

Title: Comprehensive Survey of Bullhead Lake (MWBC 68300), Manitowoc County

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Dates of Field Work: June 1998 through September 1999

Survey Purpose: Determine the status of the fish community of Bullhead Lake in Manitowoc County by the use of a comprehensive fisheries survey and contact creel survey.

Background on Bullhead Lake:

Bullhead Lake is a seepage lake located in western Manitowoc County. The lake has a surface area of 67 acres, a maximum depth of 40 feet and a shoreline development factor of 1.07. The lake has one basin with an adjoining cattail wetland. The lake bottom consists of muck, sand and gravel and the water is considered hard. Bullhead Lake is surrounded by agricultural land with an increasing number of year round residences being built. A public access is present on the western side of the lake.

A 1955 survey found the lake to be in poor condition dominated by “extremely thin” black crappie and common carp. Further the survey findings found that the lake was lacking predators and was out of balance. The fish population was chemically eradicated with a fish suffocant in 1957 and restocked with largemouth bass, muskellunge, bluegill and yellow perch. Dead fish were observed on Bullhead Lake after the winters of 1960, 1962 and 1964. Restocking efforts included muskellunge, largemouth bass and walleye. Later fisheries surveys found the lake to contain a more balanced population of game and panfish. An alum sulphate treatment was conducted in the fall of 1978 and 1988 to reduce dissolved phosphorus levels in the lake.

Findings of the 1998 – 1999 Survey:

The fisheries survey found that Bullhead Lake is predominantly a largemouth bass and bluegill lake. The survey indicates that the lake contains a good mix of game and panfish. Forage minnows appear to be lacking or absent from the population.

Largemouth bass numbers appear to be high. The majority of those bass are below the current 14-inch size limit, although the population is growing near State of Wisconsin averages. The blossoming largemouth population should benefit Bullhead Lake for many years to come. The average largemouth bass harvested during the summer of 1999 was 14.8 inches.

The walleye population is very small. Fisheries Management and other interested parties should consider the cost to benefit ratio of the walleye stocking efforts on this lake.

Northern pike were found in low numbers and there is evidence that a small year class of natural reproduced fish is present in the lake.

The bluegill population is healthy, but under high pressure from both anglers harvesting adults and largemouth bass preying on young fish. The fisheries survey and the creel survey suggests that angling pressure is modifying the bluegill population size structure by removing larger individuals. The bluegill fishery that is occurring in Bullhead Lake is providing many hours of enjoyment for the local sportfishing community. Fisheries Management and other interested parties should consider the possibility of protecting this population with more restrictive harvest limits.

Black crappie were once a major component of the Bullhead Lake population. The comprehensive fisheries survey found only weak year classes of black crappie in the population. The creel survey further found that black crappie was a minor component of the fishery. It is unclear why black crappie numbers are reduced from former levels. A combination of environmental factors and predation is likely causing poor black crappie recruitment.

The fisheries survey found very low yellow perch numbers and the creel survey further found that anglers are catching and harvesting very few perch. A combination of environmental factors, predation and angler harvest is likely causing poor yellow perch recruitment.

The creel survey found that sport anglers are using the lake at a rate of 190 hours per acre. Those who are using the lake are most likely to reside in Manitowoc or Calumet Counties. Most anglers traveled to Bullhead Lake for the opportunity to catch bluegill and largemouth bass. Very few individuals were found to be targeting other sportfish.

Bullhead Lake is a real asset to the community and is one of the highest quality water bodies in the area. Preservation of habitat should be a management priority. Further, water quality protection (point source and non-point source) is essential to the stability of the lake.

It is unclear what new regulation could be enacted to improve the panfish size structure. Some alternative regulations, which have been enacted in other Wisconsin lakes, include reduced bag limit, size restrictions, window closures or creation of refugia. However, any new proposed regulation must take into account the high angling pressure that is occurring on the lake.

Bullhead Lake is a community issue and must be viewed as such. The surrounding lakes do not appear to receive as high an amount of recreational angling pressure as that observed on Bullhead Lake. Fisheries Management and other interested parties should consider the possibility of enacting more restrictive regulations on Bullhead Lake and surrounding lakes while aggressively

addressing the environmental impediments that are preventing these lakes from reaching their potential. Redistribution of angling effort must be a priority in the management of Bullhead Lake.

Introduction

Bullhead Lake (WBIC-00168300) is a one-basin 67 acre seepage lake located in western Manitowoc County. Its maximum depth is 40 feet, its circumference measures 6705.6 feet and it has a shoreline development factor of 1.07 (Figure 1). The water is considered hard and the bottom substrate is muck or sand and gravel. The lake has public access on its west side. The watershed is mostly agriculture land with an increasing number of year round residences being constructed.

Cline conducted a barge seine survey in 1955 on Bullhead Lake and captured nine fish species: pumpkin seed, green sunfish, black crappie, yellow perch, common carp, brown bullhead, white sucker, golden shiner and northern pike (Cline 1957). The survey found abundant numbers of “extremely thin” black crappie measuring five to seven and one half inches in length and “jumbo” common carp. Largemouth bass and bluegill were found to be absent. Survey findings found the lake to be lacking predators and out of balance. The lake was stocked with 3,191 fingerlings largemouth bass in 1956.

Fisheries Management chemically eradicated the fish population of Bullhead Lake with a fish suffocant, Toxaphene on August 2, 1957. An estimated 22,500 pounds of fish were removed from the lake. The most commonly encountered species were black crappie which represented 72 percent of the kill by number. The second most encountered species was bullhead spp., which was 11 percent of the kill by number. Other species encountered were common carp pumpkinseed, green sunfish yellow perch, white sucker, bluntnose minnow, central mudminnow, and golden shiner. These other species represented 17 percent of the kill by number. Further, Cline reported finding 39 northern pike ranging in length between 18 and 35 inches and ten largemouth bass ranging between 5 and 9 inches. Bluegill were absent. The restocking included largemouth bass, muskellunge, bluegill and yellow perch.

Schultz conducted a barge seine and electrical shocking surveys in 1962 and 1964 (Schultz 1963). The surveys found largemouth bass, muskellunge, bluegill and yellow perch. Schultz remarked that it was gratifying to see that no species, except those stocked, were found. Bluegill were found to be small in size and yellow perch reproduction was poor. Further the report noted heavy fishing pressure on game species and a spring die-off of panfish in 1960 and 1962.

In the winter of 1964-65 a large winter-kill occurred on Bullhead Lake (Schultz 1966). Schultz reported finding dead muskellunge, largemouth bass and bluegill. Schultz restocked muskellunge fry and fingerling, largemouth bass adult and fingerling and walleye fry.

Schultz conducted a barge seine and electrical shocking surveys in 1965 and 1966. The survey showed a recovering stock of largemouth bass, good numbers of yellow perch and small walleye. Muskellunge and bluegill were found in low numbers. Further, the survey found green sunfish, black bullhead, black crappie and one common carp.

Belonger conducted an electrical shocking survey in 1976 and 1978 and found good numbers of walleye and black crappie along with lower numbers of largemouth bass and yellow perch (Belonger 1976). Muskellunge and bluegill were present in low numbers. Belonger noted poor over-winter survival of largemouth bass fingerlings.

Peeters sampled Bullhead Lake throughout the 1980's (Peeters data). Electrical shocking surveys found good numbers of largemouth bass, black crappie and yellow perch, and lower numbers of walleye, bluegill, green sunfish, bullhead spp. and white sucker.

Of special interest, Bullhead Lake was treated with alum sulphate on August 23, 1978 (WDNR Tech. Bul. 153) and October 8, 1988. The principle objective of the project was to lower nutrient levels by chemically binding phosphorus to the bottom sediments. The State of Wisconsin sponsored the first treatment and the Bullhead Lake Advancement Association sponsored the second treatment.

Methods

A comprehensive survey of Bullhead Lake began June 02, 1998 and continued through September 27, 1999. Sampling gear included boom electroshocking (DC pulse), mini-fyke net, standard-fyke net, and creel census.

On June 2, 1998 the lake was electroshocked at night around its circumference and all fish were netted, identified to species, measured to the nearest 1mm and had a scale removed for age determination.

On September 8, 1998 five mini-fyke nets were set in the lake (Figure 2) and fished for two nights each to capture young of year fish and other small fish. The mini-fyke nets were lifted each day, all fish were identified to species and a subsample of each species was measured to the nearest 1 mm.

On October 28, 1998, and November 04, 1998, the lake was electroshocked at night around its entire circumference. All fish were netted, fish were identified to species and measured to the nearest 1mm.

On April 05, 1999, five standard-fyke nets were set in the lake (Figure 2) to capture spring spawning fish. The nets were lifted on either one or two nights and were removed from the lake on April 16, 1999. Captured fish were identified to species, checked for previous fin clip, all first time captured fish were measured to the nearest 1mm, marked with partial caudal clip and a portion of the catch had scales removed for age determination.

On April 27, 1999, the lake was electroshocked at night around its circumference to recapture marked fish for population estimates. All fish were netted, fish were identified to species, examined for finclip, measured to the nearest 1mm and a portion of the catch had scales removed for age determination.

On May 25 and June 02, 1999 the lake was electroshocked at night around its circumference to characterize the panfish and largemouth bass population. All fish were netted, identified to species, measured to the nearest 1mm and a portion of the catch (centrarchids) had scales removed for age determination.

A contact creel census was also conducted on the lake following state guidelines. The random creel census effort began on January 01, 1999 and concluded on September 30, 1999. The lake was surveyed in a random stratified fashion, which covered all weekends and holidays and random weekdays, approximately four hours per day. The clerk interviewed anglers on the water or at the public access to determine hours of fishing effort, fish species harvest, and biological parameters.

Fisheries statistics generated for inclusion into this report include sample size, average length, length frequency by survey type, and age distribution. Baileys modification of the Peterson method was used to estimate community population size.

Results

Spring Electroshocking 1998

On June 2, 1998, the lake was electroshocked at night around its circumference and all fish were netted. Shocking was difficult due to heavy macrophytic plant growth in the littoral zone, especially in the northern half of the lake. Three species of fish were captured and a northern pike was observed (Table 1). A total of 233 fish were captured and the overall Catch Per Effort (CPE) was 183 fish per mile shocked (Table 2). Largemouth bass dominated the catch (71 percent) followed by bluegill and a brown bullhead.

The 165 largemouth bass ranged in size from 73 mm to 486 mm and averaged 266 mm in total length (Table 3). Adult fish dominated the catch, with all but 1 fish greater than 186 mm. Largemouth bass CPE was 130 per mile shocked.

A total of 67 bluegill were captured with an average length of 81 mm, they ranged in length from 32 mm to 206mm (Table 3). Most fish were less than 100 mm in length. Bluegill CPE was 53 per mile shocked.

One brown bullhead was captured which measured 268mm (Table 3).

Fall Mini-fyke Net 1998

On September 08, 1998, five mini-fyke nets with wings were deployed and fished for two nights or ten net nights (Figure 2). Six fish species were captured (Table 1). A total of 599 fish were captured, and the overall CPE was 60 fish per net night. Bluegill dominated the catch (84 percent) with substantially fewer largemouth bass, black crappie, green sunfish, pumpkinseed, and northern pike. Several snapping turtles and painted turtles were also captured.

The 502 Bluegill averaged 53 mm in length and ranged in from 25 mm to 112 mm in length (Table 4). Most bluegill were less than 90 mm in length and they had a CPE of 50 per net night.

Average length of other species captured include: 63 mm for largemouth bass, 89 mm for black crappie, 95 mm for green sunfish, 94 mm for pumpkinseed and a northern pike which measured 854 mm.

Fall Electroshocking 1998

On October 28 and November 04, 1998, the lake was electroshocked at night around its circumference, all fish were netted. Ten species of fish were captured (Table 1). A total of 901 individuals were captured, with a CPE of 355 fish per mile shocked (Table 2). Two species dominated the survey both nights, bluegill (46 percent of the catch) and largemouth bass (42 percent of the catch). Substantially fewer black crappie, yellow perch and other species were caught.

A total of 381 largemouth bass were captured which averaged 270 mm in total length and ranged from 56 mm to 519 mm in length (Table 5). The length frequency had several peaks which is an indication of several year classes of fish, dominated by those near 270 mm in length. Young of the year (YOY) largemouth bass were clearly present in the length frequency. The CPE of largemouth bass was 150 per mile shocked.

One northern pike was captured which measured 810 mm (Table 5).

Bluegill were the most commonly caught species with a total of 412 individuals captured (Table 6). They averaged 95 mm in total length and ranged in length from 22 mm to 241 mm. The length frequency had several peaks which is an indication of several year classes of fish. A clear dominant year class was not discernible, however, YOY bluegill were clearly present in the length frequency. Further, the length frequency shows a precipitous decline in bluegill greater than 170 mm in length. Bluegill CPE was 162 per mile shocked.

A total of 58 black crappie were captured. They averaged 120 mm in length and ranged in length from 52 mm to 250 mm (Table 6). The length frequency was

bimodal, an indication of multiple year classes of fish and YOY black crappie were clearly present in the length frequency. The length frequency shows a decline in black crappie greater than 160 mm in length. The CPE of black crappie was 23 per mile shocked.

The average length for other non-forage species include: 122 mm for yellow perch, 211 mm for yellow bullhead, 121 mm for pumpkinseed and 105 mm for green sunfish (Table 6). The average length for forage species include: 69 mm for mudminnow and a 174 mm white sucker was also encountered.

Spring Standard-fyke Net 1999

Five standard-fyke nets were deployed on April 05, 1999, and were fished for 11 nights or 55 net nights (Figure 2). Eleven species were captured (Table 1) totaling 432 individual fish or a CPE of 8 fish per net night (Table 2). Bluegill represented 60 percent of the total catch. Substantially fewer largemouth bass, walleye, northern pike, black crappie, pumpkinseed, yellow perch or bullhead spp. were encountered and an Iowa darter was observed.

Largemouth bass were the most commonly caught game species. The 30 largemouth bass averaged 303 mm in length and ranged from 160 mm to 510 mm in length (Table 7). This largemouth bass fyke net information should be viewed cautiously. Largemouth bass generally show avoidance to fyke nets.

A total of 29 walleye were captured (Table 7). They averaged 475 mm in length and ranged in length from 335 to 693 mm in length. Length frequency data seems to indicate small multiple year classes in the population. Further, the sampled population consisted of 23 males and 6 females. The CPE of walleye was 0.5 fish per net night.

The 8 northern pike averaged 671 mm in length and ranged in size from 476 mm to 815 mm in length (Table 7). Length frequency data seems to indicate small multiple year classes in the population. The sample population consisted of 7 females and one unknown sex northern pike. The CPE of northern pike was 0.1 fish per net night.

A total of 259 bluegill were captured (Table 8). They averaged 143 mm in length and ranged in size from 86 mm to 245 mm in length. The length frequency data indicates good year class strength of bluegill up to 170 mm in length and a precipitous decline in those greater than 170 mm. The CPE of bluegill was 5 fish per net night.

Black crappie and yellow perch were captured in substantially lower number, 41 individuals and 12 individuals respectively (Table 8). Black crappie averaged 177 mm in length and ranged in size from 124 mm to 345 mm in length. The length frequency data indicates small multiple year classes in the population. The CPE of black crappie was 0.7 fish per net night. Yellow perch averaged 178 mm and ranged in size from 135 mm to 269 mm in length. The length frequency data

indicates small multiple year classes in the population. The CPE of yellow perch was 0.2 fish per net night.

The average length for other species netted include: 133 mm for pumpkinseed, 193 mm for green sunfish, 282 mm for yellow bullhead, 255 mm for black bullhead, and 510 mm for white sucker (Table 8).

Spring Electroshocking

Recapture Effort.

On April 27, 1999 the lake was shocked at night around its circumference to look for marked fish, with all fish netted. Four species were captured (Table 1) totaling 234 individual fish or a CPE of 184 fish per mile shocked (Table 2). Largemouth bass dominated the catch representing 65 percent of the total catch. Fewer bluegill and substantially fewer walleye were also encountered.

Three walleye were captured, each of which was found to have a caudal finclip consistent with that given during the standard-fyke netting marking effort (Table 2). The Baileys modification of the Peterson population estimate, was 22 fish with a 95% confidence coefficient range of 9 to 55 individuals. These individuals were not measured and were caught at a CPE of 2 fish per mile shocked.

A total of 151 largemouth bass were captured with a CPE of 119 fish per mile shocked. (Table 2). A population estimate for largemouth bass was not calculated because no marked largemouth bass were captured. Largemouth bass averaged 278 mm in total length and ranged from 146 mm to 434 mm in length (Table 9). The length frequency indicates that several year classes of bass are present but most adults were found to be between 230 mm and 320 mm and dominated the catch.

A total of 72 bluegill were captured with a CPE of 57 fish per mile shocked (Table 2). A population estimate for bluegill was not calculated because no marked bluegill were captured. Bluegill were not measured during this shocking effort.

May and June Electroshocking

On April 25, 1999, and June 02, 1999, the lake was shocked at night around its circumference to capture centrarchids. Seven species (Table 1) totaling 536 individual fish were captured for a CPE of 211 fish per mile shocked (Table 2). Largemouth bass dominated the catch representing 63 percent of the catch. Fewer bluegill and substantially fewer black crappie, pumpkinseed, yellow perch, yellow bullhead, and mudminnow were also encountered.

A total of 335 largemouth bass were captured (Table 2). Largemouth bass averaged 277 mm in total length and ranged from 85 mm to 539 mm in length (Table 10). The length frequency indicates that several year classes of bass are present but most adults were found to be between 230 mm and 300 mm and

dominated the catch. The CPE of largemouth bass was 132 fish per mile shocked.

Bluegill were the most encountered panfish with a total of 183 individuals captured (Table 2). Bluegill averaged 129 mm in length and ranged from 50 mm to 235 mm in length (Table 10). The length frequency had a single peak, with few individuals less than 100 mm represented in the length frequency and few individuals greater than 160 mm represented in the length frequency. The CPE of bluegill was 72 fish per mile shocked.

A total of 9 black crappie were captured (Table 2). They averaged 164 mm in length and ranged in length from 150 mm to 182 mm (Table 10). The length frequency had a small single peaked population with most individuals under 170 mm in total length. The CPE of black crappie was 4 per mile shocked.

The average lengths for other species include: 160 mm for yellow perch, 274 mm for yellow bullhead, 134 mm for pumpkinseed and 84 mm for mudminnow (Table 10).

Aging

Scales for aging were collected from northern pike, largemouth bass, walleye, bluegill, black crappie, and yellow perch. Back calculated age analysis was then compared to the 1990 State of Wisconsin species averages (WDNR 1990).

The northern pike population had two year-classes, 2 and 4 years of age (Table 11). Back calculation analysis of 8 individuals indicates above average northern pike growth rates. Due to the small sample size this information should be viewed cautiously.

The largemouth bass population had nine year-classes ranging from age 1 through 8 and age 10 (Tables 11). Back calculation analysis of 235 individuals indicates near or above average largemouth bass growth rates.

Walleye age data in this report should be viewed cautiously, aging of older walleye by scale sample, as done in this survey, is often misleading. Four year-classes of walleye were found. Back calculation analysis of 29 individuals indicates near average growth, however young individuals up to age 3 appear to be growing below State of Wisconsin averages (Tables 11).

Bluegill ranged in age from 2 to 11 years (Table 11). Back calculation analysis on 201 individuals indicates near but below average growth up to age 8.

Black crappie ranged in age from 2 to 7 years (Table 11). Back calculation analysis of 46 individuals indicates below average growth up to age 3 and better than average growths beyond 3 years of age.

Twelve yellow perch were examined for age, they ranged from 3 to 7 years (Table 11). Back calculation analyses indicate that yellow perch grew at or above averages. Due to the small sample size this information should be viewed cautiously.

Comprehensive Fisheries Survey Discussion

The 1998/1999 comprehensive effort on Bullhead Lake was designed to fully characterize the fish population of the lake. Each gear type was chosen to efficiently capture certain fish species, at different sizes or was chosen for statistical comparison purposes to provide a clearer picture of the fish population contained in Bullhead Lake.

A total of 14 fish species (Table 1) or 2,932 fish were captured in the combined survey effort (Table 2). The most commonly encountered species were bluegill, which represented 51 percent of the catch by number. The second most encountered species was largemouth bass, which was 38 percent of the catch by number. Other species were far less common, black crappie represented 5 percent and walleye, yellow perch, pumpkinseed, green sunfish and yellow bullhead each represented 1 percent of the catch by number. Northern pike, central mudminnow, white sucker, black bullhead, brown bullhead, and iowa darter each made up less than 1 percent of the catch by number. No muskellunge or common carp were found in this survey.

Gamefish

Largemouth bass

Largemouth bass were found to be the dominant game species in the lake. Largemouth bass accounted for 97 percent of the gamefish encountered during the comprehensive effort. Length frequency for each gear type and scale age analysis indicates that one or two strong year-classes dominate the population. Length frequency data further suggest that recruitment is fair, however over winter survival of YOY is currently limited. It is likely that the poor survival is the result of predation.

Largemouth bass appear to grow well in this lake. At this time, the high predation pressure this population is placing on the lake should be considered beneficial, for example predation of small panfish lessens inter-species competition for food and improved panfish growth rates. Less predation on zooplankton grazers by panfish could improve water clarity by increased grazing on plant phytoplankton. The largemouth bass population should be monitored to ensure that the few dominant year classes are able to reach harvestable length before mortality occurs.

Walleye were rarely captured during the survey. A population estimate further suggested that the population is small, estimated at 22 individuals or 0.33

walleyes per acre. Length frequency data and scale age analysis indicates that small numbers from each stocking attempt were able to reach adulthood. Length frequency data didn't support the likelihood of natural reproduction within the lake basin. If present, it is extremely rare. Walleye appear to grow well once beyond three years of age.

Northern pike were found in low abundance. A population estimate was not calculable. Length frequency and scale analysis indicates that at least two year classes now exist in the lake. However, at this time recruitment appears to be very limited. Adult northern pike are growing well.

Panfish

Bluegill were found to be the dominant panfish and accounted for 86 percent of the panfish encountered during the comprehensive survey. A population estimate was not calculable, however on average, bluegill were encountered at a rate of 96 bluegill per mile shocked. Length frequency for each gear type indicates that recruitment is good, however over winter survival of YOY is limited. Scale age analysis indicates that the population is growing below State of Wisconsin averages but are showing respectable growth rates. The length frequency data shows that adult bluegill are largely absent from the population once they reach approximately 170 mm in length. Further, bluegill length at age data should be viewed cautiously, it is likely that angler harvest is removing larger individuals from each adult year class.

Black crappie were caught in low numbers and they accounted for 8 percent of the panfish catch. A population estimate was not calculable. Length frequencies for each gear type indicates that recruitment is fair, however over winter survival of YOY must be very limited. Further, the data suggests that adult black crappie are largely absent from the population once they reach approximately 170 mm in length. Black crappie in Bullhead Lake appear to be growing below the State of Wisconsin average, the establishment of forage minnows would likely aid in black crappie growth.

Yellow perch were rarely found and accounted for 2 percent of the panfish catch. A population estimate was not calculable. Length frequency and scale age analysis indicates that recruitment appears to be low and no discernible year-class is present in the population of adults beyond 150 mm in length. Yellow perch in Bullhead Lake appear to be growing above State of Wisconsin averages.

Other Panfish

Pumpkinseed and green sunfish combined accounted for 3 percent of the panfish catch. A population estimate was not calculable. Recruitment appears to be low.

Bullhead

Bullhead (brown, black, and yellow) were found in low numbers during the comprehensive effort. Combined, these species accounted for less than 1 percent of the total catch. A population estimate was not calculable. Recruitment appears to be low. The adults were quite large in size, with the largest measuring 369 mm in length.

Forage Species

Forage species are lacking in this lake. White sucker were found in low numbers. Length frequency data indicates that only adult fish were handled. A population estimate was not calculable. The white suckers, which were found in this survey, were likely the results of an angler "bait bucket" introduction. If reproduction is present it is extremely limited.

Central mudminnow were found in low numbers during the comprehensive survey. Its recruitment status is unknown. Length frequency data indicates that only adults were handled. A population estimate was not calculable. It is likely that this forage species is breeding in the wetland on the east side of the lake.

One iowa darter was observed during the comprehensive effort. It is likely that additional iowa darter would have been found if a small mesh seining survey would have been implemented. Their abundance is probably low.

Creel Census Survey

Winter Ice Angling, 1999

Fisheries Management did not conduct a statistical review of the ice creel census survey. It was found that very few anglers ice-fished Bullhead Lake and those individuals that did, caught very few fish. A hand tally of the data indicates that 40 angler were interviewed from January 1, 1999, through March ice out.

These anglers caught a total of nine fish, two of which were kept. Four of those were sub-legal northern pike, which were released, and the other five were black crappie.

The creel clerk asked interviewed parties their state and county of residence. All 40 individuals resided in Wisconsin (Table 12). Further, it was found that 15 percent resided in Brown County, 25 percent resided in Calumet County, 37.5 percent resided in Manitowoc County, 17.5 percent resided in Outagamie County, and 5 percent resided in Winnebago County.

Summer Open Water Angling, 1999

Recreational lake users were interviewed from May 1999, through September 1999. A total of 1,004 individuals or 489 parties were contacted. A total of 455 parties were found to be fishing from boats, 31 parties were fishing from the shoreline and 3 parties were recreational boaters, not fishing. Further, it was found that the majority of lake users were residents of Wisconsin (Table 12). The majority of which resided in Manitowoc County (55 percent) or Calumet County (20 percent). Residents of the Fox Valley accounted for 21 percent of lake users.

It is estimated that anglers spent a total of 12,766 hours fishing on Bullhead Lake. Anglers were asked what fish species they were pursuing (Table 13). Most individuals indicated that they were fishing for bluegill, other panfish or largemouth bass. Very few anglers were found to be fishing for walleye, northern pike, or muskellunge.

Gamefish

Largemouth bass

Anglers caught an estimated 7,187 largemouth bass from Bullhead Lake (Table 14). Of that total, only 136 fish were estimated to have been harvested (Table 15). Harvested largemouth bass ranged in size from 14.0 inches (356 mm) to 16.2 inches (411 mm) and averaged 14.8 inches (376 mm) in total length (Table 16). The fish were caught at a catch rate of 0.56 fish per hour (Table 17) with a harvest rate of 0.01 fish per hour (Table 18).

Other Gamefish

Walleye and northern pike were caught and harvested infrequently, with an estimated combined total of 36 fish caught (Table 14). Of that total only 12 fish were harvested (Table 15). No muskellunge were reported being caught.

Panfish

Bluegill

Anglers caught an estimated 21,024 bluegill from Bullhead Lake (Table 14). Of that total 8,627 fish were estimated to have been harvested (Table 15). Harvested bluegill ranged in size from 3.6 inches (91 mm) to 10.9 inches (277 mm) and averaged 7.1 inches (180 mm) in total length (Table 16). The fish were caught at a catch rate of 1.65 fish per hour (Table 17) with a harvest rate of 0.68 fish per hour (Table 18).

Other Panfish

Black crappie, yellow perch and pumpkinseed were infrequently caught and harvested, and had an estimated combined catch of 2,323 fish (Table 14). Of that catch, 1,257 fish were harvested (Table 15). Harvested black crappie ranged in size from 6.7 inches (170 mm) to 11.2 inches (284 mm) in total length, and averaged 8.0 inches (203 mm) (Table 16). Harvested yellow perch ranged in size from 5.6 inches (142 mm) to 11.4 inches (290 mm) in total length and averaged 7.3 inches (185 mm). The few pumpkinseed that were harvested averaged 6.5 inches (165 mm). Catch and harvest rates for these species was significantly lower than that for bluegill (Table 17).

Conclusions and Recommendations

The creel survey found that the lake is primarily being used by sport anglers at a rate of 190 hours per acre (Table 19). This very high fishing pressure must be taken into account when deliberating management strategies, for example Bullhead Lake was surveyed simultaneously with nearby Long Lake, Manitowoc County, where sport anglers used the lake at a rate of 44 hours per acre. Those who use Bullhead Lake, most likely reside in Manitowoc or Calumet Counties. Most anglers traveled to the lake for the opportunity to catch bluegill and largemouth bass. Very few individuals were found to be targeting other gamefish.

The comprehensive survey found that Bullhead Lake is predominantly a largemouth bass and bluegill lake. The survey indicates that the lake contains a good mix of game and panfish, with heavy predation of YOY species suspected.

Forage minnows (Cyprinidae) were absent from the Bullhead Lake fisheries community. Reintroduction of bluntnose minnow should be a management priority. Bluntnose minnows were found to be present in the population prior to the 1957 chemical eradication effort. Bluntnose minnow are a common forage minnow in other Manitowoc County lakes. A successful reintroduction of bluntnose minnow as forage would most benefit the panfish community including black crappie, yellow perch and bluegill.

Largemouth bass numbers appear to be high with the majority of those being below the current 14-inch size limit and only a moderate number of largemouth above the 14 inch size limit. It is likely that these sub-legal fish are from one or two strong year class and will recruit beyond 14 inches before natural mortality occurs. At this time the population is growing near State of Wisconsin averages. This survey found good numbers of YOY largemouth bass but found only a few individuals from the 1997 and the 1998 year class survived to one year of age. It is unclear why YOY mortality is occurring, their growth appears to be good. Predation is the most likely cause.

The blossoming largemouth population should benefit Bullhead Lake for many years to come. The largemouth bass should be monitored to ensure that continued growth occurs. Fisheries Management and other interested parties should consider the possibility of protecting this population with a 18 inch trophy size limit. The average harvested largemouth bass during the summer of 1999 was 14.8 inches (376 mm). Numerous studies have found that lakes, like Bullhead Lake, with a high predator to prey ratio will likely have better water clarity.

Walleye, which are stocked on alternating years by the State and by the Bullhead Lake Association and Walleyes for Tomorrow are not surviving. Although several year classes of walleye were found, the population is very small. Very few anglers indicated that they were at Bullhead Lake to fish the walleye population. Anglers will probably not benefit from continued walleye stocking program unless the lake balance changes significantly. Fisheries Management and other interested parties should consider whether or not to continue the walleye stocking efforts on this lake.

The Bullhead Lake Association recently reintroduced northern pike into the lake to diversify the fishery and reduce the number of small largemouth bass. The northern pike that were released are doing well. However, very few northern pike were found. There is evidence that a small year class of natural reproduced fish is now in the lake. A few anglers are already attempting to exploit the population. It is unlikely that northern pike will reduce the largemouth bass population in their present numbers. Their impact maybe more noticeable if larger year classes are recruited into the population. The current size and possession laws are sufficient to protect Bullhead Lake northern pike.

The bluegill population is healthy but under considerably high pressure from both anglers harvesting adults and largemouth bass preying on young fish. This survey found good numbers of YOY bluegill, but found that YOY mortality is occurring, predation is the most likely cause. Growth appears to be occurring but below state averages.

The fisheries survey and the creel survey suggest that angling pressure is modifying the bluegill population size structure. Electroshocking and Standard Fyke Net length frequency indices indicate a precipitous decline in bluegill numbers once fish reach approximately 170 mm (6.7 inches) in total length. The creel survey harvest length frequency data indicates that anglers are harvesting good numbers of fish that average 180 mm (7.1 inches). Anglers were found to have harvested very few fish above 203 mm (8.0 inches).

The bluegill fishery that is occurring in Bullhead Lake is providing many hours of enjoyment for the local sportfishing community and should remain so for many years to come, provided no significant changes in the water quality or habitat occur. Fisheries Management and other interested parties should consider the possibility of protecting this population with more restrictive harvest limits.

The fisheries literature suggests that an overexploited bluegill population will likely result in early-maturing fish and ultimately shift the population towards smaller individuals (Beard 2000). Populations experiencing this type of stunting have normal male and female growth rates prior to maturation, but because growth rates decrease after maturation, there are few large bluegill in the population.

A simple bag limit may be ineffective in changing the size structure of the bluegill population in Bullhead Lake. Other management options may be necessary to enhance recovery rates.

Black crappie were once a major component of the Bullhead Lake population. The comprehensive fisheries survey found only weak year classes of black crappie in the population. The creel survey further found that black crappie was a minor component of the fishery. It is unclear why black crappie numbers are reduced from former levels.

Anglers are undoubtedly harvesting enough fish to modify the population length frequency, however other environmental causation, such as improved water quality, has likely impacted the black crappie population. Black crappie should remain a minor component in this lake provided no significant changes occur in water quality, available habitat, and competition from bluegill and largemouth bass continue.

The fisheries survey found very low yellow perch numbers and the creel survey further found that anglers are catching and harvesting very few perch. A combination of environmental factors, predation and angler harvest is likely causing poor yellow perch recruitment. The creel survey found most harvested yellow perch were between 152 mm (6 inches) and 178 mm (7 inches). Eighty-five percent of the yellow perch that were encountered during the survey were less than 150 mm in total length.

Bullhead Lake is a real asset to the community and is one of the highest quality water bodies in the area. Preservation of habitat should be a management priority. Further, water quality protection (point source and non-point source) is essential to the stability of the lake.

It is unclear what new regulation could be enacted to improve the panfish size structure. Some alternative regulations, which have been enacted in other Wisconsin lakes, included a reduced bag limit, size restrictions, window closures or creation of refugia. However, any new proposed regulation must take into account the high angling pressure that is occurring on the lake.

Bullhead Lake is a community issue and must be viewed as such. The surrounding lakes do not appear to receive as high an amount of recreational angling pressure as that observed on Bullhead Lake (Figure 4). Fisheries Management and other interested parties must consider the possibility of enacting more restrictive regulations on Bullhead Lake and surrounding lakes while aggressively addressing the environmental impediments that are preventing these lakes from reaching their potential (Appendix 1). Redistribution of angling effort must be a priority in the management of Bullhead Lake.

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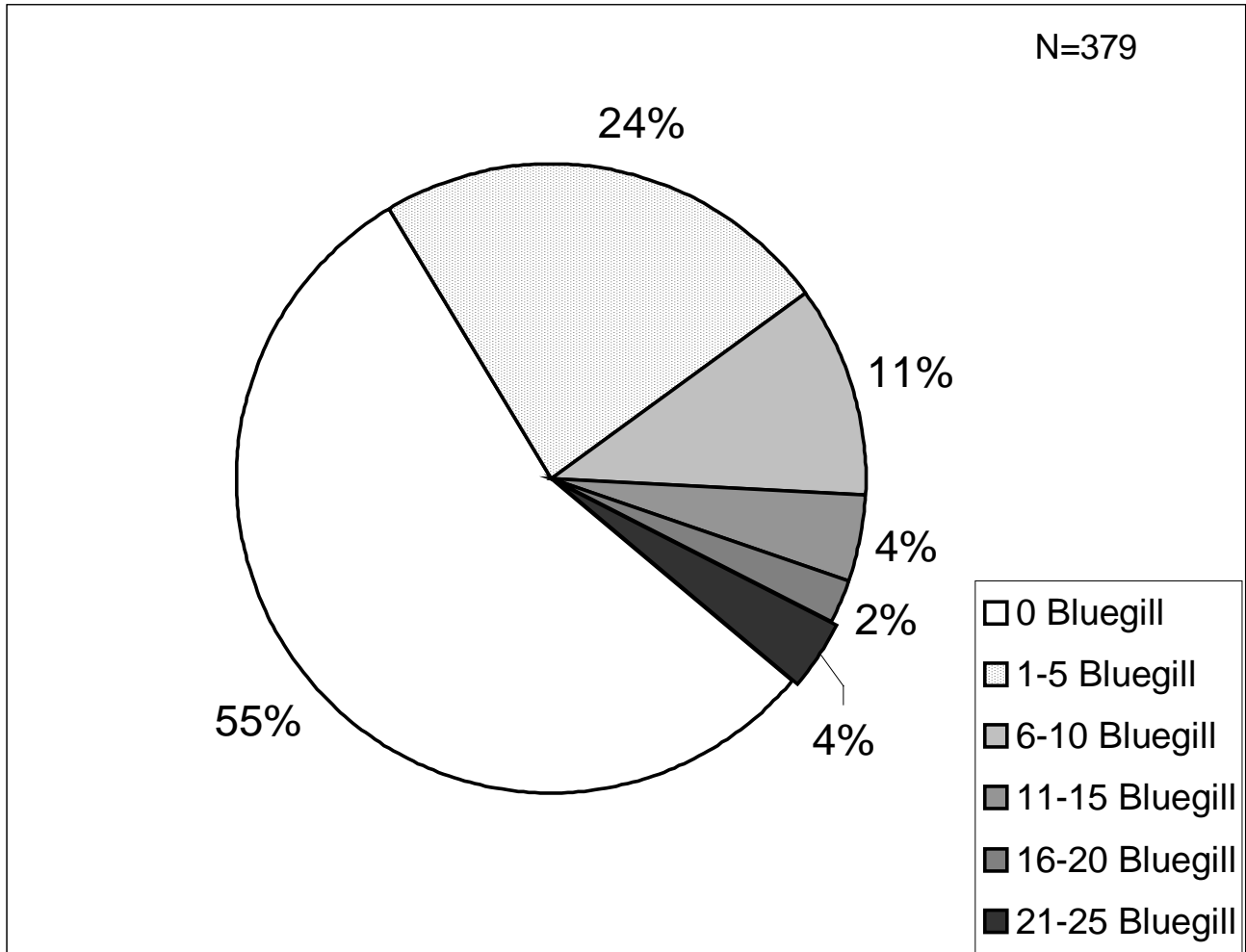


Figure 3. Estimated Number of Bluegill Harvested Per Angler Trip.

Example: Fifty five percent of those interviewed did not harvest any bluegill.

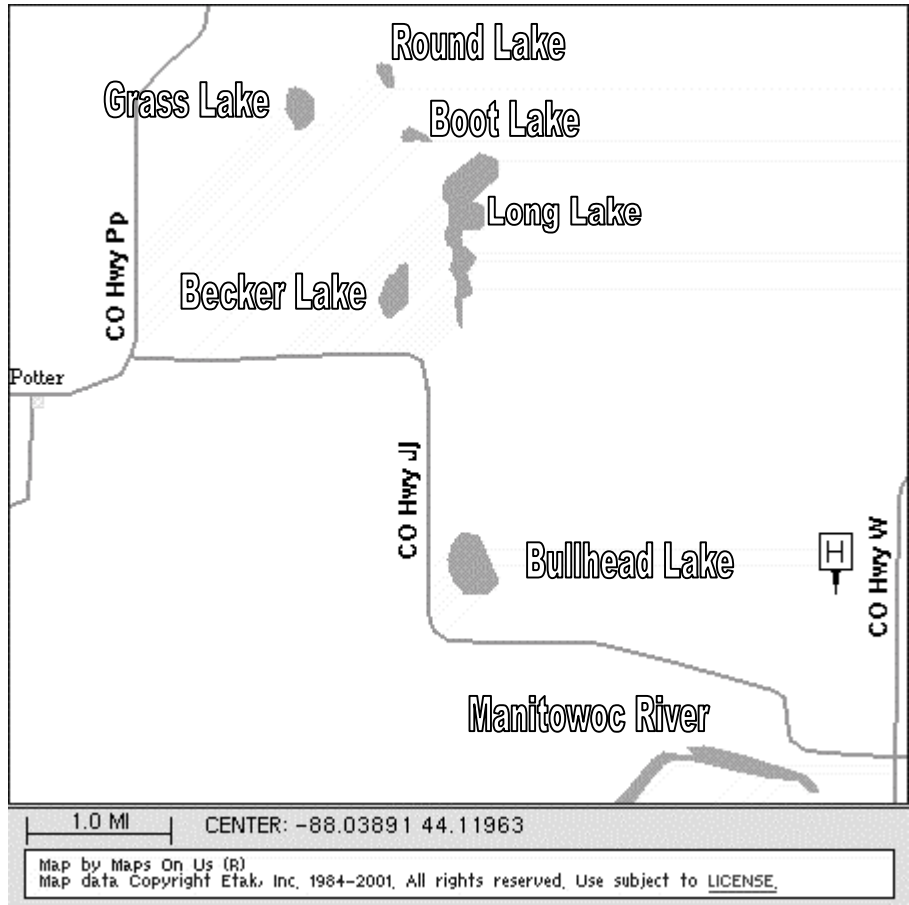


Figure 4. Location of Adjacent Water Bodies.

Table 1. Species composition for each survey type on Bullhead Lake during the 1998-1999 comprehensive survey.

Group	Common Name	Scientific Name	Spring 98 Shock	Mini-fyke net 98	Fall Shock 98	Standard-fyke net 99	Spring 99 Shock, Recapture	Spring 99 Shock
Mudminnow	Central mudminnow	<i>Umbra limi</i>			X			X
Pike	Northern pike	<i>Esox lucius</i>		X	X	X		
Sucker	White sucker	<i>Catostomus commersoni</i>			X	X		
Bullheads	Black bullhead	<i>Ameiurus melas</i>				X		
	Yellow bullhead	<i>Ameiurus natalis</i>			X	X		X
	Brown bullhead	<i>Ameiurus nebulosus</i>	X					
Sunfishes	Pumpkinseed	<i>Lepomis gibbosus</i>		X	X	X		X
	Green sunfish	<i>Lepomis cyanellus</i>		X	X	X		
	Bluegill	<i>Lepomis macrochirus</i>	X	X	X	X	X	X
	Largemouth bass	<i>Micropterus salmoides</i>	X	X	X	X	X	X
	Black crappie	<i>Pomoxis nigromaculatus</i>		X	X	X	X	X
Perches	Iowa darter	<i>Etheostoma exile</i>				X		
	Yellow perch	<i>Perca flavescens</i>			X	X		X
	Walleye	<i>Stizostedion vitreum</i>				X	X	

Table 2. Summary of the catch for each survey gear used during the 1998-1999 Bullhead Lake survey.

Species	Spring shock 98	Mini-fyke net 98	Fall shock 98	Standard-fyke net 99	Spring shock 99 Recapture Effort	Spring shock 99 May and June	Total
Central mudminnow	0	0	8	0	0	1	9
Northern pike	0	1	1	8	0	0	10
White sucker	0	0	1	12	0	0	13
Black bullhead	0	0	0	3	0	0	3
Yellow bullhead	0	0	6	14	0	5	25
Brown bullhead	1	0	0	0	0	0	1
Pumpkinseed	0	11	5	21	0	1	38
Green sunfish	0	12	3	2	0	0	17
Bluegill	67	502	412	259	72	183	1495
Largemouth bass	165	44	381	30	151	335	1106
Black crappie	0	29	58	41	8	9	145
Iowa darter**	0	0	0	1	0	0	1
Yellow perch	0	0	26	12	0	2	40
Walleye	0	0	0	29	3	0	32
Total	233	599	901	432	234	536	2932
Effort	1.27	10 net-nights	2.54	55 net-nights	1.27	2.54	
CPUE	183 fish/mile shocked	60 fish /net night	355 fish/mile shocked	8 fish/net night	184 fish/mile shocked	211 fish/mile shocked	

** Observed not collected.

Table 3. Electroshock length frequency for fishes from Bullhead Lake, June 02, 1998.

Length (mm)	Largemouth bass	Bluegill	Brown bullhead
30 - 39		9	
40 - 49		5	
50 - 59			
60 - 69		13	
70 - 79	1	13	
80 - 89		9	
90 - 99		5	
100 - 109		2	
110 - 119		1	
120 - 129		1	
130 - 139		3	
140 - 149		1	
150 - 159		2	
160 - 169			
170 - 179		1	
180 - 189	2		
190 - 199	3		
200 - 209	10	2	
210 - 219	13		
220 - 229	12		
230 - 239	17		
240 - 249	24		
250 - 259	14		
260 - 269	11		1
270 - 279	7		
280 - 289	11		
290 - 299	3		
300 - 309	1		
310 - 319	1		
320 - 329	7		
330 - 339	2		
340 - 349	2		
350 - 359	10		
360 - 369	3		
370 - 379	5		
380 - 389	2		
390 - 399	1		
400 - 409	1		
410 - 419			
420 - 429			
430 - 439	1		
440 - 449			
450 - 459			
460 - 469			
470 - 479			
480 - 489	1		
490 - 499			
500 - 509			
510 - 519			
520 - 529			
530 - 539			
540 - 549			
Total	165	67	1
Minimum	73	32	268
Maximum	486	206	268
Average	266	81	268
Std. Deviation	58	38	

Table 4. Mini-fyke net length frequencies for gamefish and panfish on Bullhead Lake, September 1998.

Length (mm)	Northern pike	Largemouth bass	Bluegill	Green sunfish	Pumpkin-seed	Black crappie
0 - 9						
10 - 19						
20 - 29			4			
30 - 39			86			
40 - 49		2	82			
50 - 59		10	181			5
60 - 69		21	76	3		5
70 - 79		9	22	1	1	7
80 - 89		2	10	1	2	2
90 - 99			5	2	5	
100 - 109			5	1	2	
110 - 119			1	1	1	
120 - 129				3		5
130 - 139						
140 - 149						5
150 - 159						
160 - 169						
170 - 179						
180 - 189						
190 - 199						
Total	1	44	472	12	11	29
Minimum	854	43	25	62	79	52
Maximum	854	82	112	127	115	146
Average	854	63	53	95	94	89
Std. Deviation		9	14	23	10	34

Table 5. Electroshocking length frequency for gamefish from Bullhead Lake, October and November 1998.

Length (mm)	Northern pike	Largemouth bass	Length (mm)	Northern pike	Largemouth bass
0 - 9			410 - 419		4
10 - 19			420 - 429		1
20 - 29			430 - 439		
30 - 39			440 - 449		
40 - 49			450 - 459		1
50 - 59		4	460 - 469		
60 - 69		3	470 - 479		
70 - 79		10	480 - 489		1
80 - 89		10	490 - 499		
90 - 99		4	500 - 509		
100 - 109		2	510 - 519		1
110 - 119		1	520 - 529		
120 - 129		1	530 - 539		
130 - 139		2	540 - 549		
140 - 149			550 - 559		
150 - 159		4	560 - 569		
160 - 169		3	570 - 579		
170 - 179		3	580 - 589		
180 - 189		2	590 - 599		
190 - 199		3	600 - 609		
200 - 209		3	610 - 619		
210 - 219		1	620 - 629		
220 - 229		5	630 - 639		
230 - 239		9	640 - 649		
240 - 249		15	650 - 659		
250 - 259		38	660 - 669		
260 - 269		47	670 - 679		
270 - 279		41	680 - 689		
280 - 289		44	690 - 699		
290 - 299		31	700 - 709		
300 - 309		19	710 - 719		
310 - 319		6	720 - 729		
320 - 329		2	730 - 739		
330 - 339		4	740 - 749		
340 - 349		5	750 - 759		
350 - 359		5	760 - 769		
360 - 369		7	770 - 779		
370 - 379		12	780 - 789		
380 - 389		8	790 - 799		
390 - 399		10	800 - 809		
400 - 409		9	810 - 819	1	
			820 - 829		
			830 - 839		
			840 - 849		
			850 - 859		
Total				1	381
Minimum				810	56
Maximum				810	519
Average				810	270
Std. Deviation					81

Table 6. Electroshocking length frequency for panfish and other fishes from Bullhead Lake, October and November 1998.

Length (mm)	Bluegill	Black crappie	Green sunfish	Pumpkin-seed	Yellow perch	Yellow bullhead	Mud minnow	White sucker
0 - 9								
10 - 19								
20 - 29	7							
30 - 39	26							
40 - 49	48							
50 - 59	54	2						
60 - 69	41	8					4	
70 - 79	15	11					4	
80 - 89	17	3	1					
90 - 99	16	1			1			
100 - 109	29		1	1	3			
110 - 119	31				7			
120 - 129	18	1	1	3	10	1		
130 - 139	21	4		1	2			
140 - 149	22	10			2	1		
150 - 159	22	11						
160 - 169	25	2			1			
170 - 179	4							1
180 - 189	5	2				1		
190 - 199	5	1						
200 - 209	4							
210 - 219	1							
220 - 229								
230 - 239		1						
240 - 249	1							
250 - 259		1				1		
260 - 269								
270 - 279						1		
280 - 289						1		
290 - 299								
300 - 309								
Total	412	58	3	5	26	6	8	1
Minimum	22	52	85	100	93	122	62	174
Maximum	241	250	124	137	163	280	76	174
Average	95	120	105	121	122	211	69	174
Std. Deviation	81	47	48	20	14	15	68	6

Table 7. Standard fyke net length frequencies for gamefish from Bullhead Lake, April 1999.

length (mm)	Northern pike	Largemouth bass	Walleye	Length (mm)	Northern pike	Largemouth bass	Walleye
0 - 9				410 - 419			
10 - 19				420 - 429		1	
20 - 29				430 - 439			
30 - 39				440 - 449			
40 - 49				450 - 459			
50 - 59				460 - 469			
60 - 69				470 - 479	1	1	1
70 - 79				480 - 489			2
80 - 89				490 - 499			
90 - 99				500 - 509			
100 - 109				510 - 519	1	1	2
110 - 119				520 - 529			
120 - 129				530 - 539	1		1
130 - 139				540 - 549			1
140 - 149				550 - 559			1
150 - 159				560 - 569			1
160 - 169		1		570 - 579			3
170 - 179				580 - 589			
180 - 189				590 - 599			1
190 - 199		2		600 - 609			
200 - 209				610 - 619			
210 - 219				620 - 629			
220 - 229				630 - 639			3
230 - 239				640 - 649			
240 - 249		1		650 - 659			
250 - 259		2		660 - 669			
260 - 269		4		670 - 679			
270 - 279		3		680 - 689			
280 - 289		3		690 - 699			1
290 - 299		3		700 - 709	1		
300 - 309		2		710 - 719			
310 - 319		1		720 - 729			
320 - 329				730 - 739			
330 - 339		1	1	740 - 749	1		
340 - 349			1	750 - 759			
350 - 359		1	4	760 - 769			
360 - 369		1	6	770 - 779	1		
370 - 379				780 - 789			
380 - 389				790 - 799			
390 - 399		1		800 - 809	1		
400 - 409		1		810 - 819	1		
				820 - 829			
				830 - 839			
				840 - 849			
Total		8	29		8	30	29
Minimum		476	335		476	160	335
Maximum		815	693		815	510	693
Average		671	475		671	303	475
Std. Deviation		140	110		140	78	110

Table 8. Standard-fyke net length frequency for panfish and other fishes from Bullhead Lake, April 1999.

Length (mm)	Bluegill	Green sunfish	Pumpkin-seed	Black crappie	Yellow perch	Black bullhead	Yellow bullhead	White sucker
30 - 39								
40 - 49								
50 - 59								
60 - 69								
70 - 79								
80 - 89	1							
90 - 99	5							
100 - 109	10		1					
110 - 119	36		4					
120 - 129	57		4	1				
130 - 139	45		7	3	4			
140 - 149	21		1	11	3			
150 - 159	18		2	11	1			
160 - 169	20		2	4				
170 - 179	11			1				
180 - 189	10							
190 - 199	7	2						
200 - 209	6							
210 - 219	3					1		
220 - 229	1				1			
230 - 239	4			1			2	
240 - 249	4			3		1	1	
250 - 259				4	1		3	
260 - 269					2		2	
270 - 279								
280 - 289				1				
290 - 299							3	
300 - 309								
310 - 319						1		
320 - 329								
330 - 339							1	
340 - 349				1				
350 - 359							1	
360 - 369							1	
370 - 379								
380 - 389								
390 - 399								
400 - 409								
410 - 419								
420 - 429								
430 - 439								
440 - 449								
450 - 459								
460 - 469								
470 - 479								1
480 - 489								2
490 - 499								2
500 - 509								2
510 - 519								1
520 - 529								1
530 - 539								1
540 - 549								0
550 - 559								1
560 - 569								1
570 - 579								
Total	259	2	21	41	12	3	14	12
Minimum	86	190	104	124	135	215	230	478
Maximum.	245	195	164	345	269	311	369	563
Average	143	193	133	177	178	255	282	510
Std. Deviation	31	4	16	52	55	50	44	28

Table 9. Electroshock length frequency for gamefish from Bullhead Lake April 1999.

Length (mm)	Largemouth bass
30 - 39	
40 - 49	
50 - 59	
60 - 69	
70 - 79	
80 - 89	
90 - 99	
100 - 109	
110 - 119	
120 - 129	
130 - 139	
140 - 149	1
150 - 159	3
160 - 169	2
170 - 179	1
180 - 189	1
190 - 199	2
200 - 209	1
210 - 219	
220 - 229	
230 - 239	6
240 - 249	6
250 - 259	18
260 - 269	19
270 - 279	20
280 - 289	28
290 - 299	17
300 - 309	7
310 - 319	2
320 - 329	3
330 - 339	
340 - 349	
350 - 359	2
360 - 369	1
370 - 379	4
380 - 389	1
390 - 399	1
400 - 409	
410 - 419	2
420 - 429	
430 - 439	2
440 - 449	
450 - 459	
460 - 469	
470 - 479	
480 - 489	
490 - 499	
500 - 509	
510 - 519	
520 - 529	
530 - 539	
540 - 549	
Total	151
Minimum	146
Maximum	434
Average	278
Std. Deviation	49

Table 10. Electroshock length frequency for gamefish, panfish and other fishes from Bullhead Lake May and June 1999.

Length (mm)	Largemouth bass	Bluegill	Black crappie	Pumpkinseed	Yellow perch	Yellow bullhead	Mud minnow
30 - 39							
40 - 49							
50 - 59		6					
60 - 69		6					
70 - 79		8					
80 - 89	1	7					1
90 - 99		9					
100 - 109		8					
110 - 119	1	15					
120 - 129		36					
130 - 139		22		1	1		
140 - 149	1	16					
150 - 159	2	16	4				
160 - 169	4	9	2				
170 - 179	6	9	2				
180 - 189	1	9	1		1		
190 - 199	7	3					
200 - 209	2	2					
210 - 219	3	1					
220 - 229	3	1					
230 - 239	13						
240 - 249	17					1	
250 - 259	36					1	
260 - 269	48						
270 - 279	62						
280 - 289	46					1	
290 - 299	19					2	
300 - 309	8						
310 - 319	5						
320 - 329	4						
330 - 339	6						
340 - 349	5						
350 - 359	4						
360 - 369	8						
370 - 379	8						
380 - 389	6						
390 - 399	4						
400 - 409	1						
410 - 419							
420 - 429	2						
430 - 439							
440 - 449	1						
450 - 459							
460 - 469							
470 - 479							
480 - 489							
490 - 499							
500 - 509							
510 - 519							
520 - 529							
530 - 539	1						
540 - 549							
Total	335	183	9	1	2	5	1
Minimum	85	50	150	134	137	240	84
Maximum	539	235	182	134	183	295	84
Average	277	129	164	134	160	274	84
Std. Deviation	51	35	11		33	24	

Table 11. Age distribution of fish from scales collected during the spring Bullhead Lake survey 1999. Length at age is measured in millimeters.

Species	1	2	3	4	5	6	7	8	9	10	11
Northern pike (state average)	305 (356)	549 (406)	711 (470)	769 (546)							
Largemouth bass (state average)	79 (97)	154 (165)	217 (229)	279 (290)	323 (338)	376 (384)	406 (414)	463 (447)	507 (454)	525 (485)	
Walleye (state average)	106 (157)	194 (246)	291 (315)	374 (368)	444 (417)	487 (462)	518 (498)	544 (536)	602 (574)	625 (599)	
Bluegill (state average)	43 (64)	74 (97)	100 (122)	129 (147)	155 (167)	168 (183)	182 (196)	192 (208)	212 (211)	228 (218)	241
Black crappie (state average)	49 (79)	128 (137)	165 (183)	254 (218)	295 (241)	320 (267)	345 (284)				
Yellow perch (state average)	69 (74)	105 (119)	150 (152)	199 (180)	231 (206)	243 (226)	269 (241)				

Table 12. Recreational User, County of Residence.
(Bullhead Lake, Manitowoc County 1999)

County	Ice Fishing County of Residence (percent)	Open Water County of Residence (percent)
Brown	15.0	7.2
Calumet	25.0	18.8
Dane		0.2
Fond Du Lac		1.3
Manitowoc	37.5	54.9
Milwaukee		0.8
Outagamie	17.5	8.7
Rock		0.4
Shawano		0.2
Sheboygan		3.4
Winnebago	5.0	3.4
Out of State		0.8

Table 13. Estimated Directed Angling Effort (hours fished) by Species by Month.
(Bullhead Lake, Manitowoc County 1999)

Species	May	June	July	Aug	Sept	Total
Gamefish						
Largemouth Bass		1,188	1,610	920	362	5,075
Walleye	995	44				44
Northern Pike	5	14	73	97	48	237
Muskellunge	62	33	73	36	18	222
Panfish						
Bluegill	1,418	2,197	2,768	2,241	1,127	9,751
Black Crappie	1,261	793	1,388	517	274	4,233
Yellow Perch	816	396	1,172	748	353	3,485
Pumpkinseed	0	111	144	86	8	349
Total Effort	4,557	4,776	7,228	4,645	2,190	23,396

Table 14. Estimated Catch by Species by Month.
(Bullhead Lake, Manitowoc County 1999)

Species	May	June	July	Aug	Sept	Total
Gamefish						
Largemouth Bass	877	1,706	2,656	1,285	663	7,187
Walleye		4	16			20
Northern Pike			12	4		16
Panfish						
Bluegill	1,969	6,035	6,320	5,182	1,518	21,024
Black Crappie	465	323	596	76	45	1,505
Yellow Perch	18	66	314	255	89	742
Pumpkinseed	4	18	24	25	5	76
Total Catch	3,333	8,152	9,938	6,827	2,320	30,567

Table 15. Estimated Harvest by Species by Month.
(Bullhead Lake, Manitowoc County 1999)

Species	May	June	July	Aug	Sept	Total
Gamefish						
Largemouth Bass	39	34	56	4	3	136
Walleye			8			8
Northern Pike				4		4
Panfish						
Bluegill	684	2,545	1,783	2,569	1,047	8,627
Black Crappie	328	149	441	26	15	959
Yellow Perch		4	87	129	9	230
Pumpkinseed		18	24	21	5	68
Total Harvest	1,051	2,750	2,399	2,753	1,079	10,032

Table 16. Sport Harvest Length Frequency for Game and Panfish, May 1, 1999 through September 30, 1999. (Bullhead Lake, Manitowoc County)

Length (inches)	Largemouth Bass	Walleye	Northern Pike	Bluegill	Black Crappie	Yellow Perch	Pumpkinseed
1							
2							
3				1			
4				4			
5				88		2	1
6				424	3	11	8
7				535	42	14	1
8				136	6	3	1
9				27	13		
10				4	3	1	
11					1	1	
12							
13							
14	20						
15	7	1					
16	2						
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32			1				
Total	29	1	1	1219	68	32	11
Minimum	14.00	15.20	32.40	3.60	6.70	5.60	5.90
Maximum	16.20	15.20	32.40	10.90	11.20	11.40	8.10
Average	14.79	15.20	32.40	7.12	8.03	7.30	6.53
Std. Dev.	.18			.49	1.51	1.72	.19

Table 17. Estimated General Catch Rate (fish per hour) by Species by Month.
(Bullhead Lake, Manitowoc County 1999)

Species	May	June	July	Aug	Sept	Total
Gamefish						
Largemouth Bass	.3850	.5762	.7401	.4858	.5125	.5630
Walleye	.0000	.0015	.0044	.0000	.0000	.0031
Northern Pike	.0000	.0000	.0033	.0015	.0000	.0015
Panfish						
Bluegill	.8643	2.0379	1.7614	1.9593	1.1739	1.6469
Black Crappie	.2041	.1090	.1660	.0288	.0346	.1178
Yellow Perch	.0077	.0221	.0874	.0964	.0685	.0580
Pumpkinseed	.0025	.0136	.0066	.0093	.0082	.0076

Table 18. Estimated General Harvest Rate (fish per hour) by Species by Month.
(Bullhead Lake, Manitowoc County 1999)

Species	May	June	July	Aug	Sept	Total
Gamefish						
Largemouth Bass	.0173	.0116	.0155	.0015	.0020	.0106
Walleye		.0000	.0022			.0012
Northern Pike	.0000	.0000	.0000	.0015	.0000	.0004
Panfish						
Bluegill	.3004	.8594	.4968	.9712	.8095	.6758
Black Crappie	.1442	.0502	.1228	.0097	.0117	.0751
Yellow Perch	.0000	.0015	.0243	.0487	.0072	.0180
Pumpkinseed	.0000	.0136	.0066	.0078	.0082	.0068

Table 19. General harvest and (catch) rates by species for selected waters during the open water fishing season.

Water Body (County)	Year	Acres	Hours/Acre	Northern Pike	Yellow Bass	Pumpkinseed	Bluegill	Largemouth Bass	Black Crappie	Yellow Perch	Walleye
Big Cedar Lake (Sheboygan)	1994	932	65.9	0.004 (0.03)			0.610 (1.500)	0.020 (0.290)	0.140 (0.220)	0.0190 (0.600)	0.030 (0.060)
Bullhead Lake (Manitowoc)	1999	67	190.5	0.0004 (0.0015)		0.0068 (0.0076)	0.6758 (1.6469)	0.0106 (0.5630)	0.0751 (0.1178)	0.0180 (0.0580)	0.0106 (0.0031)
Clark Lake (Door)	1994	868	4.2	0.066 (0.116)		0.007 (0.007)	0.056 (0.100)	0.0018 (0.007)		0.075 (0.151)	0.085 (0.156)
Escanaba Lake (Vilas)	1995	293	36.2	0.003		0.0002		0.0001		0.090	0.126
Fox Lake (Dodge)	1974	2625	268.0	0.0046		0.0306	0.5320	0.0142		0.3382	0.009
Long Lake (Manitowoc)	1999	120	44.5	0.0000 (0.0002)	0.8869 (1.1989)	0.0121 (0.0355)	0.2620 (0.9703)	0.0018 (0.1432)	0.1792 (0.2830)	0.1169 (0.1782)	
Nagawicka Lake (Waukesha)	1982	957	155.7	0.019			0.629	0.020		0.215	0.001
Nebish Lake (Vilas)	1995	98	65.5							0.071	
Palette Lake (Vilas)	1995	176	7.6	0.001						0.013	
Spruce Lake (Vilas)	1995	16	11.9					0.031 (0.252)			

Appendix 1. Description of Waters Adjacent to Bullhead Lake.

Becker Lake Calumet County T19N, R20E, Sec. 12

Becker Lake is a 31.2-acre seepage lake with an intermittent outlet to Grass Lake and an intermittent inlet from Long Lake in Manitowoc County. The drainage basin covers 14.50 square miles. The maximum depth is 51 feet with a mean depth of 15 feet. There is 0.98 miles of shoreline, of which 0.05 miles are publicly owned. Historically, northern pike, largemouth and smallmouth bass and panfish comprised the fishery.

Boot Lake Calumet County T19N, R20E, Sec. 1 (4)

Boot Lake is a landlocked 9.7-acre seepage lake that drains a 0.24 square mile watershed. During high water periods it is connected to Long Lake in Manitowoc County. The maximum depth is 15 feet and the mean depth is 6 feet. There is 0.62 miles of shoreline of which 0.1 miles are publicly owned. Historically, northern pike, largemouth bass, and panfish comprise the fishery. However the lake winterkills every three to five years (Kamke 1995).

Grass Lake Calumet County T19N, R20E, Sec. 1 (6)

The most notable lake from a wildlife standpoint is Grass Lake, which is essentially a northern bog lake in a southern setting, surrounded by farmland. Vegetation includes various orchid species, calla lilies, buck bean and a variety of other bog plants. It is the only bog of its type in Calumet County. The area is a significant nesting area for many species of ducks and Canada geese. WDNR lacks sufficient data to make further recommendations for Grass Lake.

Long Lake Manitowoc County T19N, R21E, Sec. 6, 7

Big Long Lake is primarily a natural seepage lake with a 2 mi.² watershed lying in Manitowoc County. It is one of the 50 lakes in the Long-Term Trend Monitoring Program. The lake encompasses 119 acres and has a maximum depth of 38 feet. There are 2.18 miles of shoreline, of which 0.21 miles are publicly owned. An intermittent creek flows into Big Long Lake at the north end and out of the south end to Becker Lake. There are 13 acres of adjoining wetlands.

The lake is highly eutrophic, with a secchi disc transparency rarely exceeding one meter. A bloom of blue-green algae persists during the entire open water season, at times so thick it becomes toxic. A major fish kill occurred in July of 1984. Aquatic macrophyte surveys were conducted in 1988 and 1991. They indicated that macrophyte production is limited by the algae present. Coontail and curly-leaved pondweed were the predominant species although all macrophyte growth was limited below 1.5 feet. The aquatic plant survey conducted in July 1988 found Hydrodictyon, or water net, drifting in the littoral zone (Rasman 1988). Northern pike, largemouth bass, and panfish comprise the fishery. The fishery was last surveyed in 1999.

Round Lake Calumet county T19N, R20E, Sec. 1 (2)

Round Lake is a landlocked seepage lake with a 0.7 square mile drainage basin. It covers 10.0 surface acres. The maximum depth is 55 feet and the mean depth is 30 feet. The total shoreline length is 0.55 miles of which 0.2 miles are publicly owned. Largemouth bass, panfish, and trout are common in the lake. However, A major fish kill occurred in the summer of 2000. WDNR lacks sufficient data to make further recommendations for Round Lake.