The State of Nova Scotia's Loons:
A Decade-long View From the Canadian Lakes Loon Survey

People love loons. Their haunting voice and striking plumage, combined with their presence on some of Canada's most beautiful lakes, make them one of this country's best-known wilderness symbols. Unfortunately, loon breeding lakes are being degraded annually by shoreline development, acid rain, the use of lead fishing and hunting gear, increased human activity, and fluctuating water levels. One of Bird Studies Canada's national volunteer surveys, the Canadian Lakes Loon Survey (CLLS), aims to monitor loon populations and the health of the lakes where these loons breed, in order to better understand and protect this well-loved species.

In Nova Scotia, approximately 1,200 pairs of loons breed each summer on lakes left behind by the recession and melting of the massive Wisconsin ice field. Since 1991, hundreds of dedicated volunteers with the CLLS have recorded the breeding success of loons on Nova Scotia's lakes. Using 11 years of information, this document functions not only to report on preliminary results generated from these data, but also to recognize and thank all those Nova Scotians who have contributed to the Canadian Lakes Loon Survey over the last decade.

How does the Canadian Lakes Loon Survey work?

Each year we ask CLLS participants to observe loon pairs on inland lakes. Volunteers record the number and relative size of chicks accompanying loon pairs from late June to late August. Participants also estimate the extent of human activity on their lake by ranking it on a scale of 1 (no people, no boats) to 9 (frequent water-skiing/motor boat racing) for each month of the survey, and collect data on shoreline development by providing an estimate of the percent shoreline that is less than 200 metres from

Translating Volunteer Data into Loon Breeding Success

We use CLLS data to estimate two measures of loon breeding success, based on the number of large young (LY) raised by loon pairs. A large young is defined as a chick that is at least 6 weeks old; chicks fledge between the ages of 6 and 10 weeks. These measures are:

Success 1: The proportion of all loon pairs that raised at least one LY; these pairs are also known as *successful pairs.*

Success 2: The proportion of all *successful pairs* that raised at least two LY.

What do the data show?

Breeding Success

The proportion of loon pairs in Nova Scotia that raised at least one LY increased slightly from 1991-2000 (Figure 1A), although of these successful pairs, the proportion that were able to raise two or more LY declined between 1991 and 1997 (Figure 1B). Interestingly, however, this second measure of success jumped abruptly between 1997 and 1998, such that by 1998 (and continuing to 2000), almost 60% of successful pairs raised two chicks. The reason for this jump is not clear; however, it is an interesting finding that would not have been revealed without the CLLS.

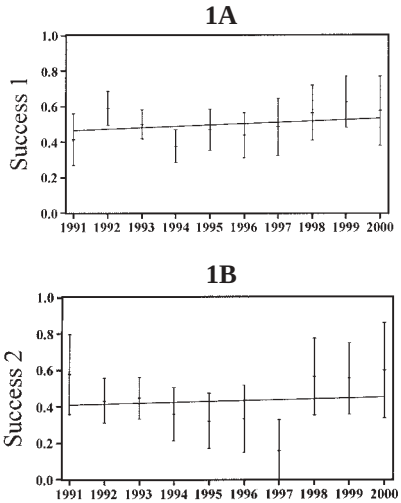


Figure 1
Proportion of: A) all loon pairs that successfully raised at least one LY; and B) all successful pairs that raised at least two LY from 1991-2000. The bars above and below each annual proportion represent the standard error in the mean, and the line represents the average trend through time. Number of observations for (A) = 683, and for (B) = 350.

Lake Acidity

Certain environmental factors, including lake area, mercury levels, and prey availability, are known to affect loon breeding success on eastern Canadian lakes. Mercury has been studied extensively in Nova Scotia – see the side panel on p. 2 for more information. Another environmental factor affecting loons is lake acidity, or pH. There is ample evidence from CLLS data

from Ontario that higher lake acidity – which corresponds to lower pH – reduces a loon pair's ability to successfully rear their young. This is probably because lake pH is related to other survival determinants such as mercury levels (lower pH = more mercury) and prey availability (lower pH = less prey). Numerous lakes in eastern Canada are naturally acidic and have a low buffering capacity, meaning that they are prone to further acidification from non-natural sources such as acid rain.

Fortunately, scientists from the Canadian Wildlife Service's Atlantic Region have sampled water from Nova Scotia's lakes and generously provided pH data for most lakes surveyed by CLLS participants. These data show that CLLS lakes range between pH 4.2 and pH 7.8 and have an average pH of 6.3, which falls on the slightly acidic side of the pH scale (pH 7.0 being neutral).

Given this, and the fact that acid rain deposition is known to have affected thousands of lakes in eastern Canada, it is interesting to consider how lake pH relates to loon productivity in Nova Scotia. We analyzed the relationship between lake pH and our two measures of breeding success. Interestingly, the ability of loon pairs to successfully rear large chicks *decreased* with increasing lake pH, although this trend was not statistically significant (Figure 2). In other words, loon pairs seemed to be better able to raise LY on lakes of slightly higher acidity.

We also noted, however, that lakes of varying pH classes were not evenly distributed across Nova Scotia: CLLS lakes in northeastern Nova Scotia (Cape Breton Island) were notably less acidic – with pH's greater than 6.0, compared to CLLS lakes elsewhere in the province.

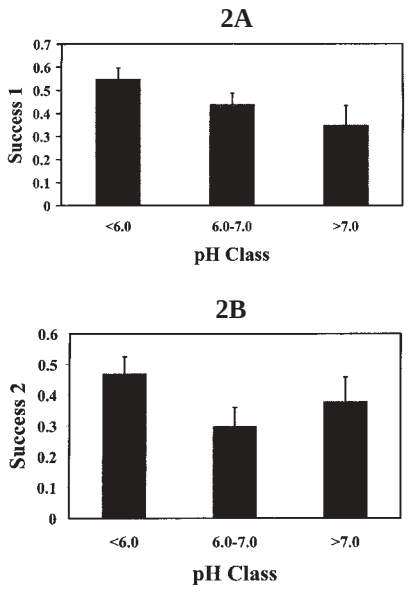


Figure 2
Proportion of: A) all loon pairs that successfully raised at least one LY; and B) all successful pairs that raised at least two LY, on acidic (pH < 6.0), neutral (pH 6.0-7.0) or alkaline (pH > 7.0) lakes in Nova Scotia between 1991 and 2000. Number of pairs observed over this time period was 92 on acidic lakes, 137 on neutral lakes, and 62 on alkaline lakes.

Mercury and Nova Scotia's Loons - where are we now?

In the latter part of the 1990s, scientists from the Canadian Wildlife Service determined that loons in Nova Scotia, particularly in and near Kejimkujik National Park, had very high levels of mercury in their blood. Blood samples showed that loons in this region had the highest blood mercury levels of any loon population sampled in North America. Further collaborative research with Acadia University into the effects of this extraordinarily high contaminant burden found that loons in Kejimkujik were showing signs of poisoning: adults were less effective at rearing their chicks as mercury in their blood increased. These results helped to explain why loons in Kejimkujik regularly showed low reproductive success over two decades of study. What is the leading cause of mercury pollution in our environment? Air pollution.

In 1998, these scientists were invited to present their results at a meeting of the Committee on the Environment for the New England Governors and Eastern Canadian Premiers. After this meeting, the six New England Governors and five Eastern Canadian Premiers signed a *Regional Mercury Action Plan*.

One of the main goals of this plan is to reduce mercury emissions by at least 50% by 2003, as well as deal with source contamination and safe waste management issues. The Action Plan also contains further provisions on Outreach and Education, Analysis and Strategic Monitoring, and Mercury Stockpile Management.

In 2003, we will need to evaluate how far we have come toward attaining the goals set out in the Action Plan. All indications are that we have moved forward in reducing emissions, and we are therefore closer to ensuring that loons and other wildlife in our region are better protected from environmental contaminants. The recent establishment of a long-term monitoring team – the Collaborative Mercury Research Network – will continue to provide further detailed information on the ecosystem-level effects of mercury.

For more information on mercury and its effects on loons, see: www.consecol.org/Journal/vol2/iss2/art10/index.html

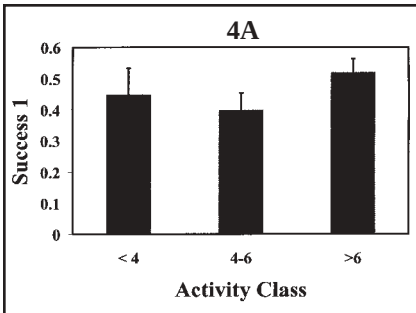
Could something other than relatively high pH in the northeastern lakes be causing loons to be less productive, thereby making it *appear* that lakes of higher pH result in poorer breeding success? To assess this possibility, we evaluated the relationship between loon breeding success and lake pH in Nova Scotia lakes *excluding* lakes from the northeastern region of the province (i.e. those below 44°70' latitude). The relationship observed among all lakes still existed, except that there was no longer a difference between weakly acidic and neutral lakes, which is probably only a function of reduced sample sizes for this lake pH class.

It therefore appears that the relationship between loon breeding success and lake acidity is not a straightforward one in Nova Scotia; it may be possible that some other important factor that varies inversely with lake acidity overrides any effect that pH may have on loon breeding success. More research (and continued loon surveying) is clearly needed.

Figure 3
Lakes in Nova Scotia that were surveyed at least once by CLLS volunteers from 1991-2000.

Human Activity

Nova Scotia's lakes are popular summer destinations. Results from the CLLS in Nova Scotia show that there is a significant positive correlation between lake size and human activity, meaning that larger lakes host more human activity than smaller lakes. We used categories of human activity during August of each year to determine how our measures of loon breeding success relate to the relative intensity of human activities. We found no significant relationship between loon breeding success and human activity; however, the proportion of successful pairs that reared two LY tended to be lower on lakes with more human activity (Figure 4B). It therefore appears that human activity on Nova Scotia's lakes may not be limiting the ability of loons to successfully raise one chick, but that it may prevent some of those pairs from raising two chicks.



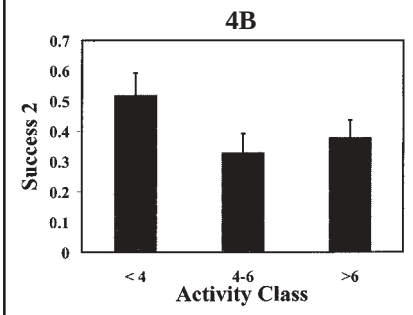
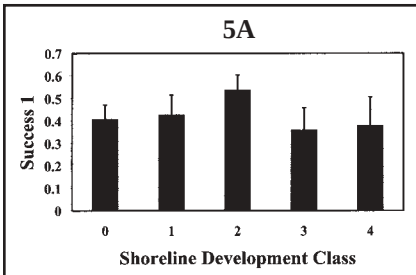


Figure 4
Proportion of: A) all loon pairs that raised at least one LY; and B) all successful pairs that raised at least two LY on lakes of varying activity classes in Nova Scotia from 1991-2000. Activity classes <4 represent light use (people, boats, but no motors), 4-6 represent moderate use (boats with motors but no water skiing or jet skiing), and >6 represent heavy use (boat motors, water skiing and jet skiing). Number of pairs observed over this time period was 44 on lakes classed "<4", 124 for lakes classed "4-6", and 123 for lakes classed ">6".

Shoreline Development

Shorelines are favoured locations for cottages and recreational activities. These activities may alter fish habitat of importance to foraging loons, and invade key areas of loon breeding habitat. When we assessed how the likelihood of raising one or two large young was related to shoreline development, no obvious patterns emerged (Figure 5). It is possible that different types of development may have positive or negative consequences for breeding loons. For example, boat docks may support better fish populations by providing fish habitat, whereas dredging and building retaining walls may reduce fish habitat. It is also possible that the qualitative values of shoreline development measured by CLLS volunteers are not precise enough to illustrate a clear relationship between shoreline development and loon breeding success.



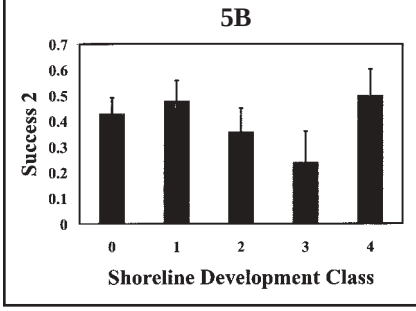


Figure 5
Proportion of: A) all loon pairs that raised at least one LY; and B) all successful pairs that raised at least two LY on lakes of varying shoreline development classes in Nova Scotia from 1991-2000. Class 0 = 0 - 20% developed, Class 1 = 21 - 40% developed, Class 2 = 41 - 60% developed, Class 3 = 61 - 80% developed, and Class 4 = 81 - 100% developed. Number of pairs observed over this time period was 79 on Class 0 lakes, 40 on Class 1 lakes, 42 on Class 2 lakes, 31 on Class 3 lakes, and 22 on Class 4 lakes.

So, what *is* the *State of Nova Scotia's Loons?*

To date, CLLS results indicate that Nova Scotia's loons are doing reasonably well, as breeding success appears to have increased from 1991-2000. Data also indicate that the association between lake acidity and loon breeding success is not a simple one in this region. And finally, while shoreline development and human use of lakes continues to increase across the province, results from the CLLS show no clear relationship between these factors and loon breeding success as of yet.

It is important to keep in mind that various factors unrelated to breeding habitat have the potential to affect Nova Scotia's loon population. For example, loons spend the majority of their time, when not breeding, at the sea coast. In fact, after fledging, young loons spend *all* of their time on the coast, where they remain for several years until they reach adulthood and move inland to breed on freshwater lakes. Oceanic conditions may therefore be just as important to loon populations as are conditions on breeding lakes. The CLLS does not currently have the ability to monitor such effects, although other Bird Studies Canada programs, such as Beached Bird Surveys or Coastal Waterbird Surveys, may eventually be able to provide some answers.

This report presents a preliminary look at the state of breeding loons in Nova Scotia. Further detailed analyses planned for 2002-2003 may reveal new patterns or may strengthen the conclusions drawn in this report. In the meantime, Bird Studies Canada is dedicated to improving the CLLS in Nova Scotia and across Canada. The most direct route to improvement is to increase the number of lakes being surveyed (there are lots in need of volunteers in Nova Scotia!) and to ensure the continued support of the hundreds of dedicated volunteers who spend their summers counting loons.

So, to all CLLS volunteers, past and present – we thank and salute you! And to all potential volunteers – why not join us? With your help, we can continue to gather data on loon breeding success for many years to come, and to thereby raise awareness of issues facing loons and their lakes across Nova Scotia.

Acknowledgements

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Bird Studies Canada / Études d'Oiseaux Canada

NOVA SCOTIA Natural Resources
Nova Scotia Habitat Conservation Fund

Canadian Wildlife Service / Service canadien de la faune

Environment Canada Atlantic Region
Environnement Canada Région de l'Atlantique

How to join the Canadian Lakes Loon Survey

The CLLS is a program of Bird Studies Canada (BSC), a national conservation organization dedicated to the study of Canada's bird populations. Participants are asked to become members of BSC. For an annual $25 membership fee, you will receive all the information you need to conduct the survey, as well as four issues of BSC's national newsletter, *BirdWatch Canada*.

For more information on the CLLS or the "Loon Friendly Lakes" Program, please contact:

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