Non-native Aquatic Plant Identification, Monitoring and Management

The 9th Annual MiCorps Conference:

Monitoring Michigan's Lakes and Streams through Citizen Science

Ralph A. MacMullan Conference Center

Higgins Lake, Michigan

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Water Resources Division

Aquatic Nuisance Control Program

Overview

- Non-native aquatic plant identification
- Aquatic vegetation survey methodology and the interpretation of aquatic vegetation survey data
- Strengths and challenges of different methods of aquatic plant management

Part 1: Non-native aquatic plant identification

Objectives:

- Using three examples, demonstrate approaches to distinguishing between non-native species and their native look-alikes
- Summarize genetic identification of non-native watermilfoil
- Share aquatic plant identification resources

Fanwort
(Cabomba caroliniana)

Leaves opposite on stem
Finely divided and fan-shaped
Attached to stem by short stalks

Small white flower

Cabomba look-alikes

Watermilfoil	Four leaves in a whorl each divided into leaflets
Coontail	5-12 leaves in whorls Leaves forked Toothed along margins
White water crowfoot	Leaves are alternate on the stem
Water marigold	Leaves are whorled

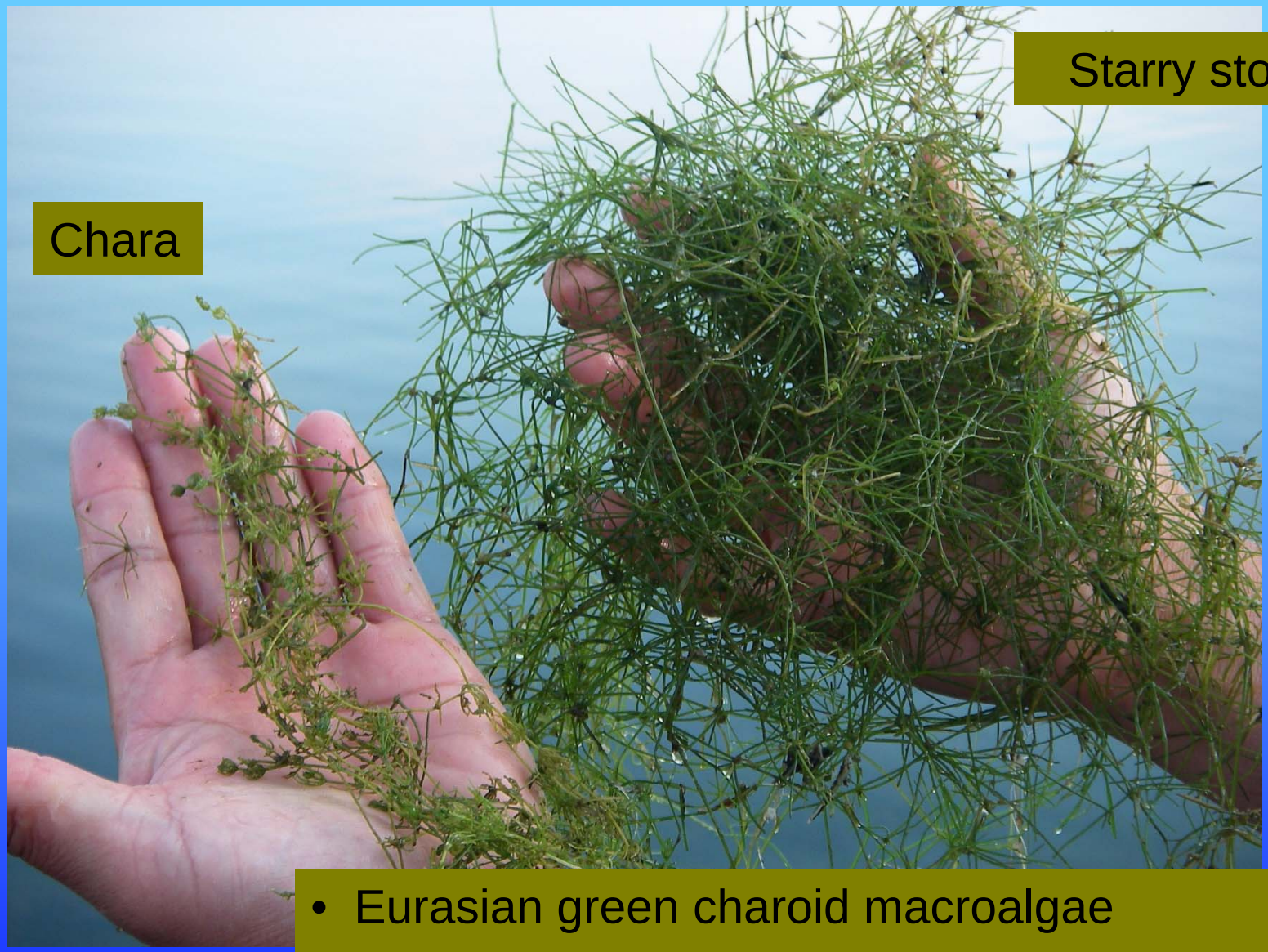
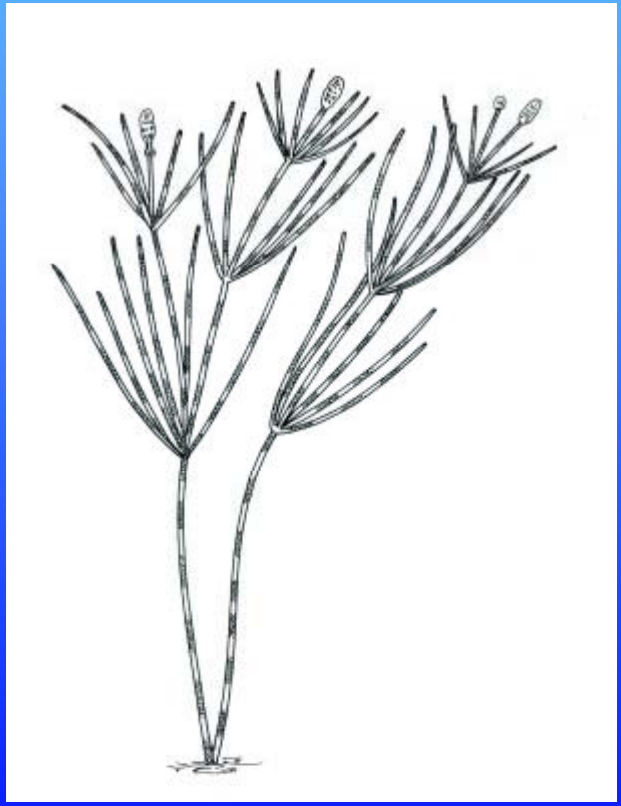


Photo by Progressive AE

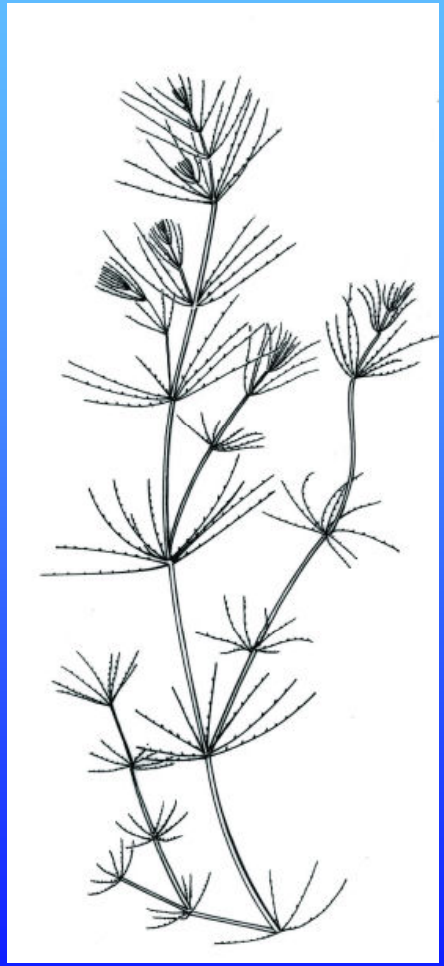
- Eurasian green charoid macroalgae
- Appears lighter, brighter green than Chara
- Irregular branching pattern makes it look disheveled

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

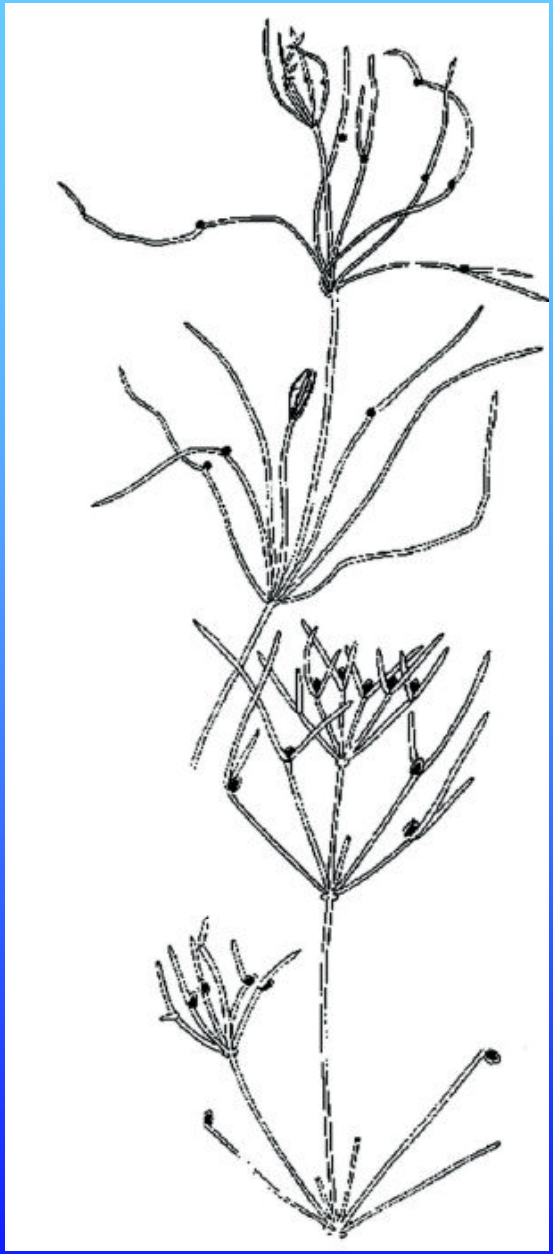
Nitella spp.



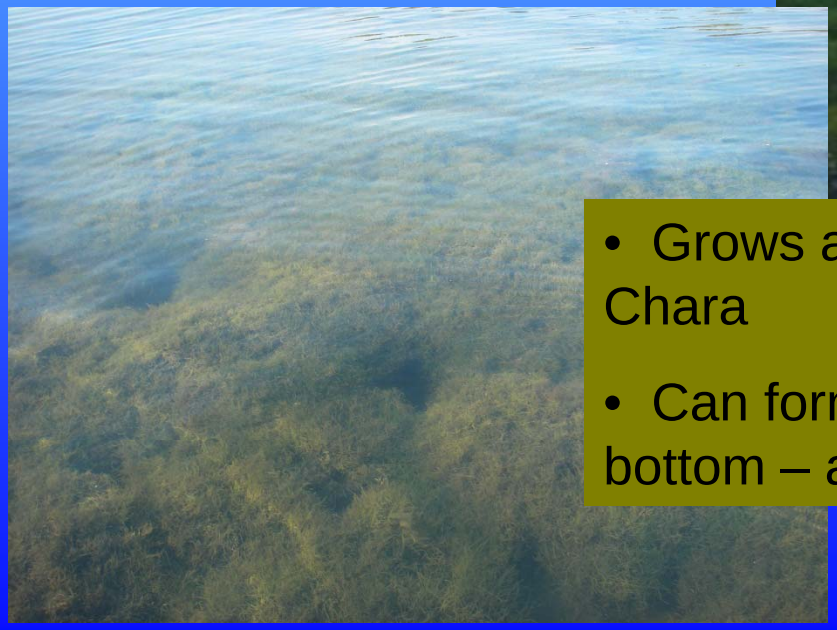
Chara spp.



Nitellopsis obtusa

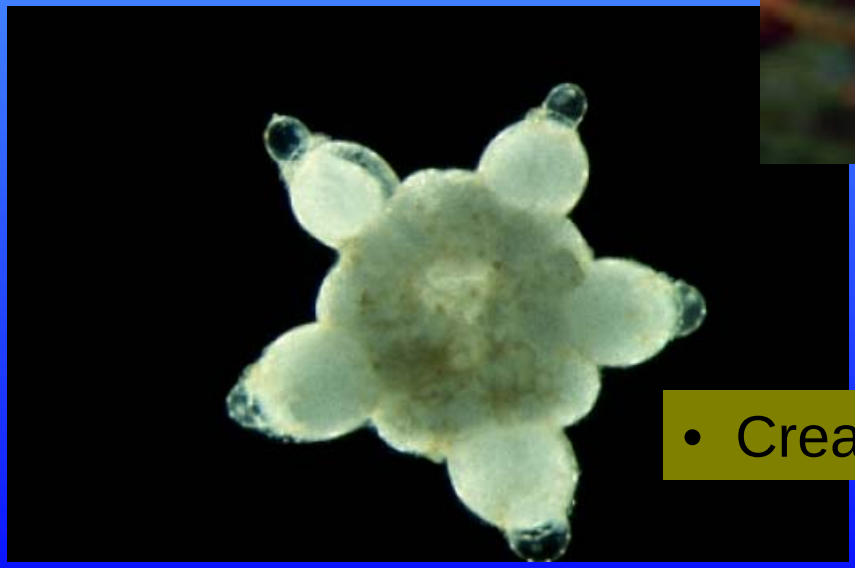


Photos by Doug Pullman



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

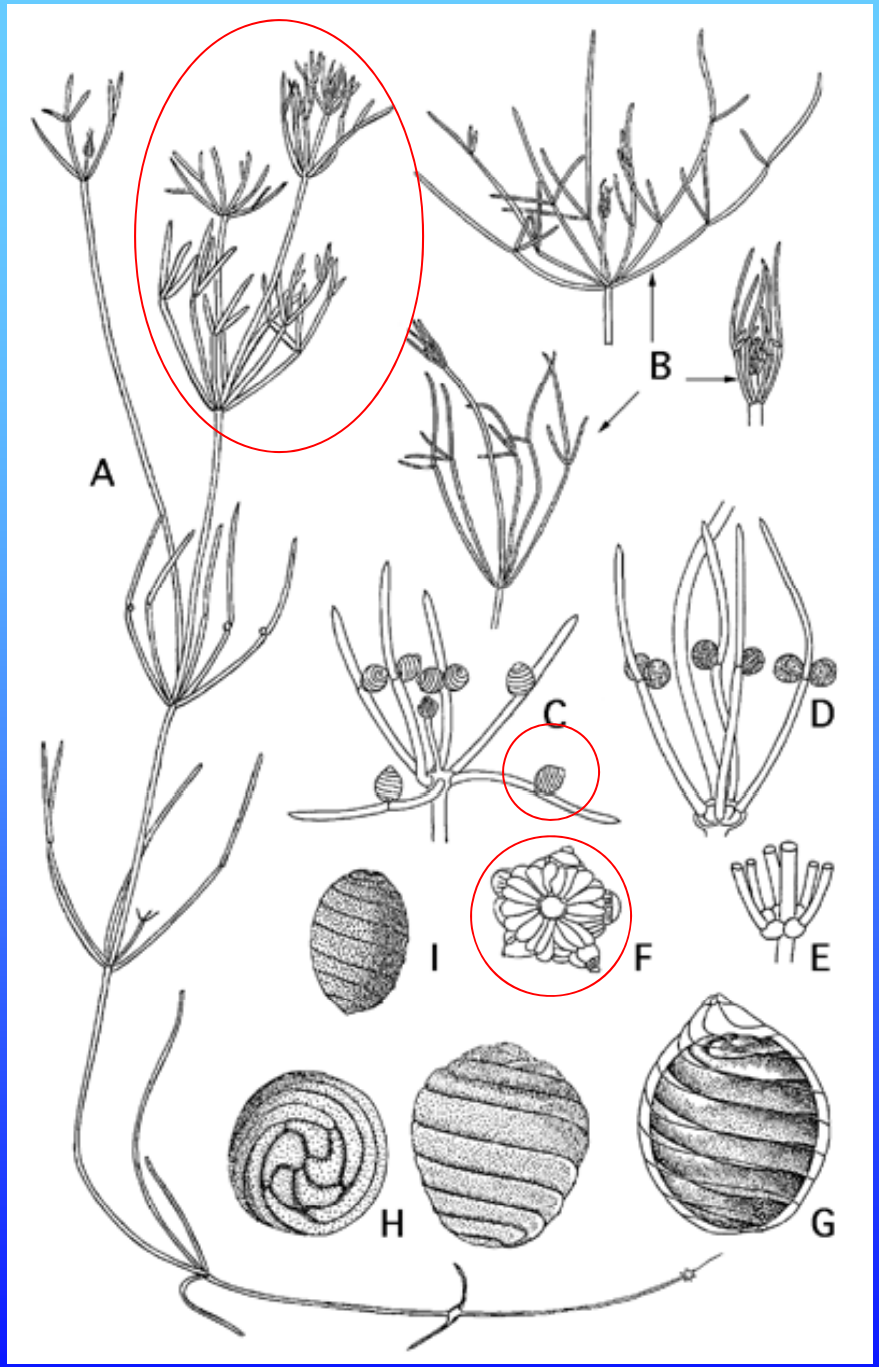
Photo by Doug Pullman



- Creamy white bulbils at base of main axis

- Dioecious
- Dark red gametangia on branches at nodes

Photo by Doug Pullman



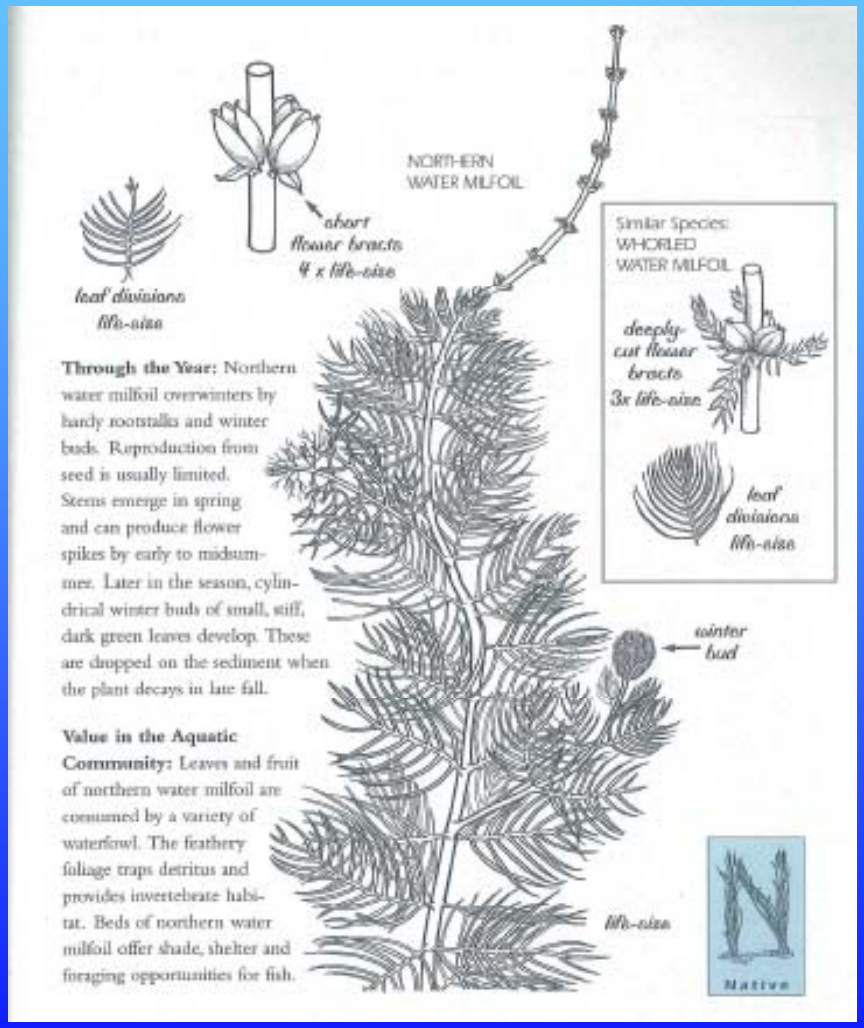
We don’t know how starry stonewort is spread within and between inland lakes.

Reproduction and candidates for dispersal

- Oospores
- Starry bulbils
- Fragments

Non-native watermilfoil

Distinguishing native and non-native watermilfoil



Distinguishing between native and non-native watermilfoil

	Eurasian	**Northern**
Number of leaflets	14-20 pairs of leaflets	5-12 pairs of leaflets
Length of leaflets	Leaflets of similar length	Lower leaflets longer than upper leaflets
Winter bud	No winter bud	Winter bud
Growth form	Branched canopy	Not branched canopy

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.

Resources for non-native aquatic vegetation identification

- A Michigan Boater's Guide to Selected Invasive Aquatic Plants

  http://web2.msue.msu.edu/bulletins2/product/a-michigan-boaters-guide-to-selected-invasive-aquatic-plants-1387.cfm

- A Field Guide to Invasive Plants of Aquatic and Wetland Habitats for Michigan

  http://mnfi.anr.msu.edu/pub/publications.cfm

- Aquatic Plants of the Upper Midwest: A Photographic Guide to Our Underwater Forests

  http://www4.uwsp.edu/cnr/uwexlakes/publications/aquaticPlantsWi/aquaticPlantsUpperMidwest.asp

- Through the Looking Glass: A Field Guide to Aquatic Plants

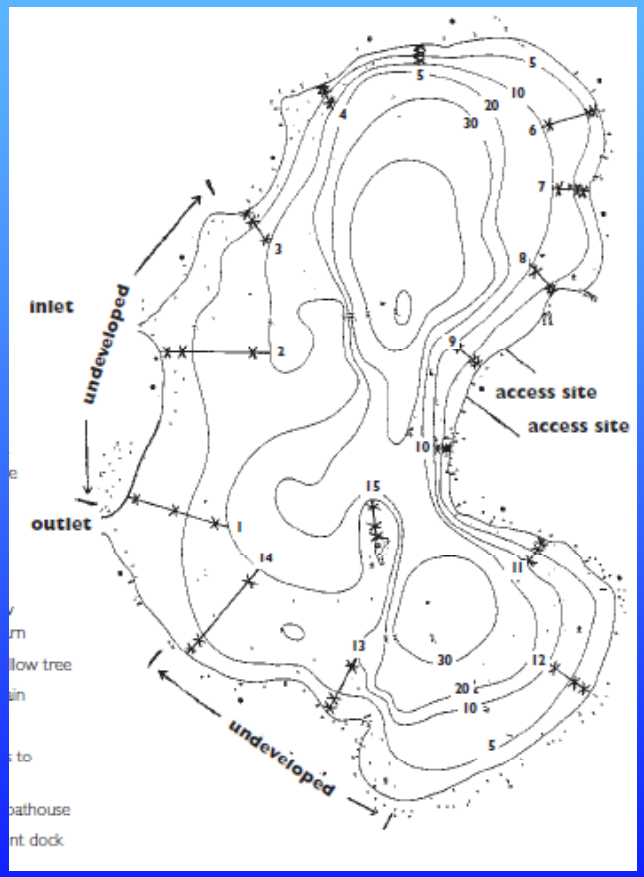
Part 2: Aquatic vegetation surveys and monitoring

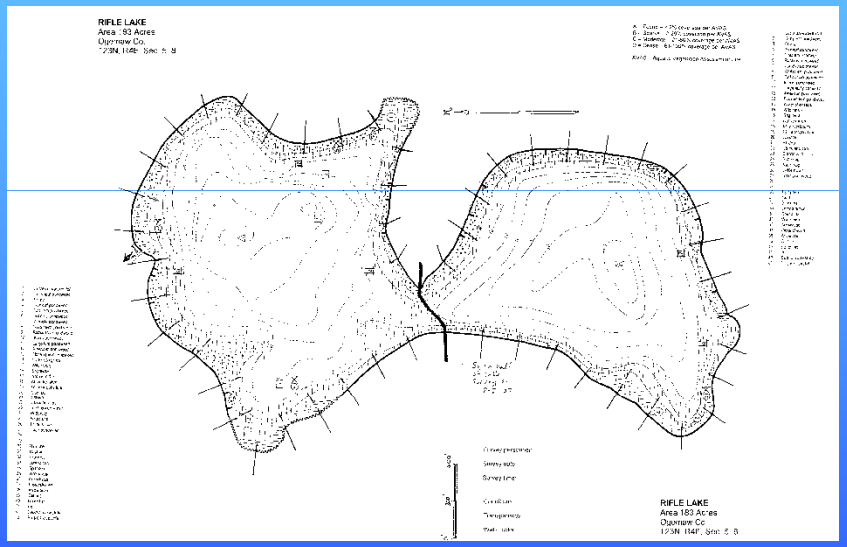
- Aquatic vegetation survey methodologies
- Survey data and summaries
- Using data summaries to evaluate management programs

MiCorps

www.micorps.net/CLMPdocuments.html

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





DEQ – ANC Program

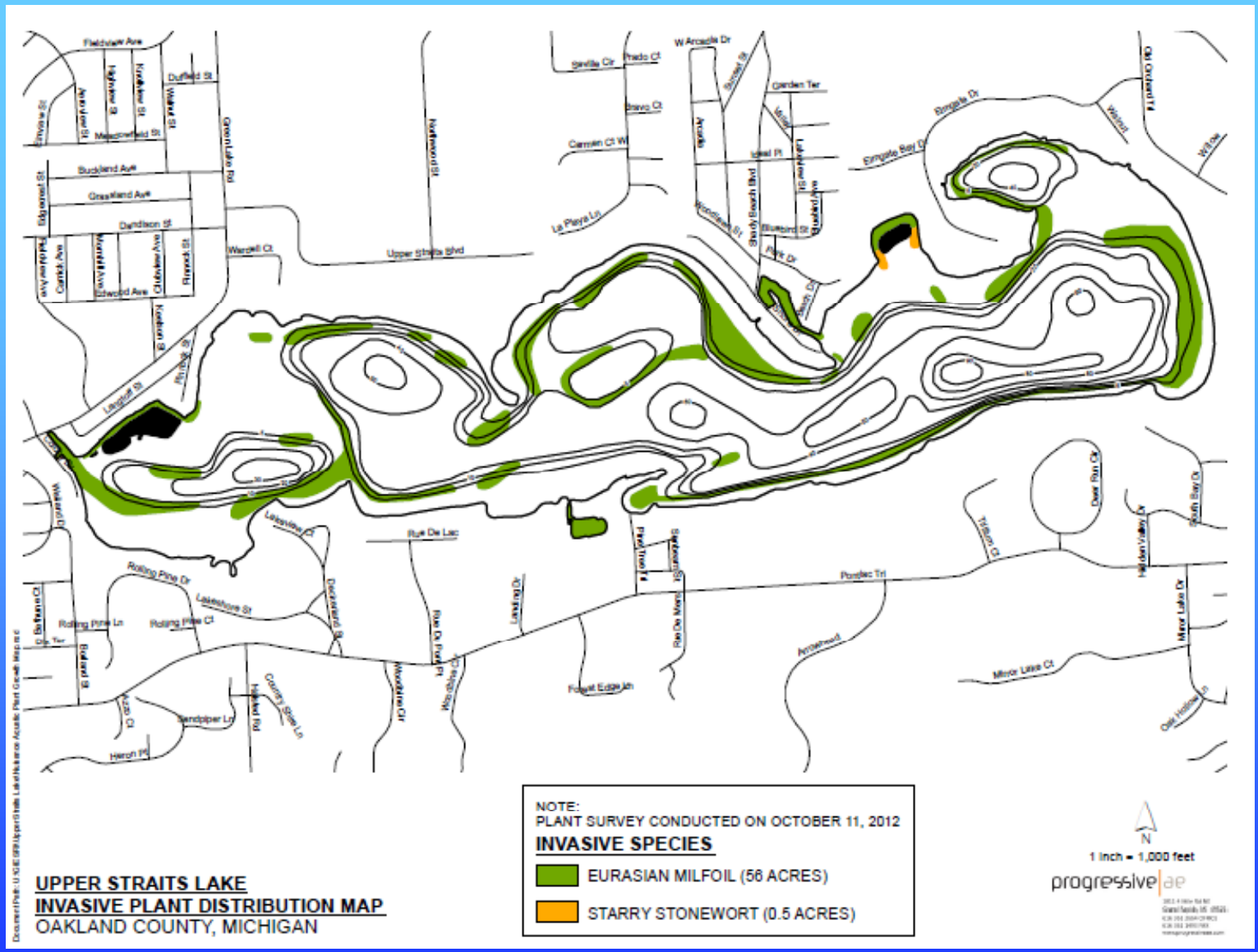
www.michigan.gov/anc

AVAS survey procedure

Common aspects of vegetation sampling methods

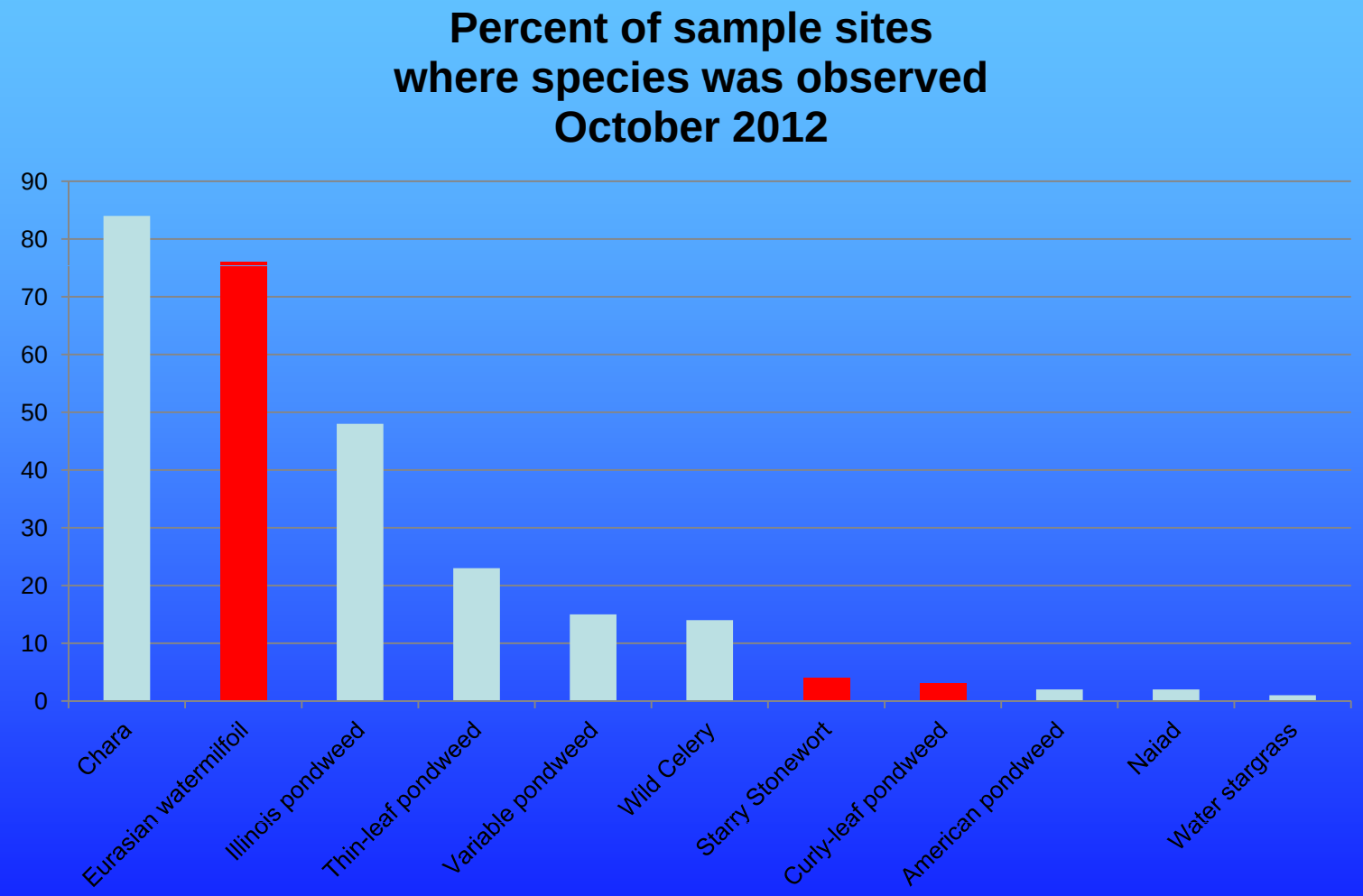
	MiCORPS/CLMP	DEQ-WRD-ANC
Spatial sampling	Transects at 1, 4, 8 feet with number based on size of lake	Shoreline segments with surveyors weaving the littoral zone
Identification of species	On rake	On rake and by eye
Estimation of density of each species	Found, sparse, moderate heavy, dense based on presence in 4 casts of the rake at each sample point	Found, sparse, common dense based on estimate of percent of area covered by species
Distribution	Percent of sample sites where species was found	Percent of sample sites where species was found
Distribution and abundance (distribution weighted by density)	Lakewide density rating	Cumulative cover value

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	LAKE NAME-								COUNTY-						SURVEY DATE:		
2																	
3	Standard Aquatic Vegetation Summary Sheet									SURVEY BY:							
4																	
5												Sum of	Total	Quotient of			
6			Total number of AVAS's					Calculations				Previous	Number	Column 9			
7			for each Density Catagory					Catagory	Catagory	Catagory	Catagory	Four	of	divided by			
8			A	B	C	D		A x 1	B x10	C x 40	D x 80	Columns	AVAS's	Column 10			
9	Code	Plant Name													Code	Plant Name	
10	No		1	2	3	4		5	6	7	8	9	10	11	No		
11																	
12	1	Eurasian milfoil				20		0	0	0	1600	1600	20	80.0	1	Eurasian milfoil	
13	2	Curly leaf pondweed						0	0	0	0	0	20	0.0	2	Curly leaf pondweed	
14	3	Chara				5		0	0	0	400	400	20	20.0	3	Chara	
15	4	Thinleaf pondweed	1					1	0	0	0	1	20	0.1	4	Thinleaf pondweed	
16	5	Flatstem pondweed						0	0	0	0	0	20	0.0	5	Flatstem pondweed	
17																	
18	6	Robbins pondweed						0	0	0	0	0	20	0.0	6	Robbins pondweed	
19	7	Variable pondweed						0	0	0	0	0	20	0.0	7	Variable pondweed	
20	8	Whitestem pondweed						0	0	0	0	0	20	0.0	8	Whitestem pondweed	
21	9	Richardsons pondweed						0	0	0	0	0	20	0.0	9	Richardsons pondweed	
22	10	Illinois pondweed						0	0	0	0	0	20	0.0	10	Illinois pondweed	
23																	
24	11	Large leaf pondweed						0	0	0	0	0	20	0.0	11	Large leaf pondweed	
25	12	American pondweed						0	0	0	0	0	20	0.0	12	American pondweed	
26	13	Floating leaf pondweed						0	0	0	0	0	20	0.0	13	Floating leaf pondweed	
27	14	Water stargrass						0	0	0	0	0	20	0.0	14	Water stargrass	
28	15	Wild Celery						0	0	0	0	0	20	0.0	15	Wild Celery	
29																	
30	16	Sagitteria						0	0	0	0	0	20	0.0	16	Sagitteria	
31	17	Northern milfoil						0	0	0	0	0	20	0.0	17	Northern milfoil	
32	18	M. verticillatum						0	0	0	0	0	20	0.0	18	M. verticillatum	
33	19	M. herterophyllum						0	0	0	0	0	20	0.0	19	M. herterophyllum	
34	20	Coontail						0	0	0	0	0	20	0.0	20	Coontail	
35																	
36	21	Elodea						0	0	0	0	0	20	0.0	21	Elodea	
37	22	Utricularia spp.						0	0	0	0	0	20	0.0	22	Utricularia spp.	
38	23	Bladderwort-mini						0	0	0	0	0	20	0.0	23	Bladderwort-mini	
39	24	Buttercup						0	0	0	0	0	20	0.0	24	Buttercup	
40	25	Najas spp.						0	0	0	0	0	20	0.0	25	Najas spp.	
41																	

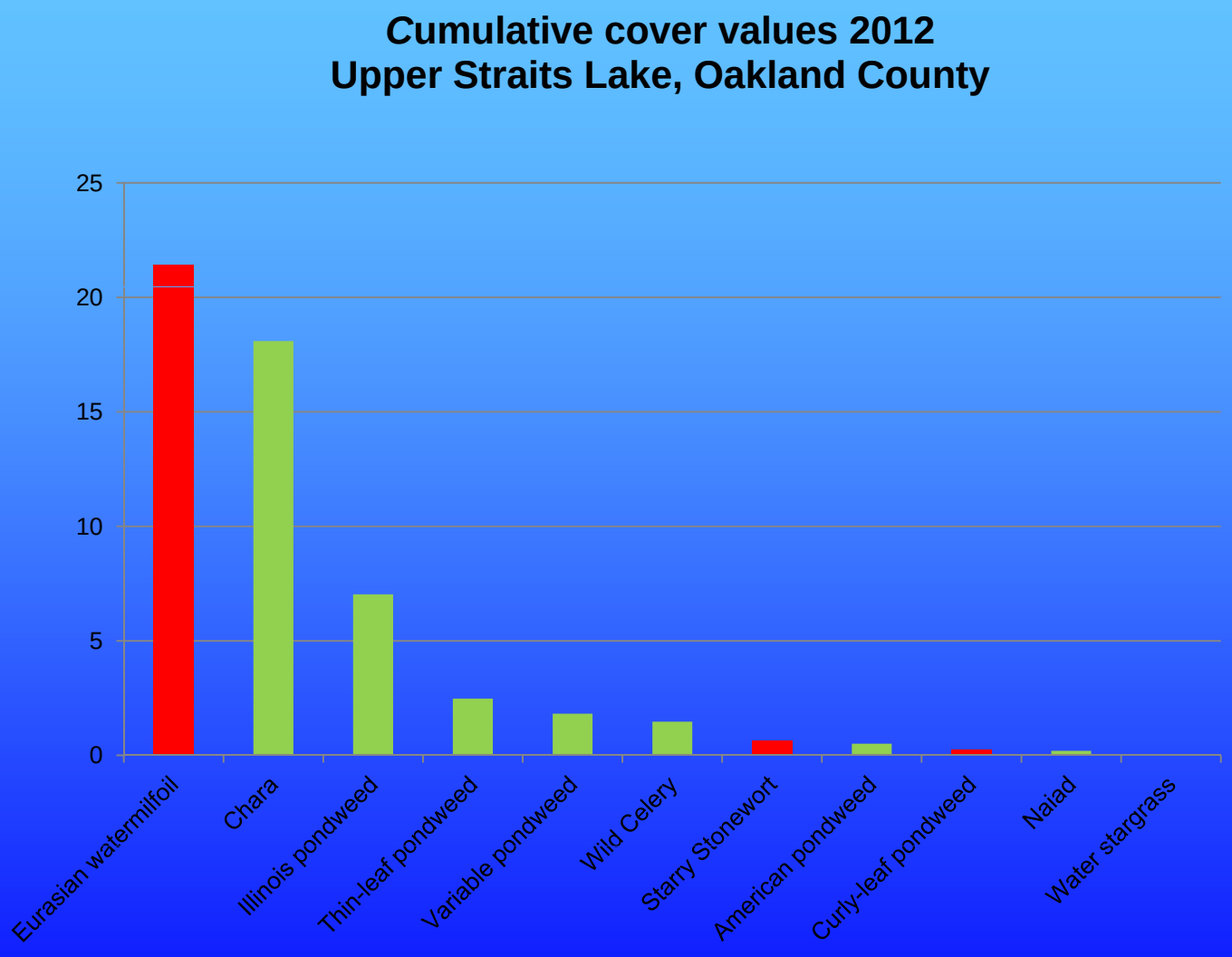


2012 non-native watermilfoil and starry stonewort map provided courtesy of Paul Hausler, Progressive AE

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



Efficacy of fluridone treatments of non-native milfoil

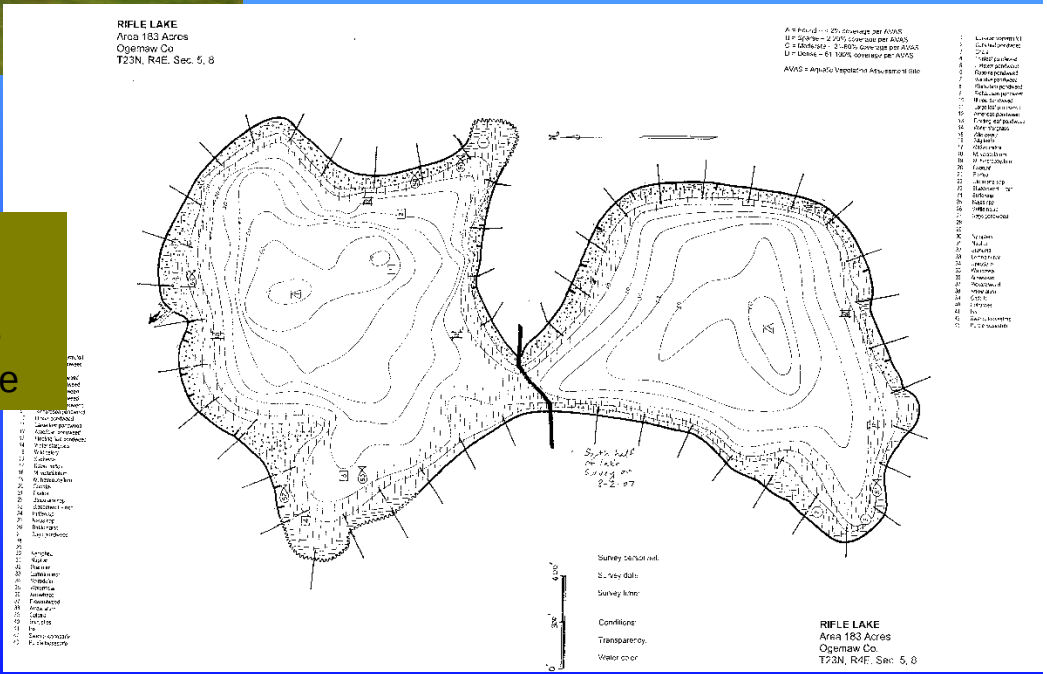
Aquatic plant management history

- 1995 8 ppb fluridone
- 2002 6 bump 6 ppb fluridone
- 2007 – 2009 contacts, no systemics
- 2010 6 bump 6 ppb fluridone
- 2011 no targeting milfoil?
- 2012 contacts early season, systemics late season
- Harvesting in late 1900's?

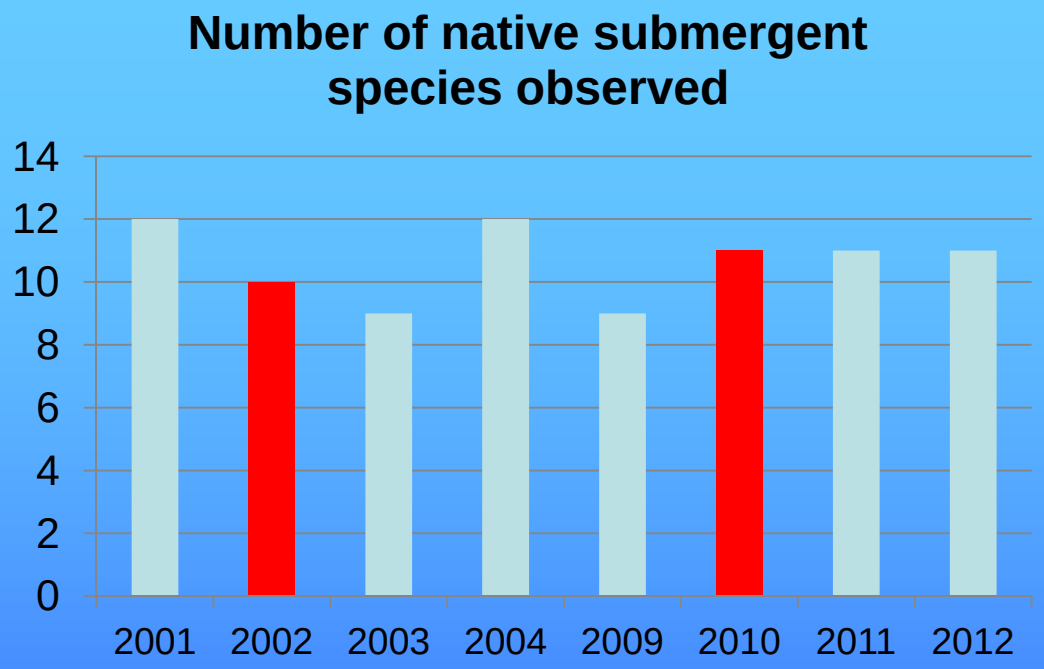
	< 2%	2-20%	21-60%	> 60 %			
YEAR	a	b	c	d	CC	%AVAS	#AVAS sites
2001	0	9	9	1	11.04	40	48
2002	0	0	0	0	0	0	48
2003	0	0	0	0	0	0	56
2004	0	0	0	0	0	0	58
2009	9	25	11	4	14.77	71	69
2010	0	0	0	0	0	0	81
2011	0	0	0	0	0	0	67
2012	5	20	12	0	7.78	42	88

Photo by Doug Pullman

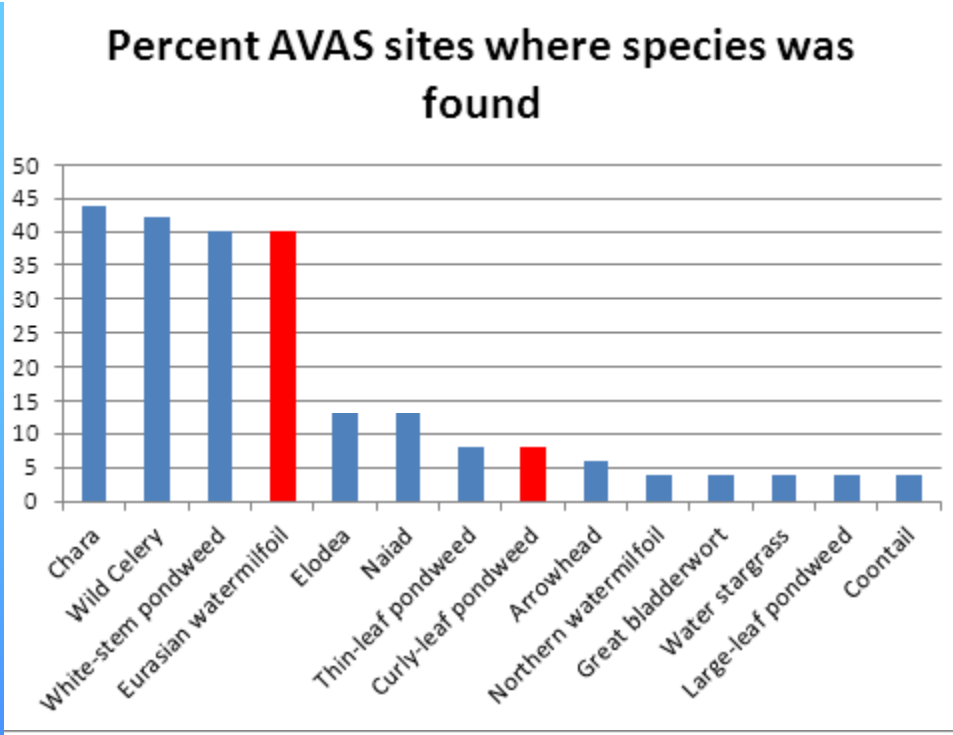
Native species abundance response

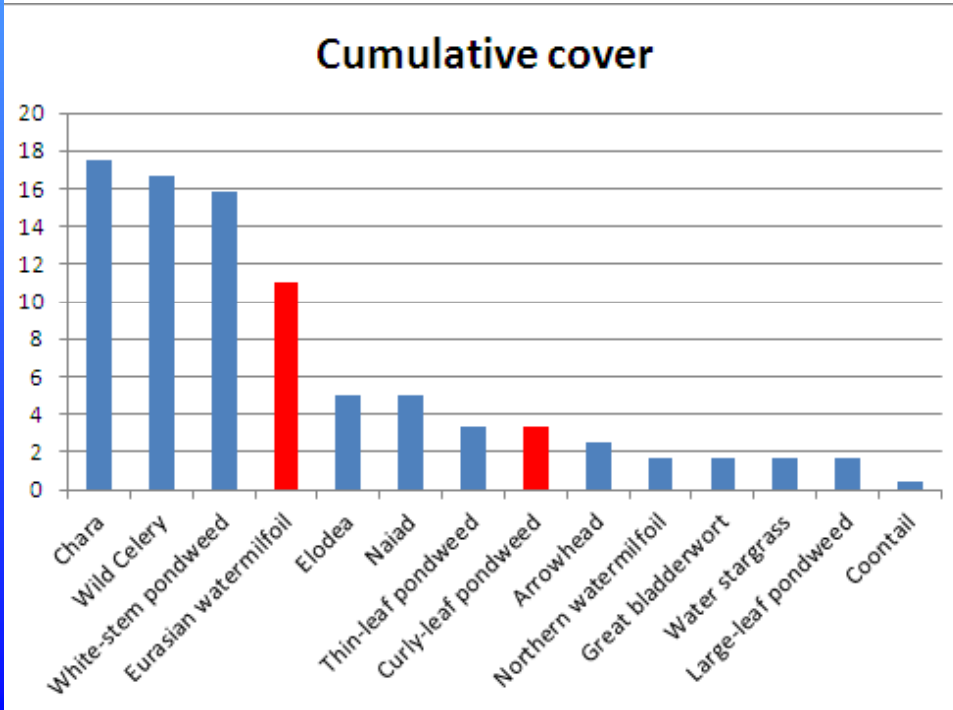


A = Found < 2 % coverage per sample site
B = Sparse 2-20 % coverage per sample site
C = Moderate 21-60 % coverage per sample site
D = Dense 61-100% coverage per sample site



- 18 native submerged species observed over eight years of surveying
- Between 9 and 12 species observed each year of sampling – don’t find all species in all years

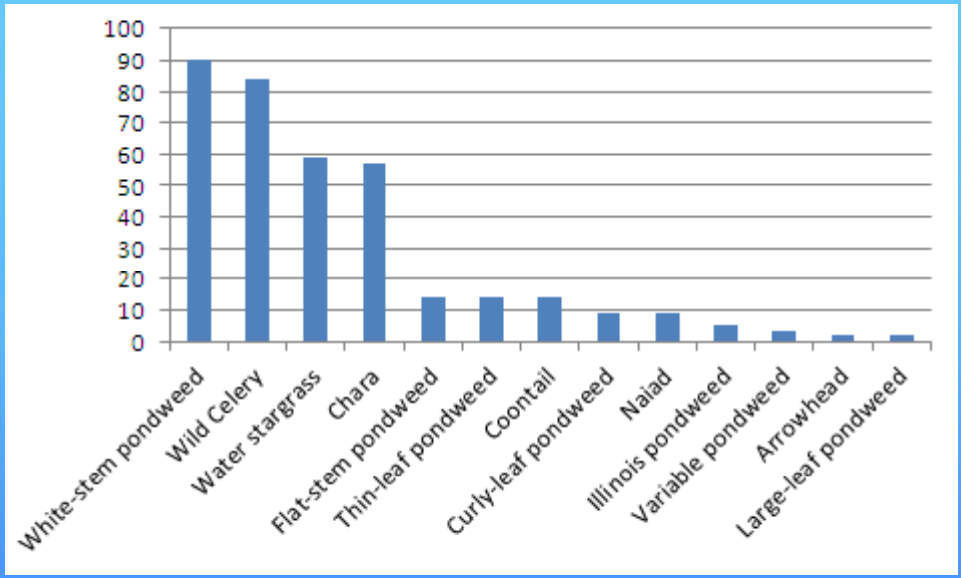




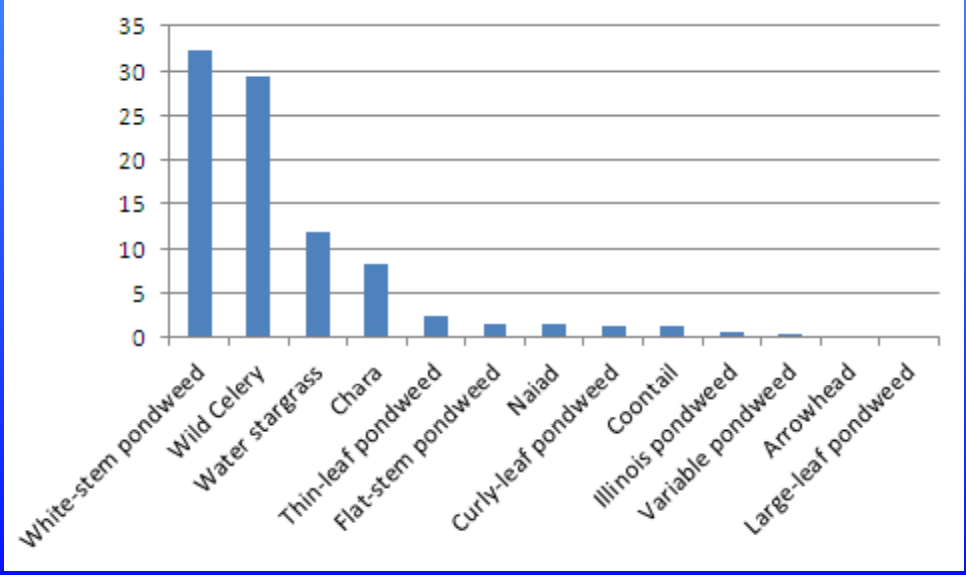
2001

- Non-native watermilfoil is codominant with native species
- Occurred in 40 percent of AVAS sites
- 12 native species present
- Use the shape of the bars to assess the plant community
- Fluridone permitted at 6 bump 6 ppb

Percent AVAS sites where species was found



Cumulative cover value



2004 – third year following spring treatment

- 12 native species
- White stem, celery, water stargrass, Chara codominant
- Non-native watermilfoil successfully spot treated with contacts and/or systemics

With vegetation survey results

- Communicate problem to stakeholders, agencies, and permitting program
- Assess treatment options based on density and distribution of non-native species
- Evaluate treatment efficacy and overall program success
- 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.

Part 3: Aquatic plant management options

- Summarize biological, chemical, physical methods of plant management
- Aquatic herbicide safety
- Defining plant control
- Strengths and challenges of methods of aquatic plant management focusing on non-native watermilfoil

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

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 watebody”
- 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

Strengths and challenges of methods of aquatic plant management

Photo by Progressive AE

Mechanical harvesting

Chemical treatment

DEQ – Aquatic Nuisance Control Program
Contact information

e-mail: deq-wrd-anc@michigan.gov
ANC Program: 517-284-5593
web address: www.michigan.gov/anc

Lisa's telephone: 517-331-5226
Lisa's e-mail: hubertyl@michigan.gov

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

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- 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

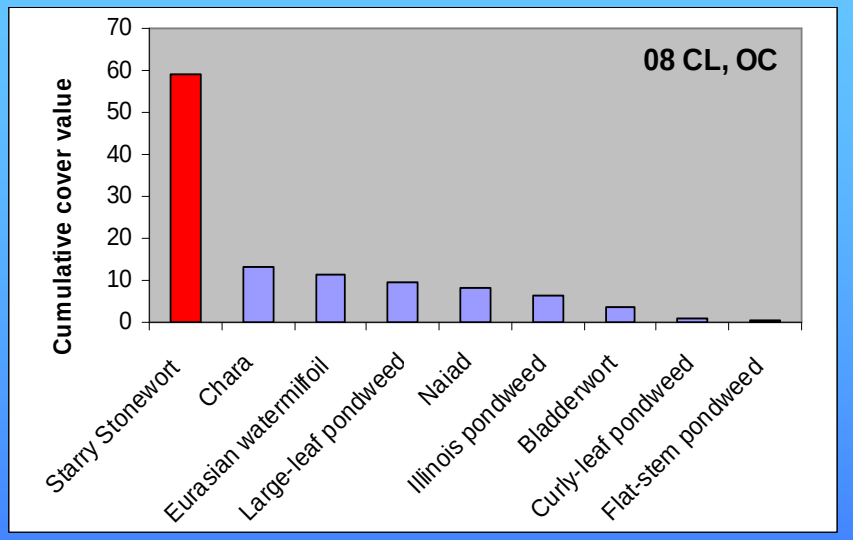
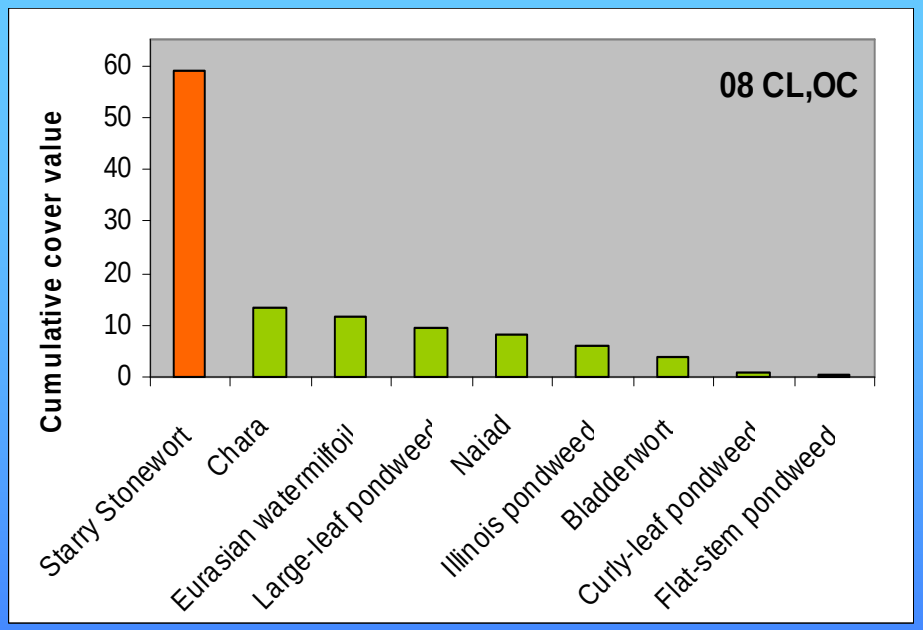
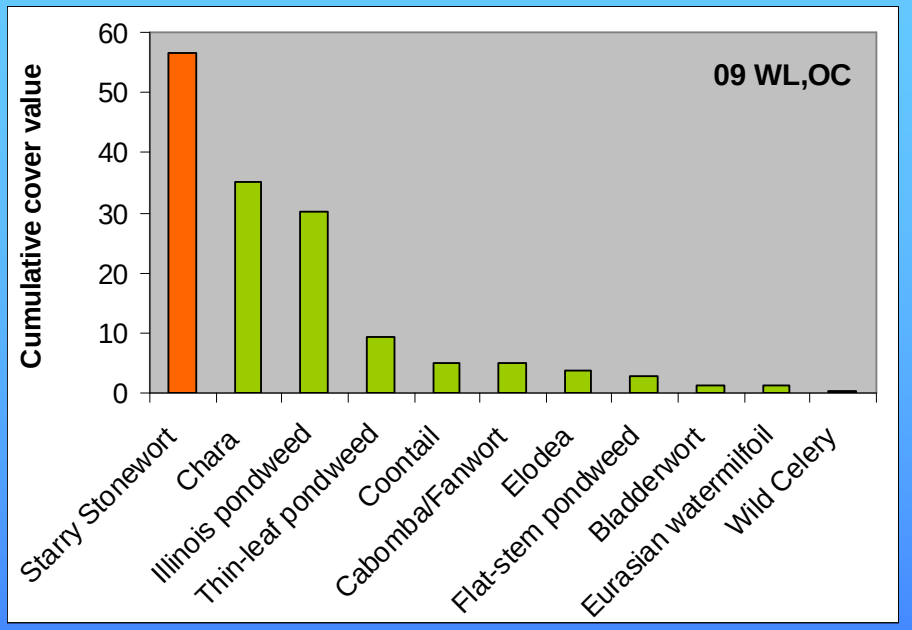
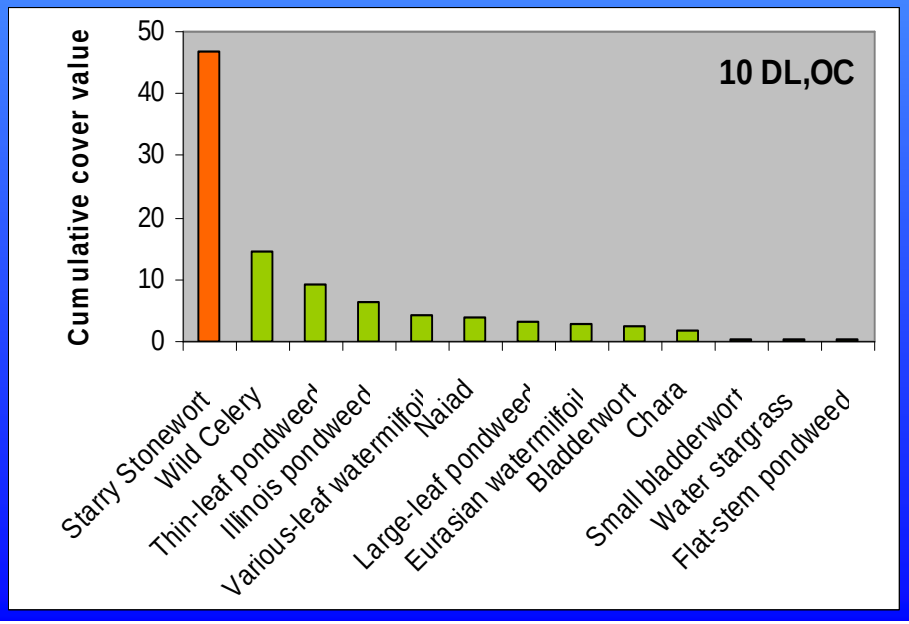


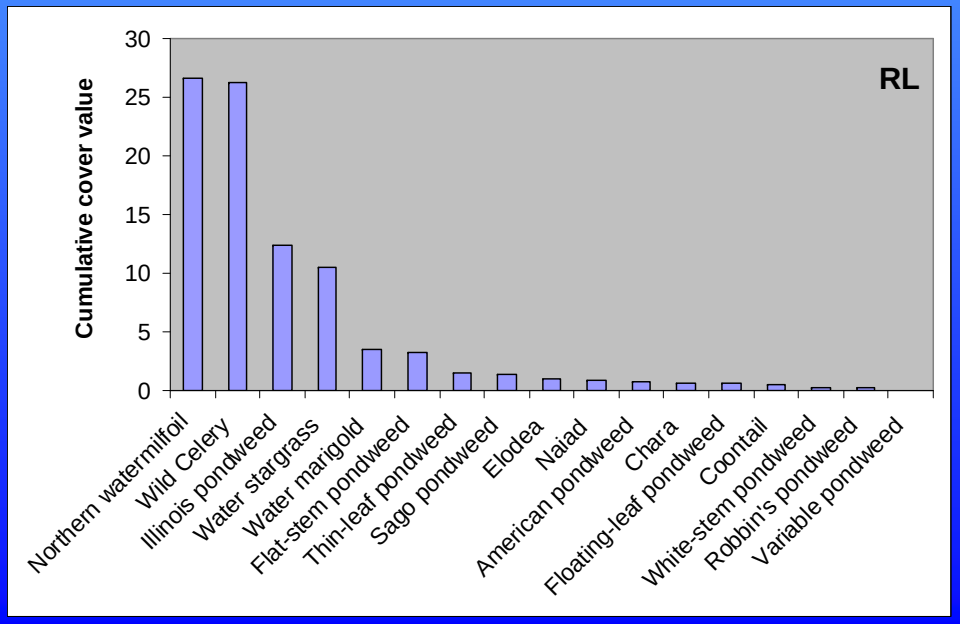
Photo by Doug Pullman

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.

Acknowledgements

Aquatic pesticide applicators
- Dick Pinagel and Steve Zulinski
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- Brett Wiseley
- Tom Alwin
- Amanda Whitscell