
Black Oak Lake Watershed Protection Program: Adaptive Lake Management Plan

A Report Integrating:

**Phase I – Information Inventory and Adaptive Lake
Management Plan (2005)**

**Phase II – Aquatic Plant Survey, Dissolved Oxygen
Profiles, Lake Transparency, Lake Trout Management,
Updated Historical Research, and Aquatic Plant
Management Plan (2007)**

**Phase III – Black Oak Lake Littoral Zone and Riparian
Area Condition (Photographic, Qualitative, and
Quantitative Assessment (2008)**

Black Oak Lake Riparian Owners Association



Photo at left: Color infrared
photograph 1998 (near ice-out),
Black Oak Lake at center.

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White Water Associates, Inc.

Black Oak Lake Watershed Protection Program: Adaptive Lake Management Plan

Phases I, II, and III Integrated Report

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Acknowledgments

Phase I

Several dedicated individuals and organizations were important to the completion of Phase I of the Black Oak Lake Watershed Protection Program. Foremost among these is John Annin of the Black Oak Lake Riparian Owners Association (BOLROA). John has been steadfast about getting information to the consultants, arranging and attending meetings, and providing ideas and feedback. BOLROA member Paul McLeod did a stellar piece of research and writing in his contribution of the history of Black Oak Lake. Grace White, long-time lake riparian owner on Black Oak Lake provided encouragement and ideas early on in the Phase I project. Conserve School teacher Jill Graff and Headmaster Stephan Andersen also contributed.

Phase II

Phase II of the Black Oak Lake Watershed Protection Program has benefited from the contributions of a growing number of people. Walt Bates, Eliot Frost, and Tom Rapp carried out Website design and maintenance. Paul McLeod continued documentation of Black Oak Lake history. Susan Knight was the chief scientist on the aquatic plant survey. Walt Bates, John Clarke, Bob Pierce, and John Annin shadowed the plant survey crew in a separate boat, going ahead of the survey crew to determine depth readings with their sonar unit. Ed Hook and Joe Beers head the Black Oak Lake Milfoil Vigilante Program and enjoy contributions of time from many volunteers. The Clean Boats, Clean Waters boat inspection is directed by Bill Hall and is carried out by many inspectors who volunteer their time at the boat landing. John Annin and Walt Bates conduct the Self-Help Water Quality Testing program.

Phase III

Phase III of the Black Oak Lake Watershed Protection Program has benefited from the contributions of Bob & Sara Beedie, George & Kathy Gelb, and Rick & Betsy Woodrow. Joe Beers heads the many volunteers that participate in the Black Oak Lake Milfoil Vigilante Program. The Clean Boats, Clean Waters boat inspection is managed by Walt Bates & Dirk Meyer. Walt Bates heads the Self-Help Water Quality Testing program.

White Water Associates, Inc. scientists Dean Premo and Kent Premo have thoroughly enjoyed working with members of the BOLROA on the Black Oak Lake Watershed Protection Program. We appreciate the opportunity to learn about Black Oak Lake and its surroundings and to play a role in its long-term conservation.

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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 and created the first iteration of the **Black Oak Lake Adaptive Management Plan**. In Phase II, we continued to gather new and existing information about the lake ecosystem and history and created an important component of the Adaptive Management Plan: an Aquatic Plant Management Plan. In Phase III, we conducted a careful qualitative, quantitative, and photographic documentation of the condition of the littoral and riparian zones of Black Oak Lake. Success of future phases depends on a coalition of participants, each carrying out appropriate tasks and communicating needs and findings to other team members. The Black Oak Lake Riparian Owners Association (BOLROA) is the lead organization in this long-range effort.

This document integrates products of Phases I, II, and III of the Black Oak Lake Watershed Protection Program. This program has received funding from three Wisconsin Department of Natural Resources (WDNR) Lake Planning Grants awarded to the BOLROA. White Water Associates, Inc. (White Water), an independent ecological consulting firm, was contracted by BOLROA to carry out significant components of the Phases I, II, and III projects. Phase I focused on an inventory of relevant information on Black Oak Lake and produced the first iteration of an Adaptive Lake Management Plan. Phase II continued information gathering and incorporated an aquatic plant management plan. Phase III focused on the littoral and riparian zones of the lake. 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 program believe that the tool by which to realize this vision is a protection-oriented¹ adaptive management plan for Black Oak Lake and its watershed.

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

Project participants continue to embrace 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 is therefore 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. With this document, the Black Oak Lake Adaptive Management Plan displays its adaptive nature. We have revised the plan by incorporating new information and new planning elements. This new version of the plan is intended to supplant the 2007 document.

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 and the methodology used in all aspects of Phases I, II, and III. Chapter 5 presents the findings from efforts to gather existing information about Black Oak Lake and its environs by providing summaries of information in eleven 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.

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 implementers 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.

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. The BOLROA and this plan endeavor 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 management 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 concerned 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).

How Was the Plan Made?

During Phase I (reported on first in the 2005 version of this plan), a team of consulting scientists (White Water) working with BOLROA, prepared the first version of 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 Phase I 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. In Phase II, new information on lake water quality and the aquatic plant community was collected and incorporated into this revised version of the 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. In Phase I, 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. During Phase II, we followed scientifically established protocols in collecting new data on aquatic plants, water clarity, and dissolved oxygen (described later in this chapter).

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 the first part of this Chapter we describe these Phase I 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 indicator(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.

The methods that we used in Phase II followed closely the goals, objectives, and tasks described in the Phase II Planning Grant Proposal submitted to the WDNR. The Phase II goals (as stated in the Lake Planning Grant proposal) were to: (1) systematically document the aquatic plant community in Black Oak Lake using the WDNR protocol for aquatic plant survey (version 3/16/06); (2) increase our knowledge regarding the dissolved oxygen and other limnological characteristics of Black Oak Lake; (3) uncover potential reasons for the change (increase) in water clarity; (4) participate in lake trout management; and (5) gather and interpret additional historical data on Black Oak Lake. There are several objectives and associated tasks that support these goals and we consider these in the next several paragraphs.

The first objective was to systematically document the aquatic plant community in Black Oak Lake using the WDNR protocol for aquatic plant survey (version 3/16/06). Preliminary to an actual survey we accomplished the task of reviewing the recent aquatic macrophyte data collected by Trout Lake Research Station students on Black Oak Lake and comparing the recent aquatic macrophyte data with that collected in the past. We also decided to incorporate findings from a Eurasian milfoil survey that was conducted in fall 2005. The final tasks under this objective were to conduct the survey of aquatic plants in Black Oak Lake using WDNR protocol and to analyze and interpret this botanical data and incorporate a written description into the Phase II Black Oak Lake Adaptive Management Plan. The results and a thorough description of the methods used are presented in Chapter 5, Part 5. The electronic results of the aquatic plant survey were submitted to the WDNR.

The second objective was to conduct frequent dissolved oxygen profiles and analysis and continue other limnological monitoring in Black Oak Lake. In fact, the first task called for collecting monthly DO and temperature profiles in Black Oak Lake. BOLROA members collected monthly DO and temperature profiles using a YSI dissolved oxygen meter and following manufacturers recommended procedures for calibration. The DO profile was conducted in the deepest part of Black Oak Lake (approximately 80 feet). The second task called for continuing with basic lake monitoring efforts as part of the Self-Help program. The final tasks under this objective called for managing the water quality data in electronic form, conducting basic quality assurance/quality control checks, and summarizing data in understandable form in the Phase II version of the Black Oak Lake Adaptive Management Plan.

The third objective addressed the recent observations (beginning in 2005) of increased water clarity in Black Oak Lake by monitoring transparency and trying to elucidate potential reasons for the changes in clarity. The first task called for measuring Secchi disk transparency for Black Oak Lake on a weekly basis during the entire ice-free season. The second task and third tasks called for developing a possible set of causes for the increase in transparency and summarizing these in the Phase II Black Oak Lake Adaptive Management Plan.

The fourth objective was for the BOLROA to participate in management of the Black Oak Lake lake trout population by meeting with the WDNR fish managers, developing a position on fish community management, and providing assistance to the WDNR. The final task called for incorporating a report of these topics into the Phase II adaptive management plan.

In Phase I, a BOLROA member prepared a human and geological history of Black Oak Lake. At the close of that phase, additional historic information was discovered and a fifth objective (and associated tasks) of Phase II was to gather and interpret this historical data on Black Oak Lake and integrate findings into the Phase II Black Oak Lake Adaptive Management Plan.

The sixth objective of our Phase II project was to integrate the Phase II findings into the new version of the Black Oak Lake adaptive management plan. Finally, the seventh objective was for BOLROA to create and manage a website devoted to Black Oak Lake.

The methods that we used in Phase III followed closely the goals, objectives, and tasks described in the Phase III Planning Grant Proposal submitted to the WDNR. The Phase III overarching goal (as stated in the Lake Planning Grant proposal) was to: document the benchmark condition of the Black Oak Lake “shoreline” (including the near-shore littoral

zone and the near-shore riparian area). The Phase III goal was supported by four objectives and we describe these and their associated work tasks in remainder of this section.

The first objective was to systematically document the littoral zone and riparian area condition of Black Oak Lake using digital photography. White Water staff trained BOLROA volunteers to conduct the digital photography and global positioning system (GPS) fieldwork and to manage digital photography data. Once trained the volunteer team deployed and systematically collected digital photos of the shoreline. These digital photos were conveyed to White Water where they were integrated into an interactive electronic archive that includes geographic information and qualitative assessment of littoral zone and riparian area. The advancement of digital photography provides an efficient tool for application in documenting the existing conditions along the shoreline of Black Oak Lake. Add this to the technology of “global positioning systems” or “GPS” and a straight-forward qualitative assessment of shoreline conditions and were able to create a practical imaged-based archive of lakefront conditions that can be used to monitor long and short term changes. A prototype of this image-based waterfront archive was developed by White Water Associates with funding and guidance from the WDNR in 2001. The field effort for the Black Oak Lake 2008 study involved a team aboard a suitable watercraft and armed with digital camera, GPS, map, and data forms for recording qualitative data collected on specific stretches of waterfront. The watercraft was positioned at a fairly uniform distance from shore (about 200 feet). Every 250-300 feet a GPS reading was obtained and a photograph was taken perpendicular to the shore at a standardized focal length.

The second objective was to qualitatively document the littoral zone and riparian area of Black Oak Lake using a volunteer-based rapid assessment technique. White Water staff trained the BOLROA volunteer work team to conduct qualitative assessment of Black Oak Lake shoreline. A simple checklist of shoreline characteristics was completed that coincided with the subject shoreline of each photograph. The volunteer team collected this data at the same time as the digital photography-GPS fieldwork. They maintained qualitative data sheets that were conveyed to White Water for inclusion in the interactive electronic archive.

The third objective was to quantitatively document the littoral zone and riparian area of Black Oak Lake using an established USEPA Lake Assessment Procedure combined with the Wisconsin Department of Natural Resources Supplemental Lakeshore Assessment. The USEPA has recently developed a methodology for surveying the

Nation's lakes (USEPA. 2007. *Survey of the Nation's Lakes. Field Operations Manual. EPA 841-B-07-004. U.S. Environmental Protection Agency, Washington, DC.*)². This method is being applied in various states and in 2007, White Water Associates assisted the Michigan Department of Environmental Quality conducted an assessment on a lake in Sylvania Tract (immediately north of Black Oak Lake). A more detailed USEPA is provided in Appendix G. Following the USEPA procedure, White Water scientists established ten physical habitat ("P-Hab") stations around Black Oak Lake prior to visiting the field (Appendix G contains a map of Black Oak Lake that presents the ten "P-Hab" stations). Once in the field, White Water scientist Dean Premo (assisted by BOLROA member Bob Beedie) recorded measurements following USEPA procedure at the P-Hab stations, including: physical habitat characterization, littoral zone habitat characterization, riparian zone habitat characterization, benthic macroinvertebrate sampling, and fecal indicator sampling. Coincident with this task, Dr. Premo conducted the WDNR Supplemental Lakeshore Assessment protocol (this protocol enhances some of the USEPA protocol and makes it more relevant to Wisconsin lakes). Since a point-intercept plant survey has already been conducted, the aquatic plant portion of the supplemental assessment was not conducted. The WDNR protocol is also included in Appendix G. White Water managed and analyzed the data from the quantitative habitat assessment.

The fourth objective was to integrate the findings from the 2008 work into a new version of the Black Oak Lake Adaptive Management Plan. This work was conducted by White Water.

² The manual can be downloaded at:
http://www.epa.gov/owow/lakes/lakessurvey/pdf/lakes_field_op_manual.pdf

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. In Phase I we focused the analysis on existing information relating to the Black Oak Lake. We sought out the kind of information that was useful to devising and implementing an adaptive management plan for the lake. We simply asked: “What is known about the lake and its surroundings?” The analysis has made us aware of what is not known as well. Phase II sought to add additional information – some collected as original research data from the lake ecosystem and some existing information that continues to be discovered. As with the Phase I version of the plan, information gaps have been identified (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 information about Black Oak Lake and its surroundings.

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 ten Parts. The first seven include descriptions of the lake; geologic, glacial, and human history; water quality; fisheries; aquatic plants; rare species; and exotic species. The eighth section summarizes threats to Black Oak Lake and its watershed. The ninth section describes the Black Oak Lake Geographic Information System (GIS) project. Finally, the tenth section introduces the Black Oak Lake website.

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.

Conserve School is a unique riparian resident of Black Oak Lake. This boarding school for grades 9-12 emphasizes environmental studies. It was established in 1996 as the wish of the late James R. Lowenstine who bequeathed his wealth and 1,200 acres of 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 available for monitoring 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 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 result of the combined interaction of human and natural processes, with humans nowadays serving as the most significant agents of change.

During Phase I, Paul McLeod (BOLROA member and local historian) prepared a history of Black Oak Lake. In Phase II, Mr. McLeod integrated newly discovered information and photographs into the human and geological history description and this is included in its entirety in Appendix B.

Part 3. Black Oak Lake Water Quality

Black Oak Lake has high water quality. The BOLROA and others have participated in the WDNR Self-Help Monitoring Program in 2002, 2003, 2004, 2005, and 2006.³ 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)⁴ 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. Secchi Disk transparencies ranged from 15 feet to 17 feet in the summer months of 2002-2004. 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).

BOLROA members report that spring 2005 Secchi Disk transparencies were more than double those typically observed. In order to track this phenomenon, Secchi Disk transparencies were collected monthly in 2005 and weekly during 2006. The pattern of increased transparencies (as compared to earlier years) has continued. Data from 2005 and 2006 are presented in Table 1. The average Secchi Disk transparencies for 2005 and 2006 were nearly 28 feet.

³ Electronic data can be accessed through the WDNR at <http://www.dnr.state.wi.us/org/water/fhp/lakes/lakesdatabase.asp>

⁴ TSI is determined using a mathematical formula and values for Secchi disk depth, phosphorus concentration, and Chlorophyll “a” concentration. TSI values range from 0 to 100, with lakes that are less fertile having lower TSI values.

Table 1. Weekly Secchi Readings in Black Oak Lake (2005 & 2006).

2005 Readings		2006 Readings	
Date	Secchi Depth (ft)	Date	Secchi Depth (ft)
---	---	5/2	15
---	---	5/9	15
---	---	5/16	18
---	---	5/23	20
5/31	42	5/30	25
---	---	6/8	36
---	---	6/13	43
---	---	6/21	42
6/29	30	6/26	40
---	---	7/5	36
---	---	7/11	31
7/19	27	7/23	26
---	---	7/28	27
---	---	8/10	27
---	---	8/16	26
8/24	24	8/22	28
---	---	9/2	26
9/9	20.5	9/7	26
---	---	9/13	27
9/21	25	9/19	26
---	---	9/28	22.5
---	---	10/4	26
10/10	24	10/10	28
MEAN DEPTH	27.5	MEAN DEPTH	27.7

Reasons for an increase in lake transparency are unknown. A shift in the food web may play a role. The cisco population has become quite low. Ciscos are a primary food source for Lake Trout and walleye. Ciscos are also efficient zooplanktivores. A possible pathway for higher water transparency is: low cisco population > higher zooplankton population > more cropping of phytoplankton by zooplankters > few phytoplankton means higher water clarity. This and other possible explanations require more investigation.

Lake temperature data taken as part of the volunteer monitoring program shows that Black Oak Lake stratifies by temperature and dissolved oxygen (DO) in the warm season. Because temperature and DO relationships are crucial to the unique population of Lake Trout in Black Oak Lake, seven profiles were taken during 2006 (presented in Table 2).

Table 2. Dissolved oxygen and temperature profiles for Black Oak Lake in 2006.											
February 14, 2006			May 2, 2006			June 13, 2006			July 23, 2006		
Meters	DO	TMP	Meters	DO	TMP	Meters	DO	TMP	Meters	DO	TMP
3	12.8	35.6	3	12.9	48.0	3	9.7	66.7	3	8.6	75.1
5	11.5	35.9	5	12.9	47.9	5	9.8	66.4	5	8.7	75.0
10	11.0	37.1	10	12.9	47.7	10	9.9	65.8	10	8.6	75.0
20	10.8	37.5	20	13.0	47.1	20	13.1	56.7	20	8.6	74.5
30	10.6	37.8	30	10.3	45.3	30	13.6	52.2	30	12.9	56.5
40	9.7	38.0	40	11.0	44.8	40	14.1	49.5	40	12.4	51.1
50	9.0	38.2	50	12.4	43.9	50	9.8	46.4	50	8.9	47.9
60	7.5	38.4	60	11.8	43.1	60	5.6	44.0	60	2.2	44.7
70	5.3	38.6	70	9.1	41.8	70	4.0	43.0	70	0.2	43.7
80	0.6	39.0	80	8.4	41.5	80	2.6	42.8	80	0.1	43.3
85	0.3	39.2	85	0.4	41.4	85	0.1	42.6	85	0.1	43.2
August 22, 2006			September 27, 2006			October 10, 2006					
Meters	DO	TMP	Meters	DO	TMP	Meters	DO	TMP			
3	8.9	72.1	3	8.6	58.1	3	11.0	55.6			
5	9.0	72.1	5	8.4	58.3	5	11.1	55.6			
10	9.0	72.0	10	8.6	58.4	10	11.1	55.5			
20	9.0	71.6	20	8.8	58.2	20	11.1	55.3			
30	12.6	60.3	30	8.5	58.2	30	11.2	55.3			
40	11.1	52.5	40	8.5	56.3	40	11.1	55.2			
50	6.1	47.7	50	3.7	48.5	50	7.8	51.9			
60	0.2	44.9	60	0.1	45.4	60	0.2	46.3			
70	0.1	43.9	70	0.1	43.9	70	0.2	44.6			
80	0.1	43.8	80	0.0	43.5	80	0.1	43.9			
85	0.1	43.7	85	0.0	43.5	85	0.1	43.7			

Depth is given in meters.
DO (dissolved oxygen) is given in mg/L.
Temperature is given in degrees Fahrenheit.

During Phase I, Black Oak Lake chemistry data for 2002 and 2003 were analyzed. These data are summarized in Table 3 and laboratory reports are in Appendix C. The pH values hover around neutral, although a one-time measure of alkalinity shows this parameter to be fairly low. In 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 nitrate+nitrite were among the parameters measured in Black Oak Lake in 2002 and 2003. Results for epilimnion and hypolimnion samples are in Table 3. Nitrogen in the water samples was low, especially inorganic forms (ammonia and nitrate+nitrite) probably due to algal uptake. 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 nitrogen (Shaw *et al.* 2002). The “rule of thumb” is, 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 (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.

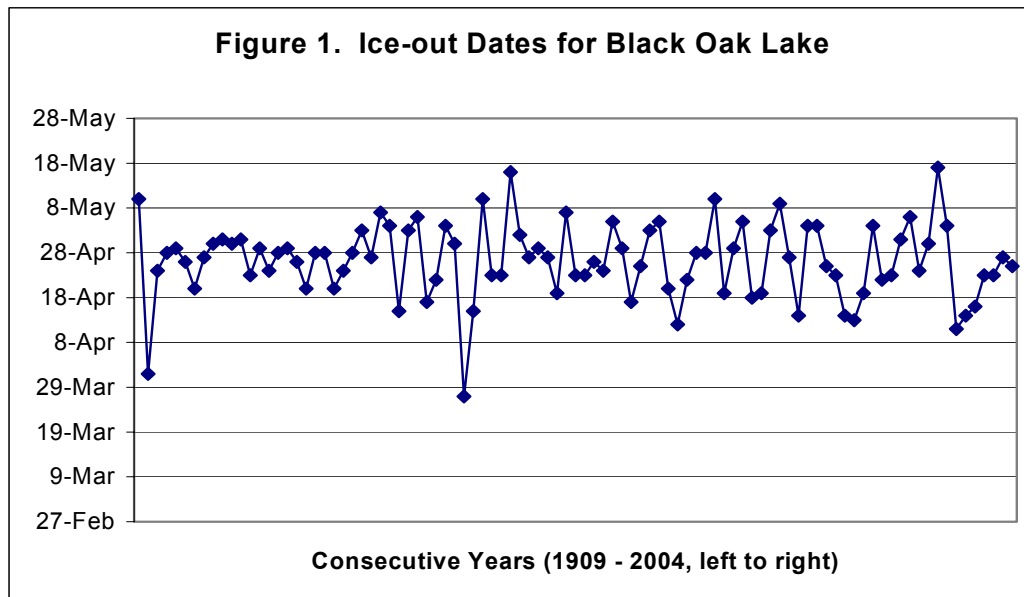
Table 3. Black Oak Lake Water Quality Data for 2002 & 2003										
	9/24 2002	10/23 2002	10/23 2002	2/19 2003	2/19 2003	5/29 2003	5/29 2003	6/30 2003	7/18 2003	8/27 2003
	surface	surface	bottom	surface	bottom	surface	bottom	surface	surface	surface
Ammonia (mg/L)	ND			0.032		ND		ND		
Nitrate+Nitrite (mg/L)	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/L CaCO ₃)								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 4. Although no quality assurance/quality control data are provided with these data, they seem to be fairly consistent with other Black Oak Lake data. These data also show that dissolved oxygen can become depleted at the deep point in the lake. The BOLROA continues with Self-Help data collection and hope to summarize and analyze the entire data set in the future.

Table 4. 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
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	Surface		0.5	0.34	0.39	0.36		

Table 4. 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
(mg/L)	Bottom		0.92	0.36	0.38	1.5		
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.



Part 4. Black Oak Lake Fisheries

Black Oak Lake has a diverse fish community 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 community has been augmented by stocking. Available stocking records (see Appendix D) for Black Oak Lake extend back to 1951. Introduced fish species 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 are not native to the lake. Walleye have been the most aggressively managed fish in Black Oak Lake (documentation in Appendix D). The primary recruitment source for this fish is from stocking and recent surveys indicate that there is a fairly high 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.

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)⁵. These two

⁵ This publication is available via the world-wide-web at:
http://www.selu.edu/Academics/Faculty/kpiller/pdfs/Piller_et_al_2005.pdf

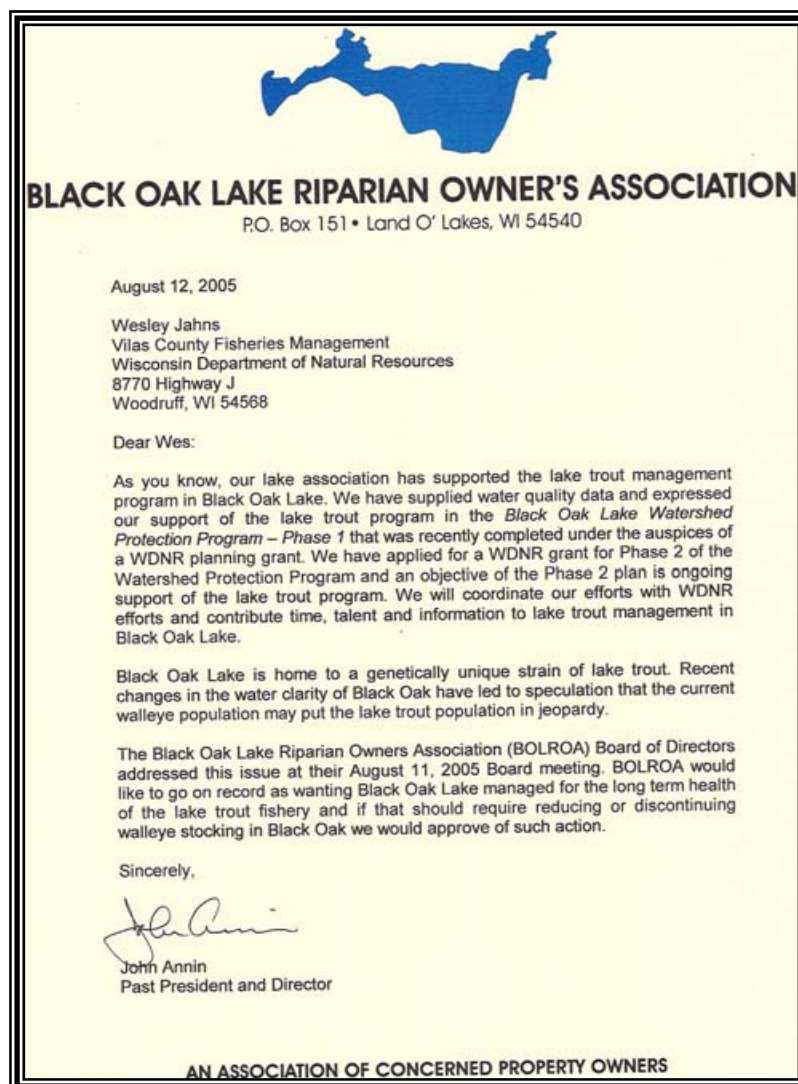
populations represent the only two extant populations of lake trout indigenous to the Upper Mississippi River Basin. Recent genetic testing has shown the Black Oak Lake population to be genetically distinct from all others. Thus, the Black Oak Lake's population of lake trout represents an absolutely 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).

In an effort to safeguard the unique lake trout of Black Oak Lake the WDNR netted fish in the fall of 2005 and collected gametes (eggs and milt) prior to releasing the fish. The eggs were fertilized and raised to fry in the hatchery. Fry were then planted in Big Carr Lake (Oneida County), Long Lake (Vilas County), and Lucerne Lake (Forest County).

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."

The BOLROA has been keenly interested in lake trout management on Black Oak Lake. The organization articulated its position in a letter (8/12/05) to Wes Jahns (WDNR Fisheries). The letter was reviewed at the August 11, 2005 meeting of the BOLROA Board of Directors the Board voted 10-0 to support this position. It is reprinted on the following page.



As of late fall 2006, e-mail correspondence of WDNR Fish Biologist Stephen Gilbert (contained in Appendix D) states the goal of needing to balance the lake trout and walleye fisheries with the available forage (ciscoes) in Black Oak Lake. He states that the best way to do this is with fishing regulations and controlling walleye stocking. The WDNR goal is to maintain the Lake Trout adult numbers at 0.5 or better per acre and keep the adult walleye numbers more in the 1.5 per acre range. By this approach, the WDNR hopes to maintain the trout fishery, provide a trophy walleye fishery, and keep the cisco population healthy. According to Gilbert, the WDNR and GLIFWC (Great Lakes Indian Fish and Wildlife Commission) will continue to conduct annual fall surveys to monitor walleye recruitment in Black Oak Lake. In 2007 the WDNR will conduct a

monitoring survey of Black Oak Lake. This will involve small mesh fyke netting and crayfish trapping in August and electrofishing in September. If funds are available, the WDNR may return to Black Oak Lake in the spring of 2008 for a comprehensive survey of the fishery. This would include a population estimate of the entire walleye population and possibly gill netting for ciscoes. Based on the results from a 2008 survey, the WDNR will evaluate the status of the walleye fishery and decide at that time if walleye stocking should be resumed or possibly trying again to get a trophy walleye regulation passed. The WDNR also plans a fall survey of the lake trout in two or three years.

Part 5. Black Oak Lake Aquatic Plants

Black Oak Lake has a diverse aquatic plant community as has been shown by collections on the lake. 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 the lake, identifying species and recording distribution within the lake. The Conserve School aquatic plant data is archived by teacher Jill Graff.

In October of 2005, White Water Associates field biologist David Tiller conducted a survey for Eurasian Water Milfoil in Black Oak Lake. This species was not found during the survey.

In 2006, a systematic aquatic plant survey following the WDNR aquatic plant survey protocol was conducted. The remainder of this section presents the methodology and findings from that extensive work. Dr. Susan Knight (WDNR and University of Wisconsin-Madison Center for Limnology) was a principal in this survey and contributed to this portion of the report. Appendix F contains an Aquatic Plant Management Plan that was prepared specifically for Black Oak Lake.

In the last few years, the WDNR has adopted a new and rigorous approach in how they deal with many aquatic plant (lake weed) issues. First, they realized that many citizens and lake groups requested permits every year to harvest or chemically treat nuisance plants, with no accounting of how successful they were. Second, the WDNR realized that they could get more information from their own routine plant sampling surveys by taking advantage of new technologies such as the Global Positioning System (GPS). In order to address both issues, the WDNR, with help from the Minnesota DNR, developed a new plant sampling survey system designed to systematically examine all parts of the lake. The protocol calls for using a rake sampler to determine what species are present, where they occur, at what depths they are found, and in what kind of substrate. The spatially explicit information can be used to create a variety of ecologically based maps such as the location of an invasive plant, where the plants grow most densely, or how a species of special concern is distributed. The survey will serve as a baseline for the future, and will be especially important should there be any changes in the lake such as a change in water level or an invasion of an exotic species.

The WDNR launched the new plant survey protocol in 2005. After some early experience and revisions, the WDNR adjusted the protocol and resumed its use in 2006. Most lake groups creating an aquatic plant management plan, requesting a permit to do a large-scale chemical treatment, or getting assistance from the WDNR with aquatic plant issues are asked to perform a plant survey according to this new protocol.

This survey protocol is called a *point-intercept sampling scheme* because we collect data all over the lake, instead of sampling along a few straight lines laid out perpendicular to the shore (as was done by WDNR plant sampling crews prior to 2005). The first step is to lay an electronic grid (like a sheet of graph paper) over a map of the lake. This step is done by Dr. Jen Hauxwell, an aquatic biologist with the WDNR's Integrated Science Services, who receives requests and determines the number of sampling points on this grid. This sampling density depends on the acreage of the lake, the depth contours of the lake, and the convolutions of the shoreline. There is a latitude and longitude associated with each intersection point on the grid. These coordinates are loaded into a computer file and then loaded into a global positioning (GPS) unit.

We conducted the Black Oak Lake survey on July 10 and 11, 2006. The weather was excellent for performing the survey. Field staff included Dr. Dean Premo (White Water), Mr. David Tiller (White Water), and Dr. Susan Knight (WDNR-University of Wisconsin). We used a White Water Associates' watercraft outfitted with a 9.9 HP Honda 4-stroke engine. BOLROA members Walt Bates, John Annin, John Clarke, and Bob Pierce assisted from a second boat.

Armed with a GPS unit (loaded with GPS points spread over the lake), a couple of sampling rakes, and empty data sheets, we headed out to the lake. The sampling rake is a double-headed metal rake secured to a pole expandable to 15 feet. For deeper points, we use another double-headed rake weighted and attached to a rope. The boat driver (Dr. Premo) used the GPS unit to navigate to each point, sometimes having to skip points too shallow or too choked with plants. Dr. Premo called out the depth from his electronic depth finder, and the sampler (Dr. Knight) used the rake-on-a-pole (if the depth was less than 15 feet) or the rake-on-a-rope to scrape the lake bottom and haul up the catch of aquatic plants. Dr. Knight called out the depth and sediment type (muck, sand or rock). She then identified each plant caught on the rake, and gave each species an abundance rating of 1 (few plants), 2 (moderate amount), or 3 (plants overflowing the rake). Mr. Tiller recorded all the data and kept track of what points still need to be sampled.

We started in the west bay of Black Oak Lake and immediately found a wide diversity of plants. One of the first species we encountered was purple bladderwort, a very interesting carnivorous plant that eats mostly zooplankton. We had to skip a number of sites in this bay as dense stands of water lilies and other vegetation prevented boat operation and the protocol demands that if we cannot reach a point by motoring or fairly easy paddling, we skip it in the interest of time.

We gradually moved east, coming into some deeper areas of the lake, with a bit less diversity. In deep lakes, such as Black Oak, plants will not grow below a certain depth. In each lake, this depth will be different, mostly due to differences in water clarity. We must sample many deep points before we can be sure we have identified the maximum rooting depth. In Black Oak Lake, we sampled all designated GPS points less than 25 feet in depth. Once this maximum plant depth was established, we watched the depth finder and did not sample deeper points. In Black Oak Lake, that meant that we did not sample over half of our assigned points. This was taken into consideration when the points were assigned so we still had good coverage of the lake. Table 5 presents the various plant encountered during the Black Oak Lake survey.

Table 5. Plants recorded during the 2006 Aquatic Plant Survey on Black Oak Lake

1. filamentous algae	15. <i>Nitella</i> sp., Stonewort
2. <i>Brasenia schreberi</i> , Watershield	16. <i>Nymphaea odorata</i> , White water lily
3. <i>Chara</i> , Muskgrasses	17. <i>Polygonum amphibium</i> , Water smartweed
4. <i>Elatine minima</i> , Waterwort	18. <i>Pontederia cordata</i> , Pickerelweed
5. <i>Eleocharis acicularis</i> , needle spikerush	19. <i>Potamogeton amplifolius</i> , Large-leaf pondweed
6. <i>Elodea canadensis</i> , Common waterweed	20. <i>Potamogeton gramineus</i> , Variable pondweed
7. <i>Isoetes</i> sp.	21. <i>Potamogeton natans</i> , Floating-leaf pondweed
8. <i>Juncus palocarpus</i> f. <i>submersus</i> , Brown-fruited rush	22. <i>Potamogeton pusillus</i> , Small pondweed
9. <i>Lobelia dortmanna</i> , Water lobelia	23. <i>Potamogeton robbinsii</i> , Robbins pondweed
10. <i>Megalodonta beckii</i> , Water marigold	24. <i>Sparganium americanum</i> , American bur-reed
11. <i>Myriophyllum alterniflorum</i> , Alternate-leaved water milfoil	25. <i>Utricularia purpurea</i> , Large purple bladderwort
12. <i>Myriophyllum sibiricum</i> , Northern water milfoil	26. <i>Vallisneria americana</i> , Wild celery
13. <i>Myriophyllum tenellum</i> , Dwarf water milfoil	27. <i>Nuphar variegata</i> , Yellow pond lily (observed, but not recorded on sample points)
14. <i>Najas flexilis</i> , Bushy pondweed	

This represents an excellent diversity of plants and these species are typical of a healthy, low to moderately fertile lake. We found no invasive plant species. Table 6 provides a summary of the distribution of aquatic plants over the survey points in Black Oak Lake and demonstrates an old ecological truism: “it is common to be rare and rare to be common.” In other words, only a few plants in Black Oak Lake could be considered “common” when it comes to their distribution among the study points. On the other hand, quite a number of plants could be considered “rare.” The most common plant is *Potamogeton robbinsii* as it was found on 174 of the 303 points sampled. A distant second-most common plant was *Potamogeton amplifolius* (found at 70 of the 303 points). Third most common was *Myriophyllum tenellum* (found at 47 of the 303 points). *Elodea Canadensis* and *Najas flexillus* were fourth and fifth most common, respectively. At the other end of the spectrum, nine species of aquatic plants were found at three or fewer of the 303 points sampled (“it’s common to be rare”). More than half of the plant species encountered was found at ten or fewer sites.

Table 6. Black Oak Lake Aquatic Plant Distribution in 2006				
Aquatic Plant	Number of Sites Where Found	Relative Frequency (%)	Frequency of Occurrence Within Vegetated Areas (%)	Frequency of Occurrence at All Sites <Maximum Depth of Plants (%)
Filamentous algae	8	1.6	3.2	2.6
<i>Brasenia schreberi</i> (Watershield)	6	1.2	2.4	2.0
<i>Chara</i> (Muskgrasses)	25	5.0	8.2	9.8
<i>Elatine minima</i> (Waterwort)	1	0.2	0.3	0.4
<i>Eleocharis acicularis</i> (Needle spikerush)	11	2.2	3.6	4.3
<i>Elodea Canadensis</i> (Common waterweed)	36	7.2	11.9	14.2
<i>Isoetes</i> sp.	3	0.6	1.0	1.2
<i>Juncus paleocarpus</i> f. <i>submerses</i> (Brown-fruited rush)	8	1.6	2.6	3.2
<i>Lobelia dortmanna</i> (Water lobelia)	3	0.6	1.0	1.2
<i>Megalodonta beckii</i> (Water marigold)	6	1.2	2.0	2.4
<i>Myriophyllum alterniflorum</i> (Altern.-leaved water milfoil)	3	0.6	1.0	1.2
<i>Myriophyllum sibiricum</i> (Northern water milfoil)	8	1.6	2.6	3.2
<i>Myriophyllum tenellum</i> (Dwarf water milfoil)	47	9.4	15.5	18.5
<i>Najas flexilis</i> (Bushy pondweed)	31	6.2	10.2	12.2
<i>Nitella</i> sp. (Nitella)	5	1.0	1.6	2.0
<i>Nymphaea odorata</i> (White water lily)	11	2.2	3.6	4.3
<i>Polygonum amphibium</i> (Water smartweed)	1	0.2	0.3	0.4
<i>Potamogeton amplifolius</i> (Large-leaf pondweed)	70	14.1	23.1	27.6
<i>Potamogeton gramineus</i> (Variable pondweed)	15	3.0	5.0	5.9
<i>Potamogeton natans</i> (Floating-leaf pondweed)	1	0.2	0.3	0.4
<i>Potamogeton pusillus</i> (Small pondweed)	1	0.2	0.3	0.4
<i>Potamogeton robbinsii</i> (Robbins pondweed)	174	35.0	57.4	68.5
<i>Sparganium americanum</i> (American bur-reed)	1	0.2	0.3	0.4
<i>Utricularia purpurea</i> (Large purple bladderwort)	2	0.4	0.7	0.8
<i>Vallisneria Americana</i> (Wild celery)	21	4.2	6.9	8.3

Table 7 provides further summary of the aquatic plant data collected during the 2006 aquatic plant survey. It provides several measures of diversity (such as species richness and Simpson Diversity Index).

Table 7. Black Oak Lake 2006 Aquatic Plant Species Survey Summary	
Total number of points sampled	303
Total number of sites with vegetation	254
Total number of sites shallower than maximum depth of plants	303
Frequency of occurrence at sites shallower than maximum depth of plants	83.83
Simpson Diversity Index	0.83
Maximum depth of plants (feet)	29.00
Number of sites sampled using rake on Rope (R)	80
Number of sites sampled using rake on Pole (P)	223
Average number of all species per site (shallower than max depth)	1.64
Average number of all species per site (vegetated sites only)	1.96
Average number of native species per site (shallower than max depth)	1.62
Average number of native species per site (vegetated sites only)	1.96
Species Richness	25
Species Richness (including visuals)	25
Species Richness (including boat survey)	27

Many of the parameters presented in Table 6 and Table 7 can be used as measures against which to detect change in the plant community of Black Oak Lake. Changes in species frequency or distribution, for example may indicate some broader change in the ecosystem. The maximum depth of rooted plants for example might be subject to change because of the higher transparency of Black Oak Lake water. These data form a valuable baseline of information for Black Oak Lake.

Recently, scientists in Wisconsin have developed a botanical metric called the “Floristic Quality Index” (FQI) to help assess lake quality using the aquatic plants that live in a lake. A group of botanical experts have assigned values called the “coefficient of conservatism” (“C”) to 128 of Wisconsin’s aquatic plants, indicating how typical a plant is of pristine conditions. A plant found only in clear, low nutrient and undisturbed conditions is given a “C” value of 10. Plants found in more nutrient rich and/or disturbed waters are given lower “C” values. The FQI varies from lake to lake in Wisconsin but ranges from 3.0 to 44.6 with a median value of 22.2 for those lakes studied. The FQI is valuable for comparing lakes around the state or looking at a single lake over time. Generally, higher FQI numbers indicate better lake quality. The calculated FQI for Black Oak Lake is 34.9.

The finding of purple bladderwort in the west bay of Black Oak Lake is noteworthy and deserves attention. Though native, this plant has become a nuisance in many lakes, especially in recent years, though no one really knows why. It is actually quite rare in Wisconsin, but for some reason is often abundant when it occurs. Members of the BOLROA should be alert to observed changes in this plant's population.

In performing a plant survey such as the Black Oak Lake survey, there must be a compromise between spending a reasonable amount of time on data collection and adequately sampling the lake. There were a few species we saw traveling from point to point, but did not collect or see near a point. Also, because of the steep pitch of the lake bottom, we did not have very many sampling points along much of the north and south shores of the central body of the lake. Because the lake is so big, our sampling points were roughly spaced one per acre. At this spacing, the grid did not always situate a point very close to shore. As shoreline and shallow points are often more diverse than deeper sites, we may have missed a few species growing close to shore, or missed some occurrences of some species seen elsewhere in the lake. Those WDNR staff involved with developing the plant survey protocol are aware of and continue to think how best to address this limitation. Another challenge of this kind of survey protocol is that rare plants are sometimes missed. For example, we did not observe any Farwell milfoil (*Myriophyllum farwellii*) that had been previously documented in Black Oak Lake. It is possible that a new infestation of an invasive species might also be missed by this kind of survey since the plant would be "rare" in the early stages of infestation.

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 the previous section, a Wisconsin Special Concern plant, Farwell's water milfoil (*Myriophyllum farwellii*) was identified in a 2001 aquatic vegetation survey, but not located in 2006. 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. A 2005 (October) survey for Eurasian Water Milfoil conducted by White Water Associates found none of this aquatic invasive species.

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. 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, grease, and oil into wetlands and surface water and have significant impact. Non-native species can pose important small-scale threats. 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>.

Part 10. The Black Oak Lake Website

The BOLROA has now established a website that serves as a clearing-house and educational resource for all things Black Oak Lake. It can be found at the following address:

www.blackoaklake.com

Part 11. Condition of Littoral Zone and Riparian Area

The major goal of the Phase III Black Oak Lake study has been accomplished. The current condition of the littoral zone and near shore riparian area was carefully and thoroughly documented in 2008. This assessment will stand as a baseline against which future changes can be measured. In this section, we summarize the findings and products of the littoral zone and riparian zone assessment.

A major component of documenting the littoral zone and near shore riparian area was a systematic coverage of the entire shoreline with digital photography. The volunteer team collected a total of 231 photos that capture the state of the shoreline in summer of 2008. This average length of shoreline captured by each photo is approximately 170 feet. Each photo was accompanied by a latitude and longitude position of the photographer. The digital photos have been incorporated into an interactive electronic archive that can be easily accessed for future reference or study. CDROM versions of the electronic archive reside with BOLROA, WDNR, and White Water Associates.

An associated product of the photographic documentation was the qualitative assessment of each of the 231 shoreline segments that were depicted in the photographs. At the time the photograph was taken, the BOLROA volunteer team did a rapid qualitative assessment of shoreline condition. This information has also been integrated into the electronic archive for future reference.

As was described in Chapter 4, we applied the U.S. EPA Lake Assessment Procedure and the Wisconsin Department of Natural Resources Supplemental Lakeshore Assessment in order to quantitatively document the Black Oak Lake littoral zone and near-shore riparian area. We summarize the results in the remainder of this Part.

Average depth of the ten stations was 3.65 feet (the range was from 2 to 7 feet). No surface film was observed at any of the ten stations. Table 8 contains the littoral zone bottom substrate data collected from the ten Black Oak Lake sampling stations. Bedrock and boulders were not observed at bottom substrate in any of the ten stations. Silt, clay, muck was the most commonly encountered substrate type (found at eight of ten stations) and sand was the next most common (found at seven of ten stations). Gravel and woody debris substrate types were each encountered at six of the ten stations. Gray colored sediment was encountered at nine of ten stations (vegetation covered the sediment at the tenth station making color assessment impossible). No odor was associated with the bottom substrate in any of the ten stations.

Table 8. USEPA Habitat Characterization – Littoral Zone Bottom Substrate										
Station	A	B	C	D	E	F	G	H	I	J
Bedrock	0	0	0	0	0	0	0	0	0	0
Boulders	0	0	0	0	0	0	0	0	0	0
Cobble	0	0	0	0	0	0	1	2	1	0
Gravel	0	0	0	2	0	3	2	3	3	3
Sand	0	0	0	3	2	3	4	2	2	3
Silt, Clay, Muck	4	4	4	1	3	2	0	0	1	1
Woody Debris	1	1	0	1	0	0	1	0	1	1
Organic	0	0	4	0	2	0	0	0	0	0
Color	Gray	Gray	Veg.	Gray	Gray	Gray	Gray	Gray	Gray	Gray
Odor	None	None	None	None	None	None	None	None	None	None
Bedrock (>4000mm); Boulders (250-4000mm); Cobble (64-250mm); Gravel (2-64mm); Sand (0.02-2mm); Silt, Clay, or Muck (<0.06mm, not gritty). 0=Absent (0%); 1=Sparse (<10%); 2=Moderate (10-40%); 3=Heavy (40-75%); 4=Very Heavy (>75%)										

Table 9 presents the observations made on aquatic macrophytes in the littoral zone. Submergent macrophytes were observed at nine of ten stations. Emergent macrophytes were not observed at any of the ten stations. Five of the ten stations had floating macrophytes present. Total macrophyte cover was “absent” at three stations, “sparse” at three stations, or “moderate” at three stations. “Very heavy” total macrophyte cover was observed at one station. Macrophytes extended lakeward from the stations in eight of ten stations.

Table 9. USEPA Habitat Characterization – Littoral Zone Aquatic Macrophytes										
Station	A	B	C	D	E	F	G	H	I	J
Submergent	1	1	4	1	0	2	1	2	2	2
Emergent	0	0	0	0	0	0	0	0	0	0
Floating	1	1	4	1	0	0	0	0	0	1
Total Aquatic Macrophyte Cover	1	1	4	1	0	2	0	0	2	2
Do macrophytes extend lakeward from plot?	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes
0=Absent (0%); 1=Sparse (<10%); 2=Moderate (10-40%); 3=Heavy (40-75%); 4=Very Heavy (>75%)										

Littoral zone fish cover observations are presented in Table 10. Aquatic and/or inundated herbaceous vegetation was observed at seven of ten stations, but was typically sparse (less than 10% cover). Woody debris and snags greater than 0.3 meters in diameter were observed at seven of the ten stations and had sparse or moderate coverage. Woody brush/woody debris less than 0.3 meters in diameter was found at three of the ten stations. Inundated live trees (greater than 0.3 meters in diameter) were not observed at any station. Overhanging vegetation within one meter of the surface was observed at one station. Ledges or sharp drop-offs were observed at one station and boulders were not observed at any of the ten stations. Finally, human structures (such as docks) were not observed as fish cover at any of the stations.

Table 10. USEPA Habitat Characterization – Littoral Zone Fish Cover										
Station	A	B	C	D	E	F	G	H	I	J
Aquatic & Inundated Herbaceous Cover	1	1	4	2	0	0	0	1	1	2
Woody Debris/Snags >0.3 m dia.	1	1	0	0	2	2	1	0	1	1
Woody Brush/ Woody Debris <0.3 m dia.	1	0	0	0	0	2	1	0	0	0
Inundated Live Trees >0.3 m dia.	0	0	0	0	0	0	0	0	0	0
Overhanging veg. w/in 1 m of surface	0	0	0	0	1	0	0	0	0	0
Ledges or Sharp Drop-offs	0	0	0	0	2	0	0	0	0	0
Boulders	0	0	0	0	0	0	0	0	0	0
Human Structures (docks, landings, etc.)	0	0	0	0	0	0	0	0	0	0
0=Absent (0%); 1=Sparse (<10%); 2=Moderate (10-40%); 3=Heavy (40-75%); 4=Very Heavy (>75%)										

Table 11 presents observations made on the riparian zone canopy (greater than 5 meters high), understory (0.5 to 5 meters high), and ground cover (<0.5 meters high). Mixed (conifer and deciduous) canopy type was observed in nine of the ten stations and deciduous canopy type was observed at one station. The coverage of big trees (>0.3 meters diameter) was moderate to heavy (very heavy at one station) and coverage of small trees (<0.3 meters diameter) was moderate to heavy (very heavy at two stations). Mixed (conifer and deciduous) understory type was observed at all ten stations. Coverage of understory woody shrubs and saplings was heavy (at three stations), very heavy (at three stations), moderate (at two stations), or sparse (one station). Tall herbs, grasses, and forbes were present at nine of ten stations with sparse coverage (five stations), heavy coverage (three stations), or very heavy coverage (one station). Ground cover woody shrubs and saplings were observed at all ten stations with coverages of sparse (two stations), moderate (six stations), and heavy (two stations). Understory herbs, grasses, and forbes were observed at all ten stations with coverages of sparse (two stations), moderate (four stations), or heavy (four stations). Standing water or inundated vegetation was not observed at any station. Barren, bare, dirt, or buildings was observed at two stations (each with moderate coverage).

Table 11. USEPA Habitat Characterization – Riparian Zone										
Station	A	B	C	D	E	F	G	H	I	J
CANOPY (>5 m high)										
Type	Mix	Mix	Mix	Dec	Mix	Mix	Mix	Mix	Mix	Mix
Big Trees (Trunk >0.3 m dia.	2	1	3	3	3	3	3	2	2	4
Small Trees (Trunk <0.3 m d.	3	3	3	3	4	3	2	2	2	4
UNDERSTORY (0.5 to 5 m high)										
Type	Mix	Mix	Mix	Mix	Mix	Mix	Mix	Mix	Mix	Mix
Woody Shrubs and Saplings	3	4	4	2	4	3	2	2	1	3
Tall Herbs, Grasses, Forbes	3	4	3	1	1	1	0	1	1	3
GROUND COVER (<0.5 m high)										
Woody Shrubs and Saplings	2	3	1	2	3	2	2	1	2	2
Herbs, Grasses and Forbes	3	3	2	3	2	2	1	3	1	2
Standing Water/ Inundated Veg.	0	0	0	0	0	0	0	0	0	0
Barren, Bare Dirt, or Buildings	0	0	0	2	0	0	0	0	2	0
0=Absent (0%); 1=Sparse (<10%); 2=Moderate (10-40%); 3=Heavy (40-75%); 4=Very Heavy (>75%); Mix = Mixed conifer and deciduous; Dec = Deciduous										

Table 12 presents observations recorded on the riparian shoreline substrate zone. Bedrock or boulder substrate was not observed at any of the ten stations. Cobble substrate was observed at seven of the ten stations with sparse or moderate coverage. Gravel substrate was observed at eight of ten stations and ranged from sparse to very heavy coverage. Sand substrate was observed at nine of ten stations and ranged from sparse to very heavy coverage. Silt, clay, or muck substrate was observed at one station and had very heavy coverage at that station. Woody debris was observed at four of ten stations in light or moderate coverage. Organic (leaf pack, detritus) was observed at one station and had heavy coverage. Vegetation was observed at two of the ten stations with sparse or moderate coverage.

Table 12. USEPA Habitat Characterization – Riparian Zone – Shoreline Substrate Zone										
Station	A	B	C	D	E	F	G	H	I	J
Bedrock	0	0	0	0	0	0	0	0	0	0
Boulders	0	0	0	0	0	0	0	0	2	0
Cobble	2	0	0	0	1	1	1	2	1	2
Gravel	3	2	0	0	4	1	4	4	2	2
Sand	2	2	0	4	2	4	2	1	1	3
Silt, Clay, Muck	0	0	4	0	0	0	0	0	0	0
Woody Debris	1	0	1	0	2	2	0	0	0	0
Organic (leaf pack, detritus)	0	0	3	0	0	0	0	0	0	0
Vegetation or other	0	2	1	0	0	0	0	0	0	0
0=Absent (0%); 1=Sparse (<10%); 2=Moderate (10-40%); 3=Heavy (40-75%); 4=Very Heavy (>75%)										

Observations on human influence in the riparian zone are contained in Table 13. Human influence was quite low. Buildings were observed outside of the plot at three of the ten stations. Docks or boats were observed inside the plot at one station and outside the plot at two stations. Lawn was observed outside the plot at one station. All other human influences (commercial development, park facilities, man-made beaches, walls, dikes or revetments, landfill/trash, roads or railroads, powerline, row crops, pasture/range/hayfield, and orchards) were not observed at any of the ten stations.

Table 13. USEPA Habitat Characterization – Riparian Zone – Human Influence Zone										
Station	A	B	C	D	E	F	G	H	I	J
Buildings	0	0	0	P	P	0	0	0	P	0
Commercial	0	0	0	0	0	0	0	0	0	0
Park Facilities/ manmade beach	0	0	0	0	0	0	0	0	0	0
Docks/Boats	0	0	0	C	0	P	0	P	0	0
Walls, dykes, revetments	0	0	0	0	0	0	0	0	0	0
Landfill/Trash	0	0	0	0	0	0	0	0	0	0
Roads or Railroad	0	0	0	0	0	0	0	0	0	0
Powerline	0	0	0	0	0	0	0	0	0	0
Rowcrops	0	0	0	0	0	0	0	0	0	0
Pasture/Range/Hayfield	0	0	0	0	0	0	0	0	0	0
Orchard	0	0	0	0	0	0	0	0	0	0
Lawn	0	0	0	0	0	0	0	0	P	0
0 = Not Present; P = Present outside plot; C = Present within plot										

Table 14 reports the observations made on littoral fish macrohabitat classification. Human disturbance was observed at three of ten stations and was either low (one station) or moderate (two stations). Cover class was recorded as “patchy” at five of ten stations, as “no/little” at four stations and “continuous” at one station. Cover type was recorded as “woody” at three of ten stations, as “vegetation” at six of ten stations, and absent at one station. Dominant substrate was recorded as “sand/gravel” at seven stations and as “mud/muck” at three stations.

Table 14. USEPA Habitat Characterization – Littoral Zone Macrohabitat Classification										
Station	A	B	C	D	E	F	G	H	I	J
Human Disturbance	None	None	None	Mod	None	Mod	None	Low	None	None
Cover Class	Patchy	Patchy	Contin	No/Lit	Patchy	Patchy	No/Lit	No/Lit	No/Lit	Patchy
Cover Type	Woody	Veg	Veg	Veg	Woody	Woody	None	Veg	Veg	Veg
Dominant Substrate	M/M	M/M	M/M	S/G	S/G	S/G	S/G	S/G	S/G	S/G
Mod = Moderate; Contin = Continuous Cover; No/Lit = No or Little Cover; M/M = Mud/Muck; S/G = Sand/Gravel										

Within plot bank features are presented in Table 15. Bank angle was considered “steep” at three stations, “gradual” at six stations, and “flat” at one station. The vertical height from waterline to the high water mark was 0.3 meters at all stations. The horizontal distance from waterline to the high water mark averaged 1.8 meters (range was 1 to 3 meters).

Table 15. USEPA Habitat Characterization – Within Plot Bank Features										
Station	A	B	C	D	E	F	G	H	I	J
Angle	Grad	Flat	Grad	Grad	Steep	Grad	Steep	Grad	Steep	Grad
Vertical Height (m) from water line to HWM	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Horizontal Distance (m) to HWM	1	1	2.5	2	1.5	2	3	2	1.5	2
HWM = High Water Mark; Flat = <5 degrees; Grad = Gradual (5-30 degrees); Steep (30-75 degrees)										

None of the target invasive species were observed in the littoral plot or the shoreline/riparian plot (see Table 16).

Table 16. USEPA Habitat Characterization – Invasive Plant Species										
Station	A	B	C	D	E	F	G	H	I	J
Target Invasive Species in Littoral Plot	None	None	None	None	None	None	None	None	None	None
Target Invasive Species in Shore-line/Riparian Plot	None	None	None	None	None	None	None	None	None	None
Target Invasive Species include: Zebra or Quagga Mussel, Eurasian Watermilfoil, Hydrilla, Curly Pondweed, African Waterweed, Brazilian Waterweed, European Water Chestnut, Water Hyacinth, Parrot Feather, Yellow Floating Heart, Giant Salvinia, Purple Loosestrife, Knotweed (Giant or Japanese), Hairy Willow Herb, Flowering Rush										

The Wisconsin Department of Natural Resources Supplemental Methodology observations are presented in Tables 17 and 18. A photo was taken of each of the ten stations and these ten photos are contained in Appendix G. Table 17 shows a total of 267 pieces of small woody material (>5cm diameter) was counted all ten littoral zone transects (average of 26.7 pieces per station). A total of 46 pieces of large woody material was tabulated in the same ten transects (4.6 pieces per station on average). None of the five target invasive species (Japanese stiltgrass, reed canary grass, Phragmites, cattails, or yellow iris) were observed at any of the ten stations.

Table 17. WDNR Supplemental Methodology to USEPA Habitat Characterization – Wood and Invasive Plant Species										
Station	A	B	C	D	E	F	G	H	I	J
Wood: >5cm diameter	90	52	7	18	60	14	5	0	10	11
Wood: >10cm diameter	12	4	0	0	14	5	1	0	5	5
Invasive: Japanese stiltgrass	No	No	No	No	No	No	No	No	No	No
Invasive: Reed canary grass	No	No	No	No	No	No	No	No	No	No
Invasive: Phragmites	No	No	No	No	No	No	No	No	No	No
Invasive: Cattails	No	No	No	No	No	No	No	No	No	No
Invasive: Yellow Iris	No	No	No	No	No	No	No	No	No	No

Table 18 tabulates that seawalls, riprap, artificial beach, and pavement were not observed in either the riparian plot or the upland plot at any of the ten stations. Lawn was observed in the upland plot at one station. Residences were observed in the upland plot of three of the ten stations. Boat lifts were observed in the riparian plot of two stations and docks were observed in the riparian plot of two stations. The WNDR protocol called for counting the number of piers between each of the ten stations (this amounts to a count of the total number of piers on Black Oak Lake. Table 18 gives the counts for each of the ten intervals. A total of 122 piers were counted on the entire perimeter of Black Oak Lake.

Table 18. WNDR Supplemental Methodology to USEPA Habitat Characterization – Landcover, Human Development, and Piers										
Station	A	B	C	D	E	F	G	H	I	J
LANDCOVER (if 1 number is given it's for riparian plot; if 2 numbers given, the 1 st is for riparian plot & 2 nd for upland plot) Key: 0 (0-1%), 1 (>1-10%), 2 (>10-40%), 3 (>40-75%), 4 (>75%)										
Seawall	0	0	0	0	0	0	0	0	0	0
RipRap	0	0	0	0	0	0	0	0	0	0
Artificial beach	0	0	0	0	0	0	0	0	0	0
Lawn	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/4	0/0
Pavement	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
HUMAN DEVELOPMENT (1 number given for riparian plot; if 2 numbers, 1 st for riparian plot & 2 nd for upland plot)										
Residences	0/0	0/0	0/0	0/1	0/0	0/1	0/0	0/0	0/1	0/0
Commercial buildings	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
Structures (sheds/boat houses)	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
Boat lifts	0	0	0	0	0	1	0	1	0	0
Swim rafts	0	0	0	0	0	0	0	0	0	0
Docks	0	0	0	1	0	0	1	0	0	0
NUMBER OF PIERS BETWEEN STATIONS										
From:	A-B	B-C	C-D	D-E	E-F	F-G	G-H	H-I	I-J	J-A
Count	6	10	18	15	23	25	8	0	7	10

The U.S.EPA protocol called for a composite sample of aquatic benthic macroinvertebrates, combining net sweeps from each station into one sample. Table 19 provides the identified invertebrate taxa and counts of individuals by taxa for the composite sample. A total of twelve taxa and 192 individual organisms were identified.

Table 19. Composite Benthic Macroinvertebrate Sample from Black Oak Lake			
Taxon	Count	Taxon	Count
Annelida: Oligochaeta (aquatic worm)	2	Zygoptera (damselflies): Coenagrionidae	6
Crustacea: Amphipoda (freshwater shrimp, scuds)	75	Trichoptera (caddisflies): Limnephilidae	2
Crustacea: Decapoda (crayfish)	1	Diptera (true flies): Ceratopogonidae	32
Crustacea: Isopoda (isopods)	26	Diptera (true flies): Chironomidae (midges)	9
Ephemeroptera (mayflies): Baetidae	21	Gastropoda (snails): Physidae	2
Anisoptera (dragonflies): Libellulidae	10	Gastropoda (snails): Planorbidae	6

Finally, the U.S.EPA protocol called for a “fecal indicator” sample at the final sampling station (Station J). In the case of Black Oak Lake, we analyzed the sample collected at Station J for *Escherichia coli* (*E. coli*). One sample and one duplicate were collected. The *E. coli* analysis resulted in values of 1 and 0 CFU (“colony forming units”) per 100 milliliters of sample. To place this value in context, the U.S.EPA recommends a water quality advisory (for swimming) when levels of the indicator bacterium *E. coli*, exceeds a limit is 235 CFU in 100 milliliters of water.

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.

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 program vision. These partners include the members of the Black Oak Lake Riparian Owners Association, 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 future phases 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.

Status: Ongoing.

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.

Status: Ongoing.

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.

Status: Not yet undertaken.

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.

Status: Not yet undertaken.

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.

Status: Completed.

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.

Status: Ongoing.

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.

Status: Completed as part of the 2008 project.

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.

Status: Not yet undertaken.

Action (Research): Conduct careful mapping of selected patches of aquatic macrophytes, including species present and relative abundances. As an example, the population of purple bladderwort would be an appropriate subject for this kind of focused study.

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.

Status: This was essentially completed as part of the systematic plant survey in work.

Action (Research): Continue to track Secchi Depth transparencies and determine reason for the high readings in found in 2005 and 2006.

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.

Status: Ongoing.

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.

Status: Not yet undertaken.

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.

Status: Not yet undertaken.

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.

Status: Completed in 2008.

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.

Status: Not yet undertaken, although qualitatively addressed in the 2008 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).

Status: Not yet undertaken.

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.

Status: Not yet undertaken.

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.

Status: Not yet undertaken.

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.

Status: Ongoing.

Action (Research): Summarize and analyze the Self Help water quality data for Black Oak Lake through the most current year.

Objective: To understand the long-term basic water quality in Black Oak Lake and plan any necessary remediation if poor water quality trends are observed.

Monitoring: Results will be reported in future iterations of the adaptive management plan.

Status: Not yet undertaken.

Action (Protection): Develop limnological, ecological, and sociological indicators for future monitoring. This was originally planned for Phase I, but is recommended for the future phases as additional information is 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.

Status: Not yet undertaken.

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.

Status: Not yet undertaken.

Future phases of the Black Oak Lake Watershed Protection Program will build on the foundation established in Phases I, II and III. 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.

Phase II has accomplished an important milestone for the Black Oak Lake Watershed Protection Program: the integration of the Black Oak Lake Aquatic Plant Management Plan. This was possible because of the rigorous survey of aquatic plants in the lake conducted in the summer of 2006. This arms the BOLROA with appropriate tools to efficiently address the discovery of an aquatic invasive plant or an imbalance of native plants. Phase III accomplished a second milestone in documenting the condition of the littoral and riparian zones of Black Oak Lake.

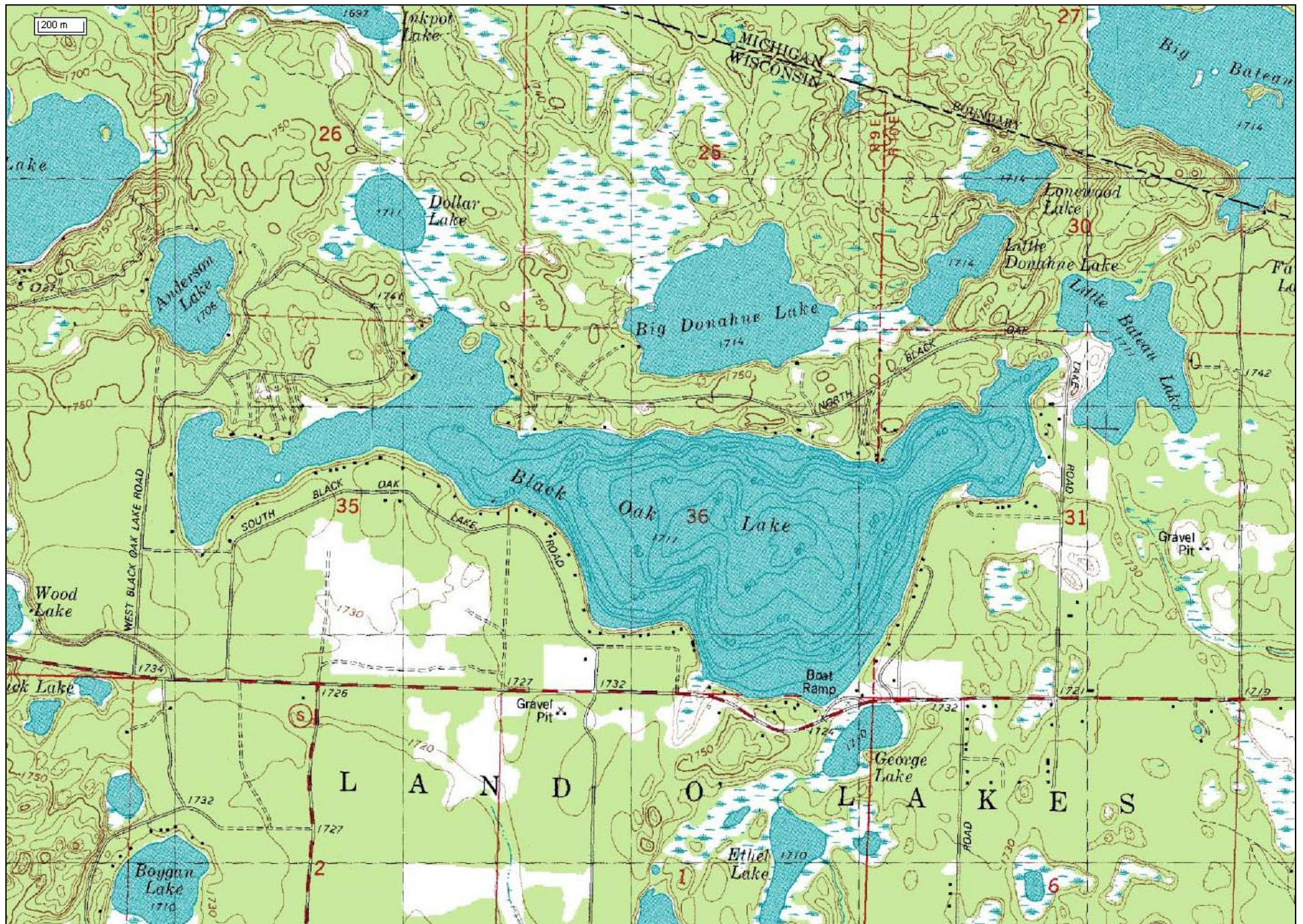
Black Oak Lake and its watershed serve its human residents well. But, in order for future generations to enjoy all of the opportunities and services that the watershed can provide, this adaptive plan should be embraced, developed, and implemented. Implementation has begun and momentum is mounting based on the work that has already occurred.

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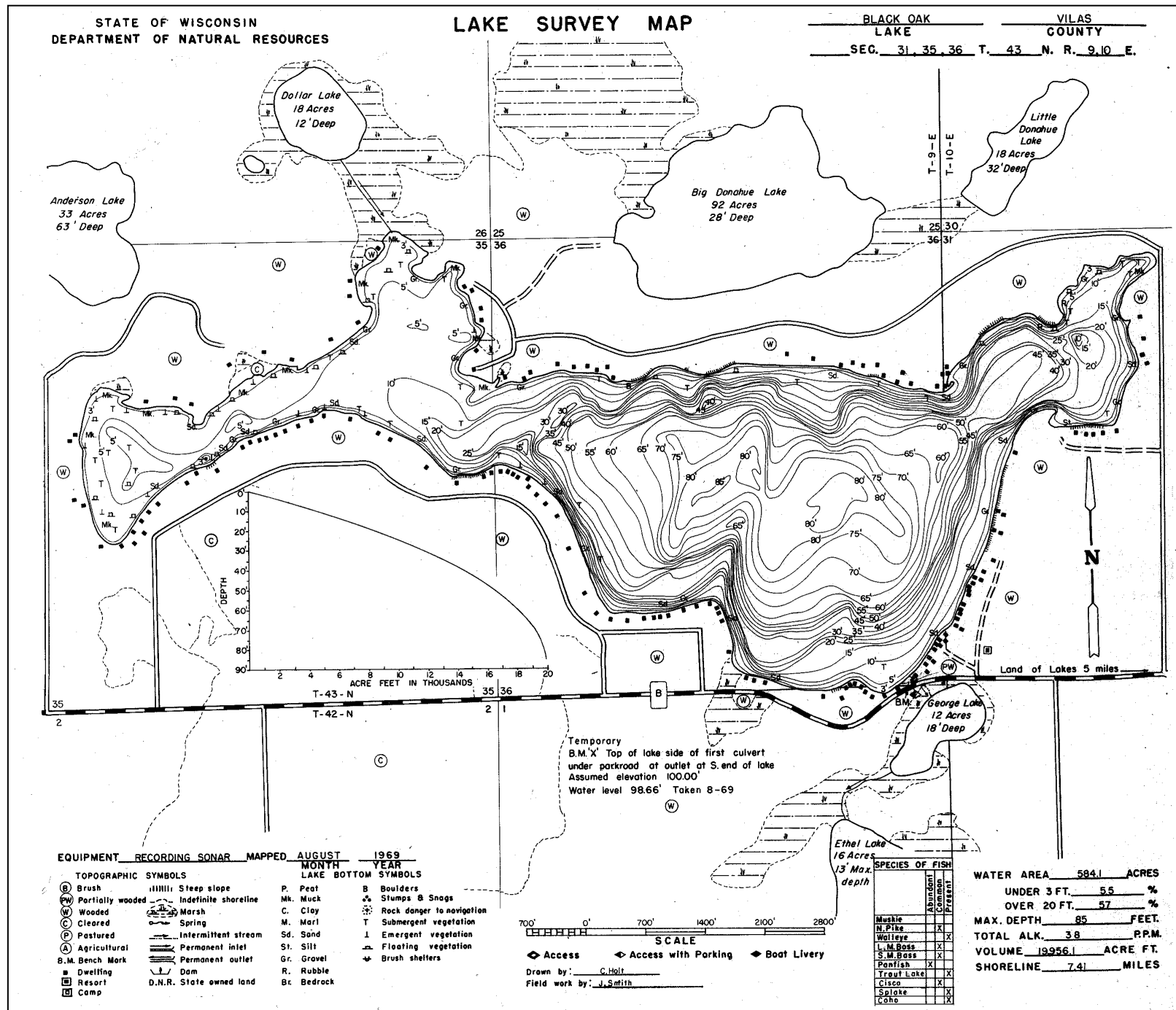
Maps

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.



A History of Black Oak Lake

A History of Black Oak Lake

by Paul McLeod

Ancient bedrock more than 2 billion years old lies beneath Black Oak Lake. Geologists have never seen that bedrock, but they have created complex geologic maps using geophysical techniques (Fig 1). Schists, gneisses, and granites lie at depths of around 100 to 200 feet below the ground surface and are overlain by young glacial sands and gravels. The bedrock is also cut by a series of northwest trending strike-slip faults. A reverse fault bounds Black Oak Lake on its south side, although the structural geology of the bedrock probably bears little relation to the shape and position of the lake.

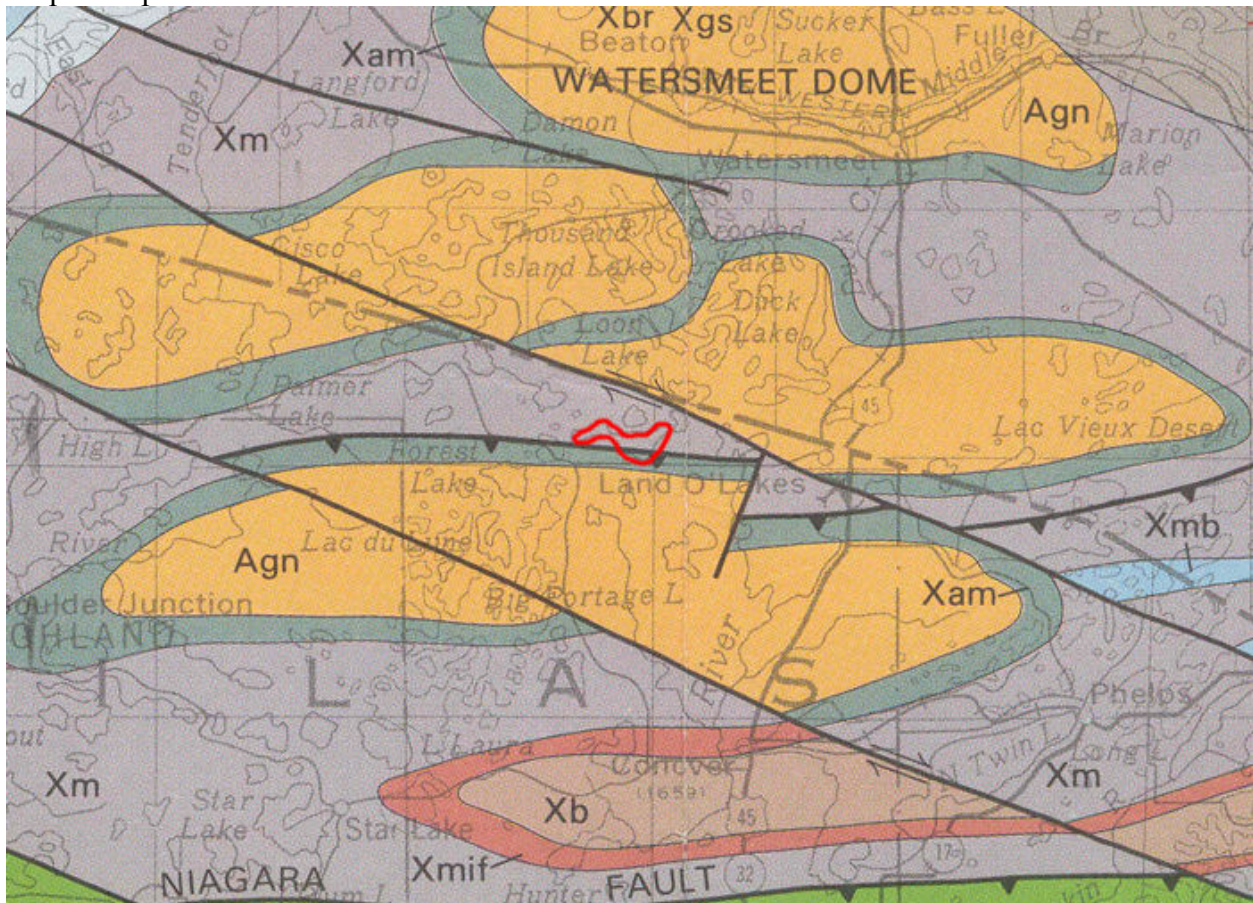


Figure 1. Bedrock geology of the Black Oak Lake area (lake outlined in red) (Simms, 1992).

The Wisconsin-aged Glacier advanced into southern Wisconsin around 25,000 years ago. A climate change beginning around 10,000 years ago caused the glacier to retreat to the north. One final short-lived advance during that retreat left an east-west trending band of poorly sorted sands and gravels called the Winegar Moraine (shown as the green color on the map below, Fig 2). That moraine bounds Black Oak Lake on its north side, indicating that is the spot where the glacier paused for a few hundred years in its retreat north. The pink color south of Black Oak Lake indicates the well-sorted sands of the glacial outwash carried by streams flowing off the front of the glacier. The elongate east-west shape of Black Oak Lake is probably directly related to the east-west trend of the glacial moraine.

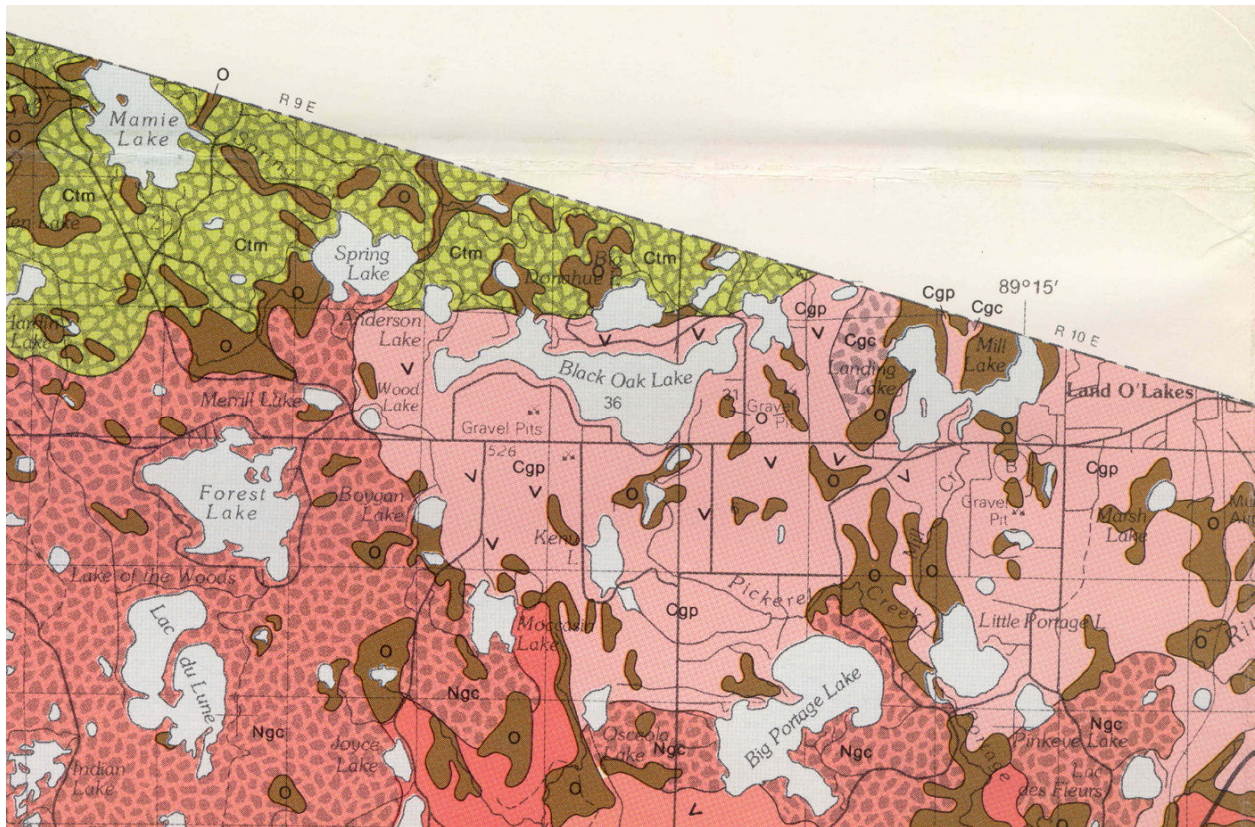


Figure 2. Glacial geology of the Black Oak Lake area (Attig, 1985).

The earliest detailed mapping of the lake began during the summer of 1860 when the Federal government's General Land Office survey reached the Black Oak Lake area (Fig 3). At that time, the logging boom had not yet reached northernmost Wisconsin, and the purpose of the survey was simply to establish townships. The government surveyors were not in the business of naming lakes, and while they were the first to carefully map the lake's shape, the lake remained unnamed into the 1880s.

Following the survey, the land was opened to homesteading and purchase from the government, and the earliest land seekers staked their claims on area lands in 1872. It is unclear whether the first three men who patented land on Black Oak Lake (Allen Lovejoy, W.P. Rounds, and Augustus Haight) actually settled in the area, or whether they were land speculators. In fact, the great rush to patent the Black Oak Lake area did not begin until the arrival of the Milwaukee, Lake Shore & Western Railroad to State Line in 1883. More than a dozen patents were issued to a variety of land speculators within two or three years of that date. Some of those patents were on homestead claims, therefore some of the men probably built small-scale cabins near the lake at that time. Cabin building proceeded in order to satisfy the requirements of the Homestead Act, and it is unlikely that any of the men intended to settle in the area permanently.

Most of the Vilas County lakes carry names today which are different than the names they carried during the 19th century. Some lakes have had three or four different names. There is no evidence that Black Oak Lake has ever had any other name. The earliest known reference to the name dates to around 1887, but the name probably dates to the homestead rush of 1883. Botanists note that there are no known Black Oak trees near the lake, but the early land owners were not botanists, so they probably misidentified the local oak species.



Figure 3. General Land Office survey of the yet unnamed Black Oak Lake, 1860 (Board of Commissioners of Public Lands)

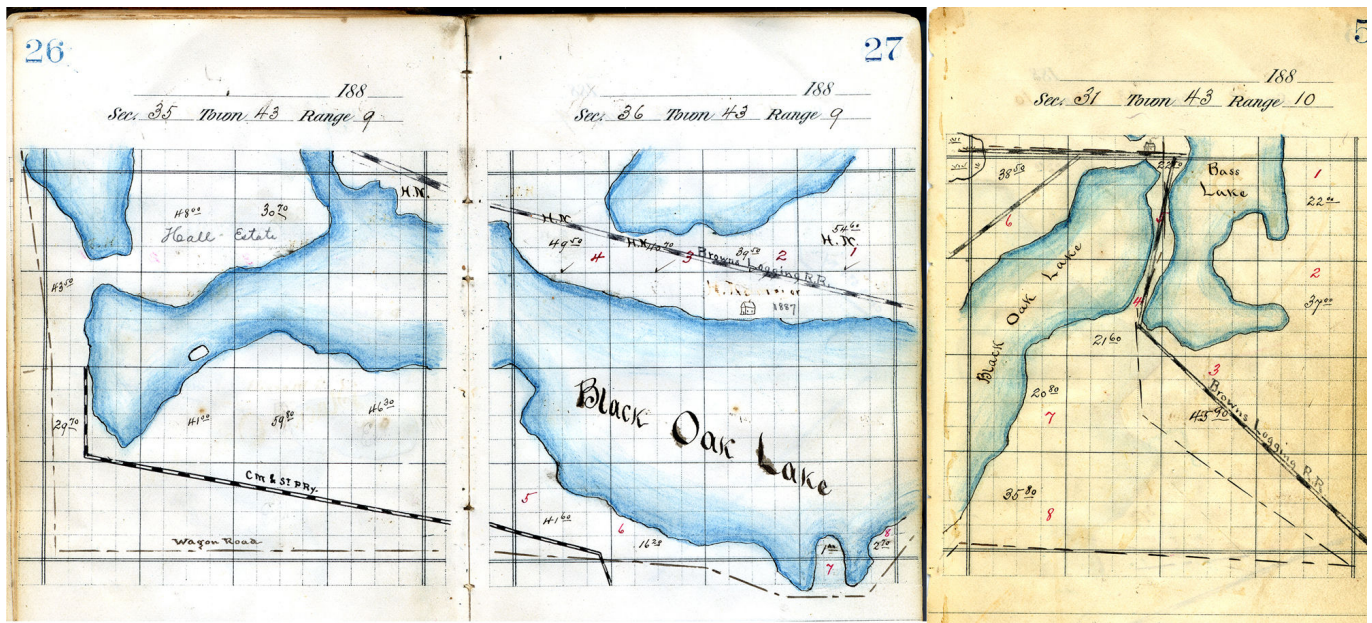


Figure 4. Franklin Newcomb mapped Black Oak Lake in 1887. He made editorial changes and additions to his own map creating a palimpsest covering the years 1887-1903 (Roberta Marling).

Rudolph Otto (1844-1898) and partners established the earliest known saw mill in the area on the south shore of Mill Lake around 1886. At that time, logging companies began selectively cutting the big white pines throughout the area and transporting them to Otto's sawmill by sled. Franklin Newcomb (1858-1925) was one of the early Black Oak Lake area homesteaders and speculators who documented the area with a series of hand-drawn maps (Fig 4). One map shows that Otto had established a logging camp on the Wisconsin/Michigan border within a mile of Black Oak Lake by 1887 to log his own lands (the five-mile distance between the Otto camp and

his mill suggests the land that Otto purchased near Black Oak Lake must have hosted some particularly large and numerous white pines). Government documents show that the Cutler & Savidge Lumber Co. of Michigan purchased 312 acres on Black Oak Lake in 1885, although it is unclear whether logging proceeded on their lands at that time.

There were probably several logging camps built along the Black Oak Lake shores during the 1880s-90s, and the remains of at least one of those camps is preserved on the lake's north shore on Dirk Meyer's property (Fig 5). This particular spot is well suited to the movement of logs from the area north of Black Oak Lake onto the frozen lake owing to the presence of a gently-inclined, north-trending, topographic trough. Most of the north shore of Black Oak Lake rises at least 20 feet above the lake-level creating a steep drop-off to the lake. Loggers could not easily move logs across the 20' drop-off to the lake, therefore they sought out the places along the lakeshore where ancient glacial drainages created troughs allowing the easy movement of logs onto the lake. Today it is possible to see the remains of at least eight buildings that sat in this particular trough. The dimensions of those buildings, together with the associated surface artifacts suggest bunkhouses, a stable, a cook house, an office, and other buildings associated with the logging camp.

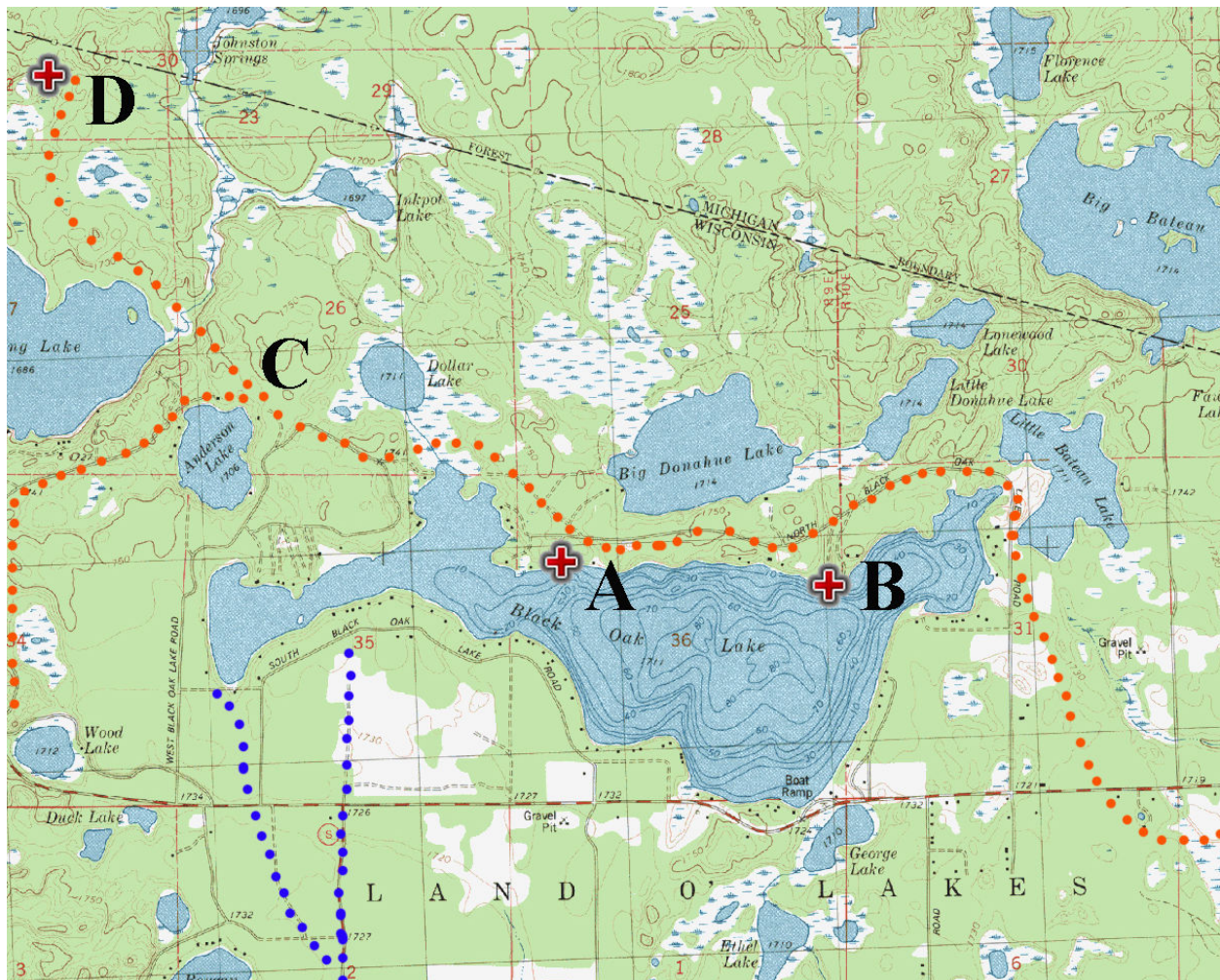


Figure 5. Topographic map of the Black Oak Lake area. The red dotted-line indicates the path of the Brown Brothers logging railroad (c. 1900-1909). The blue dotted-line indicates the approximate path of the Salsich & Wilson logging railroad (c. 1898-1910). "A" indicates the location of the historic logging camp on Dirk Meyer's

property, while “B” indicates the probable location of the logging camp on the Lowenstine property. “C” is the fork in the railroad which is pictured in Fig 7, and “D” is the location of the Brown Brothers logging camp in Fig 8.

During the years 1885-1900, loggers loaded logs onto sleds on the lakeshore, and teamsters hauled the logs across the icy lake over a well-worn trail to the Otto Mill (Fig 6). A second spot along the north shore where the glaciers left an inclined trough leading down to the lake, sat on the historic Woodhull/Lowenstine property. Development on the Woodhull/Lowenstine property during the 1920s and 1930s obliterated any remains of historic logging camps, but it seems probable that the area did host a logging camp and log landing during the 1880s-90s.

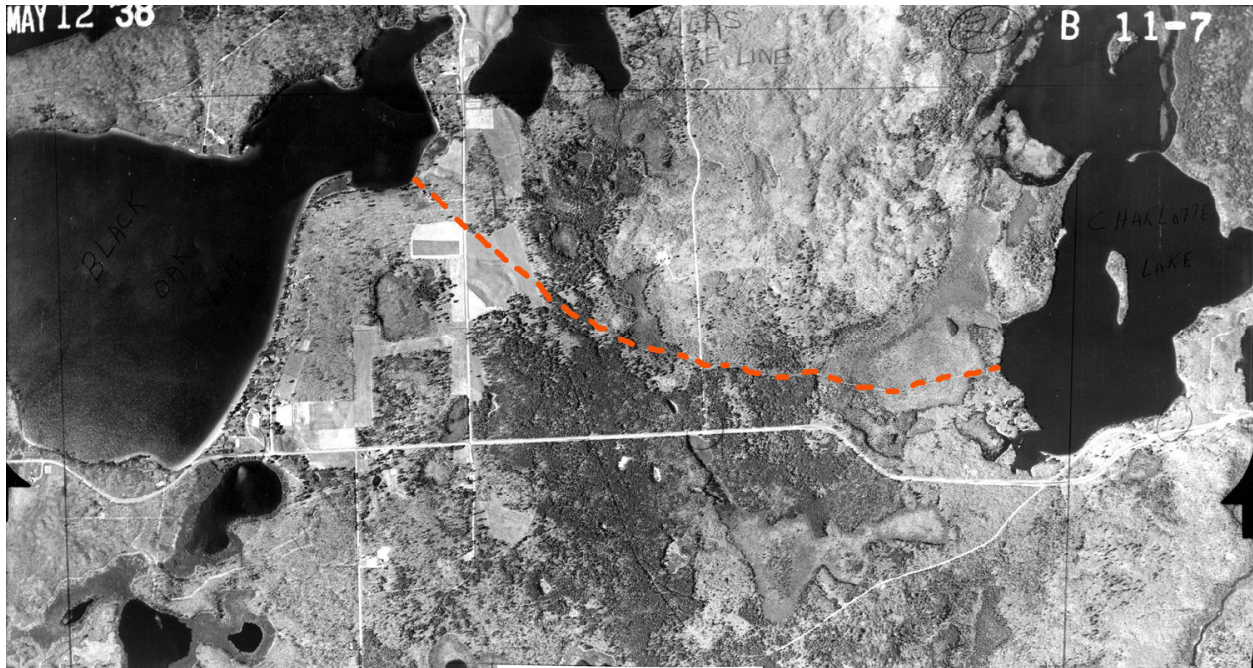


Figure 6. This airborne photo of the east Black Oak Lake area shot on May 12, 1938 preserves the trace of the sled road connecting Black Oak Lake with Mill/Landing Lake. All logs cut in the Black Oak Lake area during the years 1885-1900 traveled to the Otto Mill via this sled road. After 1900, the logging railroads rendered this sled road obsolete (Vilas County Foresters Office).

Around the time that Rudolph Otto died in 1898, logging in the Land O' Lakes area picked-up in intensity. Mary Otto, Rudolph's daughter, and her future husband, Charles Mather took over the Otto Mill and continued logging in the Black Oak Lake area. At the same time, the Brown Brothers Lumber Co. began purchasing homestead claims from private land-owners in the Black Oak, Anderson, Spring, and Forest Lake areas with a plan to begin large-scale logging operations. At the same time, the Salsich & Wilson Lumber Co. began acquiring logging rights to the lands south of Black Oak Lake. The 160-acre parcels that homesteading speculators purchased for \$1.25/acre during the 1880s sold to the logging companies for over \$1000, and the price frequently went above \$2000 if land agents got involved as middle-men. Some of the land agencies at work in the Black Oak Lake area at this time included the Northern Blue Grass Land Co., the Wisconsin Blue Grass Land Co., and the Home Investment Co.

In the quest for logs, the owners of the old Otto Mill moved away from the Black Oak Lake area after 1900 and turned their attention to unlogged tracts near Duck Lake in Michigan. The Brown Brothers and Salsich & Wilson companies focused their efforts on the Black Oak Lake area after 1900 and anticipated working in that area for a period of several years. Around 1900

both companies strategically located logging railroads in the Black Oak Lake area and built new logging camps, as well (Figs 6,7,8). Both companies employed the subcontractor Langley & Alderson, of Merrill, WI to carry out the logging operations (by 1900, logging companies increasingly began using subcontractors as a way to boost their falling profit margins). The Brown Brothers sent its logs from the north side of Black Oak Lake to its sawmill in Rhinelander, while Salsich & Wilson sent its logs from the south side of the lake to the mill at Star Lake.



Figure 7. The Brown Brothers Lumber Co. logged most of the lands on the north side of Black Oak Lake. Subcontractor Langley & Alderson managed the Brown Brothers' logging railroad and operations. This photo was shot at the fork in the logging railroad on the north side of Anderson Lake during summer, 1908 (Janet Vineyard).

The Black Oak Lake logging operations were so distant from the newspaper offices in Eagle River, that neither the *Eagle River Review* nor the *Vilas County News* carried many news items on logging activity during the early 1900s. The Salsich & Wilson Logging Company's Black Oak Lake area camp sat on its logging railroad line between Moccasin Lake and Black Oak Lake. The Brown Brothers established a large camp housing perhaps 100 men at the terminus of its logging railroad north of Spring Lake (Fig 8). It seems likely that the Brown Brothers also re-activated the logging camp on the Dirk Meyer property, although probably not for its strategic location on the lake, but because of the collection of buildings already sitting on the site. The newspapers mention that Langley & Alderson maintained their offices along the Brown Brothers' rail line, so it is also possible that Langley & Alderson established their offices at the site of the old logging camp on the Black Oak lakeshore.

Several hundred meters east of the logging camp on the Dirk Meyer property lay the remains of what may be the oldest house on Black Oak Lake (Fig 9). Little is known about the house, because courthouse documents specify neither the builder nor the owner, and because the house

predates the memories of the oldest area residents. Myrtle Lloyd, who played near the house as a girl during the late teens, recalls that the house was already vacant and in disrepair at that time. The logging activity north of the lake during the 1890s, together with the difficult access to the area, suggests that the homeowner may have been involved in area logging during the 1890s.



Figure 8. The Brown Brothers logging camp sat on the Wisconsin side of the state border immediately north of Spring Lake. The camp operated from 1900 to 1909. The photo was shot during summer, 1908 (Janet Vineyard).



Figure 9. These unidentified ruins on the north shore of Black Oak Lake may be the remains of the earliest house on the lake. Evidence suggests the house was built during the 1890s (Paul McLeod).

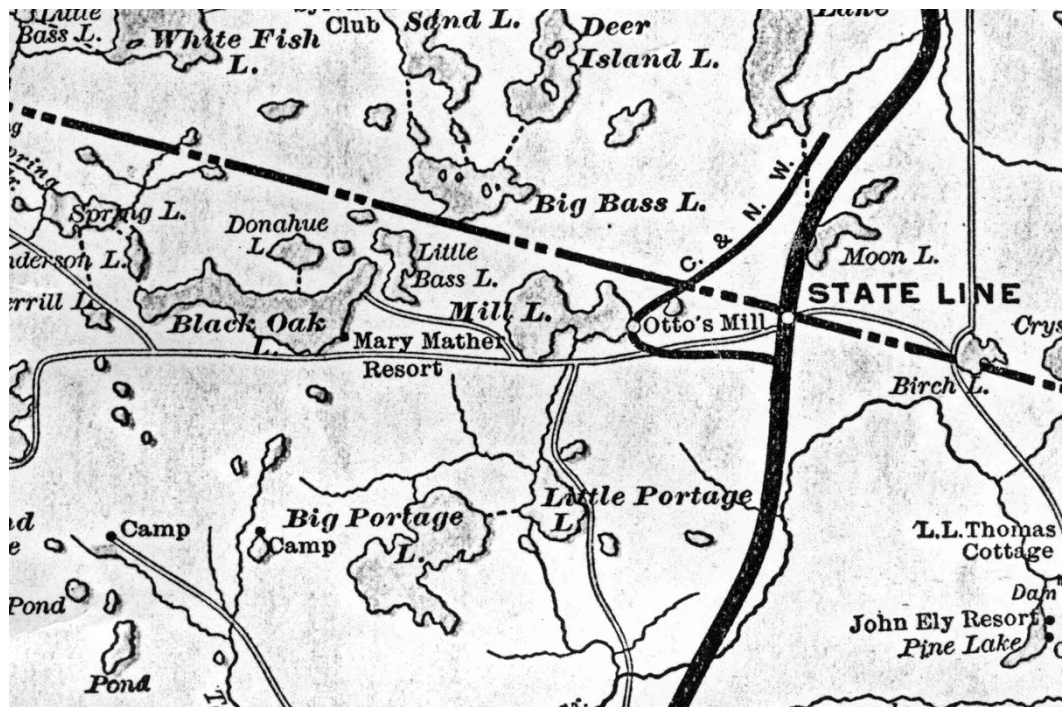


Figure 10. The Chicago & Northwestern's 1903 map shows its spur to the Otto sawmill as well as the wagon road skirting Black Oak Lake on its south side and the sled road connecting Black Oak Lake with Mill Lake. The logging railroads were in place by this time but are not included on this map (LOLHS).

During the 1890s the Eagle River newspapers made occasional reference to tourists traveling to Black Oak Lake specifically for fishing opportunities. Businessman R.D. McLeod traveled to Black Oak Lake during May, 1899, and the *Vilas County News* noted that he caught a 14 ½ pound trout. The Black Oak Lake area seems to have been experiencing a bit of schizophrenia at that time as fishermen valued the lake for its fishing opportunities and its natural beauty, while logging companies valued it for its pines, maples, hemlocks, cedars, basswood, and oaks. In 1899, the Chicago & Northwestern (successor to the M,LS & W RR) began service on its “Fish Train” to allow Chicago residents to travel to the Vilas County area to fish on weekends. The service remained popular for several decades and was a boon to the area tourist trade.

Census data and early maps show that at least as early as 1900, Mary Otto (Mather) operated a camp or “resort” on the southeast corner of Black Oak Lake (Fig 10). During June, 1900 the camp was occupied by approximately 70 men involved in area logging. A stagecoach operated between the State Line depot and Black Oak Lake, and it probably served both loggers and tourists (Fig 11). That stage line probably stopped at the Mary Otto resort (and later at the St. Clair resort) and probably also went out to Bent’s Camp, which had been established in 1896.

By 1909 the tree supply in the Black Oak Lake area had been exhausted, and both the Brown Brothers and Langley & Alderson companies had fallen on hard finances. The logging railroads were removed around 1909, and both companies went out of business during the next few years. The lands surrounding Black Oak Lake had been heavily cut during the first decade of the 20th century, and while the lands held little future value for logging companies, they began to interest summer tourists (Fig 12).



Figure 11. A stagecoach operated between State Line and Black Oak Lake around the turn of the century. That may be Mary Otto Mather standing at right, who operated a camp at the southeast corner of the lake. Photo ca. 1905 (Vilas County Historical Society).

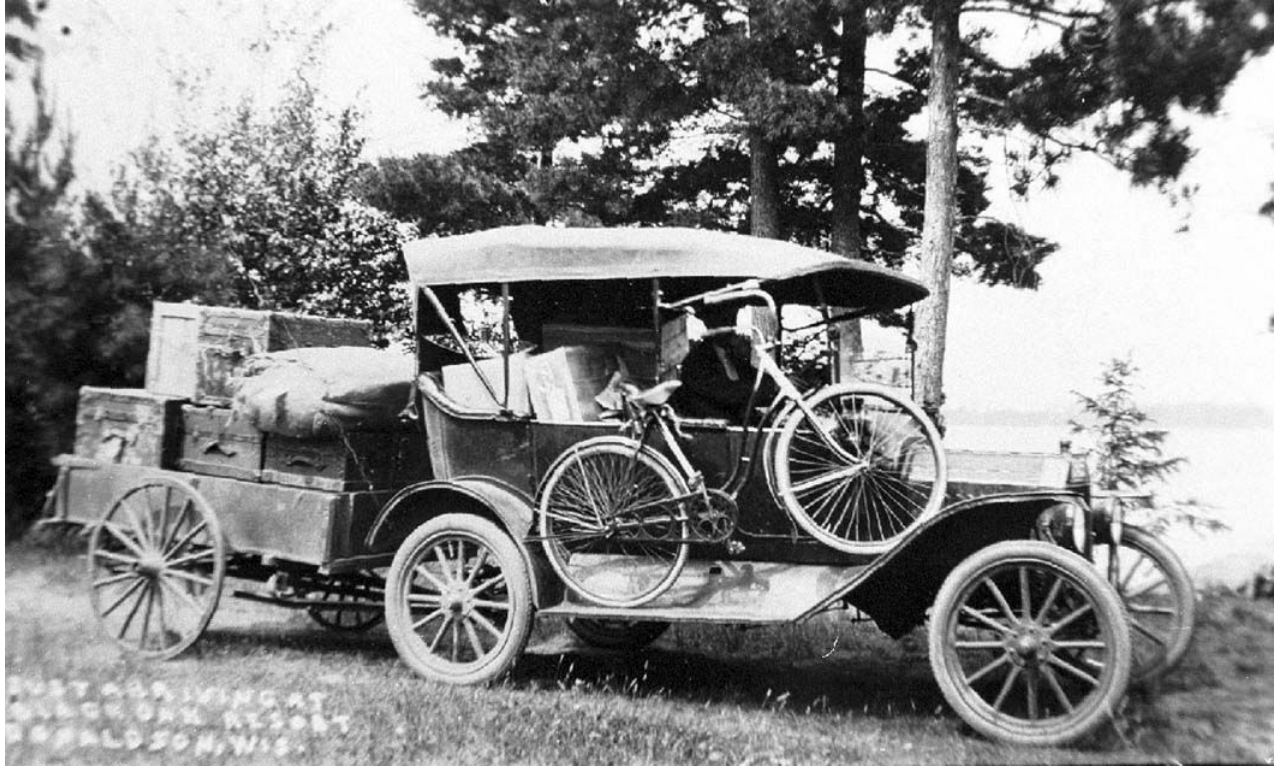


Figure 12. Black Oak Lake had been a popular tourist destination from the 1890s, but by 1910 tourists began arriving for the summer, and some of them even began building summer houses. Photo ca. 1915-20 (Vilas County Historical Society)

The earliest known reference to a residence on Black Oak Lake is an announcement carried by the *Eagle River Review* on May 8, 1908 indicating that Lee & Belle Barber were building a \$5000 house immediately north of the Black Oak Lake resort. The Barber house (extant but heavily remodeled) seems to have initiated the era of house-building along the lakeshore. A series of photographs of the Black Oak Lake area shot during the summer of 1908, which may have been commissioned by the Barbers, capture the recently completed Barber house (Fig 13). The photographs also capture that transitional period at the end of the logging era and the beginning of the summer recreation era (Fig 14). The heyday of the logging had passed, but a small group of loggers continued to harvest the last of the area trees, while at the same time the new residents on the lake were attracted by the natural setting, the serenity, and the recreational opportunities. During the period 1908-1912 a number of summer pioneers bought lots on the south and east shores of Black Oak Lake and built rustic homes including Dr. James Ely, Lee W. Barber, Emil Weisse, A.J. Keefe, and Dr. Wallace Grosvenor (Fig 15).



Figure 13. Images of the Lee Barber house and family. The house was completed during the summer of 1908, and the photographs were shot in August, 1908 (Paul McLeod).

By 1908, real estate tycoon, George T. Halbert, with his office in Minneapolis, MN, began purchasing cutover lands for resale. He began systematically surveying, platting, and marketing lakefront property on Black Oak Lake (and other area lakes) and achieved modest success during the teens and 1920s as more and more people began building on the south and east shores of Black Oak Lake (Fig. 16). By the middle 1920s, homeowners on the lake included A.J. Bates, Harvey Crooker, Archibald Patterson, O.G. Knecht, George Fagg, R. Knute, G.C. Williams, C.E. Search, E. Walker, Ed Lindsten, Dr. Craig, H.H. Barnum, B. Schroeder, Frank Ferry, and Frank Hoffman.

Halbert acquired much of the real estate he was marketing from the Brown Brothers Lumber Co., but the Brown Brothers retained a majority of its own cutover lands simply because nobody wanted those lands. After the Brown Brothers Lumber Co. went out of business in 1916, a subsidiary of that company continued in business strictly to deal with its large cutover land holdings. The Brown Brothers tried to market some of its cutover lands on the north shore of Black Oak Lake as building lots during the 1920s and 1930s, but the venture was a failure, and the entire block of lots was eventually acquired by the Crown family in the mid-1930s (Fig. 17). The property remains undeveloped today and is still locally referred to as “the Crown property”.



Figure 14. The only known photograph of the Brown Brothers logging railroad as it crosses the bog separating Black Oak and Dollar Lakes (August, 1908). After tearing out the rails in 1909, the grade became a road, and cars crossed the bog on this road until 1956 when James Lowenstine acquired the property and closed access to traffic (Paul McLeod).

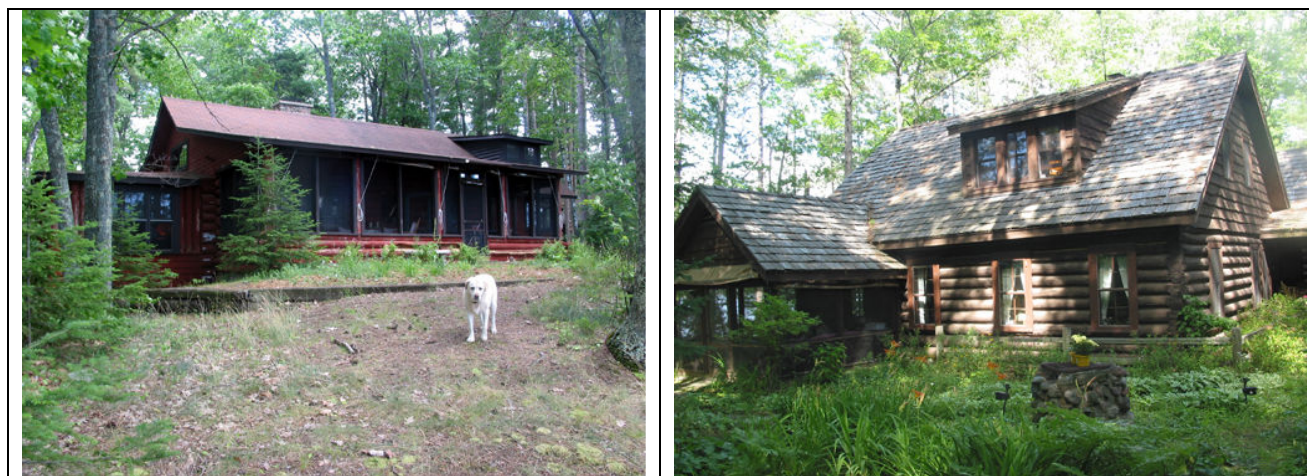


Figure 15. James Ely built an early house (1910) currently owned by George & Cathy Gelb (left). Jim and Ann Bates remodeled the A.J. Keefe house (1912) (right) (Paul McLeod).

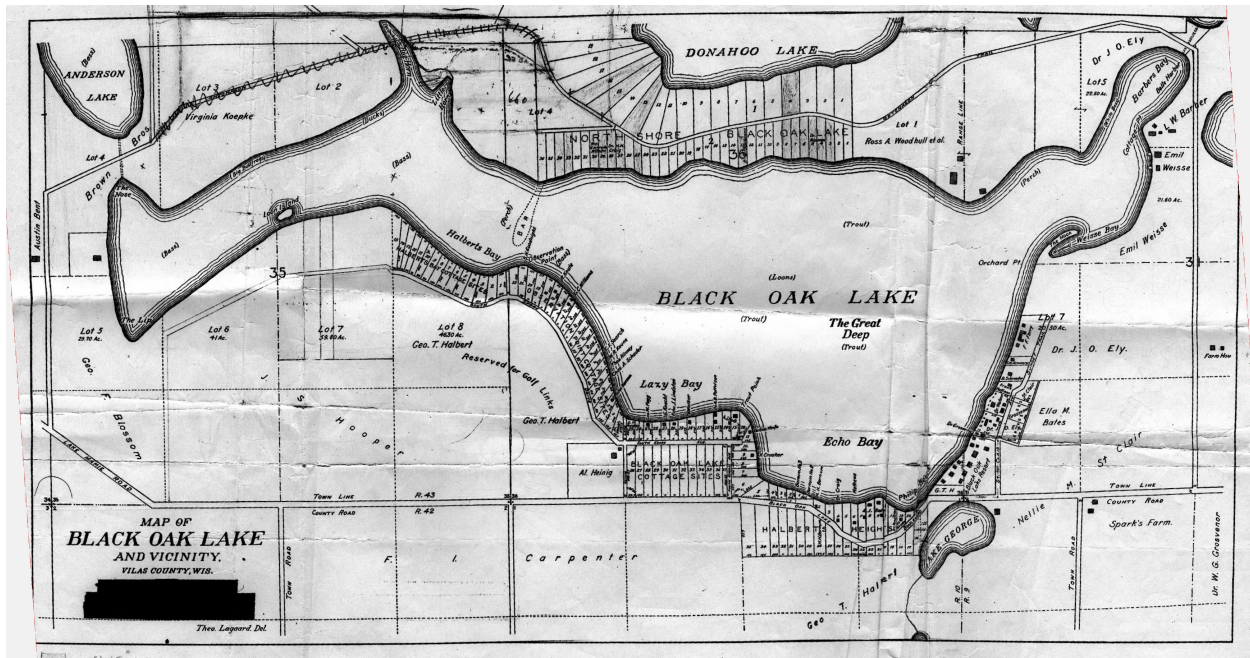


Figure 16. Around 1910, real estate tycoon George Halbert began marketing Black Oak Lake lots to Chicago area residents. The earliest development proceeded on the south and east shores. Map ca. 1926 (Tom Allman)

Chicago businessmen Ross Woodhull (1878-1944) and Mandel “Nick” Lowenstine (1882-1956) both purchased adjoining parcels of cutover land from the Brown Brothers on the north shore of Black Oak Lake in 1921. Aside from a handful of small 1880s homestead cabins, Woodhull and Lowenstine built the first large home on the lake’s north shore. They called it “Hullwood”, and it was completed in 1921 (Fig 15). Lowenstine owned Central Steel & Wire Co., while Woodhull served as a Chicago alderman and president of the board of trustees of the Chicago Sanitary District. The lifelong friends had grown up together in Valparaiso, Indiana. Lowenstine and Woodhull initially shared the house, but Lowenstine’s 1921 marriage led to his desire to build his own house immediately east of Hullwood (Fig. 19).

EDWARD O. BROWN, PRES.
ALLAN C. BROWN, V. PRES.
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BROWN BROS. LUMBER CO.

MANUFACTURERS & WHOLESALEERS
SPECIALIZING IN WHITE PINE LUMBER
WESTERN TIMBER, ETC.

OWNERS AND DEALERS IN
WISCONSIN CUTOVER LANDS
AND LAKE FRONTAGE

RHINELANDER, WIS.

April 17, 1935.

Mr. C. E. Search,
Milwaukee, Wis.

Dear Mr. Search:

You, as a summer resident and property owner on Black Oak, will without doubt be interested in keeping the ownership on the lake among your friends and associates. Brown Brothers, as you perhaps know, have held extensive frontage along the north shore since the days of the virgin pine without exerting any effort to push sales. This company, however, have chosen 1935 as the year to exert a real sales effort with this lake frontage, principally because of the publicity the Government has of late given Conservation especially from the recreational angle.

Realizing the desirability of having your friends and associates as your summer neighbors, we are giving you "Pioneers" on Black Oak the first opportunity to increase your holdings or a chance to get your friends and associates interested in this most attractive lake of your choice.

We are glad to be able to inform you that George St. Clair, an acquaintance and neighbor sympathetic to the idea expressed, will be found in Chicago at the Highway 45 Booth in the Outdoor Life Exposition* between the dates of April 22nd and 27th. He will be very glad to talk over any wooded piece in either the platted or unplatted area marked as unsold on the enclosed ownership map of the lake. If you are not able to make the contact mentioned write direct to our office and we will be glad to make arrangements to show you locations.

It is our earnest endeavor to cooperate and help you locate people of your choice, consequently we will welcome any suggestions you have or act on any people or list that you are interested in having on the lake.

Very truly yours,

*HOTEL SHERMAN

BROWN BROTHERS LUMBER CO.

By

Secretary

ACB GN

Figure 17. Brown Brothers marketing the Black Oak Lake cutover, 1935 (Sally Lippert)



Figure 18. Ross Woodhull built Hullwood around 1921, one of the few early homes on the lake not built in the log cabin style. Photo ca. 1925 (Mark Siegworth).



Figure 19. Mandel “Nick” Lowenstine built Lowenwood next door to his best friend, Ross Woodhull. The original house, built around 1923, was heavily remodeled in the 1970s (Paul McLeod).



Figure 20. Ross Woodhull (in cowboy hat) and Nick Lowenstine (in baseball cap) began inviting Valparaiso, Indiana friends up to their houses every summer beginning in the early 1920s. The photo, dating to around 1923, may have been shot during the construction of the Lowenstine house (Jane Lohmeyer).



Figure 21. Summer, 1943 at Lowenwood. (Left to Right: Maurice Lowenstine, Nick Lowenstine, Daisy Lowenstine, Justin Shauer, Ethel Shauer, Miriam Lowenstine, Ross Woodhull, Bud Lowenstine). The trophy house, which was demolished in the 1970s, housed Nick Lowenstine's fishing trophies (LOLHS).



Figure 22. Every spring, Nick Lowenstine invited his friends up for the opening week of fishing season. Left to Right: David “Mac” MacFarland (Nick’s bodyguard), C.L. Bartholomew (Valparaiso Mayor and undertaker), unid, Jim Lowenstine, Nick Lowenstine, Henry Lowenstine, and Justin Shauer (seated). Photo ca. 1946 (LOLHS)

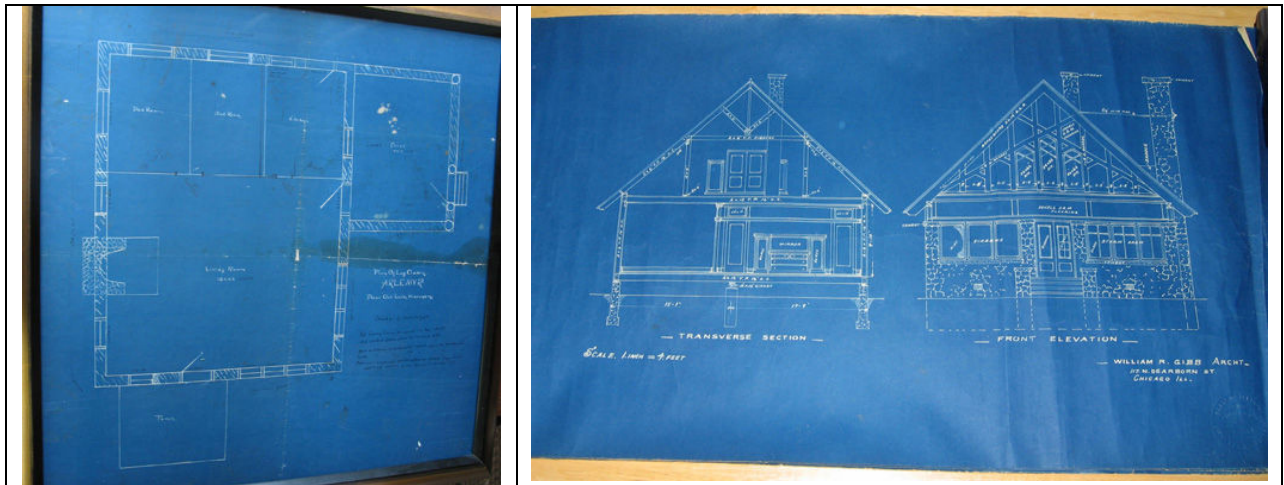


Figure 23. Simple architectural plans for the Patterson house, “Arlemyr”, built by George Fagg in 1919 (left), contrasted with complex plans for the Lowenstine house, c. 1923, William Gibb, architect (right) (Barbara Knaak, Conserve School).



Figure 24. Interior of Ross Woodhull's "Hullwood", ca. 1924 (Mary Lou Oldham)



Figure 25. "Arlemyr" interior, photographed in 1926 compared with the same well-preserved interior today. Notice the use of birch-bark in the wall decoration. "Arlemyr" was the home of Archibald Patterson and is currently owned by his granddaughter, Barbara Knaak. (Barbara Knaak, Paul McLeod)

The Brown Brothers logging railroad followed the north shore of Black Oak Lake. After the rails were torn out in 1909, the grade became a dirt road called "Ontonagon Trail" on early maps. Woodhull and Lowenstine accessed their property by way of this road. The driveway that connected Hullwood to the Ontonagon Trail appears to have been a spur of the old logging railroad. The broad, flat site on the north shore of Black Oak Lake which had been an ideal site for a logging camp and log landing was also an ideal location for the Woodhull house. West of

Hullwood, the Ontonagon Trail followed the old railroad grade across the bog separating Black Oak Lake and Dollar Lake. Residents were able to drive their cars across this grade until James Lowenstine acquired that property in 1956 and closed that portion of the road (Fig 14). Today it is not possible to drive around Black Oak Lake, and it has not been possible since 1956. The closure of that road probably inhibited residential growth on the lake's north side.

While nearly all of the homes built on Black Oak Lake during the period 1908-1928 followed a rustic log style, Lowenstine and Woodhull built sturdy, sophisticated bungalows that did not really blend in with the prevailing lake architecture. Both houses were designed by Chicago architect William R. Gibb, who may have worked for Woodhull on Chicago civic projects. Most of the other residences on Black Oak Lake were more modest in scale and materials, and most were probably not designed by professional architects. At least one rustic Black Oak Lake house dating to around 1916 (currently owned by Nancy and Elizabeth Eaton) shows evidence of having been ordered from a catalog and assembled on-site.

Both the Woodhull and Lowenstine houses were designed to accommodate large groups of Valparaiso friends (mostly men) who vacationed on Black Oak Lake from the 1920s through the 1950s (Figs 20,21,22). The largest regular group arrived early in May for the start of the fishing season and stayed for a couple of weeks each year. The annual gatherings dwindled after Nick Lowenstine's death in 1956. Woodhull's niece, Laura Chapman, who inherited Hullwood in 1944, developed tensions with the Lowenstine family which led to the establishment of a formal boundary between the two properties. James Lowenstine later bought the Woodhull property from Laura Chapman and demolished the house following her death in 1989.

Archibald Patterson, a dentist from Joliet, IL, commissioned "Arlemyr" on the south shore of Black Oak Lake. The name of the house was an anagram of Archibald, his wife Leona, and their daughter, Myrtle. The family planned the modest cabin with the builder, George Fagg around 1919, and Fagg built the house from logs cut on or near the building site (Fig. 23). The rustic interior was captured in a 1926 photo, and today the house retains much of its architectural integrity (Fig. 25). By contrast, the plans for the Lowenstine house are extensive and detailed and specify a variety of imported building materials including steel beams. Both Lowenstine and Woodhull commissioned a variety of interior and exterior photos of their houses, and while those interiors suggest a rustic flavor, the furnishings are expensive and showy (Fig. 24).

The Torres family began traveling to the Vilas county area from Evanston, IL during the late teens, and they purchased a small cabin on the far west end of Black Oak Lake from Walter Dickman in 1922 (Fig 26). Ed Torres, who began spending summers at the cabin as a child in 1922, continues to spend time at the cabin to this day. Among Ed's recollections of life on the west end of the lake are his memories of harvesting buckets full of berries to make large quantities of fruit jam. In a 1923 photo the family poses next to the fruit-filled, Mason jars with a comical sign reading "No fish but loads of berries". When the logging companies clearcut the forest around the lake, blackberry and raspberry plants were among the first opportunist species to sprout. Those plants apparently thrived into the 1920s. Among the first tree species to regrow along the lakeshore were the birches and aspens. Many old timers fondly remember the abundance of birches, and they commonly speak about a blight that killed the birches. In fact, most of those birches probably died of old age during the 1970s and 1980s.



Figure 26. The Torres cabin at the west end of Black Oak Lake. The Torres family acquired the cabin from Walter Dickman in 1922, and while the cabin was rebuilt in the 1940s, the family still owns the property (Ed Torres).



Figure 27. Ed Torres (center with hands over head) recalls that acres of berry bushes covered the clearcuts on the west end of Black Oak Lake, and during the 1920s the family harvested buckets of berries to make jam. In this 1923 photo, the sign says “No fish but loads of berries” (Ed Torres).



Figure 28. Black Oak Lake hosts a variety of unusual boat houses dating to the era 1915-1940 (Paul McLeod).

At least 15 unusual and architecturally significant boathouses still dot the Black Oak Lake shoreline. While regulations no longer permit shoreline construction, these boathouses reflect a time when it was the norm. The most significant boathouses date to the era 1915-1940 and cover a variety of architectural styles and construction materials (Fig 28).

One locally important industry which centered on Black Oak Lake was ice harvesting (Fig 29). Local men probably began cutting ice on a small scale on Black Oak Lake shortly after 1900, but increasing demands for the ice made ice-cutting a healthy business in the years before World War II. Crews of men cut the ice with hand-saws, and they stacked the large ice blocks onto horse-drawn sleds. Teamsters hauled the blocks to the ice houses of local clients or to the railroad depot for shipment to points south. Jim Ort reports that his family continued to use Black Oak Lake ice at the Mockesair Lodge ice house as late as 1960. The demand for ice dropped sharply during the 1950s, as more and more area residents purchased electric refrigerators. George St. Clair was one of the biggest ice buyers on Black Oak Lake. Many lake residents had ice houses, but most of those ice houses have been demolished. The log ice house associated with the Keefe house still stands and still retains its architectural integrity (Fig 30).



Figure 29. Ice cutters harvested the lake's ice beginning at least as early as 1910, and continued cutting ice until the late 1950s. This photo, shot around 1925, looks east from a spot near the central part of the north shore (Jim Ort).



Figure 30. Before WWII, there were dozens of ice houses around Black Oak Lake, but few survive today. This log cabin associated with the Keefe house allegedly served as an ice house (Paul McLeod).

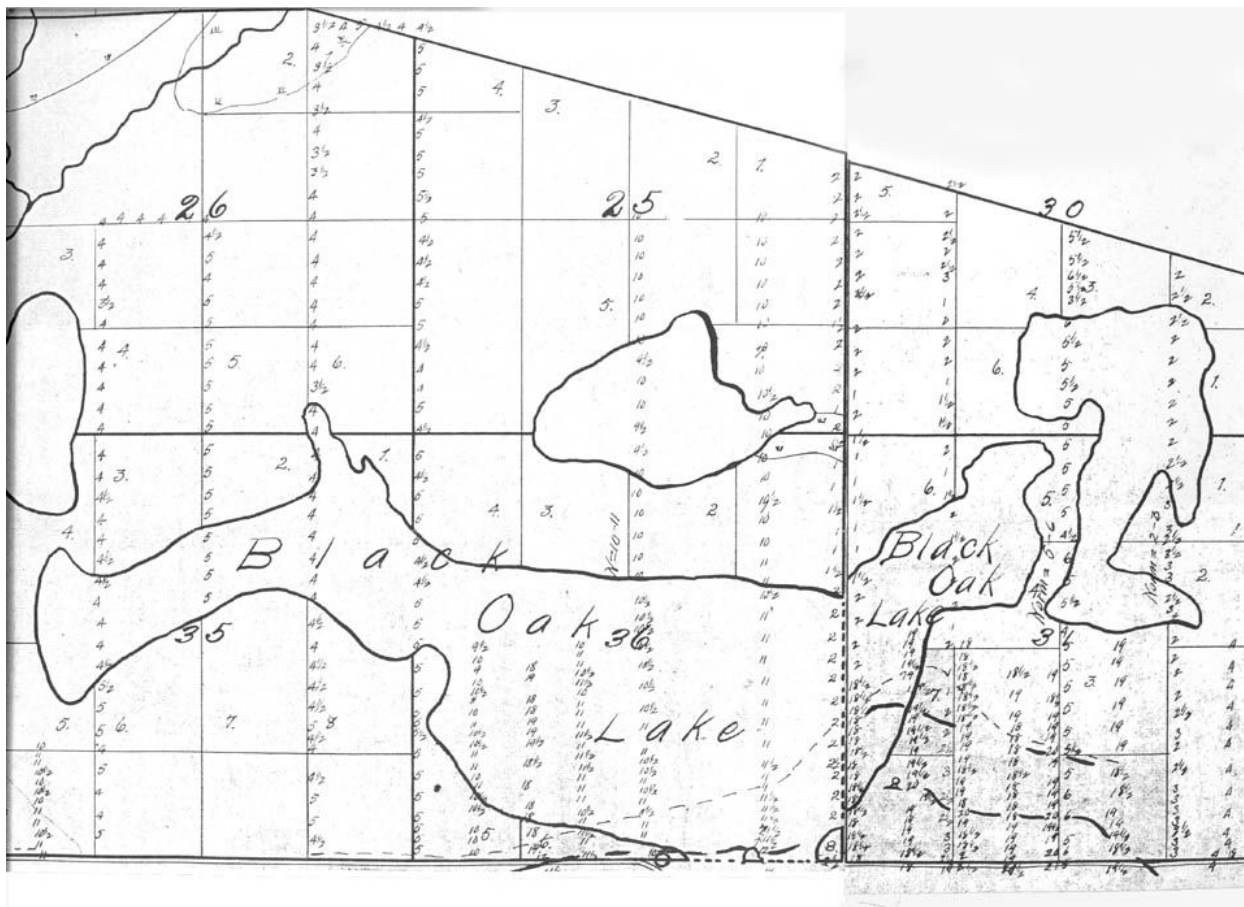


Figure 31. Frederick Carpenter commissioned a magnetic dip-needle survey of the Black Oak Lake area around 1911 in search of iron deposits (unpublished from the USGS office in Middleton, WI)

An entrepreneur named Frederick Carpenter undertook a mineral exploration survey in Vilas County during the years 1911-14, and his survey covered the Black Oak Lake area (Fig 31). Carpenter's surveyors made magnetic measurements every 100' along north-south trending lines spaced about 1000' apart. Anomalously high readings in the vicinity of George St. Clair's resort led Carpenter to close a deal with St. Clair which would allow Carpenter to open an iron mine on Black Oak Lake in exchange for a portion of the profits. It is doubtful that Carpenter ever drilled the St. Clair property, and the mine never advanced beyond the fantasy stage.

Around the same time that Carpenter was planning mineral exploitation on Black Oak Lake, Emil Wiese (1875-1950) began the earliest known environmental monitoring on the lake. By 1909, Wiese (who built the house currently owned by John and Delores Caruso) had begun to make observations on fish populations as well as recommendations to the state of Wisconsin on fish management. Wiese also began collecting "ice-out" data indicating the annual date that the ice melts on Black Oak Lake (Fig 32). His data collection began in 1909 and continues through to the present making this one of the longest-lived environmental data sets in northern Wisconsin. Wiese handed over the data-collecting duties to Joe Handlos (1891-1972) in 1922, who handed over the duties to Jim Lowenstine (1923-1996) in 1966. Walt Bates currently monitors the ice-out dates.

DATE ICE LEFT BLACK OAK LAKE					
MAY 10, 1909	↑	MAY 10, 1947	↑	APR 23, 1985	↑
APR 1, 1910	W	APR 23, 1948		APR 14, 1986	
APR 24, 1911	S	APR 23, 1949		APR 13, 1987	
APR 28, 1912	S	MAY 16, 1950		APR 19, 1988	E
APR 29, 1913	W	MAY 2, 1951		MAY 4, 1989	N
APR 26, 1914	I	APR 27, 1952		APR 22, 1990	I
APR 20, 1915	W	APR 29, 1953	S	APR 23, 1991	T
APR 27, 1916		APR 27, 1954	O	MAY 1, 1992	S
APR 30, 1917	L	APR 19, 1955	L	MAY 6, 1993	N
MAY 1, 1918	I	MAY 7, 1956	D	APR 24, 1994	LOWES
APR 29, 1919	NE	APR 23, 1957	Z	APR 30, 1995	
APR 30, 1920	W	APR 23, 1958	A	MAY 17, 1996	
APR 26, 1921	↓	APR 26, 1959	I	MAY 4, 1997	
APR 23, 1922	↑	APR 24, 1960		APR 11, 1998	BATES
APR 29, 1923		MAY 5, 1961		APR 14, 1999	
APR 24, 1924		APR 29, 1962		APR 16, 2000	
APR 28, 1925		APR 17, 1963		APR 23, 2001	
APR 29, 1926		APR 25, 1964		APR 23, 2002	
APR 26, 1927		MAY 3, 1965	↓	APR 27, 2003	
APR 20, 1928		MAY 5, 1966	↑	APR 25, 2004	
APR 28, 1929		APR 20, 1967		APR 17, 2005	
APR 28, 1930		APR 12, 1968		APR 17, 2006	
APR 20, 1931	S	APR 22, 1969	E		
APR 24, 1932	Q	APR 28, 1970	N		
APR 28, 1933	L	APR 28, 1971	I		
MAY 3, 1934	D	MAY 10, 1972	T		
APR 27, 1935	N	APR 19, 1973	S		
MAY 7, 1936	A	APR 29, 1974	N		
MAY 4, 1937	H	MAY 5, 1975	E		
APR 15, 1938		APR 18, 1976	W		
MAY 3, 1939		APR 19, 1977	L		
MAY 6, 1940		MAY 3, 1978	O		
APR 17, 1941		MAY 9, 1979			
APR 22, 1942		APR 27, 1980	N		
MAY 4, 1943		APR 14, 1981	I		
APR 30, 1944		MAY 4, 1982	J		
MAR 27, 1945		MAY 4, 1983	↓		
APR 15, 1946	↓	APR 25, 1984	↓		

Figure 32. Emil Wiese was the first lake resident to begin recording ice-out data on Black Oak Lake in 1909. Wiese also made observations on fish populations in the lake (BOLROA).



Figure 33. By 1906 George St. Clair (the only man in the photo) had taken over Mary Mather's camp on Black Oak Lake, and he began successfully marketing his Black Oak Resort to out-of-state summer tourists. George's wife Nellie stands to the left of George. Photo ca. 1920 (LOLHS).



Figure 34. St. Clair's Black Oak Resort boasted a variety of lakefront cabins by the 1920s (Mark Siegworth).

There were two commercial resorts on Black Oak Lake. H.C. and Trudy Razell operated a small group of rental cabins on the southwest shore called the Pine Terrace cabins. The Razells lived at the cabins year round, and their guests commonly returned to the cabins year after year. The resort operated between the late 1930s and the early 1970s, and several of the cabins still stand on Grace and Maury White's property.

George St. Clair operated the more famous of the two resorts (Figs 33-36). His Black Oak Resort sat on 92 acres located on the southeast shore of Black Oak Lake. St. Clair began marketing his resort in 1906, and the collection of resort buildings grew through the years. Advertisements through time indicate that St. Clair's capacity for guests grew from 25 in 1910 to 40 in 1924 to 50 in 1941. St. Clair operated the resort until his death in 1964, but the resort remained in the family until 1974 and continued to operate through 1974. At the time the St. Clair family sold the resort, current owner Ed Hook recalls that there were 16 cabins in a wide variety of styles and materials including the main lodge, a caretakers residence, a tennis court, a minnow trough, and a three-car garage.

St. Clair, born in Faribault, MN in 1873, trained as a chef before opening his resort. A 1924 biography of St. Clair describes the facilities at the resort including an electric plant, a water plant, a refrigeration plant, an athletic field, a moving picture stadium, and a diving pavilion located 200' from the shore (Jones, McVean, et al., 1924). At that time, St. Clair offered 10 cabins and a main lodge (46' x 50') which boasted two dining rooms, a reception room, and an office (all on the first floor) and sleeping rooms on the second floor. The big weekly summer event was a Sunday evening bonfire and meal which commonly attracted 200 guests.

By the 1950s the resort had begun to decay, and its popularity had fallen-off, although it continued to attract summer visitors until the St. Clair family sold the resort. Today, a private house stands on the resort site (Barbara and Ed Hook), and only a few relics remain including remnants of the tennis court, the minnow trough, and the chimney from the old lodge which was incorporated into a contemporary house.

The public beach sits adjacent to and southwest of the site of the Black Oak Resort (Fig 37,38). That beach has been popular for many years with both swimmers and boaters. The beach is also the site of an annual New Year's tradition in which area residents "plunge" through the ice into the freezing waters of Black Oak Lake (Fig 39). Another longstanding tradition is the annual regatta parade on the Fourth of July where lake residents costume their boats along a particular theme and then motor around the lake (Fig 40).



Figure 35. St Clair's resort also thrived during the 1940s and remained in business into the 1960s (LOLHS).



Figure 36. Today, the spaces between the trees give an idea where St. Clair's cabins used to sit (Paul McLeod).



Figure 37. The bathing beach associated with the Black Oak Resort, ca. 1950s (LOLHS).



Figure 38. The bathing beach on Black Oak Lake continues to be popular, 2003 (Paul McLeod).



Figure 39. Annual “plunge” into Black Oak Lake at the public beach, January 1, 2004 (Paul McLeod).



Fig 40. Entrant in the annual Black Oak Lake regatta, July 4, 2003 (Paul McLeod).

Water Data

Wisconsin Department of Natural Resources

Laboratory Report

04/17/2003

Lab: 113133790

Sample: IN009957

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Laboratory: Wisconsin State Laboratory of Hygiene
2601 Agriculture Dr
Madison WI 53707
Phone: 800-442-4618 Fax Phone: 608-224-6276

DNR ID 113133790

Sample:

Field #: 113133790
Collection Start: 10/23/2002 03:00 pm
Collected by:
ID #: 643126
County: Vilas
Sample Location: BLACK OAK LAKE
Sample Description: DEEP HOLE - SURFACE
Sample Source: SU
Date Reported: 04/10/2003
Project No: SPL018

Sample #: IN009957
Collection End:
Waterbody/Outfall Id: 1630100
ID Point #:
Account #: SL003
Sample Depth: F3
Sample Status: CORRECTED

Analyses and Results:

Analysis Method		Analysis Date		Lab Comment			
TOTAL PHOSPHORUS (AS P) (EPA 365.1)		10/30/2002					
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
665	PHOSPHORUS TOTAL	7723140	0.008	MG/L	0.005		0.016

Analysis Method		Analysis Date		Lab Comment			
FIELD TESTS							
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
20	AMBIENT AIR TEMPERATURE - FIELD	E1645712	0.0	C			
99196	BOTTOM OF SAMPLING INTERVAL - F/M		85	FT			
32	CLOUD COVER	E1641711	100	%			
300	DISSOLVED OXYGEN FIELD	7782447	10.0	MG/L			
400	PH FIELD	E1644285	7	SU			
99420	SECCHI DEPTH HIT BOTTOM		NO	Y/N			
10	TEMPERATURE FIELD	E1645704	7.89	C			
99195	TOP OF SAMPLING INTERVAL - F/M		3	FT			

Analysis Method		Analysis Date		Lab Comment			
TEMPERATURE ON RECEIPT-ICED		10/24/2002					
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
136	TEMPERATURE AT LAB	E1645696	ICED	C		0	

Wisconsin Department of Natural Resources

Laboratory Report

04/17/2003

Lab: 113133790

Sample: IN007838

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Laboratory: Wisconsin State Laboratory of Hygiene

DNR ID 113133790

2601 Agriculture Dr

Madison

WI 53707

Phone: 800-442-4618

Fax Phone: 608-224-6276

Sample:

Field #: 113133790

Sample #: IN007838

Collection Start: 09/24/2002 01:30 pm

Collection End:

Collected by: GRAF

Waterbody/Outfall Id: 1630100

ID #: 643126

ID Point #:

County: Vilas

Account #: SL003

Sample Location: BLACK OAK LAKE

Sample Description: DEEP HOLE — SURFACE ?

Sample Source: SU

Sample Depth:

Date Reported: 04/10/2003

Sample Status: CORRECTED

Project No: SPL018

Analyses and Results:

Analysis Method		Analysis Date	Lab Comment				
CHLOROPHYLL A, FLUORESCENCE (WELSC)		09/25/2002	NO BOTTLE RECEIVED, NO TEST DONE				
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
99717	CHLOROPHYLL A, FLUORESCENCE (WELSCHMAYER 1994)	479618	**	UG/L	0.26		0.87

Analysis Method		Analysis Date	Lab Comment				
AMMONIA (AS N), DISS (EPA 350.1)		10/10/2002					
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
608	NITROGEN NH3-N DISS	7664417	ND	MG/L	0.013		0.042

Analysis Method		Analysis Date	Lab Comment				
NITRATE+NITRITE (AS N), DISS (EPA 353.2)		10/10/2002					
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
631	NITROGEN NO3+NO2 DISS (AS N)	E701177	ND	MG/L	0.022		0.075

Analysis Method		Analysis Date	Lab Comment				
TOTAL KJELDAHL NITROGEN (AS N) (EPA 310/02/2002)							
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
625	NITROGEN KJELDAHL TOTAL	E1644079	0.36	MG/L	0.14		0.4

Analysis Method		Analysis Date	Lab Comment				
TOTAL PHOSPHORUS (AS P) (EPA 365.1)		09/27/2002					
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
665	PHOSPHORUS TOTAL	7723140	0.011	MG/L	0.005		0.016

**Wisconsin Department of Natural Resources
Laboratory Report**

04/17/2003

Lab: 113133790

Sample: IN007838

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Analysis Method		Analysis Date	Lab Comment				
DISS REACTIVE PHOSPHORUS AS P (ORTHO		09/25/2002					
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
671	PHOSPHATE ORTHO DISS	7723140	ND	MG/L	0.002		0.006

Analysis Method		Analysis Date	Lab Comment				
FIELD TESTS							
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
20	AMBIENT AIR TEMPERATURE - FIELD	E1645712	11.7	C			
99196	BOTTOM OF SAMPLING INTERVAL - F/M		85	FT			
32	CLOUD COVER	E1641711	25	%			
300	DISSOLVED OXYGEN FIELD	7782447	8.6	MG/L			
400	PH FIELD	E1644285	7.5	SU			
49701	SECCHI DEPTH - FEET	E1646140	14	FT			
99420	SECCHI DEPTH HIT BOTTOM		NO	Y/N			
10	TEMPERATURE FIELD	E1645704	5.6	C			
99195	TOP OF SAMPLING INTERVAL - F/M		3	FT			

Analysis Method		Analysis Date	Lab Comment				
TEMPERATURE ON RECEIPT-ICED		09/25/2002					
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
136	TEMPERATURE AT LAB	E1645696	ICED	C		0	

**Wisconsin Department of Natural Resources
Laboratory Report**

04/17/2003

Lab: 113133790

Sample: IN009956

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Laboratory: Wisconsin State Laboratory of Hygiene
2601 Agriculture Dr
Madison WI 53707
Phone: 800-442-4618 Fax Phone: 608-224-6276

DNR ID 113133790

Sample:

Field #: 113133790
Collection Start: 10/23/2002 03:00 pm
Collected by:
ID #: 643126
County: Vilas
Sample Location: BLACK OAK LAKE
Sample Description: DEEP HOLE - BOTTOM
Sample Source: SU
Date Reported: 04/10/2003
Project No: SPL018

Sample #: IN009956
Collection End:
Waterbody/Outfall Id: 1630100
ID Point #:
Account #: SL003

Sample Depth: F85
Sample Status: CORRECTED

Analyses and Results:

Analysis Method		Analysis Date	Lab Comment				
TOTAL PHOSPHORUS (AS P) (EPA 365.1)		10/30/2002					
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
665	PHOSPHORUS TOTAL	7723140	0.085	MG/L	0.005		0.016

Analysis Method		Analysis Date	Lab Comment				
FIELD TESTS							
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
20	AMBIENT AIR TEMPERATURE - FIELD	E1645712	0.0	C			
99196	BOTTOM OF SAMPLING INTERVAL - F/M		85	FT			
32	CLOUD COVER	E1641711	100	%			
300	DISSOLVED OXYGEN FIELD	7782447	0.1	MG/L			
400	PH FIELD	E1644285	7	SU			
99420	SECCHI DEPTH HIT BOTTOM		NO	Y/N			
10	TEMPERATURE FIELD	E1645704	5.56	C			
99195	TOP OF SAMPLING INTERVAL - F/M		3	FT			

Analysis Method		Analysis Date	Lab Comment				
TEMPERATURE ON RECEIPT-ICED		10/24/2002					
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
136	TEMPERATURE AT LAB	E1645696	ICED	C		0	

WISCONSIN DEPARTMENT OF NATURAL RESOURCES

Laboratory Report

03/14/2003

Lab: 113133790

Sample: IN014751

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Laboratory: Wisconsin State Laboratory of Hygiene
 2601 Agriculture Dr
 Madison WI 53707
 Phone: 800-442-4618 Fax Phone: 608-224-6276

DNR ID 113133790

Sample:

Field #:		Sample #: IN014751
Collection Start: 02/19/2003 03:00 pm		Collection End:
Collected by: GRAF		Waterbody/Outfall Id: 1630100
ID #: 643126		ID Point #:
County: Vilas		Account #: SL003
Sample Location: BLACK OAK LAKE		
Sample Description: DEEP HOLE - TOP		
Sample Source: SU		Sample Depth: M1
Date Reported: 03/13/2003		Sample Status: COMPLETE
Project No: SPL018		

Analyses and Results:

Analysis Method		Analysis Date	Lab Comment				
AMMONIA (AS N), DISS (EPA 350.1)		03/04/2003	IMPROPER SLH BOTTLE USED, RESULT APPROXIMATE				
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
608	NITROGEN NH3-N DISS	7664417	*0.032	MG/L	0.013		0.042

Analysis Method		Analysis Date	Lab Comment				
NITRATE+NITRITE (AS N), DISS (EPA 353.2)		03/04/2003	IMPROPER SLH BOTTLE USED, RESULT APPROXIMATE				
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
631	NITROGEN NO3+NO2 DISS (AS N)	E701177	*ND	MG/L	0.022		0.075

Analysis Method		Analysis Date	Lab Comment				
TOTAL KJELDAHL NITROGEN (AS N) (EPA 351.2)		02/21/2003	IMPROPER SLH BOTTLE USED, RESULT APPROXIMATE				
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
625	NITROGEN KJELDAHL TOTAL	E1644079	*0.57	MG/L	0.14		0.4

Analysis Method		Analysis Date	Lab Comment				
TOTAL PHOSPHORUS (AS P) (EPA 365.1)		03/06/2003	IMPROPER SLH BOTTLE USED, RESULT APPROXIMATE				
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
665	PHOSPHORUS TOTAL	7723140	*0.017	MG/L	0.005		0.016

Analysis Method		Analysis Date	Lab Comment				
DISS REACTIVE PHOSPHORUS AS P (ORTHOPHOSPHATE) (SM 4500PE)		03/21/2003	IMPROPER SLH BOTTLE USED, RESULT APPROXIMATE				

Wisconsin Department of Natural Resources

Laboratory Report

03/14/2003

Lab: 113133790

Sample: IN014751

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Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
671	PHOSPHATE ORTHO DISS	7723140	*ND	MG/L	0.002		0.006

Analysis Method		Analysis Date		Lab Comment	
FIELD TESTS					
Code	Description	Cas No	Result	Units	LOD Report Limit LOQ
20	AMBIENT AIR TEMPERATURE - FIELD	E1645712	32	C	Surface DO. = 13 ppm 85' = 3.5 ppm
32	CLOUD COVER	E1641711	0	%	
400	PH FIELD	E1644285	6.75	SU	
49701	SECCHI DEPTH - FEET	E1646140	7.0	FT	
99420	SECCHI DEPTH HIT BOTTOM		NO	Y/N	
10	TEMPERATURE FIELD	E1645704	35.5	C	

Analysis Method		Analysis Date		Lab Comment			
TEMPERATURE ON RECEIPT-ICED		02/20/2003					
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
136	TEMPERATURE AT LAB	E1645696	ICED	C		0	

Wisconsin Department of Natural Resources

Laboratory Report

03/14/2003

Lab: 113133790

Sample: IN014750

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Laboratory: Wisconsin State Laboratory of Hygiene
2601 Agriculture Dr
Madison WI 53707
Phone: 800-442-4618 Fax Phone: 608-224-6276

DNR ID 113133790

Sample:

Field #:		Sample #: IN014750
Collection Start: 02/19/2003 03:00 pm		Collection End:
Collected by: GRAF		Waterbody/Outfall Id: 1630100
ID #: 643126		ID Point #:
County: Vilas		Account #: SL003
Sample Location: BLACK OAK LAKE		
Sample Description: DEEP HOLE - BOTTOM SAMPLE		
Sample Source: SU		Sample Depth: F85
Date Reported: 03/13/2003		Sample Status: COMPLETE
Project No: SPL018		

Analyses and Results:

Analysis Method		Analysis Date	Lab Comment				
TOTAL PHOSPHORUS (AS P) (EPA 365.1)		03/06/2003					
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
665	PHOSPHORUS TOTAL	7723140	0.102	MG/L	0.005		0.016

Analysis Method		Analysis Date	Lab Comment				
FIELD TESTS							
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
20	AMBIENT AIR TEMPERATURE - FIELD	E1645712	32	C			
32	CLOUD COVER	E1641711	0	%			
400	PH FIELD	E1644285	6.75	SU			
49701	SECCHI DEPTH - FEET	E1646140	7.0	FT			
99420	SECCHI DEPTH HIT BOTTOM		NO	Y/N			
10	TEMPERATURE FIELD	E1645704	35.5	C			

Analysis Method		Analysis Date	Lab Comment				
TEMPERATURE ON RECEIPT-ICED		02/20/2003					
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
136	TEMPERATURE AT LAB	E1645696	ICED	C		0	

**Wisconsin Department of Natural Resources
Laboratory Report**

06/10/2003

Lab: 113133790

Sample: IN022141

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Laboratory: Wisconsin State Laboratory of Hygiene
2601 Agriculture Dr.
Madison WI 53718
Phone: 800-442-4618 Fax Phone: 608-224-6276

DNR ID 113133790

Sample:

Field #: BOTTOM	Sample #: IN022141
Collection Start: 05/29/2003 01:45 pm	Collection End:
Collected by: GRAF	Waterbody/Outfall Id: 1630100
ID #: 643126	ID Point #:
County: Vilas	Account #: SL003
Sample Location: BLACK OAK LAKE	
Sample Description: DEEP HOLE - BOTTOM SAMPLE	
Sample Source: SU	Sample Depth: F85
Date Reported: 06/10/2003	Sample Status: COMPLETE
Project No: SPL018	

Analyses and Results:

Analysis Method		Analysis Date	Lab Comment				
TOTAL PHOSPHORUS (AS P) (EPA 365.1)		06/04/2003					
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
665	PHOSPHORUS TOTAL	7723140	0.019	MG/L	0.005		0.016

Analysis Method		Analysis Date	Lab Comment				
FIELD TESTS							
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
20	AMBIENT AIR TEMPERATURE - FIELD	E1645712	24.2	C			
99196	BOTTOM OF SAMPLING INTERVAL - F/M		85	FT			
32	CLOUD COVER	E1641711	10	%			
300	DISSOLVED OXYGEN FIELD	7782447	6.2	MG/L			
400	PH FIELD	E1644285	6.5	SU			
49701	SECCHI DEPTH - FEET	E1646140	16.5	FT			
99420	SECCHI DEPTH HIT BOTTOM		NO	Y/N			
10	TEMPERATURE FIELD	E1645704	8.5	C			
99195	TOP OF SAMPLING INTERVAL - F/M		1	FT			

Analysis Method		Analysis Date	Lab Comment				
TEMPERATURE ON RECEIPT-ICED		05/30/2003					
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
136	TEMPERATURE AT LAB	E1645696	ICED	C		0	

1386 Andy

**Wisconsin Department of Natural Resources
Laboratory Report**

06/24/2003

Lab: 113133790

Sample: IN022142

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FIELD TESTS

<i>Code</i>	<i>Description</i>	<i>Cas No</i>	<i>Result</i>	<i>Units</i>	<i>LOD</i>	<i>Report Limit</i>	<i>LOQ</i>
20	AMBIENT AIR TEMPERATURE - FIELD	E1645712	24.2	C			
99196	BOTTOM OF SAMPLING INTERVAL - F/M		85	FT			
	PERCENT COVER	E1641711	10	%			
99195	TOP OF SAMPLING INTERVAL - F/M		3	FT			

Analysis Method

Analysis Date *Lab Comment*

TEMPERATURE ON RECEIPT-ICED

05/30/2003

<i>Code</i>	<i>Description</i>	<i>Cas No</i>	<i>Result</i>	<i>Units</i>	<i>LOD</i>	<i>Report Limit</i>	<i>LOQ</i>
136	TEMPERATURE AT LAB	E1645696	ICED	C		0	

**Wisconsin Department of Natural Resources
Laboratory Report**

06/24/2003

Lab: 113133790

Sample: IN022142

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Laboratory: Wisconsin State Laboratory of Hygiene
2601 Agriculture Dr.
Madison WI 53718
Phone: 800-442-4618 Fax Phone: 608-224-6276

DNR ID 113133790

Sample:

Field #: TOP	Sample #: IN022142
Collection Start: 05/29/2003 01:45 pm	Collection End:
Collected by: GRAF	Waterbody/Outfall Id: 1630100
ID #: 643126	ID Point #:
County: Vilas	Account #: SL003
Sample Location: BLACK OAK LAKE	
Sample Description: DEEP HOLE - TOP SAMPLE	
Sample Source: SU	Sample Depth: F3
Date Reported: 06/24/2003	Sample Status: COMPLETE
Project No: SPL018	

Analyses and Results:

Analysis Method		Analysis Date	Lab Comment				
AMMONIA (AS N), DISS (EPA 350.1)		06/12/2003					
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
608	NITROGEN NH3-N DISS	7664417	ND	MG/L	0.013		0.042

Analysis Method		Analysis Date	Lab Comment				
NITRATE+NITRITE (AS N), DISS (EPA 353.2)		06/12/2003					
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
631	NITROGEN NO3+NO2 DISS (AS N)	E701177	ND	MG/L	0.022		0.075

Analysis Method		Analysis Date	Lab Comment				
TOTAL KJELDAHL NITROGEN (AS N) (EPA 306/06/2003)							
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
625	NITROGEN KJELDAHL TOTAL	E1644079	0.36	MG/L	0.14		0.4

Analysis Method		Analysis Date	Lab Comment				
TOTAL PHOSPHORUS (AS P) (EPA 365.1)		06/04/2003					
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
665	PHOSPHORUS TOTAL	7723140	0.009	MG/L	0.005		0.016

Analysis Method		Analysis Date	Lab Comment				
DISS REACTIVE PHOSPHORUS AS P (ORTHO) (EPA 305/30/2003)							
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
671	PHOSPHATE ORTHO DISS	7723140	0.007	MG/L	0.002		0.006

Analysis Method		Analysis Date	Lab Comment				
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**Wisconsin Department of Natural Resources
Laboratory Report**

06/24/2003

Lab: 113133790

Sample: IN022142

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FIELD TESTS

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
20	AMBIENT AIR TEMPERATURE - FIELD	E1645712	24.2	C			
99196	BOTTOM OF SAMPLING INTERVAL - F/M		85	FT			
32	CLOUD COVER	E1641711	10	%			
300	DISSOLVED OXYGEN FIELD	7782447	9.4	MG/L			
400	PH FIELD	E1644285	7.0	SU			
49701	SECCHI DEPTH - FEET	E1646140	16.5	FT			
99420	SECCHI DEPTH HIT BOTTOM		NO	Y/N			
10	TEMPERATURE FIELD	E1645704	14.5	C			
99195	TOP OF SAMPLING INTERVAL - F/M		3	FT			

Analysis Method	Analysis Date	Lab Comment
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TEMPERATURE ON RECEIPT-ICED

05/30/2003

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
136	TEMPERATURE AT LAB	E1645696	ICED	C		0	

Wisconsin Department of Natural Resources

Laboratory Report

07/30/2003

Lab: 113133790

Sample: IO000019

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Laboratory: Wisconsin State Laboratory of Hygiene
2601 Agriculture Dr.
Madison WI 53718
Phone : 800-442-4618 Fax Phone : 608-224-6276

DNR ID 113133790

Sample:

Field #: Sample #: IO000019
Collection Start: 06/30/2003 01:00 pm Collection End:
Collected by: GRAF Waterbody/Outfall Id: 1630100
ID #: 643126 ID Point #:
County: Vilas Account #: SL004
Sample Location: BLACK OAK LAKE
Sample Description: DEEP HOLE
Sample Source: SU Sample Depth: M1
Date Reported: 07/29/2003 Sample Status: COMPLETE
Project No: SPL018

Analyses and Results:

Analysis Method		Analysis Date	Lab Comment				
HARDNESS (AS CaCO3), TOTAL REC, CALC (							
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
899	HARDNESS TOTAL RECOVERABLE CALCULATION	E1643592	22.3	MG/L	1.4		4.6

Analysis Method		Analysis Date		Lab Comment			
MAGNESIUM, TOTAL REC, ICP (SW846 6010B) 07/10/2003							
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
921	MAGNESIUM TOTAL RECOVERABLE	7439954	1.6	MG/L	0.2		0.7

Analysis Method		Analysis Date	Lab Comment				
AMMONIA (AS N), DISS (EPA 350.1)		07/16/2003					
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
608	NITROGEN NH3-N DISS	7664417	ND	MG/L	0.013		0.042

Analysis Method		Analysis Date	Lab Comment				
NITRATE+NITRITE (AS N), DISS (EPA 353.2)		07/16/2003					
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
631	NITROGEN NO3+NO2 DISS (AS N)	E701177	ND	MG/L	0.022		0.075

Analysis Method		Analysis Date	Lab Comment				
TOTAL KJELDAHL NITROGEN (AS N) (EPA 307/07/2003)							
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
625	NITROGEN KJELDAHL TOTAL	E1644079	0.27	MG/L	0.14		0.4

Wisconsin Department of Natural Resources

Laboratory Report

07/30/2003

Lab: 113133790

Sample: IO000019

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Analysis Method		Analysis Date		Lab Comment			
TOTAL PHOSPHORUS (AS P) (EPA 365.1)		07/10/2003					
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
665	PHOSPHORUS TOTAL	7723140	0.009	MG/L	0.005		0.016

Analysis Method		Analysis Date		Lab Comment			
DISS REACTIVE PHOSPHORUS AS P (ORTHO07/02/2003							
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ

Analysis Method		Analysis Date		Lab Comment			
SULFATE (EPA 375.2)		07/22/2003					
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
945	SULFATE TOTAL	14808798	ND	MG/L	4.5		15.0

Analysis Method		Analysis Date		Lab Comment			
FIELD TESTS							
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
20	AMBIENT AIR TEMPERATURE - FIELD	E1645712	23.9	C			
99426	BOTTOM OF SAMPLING INTERVAL (METERS)		85	M			
32	CLOUD COVER	E1641711	40	%			
300	DISSOLVED OXYGEN FIELD	7782447	8.2	MG/L			
400	PH FIELD	E1644285	7.0	SU			
49701	SECCHI DEPTH - FEET	E1646140	20	FT			
99420	SECCHI DEPTH HIT BOTTOM		NO	Y/N			
10	TEMPERATURE FIELD	E1645704	20	C			
99424	TOP OF SAMPLING INTERVAL (METERS)		1	M			

Analysis Method		Analysis Date		Lab Comment			
TEMPERATURE ON RECEIPT-ICED		07/01/2003					
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
136	TEMPERATURE AT LAB	E1645696	ICED	C		0	

**Wisconsin Department of Natural Resources
Laboratory Report**

07/30/2003

Lab: 113133790

Sample: IO000019

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Analysis Method		Analysis Date		Lab Comment			
CALCIUM, TOTAL REC, ICP (SW846 6010B)		07/10/2003					
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
918	CALCIUM TOTAL RECOVERABLE	7440702	6.4	MG/L	0.2		0.7

Analysis Method		Analysis Date		Lab Comment			
CONDUCTIVITY PH & ALK (SM2510B/EPA 1507/10/2003)							
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
410	ALKALINITY TOTAL CaCO3	E1640192	22.	MG/L		1.	
95	CONDUCTIVITY AT 25C	E1640291	51.	UMHOS/CM		1	
403	PH LAB	E1644285	7.80	SU		1	

Analysis Method		Analysis Date		Lab Comment			
DIG, TOTAL REC, ICP, LIQUIDS (SW846 3005A)		07/09/2003					
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
99404	DIG TOTAL REC SW846 3005A		COMPLE TE				

**Wisconsin Department of Natural Resources
Laboratory Report**

08/12/2003

Lab: 113133790

Sample: IO002184

Page 1 of 1

Laboratory: Wisconsin State Laboratory of Hygiene

DNR ID 113133790

2601 Agriculture Dr.

Madison

WI 53718

Phone : 800-442-4618

Fax Phone : 608-224-6276

Sample:

Field #:

Sample #: IO002184

Collection Start: 07/18/2003 01:00 pm

Collection End:

Collected by: GRAF

Waterbody/Outfall Id: 1630100

ID #: 643126

ID Point #:

County: Vilas

Account #: SL004

Sample Location: BLACK OAK LAKE

Sample Description: DEEP HOLE

Sample Source: SU

Sample Depth: M1

Date Reported: 08/11/2003

Sample Status: COMPLETE

Project No: SPL018

Analyses and Results:

Analysis Method		Analysis Date		Lab Comment			
TOTAL PHOSPHORUS (AS P) (EPA 365.1)		07/31/2003					
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
665	PHOSPHORUS TOTAL	7723140	0.009	MG/L	0.005		0.016

Analysis Method		Analysis Date		Lab Comment			
FIELD TESTS							
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
20	AMBIENT AIR TEMPERATURE - FIELD	E1645712	22.8	C			
99196	BOTTOM OF SAMPLING INTERVAL - F/M		85	FT			
32	CLOUD COVER	E1641711	0	%			
300	DISSOLVED OXYGEN FIELD	7782447	7.6	MG/L			
400	PH FIELD	E1644285	6.75	SU			
49701	SECCHI DEPTH - FEET	E1646140	17.5	FT			
99420	SECCHI DEPTH HIT BOTTOM		NO	Y/N			
10	TEMPERATURE FIELD	E1645704	21.7	C			
99424	TOP OF SAMPLING INTERVAL (METERS)		1	M			

Analysis Method		Analysis Date		Lab Comment			
TEMPERATURE ON RECEIPT-ICED		07/22/2003					
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
136	TEMPERATURE AT LAB	E1645696	ICED	C		0	

**Wisconsin Department of Natural Resources
Laboratory Report**

09/11/2003

Lab: 113133790

Sample: 10005411

Page 1 of 1

Laboratory: Wisconsin State Laboratory of Hygiene
2601 Agriculture Dr.

DNR ID 113133790

County: Vilas

Account #: SL004

Sample Location: BLACK OAK LAKE

Sample Description: DEEP HOLE

Sample Source: SU

Sample Depth: F85

Date Reported: 09/11/2003

Sample Status: COMPLETE

Project No: SPL018

Analyses and Results:

Analysis Method		Analysis Date		Lab Comment			
TOTAL PHOSPHORUS (AS P) (EPA 365.1)		09/04/2003					
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
665	PHOSPHORUS TOTAL	7723140	0.017	MG/L	0.005		0.016

Analysis Method		Analysis Date		Lab Comment			
FIELD TESTS							
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
20	AMBIENT AIR TEMPERATURE - FIELD	E1645712	17.8	C			
99196	BOTTOM OF SAMPLING INTERVAL - F/M		85	FT			
32	CLOUD COVER	E1641711	10	%			
300	DISSOLVED OXYGEN FIELD	7782447	9.2	MG/L			
400	PH FIELD	E1644285	7.5	SU			
99420	SECCHI DEPTH HIT BOTTOM		NO	Y/N			

Analysis Method		Analysis Date		Lab Comment			
TEMPERATURE ON RECEIPT-ICED		08/28/2003					
Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
136	TEMPERATURE AT LAB	E1645696	ICED	C		0	

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 -

PLANTING RECORD

Year	Species	Size	Number
1937	Crappie	Adult	1,500
	Lake Trout	Fry	144,960
1938	Lake Trout	Fry	150,000
	Walleyed Pike	Fry	633,070
1939	W.E. Pike	Fry	600,000
	Panfish		
	Lake Trout		150,000
	L.M. Bass	Fry	5,000
1940	W.E. pike	Fry	500,000
1940	Lake Trout	#2 Fry	3,500
1940	L.M. Bass	Fry	5,000
1941	Lake Trout	Any	126,000
1942	Lake Trout	Fry	100,000
1943	Lake Trout	Chpl.	2,500
1944	Lake Trout	Fry	122,500
1944	S.M. Bass	Fry	8,625
1946	Lake Trout	Any	240,000
	Sm B.B.	Any	50 F

W

S

Wisconsin Conservation Department

Form FI-86

(This space for mapping by field personnel)

N

PLANTING RECORD

Year	Species	Size	Number
1933	LAKE TROUT	FRY	182,000
1933	WALLEYED PIKE	FRY	515,750
1933	BLACK BASS	FGLS.	79
1934	LAKE TROUT		50,000
1935	WALLEYED PIKE	FRY	130,320
1935	BLACK BASS	FGLS.	1,200
1935	LAKE TROUT	FRY	228,330
1935	BLUEGILLS, BASS, PERCH	YRLS.	850
1935	BASS	ADULT	9
1936	PERCH	YRLS.	360
1936	BLUEGILLS	YRLS.	120
1936	BASS	ADULT	90
1937	CRAPPIE	ADULT	1,500
1937	LAKE TROUT	FRY	144,960
1938	LAKE TROUT	FGLS.	150,000
1938	WALLEYED PIKE	FRY	633,070
1939	LAKE TROUT	FRY	126,000
1939	LARGE MOUTH BLACK BASS	FRY	5,000
1939	WALLEYED PIKE	FRY	600,000
1940	LAKE TROUT	FGLS.	5,000
1940	LAKE TROUT	FRY	122,500
1940	LARGE MOUTH BLACK BASS	FRY	5,000
1940	WALLEYED PIKE	FRY	500,000

Wisconsin Conservation Department

Form F1-56

Landing _____
Cooperator _____
Address _____ Tel. _____
Boats _____ Motor _____
Other resorts (name) _____
Housekeeping cabin groups (name) _____
MOST ALL SUMMER HOMES
Remarks: _____

N

W



S

(This space for mapping by field personnel)

PLANTING RECORD

[illegible]

Wisconsin Conservation Department

Form F1-86

Landing -----
Cooperator -----
Address ----- Tel. -----
Boats ----- Motor -----
Other resorts (name) -----

Housekeeping cabin groups (name) -----

Remarks: -----

N

W

S

(This space for mapping by field personnel)

Subj: **Black Oak Lake**
 Date: 12/16/2004 10:27:43 AM Central Standard Time
 From: Wesley.Jahns@dnr.state.wi.us
 To: jonin3027@AOL.com, stu@nnex.net
 Sent from the Internet (Details)

Here are the totals from this falls lake trout sampling. The chart below is the population estimate. This is **not a valid estimate**, but right now its all we have. This estimate was calculated using the marked fish from 2001 and 2002, with 10% annual tag loss figured in as the total marks at large. This time delay(2001-2004), and the fact that both samples were obtained during spawning season with gill nets combine to make the estimate invalid. We hope to get a statistically valid estimate by doing an angling recapture this winter. I can use the 103 marked fish from this falls gillnetting as the total marks at large, and then the total number caught angling in comparison to the number of tagged(recaptured) trout from the angling sample. The number of total trout caught and the number of recaptured fish will determine the accuracy of the estimate. As I said before, the good news is that all indications lead us to believe there are more lake trout than we originally thought.

N= The estimated number of adult lake trout-1080

C.V. is coefficient of variance (32% or less is the cut-off for an acceptable estimate)

95%CI=Confidence Interval (95 out of 100 times the estimate will fall within the range of the upper limit and lower limit(356-1804). As the estimate gets better, the C.V. gets lower, and the spread of the 95%C.I. gets smaller also.

As always, if you have any questions please contact me. Happy Holidays.

Black Oak Lake 2004 Adult PE--2001-2002-2004 gillnet			
M	69	N	1,080
C	107	VAR	136,350
R	6	C.V. (%)	34
		SD	369
M=2001 marks +2002marks		95% CI	724
C= 2004 gillnet sample		Upper Limit	1,804
R=2001&2002 gillnet marks		Lower Limit	356

Notice only three mortalities this year with a significant increase in total number captured.

Total captured=106
 Mortalities = 3
 Total marked = 103
 Min. LT= 20.1 Inches
 Max.LT= 33.7 Inches
 No. Males= 72
 No. Females = 31
 2002 Recaps= 4
 2001 Recaps= 2
 Avg. Lt.- 24.2
 Avg.Lt.Females=24.7
 Avg. Lt.Males = 23.9

Subj: lake trout
Date: 10/27/2004 12:33:57 PM Central Standard Time
From: Wesley.Jahns@dnr.state.wi.us (Jahns, Wesley O)
To: jonin3027@AOL.com (John Annin), stu@nnex.net (Stu Hunt)

Here is a quick summary from our netting on Monday, Oct. 25.

Total trout caught=71—minus two mortalities= a total of 69
Number recaptured with a previous tag=4
Smallest trout 20.1 inches
Largest Trout - 32.6 inches
Number =or > 26 inches = 13

Walleye=2
No other species captured.

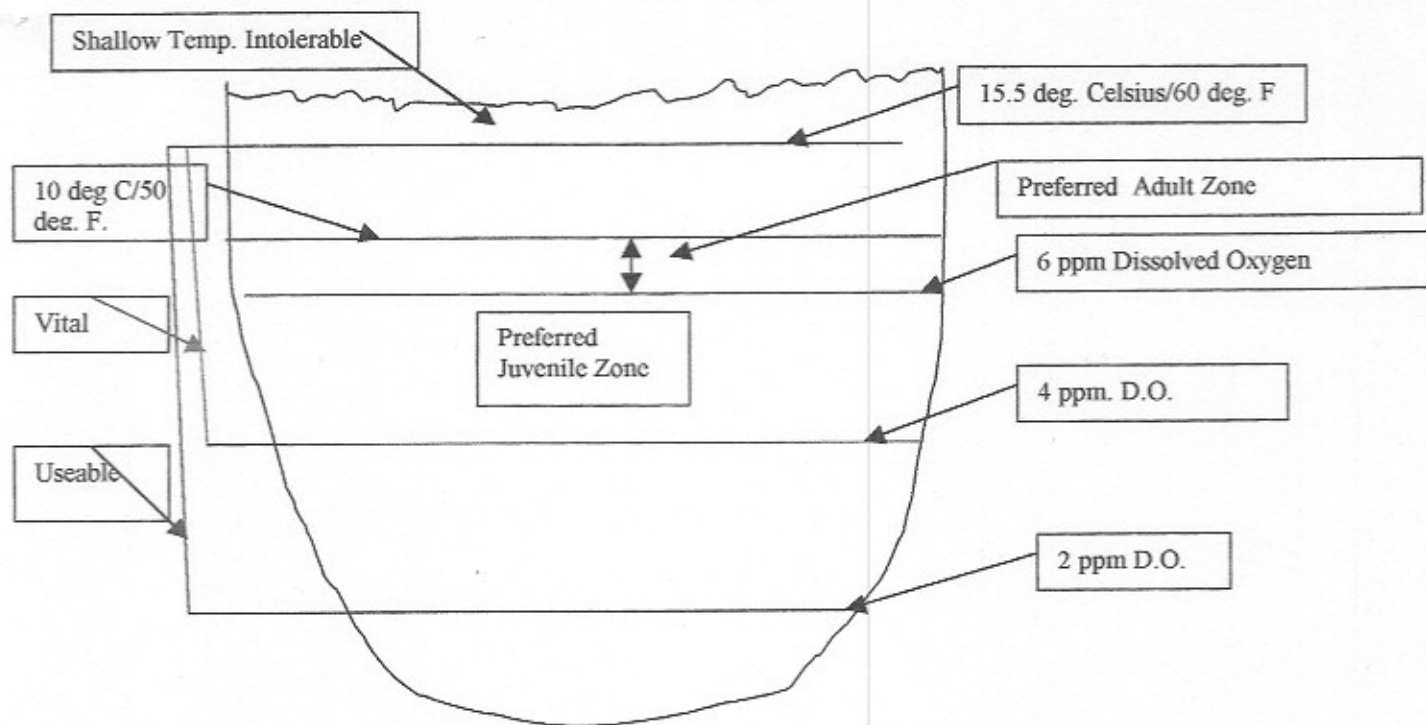
The overall population looks good based on the number of trout caught vs the number of recaptures. We also got more fish over 26 inches in this sample which is good. My major concern now is the lack of fish under 20 inches. As I think you know our plans are to monitor the population every five years at which time we will repeat the sampling with the possibility for taking eggs if needed.

We only got 2qts./ 8 oz of eggs with a target of 4 quarts. We are holding about another 15 females and will hold them until Monday if needed.

It will most likely be at least two weeks before I take a closer look at the data. At that time I will send you an update.

----- Headers -----

Return-Path: <Wesley.Jahns@dnr.state.wi.us>
Received: from rly-ya04.mx.aol.com (rly-ya04.mail.aol.com [172.18.141.36]) by air-ya01.mail.aol.com (v102.9) with ESMTP id MAILINYA12-159417fea019e; Wed, 27 Oct 2004 14:33:56 -0400
Received: from prodml01.DNR.state.wi.us (prodml01.dnr.state.wi.us [168.236.1.96]) by rly-ya04.mx.aol.com (v102.9) with ESMTP id MAILRELAYINYA45-159417fea019e; Wed, 27 Oct 2004 14:33:37 -0400
X-MimeOLE: Produced By Microsoft Exchange V6.5.7226.0
Content-class: urn:content-classes:message
MIME-Version: 1.0
Content-Type: multipart/alternative;
boundary="=_NextPart_001_01C4BC53.78FB422D"
Subject: lake trout
Date: Wed, 27 Oct 2004 13:33:37 -0500
Message-ID: <FE5741C56FE6C341813CF472E0DAB69E05BF8B43@prodml01.DNR.state.wi.us>
X-MS-Has-Attach:
X-MS-TNEF-Correlator:
Thread-Topic: lake trout
Thread-Index: AcS8U3k0A7lk9pq8TvmmtEhSGq7a8g==
From: "Jahns, Wesley O" <Wesley.Jahns@dnr.state.wi.us>
To: "John Annin" <jonin3027@AOL.com>, "Stu Hunt" <stu@nnex.net>
X-AOL-IP: 168.236.1.96
X-AOL-SCOLL-SCORE: 0:0:0:
X-AOL-SCOLL-URL_COUNT: 0



Subj: RE: Lake Trout
Date: 10/21/2004 10:42:12 AM Central Standard Time
From: Wesley.Jahns@dnr.state.wi.us (Jahns, Wesley O)
To: jonin3027@AOL.com (John Annin), stu@nnex.net (Stu Hunt)

One other note of interest. We only caught two trout with tags from previous years. One from 2001, and one from 2002. Although its too small of a sample to get a good population estimate it does indicate that our previous estimate most likely erred on the low side, which would be consistent with what we found on Trout Lake. The 2002 estimate on Black Oak ranged from 102-449, with the actual number estimated at 275. The good news is that the actual population would be closer to the 275 estimated in 2002 than it would be to the lower limit of 102.

> —Original Message—

> From: Jahns, Wesley O
> Sent: Thursday, October 21, 2004 11:30 AM
> To: 'John Annin'; 'Stu Hunt'
> Subject: Lake Trout

>
> Things went quite well last night as we caught 37 lake trout, and 13 of them were females. Unfortunately we did not get any eggs. The largest female, 33.7 inches was spent, and all the other females were hard. We intend to hold the fish in the hatchery until Monday and try again to take eggs. I don't think we will be netting again next week, even if we don't get the eggs we need, but I need to discuss that with some other people who will not be available until Monday. Besides the 33 incher we only had one other trout over 26 inches(26.3), and the smallest trout was 20.1 inches. This suggest two things: 1: Not much for recruitment of juvenile trout, and although its a small sample it is still low compared to previous catches. 2: It looks like angling harvest has increased. I will need to analyze the numbers more closely but from memory I think we had more fish over 26 inches in the past. We see this type of length frequency structure in bass populations quite often. When it was a 12 inch limit the number of bass over 12 inches dropped right off, and now that its a 14 inch limit they start to disappear at 13.5 inches.

>
> Total catch:
> Lake Trout=37
> Walleye=6
> Smallmouth=2

> Stu—No cisco's, not a single one.

> Hopefully we will get the eggs we need on Monday. Either way we plan to return the lake trout to the lake on Monday.

----- Headers -----

Return-Path: <Wesley.Jahns@dnr.state.wi.us>
Received: from rly-xb03.mx.aol.com (rly-xb03.mail.aol.com [172.20.64.135]) by air-xb01.mail.aol.com (v101_r1.6) with ESMTP id MAILINXB13-9b4177e6d92d0; Thu, 21 Oct 2004 12:42:12 -0400
Received: from prodml01.DNR.state.wi.us (prodml01.dnr.state.wi.us [168.236.1.96]) by rly-xb03.mx.aol.com (v101_r1.6) with ESMTP id MAILRELAYINXB35-9b4177e6d92d0; Thu, 21 Oct 2004 12:42:01 -0400
X-MimeOLE: Produced By Microsoft Exchange V6.5.7226.0
Content-class: urn:content-classes:message
MIME-Version: 1.0
Content-Type: multipart/alternative;
boundary="=_NextPart_001_01C4B78C.E397EFCB"
Subject: RE: Lake Trout
Date: Thu, 21 Oct 2004 11:42:01 -0500
Message-ID: <FE5741C56FE6C341813CF472E0DAB69E05BF8B3C@prodml01.DNR.state.wi.us>
X-MS-Has-Attach:
X-MS-TNEF-Correlator:
Thread-Topic: Lake Trout

Subj: Lake Trout
Date: 5/24/2004 1:27:40 PM Central Daylight Time
From: Wesley.Jahns@dnr.state.wi.us (Jahns, Wesley O)
To: jonin3027@AOL.com (Jon Annin)

File: LT.HabitatZones.doc (22528 bytes)
DL Time (32000 bps): < 1 minute

Jon—We have looked further in our files and do not have a record of the 1999 stocking. Any more information you can get regarding this stock would be greatly appreciated as it could directly effect the conclusions of the walleye stocking survival research project. Do you have a copy of the stocking receipt from the private hatchery, or a copy of the permit issued by the Department?

Here are the temp. oxygen parameters for lake trout and the various habitat zones. See graphic in Attachment for visual depiction.

Adult Lake Trout during summer stratification:

Preferred zone: The volume of the lake that is 10 deg. C., (50 deg. F) or less and has an oxygen concentration of 6 ppm. or more.

Useable habitat: The volume of the lake in which the temperature is either 15.5C, 60 deg. F, or less and the oxygen concentration is 4 ppm or more.

Tolerable: This zone extends down to the depth at which the D.O. level is 2 ppm.

Juvenile Lake Trout: Juvenile lake trout are further restricted within these zones to areas containing 6 ppm oxygen or less by the adults which seek out D.O. values of 6 ppm and higher.

What I would recommend for long term monitoring of the various habitat zones would be annual temperature/oxygen profiles conducted during late summer and taken over the deepest part of the lake. The samples should be taken at approximately the same time and date each year. Maximum thermal stratification will vary somewhat from year to year depending upon ambient air temperatures but will typically occur in late August or early September. Two separate sampling dates approximately two weeks apart will be sufficient. Say perhaps August 25 and September 8. The dates are somewhat arbitrary but I would not go much later than Sept. 8.

Temperature parameters: The most important temperature value is the 15.5 deg. C which delineates the upper boundary in the water column. Determining the water depth at which this temperature occurs will define the upper boundary of useable habitat. The next important temperature value is 10 deg. C which defines the upper limit of the preferred zone for adults.

Dissolved Oxygen parameters: There are three values that need to be determined: 6ppm, 4ppm, and 2ppm. The 6ppm oxygen reading will overlap with the 10 deg.C (or less) reading to determine the preferred zone of adults. The lower depth limit at which 4ppm oxygen occurs will determine the lower limit of the preferred zone for juveniles. The 2ppm oxygen reading will determine the lower limit of the tolerable zone.

Long term temperature/oxygen monitoring should prove valuable in assessing changes in the useable and preferred habitat zones for lake trout. If you have any further questions concerning lake trout management feel free to contact me.

<<LT.Habitat Zones.doc>>

CORRESPONDENCE/MEMORANDUM

State of Wisconsin

DATE: 4/16/2004

FILE REF: [Click here and type file ref.]

TO: Black Oak Lake File

FROM: Wes Jahns

SUBJECT: Stocking of Black Oak strain lake trout.

Recent genetic testing has shown that the Black Oak lake trout population is unique to the Upper Mississippi River Basin, and may constitute the only pure-ancestry remnants of the Pleistocene Mississippian refugial race of lake trout. Current lake trout management plans call for gill net sampling in two consecutive years on a five-year rotation beginning in 2004.

Goals are to monitor long term population structure, longevity and growth of marked fish, and natural reproduction. Objectives of the plan are to maintain natural reproduction and to introduce the Black Oak strain of lake trout into candidate lakes in hopes of establishing secondary populations of this unique strain. The following is a list of candidate lakes in order of priority as decided upon by the respective County Biologists, the Fisheries Supervisor, and Wes Jahns.

- 1: Big Carr, Oneida County
- 2: Long, Vilas County
- 2: Lucerne, Forest County
- 4: Keyes, Florence County
- 5: Lac Du Lune, Vilas County

Long Lake and Lake Lucerne were ranked evenly at this time but will be re-evaluated following the completion of temperature oxygen profiles in late summer, 2004.

2003 WDNR Fisheries Rule Development Proposal

Title: Lake Trout Regulation Change- 30-inch minimum size limit, one fish bag limit

Location: Black Oak Lake, Vilas County

Author: Wes Jahns, Fisheries Technician-- Vilas County

Statement of Problem:

Black Oak Lake is one of two lakes in the state of Wisconsin with a native lake trout population, and is the only lake sustained entirely by natural reproduction. Recent genetic testing has shown that these trout are genetically unique to Black Oak Lake. Historical data concerning the lake trout population is limited, consisting of periodic gill net sampling yielding catch per effort values. In 2002 a mark/recapture population estimate was calculated using the 2001 catch as the marks, and 2002 for the recapture sample. The adult lake trout population estimate was 275, or 0.5/acre. The lower limit of the 95% confidence interval is 102 adults, or 0.2/acre (Table 1).

There is no historical population density data available for inland lake trout populations in Wisconsin, and very little information was found in the scientific literature regarding population densities for lakes in North America. Personal communication with biologists from Ontario, Canada would suggest the Black Oak Lake density of 0.5 adult lake trout per acre is currently at, or slightly below the average of Ontario lakes. Very little age-growth data is available, but lake trout populations in general are characterized as slow growing, long lived (up to 40 years in Trout Lake), with low juvenile recruitment. If the lower limit estimate of 102 adults is accurate, any increased pressure on the population, either by angling, or inter-species competition could be devastating.

Lake trout populations in Ontario Canada have demonstrated an inverse relationship with walleye populations (Evans et al. 1991: Anthropogenic stressors and diagnosis of their effects on lake trout populations in Ontario lakes. Lake Trout Synthesis, Ontario Ministry of Natural Resources, Toronto.). As a result of several successful walleye plants, a major change in the fish community structure has resulted in a trophy walleye fishery. A 1999 survey of the adult walleye population revealed that 71% (1,405 fish) of the population was greater than 20 inches in length (see table 2). The trophy walleye fishery has generated increased angler interest in Black Oak Lake. Increased angler interest for walleye may result in higher incidental lake trout harvest. That as well as possible interspecific competition with walleye has raised concern for the future of this unique fishery.

Recommended Solution:

The current regulation is a 26- inch minimum size limit and daily bag limit of one fish. That regulation protects about 75% of the adult stock. It is recommended that the size limit be increased to 30 inches, with the daily bag limit of one lake trout remaining unchanged. A 30 inch size limit will protect approximately 90% of the population (Table 3). This would effectively eliminate angling harvest on this small population. This will

also provide uniformity with the lake trout regulation in nearby Trout Lake and protect mature fish for many years while providing a trophy fishery.

An alternative regulation would be to close the lake trout fishery entirely. This would be more difficult from an enforcement standpoint and would eliminate the opportunity for fishermen to keep a rare trophy.

A third alternative would be to keep the regulation the same and supplement the natural population through stocking if numbers begin to decline. The consequences of this action would put additional stress on the hatchery system to produce yearling lake trout, and stocking on top of natural reproduction has been shown to be detrimental to, and could actually eliminate recruitment of naturally produced juveniles.

Impact Analysis:

The Black Oak Lake association is in favor of the change and has submitted a letter stating such. Current lake trout harvest is unknown, but believed to be relatively low. This regulation change should not result in a substantial reduction to current lake trout harvest, nor seriously impact local guides or businesses.

The local Conservation Warden was consulted regarding enforcement of the proposed regulation and stated there would be no enforcement problems related to this regulation.

Lake trout management is guided by the Upper Wisconsin Basin Inland Lake Trout Management Plan. Recent sampling information revealed a self-sustaining population that is genetically unique to Black Oak Lake. This information resulted in the submittal and approval of a management project written for Trout Lake and Black Oak Lake for the 2003-2005 fiscal year. Current plans for Black Oak Lake are to monitor population density, size structure, and growth of lake trout over two consecutive years. This monitoring would be repeated on a five-year rotation.

Walleye density will also be monitored in conjunction with the size structure of the lake trout population. The walleye population is primarily stocked fish. While popular and providing a true trophy opportunity, if surveys indicate a decline in the lake trout population, walleye stocking may need to be reduced or eliminated.

Consequences of No Action:

There is a possibility that increased harvest rates, competition with walleye, and low recruitment may result in the loss of this genetically unique fishery. Walleye stocking will need to be evaluated in this light. For the immediate future, angling harvest should be largely eliminated on this unique fishery. Failure to pass the proposed regulation will not accomplish that goal.

Draft Question:

Black Oak Lake Walleye Regulation – Increase the minimum length limit from 26 inches to 30 inches with the daily bag limit of one remaining unchanged.

This genetically unique population is the only naturally sustaining lake trout population in the state of Wisconsin. Recent increases in angling pressure combined with potential competition from the trophy walleye population may threaten the survival of this unique fishery. Raising the legal size limit from 26 inches to 30 inches will protect a majority of the population while providing a trophy fishery.

Do you favor increasing the minimum length limit from 26 inches to 30 inches and maintaining a daily bag limit of one lake trout on Black Oak Lake, Vilas County?

Approvals:

Fisheries Team Leader: _____ Date: _____

Law Enforcement Sup. _____ Date: _____

Regional Fisheries Expert: _____ Date: _____

Regional Director: _____ Date: _____

LAKE TROUT 2002

Subj: Lake Trout
Date: 11/27/2002 12:07:05 PM Central Standard Time
From: Wesley.Jahns@dnr.state.wi.us (Jahns, Wesley O)
To: jonin3027@AOL.com ('Jon Annin'), stu@nnex.net ('Stu Hunt')

Just a quick summary of the totals from the gill netting for this year as compared to last.

	2001	2002
Total Trout	54	40
Avg. Length	23.9	23.7
Min. Length	16.2	15.0
Max. Length	33.8	30.5

Of the 40 trout captured this fall, six contained tags from the 2001 sampling. This yields an adult population estimate of 275 lake trout. Statistically we can determine the accuracy of these estimates. The accuracy is dependent upon the total number of fish marked in year one, the number of fish captured in year two, and the number of recaptures in the year two sample that were marked(tagged) in year one.

For this particular estimate we can say with 95% certainty that the actual population lies somewhere between a low of 102, to a high of 449. Other factors that contribute to the variability of the estimate are tag loss and mortality of fish from year one to year two. With walleye we have the ability to mark and recapture within the same year and eliminate some of the variability allowing for much more accurate estimates. However, due to behavioral factors of lake trout and the relative inaccessibility to sampling we are somewhat limited. This is another reason why we need to monitor the population over a long period of time to more accurately assess its status.

Assuming there are a total of 275 adult lake trout in the lake, and take into consideration that some of these fish may be 30 or 40 years old, it is clear that the population cannot withstand any significant harvest on an annual basis. To further illustrate the point, let's assume the maximum age is 30. If we divide 275 by 30 we get nine, meaning that it would only take nine juvenile trout per year recruiting into the adult population to sustain the 275 total over time. Again, this is without factoring in natural and angling mortality, but I think it shows just how vulnerable a slow growing, low density fishery is.

A total population of 275 calculates out to 0.5 trout per acre. I know you want to ask how this compares to other lakes but unfortunately I can not give you a specific answer. There is just not much information of this type available in the literature due to the problems associated with compiling accurate lake trout estimates. The only other lake in our area that we could possibly compare it to is Trout Lake which appears to be somewhere between 0.4 and 0.6 adults per acre.

I think the lower number of fish captured this year as compared to last is merely the coincidence of getting the net in exactly the right place at the right time. Our current plans are to monitor this fishery every five years to make sure that natural reproduction continues to maintain the population, and to continue to accumulate data on length, sex, longevity, growth, and density. I had expected the results of the genetics testing would be

available by now but I have still not received word regarding the findings. As for growth rates I only have the six recaptures from last year to determine growth during that time span. One of these fish grew from 18.4 inches in 2001 to 19.3 inches in 2002, but four of the other fish only grew one or two tenths of an inch and the sixth fish was shorter in 2002 due to measuring error dealing with live fish. This is much too small of a sample to draw conclusions but it appears that growth rates are going to be very slow, which is similar to observations from Trout Lake.

If you have any further questions feel free to contact me, and hope you have a happy Thanksgiving.

Wes.

----- Headers -----

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From: "Jahns, Wesley O" <Wesley.Jahns@dnr.state.wi.us>
To: 'Jon Annin' <jonin3027@AOL.com>, 'Stu Hunt' <stu@nnex.net>
Subject: Lake Trout
Date: Wed, 27 Nov 2002 12:06:11 -0600
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Subj: Re: Lake Trout
Date: 11/29/2002
To: Wesley.Jahns@dnr.state.wi.us

Hi Wes

Thanks for the lake trout report, very interesting.

I am surprised how small the population is. Does this mean you will close the open season on lake trout in Black Oak in order to protect the population? It would be a shame to lose them.

Please forward the genetic data when you receive it. I would like to see that also.

Best regards, John Annin

Subj: **Lakers**
Date: 12/3/2002 11:00:14 AM Central Standard Time
From: Wesley.Jahns@dnr.state.wi.us (Jahns, Wesley O)
To: jonin3027@AOL.com ('Jon Annin'), stu@nnex.net ('Stu Hunt')

In regards to your concerns about closing all lake trout fishing I do not think we have enough evidence at this point in time to support that. I do however share your concerns about protecting this unique fishery. Although we do not have a lot of information regarding lake trout densities I believe that if the current estimate of 0.5 adults per acre is accurate, that is reflective of what the realistic potential is for the lake to sustain. I want to stress that we cannot simply decide to increase the number of lake trout because the lake itself sets the limit on the number of fish it can support. With the increase in the walleye population, particularly the relatively high density of walleyes over 20 inches, there is an increased demand on the forage base, ie; ciscoes.

Like you I am concerned about possible increases in harvest due to increased angling pressure. Rather than close the fishery at this time I would favor increasing the size limit to 30 inches. The previous three years netting yielded a total of 132 lakera of which nine(7%) were equal to or greater than 30 inches. Legal harvest of lake trout this size would not be detrimental to the population and would provide the opportunity to harvest a trophy. This would also standardize regulations between Trout Lake and Black Oak.

Having stated the above, I will also say that angling pressure could be a real wild card. If in fact angling pressure does increase, hooking mortality and illegal harvest of fish under the size limit are sure to follow. In a worst case scenario if the actual population of adults is closer to 102 rather than 275, angling mortality could pose a realistic threat to the fishery.

In the near future I will discuss these issues with the Vilas County fisheries manager(Steve Gilbert) who has the authority to propose a regulation change. I will keep you informed and as always if you have further questions feel free to contact me.

Stu—if you stop here on Thursday I am upstairs in the old cement block building across the road from the service center off Hwy J. The road is just to the West of the Service Center and goes South toward the hatchery. Take the first right into the parking lot. Use the small door in the center of the building and I am office #3 upstairs.

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From: "Jahns, Wesley O" <Wesley.Jahns@dnr.state.wi.us>
To: 'Jon Annin' <jonin3027@AOL.com>, 'Stu Hunt' <stu@nnex.net>
Subject: Lakers

Subj: genetics
Date: 12/6/2002 11:38:02 AM Central Standard Time
From: Wesley.Jahns@dnr.state.wi.us (Jahns, Wesley O)
To: jonin3027@AOL.com (Jon Annin), stu@nnex.net (Stu Hunt)

I heard back from the geneticist who said he was just about to email me. Not sure when he finished the work but I wish he would have responded sooner. The manuscript will take some time to complete but the bottom line is that both Trout Lake and Black Oak Lake were determined to be pure strains and are very different from each other.

What this means is that we obviously will manage these fisheries to maintain the unique strain and will not stock fish of a different gentic make-up. Budget wise I'm sure you know things are going to be really tight the next couple years but I am going to push to attempt to have a creel census done on the lake in either 2003, or more likely 2004. This will give us an idea on angler harvest and hopefully the ability to determine the effects of angler harvest on the laker population.

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From: "Jahns, Wesley O" <Wesley.Jahns@dnr.state.wi.us>
To: 'Jon Annin' <jonin3027@AOL.com>, 'Stu Hunt' <stu@nnex.net>
Subject: genetics
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Black Oak Lake 2002 Lake Trout Management Report

Introduction:

Black Oak Lake is a 584 acre drainage lake of moderate fertility with a maximum depth of 85 feet. It has slightly alkaline, clear water of high transparency. The diverse fish community includes lake trout, cisco, walleye, northern pike, smallmouth bass, largemouth bass, bluegill, pumpkinseed, and rock bass. Coho salmon, rainbow trout, brook trout, and splake were stocked at various times between 1953 and 1970 with little or no success. Brown trout stocking also occurred as recently as October 2000 with limited success and has subsequently been discontinued.

The walleye population has historically been low density, with minimal, sporadic natural reproduction. Extended growth walleye averaging seven to eight inches long and marked with fin clips were stocked in 1989 and 1990 and assessed for survival. Stocked walleye contributed significantly to the fishery resulting in a 1999 adult population estimate of 3.4/acre. Of even greater significance is a density of 2.4 walleyes per acre over 20 inches long. Fisheries community dynamics are essential for managing lake trout populations. Studies conducted on lake trout lakes in Ontario have shown walleye populations to be detrimental to the sustenance of lake trout populations (David O. Evans, Ontario MNR, personal communication).

Previous lake trout investigations in Black Oak Lake have consisted of periodic gill net sampling to assess stocking, or to determine the status of the population based on catch per effort values. Fall fingerling lake trout of Lake Superior origin have been stocked as recently as 1980 to supplement the naturally reproducing population. Upon approval of the Upper Wisconsin Basin Inland Lake Trout Management Plan (UWBILTMP) in 2000, Black Oak Lake was identified for more intensive study. Objectives were to 1) assess the current lake trout population, 2) rehabilitate the fishery if needed. Since that time, a mark-recapture population estimate has been conducted and the status of the population appears to be stable. Natural reproduction is sustaining the fishery, and recent genetic analysis indicates that the population is a pure distinct strain.

Methods:

Gill Nets: From October 21-23, 2002, three gill nets consisting of 2 1/2 inch stretch mesh, 300 feet long and six feet high were set over the known spawning reef on the north side of the lake (Map attached). Short duration sets were used to minimize mortality. Nets were set approximately one hour prior to sunset, with lifting of the first net commencing approximately one hour after sunset. After processing the first net it was reset and the process continued with the remaining nets. Nets were reset for a minimum of two lifts per net, per night, for a total active fishing time of approximately five hours per net per night. Data was not separated for each lift, but combined for each net resulting in one net night for each of the three nets.

Fish were removed from the net and placed in a tank of fresh water. Processing of the fish took place immediately upon completion of the lift, and stressed fish were allowed to recuperate before being released back into the lake.

Swim Bladders: Lake trout and walleye exhibiting enlarged swim bladders were deflated using an 18 gauge hypodermic needle one and one-half inches long. Upon locating the proper insertion point, the needle, excluding the syringe, was poked through the skin and into the bladder and the air allowed to flow out the open end of the needle. For walleye, the removal of one or two scales at the point of insertion proved beneficial.

Floy Tagging: Model FD-94, 5/8 inch mono Med-T shrink lock floy tags were used to mark individual fish. The tags were inserted approximately one inch posterior of the anterior end of the dorsal fin. The tags were white in color and individually numbered from 235-300.

Genetic Samples: Each lake trout had a piece of the caudal tail approximately 1/2 inch x 1/4 inch removed and placed in a numbered vial containing a preservative and stored for later genetic analysis.

Summary:

Upon approval of the UWBILTMP, an evaluation of the status of the lake trout population in Black Oak Lake was initiated with gill net sampling in 2000. Prior information regarding the lake trout population was minimal and the status of the population was unknown. Gill netting conducted in October 2000 confirmed a viable lake trout population and a project proposal was written for the 2001-2003 biennium. Sampling objectives were to gather CPE, density, length frequency, sex ratio, and age-growth data resulting in the development of a management plan.

CPE: Catch per effort values were: 2002 - 4.4 lake trout per net night, (9) total net nights, 2001- 6.0 (9), 2000- 9.5 (4), 1985- 6.2 (6). Effort expended is not standardized and long term data from Trout Lake shows a decline in CPE values as effort increases. Individual net placement is also crucial and directly affects catch rate values.

Density: A mark-recapture Chapman modification of the Petersen population estimate was conducted using floy tagged fish marked during gill netting in 2001, and recaptured with gill net in 2002. Mortality during the year between samples is unknown, but this is the most accurate indicator of density available. Repeated estimates over a five-year time interval will provide a reliable long-term indicator of relative abundance. The adult lake trout population was estimated to be 275 (0.5/acre). This compares favorably with Trout Lake, (0.4-0.7/acre), and with average densities in Canadian waters, 0.4 - 0.6/acre. (David O. Evans, Ontario MNR personal communication). The lower confidence limit estimate of 102 total adults suggests caution must be exercised in regards to management.

Black Oak Lake Adult Walleye Population Estimate (Sexes Combined)			
M	46	N	275
C	40	VAR	7,855
R	6	C.V. (%)	32
N= Estimated Number		SD	89
M= 2001 Marks		95% CI	174
C= 2002 Captures		Upper Limit	449
R= 2001 Marks in 2002 Capture		Lower Limit	102

Length Frequency/Size Distribution: A length frequency comparison of the 2000 through 2002 catch is depicted in Figure 1, and a comparison of the 1985 catch is made with the 2002 catch in Figure 2. A total of 40 lake trout were captured in 2002 with an average length of 23.7 inches, ranging in size from 15.0 - 30.5 inches total length. Average length in inches for previous years was 2001 (23.9), 2000 (23.7), and 1985 (22.8). In comparison, the average length of lake trout in Trout Lake has increased from 23.4 inches in 1996, to 25.7 inches in 2002. During this time period the number of lake trout in the sample under 20 inches decreased from 51 in 1996, to zero in 2000 - 2002. In Black Oak Lake the number of lake trout less than 20 inches was, 2000 (6), 2001 (4), and 2002 (5), or 11% of the overall catch. The number of lake trout under 20 inches is a key indicator in monitoring natural reproduction, and subsequently the survival of the population as a whole.

Sex ratios: The ratio of males to females has varied from 2.2:1 in 2001, to 4.0:1 in 2000 and 2002. Female lake trout do not spend as much time at spawning sites as do males and therefore are less vulnerable to capture, and could be underestimated.

Age-Growth Data: Accurate age determinations of individual lake trout in Black Oak and Trout Lake have proven difficult. Overall, scale samples are fairly reliable the first six to eight years but become increasingly "unreadable" with age. Age-growth determinations have been made in Black Oak Lake based upon a very limited sample of yearlings fin clipped prior to stocking and recaptured at a later date. Six year-old trout varied from 18.7-25.0 inches total length.

A total of twelve otolith samples have been collected from netting mortalities but only one of the samples provided a confident age estimate. That fish was 29.3 inches and 10 years old. Two other samples of questionable accuracy were 14.1 inches (7+), and 22.7 inches (9?). The lack of accurate length at age data prevents mortality calculations, and accurate age structure determinations.

Floy tagging will provide long term growth information but will not provide specific length at age data. Of the six trout marked in 2001 and recaptured in 2002, the average length was 24.3 inches, and the average one-year growth was 0.2 inches. This is similar to the average growth of 0.4 inches per year in Trout Lake from 1996-2001.

Gill Net Bi-Catch: The total catch for all species other than lake trout in 2002 was: cisco- 30, walleye-26, burbot- 9, and rock bass-2. Walleye ranged in size from 14.0 – 28.3 inches, with a majority of the fish between 14.0 –16.0 inches. Cisco ranged from 9.0 -15.1 inches with 66% between 12.0 and 14.5 inches.

Genetics: A total of 44 tissue samples were analyzed for Mitochondrial DNA, and Microsatellite DNA (Fst + assignment tests). Black Oak Lake and Trout Lake were both determined to be pure inland populations distinctive from other populations and from each other (Kyle Piller, Wisconsin Department of Natural Resources, personal communication).

Management Recommendations: The two over-riding factors determining the direction of lake trout management in Black Oak Lake are 1) the presence of juvenile lake trout, and 2) the determination that the population represents a pure genetic strain.

Verification of natural reproduction as evidenced by the presence of juvenile trout means this is the only self-sustaining lake trout population in Wisconsin excluding Lake Superior. Stocking hatchery reared fish has proven detrimental to natural reproduction in many waters of Ontario Canada (David O. Evans, Loss of Exploited, Indigenous Populations of Lake Trout, *Salvelinus namaycush*, by Stocking of Non-Native Stocks. CJPAS). Catch per effort, length distribution, and the population estimate suggest stable adult densities and natural recruitment. Therefore I recommend the lake not be stocked with lake trout and the population managed as a unique naturally reproducing strain.

The population status needs to be monitored on a regular basis. The two main concerns for the future of the population are the increased walleye density, and a general increase in angler interest in the lake due to increased walleye densities, especially trophy sized fish. Lake trout populations in general do best in low species diversity situations, and have exhibited an adverse relationship to walleye densities. The above average density of large walleye, 2.4/acre > 20 inches, will compete directly with lake trout for available forage, specifically cisco. Adult walleye could also pose a direct threat to lake trout recruitment by direct predation on juvenile lake trout. The second threat to the lake trout population is harvest. Angler harvest could increase due to an increased interest in the trout population, and also indirectly by fishermen targeting trophy walleye. Because of a possible increase in angler harvest I will submit a regulation change to increase the minimum size of lake trout from 26 inches to 30 inches, maintaining the current bag limit of one. This will provide additional protection to mature trout and standardize lake trout regulations with Trout Lake.

Due to the concerns of increased pressure on the lake trout population listed above, I recommend a long term sampling plan using gill nets over two consecutive years on a five year rotation. Trout will be marked with floy tags both years, and the second year of the sampling used as a recapture to calculate a population estimate. At the present time there is only one known spawning reef. This results in a concentration of fish and concern has risen over disrupting the spawning process and possibly negatively affecting natural reproduction. For this reason we feel a five-year rotation is necessary, yet sufficient to monitor the population.

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. The UWBLTMP also calls for the introduction of lake trout into new waters to provide additional angling opportunities, and establish subsequent populations that preserve this unique strain. Therefore, I propose using progeny from the Black Oak strain to introduce as yearlings into Long Lake, Vilas County, Keyes Lake, Florence County, and Lake Lucerne, Forest County. All of these lakes contain smelt populations and the stocking of yearling trout at eight per acre at a

minimum weight of 40/pound is recommended. Egg taking will coincide with the two year sampling plan beginning in the fall of 2004 resulting in yearlings being stocked in 2006 and 2007. Gill netting on Black Oak Lake will be limited to three nights with nets being run the same night and not set overnight to reduce mortality. Additional netting will only be conducted to obtain the minimum number of eggs needed to produce the yearlings.

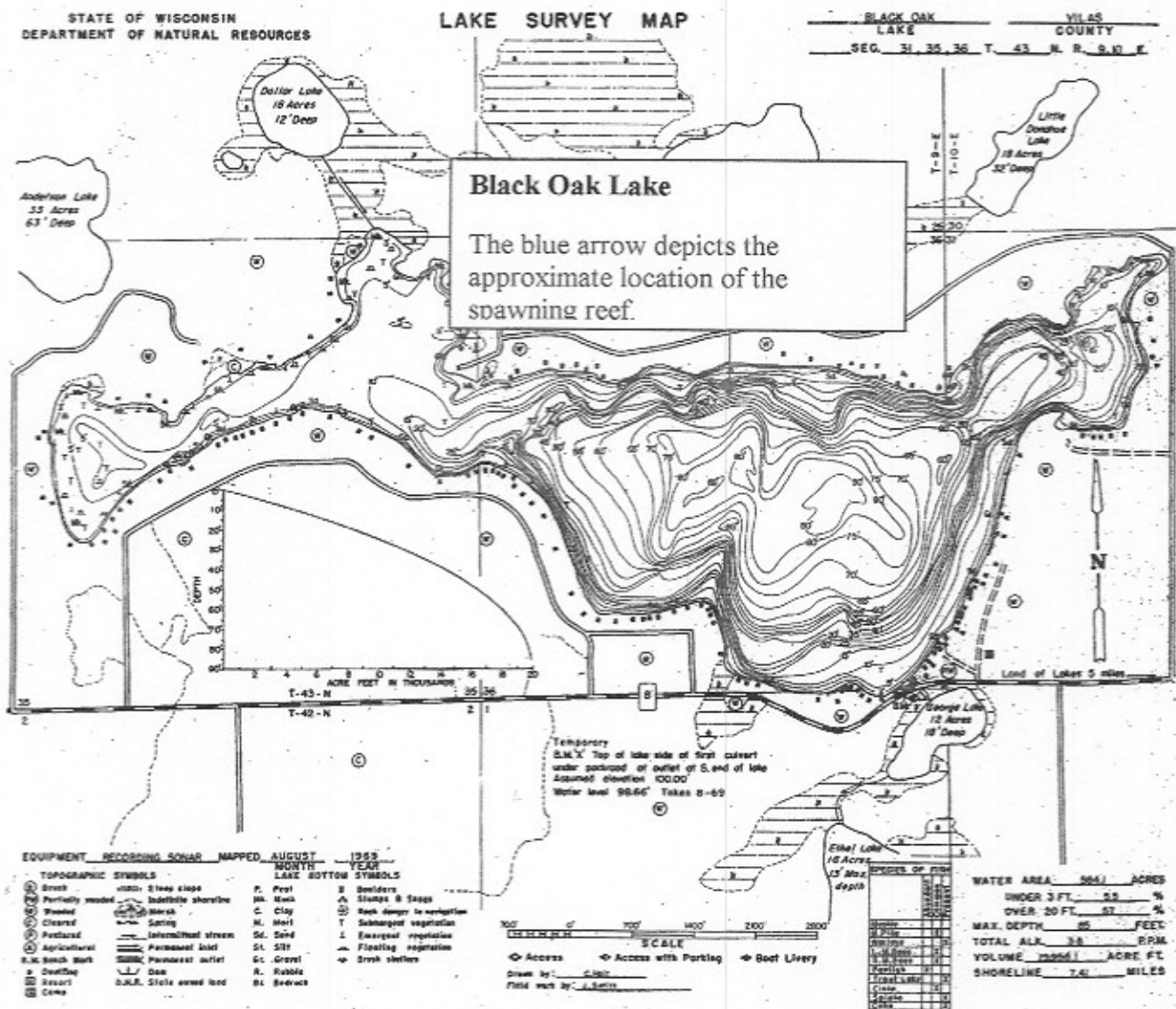
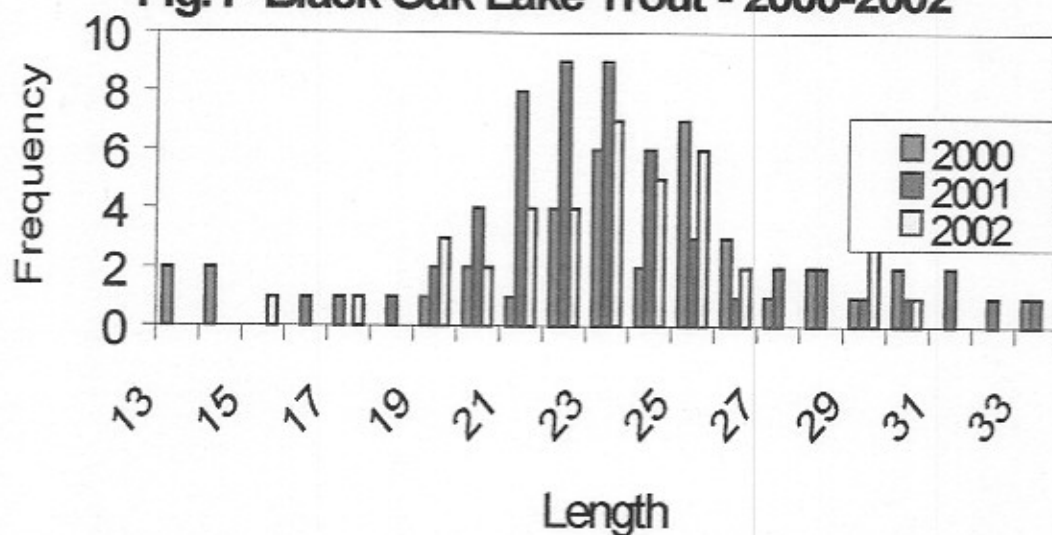
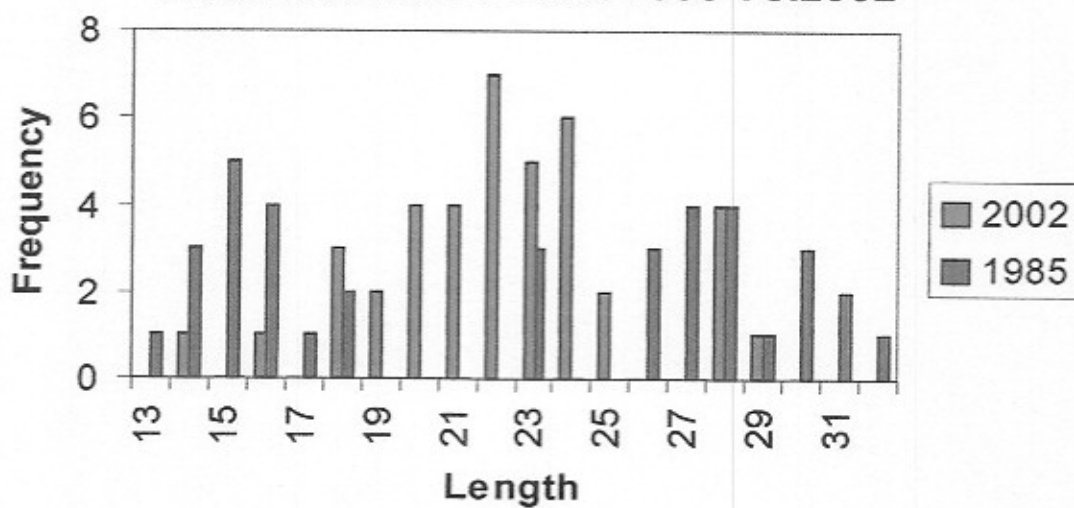


Fig.1- Black Oak Lake Trout - 2000-2002



Black Oak Lake Trout-1985 Vs.2002



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 Palette Lake. Approximately

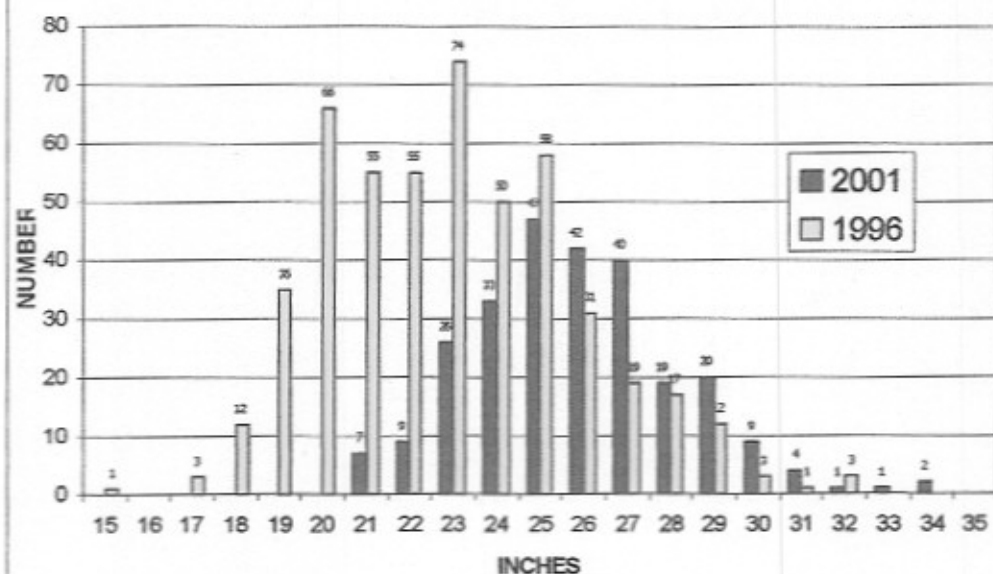
25,000 of the fall fingerlings will be reared to yearlings by the Green Lake co-op pond and stocked in Big Green Lake. In the fall of 2002 approximately 20,000 fingerlings will be transferred back to the Oehmcke hatchery where they will be held and stocked as yearlings in the spring of 2003. Although 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 was 128 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

The percentage of fish marked by fin clip in the 2001 fyke net sample was 73%, which is part of an annual downward trend from a high of 88% in 1996. Shown below is the percent composition of each clip dating from 1996 – 2001. (1998 not sampled).

Clip	1996	1997	1999	2000	2001
AD	12%	14%	14%	13%	15%
LP	7%	3%	6%	7%	4%
LV	22%	24%	21%	18%	17%
RP	21%	15%	20%	17%	16%
RV	25%	29%	26%	24%	26%
None	12%	14%	13%	21%	21%

The percentage of recaptures, fish previously marked with a floy tag is as follows: 2001- 72%, 2000 – 61%, 1999 – 52%, and 1997 – 35%. Homing tendencies, defined as the ratio of fish returning to the same site they were previously captured, was Rocky Reef: 2.1:1, and Headquarters 5.0:1. In 2000, the ratios were Rocky Reef 6.2:1. and Headquarters 3.3:1. Although some individuals have been captured at both spawning sites, the majority of the fish have repeatedly been captured at the same site.

Otolith samples continue to be collected from netting mortalities and aged by Scott Hulse, Bayfield. There were a total of six lake trout mortalities in 2001, including two fish captured by personnel from the University of Wisconsin Trout Lake Field Station. One of these fish was a 30.4 inch male with an RV clip that was aged at 40 years. Age as determined from otolith samples, combined with fin clip stocking data allow for reliable age determination, especially for fish exceeding 20 years of age.

Growth data is calculated from recaptured fish by subtracting the length at first capture from the length at the most recent recapture. A total of 52 trout from the 1996 marks were recaptured, and 58 trout from the 1997 marks. Documented growth is as follows:

	1996-2001		1997-2001	
	Male	Female	Male	Female
Average Growth(Inches)	1.9	1.6	1.8	1.4
Average Length(Inches)	25.9	26.8	24.8	26.5

Tag loss rates were calculated as follows. In 1996 a total of 495 lake trout were captured and floy tagged. The following year 168 of the tagged fish were recaptured and given a second floy tag. During 2001 fall fyke netting, a total of 28 lake trout were identified as having been double tagged for a total of 56 individual tags. Of the 56, a total of 12 tags were missing, yielding a four-year tag loss rate of 21%. This is a minimum estimate derived from a small sample size, so for population estimate calculations tag loss rates were derived from a Lake Superior study (Fabrizio, 1996).

Previous adult spawning population estimates were done using year one of the fyke net catch as the mark, and year two of the fyke net catch as the recapture, or by using multiple year fyke net catches as the mark, and the most recent years catch as the recapture. Estimates ranged from N=1415 in 1997, to N=1640 in 2000. In the fall of 2001 considerable effort was directed toward gill netting prior to peak spawning and a large enough sample was obtained to use the gill net catch as the recapture sample. Several estimates were calculated using different values for the marks.

Estimate 1: M= (388) year 2000 total fyke net catch
C= (22) year 2001 total gill net catch
R= (2) year 2001 gill net recaptures from year 2000 fyke net catch

N= 2982 SD= 1390 CV= 0.46 95%CI= 2725

Estimate 2: M=(797) Total marks 1996-2000 minus 10% annual tag loss
C= (22) year 2001 total gill net catch
R= (7) year 2001 gill net total tagged

N= 2294 SD= 618 CV= 0.27 95%CI= 1210

Estimate 3: M= (1156) total marks 1996-2000-(No Tag Loss)
C= (22) year 2001 total gill net catch
R= (7) year 2001 gill net total tagged

N= 3326 SD= 895 CV= 0.27 95%CI= 1755

Lake Trout angling as a recapture method was conducted on March 4, 2002, and March 28, 2002. A total of 29 lake trout were captured ranging in size from 11.7 – 36.2 inches, and six (21%) were floy tagged. Of the 23 trout 20 inches and longer, 15(65%) were fin clipped compared to 73% fin clips in the 2001 fyke net catch. Otoliths were removed from four juvenile trout less than 16 inches in length, and one of each pair of otoliths were examined for Oxytetracycline marks, and the other otolith was aged. An 11.7 inch trout was thought to have an OTC mark and be of hatchery origin, but the age could not be confirmed.

The following adult spawning population estimate using the ice-angling sample as the recapture sample was calculated using Trout > or = 20 inches.

M= (797)Total tagged fish (1996-2000), minus 10% annual tag loss
C= (23)Total captured during angling
R= (6)Number of tagged fish

N= 2736 SD= 814 CV= 0.30 95%CI= 1596

In October 2000, four adult lake trout were implanted with radio transmitters and released in Trout Lake in hopes of locating new spawning areas. Four additional

transmitters were purchased, and two used transmitters donated by Jeff Roth were implanted on 10/17/2001, and 10/31/2001. Gill netting was conducted the week of October 15, 2001 to capture adult lake trout for transmitter implantation. Three two and one half inch stretch mesh gill nets were set along the East shore of South Trout Lake with one net set directly over the known spawning reef by Allequash Creek, and the other two nets set north along Ben Bendrick Drive. All nets were set perpendicular to shore with the shallow end approximately 20 feet deep, and the deep end in 40 to 60 feet of water. Non floy- tagged trout with no fin clips were targeted for implantation. All unmarked trout captured in the gill nets were marked with an individually numbered bi-colored (yellow/red) floy tag.

On October 17, 2001 five fish were implanted with transmitters. The fish were held overnight in the hatchery, and the trout containing transmitter number 300 died in the tank. The other four fish were taken to the lake and released in good condition. The following week three fish were selected from the trout captured during fyke netting for implantation of the two donated transmitters, and the mortality from the previous week.

The two donated transmitters are frequency 49.154, and 49.918. These two transmitters have an expected life of 470 days. They are programmed to be on 12 hours, off twelve hours for one week, off the entire following week, and then the cycle starts over. All remaining transmitters are programmed to be on for 16 hours, then off for 8 hours. The "200" series transmitters should last through October, 2002, and the "300" series should remain charged until November 2003. The table below lists all of the trout currently implanted with transmitters in Trout Lake, and the activation time for each transmitter.

Frequency	Length	Sex	Clip	Date Tagged	Tag Number	On
49.201	21.4	Male	None	10-17-2001	1120	8 AM
49.221	26.0	Male	None	10-18-2000	Mortality	Noon
49.241	27.8	Female	RP	10-17-2000	No tag	Noon
49.261	24.6	Male	None	10-17-2000	No tag	Noon
49.300	26.8	Female	None	10-31-2001	1202	8 AM
49.321	27.2	Male	None	10-17-2001	1125	8 AM
49.341	26.0	Male	None	10-17-2001	1126	8 AM
49.361	27.8	Male	None	10-17-2001	1124	8 AM
49.154	24.1	Male	None	10-31-2001	1210	Noon
49.918	20.6	Male	None	10-31-2001	1205	Noon

style of tag used (Fabrizio, 1996). The tag-shedding models depicted in the report average approximately 50% tag loss after five years, thus the 10% annual figure used in calculating the population estimate.

The presence of juvenile trout in the ice-angling sample resulted in a length frequency quite different from previous fyke and gill net captures. Of the 29 lake trout caught angling, six (21%) were less than 20 inches in length. In comparison to the 282 lake trout captured during 2001 fall netting, none of the trout were less than 20 inches. The average length and minimum size of fish captured during fall fyke netting has increased annually since 1996, suggesting no recruitment of juvenile fish, yet the ice-angling recapture, although a small sample, showed 21% of the total to be juveniles. Local ice-fishermen also reported catching a number of juvenile lake trout incidental to the whitefish harvest.

Fall fyke net catches have declined annually since 1996, and quite dramatically in 2000, and 2001 prompting concerns of a decreasing population. Contrary to this trend, the most recent population estimate using the ice-angling recapture yielded a higher, more statistically valid estimate. The ice angling recapture sample also provided valuable information concerning juvenile fish, validating the importance of this technique for future use.

Black Oak Lake

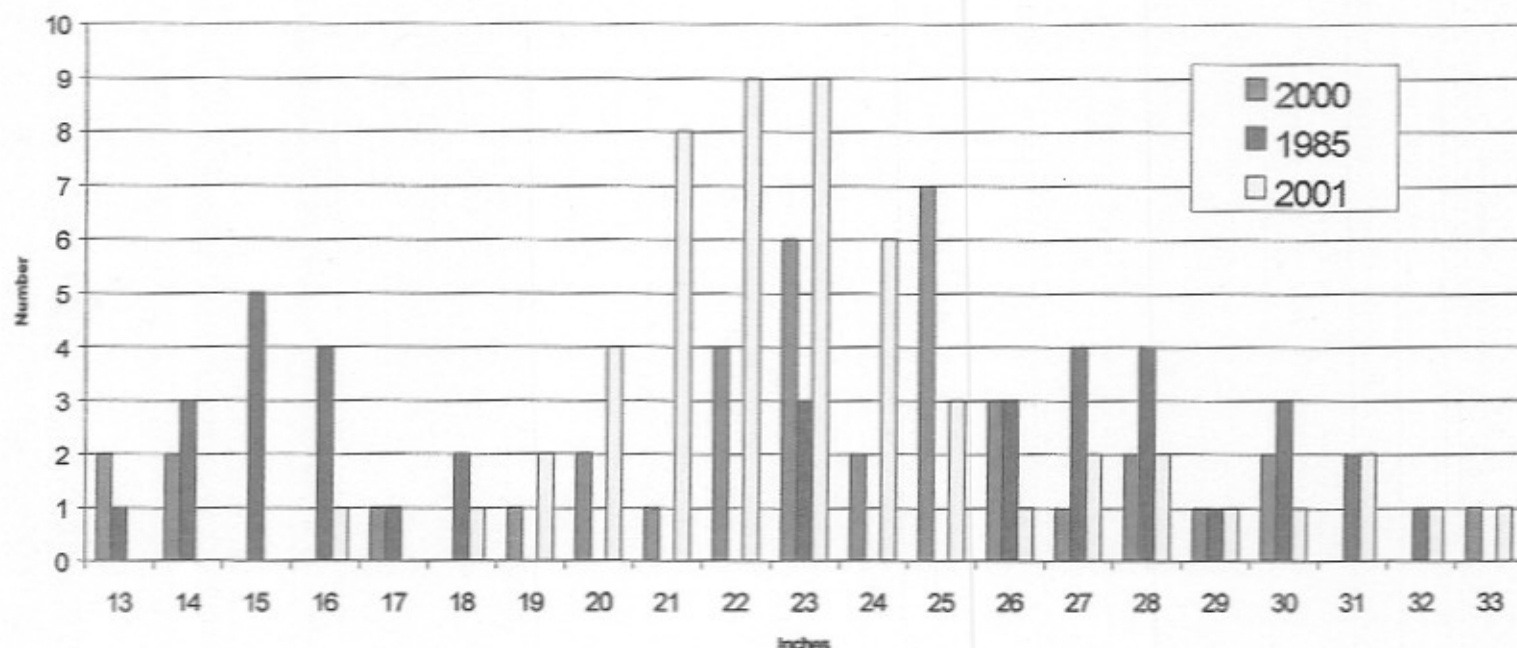
A gill net survey of the lake trout population conducted on October 24-25, 2000, revealed numerous age classes of trout ranging in size from 13.0 inches to 33.5 inches in length, none of which were fin-clipped. The most recent lake trout stocking of fin-clipped fish occurred in 1980, thereby indicating natural recruitment of juveniles. Previous sampling efforts consist primarily of limited gill netting effort, resulting in catch per effort data only. Information pertaining to growth rates, longevity, and population densities are minimal. Therefore, lake trout management in Black Oak Lake has become part of the long term Inland Lake Trout Management Plan approved in 2001.

The current management plan calls for the individual marking of lake trout with floy tags in 2001, and subsequent sampling in 2002 providing a recapture sample for the calculation of a population estimate. These estimates will be conducted every five years to provide long term monitoring of the population. Plans to supplement the population through stocking were abandoned upon determination of natural reproduction, however long term monitoring is necessary to determine if natural recruitment is sufficient to sustain the fishery. Length at age data for lake trout is difficult to document due to the lack of a reliable aging structure. Otoliths have proven to be fairly accurate and have been gathered from incidental mortalities. Recent age data from Trout Lake indicates individuals may attain forty years of age. Otolith samples have also been taken from Black Oak Lake but for reasons unknown the majority of the samples have been

unreadable. Long term sampling in conjunction with individual marking of lake trout will provide information currently lacking for the parameters listed above.

Three two and one half inch stretch mesh gill nets 300 feet long were set October 22 – October 24, 2001. For comparative purposes I will treat the multiple sets as one set, resulting in nine net lifts. A total of 54 lake trout, 86 cisco, 28 walleye, 13 burbot, one smallmouth bass, and one northern pike were captured. The catch per effort for lake trout was: 2001- 6/lift, 2000 – 9.5/lift, and 1985 – 6.2/lift. The average length was 23.9, 23.7, and 22.8 for the years 2001, 2000, and 1985 respectively. (Length Frequency-Figure 2) Of the 54 lake trout captured, 35 were males, 16 females, and three unknowns. No identifiable stocking clips (1971-1974, 1980) were observed, but lake trout captured in 2000 were given a top caudal clip of which two were identified in 2001 sampling.

**Figure 2. Black Oak Lake Length Frequency
Lake Trout 1985 vs 2000, 2001**



From: Gilbert, Stephen J - DNR
Sent: Friday, November 03, 2006 12:43 PM
To: 'Stu Hunt'
Cc: Jahns, Wesley O - DNR
Subject: RE: Blackoak Lake

Stu,

Sorry I didn't get back to you directly, but I thought that Wes did a good job of explaining what our goals were for Black Lake. We need to balance the Lake Trout and Walleye fisheries with the available forage (ciscoes). The best way to do this on Black Oak is with fishing regulations and controlling walleye stocking.

Our goal is to maintain the Lake Trout adult numbers at 0.5 or better per acre and keep the adult walleye numbers more in the 1.5/acre range. This will hopefully maintain the trout fishery, provide a trophy walleye fishery, and keep the cisco population healthy. The 1999 adult walleye estimate was 3.4/acre. This is almost three times the estimate from 1993 (1.2/acre).

The walleye stocking efforts of the state and lake association are the reason for this increase. We have seen limited natural walleye recruitment over the last 20 years. This year I had planned to switch from stocking small walleye fingerlings (about 2 inches) to extended growth fish (7 inches) to get a better bang for the buck. With the exception of 2002 we have seen very poor survival from small fingerling stocking. This was a priority four stocking and I was asking for 584 fish. Only priority 1 and 2 lakes would have received fish this year due to production limitations. Given this fact and our concerns for the lake trout and ciscoes I removed Black Oak from the stocking quotas for walleye.

We and GLIFWC will continue to conduct annual fall surveys to monitor walleye recruitment. In the summer and of 2007 WDNR will conduct a monitoring survey of Black Oak lake. This will involve small mesh fyke netting and crayfish trapping in August and electrofishing in September. If we are funded, we may be back in the lake in the spring of 2008 for a comprehensive survey of the fishery. The would include a population estimate of the entire walleye population any possibly gill netting for ciscoes. Based on the results from this survey we would evaluate the status of the walleye fishery and decide at that time if we should resume walleye stocking or possibly trying again to get a trophy walleye regulation passed. We will also be conducting a fall survey of the lake trout in two or three years.

Steve

----- Original Message -----

From: Jahns, Wesley O - DNR

To: Stu Hunt

Sent: Monday, September 18, 2006 9:18 AM

Subject: RE: Blackoak Lake

Gilbert and I were netting last week and had some long days in the field so he probably didn't check his emails. Historically Black Oak Lake would have had a low density walleye population, and most likely no walleyes at all until man put them in there. Ciscoes prey on the young walleye thereby limiting the number of young walleye that survive to grow to adulthood. If the cisco population crashes the main food source for the lake trout will disappear. We can't say for sure that the walleye population caused the cisco population to crash, or even that the cisco population has in fact declined because we do not have enough information to prove that, but all indications are that the cisco have declined. If the lakers don't have the cisco to feed on the growth rates will decline. The larger trout will be lucky to just survive. The population then could either disappear, or switch to smaller trout feeding on aquatic insects and an occasional fish. In lakes in Canada and Minnesota where the lake trout do not have a good supply of cisco to feed on and depend mainly on bug life, most of the lake trout reach a maximum size of 18 inches, with an occasional trout that becomes carnivorous growing to a larger size.

From: Stu Hunt [mailto:stu@nnex.net]

Sent: Sunday, September 17, 2006 10:58 AM

To: Jahns, Wesley O - DNR

Subject: Re: Blackoak Lake

Is Gilbert gone on vacation? Wrote to him for the plan and haven't heard anything. Can it be that the cisco's have been eaten by walleyes and trout. What will the trout do with a limited supply of cisco's. Stu

----- Original Message -----

From: Jahns, Wesley O - DNR

To: Stu Hunt

Sent: Wednesday, September 13, 2006 8:14 AM

Subject: RE: Blackoak Lake

Hi Stu-----The last time we gill netted we did not get any ciscoes in the net. I was concerned about predation on the cisco by the large walleye population that was in the lake. Last fall we spent two nights looking for cisco when they should have been up in the shallows spawning and saw very few. In the summer of 2005 I was up there with sonar and did not see hardly anything on the graph for what could have been cisco out in deep water. You will have to check with Gilbert on the walleye stocking but he is either reducing it to maintenance stocking, or eliminating it. If we lose the cisco population the lake trout will be in trouble and preservation of the lake trout population is the highest priority. We will be netting for lake trout in 2008 or 2009 to monitor the population.

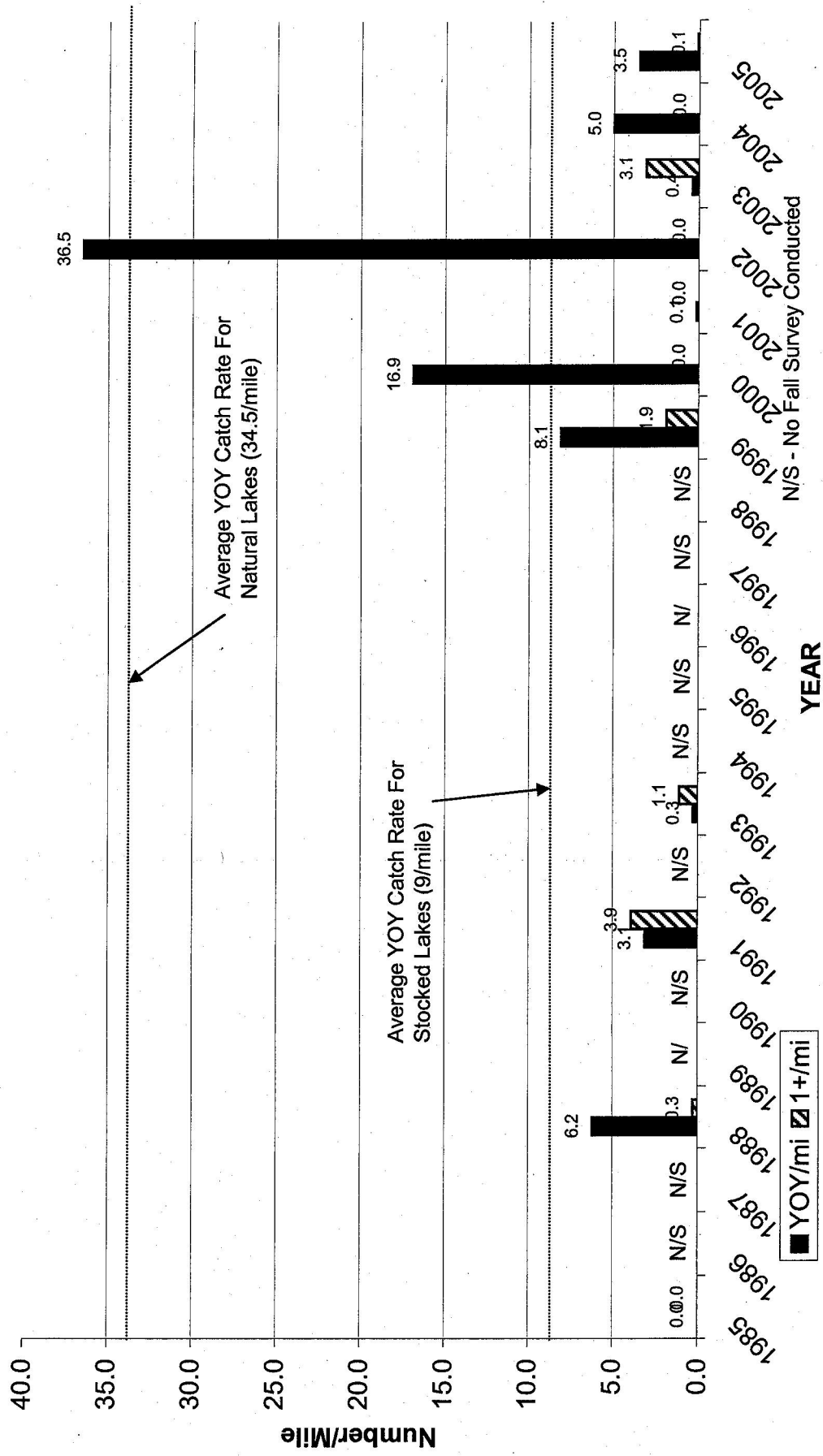
Black Oak Lake Walleye Data

Year	Stocking Fry (x1000)	Small Fingerling Date	Small Fingerling Number	Large Fingerling Date	Large Fingerling Number	Extended Growth Date	Extended Growth Number	Fall Survey Date	YOY/mi	1+/mi	Spring Adult PE Estimate	CI	#/acre Total	Males	Females
1980		25-Jun	29,550												
1981		25-Jun	15,500	08-Jul	16,500										
1982		29-Jun	30,876												
1983															
1984		28-Jun	27,990					16-Oct	0.0	0.0					
1985															
1986		21-Jul	28,000												
1987		16-Jul	25,000												
1988		15-Jul	25,000												
1989				29-Jul	1,000	20-Oct	3,174	26-Sep	6.2	0.3					
1990				05-Aug	14,254	03-Oct	2,505								
1991				26-Sep	5,400			08-Oct	3.1	3.9					
1992				24-Sep	5,500	21-Aug	1,015								
1993								22-Sep	0.3	1.1	689	199.2	1.2	0.6	0.1
1994				04-Aug	2,000										
1995				27-Sep	14,664										
1996															
1997				06-Aug	716										
1998		25-Jun	58,000												
1999															
2000		16-Jun	29,200					21-Sep	8.1	1.9	1,965	373	3.4	1.4	2.6
2001								18-Sep	16.9	0.0					
2002		25-Jun	29,200					01-Oct	0.1	0.0					
2003								16-Sep	36.5	0.0					
2004		18-Jun	29,200					13-Oct	0.4	3.1					
2005								07-Sep	5.0	0.0					
2006								08-Sep	3.5	0.1					
TOTALS	-		327,516		60,034		6,694	Average=	7.3	0.9	1,327	2.3	1.0	1.4	

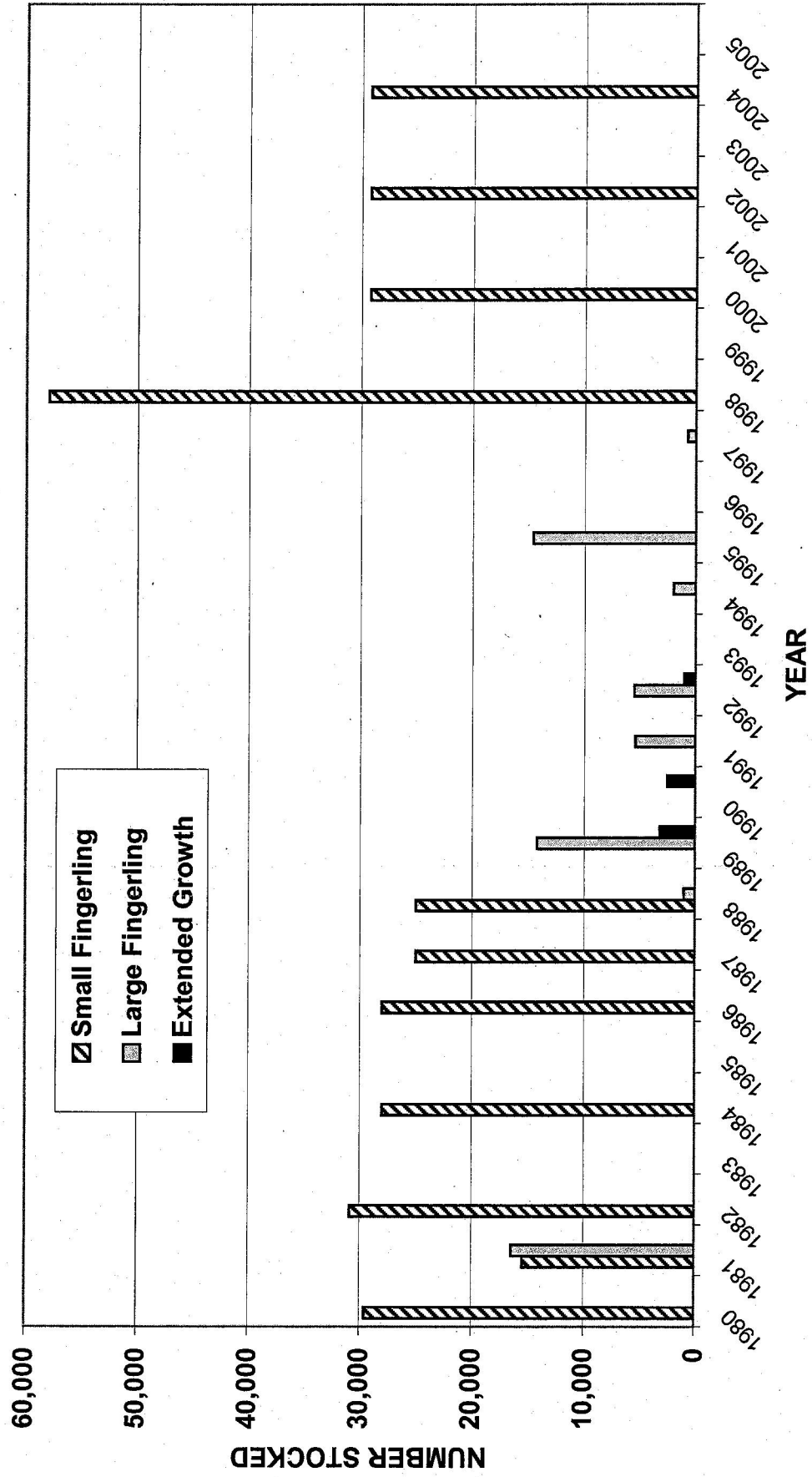
File: stocking and effort Black Oak.xls

Date: 3/20/2006 SJG

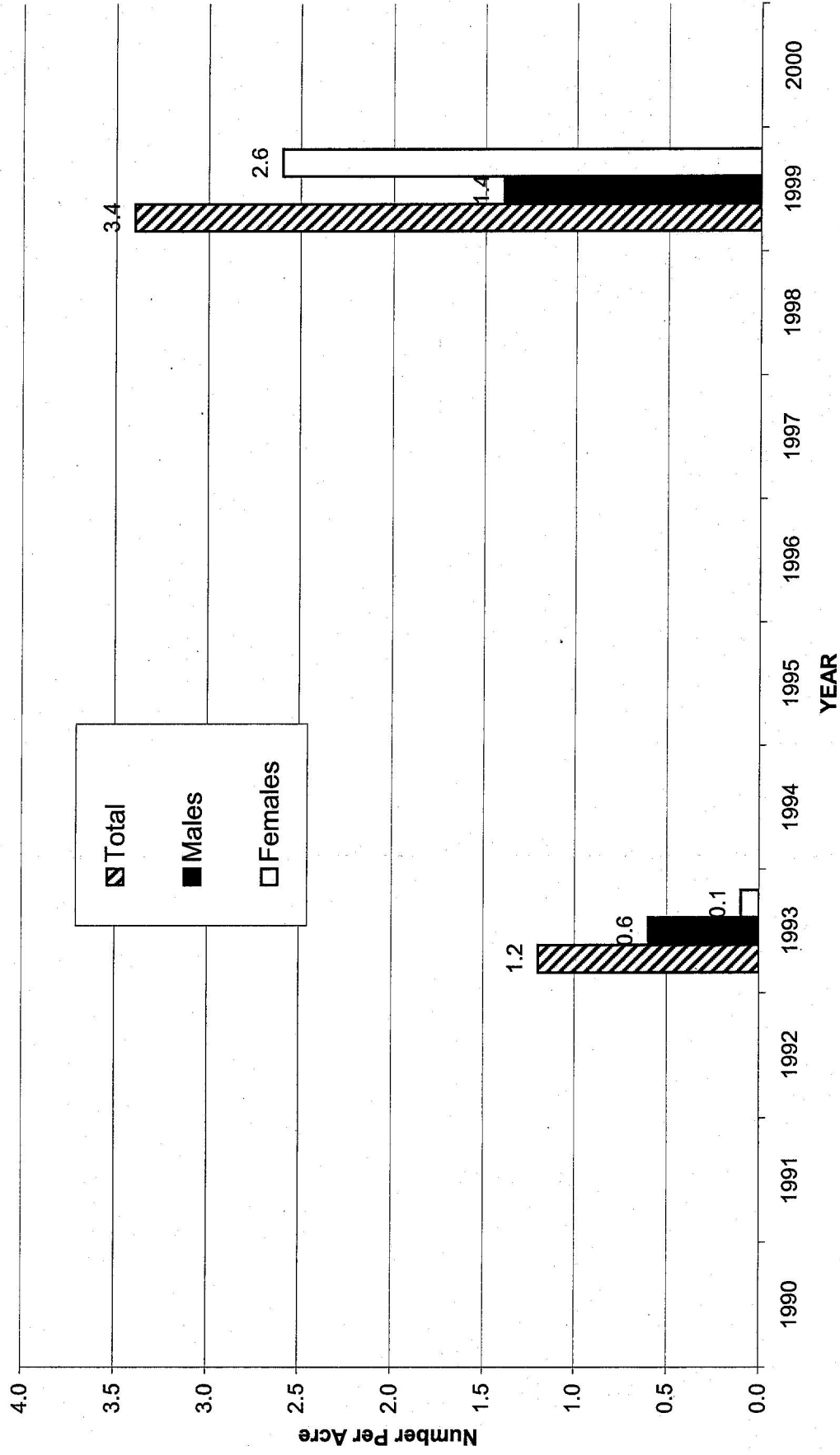
Fall Walleye Recruitment History 1985 to 2005 Black Oak Lake, Vilas County



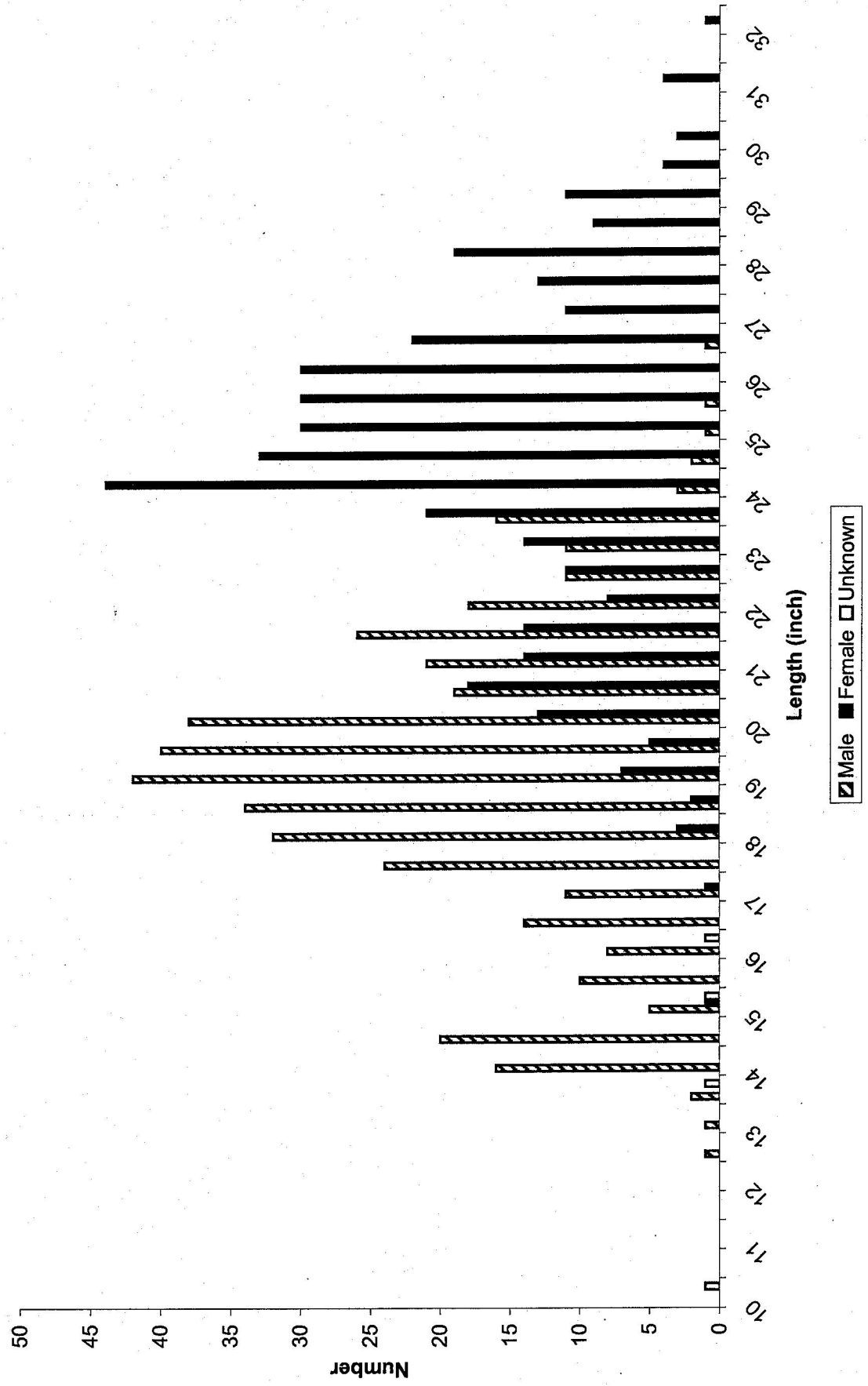
Walleye Stocking Totals 1980 to 2005 Black Oak Lake, Vilas County



Black Oak Lake Adult Walleye Population Estimate History



Walleye Length Frequency Black Oak Lake (Vilas Co.) 1999



Aquatic Plant Information

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. During this survey E. W. Milfoil was not observed. 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.

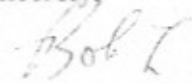
Chara	C	Pickerel Weed	PW
Large Leaf Pondweed	LLPW	Floating Leaf Pondweed	FLPW
Northern Milfoil	NM	Wild Celery	WC
White Water Lily	WWL	Burreed	BR
Yellow Water Lily	YWL	Niade	N
Rushes SPP	R	Mint	M
Water Iris	WI	Small Pondweed	SPW
Fern Weed	FW	Dwarf Milfoil	DM
Cattail	CT	Farwell Milfoil	FM
Elodea	E	Smart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

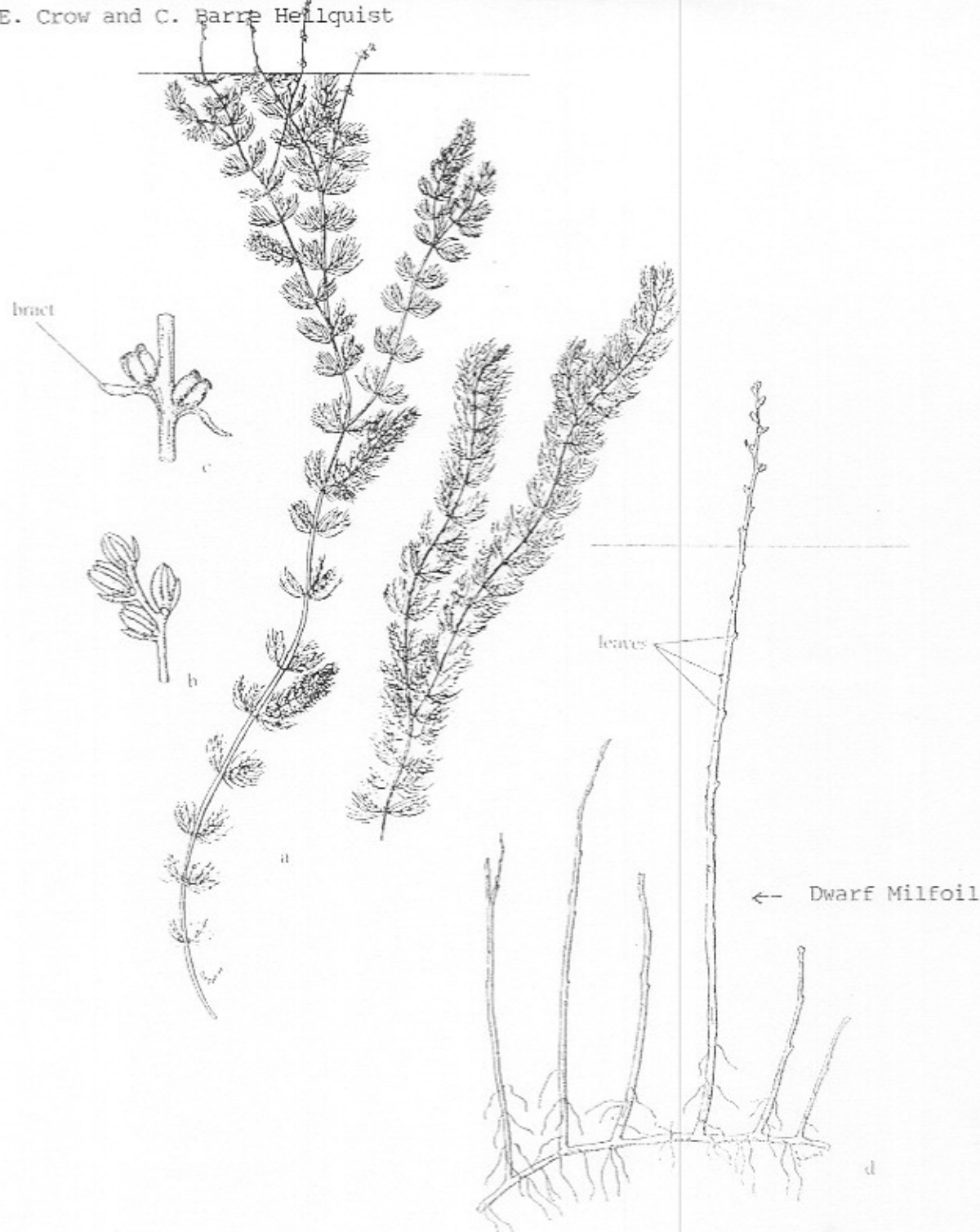


Fig. 156. *Myriophyllum alterniflorum*: a. habit; b. inflorescence; c. fruit (NH&ES).
Myriophyllum tenellum: d. habit (NH&ES).

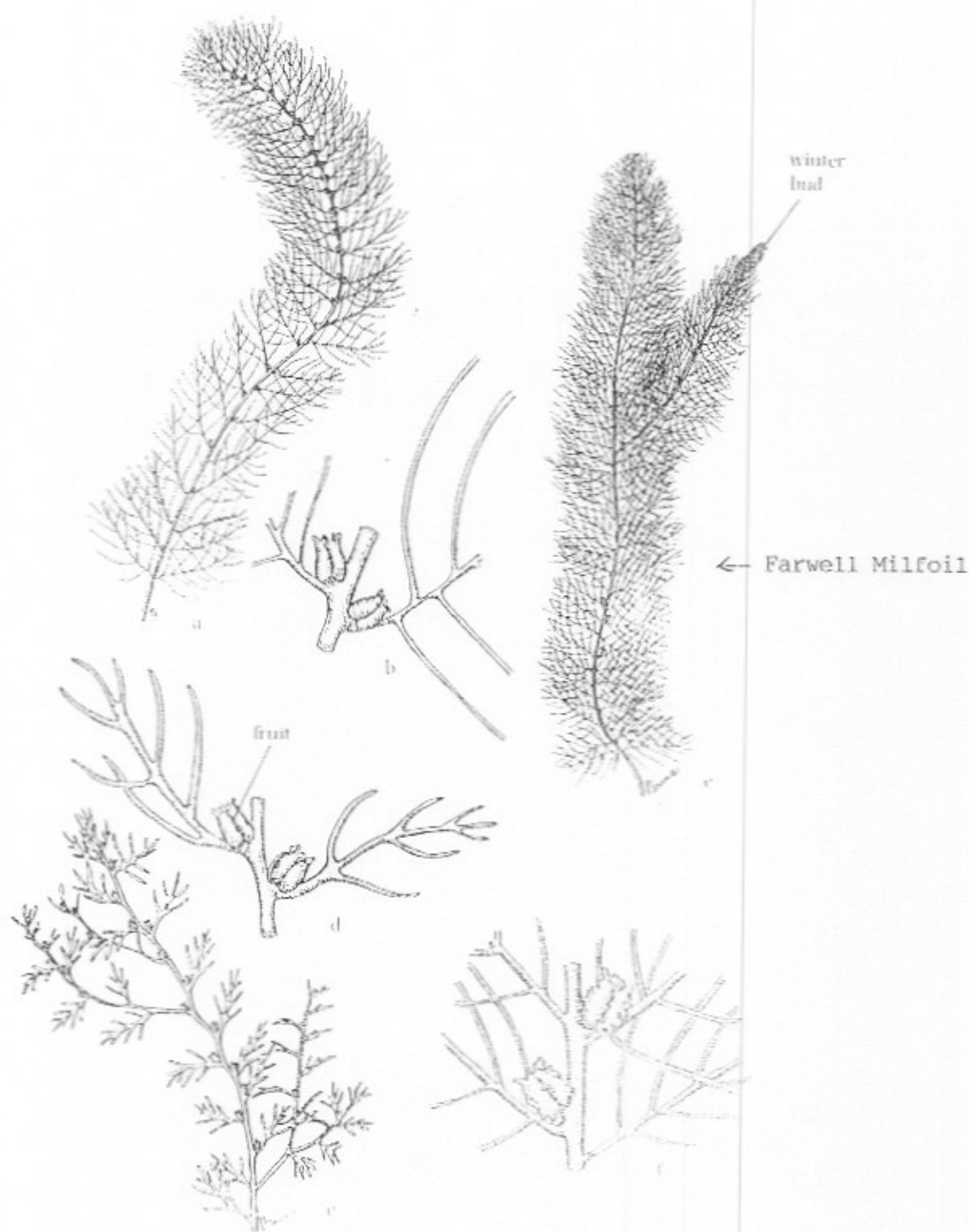
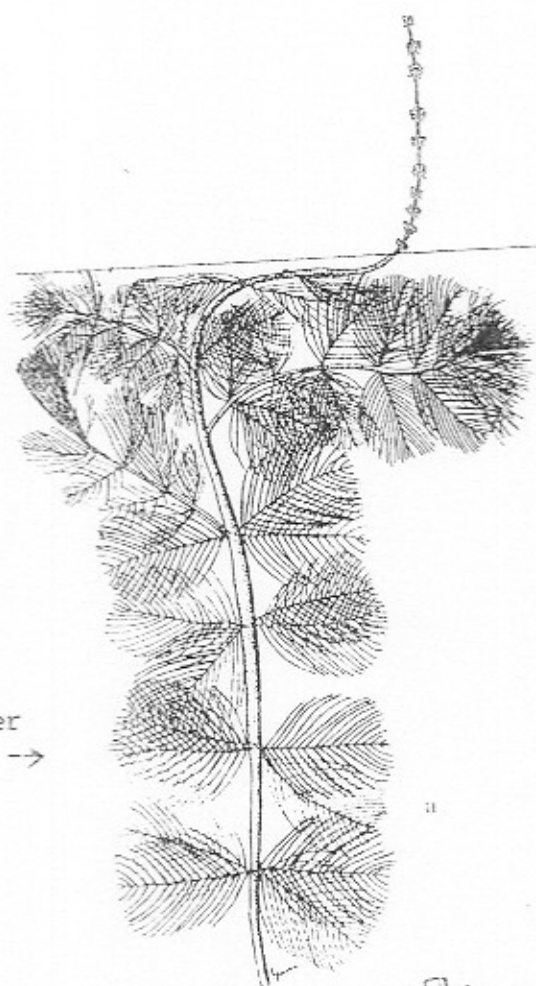


Fig. 157. *Myriophyllum humile*: a. habit, submerged plant; b. fruits on submerged plant; c. habit, terrestrial growth form; d. fruits on terrestrial plant (NHAES).
Myriophyllum farwellii: e. habit, submerged plant with winter bud; f. fruits (NHAES).

Eurasian Water
Milfoil →



a



c



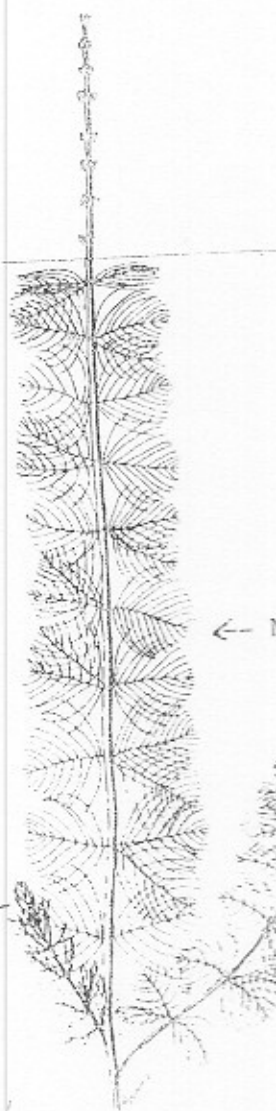
b



d

← Northern Milfoil

winter
bud



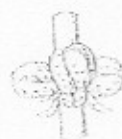
e



g



h



i



f

Fig. 160. *Myriophyllum spicatum*: a. habit, submerged form with emergent inflorescence; b. leaf; c. flowers; d. fruits (NHAFS).
Myriophyllum sibiricum: e. habit, submerged form with emergent inflorescence; f. leaf; g. flowers; h. immature fruit; i. mature fruit (NHAFS).

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*Isomer specific by AOAC method No. 5-D01-5

*2,4-Dichlorophenoxyacetic acid equivalent 19% by weight

EPA Reg. No. 264-109-8959

EPA Est. No. 33560-TN-1

KEEP OUT OF REACH OF CHILDREN CAUTION

For **PRODUCT USE** information Call 1-800-558-5106.
For **MEDICAL** and **TRANSPORTATION** Emergencies ONLY Call 24 Hours A Day 1-800-334-7577.

GENERAL INFORMATION

NAVIGATE® Granular Aquatic Herbicide contains 2,4-D formulated as the low-volatile butoxyethyl ester. This has been formulated on special heat treated attapulgite granules that resist rapid decomposition in water. NAVIGATE® sinks quickly to lake or pond bottoms and releases the weed killing chemical in the critical root zone area.

This product is designed to control the weeds listed on the label. Control of other weeds may not be satisfactory. Generally, weeds are difficult to control in lakes where water replacement comes from bottom springs.

WHEN TO APPLY

For best results, spread NAVIGATE® Granular Aquatic Herbicide in the spring and early summer, during the time weeds start to grow. If needed, this timing can be checked by sampling the lake bottom in areas heavily infested with weeds the year before.

If treatments are delayed until weeds form a dense mat or reach the surface, two treatments may be necessary. Make the second treatment when weeds show signs of recovery, but no later than mid-August.

Treatments made after mid-August may be less effective depending upon water temperatures and weed growth.

Occasionally, a second application will be necessary if heavy regrowth occurs or weeds move in from untreated areas.

HOW TO APPLY

FOR LARGE AREAS: Use a fertilizer spreader or mechanical seeder such as the Gorber or Gandy. Before spreading any chemical, calibrate your method of application to be sure of spreading the proper amount. When using boats and power equipment, you must determine the proper combination of (1) boat speed, (2) rate of delivery from the spreader, and (3) width of swath covered by the granules.

FOR SMALL AREAS (Around Docks or Isolated Patches of Weeds): Use a portable spreader such as the Cyclone seeder. Estimate or measure out the area you want to treat. Weigh out the amount of material needed and spread this uniformly over the area. More uniform coverage is obtained by dividing the required amount in two and covering the area twice, applying the second half at right angles to the first.

Use the following formula to calibrate your spreader's delivery in pounds of NAVIGATE® Granular Aquatic Herbicide per minute.

$$\frac{\text{miles per hour} \times \text{spreader width} \times \text{pounds per acre}}{495} = \text{pounds per minute}$$

Example: To apply 100 pounds of NAVIGATE® Granular Aquatic Herbicide per acre using a spreader that covers a 20 foot swath from a boat traveling at 4 miles per hour, set the spreader to deliver 16 pounds of NAVIGATE® Granular Aquatic Herbicide granules per minute.

$$\frac{4 \text{ mph} \times 20 \text{ feet} \times 100 \text{ lbs./A}}{495} = 16 \text{ lbs./min.}$$

When spreading NAVIGATE® Granular Aquatic Herbicide from a boat, we suggest setting out guide posts at frequent intervals marking out the area. This helps to steer a straight course. (See illustration below.)



AVAILABLE AT:

QUATIC BIOLOGISTS, INC.

N5174 Summit Ct

Fond du Lac, WI 54935

Phone: (920) 921-6827

Fax: (920) 921-1690

AMOUNTS TO USE

Rates of application vary with the resistance of weed species to the chemical, density of weed mats at the time of treatment, water depth, and rate of water flow through the treated area. Use the higher rate for dense weeds, where water is more than 8 feet deep and where there is a large volume turnover.

	NAVIGATE® POUNDS PER ACRE	NAVIGATE® POUNDS PER 2000 SQUARE FEET
SUSCEPTIBLE WEEDS		
Water milfoil (<i>Myriophyllum</i> spp.)	100	5
Water stargrass (<i>Heteranthera dubia</i>)		
SLIGHTLY TO MODERATELY RESISTANT WEEDS		
Bladderwort (<i>Utricularia</i> spp.)	150 to 200	7.5 to 10
White water lily (<i>Nymphaea</i> spp.)		
Yellow water lily or spatterdock* (<i>Nuphar</i> spp.)		
Water shield (<i>Brasenia</i> spp.)		
Water chestnut (<i>Tropea natans</i>)		
Cortail* (<i>Ceratophyllum demersum</i>)		

*Repeat treatment may be needed.

(SEE ADDITIONAL
PRECAUTIONS &
DIRECTIONS ON BACK)

PRECAUTIONARY STATEMENTS

CAUTION

HAZARD TO HUMANS AND DOMESTIC ANIMALS

Avoid contact with skin, eyes or clothing. When mixing, loading, or applying this product or repairing or cleaning equipment used with this product, wear eye protection (face shield or safety glasses), chemical-resistant gloves, long-sleeved shirt, long pants, socks and shoes. It is recommended that safety glasses include front, brow and temple protection.

Wash hands, face and arms with soap and water as soon as possible after mixing, loading, or applying this product. Wash hands, face and arms with soap and water before eating, smoking or drinking. Wash hands and arms before using toilet. After work, remove all clothing and shower using soap and water. Do not reuse clothing worn during the previous day's mixing and loading or application of this product without cleaning first. Clothing must be kept and washed separately from other household laundry. Remove saturated clothing as soon as possible and shower.

ENVIRONMENTAL HAZARDS

This product is toxic to fish. Drift or runoff may adversely affect fish and non-target plants. Do not apply to water except as specified on this label. Do not contaminate water when disposing of equipment washwaters. Do not apply to waters used for irrigation, agricultural sprays, watering dairy animals or domestic water supplies.

Clean spreader equipment thoroughly before using it for any other purpose unless thoroughly cleaned. Vapors from this product may injure susceptible plants in the immediate vicinity. Avoid drift of dust to susceptible plants.

MIXING AND LOADING: Most cases of groundwater contamination involving phenoxy herbicides such as 2,4-D have been associated with mixing/loading and disposal sites. Caution should be exercised when handling 2,4-D pesticides at such sites to prevent contamination of groundwater supplies. Use of closed systems for mixing or transferring this pesticide will reduce the probability of spills. Placement of the mixing/loading equipment on an impervious pad to contain spills will help prevent groundwater contamination.

DIRECTIONS FOR USE

IT IS A VIOLATION OF FEDERAL LAW TO USE THIS PRODUCT IN A MANNER INCONSISTENT WITH ITS LABELING. Read entire label before using this product.

STORAGE AND DISPOSAL

STORAGE

Do not contaminate water, food or feed by storage or disposal. Store in original container in a dry, secured storage area.

PESTICIDE DISPOSAL

Pesticide wastes are toxic. Improper disposal of excess pesticide is a violation of Federal Law and may contaminate groundwater. If these wastes cannot be disposed of by use according to label instructions, contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

CONTAINER DISPOSAL

Do not reuse empty bag. Completely empty bag into application equipment. Then dispose of empty bag in a sanitary landfill or by incineration, or, if allowed by State and local authorities, by burning. If bag is burned, stay out of smoke.

GENERAL PRECAUTIONS AND RESTRICTIONS

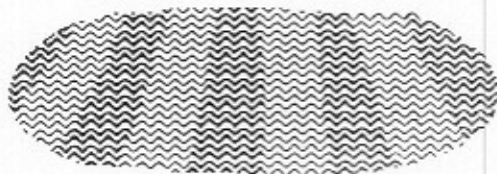
Do not use in or near a greenhouse.

OXYGEN RATIO

Fish breathe oxygen in the water and a water-oxygen ratio must be maintained. Decaying weeds use up oxygen, but during the period when NAVIGATE® Granular Aquatic Herbicide should be used, the weed mass is fairly sparse and the weed decomposition rate is slow enough so that the water-oxygen ratio is not disturbed by treating the entire area at one time.

If treatments must be applied later in the season when the weed mass is dense and repeat treatments are needed, spread granules in lanes, leaving buffer strips which can then be treated when vegetation in treated lanes has disintegrated. During the growing season, weeds decompose in a 2 to 3 week period following treatment.

Buffer lanes should be 50 to 100 feet wide. Treated lanes should be as wide as the buffer strips. (See illustration below.)



WATER pH

Lake water that is extremely acid or alkaline may influence the effectiveness of NAVIGATE® Granular Aquatic Herbicide. A pH on the acid side (pH 6.0 or below) generally favors the action of the chemical while a pH on the alkaline side (pH 8.0 or above) may reduce the action. If regrowth occurs within a period of 6 to 8 weeks, a second application may be needed.

PERMIT TO USE CHEMICALS IN WATER

In many states, permits are required to control weeds by chemical means in public water. If permits are required, they may be obtained from the Chief, Fish Division, State Department of Conservation, or the State Department of Public Health.

LIMITED WARRANTY AND DISCLAIMER

The manufacturer warrants (a) that this product conforms to the chemical description on the label; (b) that this product is reasonably fit for the purposes set forth in the directions for use when it is used in accordance with such directions; and (c) that the directions, warning and other statements on this label are based upon responsible experts' evaluation of reasonable tests of effectiveness, of toxicity to laboratory animals and to plants, and of residues on food crops and upon reports of field experience. Tests have not been made on all varieties or in all states or under all conditions. THE MANUFACTURER NEITHER MAKES NOR INTENDS, NOR DOES IT AUTHORIZE ANY AGENT OR REPRESENTATIVE TO MAKE ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED, AND IT EXPRESSLY EXCLUDES AND DISCLAIMS ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

THIS WARRANTY DOES NOT EXTEND TO, AND THE BUYER SHALL BE SOLELY RESPONSIBLE FOR, ANY AND ALL LOSS OR DAMAGE WHICH RESULTS FROM THE USE OF THIS PRODUCT IN ANY MANNER WHICH IS INCONSISTENT WITH THE LABEL DIRECTIONS, WARNINGS OR CAUTIONS.

BUYER'S EXCLUSIVE REMEDY AND MANUFACTURER'S OR SELLER'S EXCLUSIVE LIABILITY FOR ANY AND ALL CLAIMS, LOSSES, DAMAGES, OR INJURIES RESULTING FROM THE USE OR HANDLING OF THIS PRODUCT, WHETHER OR NOT BASED IN CONTRACT, NEGLIGENCE, STRICT LIABILITY IN TORT OR OTHERWISE SHALL BE LIMITED, AT THE MANUFACTURER'S OPTION, TO REPLACEMENT OF OR THE REPAYMENT OF THE PURCHASE PRICE FOR THE QUANTITY OF PRODUCT WITH RESPECT TO WHICH DAMAGES ARE CLAIMED. IN NO EVENT SHALL MANUFACTURER OR SELLER BE LIABLE FOR SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES RESULTING FROM THE USE OR HANDLING OF THIS PRODUCT.

NOTICE TO BUYER

Purchase of this material does not confer any rights under patents governing this product or the use thereof in countries outside of the United States.

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MILWAUKEE, WI 1-800-558-5106

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RP-5301-095-0AB-113

Aquatic Plant Management Plan

Black Oak Lake Watershed Protection Program: Aquatic Plant Management Plan



Photo of Pontederia cordata (Pickerelweed)

Black Oak Lake Riparian Owners Association – 2007

Cite as: Premo, Dean. 2007. Black Oak Lake Watershed Protection Program: Aquatic Plant Management Plan. Appendix F of the 2006 Adaptive Lake Management Plan. White Water Associates, Inc.

Black Oak Lake Watershed Protection Program

Aquatic Plant Management Plan

Submitted to: Wisconsin Department of Natural Resources
Attention: Kevin Gauthier
107 Sutliff Avenue
Rhinelander, Wisconsin 54501
Phone: 715-365-8937

This document is a product of a WDNR Lake Planning Grant awarded to:

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Date: January 2007

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Introduction to the Black Oak Lake Aquatic Plant Management Plan

The Black Oak Lake Watershed Protection Program is viewed as an ongoing endeavor composed of annual phases that progress toward the overall vision. A large component of Phase II (conducted in 2006) was a thorough survey of the aquatic plant community in Black Oak Lake. With that newly collected and analyzed plant data in hand, along with the extensive information inventory conducted and report during Phase I, members of the Black Oak Lake Riparian Owners Association (BOLROA) had the necessary components to prepare this ***Aquatic Plant Management Plan***. Because the Phase I work was reported in the form of a comprehensive ***Adaptive Lake Management Plan***, it was natural that aquatic plant management plan be integrated into the more comprehensive management plan.

Fortunately, Black Oak Lake does not currently have a nuisance level of aquatic plants or aquatic invasive plant species. On the contrary, it has a healthy and diverse community of native aquatic plants. Quite simply, members of the BOLROA simply want to maintain this high quality condition. In addition, the BOLROA wants to establish the foundation on which to conduct plant management should the need arise in the future (for example if an aquatic invasive plant species is detected in Black Oak Lake or the surrounding riparian area).

In preparing this plan, we have followed the guidelines prepared by the WDNR called *Aquatic Plant Management In Wisconsin*. This is a fairly new endeavor in Wisconsin (and the United States for that matter). In fact, the WDNR Guidance document is so new that it is marked “Draft.” That designation notwithstanding, we found it very useful in preparation of this aquatic plant management plan. Like the Black Oak Lake Adaptive Lake Management Plan, of which this plant management plan is a component, we fully expect this to be a living document. That is, it will be modified as new information about the Black Oak Lake aquatic plant community and its management becomes available.

The WDNR Guidance document outlines three objectives that may lead to preparation of an aquatic plant management plan:

-
- Protection - preventing the introduction of nuisance or invasive species into waters where these plants are not currently present;
 - Maintenance - continuing the patterns of recreational use that have developed historically on and around a lake; and
 - Rehabilitation - controlling an imbalance in the aquatic plant community leading to the dominance of a few plant species, frequently associated with the introduction of invasive non-native species.

The BOLROA's motivation lies in the first two objectives. Black Oak Lake is a tremendous resource with high water quality and a diverse and interesting community of aquatic plants. It also has a strong recreational history and current human use that has seemingly caused relatively minimal degradation to the ecosystem.

During two years of effort under the WDNR Planning Grant Program and through past lake association efforts, the BOLROA has essentially followed the seven-step plan outlined in the Guidance Document for developing an aquatic plant management plan:

1. Goal setting – Getting the effort organized, identifying problems to be addressed, and agreeing on the goals;
2. Inventory – Collecting baseline information to define the past and existing conditions;
3. Analysis – Synthesizing the information, quantifying and comparing the current conditions to desired conditions, researching opportunities and constraints, and setting directions to achieving the goals;
4. Alternatives – Listing possible management alternatives and evaluating their strengths, weaknesses and general feasibility;
5. Recommendations – Prioritizing and selecting preferred management options, setting objectives, drafting the plan;
6. Implementation – Formally adopting the plan, lining up funding, and scheduling activities for taking action to achieve the goals;
7. Monitor & Modify – Developing a mechanism for tracking activities and adjusting the plan as it evolves.

This document presents the ***Black Oak Lake Aquatic Plant Management Plan***. It continues the concept of “adaptive management” introduced in the ***Black Oak Lake Adaptive Lake Management Plan***. The plan will therefore be a dynamic entity, successively evolving and improving to fit the needs of the Black Oak Lake watershed. Monitoring the outcomes of plan implementation is essential to the process of adaptive management.

Besides this introductory section, this plan is organized in four additional sections. Section 2 states the purpose and goals for the Black Oak Lake Aquatic Plant Management Plan. Section 3 references the lake information inventory that has been ongoing in Black Oak Lake. Section 4 details action objectives for the aquatic plant management plan. Finally, Section 5 outlines a contingency plan for rapid response to alien plant invaders should they appear in Black Oak Lake.

Purpose & Goal Statements for the Aquatic Plant Management Plan

The Black Oak Lake Adaptive Lake Management Plan put forth the idea that watershed management should be approached with a large degree of humility in that we do not always understand the causes of environmental phenomena or the effects of our actions to manage the environment. With that thought in mind, we have crafted the following statement of purpose for the Black Oak Lake Aquatic Plant Management Plan:

Black Oak Lake has historically had a healthy and diverse aquatic plant community that has recently been documented by an aquatic plant survey (summer 2006). This plant community is essential to, and part of, a high quality oligotrophic northern lake ecosystem that also serves the human community with its recreational and aesthetic features. The Black Oak Lake Riparian Owners Association (BOLROA) strives to maintain the Black Oak Lake aquatic plant community in its present healthy state.

Supporting this purpose, we offer this goal statement:

The BOLROA endeavors to maintain a healthy plant community on Black Oak Lake by (1) monitoring the plant community with particular emphasis on changes in the native plant composition and establishment of any invasive species and (2) monitoring and educating recreational users and riparian owners of Black Oak Lake with special emphasis on minimizing the opportunities for introductions of non-native species and nutrients that might alter the current plant community dynamics.

An Inventory and Analysis of Information About Black Oak Lake

Our efforts in Phases I and II of the Black Oak Lake Watershed Protection Program have compiled extensive existing information about the historical and current conditions of the Black Oak Lake ecosystem. This information is organized and presented in the Adaptive Lake Management Plan, a document that is periodically “adapted” by integrating current information and conditions into new iterations of the plan. This information includes consideration of the watershed landscape; the geological, glacial, and human history; the water quality, fisheries, wildlife, rare species, exotic species, and ecosystem threats.

Of particular importance to this aquatic plant management plan are several aquatic plant surveys that have been conducted on Black Oak Lake. The most recent was conducted in summer 2006 and followed the **WDNR Protocol for Aquatic Plant Survey, Collecting, Mapping, Preserving, and Data Entry**. The results of this comprehensive survey are presented in Chapter 5, Part 5 of the Black Oak Lake Watershed Protection Program’s Adaptive Management Plan. Earlier professional aquatic plant surveys were conducted on Black Oak Lake in 2001 and 2005. Both focused on Eurasian water milfoil. None of these surveys has located Eurasian water milfoil in Black Oak Lake.

Also of importance to this aquatic plant management plan is the “watch-dog” and education work carried out by BOLROA members. For example, a **Milfoil Vigilante Program** was organized by BOLROA Board Member Ed Hook in June, 2002. The entire shoreline of Black Oak Lake was divided into eleven segments and each segment was assigned to a person or group that would monitor the segment. The “vigilantes” were trained to identify of Eurasian water milfoil (and other aquatic invasive plant species) by Laura Herman and Sandy Wickman (WDNR). The Milfoil Vigilante Program continues today under the direction of BOLROA Board Member Joe Beers.

Other important education and monitoring work is the Black Oak Lake **Clean Boats - Clean Waters Program** where volunteers inspect watercraft and trailers at the public access boat landing. BOLROA Board Member Bill Hall organized this program in the fall 2005. Mr. Hall was trained by Laura Felda-Marquart of the WDNR. He, in turn, trained volunteers and assigned them to man the Black Oak Lake public landing on various days during the summer of 2006. This program will continue in the summer of 2007.

Actions & Objectives for Aquatic Plant Management in Black Oak Lake

The purpose and goals stated in Section 2 provide the platform for developing actions and objectives to achieve the desired future for Black Oak Lake aquatic plant community. In this section, we present several actions and associated objectives that the BOLROA plans to implement (in some cases, continue) in future phases of the program. Recommended monitoring is also described. In some cases, the actions, objectives, and monitoring each need to be further developed so that appropriate methodology can be employed. The BOLROA will seek advice from the WDNR Aquatic Plant Manager and other experts. The plan is flexible and allows the insertion of new ideas and actions at many points along the path of aquatic plant management in Black Oak Lake. Once again, we have followed the advice provided in the WDNR guidance document entitled “Aquatic Plant Management in Wisconsin.”

Action (Research): Conduct a quantitative survey of the Black Oak Lake plant community every five years.

Objective: To watch for changes in native species diversity, abundance, or distribution and to check for the occurrence of non-native, invasive plant species.

Monitoring: BOLROA oversees this activity and maintains data with copies to WDNR.

Action (Research): Request that the WDNR conduct a “Sensitive Area Designations Assessment” on Black Oak Lake.

Objective: Identify and protect sensitive and special habitat areas and conservancy areas in the Black Oak Lake ecosystem.

Monitoring: The BOLROA oversees activity and develops further actions if necessary.

Action (Education): Continue the efforts of the BOLROA citizen aquatic invasive lake monitoring network (principally the Milfoil Vigilante Program and the Clean Boats, Clean Waters Program) that establishes volunteer monitors for Black Oak Lake that monitor for and educate about aquatic invasive plant species.

Objective: To monitor recreational traffic in and out of the lake checking for possible introduction of invasive aquatic plants on boats, engines, and trailers and to educate recreational users of Black Oak Lake regarding aquatic invasives and the special features of Black Oak Lake.

Monitoring: The BOLROA oversees activity and records instances of possible or actual introductions of aquatic invasives.

Action (Education): Create an education plan for the BOLROA members and other riparian owners on Black Oak Lake that will address issues of healthy aquatic and riparian plant communities.

Objective: To educate people who live on or near Black Oak Lake about issues and topics that affect the Black Oak Lake aquatic and riparian plant communities, including topics such as: (1) the importance of the aquatic plant community; (2) that no or minimal mechanical removal of plants along the shoreline is desirable and that any plant removal should conform to Wisconsin regulations; (3) the value of a natural shoreline in protecting the aquatic plant community; (4) nutrient sources to Black Oak Lake and the role excess nutrients might play in degradation of the aquatic plant community; (5) the importance of reducing or eliminating use of fertilizers on lake front property;

Monitoring: The BOLROA oversees activity and assesses effectiveness.

Action (Research): Identify, photograph, and describe areas of Black Oak Lake riparian area and shoreline that might be candidates for rehabilitation or restoration.

Objective: To inventory and describe areas of Black Oak Lake riparian area and shoreline and plan possible rehabilitation or restoration actions.

Monitoring: The BOLROA oversees activity and maintains data.

Contingency Plan for Rapid Response to Aquatic Plant Invaders

Although Black Oak Lake currently is home to a well-balanced native community of aquatic plants, it is important to be prepared for the discovery of an introduced invasive plant species. Unfortunately, sources of aquatic invasive plants are numerous in northern Wisconsin. Several of the actions and objectives in the previous section address minimizing the likelihood of introduction, but this section outlines a contingency plan for newly-found populations of an aquatic invasive species in Black Oak Lake. It is what the BOLROA can do by way of **rapid response** to remove or contain a plant invader.

Aquatic plants designated as aquatic invasive species include curly-leaf pondweed, Eurasian water milfoil and purple loosestrife. If one of these aquatic invasive species is discovered in Black Oak Lake, the BOLROA will follow the protocol outlined below.

If curly-leaf pondweed, Eurasian water milfoil, or purple loosestrife are detected in Black Oak Lake:

1. Have an aquatic plant expert confirm the identification of the plant.
2. Determine the extent of the aquatic invasive species' colonization in the lake (location, approximate number of plants, description of the colony). Use a global positioning system (GPS) unit to assist in locating the position and boundaries of the colony.
3. Contact the local WDNR aquatic plant manager to help ascertain whether manual removal of plants is a feasible approach to management.
4. Determine from the WDNR aquatic plant manager whether a rapid plant community evaluation is warranted. If so request the WDNR to conduct this evaluation.

-
5. If manual removal is appropriate, undertake the removal by recommended means and dispose of removed plants appropriately (follow advice of WDNR aquatic plant manager). Invasive plants can be removed from public waters (after confirmation of identification) without a permit under the following conditions by manual removal as indicated in NR 109.07 when performed in a manner that does not harm the native aquatic plant community. Depending on the extent of the invasion, a professional may be engaged for the manual removal. Note that non-chemical treatment costs are also eligible for reimbursement under a WDNR grant.
 6. Frequently monitor whether the manual removal of the invasive species was complete and report results to WDNR aquatic plant manager.

If BOLROA (in consultation with the WDNR aquatic plant manager) determines the extent or type of the invasive species' colonization is beyond feasibility of manual control, evaluate other control options including chemical and proceed by the following steps:

1. Make a determination (in consultation with the WDNR aquatic plant manager) if the chemical treatment of a pioneer infestation of an invasive aquatic plant warrants a rapid response permit and grant (requested in consultation with the WDNR aquatic plant manager).
2. If chemical treatment is warranted determine from the WDNR aquatic plant manager whether a rapid plant community evaluation needs to be conducted prior to treatment. If yes, request that the WDNR conduct this evaluation.
3. Determine the appropriate timing of treatment (based on season and other factors).
4. Authorize a BOLROA member to act on behalf of the organization to apply for the required permit and prepare the permit application.
5. Raise necessary funds for up-front payment of chemical treatment (expect to pay all the cost for control up-front because grants operate on a reimbursement basis).
6. Conduct the treatment using qualified, certified, and experience contract applicator.
7. Conduct careful and frequent follow-up monitoring to determine efficacy of treatment and need for additional treatment.

**U.S.EPA and WDNR Methodologies for
Quantitative Physical Habitat Assessment,
Map of Ten Sampling Stations on Black
Oak Lake, and Photographs Taken in 2008
of Each of the Ten Physical Habitat
Sampling Stations on Black Oak Lake**

5.0 LITTORAL AND SHORELINE ACTIVITIES

To better understand the character of near-shore habitats and conditions, the Lakes Survey team will travel to 10 evenly spaced physical habitat ("P-Hab") stations around the lake and document conditions and characteristics observed within a defined plot area. The full array of measurements and sampling described in this chapter include:

- measures or observations of littoral and riparian physical habitat structure at 10 P-Hab stations;
- observations of invasive plants and macroinvertebrates;
- sampling of benthic macroinvertebrates at each of the 10 stations and composited as a single sample; and
- collection of water sample at the last P-Hab station for fecal indicator (Enterococci) analysis.

It should be noted that for lakes with a surface area of greater than 5,000 ha (defined as Large Lakes) the Lakes Survey team will not be required to travel to the P-Hab stations and perform physical habitat assessments or benthic macroinvertebrate sampling due to the increased level of effort required to complete such large areas. Additionally, such lakes will require modified procedures for collecting the fecal indicator (see Section 5.3).

5.1 Physical Habitat Assessment

5.1.1 Summary of Method

Figure 2-2 displays the placement and distribution of P-Hab stations around the lake. The plot at each station measures 25 m by 15 m and include portions of the riparian zone (shoreline and uplands) and the littoral zone. Figure 5-1 displays the plot dimensions of a P-Hab station used in the Lakes Survey.

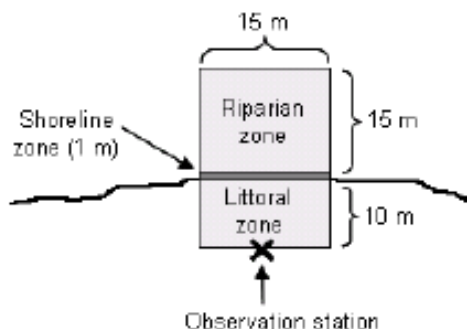


Figure 5-1. Dimensions and layout of a P-Hab station.

The approximate locations of the 10 stations are determined prior to the sampling visit and marked on the Lake Outline Sketch to be attached to the Lake Verification Form, Side 2 (Figure 3-2b). Once on the water, the Lakes Survey field team travels to a station and establishes the dimensions of the survey plot. The survey begins by estimating an observation

location 10 m (perpendicular) from the shoreline. This spot may be marked with a buoy and is the vantage point from which the team records riparian observations, and is also the point that separates the open water from the rectangular littoral plot. The remaining dimensions of the plot are visually estimated.

The riparian portion of the plot extends 15 m into the upland (beginning at the shoreline) and 15m along the lakeshore (15 m is about 3 standard canoe lengths). In this zone the team records information about the vegetation type and the height and areal coverage of trees, shrubs, and grasses. Observing the shoreline, they record information about shoreline substrate (e.g., gravel, sand), the high-water mark, and bank slope. Anthropogenic activities and other features (e.g., buildings, land use, docks) will also be noted.

The littoral region of the lake is that portion of the shoreward profile susceptible to the habitation of autotrophic plants, and includes the region of fluctuating water level between the high and low water marks (Ruttner 1969). The littoral portion of the plot measures 10 m distance from buoy to shoreline and 15 m across (7.5 m on either side of the boat). At the shore station 10 m offshore, the field team measures the water depth. They note any surface film or algae growth in the zone and probe the sediments to determine the type (e.g., gravel, sand) and areal cover of each bottom substrate type. In addition they estimate the areal cover of macrophytes and habitat/cover within the littoral plots using a simple coding system. All these observations are recorded on Side 1 of the Physical Habitat Characterization Form (Figure 5-2a). Physical habitat comments are recorded on the bottom half of Side 2 of the form (Figure 5-2b).

5.1.2 Equipment and Supplies

Table 5-1 provides the equipment and supplies needed for field operations to locate the P-Hab stations and conduct the physical habitat assessment. Field teams are to record the physical habitat observations on the Physical Habitat Characterization Form, as seen in Figure 5-2 (a) and (b).

Table 5-1. Equipment and supplies list for Physical Habitat Assessment.

Item	Quantity
Physical Habitat Assessment	
Sonar	1
GPS unit with manual, reference card, extra battery pack	1
Anchor with 50-m line	1
Float to attach to anchor	1
Surveyor's tape	1 roll
Lake Verification Form	1
Physical Habitat Characterization Forms	10
Field notebook	1
Quick reference field operations handbook	1
PVC sounding rod, 3-m length, marked in 0.1 m increments	1
Buoy for marking observation point	1

5.1.3 Locating the Physical Habitat Stations and Defining the Shoreline Boundary

A Lake Outline Sketch from a 1:100,000 topographic map should be recorded on Side 2 of the Lake Verification Form (Figure 3-2a). (Alternatively, a photocopy of the lake may be made and attached to the form, as long as the top of the copy has a continuous strip of tape going across it; if there are gaps it will catch in the scanner). A random starting point (i.e., Station A) on the lake outline should then be assigned prior to beginning sampling activities (e.g., in the office before beginning field work). Any reasonable method may be used to randomly select the starting point (e.g. tossing a coin on the map, place a compass on the map in the center of the lake and find due north). It is important that the remaining nine stations be located at equal distances around the lake going in a clockwise direction (see Figure 2-2). This can be done using a string to trace the perimeter of the lake, which can then be straightened and marked in equal intervals, or by using a planimeter wheel to measure the perimeter and dividing by 10. Coordinates entered as GPS waypoints greatly facilitate correctly locating P-Hab stations by boat in the field, especially on large lakes.

Starting at the nearest boat access point, proceed by boat around the lake near the shore, observing bank, shoreline, emergent, and subsurface characteristics. Using the Lake Outline Sketch and a topographic map or GPS unit, locate and stop at each of the 10 P-Hab stations. Position the boat at a distance of 10 m (~30 ft, offshore), anchor if necessary, and make the semi-quantitative measurements on the Physical Habitat Characterization Form, (Figure 5-2a and b). A separate Physical Habitat Characterization Form will be completed for each station. Make every reasonable attempt to record physical habitat observations and measurements for all 10 P-Hab stations. Where this is impossible, record a "K" flag in each field to clearly indicate on the form that no observations could be made at that particular station.

Reviewed by *DP*
(initials)

PHYSICAL HABITAT CHARACTERIZATION - LAKES

SITE ID: NLA06608 - 9999 DATE: 05/01/2007

STATION: ☒ A ☐ B ☐ C ☐ D ☐ E ☐ F ☐ G ☐ H ☐ I ☐ J DEPTH AT STATION (10 m offshore) 2.0 m LAT 33.07900

IF STATION WAS RELOCATED, INDICATE HERE: ☐ NEW STATION (K, L, etc.) IS IT AN ISLAND? ☐ YES ☐ NO DROPPED: ☐ YES ☐ NO LONG 096.94020

UNABLE TO SAMPLE: ☐ YES ☐ NO

LITTORAL ZONE	
Surface film type	☒ None ☐ Foam ☐ Algal Mat ☐ Oil ☐ Other
0 = Absent (0%) 1 = Sparse (<10%) 2 = Moderate (10-49%) 3 = Heavy (50-75%) 4 = Very Heavy (>75%)	
BOTTOM SUBSTRATE	
Bedrock (>4000mm; larger than a car)	0 1 2 3 4
Boulders (250-4000mm; basketball-car)	0 1 2 3 4
Cobble (64-250mm; tennis ball-basketball)	0 1 2 3 4
Gravel (2-64mm; ladybug to tennis ball size)	0 1 2 3 4
Sand (0.06 - 2mm; gritty between fingers)	0 1 2 3 4
Silt, Clay, or Muck (<0.06mm; not gritty)	0 1 2 3 4
Woody Debris	0 1 2 3 4
Color	☒ Brown ☐ Black ☐ Gray ☐ Red ☐ Other
Odor	☒ None ☐ H ₂ S ☐ Anoxic ☐ Oil ☐ Chemical ☐ Other
AQUATIC MACROPHYTES	
Submergent	0 1 2 3 4
Emergent	0 1 2 3 4
Floating	0 1 2 3 4
Total Aquatic Macrophyte Cover	0 1 2 3 4
Do macrophytes extend lakeward? ☐ Yes ☒ No	
FISH COVER	
Aquatic and Inundated Herbaceous Veg.	0 1 2 3 4
Woody Debris/Trunks > 0.3 m dia.	0 1 2 3 4
Woody Brush/Woody Debris < 0.3 m dia. (alive or dead)	0 1 2 3 4
Inundated Live Trees > 0.3 m dia.	0 1 2 3 4
Overhanging Veg. within 1 m of Surface	0 1 2 3 4
Ledges or Sharp Dropoffs	0 1 2 3 4
Boulders	0 1 2 3 4
Human Structures- Decks, Landings, etc.	0 1 2 3 4

Human Influence Zones

RIPARIAN ZONE	
0 = Absent (0%) 1 = Sparse (<10%) 2 = Moderate (10-49%) 3 = Heavy (50-75%) 4 = Very Heavy (>75%)	
CANOPY (>5 m high)	
Deciduous	0 1 2 3 4
Coniferous	0 1 2 3 4
Big Trees (Trunk > 6.3 m dbh)	0 1 2 3 4
Small Trees (Trunk < 6.3 m dbh)	0 1 2 3 4
UNDERSTORY (0.5 TO 5 m high)	
Deciduous	0 1 2 3 4
Coniferous	0 1 2 3 4
Woody Shrubs & Saplings	0 1 2 3 4
Tall Herbs, Grasses, & Forbs	0 1 2 3 4
GROUND COVER (<0.5 m high)	
Woody Shrubs & Saplings	0 1 2 3 4
Herbs, Grasses and Forbs	0 1 2 3 4
Standing Water or Inundated Vegetation	0 1 2 3 4
Barren, Bare Dirt or Buildings	0 1 2 3 4
SHORELINE SUBSTRATE ZONE	
Bedrock (>4000mm; larger than a car)	0 1 2 3 4
Boulders (250-4000mm; basketball-car size)	0 1 2 3 4
Cobble (64-250mm; tennis ball-basketball size)	0 1 2 3 4
Gravel (2-64 mm; ladybug-tennis ball size)	0 1 2 3 4
Sand (0.06 - 2mm; gritty between fingers)	0 1 2 3 4
Silt, Clay, or Muck (<0.06mm; not gritty)	0 1 2 3 4
Woody Debris	0 1 2 3 4
Vegetation or other	0 1 2 3 4
HUMAN INFLUENCE	
0 = Not Present P = Present outside plot C = Present within plot	
Buildings	0 P C
Commercial	0 P C
Park Facilities	0 P C
Docks/Boats	0 P C
Walls, dikes or revetments	0 P C
Landfill/Trash	0 P C
Roads or Railroad	0 P C
Row Crops	0 P C
Pasture/Rangeland/Hay Field	0 P C
Orchard	0 P C
Lawn	0 P C

Draft

Flag codes: K = No measurement or observation made; U = Suspect measurement or observation; F1, F2, etc. = misc. flags assigned by field crew. Explain all flags in comment sections.

2007 Physical Habitat Characterization Form - Lakes 03/20/2007

Figure 5-2(a). Physical Habitat Characterization Form, Side 1.

PHYSICAL HABITAT CHARACTERIZATION - LAKES (continued)					
SITE ID: <u>NLA06608 - 9999</u>			DATE: <u>05/01/2007</u>		
LITTORAL FISH MICROHABITAT CLASSIFICATION			BANK FEATURES (within plot)		
Human Disturbance	☐ None ☒ Low ☐ Moderate ☐ High		Angle (see figure below)	☒ Flat (<5°) ☐ Gradual (5-30°)	
Cover Class	☐ No/Little Cover ☒ Patchy Cover ☐ Continuous Cover			☐ Steep (30-75°) ☐ Near vertical/undercut (>75°)	
Cover Type (mark all that apply)	☐ Artificial ☐ Boulders ☐ Fill ☐ Woody ☒ Vegetation ☐ None		Vertical height from waterline to high water mark:		<u>0.5</u> (m)
Dominant Substrate	☐ Mud/Muck ☒ Sand/Gravel ☐ Cobble/Boulder ☐ Bedrock		Horizontal distance from waterline to high water mark:		<u>10.0</u> (m)
INVASIVE PLANTS AND INVERTEBRATES					
Littoral Plot			Shoreline/Riparian Plot		
SPECIES	Mark if observed	FLAG	SPECIES	Mark if observed	FLAG
NONE OBSERVED	☒		NONE OBSERVED	☐	
Zebra or Quagga Mussel	☐		Purple loosestrife	☒	
Eurasian watermilfoil	☐		Knotweeds	☐	
Hydrilla	☐		Hairy willow herb	☐	
Curly pondweed	☐		Flowering rush	☐	
African waterweed	☐			☐	
European water chestnut	☐			☐	
Water hyacinth	☐			☐	
Parrot feather	☐			☐	
Yellow floating heart	☐			☐	
Giant salvinia	☐			☐	
	☐			☐	
	☐			☐	
Flag Comments			Bank Angle Classes 		

Flag codes: K = No measurement or observation made; U = Suspect measurement or observation; F1, F2, etc. = misc. flags assigned by field crew. Explain all flags in comment sections.

2007 Physical Habitat Characterization Form - Lakes 03/29/2007

Figure 5-2(b). Physical Habitat Characterization Form, Side 2.

5.1.3.1 Shoreline Adjustments

Once in the field, the field team might run into conditions or problems that will require modifications to the shoreline and/or station location(s) as drawn on the Lake Outline Sketch. If this occurs, the field team makes the corrections and adjustments on the Lake Verification Form and the Physical Habitat Characterization Form and notes reasons on the comments section of the form. The general guidelines for locating or modifying the location of the littoral and shoreline stations are summarized in Table 5-2.

Table 5-2. General guidelines for locating or modifying the location of littoral and shoreline stations.

At Each Physical Habitat (P-Hab) Sampling Station:

1. Locate station using maps, aerial photos, or GPS units.
2. Define shore as either the current waterline OR the boundary between open water and the edge of dense vegetation (terrestrial, wetland, or emergent vegetation) or extensive very shallow water. (Shoreline defined by limit for navigating sample boat.)
3. If the shoreline observed in the field differs from the mapped shoreline, enter a comment on the Physical Habitat Characterization Form (Side 2) stating the apparent reason (e.g., drought, flooding, dredging). Mark "Station Relocated" on side 1.
4. If a P-Hab station is lost because of shoreline changes, position one or more new stations at approximately equal intervals. Mark "Station Relocated" at the top of the Physical Habitat Characterization Form.
5. If a station is eliminated, enter "K" flags on the Physical Habitat Characterization Form to indicate no observations, mark the "Station Dropped" box.
7. If the shoreline observed in the field differs radically from the Lake Outline Sketch and you are sure you are at the correct lake, draw a new map on the same page as the original lake. Use a string to measure the new outline, divide it into 10 equal parts, and lay out the 10 station locations.
8. At each of the 10 P-Hab stations, position the boat at an observation point 10 m from shore. Drop buoy at observation point, or maintain position while anchored.
9. Limit shoreline and riparian observations to an area 15 m (50 ft) wide by 15 m (50 ft) inland from shore, and littoral observations to an area 15 m wide (50 ft) by 10 m (30 ft) from shore to the boat.
10. Record littoral and riparian characteristics on side 1 of the Physical Habitat Characterization Form. Record any observed invasive plants and invertebrates, as well as any additional comments on side 2 of the Physical Habitat Characterization Form.

The shoreline is defined as the interface between "lake-like" conditions and riparian or wetland conditions. In most cases the shoreline will be easily identified as the current waterline. In some instances, however, the shoreline might not be obvious. Listed below are some general situations and rules that should be applied.

- If there has been a big drop in lake level due to drought, dam repair, or other reasons, shallow areas may be exposed that are usually covered with water. In this case, consider the current waterline as shoreline for the purposes of this survey, not the normal waterline.
- If there are extensive very shallow areas, or shoal-type areas, consider the shoreline to be the boundary between the shallow area and deeper open water, as defined by ease of access by small sampling boat.

- If access to the true shoreline is prevented by an area of dense aquatic or terrestrial vegetation, consider the shoreline to be the boundary between the vegetation and deeper open water. Again define the operational shoreline by ease of access by small sampling boat.

All adjustments to the shoreline based on field observations should be drawn directly on the Lake Outline Sketch and noted in the comments section of the Physical Habitat Characterization Form. If the Lake Outline Sketch does not in any way match the lake shoreline, the field team will need to draw a new sketch map approximating the shoreline, and establish the 10 P-Hab stations. A quick way to locate 10 evenly-spaced P-Hab stations is to: (a) lay a piece of string on the lake perimeter, (b) pick up the string, measure it, and mark out 10 equal parts, and (c) lay the string back on the perimeter and use the marks to locate the 10 sites on the map.

5.1.3.2 Relocating, Adding, and Eliminating Stations

The goal of the physical habitat survey is to characterize the lakeshore based on observations of conditions at 10 evenly spaced P-Hab sites around the lake. Adjustments to station locations might be needed if the field team runs into unusual conditions or problems. Below are some rules concerning modifications to the station location(s).

Actual shoreline is different than appears on the map

- If only a small portion of the shoreline differs and it does not affect, or only slightly affects, a P-Hab site location, sketch the lake shoreline on the Lake Outline Sketch and reposition the station (if needed).
- If the difference causes a contraction of the shoreline and a P-Hab station location is lost, the field team should sketch the lake shoreline on the Lake Outline Sketch and make a decision to (a) keep the station, relocate it on the revised shoreline map and adjust some or all other stations in order to keep stations evenly spaced around the lake (i.e., keep 10 stations), or (b) eliminate the station altogether (i.e., reduce the number of stations).
- If the difference causes an expansion of the shoreline the team should sketch the lake shoreline on the Lake Outline Sketch and make a decision to (a) add one or more stations, mark them on the revised shoreline map and adjust some or all other stations if needed so they are evenly spaced around the lake (i.e., designate more than 10 stations), or (b) adjust the stations so they are evenly spaced around the lake (i.e., keep 10 stations). On larger lakes the field team should try to maintain the goal of 10 stations.

P-Hab Station is inaccessible

- If a P-Hab station is inaccessible the field team must make a decision to (a) relocate the station and adjust some or all other stations so they are evenly spaced around the lake (i.e., keep 10 stations), or (b) eliminate the station altogether (i.e., reduce the number of stations). The size of the lake will help drive this decision. On larger lakes the field team should try to maintain the goal of 10 stations.

5.1.3.3 Identifying Relocated and New Stations on the Form

The field team should use the following notations when recording station location modifications.

- If a station is relocated, note the new location on the Lake Outline Sketch and check the appropriate original station letter (e.g., "C") on that form. The team also must check the box for the station letter on the Physical Habitat Characterization Form and check the box for "Station Relocated".
- If a station is lost and cannot be replaced, cross out the original station location on the pre-printed Lake Outline Sketch and check the box for "Station Dropped" on the Physical Habitat Characterization form, fill in each of the data boxes with "K" to indicate that no observations were made at the designated station, and note the reason in the comments.
- If one or more stations are added, check the nearest station locations on the Lake Outline Sketch, and fill in the box for "New Station" on a blank Physical Habitat Characterization Form.

5.1.4 Physical Habitat Characterization Form and Instructions

At each P-Hab station, make observations and measurements of the shoreline from the boat which is 10 m offshore (estimated by eye). It is important to stay 10 m from shore and to limit bank and shoreline observations at each station to the area that is within the defined plot dimensions. The littoral and riparian observation plots have fixed dimensions (Figure 5-1) that are estimated by eye. Littoral measurements pertain to the water and lake bottom in the 10 m (30 ft) distance between the boat and the shoreline and extending 15 m (50 ft) along the shore. Riparian observations at each station pertain to the adjacent land or wetland area that is 15 m wide and extends 15 m back onto land. The bank angle and shoreline substrate observations refer to a narrower shoreline zone that extends 1 m landward from the present waterline.

The shoreline boundary is defined as the approximate interface between "lake-like" conditions and riparian or wetland conditions. In cases where the lake shoreline is not obvious (e.g., where there is evidence of large seasonal change in lake level) define the shoreline as the current waterline. In cases where the lake shoreline is not visible, define the lake shoreline as the approximate boundary between open water and swamp or marsh conditions into which your boat could not easily move.

Use the rating system based on areal coverage in evaluations of riparian vegetation, shoreline substrate, littoral bottom substrate, fish cover, and aquatic macrophytes. The five entry choices range from 0 (absent) to 4 (>75% cover) and are defined in Table 5-3, which lists steps required to complete the Physical Habitat Characterization Form (Figures 5-2a and b). The second page of the form has space for comments. When estimating cover or substrate type, mixtures of more than one class might all be given sparse (1), moderate (2), or heavy (3) rankings. One dominant class with no clear subdominant class might be ranked very heavy (4) with all the remaining classes either sparse (1) or absent (0). Two dominant classes with more than 40 percent cover can both be ranked 3.

Table 5-3. Completing the physical habitat characterization form.

General	1. Fill in a Physical Habitat Characterization Form at each of the 10 P-Hab stations, clearly indicating station from which the observations have been made. 2. Survey plot dimensions: • Riparian Vegetation – 15 m along shoreline and 15 m back onto land. • Shoreline Substrate and Bank Angle – 15 m along shore and 1 m back. • Littoral (in lake) – 15 m along shoreline and 1 m out into lake 3. Use semi-quantitative ranking for vegetation, substrate, aquatic macrophytes & fish cover: • Very heavy (greater than 75% coverage) = 4 • Heavy (40 to 75% coverage) = 3 • Moderate (10 to 40% coverage) = 2 • Sparse (present, but less than 10% coverage) = 1 • Absent = 0
Littoral Habitat	1. Measure lake depth 10 m from shore at each P-Hab station, noting new location if the point has to be relocated for some reason. 2. Note the presence or absence of water surface scums, algal mats, or oil slicks. 3. Determine the lake bottom substrate visible from the boat. If the bottom is not visible, attempt to collect a sample or characterize by remote sensing with a sounding tube (e.g., PVC tubing). 4. Rank the littoral substrate sediment particle size, making multiple probes if the bottom is not visible. If the bottom is covered with logs, sticks, or other organic debris, choose "woody debris." If the substrate is concealed and remote sampling is not possible, use "Not observed" flag (K). 5. Note sediment color and odor if a sample can be seen or collected. 6. Estimate the areal coverage of the three individual aquatic macrophyte types and the areal coverage of all three types combined: submerged, emergent, and floating within the 10 x 15 m plot between the boat and shoreline. If you cannot see or probe the bottom, move closer to shore and note your new location with a Flag in the "Bottom Substrate" section. 7. Record fish habitat cover observed from the shore to the boat and 15 m along shore. 8. Record fish habitat macrohabitat classification for the general vicinity visible from the sampling station 10 m by 15 m littoral area. 9. Record invasive plant or invertebrate species observed.
Riparian Habitat	1. Divide shoreline vegetation into 3 categories: • Greater than 5 m high = canopy layer • 0.5 to 5 m high = understory layer • Less than 0.5 m high = ground cover layer <i>(Grasses or woody shrubs and tree branches can occur in >1 layer. The ground cover layer may be vegetation, water, barren ground, or duff.)</i> 2. Record the type of vegetation in the two tallest shoreline vegetation layers (canopy & understory) as none, deciduous, coniferous, broadleaf evergreen, or mixed. Define mixed as a segment where at least 10% of the areal coverage is made up of the alternate vegetation type. 3. Estimate the areal cover of the shoreline vegetation, recording the % of each coverage type within 3 vegetation classes (canopy, understory, and ground cover): 4. Rate the shoreline substrate 1 m into the riparian plot for areal coverage in particle size classes shown on the Physical Habitat Characterization Form. 5. Describe the angle of the shoreline bank back 1 m from the edge of the water 6. Estimate the vertical and horizontal distances between the present lake level and the high water line. 7. Record presence of each human influence type 8. Record invasive plant or invertebrate species observed.

On the human influence entry fields, mark "C" if present within the shoreline or littoral plot. Record a "P" if visible but adjacent or behind (outside) the plot, or "0" for absence of listed features. "Adjacent" is defined as found within a hypothetical plot of equal size to the right or left of the sampling plot. If, for some reason, you cannot make measurements at a station, record a "K" flag in all data fields for that station. This entry is very important, as there is no other way of determining whether your intent is to record the absence of features or to denote a missed station.

For any particular measurement variable, if no effort is made to collect data, or if you make an effort but for some reason are unable to obtain data, enter a "K" flag in the flag field. Explain on the Physical Habitat Characterization Form, Side 2 (Figure 5-2b) in the section designed for comments why data could not be obtained. If you collect data for a variable but have reason to believe it is suspect (or it was collected using a nonstandard protocol), enter a "U" flag in the flag field. In the comments section, explain why you think it is suspect (or describe what nonstandard procedure was used and why). If there is unusual or otherwise relevant information critical to interpreting data entered on the form, enter sequential flags (F1, F2, F3, etc.), and explain these flags in the comments section. Numbered "F" flags pertain to the front and back side of each individual form.

5.1.5 Littoral Zone Habitat Characterization

Lake depth at the observation point 10 m (30 feet) offshore in each littoral station is taken using the sonar, calibrated Secchi disk line, or the marked PVC sounding rod. Record the presence or absence of water surface scums, algal mats, or oil slicks. All measurements or observations in the following categories are recorded on the Physical Habitat Characterization Form (Figure 5-2a).

5.1.5.1 Bottom Substrate

To characterize littoral bottom substrate, restrict observations to the substrate you can detect from the boat. If you can't see the bottom, examine sediment indirectly using a long tube (e.g., the 3-m PVC sounding rod). Probe the bottom beneath the boat with the sounding rod (you may have to move closer to shore if too deep to use rod). Soft sediment can be brought to the surface for examination. Hard sediments can be "felt" with the sounding rod. Sandy substrate can be "felt" or "heard" by twisting the sounding rod and detecting grittiness. If you had to move into shallow water to use sounding rod to observe sediment characteristics, flag the observation and record (on the Physical Habitat Characterization Form comments section) the depth where you observed the sediment. Rate the cover of substrate sediment particle sizes that have very heavy, heavy, moderate, sparse, and absent areal coverage. Base these ratings on visual observations and judgments using the size classes defined on the form. If the bottom is covered with logs, sticks, or other organic debris, choose "woody debris." If the substrate is obscured by vegetation and you cannot obtain a PVC sounding rod sample, enter a "K" flag to denote "no observation made", and explain reason in comment field on back of form. However, probing with the sediment tube usually makes it possible to determine if the sediment is soft (therefore either Sand or Silt/Clay/Muck).

Sediment color and odor are subjective observations to be noted on the form, whenever possible. Select "None" or "Other" if sediment color does not match one of the categories. For sediment odor, the choices are "H₂S" (sulfurous, rotten egg), "Anoxic" (sewage odor), "Chemical" (strong odor like turpentine, paint, etc.), "Oil", or "Other" (including musty, no odor,

organic, and fishy odors). If "Other" is indicated, explain the observation on the comment form.

5.1.5.2 Aquatic Macrophytes

To characterize aquatic macrophytes, separately estimate the areal coverage (as defined in Table 5-3) within the lake area between your boat and the shoreline for each of the three aquatic macrophyte types:

- submerged,
- emergent (has erect portions above the water surface), and
- floating (either rooted or non-rooted vegetation)

Count any plant as being in only one of these types. Then estimate the coverage of all combined types of aquatic macrophytes in the same area. You may have to probe the bottom with the PVC sounding tube or your anchor if the water is turbid. Indicate ("yes" or "no") if the aquatic macrophytes extend further out into the lake than the area included in your observation area (i.e., more than 10 m [or 30 ft] from shore).

5.1.5.3 Fish Habitat Cover

Evaluate the areal cover of the listed types of fish habitat and cover features that are in the water and shoreline within the 10 x 15 m littoral portion of the field of vision at each P-Hab station (Table 5-3). Select a rating of 0 (absent) to 4 (>75% cover) based on the abundance of the various fish cover types (Table 5-3). These features are within or partially within the water and conceal fish from aquatic and terrestrial predators such as larger fish, otters, kingfishers, and ospreys.

- Aquatic and Inundated Herbaceous Vegetation -- submerged, floating, or emergent live aquatic or non-woody herbaceous plants
- Woody Debris/Snags -- inundated or partially inundated dead trees, branches, or rootwads with diameter >0.3 m (1 ft)
- Woody brush/woody debris -- inundated dead or living woody vegetation <0.3 m diameter.
- Inundated Live Trees -- inundated portions of trees >0.3 m in diameter
- Overhanging Vegetation -- <1 m from the water surface (do not include higher overhanging vegetation, which might provide perches for birds such as kingfishers)
- Ledges or Sharp Dropoffs -- overhanging banks, submerged rock shelves, and steep sloping rock walls
- Boulders -- >basketball size
- Human Structures -- docks, barges, houseboats, swimming platforms, tires, car bodies, and habitat enhancement structures (e.g., log rafts)

5.1.5.4 Littoral Fish General Macrohabitat Habitat Classification

At each physical habitat station, classify the general category of fish macrohabitat in the general vicinity of the sampling station. The hierarchical classification system defined in Table 5-4 consists of four levels. The first classification level refers to disturbance: is there major human influence in the littoral zone (not the shore) or is this area in a more or less natural state (including largely recovered areas)? The second level refers to the presence of cover: is there

cover for fish or open water or a mixture of the two? The third level defines the kind of cover: human influence includes "structures" (e.g., docks, boats, floating platforms) and "fill" (e.g., revetment boulders, trash); natural areas include in-lake vegetation, boulders, or woody materials or a mixture. The fourth level describes substrate. Check the appropriate box for each category on the Physical Habitat Characterization Form, Side 2 (Figure 5-2b).

Table 5-4. Littoral macrohabitat characteristics.

Littoral Fish Macrohabitat Classification	Classify the habitat for fish into the following categories for each respective level: 1st level (in-lake disturbance) High, Med, or Low 2nd level (in-lake cover) Cover (major fish cover), <u>O</u> pen, or <u>M</u> ixed (patchy). 3rd level (cover type) Artificial Structure (docks, boats), Fill (revetment, boulders, etc.), Vegetated, Woody, Boulders, Mixed (a combination), or None. 4th level (dominant substrate) Mud/Muck, Sand/gravel, Cobble/Boulder, or Bedrock.
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5.1.6 Riparian Zone Habitat Characterization

The riparian habitat characterization includes riparian vegetation cover, shoreline substrate, bank features, and human influences. Record all measures or observations for these categories on the Physical Habitat Characterization Form (Figures 5-2a with comments on 5-2b).

5.1.6.1 Riparian Vegetation Cover

To characterize riparian vegetation, observe the visible area from the shoreline back a distance of 15 m (50 ft) from the shore. If the high water mark is more than 15 m away from shore, the riparian plot includes parts of the shore that are sometimes inundated. On the other hand, if the "shoreline" boundary (defined as the approximate interface between "lake-like" conditions and riparian or wetland conditions) is an inundated wetland, then this area includes the wetland vegetation, or aquatic macrophytes. Conceptually divide the shoreline vegetation into three layers:

- Canopy (>5 m high)
- Understory Layer (0.5 to 5 m high)
- Ground Cover Layer (<0.5 m high)

Note that several vegetation types (e.g., grasses or woody shrubs) can potentially occur in more than one layer. Similarly note that some things other than vegetation are possible entries for the "Ground Cover" layer (e.g., water or barren ground), as indicated in Table 5-3. Before estimating the areal coverage of the vegetation layers, record the type of vegetation in each of the two taller layers (Canopy and Understory).

- deciduous,
- broadleaf evergreen,
- coniferous (needle-leaved, usually evergreen),

- mixed, or
- none

Consider the layer "Mixed" if >10% of the areal coverage is made up of the alternate vegetation type.

5.1.6.2 Shoreline Substrate

Rank, by areal coverage (very heavy, heavy, moderate, sparse, and absent) particle size classes of the substrate that are visible in the 1-m wide (terrestrial) strip nearest to the lake shoreline. These size estimates are made by eye from the boat, using the size classes and cover class ratings defined on Side 1 of the Physical Habitat Characterization Form (Figure 5-2a). If the inorganic substrate is obscured by vegetation, choose "Vegetation or Other"; if there is another type (e.g., organic flotsam), record its coverage rank in the "Vegetation or Other" category and then identify the category in the comments section.

5.1.6.3 Human Influences

Select "C" for any and all of the human activities and influences that you observe within the defined lake and riparian observation areas. If present (15 x 15 m areas to left and right) adjacent to the plot or within your field of vision behind (outside) the defined observation area, choose "P." Select "0" if human activity is not present in either lake or riparian areas.

5.1.6.4 Bank Type and Evidence of Lake Level Changes

Choose the bank angle description that best reflects the current shoreline that is dominant within your field of vision and 1 m into the riparian plot: Near vertical/undercut (>75 degrees, steep (>30 to 75 degrees; need hands to climb up), gradual, (5 to 30 degrees; can walk up), or flat (< 5 degrees). Estimate the vertical difference between the present level and the high water line (using survey pole and level or visual estimation); similarly, estimate the horizontal distance up the bank between current lake level and evidence of higher level (usually done using a laser range finder).

5.1.7 Invasive Plants and Invertebrates

Record if any invasive plant and invertebrate species listed in Table 5-5 have been observed within the habitat plot. Check the boxes on the side 2 of the Physical Habitat Characterization Form (Figure 5-2b) for any species observed within either the littoral or shoreline/riparian plots.

Table 5-5. Invasive plants and invertebrates.

Littoral Species	• Zebra (or Quagga) mussel • Eurasian watermilfoil • Hydrilla • Curly pondweed • African waterweed	• European waterchestnut • Water hyacinth • Parrot feather • Yellow floating heart • Giant salvinia
Shoreline/Riparian Species	• Purple loosestrife • Knotweed	• Hairy willow herb • Flowering rush

5.2 Benthic Macroinvertebrate Sampling

5.2.1 Summary of Method

Benthos are collected using a semi-quantitative sampling of multiple habitats in the littoral zone of lakes using a D-frame dip net (Figure 5-3). Sample collection is stratified on the following three specific habitat types: rocky/cobble/large woody debris; macrophyte beds; and organic fine muds or sand.



Figure 5-3. D-frame net used for collecting benthic macroinvertebrates.

5.2.2 Equipment and Supplies

Table 5-6 provides the equipment and supplies needed for field operations to collect benthic macroinvertebrates. Field teams are to record the benthic macroinvertebrate sampling data on the Lake Shoreline Sample Collection Form, Side 1 (Figure 5-5a).

Table 5-6. Equipment and supplies list for benthic macroinvertebrate collection.

Item	Quantity
Benthic Macroinvertebrate	
Modified kick net (D-frame with 500 μ m mesh) and 4-ft handle	1
Spare net(s) and/or spare bucket assembly for end of net	
Buckets, plastic, 8- to 10-qt capacity	2
Sieve-bucket or soil sieve with 500 μ m mesh openings (U.S. std No. 35)	1
Watchmakers' forceps	2 pr.
Wash bottle, 1-L capacity labeled "LAKE WATER"	1
Small spatula, spoon, or scoop to transfer sample	1
Funnel, with large bore spout (optional)	1
Sample jars, HDPE plastic with leakproof steam caps, 500-mL and 1-L capacity, suitable for use with ethanol	4 to 6 each sample
95% ethanol, in a properly labeled container	2 gal
Rubber gloves	2 pr.

Table 5-6. Equipment and supplies list for benthic macroinvertebrate collection.

Cooler (with suitable absorbent material) for transporting ethanol and samples	1
Benthic sample labels, with preprinted sample numbers	2
Benthic sample labels without preprinted sample numbers	4
Internal benthic sample labels on waterproof paper	6
Lake Shoreline Sample Collection Form	1
Soft (#2) lead pencils	
Fine-tip indelible markers	
Clear tape strips	1 pkg.
Plastic electrical tape	4 rolls
Scissors	1
Pocket-sized field notebook (optional)	1
Field operations and methods manual	1 copy

5.2.3 Sampling Procedure

5.2.3.1 Site Selection and Sample Collection

The process for selecting the p-Hab stations is described in the Physical Habitat Assessment Section 5.1. All benthic samples should be collected from the dominant habitat type within the 10 m x 15 m littoral zone component of each of the 10 P-Hab stations (Figure 5-4). The sampling process is described in Table 5-7.

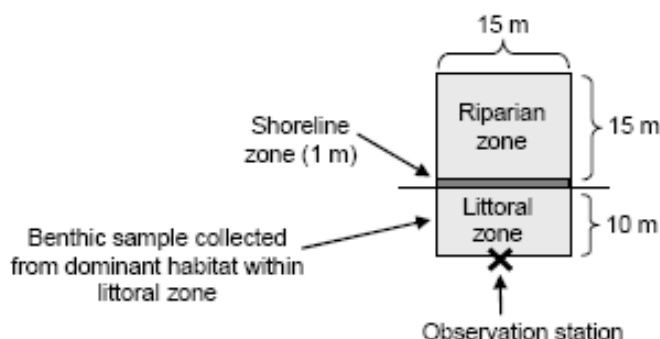


Figure 5-4. Benthic and habitat sampling station diagram.

5.2.3.2 Sample Processing in the Field

Use a 500 μ m mesh sieve bucket placed inside a larger bucket full of lake water while sampling to carry the composite sample as you travel around the lake. Once the composite sample from the collections from the 10 stations is sieved and reduced in volume, store in a 1-liter jar and preserve with 95% ethanol. Multiple jars may be required if detritus is heavy (Table

5-8). If more than one jar is used for a composite sample, use the "extra jar" label provided; record the SAME sample ID number on this "extra jar" label. The sample ID number is also recorded with a lead pencil (No. 2) on a waterproof label that is placed inside each jar. If a sample requires more than one jar, make sure the correct number of jars for the sample is recorded on the Sample Collection Form. Record information for each composite sample on the Lake Shoreline Sample Collection Form as shown in Figure 5-5(a).

Check to be sure that the pre-numbered adhesive label is on the jar and covered with clear tape. Place the samples in a cooler or other secure container for transporting and/or shipping the laboratory (see Appendix C).

Table 5-7. Procedure for benthic macroinvertebrate sampling

1. After locating the sample site according to procedures described in the physical habitat section, identify the dominant habitat type within the plot:
 - Rocky/cobble/large woody debris;
 - Shorezone vegetation and/or submerged aquatic vegetation;
 - or organic fine muds or sand.
2. After identifying the dominant habitat type, use the D-frame dip net (equipped with 500 μ m mesh) to sweep through 1 linear meter of the dominant habitat type at a single location within the 10m x 15m littoral zone sampling area, making sure to disturb the substrate enough to dislodge organisms.
 - If the dominant habitat is rocky/cobble/large woody debris it may be necessary to exit the boat and disturb the substrate (e.g., overturn rocks, logs) using your feet while sweeping the net through the disturbed area.
 - Because a dip-net is being used for sampling, the maximum depth for sampling will be approximately 0.5 m (the length of the dip-net staff); therefore, in cases in which the depth of the lake quickly drops off it may be necessary to sample in the nearest several meters to the shore.
3. After completing the 1-meter sweep, remove all organisms and debris from net and place them in a bucket following sample processing procedures described in the following section.
4. Proceed to the next sampling station and repeat steps 1-5. The organisms and detritus collected at each station on the lake should be combined in a single bucket to create a single composite sample for the lake. After sampling at all 10 stations is completed, process the composite sample in the bucket according to procedures described in the following section.

Revised by (date)

LAKE SHORELINE SAMPLE COLLECTION FORM

JD

SITE ID: NLA05603-9999

DATE: 05/01/2007

Sample ID		Sample Type *	No. of Jars	Flag	Comment																	
9999009		P	2																			
BENTHOS																						
STATION		A		B		C		D		E		F		G		H		I		J		
SUBSTRATE Rocky/Cobble/ Woody debris Macrophyte beds Organic/Fine muds Other: Note in Comments	COLL.	Sub	Coll	Sub	Coll	Sub	Coll	Sub	Coll	Sub	Coll	Sub	Coll	Sub	Coll	Sub	Coll	Sub	Coll	Sub	Coll	
	Boat	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	Wading	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
		○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
		○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
FLAG										K		F1						F2				

* Sample Types: P = Primary; D = Field duplicate

Flag	Comment
K	COULD NOT COLLECT SAMPLE - TOO DEEP (>3 m)
F1	SAMPLE COLLECTED FROM BOAT - UNSAFE TO WADE (DEEP MUCK)
F2	OTHER - IMMUNDATED GRASS AND HERBACEOUS TERRESTRIAL VEGETATION

Flag codes: K = No measurement or observation made; U = Suspect measurement or observation; F1, F2, etc. = misc. flags assigned by field crew. Explain all flags in comment sections.

EF

2007 Lake Shoreline Sample Coll. 03/19/2007

figure 5-5a. Lake Shoreline Sample Collection Form, Side 1.

Revised by
05/01/2007

LAKE SHORELINE SAMPLE COLLECTION FORM (cont.)

SITE ID: NLA06608-9999 DATE: 05/01/2007

ENTEROCOCCI (Target Volume = 250 mL)												
Sample ID	Sample Type *	Time Collected (hh:mm)	Depth Collected (m)	Sample Volume (mL)	Filt. Start Time (hh:mm)	Volume Filtered (Target = 50 mL) **				Filt. End Time (hh:mm)	Time Frozen (hh:mm)	Flag
						FIL. 1	FIL. 2	FIL. 3	FIL. 4			
500030	P	1630	0.3	250	1800	50	50	50	50	1845	1900	F3

* Sample Types: P = Primary; D = Field duplicate; F = Filter blank (enterococci sample only). Filter blank is collected at void where field duplicate sample is NOT taken.
** If <25 mL of buffer solution was used to rinse filter, indicate with an F flag and note in comment section which filter(s) were affected along with the appropriate volume(s) of buffer solution used.

Flag	Comment
F3	15 mL of buffer solution was used on Filter 3, 20 mL on Filter 4.

Flag codes: K = No measurement or observation made; U = Suspect measurement or observation; F1, F2, etc. = misc. flags assigned by field crew. Explain all flags in comment sections.



2007 Lake Shoreline Sample Coll. 03/19/2007

Figure 5-5b. Lake Shoreline Sample Collection Form, Side 2.

Table 5-8. Procedure for preparing composite samples for benthic macroinvertebrates

1. Pour the entire contents of the bucket through a sieve (or into a sieve bucket) with 500 µm mesh size. Remove any large objects and wash off any clinging organisms back into the sieve before discarding.
 2. Using a wash bottle filled with lake water, rinse all the organisms from the bucket into the sieve. This is the composite sample for the lake.
 3. Estimate the total volume of the sample in the sieve and determine how large a jar will be needed for the sample (500-mL or 1-L) and how many jars will be required.
 4. Fill in a sample label with the Lake ID and date of collection. Attach the completed label to the jar and cover it with a strip of clear tape. Record the sample ID number for the composite sample on the Sample Collection Form. For each composite sample, make sure the number on the form matches the number on the label.
 5. Wash the contents of the sieve to one side by gently agitating the sieve in the water. Wash the sample into a jar using as little water from the wash bottle as possible. Use a large-bore funnel if necessary. If the jar is too full pour off some water through the sieve until the jar is not more than $\frac{1}{2}$ full, or use a second jar if a larger one is not available. Carefully examine the sieve for any remaining organisms and use watchmakers' forceps to place them into the sample jar.
 - If a second jar is needed, fill in a sample label that does not have a pre-printed ID number on it. Record the ID number from the pre-printed label prepared in Step 4 in the "SAMPLE ID" field of the label. Attach the label to the second jar and cover it with a strip of clear tape. Record the number of jars required for the sample on the Sample Collection Form. **Make sure the number you record matches the actual number of jars used.** Write "Jar N of X" on each sample label using a waterproof marker ("N" is the individual jar number, and "X" is the total number of jars for the sample).
 6. Place a waterproof label inside each jar with the following information written with a number 2 lead pencil:

• Lake ID • Type of sampler and mesh size used • Name of lake • Date of collection	• Collectors initials • Number of stations sampled • Jar N of X
---	---
 7. Completely fill the jar with 95% ethanol (no headspace). It is very important that sufficient ethanol be used, or the organisms will not be properly preserved. Existing water in the jar should not dilute the concentration of ethanol below 70%.
 - NOTE: Prepared composite samples can be transported back to the vehicle before adding ethanol if necessary. In this case, fill the jar with lake water, which is then drained using the net (or sieve) across the opening to prevent loss of organisms, and replaced with ethanol at the vehicle.
 8. Replace the cap on each jar. Slowly tip the jar to a horizontal position, then gently rotate the jar to mix the preservative. Do not invert or shake the jar. After mixing, seal each jar with plastic tape.
- Store labeled composite samples in a container with absorbent material that is suitable for use with 70% ethanol until transport or shipment to the laboratory.

5.3 Fecal Indicator (Enterococci)

5.3.1 Summary of Method

Field teams are to collect a water sample within the littoral zone of the final habitat station (station J) where the water is about waist deep (1 meter). Teams are to use a pre-sterilized, 250 ml bottle and collect the sample at about 0.3 meter (12 inches) below the water. Following collection, samples are placed in coolers and maintained on ice prior to filtration of four 50 mL volumes. Samples must be filtered within 8 hours of collection. For "large lakes" (greater than 5,000 ha) the sample is to be collected from the launch site at the end of the day.

5.3.2 Equipment and Supplies

Table 5-9 provides the equipment and supplies needed for field operations to collect the fecal indicator sample. The Lake Shoreline Sample Collection Form (Figure 5-5b) is used to record and document the fecal indicator sample.

Table 5-9. Equipment and supplies list for fecal indicator sampling

Item	Quantity
Fecal Indicator	
surgical gloves (non-powdered)	
pre-sterilized, 250 ml sample bottle	
Lake Shoreline Sample Collection Form	1
Fecal Indicator sample labels	4 vial labels and 1 bag label
Wet ice	
cooler	1

5.3.3 Sampling Procedure

Table 5-10. Procedure for Fecal Indicator (Enterococci) sample collection.

Collect the Enterococci Sample

1. Put on surgical gloves (non-powdered).
2. Transfer sodium thiosulfate tablet from the pre-sterilized, 250 ml sample bottle to a sterile screw-cap 50-mL PP tube.
3. Approach 1 m deep sampling location slowly from downstream or downwind.
4. Lower the un-capped, inverted 250 ml sample bottle to a depth of 0.3 meter below the water surface, avoiding surface scum, vegetation, and substrates. Point the mouth of the container away from the body or boat. Right the bottle and raise it through the water column, allowing bottle to fill completely.
5. After removing the container from the water, discard a small portion of the sample to allow for proper mixing before analyses.
6. Add the sodium thiosulfate tablet, cap, and shake bottle 25 times.
7. Store the sample in a cooler on ice to chill (not freeze). Chill for at least 15 minutes and do not hold samples longer than 8 hours before filtration.

Wisconsin Department of Natural Resources
Supplemental Lakeshore Habitat Assessment
Methodology for the USEPA National Lake Assessment

WISCONSIN DEPARTMENT OF NATURAL RESOURCES
101 S. WEBSTER, PO BOX 7921
MADISON, WI 53707-7921

Method Summary:

In an effort to develop a lakeshore habitat assessment tool for the Wisconsin DNR, the following enhancements were created to supplement the USEPA National Lake Assessment physical habitat protocol. The surveys were conducted on expanded 45-meter plots based on the ten USEPA habitat plots described in section 5.0 of the Field Operations Manual (USEPA 2007). The supplemental method collected additional data on fish habitat, invasive species specific to Wisconsin, and better quantified human development impacts on lake shores. It also provided more detail on the aquatic plant composition in the near shore, littoral zone.

Purpose:

1. Collect preliminary data and test field methods to develop a lakeshore habitat assessment tool to be used by WDNR staff, consultants, or citizen volunteers in the future to characterize a lake's shoreland quality and degree of human influence.
2. Quantify the amount of woody debris in near-shore 45 m transects.
3. Document the presence of invasive species of particular concern in Wisconsin.
4. Quantify ranges of human disturbance both in the shoreland and littoral zone plots, specifically addressing shoreline modifications, paved surfaces, buildings, lawns, residences, buildings, piers, boat lifts, and swim rafts.
5. Identify aquatic plant species and relative quantities to characterize the littoral zone plant community.

Requirements:

1. Survey was completed on the same day that the lake was visited for the USEPA NLA.
2. Survey sites physically coincided with the ten randomly selected, near-shore USEPA NLA habitat plots.
3. Survey was conducted by wading or from a boat.

Equipment and Supplies:

In addition to the equipment and supplies listed in Table 5-1 of the field manual, the following equipment and supplies were needed to conduct the supplemental method:

- Two garden rake heads welded together onto an extension rod (1)
- WDNR Supplemental Methodology data sheets (10)
- Ziploc bags for collecting unknown aquatic plants (1 box)
- Waterproof paper ID tags for labeling unknown aquatic plants (50)
- *Through the Looking Glass* plant identification manual (1)
- Waders for the woody debris transects

Method:

The sampling plots used in this supplemental protocol extended for 45 meters along the shore, 10 meters lakeward, and were centered on the USEPA National Lake Assessment stations. On shore they were divided into two zones: the riparian plot within 15 meters of the water and the zone farther than 15 meters from the water, referred to as the upland plot.

1. **Woody Debris:** In 0.5 meter water depth, we walked the entire 45 meter shoreline and counted the number of small (5-10 cm) and large (> 10 cm) pieces of woody debris crossed. In clear water we sometimes conducted the survey by driving the boat slowly and counting logs crossed off the bow. In murky water, we attempted to feel the bottom substrate with a paddle to count logs.
2. **Invasive Species:** At each station we noted the presence of Japanese stiltgrass (*Microstegium vimineum*), reed canary grass (*Phalaris arundinacea*), phragmites (*Phragmites australis*), hybrid cattail (*Typha spp.*) and yellow iris (*Iris pseudacorus*) within the riparian plot.
3. **Human Development:** At each station we determined the most appropriate percent categories (0 = 0-1%, 1 = 1-10%, 2 = 10-40%, 3 = 40-75%, 4 = >75%) within the riparian and upland plots for a variety of human development parameters. For development that only applied to the shoreline, such as a seawall, the rating was applied only to the immediate shoreline. For example, a '4' rating for seawall indicated that greater than 75% of the shoreline was seawall. The variables were as follows:
 - a. Seawall: concrete or paved protective structures to prevent shoreline erosion
 - b. Riprap: loose stones or boulders placed artificially prevent shoreline erosion
 - c. Artificial beach: included both imported sand and zones cleared of natural vegetation to create a beach
 - d. Lawn: stretch of open, mown, grass-covered land
 - e. Pavement: any impervious ground cover, including driveways, roads, and impermeable patios

In addition, we counted the number of human development features present in the riparian and upland plots. The variables were as follows:

- a. Residences: private homes
 - b. Commercial buildings: included restaurants, businesses, yacht clubs, etc.
 - c. Structures: any non-resident, non-commercial buildings, such as sheds, garages, or boat houses.
 - d. Boat lifts: included jet skis and sail boats
 - e. Swim rafts: only if present within the 10 m littoral zone plot
 - f. Docks: counted individual piers, flagging multi-boat docks (e.g. marina)
4. On smaller lakes or lakes not completely developed, we recorded the number of piers between stations. We also noted any land use information between stations to help when

evaluating the full NLA Lake Assessment form, such as the presence of a golf course, marina, or causeway.

5. Aquatic Plant Surveys:

- a. Within each of the ten USEPA littoral plots, we sampled the aquatic plant community with a rake at 2 meters, 5 meters, and 8 meters from the shoreline. Using a welded, double-headed rake on a pole, we first collected the station depth. We then rotated the rake two full circles before lifting it from the lake bottom.
- b. Sifting through the plants, we identified each unique plant present on the rake down to the species level if possible. We also rated the plant density on a relative scale of 1 to 3, where 1 indicated the presence of a singular plant fragment and a 3 meant the rake was overflowing with a specific species.
- c. Last, we collected any unidentifiable specimens in Ziploc bags and included a waterproof tag with the lake name, NLA ID, date, station ID, and the temporary name used. These specimens were later identified using the *Through the Looking Glass* book or referring to an aquatic plant expert.

Works Cited:

Borman, S., R. Korth, and J. Temte. 1997. *Through the looking glass ... A field guide to aquatic plants*. Wisconsin Lake Partnership, Stevens Point, WI. 248 pgs

USEPA. 2007. *Survey of the Nation's Lakes. Field Operations Manual*. EPA 841-B-07-004. U.S. Environmental Protection Agency, Washington, DC.

SITE ID: _____

DATE: _____

NAME: _____

WBIC: _____

	A	B	C	D	E	F	G	H	I	J
PHOTO TAKEN?										

WOOD	(# of logs in 50m transect in 0.5m water depth)	A	B	C	D	E	F	G	H	I	J
	> 5 cm diameter										
	> 10 cm diameter										

INVASIVES	(Mark if observed)	A	B	C	D	E	F	G	H	I	J
	Japanese stiltgrass										
	Reed canary grass										
	Phragmites										
	Cattails										
	Yellow iris										

LANDCOVER	0 (0-1%), 1 (>1-10%), 2 (>10-40%), 3 (>40-75%), 4 (>75%)																					
	(% 50m shoreline length or area within 15m or depth of view)		A		B		C		D		E		F		G		H		I		J	
			15	+	15	+	15	+	15	+	15	+	15	+	15	+	15	+	15	+		
	Seawall																					
	Riprap																					
	Artificial beach																					
	Lawn																					
	Pavement																					

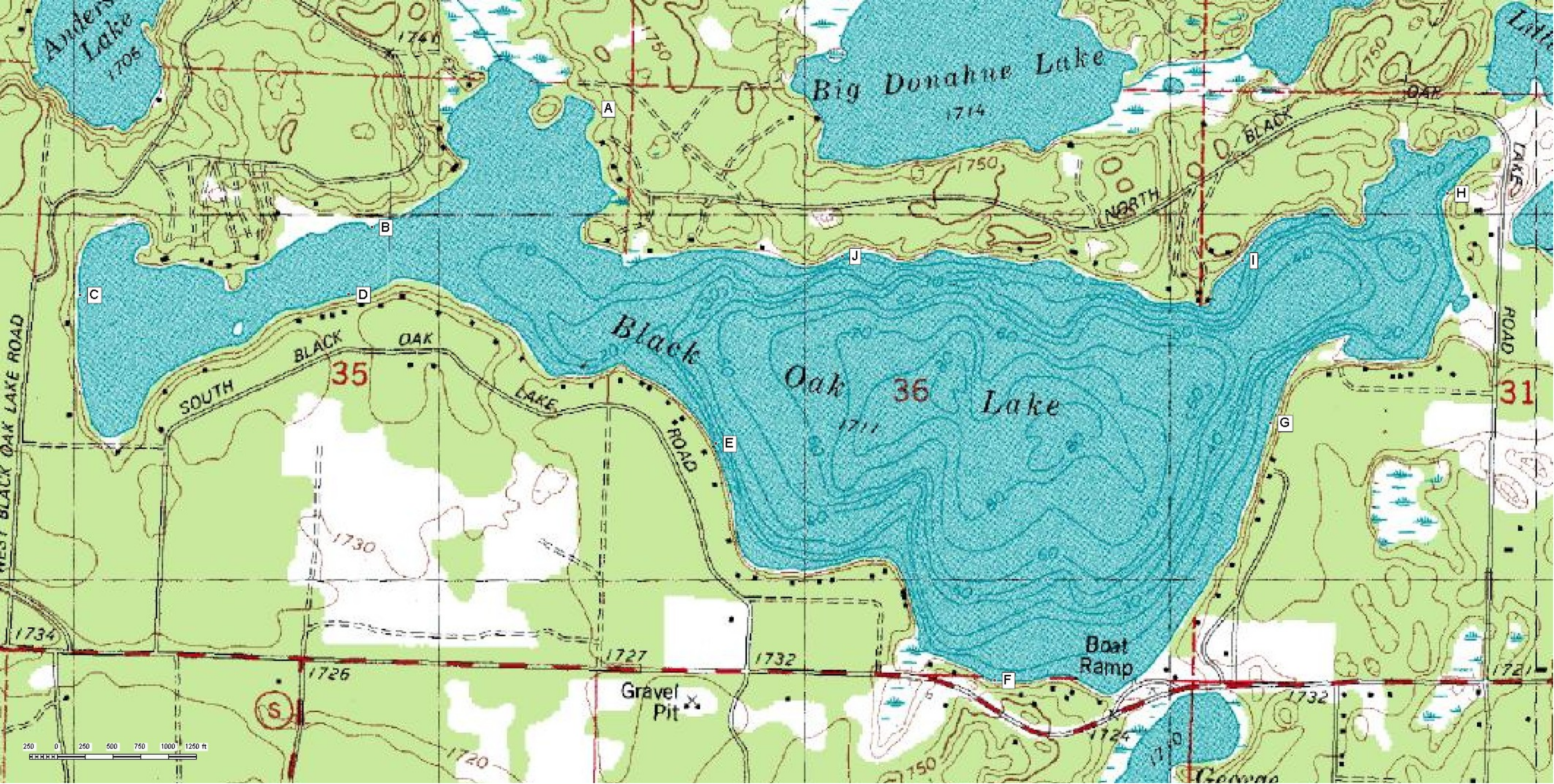
HUMAN DEV.	(# of features along 50m shoreline , 10 m lakeward, and 15m or depth of view)	A		B		C		D		E		F		G		H		I		J	
		15	+	15	+	15	+	15	+	15	+	15	+	15	+	15	+	15	+	15	+
	Residences																				
	Comercial buildings																				
	Structures (sheds/boat houses)																				
	Boat lifts																				
	Swim rafts																				
	Docks																				

SHORELINE NOTES																					
	A and B																				
	B and C																				
	C and D																				
	D and E																				
	E and F																				
	F and G																				
	G and H																				
	H and I																				
	I and J																				
	J and A																				

Piers

Site ID		Shore distance (m)		Depth (ft)																	
A	2																				
	5																				
	8																				
B	2																				
	5																				
	8																				
C	2																				
	5																				
	8																				
D	2																				
	5																				
	8																				
E	2																				
	5																				
	8																				
F	2																				
	5																				
	8																				
G	2																				
	5																				
	8																				
H	2																				
	5																				
	8																				
I	2																				
	5																				
	8																				
J	2																				
	5																				
	8																				
K	2																				
	5																				
	8																				
L	2																				
	5																				
	8																				

Numbers refer to rake fullness, ranging from 1 (just one specimen) to 3 (filling the entire rake), or V, a visual find within 2 m of the rake throw.



Black Oak Lake Sampling Points, September 2008				
Label	Latitude (d m.m)	Longitude (d m.m)	Latitude (d.d)	Longitude (d.d)
A	46 10.16376	-89 19.58082	46.169396	-88.673653
B	46 9.97902	-89 20.046	46.166317	-88.6659
C	46 9.8667	-89 20.66124	46.164445	-88.655646
D	46 9.87888	-89 20.0904	46.164648	-88.66516
E	46 9.67494	-89 19.30254	46.161249	-88.678291
F	46 9.33768	-89 18.69534	46.155628	-88.688411
G	46 9.72882	-89 18.12612	46.162147	-88.697898
H	46 10.0752	-89 17.76468	46.16792	-88.703922
I	46 9.96786	-89 18.19578	46.166131	-88.696737
J	46 9.95712	-89 19.0455	46.165952	-88.682575



Station A

USEPA & WDNR
Physical Habitat
Assessment)
Photograph taken
9/19/08



Station B

USEPA & WDNR
Physical Habitat
Assessment)
Photograph taken
9/19/08



Station C

USEPA & WDNR
Physical Habitat
Assessment)
Photograph taken
9/19/08



Station D

USEPA & WDNR
Physical Habitat
Assessment)
Photograph taken
9/19/08



Station E

USEPA & WDNR
Physical Habitat
Assessment)
Photograph taken
9/19/08



Station F

USEPA & WDNR
Physical Habitat
Assessment)
Photograph taken
9/19/08



Station G

USEPA & WDNR
Physical Habitat
Assessment)
Photograph taken
9/19/08



Station H

USEPA & WDNR
Physical Habitat
Assessment)
Photograph taken
9/19/08



Station I

USEPA & WDNR
Physical Habitat
Assessment)
Photograph taken
9/19/08



Station J

USEPA & WDNR
Physical Habitat
Assessment)
Photograph taken
9/19/08
