Spider Chain of Lakes

Comprehensive Lake Management Plan 2021

Sponsored by:

Spider Chain of Lakes Association

With Grant Support from:

Wisconsin Dept. of Natural Resources

Consulting Partners:

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Finding a balance
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Introduction

Overview of Plan

This Comprehensive Lake Management Plan addresses lake water quality, habitat, aquatic invasive species prevention, and the social framework to support the long-term health of the lakes. The Spider Chain of Lakes includes Clear Lake, Fawn Lake, North Lake, and Big and Little Spider Lake in Sawyer County. The plan will be implemented from 2022 through 2032.

The Spider Chain of Lakes Association (SCLA) initiated the planning process by securing a Wisconsin Department of Natural Resources (WDNR) grant early in 2020. The grant funded data gathering and the resulting reports used in plan development including:

SCLA Shoreland Property Owners Survey report (Sheldon, 2020),

Water and Nutrient Budget Analysis Spider Chain of Lakes, Sawyer County WI (Schieffer, Water and Nutrient Budget Analysis Spider Chain of Lakes, Sawyer County, 2021), and

Lake Shoreland & Shallows Habitat Survey Spider Chain of Lakes, Sawyer County WI (Schieffer, 2021).

Aquatic plant surveys for all project lakes were completed in 2017.

Curly-leaf pondweed (Potamogeton crispus) Point-intercept and Bed Mapping Surveys, and Warm-water Macrophyte Point-intercept Survey – Spider Chain - Sawyer County, Wisconsin (Berg, 2017).

These reports are available on the SCLA website.[1]

[1] https://spiderchainoflakes.org/page-1733703/10571336

Institutional Framework for Planning

Lake Management Goals

I. Everyone who lives on, recreates on, and affects the Spider Chain of Lakes practices good lake stewardship.
II. Spider Chain of Lakes water quality is preserved and protected.
III. Our shorelands and shallows provide healthy fish and wildlife habitat.
IV. The Spider Chain of Lakes provides quiet, wilderness-like experiences for all to enjoy.
V. Aquatic Invasive Species (AIS) are prevented from negatively impacting the Spider Chain of Lakes.
VI. The Spider Chain of Lakes Association will monitor and anticipate the impacts of climate change on the Spider Chain of Lakes, and will take appropriate action to minimize negative impacts.
VII. The Spider Chain of Lakes Association has the capacity to build relationships, provide stable funding, operate efficiently, and encourage responsible use to preserve and protect the lakes.

Plan Stakeholders

Advisory Committee

Five meetings of the SCLA Comprehensive Lake Management Plan Advisory Committee were held to gather input from citizens and partner agency elected officials and staff. Advisors represented the Wisconsin Department of Natural Resources (WDNR), Sawyer County, and the Town of Spider Lake. Members of the SCLA Aquatic Invasive Species (AIS) Committee and the SCLA board served on the advisory committee. The Town of Spider Lake provided meeting facilities for two meetings, and the remaining meetings were held virtually.

Property Owner Survey

A sociological survey was administered to all shoreland property owners of the Spider Chain of Lakes (Sheldon, 2020). The survey was designed to assess the attitudes and cultural behaviors that promote and impede the SCLA's lake protection efforts. The survey was divided into the following blocks:

- ***Survey Narrative.*** Provided an explanation of the purpose of the survey.
- ***Participant Residency***. Description of residency, tenure on the lake chain, and introduction to the lake chain.
- ***SCLA Participation and Perspectives.*** Rating satisfaction and importance of a number of SCLA activities. Self-assessment of participation and willingness to participate.
- ***Participation and Lake Use.*** Data on preferred lake activities and inventory of motorized and non-motorized watercrafts.
- ***Fishing and Fishery Management.*** Interest in fishing, species preference, and attitudes about fishery management.

- ***Attitudes about the Lake.*** Level of agreement related to physical characteristics of the lake, preferences about lake views, and concerns related to water quality.
- ***Personal Views.*** Open-ended responses to the following questions: (1) *List the three most important things to you about the Spider Chain.* (2) *List the three most important things that need to happen on the Spider Chain in the next 2 to 5 years.* (3) Non-member survey only: *According to our records, you are not currently a member of the Spider Chain of Lakes Association. If there is a specific reason for that decision, please share that with us.*

Survey notices, delivery and replies occurred from June 15, 2021 through July 21, 2021. Survey methods and results are explained in detail in the survey report (Sheldon, 2020). Survey results will be used to assist in identifying owner concerns and interests, willingness to participate in and support SCLA programs, motivations for behavior change, and characteristics of owners and their property. These will influence lake goals and objectives and help to select priorities for SCLA activities going forward.

Survey Conclusions

***A typical Spider chain shoreland property owner*.** Half of shoreland owners (50%) come to the lakes on summer weekends or weekends throughout the year. Almost nine out of ten shoreland owners (86%) have been on the Spider Chain for six or more years.

SCLA. About three-quarters of shoreland owners are SCLA members. SCLA members say that the *most* important services and activities the SCLA provides are: controlling aquatic invasive species (96%), the *Spider Lines* newsletter (96%), the SCLA monthly updates (93%), and the SCLA website (91%).

Actions. The majority of respondents say they are very willing to do, or are already doing environmental efforts such as removing lead-containing weights and lures, altering lawn practices and shoreline plantings to improve water quality, and changing how they use the lakes in order to protect them.

Activities. Most survey respondents own between one and three canoes or kayaks (95%) and between one and three motorboats (74%). The vast majority of owners own no sailboats (94%), no jet skis (92%), no ATV/UTVs (90%), and no snowmobiles (89%). The activities viewed as less important are: snowmobiling (36%), harvesting food (33%), ATV/UTV trails (27%), hunting or trapping (18%), and irrigation (14%). Eight of every ten owners (80%) are active anglers. They prefer fishing for largemouth bass, walleyes, and muskies.

Attitudes about the Spider Chain. There are very high levels of agreement on preserving and protecting an undeveloped quality on the lakes. The vast majority of owners prefer natural shorelines, peace and quiet, and the “Northwoods” and “wilderness” character of the area. Further, they realize that what they do affects the lakes and that their shoreland property values are directly linked to the quality of the lakes. The majority do not want to see lawns. The majority of shoreland owners want waterskiing hours to remain the same, neither reduced (76%) nor expanded (61%).

Lake issues. The most important lakes issues are: maintaining water quality; peace and quiet; retaining the wilderness setting; preserving the unspoiled, undeveloped shoreline; and controlling aquatic invasive species.

Comprehensive Lake Management Plan. A Comprehensive Lake Management Plan for the Spider Chain of Lakes should consider the desires of most shoreland property owners to preserve the "Northwoods" and "wilderness" nature of the lake chain. Nearly all owners say they are concerned about preserving the water quality of the lakes, preventing and controlling aquatic invasive species, and maintaining a quality fishery. Spider Chain shoreland property owners have a strong environmental stewardship ethic and the Comprehensive Lake Management Plan should use this value as a primary guiding principle.

Public Review and Comment

A draft plan was made available to the public by posting on the SCLA website[2] with notification sent to lake residents and published in the Sawyer County Record in early November 2021. The public review period ended November 30, 2021. Public comments are available from the SCLA by request. Additions were made to the plan to reflect information provided in public comment. In one case, the comments were forwarded to the Town of Spider Lake as requested.

Organizational Capacity

Spider Chain of Lakes Association is organized exclusively for charitable, educational, and scientific purposes and is a charitable organization within the meaning of Section 501(c)(3) of the Internal Revenue Code. Its purpose is to protect and improve the Spider Chain of Lakes, including the fostering of all conservation matters beneficial to the lakes, including the quality of the fish, the wildlife, and the quality of the water for the benefit and enjoyment of the Members of the Association and the general public.

The mission of the SCLA is a shared responsibility to preserve and protect the Spider Chain of Lakes for future generations. This mission includes preserving the area's natural environment, protecting the health of the watershed by sponsoring educational programs, monitoring the health of water and wildlife, participating in the enactment of water and shore land regulations, and encouraging responsible use of the irreplaceable resource by and for the citizens.

SCLA community building efforts include a picnic, boat parade, and annual meeting. An education committee guides activities such as SLEEK which provides youth education in cooperation with the Cable Natural History Museum. The SCLA annual giving program raises funds for annual expenses, for an endowment for long-term support of lake protection activities, and an emergency operating reserve fund for short-term emergencies such as the presence of newly identified aquatic invasive species.

[2] https://spiderchainoflakes.org/

Overview of Historical Management Actions

SCLA focuses on preventing, detecting, and responding to aquatic invasive species (AIS) by broadening the community's understanding of AIS threats through education, monitoring landings and lakes, and addressing invasive species through various strategies when needed.

Many of the actions identified in the Spider Chain of Lakes Aquatic Plant Management Plan (Blumer, 2013) have been completed including:

- shoreland restoration education and workshop,
- in-lake and shoreland invasive species monitoring,
- Clean Boats, Clean Waters watercraft inspections,
- an aquatic invasive species rapid response plan,
- Curly-leaf pondweed and Purple loosestrife monitoring,
- dissolved oxygen monitoring (profiles on Spider and Little Spider),
- Take Action Against Yellow Flag Iris campaign
- Spider Lake Environmental Education for Kids (SLEEK) program, and
- additional educational programming.

Newly added activities include:

- annual native plant sales,
- no-mow shoreland flyer initiative,
- contracted removal of Yellow flag iris, and
- Project Pike – to remove Northern pike (an introduced species) from the Spider Lake Chain.

Over thirty active volunteers monitor aquatic plants twice annually around the lakes' littoral zone. A Citizen Lake Management volunteer collects water quality samples, measures Secchi depth, and takes temperature and dissolved oxygen profiles on Spider and Little Spider Lake. The Clean Boats, Clean Waters Program staff inspect boats and encourage actions to prevent invasive species introduction in the Spider Chain of Lakes (Figure 1).

Purple loosestrife and Yellow flag iris are manually controlled to prevent spread. The Take Action! Against Yellow Flag Iris campaign engaged the community in invasive species work and provided them a positive experience with the SCLA to build trust and encourage further involvement. In the event of a major AIS introduction, the SCLA community will have learned and worked together and will be better informed and prepared to take on that challenge.

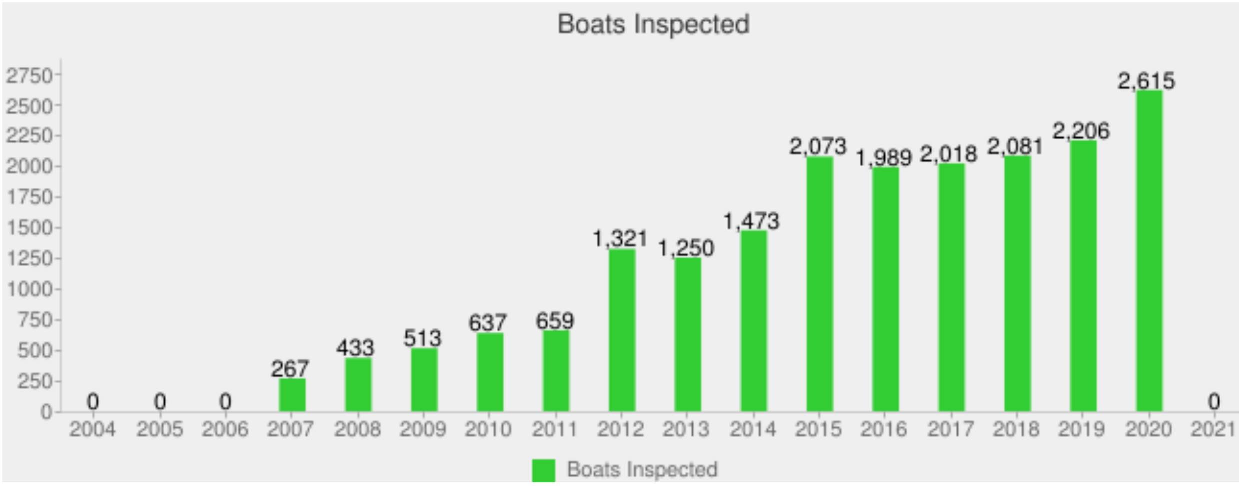


FIGURE 1. BOATS INSPECTED, CLEAR LAKE LANDING CLEAN BOATS, CLEAN WATERS PROGRAM

Plan Partners and Related Ordinances and Plans

Sawyer County Zoning and Conservation Department

The Land and Water Conservation branch is responsible for promoting, protecting and enhancing the land and waters of Sawyer County. In conjunction with federal, state, and county agencies and programs; activities include a tree planting program, a lakes information database, design and implementation of erosion control practices, and administration of the state Wildlife Damage and Farmland Preservation Programs. Educational information to lake associations, schools and other interested organizations is provided as requested. Activities are guided by the Sawyer County Land and Water Resource Management Plan 2017-2026 (Sawyer County, 2017).

The Sawyer County AIS Coordinator is a valuable asset and partner in educating Citizen Lake Monitoring Network AIS monitors, assisting with Purple loosestrife beetles, and aiding the SCLA in plant identification questions and advice.

Sawyer County Zoning is the enforcement branch for many county regulations that regulate land use. The Zoning & Conservation Department provides assistance for mitigation for shoreland properties. Sanitary permits are issued by Sawyer County Zoning. However, zoning ordinance and land use permits are handled by the Town of Spider Lake for Spider Chain of Lakes residents.

Sawyer County Lakes Forum

The SCLA is an active member of the Sawyer County Lakes Forum. The Lakes Forum purpose is to facilitate education, research, and sharing between organizations, individuals, governmental bodies and the general public of Sawyer County; to maintain and improve Sawyer County's water bodies, environs, and watersheds for now and future generations, including, but not limited to: aesthetics, water quality, wildlife habitat, fisheries, and recreation. The intent of the organization is to accomplish these purposes while respecting the rights of property owners.[3]

Town of Spider Lake

The Town of Spider Lake processes payroll for CBCW landing monitors. SCLA representatives provide input related to water quality issues to the Town of Spider Lake Board.

The Town of Spider Lake has its own zoning ordinance and issues land use permits within the shoreland zone. **Land Use Ordinance 17-88 was adopted to preserve and protect the natural assets of the town and is more restrictive than current Wisconsin statutes would normally allow.** Wisconsin state law mandates that no *new* land use ordinance be more restrictive than the Wisconsin statutes. Land Use Ordinance 17-88 is more restrictive in certain ways, but is "grandfathered," so the Town of Spider Lake is allowed to keep it. *Any change to the Land Use Ordinance must be carefully considered since certain changes would revoke its "grandfathered" status.*

Major additional shoreland protections provided by the Town of Spider Lake land use ordinance (when compared with the Sawyer County land use ordinance) result from maintaining a lakes classification system with more restrictive development standards for less developed lakes. Classes range from 1-4 with Class 4 having the most restrictive standards. Spider Lake and North Lake are Class 1, Clear Lake is Class 2, and Fawn Lake is Class 4. The ordinance regulates structure setbacks, minimum shore frontage, minimum lot sizes, and side yard setbacks by class. Allowed vegetation removal is more restrictive than state statute and Sawyer County ordinance for all lake classes. Additional provisions vary from the state statutes (Markham, 2019).

The Town of Spider Lake also has an ordinance that regulates water traffic, boating, and water sports (TOWN OF SPIDER LAKE ORDINANCE #12).

In addition to the speed and shoreline restrictions imposed by the state through the Wisconsin Department of Natural Resources, the town adds additional restrictions to watercraft speeds and use during the day (see excerpt below).

Prohibited operation.

(a) Speed restrictions. No person shall operate a watercraft on any of the waters identified by this ordinance at a speed greater than 10 mph, except as provided in sub-paragraph (b) below.

(b) Water skiing and use of any watercraft at a speed greater than that listed in Section 5 (a) above shall be permitted only on the following waters between the hours of 11:00 A.M., and 3:00 P .M., Spider Chain of Lakes (except Fawn Lake), Ghost Lake and Lower Clam Lake. Where and when these activities are permitted, speed shall conform to the provisions of Wis. Stat. 30.66 and 30.69. Motorized watercraft shall operate at slow no wake speed within the shore zone (within 100 feet of shore) including islands

(c) Personal watercraft. No person between the age of 12 and 16 shall operate a PWC without having a state approved boating certificate.

[3] https://sawyer-county-lakes-forum.org/

Wisconsin Department of Natural Resources

The Wisconsin Department of Natural Resources provides support to the SCLA for many functions including technical and financial assistance for the development of this plan and support for programs including the Citizen Lake Monitoring Network, the Clean Boats, Clean Waters Program, standardized inventory and monitoring methods, regulatory permitting and enforcement, and fisheries management.

Baseline Data and Assessments

Lakes Description

The Spider Chain of Lakes is located in Sawyer County, Wisconsin and is comprised of four hydrologically connected lakes. The lakes in the system include Clear Lake (WBIC: 2435800), Fawn Lake (WBIC: 2435900), North Lake (WBIC: 2436000), and Spider Lake WBIC: 2435700). Spider Lake is sometimes divided into two lakes and referred to as Big and Little Spider Lakes. Characteristics of the lakes are listed in Table 1.

TABLE 1. SPIDER CHAIN OF LAKES CHARACTERISTICS

Lake	**Area** (acres)	**Maximum Depth** (ft.)	**Mean Depth** (ft.)	**Trophic State** (2020)
North Lake	139.6	30	12.7	Mesotrophic[4]
Fawn Lake	30.3	35	11.2	Mesotrophic[4]
Clear Lake	254.8	30	5.8	Mesotrophic
Spider Lake	1232.8	64	14.7	Mesotrophic

The northernmost lake, North Lake, drains into Fawn Lake. Fawn Lake flows into Spider Lake. Clear Lake drains into Spider Lake from the west. The lakes connect with narrow channels which likely restrict the dispersive movement of the water. Spider Lake drains out via Spider Creek. North Lake, Fawn Lake, and Spider Lake all have large areas of wetlands in the riparian zone surrounding the lakes.

[4] WDNR classifies Fawn Lake and North Lake as Eutrophic based on historic citizen lake monitoring water clarity (Secchi depth) monitoring results. However, lake study results place these lakes in the mesotrophic category.

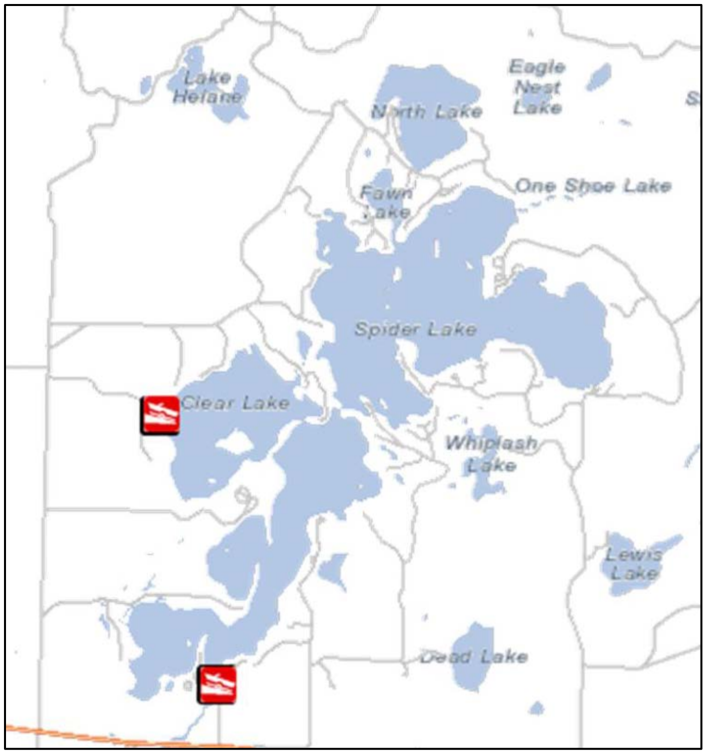


FIGURE 2. THE SPIDER CHAIN OF LAKES

Lake Depth and Substrate

The maps of lake depth and substrate presented below are from the plant surveys conducted for each lake (Berg, 2017).

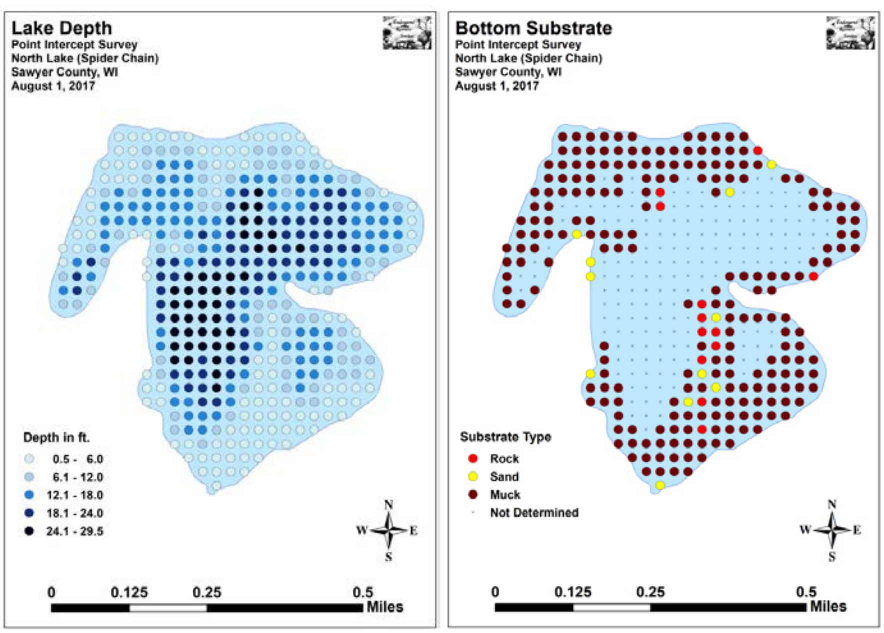


FIGURE 3. NORTH LAKE DEPTH AND SUBSTRATE

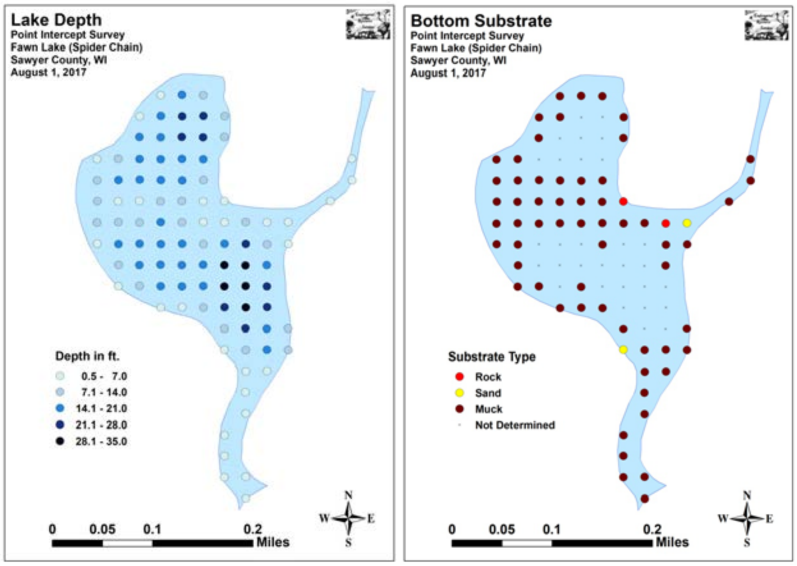


FIGURE 4. FAWN LAKE DEPTH AND SUBSTRATE

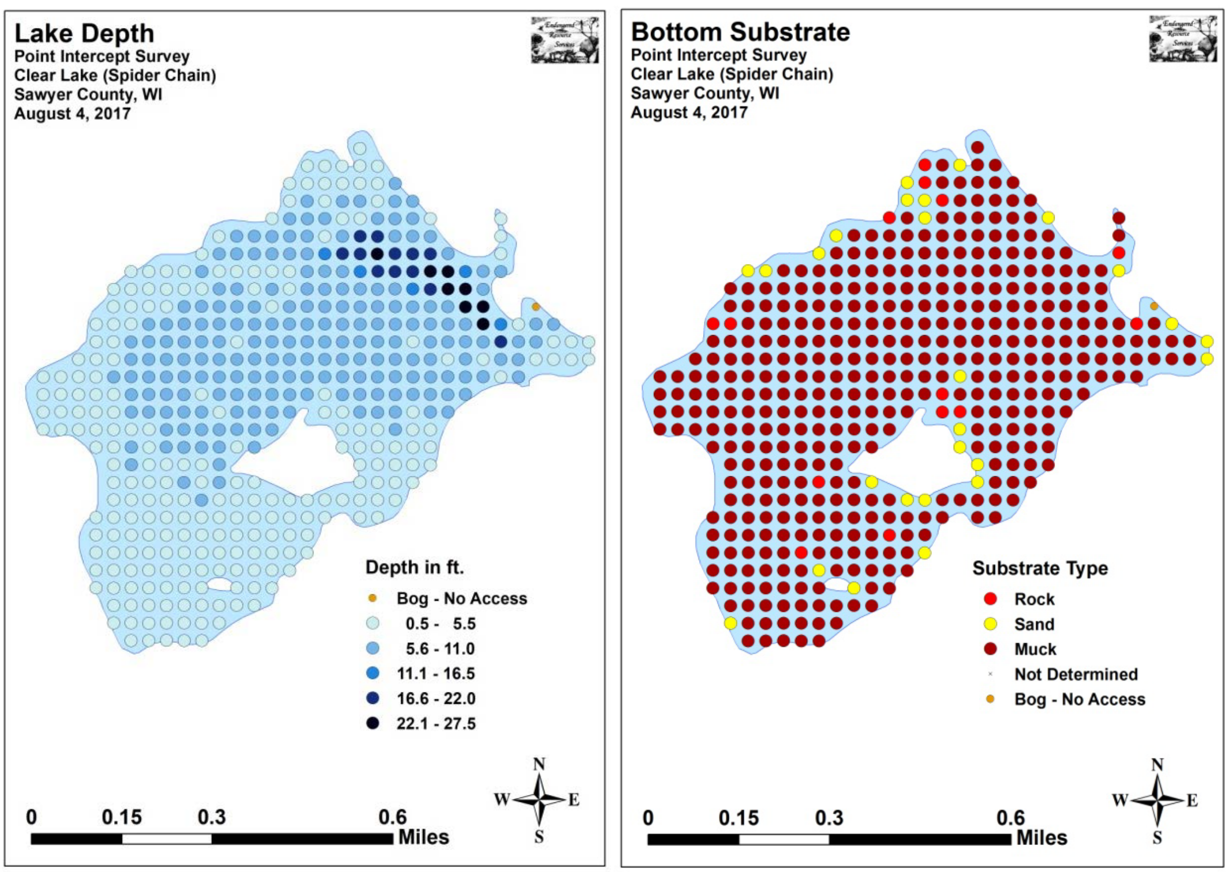


FIGURE 5. CLEAR LAKE DEPTH AND SUBSTRATE

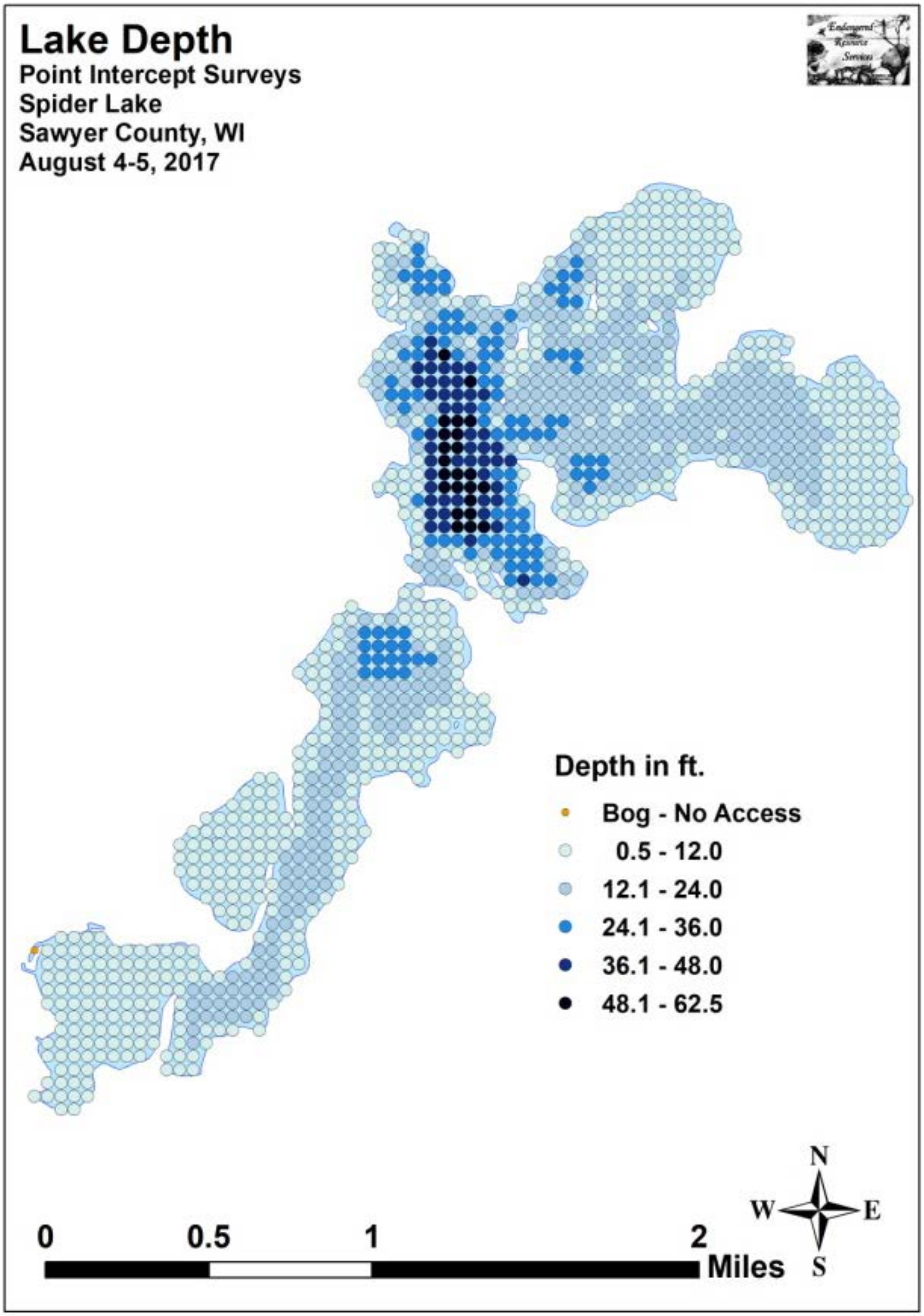


FIGURE 6. SPIDER LAKE DEPTH AND SUBSTRATE

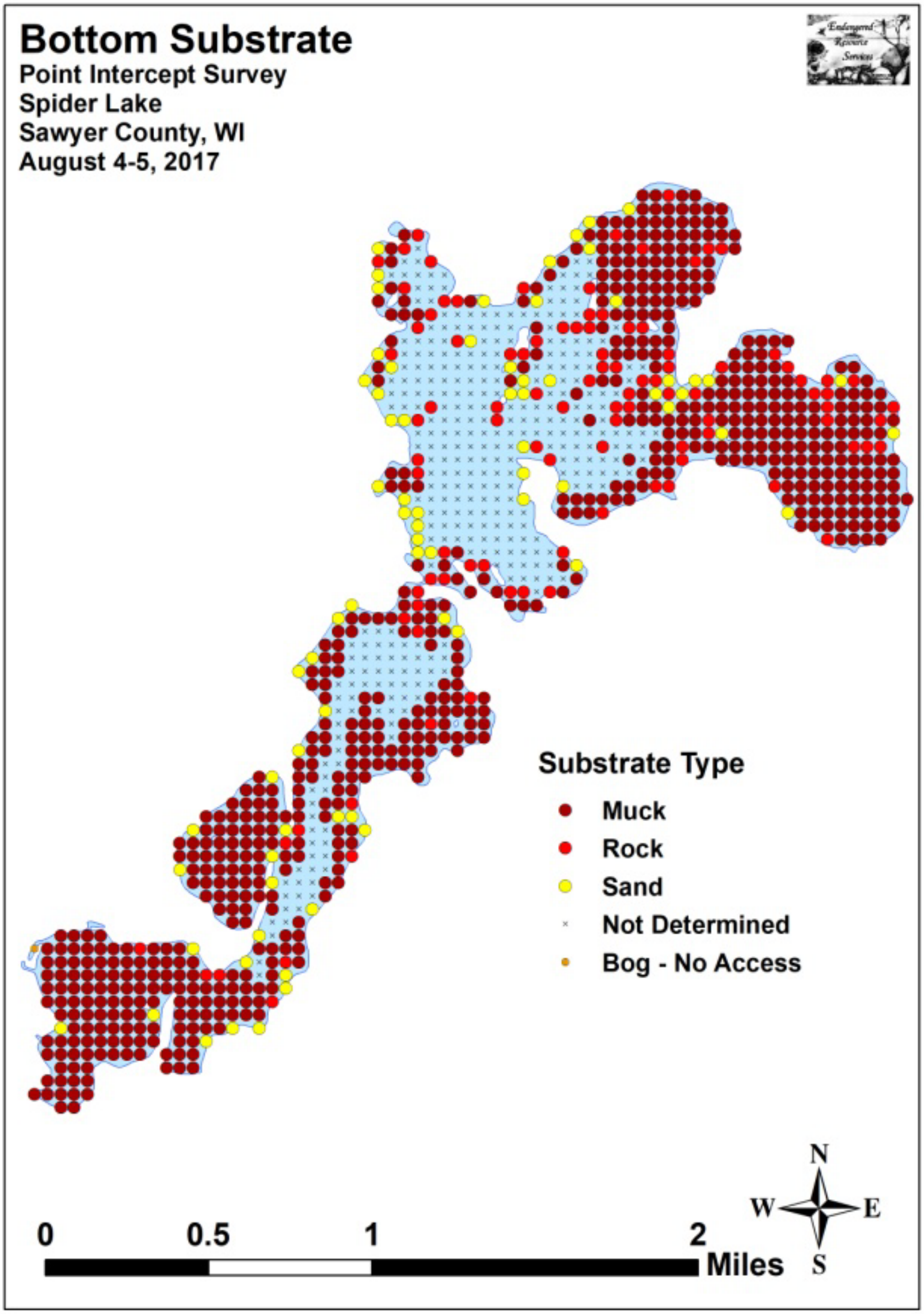


FIGURE 7. SPIDER LAKE SUBSTRATE

WDNR Lakes Classification

WDNR uses four levels of biological conditions to represent placement in the overall water quality continuum:

- *Excellent*—Waters are considered to be fully supporting their assessed designated uses.
- *Good or Fair*—Waters are considered to be supporting their assessed designated uses.
- *Poor*—Waters may not support assessed designated use(s) but have insufficient information for a decision at the impairment assessment level.

Listing thresholds and detailed methodology for assessment and analysis are included in WisCALM (Wisconsin Consolidated and Assessment Listing Methodology). Based on this methodology, the Wisconsin Department of Natural Resources publishes a list of waters considered impaired, as required by the federal Clean Water Act, every two years. Impaired waters are those that do not meet water quality standards and may not support fishing, swimming, recreating, or public health and welfare. A water body is considered healthy when it supports:

- healthy aquatic animal and plant communities,
- safe human recreation like swimming, and
- safe fish consumption.

If any of these are not supported, then the water is considered impaired (Wisconsin Department of Natural Resources, 2021).

The WDNR establishes standards for various lake types. Further, there are standards set for Fish and Aquatic Life and for Recreational Use.

Spider Lake "clearly meets" both Recreation and Fish and Aquatic Life standards even when measured against seepage lake standards which are more stringent than those for drainage lakes. A drainage lake has an outlet stream that continually flows under average summer conditions. A seepage lake does not have an outlet stream that continually flows under average summer conditions.[5] It appears that Spider Lake would more correctly be classified as a drainage lake because it has a perennially-flowing outlet. Spider Lake is also listed as a state Outstanding Resource Water. An Outstanding Resource Water (ORW) is defined as a lake or stream which has excellent water quality, high recreational and aesthetic value, and high quality fishing and is free from point source and nonpoint source pollution (see sec. NR 102.11, Wis. Adm. Code).

There is not enough data available to review status of the remaining lakes in the Spider Chain of Lakes: Clear, Fawn, and North Lake. The water quality study and proposed ongoing monitoring will aid in the status review. Initial indications from the water quality study are that the lakes would clearly meet standards and be classified as good.

[5] Wisconsin NR 102.06

Table 2. WDNR Lakes Classification and Status[6]

Lake	WBIC	Lake Classification	Fish and Aquatic Life[5]	Recreation[5]
Spider	WBIC:2435700	Deep Seepage[7]	Good - Clearly Meets	Good - Clearly Meets
Clear	WBIC: 2435800	Deep Lowland, Drainage	Unknown – limited data	Unknown – limited data
Fawn	WBIC: 2435900	Deep Lowland, Drainage	Good – limited data	Good – limited data
North	WBIC: 2436000	Deep Lowland, Drainage	Good – limited data	Good – limited data

Table 3. WDNR Lakes Class Impairment Thresholds[8]

	Deep Seepage Lake		**Deep Lowland, Drainage Lake**	
	Recreation Threshold	**Fish and Aquatic Life**	**Recreation Threshold**	**Fish and Aquatic Life**
Total phosphorus	≥20 µg/L	≥20 µg/L	≥30 µg/L	≥30 µg/L
Chlorophyll-a	>5% of days with moderate algae levels (20 µg/L)	≥27 µg/L	>5% of days with moderate algae levels (20 µg/L)	≥27 µg/L

[6] Wisconsin Department of Natural Resources Comprehensive 2020 Water Quality Assessment Spreadsheet.
[7] Spider may be classified inaccurately. The *Wisconsin Lakes Book* lists Spider Lake as a drainage lake, and it has a perennially flowing outlet.
[8] For more information, see Wisconsin Consolidated Assessment and Listing Methodology (WDNR, 2019).

TABLE 4. WATER QUALITY STUDY RESULTS

Lake	In-lake Mean Total Phosphorus (µg/L) (June 1 to Sept. 15)		In-lake Mean Chlorophyll-a (µg/L) (July 15 – Sept. 15)		% of Chlorophyll-a > 20 µg/L
	2020	**2021**	**2020**	**2021**	**2020 and 2021**
Spider[9]	13.80	13.15	3.80	4.00	0
Clear	17.20	15.30	4.90	3.70	0
Fawn	18.65	20.55	7.00	7.13	0
North	19.70	21.80	6.10	15.75	0

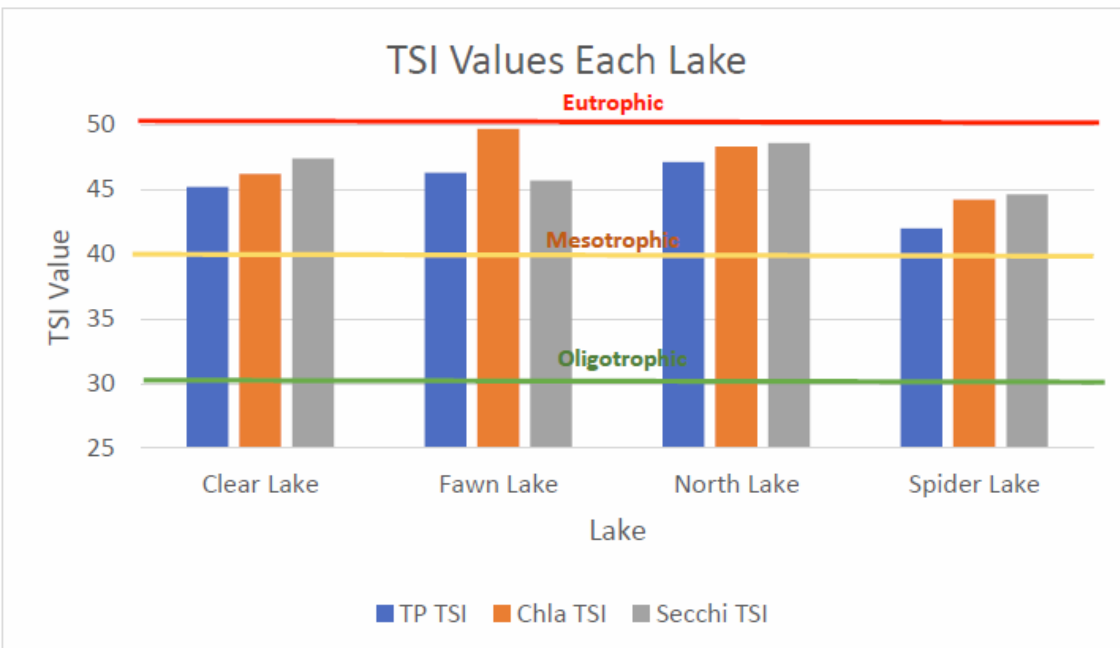
[9] Spider Lake August 2021 total phosphorus value not yet available.

Water Quality Study

The 2020 lake study conducted by Ecological Integrity Service examined lake water quality, developed a water and nutrient budget, and looked at the influence of the watershed areas draining to the lakes and other factors that influence water quality. Detailed descriptions of study methods and results are found in the report (Schieffer, 2021).

Phosphorus is the nutrient of focus in each of these lakes. The total nitrogen to total phosphorus ratio is much greater than 10 to 1 in each lake. This indicates that phosphorus is the limiting nutrient which determines the amounts of algae that grows in the water.

The 2020 sampling data indicates all four lakes have a mesotrophic trophic state, indicating moderate nutrient levels. Trophic state index results for the parameters measured are summarized in Figure 8. TP TSI is trophic state index based on total phosphorus. Chla TSI is based on chlorophyll a. Secchi is based on Secchi depth, a measure of water clarity.



30-40	Oligotrophic = very low nutrients and productivity
40-50	Mesotrophic = moderate nutrients and productivity
50-60	Mild Eutrophic =moderately high nutrients and productivity
60-70	Eutrophic = high nutrients and productivity
70-80	Hyper Eutrophic = very high nutrients and productivity

FIGURE 8. TROPHIC STATE INDEX VALUES FOR SPIDER CHAIN OF LAKES 2020

Citizen volunteers have monitored project lakes for many years, and historical data also indicates that all project lakes are in the mesotrophic category.[10] Exceptions are North and Fawn Lake which are eutrophic (more nutrient rich) in some years. However, this classification is based mostly on water clarity readings which can be decreased by tannins and other particles in the water. Both North Lake and Fawn Lake were noted to be tannin-stained in the plant survey reports (Berg, 2017).

The most comprehensive water quality data set is for Big Spider Lake where measures of lake clarity (Secchi depth), nutrients (total phosphorus), and algae growth (Chlorophyll a) have been collected since 1992. Water samples have been collected and analyzed from Little Spider Lake since 2002. With occasional exceptions, only Secchi depth was measured for the other lakes. A graph of trophic state based on July and August water quality measures is shown for Big Spider Lake as Figure 9. Similar charts are available on the WDNR website for the other lakes.

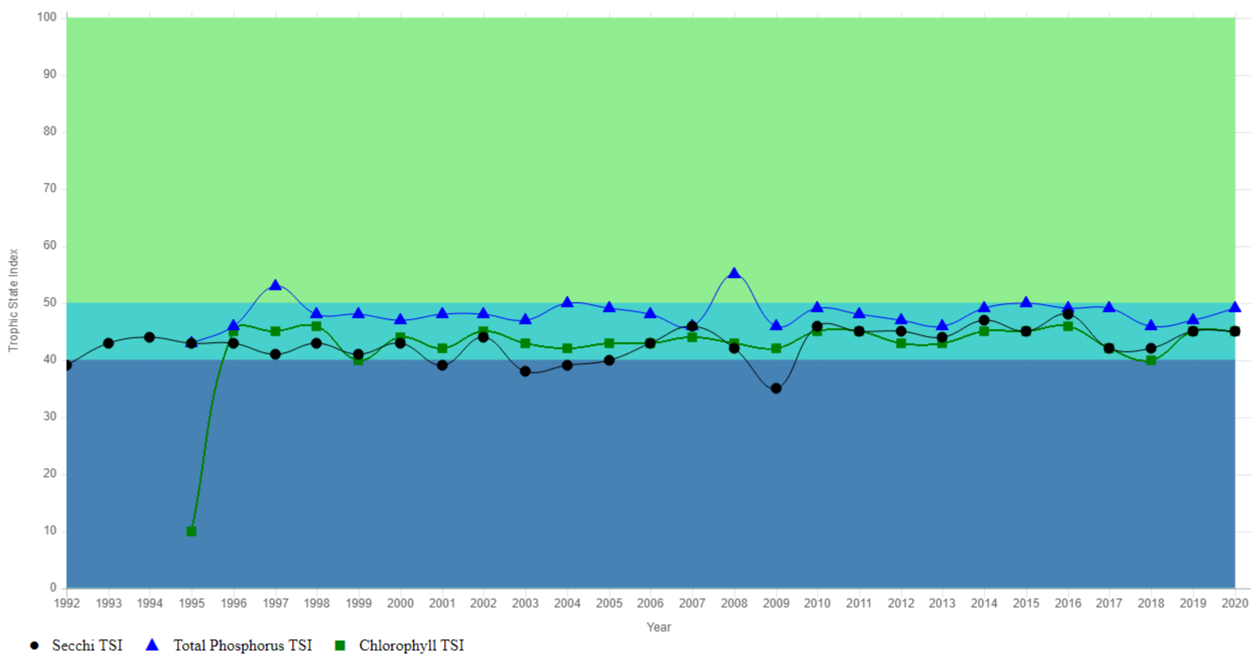


FIGURE 9. BIG SPIDER LAKE TROPHIC STATE INDEX 1992 – 2020.

[10] https://dnr.wisconsin.gov/topic/lakes/clmn

The area-weighted mean for total phosphorus in the chain of lakes was 14.9 µg/L. The mean chlorophyll-a concentration was 4.3 µg/L and the mean Secchi depth was 2.8 meters. These results also indicate moderate nutrient levels. The water budget estimate indicated that 50% of the inflowing water was from groundwater, 41% from precipitation onto the lake, and 9% from overland runoff from the watershed (Figure 10).

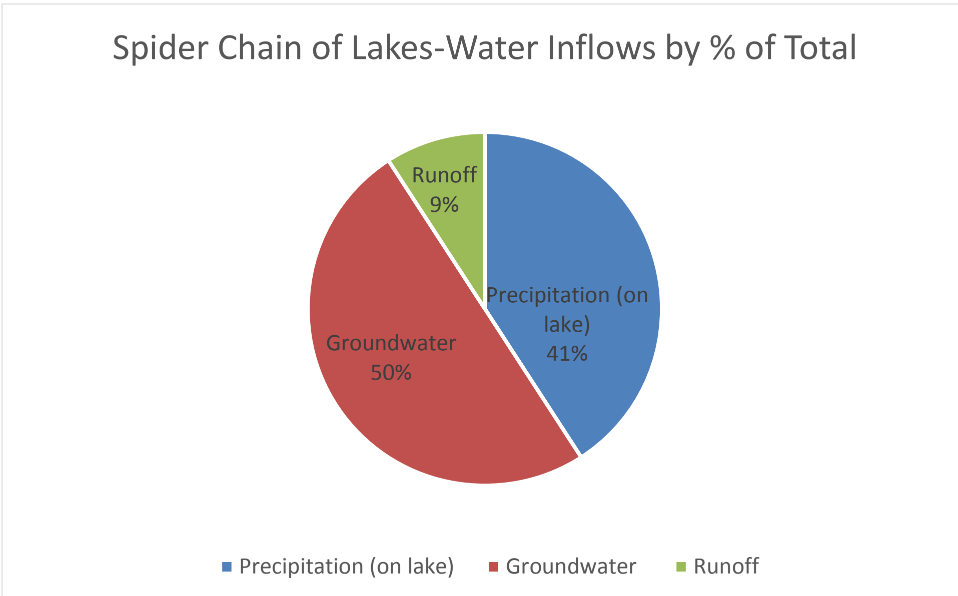


FIGURE 10. SPIDER CHAIN OF LAKES WATER BUDGET - INFLOWS

The nutrient (phosphorus) budget determined that 47.7% of the phosphorus is coming from the sub-watershed runoff around the lakes, 31.2% is from atmospheric deposition, 18.4% is from groundwater discharge into the lakes, and 2.7% is from septic systems (Figure 11). The hydraulic residence time for the Spider Chain of Lakes is 2.6 years.

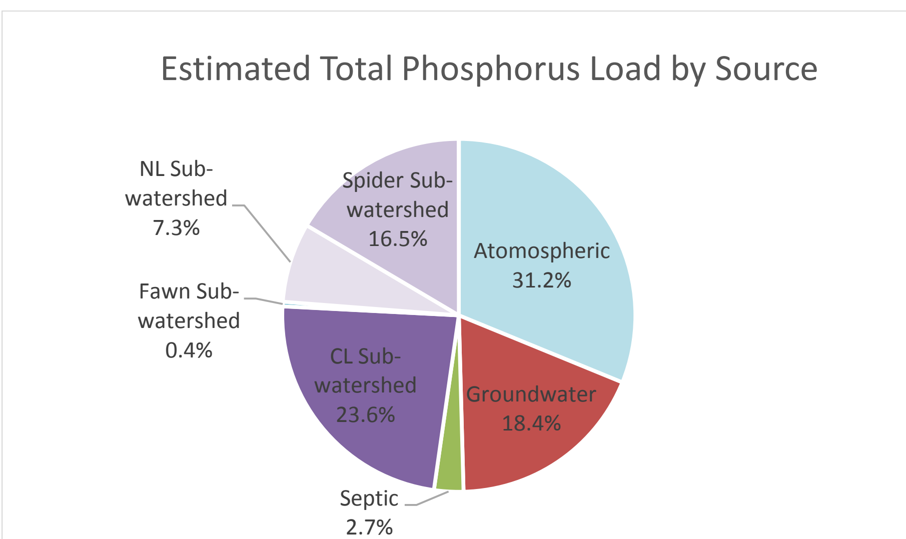


FIGURE 11. PHOSPHORUS LOAD BY SOURCE

Sediment release of phosphorus was examined in Spider Lake only. Sediment phosphorus release, also known as internal loading, occurs in the summer when the lake stratifies into layers based on temperature and water density. However, in Spider Lake, this phosphorus is not mixed into the upper lake levels where algae can grow during the growing season. Dissolved oxygen and temperature profiles indicate Spider Lake remained stratified well into September providing evidence that little or no mixing occurred.

Public Use

Public access on the Spider Lake chain consists of: two public boat landings, one hand carry access, 11 verified private landings (additional private boat landings exist on former resorts that are now condo associations), several resorts, a boys' camp, and a golf course. Recreational uses include fishing, boating, and quiet water sports. SCLA landing monitors recorded 2,615 boats entering at the Clear Lake public landing in 2020.

A Town of Spider Lake Boating Ordinance establishes timelines for various lake uses (Town of Spider Lake, 2006). The Town of Spider Lake has the authority to enforce all town ordinances including Town Ordinance #12 related to watercraft regulation. While the SCLA supports these ordinances, it has no authority to enforce them. This being the case, the SCLA promotes awareness and compliance with the ordinances through its educational materials, newsletters, and meetings.

Town of Spider Lake Ordinances include the following:

- <u>Water skis may be used between 11:00 am and 3:00 pm only.</u> This includes all towed activities such as skiing, tubing, and wake boarding/surfing. The spirit of this Town of Spider Lake ordinance is to provide peace and quiet, with no-wake, outside the designated ski hours. It was created to protect the lake for fishing and quiet sports.
- <u>Boats and personal watercraft (jet skis) have a 10 mph speed limit</u> prior to 11:00 a.m. and after 3:00 p.m. Fawn Lake has a 10 mph speed limit at all hours.
- <u>All watercraft are limited to slow-no-wake within 100 feet</u> of the shoreline.
- Users of the picnic areas are required to clean up after each use.

The Wisconsin Department of Natural Resources also regulates boating in the state:[11]

Slow-no wake speed means a speed at which a vessel moves as slowly as possible while still maintaining steerage control. Slow, no wake speed is required for a vessel operating within 100 feet of the shoreline, a swimmer, dock, raft, or pier.

In addition, personal watercraft may not be operated at faster than slow, no wake speed within:

- 100 feet of any vessel on any waterbody
- 200 feet of shore on any lake.

[11] *The Handbook of Boating Laws and Responsibilities.* Approved by the Wisconsin Department of Natural Resources. Boat Ed – a Division of Kalkomey Enterprises, LLC. 2020.

Watershed

The watershed of the Spider Chain of Lakes covers approximately 38.7 square kilometers (14.9 square miles). The majority of the land cover is forested with fairly large areas of wetlands around the lakes. Some of the drainage from the watershed area shown below in Figure 12 is captured in ponds and wetlands and does not drain directly to the lakes.

FIGURE 12. ENTIRE WATERSHED BOUNDARY FOR THE SPIDER CHAIN OF LAKES

The watershed boundary was further delineated to define the direct-drainage catchment or sub-watershed for each lake. Watershed boundaries and land cover within each catchment were derived from data from the WDNR PRESTO tool.[12] Figure 13 illustrates these catchments. No point sources such as waste water treatment plants or large agricultural facilities are found in the Spider Chain of Lakes watershed.

[12] Wisconsin Department of Natural Resources PRESTO [Pollutant Load Ratio Estimation Tool (PRESTO) | Wisconsin DNR]

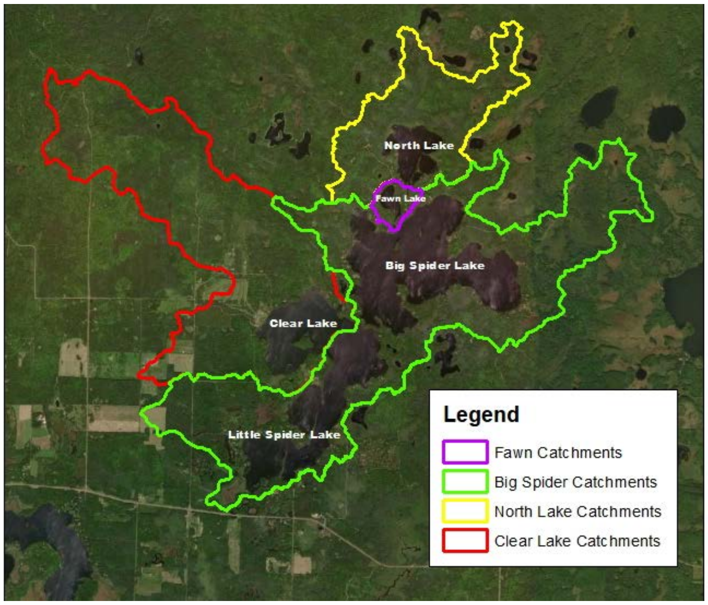


FIGURE 13. CATCHMENTS/SUB-WATERSHED BOUNDARIES

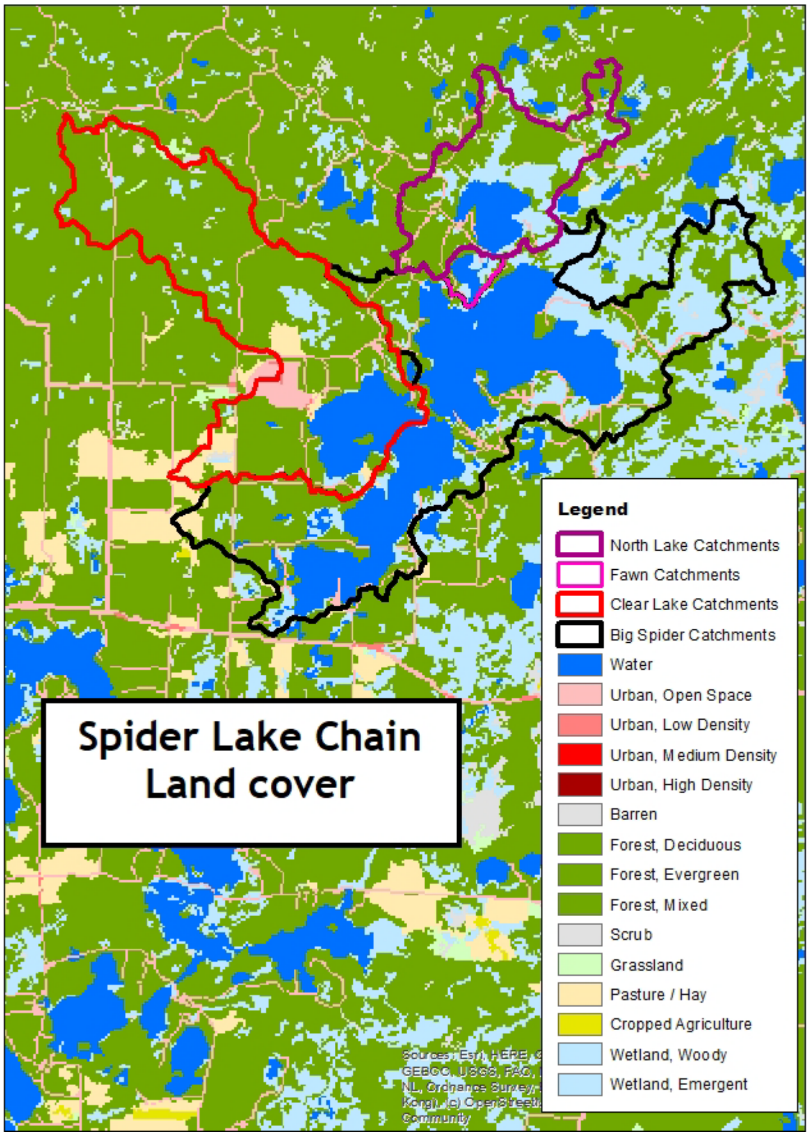


FIGURE 14. SPIDER LAKE CHAIN LAND COVER

Land cover within each catchment was used to estimate nutrient loading to each lake. Land cover by percent of each catchment/sub-watershed is summarized in Table 2.

Table 5. Land Cover by Sub-watershed

Lake Catchment	Area (km^2)	Area ($miles^2$)	Forest (all types)	Wetland (all types)	Developed ("urban")*	Agriculture	Barren	Grassland	Open Water
Clear Lake	8.9	3.4	79%	6%	7%	6%	1.4%	0.6%	0%
Fawn Lake	0.26	0.1	40%	40%	10%	10%	0%	0%	0%
North Lake	3.6	1.4	58.4%	21.2%	6%	0%	0%	0%	14.4%
Spider Lake	12.4	4.8	35.2%	20.6%	5%	1.0%	0%	0.07%	38.13%

*Developed area appears to be under-counted in land cover information available for the lakes. Developed areas near the lake do not seem to be reflected in the available data.

To help direct potential management, phosphorus loads from various land cover types within a sub-watershed were estimated. Table 3 shows the breakdown of each sub-watershed land cover contribution. The estimates of phosphorus load for all land covers are based upon export coefficient ranges, adjusted to balance the phosphorus budget of the lakes.

Table 6. Estimated Phosphorus load by Sub-watershed

	Sub-watershed Estimated Load*			
Land Cover	**Clear Lake (kg/lbs.)**	**Fawn Lake (kg/lbs.)**	**North Lake (kg/lbs.)**	**Spider Lake (kg/lbs.)**
Forested/Wetland	39.5 / 87.1	0.5 / 1.1	22.3 / 49.2	36 / 79.4
Developed#	9.7 / 21.4	0.2 / 0.4	2.6 / 5.7	16.2 / 35.7
Agriculture	15.9 / 35.1	0.7 / 1.5	0 / 0	4.8 / 10.6
Grassland	0.5 / 1.1	0 / 0	0.1 / 0.2	0 / 0
Golf course	15.4 / 34.0	0 / 0	0 / 0	0 / 0

*Based on export coefficients within the recommended range from Wisconsin and Minnesota watersheds.
Land cover data is not precise, and it appears some near-shore development is not included in data set.

Phosphorus loading into the Spider Chain of Lakes from watershed overland runoff is complex, especially for North Lake, Big Spider Lake, and Little Spider Lake because there are large areas of near shore wetlands. Wetlands slow the water running off from the land before it enters the lake. Wetlands can allow nutrients to settle and be reduced before the water enters the lake and contributes to the phosphorus load. Adjustments were made in the lake model to account for this effect.

The Clear Lake sub-watershed had the highest phosphorus load estimate because it contains high-loading land covers. One example is the golf course near the lake. Golf courses are largely turf grass which reduces water infiltration and results in higher runoff than a natural forest. Furthermore, golf courses typically apply a large amount of fertilizer, which increases the concentration of nutrients in runoff.

Phosphorus loading from each sub-watershed is estimated based on the area of various land covers. In fact, intensity and phosphorus concentration in runoff can vary greatly within a given land cover because of various factors such as slope and amount of impervious surface and lawns. These specific differences were not evaluated in this study. The timing and intensity of precipitation can also affect runoff. It was outside the scope of this study to evaluate individual storm events, and all runoff estimates are based upon the entire study period.

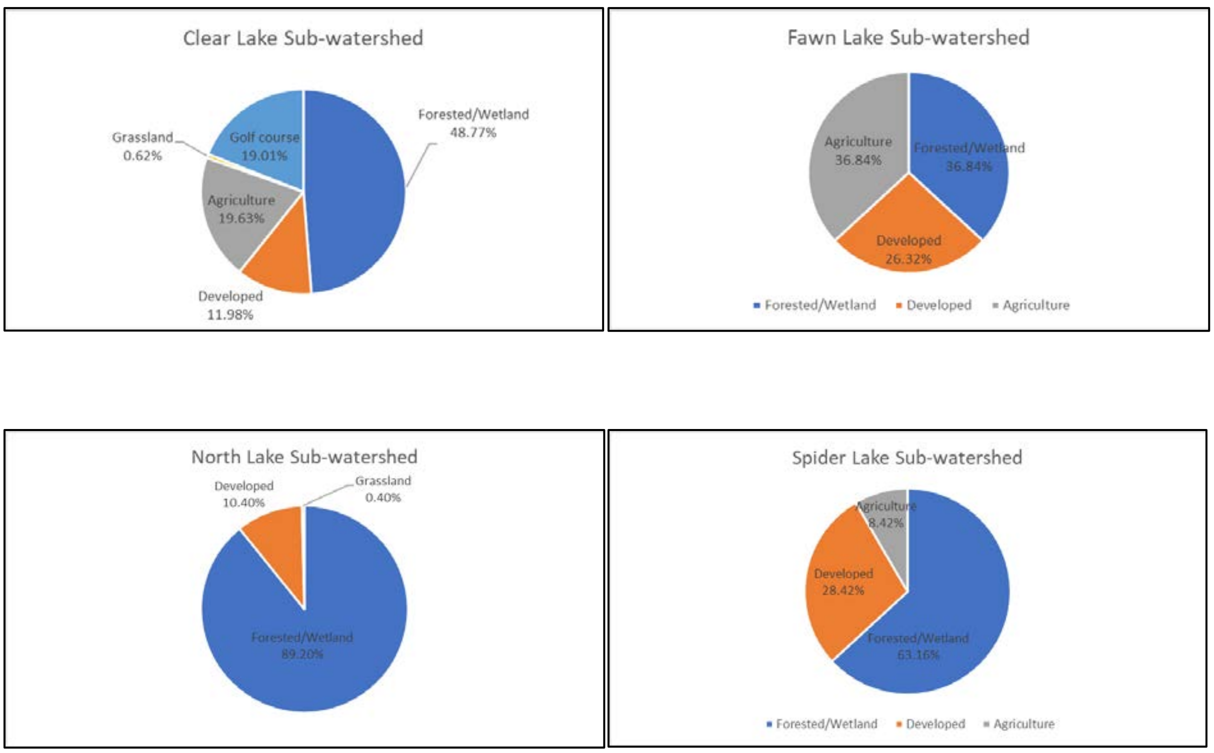


FIGURE 15. PHOSPHORUS LOADING BY LAND COVER WITHIN EACH SUB-WATERSHED

The percent of the phosphorus load from sub-watershed land cover types is displayed in Figure 15. Because forest and wetland make up most of the watershed lands, the highest contributing land type is forested/wetland. However, developed areas and agriculture have much higher phosphorus loading per unit area. The Clear Lake golf course is shown to potentially contribute 19 percent of the phosphorus to the lake. However, nutrient management information for the golf course was not analyzed in these calculations.

The lake water quality mathematical model allows prediction of water quality impacts with changes in phosphorus loading. Because sources of phosphorus from the atmosphere and groundwater are not readily managed, the influences of various changes on watershed loads were examined in the lake study.

A load response indicates that reducing and increasing the total phosphorus load from runoff, groundwater, and septic systems could result in fairly significant changes. A 20% reduction in total phosphorus loading would reduce the mean total phosphorus concentration from 14.9 µg/L to 13.3 µg/L, and the mean chlorophyll-a concentration from 4.3 µg/L to 3.7 µg/L.

Other load responses were used to determine changes from more specific sources of phosphorus. Significant water quality changes are predicted to result from increases or decreases of watershed loads even with changes as low as 20 percent. Further, reductions in watershed loading can potentially offset water quality degradation that may result from increased development around the lakes.

Discussion and Recommendations[13]

The lakes in the Spider Chain of Lakes have good water quality. And, while the overall water quality goal may be to preserve rather than to improve water quality, development and increased human activity could increase nutrient loads and degrade water quality in the future. Reducing current phosphorus loading could offset nutrient increases predicted with development and therefore preserve existing water quality.

Recommendations for Future Actions[14]

1. ***Focus on potentially high loading areas.*** *The Clear Lake sub-watershed contributes the highest phosphorus load, and it would make sense to focus work here. The load analysis shows that even a 20% reduction in phosphorus loading could result in a significant reduction in the in-lake phosphorus and chlorophyll-a concentration in Clear Lake as well as in Spider Lake. Best management practices would focus on mitigating runoff volumes and nutrient concentrations. Review of the golf course nutrient management and natural buffer area adjacent to the lake at the golf course is recommended. Agricultural areas should also be reviewed.*

2. ***Use the shoreland survey results to target management practices.*** *Since Spider Lake has the most residents, it makes sense to focus phosphorus reduction management practices on Spider Lake shoreland properties. The focus for mitigation should be areas with large impervious surfaces, residential buildings, and manicured lawns. The shoreland survey (discussed in the following section) can be used to identify priority areas to implement best management practices. Potential best management practices include infiltration devices (especially adjacent to impervious surfaces), rain gardens, and/or shoreline buffers.*

3. ***Survey residents about their septic systems.*** *The load from septic systems is roughly estimated and therefore uncertain in the nutrient budget. The estimate of septic system loading would be enhanced if the type, age, and condition of systems were known.*

[13] Summarized from the lake water quality study (Schieffer, 2021).
[14] Recommendations 1 and 2 are the top priorities.

4. ***<u>Evaluate the Fawn Lake and North Lake wetland areas.</u>*** *These lakes have higher than expected total phosphorus and the highest chlorophyll-a concentrations (based on lake model estimates from land use calculations) . It is possible phosphorus is being released at a higher amount than would typically be expected from surrounding wetlands. This information would allow for better understanding of the impact the watershed is having on these lakes.*

Shoreland

Bay Area Environmental Consulting and Ecological Integrity Service conducted and analyzed a comprehensive inventory of Spider Chain of Lakes shorelines in 2020 (Schieffer, 2021). The inventory was conducted according to standardized WDNR methods which are described in the report. The methodology involved surveying, assessing, and mapping habitat in lakeshore areas which included the riparian zone, bank, and littoral zone. The data collected include the following: percent tree cover, percent ground cover by type (impervious surfaces, manicured lawns, and natural), erosion concerns, length of modified banks, density of human structures, presence of floating/emergent plants and coarse woody habitat. Data was collected by parcel rather than shoreline length. Therefore, summaries provide data as a percentage of parcels and not by percentage of the entire shoreline length for each lake.

The data presented in the report is extensive including an overview of each lake followed by maps showing the presence and magnitude of various categories. Because the data is extensive and difficult to summarize, few results are reported here. Instead the report is incorporated by reference, and results will be considered to prioritize activities and implement programming as needed.

Maps are generated for a variety of measurements for each lake. The example map in Figure 16 illustrates percent of manicured lawn in the riparian zone. A list of all parameters examined and maps provided for each lake is included below the map.

The SCLA can access the maps as background information to focus on specific concerns. For example, maps that record bank erosion are available, if the SCLA addresses shoreline erosion through education or management efforts.

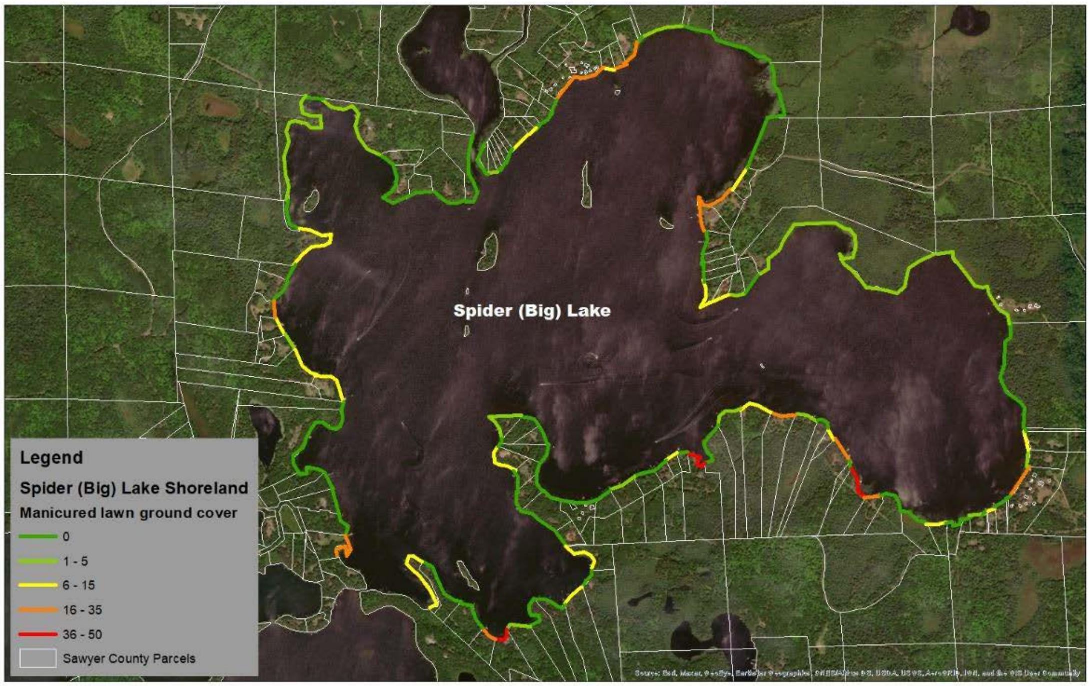


FIGURE 16. EXAMPLE MAP: SPIDER LAKE MANICURED LAWN GROUND COVER

Shoreland Inventory Maps by Topic

Tree canopy

Ground cover-shrub/herbaceous

Ground cover-impervious surfaces

Ground cover-manicured lawn

Ground cover-agriculture

Ground cover-other (duff, mulch, etc.)

Riparian structures-buildings

Modified bank-vertical sea wall

Runoff concern-point source

Runoff concern-channelized flow

Runoff potential-stair/path/road to lake

Runoff potential-lawn/soil slopes to lake

Runoff potential-bare soil

Bank modification-rip rap

Bank modification-artificial beach

Bank erosion > 1 foot face

Bank erosion < 1foot face

Aquatic plants-emergent plants present

Aquatic plants-floating plants present

Riparian zone boats on the shore

Riparian zone number of fire pits

Littoral zone-number of piers

Littoral zone-number of boat lifts

Littoral zone-number of swim rafts/trampolines

Littoral zone-boat houses

Invasive species observed

Coarse woody habitat branches, in water, touches shore

In Lake Habitats

Critical Habitat Areas

Every waterbody has critical habitat - those areas that are most important to the overall health of the aquatic plants and animals. Remarkably, eighty percent of the plants and animals on the state's endangered and threatened species list spend all or part of their life cycle within the near shore zone. As much as ninety percent of the living things in lakes and rivers are found along the shallow margins and shores. Wisconsin law mandates special protections for these critical habitats. Critical Habitat Designation is a program that recognizes those areas and maps them so that everyone knows which areas are most vulnerable to impacts from human activity. A critical habitat designation assists waterfront owners by identifying these areas up front, so they can design their waterfront projects to protect habitat and ensure the long-term health of the lake they where they live.[15]

The Spider Chain of Lakes has 31 sensitive areas which provide critical habitat (Wisconsin Department of Natural Resources, 2003). These areas are mapped in Figure 17. The Spider Chain of Lakes has an above average amount of wild, undeveloped habitat; an exceptional, diverse native plant community with good water quality; and limited wild rice bed(s) in North Lake. The lake chain has three active eagle nests and two active osprey nests. The Spider Chain of Lakes also supports a wide variety of wildlife including a nesting and reproducing loon population.

[15] https://dnr.wi.gov/lakes/criticalhabitat/Project.aspx?project=10177864

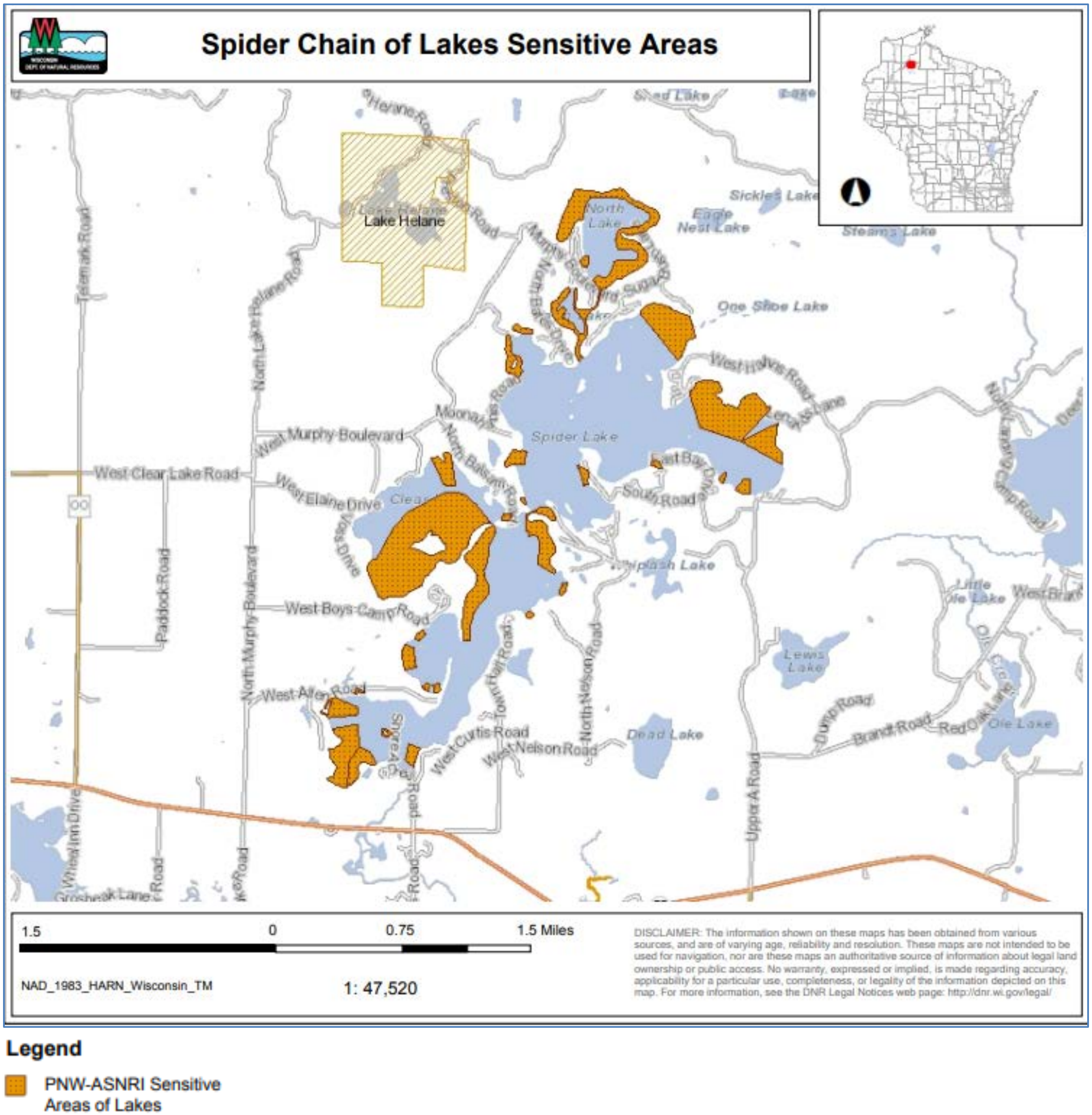


FIGURE 17. SPIDER CHAIN OF LAKES SENSITIVE AREAS

Fisheries

Fish habitat features include a broad mix of hard substrates, expansive aquatic plant beds of all three habitat types (emergent, floating, and submergent), and a moderate abundance of woody habitat. The fishery includes largemouth and smallmouth bass, walleye, a naturally reproducing muskellunge population, pan fish, and northern pike. Because northern pike are not naturally found in the chain, the SCLA has encouraged their removal through fishing.

The WDNR completed a spring fish survey in 2021, but a report is not yet available.[16] The most recent WDNR fisheries survey report was from a spring 2016 electrofishing survey (Wolter, 2016). Muskellunge were captured during the electrofishing survey, including several small fish that provided evidence of continued natural reproduction of musky in Spider Lake. The WDNR stocked musky from 1972 to 1984 as shown in Table 4. Largemouth bass in Spider Lake were relatively abundant and showed generally poor size, with only 4% of largemouth bass over 15 inches.

The smallmouth bass population was considerably lower and the size was generally more balanced with both large and small fish present. Catch and release was encouraged for smallmouth bass to allow them to meet their full size potential, which is greater than that of largemouth bass in Spider Lake. Bluegill were fairly abundant and showed poor size with only 31% of bluegill being over 6 inches. Bluegill grow slowly in Spider Lake, and neither an abundant largemouth bass population or continued stocking of extended growth walleye have been able to provide adequate predation pressure to reduce overcrowding. There are limited options for reducing abundance and improving size of bluegill in lakes like Spider with vast amounts of weedy habitat for small bluegill to hide.

WDNR walleye stocking records from 1974 to 2019 are shown in Table 5. Juvenile walleye were also captured as a part of this survey. Overwinter survival of walleye stocked in the fall of 2015 appeared to be very good.

The WDNR will likely develop a fishery management plan for the Spider Chain of Lakes in the next few years. A fishery management plan will provide a comprehensive analysis of the available historical fisheries data.[10]

[16] Wolter, Max, WDNR Fisheries Biologist, Email communication. 6/15/2021.

Table 7. WDNR Muskellunge Stocking Spider Lake

Year	Age Class	Number	Average Length (IN)
1984	FINGERLING	200	9
1977	FINGERLING	465	3
1976	FINGERLING	2,000	8.33
1972	FINGERLING	800	15

Table 8. WDNR Walleye Stocking Spider Lake

Year	Age Class	Number	Average Length (IN)
2019	LARGE FINGERLING	5,972	6.4
2015	LARGE FINGERLING	5,971	7.8
2003	SMALL FINGERLING	32,640	1.6
2001	SMALL FINGERLING	20,018	1.6
1999	SMALL FINGERLING	35,000	1.3
1997	SMALL FINGERLING	32,715	1.6
1995	FINGERLING	32,715	2
1993	FINGERLING	45,283	2.5
1991	FINGERLING	22,464	4
1989	FINGERLING	44,154	3
1987	FINGERLING	126,420	3
1985	FINGERLING	44,100	3
1983	FINGERLING	25,674	5
1981	FINGERLING	32,050	4.6
1977	FINGERLING	33	4.33
1976	FINGERLING	39,539	3
1974	FINGERLING	25,029	3

Plant Community

Functions and Values of Native Aquatic Plants

Naturally occurring native plants are extremely beneficial to lakes. They provide a diversity of habitats, help maintain water quality, sustain fish populations, and support common lakeshore wildlife such as loons and frogs.

Water Quality

Aquatic plants can improve water quality by absorbing phosphorus, nitrogen, and other nutrients from the water that could otherwise fuel nuisance algal growth. Some plants can even filter and break down pollutants. Plant roots and underground stems help to prevent re-suspension of sediments from the lake bottom. Stands of emergent plants (whose stems protrude above the water surface) and floating plants help to blunt wave action and prevent erosion of the shoreline.

Fishing

Habitat created by aquatic plants provides food and shelter for both young and adult fish. Invertebrates living on or beneath plants are a primary food source for many species of fish. Other fish such as bluegills graze directly on the plants themselves. Plant beds in shallow water provide important spawning habitat for many fish species.

Waterfowl

Plants offer food, shelter, and nesting material for waterfowl. Birds eat both the invertebrates that live on plants and the plants themselves.[17]

Protection against Invasive Species

Non-native invasive species threaten native plants in Northern Wisconsin. The most common are Eurasian water milfoil (EWM) and Curly-leaf pondweed (CLP). These species are described as opportunistic invaders. This means that they take over openings in the lake bottom where native plants have been removed. Without competition from other plants, these invasive species may successfully become established and spread in the lake. This concept of opportunistic invasion can also be observed on land in areas where bare soil is quickly taken over by weeds.

Removal of native vegetation not only diminishes the natural qualities of a lake, but it increases the risk of non-native species invasion and establishment. The presence of invasive species can change many of the natural features of a lake and often leads to expensive annual control plans. Allowing native plants to grow may not guarantee protection against invasive plants, but it can discourage their establishment. Native plants may cause localized concerns to some users, but as a natural feature of lakes, they generally do not cause harm.[18]

[17] Above paragraphs summarized from *Through the Looking Glass*. Borman et al. 1997.
[18] *Aquatic Plant Management Strategy.* DNR Northern Region. Summer 2007.

Aquatic Plant Survey Results

Endangered Resource Services completed a warm water aquatic plant inventory for project lakes in 2012 and 2017 according to the WDNR-specified point intercept method. An early season survey was conducted to identify the locations of Curly-leaf pondweed and other aquatic invasive species in April 2012 and June 2017. The 2012 early season survey was conducted in April, which is early, because of the potential for management of Curly-leaf pondweed in that year. Warm-water native plant surveys are generally conducted in July or August.

The survey and data analysis methods and detailed results for the aquatic plant survey are found in the following reports:

Berg, Matthew. 2017. Curly-leaf pondweed (*Potamogeton crispus*) Point-intercept and Bed Mapping Surveys, and Warm-water Macrophyte Point-Intercept Survey - Clear Lake - Spider Lake Chain - Sawyer County, Wisconsin.

Berg, Matthew. 2017. Curly-leaf pondweed (*Potamogeton crispus*) Point-intercept and Bed Mapping Surveys, and Warm-water Macrophyte Point-intercept Survey Fawn Lake - Spider Chain - WBIC 2435900 Sawyer County, Wisconsin.

Berg, Matthew. 2017. Curly-leaf pondweed (*Potamogeton crispus*) Point-intercept and Bed Mapping Surveys, and Warm-water Macrophyte Point-intercept Survey North Lake - Spider Chain - WBIC: 2436000 Sawyer County, Wisconsin.

Berg, Matthew. 2017. Curly-leaf pondweed (*Potamogeton crispus*) Point-intercept and Bed Mapping Surveys, and Warm-water Macrophyte Point-intercept Survey Spider Lake (Big and Little) - Spider Chain (WBIC: 2435700) - Sawyer County, WI.

A brief summary of the results most relevant to aquatic plant management are presented in this plan.

While there were some significant increases and decreases in native plant species frequency of occurrence and rake fullness on project lakes, these were attributed to natural variation rather than human influence as explained in the Spider Lake report:

> ***In 2017, we documented a lakewide decline in many of Spider Lake's top habitat producing species. Much of this decline occurred on the outer edge of the littoral zone with deep water beds being less dense and less rich than they were during the 2012 survey. Although this may appear troubling, it was similar to what we observed on many of the other deep water lakes we surveyed in 2017. Based on this observation, we believe these declines are likely temporary - the byproduct of the unusually early but cool spring, rather than some fundamental change in Spider Lake itself.***

Definitions

Rake Fullness: Is a measure of the quantity of plants found at a sample point when pulled up by a rake as shown in Figure 18. The rake fullness ranges from 0 to 3. Total rake fullness and rake fullness for individual species are recorded for each sample point.

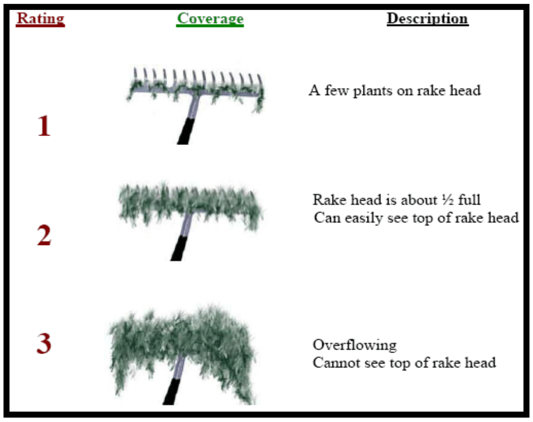


FIGURE 18. RAKE FULLNESS RATINGS

Littoral Zone: The area of the lake that extends to the deepest point at which plants will grow. Not all sample points in the littoral zone have vegetation. In clear lakes, plants may be found at depths of over 20 feet, while in stained or turbid locations, they may only be found in up to a few feet of water. While some species can tolerate very low light conditions, others are only found near the surface. In general, the diversity of the plant community decreases with increased maximum depth of the littoral zone.

Simpson's Diversity Index: The Simpson's Diversity Index value represents the probability that two individual plants (randomly selected) will be different species. The index values range from 0 -1 where 0 indicates that all the plants sampled are the same species, to 1 where none of the plants sampled are the same species. The greater the index value, the higher the diversity in a given location. Although many natural variables like lake size, depth, dissolved minerals, water clarity, mean temperature, etc. can affect diversity, in general, a more diverse lake indicates a healthier ecosystem. Perhaps most importantly, plant communities with high diversity also tend to be more resistant to invasion by exotic species.

Floristic Quality Index (FQI): This index measures the impact of human development on a lake's aquatic plants. The 124 species in the index are assigned a Coefficient of Conservatism (C) which ranges from 1-10. The higher the value assigned, the more likely the plant is to be negatively impacted by human activities relating to water quality or habitat modifications. Plants with low values are tolerant of human habitat modifications, and they often exploit these changes to the point where they may crowd out other species. The higher the index value, the healthier the lake's macrophyte community is assumed to be. Nichols (1999) identified four eco-regions in Wisconsin: Northern Lakes and Forests, North Central Hardwood Forests, Driftless Area and Southeastern Wisconsin Till Plain. He recommended making comparisons of lakes within ecoregions to determine the target lake's relative diversity and health. Spider Lake is in the Northern Lakes and Forests Ecoregion.

North Lake

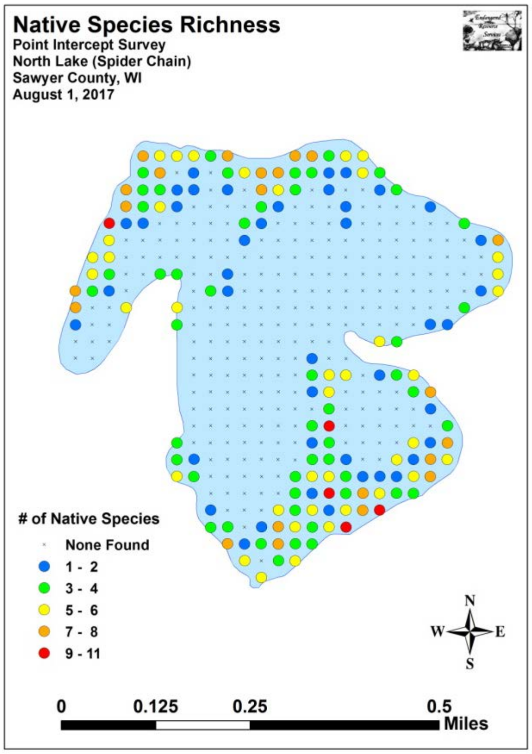
The North Lake aquatic plant survey found 46 different plant species growing in and immediately adjacent to the water (39 were found in 2012). The Simpson's diversity index was high at 0.93. The Floristic Quality Index of 38.8 (down from 39.8 in 2012) was well above the median FQI for this part of the state. Plants were present at 70.1% of the sample points within the littoral zone which extended to 14 feet. This represented 39% of the entire lake bottom which is 30 feet deep at its maximum depth. In 2012, plants grew on 79.8% of the then 13.5 foot deep littoral zone.

Most Common Species (2017)

Coontail (*Ceratophyllum demersum*)
Flat-stem pondweed (*Potamogeton zosteriformis*)
Slender naiad (*Najas flexilis*)
White water lily (*Nymphaea odorata*)

Lakewide, from 2012-2017, ten species showed significant changes in distribution. There were declines in distribution in Large-leaf pondweed (*Potamogeton amplifolius*), Creeping bladderwort (*Utricularia gibba*), Wild celery (*Vallisneria americana*), Floating-leaf pondweed (*Potamogeton natans*), and Clasping-leaf pondweed (*Potamogeton richardsonii*). Significant increases occurred in Small pondweed (*Potamogeton pusillus*), and Fries' pondweed (*Potamogeton friesii*), Northern water-milfoil (*Myriophyllum sibiricum*), and Leafy pondweed (*Potamogeton foliosus*).

Northern wild rice (*Zizania palustris)*, a plant of significant wildlife and cultural value, was present at two points in 2012 with both samples containing a single plant. At that time, the lake's entire rice population contained perhaps no more than a few hundred widely scattered individuals growing on and among the floating muck bogs in the southeast and northwest bays. During the 2017 survey, a single rice plant was found in the northwest bay. Berg noted only six other plants near the point, and found no surviving members from the population in the southeast bay. He concluded that the decline suggested the species is in danger of disappearing from the lake entirely.



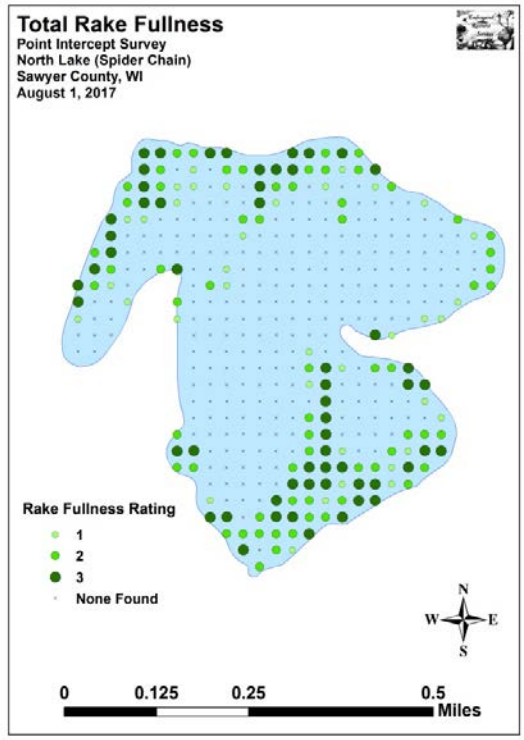


FIGURE 19. NORTH LAKE NATIVE SPECIES RICHNESS

FIGURE 20. NORTH LAKE NATIVE SPECIES RAKE FULLNESS

Fawn Lake

The Fawn Lake aquatic plant survey found 38 different plant species growing in and immediately adjacent to the water (37 were found in 2012). The Simpson's diversity index was high at 0.94. The Floristic Quality Index of 34.6 (down from 36.7 in 2012) was well above the median FQI for this part of the state. Plants were present at 80.5% of the sample points within the littoral zone which extended to 12 feet. This represented 40.4% of the entire lake bottom which is over 25 feet deep at its maximum depth. In 2012, plants grew on 88.4% of the then 12 foot deep littoral zone.

Most Common Species (2017)
Coontail (*Ceratophyllum demersum*)
White water lily (*Nymphaea odorata*)
Slender naiad (*Najas flexilis*)
Spatterdock (*Nuphar variegate*)

State Special Concern Species (2017)
Small purple bladderwort (*Utricularia resupinata*)[19]

Lakewide, from 2012-2017, four species showed significant changes in distribution. There were declines in distribution in Creeping bladderwort (*Utricularia gibba*), Common waterweed (*Elodea canadensis*), and Muskgrass (*Chara* sp.). Slender naiad saw a significant increase.

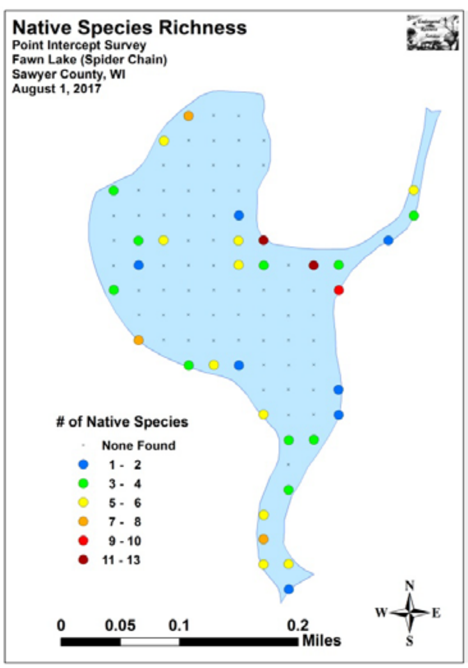


FIGURE 22. FAWN LAKE NATIVE SPECIES RICHNESS

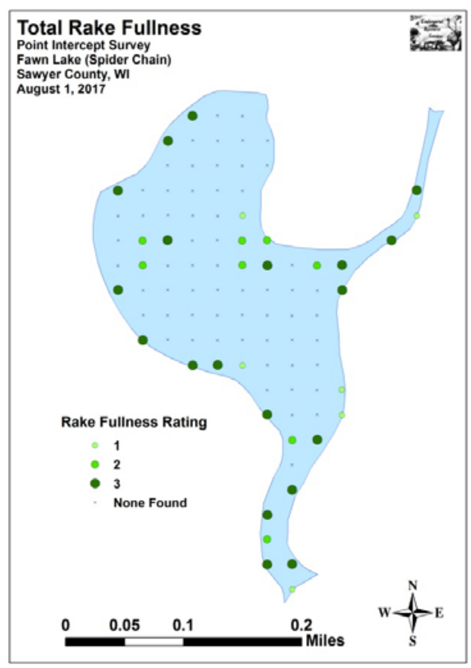


FIGURE 21. FAWN LAKE NATIVE SPECIES RAKE FULLNESS

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19 "Special concern" species are those species about which some problem of abundance or distribution is suspected, but not yet proved. The main purpose of this category is to focus attention on certain species before they become threatened or endangered.

Clear Lake

The Clear Lake aquatic plant survey found 45 different plant species growing in and immediately adjacent to the water (46 were found in 2012). The Simpson's diversity index was high at 0.91. The Floristic Quality Index of 37.5 (down from 39.6 in 2012) was also well above the median FQI for this part of the state.

Plants were present at 51.4% of the sample points within the littoral zone. With a maximum depth of plants at 21.5 feet, the littoral zone covered nearly the entire lake. In 2012, plants grew on 63.8% of the then 18 foot littoral zone.

Most Common Species (2017)

Slender naiad (*Najas flexilis*),
Fern pondweed (*Potamogeton robbinsii*),
Large-leaf pondweed (*Potamogeton amplifolius*), and
Crested arrowhead (*Sagittaria cristata*)

Lakewide, from 2012-2017, five species showed significant changes in distribution. There were declines in distribution in Variable pondweed and Slender naiad and increases in Fern pondweed, White water lily, and Southern naiad. There were also significant declines in rake density in Fern pondweed, Crested arrowhead, and Variable pondweed.

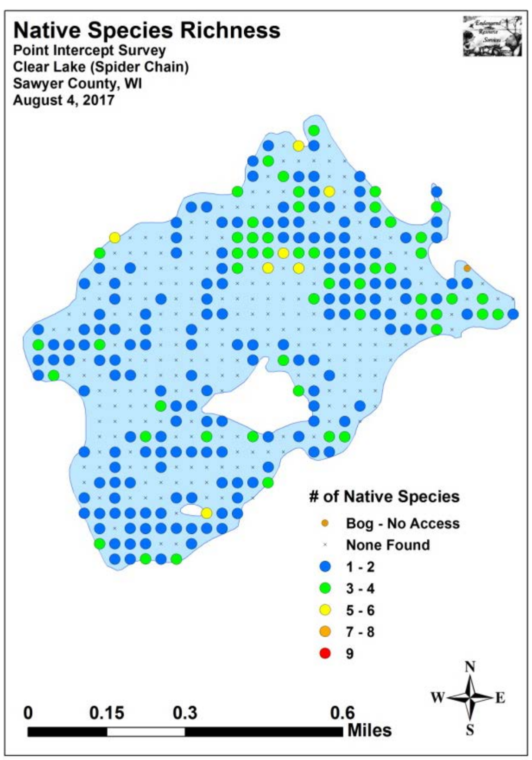


FIGURE 23. CLEAR LAKE NATIVE SPECIES RICHNESS

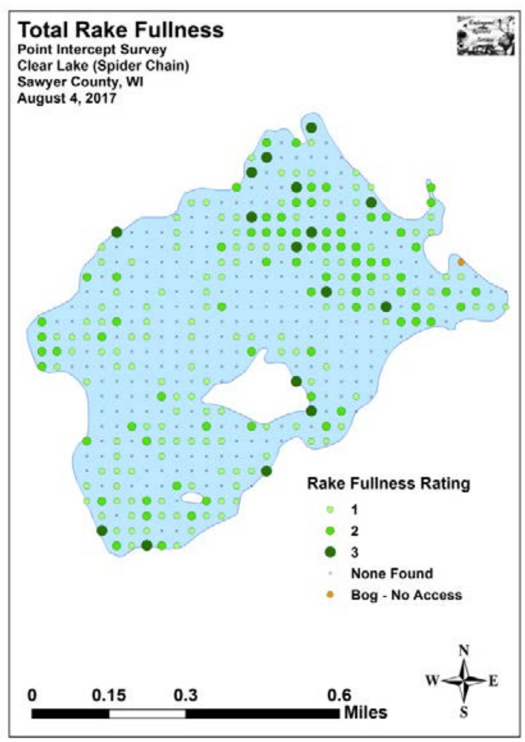


FIGURE 24. CLEAR LAKE NATIVE SPECIES RAKE FULLNESS

Spider Lake

The Spider Lake aquatic plant survey found 61 different plant species growing in and immediately adjacent to the water (57 were found in 2012). The Simpson's diversity index was high at 0.94. The Floristic Quality Index of 47.7 (down from 49.6 in 2012) was also well above the median FQI for this part of the state. Plants were present at 70.8% of the sample points within the littoral zone which extended to 15.5 feet. This represented 53.6% of the entire lake bottom which is over 64 feet deep at its maximum depth. In 2012, plants grew on 77.3% of the then 18.5 foot deep littoral zone.

<u>Most Common Species (2017)</u>
Fern pondweed (*Potamogeton robbinsii*)
Slender naiad (*Najas flexilis*)
Common waterweed (*Elodea canadensis*)
Large-leaf pondweed (*Potamogeton amplifolius*)

<u>State Special Concern Species[20] (2017)</u>
Robbins spikerush (*Eleocharis robbinsii*)

[20] "Special concern" species are those species about which some problem of abundance or distribution is suspected, but not yet proved. The main purpose of this category is to focus attention on certain species before they become threatened or endangered.

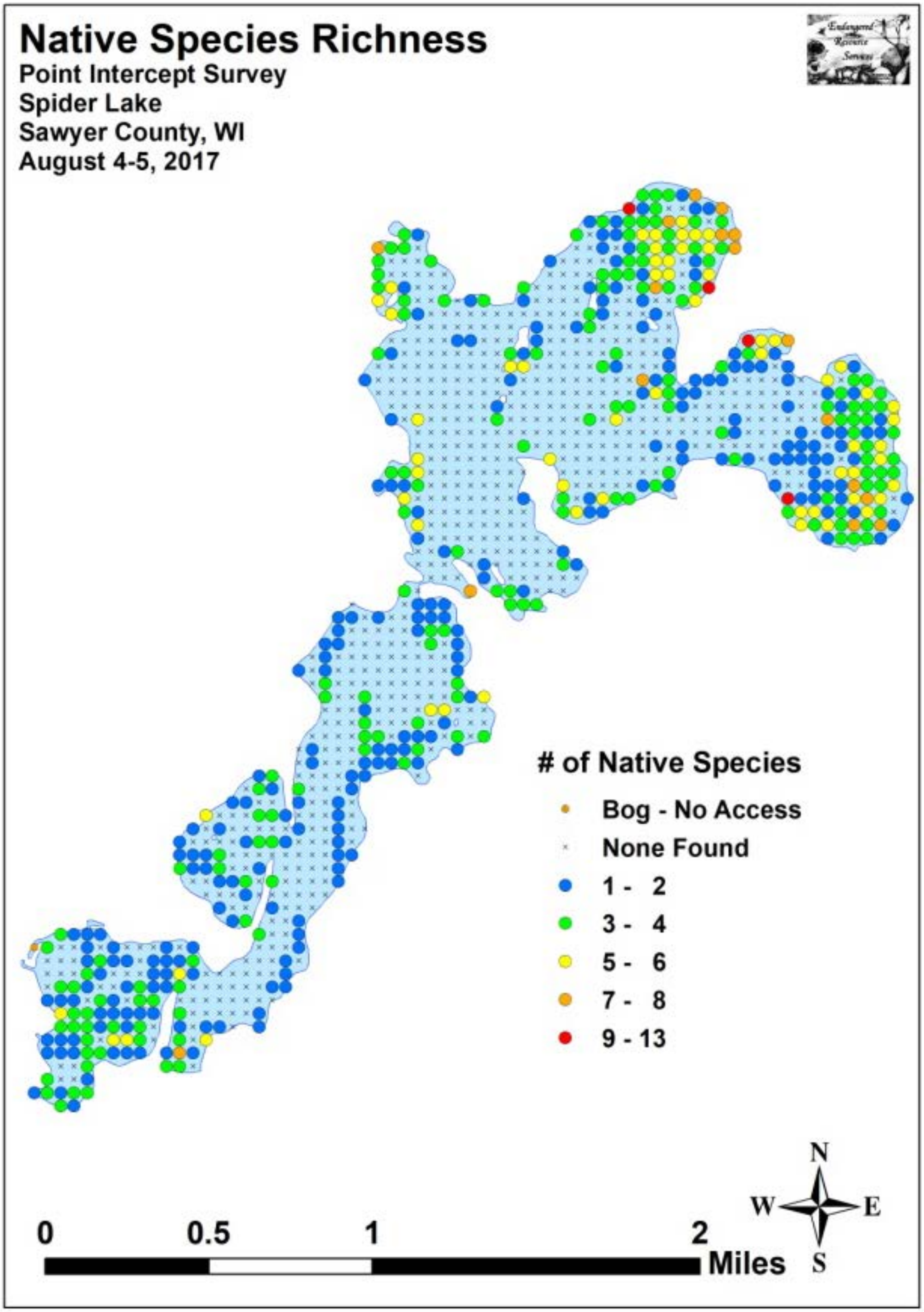


FIGURE 25. SPIDER LAKE NATIVE SPECIES RICHNESS

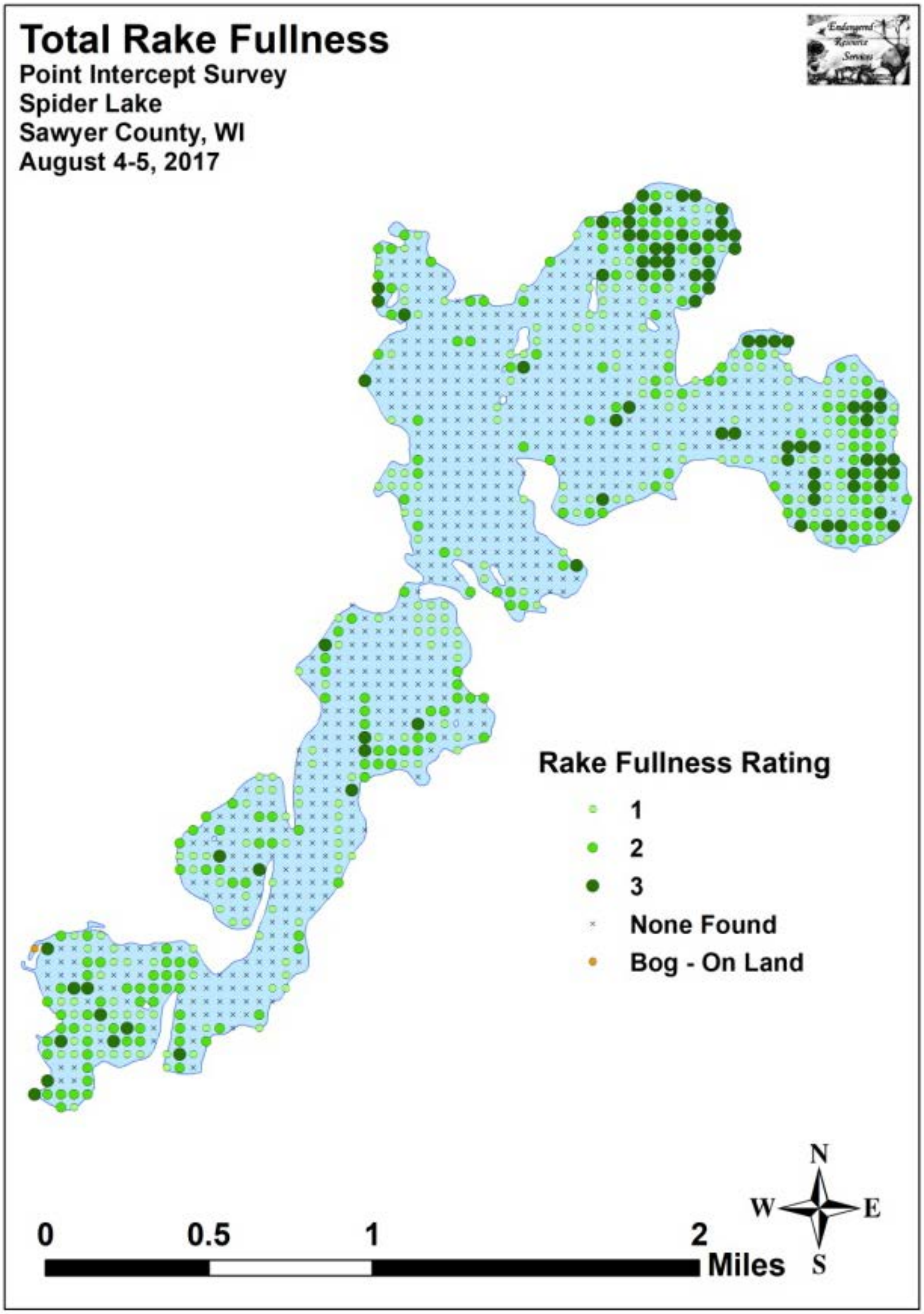


FIGURE 26. SPIDER LAKE NATIVE SPECIES RAKE FULLNESS

Lakewide, from 2012-2017, thirteen species showed significant changes in distribution. There were declines in distribution in Coontail (*Ceratophyllum demersum*), White-stem pondweed (*Potamogeton praelongus*), Clasping-leaf pondweed (*Potamogeton richardsonii*), Common waterweed, Variable pondweed (*Potamogeton gramineus*), Water star-grass (*Heteranthera dubia*), Wild celery, Needle spikerush (*Eleocharis acicularis*), Stiff pondweed (*Potamogeton strictifolius*), and Creeping spearwort (*Ranunculus flammula*). Small pondweed (*Potamogeton pusillus*), Illinois pondweed (*Potamogeton illinoensis*), and Spatterdock (*Nuphar variegata*) saw significant increases.

Table 9. Aquatic Plant Survey Summary Statistics 2017

Lake	Number of species	Littoral Zone Depth (Ft.)	% Vegetated w/in Littoral Zone	% Vegetated Entire Lake	Simpson's Diversity Index	Floristic Quality Index
North	46	14	70.1	39.0	0.93	39.8
Fawn	38	12	80.5	40.4	0.94	34.6
Clear	45	21.5	51.4	50.3	0.91	37.5
Spider	61	15.5	70.8	53.6	0.94	47.7

Aquatic Invasive Species

Yellow Flag Iris (Iris pseudacorus)

Yellow flag iris is an escaped showy perennial garden plant that is invasive in natural environments. Yellow flag iris can produce many seeds that can float from the parent plant, or plants can spread vegetatively via rhizome fragments. Once Yellow flag iris is established, it forms dense clumps or floating mats that can alter wildlife habitat and species diversity. All parts of this plant are poisonous, which results in lowered wildlife food sources in areas where it dominates.[21]

Yellow flag iris was identified on the shorelines of all lakes in the Spider Chain of Lakes except Fawn Lake in 2017. The distribution had expanded greatly since 2013 when Yellow flag iris was not identified on project lakes.

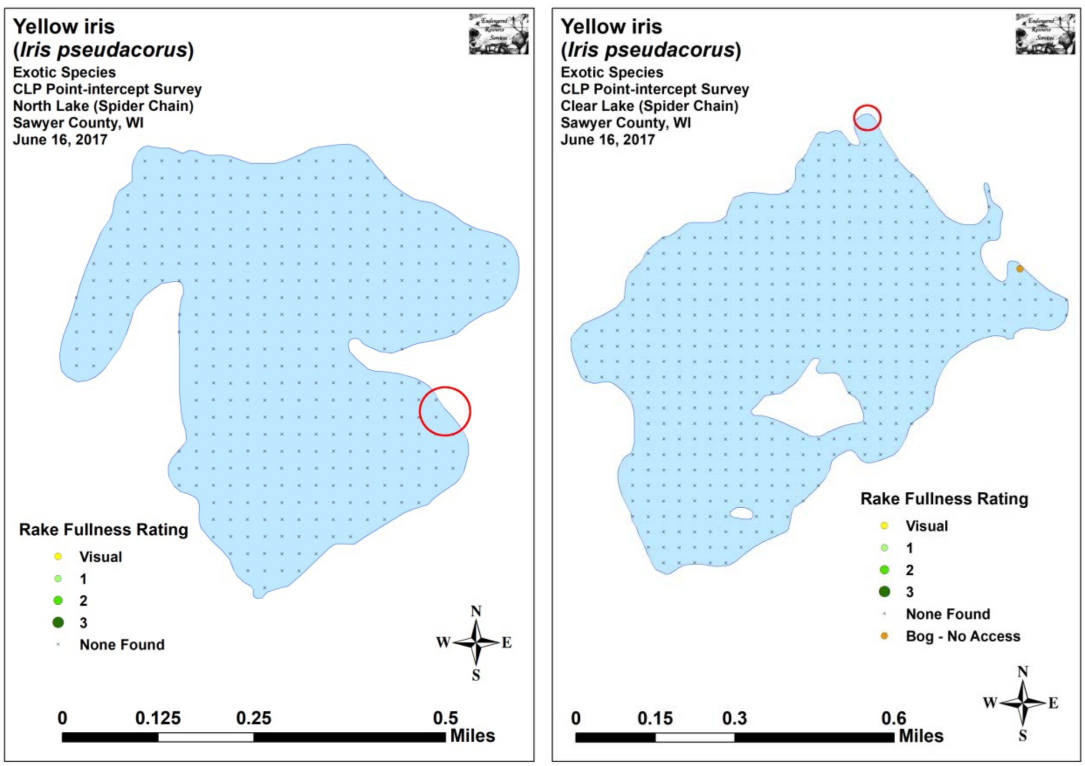


FIGURE 27. YELLOW FLAG IRIS LOCATIONS ON NORTH LAKE AND CLEAR LAKE (BERG, 2017)

[21] https://dnr.wisconsin.gov/topic/Invasives/fact/YellowFlagIris.html

Yellow Flag Iris Locations:[22]

North Lake – scattered along the shoreline

Fawn Lake – not present

Clear Lake – a few clusters in a north bay

Spider Lake - eight areas with clusters throughout Big and Little Spider

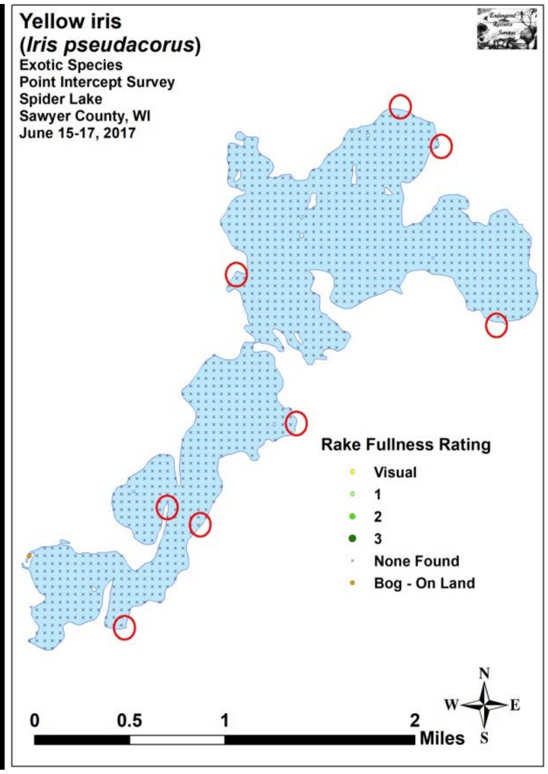


FIGURE 28. 2017 YELLOW FLAG IRIS LOCATIONS ON SPIDER LAKE (BERG, 2017)

Yellow Flag Iris Recommendations

Residents are strongly encouraged to continue to eliminate plants on their property before a minor problem becomes a significant one. Similar to loosestrife, iris plants and pods should be bagged to prevent seed dispersal, and then disposed of well away from the lake or any other wetland. June is the best time to look for this species as the bright yellow fleur-de-lis are most common at this time. At other times of the year when it is not in bloom, its leaves could be confused with Northern blue flag (Iris versicolor) – a native and non-invasive species.

[22] As described in plant survey reports (Berg, 2017).

FIGURE 29. VOLUNTEERS REMOVING YELLOW FLAG IRIS ON THE SPIDER CHAIN OF LAKES

Yellow flag iris has been the focus of volunteer hand removal and educational efforts coordinated by the Spider Chain of Lakes Association since 2019. In 2021, a contractor was paid to remove both yellow flag iris and Purple loosestrife by hand.

FIGURE 30. YELLOW FLAG IRIS FLOWER/IRIS CLUSTER AND SEED PODS HANGING IN WATER (BERG, 2017)

Purple Loosestrife (Lythrum salicaria)

Purple loosestrife is an invasive plant that grows along lake shorelines and in wetlands. Purple loosestrife spreads mainly by seed, but it can also spread vegetatively from root or stem segments. A single stalk can produce from 100,000 to 300,000 seeds per year.[23] Where *Galerucella* beetles are well established, they may keep the loosestrife population in balance with native plants.

FIGURE 31. PURPLE LOOSESTRIFE/GALERUCELLA BEETLES (BERG, 2017)

Purple Loosestrife Locations[24]

North Lake – not found

Fawn Lake – not found

Clear Lake – scattered on the west shoreline, especially near public boat landing; Galerucella beetles present

Spider Lake - scattered around the shoreline of Big Spider; especially around East Bay; no evidence of Galerucella beetles

Purple Loosestrife Recommendations

Residents are encouraged to remove any loosestrife plants they find, bag them to prevent seed dispersal, and dispose of them away from the lake. August and September are the best times to do this as the bright fuchsia candle-shaped flower spikes are easily seen. Because the plants have an extensive root system, care should be taken to remove the entire plant as even small root fragments can survive and produce new plants the following year.

[23] https://dnr.wisconsin.gov/topic/Invasives/fact/PurpleLoosestrife.html
[24] As described in plant survey reports (Berg, 2017).

Narrow-leaf Cattail (Typha angustifolia)

Hybrid and narrow-leaf cattail were observed in several locations on the Spider Chain of Lakes. Narrow-leaf cattail is an introduced species, and according to the Wisconsin DNR, is potentially invasive.[25] Some literature suggests that narrow leaf cattail does not act invasively when competing with broad leaf cattail. It can tend to be more common than broad leaf cattail because narrow-leaf cattail is more tolerant of deeper water. One study suggests that in more shallow water, which broad leaf cattail prefers, the narrow leaf cattail remained the same or declined slightly.[26] Narrow-leaf cattail can also hybridize with broad leaf cattail, and this hybrid tends to spread more quickly than narrow-leaf cattail.

Narrow-leaf Cattail Locations[27]

North Lake – not found

Fawn Lake – not found

Clear Lake – south of Butternut Island

Spider Lake - Brewer's Bay on Little Spider and along the north and northwest shorelines of Big Spider

Narrow-leaf Cattail Recommendations

Because Narrow-leaved cattail and its hybrids can be invasive along the shoreline to the point that they interfere with lake access, property owners may want to remove pioneering individuals before they become a bed. However, unless they are interfering with lake access or other human activity, removing previously established stands is probably unnecessary and unlikely to be ecologically beneficial. Because cattail seeds are transported by the wind, the continued expansion of this species in northern Wisconsin is likely inevitable.

[25] Dr. Susan Knight, Wisconsin WDNR personal communication.
[26] James B Gracea, Robert G Wetzel. Long-term dynamics of Typha populations Aquatic Botany, Volume 61, Issue 2, 1 June 1998, Pages 137–146.
[27] As described in plant survey reports (Berg, 2017).

Curly-leaf Pondweed

Curly-leaf pondweed (*Potamogeton crispus*) (CLP), an aquatic invasive plant species, was discovered in the Spider Chain in 2005. After two herbicide treatments in 2010 and 2011, Endangered Resource Services completed the original early season point-intercept surveys in 2012. The data from these surveys was used to develop a WDNR approved Aquatic Plant Management Plan (APMP) which outlined the use of herbicides to control CLP. However, because initial applications produced little change in CLP coverage and because the cost to expand the program was deemed too expensive, the SCLA decided to abandon herbicide treatments altogether and monitor CLP growth.

Most of the Curly-leaf pondweed in the Spider Chain grows in Big Spider Lake. The results of Spider Lake Curly-leaf pondweed bed mapping in 2012, 2013, and 2017 are shown in Table 7 and Figure 32. Detailed descriptions of each bed's density, location, and impact on navigation are included in the plant survey report. A point intercept survey also provided information about the extent of CLP in the Spider Chain. Results from 2017 are shown in Figure 33.

Growth of CLP in Spider Lake was described as follows:

CLP was seldom invasive to the point that it impeded navigation or excluded native vegetation. For the most part, CLP was acting like "just another plant" interspersed among other native species.

TABLE 10. CURLY-LEAF PONDWEED BEDS IN SPIDER LAKE

Year	Number of Beds	Area (acres)	Percent of Lake
2012	26	12.06	1.0
2013	28	9.22	0.8
2017	31	35.77	3.0

Definitions

Curly-leaf pondweed bed: any area where CLP was visually estimated to make up >50% of the area's plants, was generally continuous with clearly defined borders, and was canopied, or close enough to being canopied that it would likely interfere with boat traffic.

Curly-leaf Pondweed Locations[28]

North Lake – not found

Fawn Lake – 12 plants found near the lake outlet channel to Big Spider

Clear Lake – not found

Spider Lake – Dense beds and scattered plants found throughout Big Spider

[28] As described in plant survey reports (Berg, 2017).

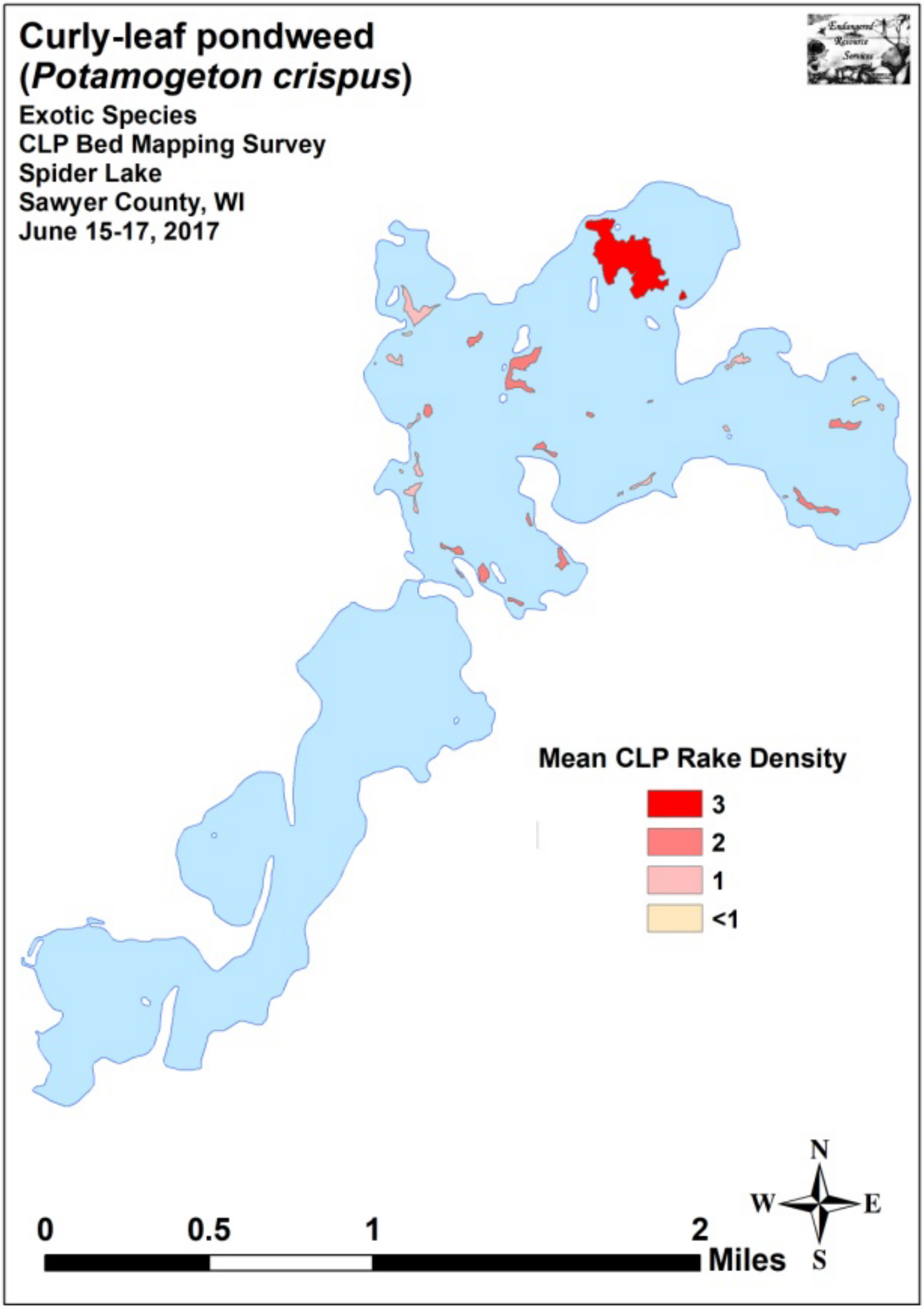


FIGURE 32. SPIDER LAKE CLP BED MAPPING SURVEY JUNE 2017

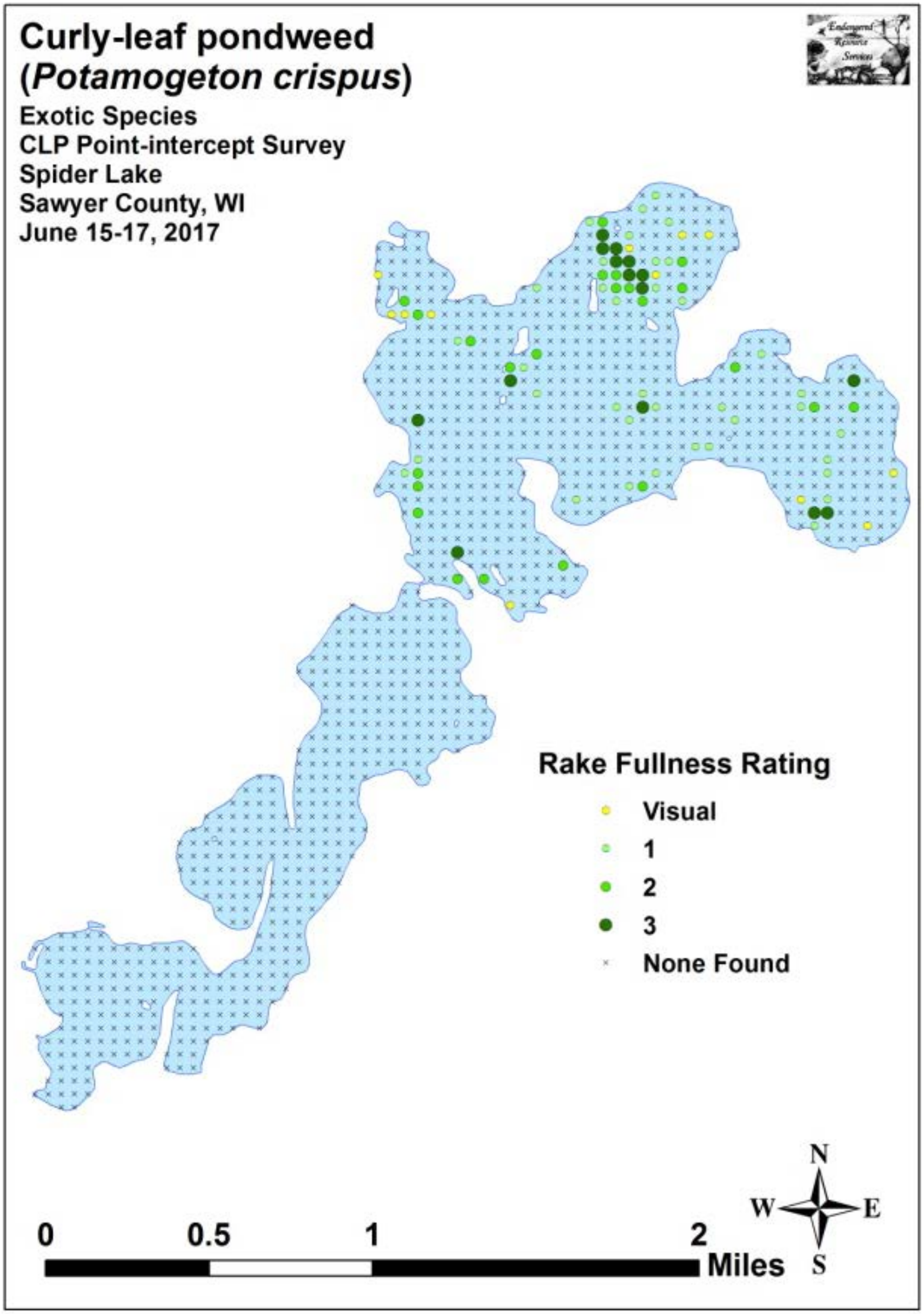


FIGURE 33. SPIDER LAKE CLP POINT INTERCEPT SURVEY JUNE 2017

Curly-leaf Pondweed Recommendations

Curly-leaf pondweed thrives in disturbed environments. If the lake association decides on a course of active management in the future, we encourage a limited and cautious approach that focuses on relieving navigation impairment as opposed to wide-scale control. Currently, Big Spider's plant community is dominated by Coontail, Common waterweed, and "pondweeds" which are all sensitive to Endothall – the most common chemical used to kill CLP. This means there is a high probability of at least some unintended collateral damage with a herbicide treatment program. The resulting barren substrate from this type of treatment is exactly the kind of disturbance the CLP is so good at exploiting. The upshot is that overly aggressive management followed by no management can ultimately make things worse instead of better when dealing with this species.

Mechanical harvesting is another common strategy for dealing with Curly-leaf pondweed. Although the initial startup costs tend to be greater than herbicide treatments, there is less risk of collateral damage to native plants.

Non-native Ornamental Water Lilies

Non-native ornamental water lilies were found on Spider Lake in August 2012. They have been verified on only 27 water bodies statewide.[29] They were not found during the most recent plant survey on the Spider Chain of Lakes (Berg, 2017).

Chinese Mystery Snails

Chinese Mystery Snails were confirmed in the Spider Lake Chain in recent years.[30]

Aquatic Invasive Species Threats

There are many non-native plant and animal species that threaten project lakes. Table 8 lists aquatic invasive species verified in Sawyer County waterbodies. Those not yet identified in the Spider Chain of Lakes include:

- Eurasian water milfoil
- Hybrid Eurasian/northern water milfoil
- Aquatic forget-me-not
- Flowering rush
- Banded mystery snail
- Japanese mystery snail
- Rusty crayfish

Zebra mussels are also found in Lake Superior and in the McKenzie Chain in Washburn County.

[29] https://dnr.wi.gov/lakes/invasives/AISDetail.aspx?roiseq=134641759

[30] Telephone communication, 12/13/2021. Pat Brown, Sawyer County Assistant Zoning and Conservation Administrator.

TABLE 11. AQUATIC INVASIVE SPECIES IN SAWYER COUNTY[31]

Waterbody Name	Waterbody ID Code (WBIC)	Eurasian Water-Milfoil	Hybrid Erasian/Northern Water-Milfoil	Curly-Leaf Pondweed	Purple Loosestrife	Narrow-Leaf Cattail	Aquatic Forget-me-not	Flowering Rush	Ornamental Water Lilies	Banded Mystery Snail	Chinese Mystery Snail	Japanese Mystery Snail	Rusty Crayfish	
Ashegon Lake	2448800										X			
Barber Lake	2382300	X												
Birch Lake	2113000			X						X	X		X	
Blueberry Lake	1835700									X				
Brunet River	2378400										X			
Callahan Lake	2434700	X												
Chippewa River	2050000				X									
Clear Lake	1841300	X								X				
Connors Lake	2275100	X		X						X			X	
Couderay River	2384700	X					X			X				
Grindstone Lake	2391200			X						X			X	
Hayward Lake	2725500	X	X	X							X			
Island Creek	2381700									X	X			
Island Lake	2381800									X	X			
Knuteson Creek	2113700												X	
Lac Courte Oreilles	2390800	X		X			X			X	X		X	
Lake Chetac	2113300			X						X	X	X	X	
Lake Chippewa	2399700	X									X			
Lake of the Pines	2275300									X	X			
Little Lac Courte Oreilles	2390500	X												
Little Moose River	2422200					X								
Little Round Lake	2395500	X												
Lost Land Lake	2418600	X	X							X	X			
Moose Lake	2420600					X								
Moose River	2420700					X								
Mud Lake	2382200	X												
Mud Lake	2434800	X												
Namekagon River	2689500		X											

[31] From https://dnr.wi.gov/lakes/invasives/ data downloaded 10/19/2021.

Table 8. Aquatic Invasive Species in Sawyer County (continued)

Waterbody Name	Waterbody ID Code (WBIC)	Eurasian Water-Milfoil	Hybrid Erasian/Northern Water-Milfoil	Curly-Leaf Pondweed	Purple Loosestrife	Narrow-Leaf Cattail	Aquatic Forget-me-not	Flowering Rush	Ornamental Water Lilies	Banded Mystery Snail	Chinese Mystery Snail	Japanese Mystery Snail	Rusty Crayfish	
Nelson Lake	2704200								X	X	X		X	
North Fork Chief River	2434000	X			X									
Osprey Lake	2395100	X			X									
Pacwawong Lake	2728700					X								
Radisson Flowage	2397400	X		X	X						X			
Round Lake	2395600	X						X		X			X	
Sand Lake	2393200									X	X	X	X	
Sissabagama Lake	2393500									X	X			
Smith Lake	2726100				X	X				X	X	X		
Smith Lake Creek	2725600									X				
Spider Lake	2435700			X		X			X					
Spring Lake	2433100									X				
Sucker Creek	2112200												X	
Teal Lake	2417000										X			
Thirtythree Creek	2114000												X	
Tiger Cat Flowage	2435000				X					X				
Totagatic Flowage	2703500			X										
Totagatic River	2689800			X					X					
Unnamed	2391100			X									X	
Unnamed	2422000					X								
Unnamed	2436100								X					
West Fork Chippewa River	2414500	X				X								
Whitefish Lake	2392000	X		X						X	X			
Winter Lake (Price Flowage)	2381100			X							X			

Lake Management Planning

Goals and Objectives

The CLMP Advisory Committee discussed priority concerns and desired results at the first meeting, and additional guidance was provided by the property owner survey. These were used to develop plan goals and objectives.

Lake Management Alternatives

Alternative actions that were considered as means to meet goals and objectives were provided by committee members and recommended by consultants. Alternatives included current actions of the SCLA and others to consider. Committee members refined the description of alternatives and selected those that remain in the plan.

Alternatives/Actions Analysis

In some cases, actions included in the Spider Lake (CLMP) lack detail for implementation or are listed for consideration only. Alternatives will be evaluated for inclusion in more detailed implementation plans and updates to this plan with the following in mind:

1) Does the action fit under one of the CLMP goals?
2) Does the action fulfill one of the CLMP objectives? If not, is the result to be obtained from the action important, and does it necessitate a new plan objective?
3) How will the action's progress toward plan objectives be evaluated?
4) What alternatives are available to reaching the objective?
    a. Is this action more likely to produce results compared with other alternatives?
    b. Is this action more cost effective when compared with other alternatives?
    c. Does the risk of no action outweigh the risk of uncertainty of success?
5) Does the SCLA have the resources available to implement the action? Volunteers? Advisors? Funding for consultants or construction?
6) Is grant funding available to support the action?
7) Who (what committee, board member, volunteer) is responsible to lead the action?

Plan Implementation

This section of the plan lists goals and objectives for lake management for the Spider Chain of Lakes. It also presents a list of actions that will be used to reach plan goals and objectives.

Goals are broad statements of desired results.

Objectives are the measurable accomplishments toward achieving a goal.

Actions are the steps taken to accomplish objectives and ultimately goals.

The SCLA board and committees will track implementation of plan actions and evaluate progress toward reaching plan goals and objectives.

Plan Guiding Principles

Spider Chain of Lakes management activities are guided by best available science and adaptive management.

Adaptive management is a systematic approach for improving resource management by learning from management outcomes. Adaptive management uses results of monitoring, evaluation of project activities, and updated information to modify and guide future project implementation.

GOALS, OBJECTIVES, AND ACTIONS

Goal I. Everyone who lives on, recreates on, and affects the Spider Chain of Lakes practices good lake stewardship.

Objective A. All stakeholders are aware of what lake stewardship means and how to practice it.

Objective B. Stakeholders who practice good lake stewardship are recognized.

Objective C. Positive suggestions for improvements are provided to stakeholders who do not practice good lake stewardship.

AUDIENCES FOR EDUCATION AND OUTREACH

- Shoreland owners and residents
- Owners of short- and long-term rentals, property managers, and renters
- Visitors
- Federal, state, and local agency and nonprofit partners (including the Town of Spider Lake and Sawyer County)
- Business owners, particularly renters of water sports equipment and realtors

FOCUS ON EDUCATION AND OUTREACH

Education and outreach are critical to reaching each of the remaining plan goals. The SCLA will commit resources to build and expand SCLA's education and outreach efforts.

MESSAGES FOR EDUCATION AND OUTREACH

The SCLA will use positive, direct messaging that encourages and involves people to maintain good practices and results in positive changes. The messages below are tied to the remaining goals of this plan.

<u>Water Quality (Goal II)</u>

a. Accurate and current data on the state of the Spider Chain of Lakes from Citizen Lake Monitoring Network and other data sources.
b. The impact of phosphorus on algae growth and other chemical inputs to the water.
c. There are simple actions and steps that can be taken by every shoreland owner to protect and improve water quality. Provide specific examples of effective water quality mitigation options.

d. Critical contribution of Town of Spider Lake land use ordinance for preservation and protection of the Spider Chain of Lakes water quality.

Habitat (Goal III)

a. Importance and benefits of a diverse native aquatic plant community.
b. If aquatic plants limit navigation around docks, limited manual removal is allowed by state regulations. Boating can effectively maintain navigation channels.
c. State regulations establish no-wake zones. These no wake zones encourage safe boat operation, prevent shoreline erosion, and preserve habitat.
d. There are simple actions and steps that can be taken by every shoreland owner to protect and improve habitat. Provide specific examples of successful habitat mitigation options.
e. Critical contribution of Town of Spider Lake land use ordinance for preservation and protection of the Spider Chain of Lakes habitat.

Wilderness Experience (Goal IV)

a. Promote information and educational opportunities regarding wildlife and wildlife monitoring.
b. Importance of maintaining the Northwoods atmosphere and undeveloped characteristics of shoreline to provide a wilderness experience.
c. Critical contribution of Town of Spider Lake land use ordinance for preserving natural shorelines.
d. Every season provides opportunities to enjoy the wilderness and a year-round connection to nature. The Spider Chain of Lakes is unique in that it is a semi-quiet lake chain. Quiet times are established in the mornings, late afternoons, and evenings which is ideal for fans of peace, quiet, and silent sports. Preservation of quiet times is high priority. The greater Sawyer County area provides opportunities for silent sports and motorized sports throughout the year.

Aquatic Invasive Species (Goal V)

a. Threats of aquatic invasive species. The Spider Chain is vulnerable to AIS invasion for several reasons:
    i. Many of the popular fishing and boating lakes in the surrounding area contain Eurasian or Hybrid water milfoil.
    ii. The Spider Chain of Lakes is a desirable fishing destination, and many boats entering the lakes have recently been in neighboring, infested waters.
    iii. The lakes in the Spider Chain of Lakes have a high percentage of relatively shallow water that would be suitable for the spread of Eurasian water milfoil.

b. Follow prevention methods: inspect, remove, and drain boats and equipment before entering the lakes. Never move live fish away from a waterbody. Dispose of unwanted bait in the trash.

c. AIS identification photos and descriptions for Eurasian water milfoil, Zebra mussels, Yellow flag iris, Purple loosestrife, Curly leaf pondweed, and other AIS threats.

d. Reductions In property values have been correlated with the establishment of AIS in a lake.

ACTIONS (METHODS FOR EDUCATION AND OUTREACH)[32]

1. Continue electronic and online presence of SCLA through its
   a. Spider Lines newsletter,
   b. SCLA website, and
   c. Monthly updates and emergency notices.

2. Provide at least two broader forums (e.g., annual meeting, zoom conference) for education and outreach.

3. Engage new owners in lake stewardship.
   a. Continue welcome packet of information to new owners. Identify owners shortly after they purchase property. Distribute the packets via personal visits.
   b. Provide outreach to real estate agents in order to educate them on Spider Chain of Lakes characteristics (e.g., quiet hours) resulting in informed buyers.
4. Reach owners of rental property, property managers, renters, and guests with lake stewardship information.
   a. Make brochures available at each property and the landings.
   b. Post information on the SCLA website.
   c. Assemble packets of information and mail to Spider Chain of Lakes rental property owners who are approved by the Town of Spider Lake.
5. Recognize owners who practice good lake stewardship in Spider Lines and/or provide good lake stewardship awards.
6. Host the Spider Lake Environmental Education for Kids (SLEEK) Program.
7. Distribute handouts and brochures on good lake stewardship.

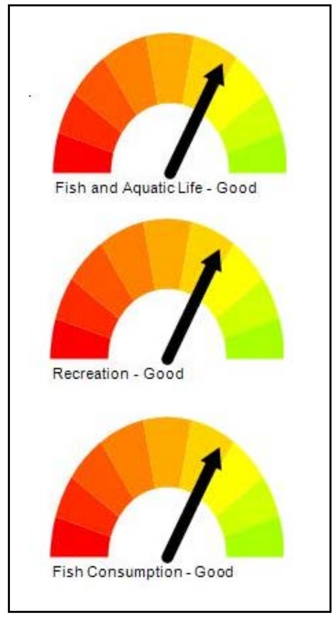
[32] SCLA members surveyed responded that the *most* important services and activities the SCLA provides are: controlling aquatic invasive species (96%), the *Spider Lines* newsletter (96%), the SCLA monthly updates (93%), and the SCLA website (91%).

Goal II. Spider Chain of Lakes water quality is preserved and protected.

Objective A. Maintain the lakes in mesotrophic state[33] with moderate nutrient levels.

<u>Evaluation/Measurement:</u> conduct citizen lake monitoring – add nutrients and temp and O_2 profiles for Fawn and Clear Lakes.

Note: Spider Lake and Clear Lake WDNR WISCALM 2018 evaluation is shown at right.[34] *There is not enough phosphorus and chlorophyll data to characterize Fawn and North Lake for recreational use. This data is being collected for a second year (2020 and 2021) as part of the project lake study, and this assessment will likely be available from WDNR in 2023.*



Objective B. Watershed inputs (flow and nutrients) to Spider Chain of Lakes are well-understood, and priority nutrient and sediment inputs are addressed.

<u>Evaluation/Measurement:</u> track implementation of projects: location, type of project installed, and nutrient reductions.

WATER QUALITY ACTIONS

1. Identify high priority sites for mitigation of runoff of nutrients to the lakes, and support mitigation efforts. Support may be available from Sawyer County and/or WDNR Surface Water grant program for mitigation projects.
2. Support shoreland restoration and runoff best management practices (potentially through the WDNR Healthy Lakes grant program) to mitigate potential impacts of future shoreland development. Use shoreland survey results to target efforts. Identify what works best to encourage participation.
3. Explore land conservancy options to protect watershed areas from development. Include partnerships with landowners, Federal, state, and local agencies, and nonprofit organizations.
4. Study blue green algae growth mechanisms in Fawn Lake, and mitigate identified sources. Potentially focus initially on internal (sediment) load and more detailed watershed evaluation.

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[33] Lakes with an intermediate level of productivity are called mesotrophic lakes. These lakes have a medium or moderate level of nutrients and algae growth.
[34] https://dnr.wi.gov/water/waterDetail.aspx?key=15477

Water Quality Actions for Future Consideration

1. Evaluate the Fawn Lake and North Lake wetlands as potential nutrient sources in order to understand and address algae growth in these lakes.
2. Study shallow, aerobic lake sediment release due to high speed boat traffic and the potential impact on lake water quality throughout the Spider Chain of Lakes.
3. Design storm water mitigation measures to accommodate high intensity storm events when/if they are designed and installed. Higher intensity storm events are anticipated as a result of climate change.
4. Investigate candidate area options for localized no-wake restrictions to improve water quality.

Goal III. Our shorelands and shallows provide healthy fish and wildlife habitat.

Objective A. Shorelands and shallows habitats are preserved and restored.

Evaluation/Measurement: Conduct follow-up lake shoreland and shallows habitat survey and assess changes (2030).

HABITAT ACTIONS

1. Support efforts to restore shoreland habitat. Use shoreland survey results to target efforts. Identify what works best to encourage participation. Options available: plant sale, healthy lakes best management practices such as fish sticks and native plantings.
2. Continue participation in Loonwatch monitoring.
3. Provide input in the development and implementation of town, county, and state ordinances, regulations, and plans to encourage protection and restoration of shoreland habitats.

Objective B. The Spider Chain of Lakes supports healthy fish populations.

Evaluation/Measurement: WDNR fisheries surveys reports

FISHERY ACTIONS

4. Participate in WDNR fish management efforts including fisheries planning,[35] fish habitat improvements, and fish stocking.

Goal IV. The Spider Chain of Lakes provides quiet, wilderness-like experiences for all to enjoy.

Objective A. Lake users have opportunities to enjoy quiet, wilderness-like experiences.

LAKE EXPERIENCE ACTIONS

1. The SCLA supports existing regulations limiting boat speeds and wakes.
2. The SCLA supports the Town of Spider Lake ordinance that establishes Spider Chain of Lakes quiet hours.
3. The SCLA supports the Town of Spider Lake land use ordinance that maintains the Northwoods atmosphere and the undeveloped characteristics of shoreline.

[35] The WDNR is planning to develop a fisheries management plan for the Spider Chain of Lakes in the near future.

Goal V. Aquatic Invasive Species (AIS) are prevented from negatively impacting the Spider Chain of Lakes.

DEFINITION: Aquatic Invasive Species (AIS) *are non-native aquatic plants or aquatic animals that can out-compete and overtake native species damaging native lake habitat and sometimes creating nuisance conditions.* Section 23.22 (1) (c), WI Stats., states that "invasive species" means nonindigenous species whose introduction causes or is likely to cause economic or environmental harm or harm to human health

AIS currently in the Spider Chain of Lakes system include Curly-leaf pondweed (CLP), Purple loosestrife (PL), Yellow flag iris, and Narrow-leaf cattail. Additional AIS threaten the lakes with Eurasian water milfoil, Hybrid Northern-Eurasian water milfoil, and Zebra mussels present in lakes within sixty miles. The SCLA also identifies Northern pike as an invasive species.

AIS IMPLEMENTATION ACTIONS

1. Maintain an active and involved Aquatic Invasive Species Committee. The AIS Committee is appointed by and reports to the Spider Chain of Lakes Association Board. Lead committee members and/or board members are designated to manage various AIS actions.

Objective A. New AIS are prevented from entering our lakes.

Evaluation/measurement: No new AIS are found in plant surveys or by volunteers.

AIS PREVENTION ACTIONS

2. Continue to conduct and/or expand Clean Boats, Clean Waters inspections at two public access points: Clear Lake and Heinemann's Landings.
3. Maintain AIS signage at the public access points consistent with Wisconsin DNR guidance. (WDNR controls signage at the Clear Lake Landing).
4. Provide input in the development of a Sawyer County ordinance that will require AIS decontamination when available at public access points.
5. Support AIS do-not-transport enforcement efforts (Sawyer County Sheriff, WDNR wardens).
6. Identify private boat launches and work with owners to identify and employ methods to limit AIS introduction at these locations.
7. Stay informed on AIS developments in area water bodies, primarily through contact with the Sawyer County AIS Coordinator and the DNR AIS Coordinator for NW Wisconsin, to understand AIS threats to the Spider Chain of Lakes.

7. Stay up-to-date on the current best practices in the nation to prevent the introduction and expansion of AIS in the environment.
8. Consider additional AIS prevention methods at public access points:
    a. Decontamination of boats, trailers and equipment entering the lake via chemical methods (mild bleach solution),
    b. Decontamination of boats, trailers, and equipment entering the lake via hot water, high pressure washing, and/or
    c. Surveillance cameras to supplement in-person landing monitoring coverage.

Objective B. If AIS are introduced, they are discovered rapidly, and an effective control plan is initiated.

<u>Evaluation/measurement:</u> AIS monitoring reports

AIS RAPID RESPONSE ACTIONS

9. Annually review and update contacts and processes in the *Spider Chain of Lakes Rapid Response Plan for Aquatic Invasive Species (see Appendix A for current draft)*.
10. Support volunteers in their efforts to learn more about available best practices for AIS response by providing or identifying volunteer training and funding conference expenses.

AIS MONITORING ACTIONS

11. Follow standard WDNR Citizen Lake Monitoring Network standards and reporting to complete AIS monitoring.
    a. Recruit and train AIS lake monitoring volunteers. Complete expert training of volunteers at least every two years.
    b. Continue to conduct volunteer AIS littoral zone monitoring, twice-per season on all five lakes.
12. Complete professional AIS meandering survey twice per year following standard WDNR protocols. A mid-June early season survey will target Curly-leaf pondweed and Yellow flag iris. A second survey in late August or September will look for EWM and Purple loosestrife.
13. Conduct Zebra mussel monitoring using available and appropriate methods. At a minimum check buoys and ask residents to check docks and lifts when removed from the lake each year. Use *Spider Chain of Lakes Rapid Response Plan for Aquatic Invasive Species* for reporting

procedures. Consider plate samplers, cinder blocks, and veliger sampling for future monitoring efforts.

14. Complete aquatic plant point intercept survey on all project lakes every 5 – 7 years.

Objective C. Curly-leaf pondweed does not severely, negatively impact navigation.

Evaluation/measurement: CLP bed mapping trends over time (acres and bed locations relative to navigation routes)

CLP MONITORING ACTION

15. Professionally map beds of Curly-leaf pondweed annually (along with early season AIS survey). If severe navigation impairment occurs for more than 2 consecutive years and negatively impacts lake users, the AIS Committee and Board will consider control measures.

Objective D. Yellow flag iris, Purple loosestrife, and other AIS (if identified) are reduced and controlled to eliminate AIS and/or maintain very low levels.

Evaluation/measures: AIS mapping trends over time (changes in frequency of occurrence by species by lake)

AIS CONTROL ACTIONS

The Spider Chain of Lakes Association will use manual and biological measures to control aquatic invasive species as preferred management methods. Chemical control will be considered only when manual and biological control measures are not effective and the AIS threat is deemed serious by the SCLA AIS Committee and Board. The Board and Committee will seek advice regarding chemical control efficacy and impacts from experienced advisors prior to initiating chemical control measures.

16. Continue *Take Action against Yellow Flag Iris* campaign to control Yellow flag iris.
    a. Professionally map Yellow flag iris (YFI) sites in mid-June each year (along with early season AIS survey).
    b. Encourage lake monitors and residents to tag YFI plants with yellow ribbon or other means acceptable to property owners, when the YFI plants are distinguishable in June/July, so they can be targeted for removal.
    c. Organize volunteer teams as feasible to remove YFI at targeted sites on request.
    d. Budget for and hire contractors to manually remove YFI and record sites on a map.

17. Continue Purple loosestrife control.
    a. Professionally map Purple loosestrife locations (along with late season AIS survey).
    b. Landowners and a volunteer will continue to identify Purple loosestrife locations.
    c. Conduct manual removal where growth is manageable.
    d. Conduct biological control (beetles) in areas of extensive growth and/or where plants are not accessible for manual removal. (Volunteers with assistance from Sawyer County AIS coordinator).
19. Continue native plant sale. Provide reasonably priced native plants to replace AIS removed and to raise awareness of the importance of native plants on the Spider Chain of Lakes landscape.
20. Continue *Project Pike* to remove non-native northern pike from the Spider Chain of Lakes.

Goal VI. The Spider Chain of Lakes Association will monitor and anticipate the impacts of climate change on the Spider Chain of Lakes, and will take appropriate action to minimize negative impact.

Objectives A. SCLA board and members understand the potential impacts of climate change on the Spider Chain of Lakes.

Objective B. SCLA takes appropriate actions to mitigate impacts of climate change on the Spider Chain of Lakes.

CLIMATE CHANGE ACTIONS

1. SCLA will monitor and identify best practices regarding climate change impact on the lake system.
2. The SCLA board and/or AIS Committee will create a yearly Climate Change Plan, outlining priorities and actions in addressing climate change impact based on the most recent WDNR guidance and observed changes to the lakes.

Goal VII. The Spider Chain of Lakes Association has the capacity to build relationships, provide stable funding, operate efficiently, and encourage responsible use to preserve and protect the lakes.

Objective A. The SCLA has effective partnerships with the Town of Spider Lake, Sawyer County, lake organizations, the Wisconsin Department of Natural Resources, area businesses, and other organizations and agencies.

SCLA PARTNER ACTION

1. Provide updates regarding SCLA lake management goals and objectives, actions, and results to partners. Discuss opportunities for coordination.
    a. The SCLA will present an annual members-focused summary of its CLMP progress each year at its annual association meeting.
    b. We will share appropriate highlights from the summary with our external partners including the Town of Spider Lake, Sawyer County, the Wisconsin DNR, and other lake associations to promote coordination of best practices.

Objective B. The SCLA board processes are efficient, and the board consists of engaged people with a variety of expertise.

SCLA BOARD OPERATION ACTION

2. Review board documents and procedures.
    a. Organize and digitally store documents.
    b. Identify needed guidance for board operations.
    c. Review and update procedures.

Objective C. Projects are funded consistent with plan priorities.

SCLA PLANNING AND FUNDING ACTIONS

3. The SCLA board and committees use the CLMP to guide activities and regularly track and adapt implementation actions.
4. The SCLA board investigates and seeks grant and foundation funding sources to carry out lake-plan actions.
5. Annual budgets support priority lake plan actions.
6. Re-evaluate fundraising goals periodically to support landing monitoring (endowment fund), AIS rapid response (emergency response fund), and other emerging needs.
7. The SCLA board will share when Preserve and Protect Funds are used to implement actions items.

Objective D. Continue to increase the percentage of Spider Chain of Lakes property owners who are members of the SCLA.

SCLA MEMBER ACTION

8. Encourage lake property owners to become SCLA members. Use the property owner survey results to target member recruitment.

Works Cited

Berg, M. (2017). *Curly-leaf pondweed (Potamogeton crispus) Point-intercept and Bed Mapping Surveys, and Warm-water Macrophyte Point-Intercept Survey - Clear Lake - Spider Lake Chain - Sawyer County, Wisconsin.*

Berg, M. (2017). *Curly-leaf pondweed (Potamogeton crispus) Point-intercept and Bed Mapping Surveys, and Warm-water Macrophyte Point-intercept Survey Fawn Lake - Spider Chain - WBIC 2435900 Sawyer County, Wisconsin.*

Berg, M. (2017). *Curly-leaf pondweed (Potamogeton crispus) Point-intercept and Bed Mapping Surveys, and Warm-water Macrophyte Point-intercept Survey North Lake - Spider Chain - WBIC: 2436000 Sawyer County, Wisconsin.*

Berg, M. (2017). *Curly-leaf pondweed (Potamogeton crispus) Point-intercept and Bed Mapping Surveys, and Warm-water Macrophyte Point-intercept Survey Spider Lake (Big and Little) - Spider Chain (WBIC: 2435700) - Sawyer County, WI.*

Blumer, D. a. (2013). *Spider Chain of Lakes Aquatic Plant Management Plan.*

Markham, L. (2019). *Comparison of 2019 Town of Spider Lake shoreland zoning standards and State of Wisconsin standards.*

Sawyer County. (2017). *Sawyer County Land and Water Resource Management Plan 2017 - 2026.*

Schieffer, S. (2021). *Lake Shoreland & Shallows Habitat Survey Spider Chain of Lakes, Sawyer County WI.*

Schieffer, S. (2021). *Water and Nutrient Budget Analysis Spider Chain of Lakes, Sawyer County.*

Sheldon, T. (2020). *SCLA Shoreland Property Owners Survey Report.*

Town of Spider Lake. (2006). *TOWN OF SPIDER LAKE ORDINANCE #12.*

WDNR. (2019). *Wisconsin 2020 Consolidated Assessment and Listing Methodology (WisCALM).*

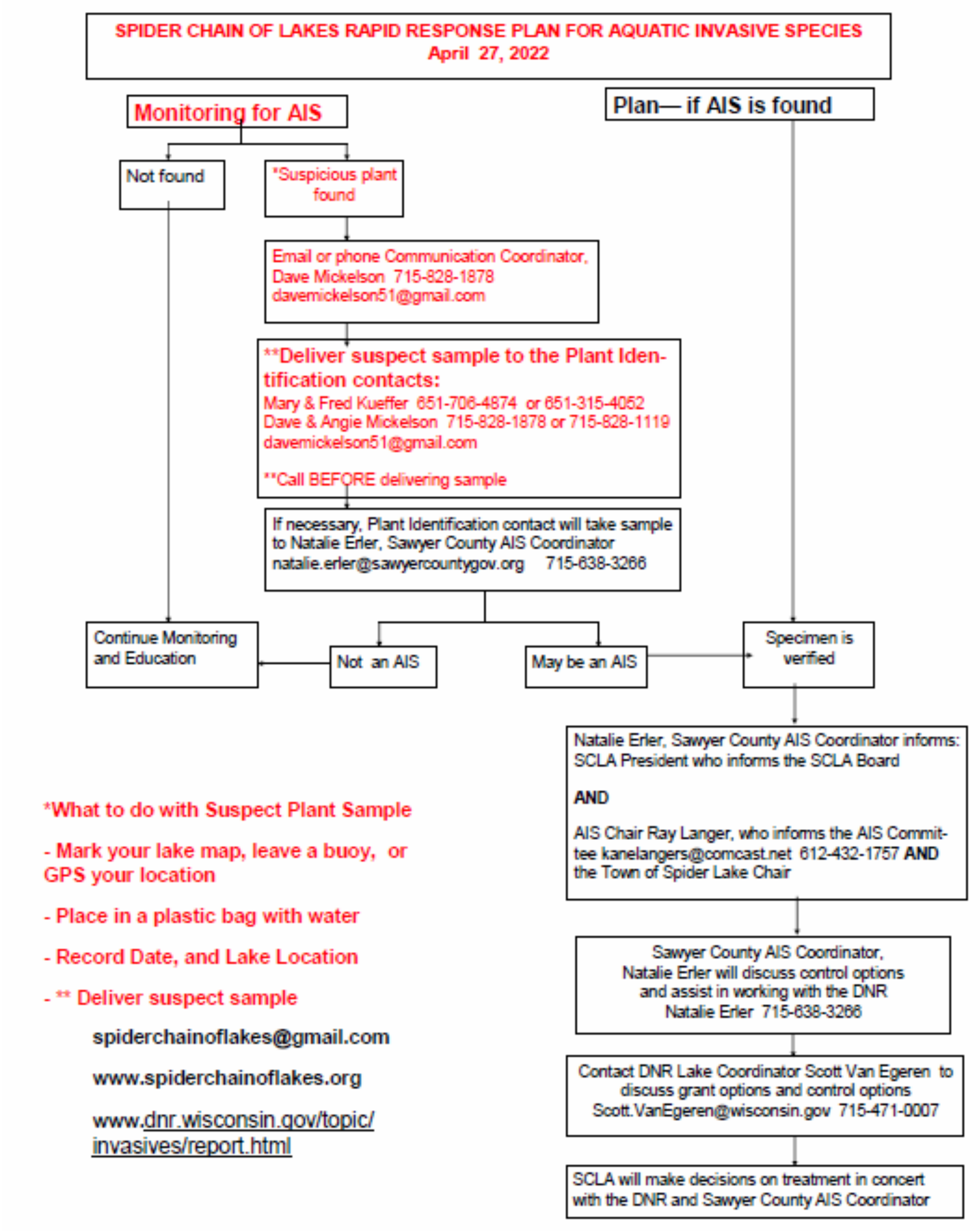
WDNR. (n.d.). *Purple Loosestrife Fact Sheet.*

Wisconsin Department of Natural Resources. (2003). *Spider Lake Chain Sensitive Area Survey Report.*

Wisconsin Department of Natural Resources. (2021). *Wisconsin Consolidated Assessment and Listing Methodology 2022.*

Wolter, M. (2016). *Spring Fisheries Survey Summary Spider Lake, Sawyer County.*

Appendix A. Spider Chain of Lakes Rapid Response Plan for Aquatic Invasive Species



Appendix B. Spider Chain of Lakes Baseline Water Chemistry Summary-2020

Lake	Chloride (mg/L)	Color (SU)	Conductivity (µS/cm	Nitrate/Nitrite (mg/L)	Total Nitrogen (mg/L	Alkalinity (mg/L)	pH (SU)	Calcium (mg/L)	Hardness (mg/L)	Magnesium (mg/L)
Clear Lake	1.8	5	63.7	ND	0.837	30	7.06	7.87	28.7	2.2
Fawn Lake	1.79	20	127	ND	0.335	60.8	7.26	17	62.2	4.83
North Lake	1.63	15	131	ND	0.318	63.4	7.54	17.4	63.7	4.89
Big Spider Lake	1.61	5	102	ND	0.451	49	7.44	13.4	48.9	4.47
Little Spider Lake								12.8	47.4	3.76

Summary of water tests/results:

Chloride: Measuring chloride can help detect the influx of polluted water from road runoff (salt) and septic system leaching. Chlorides are not naturally high in Wisconsin surface waters and do not bind to substrates (naturally less than ten mg/L). Therefore, if it is in runoff or water leaching from the water table high in chloride, it will be reflected in the lake water. All three lakes have low chloride concentrations, indicating that sewage is not entering the lake in high amounts. (There was likely no road salt runoff in July when these measurements were taken.)

Color: This test indicates the shade or tint of the water after suspended particles are filtered out of the water. Color can increase from algae growth and ferric (iron) compounds near the lake sediment. The brown color is primarily due to decomposing plant detritus. Clear Lake has a low color value while Fawn Lake and North Lake values are much higher. This is likely due to the impact of water coming from the extensive wetlands that surround these lakes. The color below 40 units is low, so the brown tint in Fawn Lake and North Lake is subtle.

Conductivity: Conductivity measures the ability of water to conduct electricity and indicates the number of ions (charged particles) dissolved in the water. The source of these ions can be runoff from the watershed, precipitation (rain picks up dust particles), dry deposition of dust particles, snowmelt, septic systems, and natural sources from groundwater and lake sediments. The data shows that Clear Lake has the lowest conductivity, half of the other two lakes. Since there is little agriculture around these lakes and the chloride levels are low, the difference may be due to groundwater inflows into the lakes. Fawn Lake and North Lake may have more groundwater high in dissolved minerals flowing in than Clear Lake does.

Nitrate/Nitrite: Nitrate is the useable form of nitrogen for plants to assimilate and grow. Nitrite is not oxidized and is the intermediate as ammonia gets oxidized into nitrates. Excessive nitrates can lead to eutrophication with increased productivity. Sources of nitrate include direct precipitation (can be the main source in low productivity lakes), runoff from the watershed with higher values from fertilizer use, septic systems, and decomposition. No nitrates or nitrites were detected in any lake.

Total nitrogen: Total nitrogen measures inorganic and organic nitrogen combined. Total nitrogen concentration above three mg/L can lead to eutrophication. Calculating the total nitrogen total phosphorus ratio can indicate which nutrient is the limiting factor in productivity. The total nitrogen to total phosphorus ratio greater than 10:1 (N:P) suggests that phosphorus is the limiting nutrient. All three lakes had a total nitrogen concentration much less than three mg/L, and all have a greater than 10:1 ratio (N:P), which shows that phosphorus is the limiting nutrient in each lake. The total nitrogen concentration in Clear Lake is more than double the concentration in Fawn Lake and North Lake. This could be due to more runoff from the watershed or the decomposition of organic matter. Nitrogen fixation (removal of nitrogen gas and fixing by bacteria) can occur with certain species of blue-green algae, which could presumably increase nitrogen concentration in the water.

Alkalinity and pH: Alkalinity is a measure of the buffering capacity of the carbonate system in the water. Carbonates can accept (absorb) the acid ion (H^+) that lowers pH. Carbonates are affected by the dissolving of carbon dioxide in water and are part of a complex equilibrium reaction. Therefore, high alkalinity indicates that the lake water can neutralize high amounts of strong acids. This allows a lake to receive acid sources (rainfall as an example) with little effect on the pH of the lake water. Lower alkalinity indicates that a lake would have limited buffering capacity, thus more susceptible to acid sources reducing the pH.

PH measures the H+ concentration on a logarithmic scale. The more pH is below seven, the more acidic and above seven more basic (or alkaline). PH values below six and above nine can adversely affect various aquatic organisms. PH can also affect multiple chemical processes in lakes. Ideally, a pH just above 7 is healthy and indicates some buffering capacity of the lake. All three lakes have excellent pH values. The alkalinity in Fawn Lake and North Lake is much higher than in Clear Lake, which indicates these lakes have a higher buffering capacity. The higher pH supports this in these two lakes compared to Clear Lake.

<u>Total Hardness/Calcium/Magnesium</u>: Total hardness measures minerals dissolved in the water, namely calcium and magnesium. Water with high hardness will leave a scale when the water evaporates away. Calcium is typically higher than magnesium in Wisconsin surface water. Calcium can influence the growth and population of various flora and fauna. Aquatic plants green algae require calcium. Calcium is also needed for mollusks to build their shells. This is important in determining the susceptibility of a lake to zebra mussels. If dissolved calcium concentration in the lake water is too low, the lake cannot sustain an adult population of zebra mussels. Literature suggests that with calcium concentration below 15-20 mg/L, the lake likely cannot support an adult zebra mussel population. Calcium values above 28 mg/L provide a favorable condition for adult mussel development. All five lakes in the Spider Chain fall at or below the 15-20 mg/L calcium concentration, indicating that all lakes have a low susceptibility to zebra mussel growth regarding calcium. North Lake may fall just into the moderate designation. There are exceptions. Some lakes with lower calcium concentrations have zebra mussels, so caution should still be exercised to prevent zebra mussel introduction into the Spider Chain. The total hardness concentrations fall within the low to moderate zebra mussel susceptibility. All lakes would be considered “soft water lakes” since the hardness concentration is below 60 mg/L (or just over).

The higher calcium and hardness values in Fawn Lake, North Lake, Big Spider Lake, and Little Spider Lake may indicate higher groundwater inputs than those of Clear Lake.

Magnesium is required for chlorophyll production in plants. Typically, surface waters contain much more magnesium than the organisms need, making fluctuations in concentration small. Low available magnesium has been implicated as a potential factor in highly oligotrophic lakes in Alaska but is not known to have been documented in Wisconsin.

References:

Mackie, G.L. and R. Claudi. 2010. *Monitoring and control of macrofouling mollusks in fresh water systems*. CRC Press, Boca Raton, FL.

Sorba, E.A., and D.A. Williamson. 1997. *Zebra Mussel colonization potential in Manitoba, Canada*. Water Quality Management Section, Manitoba Environment Report No. 97-07

Shaw, Byron, Christine Mechenich and Lowell Klessig. 2004. *Understanding Lake Data*. The University of Wisconsin Extension. Madison, Wisconsin.

Wetzel, Robert G. 2001. *Limnology: Lake and River Ecosystems*. Academic Press. San Diego California.