Description and Summary of Lake Aeration Projects to Prevent Fish Winterkill in Barron and Polk Counties, Wisconsin

Rick Cornelius

Senior Fisheries Biologist, Retired

Wisconsin Department of Natural Resources

Northern Region – Barron

April, 2006

Executive Summary

Barron and Polk Counties in northwestern Wisconsin contain many small lakes which have winterkill conditions. Desirable sport fish populations can be established in these lakes only if the occurrence of winterkill is greatly reduced or eliminated. In 1977 the first successful attempt to eliminate winterkill in an area lake using aeration occurred on Largon Lake, Polk County. By 2005-2006 seventeen lakes totaling over 3,000 acres (range 54-1,534 acres) had managed aeration projects. The aeration projects have resulted in improved sport fish populations in these lakes.

Two types of aeration systems have proven effective and relatively economical in reducing or eliminating winterkill in a variety of lakes; the compressed air aeration system and the surface aspirating aeration system. The installation, operation, maintenance, and cost of each system are discussed along with a summary of the individual lakes where aeration projects occur in the two counties. Projects are funded and operated in various ways, but often involve a variety of partnerships between the DNR, local units of government, lake districts and lake associations, and individual lakeshore property owners.

Introduction

Barron County and Polk County in northwestern Wisconsin contain numerous small lakes which have fish winterkill conditions. Dissolved oxygen levels in these lakes decline throughout the winter to the point that by mid too late winter fish start to die due to lack of oxygen. Fish winterkill severity ranges from annual total winterkills in some lakes to infrequent partial winterkills in other lakes.

An important factor which influences the frequency and severity of winterkill is a lake's morphology, including average and maximum depth, the presence or absence of shallow bays where fish can be trapped, and the presence or absence of inlets, outlets, and spring areas. Fertile lakes probably have a greater tendency to winterkill than infertile lakes due to greater oxygen demand from decaying organic matter.

Factors which can influence whether or not a lake will winterkill in any specific year include the duration and depth of ice and snow cover, the status of lake levels, and for some lakes whether or not fall turnover is complete. Because of the year to year variability of these factors, predicting whether an occasional winterkill lake will have winterkill conditions in any particular year is not possible.

Annual severe winterkill can result in total absence of fish in a lake, while occasional partial winterkills can result in an unbalanced fish population which can fluctuate greatly in numbers and composition. As winterkill lakes have become increasingly developed with seasonal and permanent dwellings, there has been increased interest in creating desirable sport fish populations in these lakes. To create desirable fish populations, winterkill conditions have to be eliminated or at least greatly reduced. In addition, management techniques to control winterkill conditions have to be simple and economical, so that lakeshore property owners, sportsmen's

clubs, and local units of government that have limited manpower and finances can feasibly undertake such projects.

The earliest attempts to prevent winterkill by the use of aeration in this area utilized spray type aerators which sprayed water into the air. This method proved ineffective in preventing winterkills in lakes. The first successful attempt at aeration in the Barron and Polk County area occurred at Largon Lake in Polk County in 1977, when a compressed air aeration system was developed and installed. From 1977 through 2005, a total of 18 aeration systems were installed in lakes in Barron and Polk Counties (Figure 1; Table 1). Two types of aeration systems have proven effective and relatively economical in reducing or eliminating winterkill in a variety of lakes; the compressed air aeration system and the surface aspirating aeration system. Both have advantages and disadvantages, as discussed below. All cost figures presented are 2005 US dollars.

Lake Selection, Site Selection, Aerator Type. Lakes as shallow as five feet maximum depth and as large as 1,534 acres have been aerated with some success in this area. However, there is no guarantee that a lake can be successfully and economically aerated, and certainly a lake with a maximum depth of five feet is on the edge of being too shallow. Strong local support for an aeration project should be important criteria in selecting a lake as a candidate for aeration. Willingness of local citizens to become actively involved in the project is also important. Before a project is initiated, it should be agreed upon as to who will do what, from purchasing the aeration system to installing it and operating it on a yearly basis.

Having electricity at the site, or at least near the site, is critical, as the aerators are driven by electric motors. Water of at least five feet maximum depth should be within several hundred feet of the shore.

The presence of public land or a willing landowner on which to site the project is important. Liability can be an issue when installing aeration systems. The landowner where the system is to be located must obtain the water regulations permit, and becomes liable for the aeration system. Therefore, it is best if the landowner is not an individual, but is a unit of government or a lake district. The liability aspect must be made clear to the landowner. Maintaining an open water barricade in accordance with Wisconsin Statute 167.26 is important in regard to liability.

Compressed air aeration systems are less labor intensive than aspirating aeration systems, and so are often the most practical if a lake group is to operate the system. However, because aspirating aeration systems are generally more powerful than compressed air systems, they may be better suited to aerate lakes greater than 250 acres and shallow lakes less than 10 feet maximum depth. A compressed air system was only marginally successful on six ft deep Camelia Lake, but a 2 hp aspirating aerator was much more successful at preventing winterkill. Four 3 hp aspirating aerators have prevented winterkill conditions from occurring in the northern one-half of 1,534 acre Prairie Lake for 15 years.

Installation of the Open Water Barricades. A very important part of any aeration project is the placement and maintenance of a barricade around the open water created by the aeration system. Wisconsin Statute 167.26 states that "(2) Any person creating ice holes by aeration of water, may, in lieu of the requirements of sub (1), erect and maintain a barricade around such holes consisting of uprights spaced every 25 feet or less, connected by a continuous rope, cord or

similar material placed 3 ½ feet off the surface of the ice. The connecting rope, and/or similar material shall have reflectorized ribbon or tape attached to it, so as to be highly visible, and shall be of sufficient strength to permit retrieval of the barricade following melting of ice. Any person erecting such a barricade shall remove the barricade and all parts thereof from the ice or water immediately after the ice has melted. (3) Persons barricading ice holes in the manner specified in this section shall not be liable for damages suffered by persons who enter within the barricaded area."

It has been the practice of some operators of compressed air systems to turn on the aerators and let the open water area develop, and then place the barricade around the open water. This method does not meet the standards of Statute 167.26, as for a time there is unbarricaded open water present, creating a potential liability.

A better way to operate is to: 1) turn on the aerators before freeze-up to blow the water out of the air lines and to identify the locations of air bubbles rising to the surface. Mark these locations using GPS or another method; 2) turn off the aerators until the ice is thick enough to walk on, and erect the barricade around the area that will become open water, making sure the barricade is large enough; 3) drill some holes through the ice where the air bubbles will come to the surface, then turn on the aerators and let the open water develop.

Any materials can be used for the barricade as long as they meet the standards of Statute 167.26. A convenient method is to use 5/8 in diameter, 5 ft long fiberglass fence posts with a 3 in by 3 in PVC sponge net float pushed up about one ft onto each fence post. Holes are drilled into the ice every 25 ft or less, forming a perimeter of the barricade, and a fence post is placed in each hole so the net float rests on the ice. The float gives the post upright stability, and the post will float for easy retrieval in the spring.

Fence post clips and zip ties can be used to attach ½ in black polypropylene rope to the fence posts. Reflective tape and markers can be purchased to place on the fence posts and rope. Black markers attached to the posts and rope provides definition against the white snow making the barricade easier to see during the day (See Appendix Table 1 for barricade material list and vendors). Signs should be placed at public access sites warning of open water due to aerator operation.

Design, Installation and Operation of a Compressed Air Aeration System. The compressed air aeration system is permanently installed at the site. The system consists of one or more air compressors housed in a shelter on the shoreline, which push air through two or more air lines which extend along the lake bottom to the deepest part of the lake that can be reached in 400 feet or less (Figure 2). Air is released from the end of the air lines into the water where it bubbles up through the water column to the surface. This action creates a current which causes warmer water near the lake bottom to rise to the surface, creating an ice-free area which allows water to be reoxygenated. The air lines should be run inside a length of 4 inch PVC pipe from the aerator shed out into several feet of water depth to protect the lines from damage. A barricade needs to be constructed around the open water.

The aeration system must be operated throughout the winter months, from December into March. Most compressed air aeration systems are not powerful enough to increase dissolved oxygen levels, or even hold them steady, but they slow the rate of decline so that adequate dissolved oxygen (greater than 2.0 ppm in the upper five to ten feet of water) is still available in late winter.

Because funding is often a concern when working with small groups of partners, the procedure has been to install the smallest aeration system which has a reasonable chance of preventing winterkill from occurring. If the system proves inadequate, it can be enlarged.

Lakes with a maximum depth of at least 10 feet and a mean depth of at least six feet can often be aerated successfully with a compressed air system. In general, one ¾ hp aeration unit may aerate a 30 to 50 acre lake, with an additional ¾ hp unit added for each 30 to 50 acres. Because fish are attracted to areas of adequate oxygen, it is not necessary to maintain desirable oxygen levels throughout the entire lake.

A single aeration unit consists of a ¾ hp or 1 hp oilless vane compressor, a two valve outlet, a muffler system, and two air lines each consisting of ¾ inch weighted heavy duty polyethylene tubing. Pre-weighted polyethylene tubing is available, but regular heavy duty polyethylene tubing weighted with ½ inch by 20 foot reinforcing rod placed end to end works well and is more cost-effective. The cost of one ¾ hp aeration unit is approximately $1,150.00, and the cost of operation of one ¾ hp unit is about $30.00 to $50.00 per month in electricity.

Ceramic diffusers are available which can be placed at the ends of the air lines to create smaller bubbles and thereby increase the aerators efficiency. However, the diffusers are a maintenance problem in that the micropores become clogged, and satisfactory results have been obtained simply by capping the ends of the air lines and drilling several 1/8 inch holes into the last several feet of tubing.

One advantage to a compressed air system is that once the system has been installed, relatively little maintenance is required beyond the erection of an open water barricade in early winter and its removal each spring. The system needs to be turned on before freeze-up to check

for problems and to blow water out of the air lines. The air line valves must be shut immediately after the compressors are turned off to keep water out of the air lines during the freeze-up period.

It is recommended that the carbon vanes in the air compressor be replaced about every nine months of operation. A vane set costs about $85.00. Other possible maintenance concerns are muskrats *Ondatra zibethica* chewing holes in the air lines that then need repair and boat anchors catching and moving air lines that then need to be reset. If reinforcing rods are used to weigh down the air lines, they should be placed end to end to keep the air lines flat on the bottom.

Design, Installation and Operation of a Surface Aspirating Aeration System. Surface aspirating aeration systems are currently (2005) in use on four area lakes (Table 1). Each aerator unit consists of an aerator floating on a molded polyethylene pontoon. The aerator consists of an electric motor (2 or 3 hp) attached to an adjustable hollow shaft that angles into the water (Figure 3). The shaft drives a propeller/diffuser that draws air through intake holes above the water surface and shoots a stream of air through the shaft into the water. Underwater power cable and mooring cable are necessary, and the open water must be surrounded by a barricade. The cost of one 2 hp unit with 200 feet of under water power cable is about $1,350.00. Operating cost is estimated at $120.00 to $180.00 per month in electricity for one 3 hp unit.

A significant difference between the surface aspirating aeration system and the compressed air system is that the compressed air system is permanently installed at the site, while the aspirating system must be installed each winter and removed each spring. Therefore, the aspirating systems are considerably more labor intensive, and may require Department of Natural Resources (DNR) assistance for installation and removal. On the plus side, the aspirating systems are portable and ideal for emergency aeration situations.

Aspirating aeration systems are not installed until the ice is thick enough for ATV travel. Chain saws are used to cut holes in the ice large enough to place each aerator/pontoon assembly. Anchoring cables are attached to the pontoons in a triangular fashion, and large cement blocks are attached at the ends of each of the cables so they will fall to the bottom as the ice is eroded away by the action of the aerators. Underwater power cables are run from the aerators to an electrical source on shore, and polyethylene floats are attached to the cables so that they do not sink to the bottom.

The individual aerators can be placed in a lake in a variety of configurations. In this area, the aerators have been placed so that the shafts of the aerators are pointing out into the main portion of the lake, and if four aerators are used, they are placed as at the four corners of a square or rectangle, 50 to 100 feet apart.

Aspirating aeration systems are generally more powerful than compressed air systems, and can sustain or even elevate dissolved oxygen levels in some instances. In general, one 2 hp aspirating aerator may aerate a 75 acre lake, with an additional aerator necessary for each additional 75 acres. Dissolved oxygen levels can be monitored, and individual aerators turned on or off as the situation dictates. However, thin ice conditions can be created when aerators are turned on and off, so it is especially important to maintain a good barricade, and at least one aerator should be operating at all times to maintain some open water. The aerators must be operated until ice-out is complete to protect the aerators from being dislodged and damaged by ice push. This type of aerator damage occurred on Staples Lake one year.

Aeration Projects

The following is a summary of the eighteen aeration projects which have taken place in Barron and Polk Counties. This summary indicates the general success of aeration in reducing or eliminating winterkill, and also shows the variety of situations where this management practice can work.

Antler Lake – Polk County

Antler Lake is a 101 acre seepage lake located in central Polk County. The lake is landlocked and has a maximum depth of twenty two ft and a mean depth of nine ft. The sport fishery consists of largemouth bass *Micropterous salmoides*, northern pike *Esox lucius* and panfish. Walleye *Sander vitreus* have been periodically stocked since 1989 when aeration was started.

Antler Lake had occasional partial winterkills, and was particularly susceptible when the lake level was below normal. A serious winterkill occurred in February of 1989, prompting the Antler Lake District to become interested in an aerator system. A cooperative project between the DNR and the Lake District was undertaken and an aeration system was installed in the fall of 1989. Three, ½ hp air compressors and associated equipment were purchased by the DNR, and the system is operated and maintained by the Lake District. There has been no winterkill since the initiation of aeration. A 1995 fisheries survey indicated that the largemouth bass population had increased significantly since the 1989 winterkill, and that some walleyes were present (Cornelius 1995a).

Bass Lake – Polk County

Bass Lake is a 138 acre seepage lake located in northern Polk County. The lake has a maximum depth of nineteen ft and a mean depth of six ft, and the south one-third of the lake is a

shallow bay with a maximum depth of six ft. The lake has had a history of periodic partial winterkills which adversely affected the fishery of largemouth bass, northern pike and panfish.

In 1997 the Polk County Sportsman's Club expressed an interest in installing and operating an aeration system in Bass Lake. Installation of a compressed air system began in the fall of 1997, but the lake froze before the air lines could be installed on the lake bottom. A DNR owned 3 hp aspirating aerator was run periodically during the winter of 1997-98 to insure that winterkill did not occur. The compressed air system was installed in the summer of 1998. The aeration system was purchased by the Sportsman's Club, and consists of three ¾ hp compressors and six air lines. The Sportsman's Club pays the operating costs, but most years DNR personnel put up the barricade. There has been no recorded winterkill since the initiation of aeration. A 1998 fisheries survey found that largemouth bass, northern pike, bluegills and pumpkinseeds were all present in sufficient numbers that good populations should develop in the absence of winterkill conditions (Cornelius 1998).

Camelia Lake – Polk County

Camelia Lake is a 60 acre lake located in the Village of Clayton in southeast Polk County. The lake has a maximum depth of six ft and a mean depth of four ft. The lake is eutrophic, with heavy summer algae blooms. Due to frequent severe winterkills, the fish population was poor, consisting of small black crappies *Pomoxis nigromaculatus*, black bullheads *Ictalusus melas,* and fathead minnows *Pimephales promelas*.

In the mid 1980s, the Village expressed interest in developing a project with the DNR to create a desirable fish population in Camelia Lake. In January of 1986, the lake was treated with rotenone to remove the undesirable fish population. Two ½ hp air compressors were installed

and started operating in the late fall of 1986. An additional ½ hp air compressor was installed in 1992.

Success of aeration was variable. Adequate dissolved oxygen levels were maintained during "normal" winters, but in severe winters, winterkill occurred. In 2000, the Village added a 2 hp aspirating aerator, and no winterkill has occurred since then. In 2005-2006, the Village may attempt running only the aspirating aerator to prevent winterkill. A likely improving fish population of northern pike, largemouth bass and panfish is present, based on anecdotal evidence of improved angling success and increased fishing pressure.

Chain Lake – Barron County

Chain Lake is a 107 acre lake located in the northeastern Barron County. The lake has three basins, two north of County highway V, and one south of County highway V. The lake has a maximum depth of nineteen ft and a mean depth of seven ft. The lake contains largemouth bass, northern pike and panfish, but has a history of periodic severe winterkills.

In 1992, the DNR and Barron County cooperated on a project to install a compressed air system in the south two basins of Chain Lake. Three ½ hp air compressors were installed, with four air lines going north of County highway V and two south of County highway V through the road culvert. There was no winterkill following aeration until the winter of 2003-04, when a serious winterkill occurred in the basin north of County highway V. Following the winterkill, the three ½ hp air compressors were replaced with three 1 hp air compressors, which will hopefully prevent future winterkills. Maintenance and electricity costs are the responsibility of lakeshore property owners, with contributions from the Brill Sportsmen's Club. A 2000 fisheries

survey found good largemouth bass and northern pike populations in terms of density and size distribution (Cornelius 2000a). However, the 2003-04 winterkill almost certainly had a significant adverse impact on the fish population.

Coon Lake – Polk County

Coon Lake is a 54 acre lake located in the Village of Frederic in northwest Polk County. The lake has a maximum depth of sixteen ft and a mean depth of ten ft. The lake is subject to widely fluctuating water levels. Coon Lake has a history of periodic serious winterkills, particularly during low water levels. In 1968 the Village installed two "Fresh-Flo" aerators, but winterkills continued. A 1979 electrofishing survey found one northern pike, several bluegills and crappies, and abundant bullheads. Coon Lake was treated with rotenone in the fall of 1980 to eliminate the bullhead population. In the summer of 1981 a compressed air system was installed consisting of two ½ hp air compressors and four air lines. Since the installation of this system, there have been two partial winterkills, in 1988-89 and in 1996-97. These winterkills occurred during low water levels. In spite of the two winterkills, a 2000 fisheries survey showed that largemouth bass and bluegill populations were re-established, and the overall fish population was improved compared to before aeration (Cornelius 2000b). The Village maintains and operates the aeration system.

Desair Lake – Barron County

Desair Lake is an 81 acre lake located in north central Barron County. The lake has a maximum depth of thirty three ft and a mean depth of seventeen ft. The lake has fluctuating water levels and is subject to heavy summer and fall algae blooms. The lake had a fairly desirable fish population of largemouth bass, northern pike and panfish until two consecutive

years of severe winterkill in 1995-96 and 1996-97. In a cooperative effort between the Lake Association, Barron County and the DNR, a compressed air system was installed and started operating in December, 1999. The system consists of three ¾ hp air compressors and six air lines. There has been no winterkill since the aeration system started operating. The Lake Association pays maintenance and electricity costs, while the DNR personnel have been putting up the barricade. A 1999-2000 fisheries survey indicated that the largemouth bass and bluegill populations which were severely impacted by the two winterkills were well on their way to recovery (Cornelius 2000c).

Diamond Lake – Polk County

Diamond Lake is a 126 acre seepage lake located north of the Village of Frederic in Polk County. The lake has a maximum depth of fifteen ft, and much of the lake is less than ten ft deep. A 1995 fisheries survey found fair populations of largemouth bass and northern pike, and good populations of bluegills and pumpkinseeds (Cornelius 1995b). Diamond Lake has a history of occasional partial winterkills. A lakeshore resident operated a surface aerator for years, but the benefits were likely insignificant. In the fall of 1995 a compressed air system was installed consisting of one ½ hp air compressor with two air lines. The system was considered underpowered for a 126 acre lake, but financial constraints precluded a larger system (one landowner was paying all electrical and maintenance costs). A partial winterkill occurred in the winter of 1995-96, and low dissolved oxygen was found during the winter of 1996-97, but no dead fish were reported. Since 1996, no winterkill has been documented.

East (Lotus) Lake – Polk County

East (Lotus) Lake is a 246 acre lake located in western Polk County near the Village of Dresser. The lake is shallow, with a maximum depth of fifteen ft and a mean depth of seven ft. The water is somewhat turbid due to carp *Cyprinus carpio* and bullhead activity, and heavy summer algae blooms can occur. East Lake has a long history of fish winterkill. A 2000 fisheries survey found a poor fish population dominated by carp and bullheads, with low numbers of northern pike and small panfish (Cornelius 2000d). The Polk County Sportsmen's Club was interested in an aeration project for East Lake, and donated funds for an aeration system. A compressed air system consisting of two ¾ hp air compressors with four air lines was installed in 2004. The system is now in its second winter of operation, and to date dissolved oxygen levels have remained well above 2.0 ppm. The Osceola Rod and Gun Club have been paying the electrical costs, while DNR personnel have been putting up the barricade.

Ice House Lake - Polk County

Ice House Lake is a six acre seepage lake located in the Village Park at Clear Lake in southeast Polk County. The lake has a maximum depth of thirty five ft and a mean depth of fourteen ft. Ice House Lake has been managed as a trout lake for many years. In 1986 the lake was chemically treated with rotenone to remove non-trout species. The lake had periodic low winter dissolved oxygen levels, which some years prevented trout from surviving over the winter. In 1987 a compressed air system was installed which consisted of one ½ hp air compressor and two air lines. This system prevented trout winterkill, but Ice House Lake still produced very few larger trout. It was surmised that a very large percentage of the stocked trout population was harvested each summer, so that winter aeration was not significantly improving the fishery. Aeration was discontinued after about four years of operation.

Kirby Lake – Barron County

Kirby Lake is a 92 acre seepage lake located in northwest Barron County. The lake has a maximum depth of 19 ft and a mean depth of eight ft. Water levels can fluctuate several ft over time. Occasional partial winterkills adversely affected the sport fish population of largemouth bass, northern pike and panfish. In 1988, a compressed air system was installed by Barron County with technical assistance and partial funding from the DNR. Two ½ hp air compressors and four air lines installed. The Lake District is responsible for operation and maintenance of the aeration system. Since the initiation of aeration, winterkill has been minimal. A partial winterkill of panfish occurred in 1992, the only documented case of winterkill. A 1995 fisheries survey found good populations of largemouth bass and northern pike (Cornelius 1995c). Bluegill and crappie populations had excellent size distributions.

Largon Lake – Polk County

Largon Lake is a 129 acre seepage lake located in northern Polk County. The lake has a maximum depth of ten ft and a mean depth of six ft. Heavy summer algae blooms are common. Prior to 1977, Largon Lake had frequent partial winterkills, and the fish population was composed mainly of a small northern pike population and a large bullhead population. The Largon Lake District was interested in improving the sport fish population, and funded and helped design the first compressed air aeration system to be installed in the area. Largon Lake was treated with rotenone during the winter of 1976-77 to remove the large bullhead population. The aeration system was installed in 1977 and consisted of four ½ hp air compressors with eight air lines. Ceramic diffusers with micropores were placed at the ends of the air lines to increase the efficiency of the aeration system. The ceramic filters proved to be a maintenance problem, as

the micropores would clog up every few years and require cleaning. Because of this, diffusers were not installed on subsequent systems, replaced by several 1/8 in holes drilled in the last several feet of capped air line. The Lake District is responsible for operation and maintenance of the aeration system. There has been no recorded winterkill in Largon Lake since the aeration system was installed 28 years ago. A 2003 fisheries survey indicated a quality northern pike population existed in Largon Lake (Benike 2004).

Little Butternut Lake – Polk County

Little Butternut Lake is a 189 acre lake located one mile west of the Village of Luck in northwest Polk County. The lake has a maximum depth of twenty three ft and a mean depth of eight ft. Butternut Creek runs through the lake. The sport fish population consists of northern pike, largemouth bass, walleye, and panfish. Little Butternut Lake has a history of occasional partial winterkills. In 1998 the Polk County Sportsmen's Club funded a compressed air system consisting of four ¾ hp air compressors with eight air lines. The aeration system, which is operated by the Sportsmen's Club and lakeshore property owners, has operated most but not all winters since its installation. No winterkill has been recorded since the aeration system was installed.

McKeith Lake – Polk County

McKeith Lake is a 72 acre landlocked seepage lake located near the Village of Cushing in western Polk County. The lake has two basins which are similar in size, one with a maximum depth of fifteen ft and the other with a maximum depth of five ft. The lake has a history of frequent severe winterkill, with fathead minnows being the main fish species present. A development company purchased considerable shoreline on McKeith Lake, which was then

plotted into building sites. The company wished to develop a desirable sport fish population in the lake, and in 1998 installed two ¾ hp air compressors with four air lines in the deeper of the two basins. No winterkill has been documented since the initiation of aeration, although dissolved oxygen levels dropped as low as 1.0 ppm throughout the water column during the winter of 2000-2001. Lakeshore property owners have been operating the aeration system.

Moon Lake – Barron County

Moon Lake is an 84 acre landlocked seepage lake located in a residential area on the south edge of the City of Rice Lake. The lake has a maximum depth of about five ft. Moon Lake has a history of frequent partial winterkills and a 1988 fisheries survey found a moderate number of northern pike, one largemouth bass, small bluegills and abundant bullheads (Cornelius 1993a). In 2001 several lakeshore property owners installed one 2 hp aspirating aerator in the lake. No winterkill has occurred since the installation of the aerator. Lakeshore property owners report that the fish population is improving.

Prairie Lake – Barron County

Prairie Lake is an elongate 1,534 acre impoundment which is part of the 3,764 acre Chetek Lakes Chain. The lake has a maximum depth of sixteen ft and a mean depth of nine ft. There is one small inlet that enters the north end of the lake. The lake is eutrophic, and heavy summer algae blooms are common. The lake has a high quality sport fish population of largemouth bass, northern pike, walleye, and panfish. Occasional partial winterkills consisting primarily of panfish but with some gamefish were a problem in the northern one-half of the lake. These winterkills were a considerable concern to the public, as Prairie Lake is a very popular fishing lake. In 1991 an aspirating aeration system was installed at Veterans Memorial Park, a county-

owned park near the north end of the lake. The aeration system consisted of six 3 hp aspirating aerators, with their shafts directed southward down the length of the lake. It soon became apparent that the continuous winter operation of all six aerators was unnecessary to maintain adequate dissolved oxygen levels. Now only four aerators are installed each winter. Dissolved oxygen levels are monitored several times per month, and from one to four aerators are operated as necessary. There has been no recorded winterkill since the aerators have been operating.

One problem that was encountered was that the aerators were top-heavy, and several have capsized during windy weather. Additional floatation helped solve this problem.

The DNR funded the initial cost of the aeration system. A maintenance agreement was signed with six units of government; Barron County, City of Chetek, and four townships. Therefore, electricity costs, which usually run from $1,000 to $1,500 per year are split six ways. DNR personnel install and remove the aerators and install the open water barricade, and the Lake Association removes the barricades. Prairie Lake continues to have a very desirable, well balanced fish population. A 2001 fisheries survey found moderate populations of walleyes, largemouth bass, and northern pike with good size distribution (Cornelius 2001). Bluegills and crappie populations also had very good size distributions.

South Twin Lake – Polk County

South Twin Lake is a 74 acre lake located in the City of Amery in southern Polk County. The lake has a maximum depth of nine ft and an average depth of five ft. The lake contains largemouth bass, northern pike and panfish. Severe winterkills were documented in 1956, 1975 and 1979, and likely occurred other years. In the fall of 1989 a compressed air system was installed by the Amery Lake District. The system consists of two 1/3 hp air compressors with

two air lines. Although the system is probably underpowered for a 74 acre lake, no winterkill occurred until January of 2001, when dissolved oxygen levels were low and some dead fish were observed. This was the only documented winterkill since the aeration system was installed. The Lake District operates and maintains the system. A 1993 fisheries survey found that moderate largemouth bass and northern pike populations were developing, and that an abundant, slow-growing bluegill population was also developing (Cornelius 1993b).

Staples Lake – Barron County

Staples Lake is located on the Barron-Polk County border. The lake is 304 acres, has a maximum depth of seventeen ft, and a mean depth of ten ft. The lake is highly euthropic and experiences heavy algae blooms during the summer and fall. Historically, Staples Lake has had a very high quality sport fish population consisting of walleye, largemouth bass, northern pike and panfish. The only recorded winterkills were in the 1930s until February of 1977, when a combination of low water levels and severe winter weather caused dissolved oxygen levels to drop below 2.0 ppm. Emergency aeration was attempted using a crisafoli pump powered by a power take-off tractor. Water was pumped from the lake through a large hose and then run down a baffle to oxygenate the water returning to the lake. Dissolved oxygen levels remained constant for about a week, and then the tractor quit and could not be restarted in twenty degree below zero temperatures. Fish started dying the next day, and a severe winterkill occurred. An unbalanced fish population developed, dominated by black bullhead and black crappie, and gamefish stocking was ineffective. Therefore, during the springs of 1984 and 1985, fyke nets were used to remove nearly three-fourths of the bullhead population, and crappies were removed to the point that catch per effort was reduced about 30% (Cornelius 1989). With additional stocking, a good

quality fish population was restored, and a 1993 fisheries survey concluded that recovery from the 1977 winterkill was complete (Cornelius 1993c).

From 1978 to 1999 no winterkill occurred, but dissolved oxygen levels dropped dangerously low during two winters. In 1999 the DNR and the Staples Lake District cooperated on an aeration project. Four 2 hp aspirating aerators were purchased by the DNR, with the Lake District paying the electrical costs of operation. Annual installation and removal of the aerators and barricade has been done mainly by DNR personnel. Dissolved oxygen levels have been very good since the aeration system has been operating.

Vincent Lake – Polk County

Vincent Lake is a 70 acre landlocked lake with a maximum depth of fifteen ft and a mean depth of nine ft. The lake is separated into two basins by a narrow channel, with the south basin being the largest. The lake is subject to considerable water level fluctuations. Vincent Lake contains largemouth bass, northern pike and panfish, and frequent severe winterkills have prevented the establishment of a desirable sport fish population. In the fall of 1993 several landowners, with technical advice from DNR, installed two ½ hp air compressors and four air lines in the south basin. Partial winterkills occurred during the winters of 1995-96 and 1996-97 even with the aerators operating. In the fall of 1997 an additional air compressor with two air lines was installed in the south basin. There has been no recorded winterkill in the south basin since the addition of the third air compressor. Lakeshore property owners operate and maintain the system. A 1999 fisheries survey found increasing populations of largemouth bass, northern pike, and bluegills, and the presence of some stocked walleyes (Cornelius 1999).

Summary

Aeration of winterkill lakes has been a useful management tool in Barron and Polk Counties. It is an affordable method of improving fish habitat in small to mid-sized lakes, and can have significant positive results. Aeration is highly visible management that anglers and lakeshore property owners can see taking place. Aeration projects are ideal for partnerships between the public and the DNR.

During 2005-2006 seventeen lakes totaling over 3,000 acres (range 54 – 1,534 acres) had managed aeration projects. In Barron and Polk Counties, aeration protects valuable high quality fisheries in Prairie Lake and Staples Lake, and has helped to maintain good quality fisheries in Kirby Lake, Antler Lake, Diamond Lake, and Little Butternut Lake. Aeration has allowed good quality fisheries to develop from poor quality fisheries in Largon Lake and Coon Lake. Fish populations are improving on Desair Lake, Moon Lake, Bass Lake, Camelia Lake, South Twin Lake, Chain Lake, and Vincent Lake due to aeration. The status of the fish population in McKeith Lake is unknown, and East Lake is only in its second year of operation. Of the eighteen aerated lakes, aeration has clearly been of little or no benefit in only Ice House Lake, and that was because occasional winterkill was not the primary limiting factor to the fish population.

The seventeen active aeration projects in Barron and Polk Counties are a significant workload for fisheries management personnel. In the previous four winters (2002-2003 through 2005-2006) WDNR staff has invested from 200 to 600 man-hours into aeration projects each year. Much of the workload takes place during the late fall and winter, a slower time of the year for field work. However, the removal of aspirating aerators and barricades occurs during ice-out in late winter and spring, and can conflict with fyke netting and other fish survey activities. No

additional aeration projects are foreseen in the near future, but as smaller, shallow lakes become developed, public interest in more aeration projects is possible. Fish management personnel will have to look at each new potential project and evaluate how it fits into the overall fisheries program, and to what extent fish management would be involved.

Acknowledgements

Retired fisheries technician Jerry Perkins was involved with the installation and operation of many of the aeration systems, and in particular helped develop installation techniques for the earliest systems. Retired fisheries technician Gary Lund and fisheries technician Todd Brecka also were involved with the installation of many of the aeration systems. Fisheries supervisor Tom Beard gave strong support to the aeration program. It should be noted that without partners from the public, none of the aeration projects would have occurred. Thanks to fisheries supervisor Terry Margenau for reviewing this report and to Kim Dahlberg for typing it.

Literature Cited

Benike, H. M. 2004. Evaluation of a 32 inch minimum length limit for northern pike, Largon Lake, Polk County, WI. Wisconsin Department of Natural Resources unpublished survey report. Barron field office.

Cornelius, R.R. 1989. Mechanical removal of bullhead and black crappie along with gamefish stocking, Staples Lake, Barron County, 1977-1986. Wisconsin Department of Natural Resources Fish Management Report 1414. 11pp.

Cornelius, R.R. 1993a. Fish survey, Moon Lake, Barron County, WI. Wisconsin Department of Natural Resources unpublished survey report. Barron field office.

Cornelius, R.R. 1993b. Fish survey, South Twin Lake, Polk County, WI. Wisconsin Department of Natural Resources unpublished survey report. Barron field office.

Cornelius, R.R. 1993c. Fish survey, Staples Lake, Barron County, WI. Wisconsin Department of Natural Resources unpublished survey report. Barron field office.

Cornelius, R.R. 1995a. Fish survey, Antler Lake, Polk County, WI. Wisconsin Department of Natural Resources unpublished survey report. Barron field office.

Cornelius, R.R. 1995b. Fish survey, Diamond Lake, Polk County, WI. Wisconsin Department of Natural Resources unpublished survey report. Barron field office.

Cornelius, R.R. 1995c. Fish survey, Kirby Lake, Barron County, WI. Wisconsin Department of Natural Resources unpublished survey report. Barron field office.

Cornelius, R.R. 1998. Fish survey, Bass Lake, Polk County, WI. Wisconsin Department of Natural Resources unpublished survey report. Barron field office.

Cornelius, R.R. 1999. Fish survey, Vincent Lake, Polk County, WI. Wisconsin Department of Natural Resources unpublished survey report. Barron field office.

Cornelius, R.R. 2000a. Fish survey, Chain Lake, Barron County, WI. Wisconsin Department of Natural Resources unpublished survey report. Barron field office.

Cornelius, R.R. 2000b. Fish survey, Coon Lake, Polk County, WI. Wisconsin Department of Natural Resources unpublished survey report. Barron field office.

Cornelius, R.R. 2000c. Fish survey, Desair Lake, Barron County, WI. Wisconsin Department of Natural Resources unpublished survey report. Barron field office.

Cornelius, R. R. 2000d. Fish survey, East (Lotus) Lake, Polk County, WI. Wisconsin Department of Natural Resources unpublished survey report. Barron field office.

Cornelius, R.R. 2001. Fish survey, Pokegama Lake and Prairie Lake as representative samples of the Chetek Chain, Barron County, WI. Wisconsin Department of Natural Resources unpublished survey report. Barron field office.

Table 1. Barron and Polk County lakes with aeration systems. Year indicates the year aeration system was installed. All systems were active in 2005-2006, except Ice House Lake.

County Lake	Acres	Maximum Depth (ft)	Mean Depth (ft)	Year	Type
Barron					
Chain	107	19	7	1992	3 - ½ hp Air Compressors
Desair	81	33	17	1999	3 - ¾ hp Air Compressors
Kirby	92	19	8	1988	2 - ½ hp Air Compressors
Moon	84	5		2001	1 - 2 hp Aspirating Aerator
Prairie	1,534	16	9	1991	6 - 3 hp Aspirating Aerator
Staples	304	17	10	1999	4 - 2 hp Aspirating Aerator
Polk					
Antler	101	22	9	1988	3 - ½ hp Air Compressors
Bass	138	19	6	1998	3 - ¾ hp Air Compressors
Camelia	60	6	4	1986	3 - ½ hp Air Compressors 1 - 2 hp Aspirating Aerator
Coon	54	16	10	1981	2 - ½ hp Air Compressors
Diamond	126	15		1995	1 - ½ hp Air Compressor
East (Lotus)	246	15	7	2004	2 - ¾ hp Air Compressors
Ice House	6	35	14	1987	1 - ½ hp Air Compressor
Largon	129	10	6	1977	4 - ½ hp Air Compressors
Little Butternut	189	23	8	1998	4 - ¾ hp Air Compressors
McKeith	72	15		1998	2 - ¾ hp Air Compressors
South Twin	74	9	5	1989	2 - ⅓ hp Air Compressors
Vincent	70	15	9	1993	3 - ½ hp Air Compressors

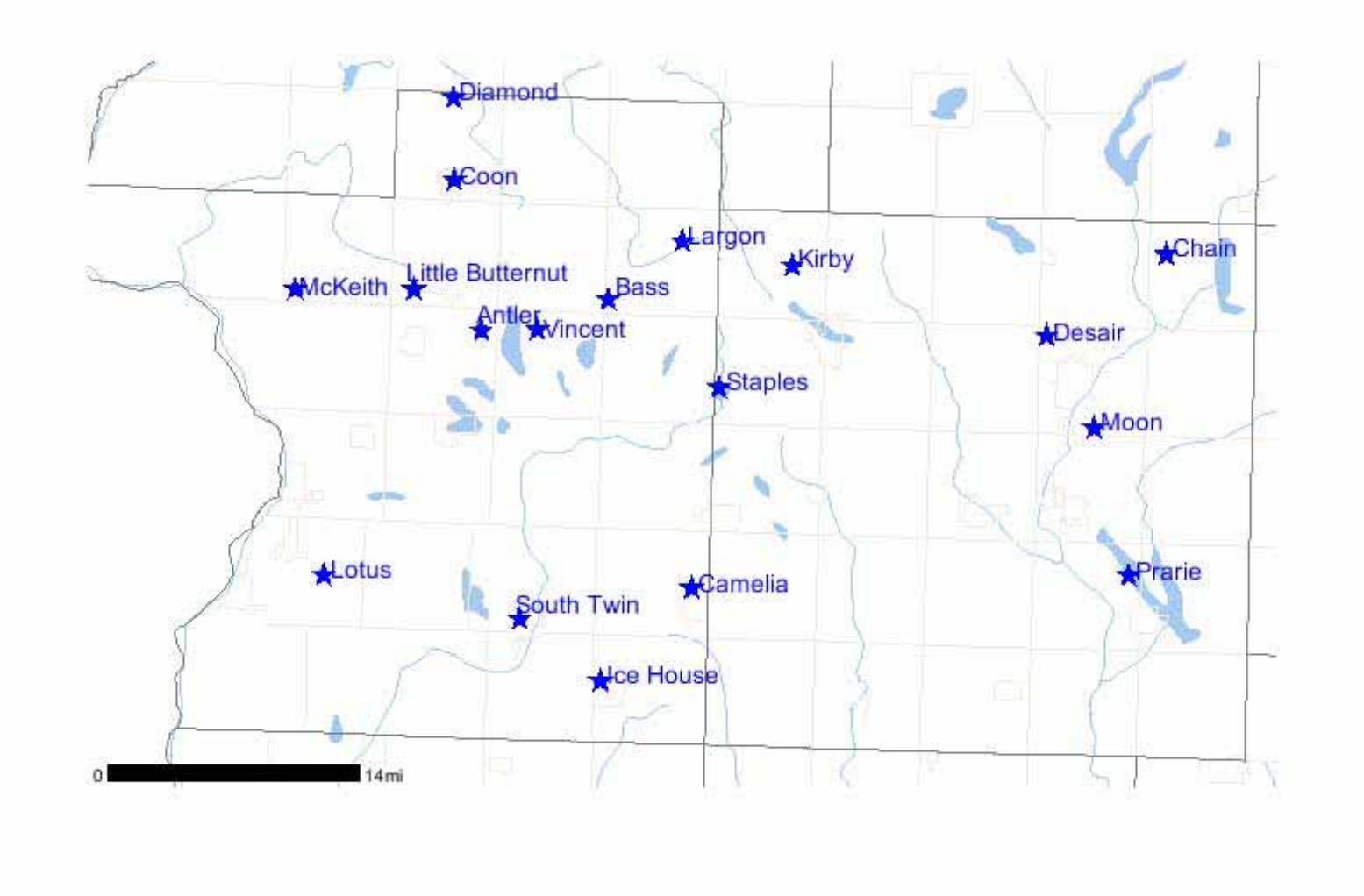

Figure 1. Barron and Polk County lake aeration projects, 1977 – 2005.

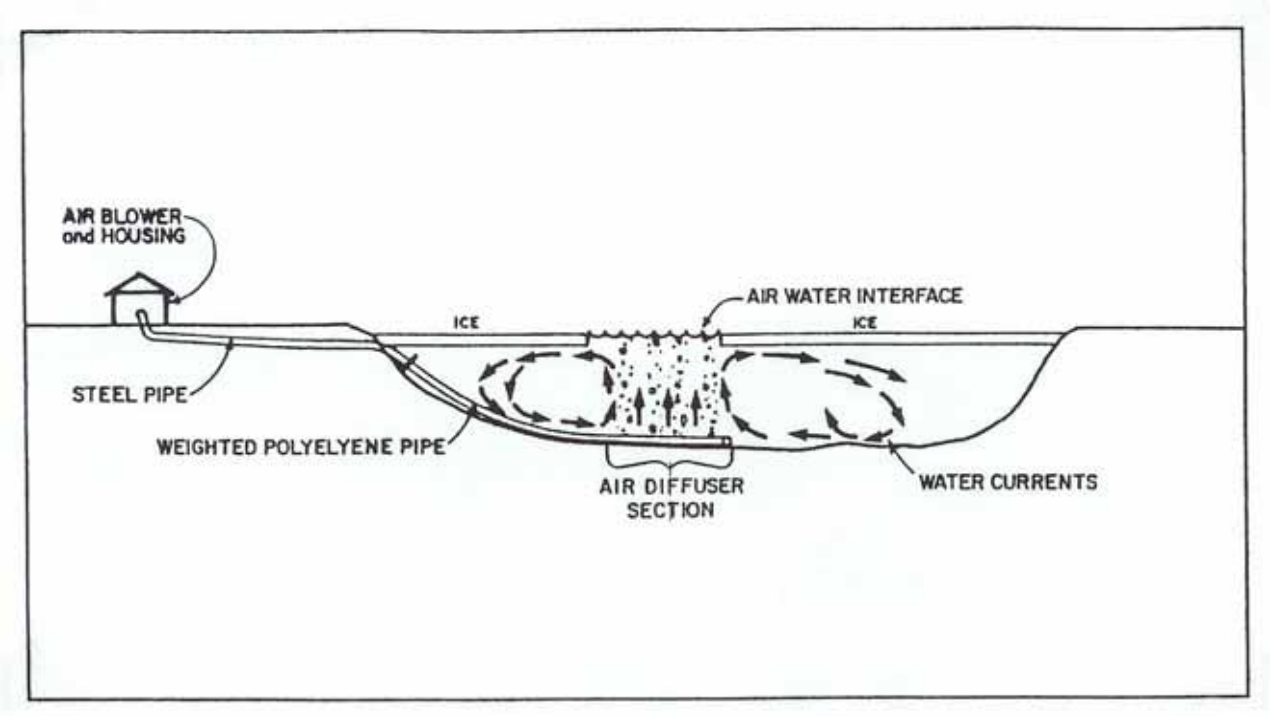

Figure 2. Compressed air aeration system.

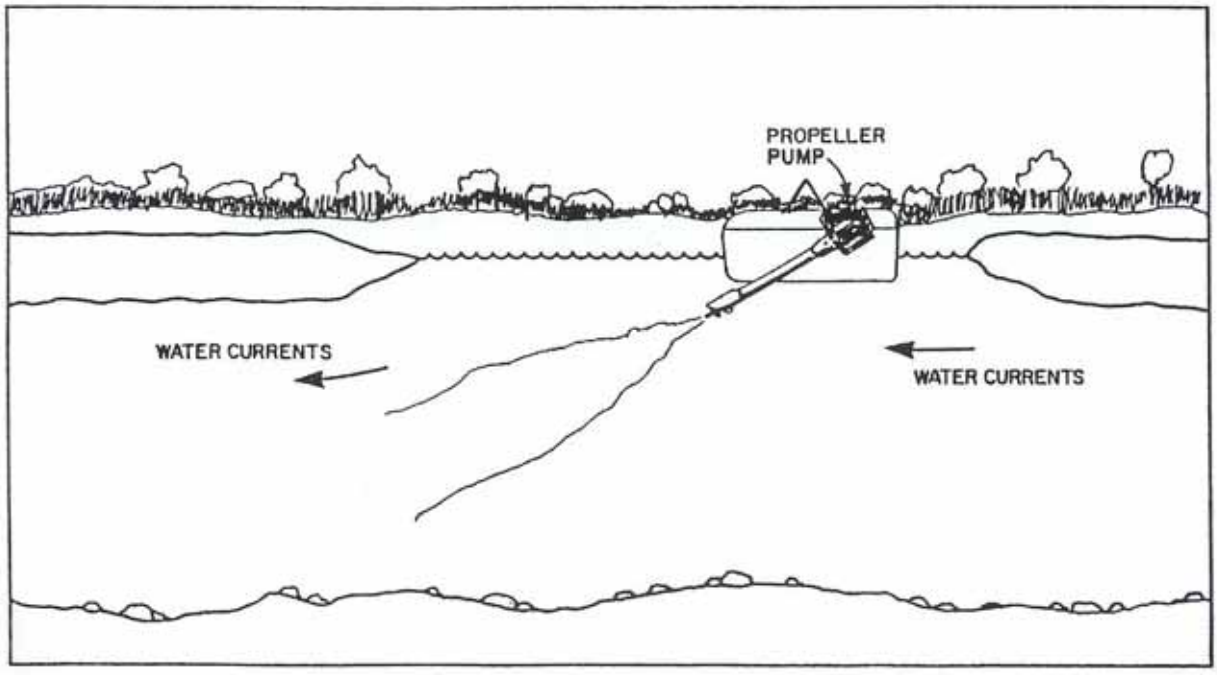

Figure 3. Surface aspirating aeration system.

Appendix Table 1. Aeration barrier fence vendors and materials.

Fiberglass Fence Posts/clips

Supplier: K- Fence
RR1 Box 195
Zumbro Falls, MN 55991
507/753-2943

Materials: 5/8 in diameter posts, 5 ft length
Cost - posts – approx. $3.40 each
Clips – approx. $7.25/25 clips

Floats

Supplier: Carlon Products Co.
800/243-6682

Materials: Model #SB-6 float approx. 3 in X 3 in with ½ in hole. One float/post. Double float every 5th post for extra buoyancy.
Cost – approx. $0.66/float

Rope

Supplier: Nylon Net Company
845 N. Main, P. O. Box 592
Memphis, TN
901/526-6500

Materials: Black polypropylene ½ in rope (600 ft role). Stock # 42167
Cost – approx. $44.96/role

Reflective tape and reflective markers

Supplier: Rent-A-Flash
13605 Stettin Drive
Marathon, WI 54448
715/472-7446 WI order dept. 800/472-7446

Materials: Tape – 6 in X 50 yd 1484 Orange
Cost – approx. $125.00

Reflective Trail Blazes, Model # CX TB-6 (Cut trail blazes in half, punch hole in one end for zip typing to the rope between post.)

Appendix Table 1 (continued).

Marker Signs

Supplier: Local lumber yards, Menards, etc.

Materials: 12 in X 8 in sheet of ¼ in peg board or other suitable lightweight material. Black spray paint. Paint signs black and zip tie to the top of every 5th post to provide contrast and daytime visibility. Need enough zip ties to connect the rope to each post, marker signs to the top and reflective markers between each post.