Pilot Study of Common Loon (*Gavia immer*) and Watercraft Interactions on Minnesota Lakes

Final Report

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ABSTRACT

Shoreline development and recreational use of northern lakes has been suggested as a possible cause for declines in North American breeding populations of the common loon (*Gavia immer*). Previous studies of human and loon interactions have not produced consistent results regarding the impact of human activities on loon productivity. A pilot study was conducted to assess the feasibility and study design for an intensive 2002 disturbance study on the Whitefish Chain of Lakes, a heavily-recreated group of lakes in north central Minnesota. Loon territory occupancy and productivity were comparable to levels found in a 1985 study on the same waterbody. Nesting loons appeared to have a high tolerance for recreational activity, but were also observed to flush nests in response to being disturbed. Furthermore, only 29% of nests were located on islands, an indication that loons may be modifying habitat preferences in response to recreational pressure. Vegetative cover (e.g., cattails) at nest sites and artificial nesting platforms may help to mitigate potential impairment to loon productivity caused by recreational activities. A framework for future study on the Whitefish Chain of Lakes compares observed human-use patterns with nesting loon response and productivity.

INTRODUCTION

The common loon (*Gavia immer*) is a long-lived, piscivorous bird characteristic of most intact lentic systems in the northern North America. The natural histories of predators, such as the loon, tend to make them especially vulnerable to local and regional extinction (Lawton 1995). Although the loon commonly occurs throughout much of Canada, this species has declined across the southern extent of its current breeding range (e.g., central Ontario, central Minnesota, central Wisconsin; Sauer et al. 1999) and has been extirpated in other parts of its historic range (e.g., Iowa, Illinois, Indiana, Ohio, Pennsylvania; McIntyre and Barr 1997).

Environmental contaminants (Evers et al. 1998), epizootic or mass die-off events (Forrester 1997) and shoreline development and human disturbance (Caron and Robinson 1994, Robinson et al. 1988) are among the suggested causes of observed declines in loon populations. Shoreline development and recreational use of lakes can result in both nest failure and permanent abandonment of traditional nesting sites (Olson & Marshall 1952, Ream 1976, Titus and VanDruff 1981). However, the overall effects of human encroachment on loon populations are obscured by varied reproductive potential among lakes (McIntyre 1975, Smith 1981, Jung 1991, Belant & Anderson 1991) and the possibility for habituation to increased activity among loons (Sutcliffe 1980, Smith 1981, Titus and VanDruff 1981, Heimberger et al. 1983, Belant & Anderson 1991, Ruggles 1994).

As a result, the application of previous disturbance studies to current management regimes is by no means universal. Some studies have found a negative correlation between recreational use and nest success (Olson & Marshall 1952, Valley 1987, Kelly 1992, Kaplan & Tischler 2001), while others have detected little or no relationship between the two variables (Smith 1981, Titus & VanDruff 1981, Caron & Robinson 1994). McIntyre (1975) found greater productivity on *high* use lakes. Since the use and popularity of northern lakes is likely to increase, it is critical to devise conservation strategies that will minimize potential impairment to breeding loons.

The Whitefish Chain of Lakes, located in north central Minnesota, supports a loon population exposed to a significant amount of recreational pressure. Approximately a three-hour drive from the Twin Cities metropolitan area, the human population of this area doubles during the summer months (estimated 100,000 people in Brainerd Lakes Area, U.S. Census Bureau website), and the density of boats on summer weekends has been estimated at 63 to 75 acres/boat (MN DNR 1999). This pilot study examines the designs of previous studies and evaluates the suitability of the Whitefish Chain of Lakes as the study site for an intensive 2002 project whose objective is to identify the variables necessary to maintain a breeding loon population in areas popular for human recreation in Minnesota.

METHODS

Study area

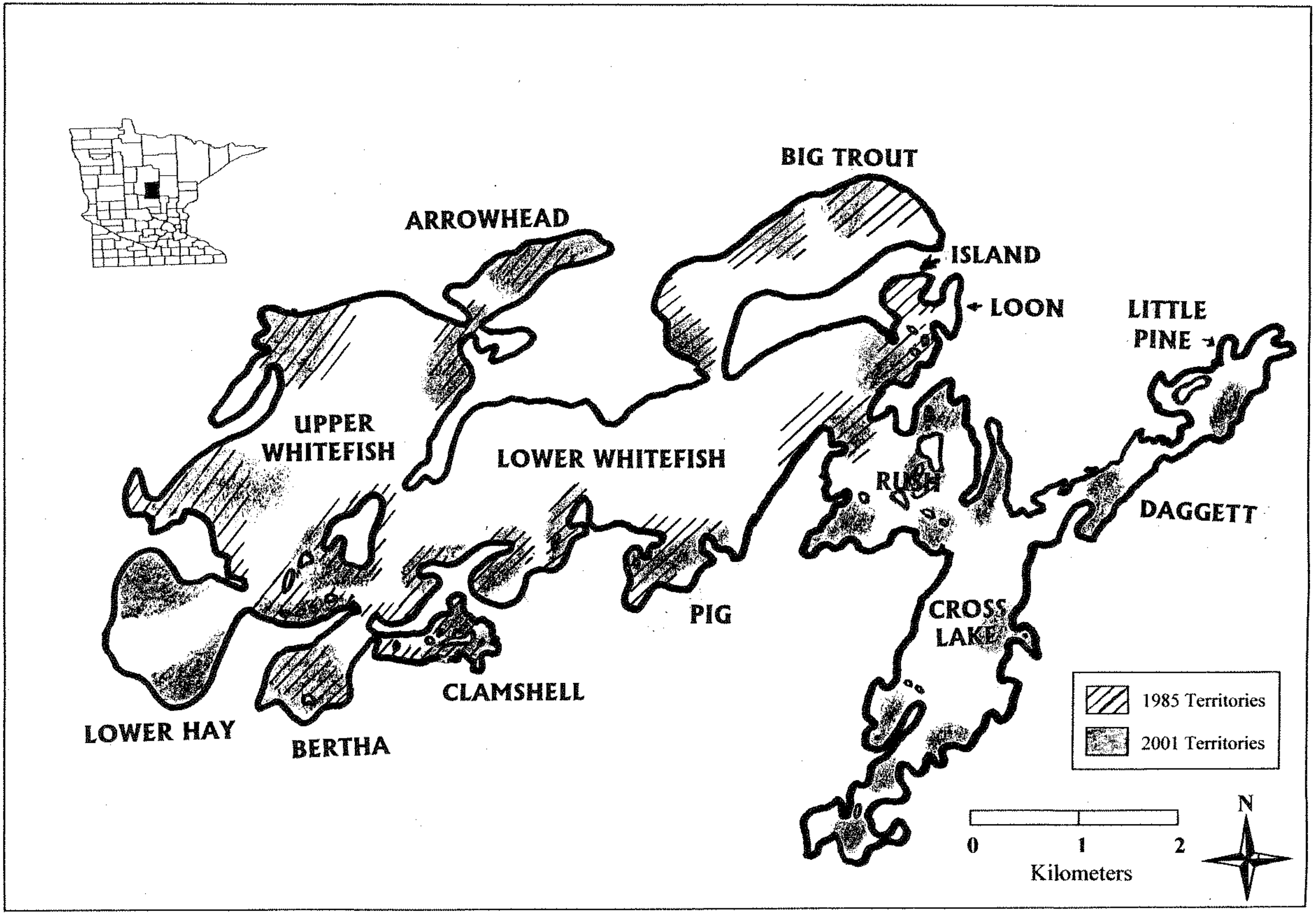
This pilot study was conducted on the Whitefish Chain of Lakes (5916 ha; Figure 1) and other nearby lakes in north central Minnesota, approximately 40 km north of the city of Brainerd. The individual lakes comprising the Whitefish Chain (n=12) were formed by the Pleistocene glaciation and connected in 1886 by the construction of the Pine River Dam (US ACOE website). The water level of the reservoir is regulated by the Army Corps of Engineers and fluctuates annually by less than 1m (US ACOE website). The Chain consists of approximately 180 km of shoreline including at least 50 islands and several shallow areas containing emergent vegetation (Valley 1987, MN DNR 1995). Much of the shoreline, however, has been developed as the site for cottages, homes, resorts and public access facilities (MN DNR 1995). Recreational activities include boat riding (52%), fishing (32%), water skiing (6%), jet skiing and other non-motorized activities (11%; MN DNR 1999).

Data collection

From 18-30 June 2001, all lakes within the Whitefish Chain and other nearby lakes (as time allowed) were surveyed for loon occupancy and productivity using a kayak or a 9.9 hp motorboat. Loon territories were defined by the presence of a closely associated pair. An attempt was made to confirm breeding activity in all identified loon territories by searching suitable habitat along islands and in protected bays for nest sites. Special care was taken to avoid disturbance to nesting loons by first scanning the shoreline with 10x42 binoculars or a 20-60x spotting scope from a distant location. Lakes were revisited, as time permitted, and locations of loon pairs were recorded to delineate territorial boundaries.

Volunteers for the Minnesota Loon Watcher Survey program and other property owners within loon territories were contacted for historical breeding information and

Figure 1. Common loon territories on the Whitefish Chain of Lakes, 1985 and 2001.



confirmation of observational data. Permission to observe loon nests from private property was obtained where necessary.

The distance between loon nests and the nearest shoreline development was estimated with the use of 1:25,000 aerial photos (Aerial PhotoMaps Inc. 1999). *Distance estimates provided in this report are meant solely for the means of evaluating disturbance on a gross scale.* As time permitted, recreational activity within the vicinity of active loon nests was observed from a cryptic location. The type, duration and approximate distance of the activity from the loon nest were recorded.

Additionally, the feasibility of surveying boaters at public access sites as an alternative means of collecting disturbance data was evaluated. This method compares use patterns of surveyed boaters within the vicinity of loon nests to the productivity of those nests (see Kaplan & Tischler 2001).

RESULTS

Territory occupancy and productivity

Thirty-two loon territories were identified on the Whitefish Chain of Lakes (Table 1). The portion of the chain monitored in 1985 by Valley (1987; Arrowhead, Bertha, Big Trout, Clamshell, Island, Loon, Lower Hay, Lower Whitefish, Pig and Upper Whitefish Lakes) supported 20 territories, suggesting the founding of one new territory during the sixteen year period (1985-2001). Figure 1 shows the territory boundaries as observed during this study in comparison to those observed by Valley (1987). Loon pairs were observed in four additional locations, but a lack of breeding evidence made it difficult to determine if these birds were territorial or merely non-breeding individuals. Due to time constraints, the eastern end of the Whitefish Chain (Cross, Daggett and Little Pine Lakes) was only visited once, increasing the possibility for error in the number of territories identified there.

Breeding was confirmed in 81% (n=26) of loon territories through either observation of young or location of nest sites. Nests were located in 24 territories (Table 1); eight were active when discovered and three remained active through the end of the study. More than half of the nests (n=14) were located on a hummock and typically associated with a cattail (*Typha spp.*) marsh along the shoreline or in shallow open water. Twenty nine percent (n=7) were built on an island or islet and 13% (n=3) were found on an artificial nesting platform.

Sixty-five percent of territories on which the nesting outcome could be determined successfully produced young (n=26, Table 1). Overall, the Whitefish Chain of Lakes produced 0.84 chicks/territorial pair (excluding one territory on which the nesting outcome was not determined). A more conservative estimate of the hatching rate which includes the four possible territories was 0.74 chicks/territorial pair (n=35 territories). Table 2 shows a comparison of nest success and hatching rates between 1985 (Valley 1987) and 2001 (this study).

Table 1. Loon occupancy and productivity on the Whitefish Chain of Lakes, 2001.

Lake	Size (ha)	Territories (n)	Nests (n) †	Chicks (n)
Arrowhead	114	2	2	1
Bertha	141.2	1	1	0
Big Trout	594.4	3[a]	3	3
Clamshell	95.2	2	2	0
Cross	753.6	6	2	5[d]
Daggett	113.6	1	1	0
Island/Loon	77.2	1[b]	1	2
Little Pine	153.6	1	0	2
Lower Hay	288	2	1	2
Pig	85.2	1	1	1
Rush	312.8	5	5	6
Whitefish	3187.6	7[c]	5	4
Total	**5916.4**	**32**	**24**	**26**

† Number of territories on which nests were located during the pilot study.
[a] A fourth breeding territory was known in previous years at W. end of lake.
[b] A second breeding territory possible at N. end of Island Lake.
[c] Possibly two additional territories in areas where breeding habitat was not identified.
[d] Three of five chicks were reported after pilot study by a loon watcher.

Three additional lakes within one mile of the Whitefish Chain (T. 137 N., R. 28, 29 W.) were visited. Clear (88 ha) and Deer (31 ha) Lakes each had one loon territory. No loons were observed on Grass Lake (18 ha), although a resident did report occasional sightings of loons. Only Clear Lake produced young (n=2); the nest was located on a cattail hummock.

Lake contacts

Of the 24 territories on which nests were located, permission was obtained from 10 nearby landowners to use their property for nest observations in 2002. Four nests can be observed from public lands. Several other contacts were able to provide information regarding current and historical nest locations and productivity.

Table 2. Loon occupancy and productivity between 1985 and 2001.

	1985†	2001‡
Territories (n)	19	20
Nest Success	63%	59%
Chicks hatched/pair (n)	1.00	0.74

† From Valley (1987).
‡ Data derived from only the lakes included in Valley (1987).

Human disturbance potential

During the two-week pilot study, recreational activity observed on the Whitefish Chain of Lakes included boat riding, fishing, water skiing/tubing, jet skiing, sailing, kayaking and swimming. The average distance between loon nests and the nearest shoreline development (docks, lawns or houses) was 136m (range: 20-640m, n=21). There did appear to be some variation in the level of recreational use near loon nest sites on the chain; in some cases, physical barriers, such as water depth or aquatic vegetation limited human-use in the vicinity of a nest.

Human activity was documented for an average of 69 minutes at three active loon nests (Table 3). Thirty four boats traveled an average distance of 69m from loon nests, however, only one boat caused a loon to flush its nest.

All watercraft observed on Bertha Lake (n=6) were fishing at the nest island, approximately 100m from the nest, but may have been out of view from the loon nest. None of the watercraft caused the loon to flush its nest, however the nest did fail on 25 June. On Rush Lake-Southeast, all observed watercraft (n=21) traveled quickly past the loon nest in the direction of either Whitefish or Cross Lakes. The loon did not flush its nest during the observation, however, the second pair member hunkered low in the water when in view of the nest. A Loon Watcher reported that this nest failed following the 4th of July, after a boat had been moored near one end of the island. Watercraft observed in the O'Brian Point territory (n=7) were traveling slowly through a narrow channel created by an island and the mainland on which the loon nest was located, or they were beached on the island and recreating in the water. The nesting loon was flushed from its nest by a pontoon boat traveling at medium speed approximately 60m from the nest. This bird remained off the nest for 16 minutes, until an inboard/outboard boat drifted toward the nest (to within 20m). Oddly enough, two separate parties who landed on an island also approximately 60m from the nest and recreated in the water (one with a dog) did not cause the loon to flush. This nest was still active at the end of the pilot study and the outcome is unknown, however, a nearby resident contacted in mid-August had not seen any young in the area.

Three other active loon nests were inadvertently approached to within 10m by me in a kayak or rowboat. In one case the loon flushed the nest; the others hunkered down on the nest but did not flush.

Table 3. Summary of boating activity in the vicinity of active loon nests.

Lake	Territory	Obs (min)	Type	Time	*n* boats	Distance from nest (m)		Duration (min)	
						Average	Range	Average	Range
Bertha		67	Weekday	Morning	6	130	100-160	20	2-33
Lower Whitefish	O'Brian Point	78	Weekend	Midday	7	94	20-240	9	1-37
Rush	Southeast	62	Weekend	Midday	21	46	40-120	1	0-6

The short time period of the pilot study did not allow for the assessment of boating surveys as an alternative method of data collection. In fact, only one party was actually encountered despite several hours of waiting at boat landing whose parking area was full.

DISCUSSION

Factors affecting disturbance on the Whitefish Chain

Preliminary data from this study suggests that loons on the Whitefish Chain of Lakes have a high tolerance for human activity. Territory occupancy appears to have remained stable since 1985 (Valley 1987). Nest success was somewhat lower than reported by Valley (1987), but compares favorably to other sites (Titus & VanDruff 1981, Kaplan & Tischler 2001). While it may be inappropriate to draw conclusions from a limited sample, loon occupancy and productivity on the Whitefish Chain of Lakes appear to reflect little change since 1985 (Valley 1987).

Previous studies have shown that loons may abandon the most suitable nesting habitat to avoid disturbance (Alvo 1981, Olson & Marshall 1952). Valley (1987) believed this was occurring on the Whitefish Chain in 1985, and results from this study support these findings. Despite the presence of at least one island in 66% of loon territories identified during this study, only 29% of the territories utilized islands for nesting. Several islands contained developed campsites, homes, or a popular swimming beach. In northern Minnesota, Ream (1976) found that 100% of loon pairs nested on islands if available and camping on islands limited productivity. Protecting island habitats may be important for maintaining loon populations, especially if land use practices result in the fragmentation of the adjacent shoreline.

Loons on the Whitefish Chain nested an average of 136m from the nearest development. Caron & Robinson (1994) found no significant increase in productivity as distance between nests and shoreline development increased. Heimberger et al. (1983) found that cottage density was a greater predictor of productivity than distance from individual cottages. Loons on the chain may have become habituated to human activity, however, disturbance was still documented in one of the three nest sites observed.

Vegetative cover (Titus & VanDruff 1981) and artificial nesting platforms (Piper et al. in Press) may mitigate reproductive impairment caused by human disturbance and shoreline development by providing protection for nests near human activity. Cattail marshes appear to be a much more abundant component of lake systems in north central Minnesota than in northern Wisconsin and Michigan (K. Tischler pers. obs.). Kelly (1992) found that where cattail habitats were present, nest success was also higher. Nearly half of all loon nests located during this study were associated with cattails. Artificial nesting platforms are a new addition to the Whitefish Chain of Lakes since 1985. Three loon pairs nested on floating platforms during this study and all successfully hatched young.

The popularity of the Whitefish Chain of Lakes for recreation is not a recent phenomenon. In fact, the level of use has not changed significantly since 1985 (MN DNR 1999). However, the type of watercraft using the Chain has changed--fishing and water skiing have declined while boat riding and jet skiing have increased in popularity (MN DNR 1999). In light of these findings, and the expectation that shoreline development will continue, an intensive disturbance study on the Whitefish Chain of Lakes is justified.

Recommended study design and considerations for 2002

Most previous human disturbance studies (Vermeer 1973, Ream 1976, Titus & VanDruff 1981, Heimberger et al. 1983, Valley 1987, Kelly 1992, Caron & Robinson 1994, Ruggles 1994) have compared loon productivity among use categories, often treating one category as the control (e.g., "high use" vs. "low use", "motorized" vs. "non-motorized"). These and additional studies (Smith 1981, Jung 1991) have also examined use levels on a lake-wide basis. The limitation with this approach is that comparisons may be obscured by variation within the system being categorized and confounding variables that may effect productivity. In the absence of a true control, Kaplan and Tischler (2001) suggested a comparison of nest success along a continuous measure of disturbance (where disturbance is nest-specific). They measured the frequency of use as well as the distance between travel routes and loon nests by conducting surveys in which canoeists recorded their travel routes on topographic maps.

Determining use patterns through surveys is not an optimal method for data collection on the Whitefish Chain of Lakes, however. Public access sites would be the best location to administer such surveys, and publicly-owned land is the source of only 28% of all boats using the lakes (MN DNR 1999). Unless use patterns of boats accessing the lakes from public access sites are not significantly different from boats gaining access through commercial or private property, results from surveys may represent a biased sample of lake-users. Furthermore, the expected error in users' judgement of distance on survey maps may be greater than the distance which would cause a loon to flush its nest, due to the large size of the chain and the high tolerance of loons to human activity.

It may be necessary to collect data at a finer resolution on the Whitefish Chain of Lakes than used by Kaplan and Tischler (2001) in order to assess loon response to activity. Nearshore disturbance by slow boat traffic (including non-motorized watercraft) and onshore disturbance by users who are camping or swimming may produce a greater threat to nesting loons than quickly-moving motorboats (McIntyre 1975, Caron & Robinson 1994, Kaplan & Tischler pers. obs.). The type, duration and proximity of disturbance events could be measured through direct observation of active loon nests from a cryptic location or through some method of remote sensing. The placement of cameras at nest sites may prove to be the most efficient method of collecting this data.

Using this approach, it is optimal to observe nests experiencing a wide range of use. If the distance between developments and nests can serve as any indication of relative disturbance level, there is some variation in use levels on the Whitefish Chain of Lakes.

Furthermore, boating data collected by the MN DNR (1999) can be used to estimate total use in the vicinity of individual loon nests.

Because boating activity may also effect loon fledging success (McIntyre 1975, Jung 1991, Caron & Robinson 1994) and since there is an abundance of anecdotal evidence suggesting detrimental effects of jet skis on loons, observations should continue in territories that successfully hatch young until the chicks are of fledging age (9 weeks).

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