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2015 Invasive Species Seminar Series

Pathway Risk Assessment: Stopping Invasions Before They Start

Tuesday, January 27, 2015
2:00pm-4:00pm Eastern Time
(speaking will begin at 2:05)

Co-hosted by the Environmental Law Institute &
The National Invasive Species Council

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2015 Invasive Species Webinar Series

ENVIRONMENTAL LAW • INSTITUTE®

Pathway Risk Assessment: Stopping Invasions Before They Start

Tuesday, January 27, 2015 • 2:00pm-4:00pm ET

NOW SPEAKING:

Stas Burgiel

Assistant Director for Prevention and Budgetary Coordination, National Invasive Species Council (NISC)

Stas serves as the NISC policy lead on issues related to preventing the introduction and spread of invasive species with a focus on the pathways for their movement. He coordinates a prevention committee convened jointly with the Aquatic Nuisance Species Task Force and also oversees the collation of information on NISC member agency budgets related to invasive species issues. Key areas of interest and activity include the role of trade agreements, links to climate change and multi-level stakeholder coordination.

Stas received his Ph.D. in international service from the American University and a B.A. in political science from Swarthmore College. He has worked and consulted for a range of nongovernmental, governmental and intergovernmental organizations, including the Global Invasive Species Programme, the Nature Conservancy, the UNEP/World Conservation Monitoring Centre and the New Zealand government, on invasive species and other environmental policy issues.

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Pathway Risk Assessment: Stopping Invasions Before They Start

Tuesday, January 27, 2015 • 2:00pm-4:00pm ET

NOW SPEAKING:

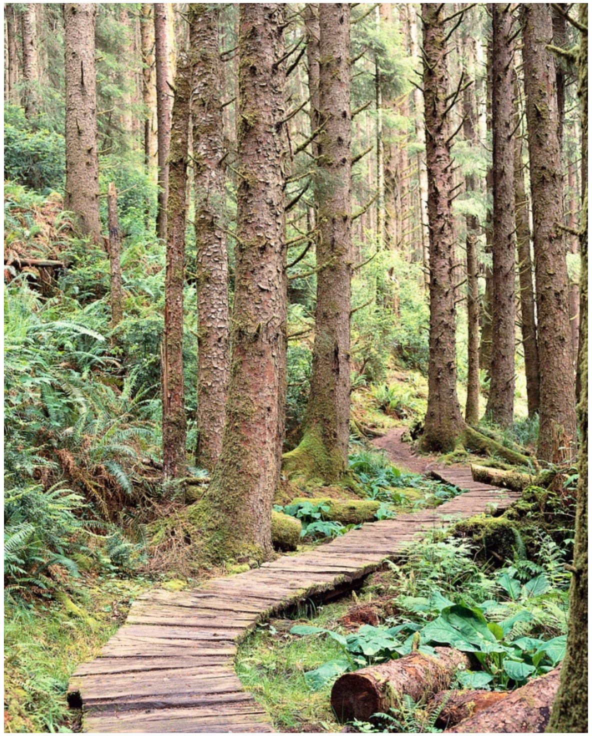
Glenn Fowler

Risk Analyst, Plant Epidemiology and Risk Analysis Laboratory, Center for Plant Health Science and Technology, USDA – APHIS – PPQ

Dr. Glenn Fowler is a risk analyst with United States Department of Agriculture, Animal and Plant Health Inspection Service (USDA-APHIS) Plant Epidemiology and Risk Analysis Laboratory and has experience generating risk analyses that inform regulatory policy regarding invasive plant pests. His areas of interest include predictive mapping, Geographic Information Systems (GIS) and quantitative risk analysis. Glenn has worked on domestic and international regulatory issues including: Karnal bunt in US wheat exports, Oregon Christmas tree exports to Mexico, red imported fire ant, sudden oak death, light brown apple moth, pine shoot beetle, citrus black spot in fruit exports, US potato exports to Mexico and Asian Gypsy moth movement from Japan and China to the United States on maritime shipments. He has also participated in bilateral technical discussions, provided GIS support during USDA-APHIS emergency operations and given training in GIS, predictive mapping and probabilistic modeling.

USDA United States Department of Agriculture

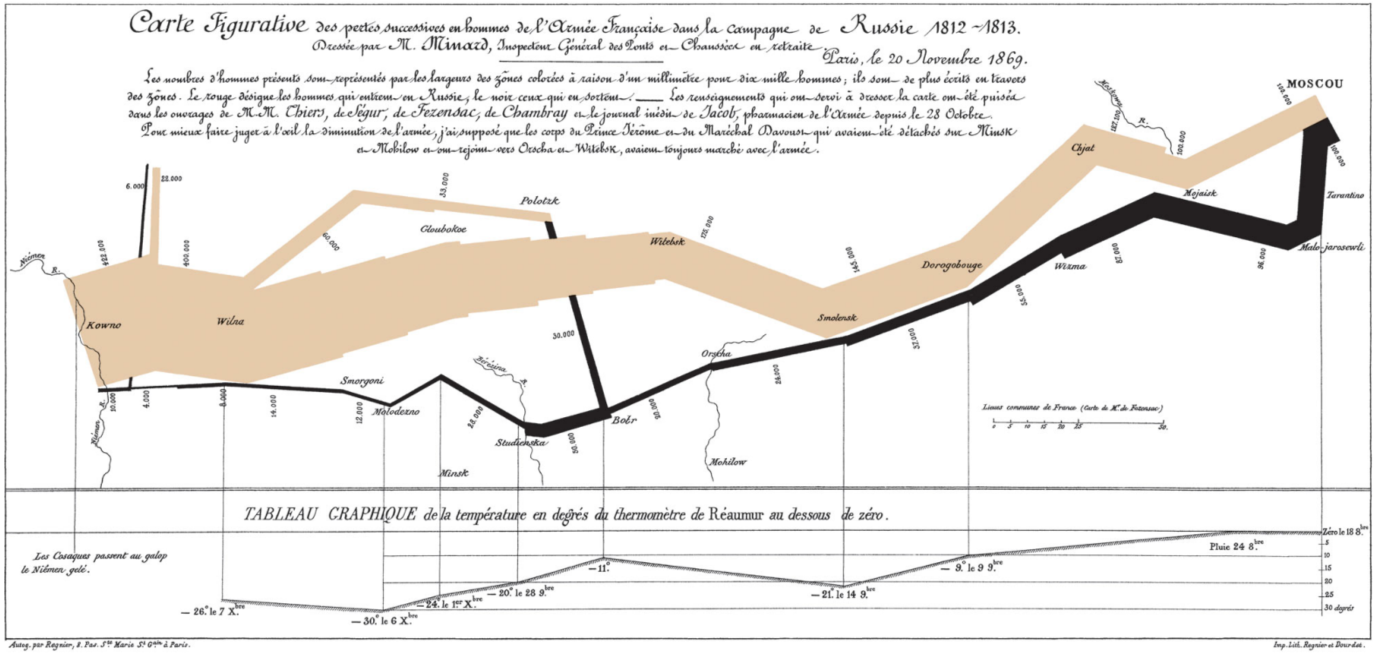
Predictive Mapping in Pathway Analysis



Glenn Fowler, Ph.D.
Plant Epidemiology and Risk Analysis Laboratory
Center for Plant Health Science and Technology
United States Department of Agriculture
Animal and Plant Health Inspection Service
Plant Protection and Quarantine
Raleigh, North Carolina

Characteristics of Pathway Analysis

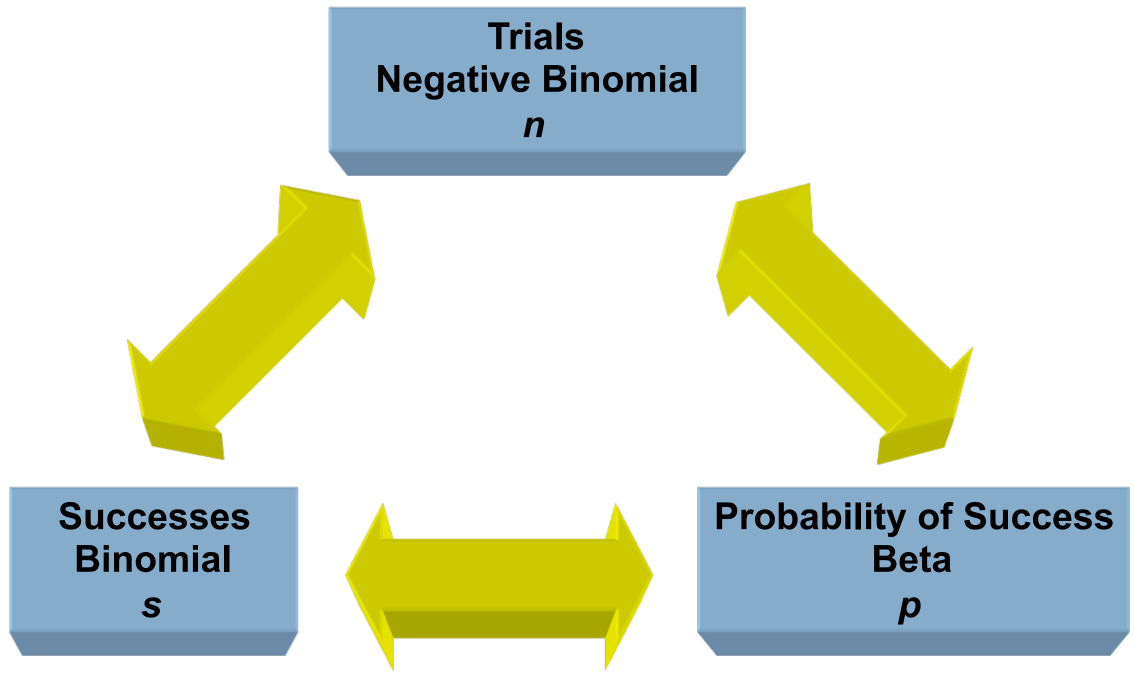
- Characterize the movement of things between locations
- In plant protection they describe the means of pest entry or spread (FAO, 2008)
- Because they involve pest movement in space and time, predictive mapping can be used to inform them



Types of Pathway Analysis

1) **Qualitative**
   - ➢ Results are expressed in non-numeric terms, e.g. low, medium, high
2) **Semi-Quantitative**
   - ➢ Results have a qualitative and associated quantitative component, e.g. Low (1)
3) **Quantitative**
   - ➢ Results expressed in numerical terms, e.g. years until first occurrence
   - ➢ Often use simulation models and stochastic processes, e.g. the binomial

Binomial Process (Vose, 2000)



Example 1: Predictive Mapping in Qualitative Pathway Analysis

Pathway Assessment: *Geosmithia sp. and Pityophthorus juglandis* Blackman movement from the western into the eastern United States

Leslie Newton, Glenn Fowler, Alison Neeley, Robert Schall and Yu Takeuchi

Introduction

- *Geosmithia morbida*, causes Thousand Cankers Disease (TCD) in Walnut (Kolarik et al., 2010; USDA-NAL-NISIC, 2010)
- Is vectored by the walnut twig beetle (WTB), *Pityophthora juglandis* (Kolarik et al., 2010)

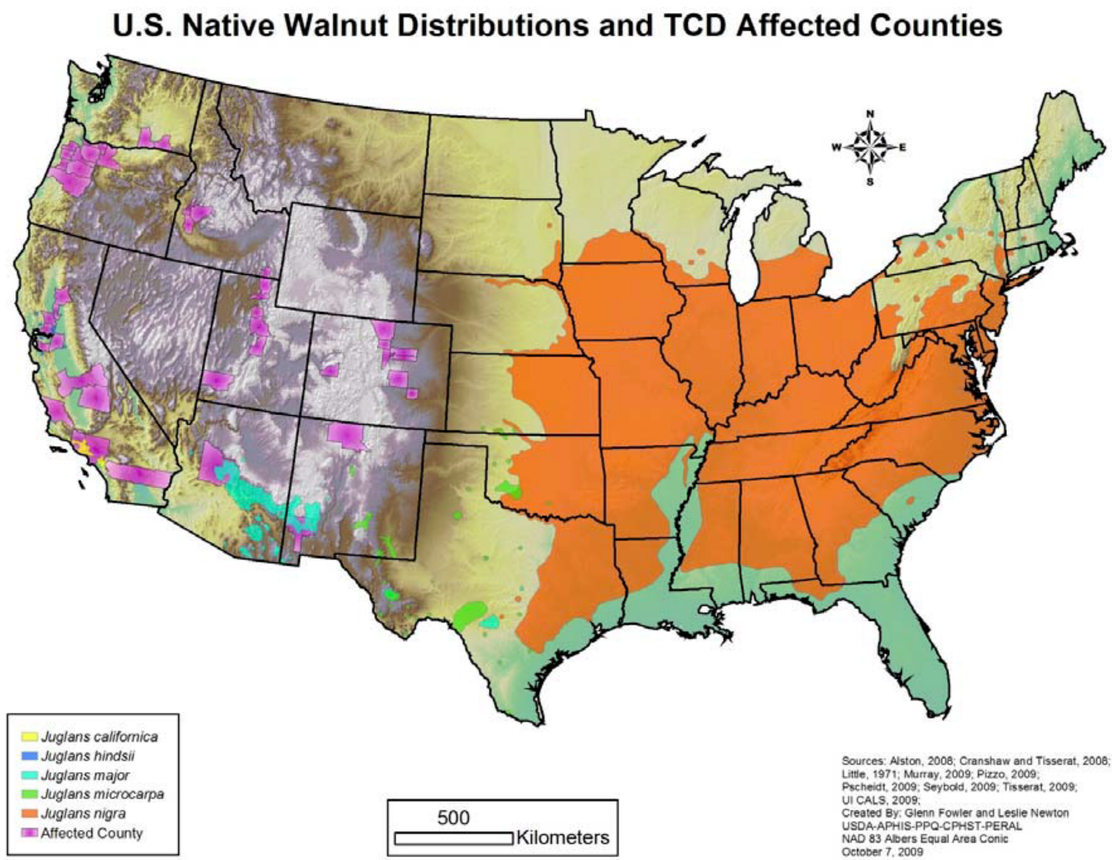
Ned Tisserat, Colorado State University, Bugwood.org

Curtis Utley, CSUE, Bugwood.org

United States Department of Agriculture

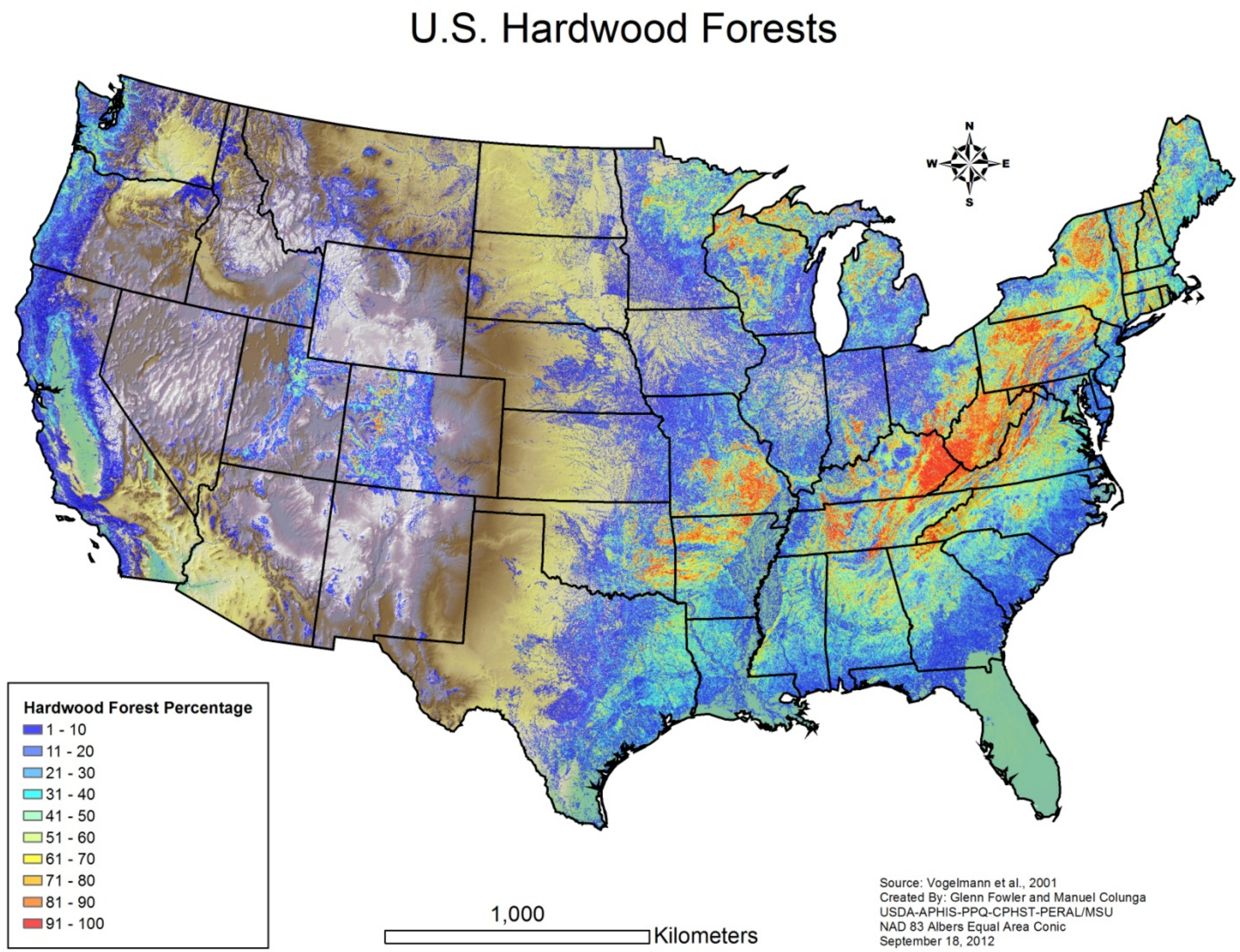
Introduction Continued

- TCD was detected killing black walnut in the western United States in 2001 and may have killed trees there in the 1990s (Cranshaw and Tisserat, 2008)
- Newton et al. (2009) generated a pathway analysis that characterized the likelihood of TCD moving into the eastern United States via human mediated pathways and natural spread
- Used predictive mapping and other evidence to estimate the approach rates, rank the pathways in terms of importance and characterize uncertainty
- Used qualitative ratings for the pathway approach rates, e.g. negligible, low and moderate
- http://www.thousandcankers.com



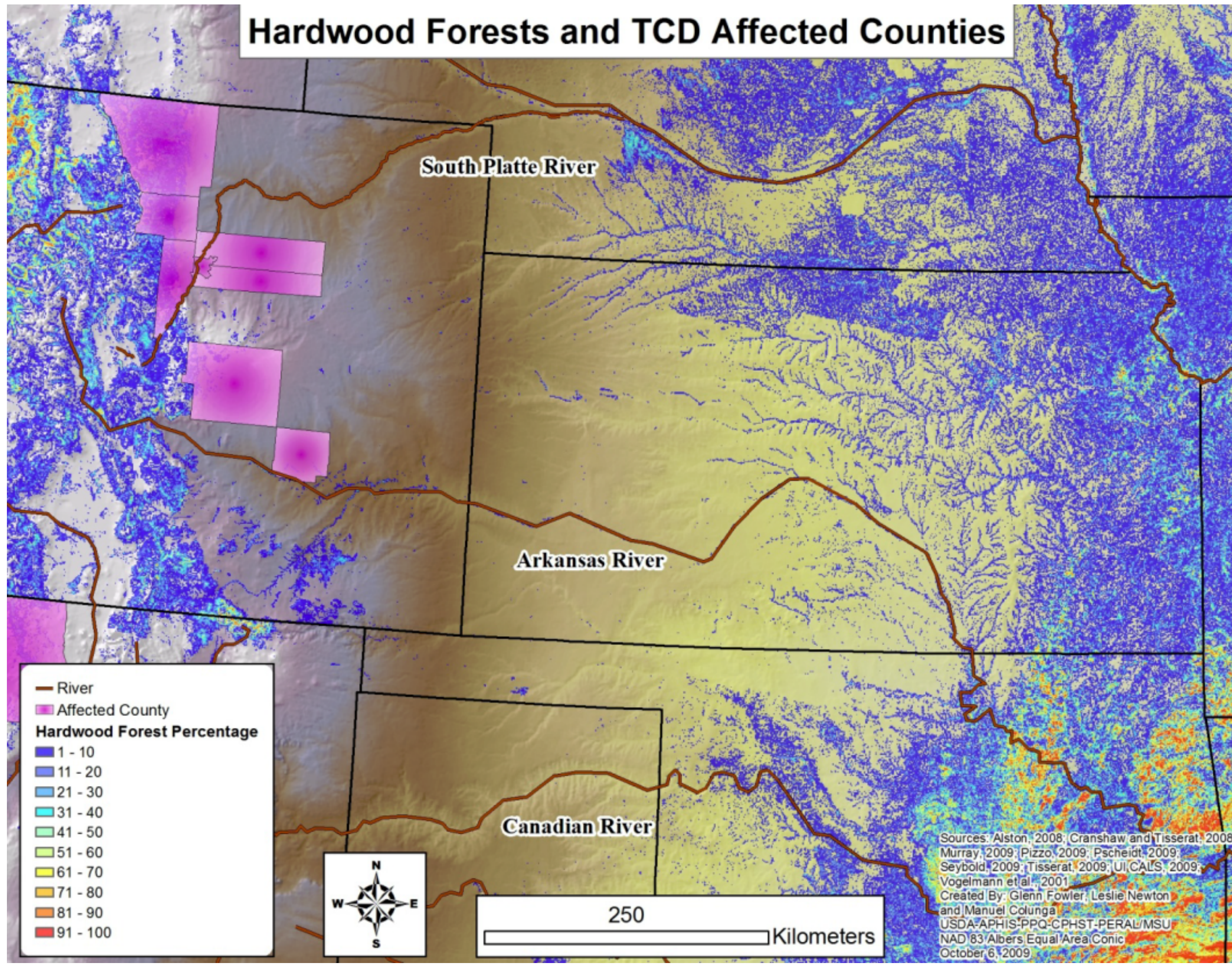
Predictive Mapping for the Natural Spread Pathway

- WTB flies 1 to 2 miles (1.7-3.2 km) (NPAG-Archives, 2008) and the Great Plains may be a barrier inhibiting natural spread
- Walnut grows along rivers (Baker, 1999) and this may provide a corridor for WTB movement across the great plains



Predictive Mapping for the Natural Spread Pathway

- ➢ Generated a composite map of TCD affected counties, hardwood forests and rivers to identify at-risk areas for WTB movement and TCD introduction
- ➢ Given the natural barrier and limited flight distance, the approach rate for the natural spread pathway was assigned a "**Low**" rating
- ➢ Areas of uncertainty include: affect of prevailing wind currents on beetle flight distances and the unknown amount of planted walnut trees in the Great Plains



TCD Qualitative Pathway Approach Rates (Newton et al., 2009)

Pathway	Estimated Approach Rate*
Timber	Low
Firewood	Low to Moderate
WPM	Low to Moderate
Nursery Stock	Low
Scion Wood	Low
Nuts	Negligible
Natural Spread	Low

*Also provided justifications and described uncertainty

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Example 2: Predictive Mapping in Semi-Quantitative Pathway Analysis

Pathway-Initiated Risk Assessment: Asian Gypsy Moth (Lepidoptera: Lymantriidae: *Lymantria dispar* (Linnaeus)) from Japan into the United States on Maritime Ships

Glenn Fowler, Yu Takeuchi, Ron Sequeira, Gary Lougee, Weyman Fussell, Michael Simon, Andrea Sato, and Xu Yan

Introduction

- Asian gypsy moth (AGM) can move on ships
- This assessment was part of a pest risk analysis that characterized the risk AGM poses to the United States from Japanese maritime shipments
- Was used to provide justification for Japan maintaining a pre-shipment inspection program
- Used the USDA Guidelines for pathway-initiated pest risk assessments (USDA-APHIS-PPQ, 2000)
- Guidelines have 3 sections that use semi-quantitative risk ratings

Photo courtesy of Russian Center of Plant Quarantine

1. Consequences of Introduction: Low (5-8); Medium (9-12); High (13-15)
2. Likelihood of Introduction: Low (6-9); Medium (10-14); High (15-18)
3. Pest Risk Potential: Low (11-18); Medium (19-26); High (27-33)

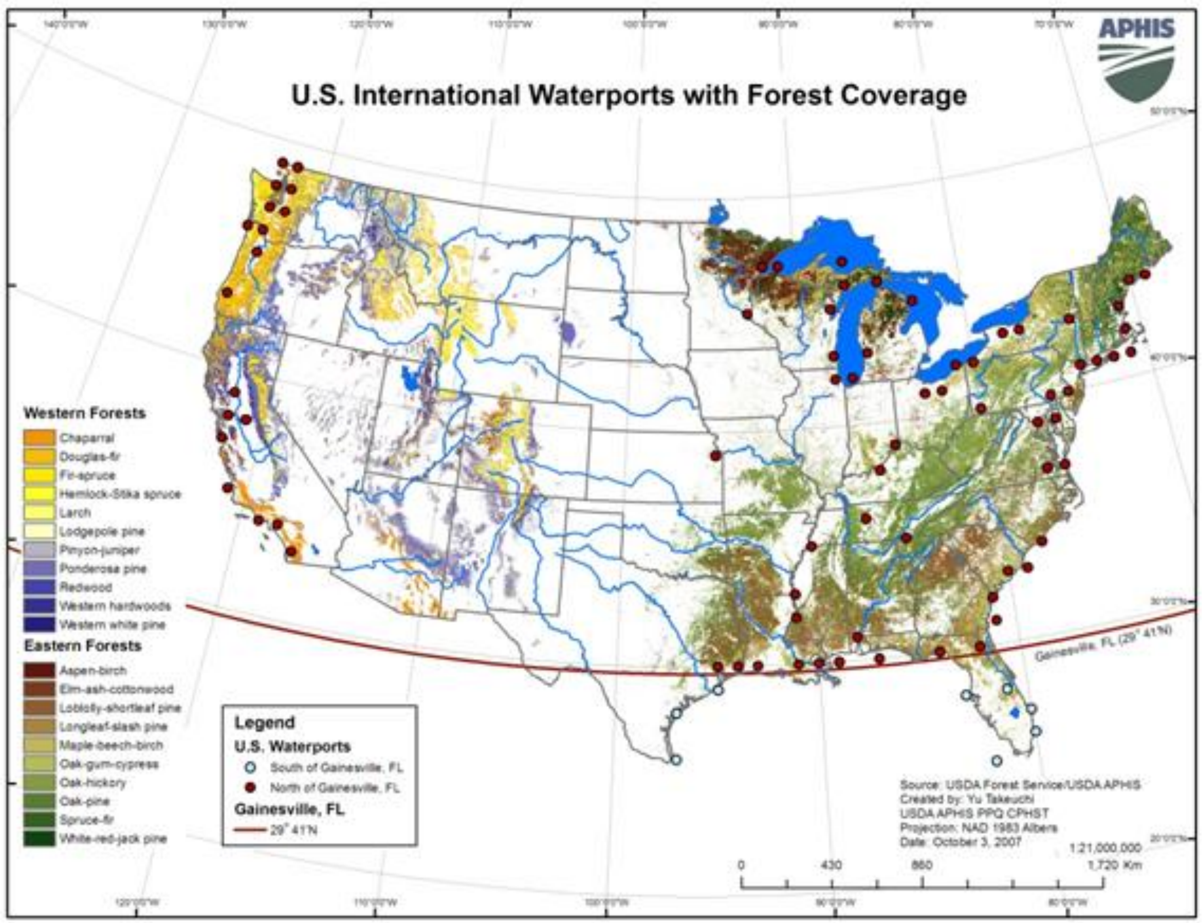
Introduction Continued

- Likelihood of Introduction section characterizes the pathway and has 6 semi-quantitative sub-elements whose sum generate the risk rating
  1. Quantity Imported Annually
  2. Survive Post-harvest Treatment
  3. Survive Shipment
  4. Not Detected at Port of Entry
  5. Moved to Suitable Habitat
  6. Contact with Host Material
- All except sub-element 1, which is based on the import volume, are scored:

  Low (1) = < 0.1%
  Medium (2) = 0.1% to 10%
  High (3) = >10%

Predictive Mapping for Sub-Element 6: Contact with Host Material

- Yu Takeuchi mapped at-risk ports that had forest within AGM's flight range
- 89.8% of the ports met this criteria indicating that AGM would likely find host material
- Because this was greater than 10%, Sub-element 6 was scored High (3)



Pest Risk Assessment Results

Likelihood of Introduction	
Risk Sub-Element	Risk Rating
Quantity Imported Annually	High (3)
Survive Post Harvest Treatment	Medium (2*)
Survive Shipment	High (3)
Not Detected at Port of Entry	High (3)
Moved to Suitable Habitat	High (3)
Contact with Host Material	High (3)
Cumulative Risk Rating	**High (17)**

*Pre-shipment inspection program

Risk Element	**Risk Rating**
Consequences of Introduction Cumulative Risk Rating	High (15)
Likelihood of Introduction Cumulative Risk Rating	High (17)
Pest Risk Potential	**High (32)**

"High: The pest is a significant threat; therefore specific phytosanitary measures are recommended. Normal port of entry inspections will not provide phytosanitary security" (USDA-APHIS, 2000)

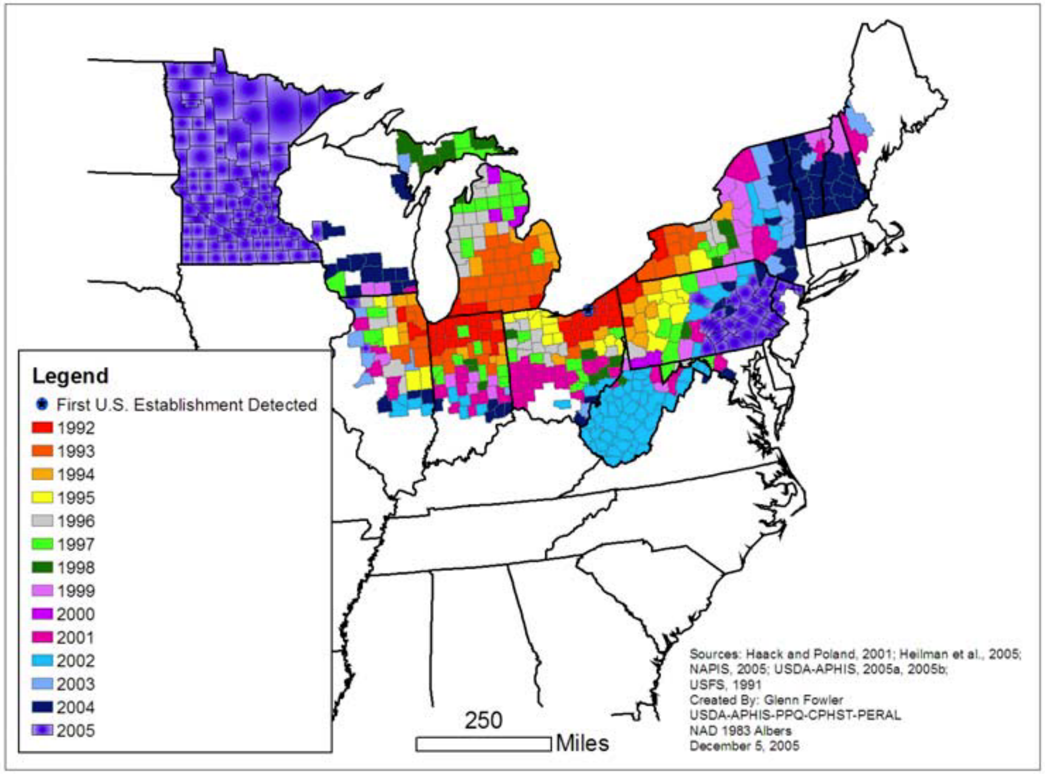
Example 3. Predictive Mapping to Directly Inform Quantitative Pathway Analysis

Quantitative pathway initiated pest risk assessment: risks to the southern United States associated with pine shoot beetle, *Tomicus piniperda* (Linnaeus), (Coleoptera: Scolytidae), on pine bark nuggets, logs and lumber with bark and stumps from the United States quarantined area

Glenn Fowler, Barney Caton, Lisa Jackson, Alison Neeley, Leon Bunce, Dan Borchert, and Rob McDowell

Introduction

- The pine shoot beetle (PSB) was discovered in the U.S. in 1992 and subsequently spread into the Northeast and North Central States (Haack and Poland, 2001)
- PSB introduction results in quarantines on at-risk timber commodities



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Introduction Continued

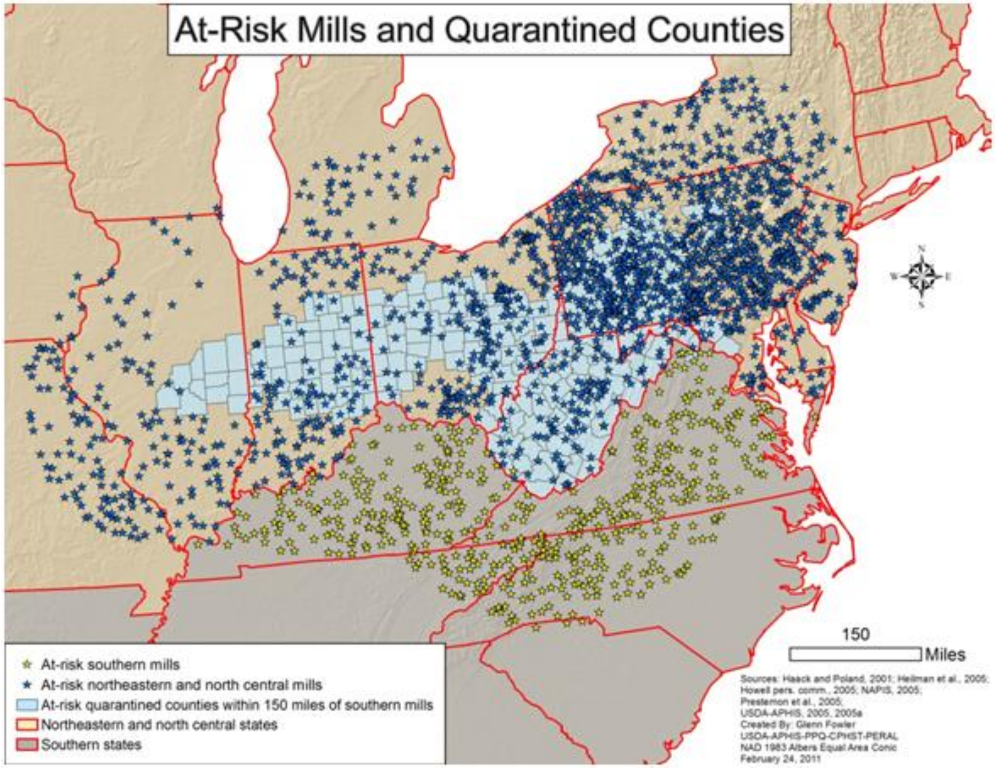
- A probabilistic pathway analysis was generated to estimate the likelihood of PSB introduction into the Southern United States associated with at-risk timber articles if deregulated
- Objective was to inform regulatory policy by identifying at-risk timber pathways for PSB colonization in the South

Predictive Mapping to Generate Probability Estimates for the PSB Pathway Model

- For example, predictive mapping was used to identify:

1. Quarantined counties that were at-risk for shipping potentially infested trees into the southern United States based on a 150 mile shipping radius (Howell pers. comm., 2005)
2. The total number of timber mills that could receive potentially infested timber from these counties
3. The number of timber mills in the southern United States that could receive potentially infested timber from these counties

- Could then calculate probability of potentially infested timber being shipped into the southern United States
- A binomial could then calculate the amount of potentially infested timber shipped into the southern United States



Summary risk table for the years until colonization in the South in the event of pathway deregulation

Pathway	Season	5th Percentile	Mean	95th Percentile
Bark Nuggets	Annual	13	250	748
	Spring/Fall/Winter	40	769	2,303
Logs and Lumber with Bark	Spring/Annual	1	1	1
	Fall/Winter	11	200	598
Stumps	Spring/Annual	52	1,010	3,025
	Fall/Winter	5,129	100,000	299,566
Bark Nuggets and Stumps	Annual	11	204	610
	Spring	24	455	1,361
	Fall/Winter	40	769	2,303
Bark Nuggets and Logs and Lumber with Bark	Spring/Annual	1	1	1
	Fall/Winter	9	167	498
Bark Nuggets, Stumps and Logs and Lumber with Bark	Spring/Annual	1	1	1
	Fall/Winter	9	167	498
Stumps and Logs and Lumber with Bark	Spring/Annual	1	1	1
	Fall/Winter	11	200	598

USDA United States Department of Agriculture

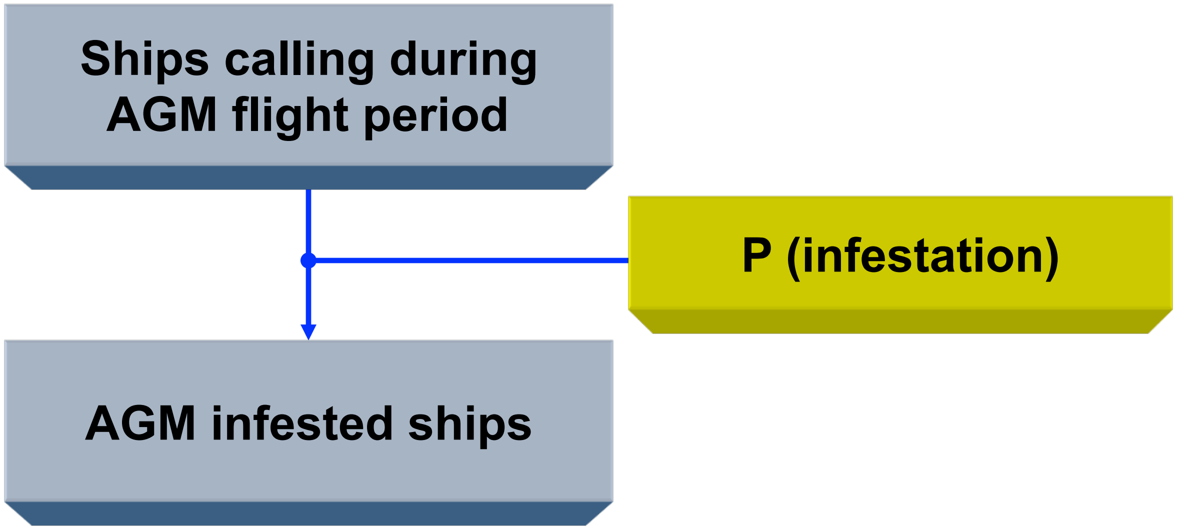
Example 4. Predictive Mapping to Indirectly Inform Quantitative Pathway Analysis

Quantitative Pathway Analysis: Asian Gypsy Moth (Lepidoptera: Lymantriidae: *Lymantria dispar* (Linnaeus)) from Japan into the United States on Maritime Ships

Glenn Fowler, Yu Takeuchi, Ron Sequeira, Gary Lougee, Weyman Fussell, Michael Simon, Andrea Sato, and Xu Yan

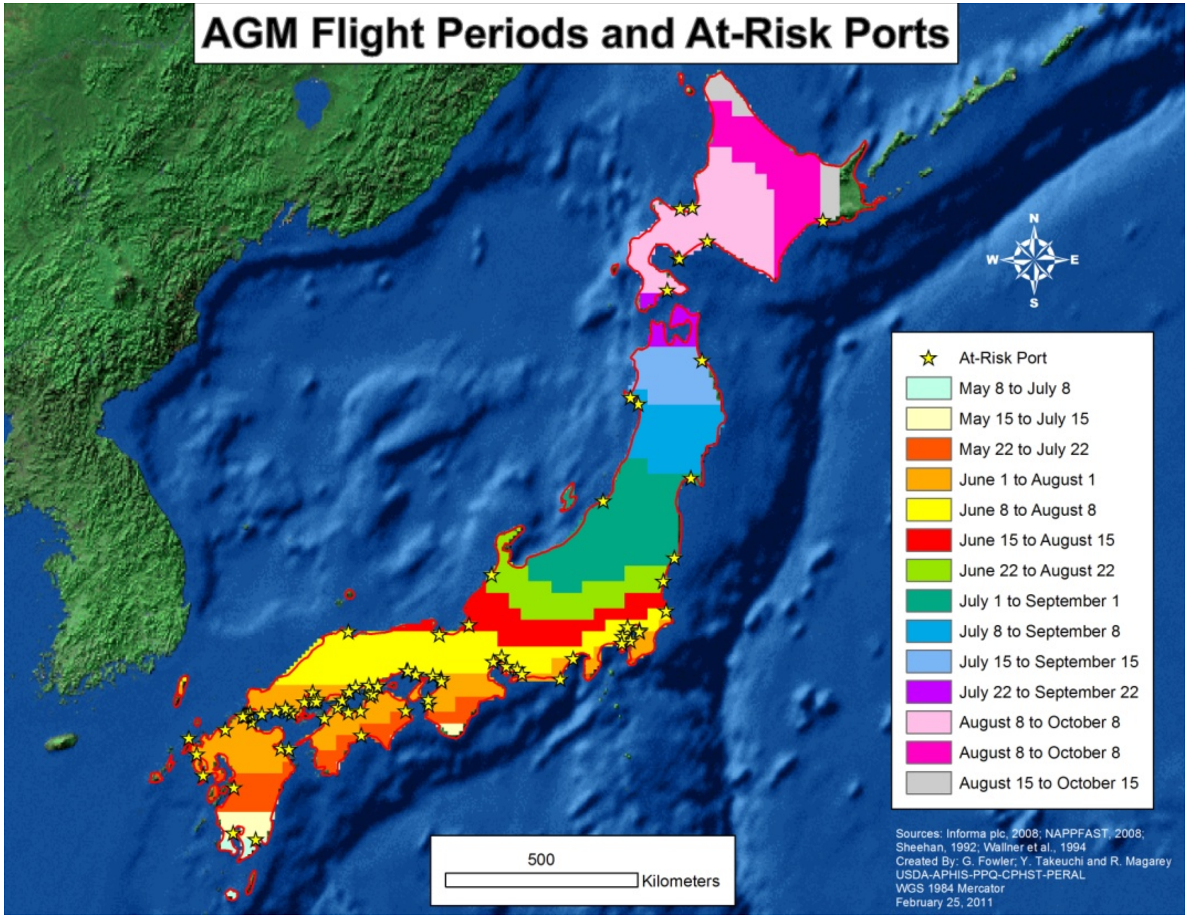
Introduction

- A second component of the pest risk analysis used to provide justification for Japan maintaining a pre-shipment inspection program
- Constructed a probabilistic model estimating the annual approach rate of AGM infested ships from Japan to the United States



Predictive Mapping to Determine AGM Flight Periods around At-Risk Japanese Ports

- Used a degree day model and predictive climate mapping to model the start of AGM flight around at-risk ports (Sheehan, 1992; NAPPFAST, 2008 (out of service))
- Assumed a 2 month flight window (Wallner et al., 1994)
- Queried the Llloyds of London Maritime Intelligence Unit database to determine the number of ships that called at ports during the flight period (Informa plc, 2008)
- This represents the number of trials in the binomial process



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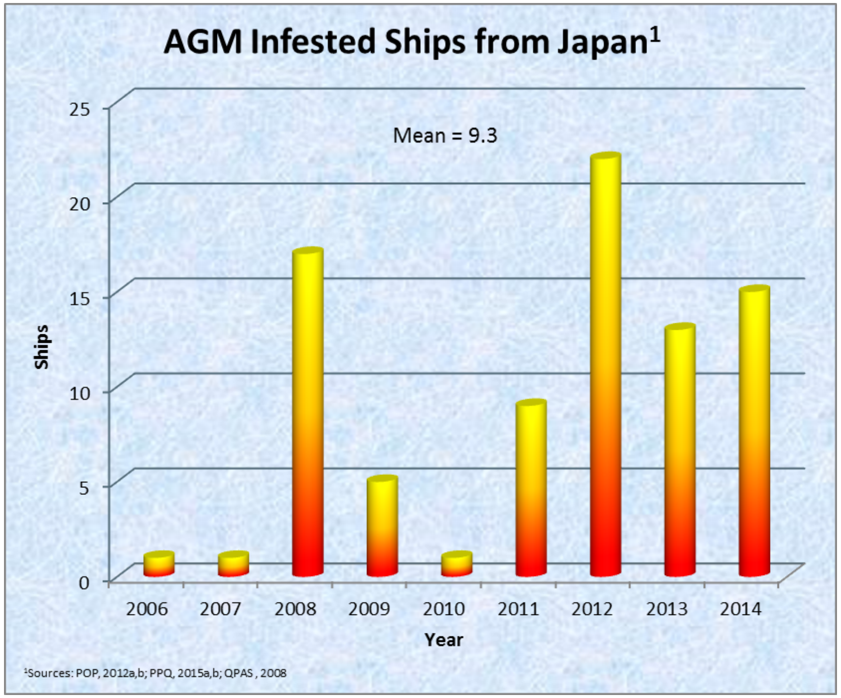
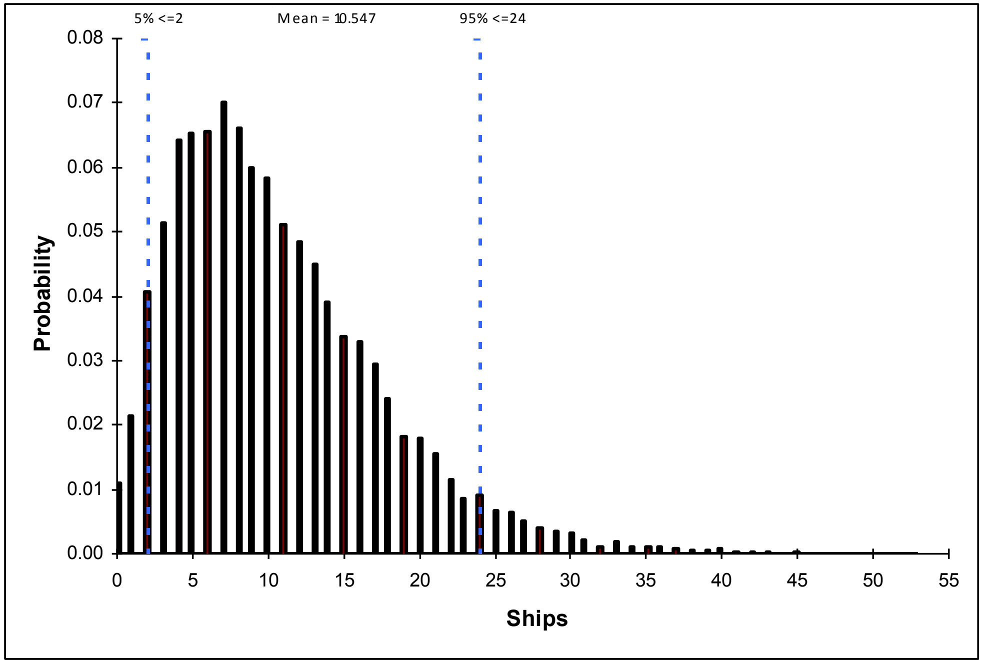
Predictive Mapping to Determine AGM Flight Periods around At-Risk Japanese Ports

- Modeled the probability of a ship that called at a Japanese port being infested based on Customs and Border Patrol interception data (USDA-APHIS, 2008)
- Could then run the binomial to model the annual number of infested ships coming to the United States from Japan



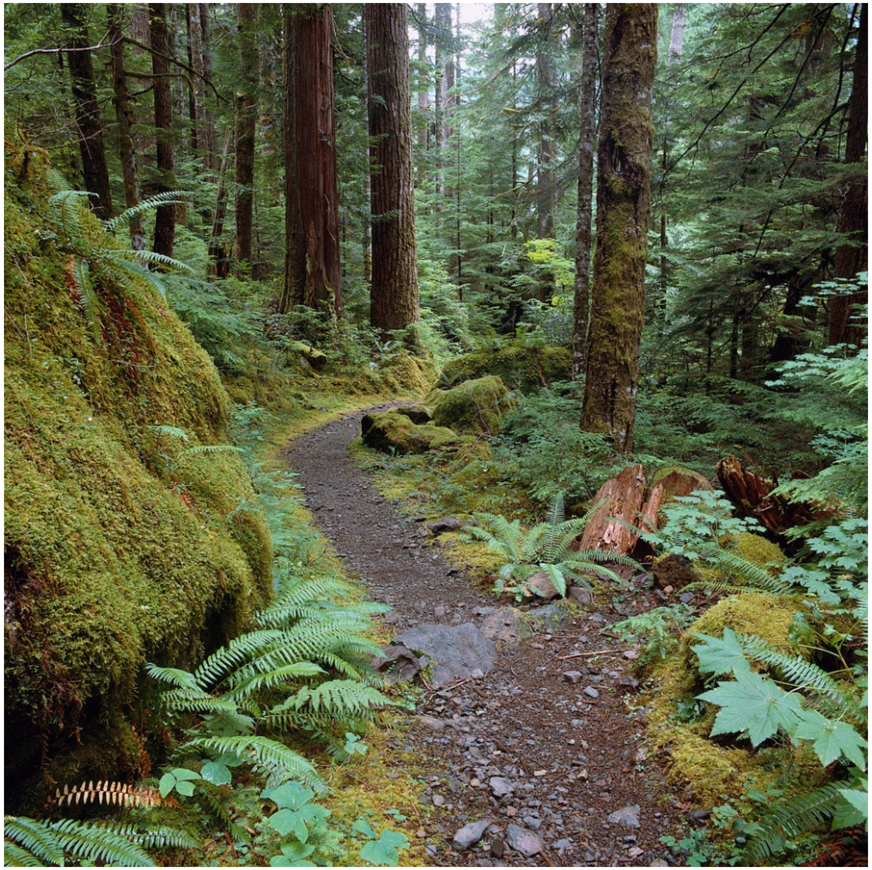


Status of Pre-Shipment Inspection Programs

- Japan implemented a pre-shipment inspection program in 2007 which has been maintained (POP, 2013)
- A similar pest risk analysis was generated for China (Fowler et al., 2009)
- China implemented a pre-shipment inspection program in 2011 (POP, 2013)

Summary and Conclusions

- Pathway analyses are dynamic and can be tailored to specific situations
- Have geospatial and temporal components
- Predictive mapping is a useful tool for increasing their precision and utility



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- Gary Lougee: USDA-APHIS
- Mike Simon: USDA-APHIS (retired)
- Weyman Fussell: USDA-APHIS (retired)

Thanks! Questions?

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Tuesday, January 27, 2015 • 2:00pm-4:00pm ET

NOW SPEAKING:

Andrew Tucker

Aquatic Invasive Species Applied Ecologist, The Nature Conservancy – Great Lakes Project

Andrew Tucker is the Aquatic Invasive Species Applied Ecologist for The Nature Conservancy's Great Lakes Project. He provides technical and scientific support to address conservation questions and to inform management actions related to the prevention, early detection, and control of aquatic invasive species in the Great Lakes basin. Andrew holds a BS in Environmental Science from Messiah College (Grantham, PA) and a PhD in Ecology, Evolution, and Environmental Biology from Miami University (Oxford, OH).

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Harmonizing Great Lakes Regulated Species Lists: Reconciling a Regional Patchwork of Approaches and Prohibited Species.

Andrew Tucker
Great Lakes Project Aquatic Invasive Species Applied Ecologist

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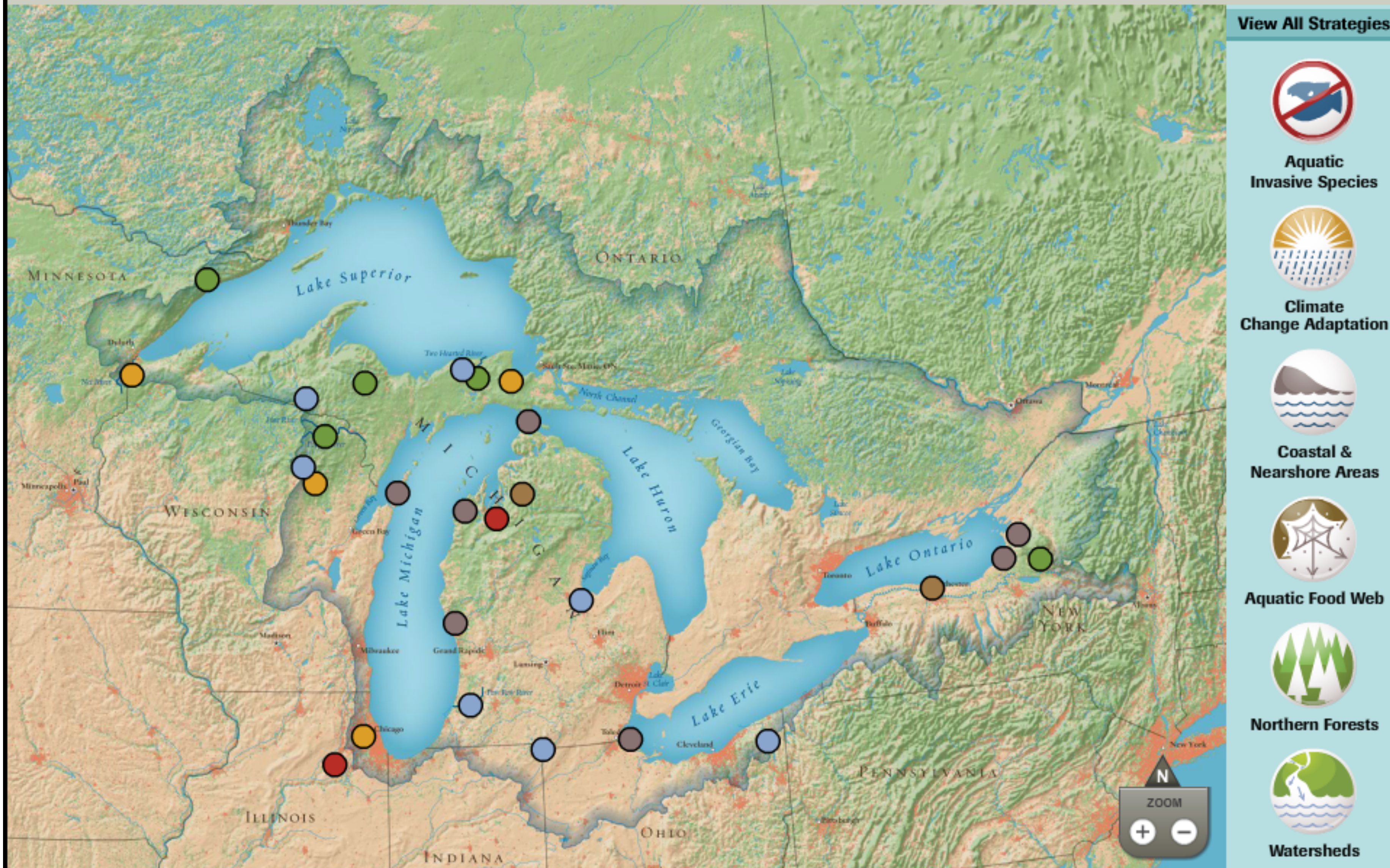

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Aquatic Invasive Species: Basin-wide threat

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Aquatic invasive Species: Basin-wide impacts

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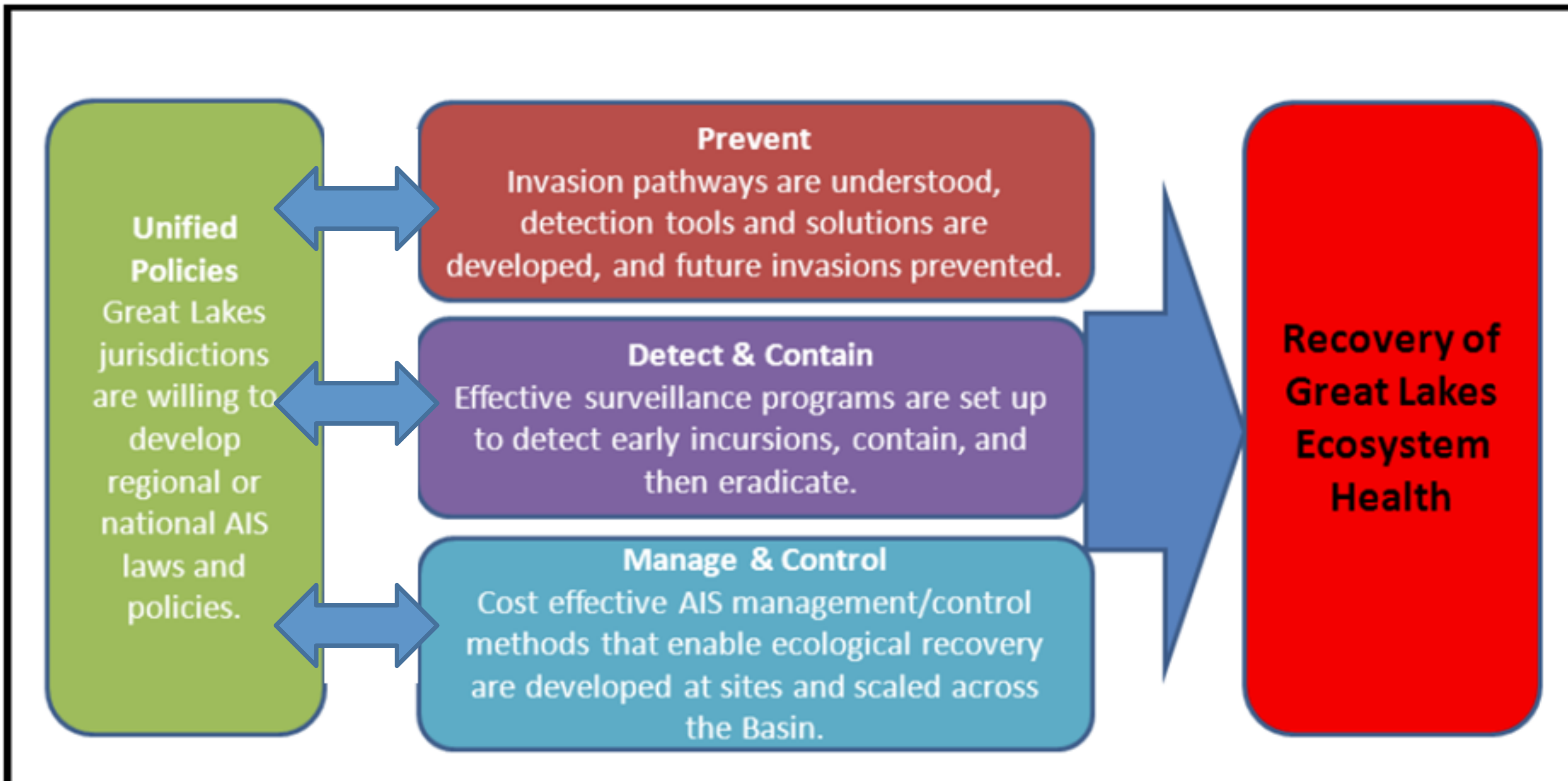
AIS THEORY OF CHANGE



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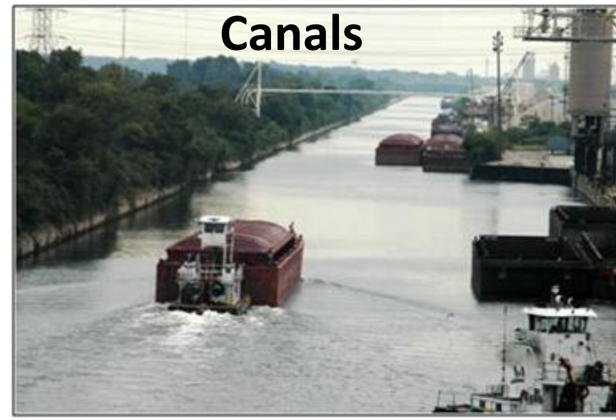
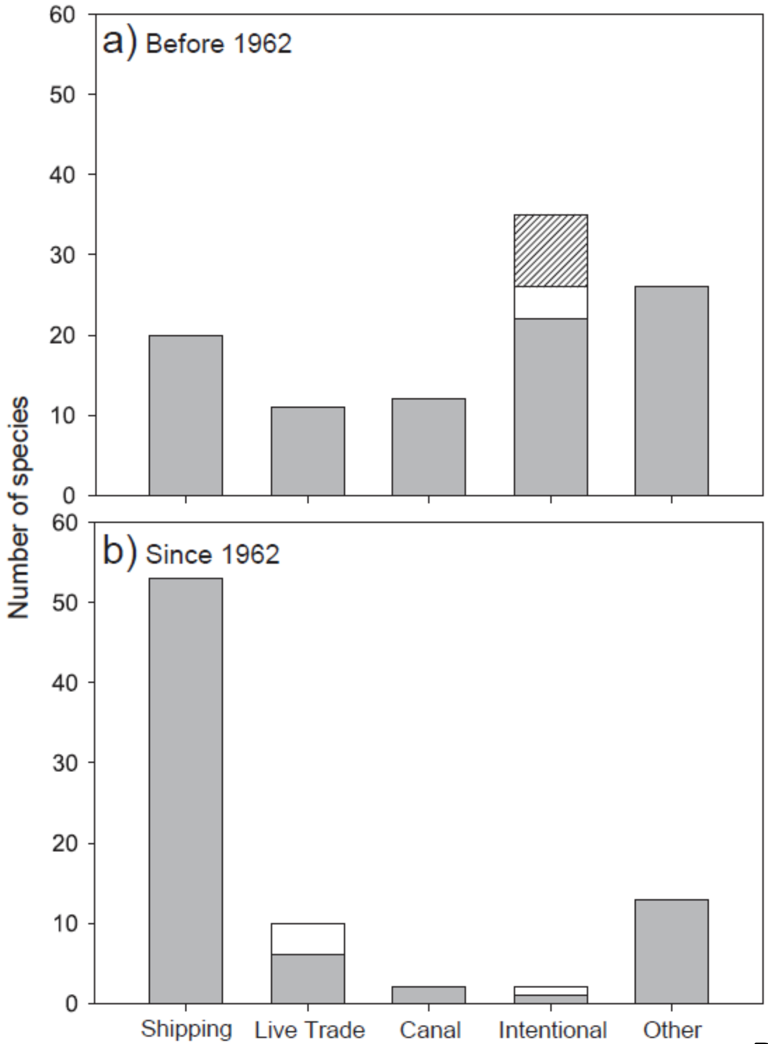
Four major pathways of introduction



Commercial Trade in Live Plants and Animals



Live trade= aquarium/ ornamental/pet releases (gray) & bait fish release (white)

Pagnucco KS et al. J Great Lakes Res 2014

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Regulations only as strong as weakest link

Peters and Lodge, Fisheries, 2009

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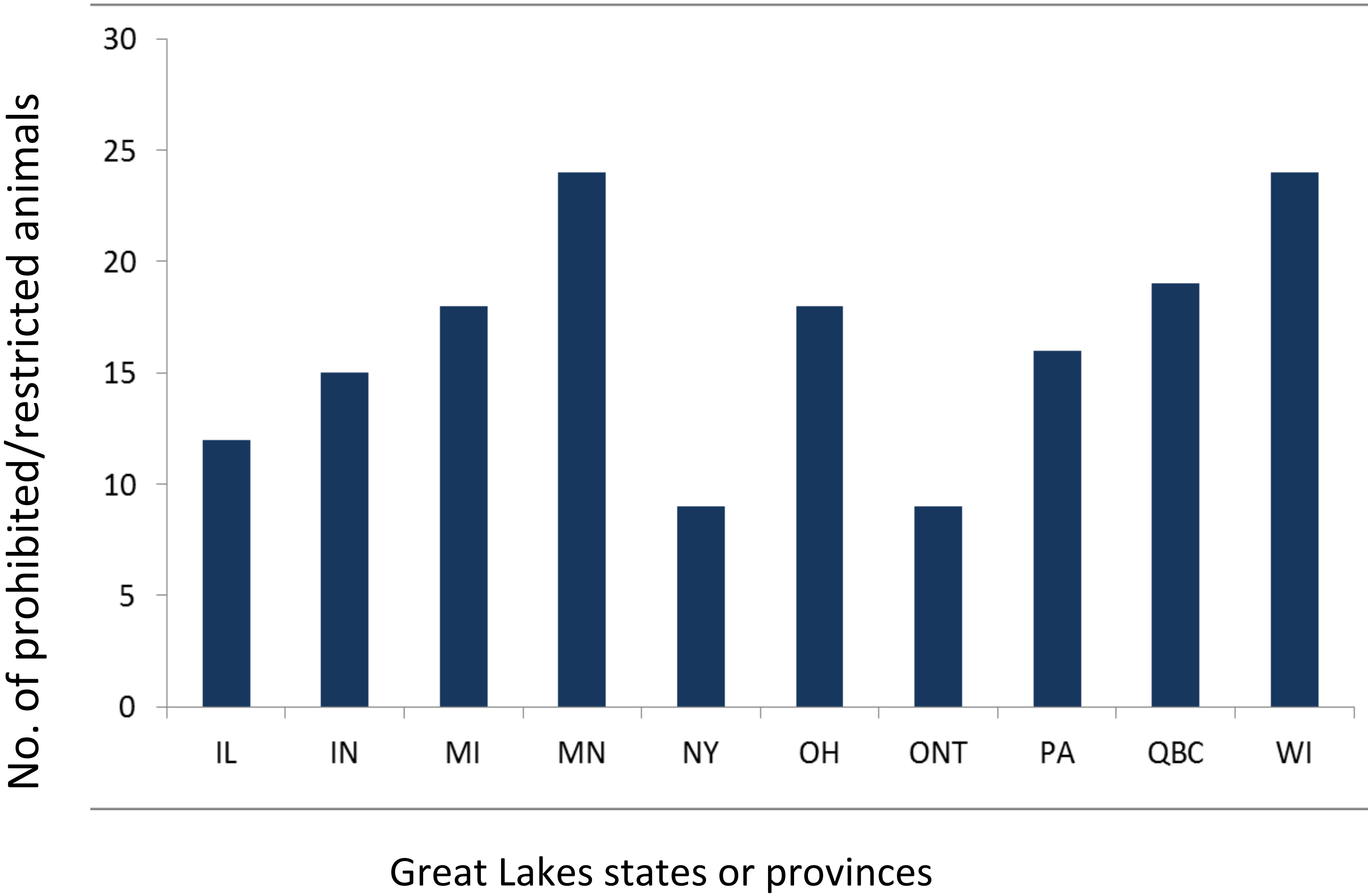

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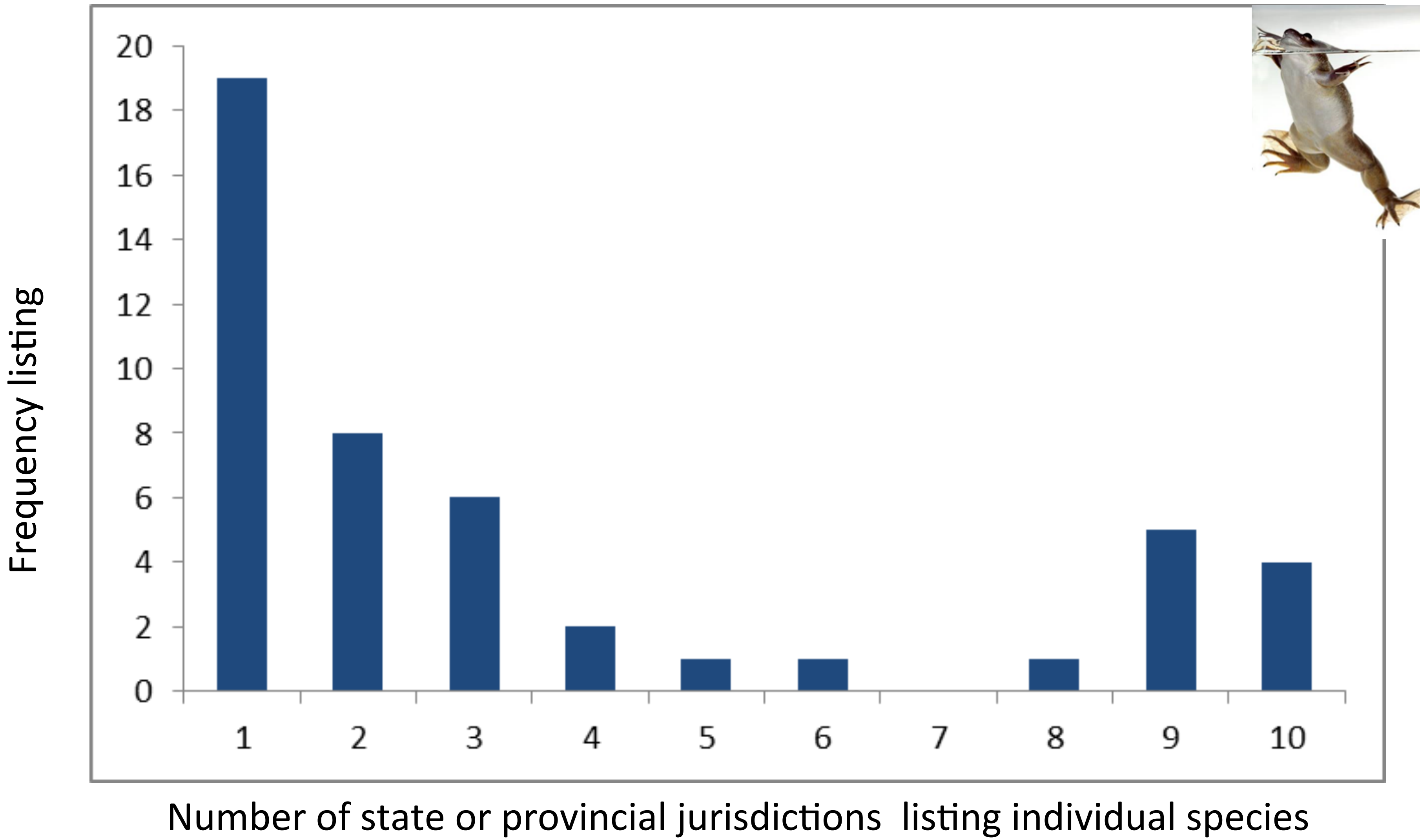

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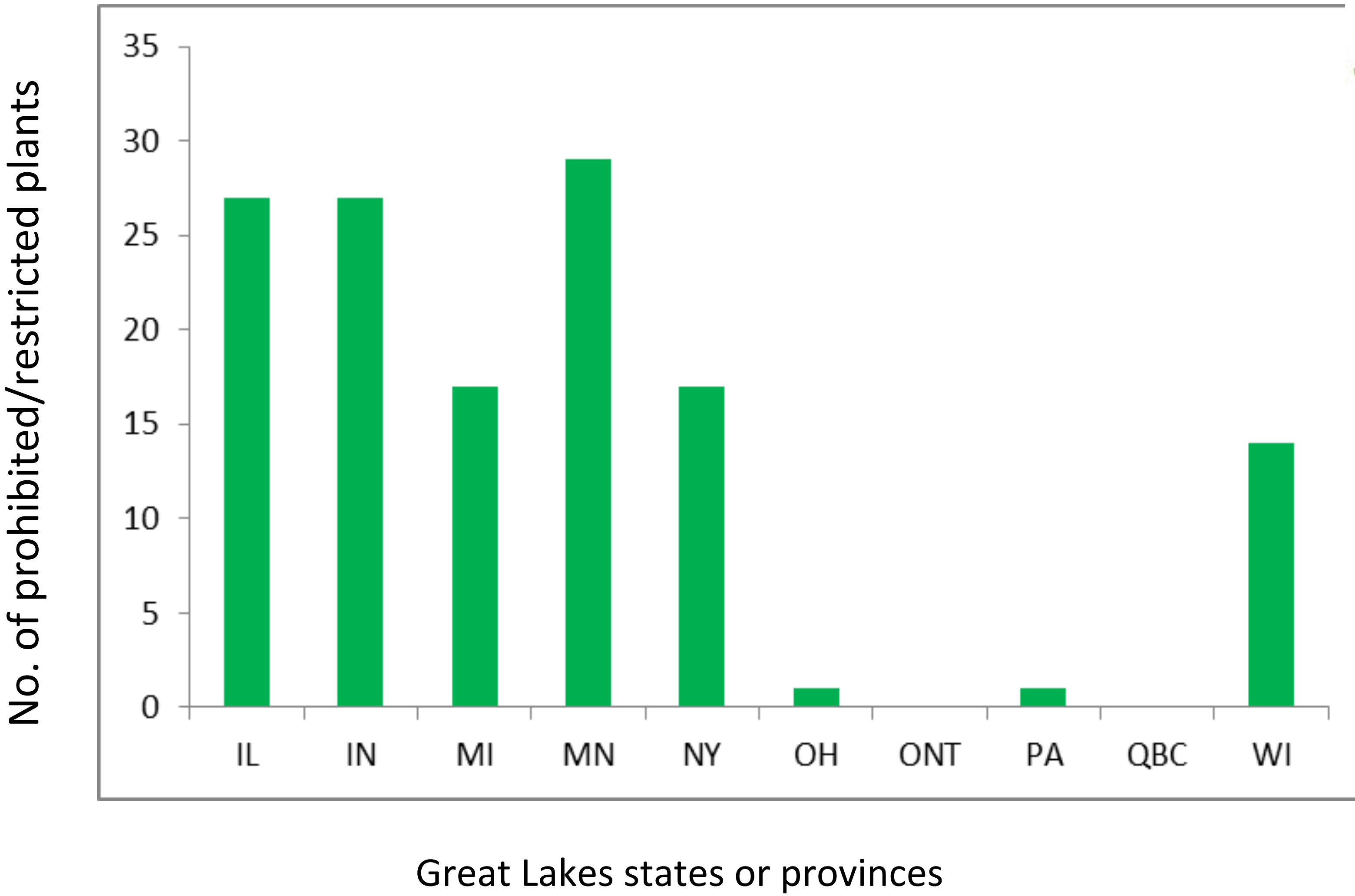

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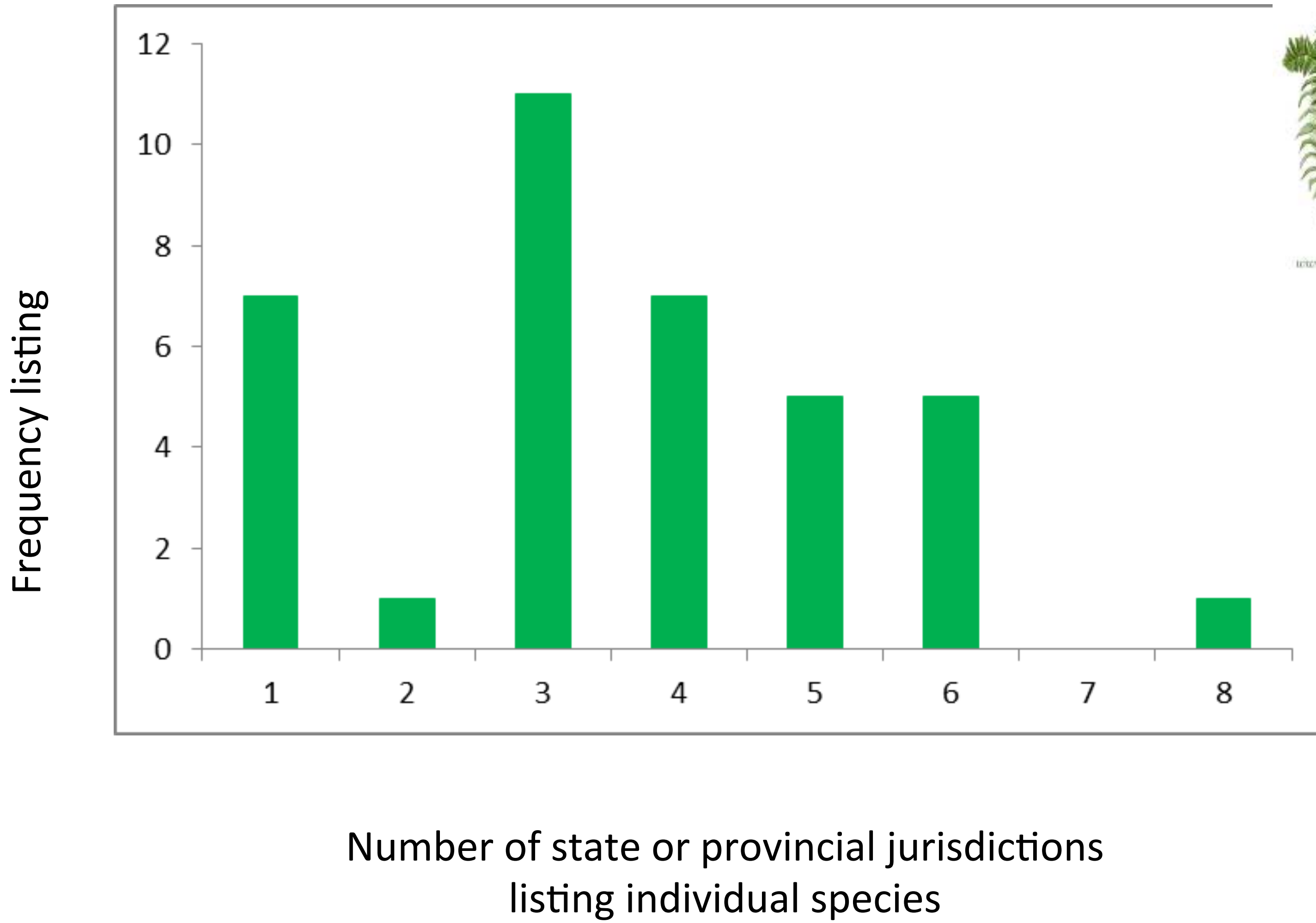

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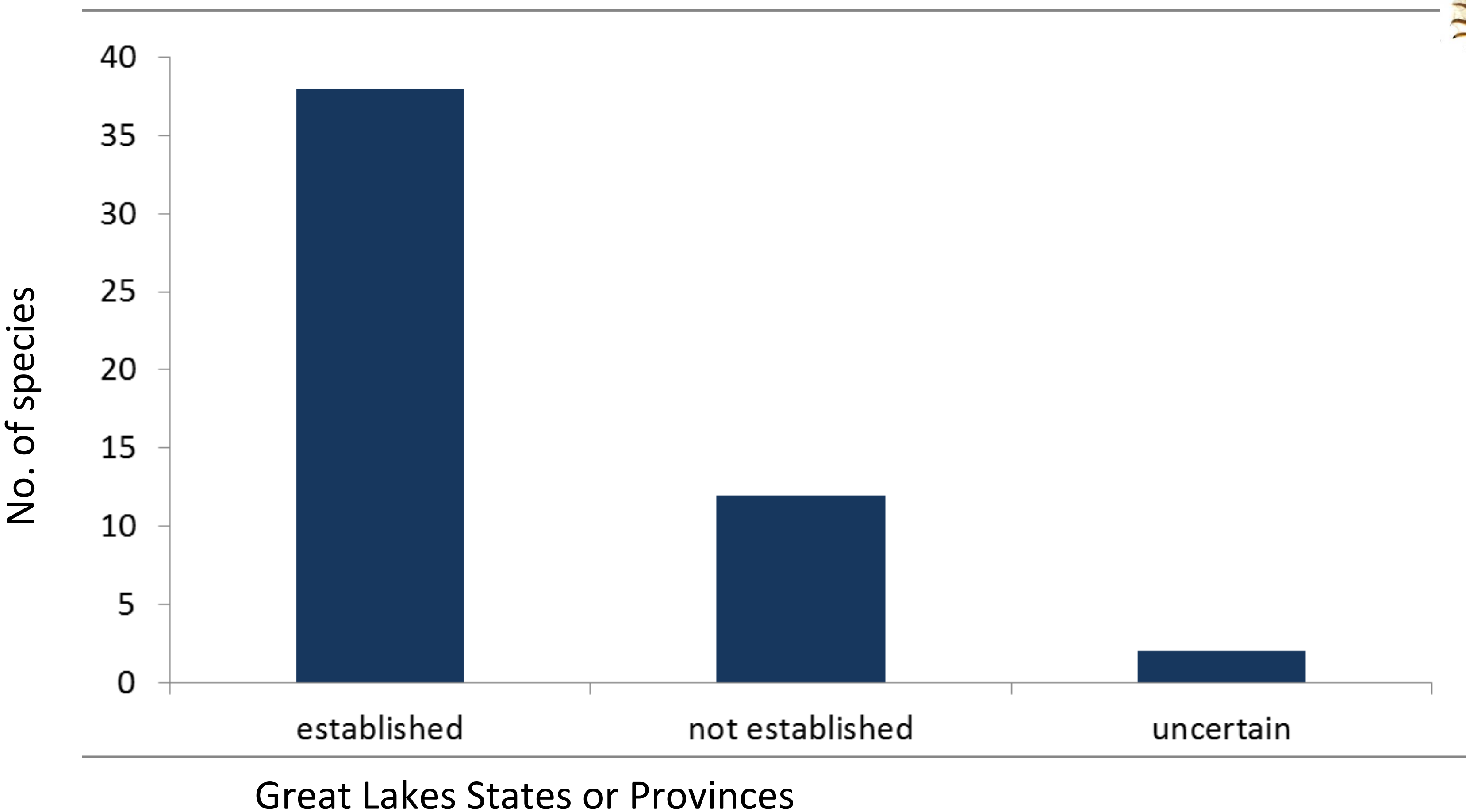

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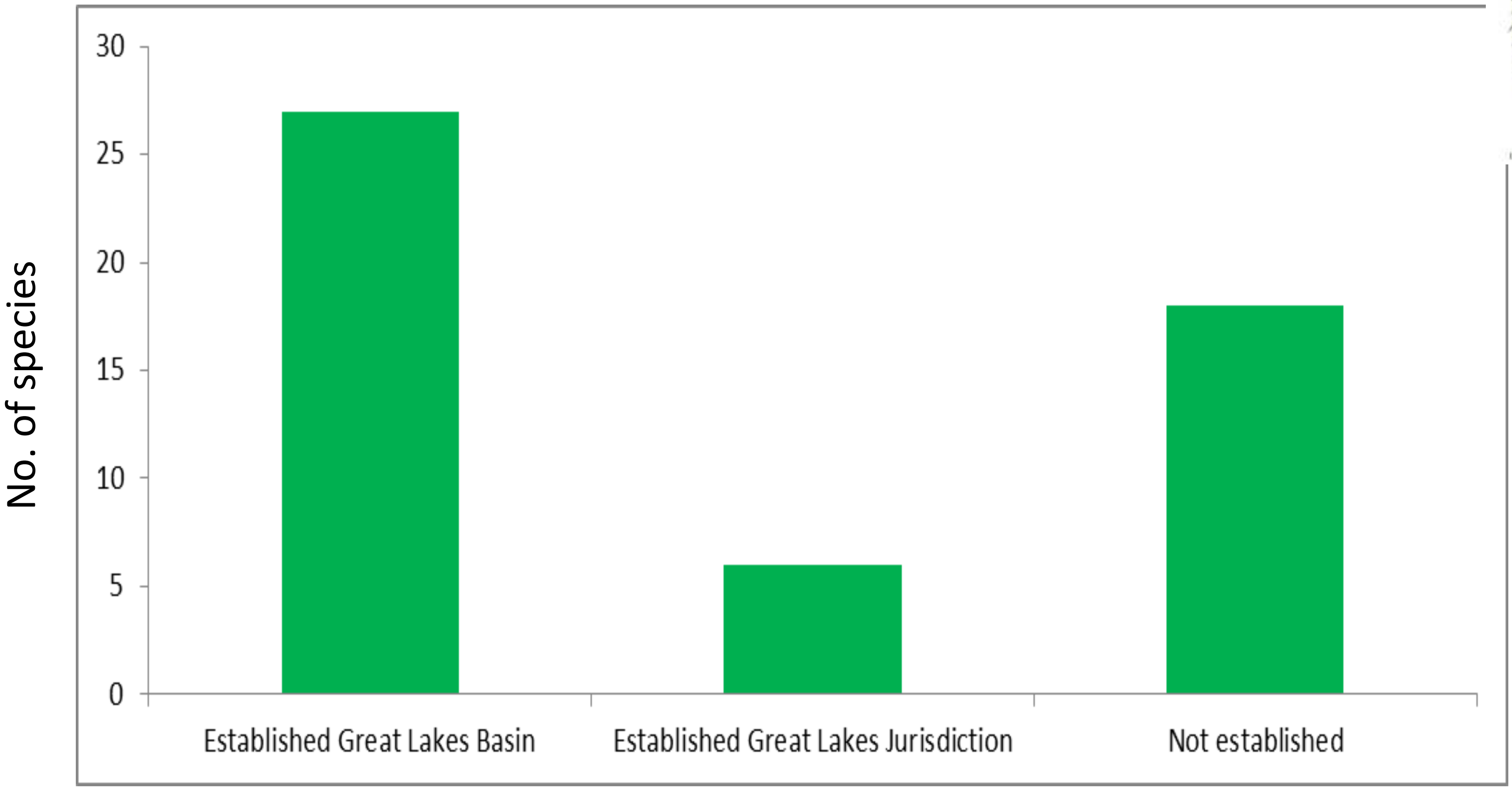

Common criteria used to assess risk

- Probability of introduction
- Environmental suitability – can species establish, reproduce and spread (climate, and habitat suitability)
- Evidence of impacts
  - history of invasiveness elsewhere
  - competition
  - predation
  - disease
  - economic impacts
  - or human health

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Existing risk assessment information in GLB

- Expert panel approach (e.g. MN, OH, MI)
- Detailed literature reviews (e.g. WI DNR, DFO Canada, GLANSIS, Lacey Act Listed Injurious sp. & USDA noxious species listing, Invasive Species Specialist Group (*ISSG*))
- Questionnaire -score based risk assessment tools (e.g. USAWRA, *Gordon et al 2013*, NY Plant risk assessment method)
- Statistical tools (USFWS model [*Hoff in review*], Kolar and Lodge 2002, Keller et al 2007)

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Assessing strength of evidence

Strength of evidence	Risk Assessments
stronger	Identified by multiple peer reviewed risk assessments & expert panels
	Identified by a peer reviewed assessment and expert panel(s)
	Identified by a peer reviewed risk assessment
	Identified by multiple expert panels
weaker	Identified by one expert panel

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Assessing strength of evidence

- Scored each species on basis of cumulative evidence for regulating
- Expert panel approach (Score 0.3 per expert panel)
- Detailed literature reviews (Score 1 point per process)
- Questionnaire -score based risk assessment tools (Score 1 point per process)
- Statistical tools (Score 1 point per process)

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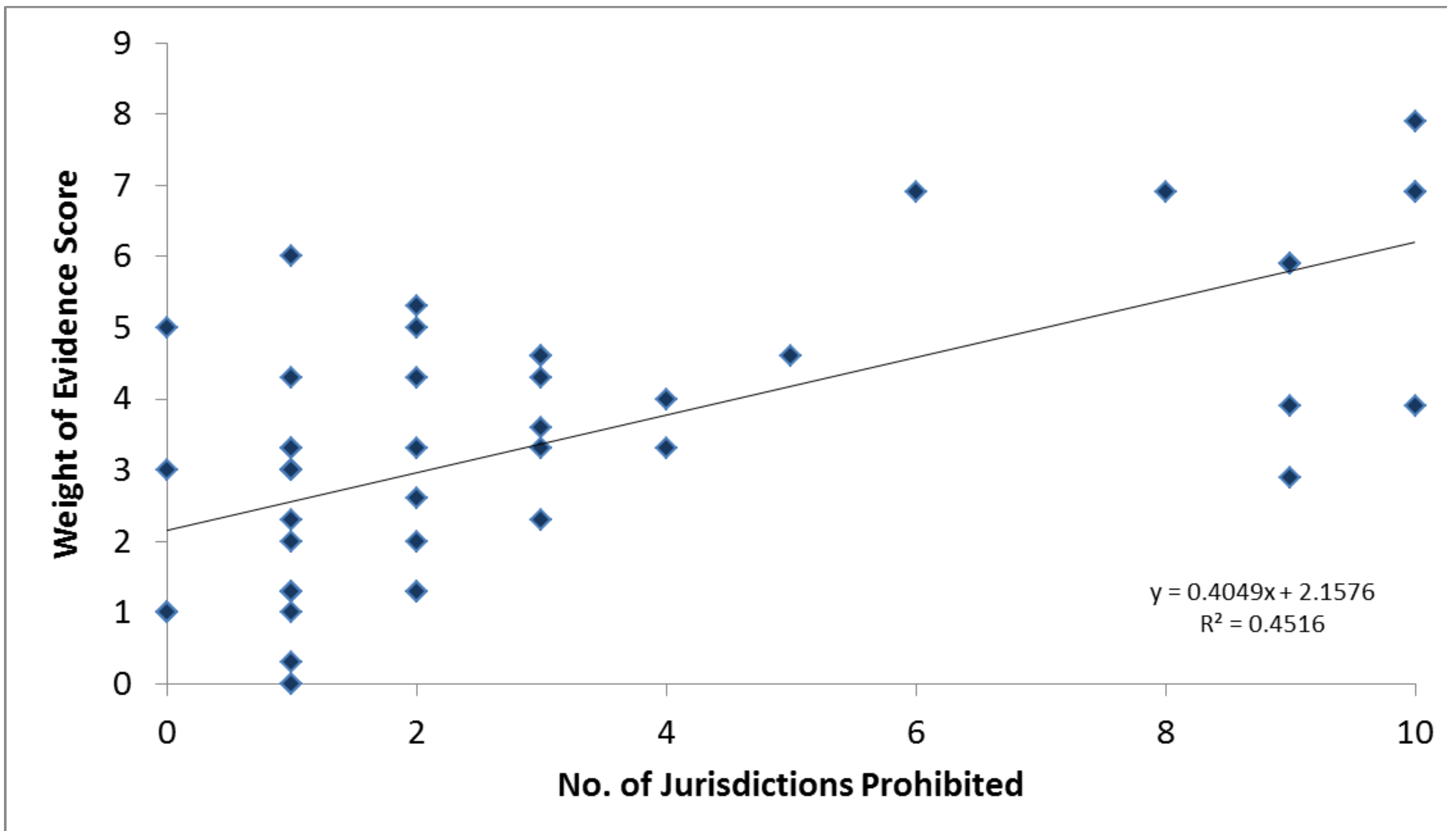
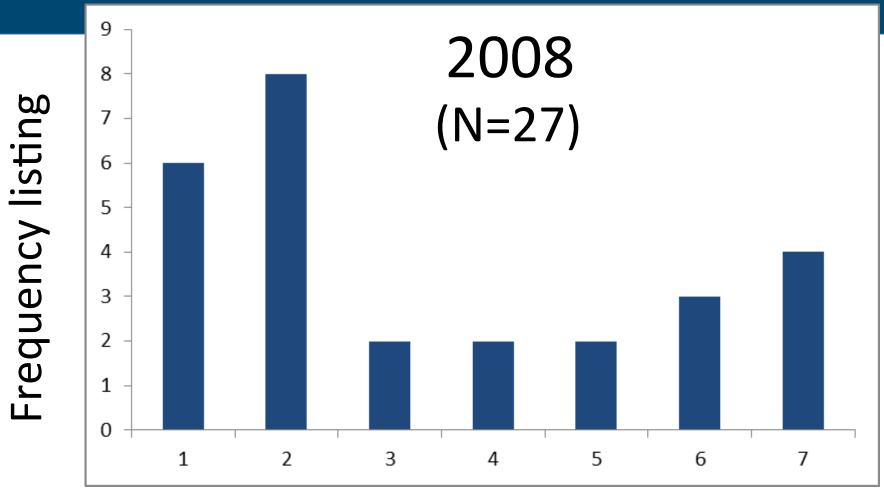
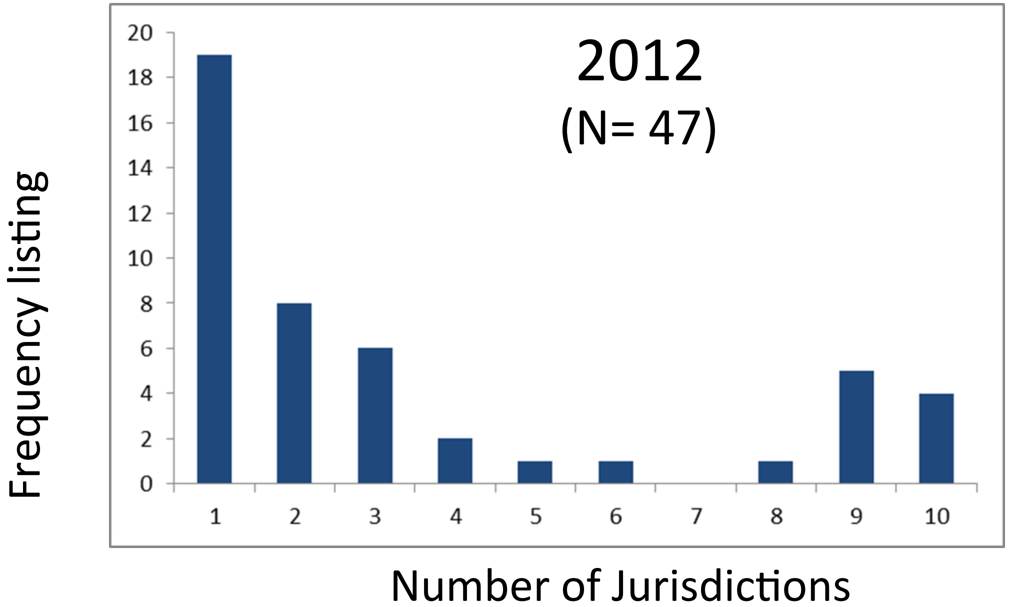
Weight of evidence (animals)



Animals – slow progress





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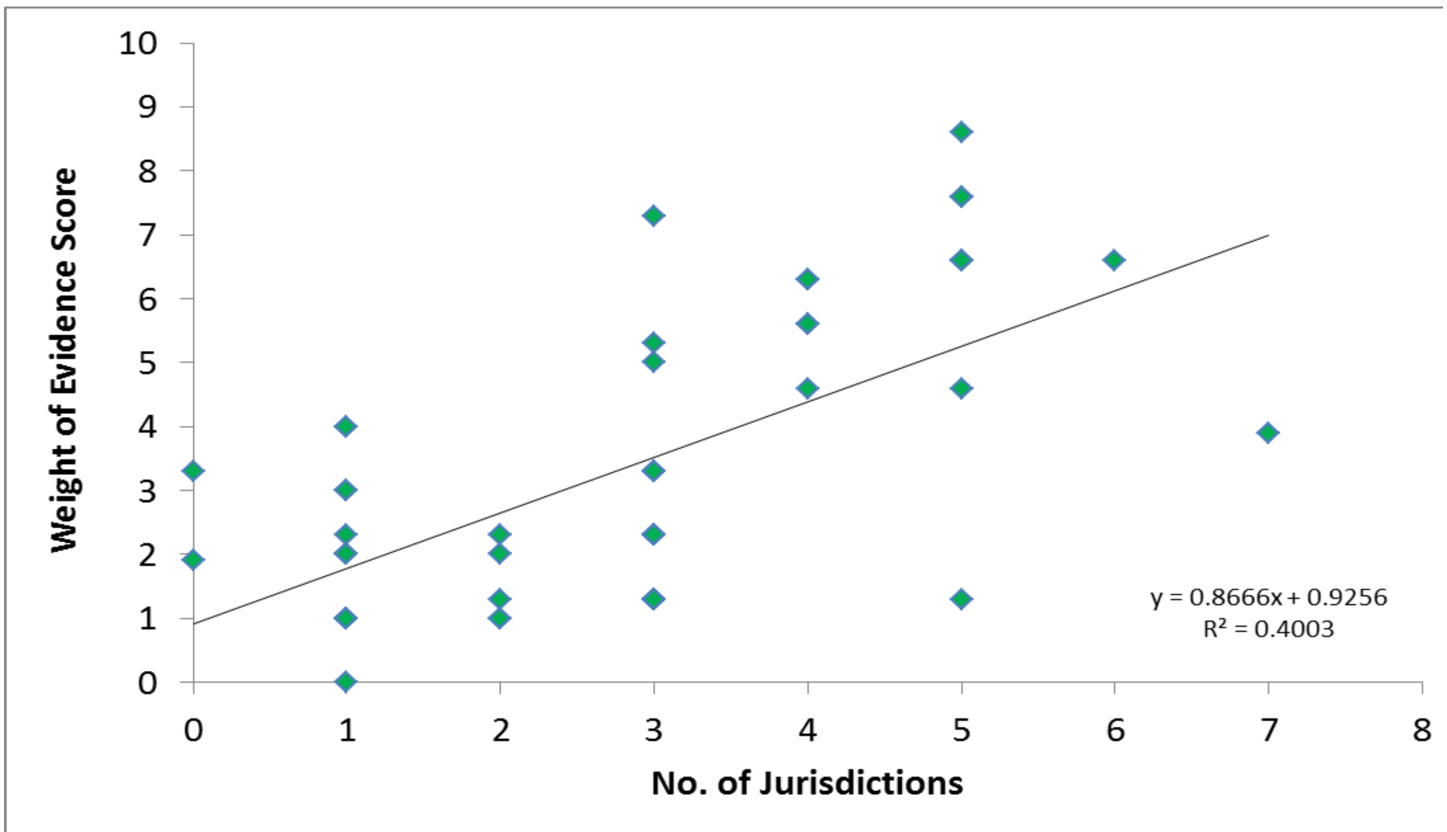
Weight of evidence (plants)



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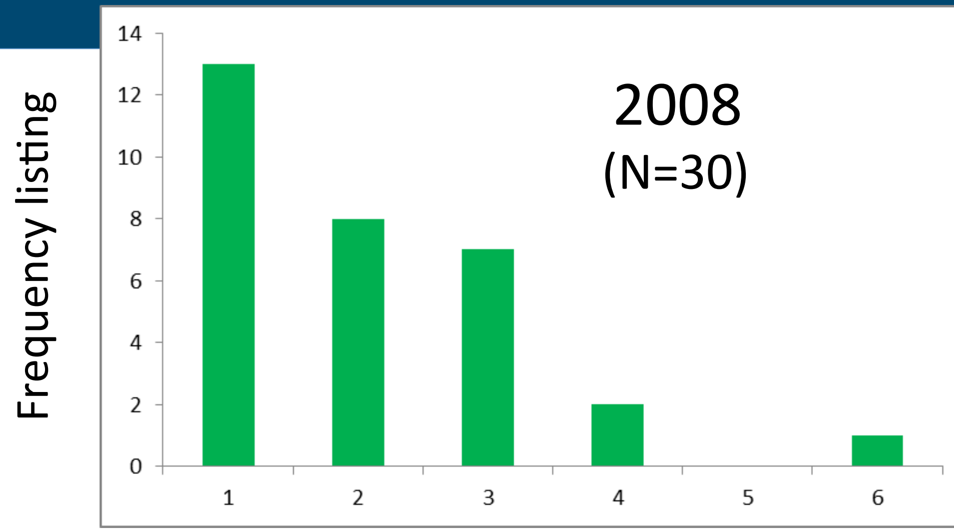
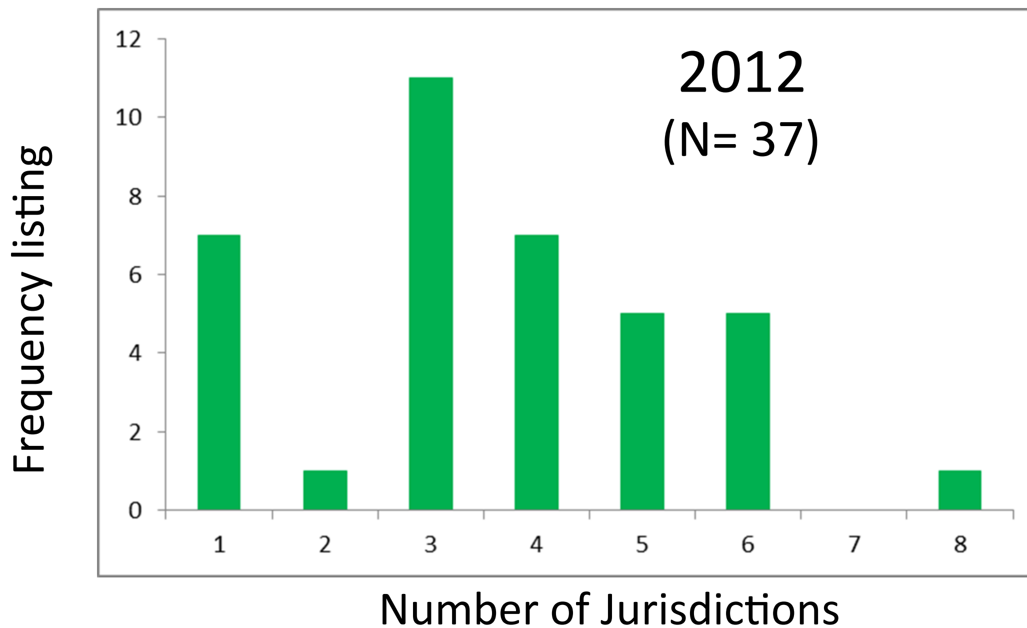
Plants – substantial progress



Reason for progress = Adoption of risk assessment methods

- Indiana and Illinois – (GL) AWRA
- New York – Plant Risk assessment method



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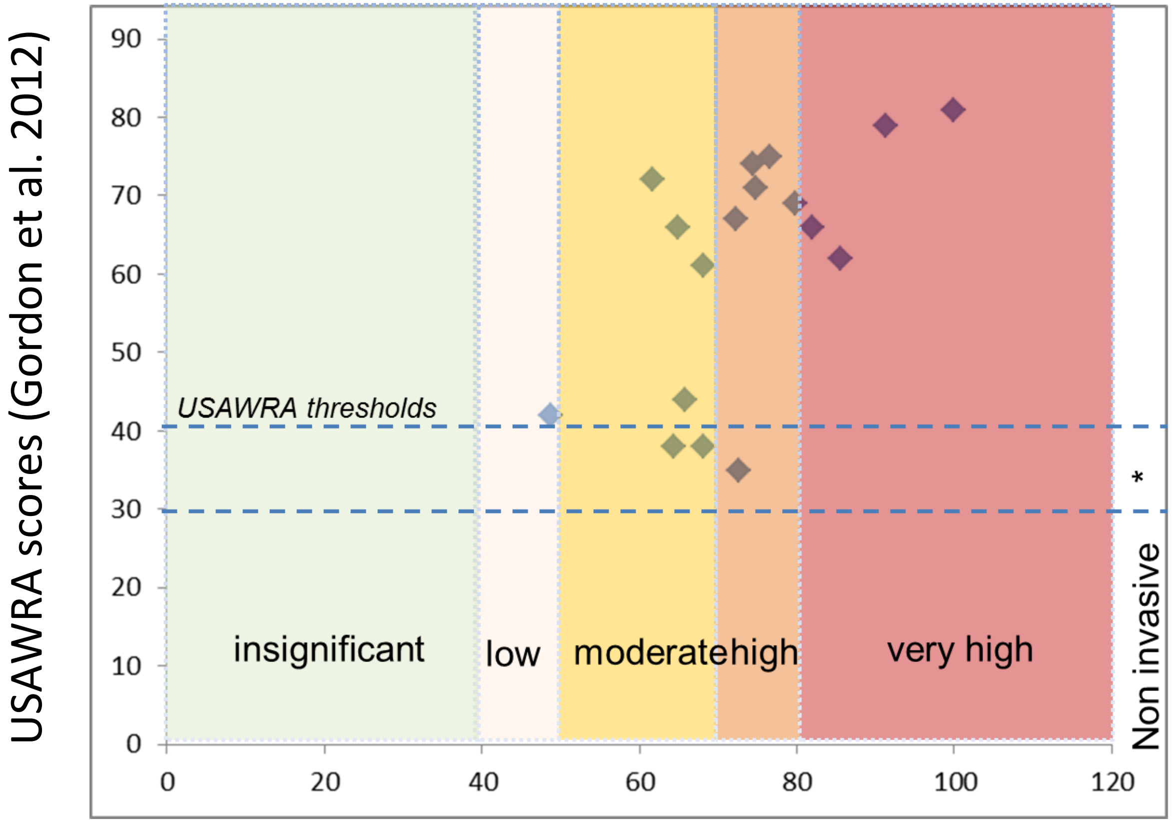
Opportunity for adoption of common risk assessment data?



NY invasiveness ranks

(* - requires further evaluation)

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Conclusions- informing risk management

- Current prohibited species lists appear to be reactive
- Variety of risk assessment methods used across basin collectively provide evidence to support broader prohibition of the majority of listed species
- Agreement between some comprehensive risk assessment methods suggests potential for adoption of consistent and scientifically defensible risk assessment method for GLB jurisdictions (e.g. MI PA 537 of 2014)

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NOW SPEAKING:

Ryan Meyer

Senior Scientist, California Ocean Science Trust

Ryan Meyer is a Senior Scientist at the California Ocean Science Trust, a boundary organization that helps scientists and decision makers collaborate more effectively. He works across the organization providing context and support that motivates staff to think deeply about the mission of promoting a constructive role for science in decision making. Ryan oversees the design and implementation of partnerships-based monitoring of California's MPAs in the Central Coast and South Coast regions, and a NOAA-funded, multi-institution effort to incorporate sea level rise into floodplain management and other coastal planning processes. He also leads OST's Citizen Science Initiative, focused on expanding the ways that citizen science programs can link with coastal and marine policy and management.

Ryan completed his PhD at Arizona State University, where he conducted research on the climate science funding in the US and Australia. He is a Fulbright Scholar, a University Fellow in the Research Institute for Environment and Livelihoods at Charles Darwin University, and an affiliate of the Consortium for Science, Policy, and Outcomes at Arizona State University.

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Questions for the panelists? Submit via the "Questions" box or raise your hand by clicking on the hand icon.

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