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## BIG CARNELIAN, WASHINGTON COUNTY: 2022 AQUATIC VEGETATION REPORT

Report by the Invasive Species Program – Division of Ecological and Water Resources  
Minnesota Department of Natural Resources

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**Lake:** Big Carnelian (DOW# 82004900)

**Lake Surface Area:** 460 acres

**Littoral Area:** 137.5 acres

**County:** Washington

**Survey Type:** Point-intercept

**Date of Survey (most recent):** August 10th, 2022

**Observer[s]:** April Londo (MN DNR)  
Karina Castillo (MN DNR)

**Report updated:** March 23rd, 2023

**Author[s]:** April Londo  
Email: [april.londo@state.mn.us](mailto:april.londo@state.mn.us)  
Phone: 651.259.5861



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### 2022 Summary:

The most recent aquatic vegetation point-intercept survey of Big Carnelian Lake (DOW# 82004900) was completed on August 10, 2022. Plants were present throughout the lake to a maximum depth of approximately 3.4 meters (11 feet). Within the littoral zone (area in the lake from the 0 – 15-foot depth range [0 – 4.5 meters]), 79% of sample points contained native submersed taxa. The average number of native submersed taxa per sample point was 3.0. Twenty-one submersed plant species were documented during the 2022 survey. Historically, curly-leaf pondweed has been observed at low densities, and to our knowledge no Eurasian watermilfoil is present in this lake. The long-term monitoring conducted in Big Carnelian Lake allows it to serve as a non-managed reference lake and therefore be used for comparison to various invasive plant control projects.

**Summary Table.** Summary of aquatic submersed plants in Big Carnelian Lake, Washington County, Minnesota (DOW# 82004900) as indicated by results of point-intercept surveys. Values were calculated from littoral depth range (0-15 feet).

PI Survey Date	Max Depth of Growth in feet [95%] <sup>†</sup>	% Points w/ Native Submersed Taxa	Mean Native Submersed Taxa/ Point	# Submersed Taxa	AVG Secchi Depth [m]
2014 AUG	23	97	3.9	19	5.8
2015 JUL	20	100	4.2	18	4.7
2016 JUL	19	70	2.6	16	4.8
2017 AUG	18	97	4.0	21	4.6
2018 JUL	17	91	3.3	18	4.8
2019 JUL	19	100	4.4	20	4.7
2022 AUG	11	79	2.9	21	

<sup>†</sup>95th percentile calculated based on all vegetated sampling points

Taxa refers to groups of submersed aquatic plant species or genera

AVG – average Secchi depth (water clarity measurement) from May – September

## Lake Description:

Big Carnelian Lake is a 460-acre lake located near Stillwater, Minnesota. It has one invasive aquatic plant species: curly-leaf pondweed (*Potamogeton crispus*, abbreviated as CLP). The maximum depth of water is 20.1 meters (66 feet). Approximately 30% of the lake is littoral (water depth zone from 0 – 15 feet where aquatic plants are likely to be found). It contains a moderate level of nutrients and is considered a mesotrophic lake. Big Carnelian Lake has high water clarity (see **Table 1 – Secchi Averages** below for historic Secchi disk observations) with transparency increasing in the last decade (data not shown). For more information concerning Big Carnelian Lake water quality see:

<http://cf.pca.state.mn.us/water/watershedweb/wdip/waterunit.cfm?wid=82-0049-00>.

**Table 1 – Secchi Averages.** Average Secchi disk observations in meters for Big Carnelian Lake, Washington County, Minnesota (DOW# 82004900). Data gathered from the Minnesota Pollution Control Agency (MPCA) and Washington Conservation District (WCD).

YEAR	MAY	JUNE	JULY	AUG	SEPT	Secchi Depth Average [May-Sept]
<b>2014</b>	6.9	7.1	5.0	5.1	4.1	5.6
<b>2015</b>	4.4	5.2	4.9	5.6	4.8	5.0
<b>2016</b>	3.6	6.1	6.0	5.2	3.5	4.9
<b>*2017</b>	6.9	6.6	5.4	4.8	3.9	4.6
<b>*2018</b>	6.1	4.6	3.5	5.0	4.9	4.8
<b>*2019</b>	6.2	4.4	4.1	4.6	4.3	4.7
<b>2020</b>	7.3	7.2	5.9	4.3	3.7	5.7
<b>2021</b>	4.9	5.2	3.5	4.2	3.6	4.0
<b>2022</b>	-	4.0	4.2	5.0	4.6	4.4

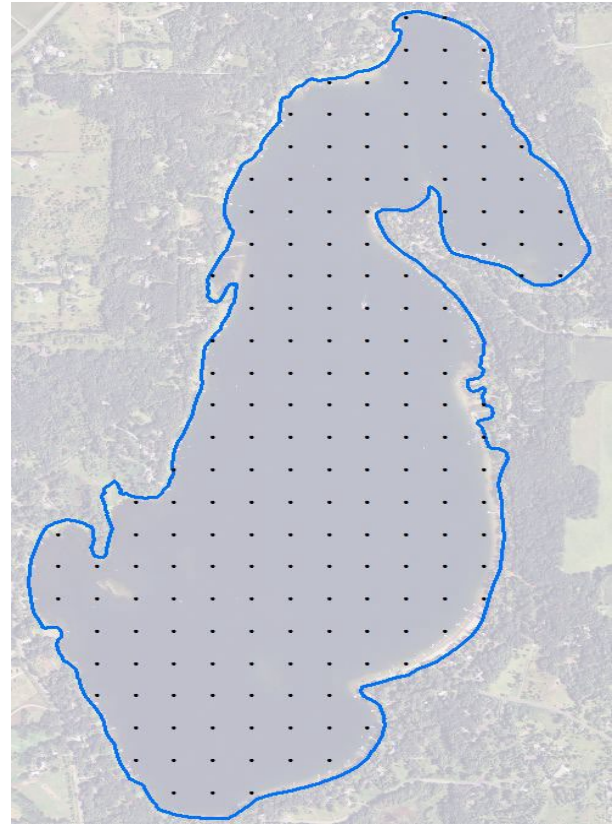
\*Data collected by the WCD

## Survey Objectives:

Point-intercept surveys were used to assess the distribution of aquatic plants in Big Carnelian Lake. The primary purpose for this type of survey is to 1) develop baseline knowledge of the current plant community in a lake, and over time, 2) compare year to year plant variation (in plant presence and spatial location). Moreover, this survey will help the Minnesota Department of Natural Resources and our partners monitor native plant communities and evaluate possible responses to invasive aquatic plant management efforts. It is important to note that distributions of aquatic plants may vary from year to year due to effects such as differences in weather, as well as the effects from plant and water quality management.

## Survey Methods:

We used a point intercept survey method developed by John Madsen in [“Aquatic Plant Control Technical Note MI-02, 1999”](#). Survey points were placed 100 meters apart using a Geographic Information System (GIS). This spacing allowed for the placement of 183 points. Plant samples were collected by throwing and dragging a double-sided rake along the lake bottom at each point. Plant samples were assessed on the boat to determine species and density (scale of zero [no plants] to 4 [dense, matted on the surface] was used in 2012 – 2017, and a zero to 3 scale in 2018 and all years thereafter). Frequencies of occurrence percentages (i.e., how often a plant species was found in the lake) were calculated based on the littoral zone (the portion of the lake that is less than 15 feet in depth).



## Survey Observations:

The Minnesota Department of Natural Resources Invasive Species Program has been conducting point intercept surveys on Big Carnelian Lake since 2014, using it as a non-treatment reference lake. For the past five years, the most dominant submersed aquatic plant species in Big Carnelian include macroalgae, flat-stem pondweed, Illinois pondweed and northern watermilfoil (> 30% frequency of occurrence). The majority of all native taxa observed have stayed fairly consistent across survey years, (see **Table 3 – Plant Frequency Occurrence** for plant frequency observations) although in recent years Naiad spp., fries pondweed, variable-leaf pondweed and fern-leaf pondweed have declined. Additionally, narrow-leaf water plantain (a species of Special Concern in Minnesota; see photo below) has been observed in Big Carnelian Lake since the first point intercept survey in 2014. Curly-leaf pondweed was not found in the most recent survey in 2022 given its early senescence, and to date, Eurasian watermilfoil has not been observed in Big Carnelian Lake.

**Table 2 – Point Intercept Metrics.** Summary of point intercepts metrics for Big Carnelian Lake, Washington County, Minnesota (DOW# 82004900). Shaded values were calculated from littoral depth range (0 – 15 feet).

<b>Survey Metrics</b>	<b>AUG 2014</b>	<b>JUL 2015</b>	<b>JUL 2016</b>	<b>AUG 2017</b>	<b>JUL 2018</b>	<b>JUL 2019</b>	<b>AUG 2022</b>
Treated (Y/N)	N	N	N	N	N	N	N
Surveyor	MN DNR	MN DNR	MN DNR	MN DNR	MN DNR	MN DNR	MN DNR
Total # Points Sampled	185	186	183	184	182	182	186
Max Depth of Growth (95%) in feet	23	20	19	18	17	19	11
# Point in Max Depth Range	110	80	73	75	67	69	52
# Points in Littoral (0-15 feet)	119	54	56	60	58	54	63
% Points w/ Submersed Native Taxa	80	100	70	97	91	100	79
Mean Submersed Native Taxa/Point	3.9	4.2	2.6	4	3.3	4.4	2.87
# Submersed Native Taxa	18	17	16	20	18	20	20
# Submersed Non-Native Taxa	1	1	0	1	0	0	1

**Table 3 – Plant Frequency Occurrence.** Historic percent frequency of occurrence for submersed vegetation within the littoral zone (0 – 15 feet) in Big Carnelian Lake, Washington County, Minnesota (DOW# 82004900).

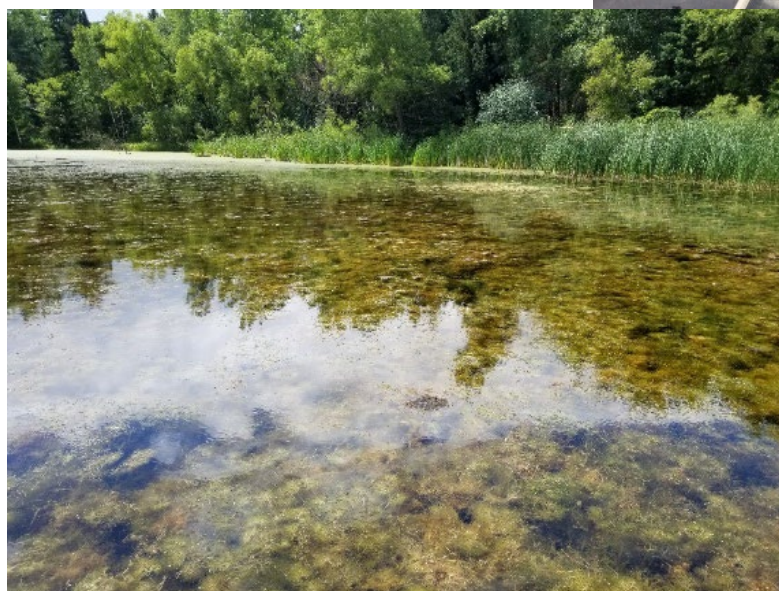
Taxonomic Name	Common Name	AUG 2014	JUL 2015	JUL 2016	AUG 2017	JUL 2018	JUL 2019	AUG 2022
<b>SUBMERSED PLANTS</b>								
<i>Potamogeton crispus*</i>	Curly-leaf pondweed*	1	6	0	5	0	0	3
<i>Ceratophyllum demersum</i>	Coontail	42	30	29	32	28	35	17
<i>Macroalgae</i>	Muskgrass and Stonewort	40	61	59	67	55	72	48
<i>Elodea canadensis</i>	Canadian waterweed	2	4	0	5	5	6	0
<i>Heteranthera dubia</i>	Water stargrass	4	7	5	8	7	9	10
<i>Megalodonta beckii</i>	Water marigold	7	11	7	2	3	15	5
<i>Myriophyllum sibiricum</i>	Northern watermilfoil	30	56	46	45	31	43	40
<i>Najas spp.</i>	Naiad	10	11	20	18	12	17	5
<i>Potamogeton foliosus</i>	Leafy pondweed	0	22	9	22	5	7	2
<i>Potamogeton friesii</i>	Fries pondweed	0	22	9	25	26	17	6
<i>Potamogeton gramineus</i>	Variable-leaf pondweed	3	0	9	8	14	9	8
<i>Potamogeton illinoensis</i>	Illinois pondweed	19	37	29	32	28	37	37
<i>Potamogeton praelongus</i>	White-stem pondweed	13	26	13	17	12	13	3
<i>Potamogeton richardsonii</i>	Clasping-leaf pondweed	8	20	20	18	16	26	17
<i>Potamogeton robinsii</i>	Fern-leaf pondweed	0	2	0	5	9	2	5
<i>Potamogeton zosteriformis</i>	Flat-stem pondweed	35	59	52	48	43	57	33
<i>Ranunculus aquatilis</i>	White water crowfoot	1	7	2	3	2	9	3
<i>Stuckenia pectinata</i>	Sago pondweed	12	24	18	13	24	30	17
<i>Vallisneria americana</i>	Water celery	16	22	29	23	16	26	25

\*denotes invasive aquatic plant

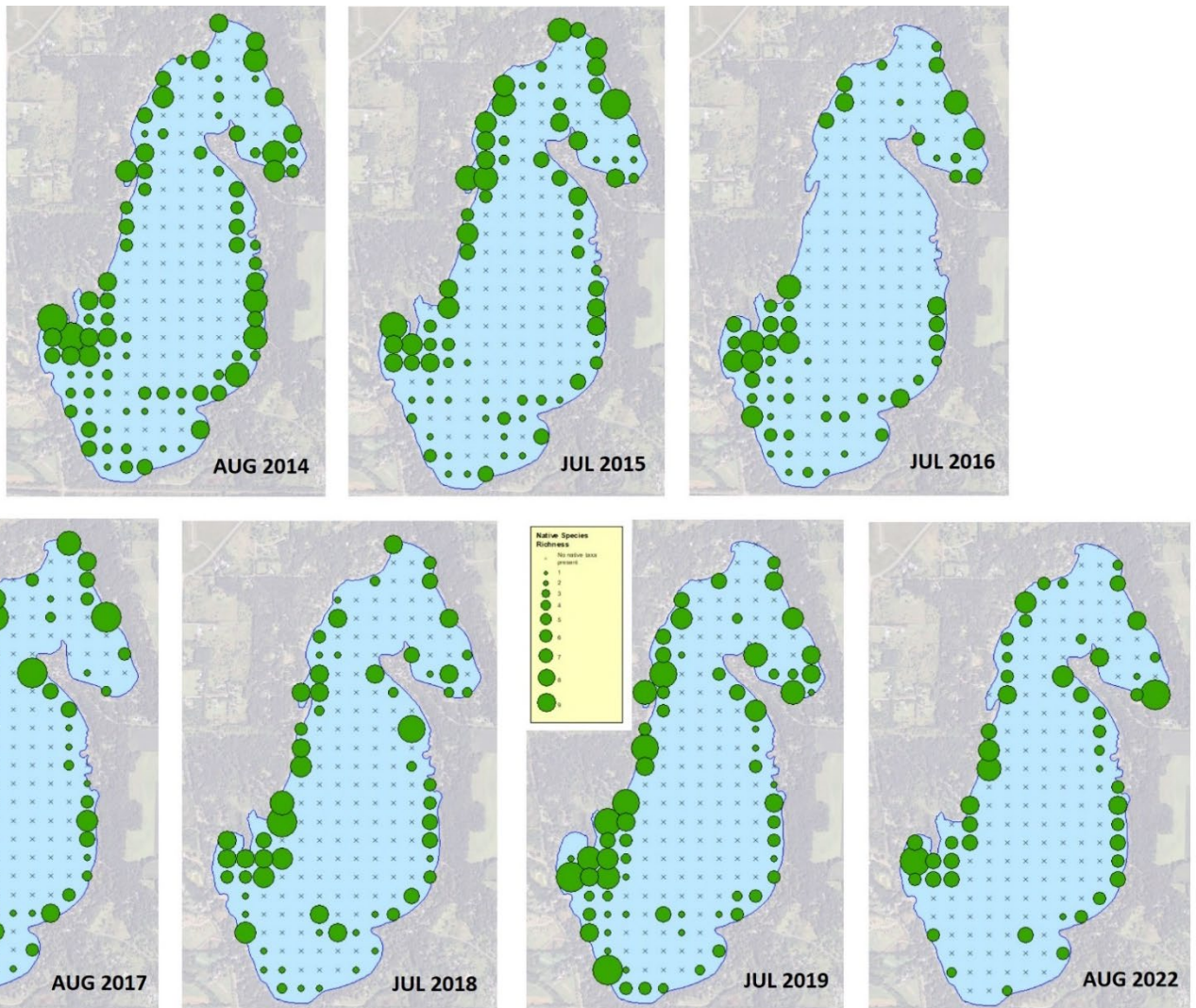
\*\*denotes rare species

**Floating, free-floating & emergent plants observed:** *Lemna trisulca* (forked duckweed), *Sagittaria* sp. (arrowhead species), *Spirodela polyrhiza* (greater duckweed), *Schoenoplectus americanus* (three-square bulrush), *Schoenoplectus acutus* (hardstem bulrush), *Typha angustifolia* (narrow-leaf cattail)

**Less common (< 5% frequency) submersed vegetation observed:** \*\**Alisma gramineum* (narrow-leaf water plantain) in 2014-2016, *Potamogeton strcitifolius* (stiff pondweed) in 2014 and 2019, *Potamogeton robbinsii* (fern pondweed) in 2015, *Eleocharis acicularis* (needle spikerush) and *Utricularia macrorhiza* (common bladderwort) in 2017, *Potamogeton pusillus* (very smallpondweed) in 2019 and 2022, *Potamogeton amplifolius* (large-leaf pondweed).



**Photos 1 – 3.** Narrow-leaved water plantain (*Alisma gramineum*) upper left; 2014), abundant northern watermilfoil (upper right; 2015), and a diverse native submersed assemblage including sago pondweed, water stargrass and naiad (lower left; 2018) observed in Big Carnelian Lake, Washington County, Minnesota (DOW# 82004900).



**Figure 1 – Native Species Taxa Density.** Spatial distribution and species richness (# of native species per sample point) of all submersed plant species from Minnesota Department of Natural Resources point intercept surveys (2014-2022). Big Carnelian, Washington County, Minnesota (DOW# 82004900).

This information can be made available in alternative formats such as large print, braille or audio tape by emailing [info.dnr@state.mn.us](mailto:info.dnr@state.mn.us) or by calling 651-259-5016.