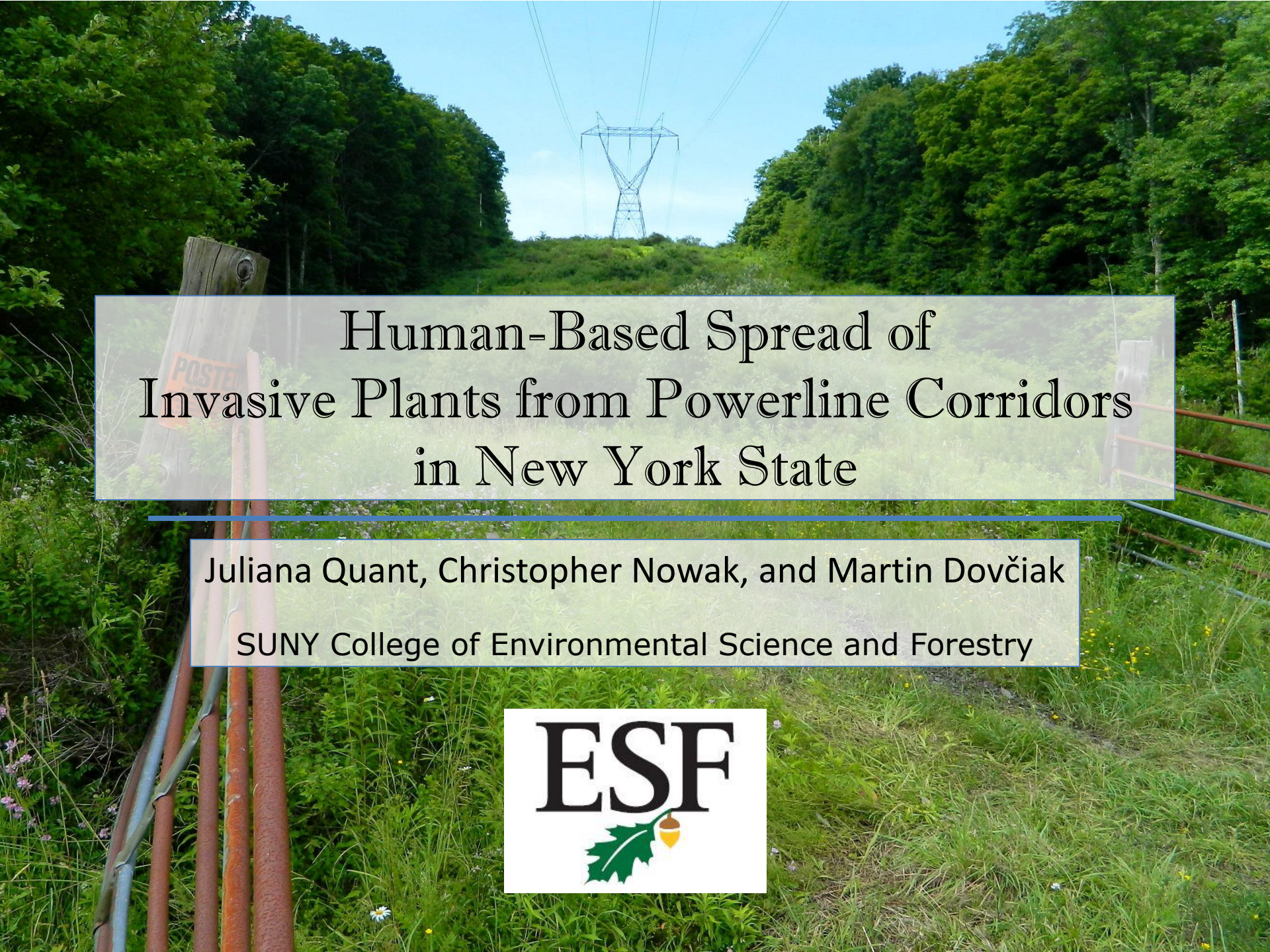

Human-Based Spread of Invasive Plants from Powerline Corridors in New York State

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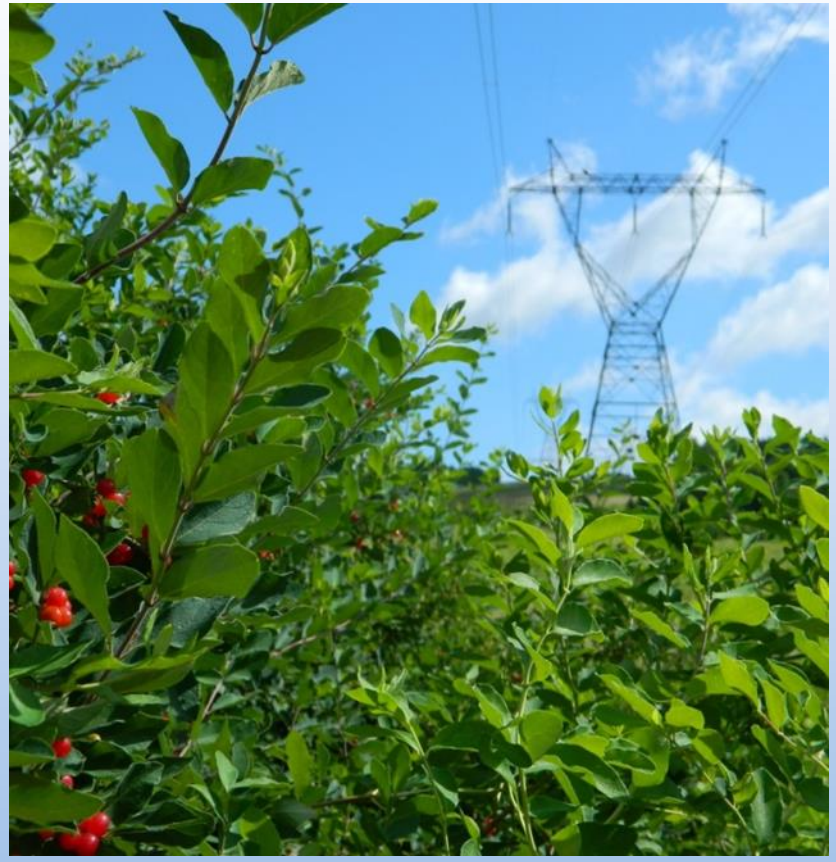
ESF

Ecological context

- Invasions (McNeely et al. 2001)
  - Non-native species establish in a new environment
  - Spread
  - Destructive to human interest
- Extent of damage (Pimentel et al. 2005)
  - 700,000 ha/year invaded
  - Purple loosestrife costs $45 million/year to control



Ecological context

- Rights-of-way as strip corridors (Forman and Godron 1986)
  - Differ from the land on either side
  - Edge and interior
  - Conduit for plant movement
  - Sources of biotic effects
- Long-distance dispersal events
  - Highly important (Cain et al. 2000)

Vegetation management and unintended movement

3 vector types

Past Research

- Seed loss over distances
  - From vehicles on roads in Montana (Taylor et al. 2012)
  - From hiker's boots in Britain (Wichmann et al. 2009)
- Accumulation during normal activities
  - Department of Defense vehicles in Montana (Rew 2011, Fleming 2008)
  - Hiker seed accumulation in Australia (Mount and Pickering 2009)

Questions

Q1. How many propagules are moved, and how many are invasive species?

Q2. How should we approach cleaning vehicles? (Is wash after scrape needed?)

How are propagule loading rates affected by _____?

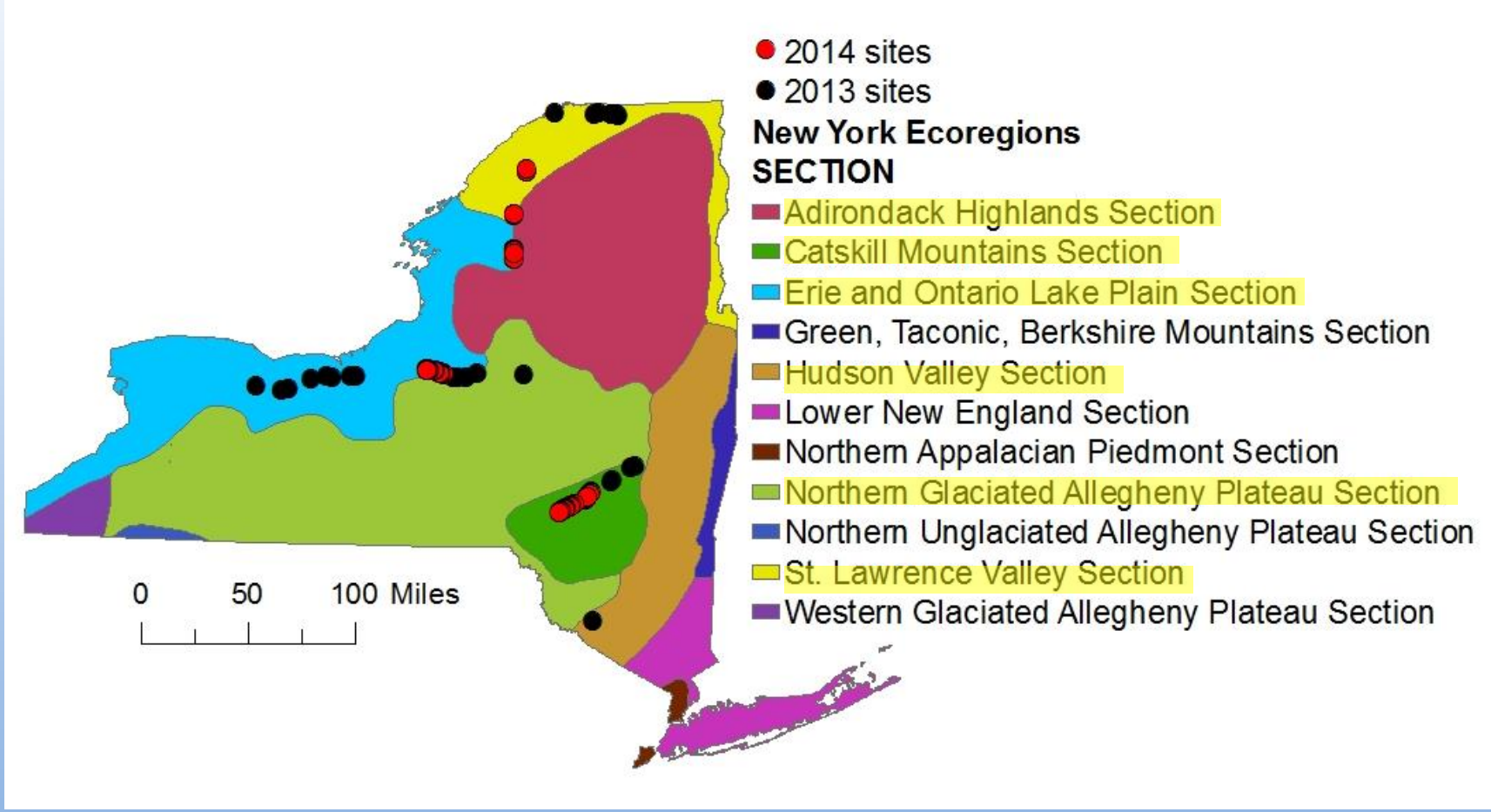
Q3. vector

Q4. soil drainage

Q5. region

Bailey's Ecoregions

- Climate, flora & fauna, terrain, soil taxa, disturbance, land use



Approach

- Accumulation during operational procedures
- Sampled particular areas of vectors
- Used readily available materials
- “Emergence” or seedling growth technique (Gross 1990)

Methods

Focal species

- 39 species: grasses, herbs, shrubs, and trees
- Listed as high priority in NY and surrounding states

Pastinaca sativa – wild parsnip

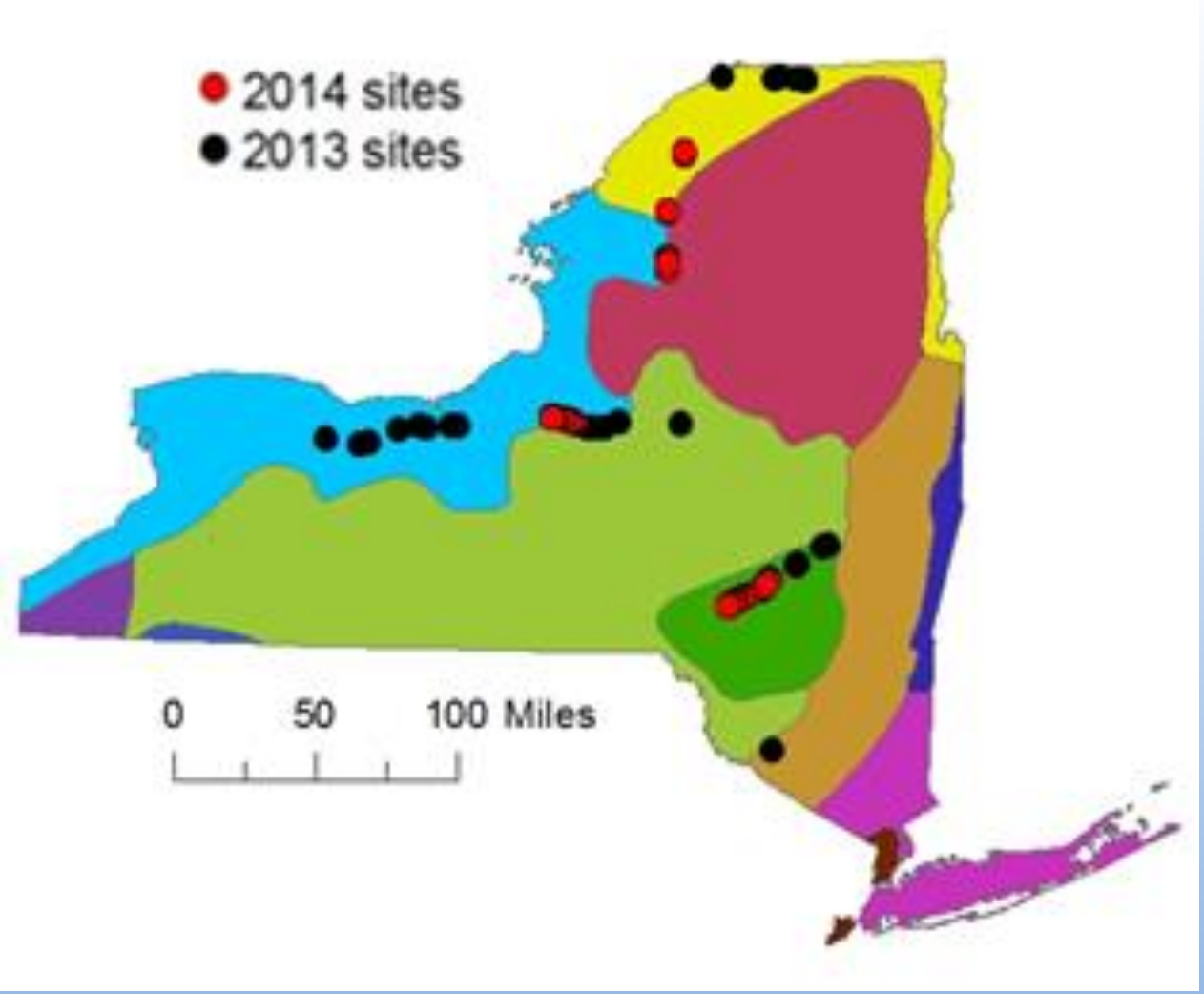
Lonicera spp. – honeysuckle

Lythrum salicaria – purple loosestrife

Photo by O. Shevtsova

Field processes

- Meet crew
  - 60 sites



Field processes

- Meet crew
- Attach GPS

Field processes

- Meet crew
- Attach GPS
- Pre-clean

Field processes

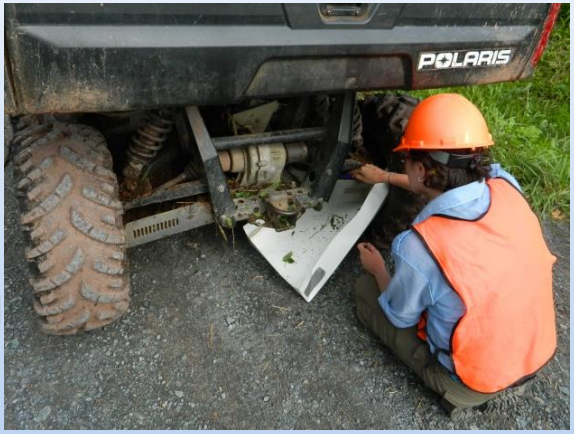
- Meet crew
- Attach GPS
- Pre-clean
- Vegetation management work

Field processes

- Meet crew
- Attach GPS
- Pre-clean
- Vegetation management work
- Sample % assessment

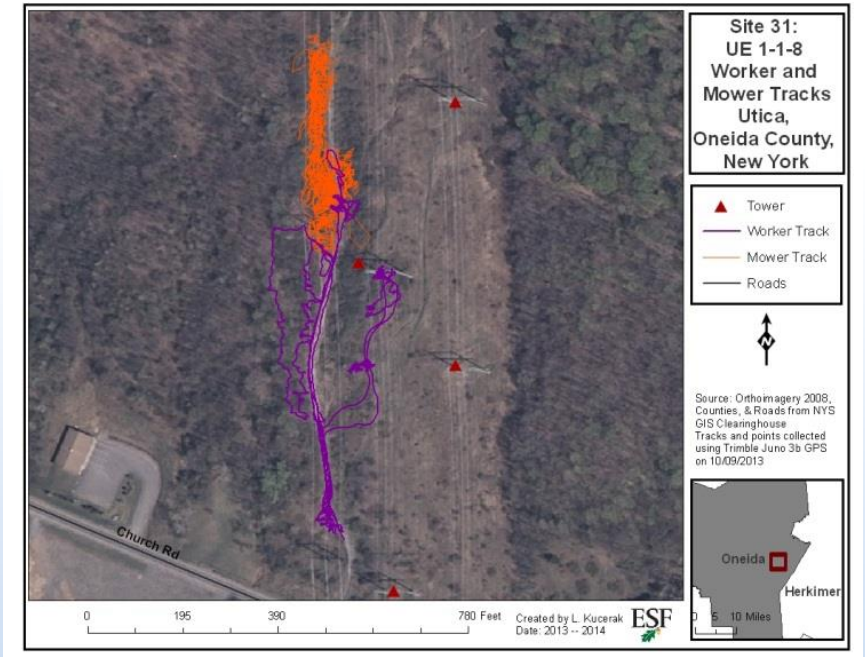


- Attach GPS
- Sampling location assessment
- Collect samples…


Field processes

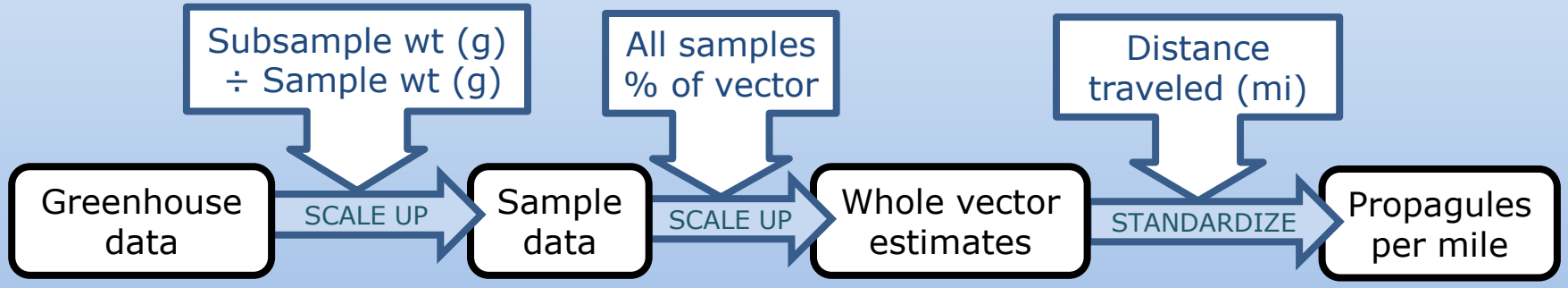
- Meet crew
- Attach GPS
- Pre-clean
- Vegetation management work
- Sample % assessment
- Collect samples…
- Vegetation survey



Greenhouse processes

Invasive status
Invasive
Possibly invasive
Not invasive

Data processes



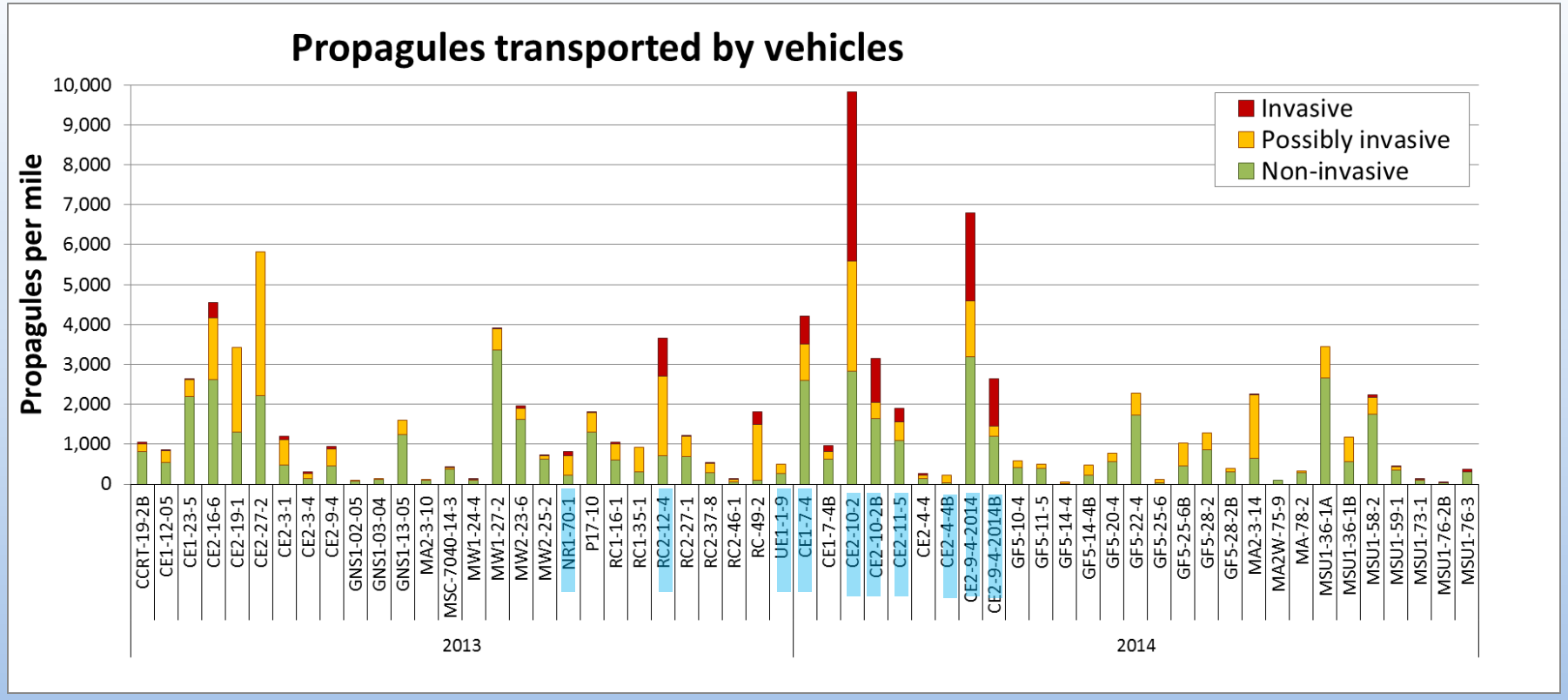
Analysis

- Categorical predictor: non-parametric
  - Mann-Whitney test (2 groups)
  - Kruskal-Wallis test (3 groups)
    - Follow-up: Dunn test with Bonferroni corrections (pairwise)
- Continuous predictor
  - Linear and 2^{nd}-order polynomial models
- Significant at $\alpha=0.1$

Results

1. How many seeds are moved, and how many are invasive species?

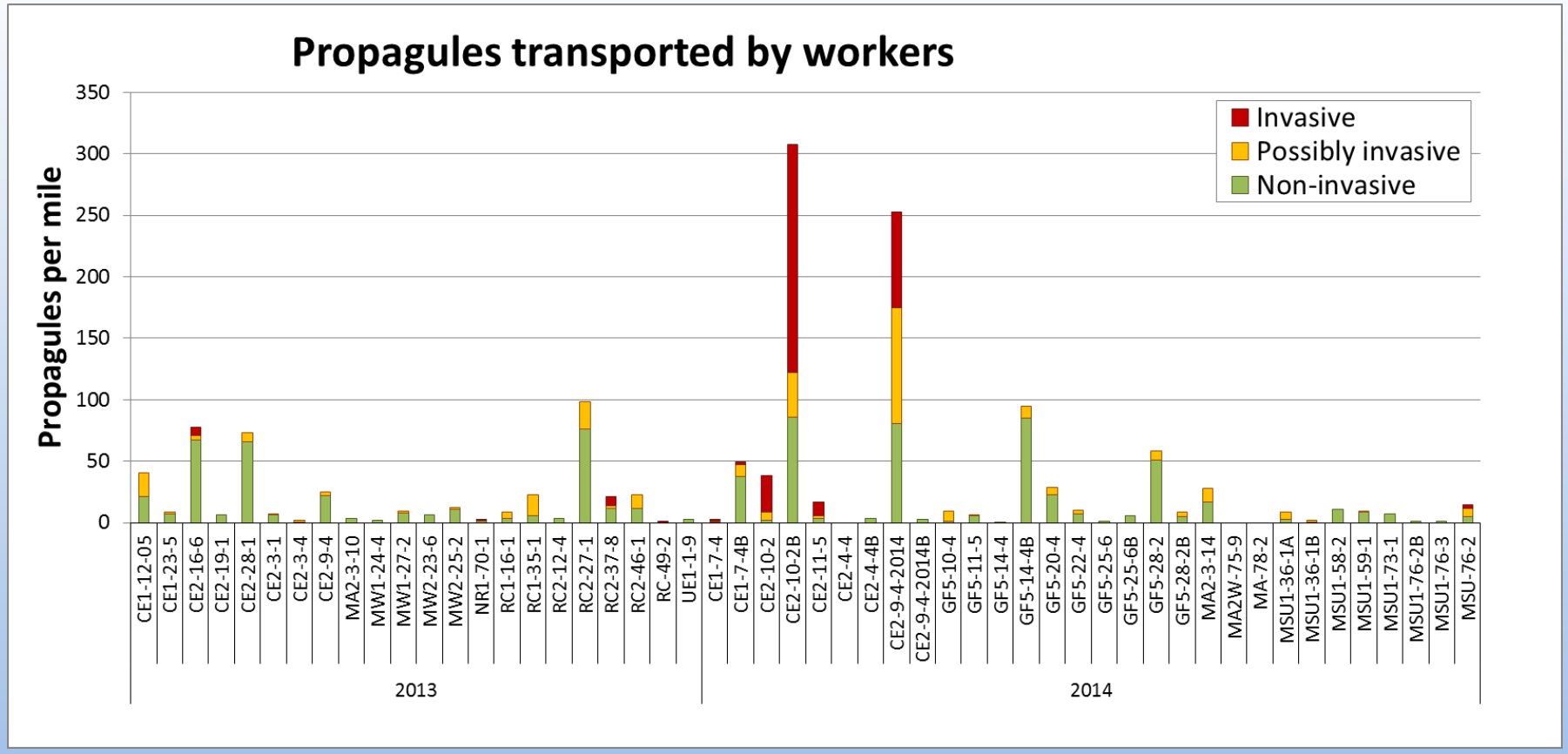
Propagules moved per mile: Vehicles



Average invasive spp.

	2013	2014
ATV	3.5%	3.2%
mower	13.1%	27.6%

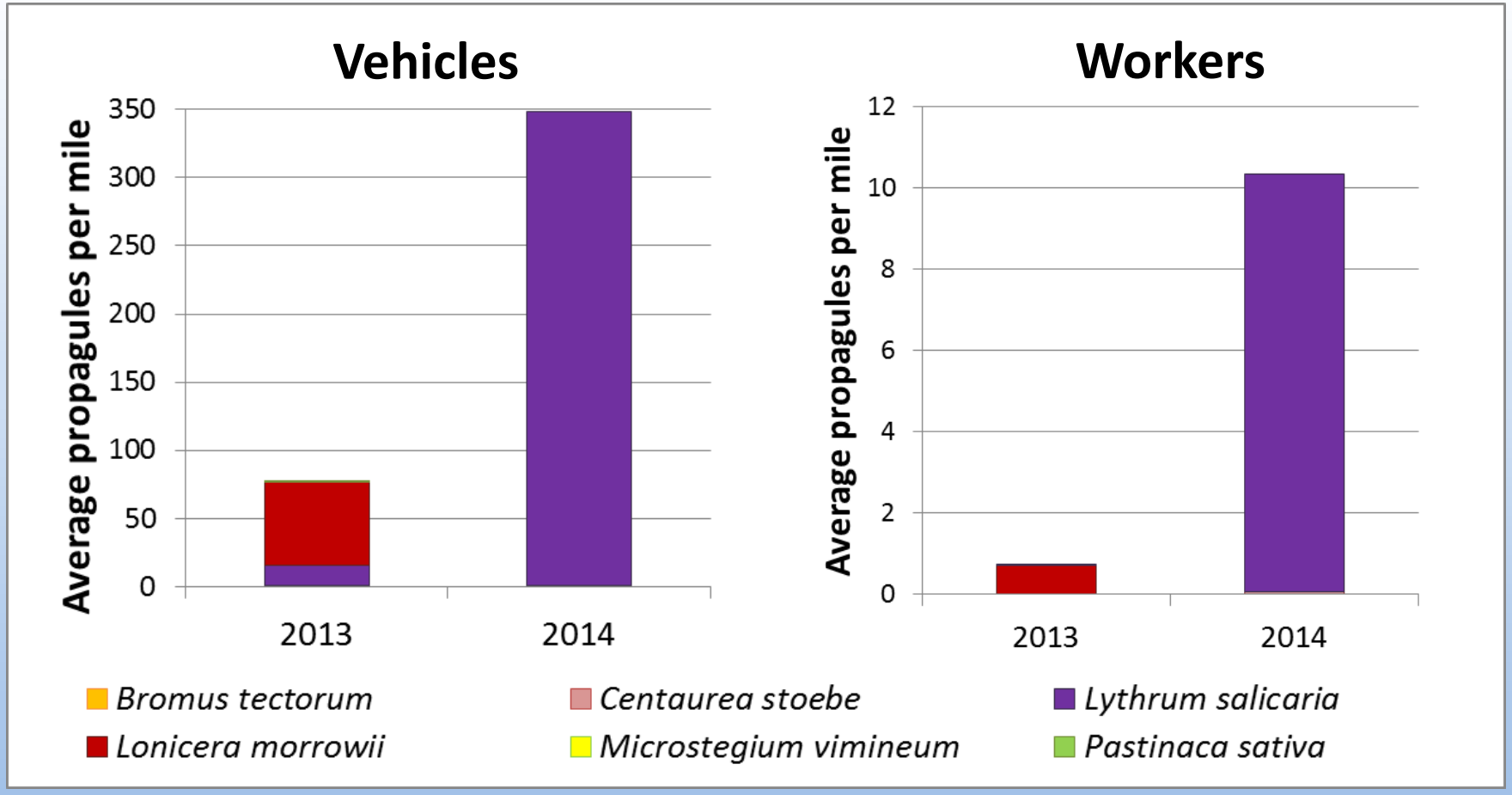
Propagules moved per mile: Workers



Average invasive spp.

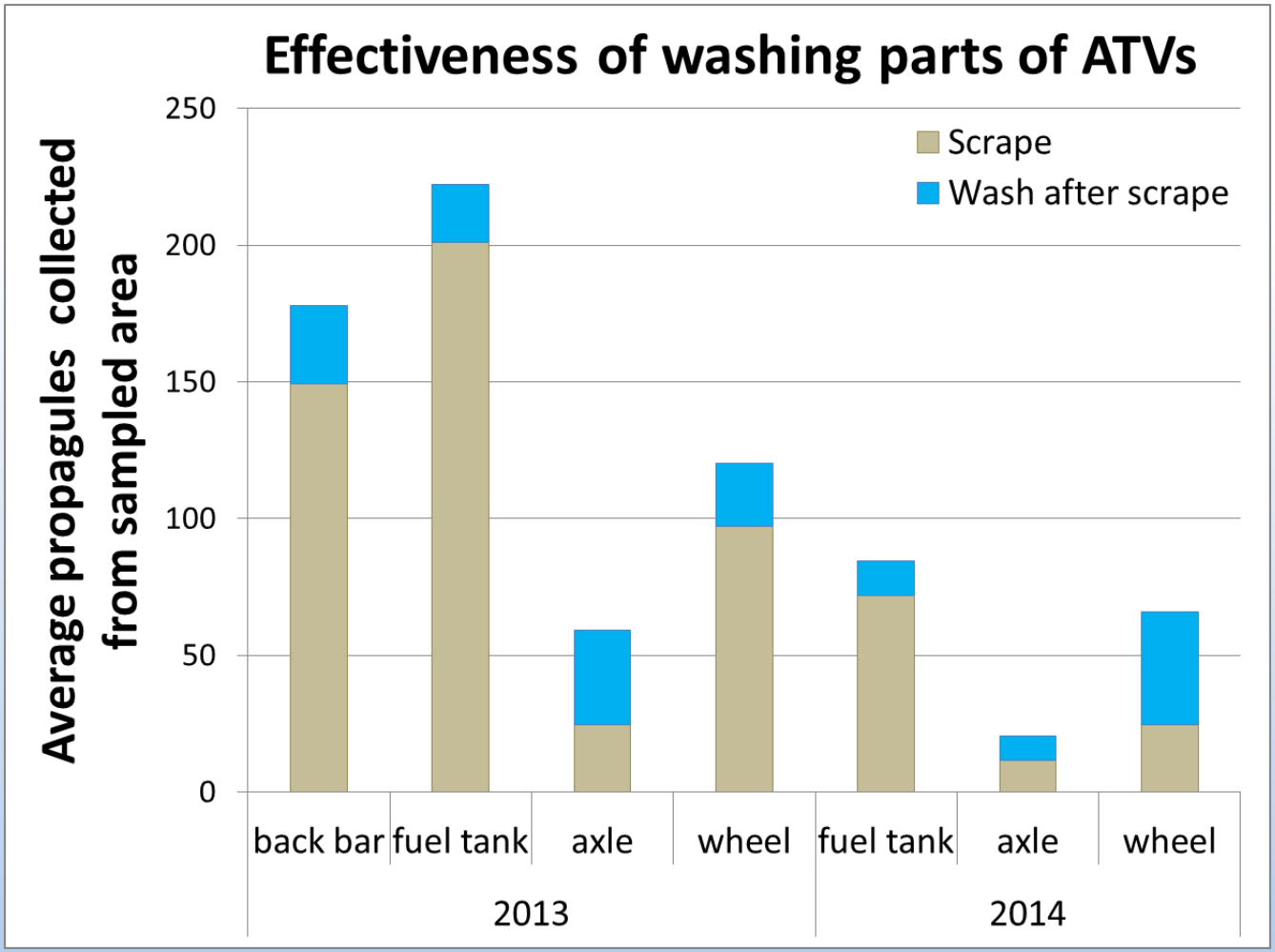
	2013	2014
worker	7.5%	11.7%

Which species were moved?



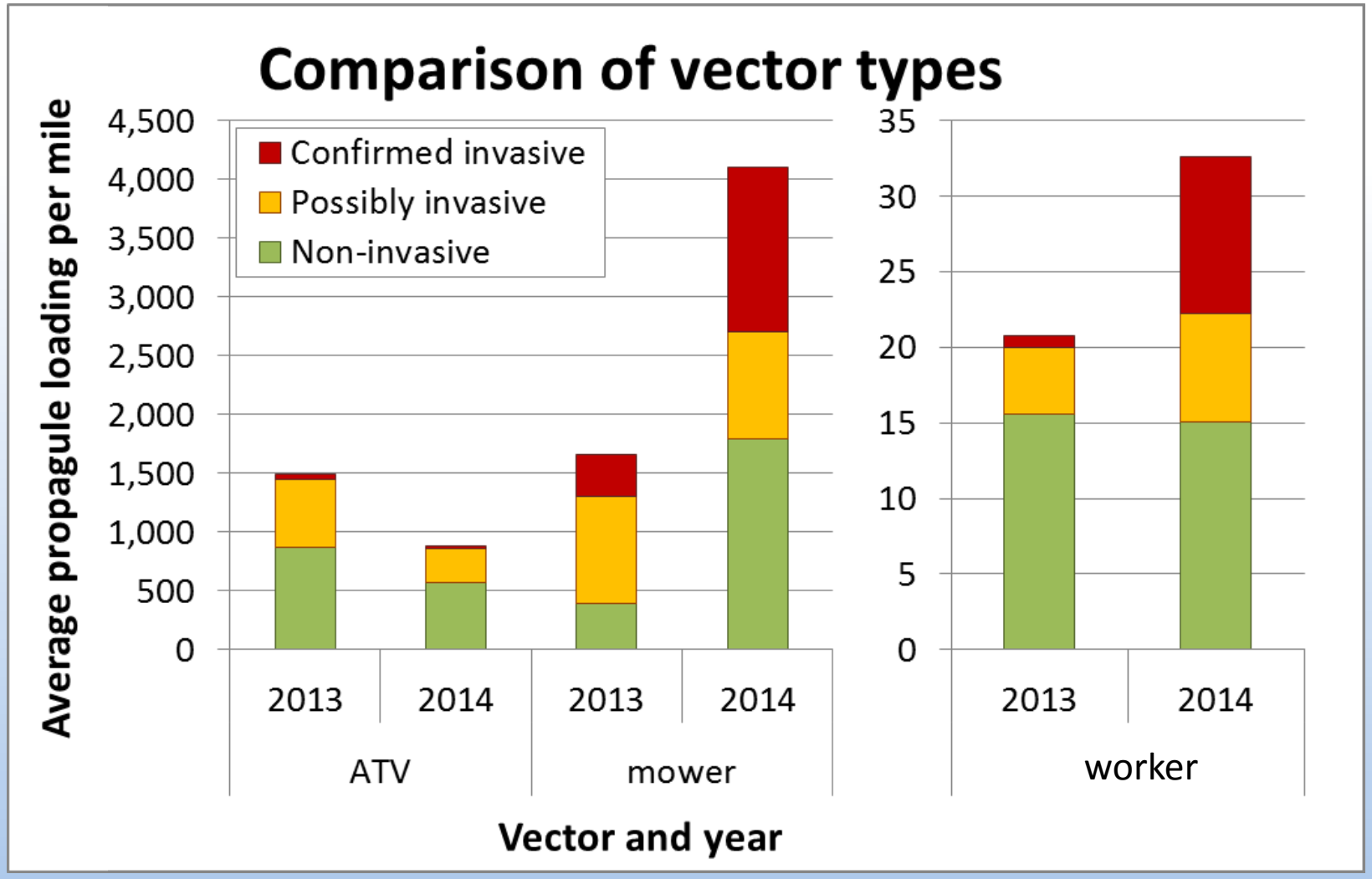
- A single mature purple loosestrife plant can produce 2.7 million seeds/year. (Thompson et al. 1987)

2. What cleaning approach is appropriate?



- Washing after scraping/brushing removes 30-50% of propagules (significant)
- Commercial wash units remove about 77% of material (Rew 2011)

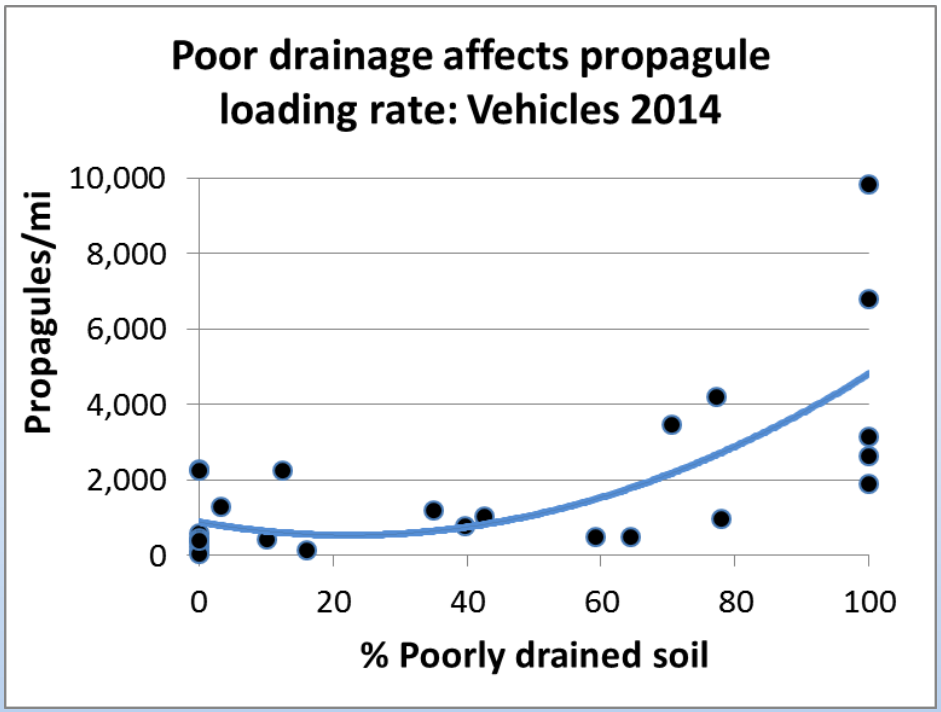
3. What difference does vector (worker, type of vehicle) make?

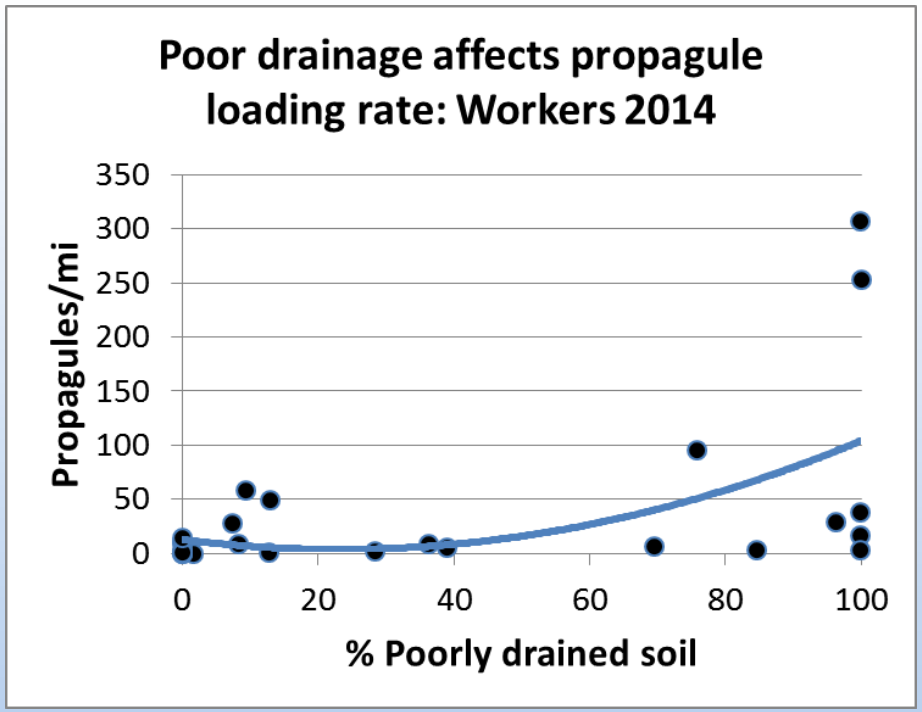


- Vehicles > workers
- In 2014, mower IE transport > ATV IE transport
- Other studies
  - 1800-5000 seeds/mi off-trail for ATVs (Taylor et al. 2011)
  - 400 seeds on boots and trousers in 100 m of roadside vegetation (Mount and Pickering 2009)

4. What impact does soil drainage have?

Effect of soil drainage

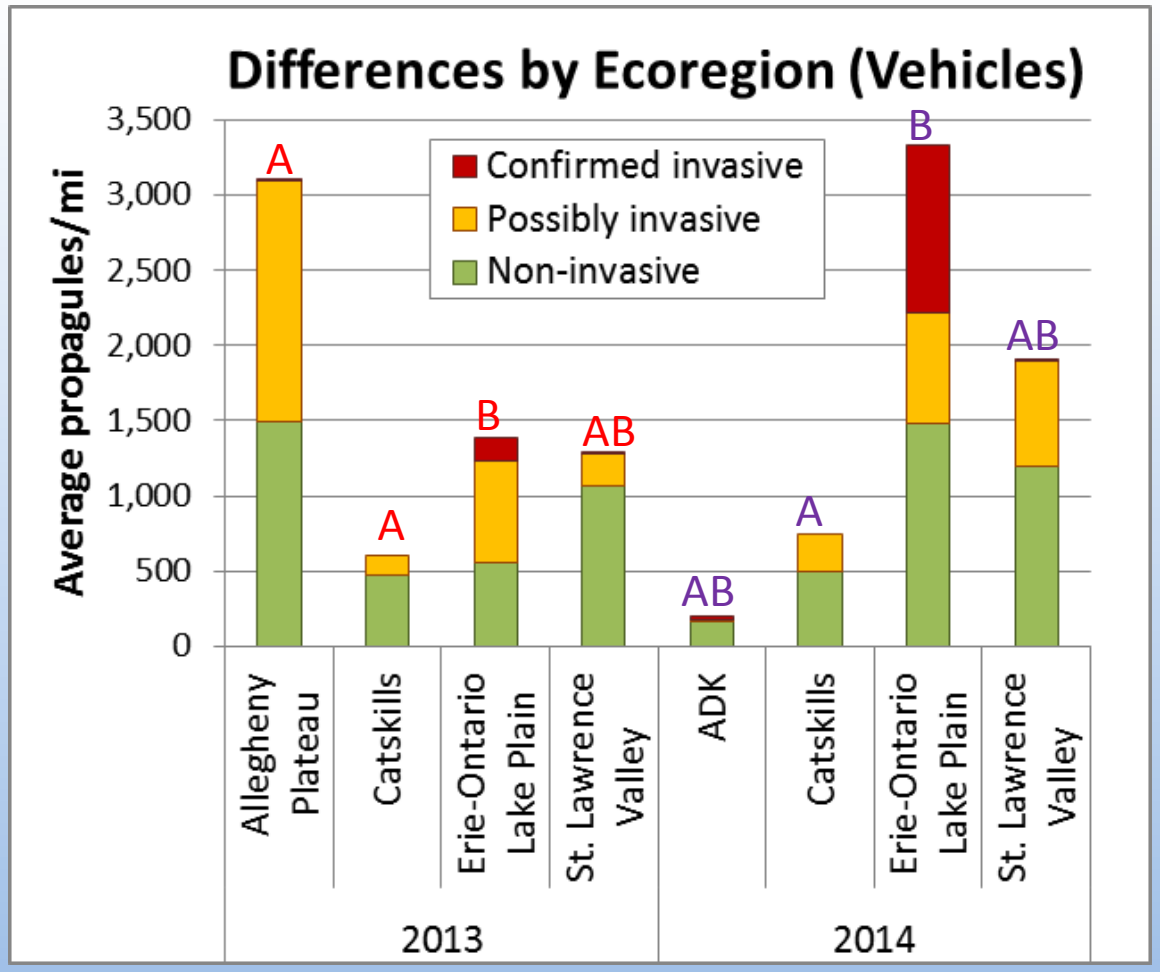




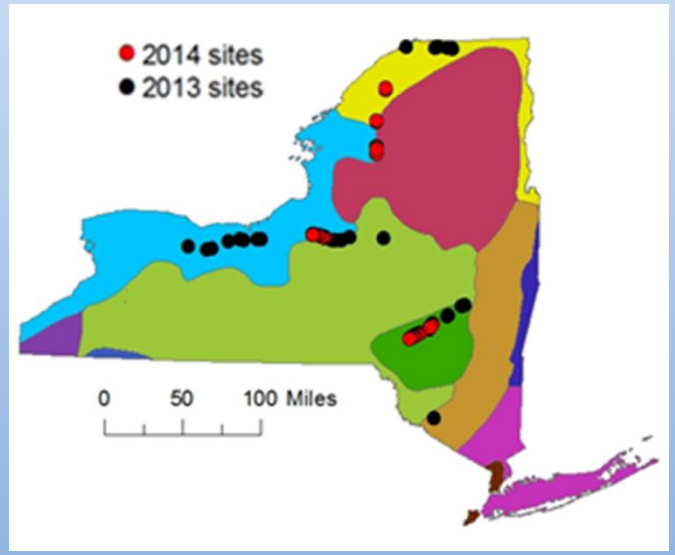
	Vehicles	Workers
Adjusted R^2	0.4501	0.2264
p	0.0004	0.0154

5. What impact does region have?

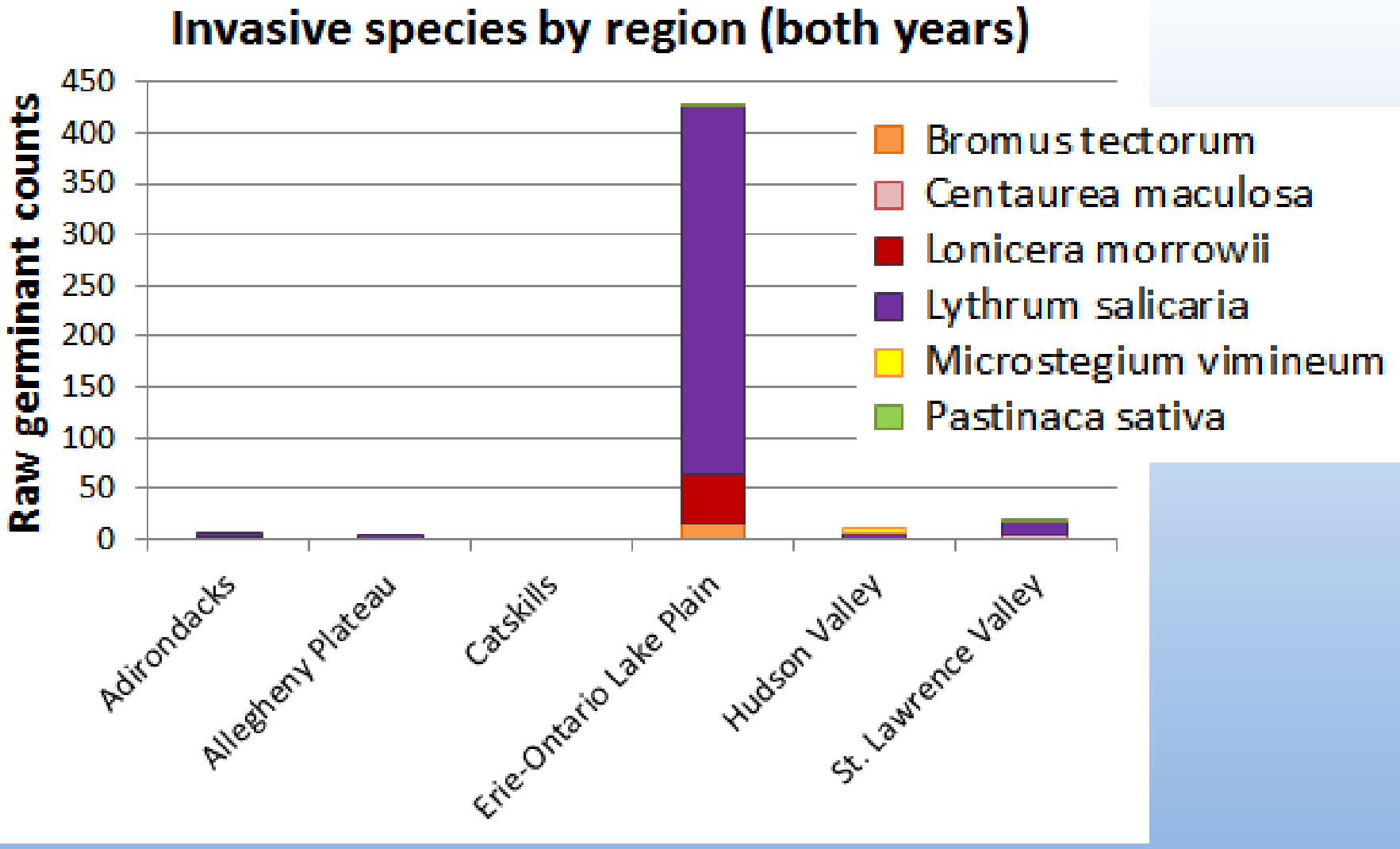
Bailey's Ecoregions



- The most invasive species come from the Erie-Ontario Lake Plain
- Worker results similar



Bailey's Ecoregions



Other factors

- Are vegetation and soil wet?
- Propagule pressure
- Tree density and height
- Shrub cover
- Season
- Herbicide vs. chainsaw use

Recommendations and Summary

Recommendations based on results

1. Seeds are moved
   - Overall invasive: 6.8%
   - One successful seed can have a big impact

Photo by O. Shevtsova

Lythrum salicaria – purple loosestrife

Recommendations based on results

1. Seeds are moved
2. Washing is needed – probably pressure washing.
   - Brushing alone misses at least 30-50% of seeds
   - Even professional washes remove only 77% (Rew 2011)

Recommendations based on results

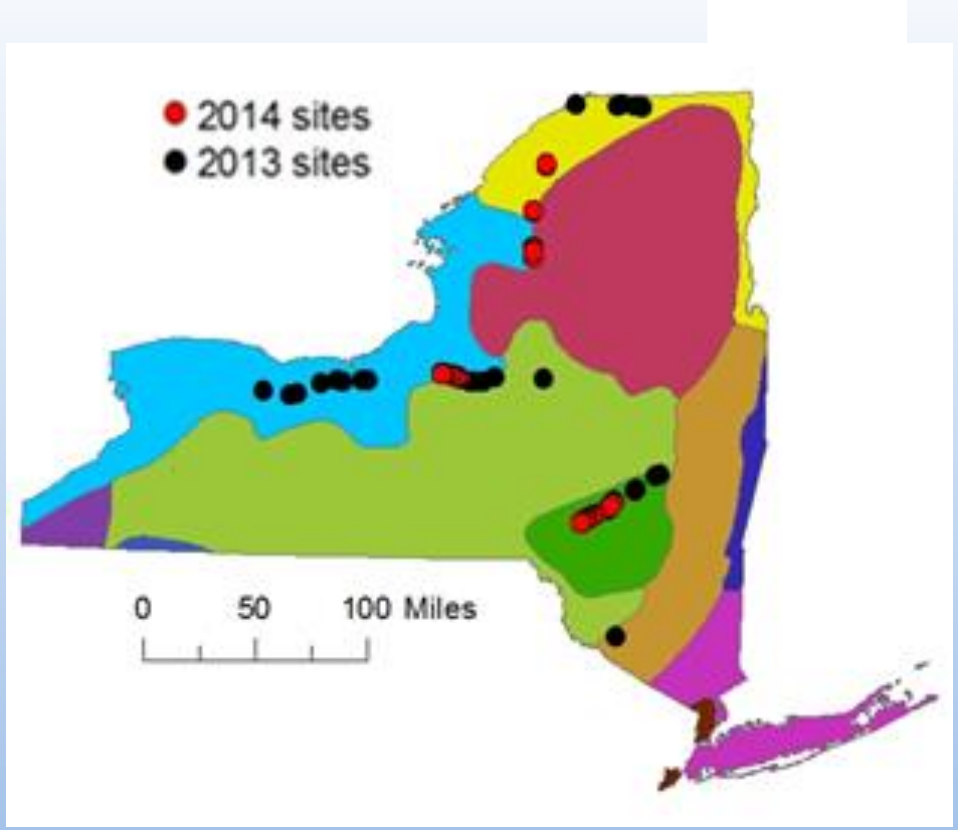
1. Seeds are moved
2. Washing is needed
3. Vehicles should be a priority, esp. mowers
   - Workers move <5% what vehicles move

Recommendations based on results

1. Seeds are moved
2. Washing is needed
3. Vehicles should be a priority, esp. mowers
4. Poorly drained sites should be a focal concern

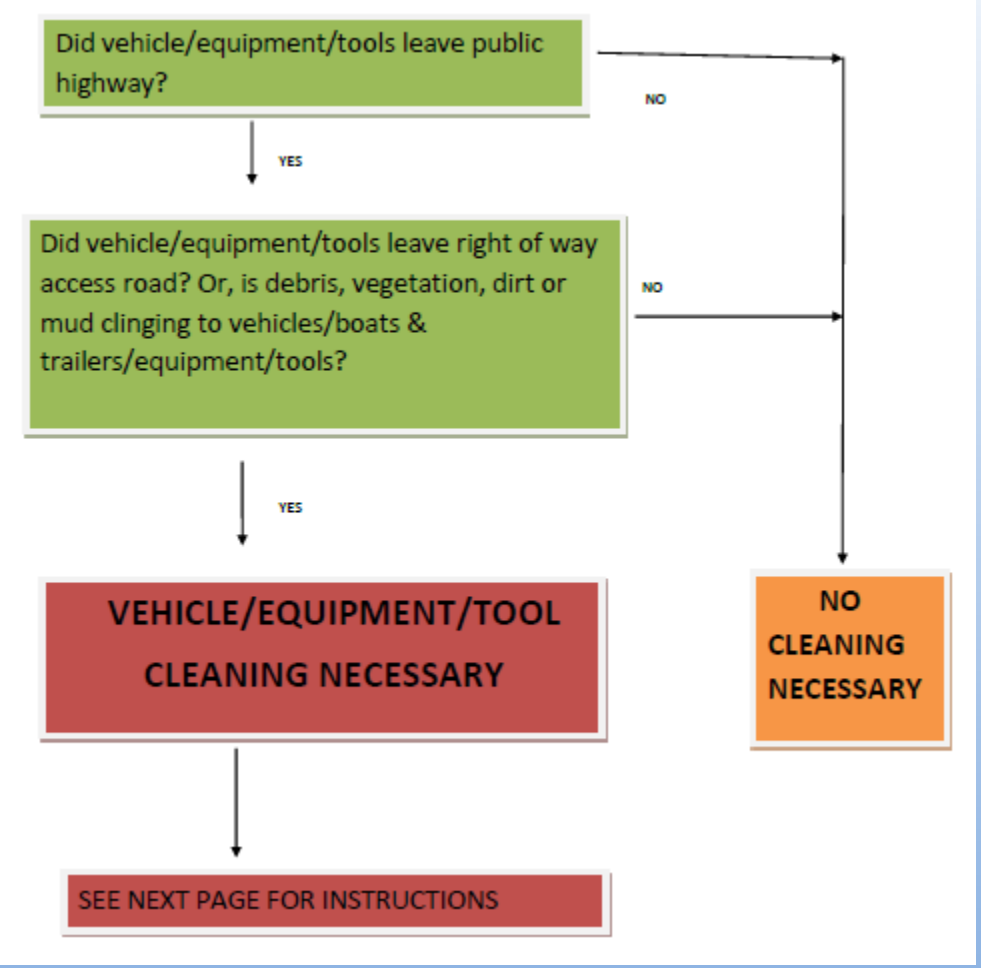
Recommendations based on results

1. Seeds are moved
2. Washing is needed
3. Vehicles should be a priority, esp. mowers
4. Poorly drained sites should be a focal concern
5. Take region into account



Best Management Practices

- "Reasonable precautions" – WDNR (Koles and Sievewright 2014)
- Permit compliance – NYPA (EEANY 2015)



Key points

- Scale
  - Workers move 10s-100s of seeds/mi
  - Vehicles move 1000s of seeds/mi
- Large amount of variation
- Science-based BMPs may help

Future research

- Repeat methods nationally
- Structured seasonal sampling
- Whole vector cleaning

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Questions?

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Focal species list

Forbs (herbaceous species)

scientific name	common name	observed?
Alliaria petiolata	garlic mustard	field only
Centaurea maculosa	spotted knapweed	field and greenhouse
Cirsium arvense	Canada thistle	field and greenhouse
Cynanchum louiseae	black swallow-wort	field only
Glechoma hederacea	ground ivy	field only
Heracleum mantegazzianum	giant hogweed	no
Lythrum salicaria	purple loosestrife	field and greenhouse
Pastinaca sativa	wild parsnip	field and greenhouse
Polygonum cuspidatum	Japanese knotweed	no
Polygonum perfoliatum	Asiatic tearhumb / mile-a-minute weed	no
Polygonum sachalinense	giant knotweed	no
Ranunculus ficaria	fig buttercup	no
Rumex acetosella	common sheep sorrel	field only
Solanum dulcamara	climbing nightshade	field only
Tussilago farfara	coltsfoot	field only

Grasses

scientific name	common name	observed?
Bromus tectorum	downy brome	greenhouse only
Microstegium vimenium	stiltgrass	greenhouse only
Phragmites australis	common reed	field only
Poa compressa	Canada bluegrass	no

Shrubs

scientific name	common name	observed?
Berberis thunbergii	Japanese barberry	field only
Elaeagnus angustifolia	Russian olive	no
Eleagnus umbellata	autumn olive	field only
Euonymus alatus	burning bush	no
Ligustrum vulgare	European privet	no
Lonicera maackii	Amur honeysuckle	no
Lonicera morrowii	Morrow's honeysuckle	field and greenhouse
Lonicera tatarica	Tartarian honeysuckle	field only
Rosa multiflora	multiflora rose	field only
Rosa rugosa	rugosa rose	no
Rubus phoenicolasius	wineberry	field only

Trees

scientific name	common name	observed?
Acer platanoides	Norway maple	no
Ailanthus altissima	tree of heaven	field only
Frangula alnus	glossy buckthorn	field only
Paulownia tomentosa	princesstree	no
Rhamnus cathartica	common buckthorn	field and greenhouse
Robinia pseudoacacia	black locust	field only

Woody vines

scientific name	common name	observed?
Celastrus orbiculatus	Oriental bittersweet	field only
Lonicera japonica	Japanese honeysuckle	field only
Pueraria montana	kudzu	no