



Resource Assessment Service

**New Germany Lake
Submerged Aquatic Vegetation Survey
2014**

Report of Survey Activity and Results

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Prepared For

Maryland Department of Natural Resources

Maryland Park Service

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SUMMARY AND RECOMMENDATIONS

The Maryland Department of Natural Resources (DNR) Resource Assessment Service (RAS) initiated a submerged aquatic vegetation (SAV) survey in New Germany Lake during summer 2011, and repeated this survey in summers 2012, 2013, and 2014. The goal of the SAV surveys was to define the distribution and relative abundance of SAV species present within the lake and monitor changes in species composition and distribution over time.

Several species of Naiads (*Najas spp.*) and Pondweeds (*Potamogeton spp.*) are present in New Germany Lake, as well as other vascular plants of the genera *Isoetes*, *Utricularia*, and *Myriophyllum*. Two species of macroalgae, *Chara vulgaris* and *Nitella flexillis*, are also commonly observed.

In 2011, biodiversity was high relative to the size of the lake, but high plant density was considered an impediment to recreation. During the 2011-2012 winter season, a near total drawdown of the lake water level was completed in an attempt to decrease the standing plant biomass the following summer. It appears this method of control was counter-productive. During the summer 2012 SAV surveys, it was observed that biodiversity decreased substantially while the invasive *Najas minor* (Brittle naiad) was observed in high densities throughout the lake at the detriment of native species. Water level drawdown did not take place again during the 2012-2013 winter season, and the summer 2013 SAV survey results indicated that in the absence of that control measure, the native plants were able to out-compete *N. minor*. During the single summer 2014 SAV survey that took place in August, native Naiads, Pondweeds, and macroalgae were recorded at relatively high densities, and no *N. minor* was observed.

At this time, we are optimistic that *Najas minor* abundance in New Germany Lake is under control. DNR recommends at least one SAV survey during the summer 2015 growing season to confirm that *N. minor* has not increased in abundance again, and will continue to be a non-threat to the native plants and overall biodiversity.

RAS biologists recommend that throughout the summer 2015 season, all swimmers and boaters be alerted to the invasive nature of *N. minor* and other exotic species such as *Hydrilla verticillata*. *Hydrilla* is a highly invasive species that was recently identified in nearby Deep Creek Lake. Specific action to combat the spread of invasive species may include fact sheets for distribution throughout the park and informational signage at the boat ramp, beach/swim area, and in the clubhouse. We encourage park staff to speak directly with visitors to alert them of the problem and provide information regarding the cleaning of any swim or boating gear before and after entering the lake. Further information about preventing the spread of invasive species should be made available on the park's website.

INTRODUCTION

The Maryland Department of Natural Resources Resource Assessment Service (RAS) initiated a Submerged Aquatic Vegetations (SAV) survey in New Germany Lake in summer 2011 and has repeated this survey each summer since. The goal of the SAV surveys is to define the distribution and relative abundance of SAV species present within the lake and monitor changes in species composition and distribution over time.

Background

Located in New Germany State Park in western Maryland, New Germany Lake is a 13 acre lake surrounded by forests. Prior to 1837, it was a 9-15 foot channelized stream called Poplar Lick Run. In 1837 the Swauger Mill Dam was constructed, creating a 9 acre lake. Lake size increased to 13 acres in 1933 when the current dam was constructed two feet higher with a concrete spillway at the same site as Swauger Mill Dam.

Today the lake is the State Park's center of summertime activity. Non-motorized small boats are available to rent; fisherman enjoy the largemouth bass, catfish, bluegill, and trout; and swimming is available from the "east beach" within a guarded swimming area. Snorkelers are likely to get a glimpse of the many salamanders that hide within and among the SAV and submerged tree limbs, and possibly even a Hellbender, a species of giant salamander endemic to North America. Hellbenders are becoming exceedingly rare and although they normally inhabit areas with large rocks and swiftly moving water, one was seen several years ago in New Germany Lake.

Because the lake is stream-fed, it receives nutrient and sediment run-off from the surrounding

watershed. Fueled by the incoming nutrients and increased water temperatures, SAV begins growing throughout the lake beginning in late spring. Similar to their terrestrial counterparts, SAV are underwater grasses which provide a myriad of important ecological functions. Through the process of photosynthesis, SAV produces oxygen which is vital to the survival of all lake organisms. It provides food, habitat and nursery grounds for many species of fish and invertebrates. It absorbs nutrients which decreases the likelihood of algal blooms and also improves water clarity by reducing turbulence which allows suspended solids to settle to the bottom and get incorporated into plant root systems. SAV also reduces shoreline erosion and is a major food source for waterfowl. Healthy native aquatic plant communities also help prevent the establishment of invasive plants like Eurasian watermilfoil (*Myriophyllum spicatum*) and Waterthyme (*Hydrilla verticillata*).

METHODS

Field

In 2011, 2012, and 2013, three SAV surveys were conducted each summer in June, August, and September. In 2014, only one survey was conducted and this survey took place on August 11. Using SCUBA and snorkel gear, natural resource biologists sampled thirty-seven 0.25 m² quadrats placed systematically but haphazardly throughout the lake. Exact quadrat locations (latitude and longitude) were recorded using a Garmin handheld GPS device. Within each quadrat, total SAV percent cover was estimated, which included all vascular plants and macroalgae, as well as the percent cover of each individual species present. *Chara vulgaris* and *Nitella flexilis*, the two species of macroalgae observed, were not differentiated but recorded simply as 'macroalgae'.

Data Analysis

Average percent cover and frequency of occurrence values were calculated for total SAV, total Macroalgae, total *Najas spp.*, total *Potamogeton spp.*, total Other, and for each individual plant species observed using the following formulas:

Frequency of Occurrence = # of quadrats where observed / total # of quadrats surveyed

Average Percent Cover = sum of % cover values / total # of quadrats surveyed

Average percent cover and frequency of occurrence graphs were created to show macrophyte density and “patchiness” change over time. To show trends in the distribution and density of each macrophyte group throughout the lake, interpolated grid surface maps were created in ArcGIS using the default settings of the Inverse Distance Weighted (IDW) function in the Spatial Analyst Extension. Total SAV, total Macroalgae, total *Najas*, total *Potamogeton*, and total Other were interpolated and mapped. Total Other generally includes *Utricularia vulgaris*, *Isoetes sp.*, and both *Myriophyllum heterophyllum* and *M. sibiricum*, but in 2014 none of these were observed.

Depth data were collected during the 2012 SAV surveys. These values were interpolated and mapped using the same method as the SAV interpolation. Depth data was not collected again in 2013 or 2014. New Germany Lake is relatively shallow (0.5 m to ~ 2.2 m) with the deepest area near the dam (Figure 1).

RESULTS

During the summer 2014 New Germany Lake SAV surveys, three species of *Najas*, three species of *Potamogeton*, and both two species of macroalgae

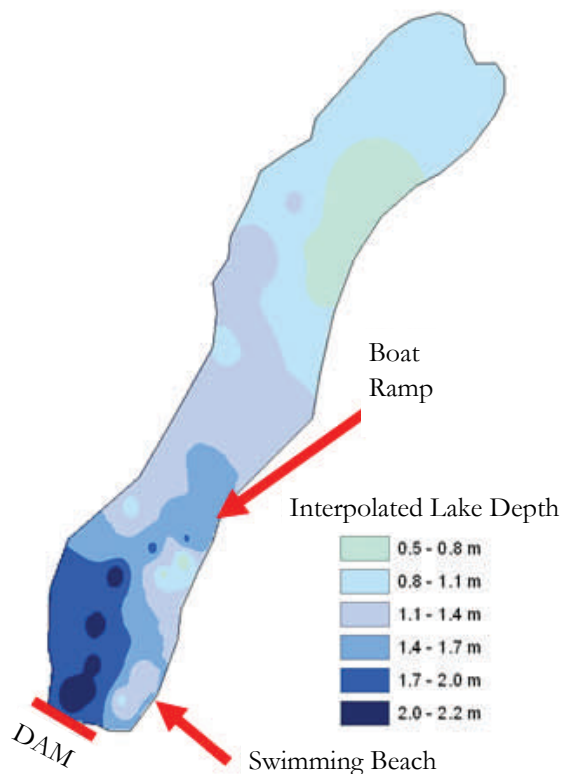


Figure 1. Interpolated water depth (m) in New Germany Lake, measured during summer 2012 SAV surveys.

were observed. The *Najas* included *N. flexilis*, *N. gracillima*, and *N. guadalupensis*. *Najas minor*, an exotic invasive that threatened the lake’s biodiversity in 2012, was not observed at all. The three species of *Potamogeton* observed included *P. pusillus*, *P. vaseyi*, and *P. diversifolius*. The macroalgae *Chara vulgaris* and *Nitella flexilis* were both present, but these were not differentiated while recording observations. See Table 1 for a list of species that have been observed in the lake since 2011, their common names, and abbreviations used in figures. Descriptions of each species or genus are given in Appendix A.

Average percent cover values and frequencies of occurrence for all sampling events are given in Appendix B. The data for each macrophyte group

Species	Abbr.	Common name
<i>Potamogeton pusillus</i>	Pp	Slender pondweed
<i>Potamogeton vasey</i>	Pv	Vasey's pondweed
<i>Potamogeton spirillus</i>	Ps	Spiral pondweed
<i>Potamogeton diversifolius</i>	Pd	Waterthread pondweed
<i>Potamogeton robbinsii</i>	Pr	Robbin's pondweed
<i>Najas flexilis</i>	Nf	Nodding naiad
<i>Najas gracillima</i>	Ng	Slender naiad
<i>Najas guadalupensis</i>	Ngp	Southern naiad
<i>Najas minor</i>	Nm	Brittle naiad (spiny)
<i>Utricularia vulgaris</i>	Uv	Common bladderwort
<i>Isoetes spp.</i>	Iso	Quillwort
<i>Myriophyllum spp</i>	Myr	Northern and Two-leafed watermilfoil
<i>Chara vulgaris</i>	Cv	Chara
<i>Nitella flexilis</i>	Nit	Nitella

Table 1. List of macrophytes observed in New Germany Lake during summers 2011-2014 SAV surveys.

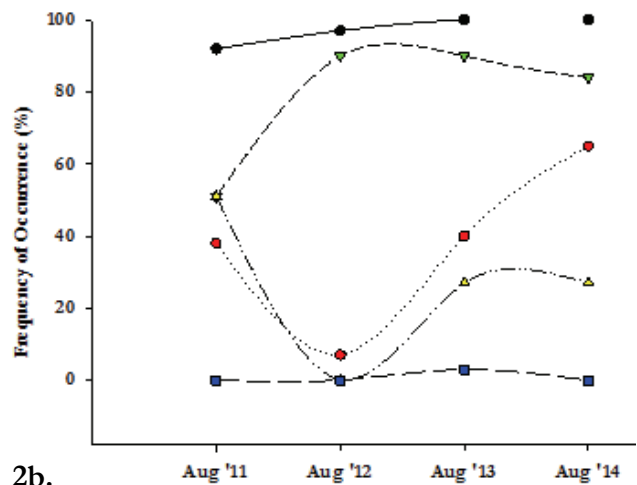
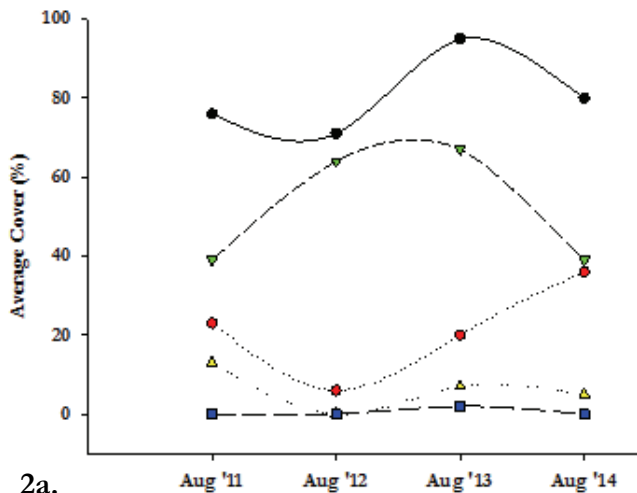
are graphed in Figure 2a and 2b. Figures 3a and 3b are graphs of August 2011-2014 *Najas spp* average percent cover and frequencies of occurrence.

Total SAV average percent cover was 80% on August 11, 2014, down from 95% the previous August. Total SAV frequency of occurrence was

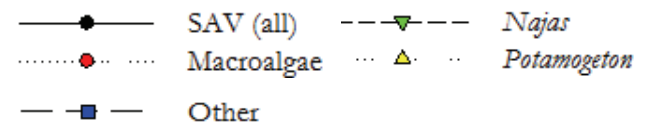
100%, the same as the previous August, meaning that SAV continued to be found throughout the lake, but not in such high densities. *Najas* dominated at the time of the survey, and of the species of *Najas* present, the native *N. guadalupensis* was the most abundant, while *N. flexilis* was the most frequently occurring.

Macroalgae were the second most abundant and commonly observed plants. Average total macroalgae percent cover was 36% in August 2014 with a 65% frequency of occurrence. These numbers are substantially higher than the previous August, when macroalgae average percent cover was 20% with a 40% frequency of occurrence.

Potamogetons, which are generally the least abundant group of plants in the lake, remained so again this year, averaging only 5% cover and 27% frequency of occurrence. Of the pondweeds, *P. pusillus* was the most prevalent this year whereas in August 2013, *P. diversifolius* was the dominant of the *Potamogetons*. No species of *Myriophyllum*, *Utricularia*, or *Isoetes* were observed in 2014.



Figures 2a and 2b. Average Percent Cover and Frequency of Occurrence graphs for 'All SAV' and other major macrophyte groups.



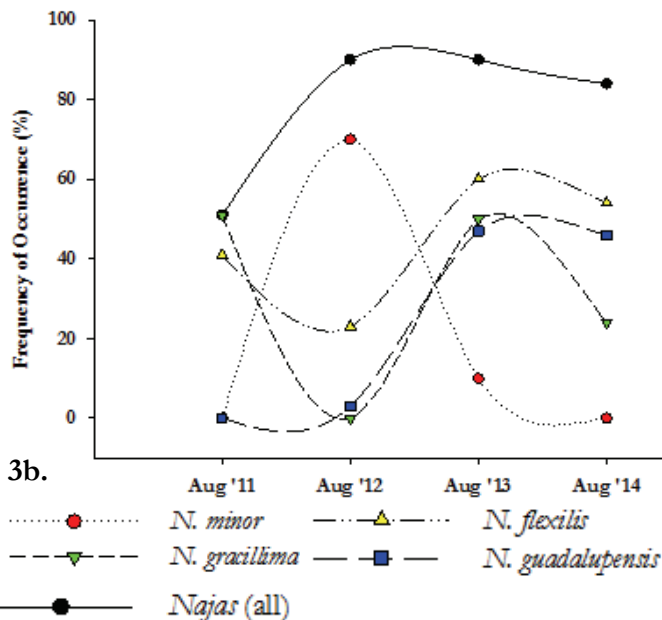
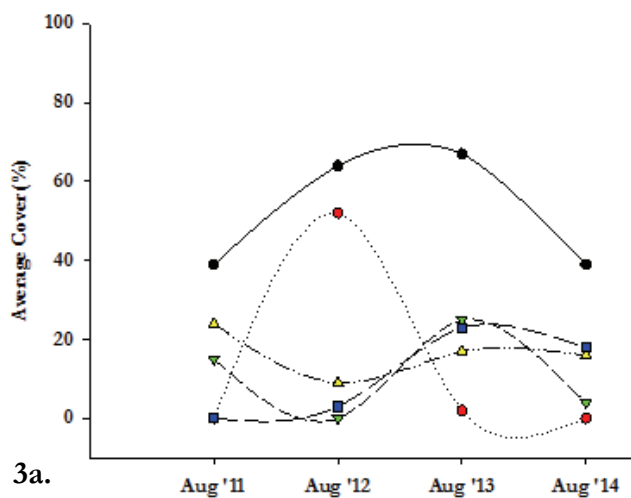


Figure 3a and 3b. Average Percent Cover and Frequency of Occurrence graphs for *Najas spp.*

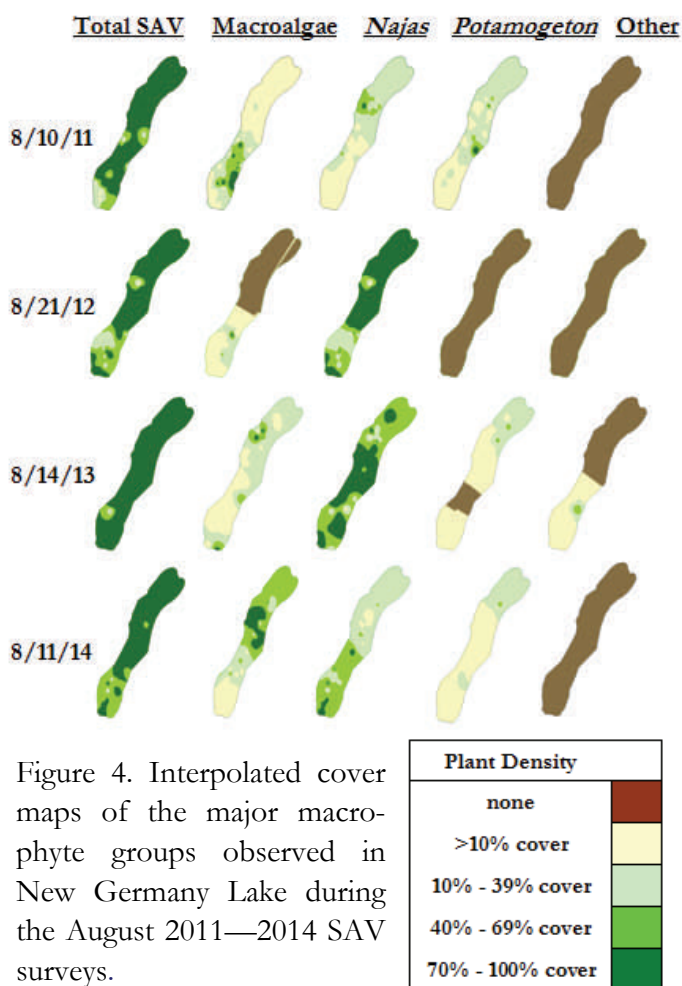


Figure 4. Interpolated cover maps of the major macrophyte groups observed in New Germany Lake during the August 2011—2014 SAV surveys.

Mapping of each genus or group (Figure 4) showed that SAV was present throughout the small lake. No genus exhibited striking spatial patterns completely favoring one area over another, but *Najas* did tend towards the southern, deeper end of the lake, while macroalgae was abundant in the northern, shallower half.

DISCUSSION

The goal of the SAV survey was to define the distribution and abundance of the SAV community throughout New Germany Lake. As such, the results of the survey provide a comprehensive view of the Lake's SAV community as a whole and how this community changes in space and time.

In the relatively short time we've been monitoring SAV in New Germany Lake, we've seen interesting changes take place that have taught us a great deal about the pros and cons of "managing" the lake's macrophytes. In 2011 when monitoring began, our survey results indicated that New

Germany Lake supported a healthy and somewhat diverse population of SAV relative to its size, including four genera of vascular plants and two species of macroalgae. Of the four vascular plants, the Naiads (*Najas spp.*) and the Pondweeds (*Potamogeton spp.*) were the most abundant. Pondweeds are perennial flowering plants with creeping rhizomes and leafy branches. Their leaf blades may either be floating or submersed and it can be difficult to differentiate one species from another. Naiads, on the other hand, are annual plants that grow in small freshwater streams or ponds. Naiads vary in size from inch-high tufts to highly branched plants two or three feet high. Perennial Bladderworts and Quillworts were also observed in New Germany Lake, though less frequently. *Utricularia vulgaris*, a bladderwort, is an interesting carnivorous plant that can trap and digest minute animals in the bladders that occur on the underwater leaves. *Isoetes sp.* is a quillwort, a hollow leaved plant with bulb-like underground rhizomes. Both the bladderwort and the quillwort are most commonly observed along the edge of the lake in shallower water. *Chara vulgaris* is a macroalgae that superficially resembles the vascular plants in the lake because of its stem-like and leaf-like structures. *Chara* plants are rough to the touch because of deposited calcium salts on the cell wall. *Nitella flexilis* is another robust freshwater macroalgae that grows up to a meter long with axes up to 1mm wide.

Although SAV is an indicator of good health, it can also become an impediment to recreational uses such as fishing, swimming, and boating, particularly in a lake as shallow as New Germany. In an effort to combat the further expansion of SAV and in the hopes of reducing the standing biomass, a near complete water level drawdown was conducted during the winter following our first SAV survey. Water level drawdown is a common method of macrophyte control in

freshwater reservoirs because it is relatively inexpensive and easily implemented, and can eliminate a large portion of plant biomass and the existing seed bank.

Unfortunately, results from our 2012 SAV surveys indicated that a major community shift took place by the end of summer 2012. Macroalgae made up the majority of the plant biomass in the June 2012 survey, but it was only observed in trace amounts in August and then was completely absent in September. Vascular plant diversity decreased as well. Where *Potamogeton spp.* were commonly observed in 2011, there were only two observation of *P. pusillus* in June 2012, and only trace amounts of *P. diversifolius* were detected in September. *Utricularia* and *Isoetes* were absent altogether. *Najas flexilis* and *N. guadalupensis* were observed, but in small amounts. *Najas minor*, however, an exotic plant from eastern Europe and Asia, was observed in high densities in practically every quadrat sampled in August and September and was by far the dominant species present in 2012 (Figure 3).

Cause for the expansion of *N. minor* in 2012 was most likely a result of the near complete drawdown of the lake water level during the 2011-2012 winter season. While Naiads are an excellent food source for waterfowl, decreased biodiversity combined with the dramatic expansion of an exotic species is not the favored state-change in any ecosystem. Although the water in the lake was drawn down specifically to control aquatic macrophytes, it is possible that the drawdown killed the majority of other plants but left small amounts of *N. minor* unscathed and able to reproduce rapidly, outcompeting the native plants during the 2012 growing season. RAS biologists consequently recommended that drawdown should not be repeated during the 2012-2013 winter season.

During the 2013 surveys, our observations showed that several species of *Najas* were present at relatively high densities and frequencies of occurrence, as well as two species of macroalgae and small amounts of *Potamogeton*. Trace amounts of *Myriophyllum sibiricum* and *M. heterophyllum*, both native Milfoils, were also observed for the first time in New Germany. The exotic invasive *Najas minor*, however, only had a 2% average cover and 10% frequency of occurrence by August 2013. It is our opinion that the lack of water drawdown during the 2012-2013 winter allowed for the native species of *Najas* and *Potamogeton* to recuperate and outcompete the invasive *N. minor*.

This trend back toward a biodiverse SAV community continued in 2014. During our August survey, *N. minor* was not observed at all. *Najas flexilis*, *N. gracillima*, and *N. guadalupensis* were all observed at high frequencies and abundance, and there was a great deal more *Potamogeton pusillus*, *P. vaseyi*, and *P. diversifolius* than the previous summer. Macroalgae also increased. It appears that in the absence of control measures, biodiversity is returning to normal in New Germany Lake, and the native SAV community appears to be recovering.

RECOMMENDATIONS

At this time, we are optimistic that *Najas minor* in New Germany Lake is under control. While the plant may still be present, and will likely remain so, it appears that the native species are able to outcompete this invasive as long as complete winter water level drawdown is not implemented. With regards to future monitoring in New Germany Lake, RAS biologists recommend an SAV survey in August 2015 to confirm that *N. minor* has not increased in abundance again, and will continue to be a non-threat to the native plants and overall biodiversity. As we have seen,

management efforts often have unpredictable consequences, so due diligence is required before future action is taken. Should additional macrophyte removal or control efforts ever be deemed necessary, a thorough evaluation of available options and their benefits and cost to New Germany Lake will take place and an action plan created.

Throughout the summer 2015 season, it will be vitally important that all swimmers and boaters, particularly those that launch their own small boat, are alerted to the invasive nature of *Najas minor* and other exotic species, such as *Hydrilla verticillata*. *Hydrilla* is a highly invasive species that was recently identified in nearby Deep Creek Lake (see Appendix C for an informational handout recently developed for distribution). It is a hearty and easily transportable plant, like *N. minor*, so action should be taken to ensure that these and other new invaders do not enter New Germany Lake. Equally important is that *N. minor* not be transported from the Park to other lakes or water bodies in the area via swim gear or boats, and staff at New Germany Lake should take action to ensure that no seeds or fragments are released over the dam.

Specific action to combat the spread of invasive species may include fact sheets for distribution throughout the park and informational signage at the boat ramp, beach/swim area, and in the clubhouse. Park staff are encouraged to speak directly with visitors to alert them of the problem and provide information regarding the cleaning of any swim or boating gear. Further information about preventing the spread of invasive species should be made available on the park's website.

APPENDIX A

New Germany Lake Submerged Aquatic Vegetation Plant Guide

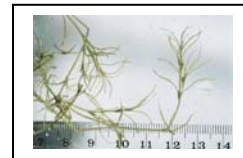
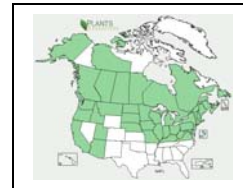
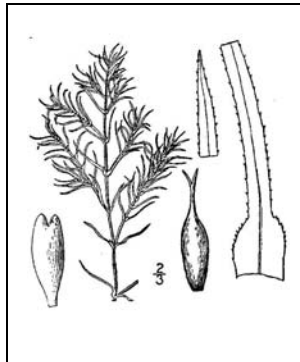
New Germany Lake SAV Guide

This plant guide provides drawings, pictures, distribution maps, and a brief description of each species of submerged aquatic vegetation observed in New Germany Lake during summer SAV surveys.

***Najas flexilis* (Slender or nodding naiad)**

Monocot. Annual. Native to the continental US, Alaska, and Canada. Found in most northern states and Canada.

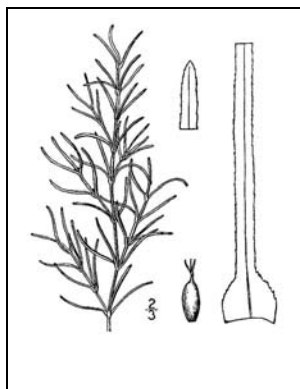
Naiads grow in small freshwater streams. They prefer sandy substrates and tolerate relatively low light. Naiads vary in size from inch-high tufts on sandy bottoms to highly branched plants two or three feet high. *Najas flexilis* is considered to be excellent food sources for waterfowl.



***Najas guadalupensis* (Southern naiad)**

Monocot. Annual. Native to the continental US, Puerto Rico, and Canada. Invasive to Hawaii. Distributed throughout US.

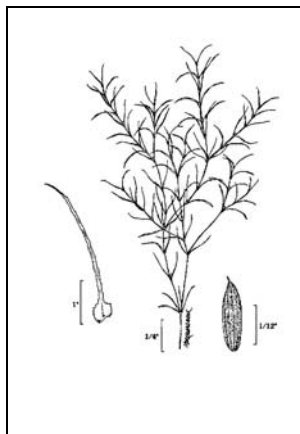
This plant grows in ponds, ditches, and streams. It produces a slender, branching stem up to 60 to 90 centimeters in maximum length. The thin, somewhat transparent, flexible leaves are up to 3 cm long and just 1-2 mm wide. They are edged with minute, unicellular teeth. Tiny flowers occur in the leaf axils; staminate flowers grow toward the end of the plant and pistillate closer to the base



***Najas minor* (Brittle naiad)**

Monocot. Annual. Invasive and established throughout eastern US and part of Canada. Native to North Africa, Japan, Turkey, India, as well as central and eastern Europe.

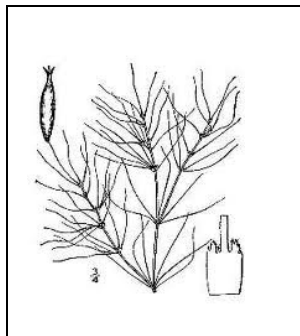
This plant prefers calm waters, such as lakes and ponds. It may grow in depths up to 4 m. It grows in dense clusters and has highly branched stems. Propagation from stem fragments or from small seeds which grow along its stem. Small flowers are located in clusters along the leaf axils. Leaves are opposite, unbranched, strap-shaped, and are around 4.5 centimeters in length. The leaves have serrations which are visible to the naked eye.



***Najas gracillima* (Thread-leaf naiad)**

Monocot. Annual. Native to the continental US, Alaska, and Canada. Found in the eastern states and California. Rare in some.

This plant prefers clear, healthy lakes. Stems are branched on the distal portion. The margins of leaf blades are minutely serrulate with 13-17 teeth per side, and the mid vein has no prickles. 1-3 flowers in each leaf axil. It propagates via seed and fragmentation. Seed surfaces are dull and pitted.



***Potamogeton pusillus* (Slender pondweed)**

Monocot. Perennial. Native to the continental US, Alaska, and Canada. Distributed throughout native range.

Slender pondweed grows in soft, fertile mud substrates and quiet to gently flowing water. Leaf blades of slender pondweed are entire and have pointed tips and can have a purplish tint. Like all other pondweeds, slender pondweed is considered an important food for waterfowl.



***Potamogeton diversifolius* (Waterthread pondweed)**

Monocot. Perennial. Native to the continental US and distributed throughout with the exception of far northeast.

This pondweed produces a very narrow, compressed stem branching to around 35 cm. It has thin, pointed linear leaves a few cm long spirally arranged about the thin stem. Flowers emerge from the water surface.



***Potamogeton vaseyi* (Vasey's pondweed)**

Monocot. Perennial. Native to the continental US and Canada. Distribution limited to the northeastern US and eastern Canada.

Not previously documented in Maryland, Vasey's pondweed is considered threatened, endangered, or of special concern where found in northeastern US states. It grows in quiet waters and has dimorphic leaves: very narrow, flaccid, submersed leaves and wider, thicker floating leaves.



***Potamogeton spirillus* (Spiral pondweed)**

Monocot. Perennial. Native to the continental US and Canada, but distributed only throughout the northeast US and northern mid-west, and eastern Canada.

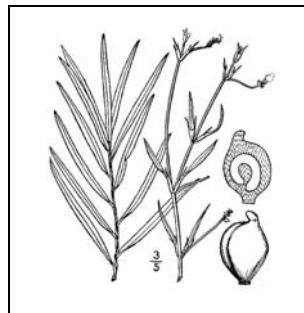
Spiral pondweed usually grows in shallow water: lakes, ponds, wet swales, and rarely quiet river borders. The submersed leaves are often curved, giving the whole bushy plant the aspect of a broad-leaved *Najas*



***Potamogeton robbinsii* (Robbin's pondweed)**

Monocot. Perennial. Native to the continental US, Alaska, and Canada. Distribution limited to ~ half US states and most of Canada.

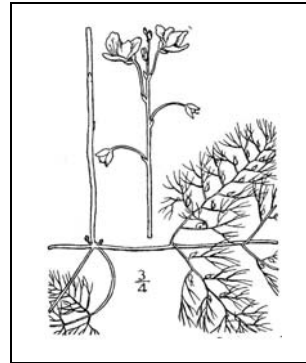
This pondweed is found in deep to shallow, often muddy waters of lakes, ponds, and rivers. It is the only *Potamogeton* that has branching inflorescences, though it rarely flowers. This plant is believed extirpated from Maryland and is threatened or endangered in several of its native states.



***Utricularia vulgaris* (Common bladderwort)**

Dicot. Perennial. Native to the continental US, Alaska, and Canada.

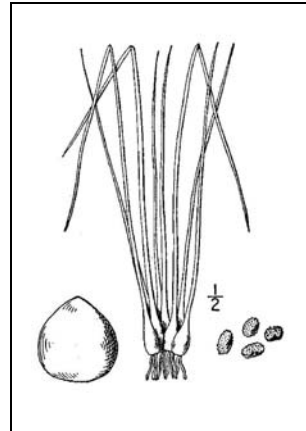
Several species of bladderwort occur in the Chesapeake Bay region, primarily in the quiet freshwater of ponds and ditches. They can also be found on moist soils associated with wetlands. Bladderworts are considered carnivorous because minute animals can be trapped and digested in the bladders that occur on the underwater leaves.



***Isoetes* spp. (Quillwort)**

Lycopod. Perennial. Native to the continental US, Alaska, and Canada. Distributed throughout.

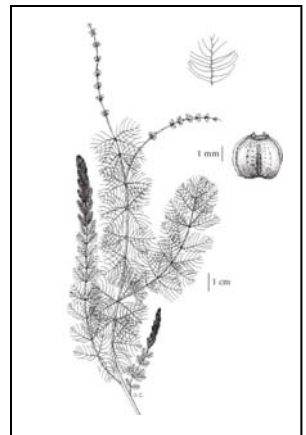
Quillwort leaves are hollow. Each leaf is narrow (2–20 cm long and 0.5–3 mm wide). They broaden to a swollen base up to 5 mm wide where they attach in clusters to a bulb-like, underground rhizome. This base also contains male and female sporangia, protected by a thin velum. Quillwort species are very difficult to distinguish by general appearance.



***Myriophyllum sibiricum* (Northern water milfoil)**

Dicot, Perennial. Native to the continental US, Alaska, Canada, and elsewhere. Distribution throughout Canada and the US with the exception of southeastern states from TX east to FL.

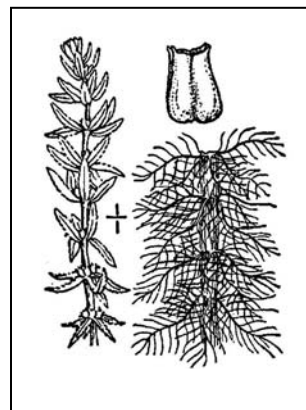
This plant is distinguished from the Eurasian water milfoil by its less finely divided leaves and larger floral bracts. It typically has 5-10 thread-like segments on each side of the midrib whereas Eurasian water milfoil has 12-24 segments. It is found in shallow to deep water of lakes, ponds, marshes, where its presence significantly increases the abundance of macroinvertebrates, although the value of milfoil is likely due more to its value as habitat than as food.



***Myriophyllum heterophyllum* (Two-leafed water milfoil)**

Dicot, Perennial. Native to the continental US and Canada with distribution throughout the eastern US and Canada.

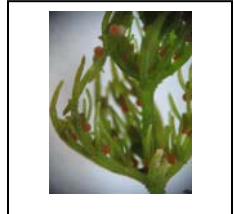
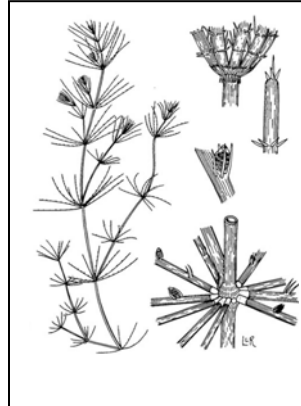
Two-leafed water milfoil has fine densely packed, featherlike leaves whorled around a main stem. It can grow up to 15 feet and may exhibit a three to six inch green spike-like flower above the waterline in late June or in July. A cross-section of the stem will reveal “pie-shaped” air chambers.



Macroalgae

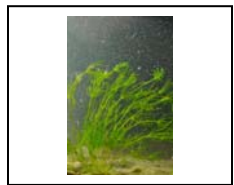
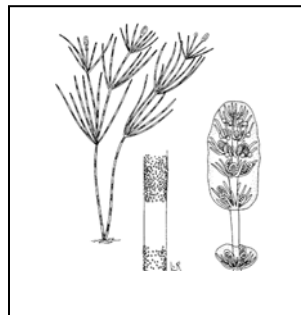
***Chara vulgaris* (Chara, Common stonewort)**

Chara is a green alga belonging to the Charales, a lineage that may have given rise to all land plants. The stoneworts are a very distinctive group of green algae that are sometimes treated as a separate division (the Charophyta). These algae can occur in fresh or brackish waters, and they have cell walls that contain large concentrations of calcium carbonate. Charophytes have relatively complex growth forms, with whorls of "branches" developing at their tissue nodes. Charophytes are also the only algae that develop multicellular sex organs.



***Nitella flexilis* (Nitella, Smooth stonewort)**

Nitella flexilis is closely related to *Chara vulgaris* in the Stonewort family, a group of complex algae that superficially resemble vascular plants more than they do other groups of algae. *Nitella* is a green, freshwater algae; a robust species growing up to a meter long with axes up to 1mm wide. Branches in whorls once or twice divided.



Vascular plant drawings were obtained from Britton and Brown (1913) via the USDA Plant Database.
USDA-NRCS PLANTS Database / Britton, N.L., and A. Brown. 1913. *An illustrated flora of the northern United States, Canada and the British Possessions*. 3 vols. Charles Scribner's Sons, New York.

Distribution maps were obtained from the USDA Plant Database.
USDA, NRCS. 2011. The PLANTS Database (<http://plants.usda.gov>, 10 November 2011). National Plant Data Team, Greensboro, NC 27401-4901 USA.

Images were obtained from the following:

Najas flexilis: www.vilaslandandwater.org
Najas guadalupensis: www.aquahobby.com
Najas minor: www.outdooralabama.com
Najas gracillima: www.wisplants.uwsp.edu
Potamogeton pusillus: <http://flora.nhm-wien.ac.at>
Potamogeton diversifolius: www.dcnr.state.al.us
Potamogeton vaseyi: www.botany.wisc.edu
Potamogeton spirillus: www.uwgb.edu/
Potamogeton robbinsii: www.yankee-lake.org
Utricularia vulgaris: www.dnr.state.md.us/bay/sav/key
Isoetes spp.: www.nybg.org
Myriophyllum sibiricum: www.mainevolunteerlakemonitors.org
Myriophyllum heterophyllum: www.missouriplants.com
Chara vulgaris: www.biolib.cz
Nitella flexilis: www.diszhal.info

APPENDIX B

New Germany Lake Submerged Aquatic Vegetation Data Summary Table including Average Percent Cover values and Frequencies of Occurrence for all Macrophytes Observed in the Lake during 2011-2014 Summer Surveys

Average percent cover values (un-shaded columns) and frequencies of occurrence (in parentheses and shaded grey) for all species and major macrophyte groups observed in New Germany Lake during summers 2011-2014 submerged aquatic vegetation surveys.

Date	SAV	MA	Nf	Ng	Ngp	Nm	Total
June '11	62 (96)	53 (76)	0.6 (2)	0 (0)	0 (0)	0 (0)	0.6 (2)
Aug '11	76 (92)	23 (38)	24 (41)	15 (51)	0 (0)	0 (0)	39 (51)
Sept '11	81 (98)	20 (36)	13 (31)	32 (51)	8 (11)	0.8 (4)	54 (67)
June '12	60 (94)	51 (84)	5 (23)	0 (0)	0 (0)	2 (13)	7 (29)
Aug '12	71 (97)	6 (7)	9 (23)	0 (0)	3 (3)	52 (70)	64 (90)
Sept '12	89 (100)	0 (0)	3 (8)	0 (0)	8 (17)	76 (92)	87 (100)
June '13	53 (94)	4 (32)	0.6 (3)	3 (13)	8 (23)	36 (81)	48 (90)
Aug '13	95 (100)	20 (40)	17 (60)	25 (50)	23 (47)	2 (10)	67 (90)
Sept '13	80 (94)	2 (3)	37 (70)	32 (70)	0 (0)	5 (15)	74 (94)
Aug '14	80 (100)	36 (65)	16 (54)	4 (24)	18 (46)	0 (0)	39 (84)

Najas

Nf: *N. flexilis*
 Ng: *N. gracillima*
 Ngp: *N. guadalupensis*
 Nm: *N. minor*

Date	Pp	Pv	Pr	Ps	Pd	Total
June '11	1 (10)	0.02 (2)	0 (0)	2 (24)	0 (0)	3 (36)
Aug '11	0 (0)	0.1 (3)	0 (0)	11 (44)	2 (5)	13 (51)
Sept '11	2 (9)	0.2 (4)	0 (0)	0 (0)	2 (11)	4 (24)
June '12	2 (6)	0 (0)	0 (0)	0 (0)	0 (0)	2 (6)
Aug '12	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Sept '12	0 (0)	0.3 (3)	0 (0)	0 (0)	0.1 (8)	0.4 (11)
June '13	2 (6)	0 (0)	0 (0)	0 (0)	0 (0)	2 (6)
Aug '13	0.2 (3)	0 (0)	0 (0)	0 (0)	6 (23)	6 (27)
Sept '13	2 (18)	0 (0)	0.8 (9)	0 (0)	0.6 (6)	3 (30)
Aug '14	3 (24)	1 (3)	0 (0)	0 (0)	1 (8)	5 (27)

Potamogeton

Pp: *P. pusillus*
 Pv: *P. vaseyi*
 Pr: *P. robbinsii*
 Ps: *P. spirillus*
 Pd: *P. diversifolius*

Date	Uv	Iso	Myr	Total
June '11	0 (0)	6 (18)	0 (0)	6 (18)
Aug '11	0 (0)	0 (0)	0 (0)	0 (0)
Sept '11	2 (2)	0 (0)	0 (0)	2 (2)
June '12	0 (0)	0 (0)	0 (0)	0 (0)
Aug '12	0 (0)	0 (0)	0 (0)	0 (0)
Sept '12	0 (0)	0 (0)	0 (0)	0 (0)
June '13	0 (0)	0 (0)	0.2 (3)	0.2 (3)
Aug '13	0 (0)	0 (0)	2 (3)	2 (3)
Sept '13	0 (0)	0 (0)	0 (0)	0 (0)
Aug '14	0 (0)	0 (0)	0 (0)	0 (0)

Other

Uv: *Utricularia vulgaris*
 Iso: *Isoetes* sp.
 Myr: *Myriophyllum sibiricum* or *M. heterophyllum*

APPENDIX C

Deep Creek Lake *Hydrilla verticillata* fact sheet

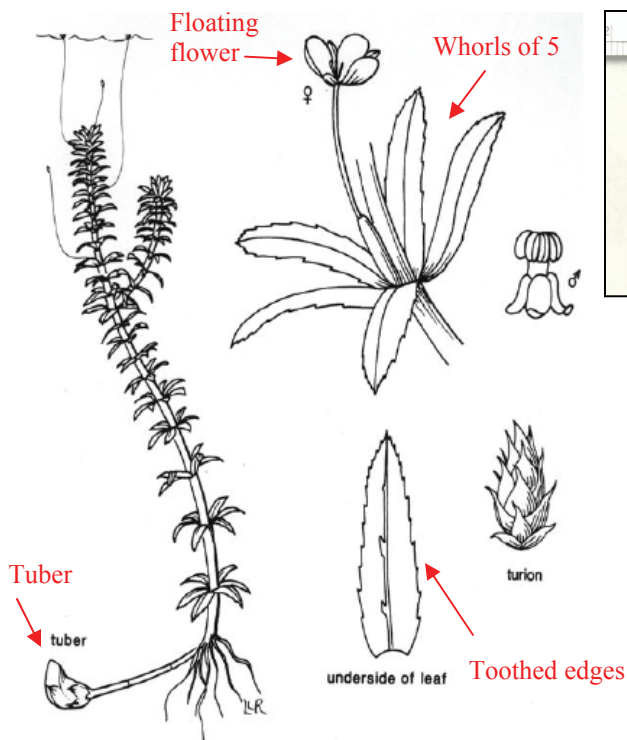
Attention:
Invasive *Hydrilla* has been identified in Deep Creek Lake!

What is it?

Hydrilla verticillata, also known as Water Thyme, is an invasive aquatic plant from Asia and Africa. It came to the United States decades ago as an aquarium plant and has since spread across the country from waterbody to waterbody, transported as fragments on boats and swimming gear.

How do you identify it?

Hydrilla stems are long, slender and freely branching with whorls of 3-5 linear leaves (most commonly 5). Leaves have strongly toothed or serrated edges. The serrations are small but visible without magnification. Small white flowers may be seen floating on the surface. Roots form along nodes of rhizomes that grow horizontally atop or just below sediment surface. Tubers are also commonly found at the end of runners that branch from the buried rhizome.



Why is it a concern that *Hydrilla* is in Deep Creek Lake?

Hydrilla can outcompete native plants along shore in shallow areas and coves, and because it has lower light requirements, also has the potential to grow deeper without competition.

By outcompeting native plants, *Hydrilla* may lead to changes in water temperature and oxygen availability for aquatic organisms, not only lowering plant diversity, but also lowering diversity of both fishes and aquatic invertebrates.

Hydrilla can create dense surface mats that interfere with water flow, boat traffic, and fishing, and that may also limit the light available to native species.

Hydrilla fragments can sprout roots and establish new plants, so boats with outboard motors can easily spread it to other parts of the lake and other waterbodies.

Are there other plants in Deep Creek Lake that look like *Hydrilla*?

Yes! *Elodea canadensis*, also known as Common waterweed, has a similar appearance to *Hydrilla* and is found throughout Deep Creek Lake. *Elodea* leaves are more often seen in whorls of 3 and are not as markedly toothed or pointed as those of *Hydrilla*. *Elodea* also lacks the tubers that *Hydrilla* forms in late summer or early fall.



Whorls of 3
instead of 5!



As a concerned citizen, how can I help?

Avoid running through dense beds of vegetation with your boat. Inspect your boat, trailer, and equipment before and after launching in any water body. Remove and properly dispose of any plant matter that you find—either place it in a trash can or well above the water line where it won't wash back into the water.

If you suspect you have *Hydrilla* near your property or have seen *Hydrilla* in the lake, please record the location and send as much information as possible to Mark Lewandowski at mark.lewandowski@maryland.gov

The End