



LAPA - West
Lakes and Ponds Association of Western Massachusetts
The Western Chapter of COLAP
Massachusetts Congress of Lakes and Ponds



DATA ANALYSIS SUMMARY

Introduction...

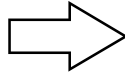
The following data analysis summary is the result of a project funded by the Massachusetts Environmental Trust. The overall goal of this project is to develop a transferable process of cost-effective water quality data analysis leading to improved volunteer monitoring practices and the development of effective lake management strategies. Through this process a unique panel of experts was convened including, Dr. Steve Souza of Princeton Hydro LLC., Dr. Dave Mitchell with Dr. Ken Wagner of ENSR, Dr. C. Barre Hellquist of the Massachusetts College of Liberal Arts, Dr. Paul Godfrey of the University of Massachusetts, and Jerry Schoen Statewide Coordinator of the Massachusetts Water Watch Partnership. The panel reviewed and analyzed water quality data in order to evaluate environmental monitoring practices and the ecological health of a particular water body.

The project utilized a case-study approach using prior water quality monitoring data from Onota Lake, collected by volunteers from the Lake Onota Preservation Association (LOPA) and paid consultants. LOPA is a model of the progress that volunteer monitors have begun to make. LOPA has collected years of water quality data, has collaborated with the City of Pittsfield, has begun several implementation projects, and has completed a DEP/EPA Approved Quality Assurance Project Plan (QAPP). For these reasons Onota Lake serves as an excellent model of what volunteer water quality monitors can accomplish.

Data from Onota Lake will be also be incorporated as a case study/template into the Data Interpretation Manual developed by MassWWP. Incorporating data reviewed by the scientific advisory panel into this statewide manual will expand the manual to include an example that will be able to be used by volunteers in their efforts to analyze their own data.

Through this project, data from Onota Lake was reviewed and analyzed independently by members of a scientific advisory panel after which the panel members convened at a one day conference and discussed and dissected the data explaining what it means for management actions and future monitoring needs. The following is a summary of the recommendations of the data analysis conference.

The Golden Rule Of Successful Lake Management



Don't Just Treat The Symptom.... Correct the Cause

Evaluate and prioritize negative impacts to the use and enjoyment of the lake. This may include:

- Weed growth
- Algae scums or mats
- Poor fishing
- Reduced clarity
- Shoreline erosion
- Decline in aesthetics

For a Management and Restoration Plan to be successful it must:

1. Be objective and based on sound data
2. Have clearly defined goals and objectives
3. Have the support and backing of the membership, community and regulatory authorities

Identify Relevant Information & Reports

Reports can be broken down into 4 information types

- | | |
|--|---|
| • Numeric data (water quality data, profiles) | • Descriptive material (geology, climate) |
| • Biological community data (species, abundance) | • Socioeconomic (land use, zoning, political) |

Relevant Information & Reports on Onota Lake

<i>Diagnostic / Feasibility Study for Onota Lake, Pittsfield, MA, IT Corporation, March 1991, Principal Investigator – Dr. Steve Souza</i>	<i>LOPA Volunteer Monitoring Program, 1998 Report, Prepared by Robert W. Race</i>
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Environmental Impact Review and Managerial Implications for a Proposed Drawdown of Onota Lake, Pittsfield, MA, Fugro East, Inc., July 1996, Principal Investigator – Dr. Ken Wagner

Re: Onota Lake Water Testing, Aquatic Control Technology, Inc., August 19, 1999

Re: Onota Lake Nuisance Aquatic Vegetation Management Program - Year One Update (1999), Aquatic Control Technology, Inc., October 25, 1999

Onota Lake Monitoring Program, 1997, American Lakes & Wetlands Services, Inc., Principal Investigator – Sean Lonergan

LOPA Volunteer Monitoring Program – 1999 Summary Report, Prepared by Robert W. Race

Onota Lake – Summary of Previous Recommendations for Lake Management, Prepared by Lake Onota Preservation Association, 1998

LOPA Volunteer Monitoring Program – 2000 Annual Report, Prepared by R. Race, B. Winn, and J. Winn

Onota Lake Management Plan, 1999, Prepared by Lake Onota Preservation Association (LOPA)

Long-range Aquatic Vegetation Management Plan – Onota Lake – Pittsfield, MA, Aquatic Control Technology, Inc., December 2000

1996 Data Summary, Prepared by Lake Onota Preservation Association (LOPA)

Presentation Material, LOPA – Robert W. Race, September 2000

1997 Data Summary, Prepared by Lake Onota Preservation Association (LOPA)

LOPA Sedimentation Report

Focus or Prioritize Review....Divide material or sections among the volunteers

Note: The following section outlines a general method of review and presents Onota Lake data as an example.

Lake and Watershed Setting

The Lake and Watershed Setting can be determined by:

- Surface Area and Lake Morphology
- Bathymetric Map
- Watershed and Land Use Map/Analysis

Onota Lake Morphology

Lake Area	250 ha
Max Depth	20.6 m
Mean Depth	6.4 m
Max Volume	$15.98 \times 10^6 \text{ m}^3$
Watershed Area	25.7 km^2
Shoreline Length	16.3 km
Max width	1.0 km
Max length	3.4 km

Onota Lake behaves as if it is two lakes in one. The North Basin is an impoundment created by the Onota Lake Dam while the South Basin remains the naturally formed lake. The two basins have extremely different characteristics. In basic terms, the lake overall is large and deep.

Lake Database Evaluation

Evaluate your lake database by examining:

- Sampling Locations
- Sampling Parameters, Duration and Frequency
- Data Quality (lab results below detection limits may mean that the laboratory is not able to meet your needs)

Onota Lake has had a wide range of studies, including a formal Diagnostic Feasibility Study, that make up its lake database. In addition to studies, Onota Lake has several years of volunteer monitoring data to add to its database.

Hydrologic Budget

Examine the hydrologic budget to determine where the water comes from, how much and how fast by:

- Major inputs/outputs
- Flushing rate/variation
- Water level fluctuations

Onota Lake Hydrologic Budget, from Table 9.7 of the Diagnostic Feasibility Study	
Inputs	$10^6 \text{ m}^3/\text{yr}$
Tributary and Surface Runoff Inputs	7.36
Precipitation directly on lake surface corrected for evaporation	0.875
Ground Water Recharge and subsequent influx of surplus to tributaries	0.0469
Direct seepage of ground water to lake	8.70
Total Input Budget	17.0
Outputs	
Total Annual Outflow	21.8

Seasonal Dissolved Oxygen and Temperature Profile

Seasonal dissolved oxygen and temperature profiles are determined by examining:

- Seasonal profile for temperature and dissolved oxygen showing the seasonal progression of thermocline deepening and loss of dissolved oxygen

Focus or Prioritize Review....continued**Nutrient Budget**

Examine the nutrient budget by:

- Major Total Phosphorus and Total Nitrogen sources
- Internal vs. external loading

Onota Lake Nutrient Budget, from Diagnostic Feasibility Study						
Source	Total Phosphorus (kg/yr)		Total Nitrogen (kg/yr)		Suspended Solids (kg/yr)	
Runoff	632.9	50.2%	7297	62.9%	1.08×10^6	100%
Internal	373.0	29.6%	-	-		-
Septic	188.2	14.9%	768	6.6%		-
Precipitation	62.5	5.0%	2500	21.6%		-
Dryfall	5.14	0.4%	1028	8.9%		-
Total	1,261.7		11,593.3		1.08×10^6	

The majority of the total phosphorus enters Onota Lake via runoff. However, Onota Lake also has a sizable internal load of phosphorus.

Note- Septic load should now be significantly reduced since nearly 100% of the shoreline is now sewered.

Trophic State Analysis – results in an analysis of the use impairment

A trophic state analysis integrates the results of the water quality, morphology, hydrologic and nutrient loading studies by examining there is both a permissible and critical load:

- Phosphorus and nitrogen fraction levels
- Chlorophyll (peak, mean levels)
- Secchi disk transparency and seasonal trends

Onota Lake Trophic State Analysis Table 10.6 of
Diagnostic Feasibility Study

Annual Load	1261.7 kg/yr
Areal Load	0.505 g/m ² /yr
TP Retention	0.684
Hydraulic Retention Time	0.88 yr
Mean Depth	6.4 m

The internal loading is different in the two basins of Onota Lake. The trophic state of the north basin is mesotrophic to eutrophic while the trophic state of the south basin is mesotrophic to oligotrophic.

Note: Calculations can be found in D/F Study.

Biological Community Indicators

Biological community indicators include:

- Phytoplankton - counts, species, groups
- Macrophyte - cover, abundance, composition
- Riparian vegetation/wetlands - location, type
- Fish and invertebrate communities- species abundance

Onota lake is represented by an assemblage of aquatic plants. Many species are represented, and while some species are abundant no species are dominant. Native species are not as much of a concern as exotic species. Two species of macrophytes, Eurasian watermilfoil and curly leaf pondweed have been problems in the north basin.

Alkaline lakes, like Onota Lake, are common in the Berkshire area and are likely to have rare species. In order to make management decisions based on the aquatic plant community it is important to understand the life cycles of each species and how they reproduce. Some plant species may come and go without indicating changes in the overall health of the lake. Understanding when certain species are abundant and why will provide information about the health of the lake.

Implementing the Restoration & Management Plan...

Decision Making...

- Make full use of diagnostic data in decisions
- Address short and long term problems
- Balance in-lake and watershed efforts
- Recognize aesthetic and recreational values
- Recognize ecological limits
- Prioritize projects accordingly
- Develop a time-table, but be flexible
- Review and make sure that it is cost-effective

Management & Restoration Options

- Source Control - Reduce pollutant load at point of origin, by decreasing inputs you decrease rate of eutrophication
- Delivery Control - Intercept and decrease pollutants before they enter lake, focus on stormwater
- In-lake Restoration - Techniques designed primarily to mitigate or reverse the effects of pollutant loading and lake eutrophication

General Recommendations

- Decrease storm related Non-Point Source (NPS) phosphorus loading through the use of stormwater quality Best Management Practices (BMPs)
- Decrease Septic loading via sewerage of problem areas and implementation of septic management efforts
- Control weed growth and the spread of exotics
- Improve and enhance available fish habitat

Watershed Management Options

- Watershed planning initiatives
 - Land Use Ordinance
 - Regulations
- Stormwater management/ordinance
- Erosion control
- Citizen Education (i.e., Product Modification)
- Sewering/Infrastructure Improvements (Septic management)
- Waterfowl control

Watershed Management Techniques Recommended for Onota Lake

- Stormwater retention/detention (at major tributaries)
- Stormwater management ordinance for new development (State Stormwater Policy)
- Erosion control (some being done at Burbank Park)
- Land use ordinance
- Citizen Education (i.e., Product Modification)
- Sewering/infrastructure improvements (complete)

Panel Commentary

The purpose of watershed management is to prevent further degradation to the water body. Watershed management techniques primarily address the potential for algae blooms rather than addressing macrophytes. Control of existing weeds really comes from in-lake methods.

In-Lake Management Techniques*

- Algae control
 - Aeration
 - Nutrient inactivation/Sediment Inactivation
 - Biomanipulation
 - Spot Dredging
 - Shoreline stabilization
 - Power Boat/Jet Ski Limitations
 - Weed control
 - Overwinter drawdown
 - Harvesting
 - Herbicide Treatments
 - Biological Controls
 - Macrophyte Barriers
- * All of these techniques should be accompanied by a water quality monitoring program

In-Lake Management Techniques Considered for Onota Lake in 1991 Diagnostic Feasibility Study

- Construction of Thomas Island culvert accompanied by dredging (currently being implemented under s319 Grant)
 - Weed Harvesting (not done since 1998 – no plans to resume)
 - Spot dredging (not being planned)
 - Aeration (not being planned)
 - Sediment inactivation with sodium aluminate of aluminum sulfate (not being planned)
 - Macrophyte barriers to create fishing lanes (not being planned)
 - Drawdown overwinter to 4 ft depth (currently drawing down to 3 ft each year since 1996/7 due to permitting limitations)
 - Power boat limitations (not being planned)
 - Herbicide treatment (not in IT D/F Study) (1999/2000 Whole lake SONAR treatment – 2001 spot treatment)
 - Biological (e.g. weevils)
- * All of these techniques should be accompanied by a monitoring program including quarterly in-lake and tributary sampling (current bi-weekly in-lake program – no tributary monitoring)

Panel Recommendations

• Weed Harvesting

Different management practices are required for annual versus perennial species based on the way in which they reproduce. Harvesting annuals will work because the seeds are harvested and removed. Harvesting milfoil can feed the problem by increasing fragmentation.

• Sediment inactivation with sodium aluminate and aluminum sulfate

Consistent alum treatment introduced at a rate equivalent to the daily average load of phosphorous has been used in two cases where both lakes have responded tremendously. The treatment resulted in lakes that were no longer dominated by blue-green algae. Generally alum treatment is expensive and creates toxicity issues at both low and high pH by releasing aluminum. Alum should be used with caution. Alum treatment can be successful when used to treat internal phosphorus loading after the watershed inputs have been adequately controlled.

• Macrophyte barriers to create fishing lanes

Macrophyte barriers are expensive but do a good job, especially in small areas.

• Drawdown overwinter to 4 ft depth

Drawdown seems to be one of the most proven, long-term in-lake methods.

• Biological

Carp are illegal to introduce in Massachusetts. Weevils are native, however they have demonstrated mixed results and can not address any species other than milfoil

Developing Long-Term Lake Management

The Steps of a Long-Term Lake Management Plan

1. Explicit statement of problems and goals
2. Data to identify problems and trends
3. Data to determine causal relationships
4. Data to support management evaluation
5. Review of appropriate management options
6. Recommendations of management actions
7. Future Monitoring to track progress

Step 1: Example - Onota Lake Explicit Statement of Problems and Goals

- Maintain a reduced Submerged Aquatic Vegetation density to support recreation, fish and wildlife habitats
- Control exotic invasive species (i.e., Eurasian watermilfoil)
- Maintain moderate to high water clarity
- Monitor nutrient and oxygen levels and status of biological communities
- Educate lake users and watershed regarding their role in improving and protecting lake

Step 2: Example - Onota Lake Data to Identify Problems and Trends

- Estimate rooted aquatic plant distribution, composition and abundance
- Monitor oxygen concentration in deeper waters
- Monitor nutrient levels, algal abundance and Secchi disk transparency
- Monitor sediment accumulation
- Monitor fish and wildlife community health

Step 3: Example - Onota Lake Data to Determine Causal Relationships

- Determine potential controlling mechanisms for macrophytes - light, nutrient, sediment, water levels
- Determine potential controlling mechanisms for algal abundance - nutrient, identification of internal and external loading.

Step 4: Example - Onota Lake Data to Support Management Evaluation

- Monitor tributary and storm drain loading (dry/wet)
- Quantify available Phosphorus fractions
- Update bathymetry
- Quantify milfoil population recovery and shifts in other plant species
- Conduct fishery Survey

Step 6: Example - Onota Lake Recommended Management Actions

- Aquatic Plants
 - water level drawdown
 - handpulling or benthic barriers
 - low dose chemical treatment as needed
 - boat speed restriction in shallow areas
- Water Quality
 - watershed landowner education
 - source control
 - pollutant and sediment trapping
 - aeration

Step 7: Example - Onota Lake Future Monitoring to Track Progress

- Sample tributaries (water quality & flow)
- Sample dry/wet events
- Sample deep water phosphorus, using alpha bottles, monthly during stratification.
- Assess dissolved vs. total Phosphorus fraction with depth
- Continue or expand plant monitoring
- Continue or expand reptile and amphibian surveys
- Lobby for MA DFW fish survey
- Sample at both deep holes once during the winter
- Chlorophyll and pH samples are necessary only in the two deep holes
- Sample after spring thaw for TSS, TDS, TP, dissolved phosphorus, nitrate, DO, temperature, pH and flow at tributaries during one or two storm events, 15-30 minutes after the storm starts
- Test North Basin clarity with a secchi disk before and after a busy boating weekend, due to location of marina and water ski course in north basin

Summing it all up...

The water quality of Onota Lake is appropriate to its uses. However, the usability and recreation options are threatened. A lake management strategy that treats the symptoms without addressing the problem will only change the symptoms of the problem. There is very little to no dissolved oxygen (DO) in the hypolimnion during stratification, which raises a red flag. When comparing the values from 1986-2000 the data shows a solidly mesotrophic lake. Current concerns are for the continuing loss of bottom DO and excess growth of aquatic plants. Nutrient and sediment inputs, algae blooms, and the introduction of exotic plants are common concerns of lakes and ponds throughout Massachusetts.

Put the Plan into Action

- Update Management Plan
- Inform community
- Plan finances
- Develop schedule
- Obtain permits and select contractors as needed
- Monitor consistently
- Evaluate success

Prioritize Your Efforts

- Distinguish between the symptoms and causes of eutrophication
- Focus on correcting causes of degraded water quality and accelerated eutrophication
- Use diagnostic data and use impairment analysis to direct efforts and make decisions
- Identify required permits and approvals
- Review to insure that return on investment and cost-effectiveness have been maximized