Aquatic plant communities and management of aquatic invasive species

Lake and Stream Leaders Institute 2013

Kellogg Biological Station

Hickory Corners, Michigan

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Michigan Department of Environmental Quality

Water Resources Division

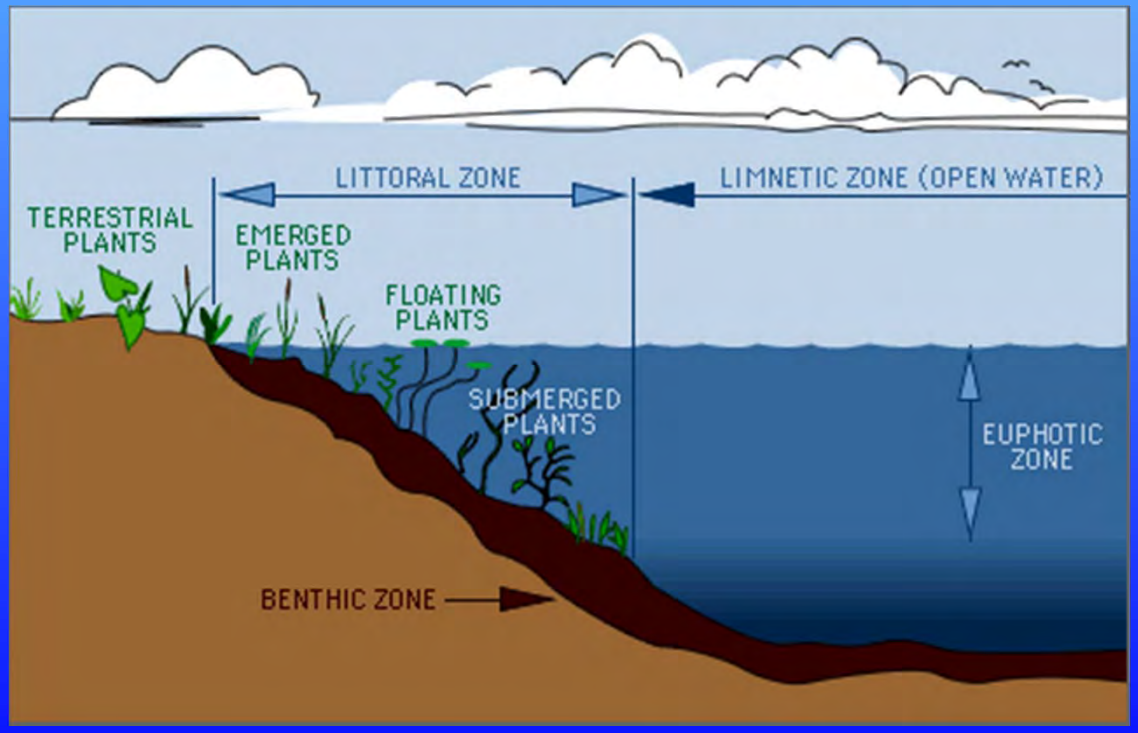
Aquatic Nuisance Control Program

Overview

- Ecological functions of aquatic plant communities
- Assessing aquatic plant communities
- Non-native watermilfoil identification and management
- Responding to hybrid watermilfoil
- Non-native macroalgae: starry stonewort
- Aquatic Invasive Species Program in Michigan

Littoral zone

- Emergent plants
- Floating-leaved plants
- Submersed plants
- Algae (planktonic, filamentous, macroalgae)



- Ecosystem functions of aquatic plants
  - Food and habitat to fish, wildlife and aquatic organisms
  - Stabilize sediments
  - Improve water clarity
  - Moderate wave energy
- Human services
  - Fishing, recreation, wildlife

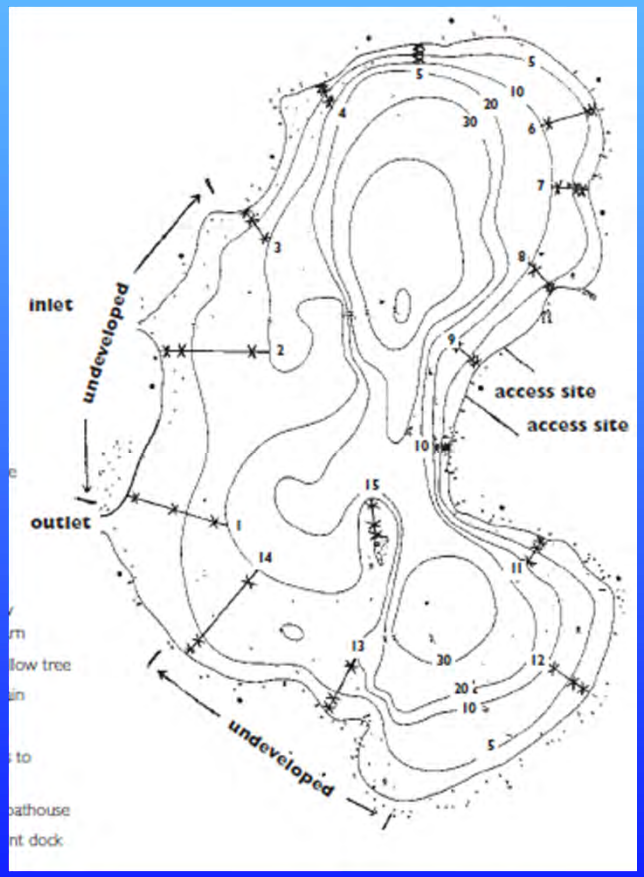
Introduction and spread of non-native species can compromise these functions

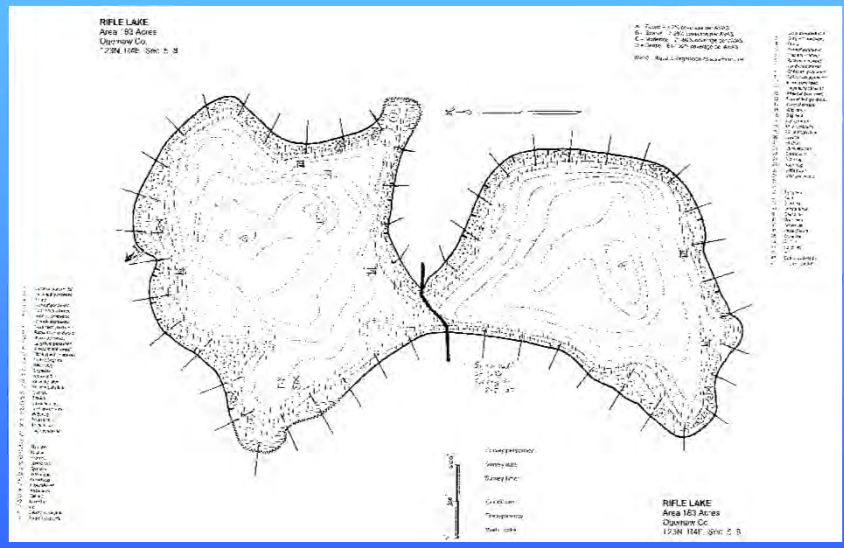
It is critical to assess the status of aquatic plant communities through vegetation surveys prior to making management decisions

MiCorps

www.micorps.net/CLMPdocuments.html

Sample at 1, 4, 8 feet depth at multiple transects

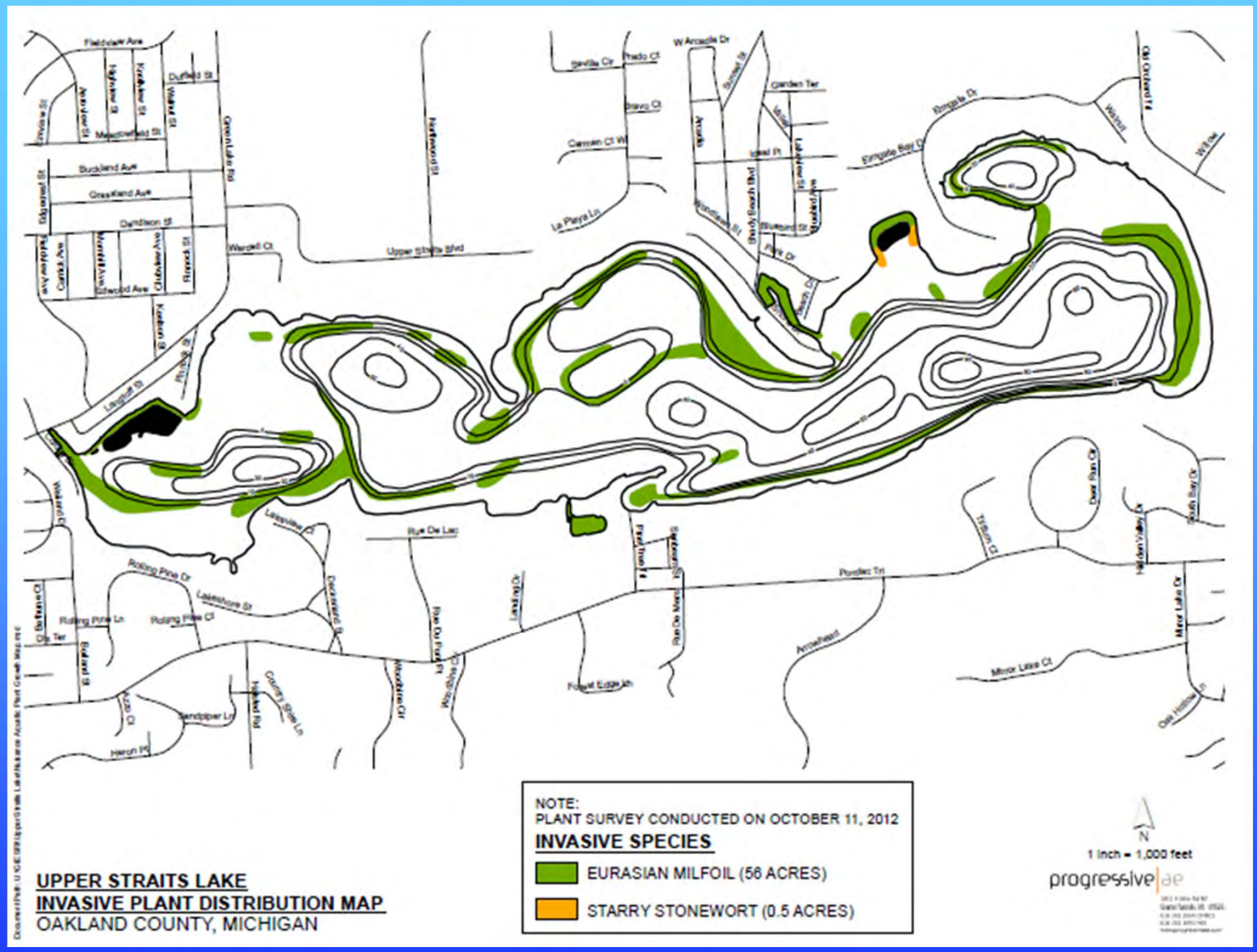




DEQ – ANC Program

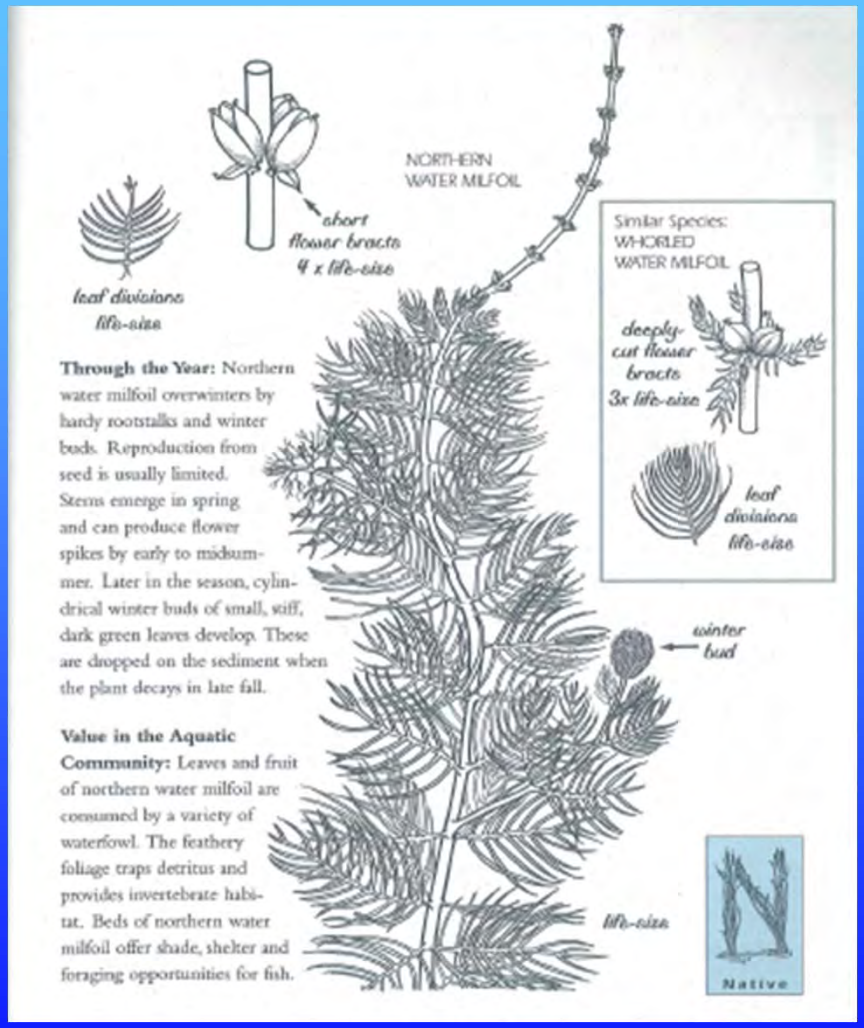
www.michigan.gov/anc

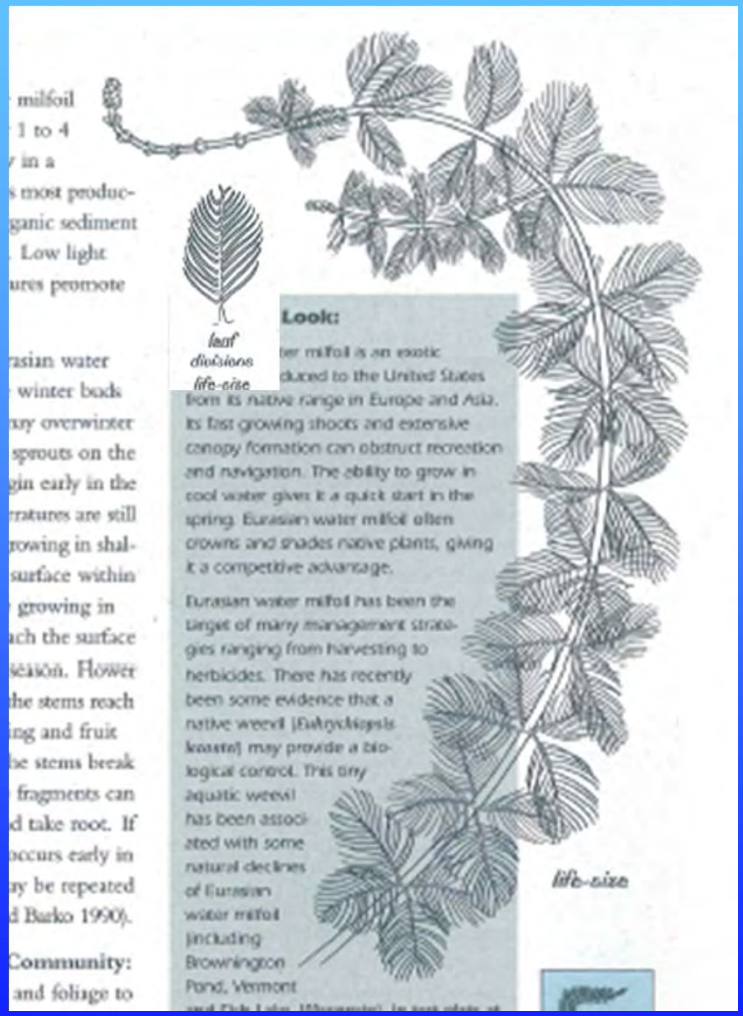
AVAS survey procedure



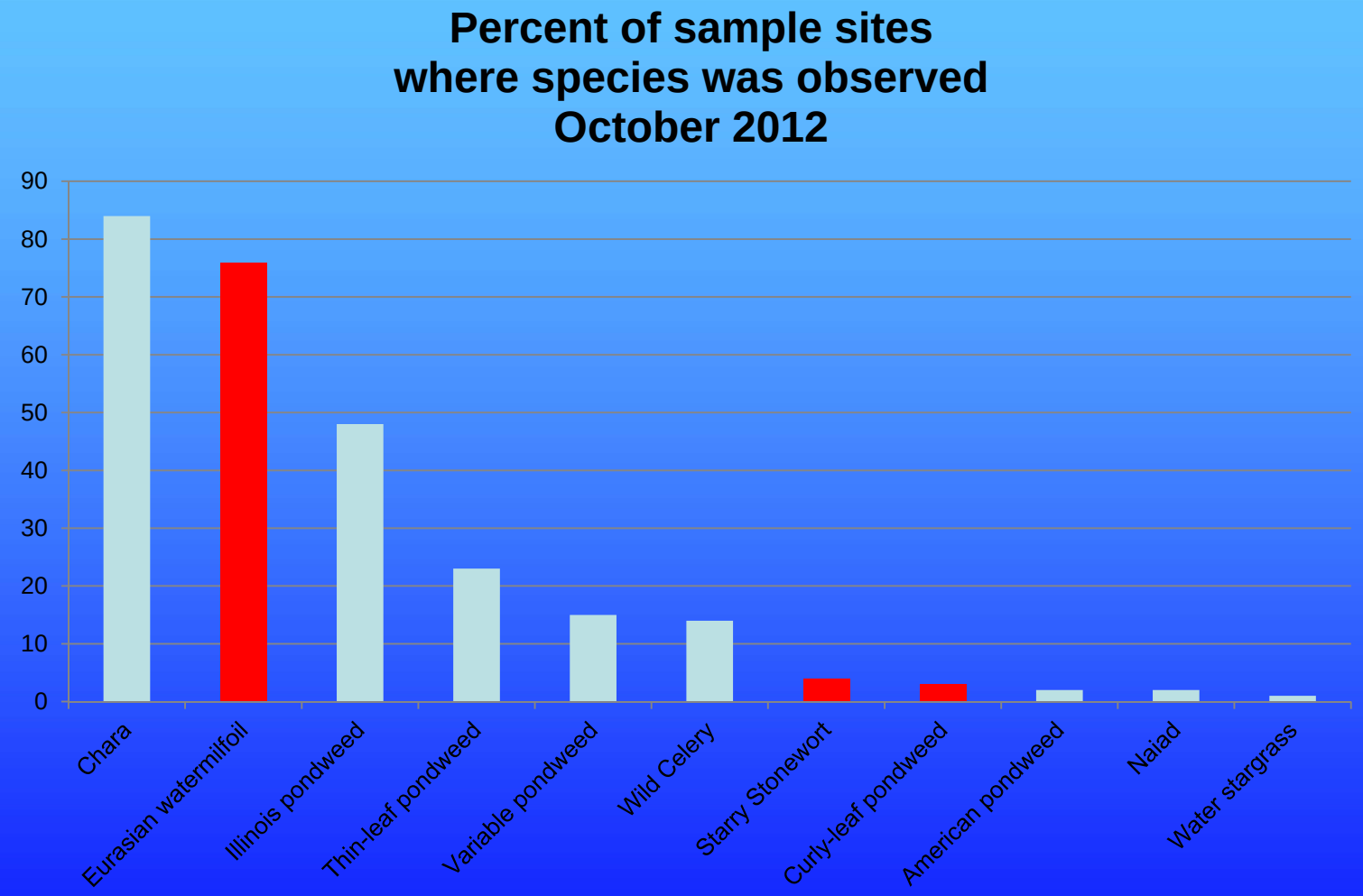
2012 non-native watermilfoil and starry stonewort map provided courtesy of Paul Hausler, Progressive AE

Distinguishing native and non-native watermilfoil

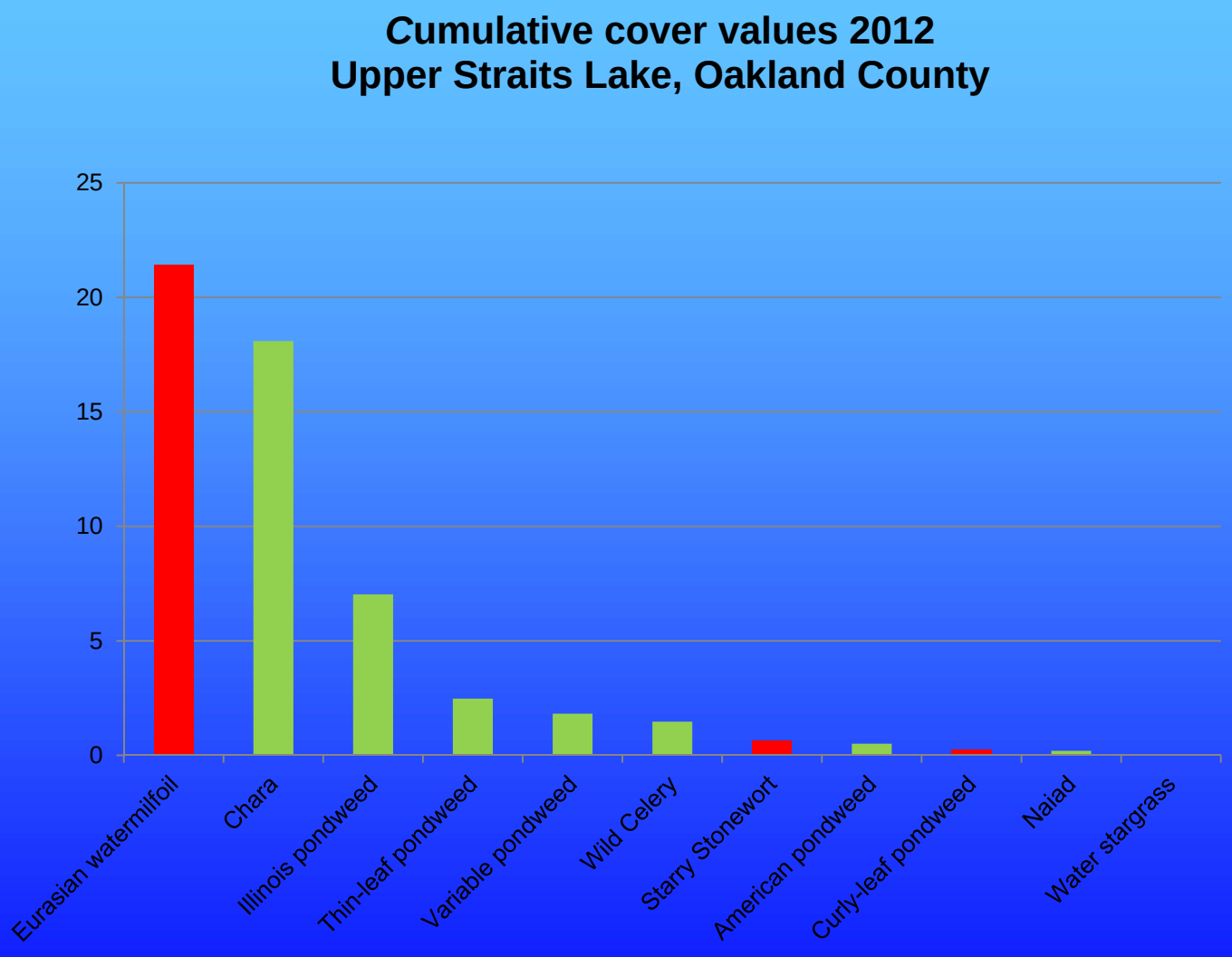




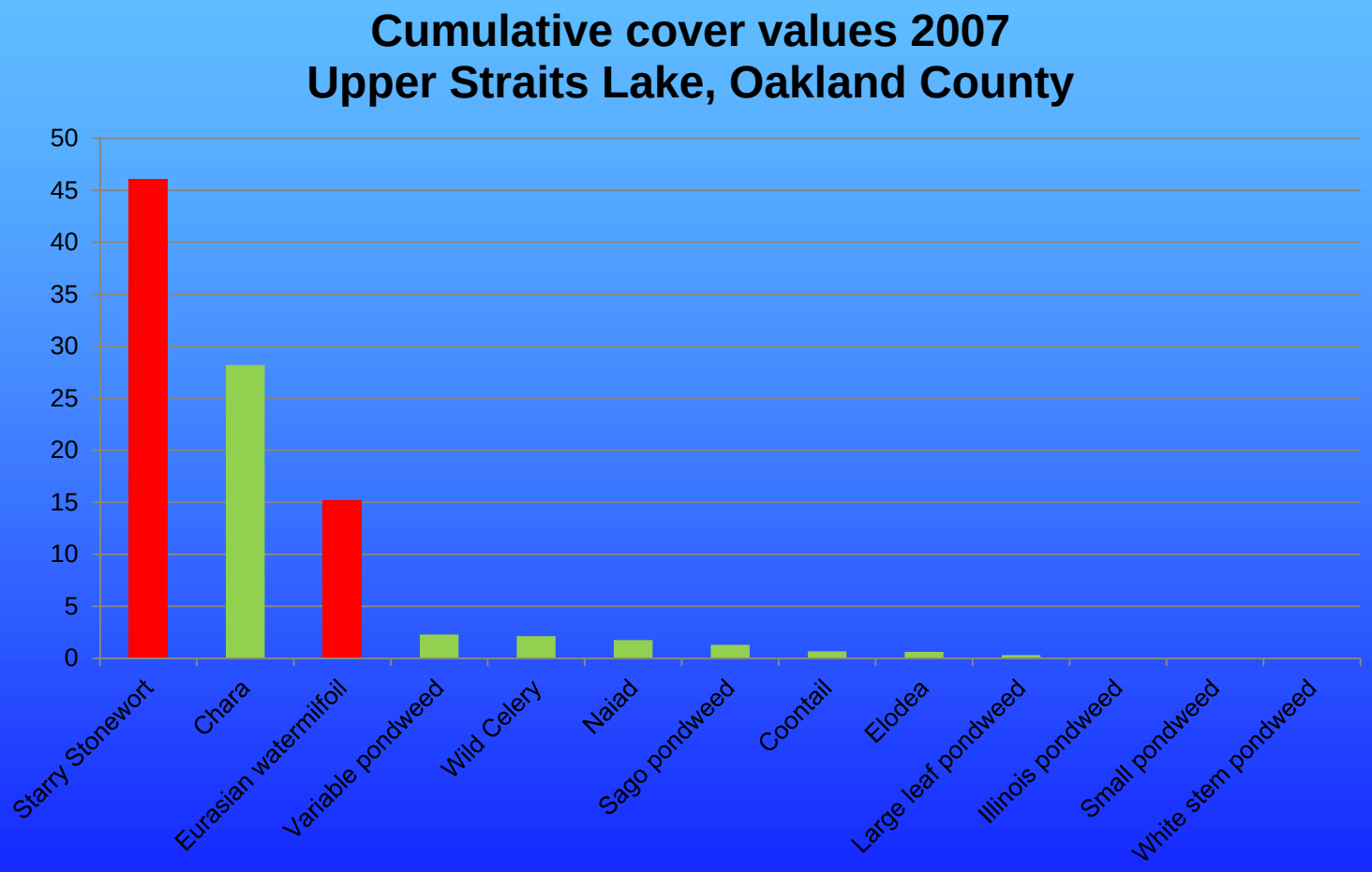
Non-native watermilfoil was widely distributed in Upper Straits Lake in the October 2012 vegetation survey



Non-native watermilfoil dominated the plant community in terms of both distribution and abundance



2007 survey indicated that starry stonewort dominated the plant community at Upper Straits Lake



Management options for non-native watermilfoil

- Biological
  - milfoil weevils
- Physical
  - suction harvesting, machine harvesting, hand pulling
- Chemical
  - Contact herbicides
  - Systemic herbicides
    - 2,4-D, triclopyr, fluridone

Assess pros and cons of all management options

Aquatic herbicide safety

- EPA registration process under the Federal Insecticide, Fungicide, and Rodenticide Act 1947
  - Toxicity to humans, chemistry, fate, ecological toxicity
  - Registration review
- It is a violation of federal law for any person to use any registered pesticide in a manner inconsistent with label directions.
- DEQ Water Toxics Unit reviews all aquatic algaecides and herbicides prior to approval on ANC permits

Defining aquatic plant control

- Aquatic Plant Management Society
  - “techniques used alone or in combination that result in a timely, consistent and substantial reduction of a target plant population to levels that alleviate an existing or potential impairment to the uses or functions of the waterbody”
- Resource managers and stakeholders must establish expectations

Levels of aquatic plant control

- No attempt to control
- Control efforts to eradicate a plant species
  - Sustained, multi-year, can be small scale, may be expensive per acre, sustained monitoring is key
- Intermediate control that is incomplete or temporary

Emerging issues

Overview of hybrid watermilfoil

- Hybrids happen
- Identification not possible in field
- Hybrids are widespread in Michigan
- Hybrids vary in their response to herbicides
- Aquatic plant management responses
- Tolerance and resistance management

Hybrids happen

Eurasian watermilfoil x Northern watermilfoil

Myriophyllum spicatum x *Myriophyllum sibiricum*

↓

Hybrid watermilfoil

- EWM colonizes a lake with native watermilfoil, hybrid event occurs
- Hybrid watermilfoil colonizes a lake
- Data suggest multiple hybridization events in Michigan
- Changes over time within a lake can be rapid

Identification not possible in field

Characters in the field are not reliable

Genetic identification is the only reliable method of identification of watermilfoil

Samples of non-native watermilfoil from Upper Straits Lake, Oakland County

4

5

Genetic analysis in August 2012 indicates that Upper Straits Lake has both Eurasian and hybrid watermilfoil

Lake Name: Upper Straits Lake
Date Received: 8/6/12
# of Samples Sent: 9
# of Samples Processed: 7
Genetic IDs:
E. of Kaueman Res.- 1 Eurasian watermilfoil (Myriophyllum spicatum);
Front of Laimbeer Res.- 2 Eurasian watermilfoil (Myriophyllum spicatum);
Front of Nature Sanc.- 1 Hybrid (Myriophyllum spicatum x Myriophyllum sibiricum);
Point of Elmgate Bay- 1 Eurasian watermilfoil (Myriophyllum spicatum);
Front of Boerger Res.- 1 Hybrid (Myriophyllum spicatum x Myriophyllum sibiricum);
Whispering Pines Beach Front- 1 Hybrid (Myriophyllum spicatum x Myriophyllum sibiricum)
Two of your samples didn't work because of poor DNA quality: 1 from Between Laimbeer Res and Nature Sanc. and the other from Point of R.C. Bankers Penin.

Hybrid watermilfoils are widespread in Michigan

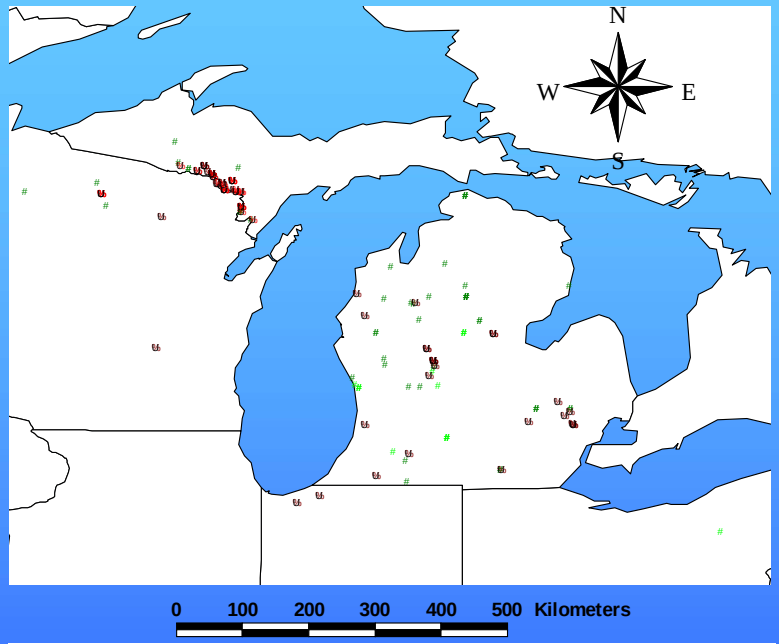


Figure 5. Geographic distribution of EWM (circles) and hybrid watermilfoils (squared) in the Great Lakes basin. The two different shades of green and red correspond to the two different genetic groups of EWM and hybrids, respectively, identified in this study (see "Comparison of ITS and AFLPs" for more details). In addition to samples from this project (Lower Peninsula of Michigan), the map includes lakes sampled around the Great Lakes basin in order to illustrate the genetic diversity present at the basin-scale.

- Among the lakes from which watermilfoil has been sampled and analyzed genetically, 25-50 percent have a hybrid watermilfoil biotype
- Lower and Upper Peninsula of Michigan

Hybrid watermilfoils vary in their response to herbicides

- Variation in response to different herbicides among hybrids
  - 2,4-D, fluridone, triclopyr, contacts
- In comparison to EWM and among hybrids
- Some hybrids respond typically
- Some hybrids respond atypically
- Currently lack predictive capability
- Changes in response can occur quickly

Aquatic plant management responses to herbicide tolerance

- Increase rate of 2,4-D from the standard 100 lb/acre
  - Application rate on the new product label for Navigate is water volume based, which will help at depth
- Modifications of the 6-bump-6 ppb fluridone
- Use different active ingredient (triclopyr)
- Use contact herbicides
  - Challenges permitting requirements that limit offshore treatment with contact herbicides

Tolerance and resistance management - a new level of lake monitoring for watermilfoil management?

- ✓ Get genetic identification
  - ✓ submit samples to GVSU
- ✓ Get susceptibility analysis
  - ✓ expensive, proprietary, and not well developed
- ✓ Monitor field response late season after treatment and early season in year after treatment
- ✓ Consider monitoring 2,4-D treatments for changes in efficacy
- ✓ Monitor 2,4-D residues to check for target concentration

www.gvsu.edu/wri/thum/milfoil-genetic-identification-services-15.htm

Two documents

1. Chain of custody record
2. Collection and shipping protocol

Why invest in genetic analysis of watermilfoil?

	Hybrid identification is unknown	Hybrid identification is known
Herbicide treatment response is typical	No problem	No problem
Herbicide treatment response is atypical	Potential accountability problem	Prepared for next diagnostic steps as technology develops

Acknowledgements

- Dr. Ryan Thum, Grand Valley State University
- Dr. Michael Netherland, US Army ERDC
- Dr. Mark Heilman, SePRO
- Dr. Doug Pullman, Aquest
- Paul Hausler and Pam Tyning, Progressive AE
- Aquatic Nuisance Control Program staff
  - Tom Alwin, Eric Bacon, Amanda Whitscell, Brett Wiseley

Starry stonewort can be a problem in Michigan

- Can reach monoculture, nuisance level
- Can impede recreation
- May have significant ecological impacts
- Permitting treatment and managing the species in a vacuum of information about the ecology and impact of the species
- http://www.youtube.com/watch?v=HTq5M7s1OZQ&feature=youtu.be

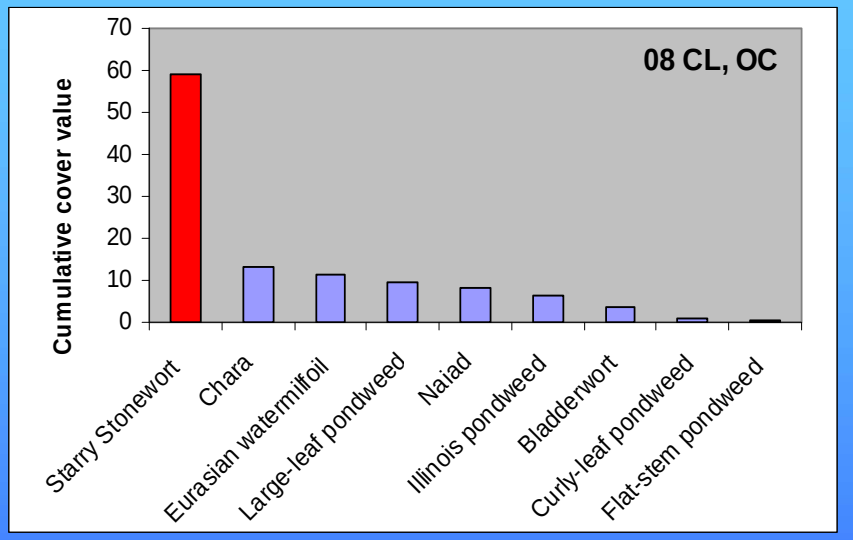


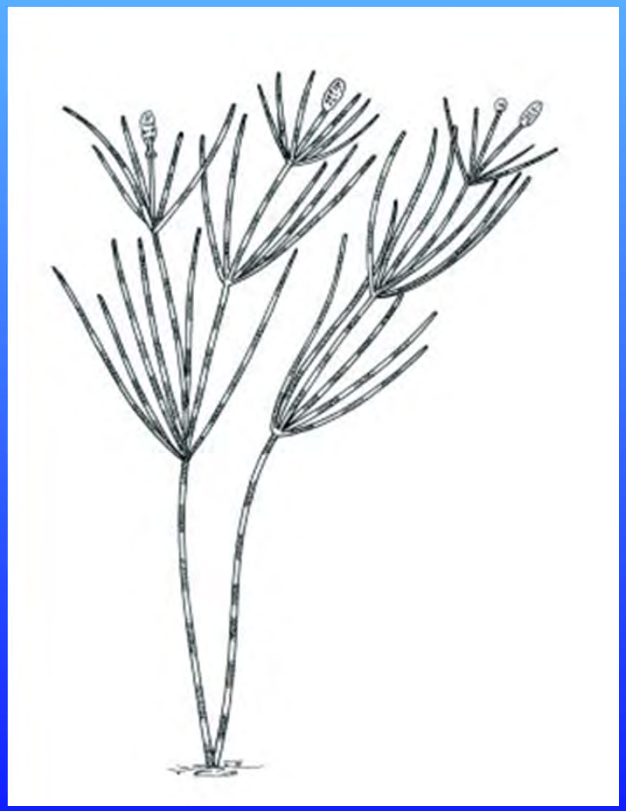
Photo by Doug Pullman

Photo by Progressive AE

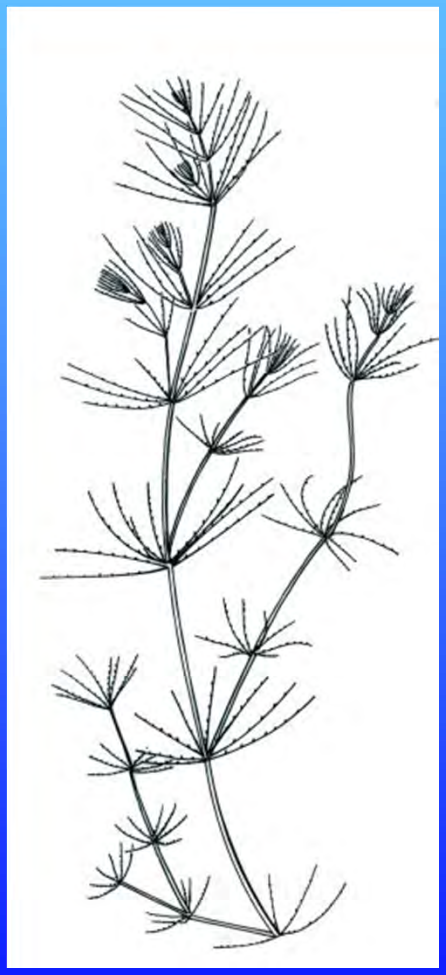
- Eurasian green charoid macroalgae
- Appears lighter, brighter green than Chara
- Irregular branching pattern makes it look disheveled

- Longer internodal cells than Chara
- Main stem to 80 cm (or more)

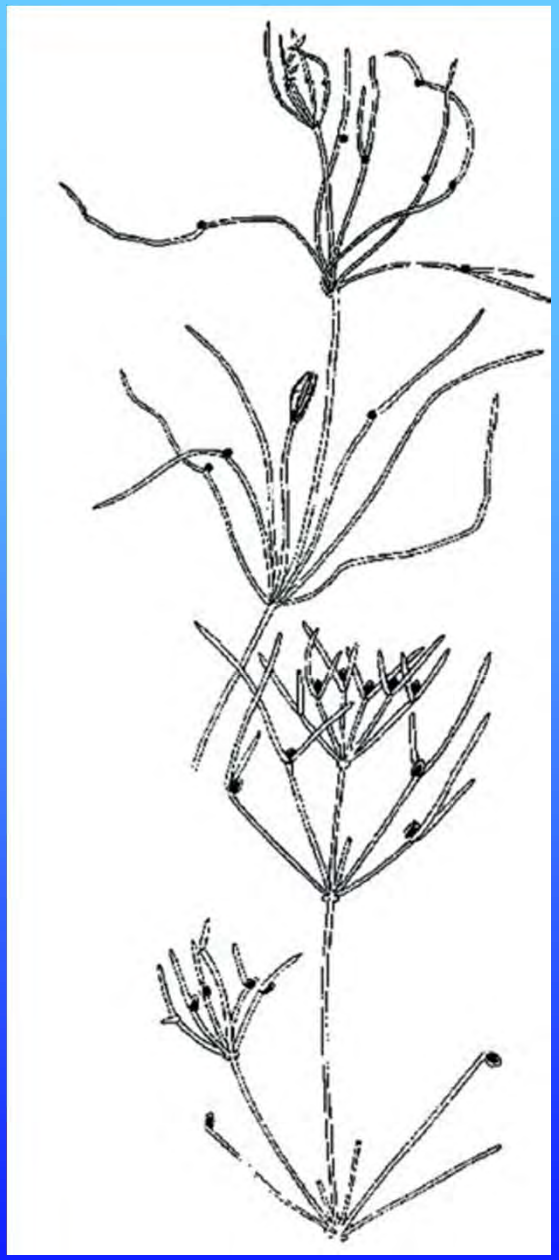
Nitella spp.



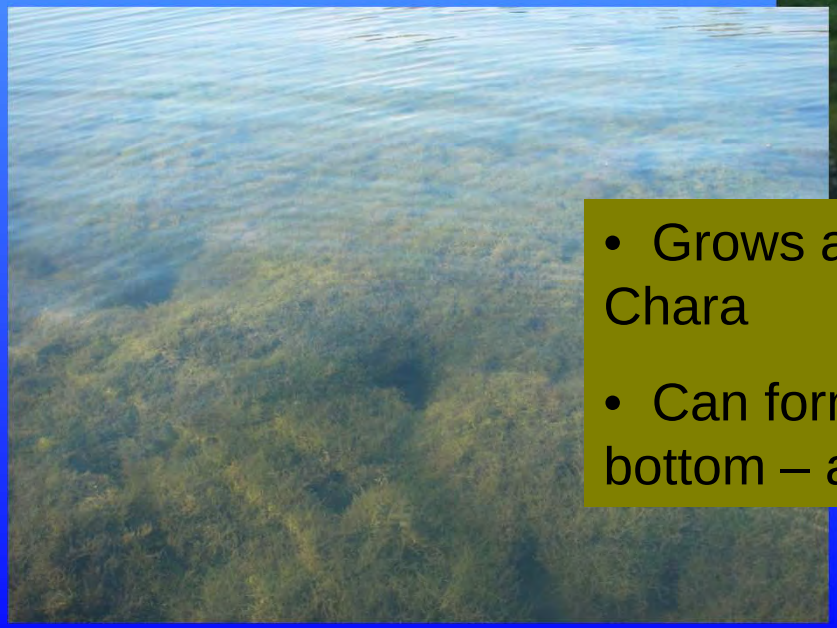
Chara spp.



Nitellopsis obtusa

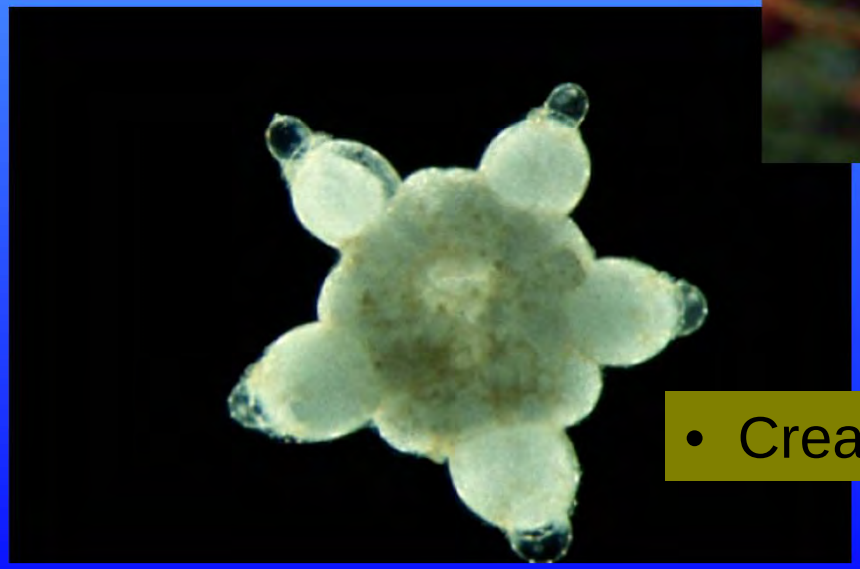


Photos by Doug Pullman



- Grows at greater depth and to greater height than Chara
- Can form dense mats that completely cover lake bottom – a benthic barrier

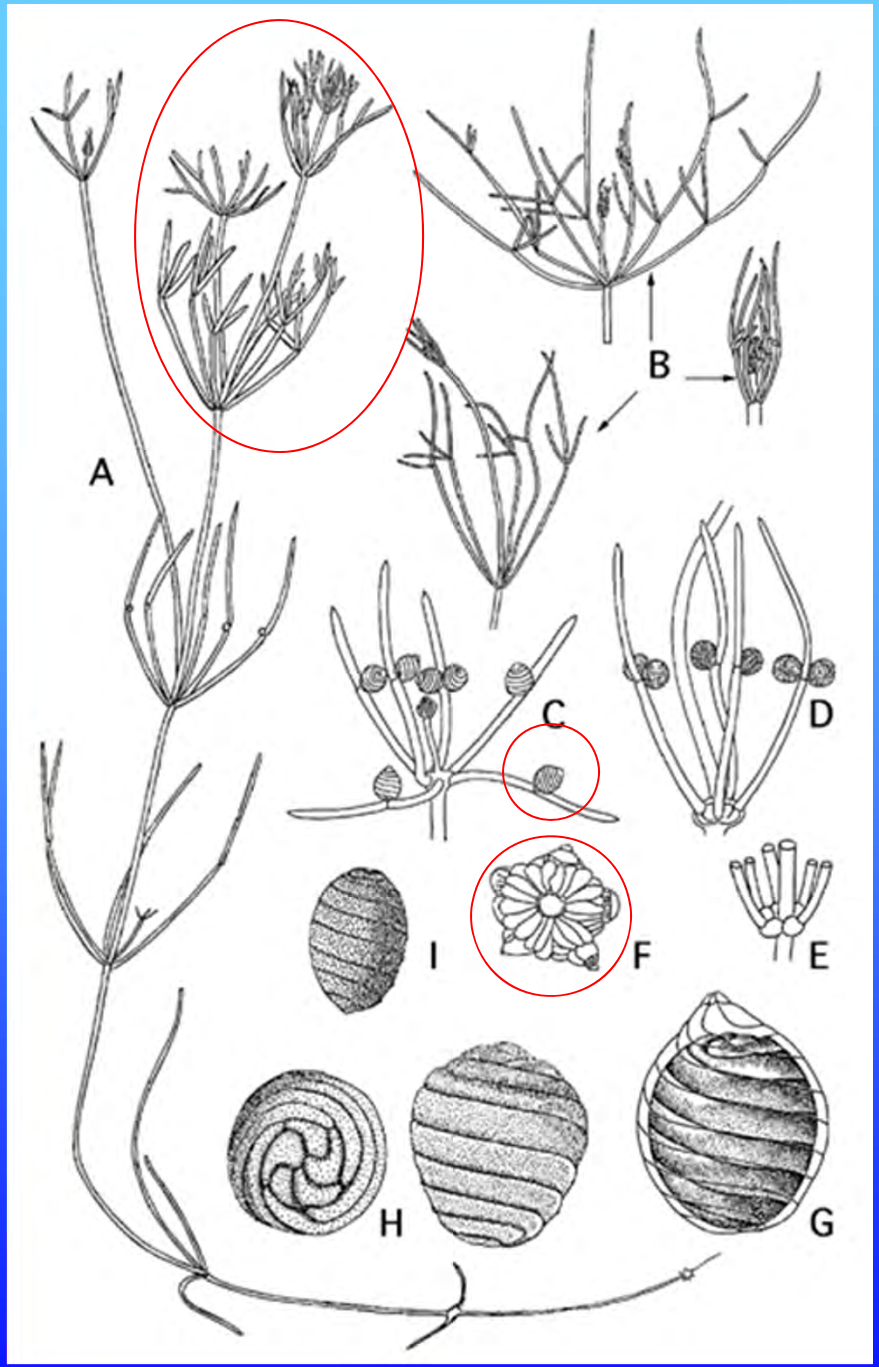
Photo by Doug Pullman



- Creamy white bulbils at base of main axis

- Dioecious
- Dark red gametangia on branches at nodes

Photo by Doug Pullman



We don’t know how starry stonewort is spread within and between inland lakes.

Reproduction and candidates for dispersal

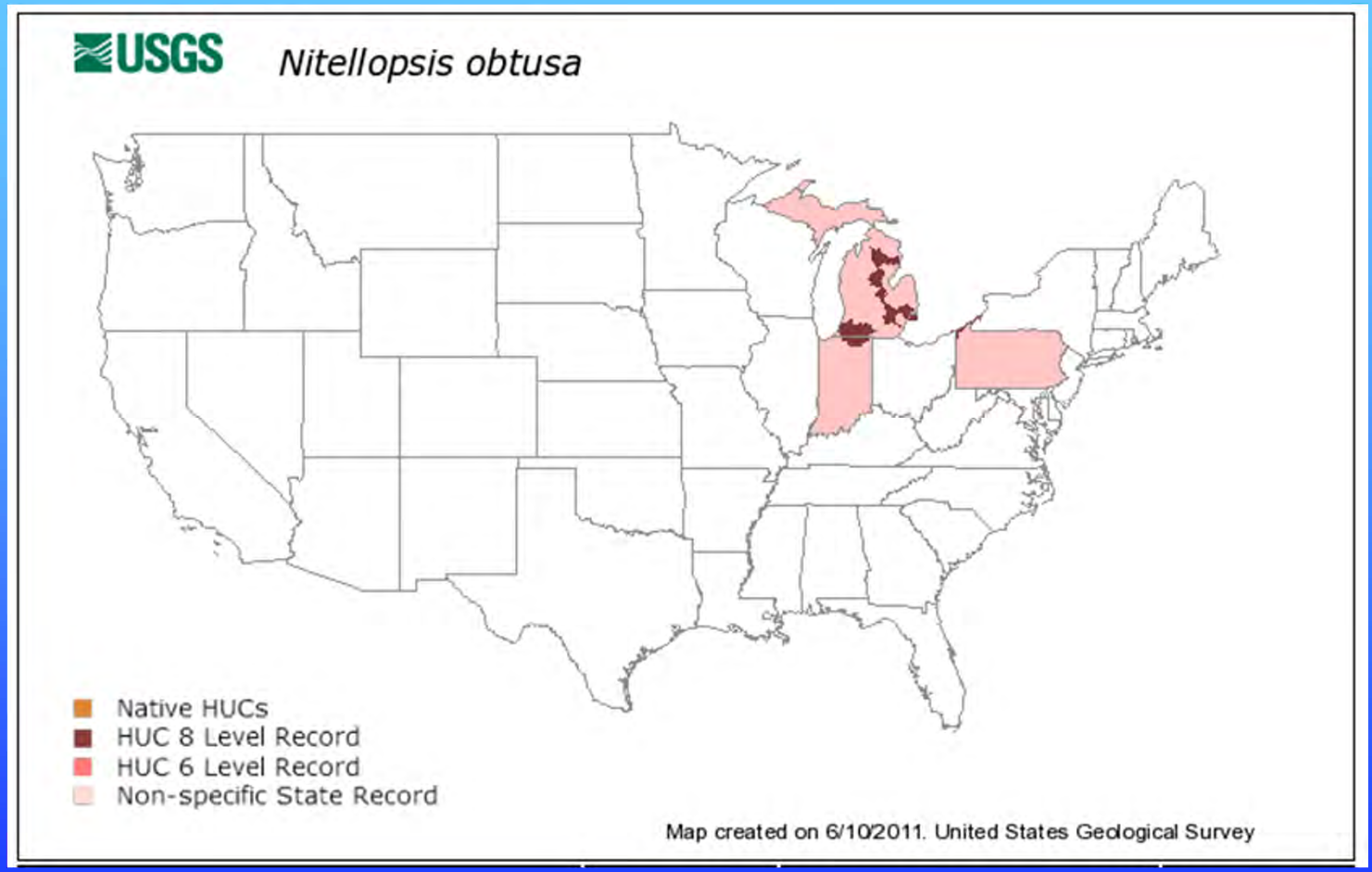
- Oospores
- Starry bulbils
- Fragments

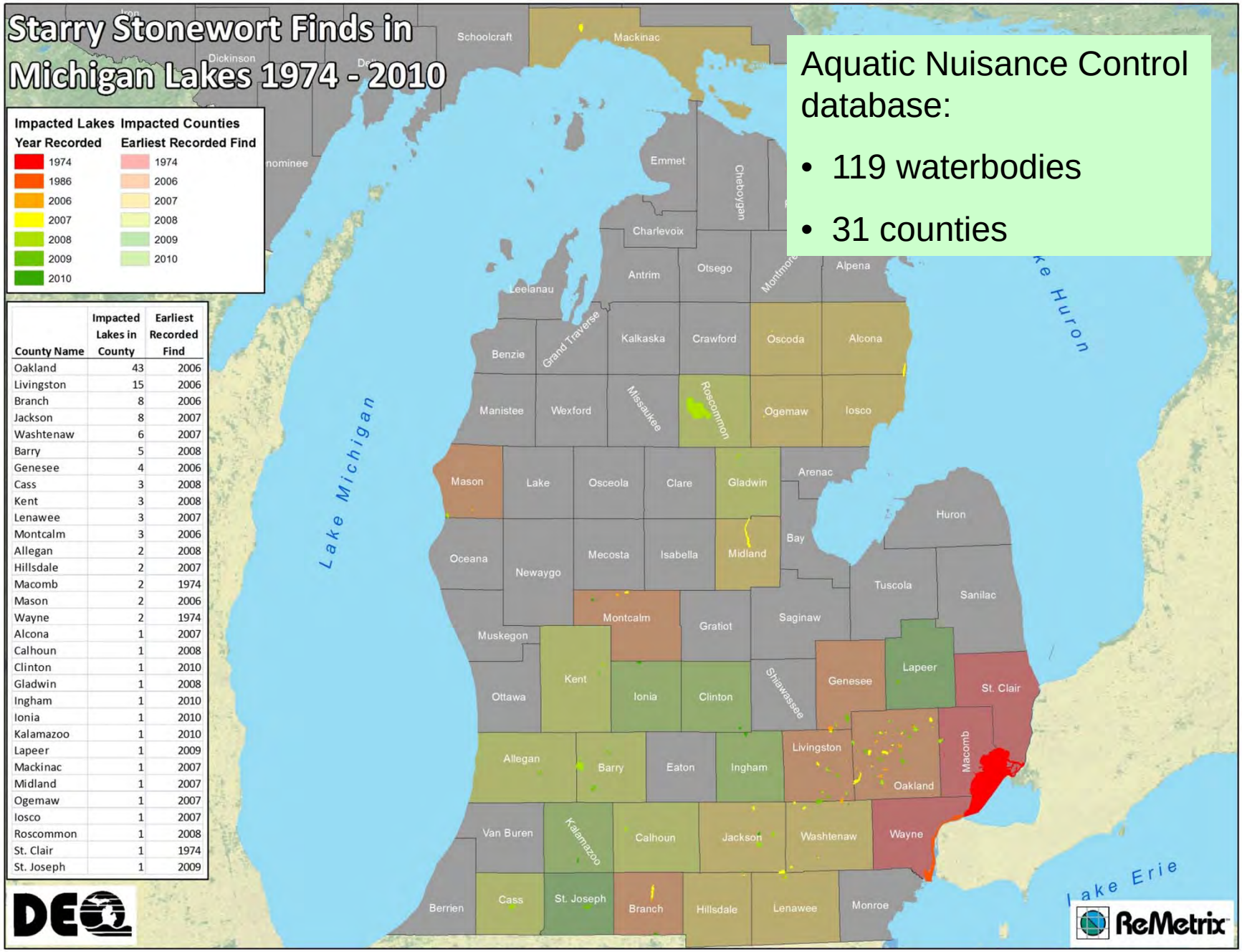
Status in native range: not a nuisance

- Thought to be extirpated but rediscovered in Germany and Japan
- Rare in Bremen, Germany
- Vulnerable in Sweden

Introduction history

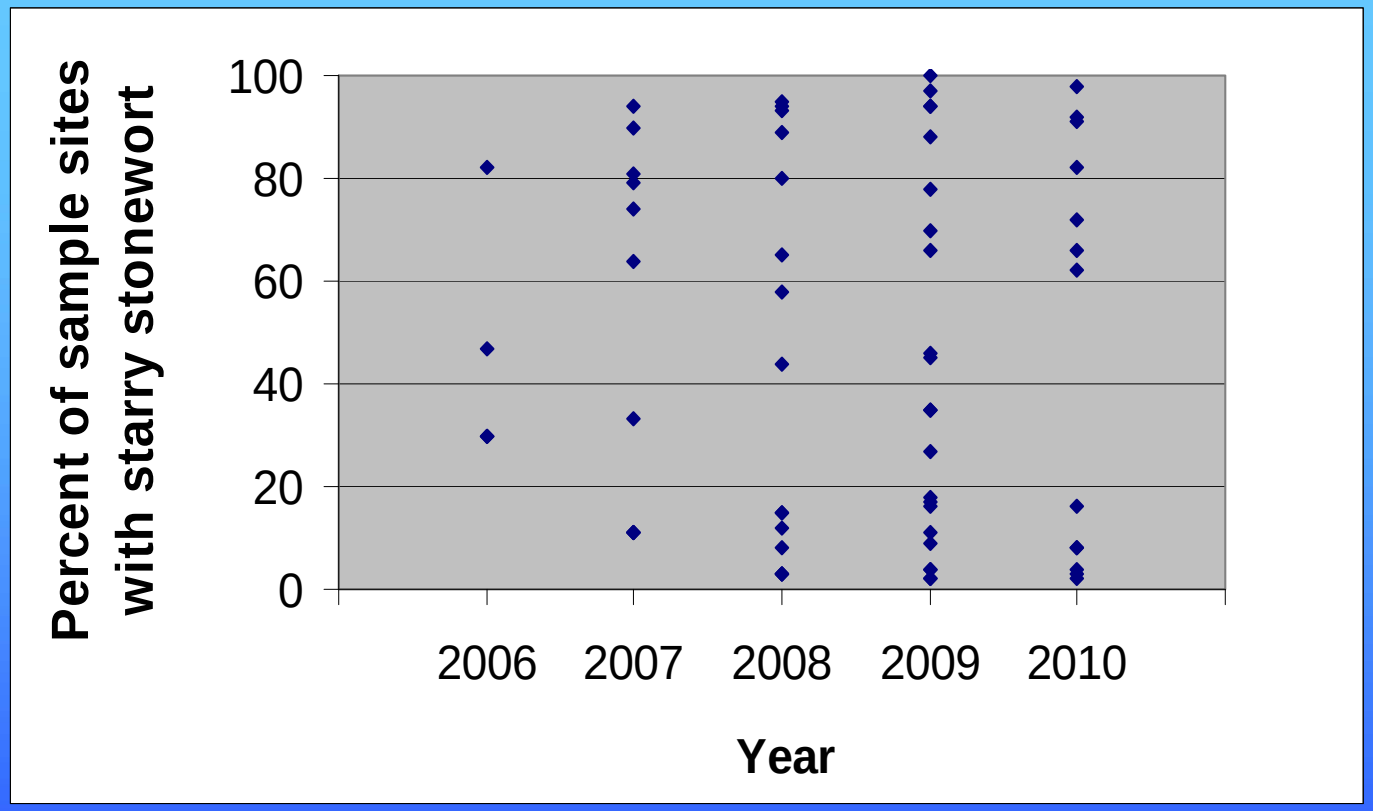
- Native to Eurasia from west coast of Europe to Japan
- Ballast water introduction
- Found in the St. Lawrence River in 1978
- St. Clair – Detroit River system in 1983
  - 9th most common plant at the time
- Lake Ontario embayments and Oneida Lake
- Inland lakes in Michigan confirmed by Dr. Doug Pullman of Aquest in 2006


USGS
Nitellopsis obtusa
Native HUCs
HUC 8 Level Record
HUC 6 Level Record
Non-specific State Record
Map created on 6/10/2011. United States Geological Survey



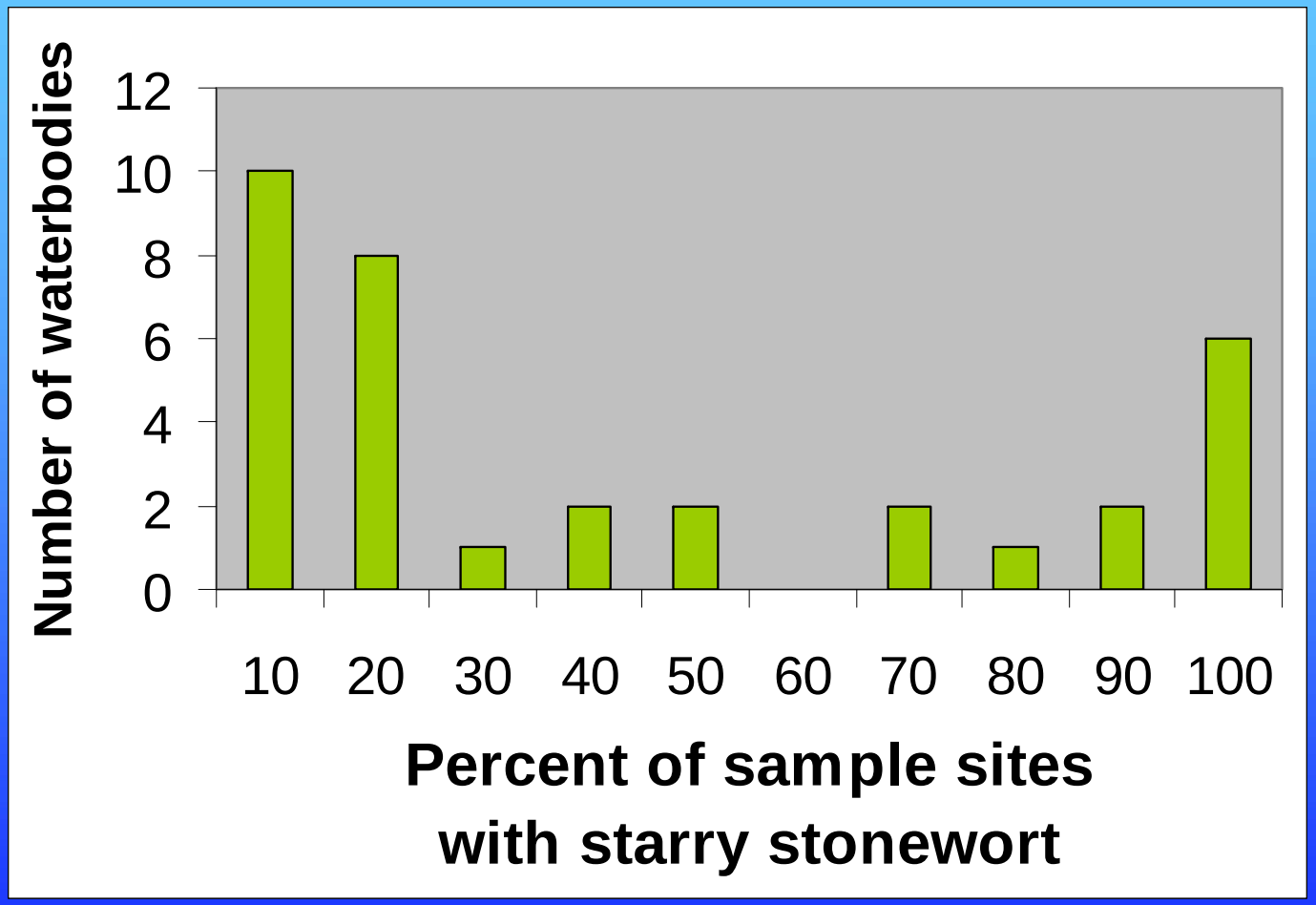
County Name	Impacted Lakes in County	Earliest Recorded Find
Oakland	43	2006
Livingston	15	2006
Branch	8	2006
Jackson	8	2007
Washtenaw	6	2007
Barry	5	2008
Genesee	4	2006
Cass	3	2008
Kent	3	2008
Lenawee	3	2007
Montcalm	3	2006
Allegan	2	2008
Hillsdale	2	2007
Macomb	2	1974
Mason	2	2006
Wayne	2	1974
Alcona	1	2007
Calhoun	1	2008
Clinton	1	2010
Gladwin	1	2008
Ingham	1	2010
Ionia	1	2010
Kalamazoo	1	2010
Lapeer	1	2009
Mackinac	1	2007
Midland	1	2007
Ogemaw	1	2007
Iosco	1	2007
Roscommon	1	2008
St. Clair	1	1974
St. Joseph	1	2009

Improving detection of starry stonewort



- Increasing detection at low distribution
- Age of infestation is usually unknown
- Can not be certain whether we are detecting spread or just detecting presence

What is the frequency of different levels of infestation?



We don't know if this distribution of levels of infestation extends to the larger inventory of waterbodies with starry stonewort.

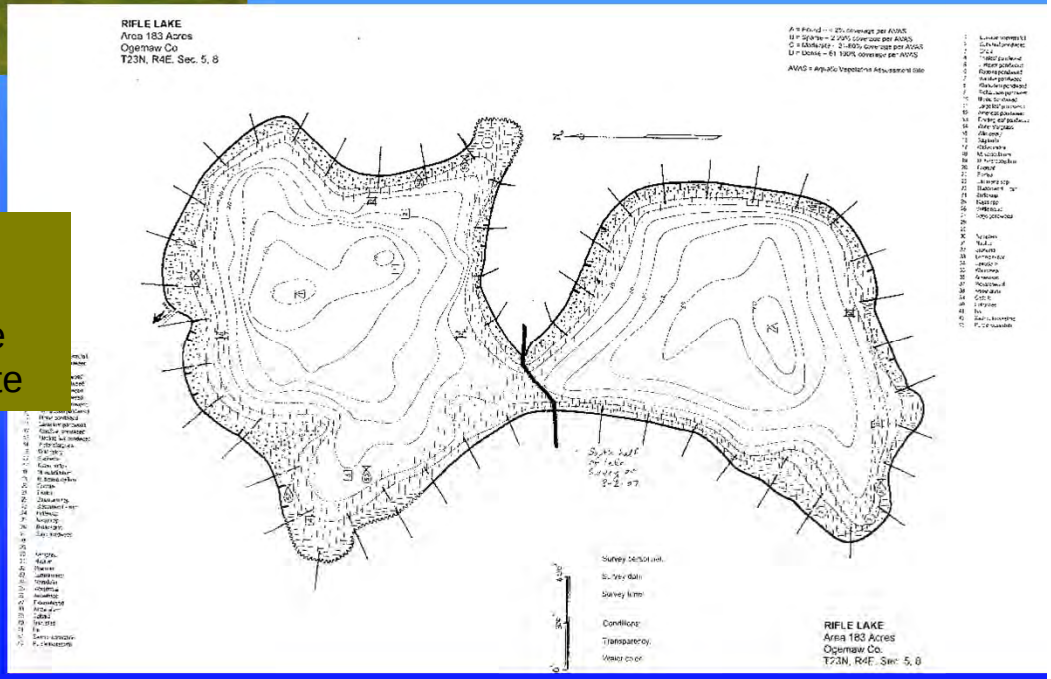
Ecology and impacts of starry stonewort are unknown for inland lakes in North America

- Basic ecology
  - Temperature, light, nutrient, substrate requirements
  - Phenology and annual variation
  - Spread within and between lakes
  - Association with zebra mussels
  - Allelopathic effects
- Ecological impacts
  - Native plant community
  - Sediment water interface
  - Water quality
  - Primary production and algal community
  - Secondary production and zooplankton community
  - Fish and other aquatic organisms

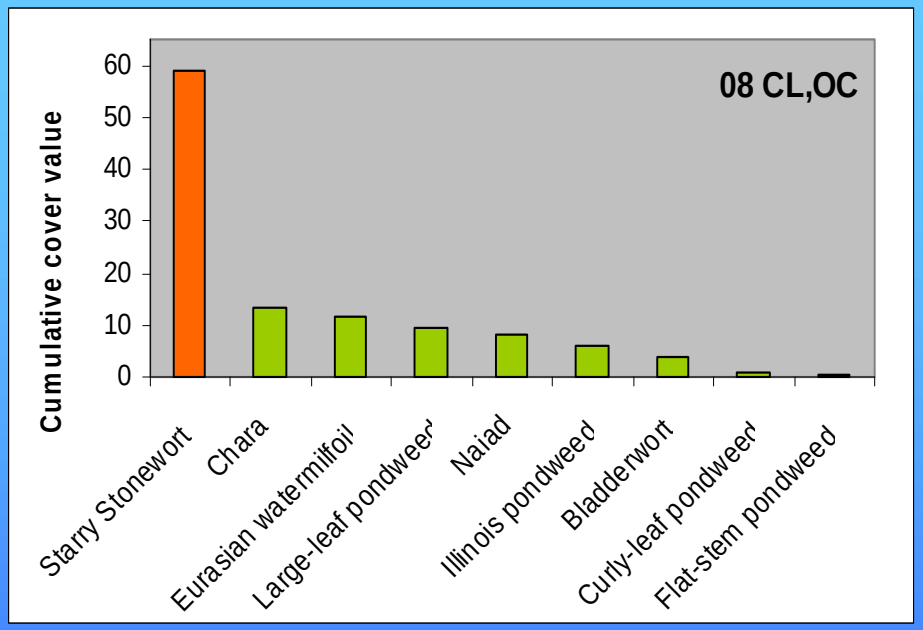
Photo by Doug Pullman

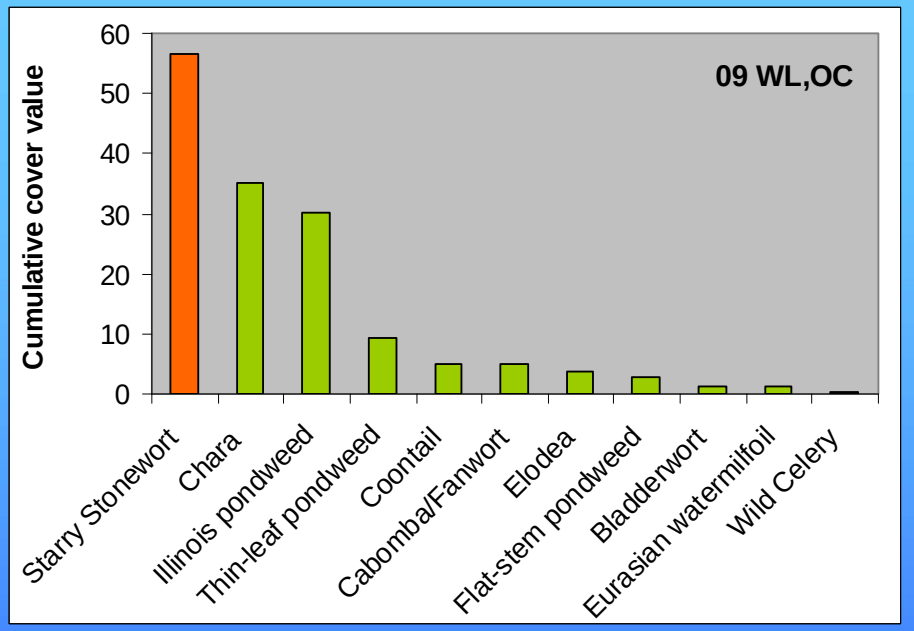
Native species abundance response

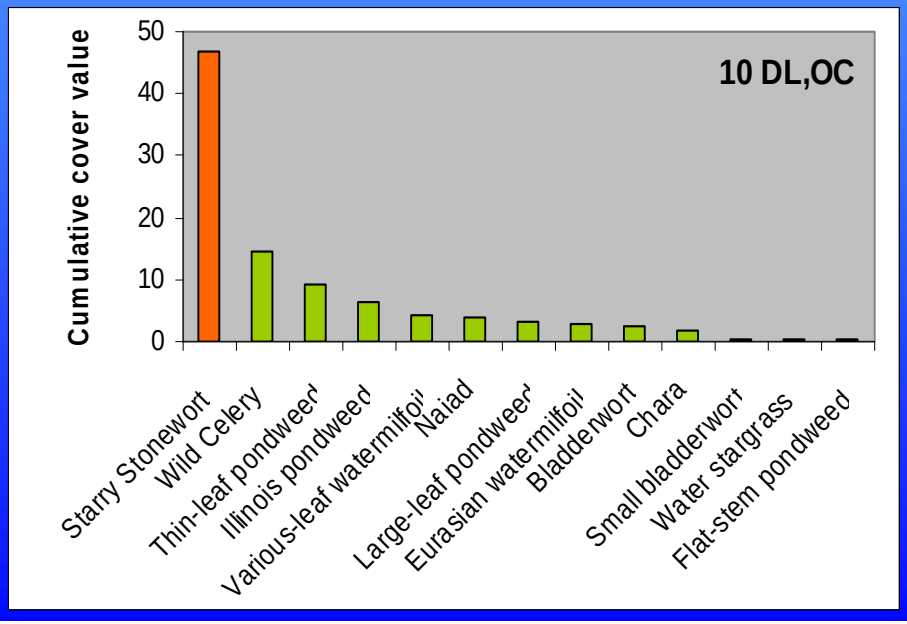
A = Found < 2 % coverage per sample site
B = Sparse 2-20 % coverage per sample site
C = Moderate 21-60 % coverage per sample site
D = Dense 61-100% coverage per sample site

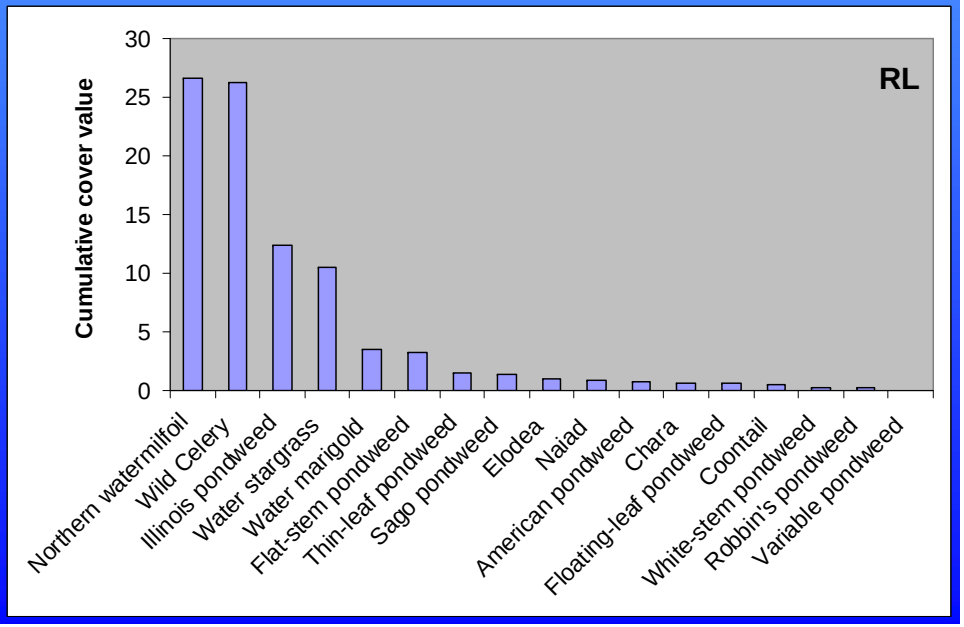


Starry stonewort can dominate the plant community in terms of distribution and abundance.

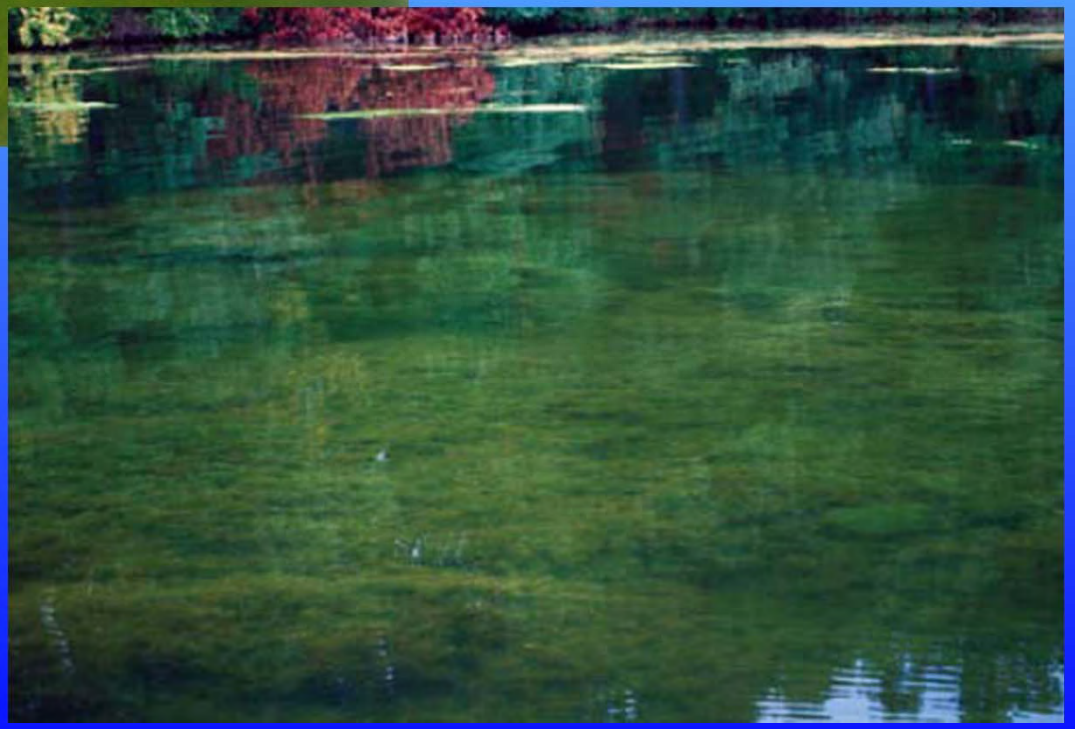








Photos by Doug Pullman



In the absence of scientific information, managers are relying on anecdotal or local observations of impacts to fisheries and recreation and making a decision about treatment.

Heavy management without information about the basic ecology and ecological impact of starry stonewort

Photo by Progressive AE

BMP?

Mechanical harvesting

- Efficacious?
- Significant physical disturbance
- Non-selective removal
- Impacts to aquatic organisms

Chemical treatment

- Efficacy ?
- High rates of copper
- Additional Hydrothol
- Treatment beyond standard permitted areas
- Expense

With vegetation survey results

- Communicate problem to stakeholders, agencies, and permitting program
- Assess treatment options based on density and distribution of starry stonewort
- Evaluate treatment efficacy
- Be prepared in anticipation of improved treatment technologies

It pays to invest in learning to do vegetation surveys or raise the budget to hire a consultant.

Acknowledgements

Aquatic pesticide applicators
- Dick Pinagel and Steve Zulinski
- Jason Broekstra, Jaimee Conroy, Andy Tomaszewski, BreAnne Grabill, and Steve Hansen
- Jeff Knox

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- Doug Pullman
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- Pam Tyning

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- Richard Dirks and Doug Henderson, Remetrix

Aquatic Nuisance Control Program Staff
- Eric Bacon
- Laura Esman
- Matt Preisser
- Jessica Koerner
- Brett Wiseley
- Tom Alwin
- Amanda Whitscell

DEQ – Aquatic Nuisance Control Program
Contact information

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State of Michigan AIS team

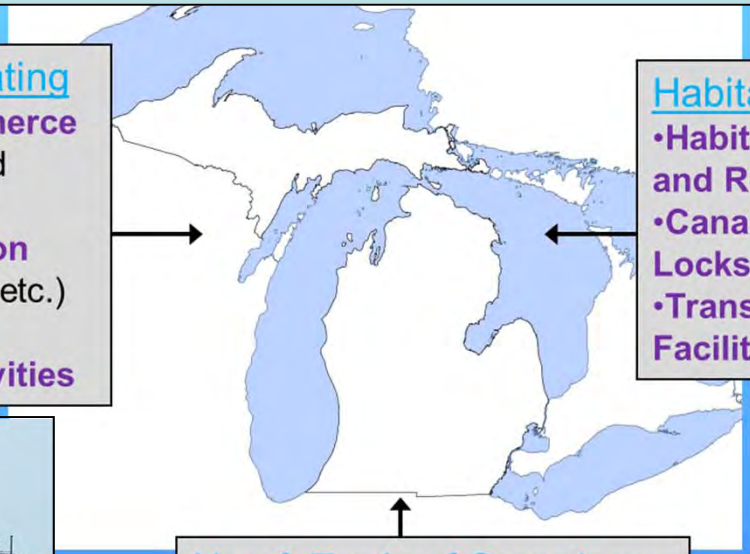
- **Department of Environmental Quality**
  - **Water Resources**
    (Sarah LeSage, Anne Hokanson, Eric Bacon, Tom Alwin, Jennifer Johnson, Kevin Walters)
  - **Office of the Great Lakes** (Roger Eberhardt, Matt Preisser, Emily Finnell)
- **Department of Natural Resources**
  - **Fisheries** (Tammy Newcomb, Nick Popoff, Tom Goniea, Seth Herbst)
  - **Wildlife** (Sue Tangora, Matt Ankney)
  - **Parks and Recreation** (Jason Fleming, Alicia Selden)
  - **Law Enforcement** (Steve Huff)
- **Department of Agriculture**
  - **Pesticide and Plant Pest Management** (Mike Bryan)
  - **Animal Industry** (Nancy Barr)
- **Others**
  - Department of Transportation (Dave Schuen)
  - DNR Forestry (Ron Murray)
  - Attorney General (Bob Reichel)

AIS State Management Plan

Finalized June, 2013

- Goal I: Prevent new introductions of AIS into Michigan waters.
- Goal II: Limit the spread of established populations of AIS into uninfested waters of the state.
- Goal III: Develop an early detection and rapid response program to address new AIS invasions.
- Goal IV: Manage and control AIS to lessen the harmful ecological, economic, social and public health impacts resulting from infestation of AIS.

Prevention of Aquatic Invasive Species in Michigan Waters Vectors and Pathways Concept Map



Shipping & Boating

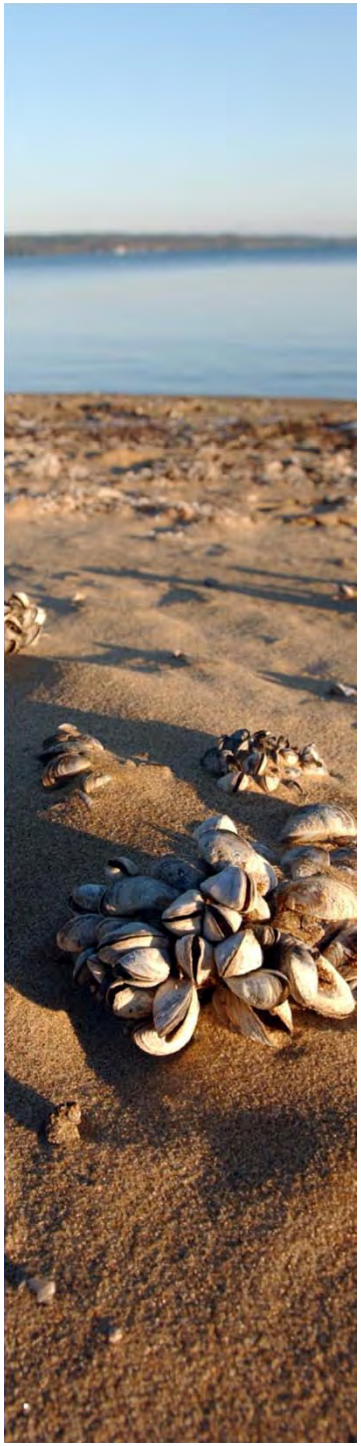
- **Maritime Commerce** (ballast water and vessel fouling)
- **Water Recreation** (boating, fishing, etc.)
- **Research and Monitoring Activities**

Habitat Alteration

- **Habitat Modification and Restoration**
- **Canals and Lift Locks**
- **Transportation Facilities**

Use & Trade of Organisms

- **Organisms in Trade**
- **Fishing** (Live Bait)
- **Fish Stocking and Hatchery Activities**



AIS Advisory Council

- Established by law in 2011
- Appointed members voting members
- Additional non-voting members and participants
- State agencies, local gov., industries, environmental groups, university, etc.
- Objective- satisfy statutory requirements to make recommendations on:
  - Ballast water
  - AIS State Management Plan
  - Organisms in trade
  - Phragmites management
  - AIS Program funding

Final report and recommendations expected summer 2013

Questions about Michigan's Aquatic Invasive Species State Management Plan or
Aquatic Invasive Species Advisory Council?
Contact:

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517-241-7931

or visit

www.michigan.gov/aquaticinvasives

Acknowledgments- the USFWS and the GLR