

# Invasive Aquatic Plants in Trade: Quantifying Availability and Risk to Wisconsin Waters

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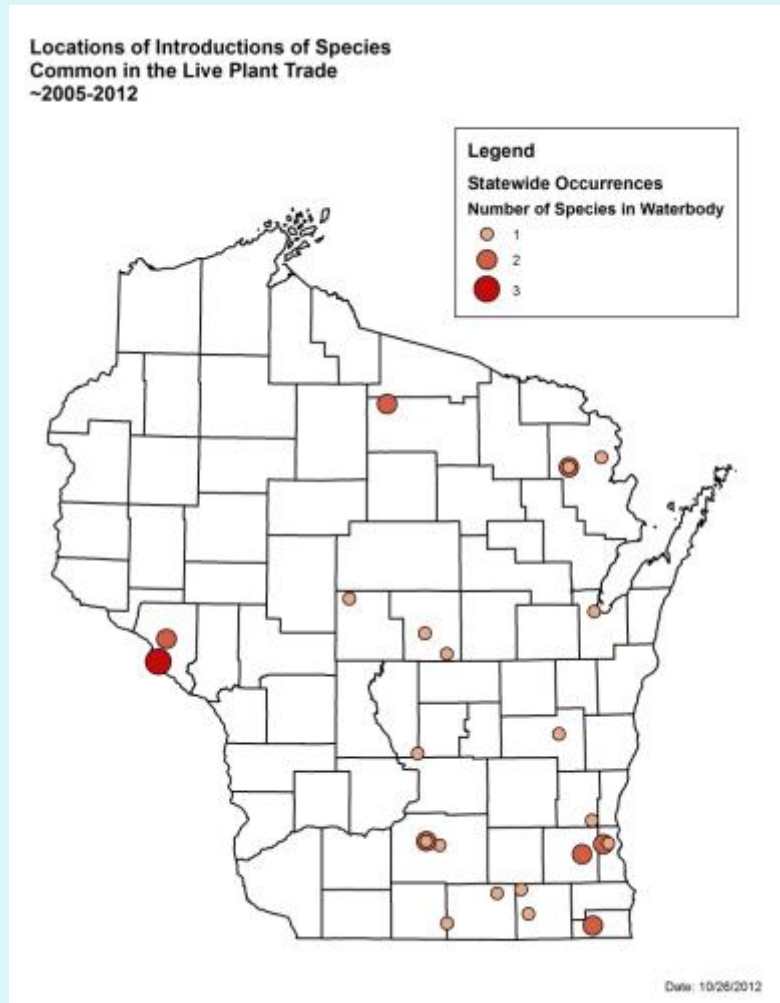
# Live Plant Retailers



- Aquarium and pet stores
- Nurseries and garden centers
- Pond and water garden stores

# Recent Invasive Species Introductions in WI

- Often species used in horticulture or aquarium plant trade
  - Prohibited
  - Water lettuce
  - Water hyacinth
  - Variegated water celery
- Often introduced into ponds (73%)



# An ounce of prevention...



# An ounce of prevention...

- **Case Study: Introduction of a Regulated Species**

Yellow floating heart (*Nymphoides peltata*)

- Removal Efforts
- Walworth County
  - \$67,855.75 over 4 years
  - Chemical treatment, manual removal, dredging, relining
- UW Botanical Garden
  - \$30,000 over 2 years
  - 2 years of control – eradication successful
  - Ponds drained and relined



Photos: Heidi Bunk, WDNR

# WI Invasive Species Rule: NR 40

- Rule went into effect in fall 2009
- Focus on education and stepped enforcement
- Live plant retailers prior notification
  - *Licensed* nurseries sent letter from DATCP
  - *Unlicensed* nurseries - no prior communication
  - Pet stores/Aquarium shops – no prior communication
- County AIS coordinators contacted some

# Reducing Invasive Live Organisms in Trade in Great Lakes Watersheds

*Timeline: September 2011 through December 2013*

## Four-part study

- 1) Retailer stock surveys*
- 2) Retailer social surveys*
- 3) Retailer outreach & education*
- 4) Biological (pond) surveys*

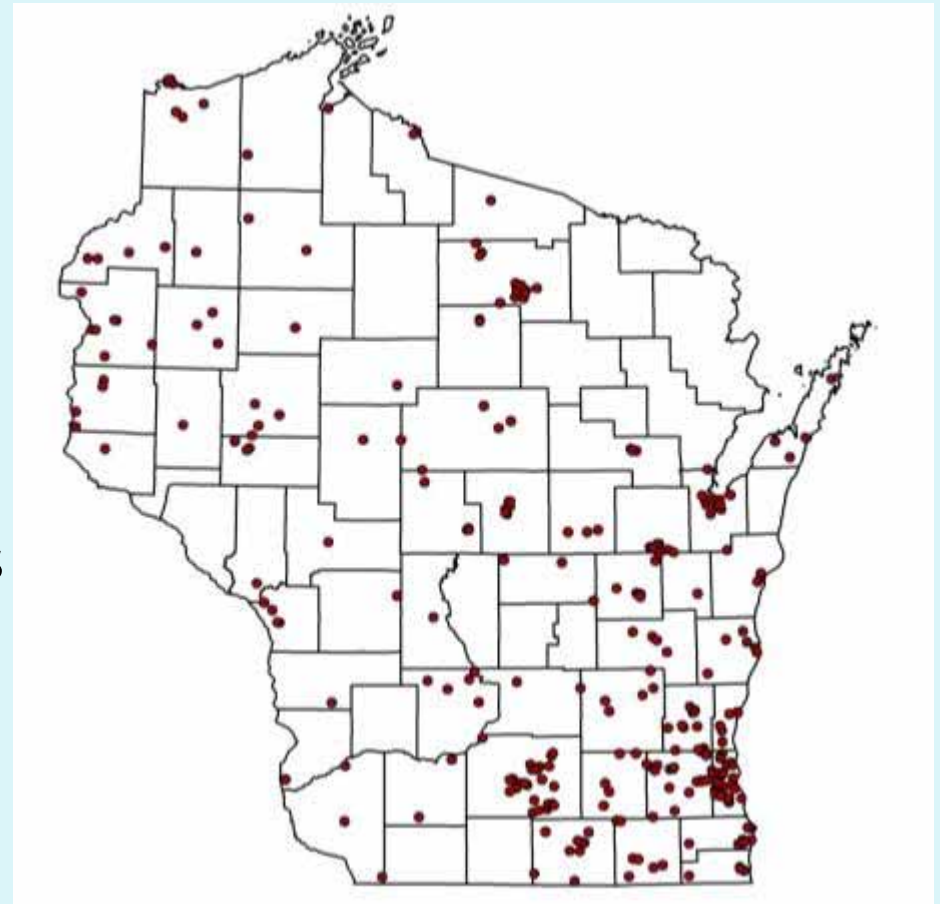
Great Lakes  
RESTORATION



Chrystal Schreck, Kelly Wagner, Alison Mikulyuk, Scott Van Egeren,  
Jennifer Hauxwell, and Mindy Wilkinson

# Retailer Stock Surveys

- Visited 297 stores statewide
  - 165 had aquatic plant displays
  - 66 with aquarium plants
  - 99 with nursery plants
- Unlicensed and licensed stores





# Retailer Stock Surveys

## Prohibited AIS

- *Cabomba caroliniana* (Fanwort)
- *Crassula helmsii* (Australian stonecrop)
- *Egeria densa* (Brazilian waterweed)
- *Hydrilla verticillata* (Hydrilla)
- *Lagarosiphon major* (African elodea)
- *Myriophyllum aquaticum* (Parrotfeather)
- *Najas minor* (Brittle naiad)
- *Nymphoides peltata* (Yellow floating heart)
- *Trapa natans* (Water chestnut)



# Retailer Stock Surveys

## Restricted AIS

- *Butomus umbellatus* (Flowering rush)
- \**Cirsium palustre* (European marsh thistle)
- \**Epilobium hirsutum* (Hairy willow-herb)
- \**Glyceria maxima* (Tall manna grass)
- *Lythrum salicaria* (Purple loosestrife)
- *Myriophyllum spicatum* (Eurasian watermilfoil)
- *Phragmites australis* (Common reed)
- *Potamogeton crispus* (Curly-leaf pondweed)
- *Typha angustifolia* (Narrow-leaf cattail)
- *Typha x glauca* (Hybrid cattail)

\*Split listed



# Retailer Stock Surveys

## Watch AIS (35 spp)

- *\*Arundo donax*
- *\*Azolla pinnata*
- *Callitriche stagnalis*
- *\*Eichornia crassipes*
- *\*Hydrocotyle ranunculoides*
- *\*Hygrophila polysperma*
- *\*Iris pseudacorus*
- *Limnobium spongia*
- *\*Limnophila sessiliflora*
- *\*Lysimachia nummularia*
- *Marsilea mutica*
- *Marsilea quadrifolia*
- *Myriophyllum pinnatum*
- *\*Oenanthe javanica*
- *\*Pistia stratiotes*
- *\*Typha laxmanii*

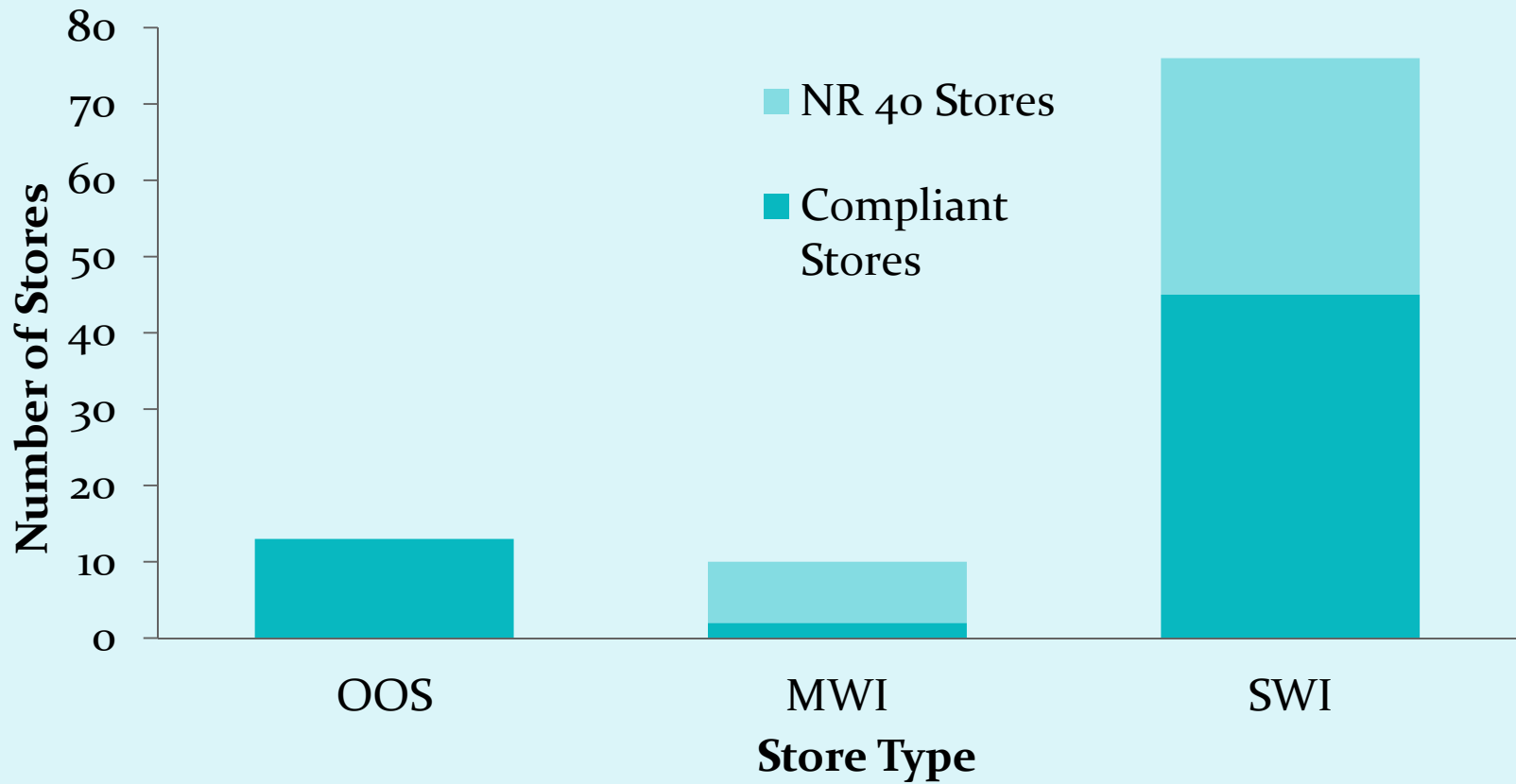


\* Proposed for regulation in NR 40 revision

# Retailer Stock Surveys

- 39.4% nursery stores selling regulated aquatic species
- 39.4% aquarium stores selling regulated aquatic species
- Non-compliance rate for licensed nurseries (38.8%) no different from unlicensed nurseries (33.3%)
- Non-compliance rate in CT aquarium stores very similar (30%; June-Wells et al. 2012, LRM)

# Retailer Stock Surveys



P=0.0001

# *Cabomba caroliniana*

Sold as: cabomba



Status in Trade: Very common  
27% of aquarium stores  
3% nursery stores

Photos tropica.com, bugwood.org

# *Egeria densa*

Sold as: anacharis, wide-leaf anacharis, elodea



Status in Trade: Very common

18% of aquarium stores

14% of nursery stores

Photos from bugwood.org

# *Eichhornia crassipes*

Sold as: water hyacinth

62% nursery stores

11% aquarium stores



# *Pistia stratiotes*

Sold as: water lettuce

58% nursery stores

11% aquarium stores

Status in Trade:

Very common



# *Iris pseudacorus*

## Yellowflag Iris



Status in Trade:  
Very Common

38% of nursery  
stores

photo Leslie J. Mehrhoff, Uconn, [bugwood.org](http://bugwood.org)

# *Myriophyllum aquaticum*

## Parrotfeather



Status in Trade: Very Common

27% of nursery stores

5% of aquarium stores



photo bugwood.org

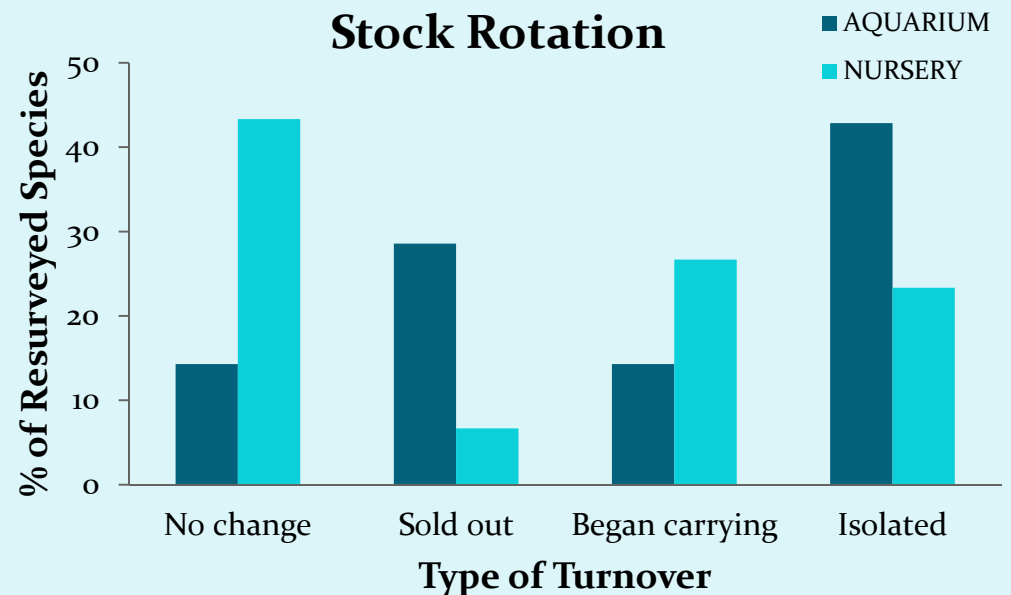
# Availability

## Nursery Stores

Scientific	Common	Regulation Status	% Nursery Stores
<i>Nymphaea spp.</i>	Hardy water lilies	Unregulated	80%
<i>Lysimachia nummularia</i>	Creeping Jenny, Moneywort	Unregulated*	71%
<i>Eichhornia crassipes</i>	Water hyacinth	Unregulated*	62%
<i>Pistia stratiotes</i>	Water lettuce	Unregulated*	58%
<i>Iris pseudacorus</i>	Yellowflag iris	Unregulated*	38%
<i>Myriophyllum aquaticum</i>	Parrotfeather	Prohibited	27%
<i>Oenanthe javanica</i>	Variiegated water celery	Unregulated*	22%
<i>Egeria densa</i>	Brazilian waterweed, Anacharis	Prohibited	14%
<i>Typha angustifolia</i>	Narrow-leaf cattail	Restricted	5%
<i>Nymphoides peltata</i>	Yellow floating heart	Prohibited	4%
<i>Phragmites australis</i>	Common reed	Restricted	4%
<i>Cabomba caroliniana</i>	Fanwort, Cabomba	Prohibited	3%
<i>Glyceria maxima</i>	Tall manna grass	Pr/Restricted	1%

# Stock Rotation

- Resurveyed subset of stores every 2 weeks
- Aquarium stores have more turnover of stock than nurseries
- No difference in stock rotation between local chains vs independents

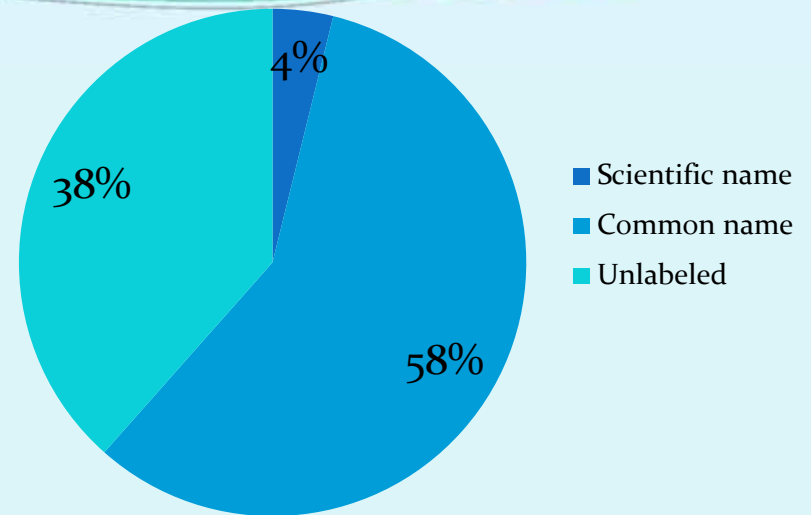


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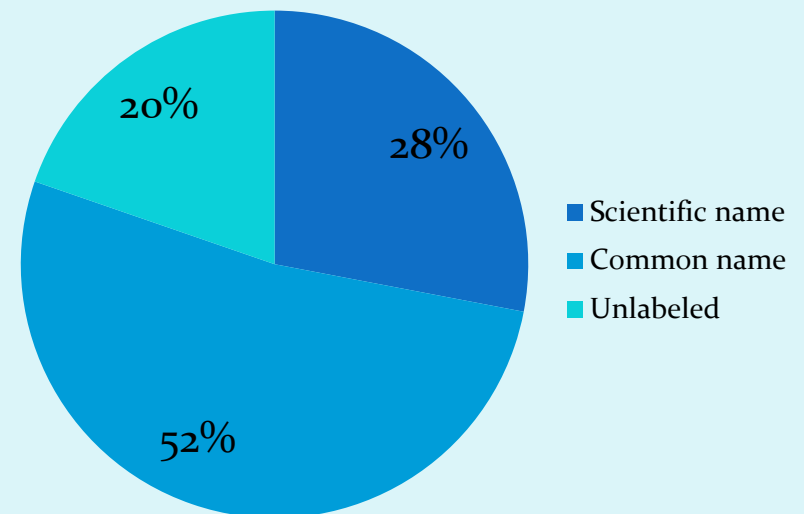
# Labeling

- Nursery stores use scientific names more often than aquarium stores ( $P < 0.0001$ )
- Differences by species for nurseries ( $P < 0.0001$ ) but not aquarium stores
  - Water lettuce & water hyacinth unlabeled (“floaters”)
  - Parrotfeather unlabeled
- Mislabeling relatively rare
  - 6.3% stock in aquarium
  - 1.8% stock in nurseries

## Aquarium Stores



## Nursery Stores



# **Aquatic Plants in Trade**

## *Social Survey & Education*

***Winter 2011-2012: First Contact***

***Spring 2012: Mailed Social Survey***

***Summer 2012: Mailed Educational Materials***

***Summer/ Fall 2012: In-store Visits***

***Spring 2013: Mailed Follow-up Social Survey***

# Retailer Social Survey

- Mailed social survey to 584 known and suspected aquatic plant retailers
  - Pet and aquarium stores
  - Licensed & Unlicensed plant nurseries
  - Pond and water garden stores
- Purpose: to assess availability, current knowledge, and self-reported behaviors

# Availability

Social surveys suggest WI stores also carry:

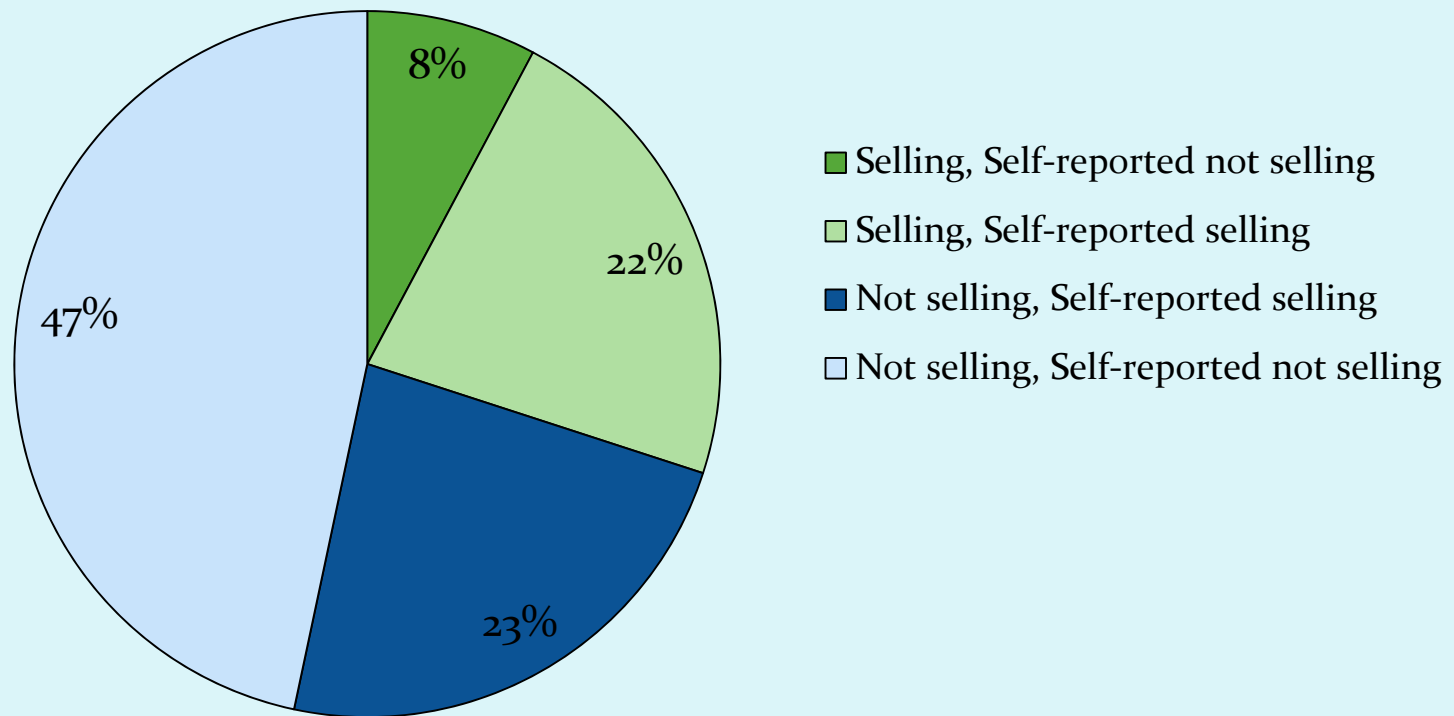
- Flowering rush, 11.3% of respondents
- Purple loosestrife, 0.5%
- Brittle waternymph, 1.3%
- Eurasian water milfoil, 1.7%
- Hydrilla spp., 3.4%
- African elodea, 2.7%



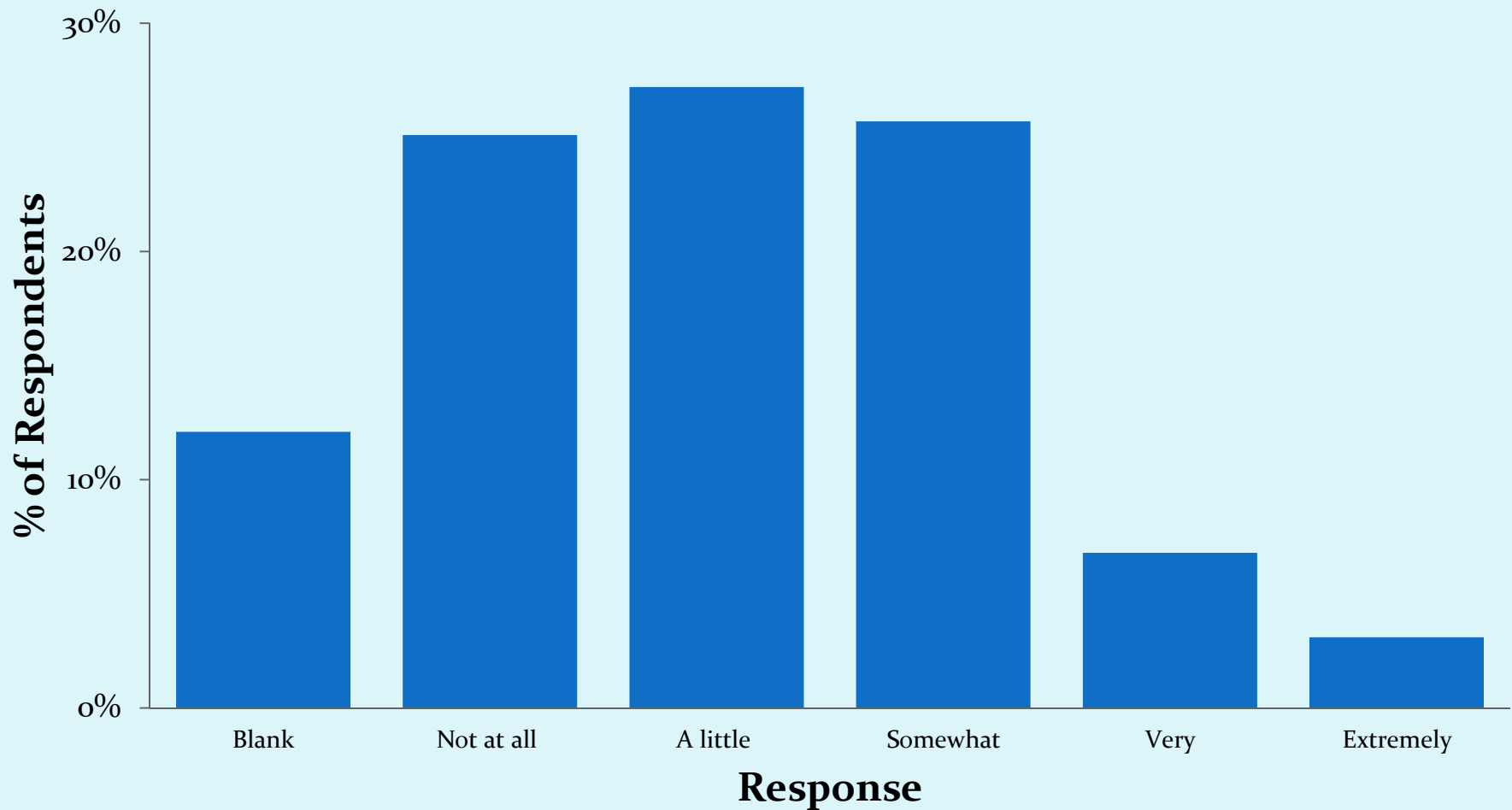


# Self-Reported Sale vs. Visit

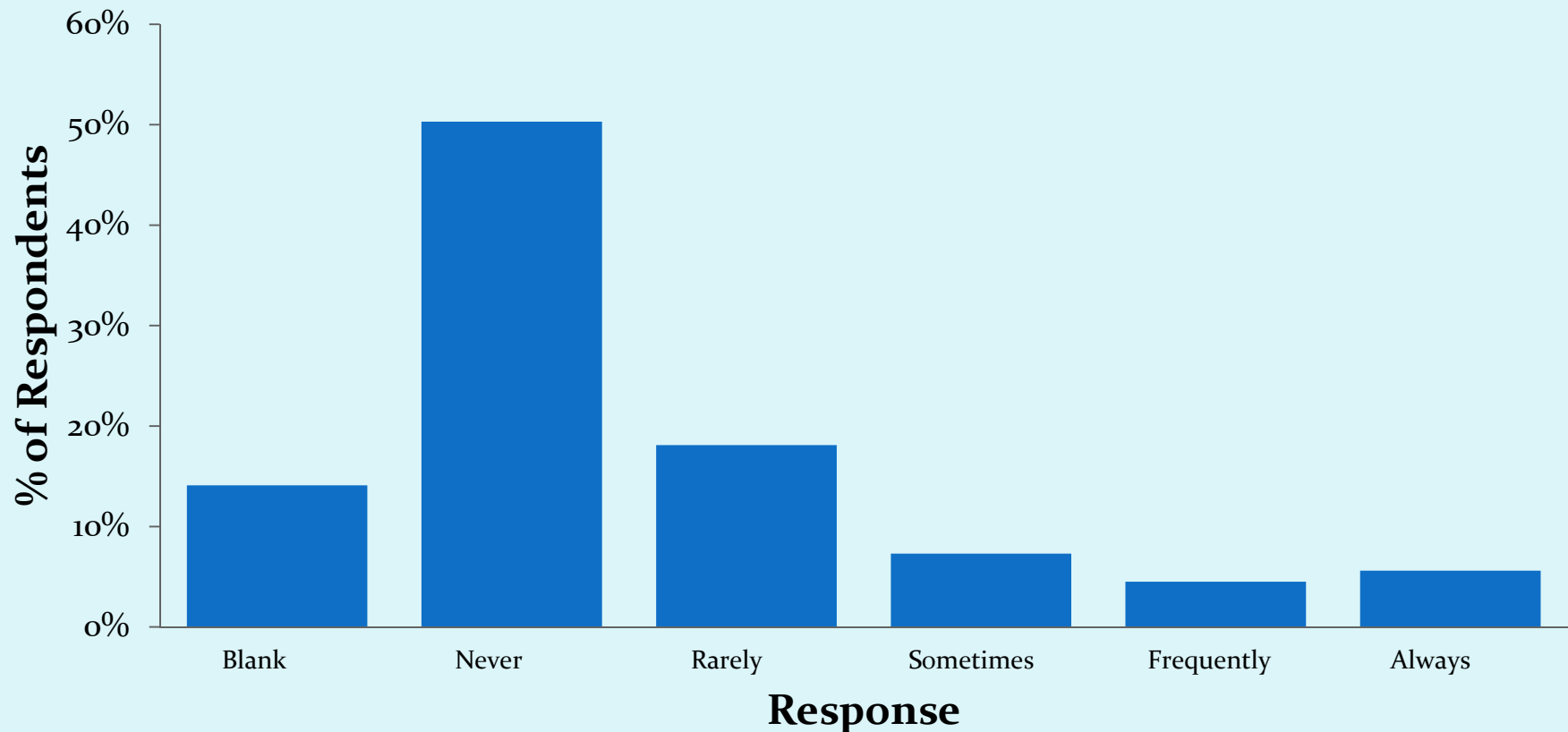
NR 40 Sales



# Knowledge: How knowledgeable do you feel you are about invasive species regulations in Wisconsin?



**Behavior:** In the past 12 months, prior to setting your aquatic plant stock out for sale, how often did you rinse soil or sediment from roots?



# Planning for Education & Outreach

## *Audience evaluation*

- Reviewed resources and the industries
- Unique industries with intersecting regulations
- Large spectrum within the industry
  - Big box stores → basement stores

## *Intersect with regulations in unique ways*

- Require individualized approach

*First, what are the intersections?*



*Myriophyllum aquaticum*  
Parrot feather

*Procambarus clarkii*  
Red swamp crayfish  
ALL nonnative crayfish are regulated



*Egeria densa*  
Brazilian waterweed



*Myiopsitta monachus*  
Monk parrot or Quaker parakeet



# Education & Outreach

June/ July 2012

Educational materials mailed to  
584 retailers

- Informational letter
- Overview of the regulations
- Color photo guides of plants

August – October 2012

Educational Visits to 108 retailers

- Friendly DNR staff provided packet and covered information (Not Enforcement)
  - Regulations
  - Plant Identification
  - Best Management Practices



CHAPTER NR 40:  
INVASIVE SPECIES IDENTIFICATION, CLASSIFICATION AND CONTROL,  
AQUATIC INVASIVE PLANTS SUBCHAPTER

The Invasive Species Rule (Chapter NR 40) went into effect on September 1, 2019. The rule establishes a comprehensive, science-based way to identify and regulate invasive species in Wisconsin. The rule divides species into 2 categories: "Prohibited" and "Restricted," with different regulations and control requirements. The rule also establishes "Restricted" regulations to allow other actions we can take to slow the spread of invasive species. Chapter NR 40 covers over 700 species, including plants, animals, and microorganisms.

NR 40.01(2) defines Invasive Species as "any organism that is not native to Wisconsin, or that is native to Wisconsin but is not native to the area where it is introduced."

**Prohibited Invasive Plants**

- These species are not just in the state - they are spreading.
- These species are likely to cause irreparable harm to the state's natural resources.
- It is not possible to eradicate these species.

**Regulations:** Control, transport, possess, transfer, and disposal. Control Authority: DNR and DNR Field Office.

**Restricted Invasive Plants**

**YOU CAN HELP PROTECT OUR ENVIRONMENT**

**CRYSTAL SCHRECK**  
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**DO NOT RELEASE**

Thank you for your help in protecting our environment.

**STOP AQUATIC HITCHHIKERS!**  
Prevent the spread of invasive species. It's the law.

**Wisconsin's Invasive Species Rule: Chapter NR 40**  
Species Lists and Information for Pet & Aquarium Owners

**Not in our Backyard**

**Keeping invasive fish species out of Wisconsin waters**

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**What you need to know to keep them where they belong**

**Bureau of Fisheries Management**  
PUB-FH-716-2012

...and other species that cause harm to the economy, environment or public health. These species may cause and support local infestations in new fish communities. Some types of organisms can be invasive. Wisconsin regulates fish, plants, and other organisms.

Chapter NR 40.01(2) defines Invasive Species as "any organism that is not native to Wisconsin, or that is native to Wisconsin but is not native to the area where it is introduced."

- Restricted Invasive Species**
- Usually widely established in the state
  - High environmental or economic impact
  - Complete eradication is unlikely
- Regulations:** Control, transport, transfer, or introduction without a permit. Possession is allowed except for fish or reptiles. Control/management but not required.

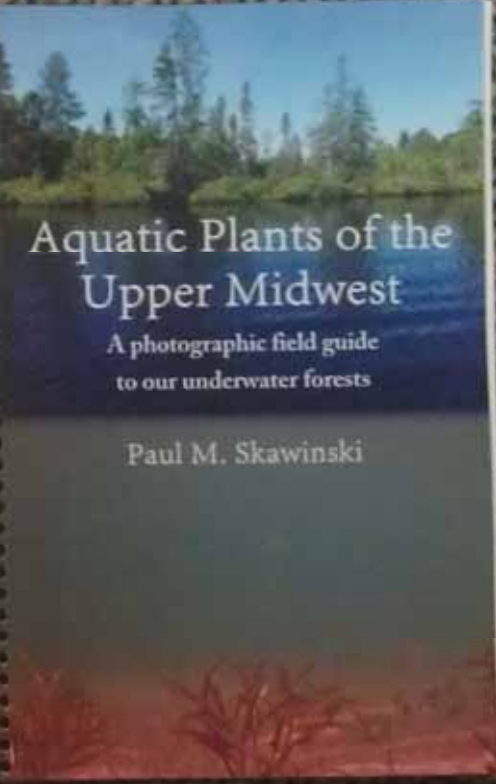
...the species is illegal. Certain exemptions do exist with these regulations.

How much you need to know about the Invasive Species Rule. The species listed that you are likely to encounter in the pet and aquarium trade.

...species other than fish. The more of a pet partner and the less known to have occurred in the pet trade. For sharks may not be as high as that of other species in Wisconsin. It is also important to be the rule.

- Invasive Fish Species**
- Bluntnose minnow
  - Tilapia
  - Weather loach
  - Chinese fish
  - Banded shrew

Required fish may only be kept in safe, contained facilities. They should never be released. For more information, please visit our website or view the publication "Not in Our Backyard" PUB-FH-716-2012.



## INVASIVE AQUATIC PLANTS & THEIR OTHER NAMES WISCONSIN REGULATED SPECIES

This document highlights some of the alternate names (synonyms and misnomers) that have been used for some of the more common invasive aquatic plants. These species are PROHIBITED invasive species under the Invasive Species Rule, Wisc. Adm. Code Ch. NR 40. These plants may not be transferred (bought or sold), transported, possessed or introduced without an invasive species permit from the Wisconsin DNR. Visit: [dnr.wi.gov](http://dnr.wi.gov), keyword: "invasives" for more information.

### DO NOT SELL THESE SPECIES

#### Cabomba, *Cabomba caroliniana*

Photo by Ann Murray

*Cabomba aquatica*  
*Cabomba australis*  
*Cabomba caroliniana* var. *caroliniana*  
*Cabomba caroliniana* var. *flavida*  
*Cabomba caroliniana* var. *pulcherrima*  
*Cabomba pulcherrima*  
*Cabomba viridifolium*  
*Nectris caroliniana*

Carolina fanwort  
Carolina water-shield  
Fish-grass  
Green cabomba  
Purple cabomba  
Silver-green cabomba  
Washington grass  
Washington plant



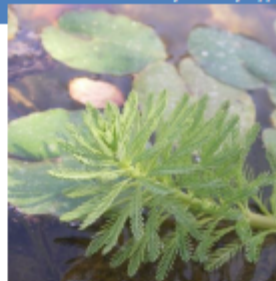
Opposite, fan-like leaves

#### Parrot feather, *Myriophyllum aquaticum*

Photo by Courtney Ripp

*Erythraea aquatica*  
*Myriophyllum brasiliense*  
*Myriophyllum brasiliensis*  
*Myriophyllum brasiliensis* var. *spiralis*  
*Myriophyllum proserpinacoides*

Brazilian water-milfoil  
Red-stemmed parrot's feather  
Thread-of-life  
Water-feather



Whorls 4-6, 6-30 segments on each leaf

#### Brazilian waterweed, *Egeria densa*

Photo by Ann Murray

*Anacharis densa*  
*Elodea densa*  
*Elodea densa* var. *longifolia*  
*Philotria densa*

Anacharis  
Brazilian elodea  
Common waterweed  
Elodea  
South American waterweed  
Wide-leaf anacharis



Whorls of 4-8, Serrate margins

Photos: Vic Ramey and Ann Murray, University of Florida/ Center for Aquatic and Invasive Plants; Courtney Ripp, Wisconsin DNR; Glenn Miller, Oregon Department of Agriculture; Christian Fischer.

## Are Your Snails Okay?

### Invasive Snails

Chinese Mystery Snail or Japanese Trapdoor Snail (Restricted Invasive Species in Wisconsin)  
*Cipangopaludina chinensis*, *Bellamya chinensis* or *Viviparus malleatus*

- Produces live young



**DO NOT SELL**



Photo: Amy Benson - iStock

Banded Mystery Snail  
*Viviparus georgianus*  
(not yet regulated)  
- Wide bands  
- Round shoulder  
- live birth



**CAUTION**

### Non-invasive Snail

Mystery Snail, Spike-topped Apple Snail or Apple Snail  
*Pomacea bridgesii* or *Pomacea densa*  
(not regulated in Wisconsin)

- Lays eggs  
- Narrow bands  
- Square shoulder



DRAFT v. 8.13.12

**OKAY to SELL**



Apple snail image from <http://www.appleaerial.net>

## CRAYFISH AND THE INVASIVE SPECIES RULE

### What is a Crayfish?

Crayfish are decapod crustaceans in the following families:  
*Astacidae*, *Cambaridae* and *Parastacidae*

*Cambaridae*: Includes over 400 species, found mostly east of the Great Divide in North America.  
*Astacidae*: includes twelve species in three genera. These are native to Europe and western North America.  
*Parastacidae*: includes fifteen genera, all of which are native to the Southern hemisphere.

Non-native crayfish can be incredibly invasive in natural ecosystems. Under Wis. Adm. Code s. NR 40.04(2)(c)(12), all non-native crayfish are prohibited species in Wisconsin. There is one exception, the rusty crayfish, which is classified as a restricted species and considered an "established non-native crayfish." Rusty crayfish are restricted under NR 40, and are the only non-native crayfish that may be possessed *live* without a permit or for personal use.

All other live non-native crayfish may not be transported, transferred (bought or sold) or introduced in Wisconsin. Additionally, they may not be possessed unless an invasive species permit is issued by the DNR for research or public display purposes.

### Native Crayfish Species

Wild crayfish can be captured according to the rules as described in NR 19.27, which covers seasons, methods of harvest, and bag limits. If the crayfish is a prohibited non-native species, it must be immediately killed before a person can keep it. A fishing license or small game license is required to collect or harvest crayfish from the wild by any person age 16 or older. A bait dealer license is required to sell crayfish (live or dead) as bait for fishing. It is not legal to possess hook & line fishing gear while in possession of live crayfish on any inland waters, except for the Mississippi River. The following list includes Wisconsin native crayfish which may be possessed, transported, purchased and sold in the state.

*Cambarus diogenes* - Devil Crayfish  
*Fallicambarus fodiens* - Digger or Chimney Crayfish



# Education & Outreach

- 2<sup>nd</sup> round of mailed surveys sent out March 29th
- Follow-up social surveys and stock surveys will enable better assessments of the educational efforts
- Lessons learned will help us reach other business audiences more effectively
  - Provide information *on* their terms and *in* their terms
  - Provide tools for success
  - Utilize enforcement when appropriate



# Biological Pond Surveys



# Landscape Presence

- Surveyed 148 ponds (22 dry)
- Found no prohibited spp.
- Found restricted spp. in 68% of ponds
  - Cattails, EWM, CLP, PL, Phragmites, Glyceria
- Found watch spp. in 70% of ponds
  - RCG, creeping Jenny, yellow iris, water hyacinth, water lettuce



# Landscape Presence

- RCG: 69.6%
- Hybrid cattail: 54.7%
- Purple loosestrife: 12.2%
- EWM: 11.9%
- Phragmites: 4.1%
- Narrow cattail: 3.4%
- *Glyceria maxima*: 1.4%
- Yellow iris: 1.4%
- Water lettuce: 0.8%
- Water hyacinth: 0.8%
- Creeping Jenny: 0.7%



# Landscape Presence

- CLP presence strongly related to golf courses ( $P < 0.0001$ )

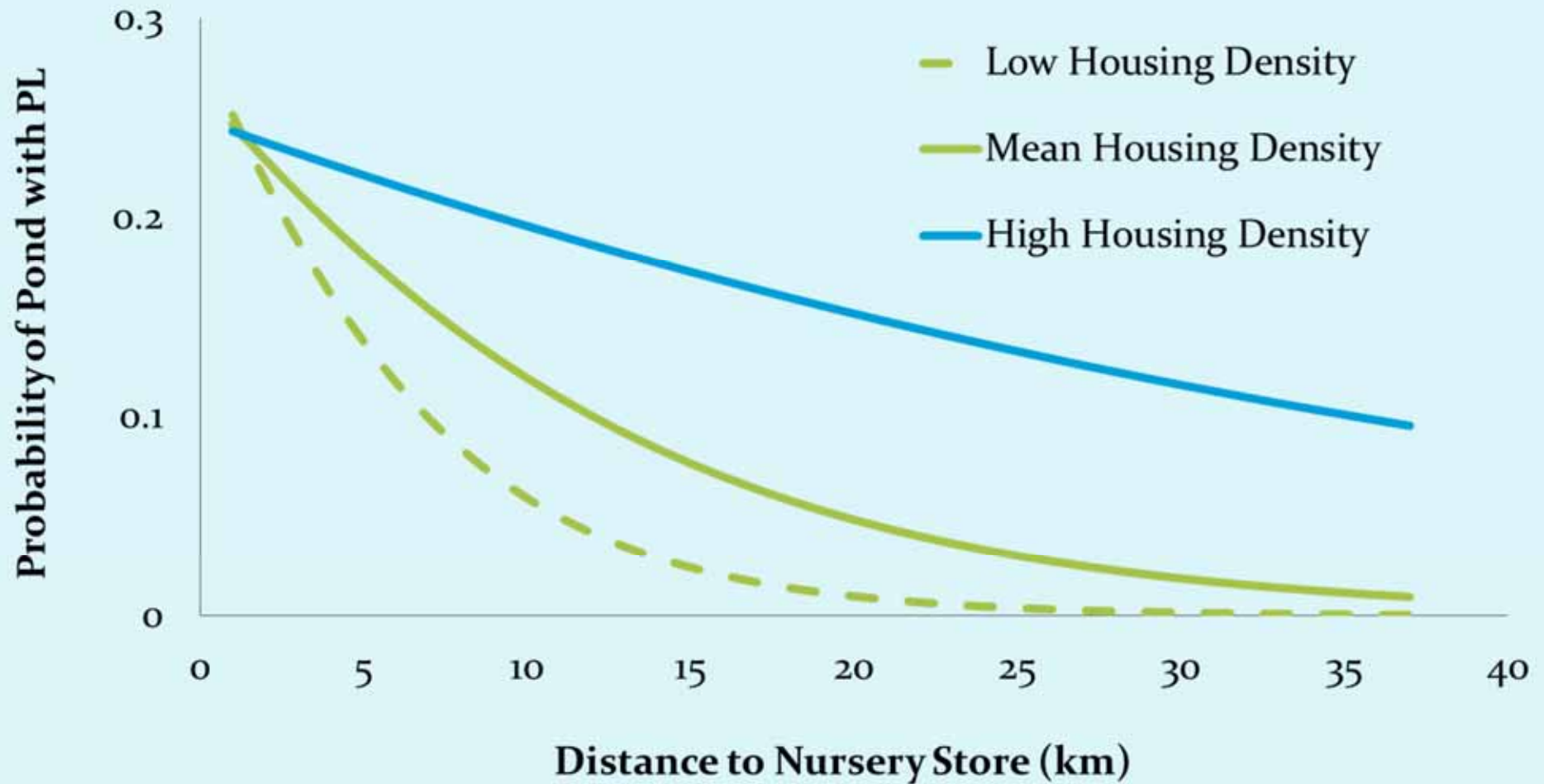


# Is store presence related to landscape presence?

- Maybe, for purple loosestrife
  - LYTSAL~distance to nursery selling aquatics + housing density ( $P=0.003$ )
- No other species shows similar relationship to store



## Predicted Probability of Pond with Purple Loosestrife



# Which ponds are planted?

- 5 planted ponds



Those closest to houses!

P=0.005

Sens: 100%    PV+:10.2%

Spec: 69.2%    PV-: 100%

AUC: 0.815



# Conclusions

- Stores are still selling regulated plants
- Regulations alone not very effective
- Education a key component
  - Continue working with retailers and consumers to understand regulations and be able to identify plants
- Follow-up surveys will enable us to evaluate and improve educational efforts

# Thank You



- Work funded by EPA Great Lakes Restoration Initiative
- Thank you to Elizabeth Haber, Diane Menuz, Martha Barton, Michelle Nault, Erin Vennie-Vollrath, Alison Mikulyuk, Scott VanEgeren , Mindy Wilkinson, Jen Hauxwell



# Questions?

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