

Risk Assessment for Invasive Species

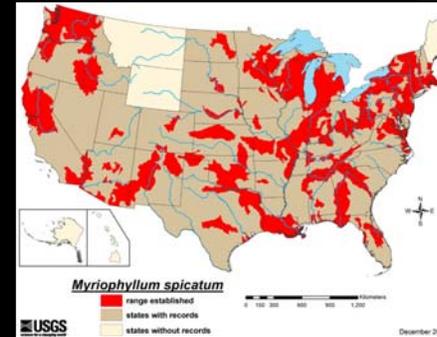
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Loyola University
Chicago



GLRI: Preventing Invasions from Trade in Live Aquatic Organisms
Co-operative agreement between University of Notre Dame and
USFWS

Known Invaders in Trade

Taxa	Species	
Plants	<i>Cabomba caroliniana</i> (Cabomba)	
	<i>Egeria densa</i> (Brazilian waterweed)	
	<i>Eichornia crassipes</i> (Water hyacinth)	
	<i>Glyceria maxima</i> (Tall mannagrass)	
	<i>Hydrocharis morsus-ranae</i> (European frog-bit)	
	<i>Iris pseudocorus</i> (Yellow iris)	
	<i>Lysimachia numularia</i> (Moneywort)	
	<i>Marsilea quadrifolia</i> (Water shamrock)	
	<i>Mentha aquatica</i> (Water mint)	
	<i>Myosotis scorpioides</i> (Water forget-me-not)	
	<i>Myriophyllum aquaticum</i> (Parrot feather)	
	<i>Myriophyllum spicatum</i> (Eurasian watermilfoil)	
	<i>Najas minor</i> (Lesser naiad)	
	<i>Nymphoides peltata</i> (Yellow floating-heart)	
	<i>Pistia stratiotes</i> (Water lettuce)	
	<i>Potamogeton crispus</i> (Curly-leaved pondweed)	
	<i>Trapa natans</i> (Water chestnut)	
	<i>Typha angustifolia</i> (Narrow-leaved cattail)	
	Fish	<i>Ameiurus melas</i> (Black bullhead)
		<i>Cyprinus carpio</i> (Common carp, koi)
<i>Carassius auratus</i> (Goldfish)		
<i>Gambusia affinis</i> (Mosquitofish)		
<i>Micropterus salmoides</i> (Largemouth bass)		
<i>Misgurnus anguillicaudatus</i> (Oriental weatherloach)		
<i>Notemigonus crysoleucas</i> (Golden shiner)		
<i>Pimephales promelas</i> (Fathead minnow)		
Molluscs		<i>Corbicula fluminea</i> (Asiatic clam)
Crayfish	<i>Orconectes rusticus</i> (Rusty crayfish)	



Potential for Future Invasions

Taxa	Species
Plants	<i>Aponogeton distachyos</i> (Water hawthorne)
	<i>Houttuynia cordata</i> (Chameleon)
	<i>Marsilea mutica</i> (Water fern)
	<i>Ophiopogon japonicus</i> (Mondo grass)
	<i>Ranunculus lingua</i> (Greater spearwort)
	<i>Salvinia auriculata</i> (Eared watermoss)
Fish	<i>Aristichthys nobilis</i> (Bighead carp)
Amphibia	<i>Xenopus laevis</i> (African clawed frog)



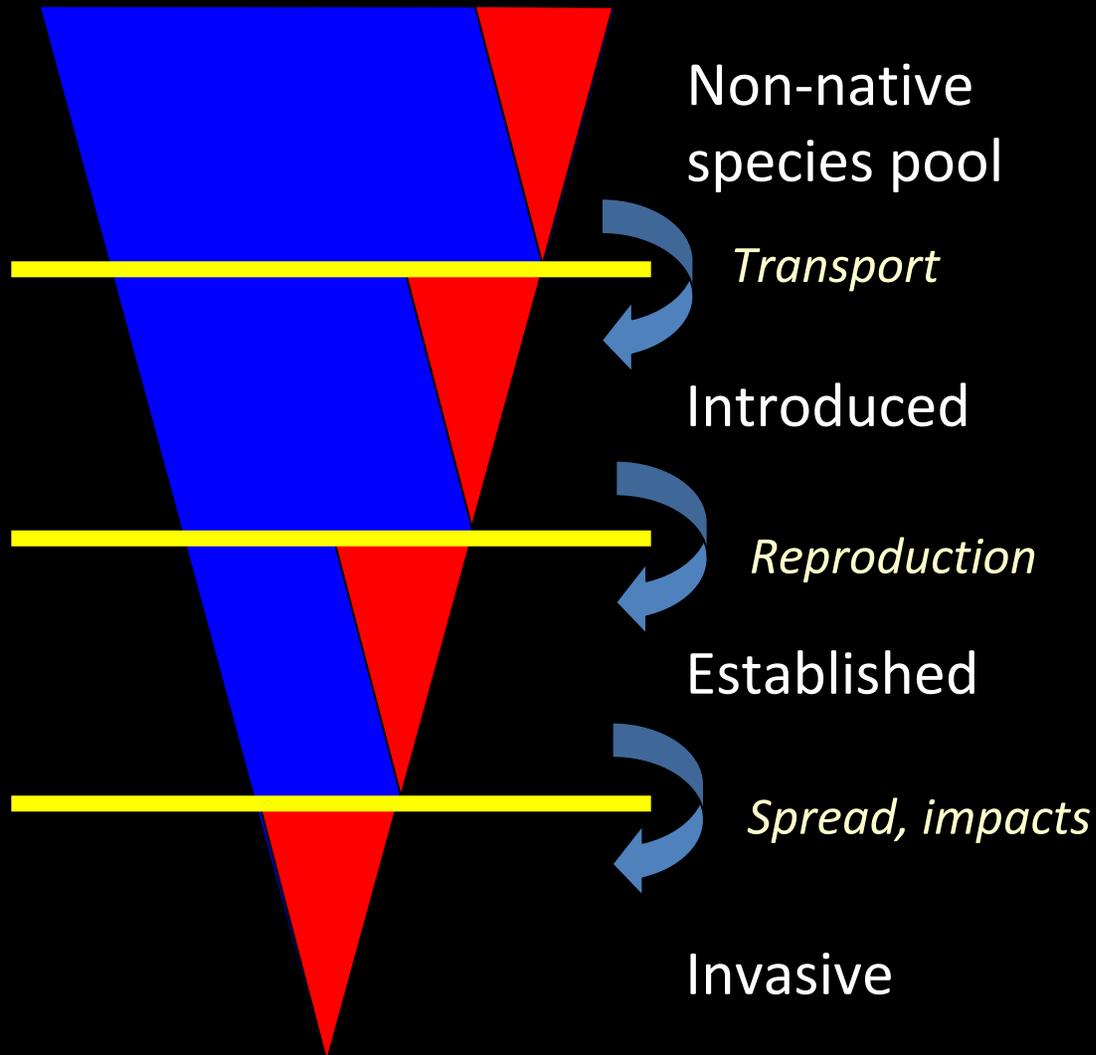
Response

Species	IL	IN	MI	MN	NY	OH	ON	PA	WI
Bighead carp (<i>Hypophthalmichthys nobilis</i>)	X	X	X	X	X	X	X	X	X
Bitterling (<i>Rhodeus sericeus</i>)			X						
Black carp (<i>Mylopharyngodon piceus</i>)	X	X	X	X	X	X	X	X	X
Chinese weatherloach (<i>Misgusnus anguillicaudatus</i>)			X						
Eastern banded killifish (<i>Fundulus diaphanus</i>)						X			
Grass carp, triploid (<i>Ctenopharyngodon idella</i>)			X	X	X		X		X
Grass carp, diploid (<i>Ctenopharyngodon idella</i>)						X		X	X
Ide/Orfe (<i>Leuciscus idus</i>)			X						
Mosquitofish, eastern (<i>Gambusia holbrooki</i>)									X
Mosquitofish, western (<i>Gambusia affinis</i>)									X
Piranha (<i>Multiple genera</i>)					X				
Round goby (<i>Neogobius melanostomus</i>)	X	X		X		X	X	X	
Rudd (<i>Scardinius erythrophthalmus</i>)	X	X	X	X		X	X	X	
Ruffe (<i>Gymnocephalus cernuus</i>)	X	X		X		X	X	X	
Sea lamprey (<i>Petromyzon marinus</i>)				X		X			
Silver carp (<i>Hypophthalmichthys molitrix</i>)	X	X	X	X	X	X	X	X	X
Snakehead, giant (<i>Channa micropeltes</i>)									X
Snakehead, northern (<i>Channa argus</i>)	X	X	X	X	X	X	X	X	X
Snakehead family									X
Red shiner (<i>Cyprinella lutrensis</i>)									X
Tench (<i>Tinca tinca</i>)			X						
Three spine stickleback (<i>Gasterosteus aculeatus</i>)						X			
Tilapia (<i>Multiple genera</i>)								X	
Tube-nose goby (<i>Proterorhinus marmoratus</i>)	X	X		X		X	X	X	
Walking catfish (<i>Family Clariidae</i>)	X								
Walking catfish (<i>Clarias batrachus</i>)						X			
White perch (<i>Morone americana</i>)		X		X		X			
Zander (<i>Sander lucioperca</i>)				X					X

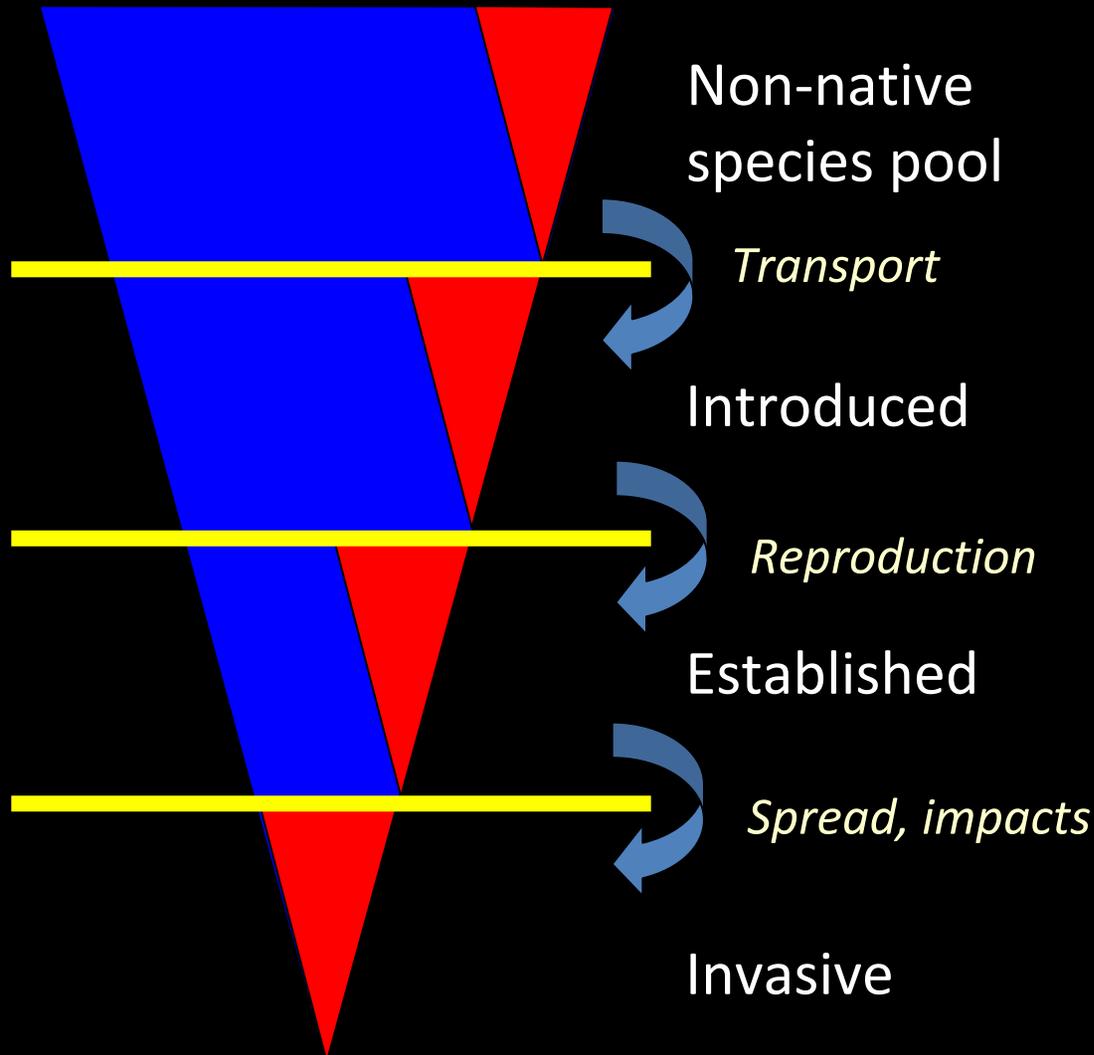
Three Potential Approaches

1. Allow everything into trade
2. Allow nothing into trade
3. Risk Assessment to identify high risk species,
and to support prohibited and/or allowed lists

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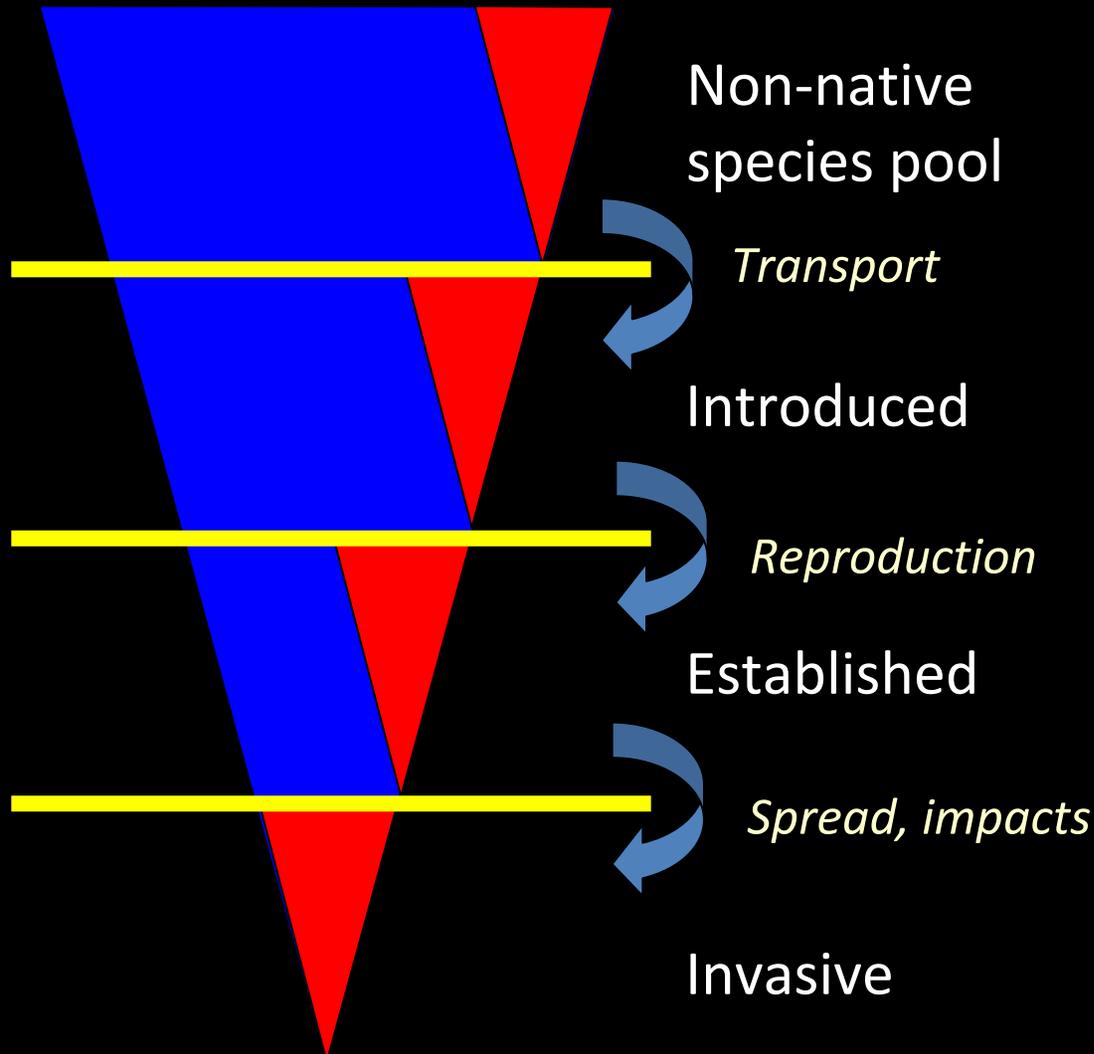


Risk Assessment for Invasive Species



Goal of RA is to identify establishers/invasers prior to introduction

How Do We Do Risk Assessment?



1. Begin by gathering data about species that have been introduced in the past
2. Look for traits associated with invasiveness
3. If patterns are strong, they can be used for prediction

Three General Approaches to Risk Assessment

Tier 1: Rapid Risk Assessment (Screening)

- Takes hours to complete
- Generally based on species' history of invasion and climate match

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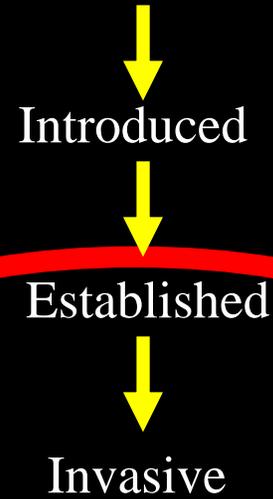
Tier 3: Literature review

- Months to years to complete
- Based on as much data, of any type, as can be collected

Tier 2 Statistical: Mollusks in the Great Lakes



3. Invasion Process Species Elsewhere



Gather species trait data and analyze using statistical techniques

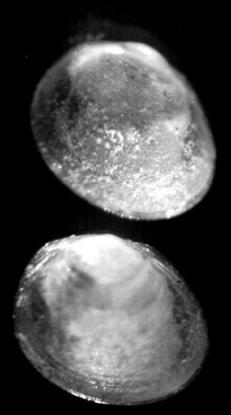
Species Traits

Trait	Levels		
Type of Reproduction	Separate sexes Sequential hermaphrodite Simultaneous hermaphrodite Self-fertilizing hermaphrodite	<i>Dreissena polymorpha</i>	<i>Pisidium henslowanum</i>
Egg Brooding	Ovoviviparous or viviparous	<i>Corbicula fluminea</i>	
Maximum Size	mm		
Fecundity/female/year	Log_{10} (propagules released)		
Longevity	Years		
Established Elsewhere	Yes or No		
Latitude Range	Highest - Lowest		
Larval Stage	Yes or No	<i>Potamopyrgus antipodarum</i>	<i>Bithynia tentaculata</i>

Dreissena polymorpha



Pisidium henslowanum



Corbicula fluminea

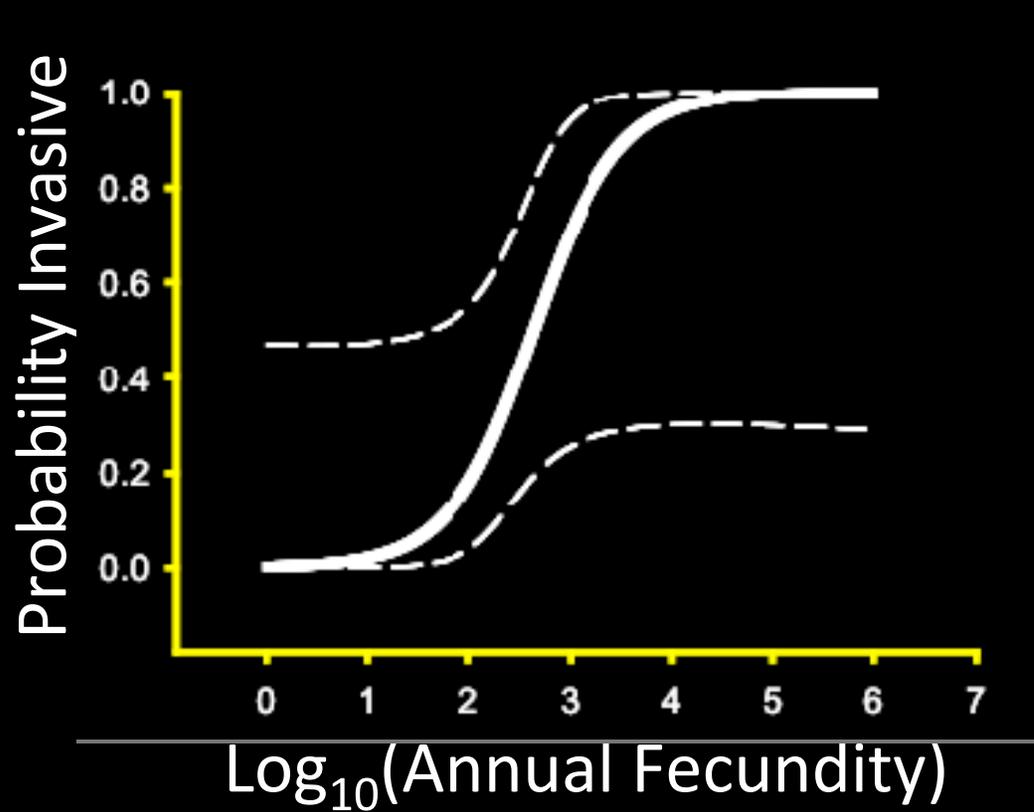


Potamopyrgus antipodarum

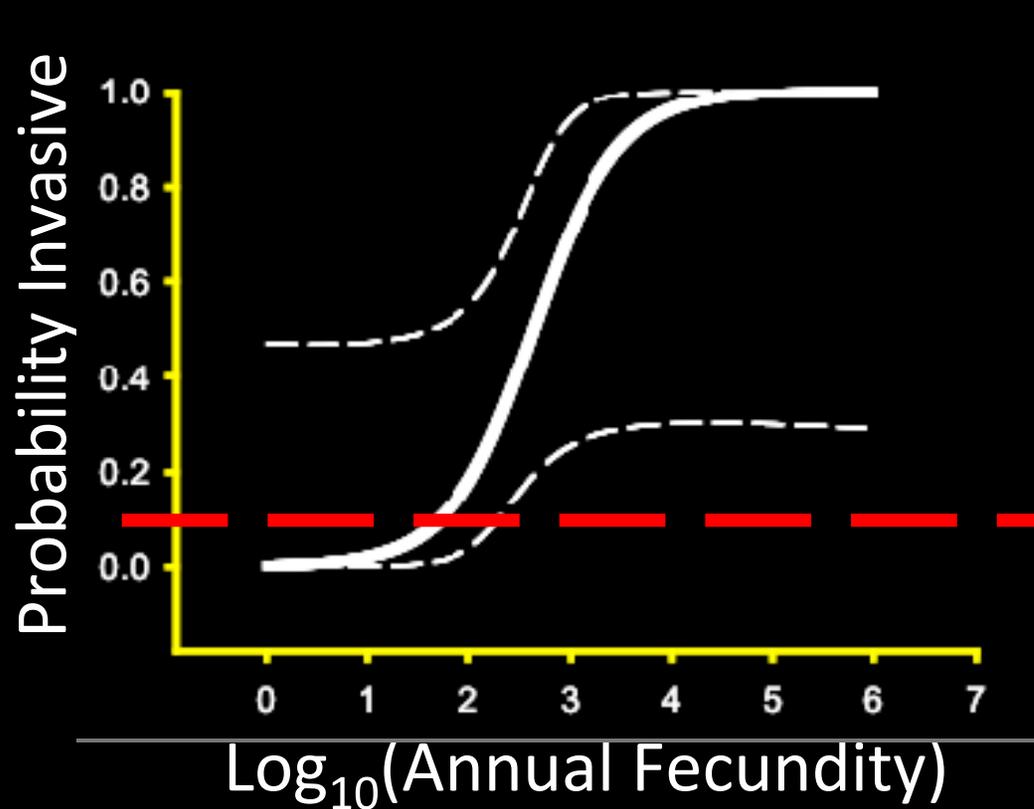


Bithynia tentaculata

Fecundity Predicts Invasiveness



Fecundity Predicts Invasiveness



10% risk of ecological and/or economic impacts if species becomes established

Tier 2 Questionnaire: Aquatic Plants in GL

38 questions in 12 categories with scores summed

- Climate/distribution
- Invasiveness elsewhere
- Habitat breadth
- Potential for spread
- Generation time
- Reproductive capacity
- Competitive ability
- Impacts to water flow
- Impacts to water chemistry
- Impacts to native systems
- Other negative impacts
- Response to management

AqWRA score

- Range of possible scores 3 to 91

Some Risk Assessment Considerations

- 1) There are a lot of species to assess!
 - Make sure that the risk assessment tool(s) chosen match your capacity and need
- 2) Mistakes will be made
 - No risk assessment is perfect, and some invaders will get through, and some benign species won't
- 3) Despite mistakes, risk assessments are worthwhile
 - Risk assessment tools shown to produce net environmental and economic benefits

Project Goals

Research Objectives

Objective 1: Develop risk assessment tools for fishes, plants, mollusks, amphibians, reptiles and crustaceans for the GL Basin.

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Communication (Objective 3)

Produce and make freely available text and online versions of risk assessment tools. Conduct workshops in their use and application.



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Objective 1: Develop risk assessment tools for fishes, plants, mollusks, amphibians, reptiles and crustaceans for the GL Basin.

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Outcomes

GL governments have scientifically rigorous and comprehensive information and tools to support coordinated action to manage high risk aquatic species in trade now and in the future.

Participants

- David Lodge, University of Notre Dame. Lead PI.
- Mike Hoff, Nate Caswell, Matt Curtis, USFWS.
- Reuben Keller, Loyola University Chicago.
- Lindsay Chadderton, The Nature Conservancy.
- Pat Charlebois, IL-IN SeaGrant.
- Jennifer Howeth, University of Alabama.
- Crysta Gantz, University of Notre Dame.
- Nick Mandrak, Department of Fisheries & Oceans Canada.
- Erin Grey, University of Notre Dame, Post-doc.

Progress

- Plants: Questionnaire risk assessment finalized, manuscript in review
- Mollusks: Statistical/Questionnaire risk assessment finalized, training to come.
- Fishes: Rapid risk assessment ready to write up, Statistical risk assessment hopefully completed this Fall
- Crustaceans, reptiles, amphibians: recently begun....

Summary

- All Great Lakes states are subject to risks from invasive freshwater species in trade
- For most species, protections are as good as the least effective regulations/enforcement across the Basin
- Coordination is essential to meet goals of preventing new invaders from arriving
- Risk assessment tools can provide net environmental and economic benefits

OIT Outreach

- **Poster and tip card for aquatic plant nurseries - “plant this not that”**
- **Mollusk tool – “buy this not that”**
- **Phone app for use by hobbyists**
- **OIT Website**

OIT Website

- Unique URL – e.g., www.OIT.org
- Overview of issue and pathways
- Examples for each pathway
- Available guidelines
- Links to BMPs, other resources, etc.

OIT Website

- **Incorporate IISG regulations database**
 - **comprehensive for U.S. aquatic regulations**
 - **plans to add in Canadian information**
 - **searchable by jurisdiction & taxon**
 - **links to individual regulations**
 - **contacts for each jurisdiction**
- **Need your continuing support for regulations information**

OIT Website

- **Interface USGS NAS database for species information via pathway**
- **Interface with ND server to provide access to RA tools and species assessments**

Applying Risk Assessment - Misidentification

