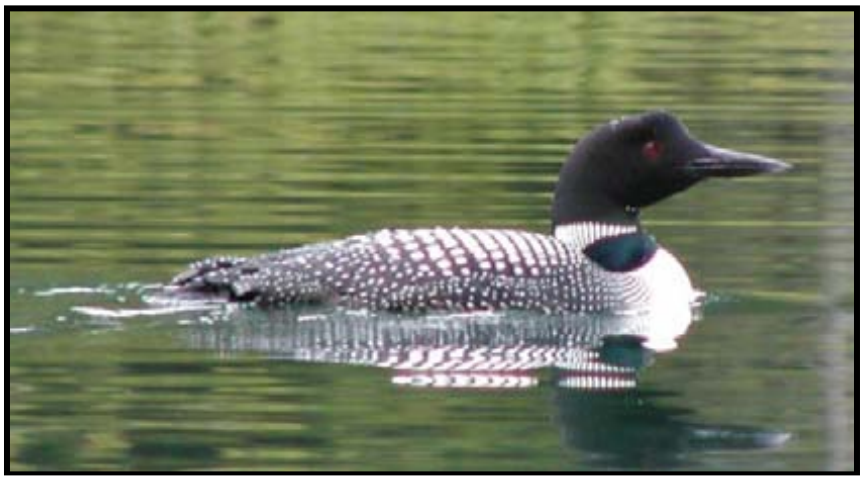
Conservation Plan for the Common Loon in Montana



MONTANA
Common Loon
Working Group

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2009

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Cover Photo: Common Loon (*Gavia immer*) by Chris Hammond.

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EXECUTIVE SUMMARY

Common loons (*Gavia immer*) breed on lakes in the forested regions of Alaska, Canada, and the most northern portions of the continental United States. Breeding habitat once reached south to Utah and California (Evers 2007). Breeding populations in Oregon, Utah, and California were extirpated during the mid-1900s (Evers 2007). Today, Wyoming supports about 19 to 25 breeding pairs, mostly in the northwest corner of that state, while Washington has fewer than fifteen territorial pairs (personal communications Dan Poleschook, Jr. and Ginger Gumm). Taylor (2001) documented successful breeding on only two lakes in northern Idaho.

Montana now supports the largest breeding population of common loons in the western continental United States with a 10-year average summer count of 216 individuals. This population consists of an average of 62 territorial pairs, 52 non-breeding "single" adults, and 41 chicks. Since surveys began in the late 1980s, the population has remained remarkably stable. Fecundity in Montana appears to be above average in comparison to many other states ranging between 0.66 and 0.70 chicks fledged per territorial pair.

Globally, the population of common loons is considered "secure" (G5 Ranking). Montana"s lists the common loon as a species of concern with a state ranking of S3B (NatureServe). Region 6 of the U.S. Fish and Wildlife Service lists common loons as a Species of Management Concern while the U.S. Forest Service in Region 1 lists it as a "sensitive species". The Montana Bird Conservation Plan, prepared by the Partners in Flight program, places the common loon as Level I, the highest level, on its Priority Bird Species List. The recently completed Montana Comprehensive Fish and Wildlife Conservation Strategy lists the common loon as a Tier I species (a species with the greatest conservation need).

Common loons are relatively long-lived birds with a relatively low reproductive rate. Data from other areas indicate that the average age of first-time breeders is about seven years old. Loons only lay only one to two eggs at a time. They will often renest if the first nest fails early in the season; the second nest rarely has more than one egg. They raise no more than one brood per year. It takes approximately 12 weeks for loon chicks to fledge from a lake. Both parents are needed to defend the territory and raise the young. In Montana, about 50% of loon nests fail each year due to natural causes (flooding, predation) and human factors (disturbance). Of the average 41 chicks that fledge from Montana"s lakes each year, only about 20% (less than10) are expected to survive to adulthood and return to Montana area to breed. Juvenile loons take three years to mature. They typically spend their first three winters on or near the western coast before returning to their natal area.

Loons are extremely territorial and sensitive during the nesting season. Disturbance of loon nesting areas by humans can cause annual nest failures and consequently affect long-term occupancy of lakes and population viability. If nests sites are protected through efforts such as habitat conservation, floating signs, information and educational programs, volunteers, and use of nesting platforms, these nest sites can continue to be successful. Montana has an active loon conservation network led by a group of concerned representatives from agencies, tribes, nonprofit organizations, industry, and landowners known as the Common Loon Working Group.

The CLWG has used a number of these tools to protect nesting lakes that has help to maintain a stable viable breeding loon population in Montana.

Montana Fish, Wildlife & Parks recently pursued funding from the U. S. Fish and Wildlife Service‟s State Wildlife Grants Program to complete research essential to future management of common loons. This funding led to six years of research on Montana‟s common loon ecology and also color banding of over 160 adults and chicks. Part of this grant was also used to update Montana‟s management plan for common loons and has resulted in this new Conservation Plan

This **Conservation Plan for the Common Loon in Montana** includes chapters on population management, habitat management, disturbance, research, information and education, and coordination. Each chapter contains a specific goal along with objectives and strategies for achieving or maintaining the goal. The document also includes numerous appendices including a list of all Loon Lakes with various classification codes (Appendix A). Appendix B includes a set of Best Management Practices to protect loon nesting habitat while also allowing some degree of development and recreational use of these areas. Appendix C provides an example and instructions on how to write a Lake Site-Specific Management Plan. This plan for lakes is a tool to anticipate and/or resolve potential conflicts for a specific loon nesting lake.

This document strongly recommends that the CLWG and associated agencies and organizations and individuals continue to work together to continue to:

1. Annually monitor common loons in May and July;
2. Maintain the current effective outreach, educational, and management programs;
3. Maintain data from annual surveys and band observations; and
4. Review and analyze productivity data annually to monitor trend.

The Plan also recommends that the CLWG continuously evaluate objectives and strategies, particularly if the population growth rate declines to below 1.0 for five consecutive years.

INTRODUCTION

Common loons (*Gavia immer*) have long been a symbol of the remote northern lakes and wilderness. Because of their eerie calls, striking plumage, fierce territoriality, and a habitat selection that coincides with people, the common loon has garnered a significant amount of national attention. In the United States, public interest in common loon habitat and ecology increased dramatically during the latter part of the 20th century. A number of private organizations have developed strong interests in loon ecology and conservation and include Maine"s Biodiversity Research Institute, North American Loon Fund (which spawned many state non-profit loon organizations), and many state loon societies. Similarly, state, federal, and Canadian wildlife resource agencies have increased their research and management efforts on common loons over the last 10 to 15 years, with gains in annual survey intensity, and knowledge of bio-accumulation of methyl mercury, migration, winter habitats, intra-specific strife, and general ecology. Today, these organizations cooperate with each other locally and nationwide to coordinate common loon inventories, research programs, and other management and educational activities that help maintain common loon habitat in much of its historic range. These organizations have recognized the overall concern about the effects that ever-increasing human development, recreational activities, and worldwide pollution may be having on common loon populations.

STATUS

The global population of common loons is considered "secure" (G5 Ranking) with a state ranking of S3B (NatureServe). Region 6 of the U.S. Fish and Wildlife Service lists it as a Species of Management Concern. The U.S. Forest Service in Region 1 lists the common loon as a "sensitive species". The Montana Bird Conservation Plan, prepared by the Partners in Flight program, lists the common loon as Level I, the highest level, on its Priority Bird Species List. The recently completed Montana Comprehensive Fish and Wildlife Conservation Strategy lists the common loon as a Tier I species (a species with the greatest conservation need).

DISTRIBUTION

General Distribution

Common loons breed on lakes in the forested regions of Alaska, Canada, and the most northern portions of the continental United States (Evers 2007). Historically, breeding populations of common loons existed across much of the northwestern United States including California, Idaho, Montana, Oregon, Washington, and Wyoming (Figure 1). Today, however, of the lower 48 states, Minnesota has the largest population of adult common loons with approximately 13,000, followed by Maine, Wisconsin, Michigan, and New York with approximately 4000, 3000, 2000, and 1000, respectively (Evers 2007). Wyoming supports about 19 to 25 breeding pairs, mostly in the northwest corner of that state, while Washington has fewer than five territorial pairs (Evers 2007). Breeding populations in Oregon and California were extirpated during the mid-1900s (Evers 2007). Taylor (2001) documented successful breeding on two lakes

in northern Idaho. Montana has the largest breeding population of common loons (*Gavia immer*) in the western continental United States supporting an average of 200 individuals (adults, juveniles, and chicks) each year. Montana"s common loon population exists at the southern most extent of the current western North American range and therefore population levels may fluctuate more than within core areas because fragmentation and local extinctions can reach high levels near population edges (Mehlman 1997).

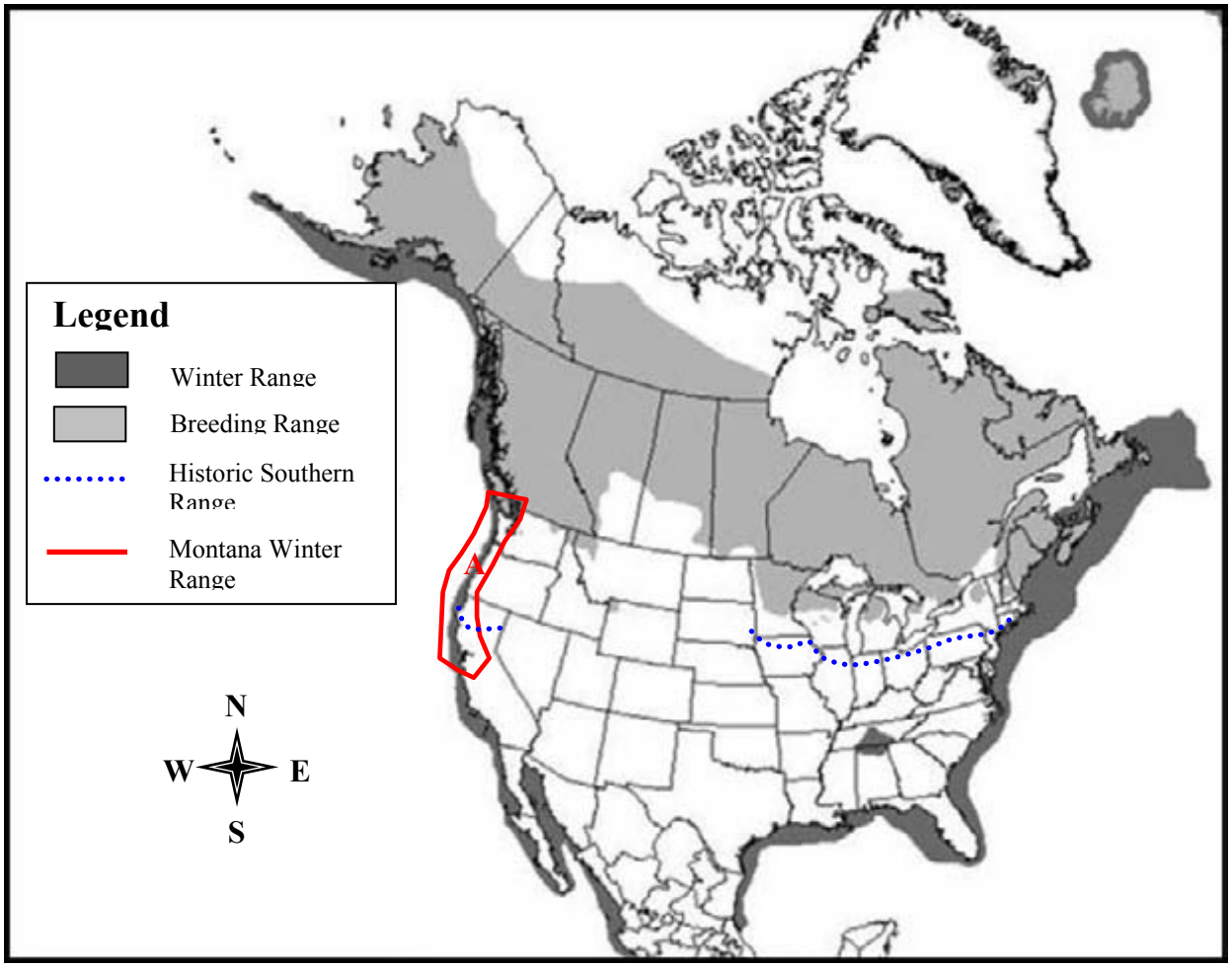

Figure 1. Distribution of the common loon in North America (modified from Evers 2007, McIntyre 1988). Polygon A depicts the winter range for Montana common loons based on band observations (Appendix D).

Montana Distribution

Most loon observations range from the Rocky Mountain Front west to the Idaho-Montana border with breeding limited to the northwest corner; however, breeding has occurred sporadically in other parts of the state (Skaar 1990) (Figure 2) and common loons are frequently observed on reservoirs and lakes throughout the state during migration.

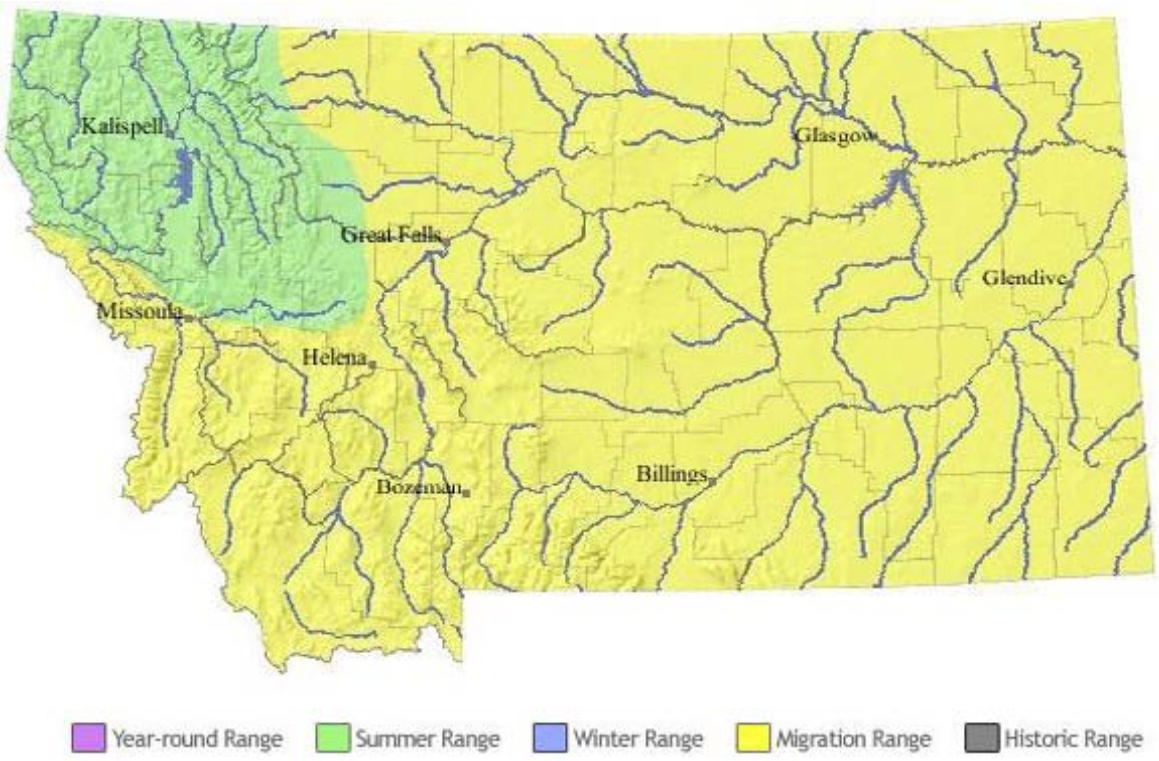

Figure 2. Range of common loons in Montana. Summer range is also core breeding range (Montana Natural Heritage Program).

Migration

The common loon population that breeds in Montana is thought to be relatively distinct from populations in central and possibly northwest Canada. Migratory loons captured in October 2006 on Flathead Lake and implanted with satellite transmitters moved to southwest inland lakes and the Gulf of California for the winter (Gullett 2008). A few of these loons then returned to central Alberta during the nesting season. In contrast, all the winter band re-observations or returns from Montana breeding loons have come from the west coast from Washington to mid-California (Figure 1, Appendix D). Several banded loons have been retrieved or observed during the spring or fall from lakes in Idaho, Washington, and Oregon. No data suggest at this point that Montana breeding birds spend any time in the southwest. Efforts are underway to begin banding birds and collecting data for the common loon population in British Columbia (personal communications Dan Poleschook, Jr. and Ginger Gumm).

BIOLOGY

General Ecology

Loons are piscivorous birds that evolved as diving specialists. The posterior position of the legs makes the loon an efficient swimmer, but severely limits its ability to walk on land. As a result, loons come ashore only to nest and breed, with nests typically located within three feet (1 m) of water (Vermeer 1973). They are a relatively long-lived species (25 to 30 yrs.) with delayed breeding maturity and relatively low fecundity (Evers 2002). Loons lay one or two eggs, rarely three, and if chicks can survive to fledging they have a considerably greater chance of survival (Croskery 1991). The average number of chicks fledged per territorial pair ranges from 0.29 to 0.96 for well-monitored populations (Table 1). Chicks surviving their first summer migrate and do not return for 2.5 years (McIntyre and Evers 2000). Most mortality for loons has been associated with the non-breeding season, during juvenile migration, or during the first 2.5 years when juveniles remain on the coast. The average age of first breeding was seven years, and adult (i.e., >3 yr. old) annual survival rates ranged from 0.91 to 0.97.

Subadult loons that survive to breed typically established territories within 10 miles (16 km) of their hatch site (Evers 2002). In Montana the distance for the only adult banded as a juvenile and then observed to establish a territory was over 19 miles (30 km) from Lake Rogers to Upper Thompson Lake‟s east lobe (Appendix D). Considering the poor pioneering capabilities of common loons, any sustained period of territory vacancy over even a small geographic area, associated with disturbance would negatively impact a population‟s ability to reoccupy those available territories. Abandoned territories or territories with no recruitment may remain vacant or become vacant because dispersal distance from nest site appears to be up to 40 miles (64 km), but usually around 8 miles (13 km) (McIntyre and Evers 2000).

Montana‟s loons breed on freshwater lakes arriving just as the winter ice melts off, usually in late March or early April. Skaar (1990) found that loons generally did not nest on lakes smaller than 13 acres in size and that when nesting on smaller lakes loons used surrounding lakes for foraging. His initial observations were later supported by the Montana Loon Ecology Project (Paugh 2006, Hammond 2008). Kelly (1992) reported from 1986 to 1990, over 50% of nests were in incubation by May 7 and 68% of the chick hatched between May 24 and June 7. Many territorial common loon pairs will renest in late May or early June if their nesting effort fails. Some hatches have occurred as late as the first week in July.

Reproduction and the recruitment rate of species with low reproductive potential is one of the important biological factors to monitor and consider in management. This is particularly true in common loons with the average age of first time breeders about seven years old. Based on research in many states, including Montana, the reproductive potential of loon depends on many factors. At the landscape scale, loons must be able to locate and select attractive territories. Research shows that important factors influencing this selection are the proximity to other territorial pairs and active feeding lakes (Hammond 2008) which in turn are most likely influenced by a loon‟s fidelity to its breeding and/or natal territory (Evers 2001). Although this appears to be counterintuitive, that a territorial species is highly attracted to already occupied

habitats for which they need to compete, it is beneficial to the species in the long term to take over an existing territory that already provides the necessary biological factors than to explore new unoccupied territories that may not provide those factors. In fact this habitat use pattern follows the ideal pre-emptive distribution model (Pulliam and Danielson 1991) where the best territories are occupied first and defended from competing loons.

Table 1. Fecundity (chicks fledged/territorial pair) estimates for North American common loon populations (Modified from Evers 2007). Fecundity value of 0.48 is equal to a population growth rate of 1.0.

Region	Fecundity Values
Maine (Rangeley Lakes)	0.29
Minnesota (Itasca State Park)	0.29
Ontario (Northwestern)	0.32
Minnesota (Boundary Waters Canoe Area)	0.37
Alaska (Kenai National Wildlife Refuge)	0.48
Michigan (east. Upper Peninsula)	0.51
New Hampshire (statewide)	0.52
Michigan (Seney National Wildlife Refuge)	0.59
Montana (statewide)	**(0.69)[a] 0.66[b] (0.7)[c]**
Vermont (statewide)	0.72
Michigan (Ottawa National Forest)	0.76
Michigan (Isle Royale National Park)	0.79
New York (Adirondacks)	0.96

[a] Estimate from 1986 to 1987 from the Montana Loon Study.
[b] Estimate from 1999 to 2003 from the Common Loon Annual Report.
[c] Estimate from 2006 to 2008 from the Montana Loon Ecology Project.

Another important biological factor is the availability of potential nest sites. In Montana loons generally select secure nest sites in sheltered bays and lee sides of islands and peninsulas with adequate substrate for nesting. Nests are usually located on the waters edge in areas with a water depth of one to three meters. Loons build up their nests with aquatic plant materials, but many nests are mostly matted down vegetation. However, loon nests have been observed on many different substrates such as logs, stumps, muskrat houses, gravel, and small sticks and pinecones (Montana Loon Ecology Project 2003-2008). Lakeshores that do not offer shelter from winds, waves, and large boat wakes are not suitable for loon nesting. Loons also generally select nesting locations that are secure from human development such as docks, boat ramps, lawns, etc. Second, there must be potential nest sites available. In Montana, loons have built nests on islands, shorelines, hummocks, and artificial platforms, constructing their nests of grasses/sedges, cattails, emergent vegetation, sticks and pine cones, and gravel (Montana Loon Ecology Project 2003 to 2008).

Overall reproductive success, or chicks that survive to fledge, depends on both the successful hatch of a loon nest and the survival of the hatched chick(s). The most influential factors on nest success in Montana were shoreline complexity, perimeter, and territory type (Paugh 2006). Shoreline complexity is a comparative figure relating the shoreline length to the circumference of a circle that has the same area as the lake. The smallest possible SDI value = 1.0 would be produced be a perfect circle, thus shoreline irregularities (e.g., coves, inlets) increase SDI. Territory types were classified as whole-lake territories where the loon pair defended an entire lake, partial-lake territories where multiple pairs defended territories on one lake, and multiple-lake territories where pairs defended and/or used multiple small lakes in a complex. Chick survival is estimated as a hatched chick that survives to fledge at 10 to 13 weeks of age, although, most research shows minimal mortality once chicks reach four to five weeks of age (Paugh 2006, Parker 1988). Kelly (1992) and Paugh (2006) documented relatively high chick survival for Montana, 0.91-0.93 and 0.77 respectively. Paugh (2006) found that a recreational user-hour measurement (Mean Angler Trips) negatively influenced chick survival, suggesting that boat use may have some impact on chick survival. The overall reproductive success of territories in Montana was most influenced by the complexity of the shoreline (positive influence, Figure 3) and the presence of islands (negative influence, Figure 4) (Hammond 2008).

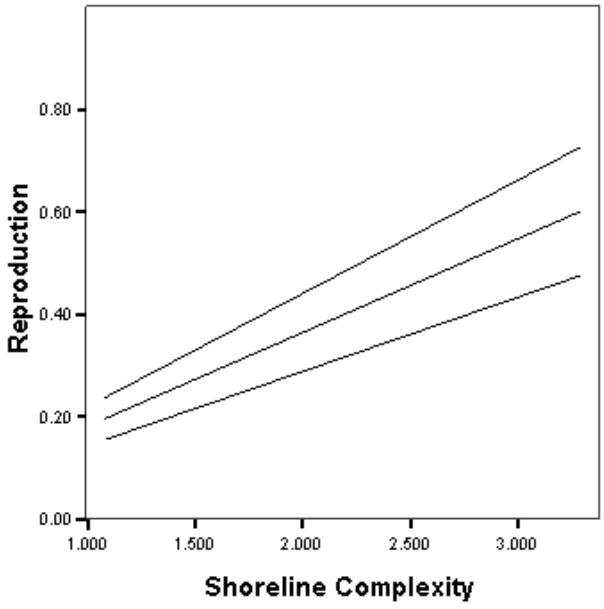

Figure 3. Relationship between shoreline complexity and common loon reproduction with 95% confidence, Montana, 2005-2007.

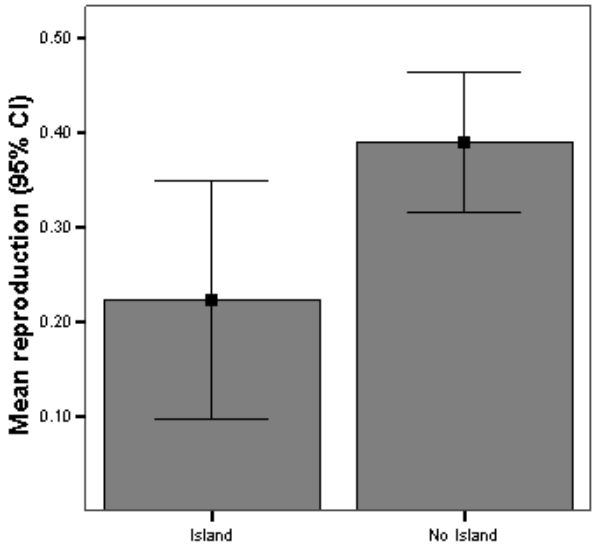

Figure 4. Common loon reproduction on lakes with and without islands for the common loon, Montana, 2005-2007.

Disturbance

Common loons are becoming increasingly affected by human disturbance with expanding access to remote lakes, inducing a decline in breeding populations in several areas (Caron and Robinson 1994, Clay and Clay 1997, Piper et al. 2002, Titus and VanDruff 1981, Vermeer 1973). Loons nest on popular fishing lakes throughout their breeding grounds (Vermeer 1973). These lakes also have the highest recreational use (Titus and VanDruff 1981, Vermeer 1973). Motor boats and canoes seem to be the main causes of nest flushing (Kelly 1992, Titus and VanDruff 1981, Vermeer 1973). When adults are flushed from the nest, eggs become vulnerable to predation by bald eagles, ravens, crows, etc. (Alvo 1981, Alvo and Blancher 2001, Croskery 1991, Titus and VanDruff 1981). In addition, eggs may be knocked off the nest or become overheated or chilled if adults are disturbed for extended periods (Croskery 1991). Fortunately, we have not observed a population decline in Montana (CLWG Annual Reports). This is most likely due to the comprehensive management and mitigation efforts enacted by the working group through outreach, education programs, and interns. Kelly (1992) demonstrated the negative effect of recreation on reproductive success could be effectively mitigated by placing floating signs around nest sites (Appendix F) and showed that the number of two-chick broods significantly increased in years where signs created voluntary closures.

Current Population

Based on the coordinated mid-July surveys initiated in mid-1980s, it appears Montana has maintained a fairly stable breeding population of common loons. From 1999 to 2008, the number of lakes surveyed ranged 141 to 205 with an average of 62±10 territorial pairs observed (Figure 5). Over this decade, the average annual production ranged from 35 to 52 with an average of 41

±14 (Figure 5). Unpaired or single bird counts have ranged from 30 to 77 (average53 ± 30) (Figure 5) and consistently comprised 17% to 35% of the total population (average of 24%) counted each year. In some years, many non-breeding loon lakes were not surveyed due to personnel needs for fire suppression, such as 2003.

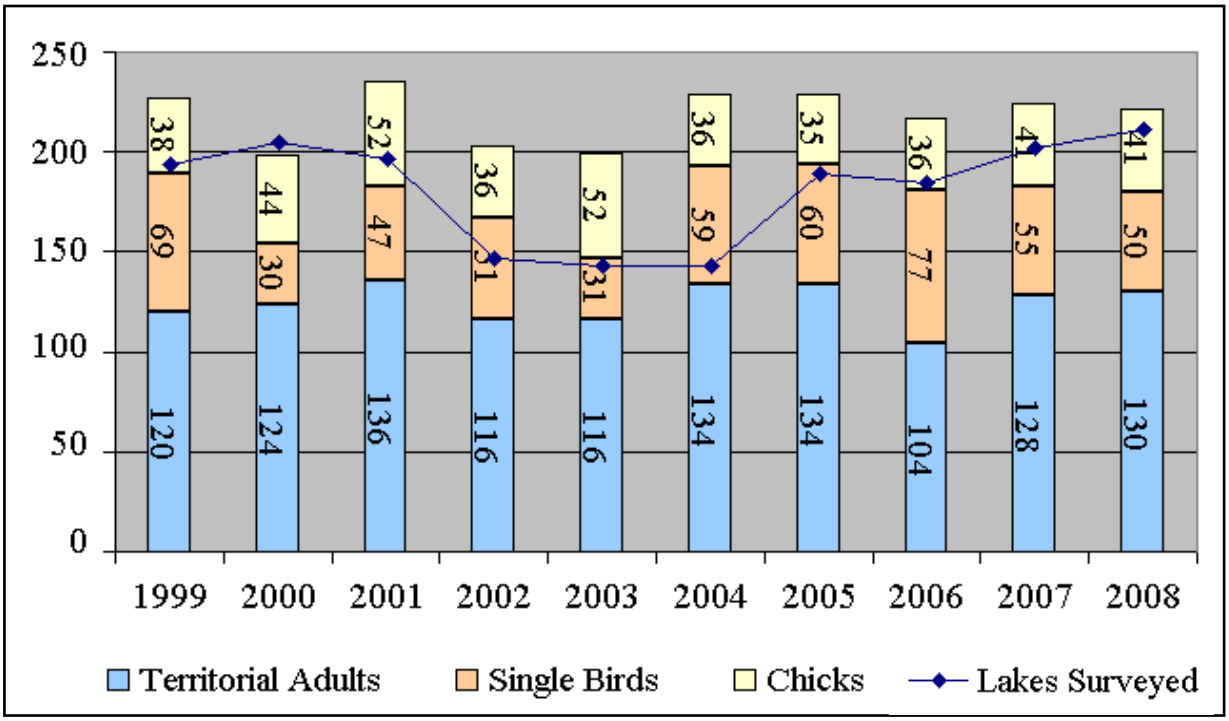

Figure 5. Numbers lakes surveyed and common loons observed on Loon Day, Montana, 1999-2008.

RESEARCH AND MANAGEMENT

History

In 1982, Don Skaar initiated the first comprehensive work on common loons in Montana. Through his extensive surveys across the breeding region, Skaar located 62 lakes with territorial pairs of loons. In 1990, Skaar completed the first management plan for common loons in Montana. This plan set in motion a number of subsequent research and management efforts aimed to maintain a strong and viable population of breeding common loons in Montana. He recommended future research focus on the effects of increasing recreational use and development on common loon nesting success and persistence in the region.

Shortly after the work of Skaar, the project then known as the Montana Loon Study began its transition into a non-profit organization, the Montana Loon Society. During the transition, Lynn Kelly finished her Master‟s research on the effects of human recreation on loon productivity. Her results (Kelly 1992) led to the implementation of the voluntary nesting area closure program using floating signs and public education. Skaar and the Montana Loon Society also initiated a

coordinated annual mid-July Loon Day survey on all possible loon nesting or occupied lakes using help of agency staff and numerous volunteers. In the mid 1990s, the Montana Natural Heritage Program developed a centralized database for all Loon Day observations. Through cooperation with Montana Fish, Wildlife, and Parks, the Heritage Program continues to store annual survey data. Pat Dolan with the Lolo National Forest completed The Common Loon (Gavia immer) in the Northern Region: Biology and Management Recommendations for loon lakes in USDA Forest Service Region 1.

Recognizing the need for collaboration in managing common loons in Montana, a team of biologists from both government and non-government agencies including Montana Department of Fish, Wildlife and Parks (FWP), Montana Department Of Natural Resources (DNRC), USDA Forest Service (USFS), Glacier National Park, Plum Creek Timber Company, Avista Corporation, Confederated Salish and Kootenai Tribes, the Montana Loon Society, and private citizens created the Common Loon Working Group (CLWG). The working group now also includes members U.S. Fish and Wildlife Service, University of Montana, The Center for Biological Diversity, lakeshore homeowner representatives, and other interested citizens and organizations. The CLWG usually meets twice a year and is open to anyone interested in common loon management and conservation. Today, this group helps coordinate annual common loon monitoring and management activities, secures funding for research and management programs such as the Loon Ranger program, and compiles annual reports and summaries. This group also worked with the lead author to complete this document, an updated Common Loon Conservation Plan for agencies to adopt for Montana.

Loon Ranger Program

In 2000, the CLWG implemented a Loon Ranger Program modeled after a Loon Ranger program was initiated in New Hampshire. Using FWP"s student summer internship program, the CLWG typically selects two or three student interns to be "Loon Rangers" from early May through mid July (Appendix J). After training, these students work at public access sites and with homeowner"s organizations, providing information to the recreating public about the effects of human activities on loon nesting, searching for banded loons and active nests, and placing floating signs around actives nest sites, where warranted (Appendix F). The Loon Ranger program has broadened to include several seasonal Forest Service wildlife technicians. All loon rangers provide public educational pamphlets; give campfire presentations, and presentations to homeowners" associations and other groups (Appendix H). The CLWG has documented that the Loon Ranger program has enhanced common loon nesting success and chick survival (Bissell 2002).

Recent Research

Since the early 2000s, the northwest Montana agencies and non-profit organizations have worked together to fund and complete several research projects on the nesting ecology of common loons. Montana Fish, Wildlife and Parks used funds from the State Wildlife Grants program (funded by the U.S. Fish and Wildlife Service for nongame species) and contracted with two universities to complete two master theses research projects on common loon nesting ecology and population dynamics. The Confederated Salish and Kootenai Tribes under the same

grant investigated migration routes and patterns of common loons staging on Flathead Lake. In addition, Montana Fish, Wildlife and Parks received results from our ongoing collaboration with a nationwide genetics project. The early results only indicate the sex of juveniles. Note that the only way to sex chicks is by DNA. Interestingly, the population has nearly a 1:1 ratio with 13 females and 15 males. The results of new research and the continued annual trend monitoring by the CLWG over the last decade has led to a need to update the original 1990 Conservation Plan.

MANAGEMENT AND CONSERVATION RECOMMENDATIONS

To reflect Montana‟s overall interest in maintaining and conserving common loons, the CLWG and FWP jointly pursued funding from the State Wildlife Grants Program to complete research essential to future management of common loons. Part of this grant is being used to revise and complete a new Common Loon Conservation Plan.

This Common Loon Conservation Plan includes sections on population management, habitat management, disturbance, research, information and education, and coordination. Each section contains a specific goal along with objectives and strategies for achieving or maintaining the goal. The document also includes numerous appendices including Best Management Practices for landowners near loon nesting lakes (Appendix B), example and how-to guide for Loon Lake Management Plans (Appendix C), and other summary biological data important to maintaining a viable population of breeding common loons in Montana.

This document asks that the CLWG continue annual monitoring, maintain the current outreach and educational programs, and review and analyze productivity data annually. The Plan also recommends that the working group continuously evaluate objectives and strategies, particularly if the population growth rate, λ, remains less than 1 for five consecutive years.

POPULATION MANAGEMENT

Population Management Goal:

Maintain a stable common loon population by monitoring important demographic parameters within known breeding areas of Montana. The Montana Common Loon Working Group will reevaluate this plan if a population decline is noticed over any five year period.

Conserving wildlife populations begins with a comprehensive understanding of the factors and dynamics responsible for population growth and stability. Information regarding important vital rates and how these vital rates influence the population growth rate (lambda or λ) provide managers with valuable insight for the best management strategies. Two particularly useful analyses for identifying key vital rates and risk are sensitivity analysis and population viability analysis.

In 2004, a sensitivity analysis and life-stage simulation analysis was conducted for Montana‟s common loons (Hammond unpublished) to determine which vital rate had the most influence on λ. That vital rate was fecundity, defined as the number of female chicks produced per breeding female. Current management strategies are designed with this in mind, and management actions implemented by multiple agencies and landowners specifically target maximizing chick production. Their combined efforts have the greatest influence on population growth and the long-term viability of Montana‟s common loon population.

Viability is defined as the likelihood of the persistence of a well-distributed population for a specified time, typically a century or longer (Morrison and Doak 2002). Two separate population viability analyses, count-based and demographic, were used to assess the viability of the loon population in Montana for 50 to 200 years into the future. The count-based model used existing count data from the 2005 Annual Loon Report by Gael Bissell MFWP. The demographic model used vital rates from existing literature to supplement the limited vital rates available for the Montana population. The deterministic lambda from the count-based model (λ = 1.044) was nearly equal to the demographic model (λ = 1.042). The count-based model generated extinction probabilities from 0.00008 at an initial population size (N_0) of 230 loons to 0.88 at an initial population size of 51. For the demographic model, extinction probabilities were 0 for all population sizes except for N_0 = 51. It has been shown that excessive variance can cause a population viability analysis to be overly pessimistic. The variance in the count-based model was over twice the variance of the demographic model, leading to much higher predictions for the risk of extinction. These measurements are best used as a relative measurement and not an absolute prediction of the extinction risk of loons in Montana. There is minimal to no extinction risk to the loon population in Montana if habitat and disturbance conditions as well as information and education efforts remain the same.

Objectives and Strategies

- Maintain an average annual population size of at least 62 territorial pairs with an average annual nest success rate of at least 50% when averaged over a five year period. If the averages fall below 56 pairs or 40% the Common Loon Working Group will meet to determine the cause(s) of the decline and develop management recommendations to return the number of territorial pairs or success rate to the acceptable level.
    - Estimate annual and average annual (over five years) population size, reproductive success, and recruitment.
    - Conduct coordinated and standardized survey to count territorial pairs, single birds, subadults, and chicks (young of the year) in order to estimate nest success and fledging success (Appendix A, Appendix E, Monitoring).
        - Determine band status of all breeding adults by coordinating band reobservation efforts to maximize the use of volunteers during the May surveys (Appendix D).
        - Maintain annual May (Saturday closest to the 15th) and July (3rd Saturday) surveys using the recommended survey frequency for each lake (Appendix A) and the standard survey protocol (Appendix E).
        - Where possible, survey other lakes that may have loon activity at least once every 3 to 5 years (Appendix A).
- Maintain an average annual fecundity rate of greater than or equal to 0.60 chicks fledged per territorial pair. If the averages fall below 0.48 the Common Loon Working Group will meet to determine the cause(s) of the decline and create management recommendations to return the ratio to the acceptable level.
    - Use July survey data to estimate fecundity (chicks fledged per territorial pair).
    - Compare fecundity estimates to population model included in USFWS Loon Conservation Plan to estimate λ (Fecundity when measured as chicks fledged per territorial pair should be at least 0.48 for $\lambda = 1$).
- Estimate additional important demographic rates.
    - Use band observation data to estimate adult minimum survival, territory fidelity, and juvenile recruitment.
    - Use marked birds to explore dispersal distance of displaced breeders and recruited juveniles.

- Use survey data to estimate annual territory success.
- Estimate long term lambda using total population estimates.
- Estimate lambda using the demographic model with multiple simulations. Regularly update the model based on band observation data.

HABITAT MANAGEMENT

Habitat Goal:

Maintain current number and spatial distribution of nesting territories as well as identify and protect quality potential territories that provide suitable nest and nursery sites.

The degree to which an individual animal can successfully interact with a landscape to meet its biological needs indicates the degree of habitat suitability associated with that landscape. Suitable habitat provides individuals with everything they need for survival and reproduction, such as adequate food, breeding sites, and security for successfully raising young. Connectivity between fragmented areas of suitable habitat via dispersal of juveniles increases the potential for gene flow among populations and is essential for the long-term stability of a population. To ensure long-term viability of a species, managers must take the necessary steps to establish and maintain adequate areas of suitable habitat as well as connectivity between populations.

Establishing patterns of habitat use by common loons is important for developing an appropriate management strategy. The configuration and quantity of common loon breeding territories likely depends on several factors; most importantly philopatry and dispersal (Evers 2001). Philopatry, measured as territorial fidelity from year to year, is high in loons, with a mean of 81% (McIntyre and Evers 2000). Limited data on territory fidelity for Montana also produced a mean of 81% (60% for males and 94% for females) (MFWP unpublished data). Hammond (2008) revealed that the most influential factors explaining territory occupancy in Montana were the number of territorial pairs and feeding lakes within 6 miles (10 km). Breeding adult dispersal distances are usually around 1.2 miles (2 km), while juvenile dispersal is around 11 miles (18 km) (Evers 2007). However, a breeding female in Montana dispersed over 19 miles (30 km) from Upsata Lake to Colburn Pond, well beyond distances cited in other research. The reoccupation of territories is therefore assumed to be the result of juveniles returning as adults. Thus, any sustained period of territory vacancy, over even small lake complexes, could negatively affect a population‟s ability to reoccupy those available territories.

Habitat characteristics of breeding territories for common loons are well documented (Evers 2007, Newbrey 2002, Paugh 2006, Titus and VanDruff 1981, Vermeer 1973). Specific to Montana, Paugh (2006) investigated nest scale and lake scale habitat characteristics in relation to nest success and chick survival and found that shoreline complexity, perimeter, and territory type had the greatest positive effect on nest success. Highest nest success was observed on lakes less than 60 acres (24 ha) in size and the lowest on large lakes with multiple loon pairs. Paugh (2006) observed that chick survival was best estimated by landscape scale habitat features, primarily the number of feeding lakes within 6 miles (10 km). His research should alert managers that not only are lake scale habitat factors important to loon management, but so are landscape scale factors, especially complexes of quality lakes.

Hammond (2008) continued and expanded on the research conducted by Paugh (2006) to explore demographic and landscape relationships. Model results from simulations provide managers with expected population responses prior to considering management actions. Additionally, probabilities of occupancy, along with rates of colonization and abandonment, will help to prioritize conservation efforts so managers can protect lakes that have the greatest chance of remaining occupied over time while continuing to produce offspring.

Most of Montana"s common loon breeding is concentrated in the northwest part of the state north of Missoula and west of the continental divide. There are a few exceptions of nesting along the east front of Glacier National Park on the Blackfeet Indian Reservation and outside of Yellowstone National Park. The areas of highest breeding densities (Figure 2) are west of Kalispell along the Highway 2 to the Thompson Chain of Lakes, north of Whitefish along Highway 93 north to Eureka, and along Highways 83 and 200 including the Swan, Clearwater, and Blackfoot River valleys. Additional breeding takes place in or adjacent to Glacier National Park (Figure 2).

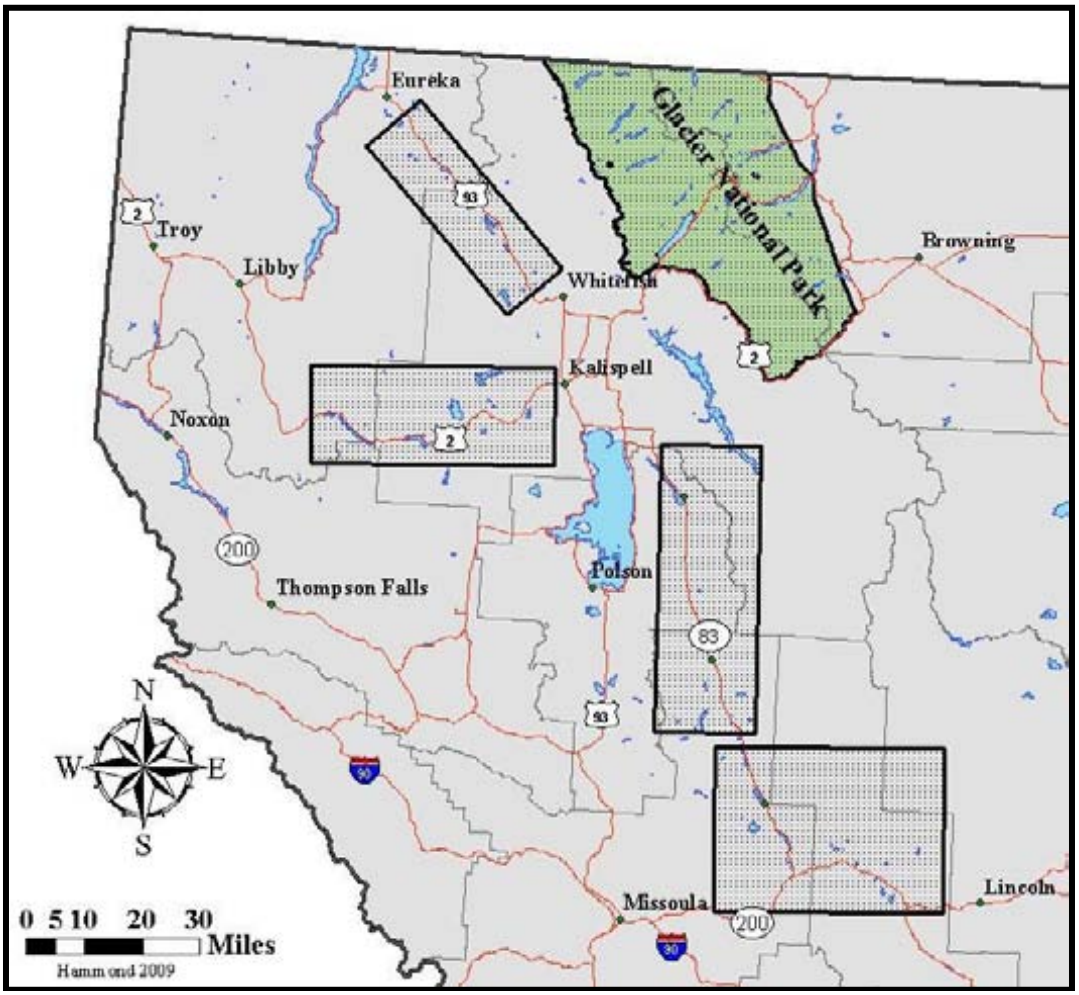

Figure 6. Concentrations of breeding common loons in Montana.

Objectives and Strategies

- Protect and conserve loon habitat.
    - Assess risk or identify existing areas of conservation concern at multiple scales (nest site, lake, and landscape).
    - Use territory history, occupancy probabilities, and reproduction to prioritize protection (Appendix A).
    - Identify opportunities to conserve important habitats including nesting and nursery habitat on lakes owned by landowners likely to sell, subdivide, or lease and specifically target education efforts (Appendix H) and the importance of relationship building with these landowners.
    - Inventory loon territories/lakes for other species (especially species of concern and threatened and endangered species) and sensitive habitat types (e.g. wetlands).
    - Use land conservation easements, land acquisitions, or other management plans where ever possible to protect nests/territories/lakes at risk of loss due to human impacts.
- Develop lake/site specific management plans that address local concerns or risk factors to ensure long term availability of each nesting territory (address development, no wake regulations, land ownership patterns, etc.) (Appendix C).
    - Local coordinators and/or biologists monitor proposed shoreline developments and no wake regulations of all breeding lakes and high potential lakes and actively participate in all levels of planning to provide comments to city and/or county planners and homeowners associations.
    - Identify lakes where water fluctuation is a primary cause of nest failure and coordinate with local water control agencies to mitigate water fluctuations where possible. Otherwise, consider the use of floating islands (Appendix G).
    - Record locations of all current, past, and suspected nesting and nursery sites.
    - Identify location, type, and impacts of current and probable future disturbance on nesting and nursery habitat.
    - Explain and diagram floating sign placement around known nest locations and the placement of onshore signs (Appendix F).

  - Describe historic and current public issues, concerns, and conflicts (e.g. lakeside trails, float plane use, fishing pressure).

  - Identify the amount of information and education effort needed (Appendix H).

- Reduce impacts of existing and future shoreline development on lakes that provide quality loon habitat.

  - Provide counties model regulations and Loon Friendly Best Management Practices to incorporate into regulations, neighborhood plans, and recommended standards and guidelines for developing on loon lakes (Appendix B).

  - Provide homeowners/landowners and agencies with lake management plans showing nest and nursery sites and make recommendations for setbacks, season closures, dock location, wake restrictions, etc (Appendix C).

  - Maintain and enhance mitigation efforts to minimize effects of shoreline disturbance on nesting loons.

  - Federal agencies, state agencies, and private landowners apply the Loon Conservation Plan and BMPs (Appendix B) before choosing sites for recreation facilities, homes, or other developments.

- Create contribution programs to collect donations for conservation efforts from homeowners associations, local conservation groups, and other entities.

- Implement generic recommendations and considerations for the use of artificial nesting platforms (Appendix G).

- Implement generic recommendations and considerations for the use of floating signs (Appendix F).

- Implement territory ranking system using probability and coordinator codes (Appendix A, Appendix C).

DISTURBANCE

Disturbance Goal:

Minimize breeding season (April 15 to July 15) disturbance throughout known common loon breeding areas of Montana.

Common loons are impacted by human disturbance to an increasing degree. Loons spending more time off the nest leave eggs vulnerable to predators and cooling (Christenson 1981). This has induced a decline in breeding populations in several areas (Caron & Robinson 1994, Clay & Clay 1997, Piper et al. 2002, Titus & VanDruff 1981, Vermeer 1973). This type of response is suspected in Montana, but quantifying it is complicated because of increases in observation and education protocols implemented 1989 (Bissell 2006).

Kelly (1992) showed that loons spend over twice the amount of time off the nest when the cause of nest flushing is human related (i.e. boats or people walking the shoreline). Her study also showed that flushing distances decreased by 50% from 460 ft (140 m) during the first week on the nest to only 230 ft (70 m) during the fourth week on the nest (Kelly 1992). In addition, high levels of boat-related disturbance can cause formerly occupied territories to be less attractive to potential new pairs. In some instances wakes from passing boats can erode nesting habitat and flood existing nests. There are also concerns about the impact of personal watercraft on loons. Although not thoroughly studied, the effects of personal watercraft on loon behavior in Montana are apparent. Loons with chicks stop feeding or loafing and assume an alert posture when they hear personal watercraft approaching, even though the vehicle is still at a great distance (estimated to be over 300 to 400 yards). Incubating loons also tended to lower their head, in the presence of personal watercraft at greater distances than fishing and other boats (Figure 7). This behavior was not observed when fishing or ski boats approached at the same distance and speed. Floating signs set at 100-150 yards tended to mitigate the effects of all motorized craft near loon nesting areas during the nesting season in the Clearwater drainage on their nests, with a lowered head, in the presence of personal watercraft. It was shown that the number of 2 chick broods increased significantly after the placement of floating signs and on shore signs when disturbance was a factor (Kelly 1992).

Figure 7. A nesting loon's response to disturbance.

Considering the poor pioneering capabilities of common loons, any sustained period of terri associated with disturbance would negatively impact a population's ability to reoccupy those available territories. Abandoned territories or territories with no recruitment may remain vacant

or become vacant because dispersal distance from nest site appears to be up to 40 miles (64 km), but usually around 8 miles (13 km) (McIntyre and Evers 2000).

Refer to Appendix B and Appendix C for more information and recommendations regarding mitigation measures for disturbance. Refer to Appendix E for photos of common loon responses to disturbance.

Objectives and Strategies

- Minimize recreation related impacts in nest and nursery areas (See Information and Education Chapter and Appendix H).
    - When necessary use floating signs and/or onshore signs to protect nesting loons and follow recommended protocol for sign use (Appendix C, Appendix F).
    - Partner with homeowners associations and outdoor programs to disseminate loon conservation material (See Information and Education Chapter and Appendix H).
    - Time near-shore disturbance (i.e. timber harvest, fuels reduction, boat launch repairs) within 150 yards (140 m) for dates outside of breeding season (August 1 to May 1) and coordinate with the area coordinator (Appendix A, Appendix B, Appendix C).
    - Assign a hazard rating to territories, nest sites, and nursery areas. See Appendix C for an example.
- Measure areas of increased disturbance and concentrated recreational use to update the conservation plan (Appendix B, Appendix C).
    - Collaborate with management agency personnel to obtain numbers and trends of campers/day use in core population areas.

COORDINATION

Coordination Goal:

Maintain and improve communication, coordination, and collaboration by all entities involved in conserving common loons in Montana.

Since its inception in 1998, the Montana Common Loon Working Group (CLWG) has established communication, collaboration, and cooperation among public agencies, private entities, non-profit organizations, universities, conservation organizations, homeowners associations, and individuals interested in the conservation of the common loon in Montana. Over the years partnerships were formed. Through its technical and research guidance, the CLWG established the Loon Ranger Program and assisted with the Montana Common Loon Ecology Project. The program has apparently mitigated, to some degree, the negative effects of shoreline development and disturbance observed in other areas of the United States while the Montana Common Loon Ecology Project provided explanations for previously unanswered questions. Through extensive coordination efforts the CLWG has ensured the persistence of the common loon population in Montana.

Objectives and Strategies

- Improve and maintain coordination between Montana Fish, Wildlife and Parks, Montana Department of Natural Resources, Montana Natural Heritage Program, U.S. Forest Service, Glacier National Park, Confederated Salish and Kootenai Tribes, Montana Loon Society, Plum Creek Timber Company, Avista, Blackfeet Nation, and other interested organizations.
    - Obtain new partners for the Montana Common Loon Working Group.
    - Obtain agency and partner cooperation regarding the objectives and strategies outlined in the Conservation Plan.
    - Ensure the CLWG continues to meet at least twice annually, generally in February and July.
    - Secure annual interagency funding agreements from all agency members of the working group to ensure that education and monitoring efforts continue.
    - Ensure the Montana Natural Heritage Program remains a primary source of common loon information for the public.

  - Ensure coordinators communicate with co-chairs throughout the breeding season and ensure intern supervisors coordinate with participating agencies on roles and responsibilities.

  - Recruit additional volunteers/citizen scientists and ensure they are trained and know appropriate contact and safety information (Appendix A, Appendix J).

  - Ensure coordinators follow protocol for the rescue of live common loons, the recovery of dead loons, and the collection of other biological samples (Appendix I).

  - Provide assistance for loon conservation or management activities to other working group members.

  - Encourage partnerships with other organizations (Ducks Unlimited, Trout Unlimited, Flathead Wildlife Inc., etc.).

  - Encourage coordination of all aquatic research projects on lakes with nesting loons.

- Establish annual Loon Ranger internship positions for the areas with the highest densities of loons (i.e. Kalispell West, Kalispell North, Clearwater/Blackfoot).

  - MFWP will continue to support two to three interns (not necessarily providing funding) through the state‟s intemship program.

  - Internship supervisors and coordinators will be agreed upon at February CLWG meetings.

- Establish continuous and reliable funding and coordination for research and internship programs.

  - Develop an Adopt-A-Loon program through the Montana Fish, Wildlife and Parks Nongame Wildlife Checkoff.

  - Promote and advertise Montana Loon Society vehicle license plates.

  - Establish memorandums of understanding between Montana Fish, Wildlife and Parks, Montana Loon Society, U.S. Forest Service, and Montana Department of Natural Resources, as needed.

  - Establish annual Loon Ranger budget with Montana Loon Society, regarding funding for positions.

  - Fish, Wildlife and Parks pays for biological samples except when a carcass is used for study skin or taxidermy in which case the agency requesting the skin will pay.

- Encourage the continuation of the Citizen Science Loon Program in Glacier National Park.

- Establish communication with biologists in Canada and neighboring states to coordinate and share data for surveys conducted within approximately 20 miles (60) km of the border.

- Establish communications/partnerships with Audubon and other groups, along the coast and migratory lakes, and neighboring states to increase band observations.

- Encourage enforceable regulations that benefit common loons.

  - Cooperate with MFWP enforcement and other agencies to obtain enforceability of onshore signs and floating signs.

  - Cooperate with enforcement to establish thresholds for disturbing and harassing common loons through existing wildlife disturbance and harassment laws and ensure that interns and all field personnel are familiar with the procedures for reporting potential violations (Appendix J).

- Implement no-wake zone rules as part of lake management plans (Appendix C).

MONITORING

Monitoring Goal:

Implement effective monitoring programs and strategies for all concerns facing common loons through collaboration and coordination with all members of the Montana Common Loon Working Group.

Successful management of any wildlife population relies on extensive monitoring of several population parameters, as well as threats that may confront the population. Biologists, technicians, researchers, interns, and volunteers have diligently surveyed Montana‟s loon population for over 25 years collecting information pertinent to management of the population. Recent research has banded more than 50% of the breeding population and nearly 100 juveniles. In the past 5 years we have recovered or had birds observed all along the Pacific Coast from just north of Seattle, WA south to Santa Barbara, CA. Continued collection of this data would provide managers with a long-term regional specific survival, fidelity, wintering area, and dispersal data set. Band confirmations during the breeding season are best collected during May and June as some breeding pairs may nest, fail, re-nest, fail and not be on territory for July surveys. In addition, CLWG recognized the need to monitor risks to population and have established a working relationship with the Biodiversity Research Institute to analyze blood samples for methyl-mercury and other heavy metal contaminants (Figure 8). A well designed monitoring program will ensure that no data are lost and Montana will ultimately benefit in the information it will gain for years to come.

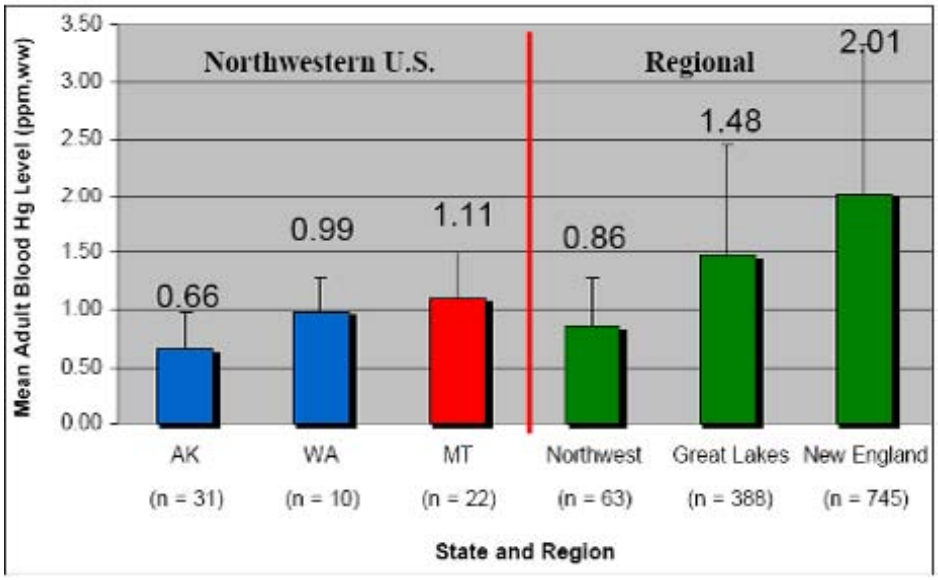

Figure 8. Mean adult common loon blood mercury (Hg) levels, 1992-2003 (from Savoy 2004).

Objectives and Strategies

- Monitor loons on breeding lakes during the May survey, and, if possible, make every attempt to identify birds observed on other lakes as marked or unmarked.
    - Secure high quality spotting scopes for personnel collecting field data.
    - Area coordinators (Appendix A) prioritize collection of observations of known banded breeding birds in respective areas.
    - Emphasize responsibilities of loon rangers to include band observation collection on lakes with loons banded as adults (Appendix D, Appendix J).
    - Coordinators obtain confirmation as soon as possible and provide updates to band observation data collector every two to three weeks during the breeding season.
    - Recruit wildlife biologists, technicians, and volunteers from local Audubon chapters, Montana Loon Society, etc. to assist with band observations.
    - Encourage the observation of single birds to identify juvenile recruitment or transient adults via bands (Appendix D).
    - Report all observations of adults banded as juveniles to co-chairs immediately as this is vital data for estimating recruitment of future breeders into the population.
    - Collect use related data at public access sites.
    - Collect observational data on type, location, and duration of watercraft use (canoe, float tube, personal watercraft, boat, etc.).
- Enhance the common loon database currently managed by MFWP (Montana Natural Heritage Program).
    - Create databases for the following: Mortality and Recovery Information, Recruited Birds from Marked Population, Marked Birds, Annual Band Observation, and Site Specific Management Plans.
    - Link all databases by a unique lake identifier (LLID).
    - Create centralized website/location (storehouse) for Montana loon research and other related documents (Theses, Management Plans, Annual Report, Biodiversity Research Institute Reports, Fish, Wildlife and Parks reports, etc).
    - Ensure that loon observation data are entered in timely manner (no later than September 15th).

- Maintain working relationship with the Biodiversity Research Institute (BRI) and other entities to monitor bioaccumulation of environmental contaminants and recoveries.
    - Assign individual to work with BRI to track banded bird recoveries.
    - Assign individual to collect and deliver samples (egg shells, whole eggs, recovered birds) to appropriate destination. Present results as they are collected at CLWG meeting (Appendix I).
- Contract to band more loons either annually or once every five to seven years to maintain marked population of at least 50% of the breeding adults on core lakes where in order to maintain the banding dataset into the future.

INFORMATION AND EDUCATION

Information and Education Goal:

Provide agencies and the public with the best available science and information related to factors affecting common loons, their management, and ongoing research.

Few bird species are more recognizable than the common loon. Whether it is the beautiful black and white plumage or the unmistakable vocalizations, the loon symbolizes wildness. As such the common loon garners nationwide attention made obvious by the number of organizations dedicated to its conservation. Successful conservation strategies require public awareness and involvement. Creating and distributing information for loon conservation will increase the public‟s understanding of current and future conflicts and illustrate the uniqueness of Montana‟s common loon population. In addition, education on how to avoid impacts, how to use BMPs, or how to use other tools helps decision-makers recognize the sensitivity and relative rarity of common loons.

The CLWG implemented the highly successful Loon Ranger Program in 2000 (Appendix J). Loon Rangers are often students, technicians, or volunteers coordinated by the CLWG using limited agency budgets and various grants and donations provide by organizations. A Loon Ranger‟s primary responsibility is providing education at boat launches on lakes with nesting loons. They are also responsible for locating nests, identifying problems, and collecting important territorial pair data and chick data. In addition, the rangers place protective floating signs around at risk nests (Appendix F) and floating platforms (Appendix G). The success of the floating sign program is tied to the information and education provided by Loon Rangers pertaining to the conservation and management of loons. The program remains a vital part of the conservation strategy of loons in Montana. Glacier National Park initiated a citizen science loon project in 2005 modified from the loon ranger program with a coordinator to train and direct volunteers to survey loon lakes and develop educational materials; funding for this project is uncertain beyond 2008.

Objectives and Strategies

- Provide consistent education and outreach programs to the public (Appendix H).
    - Provide information and education standards for common loon conservation.
    - Maintain and advertise the Loon Education Trunks at the Murphy Lake (Fortine) and Tally Lake Ranger (Kalispell) District Offices, the Montana Natural History Center (Missoula), and the Confederated Salish and Kootenai Tribes (Polson).
    - Distribute campfire talk outlines and materials.

- Distribute Montana‟s Loons PowerPoint presentation.
- Distribute lead-free fishing weight samples and lead pamphlets.
- Distribute the Montana Loon Society pamphlet.
- Distribute bookmarks with loon conservation message.
- Develop a Living with Loons information pamphlet.

- Provide training to promote safety of Loon Rangers and all others in field and with the public.
- Ensure all new biologists, citizen scientist volunteers, interns, and bio-techs are trained each spring prior to field time.
  - CLWG sets training date(s), makes it a priority for new interns and technicians to attend, and designates first line supervisors for interns.
  - Create training manual that can also be used when individual are not able to attend training. Supervisor can use manual to ensure individual receives proper training and information prior to being sent out alone (Appendix J).
- Define roles of working group members in relation to information and education.
  - Interns will consistently visit public access sites and campgrounds to communicate with recreationists.
  - Coordinators, biologists, and interns will describe the situation for Montana‟s common loons and explain the purpose of floating buoys and conservation measures at various public speaking opportunities.
- Work with counties, planners, realtors, lakeshore homeowners associations, and others where there is common loon habitat to develop Site Specific Management Plans and loon-friendly BMPs.
  - Develop model regulations for areas with common loon habitat.
  - Develop standards and guidelines from existing county BMPs.
  - Provide educational workshops on common loons and other sensitive species for northwest Montana lakes.

RESEARCH

Research Goal:

Develop new research projects as needed and maintain current research projects to answer specific questions to guide common loon conservation and management.

Research of the loon population in Montana stemmed from the recommendations outlined in the first loon management plan finished by Don Skaar in 1990. A few years later, Dolan (1994) identified additional research needs and priorities. The research needs and recommendations, as well as how they were addressed, are summarized in Table 2. In 1992, Lynn Kelly completed research on the effects of human disturbance on loon productivity. Montana Fish, Wildlife and Parks (FWP) initiated the Common Loon Ecology Project in 2003 using a combination of State Wildlife Grant funds from the U.S. Fish and Wildlife Service along with private, tribal, and state assistance. Two Master"s theses (Hammond 2008, Paugh 2006) were completed between 2003 and 2008. The Loon Ecology Project research focused on both habitat and population characteristics of Montana"s breeding population and helped develop and confirm a number of population and habitat parameters for population models (See Population Management Chapter). Also, Montana Fish, Wildlife and Parks received results from our ongoing collaboration with a nationwide genetics project. The early results only indicate the sex of juveniles. Note that the only way to sex chicks is by DNA. Interestingly, the population has nearly a 1:1 ratio with 13 females and 15 males.

Objectives and Strategies

- Procure funding and continue data collection to estimate survival rates for adults and juveniles based on bands and complete ongoing research.
- Encourage the analysis of data collected on loon forms, etc., and determine whether the data are useful for management purposes.
- Use information collected on floating sign and onshore sign placement to evaluate the effectiveness in relation to the nest and nursery sites.
- Investigate relationships of how common loons may be affected by exotic species such as purple loosestrife, Eurasian water milfoil, zebra mussels, tiger muskie, northern pike, bullfrogs, and snapping turtles.
    - Identify species and locations where interactions with exotic species occur. Record observations in the comment section on the Loon Survey Form (Appendix E) and report this information to the area coordinator (Appendix A).

- Investigate risks to the population that occur both in and out of the state (oil spills, botulism, emaciation syndrome, mercury, lead, etc.).

Table 2. Past and proposed research topics relevant to common loons in Montana.

Research Topic	Investigator	Research Conducted
Effectiveness of different measures to protect loon nesting and rearing areas	Kelly (1992)	The Effects of Human Disturbance on Common Loon Productivity in Northwestern Montana
Conditions under which artificial nesting platforms can be used successfully for loons	Desorbo et al. (2007) & (2008), Piper et al. (2002)	Reproductive Advantages for Common Loons Using Rafts, Floating Platforms Increase Reproductive Success of Common Loons
Physical/biological characteristics of loon nesting lakes	Kelly (1992), Paugh (2006), Hammond (2008)	The Effects of Human Disturbance on Common Loon Productivity in Northwestern Montana, Common Loon Nesting Ecology in Northwest Montana, A Demographic and Landscape Analysis for Common Loons in Northwest Montana
Specific requirements for nesting loons	Kelly (1992), Paugh (2006)	The Effects of Human Disturbance on Common Loon Productivity in Northwestern Montana, Common Loon Nesting Ecology in Northwest Montana
Cause of loon nest failures and chick loss	Paugh (2006)	Common Loon Nesting Ecology in Northwest Montana
Lake/territory selection by first time breeding loons	Hammond (2008)	Montana Loon Ecology Project, A Demographic and Landscape Analysis for Common Loons in Northwest Montana
Turnover of breeding loons and pair bond duration	Hammond, Paugh (2003-8)	Montana Loon Ecology Project
Status of pollution of loon lakes by toxic chemicals	Savoy (2004)	Summary of Capture and Banding Efforts and Methylmercury Exposure to Montana's Breeding Common Loon Population, Montana Loon Ecology Project. Current contaminant research at the BioDiversity Research Institute.
Effectiveness of signs around loon nests and nursery areas	Kelly (1992)	The Effects of Human Disturbance on Common Loon Productivity in Northwestern Montana
Migration and wintering locations	Gullett, Hammond, Paugh (2003-8)	Montana Loon Ecology Project
Effects of disturbance on loon chicks	Kelly (1992), Paugh (2006), Hammond (2008)	The Effects of Human Disturbance on Common Loon Productivity in Northwestern Montana, Common Loon Nesting Ecology in Northwest Montana, A Demographic and Landscape Analysis for Common Loons in Northwest Montana
Effects of global warming on nesting		Not Yet Addressed
Effects of wake on nesting habitat		Not Yet Addressed
More effective and meaningful measures of disturbance impact on loon productivity		Not Yet Addressed
Status and effect of eutrification of loon lakes		Not Yet Addressed
Effects of exotic species on loon ecology		Not Yet Addressed

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