Bear Lake Improvement Program: A Success Story of EWM Management

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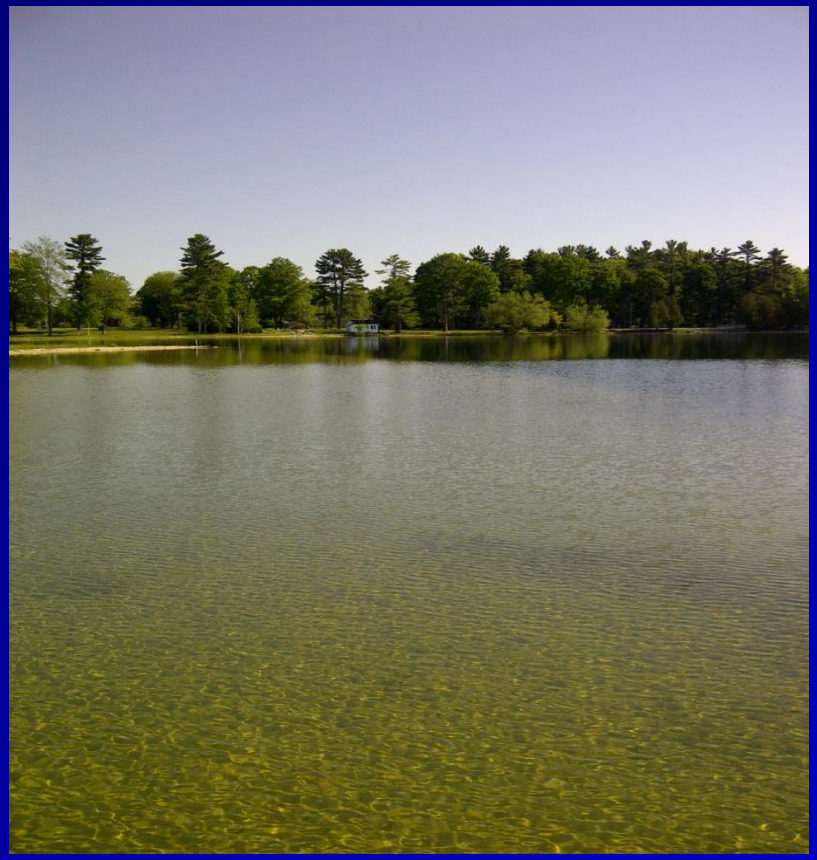
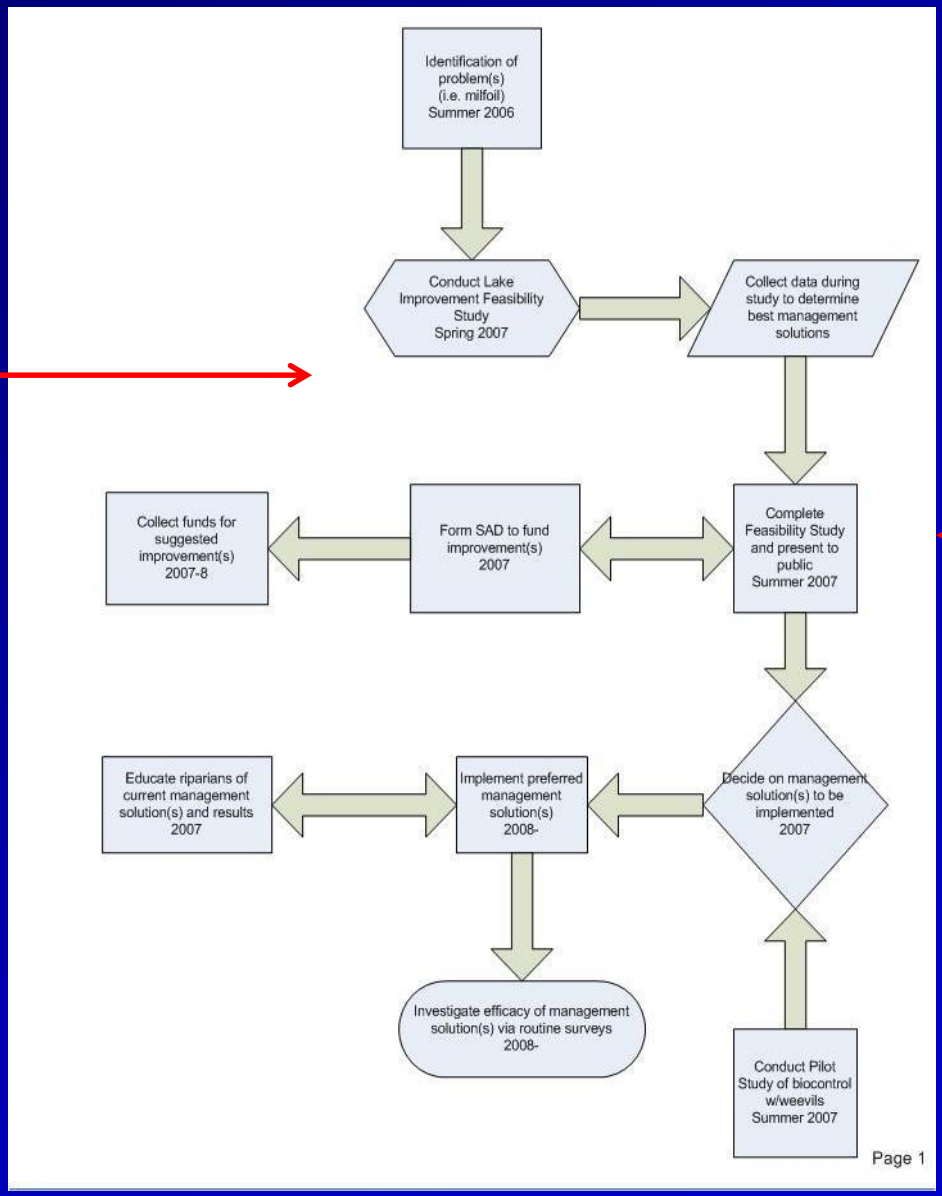


Bear Lake Improvement Program Formation

With assistance from Community Council to Control Milfoil (CCCM) formed by Raiff et al. CCCM was comprised of stakeholders such as BLPOA members, Promoters, Trigenta, Lions, the golf course, and other concerned citizens



1st Meeting of BLIB Held on 8/30/07

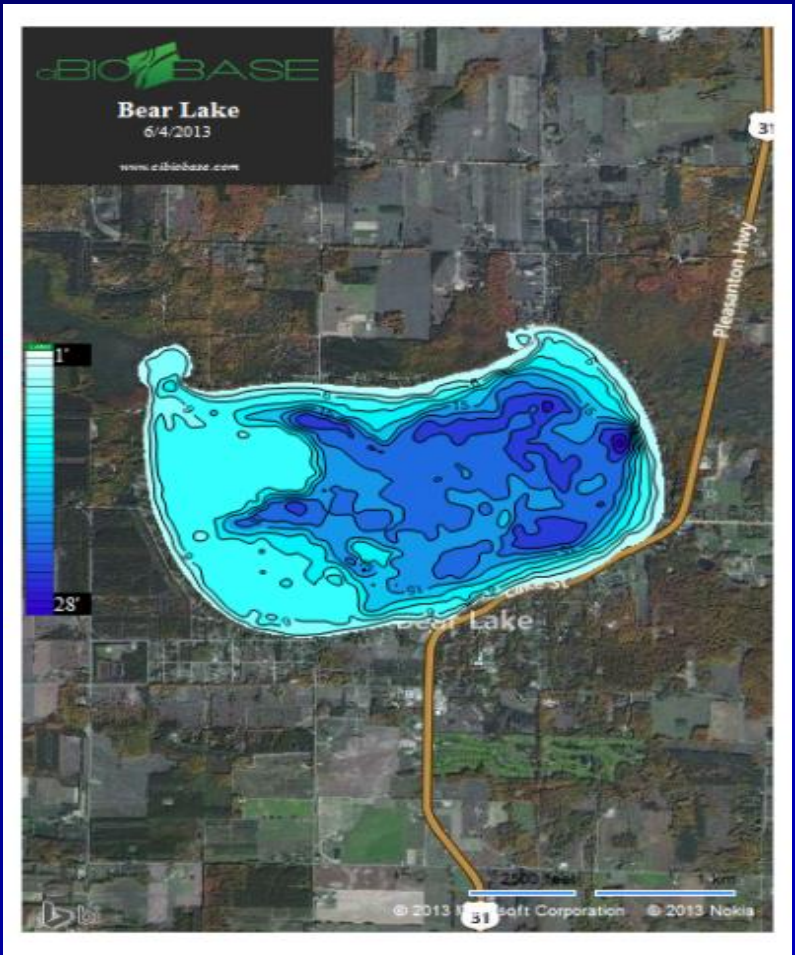
What the BLIB Does:

- Holds regular meeting to interface with public on lake concerns
- Commissions the limnologist to educate riparians by attendance at all meetings, a spring newsletter, and with a booth at Bear Lake Days
- Commissions the limnologist to conduct two GPS surveys of the entire lake bottom to scan for EWM and other invasives
- Commissions the limnologist to oversee each aquatic herbicide treatment to assure performance is to spec
- Commissions the limnologist to collect water quality data on the lake in spring and fall of each year and to provide an annual progress report
- Tests EWM for genetic hybridity (which complicates treatment)
- Essentially, insurance for Bear Lake!

The Bear Lake Improvement Board: Members P.A. 451 of 1994 (Part 309)

- Dave Adams, Pleasanton Township Representative
- Bob Yates, Bear Lake Township Representative and Secretary
- Greg McPherson, Village of Bear Lake Representative
- Don Brisbin, Riparian Representative and Chairman
- Ken Hilliard, Manistee County Drain Commissioner and Treasurer
- Pauline Jaquish, Manistee County Board of Commissioners

Bear Lake Physical Characteristics



- Primarily groundwater-fed
- Approx. 1,843 acres (during high water periods)
- Max. Depth = 24 ft.
- Mean Depth = 14.4 ft.
- Lake Volume = 26,503 acre-feet
- Shoreline Length = 7.62 miles
- Hydraulic Retention Time = 2.19 yrs.
- Watershed drainage area = 9,386 acres
- Shoreline Development Factor = 1.3
- Predominantly well-drained soils; some ponded soils in the West, East Bays and at SE shore of lake

Bear Lake Aquatic Algae Analyses*

- 10-15 species of Green Algae (Chlorophyta); Preferred source
- 8-10 species of diatoms (Basillariophyta)
- 2 species of Blue-green algae (Cyanobacteria); including *Microcystis* sp. (less-preferred)
- A good balance; focus future analyses on relative proportion of blue-greens: greens

Bear Lake Native Aquatic Plants

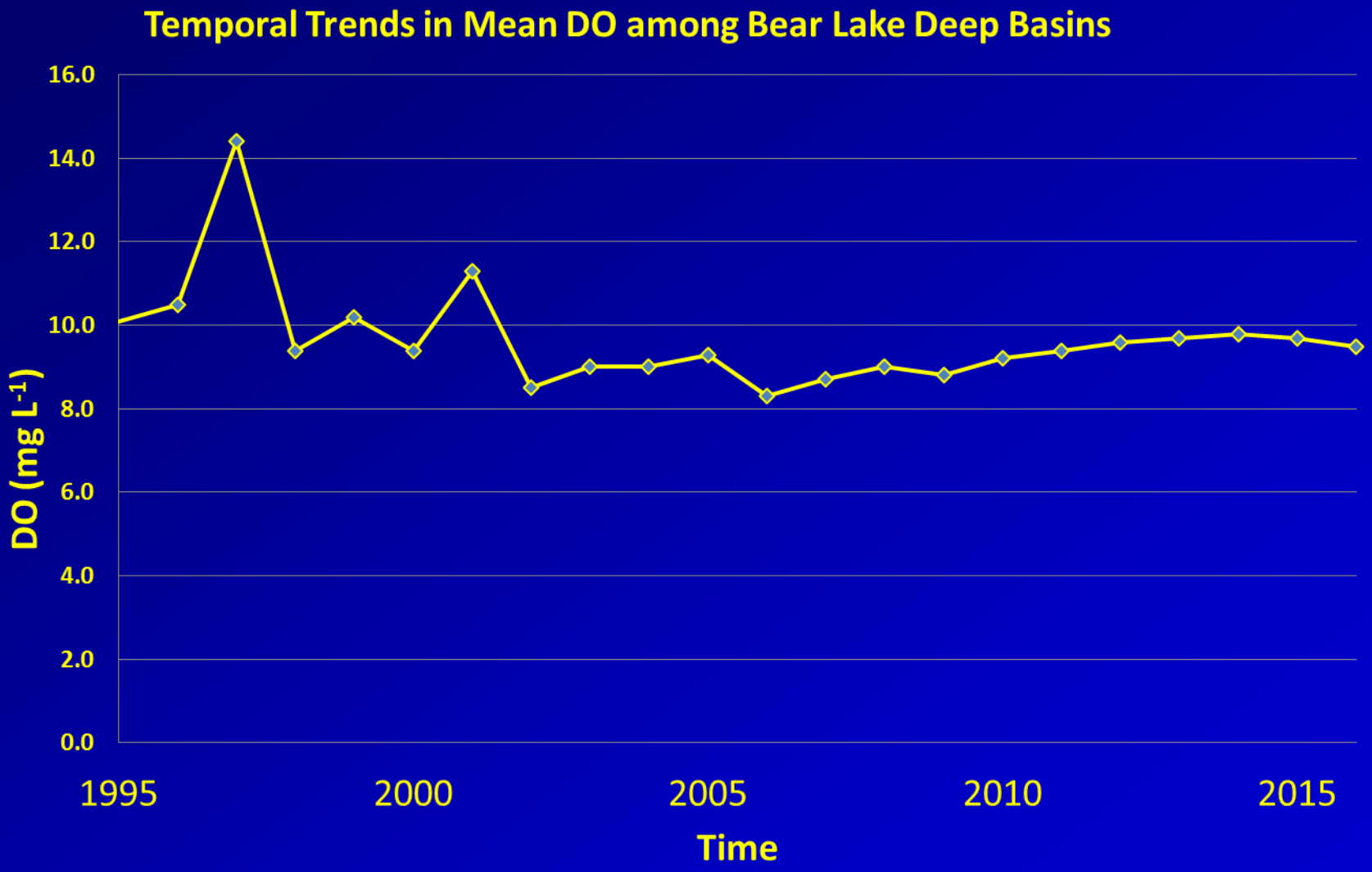
- 21 Submersed, rooted species (was 13 prior to EWM management)
- 3 Floating-leaved, rooted species
- 4 Emergent, rooted species
- Robbin's Pondweed common throughout lake; Also common were Chara sp., Illinois and Variable-leaved Pondweeds
- Growth of riparian vegetation around shoreline is encouraged

Scirpus – a bulrush

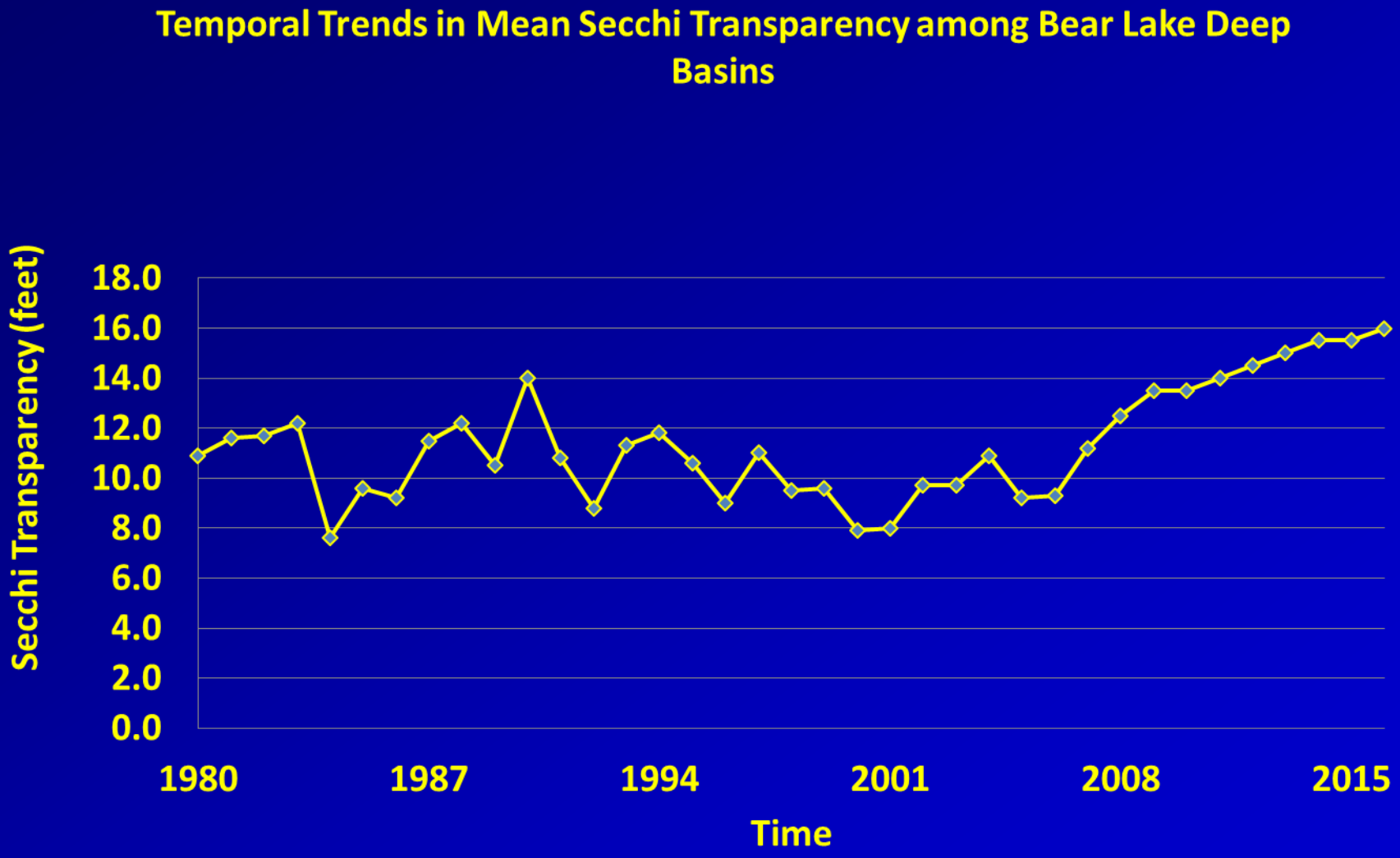
Potamogeton illinoensis – a pondweed

Native Aquatic Plant Species	***Aquatic Plant Common Name***	***% cover in/around Bear Lake (June 2016)***	***% cover in/around Bear Lake (Sept. 2016)***
Chara vulgaris	Muskgrass	4.5	5.5
Potamogeton illinoensis	Illinois Pondweed	4.0	9.0
Potamogeton pusillus	Small-leaf Pondweed	2.8	6.0
Potamogeton robbinsii	Fern-leaf Pondweed	8.1	16.7
Stuckenia pectinatus	Sago Pondweed	0.9	3.3
Potamogeton amplifolius	Large-leaf Pondweed	0.9	7.0
Potamogeton praelongus	White-stem Pondweed	2.0	8.8
Potamogeton gramineus	Variable-leaf Pondweed	6.5	13.7
Potamogeton natans	Floating-leaf Pondweed	3.0	4.0
Potamogeton zosteriformis	Flat-stem Pondweed	0.5	3.0
Vallisneria americana	Wild Celery	8.0	8.9
Najas guadalupensis	Southern Naiad	5.5	9.4
Najas flexilis	Slender Naiad	0.2	1.4
Myriophyllum tenellum	Leafless Watermilfoil	19.0	24.7
Megalodonta beckii	Water Marigold	4.0	5.6
Ceratophyllum demersum	Coontail	2.0	2.0
Elodea canadensis	Common Elodea	5.8	9.0
Utricularia vulgaris	Common Bladderwort	4.0	6.6
Utricularia minor	Small Bladderwort	0.1	0.1
Nymphaea odorata	White Waterlily	0.4	0.4
Nuphar variegata	Yellow Waterlily	0.6	0.7
Brasenia schreberi	Watershield	0.5	1.9
Typha latifolia	Cattails	0.9	0.9
Scirpus acutus	Bulrushes	0.7	1.2
Iris versicolor	Blueflag Iris	0.1	0.2
Decodon verticillatus	Swamp Loosestrife	0.9	1.0

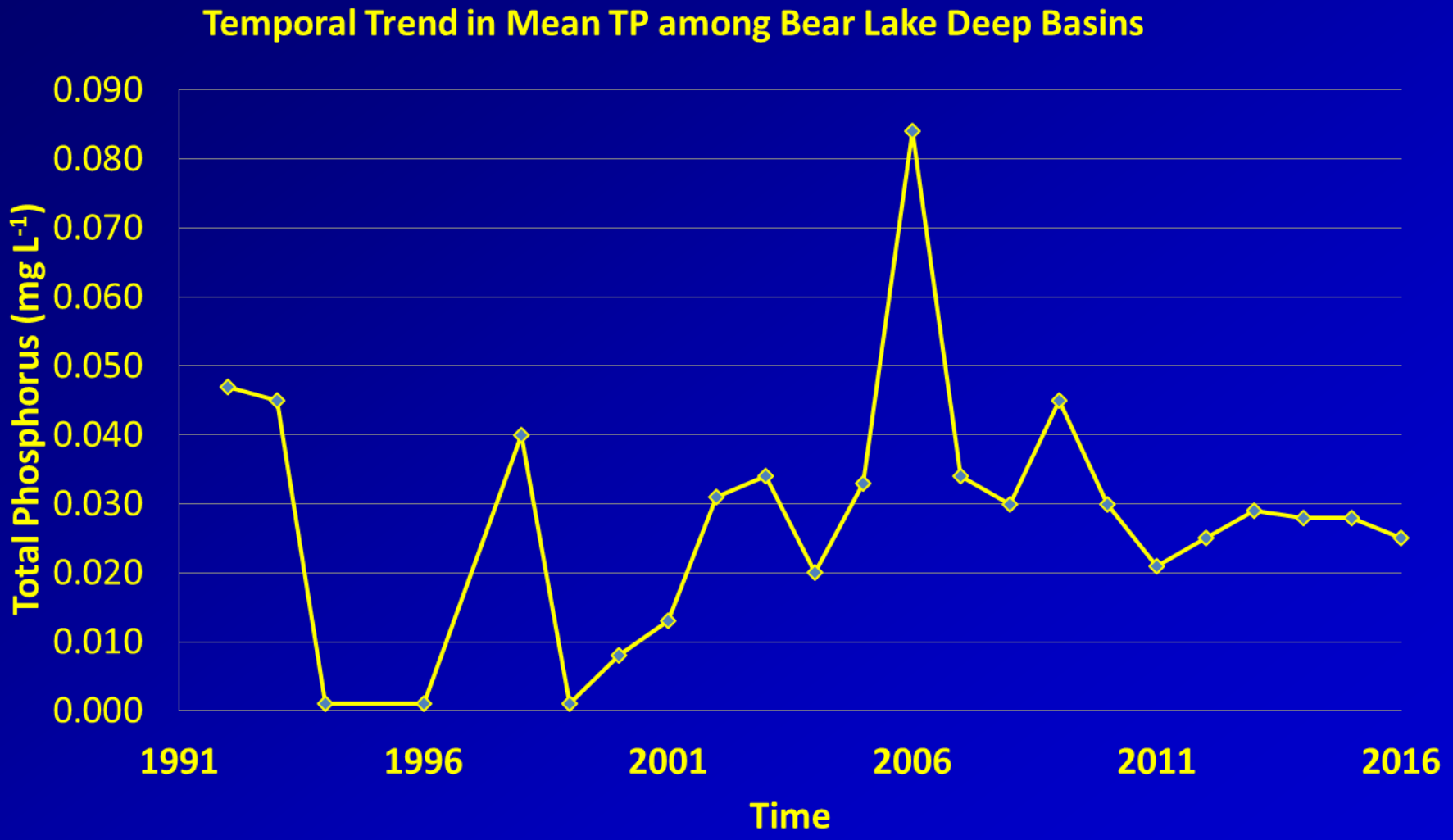
Bear Lake Annual Mean Dissolved Oxygen Concentrations



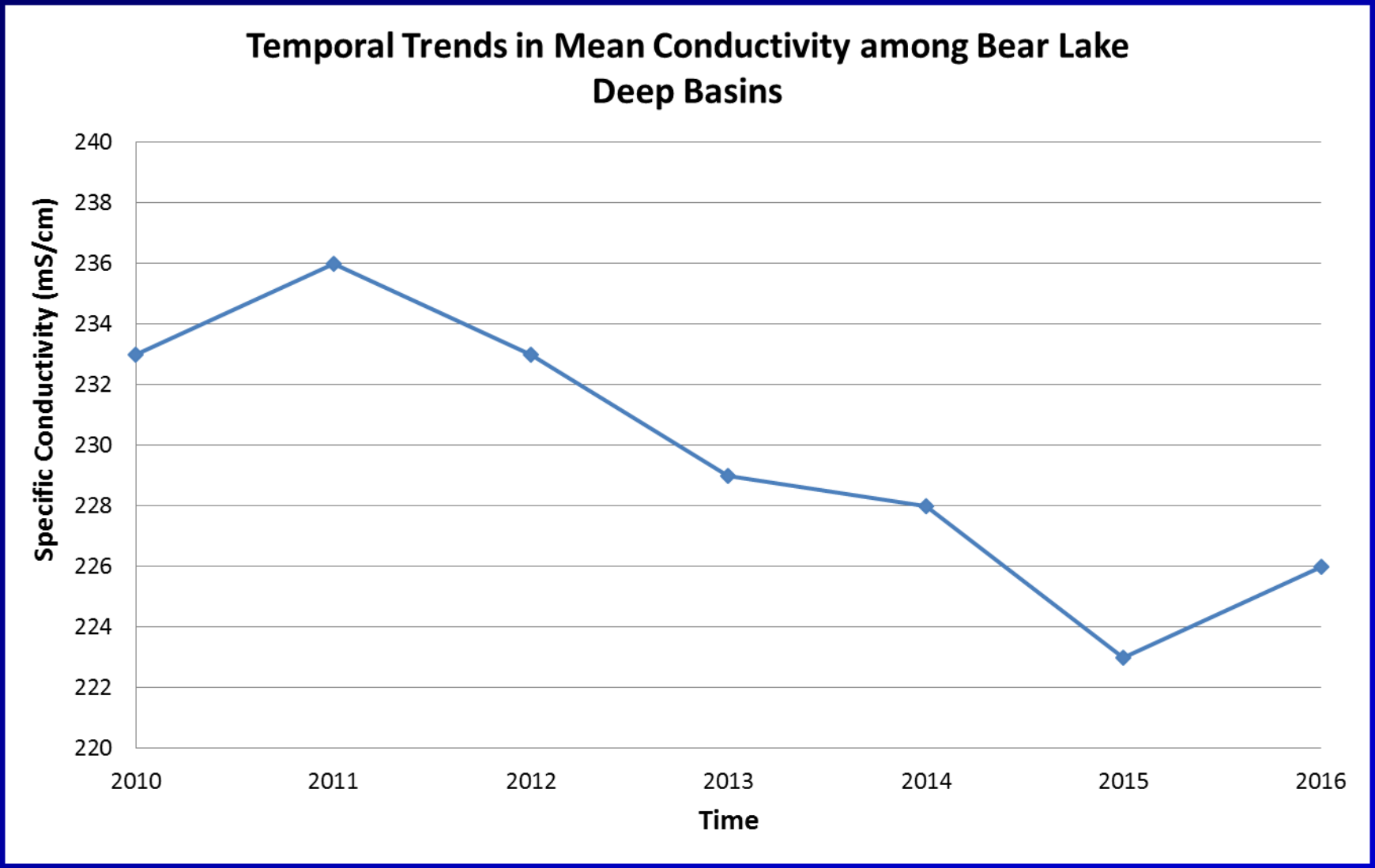
Bear Lake Annual Mean Secchi Transparency



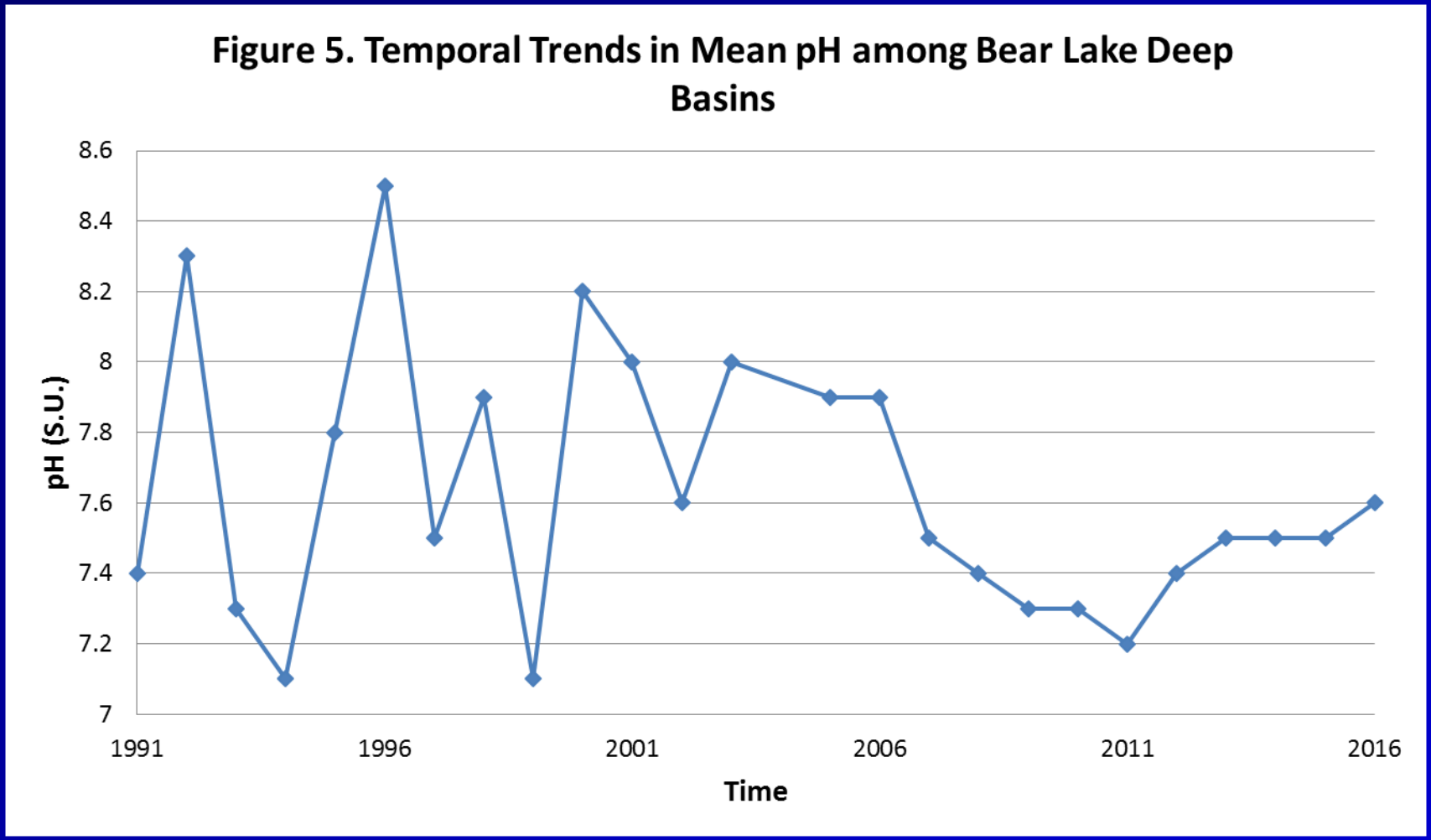
Bear Lake Annual Mean Total Phosphorus Concentrations



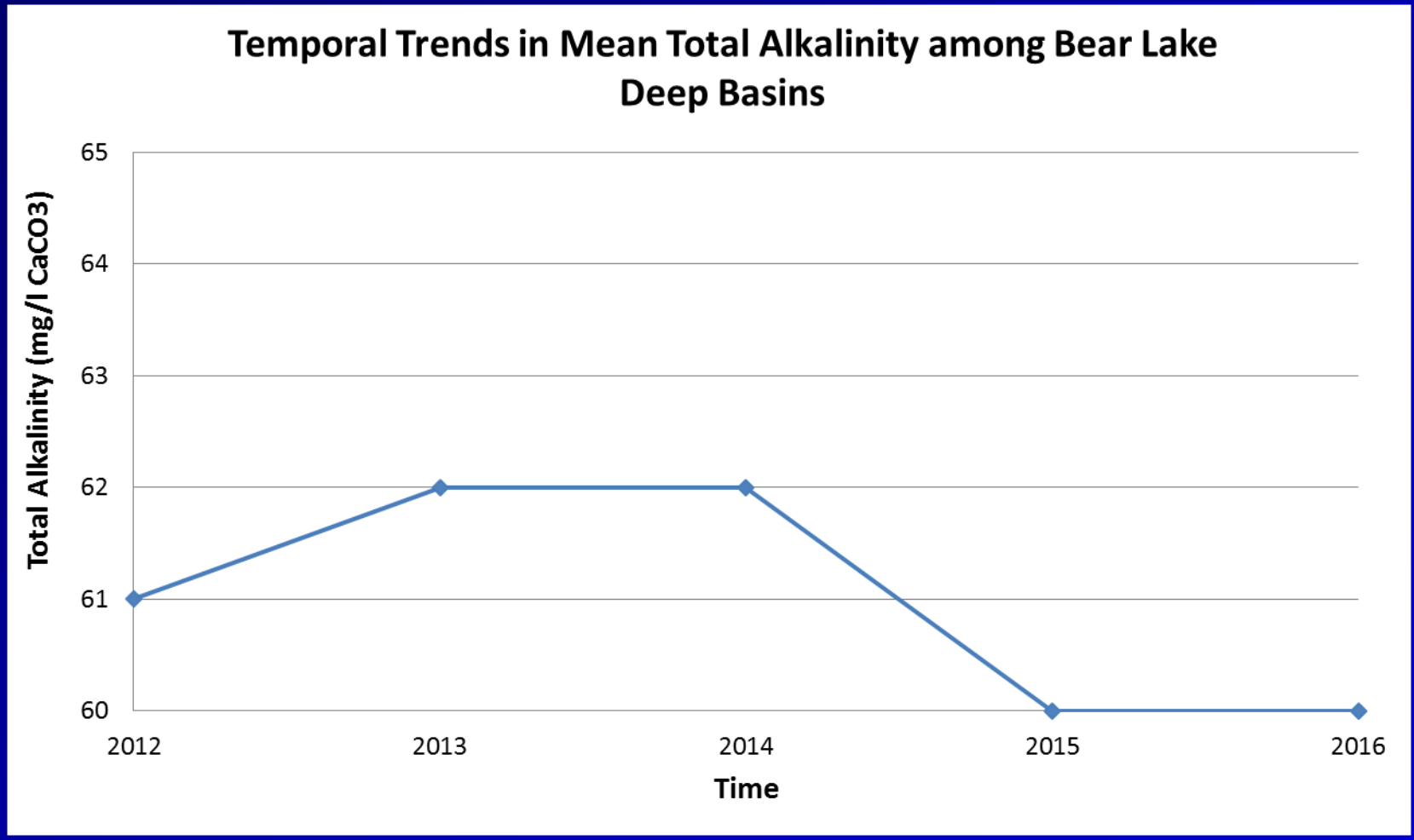
Bear Lake Annual Mean Conductivity



Bear Lake Annual Mean pH Values



Bear Lake Annual Mean Alkalinity Values



Sample 1 – Bear Lake Marina	Sample type – Dip Net/Sediment Grab				
		Odonata	Coregonidae	2	Damselfly larvae
		Ephemeroptera	Isonychidae	3	Mayfly larvae
		Trichoptera	Limnephilidae	1	Caddis larvae
		Diptera	Chironomidae	2	Midge larvae
			Total	**8**	
Sample 2 – Northwest Cove	Sample type – Dip Net/Sediment Grab				
		Diptera	Chironomidae	4	Midge larvae
			Total	**4**	
Sample 3 – Mid-lake sample – milfoil bed	Sample type – Dip Net/Sediment Grab				
		Diptera	Chironomidae	1	Midge larvae
		Amphipoda	Gammaridae	1	Freshwater shrimp
			Total	**2**	

The Problem: Eurasian Watermilfoil (*Myriophyllum spicatum* L.)

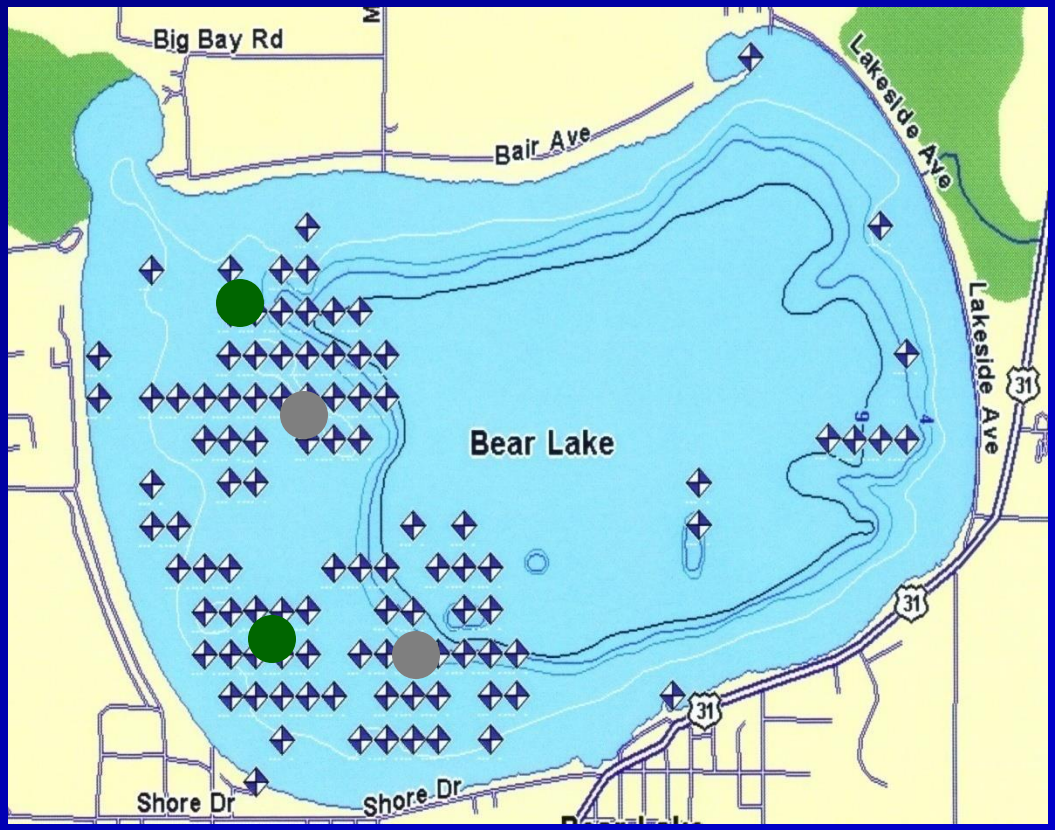
- Highly invasive; not native to U.S. waters
- Growth rates up to 1 inch per day
- Spreads via numerous reproductive means – fragmentation, seed, turion, and sedimentary stolons
- Displaces favorable native aquatic plants
- Disrupts ecological balance of Bear Lake


Bear Lake Eurasian Watermilfoil, 2007


Big Bay Rd
Bair Ave
Lakeside Ave
Lakeside Ave
Bear Lake
9
4
31
31
31
Shore Dr
Shore Dr

Bear Lake Weevil Experimental Sites

- 2 control and 2 treatment sites
- Test plot areas 144 ft^2 in size; marked with GPS
- Weevil stocking density of ~182 weevils m^{-2}
- Depth of experimental sites approximately 6-8 feet
- Areas marked with yellow sediment stakes
- Not significant results
- Predation by fish evident



Treatment Sites

Control Sites

EWM Overgrowth in Other Lakes:

EWM Management Options Considered

- **Mechanical Harvesting** – Causes fragmentation of EWM stems, temporary, not feasible

- **Biological Control** – Was considered for long-term control, yet not reliable for resisting "spread", failed to prove satisfactory results on EWM; no longer available

- **Chemical Herbicides** – Contacts such as Reward offer only temporary control; do not kill entire plant. Systemics such as 2,4-D very effective and allow for localized treatments. Triclopyr may be used for spot-treatments near shore

- **No Action** – Would have likely lead to a whole-lake treatment (SONAR) or declines in property values

What Has Been Used to Treat Bear Lake EWM?

- **Systemic Herbicide 2,4-D-** Different than land-applied formula
  biodegrades into Cl, CO2, and NH3+
  Kills roots of plant to allow other natives to replace EWM
  Can only be used 250+ feet offshore

- **Systemic Herbicide Triclopyr-**
  Two week watering restriction in smaller lakes for ornamentals
  Kills roots slowly to allow for less algal blooms and more natives
  Can be used in shallow areas near shore

What Happens if We Kill Too Much Vegetation ?

Toxic Blue-green algae bloom, Spring Lake, Ottawa County, MI

Lake may not be able to break down plant matter fast enough

What Will Happen If We Do Nothing?

- EWM will displace native aquatic plant species
- Fishery will decline in quantity and quality
- Excessive die-off of massive EWM beds will cause major declines in water quality parameters
- Hydrilla or other species may invade and further destroy the lake

Bear Lake EWM Program Proposed Cost Estimates (2017-2021)

Management Item	2017	2018	2019	2020	2021
EWM Management Methods/Herbicides MDEQ permit	$8,500	$8,500	$8,500	$8,500	$9,000
Legal Expenses/Publ.	$9,000	$1,500	$1,500	$1,500	$1,500
Professional Services/Audit	$15,000	$15,000	$15,000	$15,000	$15,000
Contingency	$3,250	$2,500	$2,500	$2,500	$2,600
TOTAL ANNUAL COST	$32,750	$27,500	$27,500	$27,500	$27,500

Future Management Recommendations

- Continue monitoring vegetation for necessary spot-treatments of invasive aquatic plants and to assess native biodiversity
- Continue monitoring water quality and tie in with watershed plan
- Continue riparian education
- Continue to keep assessment equivalent to a mid-range year of treatment (not too low, not too high)
- Assist the BLIB with by-laws and future objectives

Questions or Comments ?