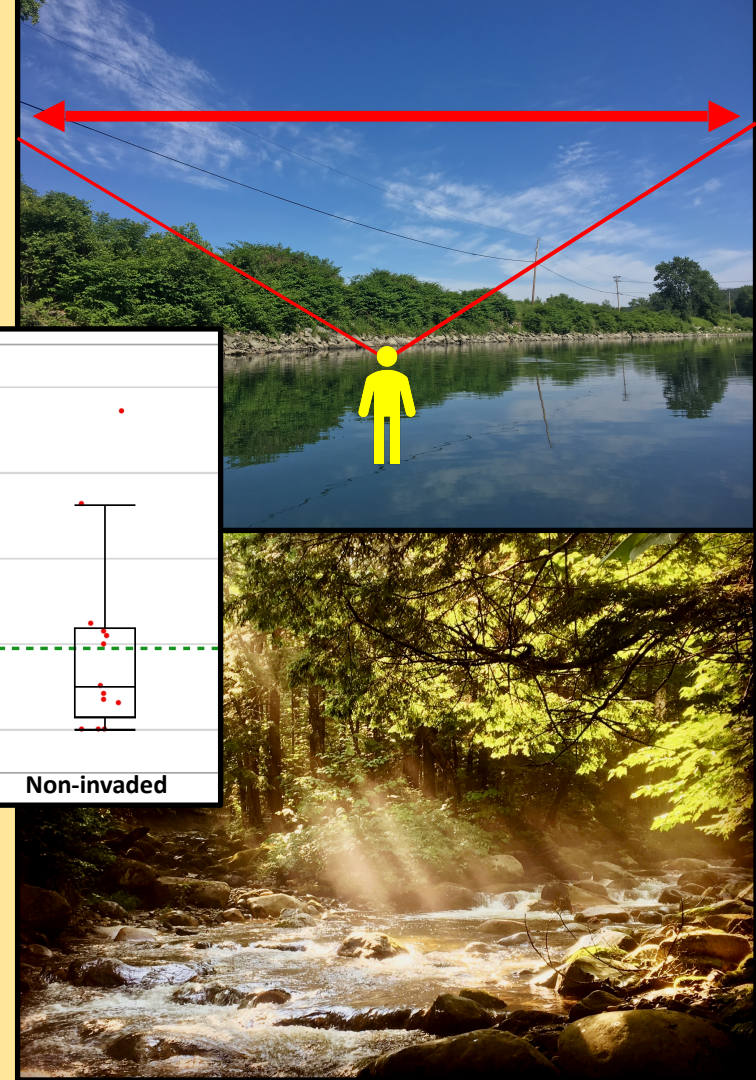
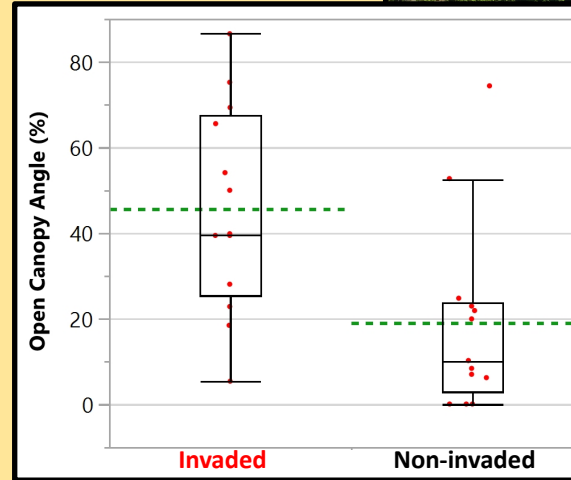
- **61% reduction of CWD in invaded plots when compared to non-invaded plots**
- **Although CWD is non-static, there was no CWD found along the banks in invaded stands**



- **38% reduction in canopy cover**
 - Mostly at the water's edge
- **Shift from high-shade (diffuse light) to dense low-shade** (kelty et al. 2014)
 - High quality to low quality light
 - Reduces regeneration

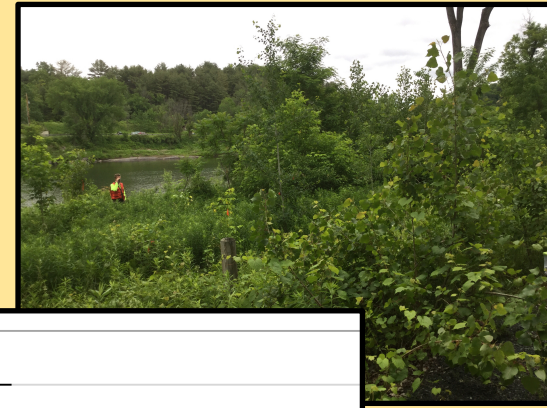
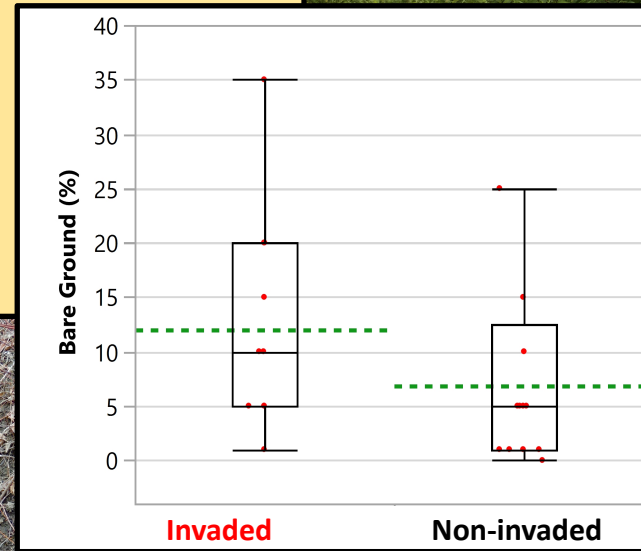


- **139% increase in open-canopy angle (i.e., solar radiation)!**
 - Increases water temps
 - Degradation of water quality
 - Cold-water fishery implications
 - Potential feedback loops with aquatic invasive plants

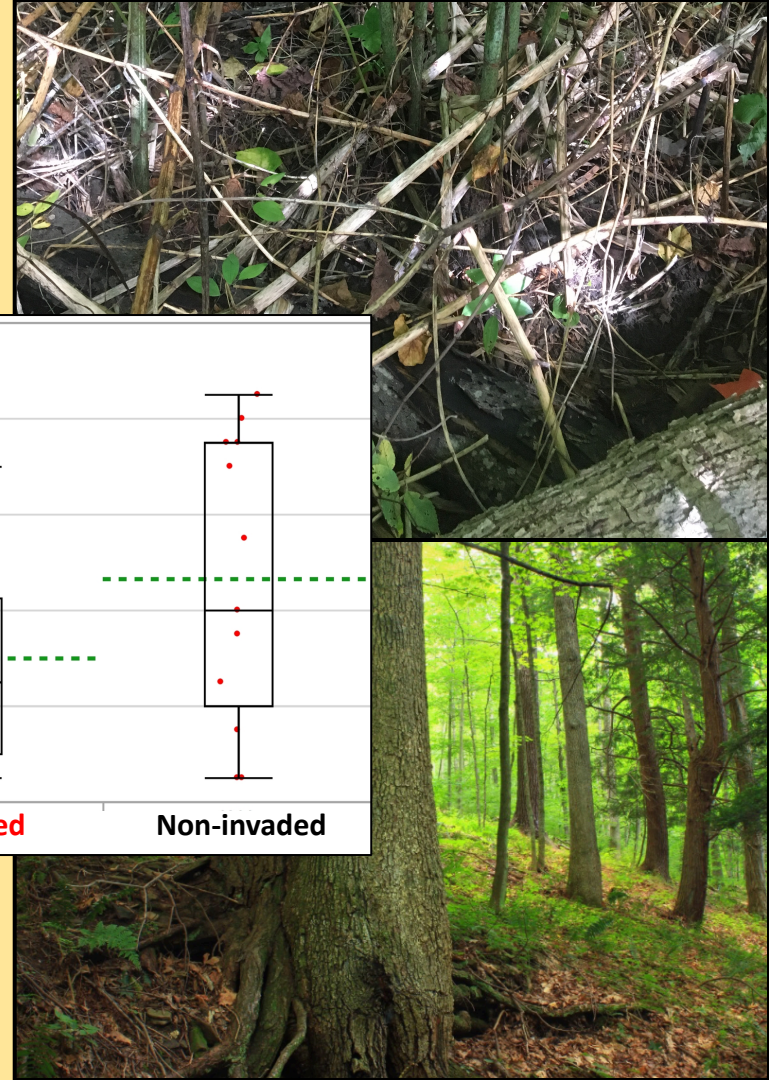
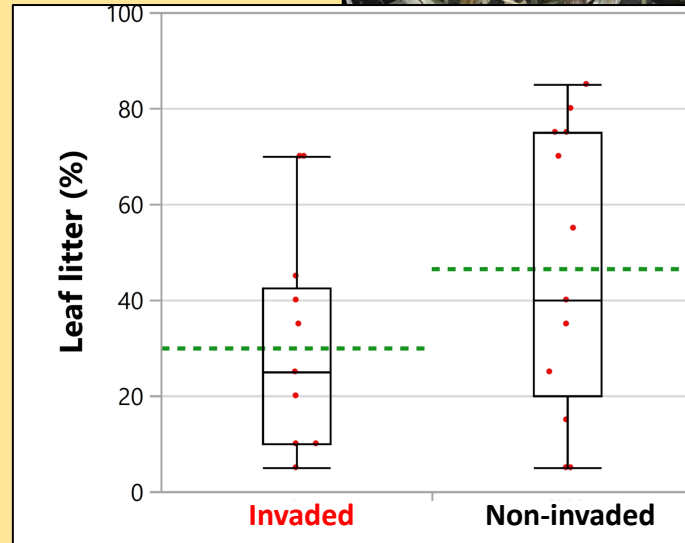


- **Invaded stands had a 14% reduction in ground cover vegetation and a 76% increase in bare ground**

- Allelopathy
- Dense low-shade

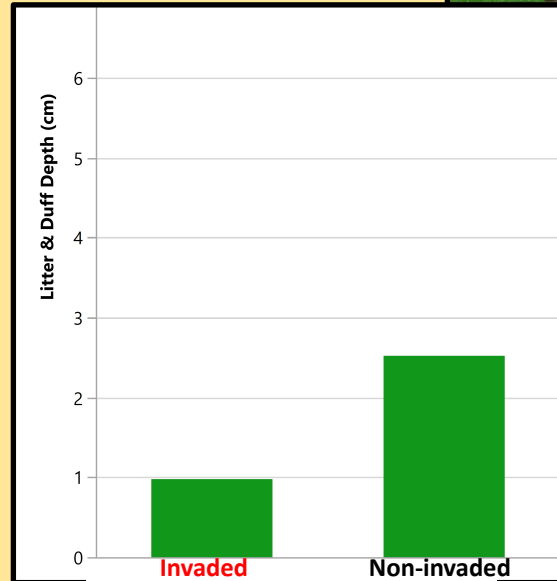


- **36% reduction in leaf litter**
 - Base of the food web
 - Shelter and habitat for aquatic organisms & microbial community
 - Nutrient cycling & water quality

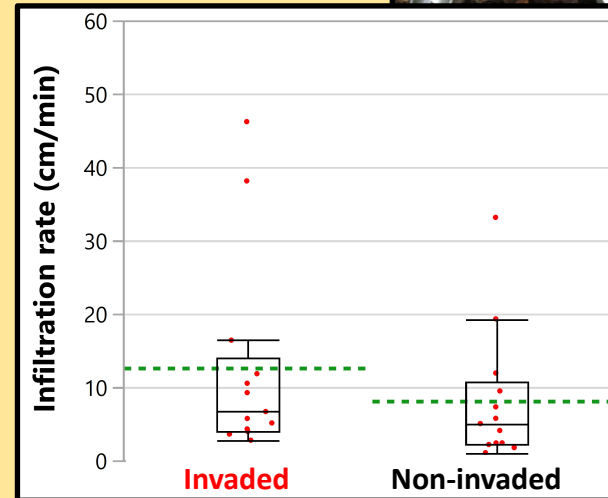


- **60% decrease of litter and duff soil layer in invaded stands**

*Litter and duff decreases soil compaction and erosion and increases infiltration rates



- **55% increase in infiltration rates in invaded stands**
- Surprising, but....



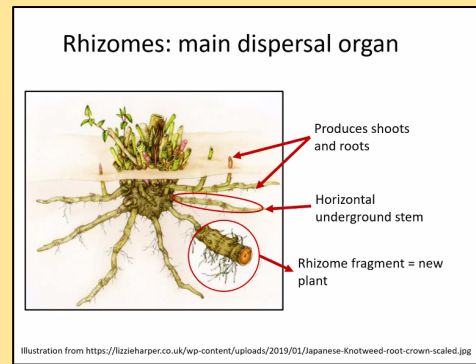
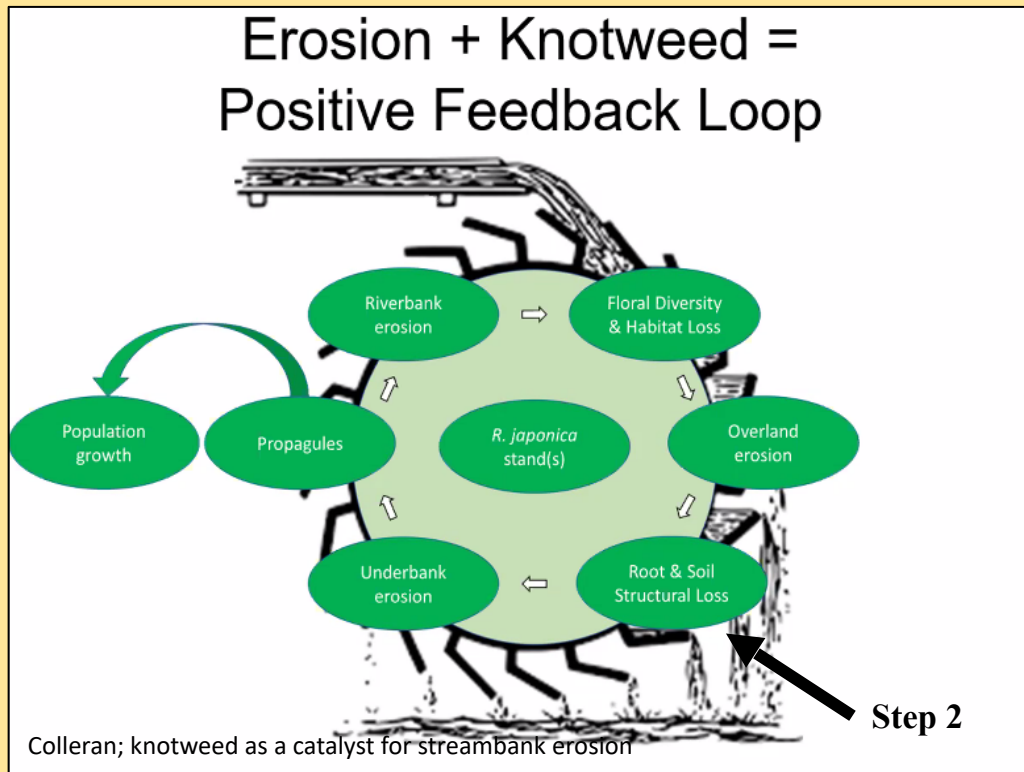
Soil Erosion & Bank Collapse

- Although knotweed creates little organic material, it does create loose soil structure
- This can help with soil compaction and density
- This would also increase infiltration rates (USDA-NRCS 2014; Sun et al. 2018)
- But also leads to bank collapse 😞



Knotweed – A Catalyst for Erosion

Step 1: outcompete other vegetation



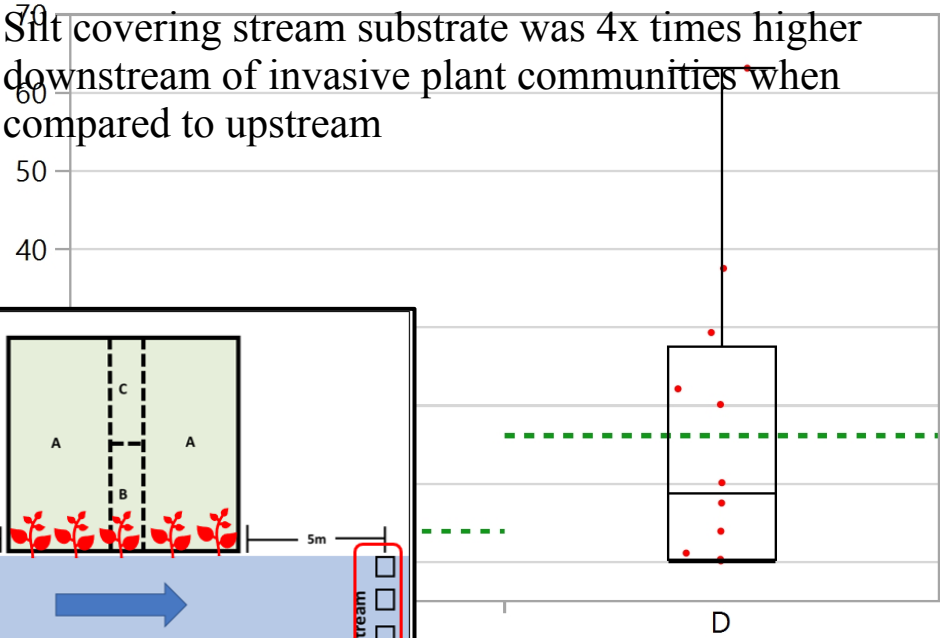
* A plants goal is to spread its genes (via bank collapse?)



*underbank erosion leading to bank collapse

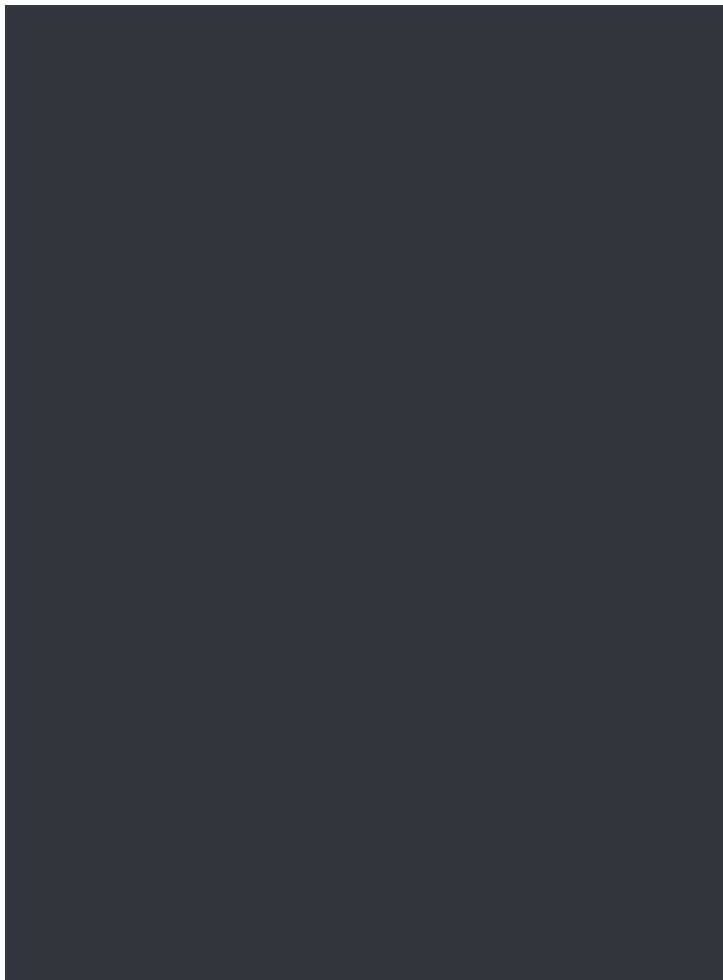
- Silt covering stream substrate was 4x times higher downstream of invasive plant communities when compared to upstream

ness (%)



U) and Downstream (D)







Impacts



Lack of CWD

Less log jams and pools

Less refuge for stream fish

Less opportunity for sediment to settle out

Less organic material storage

Less structural diversity and habitat complexity

Less biodiversity

Reduced organic material

Less food resources

Base of the food web

Impacts



Lack of CWD

Less log jams and pools

Less refuge for stream fish

Less opportunity for sediment to settle out

Less organic material storage

Less structural diversity and habitat complexity

Less biodiversity

Reduced organic material

Less food resources

Base of the food web

Impacts



Lack of CWD

Less log jams and pools

Less refuge for stream fish

Less opportunity for sediment to settle out

Less organic material storage

Less structural diversity and habitat complexity

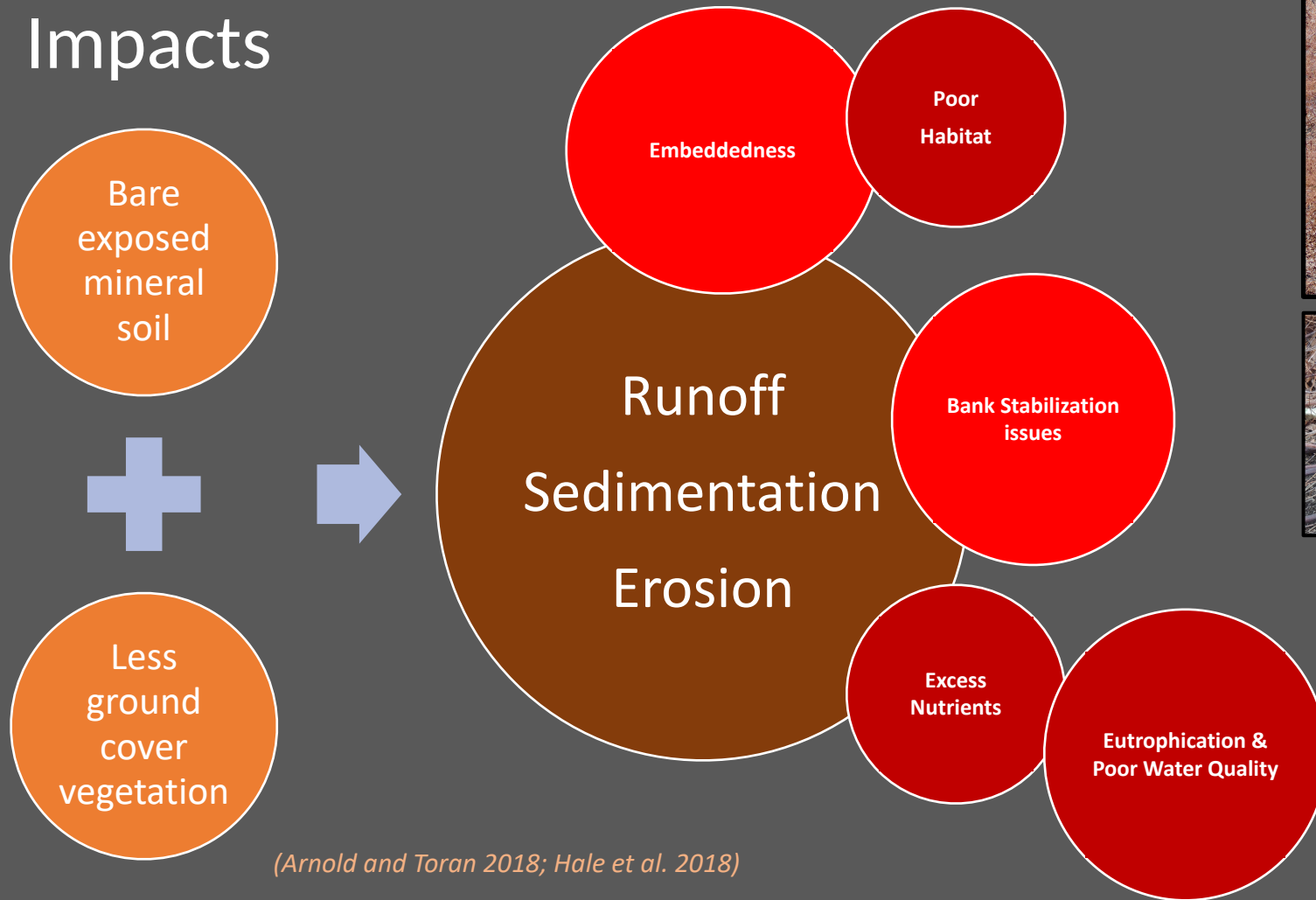
Less biodiversity

Reduced organic material

Less food resources

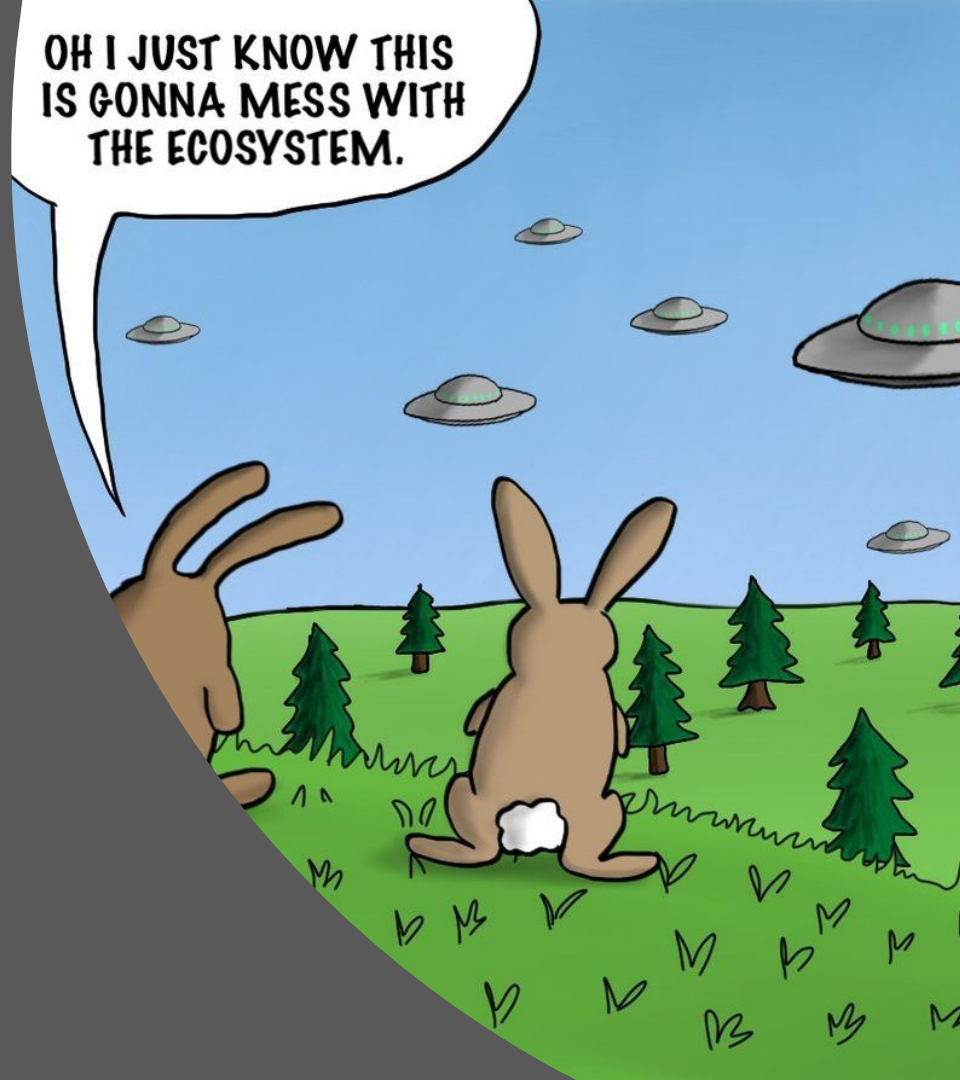
Base of the food web

Impacts

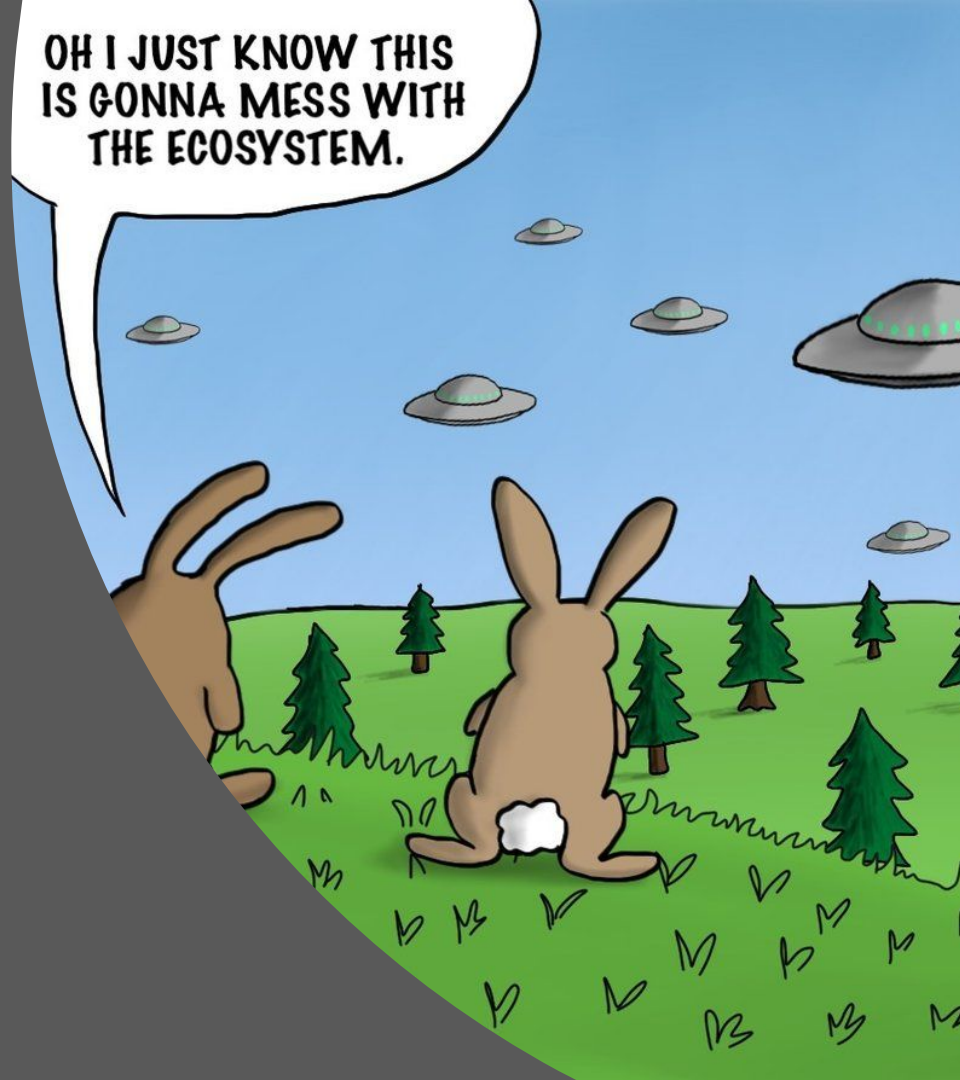


(Arnold and Toran 2018; Hale et al. 2018)

OH I JUST KNOW THIS
IS GONNA MESS WITH
THE ECOSYSTEM.



OH I JUST KNOW THIS
IS GONNA MESS WITH
THE ECOSYSTEM.



Prevention and Early Detection

- Best practices for prevention
- Watch List
- “Nip it in the bud”
- Goal = eradicate from site



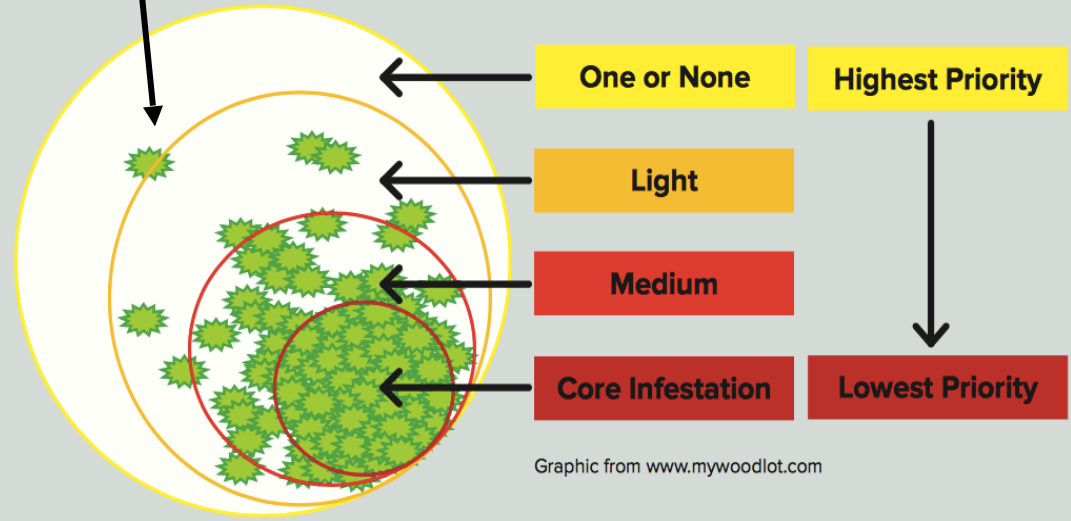
**Don't
Let
This
Turn
Into
That**



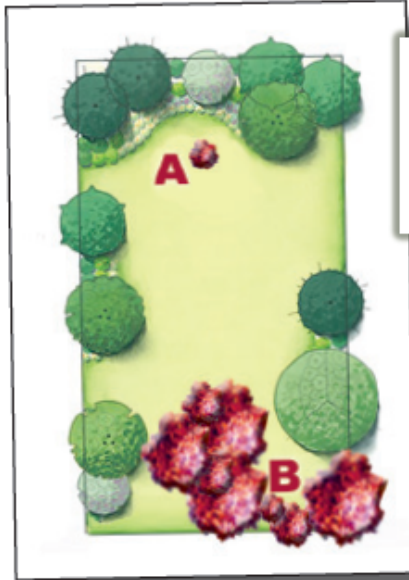
Prioritizing Management

- Prioritize control efforts by the size and intensity of the invasion
- Smaller invasions first
- Prevents smaller infestations from becoming unmanageable
- Work towards core areas over time

Control work would begin here



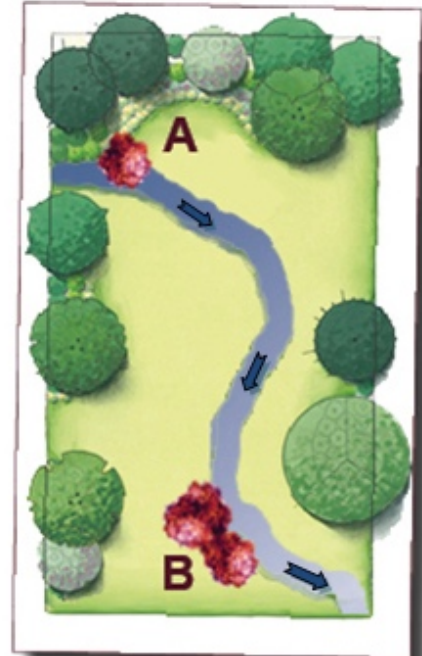
Containment and suppression



Strategy: Start with Small Populations, or Deal With "Spot Fires" / **Outliers**

Starting with small populations is more likely to result in early success.

Could use multipronged approach: eradicate outliers, suppress "source population"



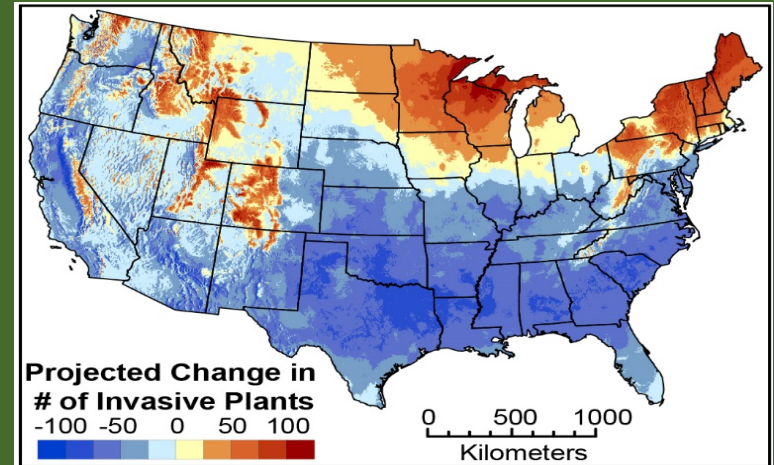


MIPEG-2019

www.maine.gov/dacf/mnap/publications/mipfg.html

“Eastern North America is the recipient of more invasive shrub species into Natural Areas than any other geographic region of the world”

(Maynard-Bean & Margot Kaye 2020; Penn State Univ.)



Future hotspots of novel invasive plants by ~2050

(Allen & Bradley, 2016)



“Eastern
the re
invasiv
into Natu
other ge

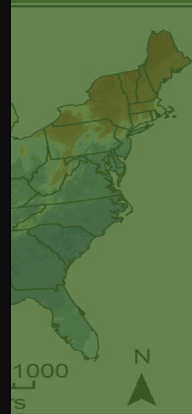
Prevention and Early Detection!



An ounce of prevention is worth
a pound of cure.

~ Benjamin Franklin

AZ QUOTES



(Maynard-Bean & Margot Kaye 2020; Penn State Univ.)

~2050

(Allen & Bradley, 2016)

sive plants by



DEPARTMENT OF
Agriculture, Conservation & Forestry



Thank You!

Chad.Hammer@maine.gov

Phone: 207-287-8040

Cell: 207-441-1214

Realize that everything connects to everything else.
~Leonardo da Vinci



(www.financialtimes.com)