Allied Biological

Tuxedo Lake

- Orange County, NY
  - Hudson Valley Region
- Village of Tuxedo Park
- Private Access
- Lake Warden Program
  - Patrol Areas
  - Regulate Boating
  - Regulate Fish Stocking
  - Mandated Steam Cleaning
    - Boats not over wintered
    - Consultant Boats

Tuxedo Lake

- 288 Surface Acres
- Class AA (T)
- Mean Depth: 29.2 feet
- Max. Depth: 62.4 feet
- Limited Littoral Zone
  - ~ 5% to 10%
  - Limited Plant Growth
- CSLAP
  - 2008 to present

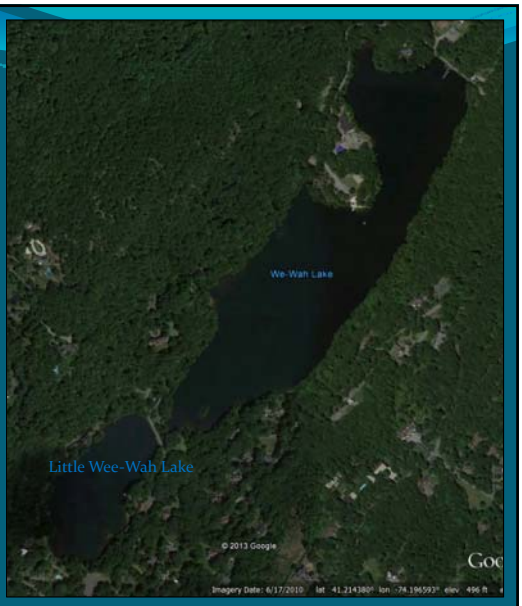
Other Basins

Wee-Wah Lake

- 57.6 surface acres
- 8.2 ft. AD
- 17.4 ft. max depth
- Drawn-down ~6 feet
  - Dam Repairs
- Swimming Beach

Little Wee-Wah Lake

- 11.1 surface acres
- 7.2 ft. AD
- 15.1 ft. max depth



Water Flow

Ramapo River

↑

Wee-Wah Lake

↑

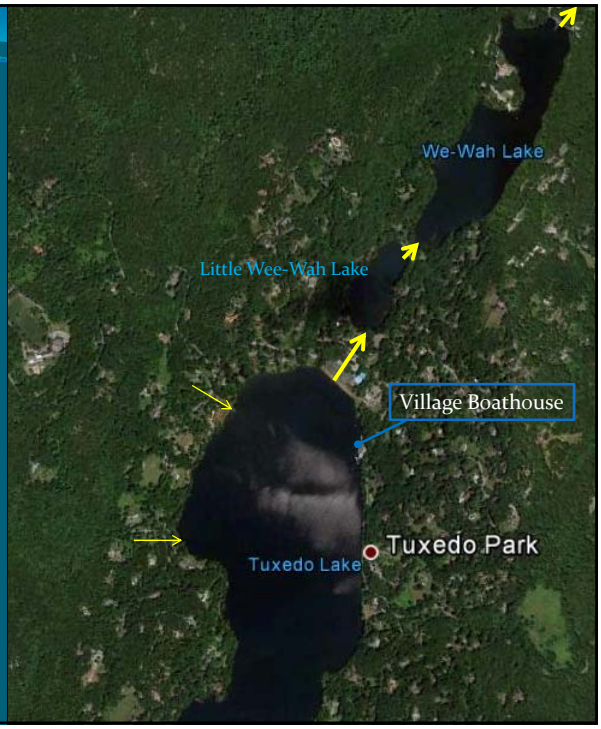
Little Wee-Wah Lake

↑

Tuxedo Lake

↑

Summit Brook



Eurasian Water Milfoil Discovery

- **October 9, 2011: Discovered by CSLAP volunteers**
  - Observed during paddling the lake
  - "aquatic weeds that looked unusual"
  - Collected plant samples
  - Verified by experts in Albany and the Adirondacks
- **October 16, 2011: Follow-up Survey**
  - Conducted by Jospe and Hays
  - Confirmed infestation along the dam shoreline
    - Provided a detailed description
  - Did not observe EWM along other shores or in the Southern part of the basin
- **October 17, 2011: Contacted Allied Biological**

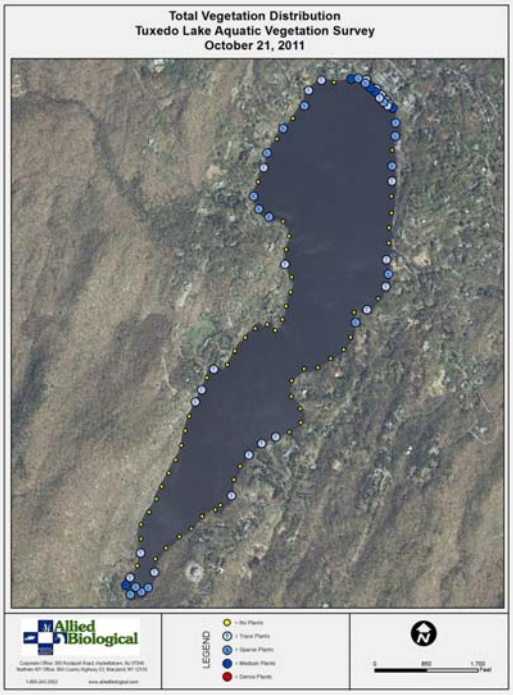
Point-Intercept Macrophyte Survey

October 21, 2011

Targeted 100 sample locations throughout the littoral zone
- Actual Number: 104
- Mostly along the shorelines

Additional locations along the dam, and southern end of basin
- Visual survey between all locations (clarity ~12 feet)
- But not ideal weather

- All locations GPS-referenced
  - sub-foot accuracy
- One weed anchor toss/site



October 21, 2011 Tuxedo Lake Aquatic Macrophyte Abundance

Aquatic Macrophyte	Total Abundance Sites	Total Abundance %	Trace Abundance Sites	Trace Abundance %	Sparse Abundance Sites	Sparse Abundance %	Medium Abundance Sites	Medium Abundance %	Dense Abundance Sites	Dense Abundance %
Total Sites	104	100%								
Total Submersed Vegetation	48	46%	23	48%	20	42%	5	10%	0	0%
Tape-grass	31	30%	19	61%	11	35%	1	3%	0	0%
Robbin's Pondweed	18	17%	13	72%	2	11%	3	17%	0	0%
Slender Naiad	18	17%	9	50%	9	50%	0	0%	0	0%
Small Pondweed	9	9%	8	89%	1	11%	0	0%	0	0%
Eurasian Water Milfoil	6	6%	4	67%	1	17%	1	17%	0	0%
Bass Weed	6	6%	3	50%	3	50%	0	0%	0	0%
Arrowhead	5	5%	5	100%	0	0%	0	0%	0	0%
Benthic Filamentous Algae	5	5%	4	80%	1	20%	0	0%	0	0%
Watermoss	3	3%	1	33%	2	67%	0	0%	0	0%
Stonewort	1	1%	1	100%	0	0%	0	0%	0	0%

Low Macrophyte Diversity (n = 8)
- Limited Littoral Zone
- Substrate
- Survey Timing (late Oct.)

Tape-grass (wild celery) was dominant submersed macrophyte
- 30% of sites

Macro-algae and BFA observed

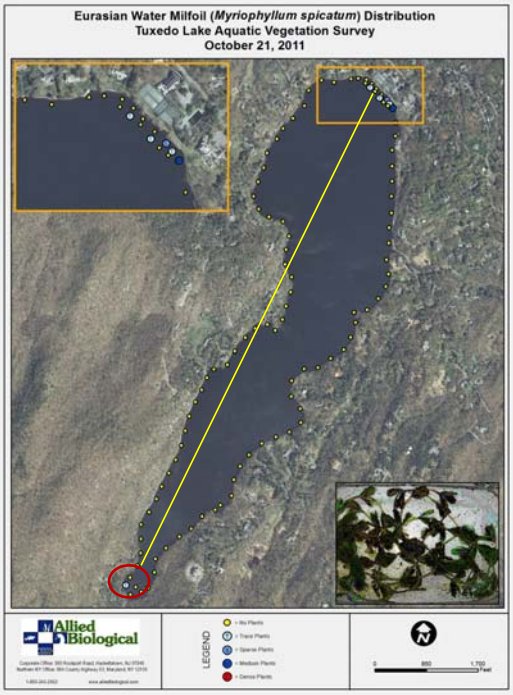
No Floating macrophytes (i.e. lilies)

Eurasian Water Milfoil Abundance and Distribution

- EWM collected at 6 sites
  - 4 Trace, 1 Sparse, 1 Medium
- Five sites located along the Dam shore
- But also observed in between sample locations

But….

One trace site collected at the south end of the lake (~ 1.75 miles from dam!)



Eurasian Water Milfoil Control Options

- **Herbicides**
  - Renovate OTF (granular) with a containment curtain
  - Water Use Restrictions
  - EWM at the Outlet (downstream effects)
  - Negative Public Perception
- **Benthic Barriers**
  - Labor Intensive
  - Underwater Obstructions
  - Expensive (materials, installation, and maintenance)
- **Suction Harvesting (DASH)**
  - Non-selective
- **Hand Pulling**
  - Relatively low stem density
  - Selective
  - Positive Public Perception

2012 EWM Control at Tuxedo Lake

2012 Hand Pulling
- Aquatic Inv. Management, LLC (AIM)
- Three Diver Crew
- Conducted July 9-13, 2012

Total Bags Harvested
- 23.25 bags
- 581.25 lbs.
- Dam shoreline-2 days hand pulling
- Sporadic Growth:

East Shoreline
- At boat club
- South of boat club
- Other Potential Sites

South End of Lake
- Low density growth
- But very suitable for EWM

West Shoreline
- Devoid of EWM

Fragment Curtain
- 1/16" mesh curtain
- Foam float top/weighted bottom

Air compressors
- 4 hour run time
- Can be refueled

Divers: 10 hour work day
- Average in water time: ~7 hours day
- Crew Rotation
- All Divers SCUBA certified

Training Includes:
- Hand Harvesting Techniques
- Safety Protocols
- Hand Signal Communication
- Formation Swimming
- Aquatic Plant ID
- Littoral Zone Identification

Photo Courtesy of AIM

Hand Pulling in Action!

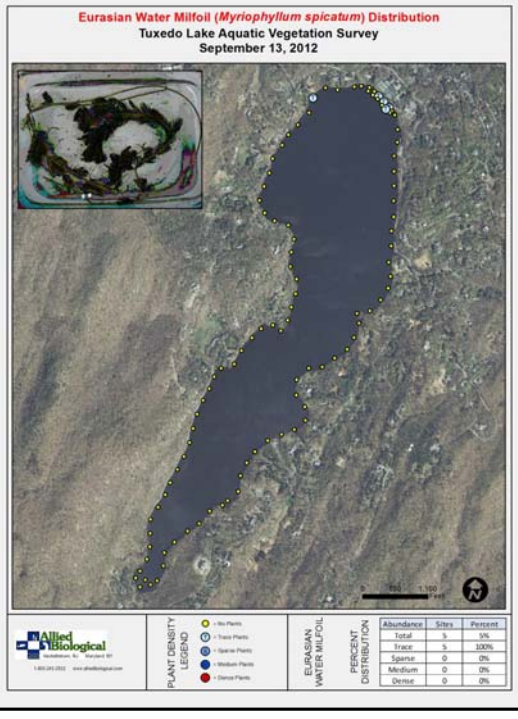
Photos Courtesy of AIM

2012 Point-Intercept Surveys

- **Assumed EWM spread to Little Wee-Wah and Wee-Wah Lakes**
  - Based on EWM location and flow dynamics
  - Confirmed in Wee-Wah Lake (Feb. 2012)
- **ABI to conduct Point-Intercept Surveys in these two basins**
  - Determine the abundance and distribution of EWM
  - Survey: June or July
    - Maps to be used by AIM to Hand Pull these basins, or
  - Develop alternate EWM Control Programs
- **Tuxedo Lake to be surveyed in late season (Sept.)**
  - Determine the efficacy of hand pulling project
  - Planning for hand pulling efforts in 2013
  - Identify any new infestations in the basin

Tuxedo Lake

- 2012 Point-Intercept Survey
- Sept. 13, 2012
- Utilized same 104 sample locations as 2011 Survey
- Visual Littoral Zone Survey as well



Sampling Location	# of Stems Observed	Notes
Near site T4	5 rooted stems	Hand pulled 4 stems near surface; at least one more observed
Near site T42	10-15 rooted stems	Mixed in with other plants
Site T85 (and nearby)	4 rooted stems; one fragment on anchor	Hand pulled the 4 stems
Near site T89	2 stems rooted stems	
Site T92	1 stem on anchor	
Between T92 and T93	2 stems rooted stems	
On shore near T93	2 floating stems	Removed from lake
Site T93	2 stem fragments on anchor	
Near T94	5 stems (one on anchor)	
Between T94 and T95	17 rooted stems	Clumps of 9, 3 and 5 stems
Site T96	~20 rooted stems	One floating stem observed and collected
Near site T97	2 rooted stems	
Site T98	2 stems on anchor	
Near site T101	2 rooted stems	
Near site T103	1 rooted stem	
Near T104	4 rooted stems	Located near end of dock; hand pulled

September 13, 2012 Tuxedo Lake Aquatic Macrophyte Abundance

Aquatic Macrophyte	Total Abundance		Trace Abundance		Sparse Abundance		Medium Abundance		Dense Abundance	
	Sites	%	Sites	%	Sites	%	Sites	%	Sites	%
Total Sites	**104**	**100%**								
Total Submersed Vegetation	**53**	**51%**	15	28%	24	45%	14	26%	0	0%
Wild Celery	**37**	**36%**	8	22%	19	51%	10	27%	0	0%
Arrowhead Rosette	**14**	**13%**	12	86%	2	14%	0	0%	0	0%
Robbin's Pondweed	**14**	**13%**	12	86%	2	14%	0	0%	0	0%
Slender Naiad	**12**	**12%**	8	67%	0	0%	4	33%	0	0%
Bass Weed	**6**	**6%**	6	100%	0	0%	0	0%	0	0%
Leafy Pondweed	**6**	**6%**	5	83%	1	17%	0	0%	0	0%
Eurasian Water Milfoil	**5**	**5%**	5	100%	0	0%	0	0%	0	0%
Benthic Filamentous Algae	**5**	**5%**	5	100%	0	0%	0	0%	0	0%
Water Moss	**4**	**4%**	2	50%	2	50%	0	0%	0	0%
Stonewort	**1**	**1%**	1	100%	0	0%	0	0%	0	0%
Small Pondweed	**1**	**1%**	1	100%	0	0%	0	0%	0	0%
Pipewort	**1**	**1%**	1	100%	0	0%	0	0%	0	0%
Spikerush	**1**	**1%**	1	100%	0	0%	0	0%	0	0%
Spiral-fruited Pondweed	**1**	**1%**	0	0%	1	100%	0	0%	0	0%

Increase in macrophyte diversity (n = 13)
- Timing of the survey (Sept. vs. Oct.)

Distribution similar, but abundance increased

Dwarf water milfoil also observed

Still no floating macrophytes

July 12, 2012 Little Wee-Wah Lake Aquatic Macrophyte Abundance

Aquatic Macrophyte	Total Abundance		Trace Abundance		Sparse Abundance		Medium Abundance		Dense Abundance	
	Sites	%	Sites	%	Sites	%	Sites	%	Sites	%
Total Sites	25	100								
Total Submersed Vegetation	17	68%	12	71%	4	24%	1	6%	0	0%
Eurasian Water Milfoil	16	64%	13	81%	3	19%	0	0%	0	0%
Robbin's Pondweed	8	32%	5	63%	3	38%	0	0%	0	0%
Slender Naiad	7	28%	7	100%	0	0%	0	0%	0	0%
Benthic Filamentous Algae	5	20%	3	60%	1	20%	1	20%	0	0%
Bass Weed	4	16%	4	100%	0	0%	0	0%	0	0%
Spike Rush	1	4%	1	100%	0	0%	0	0%	0	0%

Very Low Diversity (n = 5 plus BFA)
EWM was the dominant macrophyte

- 64% of the sites surveyed
- Most at trace density

Little Wee-Wah Lake Total Sub. Vegetation and EWM Distribution

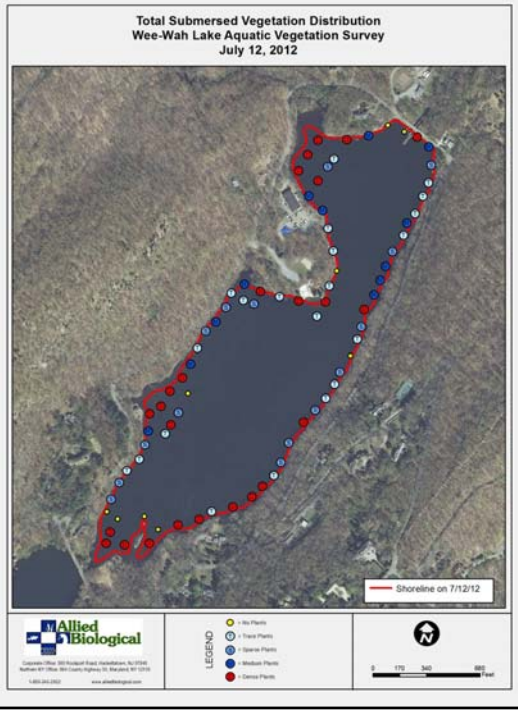
Wee-Wah Lake July 12, 2012 Aquatic Macrophyte Abundance

Aquatic Macrophyte	Total Abundance		Trace Abundance		Sparse Abundance		Medium Abundance		Dense Abundance	
	Sites	%	Sites	%	Sites	%	Sites	%	Sites	%
Total Sites	82	100%								
Total Submersed Vegetation	73	89%	21	29%	15	21%	12	16%	25	34%
Common Waterweed	70	85%	22	31%	17	24%	11	16%	20	29%
Small Pondweed	50	61%	27	54%	12	24%	5	10%	6	12%
Benthic Filamentous Algae	35	43%	19	54%	8	23%	6	17%	2	6%
Eurasian Water Milfoil	25	30%	20	80%	4	16%	1	4%	0	0%
Slender Naiad	5	6%	4	80%	0	0%	0	0%	1	20%
Arrowhead (rosette)	2	2%	2	100%	0	0%	0	0%	0	0%
Robbin's Pondweed	1	1%	1	100%	0	0%	0	0%	0	0%
Spikerush	1	1%	1	100%	0	0%	0	0%	0	0%
Spiral-fruited Pondweed	1	1%	1	100%	0	0%	0	0%	0	0%
Total Floating Vegetation	15	18%	9	60%	3	20%	3	20%	0	0%
Floating Filamentous Algae	15	18%	9	60%	3	20%	3	20%	0	0%

Low Aquatic Macrophyte Diversity (n = 8)
Increased BFA and FFA
Dominant Macrophyte: Common Waterweed
- 85% of sites (45% at nuisance density)
- Not present in other basins

EWM at 30% of sites
- Most at trace density
- But mixed with other plants
- Reduced hand pulling efficacy?

Wee-Wah Lake Total Submersed Vegetation and EWM Distribution



2012 Hand Pulling in Wee-Wah and Little Wee-Wah Lakes

2012 Hand Pulling
- Conducted by AIM
- July 16-20, 2012

Little Wee-Wah Lake
- Total Bags Harvested: 11
- Total Weight: 275 lbs
- Most EWM at southern inlet end
- Sporadic growth throughout

Wee-Wah Lake
- Total Bags Harvested: 11
- Total Weight: 275 lbs
- Most in southern shallows
- But sporadic growth throughout
- Mixed in with native waterweed

Time Line of Rapid Response

- Oct. 9, 2011: Initial Discovery of EWM
- Oct. 16, 2011: Confirmed Infestation
- Oct. 21, 2011: Tuxedo Lake Macrophyte Survey (ABI)
- Jan. and Feb., 2012: Village Board Meetings
- July 9-13, 2012: Tuxedo Lake Hand Pulling (AIM)
- July 12, 2012: Wee-Wah and Little Wee-Wah Lake Macrophyte Surveys (ABI)
  - EWM Maps to AIM on 7/13/12
- July 16-20, 2012: Wee-Wah/Little Wee-Wah Lakes Hand Pulling (AIM)
- September, 13, 2012: Tuxedo Lake Macrophyte Survey (ABI)
- February, 2013: Planning for 2013 EWM Control Program

2013 EWM Control Program

- **Hand Pulling EWM**
  - To be conducted by AIM
  - Tuxedo Lake (<1 week)
  - Wee-Wah and Little Wee-Wah Lake (>1 week)
- **Aquatic Plant Surveys**
  - At this time, no Point-Intercept surveys planned
    - Possible add-on late in season
  - AIM will conduct visual littoral zone surveys
  - Budget shifted to WQ program
    - Rotated out of CSLAP in 2013

Thank You!

Acknowledgements

- Tom Wilson, Mayor of Tuxedo Park
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