The case for data sharing:
Monitoring plants in Minnesota's lakes
Mike Verhoeven, MAISRC Fellow – 3 March 2021
How?

Survey Types – Each has it’s place in AIS work
What’s special about the PI survey?
Under every report is a dataset
Logistical consideration

Why?

Logistics
Row the Boat
Know your Enemy

Put your data to work with us!
Names include:

AIS Sentinel
Baseline Monitoring
AIS Early Detection
UMN - Starry Trek
Opportunistic Surveys
Rare Species Search
Targeted Search
### Abundance Ranking

<table>
<thead>
<tr>
<th>Rank</th>
<th>Rake Coverage</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
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<td>Sparse; plants covering &lt;25% of the rake head</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Common; plants covering 25%-75% of the rake head</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Abundant; plants covering &gt;75% of the rake head</td>
</tr>
</tbody>
</table>
Names include:

- Meander survey
- Delineation survey
Names include:

Point-intercept
Grid-point
We can quantify our precision!

Present = # of places found

Samples = # of places surveyed

Freq = Present / Samples

SE = \sqrt{Freq \cdot \frac{(1 - Freq) \cdot \text{Samples}}{Samples}}
Inspection by the Invasive Species Program
Division of Ecological Resources
Minnesota Department of Natural Resources

Lake: Cedar Lake  DOW Number: 70009100  Date of inspection: June 24, 2009
County: Scott  Observer(s): B. Hummel, A. Doll
Time - On Water: 1000h  Off water: 1700h

Type of inspection: Point-intercept survey of aquatic plants
Author[s] of report: A. Doll, B. Hummel  Date of report: July 10, 2009

Methods - Lakewide vegetation survey
A point-intercept survey method was used and followed the methods described by Madison (1999) and MnDNR (2000). Survey waypoints were created using a Geographic Information System (GIS) computer program and downloaded into a handheld Global Positioning System (GPS) receiver. Survey points were placed in a grid pattern and spaced 100 meters apart.

One survey crew, consisting of two surveyors and a boat conducted the survey. A total of 104 waypoints were surveyed. No areas of the lake were deeper than 15 feet. (Figure 1, Table 1).

Table 1. Sampling effort by water depth.

<table>
<thead>
<tr>
<th>Water depth interval (feet)</th>
<th>Number of samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 5</td>
<td>10</td>
</tr>
<tr>
<td>5.1 to 15</td>
<td>94</td>
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<tr>
<td>Sample sites in 0-15 ft zone</td>
<td>104</td>
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<td>16 to 20</td>
<td>9</td>
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<td>Total samples</td>
<td>104</td>
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1:/PAW/SHRDATA/EXOTICS/Mn-dnr project plots survey surveys 2009/Cedar_Scott/Cedar Lake Pt Ini report 2009.doc
p. 1 of 5
Spider Lake Survey Results

A point-intercept aquatic plant survey was completed on August 7, 2017 at Spider Lake. The point-intercept method is considered the standard protocol by MnDNR for sampling macrophytes because it offers a methodology that is quantitative (i.e., frequency of occurrence), repeatable (can be used to track trends in aquatic plant communities over time), and georeferenced (can be used to compare plant communities within different areas of a lake). From this data, a Floristic Quality Index (FQI) was calculated that measures the diversity and health of the aquatic plant community.

The FQI calculation is based on both the quantity of species observed (species richness) as well as the quality of each individual species. Every aquatic plant in Minnesota has been assigned a coefficient of conservation value (c-value) ranging from 0 to 10. The c-value of all aquatic plants sampled from a lake is used to determine the FQI for a given lake. Species with a c-value of 0 include non-native species such as curly-leaf pondweed (Potamogeton crispus) that are indicative of a highly disturbed environment. In comparison, the native species Oakes pondweed (Potamogeton oakesianus) has a c-value of 10 because this species is extremely rare and only found in undisturbed, pristine environments.

The average FQI score for Minnesota lakes in the North Central Hardwood Forest (NCHF) ecoregion is 35.716 with a median of 22.5 (Radonski and Perleberg 2013). A study of 41 Minnesota lakes surveyed across the state, as part of the EPA’s National Lakes Assessment Project, yielded a maximum FQI score of 80. In 2016, the MnDNR developed a robust geodatabase of aquatic plant surveys and associated FQI scores from more than 3,600 lakes across the state. FQI scores ranged from 0 to 49 with a median of 25.129. Included in Table 2 is a list of all native aquatic plants sampled and their associated c-values and frequency of occurrence values. Error! Reference source not found. Includes Introduced species which have been assigned a c-value of 0. FQI scores from the MnDNR geodatabase reflect a value from their FQI calculation; therefore, Table 2 provides the best means of comparison with the MnDNR geodatabase. Error! Reference source not found. is useful in that introduced species are both an indication of anthropogenic stress and a stressor themselves in terms of their direct impact to the surrounding plant community. The FQI score of 26.84 for Spider Lake was slightly higher than the median FQI score for assessed lakes in the DNR geodatabase and the NCHF ecoregion average. The FQI score for Spider Lake is reflective of the lake’s high quality near-shore aquatic plant community which contains several high quality emergent plant species including blue flag iris (Iris versicolor), sessile arrowhead (Sagittaria rigida), and softstem bulrush (Schoenoplectus tabernaemontani). The near-shore aquatic plant community is directly correlated with the largely intact nature of the riparian buffer surrounding Spider Lake.
Snail Lake Macrophyte Survey
June 8th, 2011
Ramsey Conservation District & Ramsey County Public Works Environmental Resources

Methods:

The point intercept method incorporating a Global Positioning System (GPS) was used to assess the aquatic macrophyte community on Snail Lake on June 8th, 2011. Samples were taken at evenly spaced (70 m) geo-referenced points. Data on depth, plant species, and abundance rank was recorded.

A double-tined metal rake attached to a rope was used to collect specimens. At each point the device was thrown out approximately 1 meter and then dragged across the substrate for approximately 1 meter. Species were identified and given a ranking based on cover of rake tines. Plant species that were floating in the water at the collection points were also counted. The table below includes the ranking system.

<table>
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<th>Percent Cover of Times</th>
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Results:

Data was collected at 110 points. Aquatic macrophytes were found at 94 points. Niphila and filamentous algae were the most common species present in the survey. Other species present were Eurasian watermilfoil (Myriophyllum spicatum), coontail (Ceratophyllum demersum), flatstem pondweed (Potamogeton amplifolius), chara, slender naiad (Najas flexilis), claspers-leaf pondweed (Potamogeton perfoliatus), softstem bulrush (Scirpus validus), large-leaf pondweed (Potamogeton amplifolius), spatterdock (Nuphar luteum), bladderwort (Utricularia sp.), white waterlily (Nymphaea odorata), wild celery (Valvularia americana), leafy pondweed (Potamogeton foliosus), Canada waterweed (Elodea canadensis), and sago pondweed (Potamogeton pectinatus). Secchi disk reading on June 14th was 3.8 m.

Depth measurements were taken at the 110 survey points. Point number, depth, plant species and abundance ranking data is reported in the map and table included in this file.
Table 1. Sampling effort by water depth

<table>
<thead>
<tr>
<th>Water depth interval (foot)</th>
<th>Number of samples</th>
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<tbody>
<tr>
<td>0 - 5</td>
<td>10</td>
</tr>
<tr>
<td>5 - 10</td>
<td>90</td>
</tr>
<tr>
<td>10 - 30</td>
<td>104</td>
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<tr>
<td>30 - 50</td>
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</tr>
<tr>
<td>50 - 70</td>
<td>103</td>
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</table>

Spider Lake Survey Results

A point-intercept aquatic plant survey was completed on August 7, 2017 at Spider Lake. The point-intercept method is considered the standard protocol by MnDNR for sampling macrophytes because it offers a methodology that is quantitative (e.g., frequency of occurrence), reproducible (can be used to compare plant communities within different areas of a lake), and generalizable (can be used to compare plant communities across different lakes). Using this method, a Floristic Quality Index (FQI) was calculated to measure the diversity and health of the aquatic plant community.

The FQI calculation is based on both the quantity of species observed (species richness) as well as the quality of each individual species. In Spider Lake, MnDNR has accepted a coefficient of floristic richness (c-value) ranging from 0 to 10. A c-value of 10 applied to all aquatic plants sampled from a lake is used to determine the FQI for a given lake. Species with a c-value of 10 include non-native species such as curly-leaf pondweed (Potamogeton crispus) or those indicative of a highly disturbed environment. In comparison, the native species cabins pondweed (Potamogeton pectinatus) and knob pondweed (Potamogeton nodosus) have a c-value of 10 because this species is extremely rare and only found in undisturbed, pristine environments.

The average FQI score for Minnesota lakes in the North Central hardwood forest (NCWF) ecoregion is 29.7/72 with a median of 25.5 (Hennelly & Pechlaner, 2012). A study of 41 Minnesota lakes revealed that an average score of 29.7/72 is a reasonable minimum FQI score of 30. In 2016, the MnDNR developed a robust database of aquatic plant surveys and associated FQI scores from more than 1,000 lakes across the state. FQI scores ranged from 0 to 90 with a median of 29.1. Included in Table 2 is a list of all native aquatic plants sampled and their associated c-values and frequency of occurrence. Error: Reference sources not found. Includes: introduced species which have been assigned c-values of 0. FQI scores from the MINNIRI database exclude introduced species from their FQI calculation; therefore, Table 2 provides the best assess of comparison with the 2006 guidelines. Error: Reference sources not found. Includes: introduced species which are not introduced species are both an indication of anthropogenic stress and a stressor themselves in terms of their direct impact to the surrounding plant community. The FQI score of 26.64 for Spider Lake was slightly higher than the median FQI score for all lakes in the MN DNR database and the SPP average. The FQI score for Spider Lake is reflective of the lake’s high quality near-shore aquatic plant community which contained several high quality emergent plant species including Blue flag iris (Iris versicolor), bulrush (Scirpus aquaticus), and yellow birch (Betula alleghaniensis). The near-shore aquatic plant community is directly correlated with the largely intact nature of the riparian buffer surrounding Spider Lake.
Critical Considerations
Conducted via Point-Intercept
Stored in an electronic “tabular” form
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MAISRC.UMN.EDU
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MAISRC.UMN.EDU
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**Note:** The highlighted cells indicate areas of concern or significant findings.
User side

MN Plant Survey Database

University side

Data upload website

Data View and download

R Shiny web app

Associated statewide datasets (thermal models, herbicide treatment data, others)

Data are verified by researchers before inclusion in db

Upload report generated

Data uploaded in a required format

Verhoeven et al. In prep
18 years of data from
1526 lakes
3404 surveys
353,148 locations sampled
564,038 observations of native and invasive species
A correction: these data aren’t for research only

Database of Aquatic Plant Habitat

Since the 1980s, lake associations have been doing point intercept studies and aquatic plant surveys to meet permit requirements and write lake management plans. Other water agencies that survey aquatic plants, like Watershed Districts or the Pollution Control Agency, collect plant data in different formats.

Until today none of this disparate data has been standardized. Researchers in both agencies and academia cannot benefit from all this work that has been done. Over 40 years of data collection cannot be used today to inform decision makers as we attempt to deal with a changing climate.

In 2020 MLR began working with multiple partners, including scientists at University of MN, State Agencies, MN Association of Watershed Districts and other partners to both standardize data collection of aquatic plants in MN, and create a usable database for future researchers.
PI surveys cost about $3k. We know of at least 4336 of them for our lakes.

Verhoeven et al. *In prep*
That’s $13,008,000 of work...
3 reasons “Why”
Logistics
Row the Boat
Know your Enemy
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Implications for Management and Control

Management works. Results may vary.

Productivity ↔ curly-leaf pondweed

Less snow = more curly-leaf
18 years of data from 1526 lakes 3404 surveys 353,148 locations sampled 564,038 observations of native and invasive species

Curlyleaf pondweed Potamogeton crispus

Eurasian watermilfoil Myriophyllum spicatum
Eurasian watermilfoil
Myriophyllum spicatum

Curlyleaf pondweed
Potamogeton crispus

32 native plant species
Put your lake data to work!

Plant survey data that’s already been collected about your lake could help inform important ongoing research at the Minnesota Aquatic Invasive Species Research Center.

MAISRC researchers are rethinking assumptions about lake management and rigorously analyzing decades of statewide lake data to inform and improve the future of lakewide plant management. **Be a part of the solution!**

Email maisrc@umn.edu for instructions on how to send your data, and sign up to receive updates on our work at [www.maisrc.umn.edu](http://www.maisrc.umn.edu).
Thank you to our funders and partners!
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https://www.maisrc.umn.edu/integrated-surveillance
Want to join the fight against AIS?

Follow us on social media, join our email newsletter, or consider a donation.

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Thank you to our funders and partners!

University of Minnesota
Driven to Discover™

Environment and Natural Resources Trust Fund

maisrc.umn.edu
Thank you to our funders and partners!