Case Studies and Lake-Specific Management Techniques: Successful Projects

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Invasive or Exotic Species:

By definition, an "exotic" species is one which is not native to a particular geographic area. Many of the exotic species present in our waterways originated from the Caspian Sea and are of Eurasian origin, largely a result of increased global shipping commerce and economic progress.

Eurasian Watermilfoil (*Myriophyllum spicatum*)

- Early season canopy-forming growth
- Exotic submersed macrophyte from Eurasia
- Shades light from native macrophytes
- Creates a high BOD, depletes oxygen
- Must be controlled with herbicides or biological control

Hybrid Watermilfoil (*M. spicatum var. sibiricum*)

Photo courtesy of Blair Wickman

- Characteristics of a native species of Watermilfoil (usually *M. sibiricum*, or *M. heterophyllum*) **and** Eurasian Watermilfoil)
- Generally thicker stems, hardy, stems often appear pink or buff-off white
- Unpredictable response to management control methods

Curly-Leaf Pondweed (*Potamogeton crispus*)

- Invasive, exotic
- Early to germinate; dies back in mid-summer – usually!
- Forms highly viable and resistant turions
- May grow in monotypic stands, prefers disturbed habitats
- Managed through mechanical harvesting and/or use of systemic herbicides

Blue Green Algal Blooms

- Often present in hyper-eutrophic systems
- Indicators of "internal loading" of phosphorus
- May contain toxins which can be fatal to animals and humans

Spring Lake, Ottawa Co, MI (July, 2009)

Aquatic Plant Management Techniques

Chemical Herbicides & Algaecides

- Applied to both exotic and native aquatic plants
- Most commonly used: 2,4-D, Reward, Triclopyr, Fluridone, Aquathol-K, $CuSO_4$, Glyphosate
- Requires MDEQ permit; residue sampling may be required (i.e. Triclopyr, Fluridone)
- Shallow well restrictions, swimming restrictions, watering restrictions-Notifications required

Mechanical Harvesting

- Removes nuisance aquatic vegetation to reduce organic matter accumulation
- Requires a dump site for plant debris
- No permit required by the MDEQ but sometimes required for use of MDNR launch site
- NOT recommended for EXOTIC species that fragment!!

The EWM Weevil (*Euhrychiopsis lecontei*)

- Discovered for EWM control by S. Sheldon in 1995
- Larvae and pupae de-vascularize EWM stem tissue
- Adults over-winter in shoreline riparian vegetation
- Adults appear to be eaten by fish in lakes of low macroinvertebrate biodiversity
- Not effective in controlling rapid spread of EWM; variable results in many lakes nationwide

Adult weevil

Weevil from Bear Lake Bluegill fish

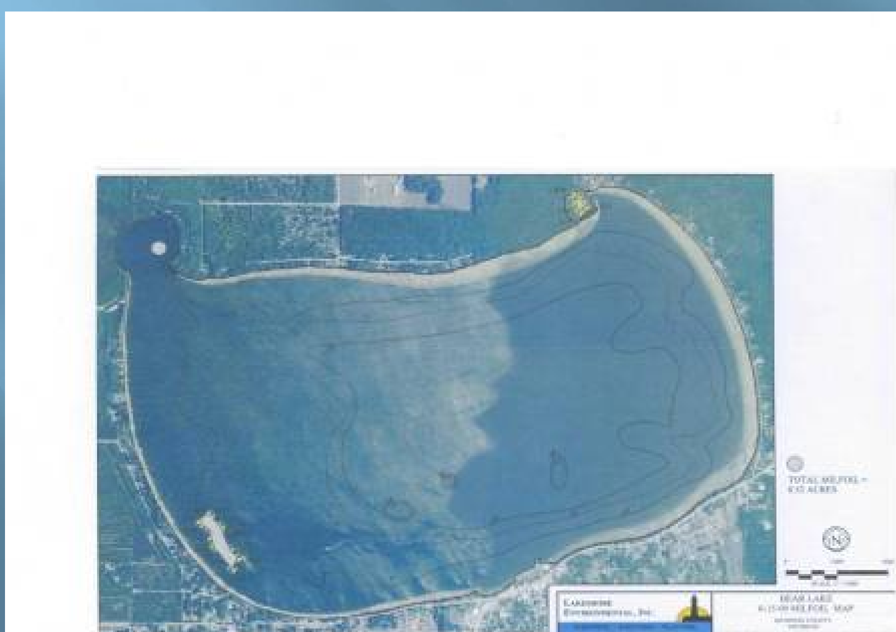
Pupae in EWM Stem

Bear Lake (Manistee County, MI):
A Case Study for Selective Aquatic Herbicide Control

- Approximately 320 acres of EWM treated with systemic aquatic herbicides such as 2,4-D in main lake during mid-June and early July of 2009 and Triclopyr in west & east bays and near the village.
- EWM acreage was at 11.0 acres in bays and main lake during 2009; Treated w/same herbicides as in 2008.
- Current EWM acreage is 0!!
- Lake is currently on a watershed management program and is undergoing re-evaluation of long-term strategies for BMP's to reduce nutrient loads.

The GPS Point-Intercept Grid Survey Method

EWM Distribution, July 2008



EWM Distribution, July 2009

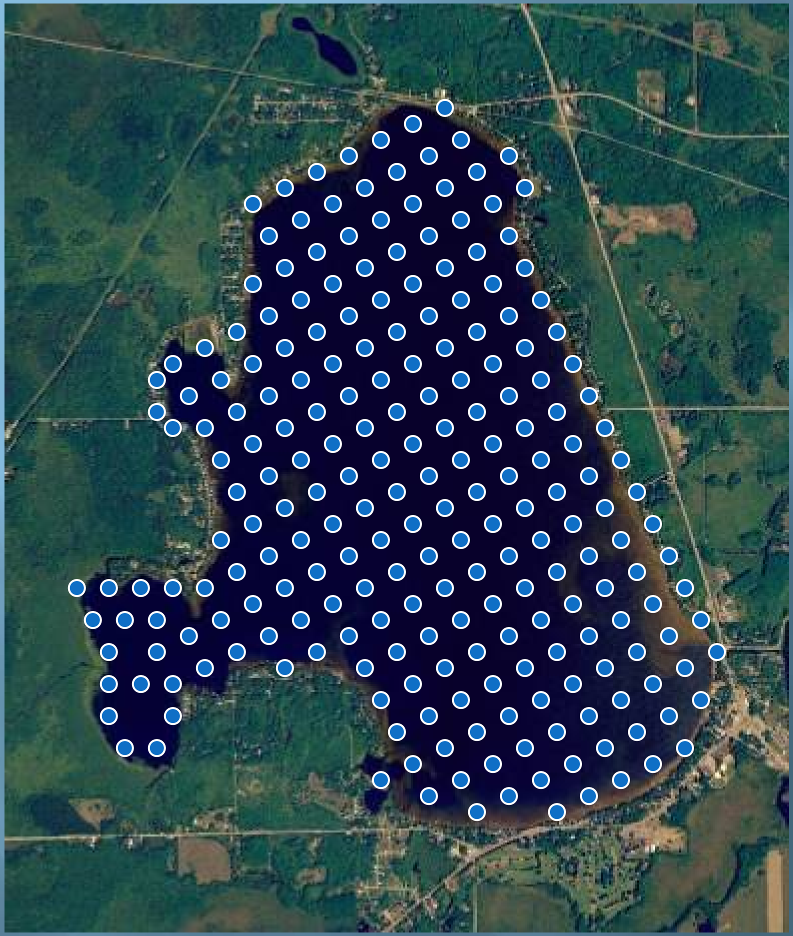
EWM Management Options Considered

- Mechanical Harvesting – Causes fragmentation of EWM stems, not feasible
- Biological Control – Was considered for long-term control, yet not reliable for resisting “spread”, preferred use as Integrated Management Option
- Chemical Herbicides – Contacts such as Reward offer only temporary control; do not kill entire plant. Systemics such as Triclopyr are highly expensive, not ideal for large, open waters. Systemics such as 2,4-D very effective and allow for localized treatments.
- No Action – Would have likely necessitated a whole-lake treatment (SONAR).

Lake Mitchell: A Case Study for Integrated Management

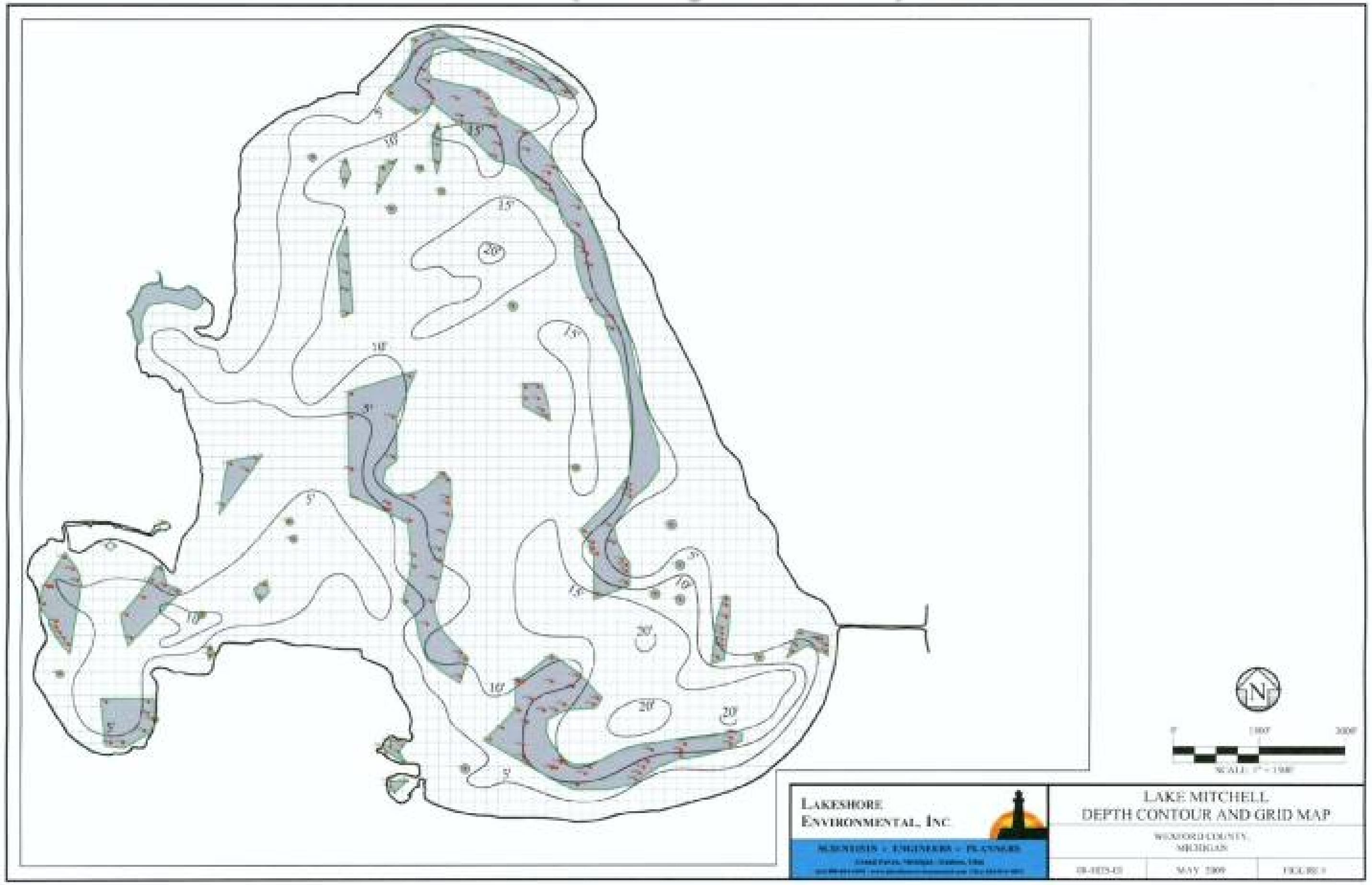
- Approximately 365 acres of EWM treated with systemic aquatic herbicides such as 2,4-D & Triclopyr during early June of 2009
- EWM estimated at 55 acres in fall of 2009
- Nuisance un-navigable areas were mechanically harvested in late June/early July (39 acres)
- 10,000 weevil units were placed adjacent to the wetlands in Big Cove to feed on viable EWM.
- Lake is currently on a watershed management program and is undergoing re-evaluation of long-term strategies for BMP's to reduce nutrient loads.

The GPS Point-Intercept Aquatic Vegetation Survey Method



- U.S. Army Corps of Engineers Method for whole-lake aquatic vegetation surveys of all aquatic plant forms
- Non-biased; amenable to statistical analysis
- Useful for aquatic plant management plans
- Easily conducted for future surveys; allows for seasonal and yearly comparisons among all data points

Lake Mitchell EWM Distribution (May, 2009)



Spot-Treatment of 2,4-D for EWM Control

Weevil Stocking in Big Cove

Harvesting in Coves, Var. Regions

Round Lake (Mason County, MI): A Case Study for Selective Aquatic Herbicide Control, Whole-lake Fluridone Treatment, Mechanical Harvesting, & Biological Control

- > 270 acres of EWM canopied in lake in September, 2006
- In 2007, ~ 120 acres harvested and 5,000 weevils placed in protected areas for evaluation/fisheries study
- Lake mean depth < 6.0 feet
- Whole-lake fluridone treatment occurred in May of 2008 – partially successful
- Selective treatment of EWM with 2,4-D occurred in June of 2009 – very successful with only < 5.0 acres remaining
- Native aquatic plant communities re-bounding well and fishery has improved dramatically

Round Lake, September, 2006

Round Lake, July 2007

Ideal conditions for weevils; LRBOI conducted fishery study/showed evidence of mild predation by bluegills due to lack of food

Round Lake, May 2008

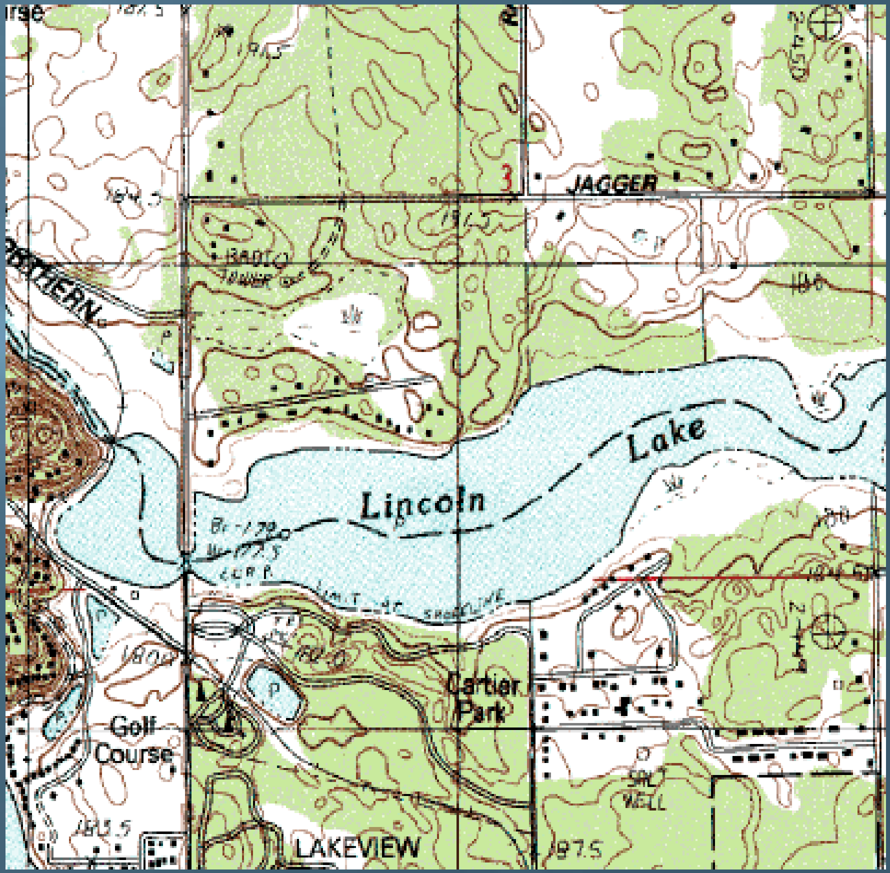
SONAR (fluridone treatment applied to entire lake volume; bump treatment not permitted due to high concentrations

Round Lake, September 2009

Round Lake now, with < 5.0 acres of EWM and balanced plant biodiversity

Lincoln Lake (Mason County, MI): A Case Study for Selective Aquatic Herbicide Control & Mechanical Harvesting

- Approximately 30 acres of EWM treated with systemic aquatic herbicides such as 2,4-D in main lake during mid-June of 2008 and 2009.
- Approximately 70 acres of nuisance native aquatic plant growth harvested in 2008 and 56 acres in 2009.
- Lake has low base flow and very high nutrient concentrations.
- Lake is currently on a watershed management program and is undergoing re-evaluation of long-term strategies for BMP's to reduce nutrient loads.



October 2006 (Pre-Management)

The Problems:

Dense EWM, Curly-leaf Pondweed, Coontail, Water Stargrass, Elodea, Lilypads, and Pondweeds; Shallow depths

The Challenges:

Avoiding Wild Rice areas; Silt/sedimentation interferes w/management activities; Protecting fishery spawning areas

August, 2009 (Before Harvest)

August, 2009 (After Harvest)

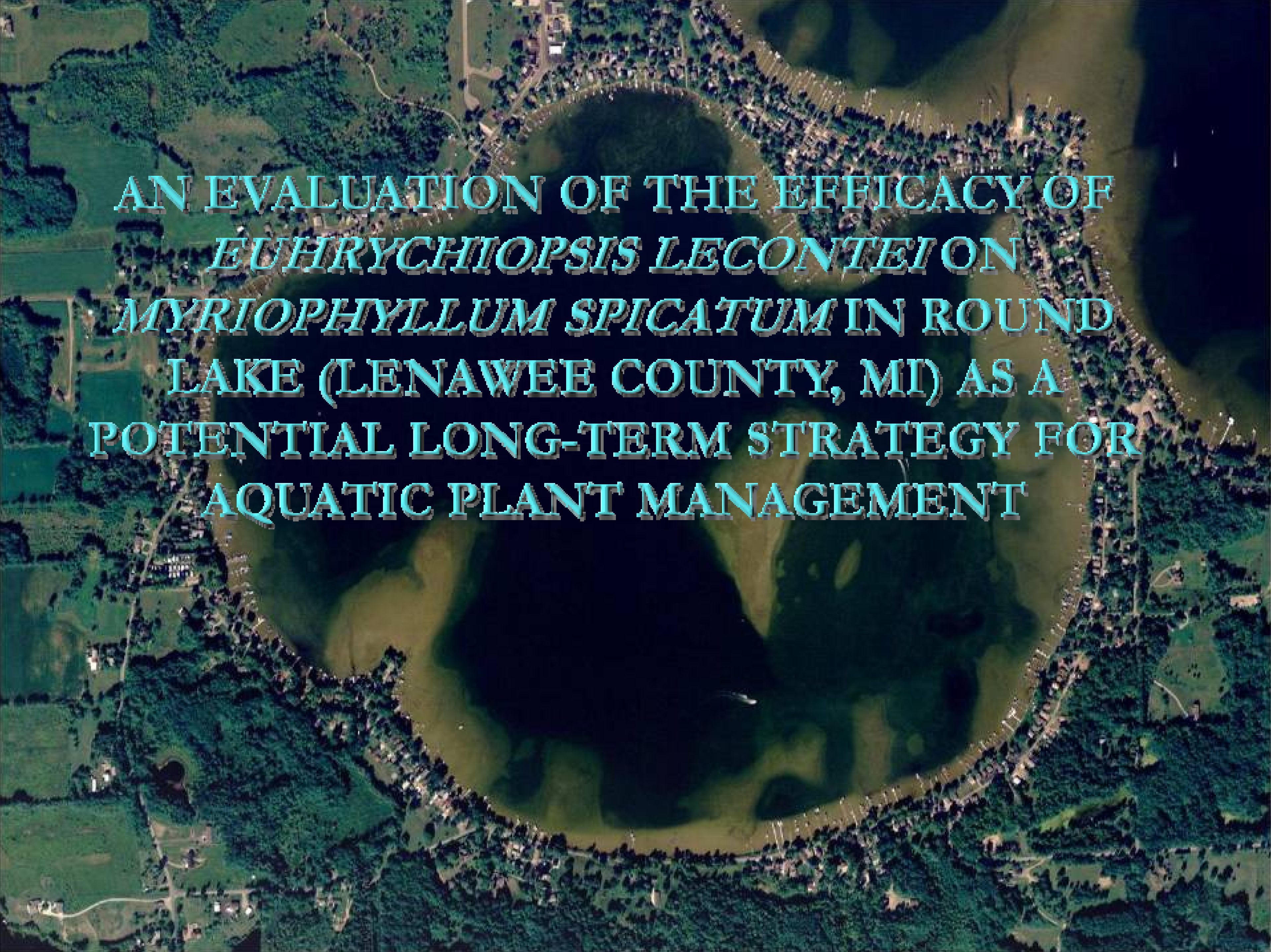
August, 2009 (Before Harvest)

August, 2009 (After Harvest)

August, 2009 (Before Harvest)

August, 2009 (After Harvest)

AN EVALUATION OF THE EFFICACY OF *EUHRYCHIOPSIS LECONTEI* ON *MYRIOPHYLLUM SPICATUM* IN ROUND LAKE (LENAWEE COUNTY, MI) AS A POTENTIAL LONG-TERM STRATEGY FOR AQUATIC PLANT MANAGEMENT



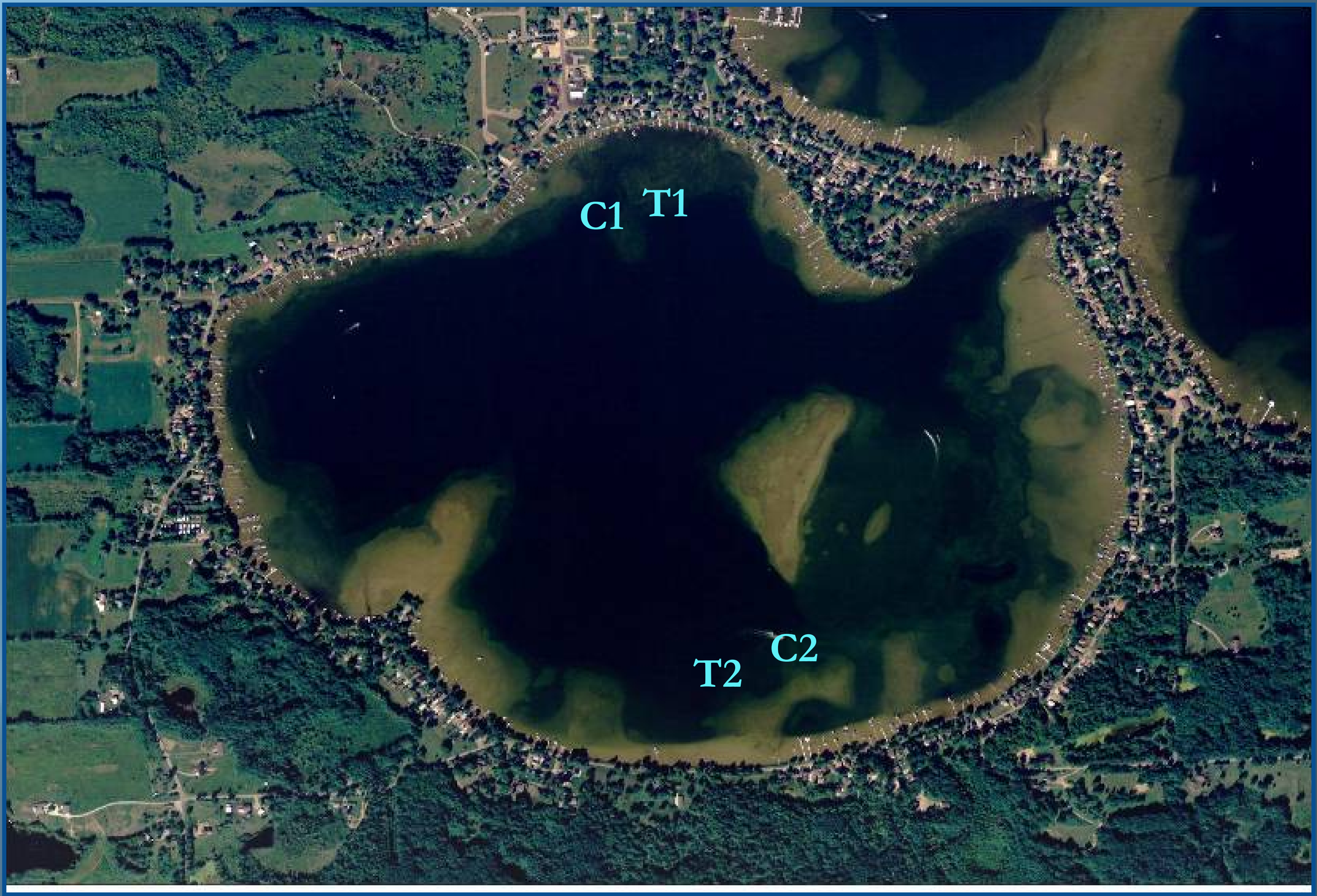
Round Lake Weevil Experimental Sites

- 2 control and 2 treatment sites (independent sites, approx 1,000 ft apart)
- Test plot areas 625 ft^2 (58.06 m^{-2}) in size; marked with GPS
- Weevil stocking density of ~157 weevils m^{-2} in treatment sites- Newman Research
- No weevils stocked in Control sites
- Depth of experimental sites approximately 8-10 feet

Round Lake Field Evaluation Methods

- 60 milfoil stems collected pre-treatment and post-treatment [weevil] for each of the 4 sites (BACI statistical design)
- Stems collected by skin divers from above sediment interface
- 0.25 m^{-2} quadrat samples collected among all sites to estimate stem density of EWM
- Transect data of native species collected at sites

Round Lake Weevil Experimental Sites



Round Lake Laboratory Experimental Methods

- EWM stems carefully separated by species (i.e. hybrid vs. pure strain) and analyzed for stem parameters for all pre-treatment and post-treatment sites

- Each individual stem carefully inspected w/ Microscopy for all weevil life stages and data recorded

Milfoil Stem Parameters Measured at Experimental Sites

- Index of EWM stem damage (0-5 scale); Dissection microscope
- EWM stem Compressional diameter (mm); Calibrated digital calipers
- Number of EWM lateral branches
- EWM stem length (cm); Meter stick
- Degree of weevil damage spread from transplant sites; Native plant species present
- EWM Stem density
- Degree of Hybridization

Index of Stem Damage

- 0 = Absence of weevil damage
- 1 = Presence of necrosis on stem; no leaf defoliation
- 2 = Presence of larvae in stem; no leaf defoliation
- 3 = Presence of larvae in stem and/or stem vascular tissue degradation and some leaf defoliation
- 4 = Presence of larvae in stem and/or severe degradation of stem vascular tissue, and moderate leaf defoliation
- 5 = Severely damaged stem tissue and complete leaf defoliation

Photograph courtesy of Dr. Ray Newman, University of Minnesota, Used with permission.

Round Lake Pre-Weevil

Site	Mean Index of Stem Damage (0-5)	Mean Stem Diameter (mm)
C1	Good	1.59 ± 0.27
C2	Good	1.59 ± 0.21
T1	Excellent	1.68 ± 0.25
T2	Good	1.70 ± 0.29

Round Lake Post-Weevil

Site	Mean Index of Stem Damage (0-5)	Mean Stem Diameter (mm)
C1	0.3	1.95 ± 0.47
C2	0.2	1.94 ± 0.44
T1	2.4*	1.84 ± 0.45
T2	1.3*	1.70 ± 0.43

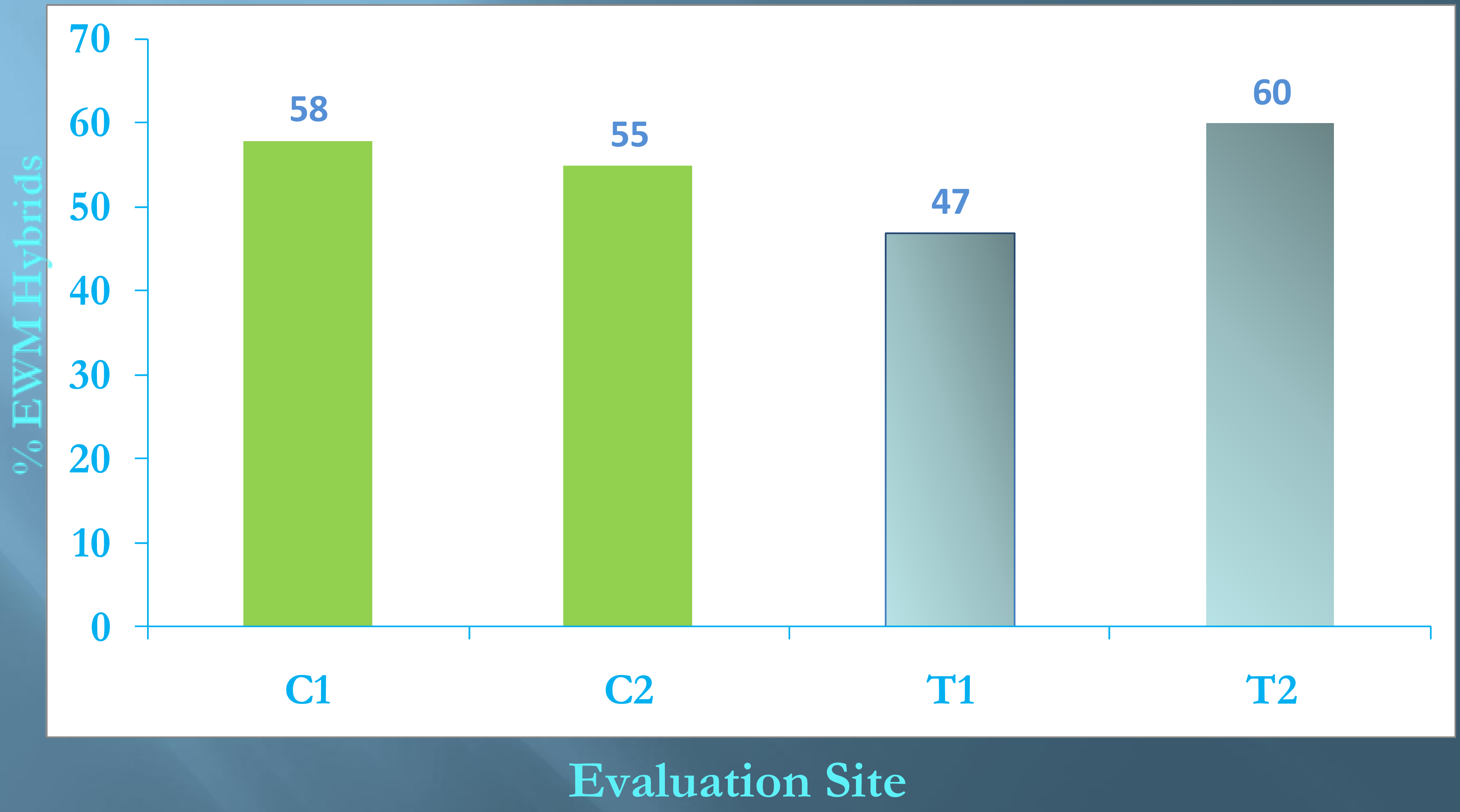
Round Lake Pre-Weevil

Site	Mean # Lateral Stem Branches	Mean Stem Length (cm)
C1	1.3	187.3 ± 53.8
C2	1.5	160.0 ± 35.6
T1	1.6	223.0 ± 49.3
T2	2.3	177.6 ± 30.3

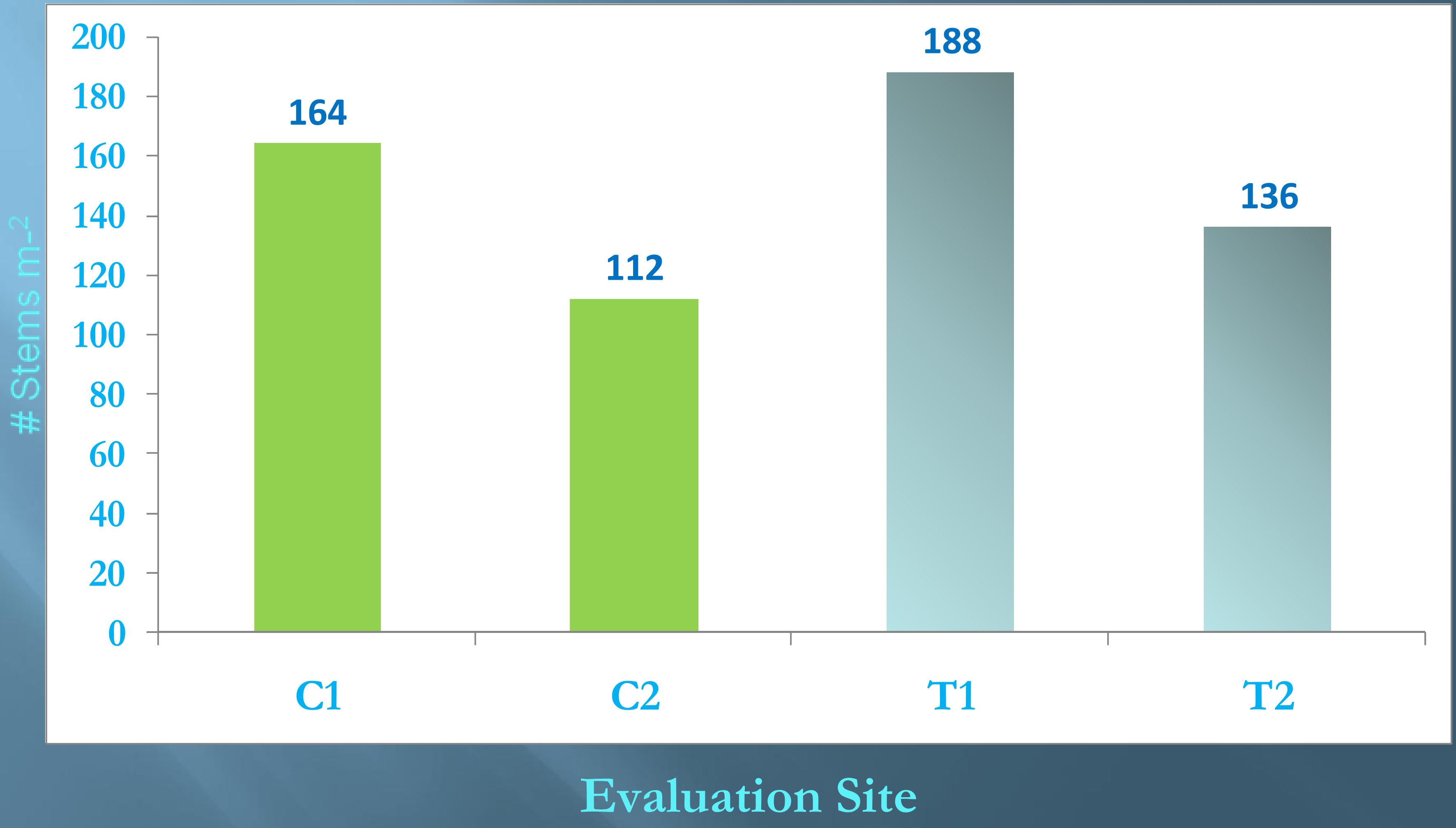
Round Lake Post-Weevil

Site	Mean # Lateral Stem Branches	Mean Stem Length (cm)
C1	2.1	140.3 ± 17.7
C2	2.1	147.7 ± 17.4
T1	2.3	140.3 ± 16.22*
T2	2.0	139.1 ± 17.8**

Percentage of EWM Hybrids among Evaluation Sites



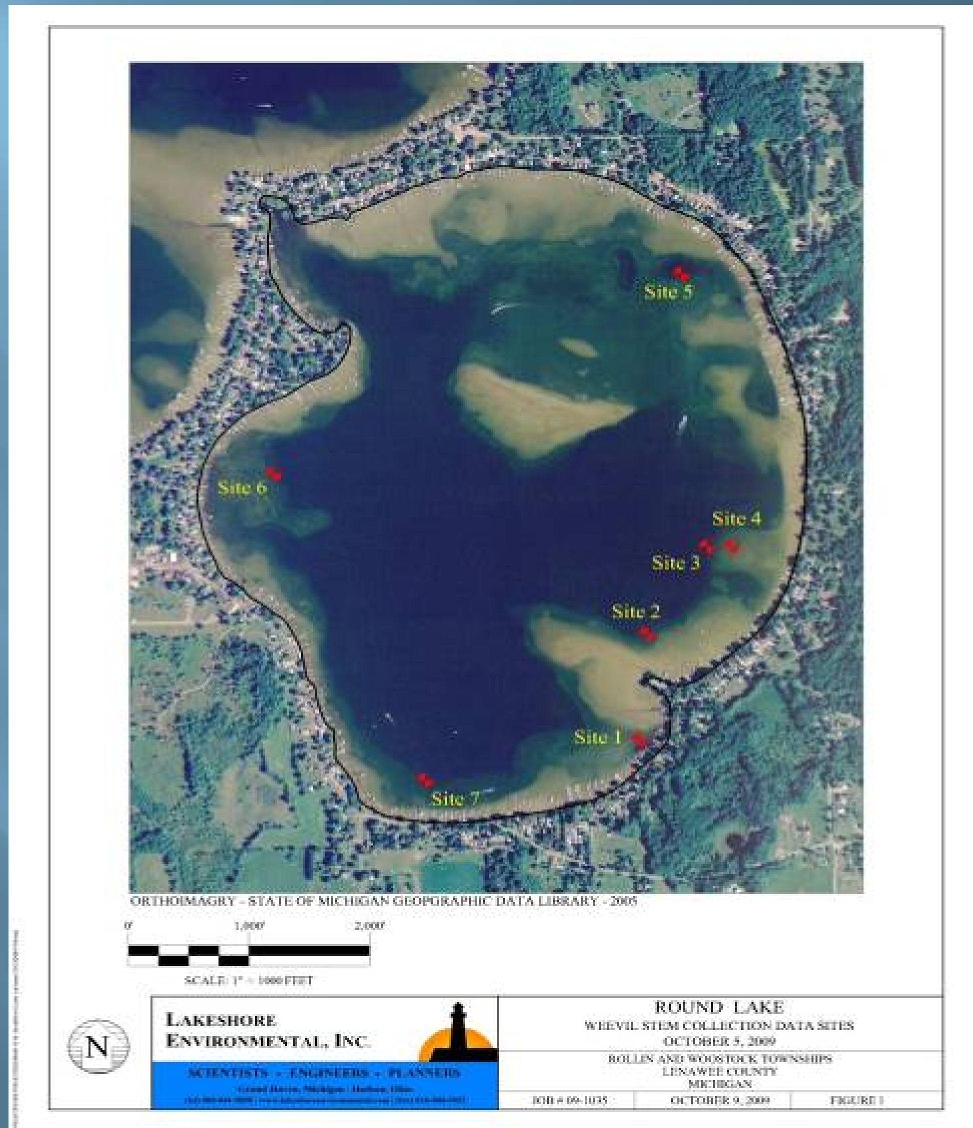
Evaluation Site EWM Stem Densities



Round Lake Stem Data Conclusions

- Sites T1 & T2 had significant reductions in Mean EWM stem length from July-September. Also, both sites had significant increase in index of weevil damage to EWM stems (site T1 had a higher damage index value) Was this due to less hybrids or higher stem densities??
- Sites T1 and C1 had highest stem densities of evaluation sites.
- The number of stem lateral branches increased in late summer…due to seasonal growth effect or weevil stimulation?
- Current data set strong after stocking 54,000 weevils in Round Lake during 2009 - EWM beds used in Evaluation during 2008 are sparse with some areas absent

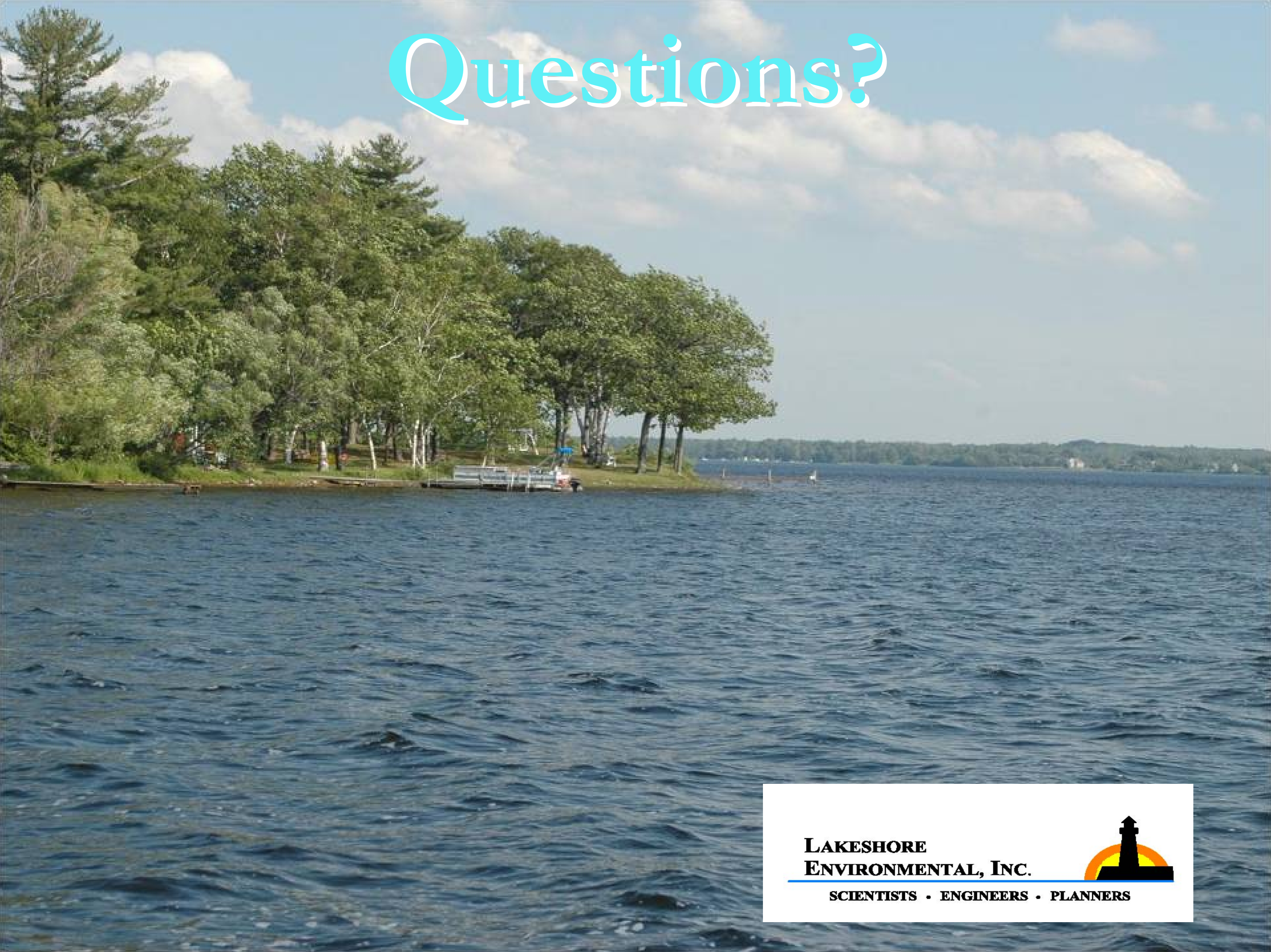
Weevil Stocking Sites used in 2009



Lake-Specific Management Conclusions:

- Management options should consider lake ecology, physico-chemical characteristics, longevity of solution, potential impacts to the ecosystem, riparian needs/philosophies, and costs
- In nutrient-rich systems and lakes with large, predominantly impervious watersheds, watershed management is a critical component for long-term success
- Lake management techniques should aim to work with nature to avoid further alteration of system and reduce maintenance when possible (Note: this is often unattainable, especially for artificial aquatic ecosystems)

Questions?



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