The Wisconsin Loon Population Project:

Insuring Loons Will be Here for the Grand Kids

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by

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PROJECT OVERVIEW

The Wisconsin Department of Natural Resource Bureau of Integrated Science Services and partners at the US Geological Survey in La Crosse and the University of Wisconsin Department of Wildlife Ecology in Madison are collaborating to conduct a 5-year research project designed to evaluate the population status of Common Loons (*Gavia immer*) in northern Wisconsin and to recommend management strategies to maintain a healthy population in Wisconsin into the future. Exposure to mercury in fish, habitat loss due to lakeshore development, and increased recreation disturbance on lakes are identified as important threats to the future of the population. The research is funded by a $500,000 STAR grant from the US Environmental Protection Agency received by the Wisconsin DNR in 2002. Salary and supply funds received in this federal grant were distributed through contracts and services to northern Wisconsin residents and businesses.

The study occurs in a 5000 square mile "risk assessment" region of northern Wisconsin including all of Vilas, Oneida, and Iron, and portions of Forest, Price, Lincoln, and Langlade counties (see attached map). The research project uses Population Viability Analysis, a conservation biology method, to produce a population estimate of loons in the risk assessment area and develops a population model that predicts future numbers of loons by measuring adult and chick survival, egg hatching rates, and juvenile recruitment rates. The juvenile recruitment rate is the number of chicks hatched that survive to become breeding adults. By measuring the adult and chick survival rates, egg hatching rates, and recruitment rates, the model predicts how many loons will be in the area 10, 20, even 50 years in the future. We are also measuring the impact of mercury exposure (mercury levels are elevated in fish on some northern Wisconsin lakes), shoreline habitat changes, and human disturbance on the Wisconsin common loon population and will recommend strategies for reducing the impact of these factors so that we can sustain the loon population. The research project is ongoing (scheduled to be

completed March 2006) thus results described in this summary should be considered preliminary. The final report will be available in April 2006.

Currently, LoonWatch (Sigurd Olson Environmental Institute at Northland College, Ashland, WI) estimates that there are 3100 adult loons in Wisconsin, many more than in Michigan (650) but about 75% less than Minnesota (12,050). Our preliminary findings show that more than one third of the Wisconsin loon population is found within the Vilas, Oneida, Iron, Forest county study area – loons are attracted to the numerous lakes found in the region. In 2003 we estimated there were 1200 adult loons and 510 breeding pairs in the region. The loon population estimates are derived from observations made by 8 biologists. All loons present in May, early July, and mid August were tallied on all lakes within 32 area quadrats randomly sampled each year. Each area quadrat was 9 square miles. Each year, between 120–170 lakes are monitored. It is known that loons only nest on lakes greater than 10 acres. Lakes this size or larger are required for loons to get airborne and to provide the fish needed to feed themselves and their young - a loon family of 2 adults and 2 chicks is estimated to consume 1200 lbs of fish from the time they arrive in April until they depart in November. Within our study area there are nearly 1600 lakes greater than 10 acres and our biologists surveyed 425 of them between 2002–2004.

We found that loons are relatively common on Vilas, Oneida, Iron, and Forest county lakes . The most impressive observation was of 32 pairs of loons on the Turtle Flambeau Flowage, Iron County, in 2003; 25 of the pair nested, and half produced chicks. The numerous islands and bays provide excellent loon nest habitat on this 13,545 acre flowage. Also encouraging was the fact there were 5 breeding pairs on Star Lake, 4 pair on Trout Lake, and 3 pair on Plum Lake in Vilas County as well as 4 pair on both Clear Lake and Lake Tomahawk in Oneida county. All of the lakes with multiple pairs of loons described above are large in size, have excellent loon nest habitat, and have extensive amounts of shoreline in public ownership (state and national forest lands). However, breeding bird studies conducted by Dr. Alec Lindsay, Northern Michigan University in the 1990s, conclude that loons are more likely found on lakes with low levels of housing development in Vilas and Oneida county. During 2003 we found no loons nesting on nearly 4000 acres of surface water in Vilas and Oneida county, including many lakes on the Three Lakes chain (Medicine, Laurel, Big Stone, Deer, and Dog Lakes), Little St. Germain, Big St. Germain, and Lost Lake in Vilas County. Up to 20 pair could be expected to nest on these lakes. Loons often defend territories as large as 200 acres. Only 2 pair were found on Lake Nokomis (2453 acres) in Lincoln County where up to 10 pair could be expected if adequate nest habitat were available. The shorelines of these large lakes are highly developed, the lakes receive high use by boaters, and have poor water clarity. It could be that the development has resulted in loss of nesting habitat, created more disturbance, reduced the water clarity, or a combination of the above. We did find loons nesting on some very developed lakes such as Lake Minocqua and Catfish Lake on the Eagle River chain - each lake had one breeding pair in 2003, however no chicks survived on Lake Minocqua in 2003 & 2004 and none hatched on Catfish Lake in

2003. Both loon pair chose nest sites on islands that were as far from disturbance as possible.

Islands are critical nesting habitat for the ground-nesting common loon as they offer some protection from nest predators such as mink, raccoon, red fox, and fisher. When islands are not available, loons will frequently nest on wetland and bog edges of lakes. These wetlands may also offer limited protection from predators and the nests are often at the ordinary high water mark (OHWM) as loons nest no more than 3-4 feet from the water's edge. Loons are not agile on land as their legs are placed far back on their body to provide excellent propulsion when diving for fish. For this reason, shore land at the OHWM is also critical nesting habitat for the common loon. Development of these wetland fringes for docks or removal of the wetland vegetation has caused the loss of loon nest habitat on some lakes within our study area.

We have found that a small number of loons nesting within our study area are very tolerant of human disturbance, allowing for close approach, even to nests. These birds are nesting on lakes with high amounts of human activity and appear to have become accustomed to it. However these birds are the exception, most loons are skiddish, and likely to flush from their nests if approached closely. Therefore it is important that nesting loons be given a wide berth (200 feet) when using lakes in May and June, the primary nesting period for loons in Wisconsin. Chicks developing in eggs left unattended for long periods will cool and can die.

Wisconsin Loon Population Model

At the present time, adult common loon survival is very good in Vilas, Iron, Forest, and Oneida counties. We have individually color-marked over 1200 loons in these counties and have found that 90% of adults survive from year to year (we re-observe them on the lakes at which they were banded). This is a very good rate of adult survival. Adult loons can be injured or killed on the breeding grounds through human contact or by natural causes. A few cases of adult loons fighting to the death for ownership of a nesting territory were recorded during our study including documented events on Clear Lake and Mason Lake in Oneida County this year. Bald eagles diving and striking loons in the water have been observed but no eagles we observed were successful at killing an adult loon. Three adult loons were killed on the nest while incubating but it is not certain which predator was responsible. Last fall, an adult loon from our study was found dead in Green Bay, she had died of lead poisoning. One lead sinker and one lead jig were found in her stomach. This bird had a breeding territory on Spring Lake near Eagle River and was heading south for the winter when it was stricken. Up to 30% of loon mortality in New England is thought to be due to lead poisoning thus use of lead alternatives when fishing is encouraged. Also, we recently recovered an injured, banded loon on Muskellunge Lake in Vilas County which had a fish hook in its leg that had caused an infection as well as a Johnson Silver Minnow lure lodged in its throat. It was taken to the Raptor Education Group (REGI) in Antigo, Wisconsin, where it was rehabilitated, and released back to Muskellunge Lake. That bird is now flying again and has rejoined

its mate. Another injured bird on Presque Isle Lake was rehabilitated at the Northwoods Wildlife Center in Minocqua and at REGI in Antigo this year. The bird had an injured leg and could not dive or fly off the lake, the cause of the injury is not known. This bird has also been rehabilitated, returned to Presque Isle Lake, and is reported to be diving well and has also been joined by another bird (its mate?). In both cases, the public reported these injured birds and we encourage folks to continue reporting these observations.

While adult survival was very good, loon chick production was low during 2002-2004 and is less than that necessary to allow the Wisconsin loon population to increase. Nest predation is a leading cause of nest failure and raccoons are the most common predator. We placed infrared cameras near loon nests and recorded raccoons at predated nests more often than other species which included red fox, mink, and raven. Nest predation by bald eagles has also been observed. Other causes of nest failure include 1) flooding of nests due to water level changes or wave action, 2) abandonment due to black flies (a loon-specific black fly infests some lake shores in May and can lead to nest abandonment as the loons have been seen to be covered by a cloud of these flies while incubating), 3) repeated human disturbance resulting in nest abandonment, and 4) failure of eggs to hatch. Over 50% of nest attempts fail, but loons will nest up to 3 times in a given year, giving them at least a second chance in many cases. Also, wild loons live 20-25 years thus they have numerous nesting seasons to attempt to produce young.

Once chicks hatch, approximately 85% survive to fly off the nest lake in the fall. After hatching, adult loons and chicks leave the nest, and adults often take the vulnerable chicks to quiet bays where chicks ride on the adult's back until better able to fend for themselves. This behavior protects them from predators and boat traffic, as well as keeps them warmer in the cold spring waters. We placed radio transmitters on a number of loon chicks in 1996-1997 and determined that a few chicks were taken by eagles, fish, and snapping turtles, and a very small number were killed by other adult loons trying to take over a loon territory. Also, we observed one pair of loons lose their chicks when the family was overrun by a pontoon boat on Upper Buckatabon Lake in 2005, the chicks were likely killed by the impact as they were not seen again – we suspect that the folks on the boat never saw the birds. Field observers have also reported boats and jet skis chasing loons though none of the chases resulted in chicks being lost.

Project collaborator Dr. Walter Piper of Chapman University, Orange, CA, is working with us to determine the Wisconsin loon juvenile recruitment rate. Juvenile recruitment refers to the proportion of loon chicks hatched in northern Wisconsin that return to the breeding grounds to gain their own territories. Dr. Piper has banded all loon chicks in a cluster of 60 lakes in Oneida county during 1994 -1999 with unique colored leg bands. These leg bands allow his observers to identify individuals when they return as adults. Loons do not return to Wisconsin for 3 years after their first migration south, spending the second and third summers on the coastal waters of the Atlantic and Gulf of Mexico. After 3 years the juvenile loons reach maturity, gain adult breeding plumage, and return to the area in which

they were raised. This begins their quest to gain a breeding territory. Dr. Piper has re-sighted 46% of the chicks banded in his lake cluster 1994-1999 as adult birds in Lincoln and Oneida counties during 2002-2004. On average, these birds gain their own breeding territories at about 6 years of age – the returning birds often have to displace resident breeding birds through territorial contests to gain a lake to breed on and this can take several years. As more lakes become developed, there may be fewer lakes upon which loons can nest as habitat changes and disturbance increases. This may reduce the carrying capacity for loons in the study area in the future and increase competition-related mortality between loons.

As mentioned previously, preliminary population models indicate that just enough chicks were produced 2002 – 2004 to replace the Vilas, Oneida, Forest, and Iron county adult loon population as it ages. If the rate of nest success or adult survival were to get only marginally lower, the population model indicates that the number of loons breeding in these counties could begin to decline in the future. It is known that the breeding range of common loons in the north central United States has shrunk north about 300 miles over the past 100 years (loons historically nested as far south as northern Indiana, Illinois, and Iowa) – this retreat north could continue if the current population parameters for loons in Vilas and Oneida counties get lower. However, if these rates improve, the population is likely to increase. Increased protection of loon breeding habitat on lakes in this region may be critical to insuring loons are present on lakes in the future. Final population modeling will be conducted by USEPA and WDNR scientists this fall and winter and results, including management recommendations, will be available March 2006.

Wisconsin Loon Habitat Model

A portion of our project is focused on determining the specific lake habitat features necessary for loons to successfully nest. GPS units, computers, aerial maps, and shoreline mapping surveys are used to locate houses, loon nests, identify shoreline vegetation and habitat type, and quantify lake characteristics in our study area. We are using this data to develop a Wisconsin Loon Habitat Model to be completed in March 2006. The habitat model will explore the relationship between loon presence or absence on lakes, nest success, lake and shoreline characteristics, levels of shoreline development, and levels of human disturbance. The model will be used to identify the specific habitat features required by loons to successfully nest and persist in good numbers in northern Wisconsin into the future. We will be assisted in the habitat model development by scientists at the USEPA Narragansett Laboratory in Rhode Island where they are developing a loon habitat model for New England. These models will help us determine the specific features of lakes that need to be protected to insure loons nest on these lakes into the future. Our previous research in the 1990s has shown that lakeshore development in Vilas and Oneida counties has resulted in significant alteration of shoreland vegetation, a decrease in breeding green frogs, and changes in breeding bird composition. A record rate of housing construction has occurred on the lakeshores within our study area over the past decade and protection of shore land habitat is now essential to safeguard existing wildlife and fish populations.

Mercury Exposure and Wisconsin Loons

Elevated mercury levels have been found in some fish in Wisconsin lakes prompting the state to issue human health fish consumption advisories. Fish-eating wildlife, such as loons, are also at risk to mercury toxicity. Mercury can cause damage to the nervous and immune systems. By collecting and analyzing blood samples from loons at the time of banding, we have determined that adult and chick loon mercury exposure is 2-5 times higher on acidic lakes in Vilas, Oneida, Iron, and Forest counties (primarily seepage lakes with pH $<$ 6.3) when compared to neutral pH lakes (pH $\geq$ 7.0) in the same counties. On average, loon mercury levels are higher in New England and the Canadian Maritimes when compared to Wisconsin, but Wisconsin loon mercury levels are higher than that measured in Minnesota, Montana, and Alaska. Wisconsin loon mercury exposure levels are about 1000 times higher than humans, primarily because loons eat nearly 100% fish, and fish are the primary source of mercury in the diet. We also found that loon food items (primarily yellow perch) have 2-5 times higher mercury levels on acidic seepage lakes in Vilas and Oneida counties, establishing them as the source of the elevated mercury levels found in loon blood and eggs collected on acidic lakes in our study area. Other researchers have shown that atmospheric deposition of mercury to Wisconsin lakes in rain and dust particles is the primary source of methylmercury in Wisconsin fish, and processes in acidic lakes result in the higher concentrations of mercury found in fish from these Wisconsin lakes. A primary source of mercury in the atmosphere is burning of coal to produce electricity – mercury is in coal and is emitted from the stacks when burned. Wisconsin DNR and the US Environmental Protection Agency have differing plans for reducing the amount of mercury emitted by coal plants but both plans should result in significant reductions over the next few decades. Previous work conducted by our research team (Wisconsin DNR, USGS, University of Wisconsin – Madison) and funded by the Electric Power Research Institute and the Wisconsin Utilities Association found little evidence that current levels of mercury exposure are directly impacting adult loon and loon chick survival in Wisconsin. However we did find that immune function is suppressed in loon chicks with blood mercury levels consistent with those collected from loon chicks on acidic lakes. Also, these studies show that loon chicks hatched from eggs collected from nests on acidic lakes have higher mercury levels, behavioral alterations, higher blood Hg levels at hatch, lower hatch mass, lower final body mass, more severe physiological effects, and suggestion of more depressed immune function than chicks from neutral-pH lakes. At present we can only speculate that these negative effects may have been related to exposure to mercury. Carefully designed laboratory studies are required to establish a cause-effect relationship. We have found that loon chick survival is lower on acidic lakes in Wisconsin, however a direct link between elevated mercury exposure and lower chick survival must wait until new laboratory studies are conducted.

SUMMARY

Common Loons are commonly found breeding on northern Wisconsin lakes – adult survival is high and juvenile recruitment appears good, however nest success is low. Mercury exposure is higher in loons nesting on acidic lakes in Wisconsin due to elevated mercury levels in the fish they consume. While no direct signs of mercury toxicity have been observed in adult loons and chicks in Wisconsin, loon chicks have reduced immune function when exposed to Hg levels similar to those found in fish on acidic Wisconsin lakes and loon chick survival is lower on these acidic lakes. A direct link between elevated mercury exposure in loon chicks and reduced survival cannot be made at this time. Mercury levels in some Wisconsin loon eggs do exceed that associated with reduced hatching rates and behavioral alterations in other sensitive avian species. Chicks hatched from eggs collected on acidic lakes in Wisconsin have higher levels of mercury in blood at hatch and developmental abnormalities. Reductions in atmospheric deposition of mercury to Wisconsin lakes will lead to a reduction in fish mercury content, therefore a reduction in loon chick and egg mercury levels will also occur. It is probable that this reduction will lead to an improvement in loon reproductive performance on acidic lakes in Wisconsin. Policy and management actions that promote protection of critical loon nesting habitat (wetland shore lines, islands) is critical to maintaining and improving common loon reproductive performance in Wisconsin.