

A

APPENDIX A

Littoral Frequency of Occurrence of Aquatic Plants from available Point-Intercept Surveys

Point-Intercept Data Matrix

Scientific Name	Common Name	LFOO (%)			
		2012	2015	2020	2024
<i>Ceratophyllum demersum</i>	Coontail	42.8	54.4	55.9	49.5
<i>Myriophyllum spicatum</i>	Eurasian watermilfoil	56.3	65.3	24.0	29.5
<i>Lemna trisulca</i>	Forked duckweed	59.7	40.3	11.2	1.0
<i>Vallisneria americana</i>	Wild celery	4.8	14.1	23.9	33.4
<i>Stuckenia pectinata</i>	Sago pondweed	10.5	21.5	8.5	7.0
<i>Heteranthera dubia</i>	Water stargrass	5.3	11.7	13.4	5.2
<i>Elodea canadensis</i>	Common waterweed	3.6	15.6	7.8	4.0
<i>Lemna minor</i>	Lesser duckweed	1.7	6.9	4.8	5.9
<i>Wolffia spp.</i>	Watermeal spp.	1.2	6.6	5.5	5.1
<i>Chara spp.</i>	Muskgrasses	3.4	10.4	0.7	1.6
<i>Potamogeton crispus</i>	Curly-leaf pondweed	7.3	5.0	2.2	0.7
<i>Myriophyllum sibiricum</i>	Northern watermilfoil	0.0	0.8	0.0	3.5
<i>Potamogeton friesii</i>	Fries' pondweed	2.6	1.3	1.2	0.5
<i>Potamogeton pusillus</i>	Small pondweed	0.0	4.0	0.0	0.9
<i>Spirodela polyrhiza</i>	Greater duckweed	0.0	0.0	0.0	2.8
<i>Nymphaea odorata</i>	White water lily	0.2	1.0	1.7	1.0
<i>Potamogeton nodosus</i>	Long-leaf pondweed	0.2	1.1	0.7	0.5
<i>Zizania aquatica</i>	Southern wild rice	0.0	0.0	0.0	0.0
<i>Ranunculus aquatilis</i>	White water crowfoot	0.2	0.0	0.0	0.3
<i>Potamogeton natans</i>	Floating-leaf pondweed	0.0	0.0	0.0	0.3
<i>Potamogeton zosteriformis</i>	Flat-stem pondweed	0.2	0.3	0.0	0.0
<i>Potamogeton richardsonii</i>	Clasping-leaf pondweed	0.0	0.0	0.0	0.2
<i>Potamogeton praelongus</i>	White-stem pondweed	0.0	0.0	0.0	0.2
<i>Najas flexilis</i>	Slender naiad	0.0	0.0	0.0	0.2
<i>Elodea nuttallii</i>	Slender waterweed	0.0	0.0	0.0	0.2
<i>Potamogeton illinoensis</i>	Illinois pondweed	0.0	0.2	0.0	0.0
<i>Fissidens spp. & Fontinalis spp.</i>	Aquatic Moss	0.0	0.0	0.2	0.0

B

APPENDIX B

Select Aquatic Plant Species Information & Distribution Maps

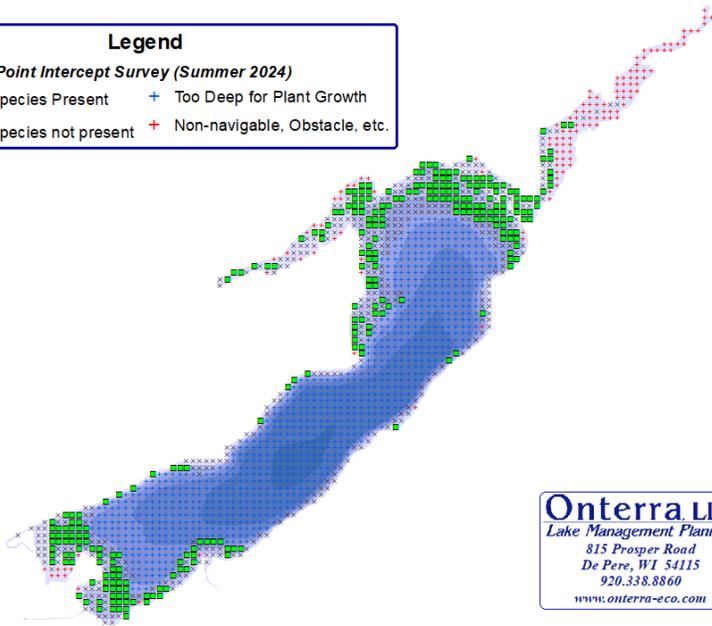
Coontail (*Ceratophyllum demersum*)

Native 

FLORA of WISCONSIN: <https://wisflora.herbarium.wisc.edu/taxa/index.php?taxon=3082>

Legend
Point Intercept Survey (Summer 2024)

■ Species Present	+ Too Deep for Plant Growth
× Species not present	+ Non-navigable, Obstacle, etc.



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Photo Credit: Onterra

- Coontail has whorls of leaves which fork into two to three segments, providing surface area for invertebrate habitat.
- Does not produce true roots and is often found growing entangled amongst other aquatic plants or matted at the surface.
- Coontail has a high tolerance for low-light conditions which allows this plant to become more abundant in eutrophic waterbodies with higher nutrients and low water clarity.

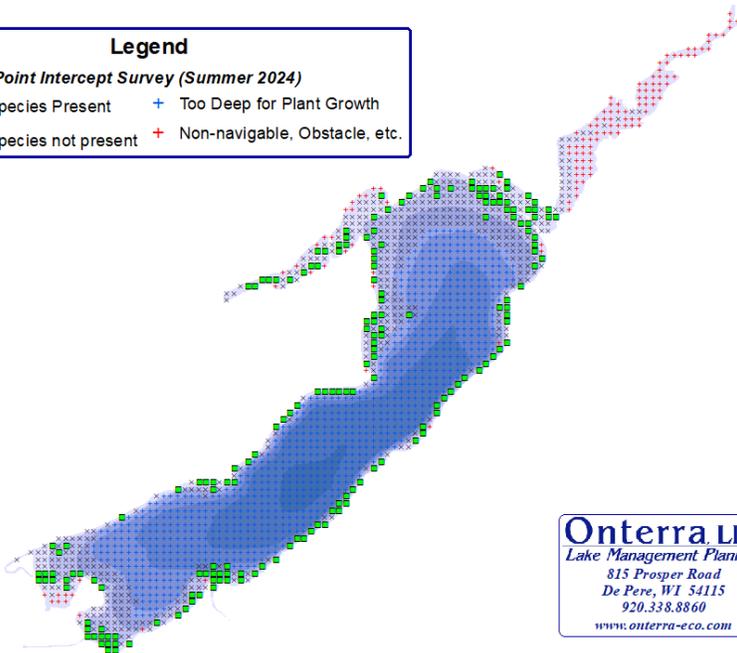
Wild Celery (*Vallisneria americana*)

Native 

FLORA of WISCONSIN: <https://wisflora.herbarium.wisc.edu/taxa/index.php?taxon=5329>

Legend
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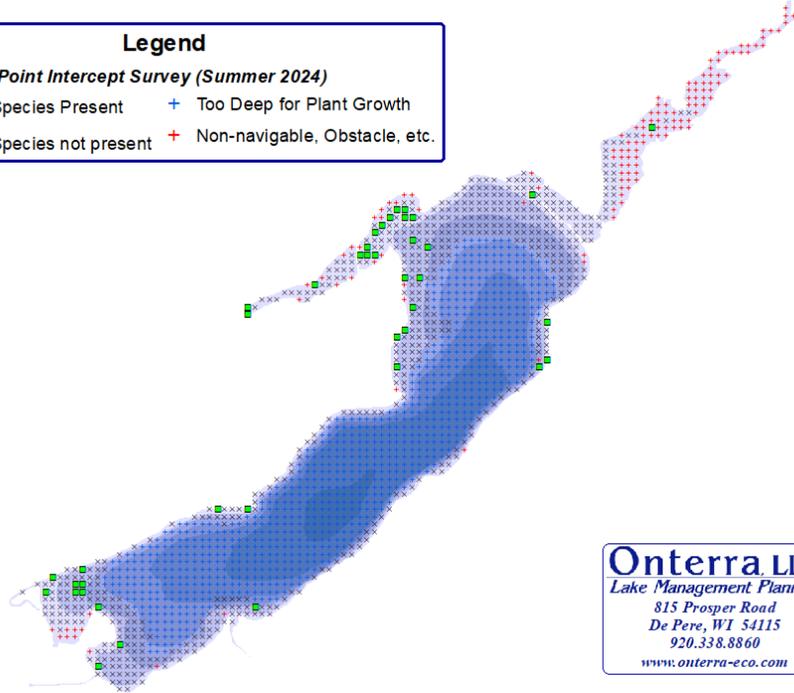
- Wild Celery has long ribbon-like leaves that tend to sway with the current and projects a singular small white flower to the surface from a spiraling stalk.
- Prefers to grow over harder substrates and is tolerant of low-light conditions.

Sago pondweed (*Stuckenia pectinata*)

Native 

FLORA of WISCONSIN: <https://wisflora.herbarium.wisc.edu/taxa/index.php?taxon=5170>

Legend
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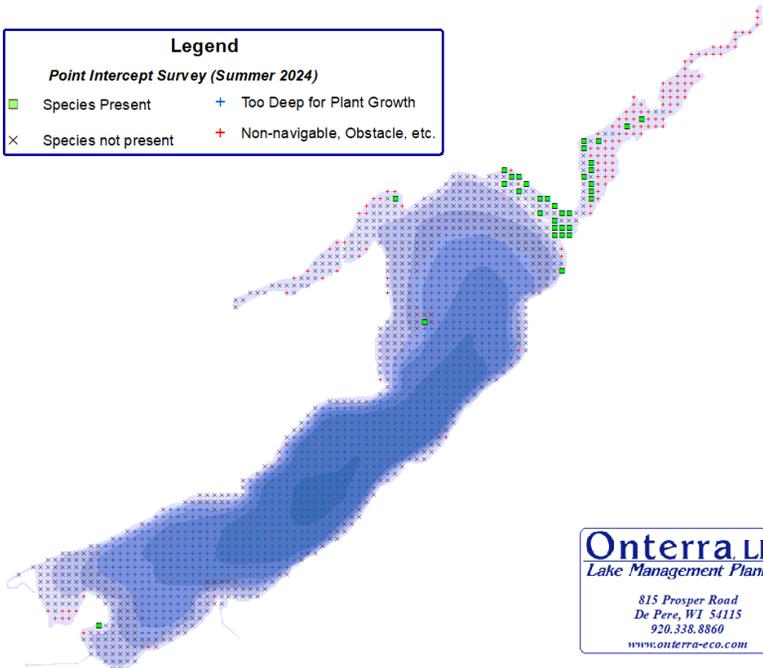
- Tolerant of disturbance and is often found in greater abundance in degraded lakes that have higher nutrient concentrations and low water clarity.
- Waterfowl have been observed to use sago pondweed as a major food source.

Lesser duckweed (*Lemna minor*)

Native 

FLORA of WISCONSIN: <https://wisflora.herbarium.wisc.edu/taxa/index.php?taxon=4036>

Legend
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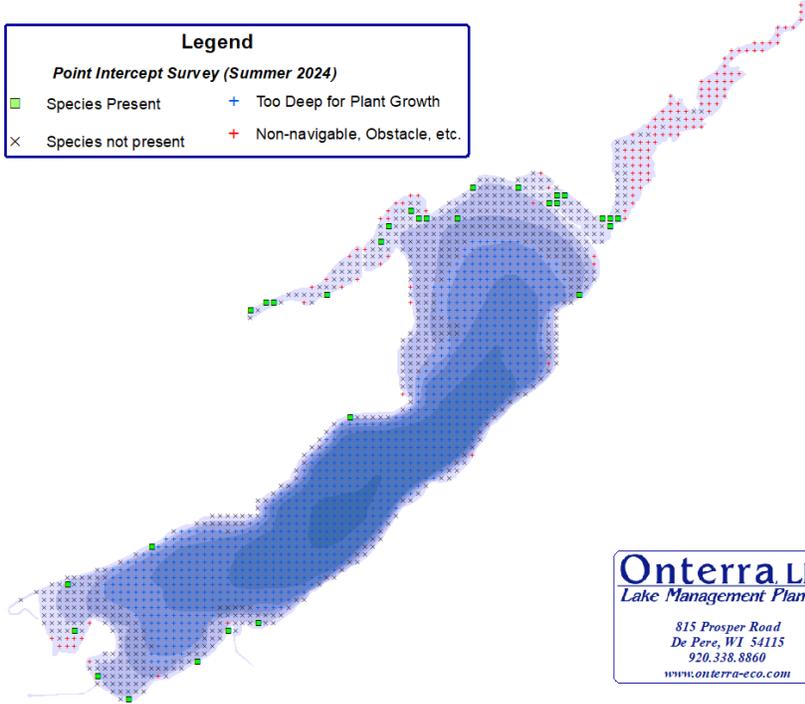
- Free-floating aquatic plant species found in nutrient rich still or slow-moving water
- It produces a winterbud that sinks to the bottom and overwinters in the sediment
- This perennial plant is the smallest plant known to produce a flower on earth.

Water stargrass (*Heteranthera dubia*)

Native 

FLORA of WISCONSIN: <https://wisflora.herbarium.wisc.edu/taxa/index.php?taxon=3838>

Legend	
<i>Point Intercept Survey (Summer 2024)</i>	
 Species Present	 Too Deep for Plant Growth
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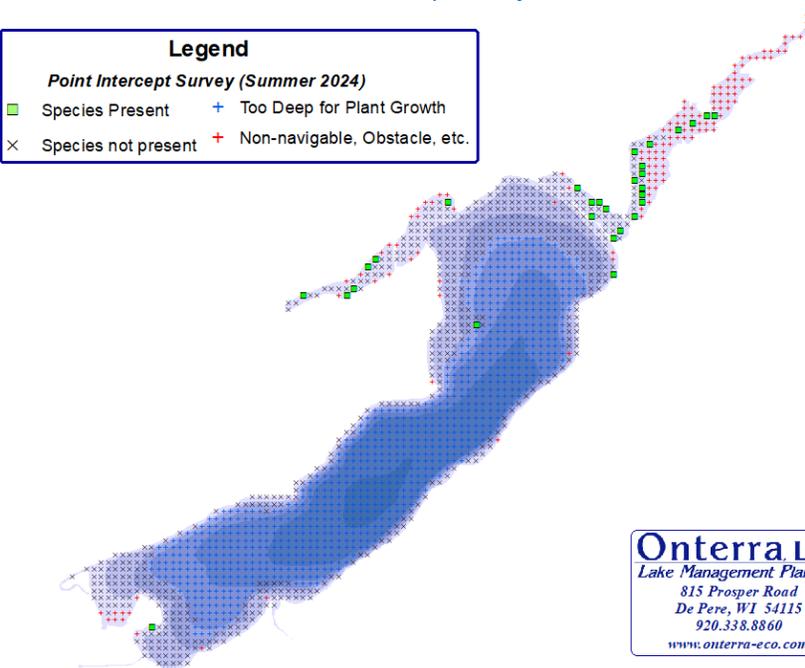
- Water stargrass has a similar morphology to some of the pondweed species with a rooted base, stem, and leaves that project off of the stem. A notable difference is that water stargrass does not have a midvein on its leaves like all pondweeds do.
- Does not produce true roots and is often found growing entangled amongst other aquatic plants or mated at the surface in very shallow water.

Watermeal (*Wolffia* spp.)

Native 

FLORA of WISCONSIN: <https://wisflora.herbarium.wisc.edu/taxa/index.php?taxon=1425>

Legend	
<i>Point Intercept Survey (Summer 2024)</i>	
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Photo Credit: Unknown

This plant is more commonly found in productive aquatic environments with high nutrients.

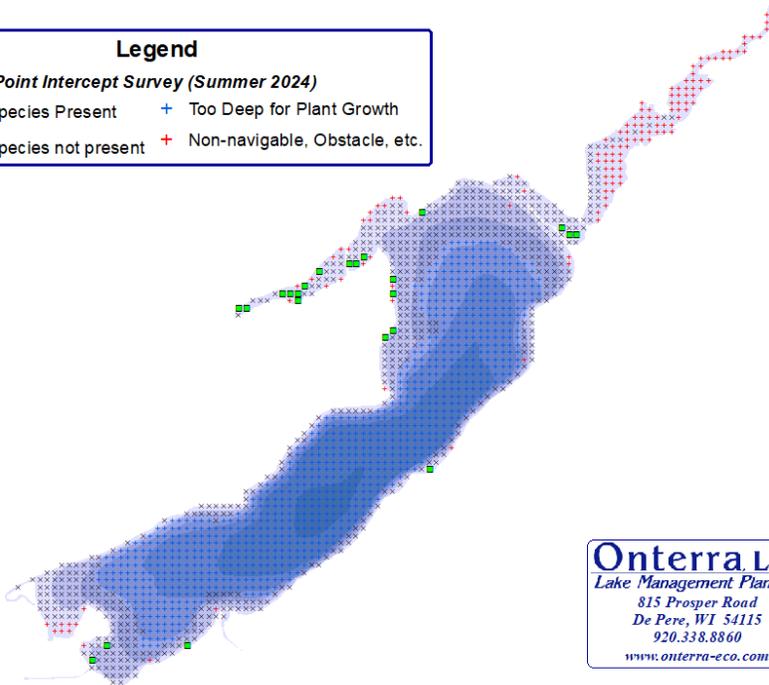
This free-floating aquatic plant has the texture of coarse sand.

Common waterweed (*Elodea canadensis*)

Native 

FLORA of WISCONSIN: <https://wisflora.herbarium.wisc.edu/taxa/index.php?taxon=3499>

Legend			
<i>Point Intercept Survey (Summer 2024)</i>			
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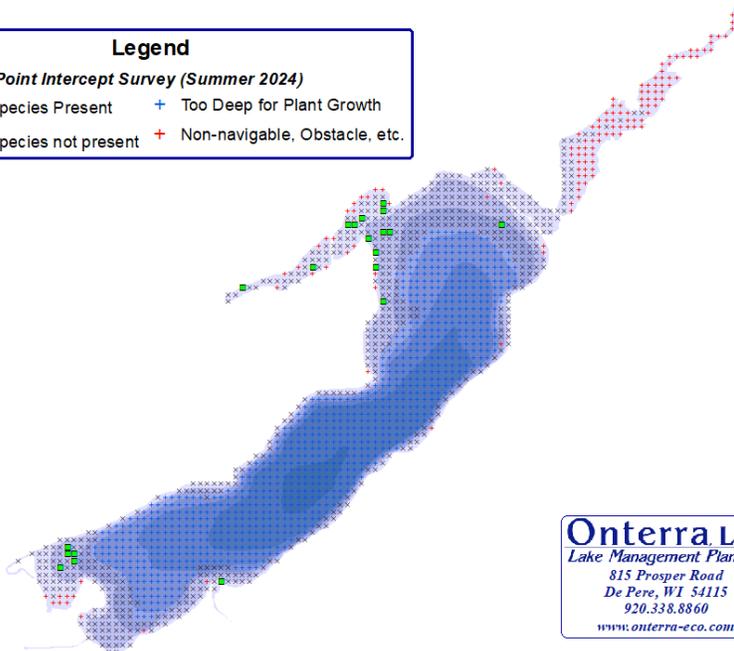
- Although it sometimes produces root-like structures that bury themselves into the sediment, it is largely an unrooted plant that can obtain nutrients directly from the water.
- As a result, this plant's location in a lake can be dependent upon water movement.

Northern watermilfoil (*Myriophyllum sibiricum*)

Native 

FLORA of WISCONSIN: <https://wisflora.herbarium.wisc.edu/taxa/index.php?taxon=4312>

Legend			
<i>Point Intercept Survey (Summer 2024)</i>			
	Species Present		Too Deep for Plant Growth
	Species not present		Non-navigable, Obstacle, etc.



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- Northern watermilfoil is arguably the most similar native species to the invasive Eurasian watermilfoil. These two plants can hybridize with one another.
- Northern watermilfoil also has less leaflets on its leaves (5-10 pairs) than Eurasian watermilfoil (12-16 pairs).
- Northern watermilfoil can be distinguished from the invasive Eurasian watermilfoil in that northern watermilfoil has more whorls of leaves per length of stem which appears as a bushier plant than Eurasian watermilfoil.

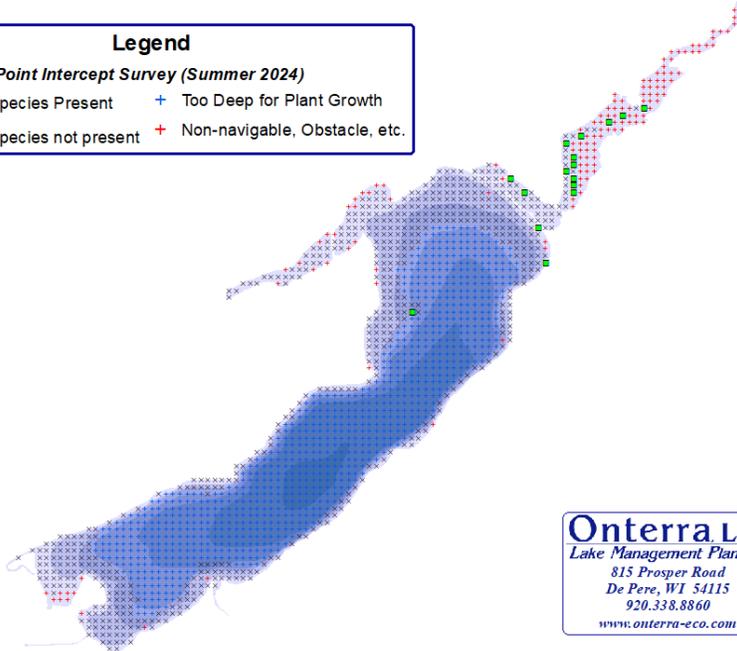
Greater duckweed (*Spirodela polyrhiza*)

Native 

FLORA of WISCONSIN: <https://wisflora.herbarium.wisc.edu/taxa/index.php?taxon=22037>

Legend
Point Intercept Survey (Summer 2024)

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 Species not present	 Non-navigable, Obstacle, etc.



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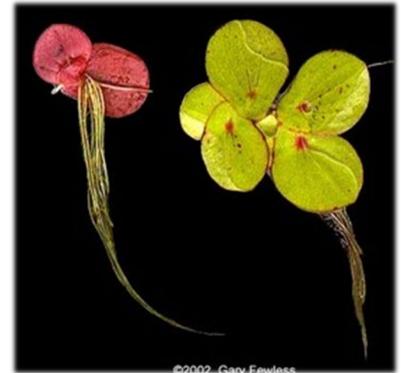


Photo Credit: Gary Fewless

- This free-floating aquatic plant species is more likely to be found in lakes that have high nutrient concentrations.
- Greater duckweed is generally larger than other duckweed species and has multiple roots (5 to 12+) under each frond.

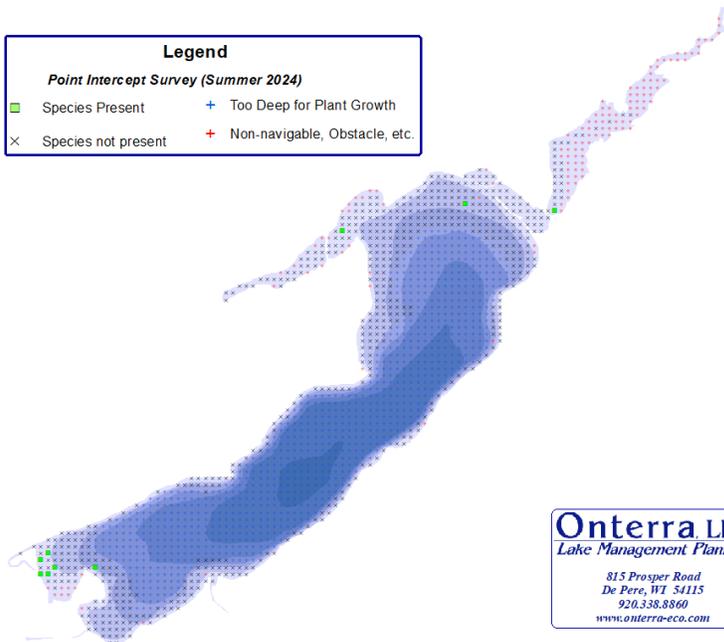
Muskgrasses (*Chara spp.*)

Native 

FLORA of WISCONSIN: <https://wisflora.herbarium.wisc.edu/taxa/index.php?taxon=22152>

Legend
Point Intercept Survey (Summer 2024)

 Species Present	 Too Deep for Plant Growth
 Species not present	 Non-navigable, Obstacle, etc.



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Photo Credit: Onterra

- These groups of plants grow unrooted and generally low along the bottom of the water column and can provide dense coverage. Their large beds help stabilize bottom sediments.
- Muskgrasses do not have forked ends, and they commonly have a skunk like smell.
- Muskgrasses require lakes with good water clarity, and are often some of the deepest growing plants in the lake.

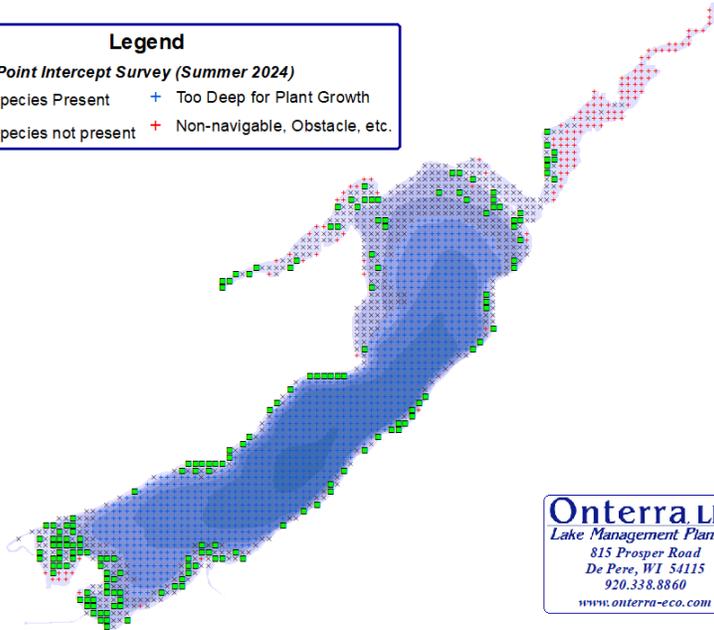
Eurasian watermilfoil (*Myriophyllum spicatum*) Exotic

FLORA of WISCONSIN: <https://wisflora.herbarium.wisc.edu/taxa/index.php?taxon=4313>

Legend

Point Intercept Survey (Summer 2024)

<p>■ Species Present</p> <p>× Species not present</p>	<p>+ Too Deep for Plant Growth</p> <p>+ Non-navigable, Obstacle, etc.</p>
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Photo Credit: Onterra

- A common and problematic invasive species in Wisconsin. Most developed lakes in Wisconsin have been exposed to this plant and some have even experienced change in its aquatic environment due to this plant.
- It can be identified by its slender shape when held out of water, the leaves are in whorls of around four, and each leaf has 24 or more leaflets (12 on each side of a leaf). There are some native milfoil plants in Wisconsin, but they are more likely to hold their bushy shape when pulled out of the water and have less leaflets on each of their leaves.

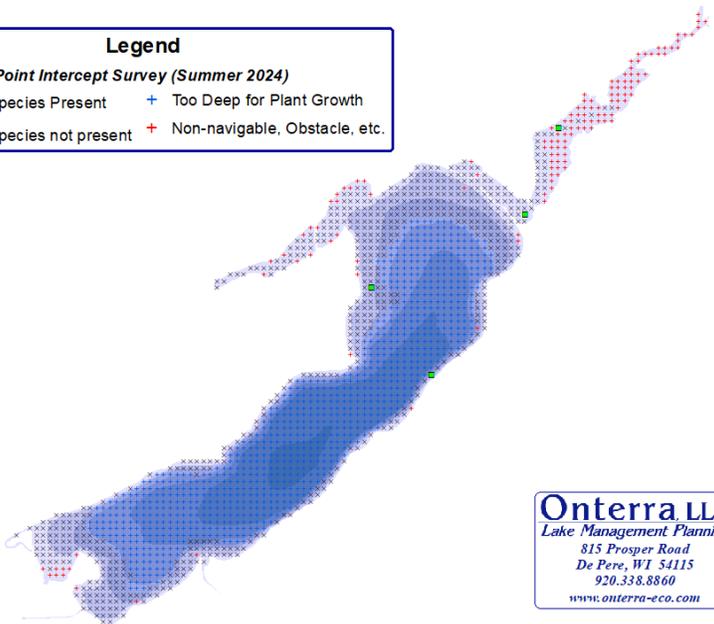
Curly-leaf pondweed (*Potamogeton crispus*) Exotic

FLORA of WISCONSIN: <https://wisflora.herbarium.wisc.edu/taxa/index.php?taxon=4618>

Legend

Point Intercept Survey (Summer 2024)

<p>■ Species Present</p> <p>× Species not present</p>	<p>+ Too Deep for Plant Growth</p> <p>+ Non-navigable, Obstacle, etc.</p>
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- A common and problematic invasive species in Wisconsin. It is more likely to be seen in the beginning half of the growing season, as it generally finishes its life cycle and starts to decay earlier than the native plants in Wisconsin.
- It's easily identifiable by its curly and serrated leaf edges which none of the native pondweeds of Wisconsin have.

C

APPENDIX C

Comment Response Document for the Official First Draft

Delavan Lake Draft Aquatic Plant Management Plan Official First Draft: July 8, 2022

Response Comments by Eddie Heath (Onterra, project manager)

WDNR Comments from Heidi Bunk (Regional Lakes Biologist)

Hi Eddie and Adam – thank you for the draft of this Delavan Lake APM plan. I do want to follow up with Adam for a couple of modifications. One is the potential purchase of a small custom machine from Aquarius and explaining in the plan what that would involve (in preparation for a possible RBF grant). The second is a look at the distribution of the coontail versus native pondweeds. Coontail harvest is very little of the overall harvested biomass. The *unconventional distribution map* I am asking for will help Adam and I determine if the coontail canopy is outcompeting the native pondweed populations.

Most of my other comments are pretty minor.

- Page 8, second paragraph. The 2015 survey was a joint effort with DLSD (Charlie Handel) and DNR (Samm Posnanski was primary but there were other DNR employees that helped). **Updated language added**
- Page 11, Figure 2.2-3. The color for rake fullness 3 doesn't match the color in the graph. I recommend using more contrasting colors, such as green, blue and red. **Colors updated to match Map 3**
- Page 11, Figure 2.2-4. No particular comment here except that coontail, wild celery and EWM continue to dominate. Elodea is less in 2024 along with waterstar grass and sago. I will reference this later. **Comment acknowledged**
- Page 15, Figure 2.2-10 I am surprised by this finding. I would like to look into the distribution maps over the years. I know for instance, in the past, it was quite prevalent in the inlet. **As shown in Appendix C, duckweeds and watermeal continue to be prevalent in the inlet area. Very little of these floating duckweed species were found in other areas of the system.**
- Page 20, Figure 2.3 -2. Good news on the long term trends for EWM. **Comment acknowledged**
- Page 20-21 Hydrocotyle ranunculoides or Floating Pennywort. You state that it has been documented in the southwestern bay of the lake. Did you mean SW bay of the inlet? Figure 2.3-3 indicates this. **Additional text and reference to Map 5 added for clarity.**
- Page 23 – Starry stonewort was documented in at least 5 more waterbodies this year. I will get the latest from Patrick and pass on to you. **Updated based upon information Patrick shared**
- Page 24 – thanks for conducting this late season point subset point intercept survey for Starry Stonewort. We should have Patrick enter that into SWIMS as a record. **We will send over the data when we batch our 2025 PI data this fall.**
- Page 26 – Coontail harvest is only 1% of harvested biomass while Wild Celery is 60%. I understand that you will need to harvest floating mats of celery, but would like to discuss possibilities to harvest more coontail to allow those 9 species of pondweed that you have documented in the lake to have a higher proportion of the biomass. The EWM harvest seems to be proportional to the overall Frequency of Occurrence of EWM from the plant survey. The coontail FOO is 49.5 % coverage but only 1% of harvested biomass. **Comment acknowledged**
- Page 26 – I would like to have a representation of the areas that receive the most versus least harvest. I know that the harvesting in the west end has been reduced in more recent years due to lack of available offload sites. Adam and I can discuss this and how the data can be represented. **A figure was added (no 2.4-3) that includes a color-shaded map and corresponding pie chart based upon proportional aquatic plant removal totals in 2024.**
- Page 26, Figure 2.4-3. To confirm, the range is the green and the median is the black line? **The figure legend did not show up on the OFD, now corrected. The black line is the phosphorus removal prediction based upon the average of the three models. The green is the minimum/maximum range of the three models.**

- Map 10 (separate file attachment) – use this as the basis for the new harvesting equipment Adam is pursuing from Aquarius. I recall the Adam was also interested in using the equipment in the inlet and outlet, so add maps appropriate for the site of that equipment. **Added text to page 25 and 34. Map 10 modified to be the “Nuisance Navigation in Channels Map,” applicable to herbicide treatment or specialized mechanical harvesting equipment.**
- Appendix of plant distribution maps: I would like to ask for an unconventional map that I normally don’t request. I would like to see a map (or possibly a couple of maps if you need to display the data that way) of the pondweed species distribution. I don’t need to see Sago, since you have that covered in Appendix C. I would like to get a good idea of where the more rare (i.e for Delavan) pondweeds are residing in the lake. **Created Map 12, which shows the distribution of all native pondweeds from the 2024 PI survey in the genus *Potamogeton*.**
- Standard item that is needed as of yet: A map showing the off load sites, haul routes and a map for each disposal site with the wetland/floodplain boundary layers illustrated. **Created Map 11.**
- Another standard item needed: A packaged .pdf for Adam to print off for each of his teams. This would include Maps 6 through 10 and pages 34 and 35 of the main plan. **Upon acceptance of the complete APM Plan by the WDNR, Onterra will extract the relevant sections and maps into a stand-alone PDF for the DLSD’s use in permitting.**

I will also send your draft documents to Travis Motl, our fisheries biologist, and Patrick Siwula, our Aquatic Invasive Species Biologist, for any further comment. Thank you so much for the draft plan!

WDNR Comments from Patrick Siwula (Regional AIS Biologist)

Thanks for the opportunity to comment – Here are a few notes from my perspective and addressing Heidi’s comments below as well:

- If you can send over the information from your late season survey targeting starry stonewort (SSW), I can see about incorporation into SWIMS, likely as an AIS early detection fieldwork event. If you are able to enter that information yourselves, that would be greatly appreciated and I’d also be interested in the sub-PI data sheet if willing to share. (and glad to hear no SSW was found during the survey). **When Onterra batches our 2025 PI data, we will also work up the 2024 sub-set PI from this investigation and send to WDNR. More communications will be forthcoming.**
- Pages 23/24: There were 6 new SSW lakes this year with total WI waterbodies with SSW now over 40, and can find the most up-to-date list on our webpage here: https://apps.dnr.wi.gov/lakes/invasives/AISLists.aspx?species=STARRY_STONEW&status%20%3C%3E%20OBSERVED&groupBy=Year **Reference added**
- For relevance to Delavan, would suggest noting it is now present in the nearby Lauderdale chain (all 3 lakes, one of this year’s findings) along with Geneva. **Reference added**
- Page 20: Aside from Horicon Marsh, Floating Marsh Pennywort (*Hydrocotyle ranunculoides*) is also now documented in [Twin Lakes](#) (Green Lake County, 2024 finding). **Reference added** Will be interested in the results of potential drawdown impacts to Pennywort at Delavan to inform other management efforts, and please keep us posted if that comes to fruition. **Text added about keeping the WDNR updated on results**
- Page 31: can note that any detections/specimens of new invasive species at Delavan will be send to the DNR AIS Biologist (myself for Walworth Co.) **Contact added.**

WDNR Comments from Travis Motl (Regional Fisheries Biologist)

- My recommendation would be to add the observer requirement to the bullet on page 33 since they are allowed to harvest before June 15 “if necessary.” Delavan is a productive Fishery so I’m not overly concerned that they always have a second observer later in the season. Heidi Bunk follow up comment: Essentially, we want one person operating the harvester and one person using a net to remove animals from the conveyor. **Text added about the second observer requirement for targeting “Habitat” areas prior to June 15.**