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WHITE WATER ASSOCIATES, INC.

LAKE JULIA STEWARDSHIP PROJECT - PHASE 3

UNDERSTANDING THE AQUATIC FOOD WEB IN THE LAKE JULIA ECOSYSTEM: A STUDY OF AQUATIC INVERTEBRATES AND SMALL FISHES

Submitted to:

Lake Julia Lake Association
Attention: Harry Helwig, President
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Bluntnose Minnow (Lake Julia 2004)

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SECTION I. INTRODUCTION

The partnership composed of the Lake Julia Association, Nicolet Area Technical College, and White Water Associates, Inc. has completed its third year of a multi-faceted study designed to assess and perpetuate the overall ecological health of Lake Julia. This ongoing study is funded by Lake Planning Grants from the Wisconsin Department of Natural Resources.

In Phase 1 (2002), White Water Associates' ecologists assisted by science students from Nicolet Area Technical College, conducted functional assessments of twenty wetlands within the Lake Julia watershed. Phase 1 studies focused on functional assessments of wetlands surrounding Lake Julia. In general, the wetlands in the immediate vicinity of the lake were found to be in good condition. The shoreline wetlands undoubtedly contribute greatly to the health and pristine nature of Lake Julia.

In Phase 2 (2003) the focus of the study shifted to those aquatic plants visible to the naked eye (so-called "aquatic macrophytes"). White Water Associates' ecologists conducted surveys of dominant aquatic macrophytes in Lake Julia. The Phase 2 field effort included assistance in plant collection, identification, and specimen preparation by a high school biology teacher and Master's Degree candidate at Michigan Technological University, Jennifer Toivonen. Data were incorporated into the ongoing GIS project by Kent Premo, M.S. of White Water Associates, Inc. Ms. Toivonen prepared specimens of selected plants for use in the Nicolet Area Technical College Herbarium.

Phase 3 of the Lake Julia Stewardship Project was conducted in 2004. The Phase 3 focus was to gain a better understanding of important components of the aquatic food web in the Lake Julia Ecosystem: macroinvertebrate organisms and small fishes (minnows and young game fishes). Phase 3 has built on the earlier phases of the project. In fact, the aquatic plant community (characterized in Phase 2) is a crucial habitat component that provides food and structural habitat and sustains invertebrates and small fishes. In turn, these organisms are food for larger game fishes and lake-associated animals such as belted kingfisher, common loon, osprey, bald eagle, river otter, and many more. Humans, of course, benefit directly through

game fishing and the aesthetic enjoyment of the wildlife supported by a healthy northern lake ecosystem.

This report is divided into six sections: Section I, the Introduction (this section); Section II, Background; Section III, Description of Project Area; Section IV Survey Methods; Section V, Findings; Section VI, Summary and Recommendations.

SECTION II. BACKGROUND

Most people that enjoy lakes for their recreational and aesthetic attributes rarely consider the small animals that live in the lake. The aquatic invertebrate animals can comprise a very diverse community and include insects and their larval forms, crayfish, leeches, snails and clams, flatworms, freshwater sponges, freshwater jellyfish, hydras, bryozoans, and many others. Likewise, the small fishes in the lake are under-appreciated as to their roles in the aquatic ecosystem. These small fishes can include species of darters, minnows, dace, shiners, chubs, stickleback, and the young of gamefish and panfish. The casual observer, even many fishermen, lump all of these into the category of "minnows" or "baitfish" and rarely seek to identify them as individual species. Together, the small fishes and the aquatic invertebrates in a lake form an interesting, beautiful, and important community of animals. They are crucial to the lake ecosystem by consuming microbes, algae, and aquatic macrophytes thus processing the energy, nutrients, and carbon contained in these organisms. Small fishes and invertebrates also consume each other and are, in turn, eaten by larger fishes, frogs, turtles, birds, and mammals. They are truly integral parts of the aquatic foodweb.

In some lakes, the aquatic invertebrate and small fish community is undergoing a reduction in diversity and abundance. There are possibly several interrelated causes for these declines, but deterioration of the near shore habitat (the so-called "littoral zone") is more and more being identified as a main factor. A recent article in *Wisconsin Natural Resources Magazine* (February 2005, pages 23 –28) refers to the small fishes in the littoral zone as "Shoreside Sentinels" and documents scientific observations that show declines in the diversity and abundance of these fishes in Wisconsin lakes whose shorelines are experiencing development such as docks and piers, rip-rap, manicured lawns, and seawalls. These changes will bring dramatic and unfortunate consequences to aquatic ecosystems.

Aquatic invertebrates and small fishes are also highly susceptible to "biological pollution." Non-native (also called "alien" or "exotic") species of plants and animals, transported on boats and trailers or dumped from minnow buckets and home aquariums, may come to dominate a water body to the exclusion of a healthy diversity of native species. Plants

like Eurasian milfoil (*Myriophyllum spicatum*) can dominate a lake and at the same time do not harbor the same habitat and food values to the native aquatic animal community. Fortunately, we have not found Eurasian milfoil in Lake Julia. Non-native animals such as zebra mussels and some exotic species of snails can also run rampant in an aquatic ecosystem to the detriment of native species. As will be reported later, one non-native species of snail has become established in Lake Julia. Spiny waterfleas have invaded some northern Wisconsin lakes. Another non-native invertebrate that has caused problems in northern lakes is the rusty crayfish. The fish community too has its alien invaders. Recent news has highlighted notable finds of the Asian snakehead fish (*Channa argus*) in the eastern U.S. and round gobies (*Neogobius melanostomus*) are found now in all of the Great Lakes. There is much to be vigilant for when it comes to perpetuating a high quality ecosystem such as Lake Julia.

SECTION III. DESCRIPTION OF PROJECT AREA

Lake Julia is a 238-acre lake lying immediately south of Rhinelander, Wisconsin. Lake Julia is classified as a stratified seepage lake in the WDNR "self-help lake monitoring" program. With the presence of a small stream on the north end accounting for some outflow, it may be more accurate to classify it as a groundwater drainage lake (fed primarily by groundwater and precipitation with some contribution of runoff, and a stream accounting for most outflow). Another drainage area on the northwest end (termed Wetland 16 in the Phase 1 report) may also account for outflow from the lake, either connected through groundwater movement or a branch of the main outflow. The trophic state index (TSI) is currently determined to be mesotrophic. Mesotrophic lakes are characterized by moderately clear water, with some chance of low dissolved oxygen in the winter. The majority of the bottom substrate is composed of sand, gravel, and/or cobble. The south end of the lake also incorporates some peaty substrate.

Lake Julia has experienced relatively little development, especially for a lake in an urban setting. For this reason, it remains a high quality water resource and a lake of extraordinary aesthetic quality.

During the Phase 2 (2003) aquatic plant survey, 41 species of vascular plants and 2 species of macrophytic (visible to the naked eye) algae were catalogued. Lake Julia has an interesting and diverse aquatic plant community that includes many showy and aesthetically pleasing species. The aquatic macrophytes in Lake Julia form excellent structural and feeding habitat for invertebrates and fishes. The Phase 2 report contains a thorough treatment of the aquatic plant community of Lake Julia.

In the two previous years of the Lake Julia Stewardship Project we evaluated the wetlands surrounding Lake Julia (Phase 1) and then assessed the diversity of species and coverage of aquatic and emergent vegetation in the lake (Phase 2). The logical next step seemed to be an investigation of the food base of invertebrates and small fishes.

SECTION IV. SURVEY METHODS

One of our first steps in the project was to interview fisheries biologists and lake specialists in the region. We first talked to Bob Young (WDNR Fisheries Biologist) about the ecology of small, littoral zone fishes in northern lakes. He told us, that in his experience, lakes have far fewer non-game fish species then streams. Usually only three or four species of non-game fish comprise the total species number in an average lake. John Kubisiak (WDNR Fisheries Biologist in Rhinelander) reiterated this observation. Kubisiak further observed that that the food base for larger fish (referred to as "bait fish") is more often then not small, young bluegills, perch, walleye, bass, musky or other game fish that are present. Huge numbers of eggs and young are produced but only a small fraction of those reach adult size.

We considered three fundamental ways to capture small fish: (1) a seine with two people using the ends to trap the fish against the shore or close by drawing the ends toward each other, (2) baited "minnow" traps, or 3) mini-fyke nets that direct moving fish toward a funneled opening and into a mesh trap. Minnow traps are not particularly effective and need to be checked every day during their deployment. Fyke nets are expensive and also need close attention over a period of time (more time than is allowed by the Planning Grant budget). We decided that using the seine method would allow us to adequately cover most of the relatively shallow areas of Lake Julia in the most efficient way possible. The seine that we used was three feet wide by twelve feet long and had one-quarter inch mesh.

For sampling invertebrates we used a hand-held, very small diameter mesh net with a strong, D-shaped metal rim for scraping the bottom and moving through dense vegetation. The contents of sweeps in a given substrate were emptied into white trays with water for sorting and identification of aquatic organisms.

We spent two long days for field sampling. On July 27 and 28, 2004, we covered fifteen sample sites on Lake Julia (see Exhibit 1) and one (the boat landing) was covered on two days. Using the seine proved difficult in some parts of the lake because thick or coarse vegetation or water depth that was to great. In areas at the south end of the lake there was large woody material to contend with and a soft peaty bottom that provided some challenges to use of the

seine. In all the shallow water of Lake Julia we saw minnows that we were unable to seine. In several instances we were able to use the invertebrate net to scoop up a tiny fishes for identification.

Invertebrates were collected in shallow water habitats throughout Lake Julia. Sampled substrates included organic detritus, gravel, rock, and a variety of aquatic vegetation. For the most part, invertebrates were identified in the field.

In all, fifteen sites around Lake Julia were sampled for aquatic invertebrates and small fishes. These fifteen sampling sites were marked with a GPS unit for later mapping purposes.

SECTION V. FINDINGS

We found three species of minnow, they were: bluntnose minnow, golden shiner, and mimic shiner (see Exhibit 1). The minnow populations were far out numbered by the most abundant baitfish in the lake, the bluegill, which we found in all shallow water habitats.

We did not find large numbers or a wide variety of species of invertebrates (see Box 1. and Exhibit 2). We assume these would be comparable to other lakes in the area with a similar chemical make up. Lake Julia apparently has sufficient calcium carbonate to support shell-building animals snails and mussels) and crayfish.

Box 1. List of Invertebrate Organisms Observed in Lake Julia.

amphipods	dragonflies	freshwater sponges
aquatic worm	fingernail clam	threadworm
mussels	isopod	predaceous diving beetle
bloodworm	mayflies (two species)	water boatman
caddisfly	microcrustacea	water mite
Chinese mystery snail	midge larvae	water scorpion
crayfish	mosquito larvae	water strider
damselfly	Dugesia spp. (Planerian)	whirligig beetles
Daphnia spp.	Planorbid snail	Chinese mystery snail

The one invertebrate we were surprised by was a large snail that most lake residents would find familiar. At 1-2 inches and olive brown, this snail is found in many places and often in piles. The piles are presumed to be middens of some animal that is eating these snails (unless there is another reason for piles of empty shells). We would guess that it would be raccoon or otter. The book we used to identify the snail only went to family and it was termed a viviparid.

Coincidently, on another project for the Gile Flowage in Iron County, we spoke to Craig Roesler, a WDNR biologist (Hayward) whose job it is to monitor exotic/invasive species. He mentioned that a large olive brown snail called the *Chinese Mystery Snail* had been found in the Gile Flowage and some other northern lakes in Wisconsin and that so far no problems had been observed. Our tentative identification from internet sources indicated that the large brown snail in Lake Julia is the Chinese Mystery Snail (*Cipangopaludina chinensis* or in some literature *Viviparus malleatus*). Specimens sent to a malacologist confirmed this species identification.

The Chinese Mystery Snail has been discovered in states from New York to Washington to the Gulf states. The probable introduction vehicle is likely to be aquarium owners who sometimes use snails to help keep their aquariums clean. When deciding to dispose of their aquarium it is simply dumped in the lake.

Exhibit 1. Invertebrate and Fish Sampling Sites in Lake Julia.

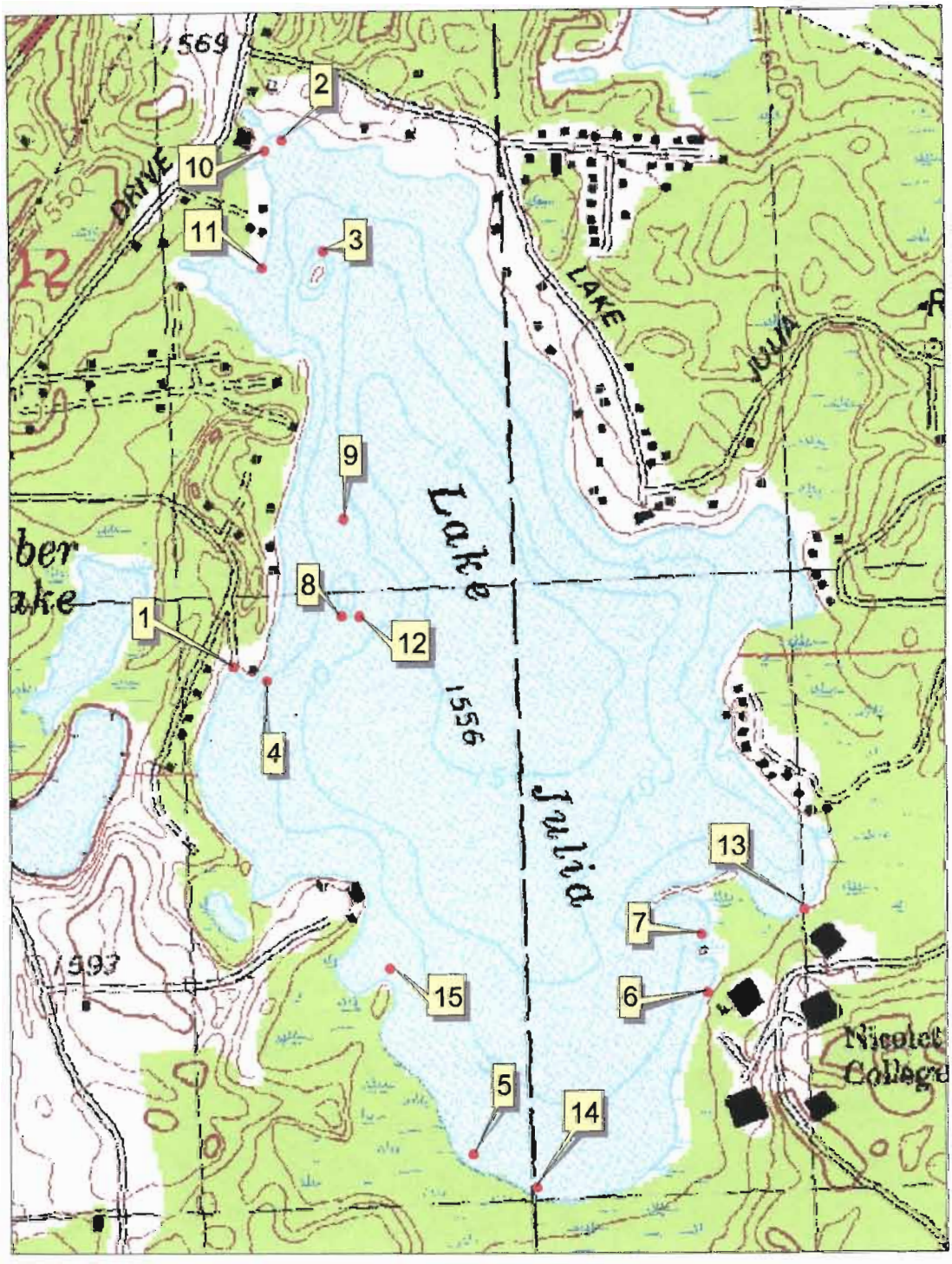

Exhibit 2. Sampling Results for Aquatic Invertebrates and Small Fishes in Lake Julia in July 2004 (sampling sites are shown in Exhibit 1)...page 1 of 2					
Site	Date	Location	Invertebrates	Fish	Notes
1	7/27	N45.61449 W89.43569 Public Boat Landing	Amphipods, water beetle, dragonflies, isopods, water mite, aquatic worm, damselfly, micro-crustacea	41 bluegills, 12 mimic shiners	Invertebrates were not abundant. The gravel and sand bottom was also sampled but found nothing. The inverts were in the vegetation with organic debris.
2	7/27	N45.62215 W89.43457 North end by houses	Planeria spp., mayfly (two species), isopods, amphipods, dragonfly, water mite, caddisfly, water scorpion, worm, microcrustacea, mosquito larvae	2 golden shiners (caught in the invert net)	Unable to sample fish with seine at this site. We saw a great many small bluegills, several largemouth bass, and many tiny shiners. Substrate was some sand, silt, cobble size rock, and lots of organic material.
3	7/27	N45.62050 W89.43374 Island – north end	Mayfly (two species), Chinese mystery snails	Largemouth bass, Rock bass. Many mimic shiners	We snorkeled in this section. Underwater logs provided good habitat structure
4	7/27	N45.61428 W89.43500 Closed Resort	None sampled	Caught six bluegills. Observed many small bluegills	Seined the shoreline. Substrate of cobble, gravel, and sand. Drops off quickly.
5	7/27	N45.60733 W89.43079 South end.	Whirligig beetles	Bluegills were observed.	Very soft bottom with many stumps made it difficult to seine.
6	7/27	N45.60959 W89.42586 Nicolet College	Amphipods, water mites, water strider, whirligig beetles, isopod, mayfly, worm, crayfish	Observed largemouth bass, bluegill, & shiners (species unidentified).	Tried the seine but caught nothing. Bottom was large cobble/boulder, with sand and gravel. Lots of algae.
7	7/27	N45.61044 W89.42597 Second College bay	Damselfly, water strider, water beetle, Planorbid snail, Chinese mystery snail, amphipods, water mite		Invertebrates were netted from boat. Substrate was big cobbles and lots of organic material. The Chinese Mystery snails were abundant.

Exhibit 2. Sampling Results for Aquatic Invertebrates and Small Fishes in Lake Julia in July 2004 (sampling sites are shown in Exhibit 1)...page 2 of 2					
8	7/27	N45.61521 W89.43344 Little Island	Chinese Mystery snail, amphipods, water strider	Rock bass	
1	7/28	N45.61449 W89.43569 Public Boat landing	None sampled	17 bluegills, 9 bluntnose minnows. 1 musky (about 2 inches long)	We sampled this site on 7/27 and 7/28
9	7/28	N45.61657 W89.43339 Shoal	Amphipods, isopod, pea clam, sponges, fingernail clam, Daphnia spp., Planorbid snail, lots of micro-crustacean	Saw no fish	Substrate was sand and cobble. We observed 1 bald eagle 2 juvenile merlin
10	7/28	N45.62200 W89.43494 Bar Bay	Mayfly, thread worm, micro-daphnia, fingernail clam, isopod, water mite	Observed some very tiny minnows	Lush floating and submersed vegetation (including Vasey's Pondweed)
11	7/28	N45.62027 W89.43503 Shoal at end of Helweg Bay	Chinese mystery snail, damselfly, dragonfly, water scorpion, mayfly, water mite, water strider		Substrate of sand, gravel, and cobble
12	7/28	N45.61520 W89.43307 Island Shoal	Chinese mystery snail, water boatman, isopod, amphipods, dragonfly, microcrustaceans	Captured small largemouth bass	Substrate of sand, gravel, and cobble
13	7/28	N45.61078 W89.42382 Nicolet dock	Water strider, Chinese mystery snail, amphipod, water mite, mosquito larvae, blood worm, isopod, water scorpion	Many young bluegill. Also bluntnose minnow	
14	7/28	N45.60683 W89.42947 South end	Amphipods (numerous), midge larvae, water mite, Chinese mystery snail, mosquito larvae	Observed bluegills and unidentified minnows	Substrate is chunks and ledges of old peat
15	7/28	N45.60998 W89.43249 Wallace Bay		Bluegills	

SECTION VI. SUMMARY AND RECOMMENDATIONS

Lake Julia has a typical assemblage of invertebrates and small fish species and they seem to be present in healthy population sizes. This is due in part to the good diversity of habitat types found in the Lake Julia ecosystem (see photograph appendix for illustrations of habitat types). It is also due to the fact that despite its urban setting, Lake Julia has a large component of its shoreline in either an undeveloped or a minimally developed state. Thus Lake Julia continue to provide adequate littoral zone habitat of high quality.

Shoreline development has been one of the largest impacts on Wisconsin lakes. Piers, seawalls, rip-rap, and sandy beaches can not replace natural gravel, stone, cobble, and large woody material when it comes to aquatic habitat. Mechanical harvesting of "weeds" or chemical treatment may at times be management tools of choice but these techniques also remove habitat from the aquatic ecosystem.

Recent work by the WDNR has documented a decline of minnow species in lakes that formerly were more species rich. The surprise is that the decline has happened in spite of good water quality. At least some of this decline is linked to shoreline development (piers, rip-rap, sandy peaches, etc.). This decline in minnow species may signal larger problems for the ecosystem, but is a concern in-and-of-itself as these diminutive fishes are part of the natural heritage in Wisconsin.

Our Phase 2 work showed that Lake Julia has a healthy and diverse community of native aquatic plants. Our work this year in Phase 3 demonstrates the diversity of habitat and small fishes in the littoral zone. It should be a goal of the Lake Julia Lake Association to perpetuate this condition into the future. One of the tools that can be applied to fulfill this goal is education. Existing landowners on Lake Julia should be made aware of the rich littoral zone community in and the possible impacts of shoreline development on the constituents of that community.

A second goal should be to continue to monitor Lake Julia's population of the alien invader Chinese Mystery Snail and to keep watch for other non-native mollusk species. These creatures have the potential to quickly multiply in number, even reaching nuisance population levels. Keeping aliens species from becoming established in Lake Julia also relies on education

of various lake users. Accidental introduction of non-native species (such as the emptying of an aquarium into the lake, the transport of life stages on boats or trailers, or the use of non-native minnow species for fish bait) are the cause of a nuisance population becoming established.

As we pointed out in our Phase 2 report, keeping the lake healthy isn't just a matter of taking care of the lake itself. The riparian edge functions to protect and "feed" the littoral zone habitat of the lake. To keep Lake Julia's high quality attributes, lakeside development should strive to keep an intact riparian edge, vegetated with native vegetation. Even a strip of wet meadow plants (sedges, milkweed, rushes, etc.) only a few feet wide does much to protect the lake from fertilizer runoff and preserves habitat connectivity for species such as frogs and turtles. Trees that die and fall over into the water should not be viewed as debris to be cleaned up, but as structural habitat that is crucial to the animals in the lake.

Over the past three years White Water Associates scientists, with help from students and teachers, and Lake Julia residents, have studied Lake Julia. We first looked at wetlands that protect and contribute to Lake Julia's water quality. We next examined the aquatic plant community of Lake Julia. Finally, we investigated the littoral zone invertebrates and small fishes. Results from these three rather disparate topics all speak to the high quality of this urban lake...truly a gem to be protected.