

Plant Restoration Planning for a Recreational Lake Ecosystem

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Introduction

Motivation

- Freshwater lakes are a valuable resource for human recreation and ecosystem services, but they are vulnerable to anthropogenic land-use changes¹

Lake History

- Reflection Lake of Elk, WA (Fig. 5) is a residential lake characterized by recreational use and continual aquatic plant management from the Reflection Lake Community Association (RLCA)
- Excessive plant growth has raised concern for nutrient overloading in the lake
- The lake has been previously stocked with grass-carp and treated with herbicide for aquatic vegetation control
- Invasive grass-carp and non-native plants have limited growth of native vegetation which is important for ecosystem function

Project Goals

- Supporting growth of a diverse native plant community amidst grass carp invasion to support nutrient cycling and habitat
- Creating a restoration plan for the RLCA that prioritizes ecosystem health while maintaining space for recreation

Water Quality Analysis

Sampling and Analysis Methods

- Vernier Go Direct probes used to measure water quality parameters at the surface, Secchi disk used for turbidity measurements
- Water samples collected at six locations around the lake (Fig. 1, 4)
 - Filtered on site through 0.45µm filters
- Water samples analyzed using ion chromatography

Results

- No abnormal results found, all within range for supporting organisms² (Table 1 and Table 2)

Table 1. Water quality results

DO (mg/L)	9.61
Conductivity (µS /cm)	208
pH	8.41
Alkalinity (mg/L CaCO ₃)	98
Turbidity (m)	3.53

Table 2. Results of ion chromatography. *Phosphate levels were less than limit of detection (0.5 mg/L). **Concentrations of chloride, nitrate, and sulfate were detected at higher levels in the stream.

Site	Chloride (mg/L)	Phosphate* (mg/L)	Nitrate (mg/L)	Sulfate (mg/L)
S. Open Water	2.726	<LOD	1.556	5.477
N. Open Water	2.759	<LOD	1.5935	5.4845
Turtle Dock	2.610	<LOD	1.500	5.4875
Bings Landing	2.805	<LOD	1.5915	5.5115
S. Outflow	2.784	<LOD	1.588	5.5655
Stream**	5.802	<LOD	6.960	7.842

Current Plant Community

- On October 28, 2024 a survey was conducted to identify plant species present at Reflection Lake to determine native plants that characterize this community and any invasive threats (Table 3)
- Five sites were surveyed: Turtle Dock, Bing's Landing, Bishop Park, Spring Stream, and Bald Eagle Point (Fig. 1)

Plant Name	Vegetation Type	Site Found
Sago Pondweed (<i>Stuckenia pectinata</i>) (Fig 2)	Submerged	Turtle Dock, Bing's Landing
Coontail (<i>Ceratophyllum demersum</i>)	Submerged	Turtle Dock
Marsh Seedbox (<i>Ludwigia palustris</i>)	Submerged	Bishop Park, Bing's Landing
Spiral Ditch Grass (<i>Ruppia cirrhosa</i>)	Submerged	Bing's Landing
Duckweed (<i>Lemna minor</i>)	Floating	Spring Stream
*Yellow Flag Iris (<i>Iris pseudacorus</i>)	Emergent	Turtle Dock
Watercress (<i>Nasturtium officinale</i>)	Emergent	Spring Stream
Rice Cutgrass (<i>Leersia oryzoides</i>)	Emergent	Bald Eagle Point
Broadleaf Cattail (<i>Typha latifolia</i> L.)	Emergent	Bald Eagle Point, Bing's Landing
Hardstem Bulrush (<i>Schoenoplectus acutus</i>) (Fig 2)	Emergent	Bald Eagle Point
*Curly Dock (<i>Rumex crispus</i>)	Terrestrial	Bald Eagle Point
*Reed Canary Grass (<i>Phalaris arundinacea</i>) (Fig 2)	Terrestrial	Bald Eagle Point, Turtle Dock

Table 3. Plant species identified during the Oct. 28 survey, *Invasive

Seedbank Experiment

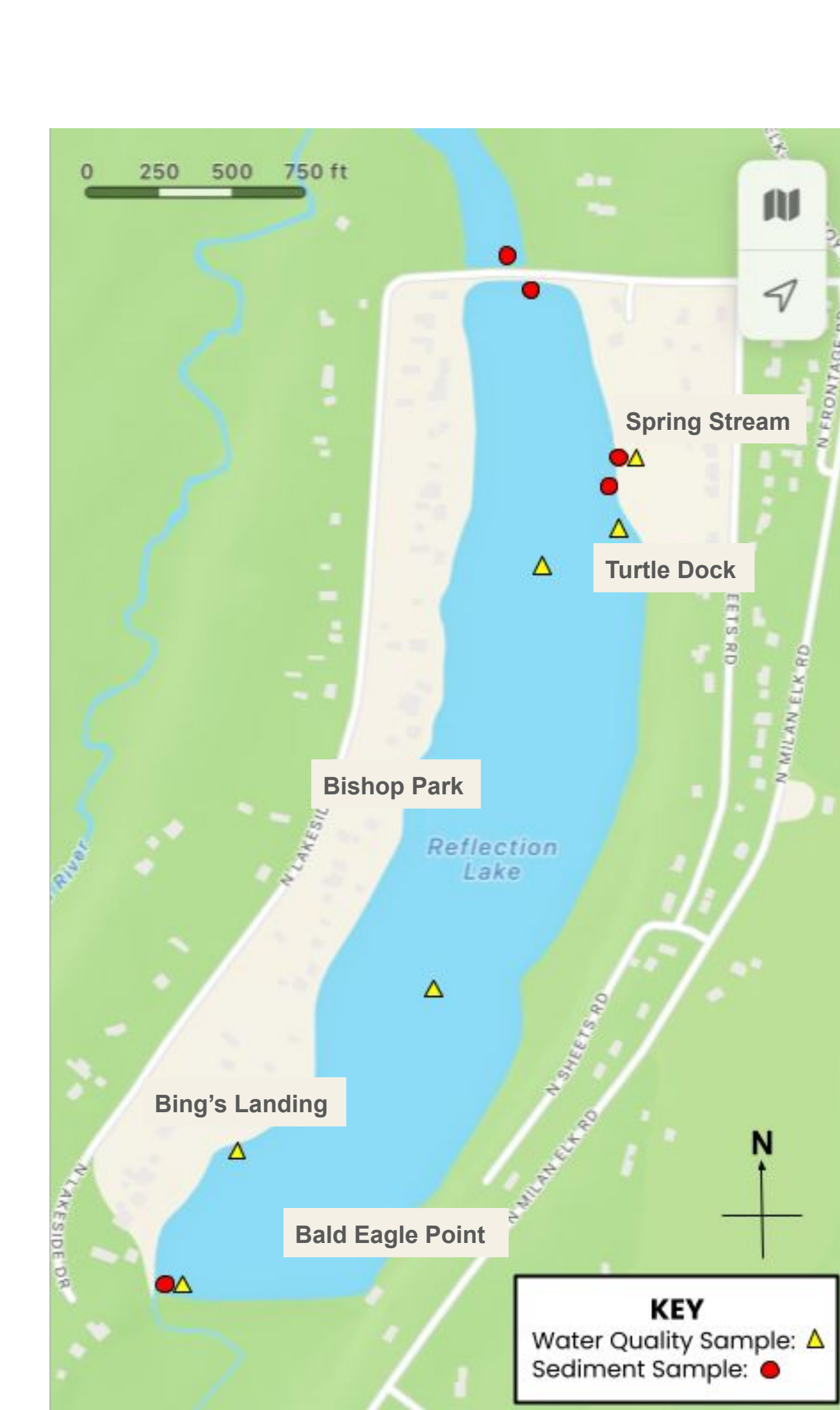


Figure 1. Sampling locations for water quality (triangles) and seed bank assessment (circles) at Reflection Lake

Sampling and Setup

- Conducted a seed bank analysis: a way of understanding what plants exist in an ecosystem's sediment
- Collected sediment samples for seed bank analysis at 5 representative locations (Fig. 1)
- Divided into aquatic tanks and partially submerged trays for growth

Seed Bank Results

Total: At least 10 different species, emergent and submerged

- Greatest biodiversity observed at and around the spring
- Informs locations to target for future restoration



Figure 2. Hardstem Bulrush (left), Sago Pondweed (middle), and Reed Canary Grass (right) were all species observed at Reflection Lake on 10/28/24

Restoration Recommendations

- Establishing numerous fenced off plant growth areas between Turtle Beach and Bald Eagle Point while grass carp remain in the lake to promote aquatic habitat and biodiversity
- Implementing a floating island to reduce algal blooms in summer and provide habitat to wildlife
- Performing a wildlife assessment to determine which vegetation types would most benefit the biotic community
- Revegetating the shoreline with caged emergent bulrush and cattails which will prevent herbivory and restore habitat, enhance nutrient cycling, and provide water filtration^{3, 4}



Above: Figure 4. Water and sediment sampling at Reflection Lake
Below: Figure 5. Reflection Lake on October 13th, 2024



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(1) Bastin, J.-F., Finegold, Y., Garcia, C., Mollicone, D., Rezende, M., Routh, D., ... Crowther, T. W. (2019). The global tree restoration potential. *Science*, 365(6448), 76–79. <https://doi.org/10.1126/science.aax0848>
(2) Illinois EPA. (1998). Lake Notes: Common Lake Water Quality Parameters. <https://epa.illinois.gov/topics/water-quality/surface-water/lake-notes.htm>
(3) U.S. Department of Agriculture, Natural Resources Conservation Service. (2002). Plant guide: Sand bluestem (*Andropogon hallii* Nash.). https://plants.usda.gov/DocumentLibrary/plantguide/pdf/prng_scaco2.pdf
(4) U.S. Department of Agriculture, Natural Resources Conservation Service. (2006). Plant guide: Broad-leaved cattail (*Typha latifolia* L.). https://plants.usda.gov/DocumentLibrary/plantguide/pdf/prng_tyfa.pdf