Black Oak Lake Watershed Protection Program

Phase I – Information Inventory and Adaptive Lake Management Plan

Submitted to:

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White Water Associates, Inc. scientists Dean and Kent Premo have thoroughly enjoyed working on Phase I and appreciate the opportunity to have learned something about Black Oak Lake in the process.

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Contents

APPENDICES

Chapter 1

What Is the Black Oak Lake Watershed Protection Program?

The Black Oak Lake Watershed Protection Program is viewed as an ongoing endeavor composed of annual phases that progress toward the overall vision. In Phase I, participants learned about the lake and the landscape. Success of future phases depends on a coalition of participants, each carrying out appropriate tasks and communicating needs and findings to other team members. It is strategic that the Black Oak Lake Riparian Owners Association (BOLROA) is the lead organization in this long-range effort.

This document represents the Phase I product of Black Oak Lake Watershed Protection Program with funding from a Wisconsin Department of Natural Resources (WDNR) Lake Planning Grant awarded to BOLROA. White Water Associates, Inc. (White Water), an independent environmental laboratory and ecological consulting firm, was contracted by BOLROA to carry out significant aspects of the Phase I project. Phase I focused on an inventory of relevant information on Black Oak Lake and its surroundings and produced the first iteration of an Adaptive Lake Management Plan. The vision of the Black Oak Lake Watershed Protection Program is to ensure the perpetuation of a healthy Black Oak Lake and its surrounding landscape ecosystem far into the future. Participants in Phase I believe that the tool by which to realize this vision is a protection-oriented[1] adaptive management plan for the Black Oak Lake and its watershed.

Phase I also resulted in two additional significant products: (1) the Black Oak Lake Geographical Information System (GIS) project – a geographic database available to future phases to organize and analyze data about the lake and watershed; and (2) the initial version of the Black Oak Lake Adaptive Management Plan.

[1] A protection-oriented plan (*sensu* the Vilas County, Wisconsin Lake Resource Guide) addresses a lake in good condition.

Project participants have embraced the concept of "adaptive management" in their approach to the Black Oak Lake Watershed Protection Program. Simply stated, adaptive management uses findings from planned monitoring activities to inform future management actions and periodic refinement of the plan. An adaptive management plan accommodates new findings by integrating this information into successive iterations of the comprehensive plan. The plan will therefore be a dynamic entity, successively evolving and improving to fit the needs of the Black Oak Lake watershed. A central premise of adaptive management is that scientific knowledge about natural ecosystems is uncertain and therefore a practical management plan allows for ongoing adjustments in management designed to "adapt" to changing conditions and new information or understanding. Monitoring the outcomes of plan implementation is essential to the process of adaptive management. It is the goal of the Black Oak Lake plan that future monitoring will focus on tangible indicators designed to measure progress toward specific program goals.

Besides this introductory chapter, this plan is organized in seven additional chapters. Chapter 2 describes the audience for the Black Oak Lake Adaptive Management Plan. Chapter 3 addresses why there should be a plan and discusses adaptive management and the underlying assumptions of the approach. Chapter 4 details how the plan was created, including the methodology used in all aspects of Phase 1. Chapter 5 presents the findings from efforts to gather existing information about Black Oak Lake and its environs by providing summaries of information in nine subsections. Chapter 6 (*What Goals Guide the Plan?*) presents the desired future condition and goals established by the Black Oak Lake Riparian Owners Association and the plan writers. Chapter 7 (*What Objectives and Actions Move Us Toward the Goals?*) offers a logical menu of practical management actions ready to be adopted and adapted by those interested in taking an active role in caring for Black Oak Lake and its surroundings.

Chapter

2

Who Is the Audience for the Black Oak Lake Adaptive Management Plan?

The title of Chapter 3 poses the question: "Why have a Black Oak Lake Adaptive Management Plan?" The short answer is *"Because we care!"* We believe that people working together in the stewardship of this lake can make a difference. We can protect and restore a healthy ecosystem if we take a long-term, strategic approach. That approach is presented in this adaptive plan. It is an *adaptive* plan in the sense that it will grow and evolve. Implemented actions will be monitored. The plan will be evaluated. It will be reviewed and refined as years go by – as new generations take up their stewardship responsibility.

People who care about the Black Oak Lake Watershed are the audience for this plan. You will be the implementors and evaluators. You will be the reviewers and future plan writers. Many of them live in or near the watershed. These are the "grassroots" – the constituency most connected to Black Oak Lake and its surroundings. *People who care* are also those who live beyond the watershed boundaries. This part of the audience includes foundations and other funding agencies, resource and regulatory agencies concerned with environmental quality, and other citizens that are working on their watersheds.

For those in the "grassroots" camp, this plan is intended to provide you with a practical approach to carrying out protection and restoration of Black Oak Lake. The plan does not have all the answers (it doesn't even have all the questions). It does not recommend every conceivable rehabilitation or protection action. But the plan does provide plenty to get started and it leaves room for ideas and contributions from others. Our recipe mixes a pinch of the theoretical with a cupful of the practical. Those of you who are "hands-on" have plenty to do.

The mixed audience of this plan challenges the authors to present a plan that is scientifically grounded and technically oriented, but at the same time accessible and understandable by the public who will in large part be responsible for its implementation. Although scientists are the primary authors of the plan, the writing is aimed at the public.

We define terms where clarity is needed and cite other literature for those interested in the source of a statement, or in learning more about the topic. BOLROA has interacted with the plan writers throughout the process and reviewed a draft of the plan. BOLROA has encouraged our practical approach so that applications of the plan are conspicuous.

We will end this chapter with our strongest management recommendation:

Approach watershed management with a large degree of humility.

Lake and watershed ecosystems are enormously complex. Our understanding of how they work is not complete. Our ability to predict outcomes from specific actions is uncertain. New discoveries are made every day that have important implications for future watershed management. We may never know all we need, but that fact can't stop us from starting work on Black Oak Lake today. The fact that ecosystems are inherently resilient is to our great advantage. They are able to rebound from disturbance and repair themselves from injury. In fact, some of today's best watershed managers state that "...successful restoration usually has less to do with skillful manipulation of ecosystems than it does with staying out of nature's way" (Williams et al 1997). This plan is intended to complement nature's own processes.

Chapter

3

Why Have a Black Oak Lake Adaptive Management Plan?

Why have a Black Oak Lake Adaptive Management Plan? The gut-level answer ("*because we care*") was offered in Chapter 2, but the question deserves more thoughtful reflection – the focus of this chapter. This requires consideration of environment, economy, history, and culture. This chapter also defines some important terms and presents the process and underlying assumptions.

Part 1 — Why Should We Care?

The health of a watershed and the health of local economies like those that exist in the Black Oak Lake Watershed are highly integrated. A sustainable economy depends on a healthy environment. In fact all social and economic benefits are based on the biological and physical properties of watersheds (Williams *et al.* 1997). Our economy should be viewed as being nested inside our environment (Lanoo 1996).

This link between a healthy environment and the economy is true at several scales. For example, most property owners on Black Oak Lake have invested in an ecosystem. The reasons that they have purchased the property are typically linked to the quality of the environment. The economic value of their investment is linked to the health of lake and surroundings. If the ecological health declines, so does the value of the property in dollars.

At a slightly larger scale, this same principal linking the environment and economy applies to municipalities. The Land O'Lakes community is caretaker of many ecosystems including Black Oak Lake. The long-term economic health of the municipality is tied to the health of Black Oak Lake and other lakes and streams in the area. At even larger scales yet, this applies to Vilas County, to the State of Wisconsin, and so on.

The Black Oak Lake Riparian Owners Association and this plan aspire to cultivate a deep connection to the lake and its surroundings. It is the people of the watershed that will make the management plan work. Lake and watershed stewardship must be a cultural imperative. In some ways, watershed restoration is about cultural restoration – rejuvenating citizens' civic responsibility to care for the environment in which they live. This is what Aldo Leopold referred to as "...the oldest task in human history: to live on a piece of land without spoiling it."

People need to feel vital by working to improve, beautify, or build. Sometimes that need is expressed by gardening, caring for a lawn, or volunteering on civic projects. BOLROA and this plan endeavors to harness that energy and apply it to restoration and protection actions focused on Black Oak Lake and its landscape. Education, rehabilitation, and protection become outlets for this creative energy.

Why should you care about creating and implementing a practical watershed plan? Because we realize the economy and the economic options available to citizens in the watershed are tied to a healthy environment. Because we are all connected to the Black Oak Lake landscape in some way… because we feel a civic responsibility to care for the lake… because we can feel vital by doing meaningful work on the watershed.

The adaptive management plan will be successful if it allows and organizes meaningful stewardship work for Black Oak Lake. It needs to make provision for different kinds of approaches and different kinds of people who want to be part of the process. It has to be strategic and integrated so that various actions complement one another, and are consistent with the lake's natural processes. The plan should discourage management actions that work at cross-purposes or whose outcomes are undesirable.

Part 2 — What Is an Adaptive Management Plan?

An adaptive management process (Walters, 1986) is the most appropriate model to use in lake and watershed management. In adaptive management, a plan is made and implemented based on best available information and well-defined goals and objectives. Outcomes of management actions are monitored to ascertain whether they are effective in meeting stated goals and objectives. Based on this evaluation the plan is adapted (modified) in a process of continuous learning and refining.

Adaptive management concedes and confronts a truth that most resource managers are reluctant to acknowledge – uncertainty. Because natural systems are so diverse, so complex, and so variable, almost all management actions will have uncertain outcomes. An adaptive management approach essentially takes a position that says, "We will make our best attempt and get better as we go along. We'll listen to what the natural system tells us." In adaptive management monitoring is crucial. Adaptive management uses information from monitoring to continually evaluate and refine management practices. Monitoring measures the success of restoration or management. Well-designed monitoring should indicate how effectively management measures are working and give us new insights into ecosystem structure and function. Monitoring should provide needed information to adapt management goals.

The Black Oak Lake Adaptive Management Plan can be implemented through four kinds of management actions: rehabilitation, education, protection, and research. These four work in concert to achieve watershed restoration. Monitoring actions serve all four of these overall management actions. Each is summarized in the following bullets.

- Rehabilitation actions are those that manipulate site-specific elements of ecosystems. Examples include planting lakeside natural vegetation, placing a fish structure, and healing an area of active erosion. Rehabilitation actions are local. Individual rehabilitation projects contribute to overall lake and watershed restoration.

- Education actions are all of those activities that serve to promote lake and watershed stewardship and educate people about the natural ecosystems. These actions can be very local (e.g., a field trip with a class of 6th graders) or watershed-wide (such as BOLROA newsletter). Education actions can extend beyond the borders of the watershed as well such as presentations at the Wisconsin Association of Lakes annual conventions. In fact, education actions are potentially global in scope via the world-wide-web.

- Protection actions are used when high quality areas or elements are identified and need to be safeguarded. Much of Black Oak Lake adaptive management will fall under this kind of action. There are numerous forms that protection actions can take including protecting water quality, maintaining the native lake trout population, conservation easements, zoning, buffer zones as part of voluntary best management practices (BMPs), restrictive deeds, and prescribed green-space in new developments.

- Research actions are important to learn about the system being managed. So often we know very little about the plants, animals, habitats, and ecosystems that our management actions are affecting. Black Oak Lake and its landscape are great candidates for research actions.

One word of caution is warranted. Our society typically thinks a long term planning horizon is twelve months. Unfortunately, this is out of synchrony with the way an ecosystem functions. An ecological clock ticks off time in years, decades, centuries, and even millennia. Restoration must be viewed from this perspective. In fact the final outcomes of some of the good work put in place today might not be apparent until a new generation of lake stewards is on the scene.

Part 3 — What Are the Plan's Underlying Assumptions?

As an adaptive plan, a basic assumption is that the management actions will change over time under the influence of many stakeholders. Through iterative refinement, the plan will more closely reflect the needs of the lake and the people who care about it. This plan has assumed a desired condition of sustainable lake health. The plan attempts to reflect the collective vision of the people and organizations that are concemed with the lake and the surroundings. BOLROA, Conserve School, Vilas County Land and Water Conservation Department, the Wisconsin Department of Natural Resources, and the community of Land O'Lakes are among these stakeholders.

In 2001, the Vilas County Land and Water Conservation Department published the "Vilas County Lake Resource Guide" to assist Vilas County lake organizations in the development of lake management plans. The Black Oak Lake plan principally follows what the Vilas County guide designates as a "protection-oriented plan."

At a larger geographic scale the WDNR published the Headwaters Basin Integrated Management Plan (2002) that provides a snapshot of current conditions of land and water resources in the larger drainage basin that includes Black Oak Lake. This publication outlines nineteen issues of concern to the basin, including control of exotic species, shoreline development, resource inventory and monitoring, habitat loss, user conflicts, and protection of endangered, special concern, or unique species. Black Oak Lake is listed as an "outstanding resource waters" by that publication. This document also outlines the various offices and their authorities over the resources in the region.

The integrating feature of this lake management plan is Black Oak Lake and its surrounding environment. The adaptive management plan assumes that proper planning in the beginning of the process will save time and money throughout the life of the program and that this can be accomplished by managing the causes rather than (or at least, in addition to) managing the symptoms of any impairments (Stream Corridor Restoration — Principles, Processes, and Practices).

Chapter

4

How Was the Plan Made?

A team of consulting scientists (White Water) working with BOLROA, prepared this plan. The process began with meetings between White Water scientists, BOLROA, and representatives from Conserve School for the purpose of sharing ideas about the planning process and elements of the plan. Information gathering was conducted by each of these parties. Meetings, phone conversations, and email correspondence were used to evaluate the kind of information gathered and to discuss status of the information gathering process. A draft of this document was submitted to BOLROA for review and comment.

Existing information was the basis for the current planning activity. As lake management proceeds, additional baseline information will be required for specific subjects and areas of interest. Collection of such information is part of the ongoing management process and can be incorporated into future versions of this adaptive plan. Existing information is found in many repositories and forms: anecdotal accounts of residents, resource agency reports and memos, municipal planning and zoning documents, scientific reports, old and new photographs, best guesses of knowledgeable people, and government land office records. Not all of the existing information is of equivalent value in the planning process. Some is not verifiable or the methods by which it was collected are unknown. We discovered only one scientific peer-reviewed paper regarding Black Oak Lake (that one addresses the population of genetically unique lake trout). As management is ongoing it will be necessary to gather new information about specific areas in order to devise and implement new management actions.

The methods that we used in Phase I followed closely the goals, objectives, and tasks that were described in the Planning Grant Proposal submitted to the WDNR. The Phase I goals (as stated in the Lake Planning Grant proposal) were to (1) inventory relevant information on Black Oak Lake and its watershed and (2) prepare an initial version of an adaptive lake management plan. Early on in the project, nine objectives and associated tasks were established that guided the Phase I activities toward achievement of the project goals. In this Chapter we describe these objectives and tasks. The task descriptions reflect the methodology used by project participants (White Water, BOLROA, and Conserve School). This section also indicates the primary responsibility among project participants for specific tasks.

The first objective was to develop a strategy to perpetuate the quality of Black Oak Lake and its watershed ecosystem. Four tasks supported this objective: (a) articulate a general strategy in the form of a Lake Planning Grant proposal; (b) meet with project partners at beginning of program to identify and prioritize initial lake management needs and establish long-term goals; (c) meet with project partners at outset of Phase I project to develop agreed upon strategy and specific approach to Phase I; and (d) assign specific tasks to project partners. These tasks were accomplished by meetings held at Conserve School (with representation by White Water, BOLROA, and Conserve School) and at White Water Associates offices (with representation by White Water and BOLROA). The effort was primarily carried out by BOLROA and White Water.

The second objective was to gather, consolidate, assess, and manage information about fish and aquatic life and habitats of Black Oak Lake. Three tasks supported this objective: (a) collect and review historical information regarding the fishery resource in Black Oak Lake (especially information about the rare lake trout population); (b) collect and review existing information about other aquatic life in the lake (including invertebrates and plants); and (c) collect and review existing information about other aquatic habitats in Black Oak Lake. These tasks involved contacting various resource agency personnel in the WDNR and research scientists at the University of Wisconsin Trout Lake Research Station. It also included review work conducted by students at Conserve School and a survey for aquatic plants conducted by a consultant under contract with BOLROA. Information from these disparate sources represents a large variety of quality and application, and this must be considered when deciding how or if to use a specific data set in management of the Lake. Tasks under the second objective were primarily carried out by BOLROA and White Water.

The third objective was to gather, consolidate, assess, and manage information about Black Oak Lake water quality and potential risks to water quality. Two tasks were applied to achieving this objective: (a) collect and review existing limnological information about Black Oak Lake and (b) analyze and summarize existing Black Oak Lake water quality data. Water quality data for Black Oak Lake came from mainly non-professional sources lacking standardized collection protocol and instrument calibration. Nevertheless, these data provide insight into lake water quality and are a useful starting point for adaptive lake management. Tasks under the second objective were primarily carried out by BOLROA and White Water. Conserve School provided some water quality data collected as student projects on Black Oak Lake.

The fourth objective was to gather, consolidate, assess, and manage information about the Black Oak Lake Watershed, especially those attributes relevant to lake health. This ambitious objective involved five tasks: (a) visually characterize the Black Oak Lake watershed area; (b) map land cover/use and soils of the watershed; (c) depict slopes through topographic maps and digital elevation models to identify runoff patterns and environmentally "risky" areas in terms of contribution of non-point source (NPS) pollution to Black Oak Lake; (d) determine existing institutional programs that affect lake quality; (e) assemble relevant and appropriate information into a Geographical Information System (GIS) project for future management and analysis of data. Tasks a, b, and c involved using existing layers of geographic information available from the WDNR and other sources and manipulating these data within the GIS project. Task d required an inventory of the programs within the region that address lake quality. Finally, Task e involved the technical development of a GIS project that was customized for the Black Oak Lake Watershed and designed to accommodate future input of data and findings. The GIS project was developed following appropriate protocols for WDNR projects. Existing GIS data layers were assessed for their ease of access and compatibility with the GIS project. They were also assessed for their contribution to furthering project goals. For the Phase I GIS project, existing data layers available data sets from outside sources (e.g., U.S. Geological Survey, WDNR and Michigan Department of Natural Resources) were not amended, other than reducing them from statewide or countywide coverage to facilitate ease of portability and storage. Future project phases will involve the integration of existing layers with new data collected during the course of the program. White Water staff carried out all tasks under this objective.

The fifth objective was to prepare a history of the Black Oak Lake area and human community. This significant task included six tasks: (a) research geologic and glacial history of the area; (b) research original survey records and early homesteading of the watershed; (c) obtain a collection of historic photographs that document Black Oak Lake's history; (d) research the areas logging and early tourism history; (e) conduct interviews of lake residents; (f) inventory existing written information about the Black Oak Lake community; and (g) prepare a written history that documents and consolidates findings of tasks a-f. Paul McLeod (BOLROA member and local historian) was responsible for carrying out the tasks in this objective. Meticulous research and careful scrutiny was required to reduce an enormous amount of information into a succinct and valuable history of the Black Oak Lake area.

The sixth objective was to create an initial adaptive lake management plan for Black Oak Lake that aspires to high quality lake management of the lake and nearby environment. This rather complex task was guided by two basic tasks: (a) develop adaptive management recommendations for Black Oak Lake using information gathered in objectives 2, 3, and 4 (for example, recommendations include topics such as lake trout habitat, aquatic invertebrate diversity, special species habitat, protection of sensitive areas, and non-native species); and (b) prepare a practical written plan, grounded in science, that includes sections on implementation, monitoring, and adaptive management. The Phase I plan will lay the basis for its expansion in future phases and identify where more information is required. White Water scientists carried out tasks under this objective.

Because other organizations are involved with water resources planning and management in northern Wisconsin, a seventh objective was established to integrate recommendations from existing plans (for example, Headwaters Basin Integrated Management Plan and/or County Land and Water Resources Management Plan) into the Black Oak Lake Plan. Two tasks supported this effort: (a) review existing basin plan and County Land and Water Resources Management Plan and draw information and recommendations from these (as appropriate) for use in the Black Oak Lake plan; and (b) prepare a written section of the Black Oak Lake Plan that documents this review. Tasks under this objective were carried out by BOLROA and White Water.

The eighth objective had an education orientation, specifically to deliver an educational program that serves to increase support and capacity of BOLROA and Conserve School faculty and students and enhances local understanding of Black Oak Lake water quality and factors that affect lake health. Four tasks were outlined to progress toward this objective: (a) develop and deliver a seminar that reports the outcomes of the Phase I project for all project participants and other interested people; (b) provide technical assistance to Conserve School faculty and students; (c) provide written education material about the project and about water quality aspects of Black Oak Lake that can be used for press releases and as handouts at lake association gatherings and other meetings; and (d) develop a website that highlights ongoing aspects of the Black Oak Lake Watershed Protection Program and the Phase I project. Primary activity toward this objective involved Task b and included consultations provided by White Water scientists to Conserve School students and staff. This report and plan will provide materials that can be used to accomplish Tasks a, b, and d in Phase II of the program.

The ninth (and final) objective was to describe limnological, ecological, and sociological indicators that can be used in future monitoring efforts to gauge successful implementation and outcomes. As previously stated, monitoring is an essential aspect of adaptive management. For this objective, six tasks addressed indicators of various types: (a) describe specific water quality objectives (limnological indicators) in form of Trophic Status Index or similar indicators; (b) describe specific baseline index for aquatic invertebrate diversity (ecological indicator) in littoral zone habitats in the Black Oak Lake;

(c) describe specific indicator(s) against which to measure lake trout population stability (ecological indicator); (d) describe specific indictor(s) against which to measure biological pollution (that is, non-native deleterious plant or animal species) in Black Oak Lake (ecological indicators); (e) describe specific educational and lake association capacity goals (sociological indicators) that will mark progress in these aspects of plan implementation; and (f) describe specific recreational use and/or human development indicators that provide a basis for monitoring these aspects of the Black Oak Lake ecosystem (sociological indicators). Phase I involved the preliminary development of these indicators in the form of a list of candidate indicators that will be refined and developed further in future program phases. White Water scientists carried out tasks under this objective.

Chapter
5

What is the State of Black Oak Lake?

An understanding of the history, features, and conditions of the Black Oak Lake and its landscape is the starting point for developing strategies that seek to protect and restore the biological integrity of the area. In fact, restoration ecologists suggest that not understanding the workings of the ecosystem prior to trying to manage it would make most efforts ineffectual or even detrimental. We have focused our watershed analysis on existing information relating to the Black Oak Lake. We have sought out the kind of information that will be useful to devising and implementing an adaptive management plan for the lake. We have simply asked: "What is known about the lake and its surroundings?" The analysis has made us aware of what is not known as well. Important information gaps have been identified and the act of gathering new information is considered in Chapter 7 as actions to be taken during ongoing plan implementation.

This chapter is intended to teach us about Black Oak Lake. What is the lake like? What is the geology and soils? What is its land cover? What organisms live here? What is the human community? How healthy is the lake? How have humans contributed (or detracted) from that health? Do threats to watershed health exist? This chapter identifies and organizes this existing information.

If you are new to the area, this chapter will make you familiar with features and conditions that exist here and provide some insight as to why things are the way they are. If you are a life-long resident of the Black Oak Lake area, you may be familiar with parts of the discussion in this chapter. You may have things to contribute or correct. This would be a welcome response. Become engaged! Improve the understanding of the watershed by adding your knowledge in future iterations of the plan.

We present Chapter 5 in eight Parts, the first seven fall into descriptive categories: the lake; geologic, glacial, and human history; water quality; fisheries; aquatic plants; rare species; and exotic species. The eighth section summarizes the threats that impinge on Black Oak Lake and its watershed. The ninth section describes the Black Oak Lake Geographic Information System (GIS) project.

Part 1. Black Oak Lake and the Surrounding Area

The Black Oak Lake Watershed Protection Program views Black Oak Lake as part of a larger landscape ecosystem (referred to as the Black Oak Lake Watershed). The watershed affects the lake and the lake influences the watershed in a tightly connected ecological system. Although Phase I of the program focused on Black Oak Lake itself and the immediate riparian ecosystem, future phases will address other aspects of the watershed as part of an integrated and adaptive management system. To provide context for this report, this section describes Black Oak Lake and its surroundings.

Black Oak Lake is a 584-acre lake located near the town of Land O' Lakes (population 880) in northern Vilas County, Wisconsin (Vilas County boasts 1,300 lakes). Black Oak Lake is deep (>80 feet in places) and has a tremendous diversity of aquatic habitats (from shallow to deep water). Map 2 in Appendix A provides a bathymetric map of the lake along with some habitat notes. Black Oak Lake can be best described as a "Groundwater Drainage Lake" even though it has a minor inflow of water from Dollar Lake to the north. Its outflow stream is small. There is a public park on the lake with a public swimming beach, picnic area, and boat landing. Black Oak Lake is an important resource used by the public for a diversity of recreational and educational pursuits. Map 1 in Appendix A shows Black Oak Lake in its landscape context.

Black Oak Lake is unusual in that, despite human development, it has a highly intact riparian area. The shoreline totals nearly 7½ miles and in this area there are 140 ownership parcels (averaging almost 300 feet of lake frontage per parcel). Large stretches of shoreline on the northern shore of the lake are essentially undeveloped. The near shore littoral zone has large woody material that falls into the lake from the forested riparian area and provides wonderful habitat for a variety of organisms.

A unique riparian resident of Black Oak Lake is Conserve School, a college preparatory boarding school (grades 9 through 12), emphasizing environmental studies. Conserve School was established in 1996 as the wish of the late James R. Lowenstine. Realizing the importance of conserving the area's natural resources, Lowenstine bequeathed his wealth and 1,200 acres of pristine woodlands in Northern Wisconsin to found a school that would teach young people the importance of stewardship and ethical, environmental leadership. The Conserve School ownership of Black Oak Lake Riparian area is substantial and provides long-term protection against over-development of the near shore uplands. The faculty and students of Conserve School represent significant human resources potentially available for monitoring watershed and lake health and implementing aspects of the adaptive management plan.

The Black Oak Lake landscape has several lakes including Anderson Lake, Big Donahue Lake, Little Donahue Lake, Little Batteau Lake, Big Batteau Lake, Spring Lake, Lake Elaine (formerly Lonewood Lake), Dollar Lake, and George Lake. This complex of aquatic habitats forms an abundance of riparian habitats for birds, mammals, amphibians, reptiles, and invertebrates that require this kind of habitat. The land matrix of this complex of lakes is largely forested, with some prime examples of northern hardwoods forest stands. Large tracts of undeveloped land exist offering high quality habitat for many terrestrial organisms and very stable surroundings that are protective of the lake environment. Immediately adjacent to the north of the Black Oak Lake Watershed is the Sylvania Recreation Area – a wilderness area in Michigan's Upper Peninsula. This further protects and sustains many of the environmental attributes of the Black Oak Lake area.

The general attributes of the Black Oak Lake watershed described above combine to make this area exceedingly unique. It is a worthy goal to develop a management plan that serves to perpetuate this high quality ecosystem far into the future. The next section describes the methods and activities undertaken in Phase I that begin the progress toward this goal.

Part 2. Geologic, Glacial, and Human History of the Lake

Knowing what the Black Oak Lake and the surrounding area was like under more or less natural conditions allows us to better understand the structures and functions that might be desirable to protect and restore through adaptive management. Watershed history provides insights as to what conditions are reasonable to establish as goals. This is not to say, that a plan might aspire to turn back the clock to a time when no humans existed on the watershed. Humans are now an important feature of the watershed. The management plan recognizes that condition. Watershed history provides us clues as to what is reasonable to hope for and what is not. It clarifies for us what natural and human disturbances exist and how they influence the watershed.

In the not too distant past, the Black Oak Lake landscape was molded and influenced by natural disturbances such as fires, blowdowns, floods, beaver, insect outbreaks, and climate. Today's landscape is the obvious result of the combined interaction of human and natural processes, with humans nowadays serving as the most significant agents of change.

Paul McLeod (BOLROA member and local historian) prepared a thorough history of Black Oak Lake and this is included in its entirety in Appendix B.

Part 3. Black Oak Lake Water Quality

Black Oak Lake has high water quality. BOLROA and others have participated in the WDNR Self-Help Monitoring Program in 2002, 2003, and 2004.[2] The 2002 lake monitoring results indicated that Black Oak Lake was "oligotrophic" based on Secchi disk depth, phosphorus concentration, and Chlorophyll "a" concentration. The Trophic State Index (TSI)[3] at the point of measurement in Black Oak Lake (the "deep hole") is 40. This places Black Oak Lake in the oligotrophic category, but where bottom water may become oxygen-depleted in the summer. In other words, Black Oak Lake is on the borderline between mesotrophic (relatively more fertile) and oligotrophic (relatively less fertile). As evidence of this status, the 2003 Self-Help report placed Black Oak Lake in the mesotrophic category and the 2004 report placed it back in the oligotrophic category. These reports are at www.dnr.state.wi.us/org/water/fhp/lakes/lakesdatabase.asp.

Black Oak Lake water tends to be quite clear with Secchi Disk transparencies ranging from 15 feet to 17 feet in the summer months 0f 2002-2004. BOLROA members report that spring 2005 Secchi Disk transparencies have been more than double the typical transparencies. In 2002, water quality data was collected during May, June, July, August, September, and October. The average Secchi disk depth during that period was 15.6 feet (range: 14-17 feet). The average Chlorophyll "a" concentration during the same period was 2.57 µg/L (range: 0.9-4.8). The average total phosphorus was 10.8 µg/L (range: 8-17). Lake temperature data taken as part of the volunteer monitoring program shows that Black Oak Lake stratifies by temperature in the warmer season.

Additional water chemistry samples were obtained in 2002 and 2003 for Black Oak Lake and analyzed by the WDNR laboratory. These data are summarized in Table 1 and the laboratory reports are provided in Appendix C. The pH values for the lake hover around neutral, although a one-time measure of alkalinity shows this parameter to be fairly low. Iin other words, Black Oak Lake does not have a large buffering capacity to protect it from becoming more acidic should increased acid precipitation occur.

Total Kjeldahl nitrogen, ammonia, and nitate+nitrite were among the parameters measured in Black Oak Lake by the WDNR 2002 and 2003. Results for the analyses for

[2] Electronic data can be accessed through the WDNR at http://www.dnr.state.wi.us/org/water/fhp/lakes/lakesdatabase.asp

[3] TSI is determined using a mathematical formula and values for Secchi disk depth, phosphorus concentration, and Chlororphyll "a" concentration. TSI values range from 0 to 100, with lakes that are less fertile having lower TSI values.

epilimnion and hypolimnion samples are summarized in Table 1. Nitrogen in the water samples was low, especially inorganic forms of nitrogen (ammonia and nitrate+nitrite) probably due to uptake by algae. Total nitrogen is the sum of total Kjeldahl nitrogen plus nitrate+nitrite (Shaw *et al.* 2002) and the average total nitrogen for Black Oak Lake epilimnion over four sampling periods was 0.39 mg/L. In this instance all of the nitrogen was represented by Kjeldahl nitrogen (nitrite-nitrate nitrogen values were less than detection). The ratio of total nitrogen to total phosphorus is indicative of whether plant growth in a lake is limited by phosphorus or by nitrogen (Shaw *et al.* 2002). The "rule of thumb" is that, if the ratio of N:P is less than 10:1 then a lake is "nitrogen-limited", but if the ratio is greater than 15:1 algal growth is controlled by phosphorus (that is, phosphorus-limited). Total phosphorus was quite low (averaging 0.0115 in Black Oak Lake epilimnion over four sampling periods). The N:P ratio was therefore 34:1 (0.39/0.0115) and Black Oak Lake would be considered a phosphorus-limited lake.

Table 1. Black Oak Lake Water Quality Data for 2002 & 2003 (WDNR Lab Report)

	9/24 2002	10/23 2002	10/23 2002	2/19 2003	2/19 2003	5/29 2003	5/29 2003	6/30 2003	7/18 2003	8/27 2003
	surface	surface	bottom	surface	bottom	surface	bottom	surface	surface	surface
Ammonia (mg/L)	ND			0.032		ND		ND		
Nitrate+Nitrite	ND			ND		ND		ND		
Total Kjeldahl Nit. (mg/L)	0.36			0.57		0.36		0.27		
Total Phos. (mg/L)	0.011	0.008	0.085	0.017	0.102	0.009	0.019	0.009	0.009	0.017
Ortho-phos. (mg/L)	ND			ND		0.007		ND		
Dis Oxygen (mg/L)	8.6	10.0	10.1			9.4	6.2	8.2	7.6	9.2
Calcium (mg/L)								6.4		
pH (SU)	7.5	7.0	7.0	6.75	6.75	7.0	6.5	7.0	6.75	7.5
Alkalinity (mg/LCaCo3)								22.0		
Conductivity (µS/cm)								51		
Magnesium (mg/L)								1.6		
Potassium (mg/L)								1.0		
Sulfate (mg/L)								ND		
Hardness (mg/L)								22.3		

Conserve School teacher Jill Graff collected water quality data for several dates in 2000, 2001, and 2002. These data are presented in Table 2. Although no quality assurance/quality control data are provided with these data, they seem to be fairly consistent with the WDNR laboratory data. Both the Conserve School data and the Self Help data show that dissolved oxygen can become depleted at the deep point in the lake.

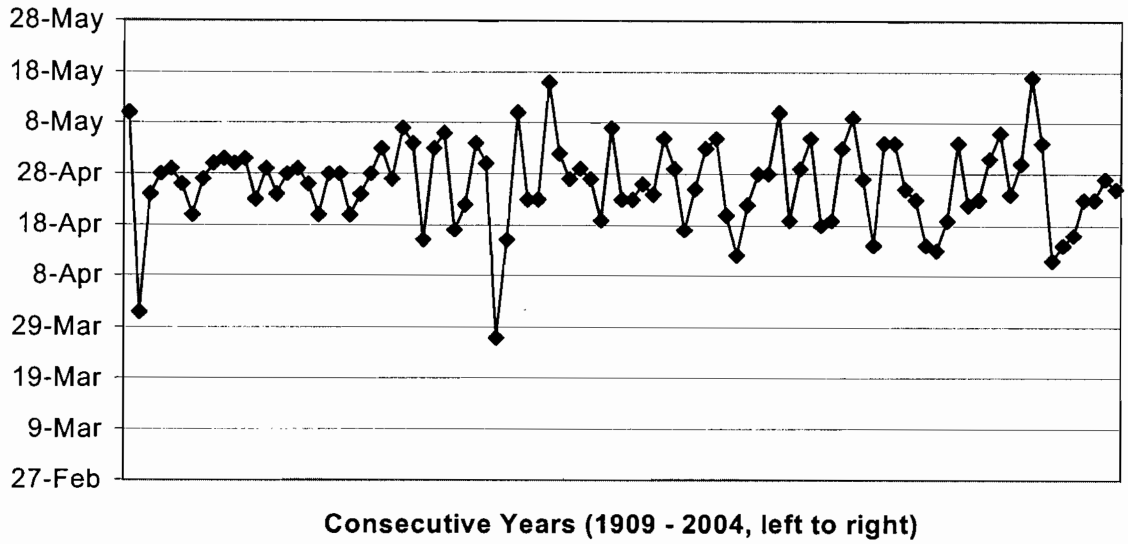
Table 2. Black Oak Lake Water Quality Data for 2000, 2001, & 2002 (Conserve School)

		10/24/00	3/27/01	5/14/01	7/22/01	10/11/01	2/17/02	5/13/02	6/21/02
Alkalinity (mg/L)	Surface	23	25	23	22	25			
	Bottom	28	26	33	22	28			
Calcium (mg/L)	Surface	5.5							
	Bottom	6.1							
Chloride (mg/L)	Surface	ND							
	Bottom	ND							
Conductivity (lab)	Surface	51							
	Bottom	58							
Dissolved Oxygen (mg/L)	Surface						12.4	11.4	
	Bottom						2.8	11.4	
Iron (mg/L)	Surface	ND							
	Bottom	1,5							
Magnesium (mg/L)	Surface	1.3							
	Bottom	1.3							
Manganese (mg/L)	Surface	3.7							
	Bottom	160							
Ammonia (mg/L)	Surface	ND	0.056	0.052	ND	ND	ND	0.013	
	Bottom	0.42	0.034	ND	0.051	0.35	0.191	0.019	
Nitrate+Nitrite (mg/L)	Surface	ND	0.053	ND	ND	ND	0.07	0.067	
	Bottom	ND	0.015	ND	ND	ND	0.124	0.059	
Total Kjeldahl Nitrogen (mg/L)	Surface	0.33	0.45	0.34	0.39	0.36	0.54	0.40	
	Bottom	0.78	0.77	0.36	0.38	1.5	1.18	1.18	
Organic Nitrogen (mg/L)	Surface	0.33							
	Bottom	0.36							
Total Nitrogen (mg/L)	Surface		0.5	0.34	0.39	0.36			
	Bottom		0.92	0.36	0.38	1.5			

Table 2. Black Oak Lake Water Quality Data for 2000, 2001, & 2002 (Conserve School)									
		10/24/00	3/27/01	5/14/01	7/22/01	10/11/01	2/17/02	5/13/02	6/21/02
PH (lab)	Surface	8.1	6.9	7.4	8.2	7.9	7.0	7.0	
	Bottom	7.1	6.8	7.1	6.6	7.0	6.5	7.0	
PH (field)	Surface						7.0	7.0	
	Bottom						6.5	7.0	
Tot. Phosphorus (mg/L)	Surface	0.012	0.018	0.02	0.011	0.011	0.015	0.017	
	Bottom	0.14	0.034	0.017	0.05	0.16	0.125	0.132	
Dissolved Phosphor. (mg/L)	Surface	ND							
	Bottom	0.085							
Ortho-phosphor. (mg/L)	Surface							ND	
	Bottom							ND	
Potassium (mg/L)	Surface	0.61							
	Bottom	0.69							
Sodium (mg/L)	Surface	0.68							
	Bottom	0.69							
Solids (dis) (mg/L)	Surface	34							
	Bottom	38							
Solids (susp) (mg/L)	Surface	ND							
	Bottom	5							
Solids (volatile) (mg/L)	Surface	50							
	Bottom	11							
Sulfate (mg/L)	Surface	ND							
	Bottom	ND							
Turbidity (NTU)	Surface	0.71							
	Bottom	1.4							

Over the years several Black Oak Lake residents have kept a unique record of the dates that ice has left Black Oak Lake. This has resulted in nearly a century-long uninterrupted data set for the lake. The actual data set is contained in the historical treatment provided in Appendix B. The data is graphed in Figure 1.

Figure 1. Ice-out Dates for Black Oak Lake



Part 4. Black Oak Lake Fisheries

Black Oak Lake has a diverse community of fishes including walleye, largemouth bass, smallmouth bass, brown trout, lake trout, cisco, northern pike, bluegill, pumpkinseed, yellow perch, rock bass, white sucker, bluntnose minnow, and black bullhead. Like most lakes, the natural fish populations of Black Oak Lake have been augmented by introductions by the WDNR. Fish stocking in Black Oak Lake has had a long history with available written records extending back to 1951. According to those records the list of fish introduced to Black Oak Lake includes lake trout, brown trout, rainbow trout, brook trout, coho salmon, splake, walleye, largemouth bass, smallmouth bass, bluegills, yellow perch, and black crappie. Many of these species were clearly not native to Black Oak Lake. The available stocking records are located in Appendix D of this document. Walleye have been the most aggressively managed fish in Black Oak Lake based on the stocking record and population estimates in the lake. The primary recruitment source for this fish is from stocking and recent surveys indicate that there is a fairly large density of large adult fish. The high density of this piscivorous fish has a significant effect on other fish species in the lake, through both direct predation and through competition for food source.

Black Oak Lake is one of two lakes in Wisconsin (nearby Trout Lake is the other) that harbors inland populations of self-sustaining lake trout (Piller *et al.* 2005)[4]. These two populations represent the only two extant populations of lake trout indigenous to the Upper Mississippi River Basin. Recent genetic testing has shown the Black Oak Lake population to be genetically distinct from all others. Thus, the Black Oak Lake's population of lake trout represents an absolutely unique part of the world's biodiversity.

This recent genetic testing lake trout from Black Oak Lake (see Piller et al 2005 publication included in Appendix D) indicates that the strain has remained pure in spite of continued introduction of non-native lake trout strains. The management implications of these findings are significant. The genetically distinct population of lake trout in Black Oak Lake should be given a high level of protection (Piller et al 2005) and a strong effort should undertaken to guard against additional human-caused impacts (over-fishing, habitat loss, and genetic degradation by way of lake trout stocking).

Black Oak Lake's lake trout population receives management attention through management effort directed specifically at Black Oak Lake and through statewide lake trout management planning. Appendix D contains documentation for these efforts. Population estimates for lake trout in Black Oak Lake are uncertain (latest estimates put the population at under 1,000 individuals). Recaptured marked individuals demonstrated very slow growth rates. There is some concern by the WDNR that the increasing walleye populations (especially those fish over 20 inches) will significantly compete with lake trout for forage (primarily ciscos) and will directly consume juvenile lake trout. A 2003 Fisheries Rule Development Proposal (see Appendix D) called for an increased size limit on lake trout in Black Oak Lake in order to protect a greater proportion of the population from harvest. The 2002 Lake Trout Management Report for Black Oak Lake (see Appendix D) states that, "Preservation of this unique lake trout resource should be the top management priority for Black Oak Lake. Walleye stocking may need to be re-evaluated should the lake trout population begin to decline."

[4] This publication is available via the world-wide-web at:
http://www.selu.edu/Academics/Faculty/kpiller/pdfs/Piller_et_al_2005.pdf

Part 5. Black Oak Lake Aquatic Plants

Black Oak Lake appears to have a fairly diverse aquatic plant community. In October 2001 a biological consultant conducted a brief survey of the lake with the purpose of determining the presence or absence of Eurasian water milfoil (an aggressive non-native plant). During five hours of inspection no Eurasian water milfoil was discovered. Twenty-three aquatic plant species were identified in this survey (a respectable number, given the brevity of the survey). The report for this survey is included in Appendix E. Among the plants identified were three native milfoils: dwarf water milfoil, northern milfoil, and Farwell milfoil. The latter is a Wisconsin Special Concern species indicating the relative rarity of this plant and that Black Oak Lake offers an uncommon patch of habitat in order for the species to exist here. The 2001 survey also provided a rough indication of where in Black Oak Lake individual species were observed.

In 2004, a science class from Conserve School conducted a class project on aquatic plants in Black Oak Lake. This effort identified species and recorded distribution within the lake. This information and the 2001 aquatic plant survey can provide a baseline on which future aquatic plant monitoring can be established. The Conserve School aquatic plant data is archived by Jill Graff (a teacher at Conserve School).

Part 6. Black Oak Lake Rare Species

Black Oak Lake provides habitat for rare species such as common loon, bald eagle, and Farwell milfoil. Common loons frequently use the lake as a fishery during the nesting season and often several individuals are seen on the lake actively feeding. An active and historically successful bald eagle nest exists in the riparian area of Black Oak Lake and the adults and juveniles use the lake for fishing. As mentioned in a previous section, a Wisconsin Special Concern plant, Farwell's water milfoil (*Myriophyllum farwellii*) was identified in a 2001 aquatic vegetation survey. Perhaps the most unique biotic element of the Black Oak Lake ecosystem is the indigenous strain of lake trout. The presence of these rare elements is an additional indicator of the high quality of Black Oak Lake and strengthens the case for why the lake should have a plan in place that protects this unusual and healthy ecosystem.

Part 7. Black Oak Lake Exotic Species

The discovery of non-native species (sometimes called "exotic" or "alien" species) is a disturbingly common phenomenon in northern Wisconsin. Eurasian water milfoil, purple loosestrife, spiny water flea, rusty crayfish, and Chinese mystery snail are just a few of the prolific and often deleterious non-native species that are in the region. Fortunately, Black Oak Lake has remained relatively free of such interlopers. One exception, however, is the discovery of a population of the non-native and potentially destructive rusty crayfish. This species was first noted in a 1985 WDNR fish survey report. Fortunately, in twenty or more years of existence in Black Oak Lake, this population has not yet caused apparent damage to the lake ecosystem. Nevertheless, this is a species that requires attention in the adaptive lake management plan. Monitoring for other non-native species is also of paramount importance in the future.

Part 8. What Significant Threats Exist for Black Oak Lake and Its Surroundings?

There are many significant watershed-scale threats that exist in any landscape, including the Black Oak Lake Watershed. Although many threats overlap and combine, they can be organized in four categories: chemical threats, biological threats, physical threats, and social threats. Land use activities and associated human-caused disturbances undoubtedly have the greatest potential for producing long-term changes in the watershed ecosystem. Chemicals, introduced through many activities including septic, lawn maintenance, boat fuel, and forestry (pesticides and nutrients), urban activities (municipal and industrial waste contaminants and transport), and acid precipitation have potential for degrading water quality. Chemical threats can also come from storm water runoff from streets and roads that can introduce salts, oils and grease, and other materials. Biological disturbances due to improper forestry practices or recreational activities occur frequently and can also have significant negative impact. Wetland loss or degradation due to development or other land use also is a threat to the quality of the Black Oak Lake Watershed ecosystem. The introduction of exotic flora and fauna species can introduce widespread, intense, and continuous stress on native biological communities. Physical disturbance effects can occur at landscape scale. Activities such as road building and maintenance all have high potential for introducing long-lasting changes to the watershed ecosystem. These all serve to mobilize sediments into wetlands and the lake. Finally, social threats can occur in many forms including ignorance, apathy regarding watershed stewardship, and inadequate zoning and land use planning. The Black Oak Lake Watershed is an area of increasing development pressures.

Threats can exist at a small scale as well. These smaller scale threats can be cumulative in their impacts. Threats such as improper culvert installation can be a chronic source of sediment input to a stream or wetland. Runoff from parking areas can introduce warm water or grease and oil into wetlands and surface water and have significant local impact. Non-native or "alien" species can pose important small-scale threats that can turn large scale. Purple loosestrife, for example, can establish in small wetland pockets and out-compete the native flora, thus degrading important wildlife habitat. If too great a proportion of a lakeshore includes highly managed lawns, long-term impacts to the lake can be expected. Large woody material is an important habitat in the littoral zone of the lake, yet riparian owners often want to "clean up" this important habitat. Large woody material provides direct habitat for plants and animals. These small threats can add up to mean significant impact.

Part 9. Black Oak Lake Geographic Information System (GIS)

The Black Oak Lake GIS is an ArcView 3.2 compatible project file and accompanying data collected from various sources: USGS, WDNR, Michigan DNR, and the State of Wisconsin. The data are compiled and formatted into several overlapping views, and organized in a manner that allows best use in mapping, visual analysis, and presentation purposes. This PDF is furnished in CD-ROM format, with an explanatory PDF file included in the top-level directory; data are organized into subdirectories explained by the PDF file. Because the project file has as its native format ArcView 3.2 (a commercial product of ESRI), the main project file will not be viewable on computers without this specialized program. Free viewing software such as ArcExplorer (also a product of ESRI) will allow one to load and manipulate the data, but significant effort has gone into the organization of the project file itself and use of ArcView 3.2 is recommended. Conserve School should have a copy of ArcView, this according to its staff. Newer versions of ArcView may or may not be as useful in viewing this data. Certain necessary dependent extensions are necessary and furnished on CD-ROM. Their installation is explained there.

To learn more about the ArcView program, visit the ESRI website: http://www.esri.com.

Chapter

6

What Goals Guide the Plan?

"Protect the Best and Restore the Rest" has become the credo of successful watershed managers across the country. Its simplicity is profound because it acknowledges that watershed restoration is more than identifying the worst areas and trying to rehabilitate them. It recognizes that of equal or greater importance is identifying those areas that are of high or moderate quality in the watershed and establishing mechanisms to maintain that quality. "Protect the Best and Restore the Rest" also implies the importance of identifying imminent threats to watershed health and working to eliminate them. This simple principle, is founded on the restoration ecology fact that the most certain way to successfully restore the structure and function of part of a broken watershed ecosystem is to rely on intact areas of the watershed to serve as the donors of healthy "parts" (such as aquatic insect species or good quality water). "Protecting the Best" allows us to "Restore the Rest" more effectively and economically. But, protecting the best is prerequisite.

Developing goals for a lake management and protection program should begin with defining the ***desired future condition*** of the lake and surrounding landscape. This desired future condition should reflect the common vision of the participants. This vision serves as a foundation for goals and objectives.

BOLROA has considered the desired future condition of the watershed. Its leaders articulated a set of goals directed toward that condition in the by-laws of the organization:

- Protect Black Oak Lake waters and shoreline for recreation;
- Protect and enhance the Black Oak Lake environment;
- Manage natural fish and wildlife habitats;
- Work to keep and initiate protective zoning ordinances consistent with private property rights; and
- Promote safety.

The primary goal of the Black Oak Lake Watershed Protection Program is to perpetuate the quality of Black Oak Lake and its watershed ecosystem into the future. Sometimes this will mean protecting what is good about the lake and its surroundings and sometimes it may mean restoring some feature that has been degraded. ***Restoration is reestablishment of the structure and function of an ecosystem including its natural diversity*** (Cairns 1988; National Research Council 1992). It implies rehabilitating and protecting sufficient components of the ecosystem so that it functions in a more or less natural way, provides habitat for native plants and animals, and supports reasonable human uses.

The plan writers for the Black Oak Lake Adaptive Management Plan offer several supporting goals. In an adaptive plan, new goals can be adopted as the plan evolves. We conclude this chapter by presenting these goals organized under topical headings.

Restoration

Apply rehabilitation, protection, and education actions under the direction of specific objectives to the identified high quality areas, threatened areas, and critical areas.

Gather information that is useful in planning and monitoring restoration actions and devising education programs.

Monitoring

Establish a monitoring system in the Black Oak Lake Watershed that will provide data that reveals the quality of the system and establishes methods to evaluate the effectiveness of management efforts.

Cultural Climate

Encourage a political and cultural atmosphere that allows and promotes good watershed stewardship including cooperation between citizens, businesses, public agencies, and municipalities.

Sustainable Economy

Foster an environment that promotes a sustainable economy, provides a diversity of economic options for the residents of the watershed, and does not diminish opportunities for future generations of watershed residents.

Recreation

Promote a sustainable recreation in Black Oak Lake where all citizens can enjoy the opportunities of the natural and human-sustained environment while respecting the natural environment as well as the rights of fellow citizens and property owners.

Program Maintenance

Provide for continual funding to support the implementation and periodic update of the Black Oak Lake plan.

In the next chapter of this plan, we present possible objectives and actions that will serve to move toward these goals. This is not an exhaustive treatment, but a starting point, integrated with monitoring so that adaptive management can take place in subsequent years.

Chapter

7

What Objectives and Actions Move Us Toward the Goals?

The Black Oak Lake watershed is healthy and diverse. Our challenge is to perpetuate that condition into the future. The opportunity for success stems from an unusual and capable set of program partners that are prepared to devote themselves to the realization of the program vision. These partners include the members of the Black Oak Lake Riparian Owners Association, the faculty and students of Conserve School (a school dedicated to the study of the environment), the ecological scientists of White Water Associates, Inc., the WDNR, the Vilas County Lakes Association, and the Wisconsin Association of Lakes.

Abraham Lincoln is attributed with the following wisdom: *"If I had an hour to cut down a tree, I'd spend the first 45 minutes sharpening my ax."* Planning and preparation are important for any task, but especially when working with a system as complex as a lake or watershed. The vision and goals described in the previous chapter provide the basis for developing objectives and actions to achieve the desired future outcomes for the Black Oak Lake Watershed. In keeping with the spirit of an adaptive management plan, we present several objectives and associated actions that could be undertaken in the second phase of the program. Recommended monitoring is also described. The actions, objectives, and monitoring each need to be further developed so that appropriate methodology and accurate estimates of required effort can be described. Keep in mind that the plan is flexible and allows the insertion of new ideas and actions at many points along the path of lake and watershed management.

Action (Research): Conduct several temperature and dissolved oxygen profiles over the annual cycle in Black Oak Lake.

Objective: To develop a better understanding of available and usable lake trout habitat in Black Oak Lake.

Monitoring: BOLROA oversees activity and maintains data.

Action (Education): Work closely with the WDNR to understand and manage the lake trout population in Black Oak Lake. Support the WDNR in the goal of not introducing new genetic material into the lake in the form of outside lake trout strains.

Objective: To support scientific and aggressive protection of lake trout in Black Oak Lake.

Monitoring: Document the meetings and other contacts made to the WDNR and others.

Action (Research): Conduct an assessment of rusty crayfish distribution and population within Black Oak Lake. This could be conducted by an advanced science project at Conserve School or graduate student project.

Objective: To understand the potential impact represented by this exotic species.

Monitoring: A written report should document the findings.

Action (Research): Conduct a survey of amphibians that use Black Oak Lake and its riparian area as habitat.

Objective: To fulfill an information deficit for the Black Oak Lake area on amphibians.

Monitoring: A written report should document the findings.

Action (Education): Establish a kiosk at the public beach/boat launch that describes the dangers of non-native species introductions to Black Oak Lake and outlines how such introductions can be minimized.

Objective: Prevent new introductions of non-native species to Black Oak Lake.

Monitoring: Document that the kiosk is maintained with literature and educational material.

Action (Research): Conduct periodic assessments of Black Oak Lake for non-native aquatic plants.

Objective: To provide an early warning of introductions of non-native plant species to allow rehabilitation actions to occur when populations are still small.

Monitoring: Document the number and timing of surveys and maintain record of findings.

Action: (Research): Conduct an assessment of aquatic invertebrates in the littoral zone (shallow water) habitats of Black Oak Lake.

Objective: To determine the diversity of the aquatic invertebrate community and help establish a baseline for future monitoring of this important component of the Black Oak Lake ecosystem.

Monitoring: A written report should document the findings.

Action: (Research): Conduct a survey of small littoral zone fishes (minnows and game fish young) in Black Oak Lake by major lake areas.

Objective: To understand the diversity of this component of the fish community and assess how it contributes to the lake ecosystem (for example as food for larger fish).

Monitoring: A written report should document the findings.

Action (Research): Conduct careful mapping of selected patches of aquatic macrophytes, including species present and relative abundances.

Objective: To establish a baseline for monitoring changes in aquatic vegetation in the lake.

Monitoring: A written report should document the findings along with a methodology for follow up monitoring.

Action (Research): Continue to track Secchi Depth transparencies and determine reason for the high readings in 2005.

Objective: To understand the causes of an apparent dramatic increase in lake transparency.

Monitoring: A written report should document the findings along with a methodology for follow up monitoring.

Action (Research): Identify and map (with inclusion in the GIS project) important wetlands within the Black Oak Lake watershed.

Objective: To protect and monitor the health of important wetlands that influence Black Oak Lake.

Monitoring: A written report should document the findings along with a methodology for follow up monitoring. The findings should be databased in the GIS project.

Action (Support): Develop a system that helps to organize and coordinate the many kinds of actions that will take place on the Black Oak Lake.

Objective: To organize and track projects and archive findings in a single repository.

Monitoring: BOLROA should oversee and document this process.

Action (Research): Document the state of development of the Black Oak Lake Shoreline using digital photography. This documentation should include a count of piers along the Black Oak Lake shoreline.

Objective: To create a baseline for today's state of shoreline development against which to monitor long term changes.

Monitoring: The findings should be documented in a report and databased in the GIS project.

Action (Research): Document the plant species in the riparian area of Black Oak Lake.

Objective: To establish a baseline of the native and non-native plant species present in the landscape and assist future monitoring of alien plant establishment.

Monitoring: The findings should be documented in a report and databased in the GIS project.

Action (Rehabilitation): Check on the feasibility of adding loon nesting habitat (in the form of artificial floating islands) to appropriate site(s) in Black Oak Lake. If feasible, install.

Objective: To encourage use of Black Oak Lake for breeding of common loons.

Monitoring: Monitor loon use of the artificial island(s).

Action (Education): Establish an award or recognition of riparian owners that preserve or rehabilitate "natural shoreline" habitat on their property. This could be recognized in BOLROA newsletter along with an article about the ecological benefits of natural shorelines.

Objective: To encourage good shoreline stewardship by riparian owners.

Monitoring: Monitor by general awareness of landowners and changes in shoreline maintenance behavior.

Action (Research): Undertake additional research on habitat, life history, and population structure of the lake trout in Black Oak Lake. (Most likely undertaken by WDNR or university researchers).

Objective: To understand more about the viability and threats to this rare populations.

Monitoring: Results would be documented in agency reports or peer-reviewed publications.

Action (Research): Continue with the volunteer lake monitoring program.

Objective: To establish a long-term record of basic water quality in Black Oak Lake.

Monitoring: Results will be documented in WDNR reports.

Action (Protection): Develop limnological, ecological, and sociological indicators for future monitoring. This was originally planned for Phase I, but is recommended for the next phase since more information will be available.

Objective: To establish measurable benchmarks against which long term monitoring can be measured.

Monitoring: Develop a written protocol describing indicators and how they are to be measured and monitored.

Action (Research): Integrate new information into the GIS project where appropriate.

Objective: To store and analyze geographically based environmental data.

Monitoring: Each year new map products and information reports can be produced to monitor progress.

Future phases of the Black Oak Lake Watershed Protection Program will build on the foundation established in Phase I. Monitoring indicators will be developed and applied. Other aspects of the Black Oak Lake watershed ecosystem will be explored. For example, future phases will address watershed wetlands, more thorough aquatic and riparian vegetation assessment and mapping, current and anticipated land use and land cover, survey of lake users on desired future conditions of Black Oak Lake, and education of lake users on topics such as the importance of the riparian zone to lake health. Future phases will include revisions to the lake management plan and monitoring tasks that support adaptive management. Relevant findings in these future phases will be incorporated into the Black Oak Lake GIS project.

Black Oak Lake and its watershed serve its human residents well. But, in order for future generations to enjoy all of the opportunities and free services that the watershed can provide, this adaptive plan should be embraced, developed, and implemented. It may seem slow at first, but considerable momentum already exists because of the hard work that has already occurred. The Black Oak Lake Watershed has begun this next millennium with a well-prepared and duly concerned human population ready to take up a rewarding stewardship responsibility.

Literature Cited

Cairns, J. Jr. 1988. Increasing diversity by restoring damaged ecosystems. Pages 333-343 in E.O. Wilson, editor. Biodiversity. National Academy Press, Washington, DC.

Lanoo, Michael J. 1996. Okoboji Wetlands – A Lesson in Natural History. University of Iowa Press. 156 pages.

Piller, Kyle R., Chris C. Wilson, Carol Eunmi Lee, and John Lyons. 2005. Conservation Genetics of Inland Lake Trout in the Upper Mississippi River Basin: Stocked or Native Ancestry? Transactions of the American Fisheries Society 134:789–802. At: http://www.selu.edu/Academics/Faculty/kpiller/pdfs/Piller_et_al_2005.pdf

Shaw, Byron, Christine Mechenich, and Lowell Klessig. 2002. Understanding Lake Data. University of Wisconsin Extension. Publication G3582. 20 pages.

National Research Council. 1992. Restoration of aquatic ecosystems: science, technology, and public policy. National Academy Press, Washington, DC.

Stream Corridor Restoration — Principles, Processes, and Practices. 1998. National Technical Information Service, Springfield, Virginia 22161. (703) 605-6000.

Walters, C. 1986. Objectives, constraints, and problem bounding. In W.M. Getz, ed., Adaptive Management of Renewable Resources. Macmillan Publishing Company. New York. p. 13+.

Williams, Jack E., Christopher A. Wood, and Michael P. Dombeck, eds. 1997. Watershed Restoration: Principles and Practices. American Fisheries Society, Bethesda, Maryland. 561 pages.

Wisconsin Department of Natural Resources. 2002. Headwaters Basin Integrated Management Plan. A Report by the Wisconsin Department of Natural Resources in Cooperation with the Headwaters Basin Partnership Team and Stakeholders. 259 pages.

Appendix

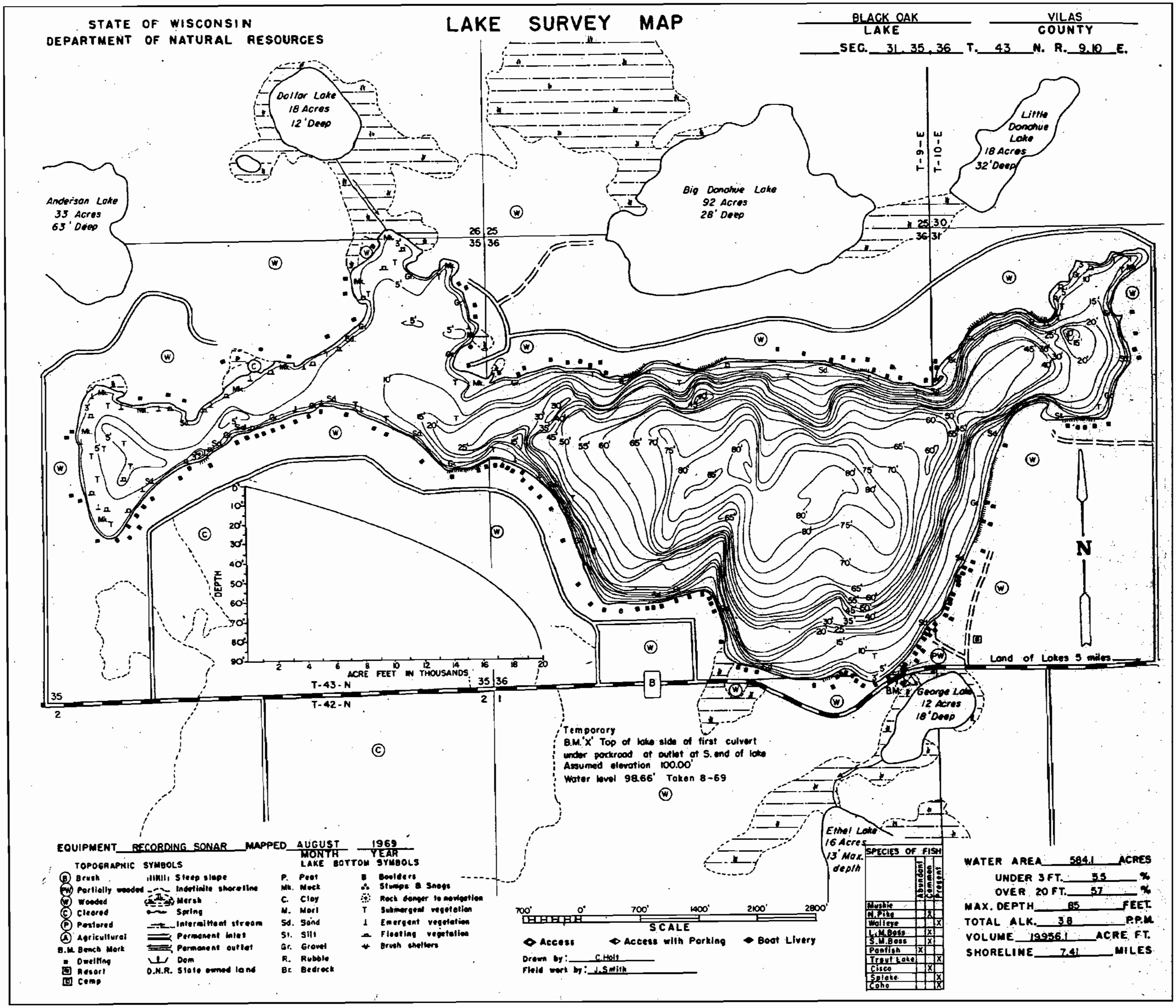
A

Maps

Map 1. Black Oak Lake in Its Landscape Context.

Source: USGS Topographic Map (1:24,000 Scale) Coverage, Black Oak Lake Quadrangle

Map 2. Black Oak Lake Bathymetry and Habitat.



Appendix

D

Fish Information

COUNTY: VILAS | WATERBODY NAME: BLACK OAK L | REPORT CREATED: APR 12, 2004 - 09:00 AM

	YEAR	SPECIES	STRAIN	AGE CLASS	AVG LENGTH (INCHES)	NUMBER FISH STOCKED	LEGAL DESC & LOCAL
1	1972	LAKE TROUT	UNSPECIFIED	YEARLING	5.0	17,120	T33N R9E S35 -
2	1973	LAKE TROUT	UNSPECIFIED	YEARLING	5.0	25,349	T33N R9E S35 -
3	1974	LAKE TROUT	UNSPECIFIED	YEARLING	7.0	12,500	T33N R9E S35 -
4	1977	LAKE TROUT	UNSPECIFIED	FINGERLING	3.0	70,000	T33N R9E S35 -
5	1978	LAKE TROUT	UNSPECIFIED	FINGERLING	2.0	80,000	T33N R9E S35 -
6	1979	LAKE TROUT	UNSPECIFIED	FINGERLING	4.0	25,000	T33N R9E S35 -
7	1980	LAKE TROUT	UNSPECIFIED	FINGERLING	4.0	15,000	T33N R9E S35 -
8	1980	WALLEYE	UNSPECIFIED	FINGERLING	2.0	29,550	T33N R9E S35 -
9	1981	WALLEYE	UNSPECIFIED	FINGERLING	2.0	15,500	T33N R9E S35 -
10	1981	WALLEYE	UNSPECIFIED	FINGERLING	3.0	16,500	T33N R9E S35 -
11	1982	WALLEYE	UNSPECIFIED	FINGERLING	1.0	30,876	T33N R9E S35 -
12	1984	WALLEYE	UNSPECIFIED	FINGERLING	2.0	27,990	T33N R9E S35 -
13	1986	WALLEYE	UNSPECIFIED	FINGERLING	2.0	28,000	T33N R9E S35 -
14	1987	WALLEYE	UNSPECIFIED	FINGERLING	2.0	75,000	T33N R9E S35 -
15	1988	BROWN TROUT	UNSPECIFIED	ADULT	15.0	164	T33N R9E S35 -
16	1988	WALLEYE	UNSPECIFIED	FINGERLING	2.0	25,000	T33N R9E S35 -
17	1989	BROWN TROUT	UNSPECIFIED	YEARLING	9.0	3,200	T33N R9E S35 -
18	1989	WALLEYE	UNSPECIFIED	FINGERLING	3.0	12,054	T33N R9E S35 -
19	1989	WALLEYE	UNSPECIFIED	FINGERLING	6.0	1,826	T33N R9E S35 -
20	1989	WALLEYE	UNSPECIFIED	FINGERLING	7.0	583	T33N R9E S35 -
21	1989	WALLEYE	UNSPECIFIED	FINGERLING	8.0	765	T33N R9E S35 -
22	1990	BROWN TROUT	UNSPECIFIED	FINGERLING	6.0	7,550	T33N R9E S35 -
23	1990	BROWN TROUT	UNSPECIFIED	FINGERLING	5.0	2,450	T33N R9E S35 -
24	1990	LARGEMOUTH BASS	UNSPECIFIED	FINGERLING	3.0	2,230	T33N R9E S35 -
25	1990	WALLEYE	UNSPECIFIED	FINGERLING	7.0	2,505	T33N R9E S35 -
26	1991	BROWN TROUT	UNSPECIFIED	FINGERLING	6.0	10,000	T33N R9E S35 -
27	1991	WALLEYE	UNSPECIFIED	FINGERLING	5.0	5,400	T33N R9E S35 -
28	1992	BROWN TROUT	UNSPECIFIED	FINGERLING	6.0	10,000	T33N R9E S35 -
29	1992	WALLEYE	UNSPECIFIED	FINGERLING	4.0	5,500	T33N R9E S35 -

30	1993	BROWN TROUT	UNSPECIFIED	FINGERLING	6.0	10,000	T33N R9E S35 -
31	1994	BROWN TROUT	UNSPECIFIED	FINGERLING	6.4	10,000	T33N R9E S35 -
32	1994	WALLEYE	UNSPECIFIED	FINGERLING	3.0	14,700	T33N R9E S35 -
33	1995	BROWN TROUT	UNSPECIFIED	FINGERLING	5.8	11,900	T33N R9E S35 -
34	1995	WALLEYE	UNSPECIFIED	FINGERLING	2.8	14,664	T33N R9E S35 -
35	1997	WALLEYE	UNSPECIFIED	LARGE FINGERLING	2.5	716	T33N R9E S35 -
36	1998	BROWN TROUT	ST. CROIX	LARGE FINGERLING	6.2	10,000	T33N R9E S35 -
37	1998	BROWN TROUT	ST. CROIX	YEARLING	7.5	2,400	T33N R9E S35 -
38	1998	BROWN TROUT	ST. CROIX	YEARLING	9.0	2,500	T33N R9E S35 -
39	1998	WALLEYE	UNSPECIFIED	SMALL FINGERLING	1.5	58,000	T33N R9E S35 -
40	2000	BROWN TROUT	ST. CROIX	LARGE FINGERLING	5.9	10,000	T33N R9E S35 -
41	2000	WALLEYE	LAC COURTE OREILLES	SMALL FINGERLING	1.7	29,200	T33N R9E S35 -
42	2002	WALLEYE	MISSISSIPPI HEADWATERS	SMALL FINGERLING	1.5	430	T33N R9E S35 -

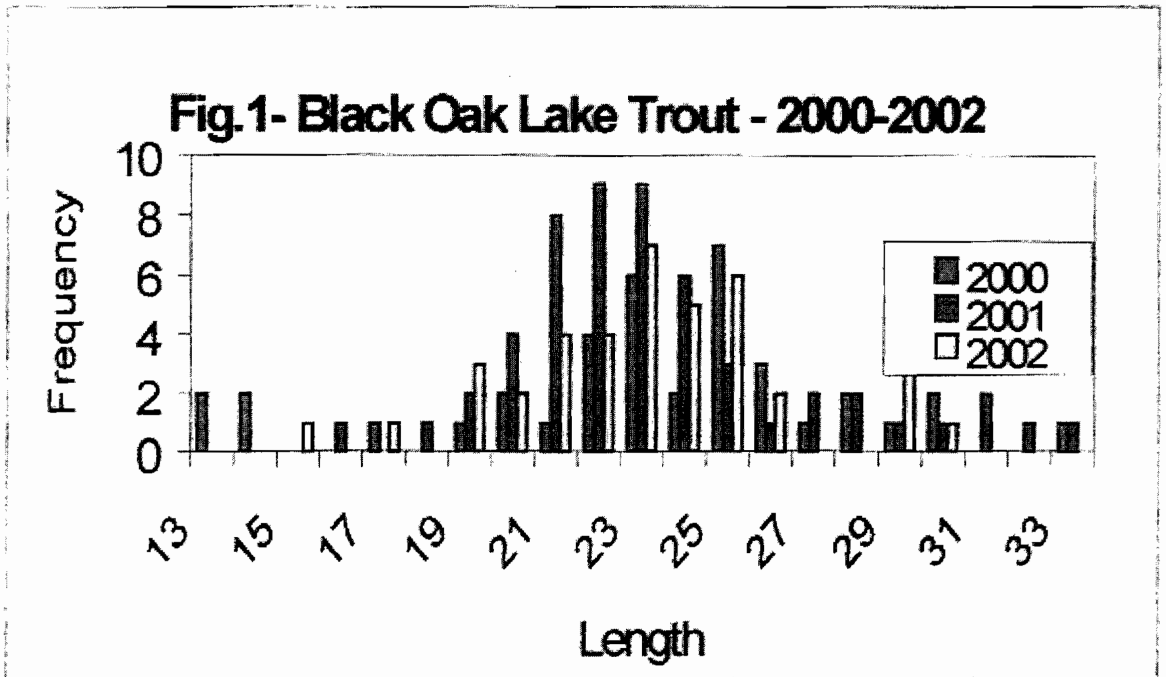
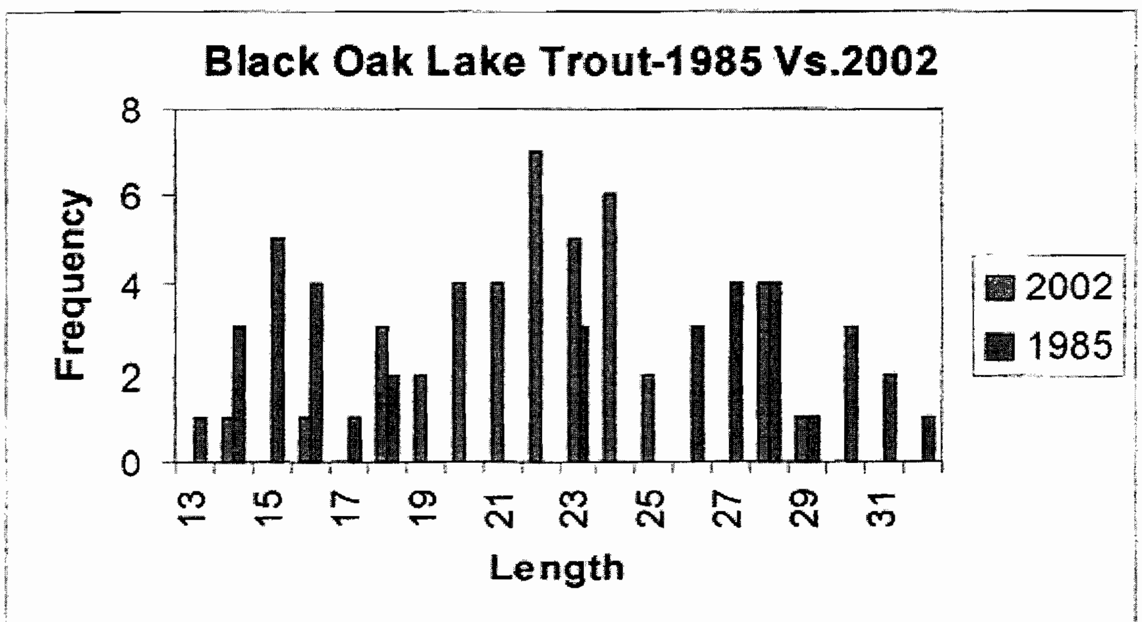


Fig.1- Black Oak Lake Trout - 2000-2002
Frequency
10
8
6
4
2
0
2000
2001
2002
13
15
17
19
21
23
25
27
29
31
33
Length


Black Oak Lake Trout-1985 Vs.2002
Frequency
8
6
4
2
0
2002
1985
13
15
17
19
21
23
25
27
29
31
Length

BLACK OAK LAKE
LAST TWO PAGES

2001 Lake Trout Management

Trout Lake

Summary:

The two lakes identified in the Upper Wisconsin Basin Inland Lake Trout Management Plan for lake trout sampling in 2001 were Trout Lake and Black Oak Lake. Trout Lake has now been sampled annually since 1996, although no fyke netting or floy tagging occurred in 1998. The total number of trout captured has dropped annually, and quite noticeably the last two seasons, particularly in 2001. The two main spawning areas have been designated Headquarters, and Rocky Reef. The latter site has dropped off dramatically (71%) from 231 trout in 1996, to 66 trout in 2001. The Headquarters site has dropped 37% from 264 in 1996, to 194 lake trout captured in 2001. Historical sampling indicates a peak in spawning near November 1, with water temperatures near 46 degrees F. Sampling efforts are planned around this date, but due to abnormal weather patterns the previous two years, water temperatures have been above the optimum of 46 degrees. The drop in catch rates does not correspond to population estimates conducted at these sites using year one as the mark, and year two as the recapture. During this time population estimates have ranged from a low of N= 1415(1997) to a high of N= 1640(2000).

Prior to the ice-angling sample collected in March 2002, five years of sampling yielded only two juveniles. Length frequencies continue to point toward an aging population, with no recruitment of sub-adults. Increasing length at age data, albeit minimal, continues to expand upon our knowledge of longevity for individuals within this population. Otoliths removed from a 30.4 inch male were aged at 40 years old. This fish had a RV stocking clip that when referenced to the above age and the stocking history was determined to be either 39 or 41 years old. Unfortunately the two cohorts were given the same clip, and separated by only one year. The 1960 cohort was of Trout Lake origin, the 1962 cohort was of Lake Superior origin. The capture numbers for these two cohorts have been grouped together and were believed to consist primarily of the Trout Lake strain, however no definitive determination can be made. One thing we can be sure of is that this is a long-lived, old age population with little or no recruitment of sub-adults for the previous five years (1996-2001) into that segment of the spawning population currently sampled.

Due to poor recruitment and the success of previous yearling plants, it is vitally important that an agreement has been made to produce yearling trout of the Trout Lake strain. Approximately 100,000 fry were hatched at the Art Oehmcke Hatchery in January 2002, and will be reared to spring fingerlings. In the spring of 2002 approximately 50,000 of the trout will be transferred to the Westfield hatchery where they will be reared to fall fingerling, with the remaining fingerling being stocked in Pallette Lake. Approximately

25,000 of the fall fingerlings will be reared to yearlings by the Green Lake co-op pond and stocked in Big Green Lake. In the fall of 2002 approximately 20,000 fingerlings will be transferred back to the Oehmcke hatchery where they will be held and stocked as yearlings in the spring of 2003. Although I continue to believe that high-density spring fingerling stocking may provide necessary recruitment, determination of success is several years away. Fall yearling plants have proven successful in the past. In a 1981 gill net survey the 1970, 1971, and 1972 plants of yearling lake trout comprised 69% of the 228 lake trout captured. The current plan is to produce 20,000 yearlings to be stocked in three consecutive years ending in the spring of 2005. All fish will be fin clipped prior to stocking for future identification. Propagation disease concerns will be re-evaluated at this time and the introduction of lake trout into other surrounding waters will be reconsidered.

On May 7, 2001, 100,000 lake trout fingerling averaging 2.1 inches in length, and weighing 490 per pound were stocked in Trout Lake at the South Trout boat landing. The fish were marked with oxytetracycline by submersing in a 500 ppm bath for six hours. One hundred of the fingerlings were held in the hatchery an additional month allowing for growth to help facilitate the removal and examination of the otoliths. Upon examination the OTC mark was present in all specimens, but the quality of the mark was much poorer than previous years samples requiring increased effort and at times an experienced "eye" to detect the mark.

Sampling Results:

A total of four, four-foot fyke nets were set on October 29, 2001 and fished through November 2, 2001. A total of 260 lake trout were captured in 16 net nights yielding a CPE of 16.2 trout per net night. All fish were transported to the Oehmcke Hatchery where they were measured and examined for fin clips, sex, and prior year floy tags. Untagged fish were given an orange floy tag with numbers 1401-1418 representing Rocky Reef fish, and numbers 1201-1258 designating lake trout captured at the Headquarters site. Capture by site was: Headquarters- 194, and Rocky Reef-66. Composition by sex was128 males, and 132 females for a ratio of 0.97 males per female. This ratio has dropped annually from a high of 3.5 males/female in 1996. Males ranged in size from 20.0 – 31.3 inches, and females 20.1 – 33.7 inches. Minimum length has increased annually since 1996 (Figure 1), and average length increased annually until 2001 when it leveled off.

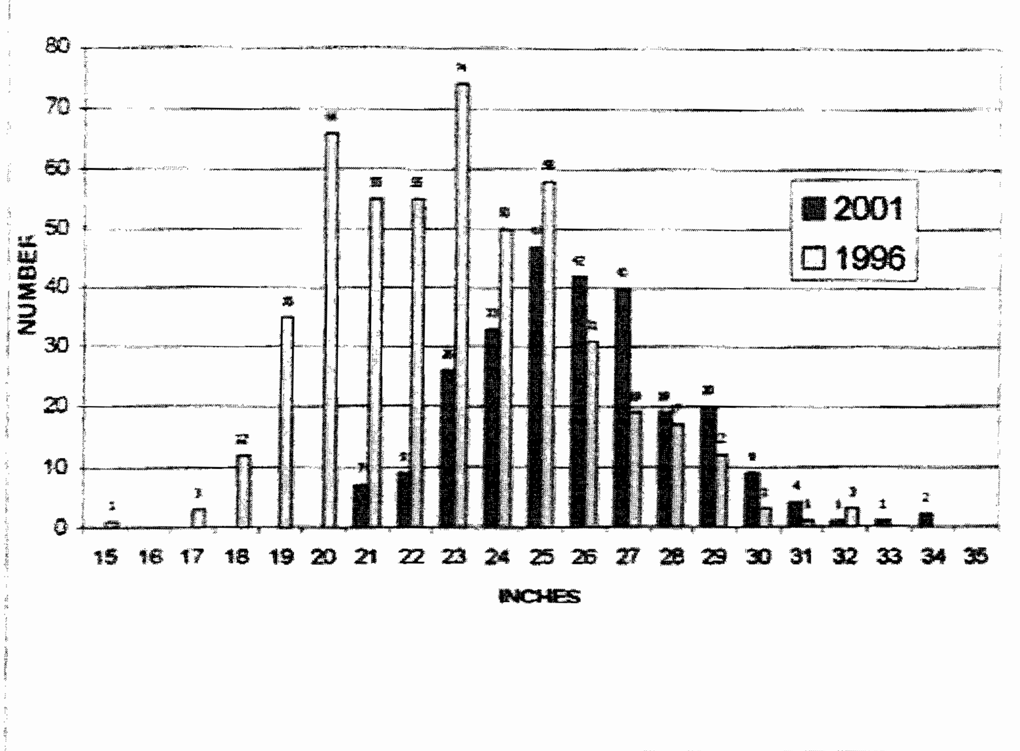


Figure 1. 1996 vs 2001 Trout Lake Lake Trout Length Frequency

The chart below shows average length (inches) by year and sex.

Year	Sexes Combined	Males	Females
2001	25.4	25.0	25.7
2000	25.4	25.2	25.7
1999	24.9	24.7	25.2
1997	23.8	23.4	24.8
1996	23.4	23.1	24.3

Appendix

E

Aquatic Plant Information

Aquatic Biologists, inc.
SINCE 1977

N5174 SUMMIT COURT
FOND DU LAC, WI 54935
(920) 921-6827
FAX: (920) 921-1690
Specialists in Lake & Pond Management, Services, & Supplies

January 8, 2002

Ed Hook
P.O. Box 803
Land O'Lakes, WI 54540

Black Oak Lake (Vilas County) – Re: Eurasian Water Milfoil Survey

On October 11, 2001 several members of the Black Oak Lake Association along with Aquatic Biologists, Inc. visually inspected the entire lake shoreline looking for evidence of E. W. Milfoil.

Five hours were spent on the lake cruising, dragging, and visually inspecting the lake bottom. **<u>During this survey E. W. Milfoil was not observed</u>**. However, three other beneficial milfoil species were identified:

* Dwarf Water Milfoil (M. Tenellum)
* Farwell Milfoil (M. Farwellii) (A rare and threatened endangered species)
    * I.D. was confirmed by Laura Herman (Wisconsin DNR)

Northern Milfoil (M. Sibiricum)

Twenty-three aquatic plant species were identified while looking for E. W. Milfoil. The enclosed lake map shows predominant species locations.

Chara	C	Pickerel Weed	PW
Large Leaf Pondweed	LLPW	Floating Leaf Pondweed	FLPW
Northern Milfoil	NM	Wild Celery	WC
White Water Lily	WWL	Burreed	BR
Yellow Water Lily	YWL	Niade	N
Rushes SPP	R	Mint	M
Water Iris	WI	Small Pondweed	SPW
Fern Weed	FW	Dwarf Milfoil	DM
Cattail	CT	Farwell Milfoil	FM
Elodea	E	Smart Weed	SW
Water Crowfoot	WCF	Bladderwort	BLW
Watershield	WS		

Aquatic Biologists, Inc. would recommend that certain key people within your lake association learn to identify the characteristics of the different milfoil species. Visually inspecting your shorelines along with your boat access sites on occasion should become part of your long-range preventative maintenance plan.

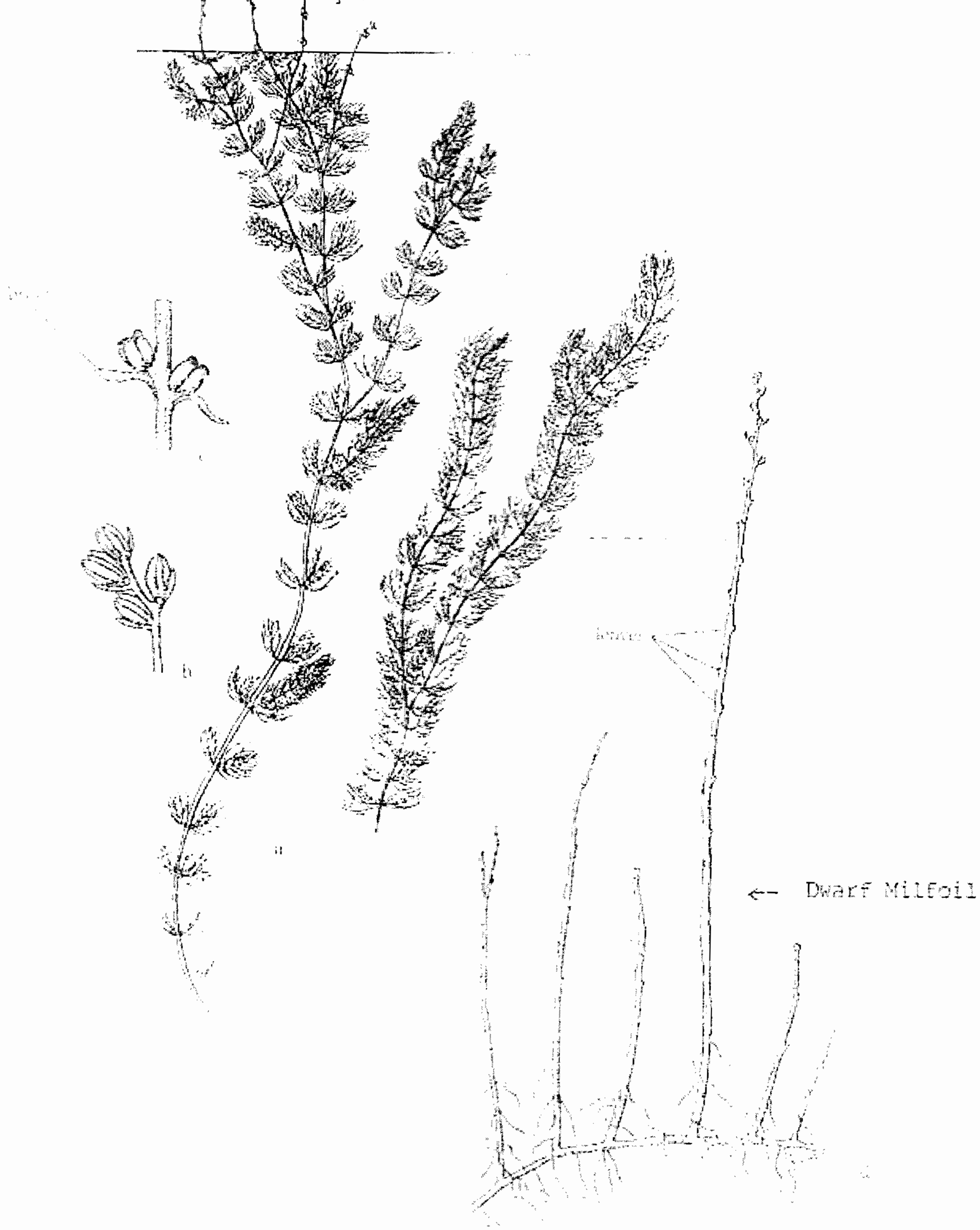
On busy holiday weekends it may be a good idea to assign a volunteer to visually inspect boats entering and leaving your lake. You could also use this time to educate people about your concern, and also address the issue of boats and trailers introducing E. W Milfoil.

If and when you clearly identify E. W. Milfoil in your lake our experience is to address it as soon as possible. Small patches can be removed by digging up the roots and carefully removing the entire plant. Larger areas can be selectively and effectively controlled with (2,4D) Navigate®, a Granular aquatic herbicide. A Wisconsin DNR aquatic plant management permit is required before any chemical application can be made. We would further recommend positive identification on the milfoil before any control measures are made.

Sincerely,

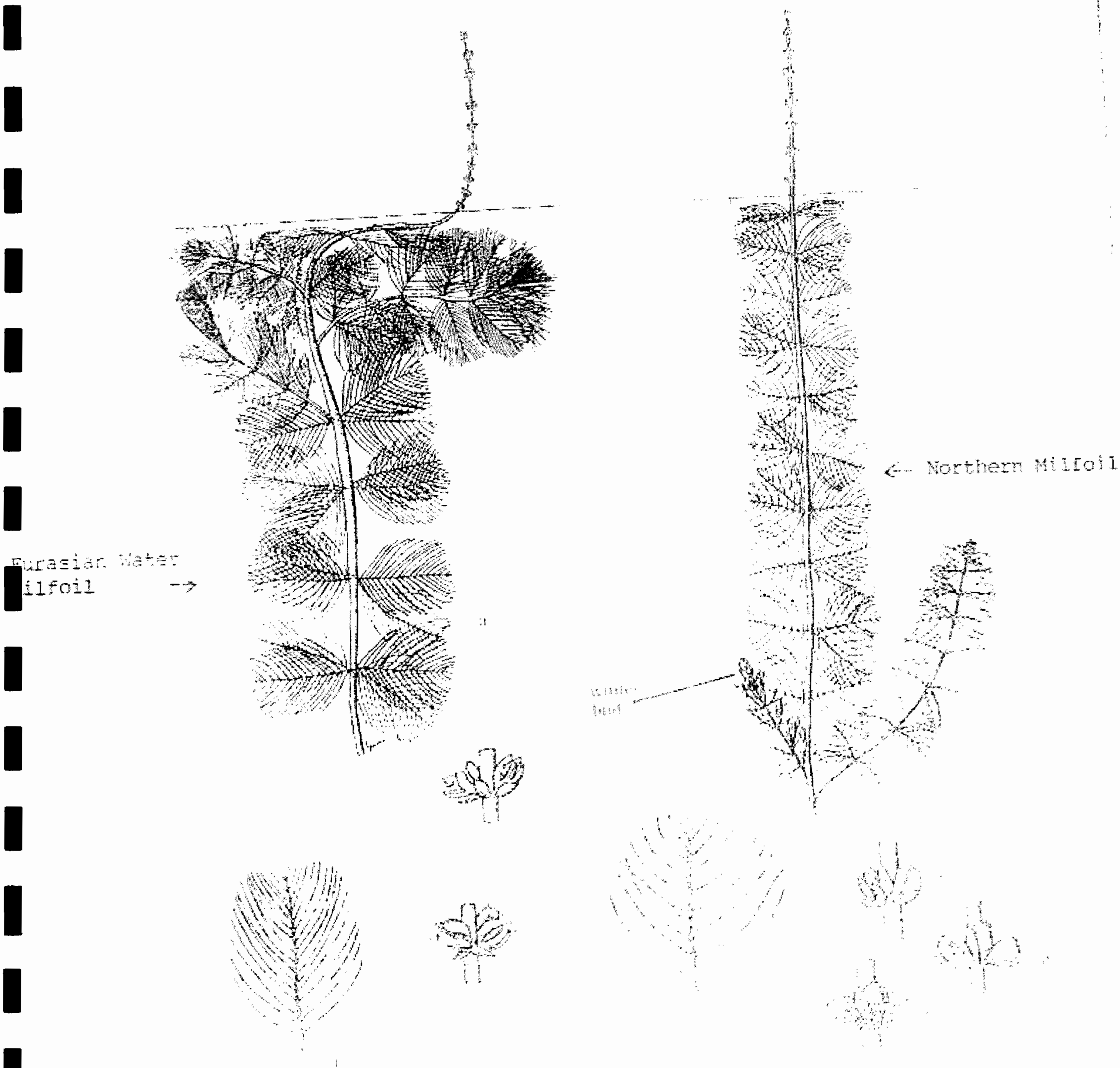
Robert J. Langjahr
RJL/jz
Enclosures

Copied from a Revised and Enlarged Edition of Norman C. Fassett's A Manual of Aquatic Plant
Aquatic And Wetland Plants of Northeastern North America
Volume One PTERIDOPHYTES, GYMNOSPERMS, AND ANGIOSPERMS: DICOTYLEDONS
Garrett E. Crow and C. Barre Hellquist



Myriophyllum alterniflorum, a. habit [illegible]
Myriophyllum tenellum, d. habit (NH) [illegible]

← Farwell Milfoil



Eurasian Water
ilfoil
Northern Milfoil