Avian Riparian Habitat and Water Regulation

Prepared for Pimicikamak Okimawin
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Introduction

Electricity generation and flood control are the central reasons for why the Lake Winnipeg Regulation (LWR) came to be. The power generation and flood control derived from the LWR provide society with great benefits. These benefits are now known to come at a significant cost in terms of downstream effects (LeRoy Poff et al. 1997). When the LWR was conceived of and implemented in the early 1970s, modern ecology, and particularly ecosystems ecology, was in its infancy (Dritschilo 2006, Kormondy 2012). The quantitative science of ecosystems ecology has grown immensely in the last forty years and now provides “sophisticated theoretical constructs and methodologies” to understand ecosystems and to help solve problems (Kormondy 2012). It is a dynamic and complex science, which helps us to better understand the extent of our dependence on clean air, stable climate, fresh water, biodiversity and other critical life-support on the healthy cycling of nutrients, energy and water in intact ecosystems. Birds can tell us a lot about the health of ecosystems, and also play an important part in the ecosystem services.

Birds provide countless unseen services, that if lost would lead to negative effects on ecosystem health and human economies. Birds pollinate plants and are responsible for pollinating both crop and medicinal plants, three-quarters of which cannot pollinate on their own (Wells et. al. (1) 2014, Nabhan and Buchman 1997). Birds spread seeds and do so very efficiently due to their ability to fly (Wells et. al. (1) 2014). Forests would look very different over time if birds no longer moved seeds out from parent trees (Low 2014). Birds control insect outbreaks. Parks Canada estimates that woodpeckers can consume up to 30% of mountain pine beetle in infested forests (Parks Canada 2014, Wells et. al. (1) 2014). Evening grosbeaks, a boreal bird in decline, are known to greatly reduce spruce budworm outbreaks (Wells et. al. (1) 2014). Birds fertilize landscapes by moving nutrients from place to place, most often from energy-rich water sources to land. This is a largely unrecognized service provided to ecosystems (Wells et al. 2014). Many of these services will only become obvious over time if birds disappear or decline significantly from the landscape (Low 2014).

Birds provide us with important social, cultural and economic services. Firstly, they are fascinating animals; they animate our world with their behavior, beauty, song, long migrations and presence. They are the subjects of a growing tourist industry in bird watching that is largely untapped in many areas, including Manitoba. Indeed, the US Fish and Wildlife Service estimates that yearly expenditures on equipment and birding trip related costs total $40 billion (which, to put it in perspective, is about five times the total revenue of Major League Baseball (Wells et al. (1) 2014, USFWS 2013, Brown 2013). Numbers are believed to be similar in Canada although more difficult to find (Wells et al. (1) 2014). Birds provide food for people, both as farmed animals and as hunted wild populations, both by indigenous and non-indigenous hunters. Bird hunting and bird watching tourist industries provide jobs and income in remote, often economically struggling areas (Wells et al. (1) 2014).

Traditionally birds have been important to indigenous people in Canada. Migrating waterfowl have been hunted for thousands of years by Aboriginal peoples living in Canada's boreal forests. The hunting of birds, aside from being an important food source is widely understood as providing cultural and social benefits to northern communities. Boreal birds feature in indigenous cultural beliefs and traditions, in myth and story that is also fused with traditional dependence upon birds for food (Wells et al. (1) 2014).

In a world where local food security is growing in importance, having a sustainable population of waterfowl for consumption by northern communities is vital. Because traditional indigenous ways of life are so dependent upon wildlife and ecological integrity, first nations leadership on these issues has been highlighted as vital to future planning and management (Wells et al. (1) 2014, IBCSP 2013). Indeed the International Boreal Conservation Science Panel recognizes that outcomes of land-use planning and management "significantly improve when Aboriginal peoples retain their leadership in decision making." (IBCSP 2013). Pimicikamak know its territory, both in a historical context and on a day to day basis and are therefore best positioned to lead in the ecological stewardship of the land and water.

Hydro-electric and flood control schemes in the boreal forest have greatly changed vast areas of the shorelines of northern lakes and river systems. A now extensive body of scientific research over decades has revealed that anthropogenic alteration of flow regimes has significant ecological effects (LeRoy Poff 1997). The health of riparian ecosystems downstream of the LWR has been deeply affected, thereby reducing the variety of natural habitats for plants and animals. Despite the extensive knowledge of the negative effects of dams and diversions on riparian ecology, the depth of the change in the Upper Nelson River has been sporadically monitored and focused narrowly on a few species. Meaningful mitigations for bird communities have rarely been implemented.

In Cross and Sipiwesk Lakes in Pimicikamak territory, these losses are likely to be substantial. There is potential, however, to create state of the art environmental practices that will take into account the needs of power generation, flood control and the downstream effects of the LWR.

An experience on a dammed lake and a natural lake in Northern Manitoba 2014

In 2014, I spent two months surveying breeding birds in Manitoba on contract for the Manitoba Breeding Bird Atlas (MBBA). I surveyed in many areas including Riding Mountain, The Pas, Granville and South Indian Lakes out of Leaf Rapids and also the northern shoreline of Lake Winnipeg. On one of my assignments, I spent an extended period of time in the Leaf Rapids area, where we attempted to survey the South Indian Lake reservoir. My two companions, Jack Dubois and David Wright are experienced canoeists, having canoed many of the large lakes and river systems over the last 30 to 40 years in Manitoba and elsewhere. We discovered that South Indian Lake was un-workable for surveying birds by canoe, as there were very few places where we could safely get to shore. The shoreline had drastically changed since Jack's last (pre-dam) visit. Gone are the natural sandy beaches and low-angle shorelines. Now, there are steep and undercut muddy banks with trees falling into the water creating treacherous log-jams along the shoreline. During my time on the lower reaches of South Indian Lake I observed that there was very little variation outside of the steep, inaccessible and deeply muddy banks. Traditional Cree camps were inundated, leaving very few places to camp and making the logistics of surveying specific sites each day impossible. The water was turbid and there were very few marshes along the shoreline.

After this difficult period on South Indian Lake, we re-located to Granville Lake, which retains its natural character and seasonal flooding patterns. Unfortunately, the danger of not being able to get to shore if waves came up on the lake and the logistics of being able to camp in specific locations meant we withdrew from South Indian Lake. This decision meant we were unable to survey the northern end of South Indian Lake, and as such, missed out on data from northern boreal forests approaching tree line. This would have produced a different array of birds than those we detected on Granville Lake.

Granville Lake, in contrast to South Indian Lake, has a natural shoreline shaped by tens of thousands of years of natural processes. Putting a canoe ashore here is possible almost anywhere and natural beaches abound. There is a mosaic of natural wetlands up every back-water and side-arm of the lake, and these wetlands are varied so as to provide for a wide array of niches for nesting species. Traditional Cree camps exist on Granville Lake, and have been meeting places of people for thousands of years. We were lucky enough to be invited to visit one of them - a true cultural treasure.

Another stark contrast to South Indian Lake was the clarity of the water, and the diversity of invertebrate and small fish life evident in the shallow water next to shore. Here was the beginning of a food-web supporting life in the lake. This was a living lake. This obvious contrast between the uniform, degraded shoreline on South Indian Lake and the vibrant living shoreline of Granville Lake was very evident. I suspect that the success of a broad range of species relying on natural riparian habitat that used to fringe South Indian Lake are greatly reduced compared to the pre-flooding riparian ecosystems.

While South Indian Lake is not part of the LWR, it is part of the Churchill River Diversion (CRD) that was built to create a more reliable flow to generating stations further down the Nelson River. While the problems on South Indian Lake differ in specifics from those of Cross and Sipiwesk Lakes, the riparian disturbance, unnatural flooding regimes, degradation and uniformity of shoreline mirror some of the problems found in the downstream lakes affected by the LWR.

Boreal Forests as 'North America's Bird Nursery'

So important to breeding birds is Canada's Boreal Forest that it has been dubbed 'North America's Bird Nursery' (Blancher and Wells 2005). The mosaic of wetlands, peat lands, fens, seasonally flooded meadows (swamps) and shallow lakes provides habitat for hundreds of species of migratory birds. Three hundred and three species of birds breed in the boreal forests and this accounts for 43% of all regularly occurring birds in North America (Blancher and Wells 2005, Wells et al. 2014). To illustrate the sheer abundance of birds nesting in the boreal region; an estimated 3 – 5 billion birds born in the boreal forest depart Canada to migrate south to wintering grounds. This is about 90% of Canada's total bird population (Cheskey et al. 2011, Wells et al. 2014). Breeding is a critical phase of life for birds, where their habitat requirements are very strict due to the high demands of breeding. Thus, a huge number of birds make migrations of thousands of kilometers to the boreal forests to nest (Wells et al. 2014).

The basis for this grand migration of breeding birds is the summer-glut of invertebrates, which are born in and tied to marshes, bogs, lakes, ponds, beaches, wetlands and waterways of the boreal forest. These invertebrates either directly or indirectly feed (through their contribution to the food web) growing nestlings and fledglings of birds (Wells et al. 2014). The countless mosquitos, black flies, midges, dragonflies, moths (and caterpillars), beetles, bugs and spiders, all provide food for birds, either as eggs, larvae or adults. Indeed, songbirds switch to feeding insects to their young even if they eat other types of food outside of the breeding season so that they can take advantage of the bounty of boreal forests (Macleod and Perlman 2001).

A variety of wetlands are critical for birds

What makes the boreal forests of Manitoba so indispensable is the variety of watery habitats available to birds. The structural diversity of wetland habitat in Manitoba starts on a big scale. The province contains four of the country's seven major boreal ecozones: Boreal Plains, Boreal Shield, Hudson Plains and Taiga Shield (Wells et al. (2) 2014). Riparian habitat is the interface where land and water meet making it highly productive in terms of energy and nutrients, allowing for disproportionately high species diversity in relation to surrounding habitats (Bub et al. 2004). This is the defining feature of boreal landscapes on a grand scale, which is why so many species of birds make long migrations to nest in the boreal region.

Along naturally occurring shorelines, the seasonal flooding regimes, alluvial sediment patterns and other natural processes over long periods of deep time have created a mosaic of different habitats which allows for a wide array of different ways of making a living (a biological niche) for birds. Therefore, biodiversity of birds is very high in natural riparian areas (Bub et al. 2004).

Riverine and lake wetlands are particularly productive habitat. Naturally occurring wetlands are a diverse mosaic of different depths, water flow, sediments, drainage, vegetation types and structure (NWWG 1997). This natural variety of structure allows for a mosaic of different habitats across the land. Some are seasonally flooded sedge meadows, some are shallow lakes or beaver ponds, some are floating moss bogs, and others are clear lakes with rocky shorelines and small islands. In turn, this mosaic of habitats supports different communities of plants and therefore a wide variety of biological niches for a wide array of birds. It is the very diversity of the structure and function of these critical habitats that provides the basis for biodiversity.

Birds depend on riparian habitat in the boreal forest:

The boreal forest is a mandatory stopover for millions of arctic breeding birds as well as year round residents and, as mentioned, vast numbers of birds breeding directly in these water-logged forests. Habitat for birds is very specific, particularly during breeding and migration. Any change in habitat can reduce nest success (TSWS 2006). Successful breeding requires habitat that provides birds high energy food in close proximity for nestlings and/or fledglings, protection from predators, thermal cover, perches as lookouts or to sing from, appropriate nest sites, safe roosting sites and escape routes. Even with relatively perfect habitat, nest failure is high. When habitat is degraded, nesting can face unsustainable failure rates (see Lesser Scaup example below). When habitat is lost altogether, the species living in, breeding in or stopping in on migration are lost from the landscape (see Piping Plover example below).

Bird groups whose breeding and/or migratory staging depends on boreal riparian habitat:

Shorebirds:
Shorebirds have long, slender bills that are used to probe nutrient-rich mudflats next to water to eat invertebrates, molluscs, worms and crustaceans. For many shorebirds, the wetlands of the boreal forests are stopover points on their particularly long migrations, often from South America to the arctic tundra (Boreal Songbird Initiative 2014). Further, an estimated 7 million shorebirds nesting directly in boreal wetlands include spotted and solitary sandpipers, greater and lesser yellowlegs, Wilson's Snipe, Short-billed Dowitcher, Red-necked Phalarope, Semipalmated and Piping Plovers. (Blancher and Wells 2005, Boreal Songbird Initiative 2014).

Waterfowl:
Millions of waterfowl make the journey to the boreal forest to breed or to stopover on migration to the arctic tundra. Furthermore, an estimated 38% of all the waterfowl in Canada and the United States breed in the boreal forests of Canada and Alaska (Blancher and Wells 2005). Boreal wetland nesting waterfowl include Canada Geese, Common, Red-breasted and Hooded Mergansers, Buffleheads, Greater and Lesser Scaup, Mallards, American black ducks and many more. Many of these species are important as food for both indigenous and non-indigenous hunters. (Blancher and Wells 2005)

Landbirds:
Many songbirds are intimately connected to wetlands for breeding, either nesting adjacent to or in wetlands. These birds rely upon the bounty of insects available in boreal wetlands to feed their nestlings. Indeed these tiny birds migrate to the boreal forests from as far away as the Amazon and Central America in order to do so (Chesky et al. 2011, Boreal Songbird Initiative 2014). Once the nestlings are fledged, they must fatten themselves up on this insect bounty in order to survive their first long migration to the tropics. Mortality on migration is thought to be between 30% and 60% for neotropical migratory songbirds (Martin and Finch 1995, Sillet and Holmes 2002) and for first year birds, mortality can be as high as 90% (Sillet and Holmes 2002). Survival on migration is therefore dependent on breeding success in the boreal forest. Some species of songbird tied to wetland breeding habitat are Palm, Conneticut and Yellow Warblers, Common Yellowthroats, Northern Waterthrush, Leconte's and Swamp Sparrows, Rusty Blackbirds (whose populations are in steep decline), Alder Flycatcher (Boreal Songbird Initiative 2014). Many of these species nest primarily in the boreal region and no-where else (Cheskey et al. 2011).

Other Waterbirds:
Many other families of birds are tied to water and to breeding in the boreal forest. Rails, Gulls, Terns, Grebes, Bitterns and Loons nest in wetlands and lakes. Many species of gulls and terns require small rocky islands to nest on e.g. Common and Caspian Terns, Ring-billed and Herring Gulls (Boreal Songbird Initiative 2014). Their flightless young are vulnerable to predation and thus, without small islands in the lakes of the boreal forests they rarely survive, or adults simply do not attempt to nest. Rails and Bitterns are secretive birds that require sedge and reed marshes for nesting, feeding on plants and invertebrates in the wet meadows and shallow marshes of their preference. Species such as Loons and Grebes dive for small fish. "…Common loons require clear lakes with rocky, forested shorelines, deep bays, small islands, floating bogs in forested landscapes" (Boreal Songbird Initiative 2014). They choose these sites because without the specific characteristics of habitat they suffer high nest failure due to the habitat not meeting the survival needs of breeding loons. All birds are similarly selective in their choice of breeding habitat.

Impacts of changed flow regimes on bird habitat

Changes to natural flooding regimes are known to play a critical role in impacts to ecosystem integrity, variety of habitats and biodiversity (Steen et al. 2006, LeRoy Poff et. al. 1997). Focusing on only a few key species in a habitat fail to provide for habitat needs for the wider range of species (LeRoy Poff 1997). Variations in magnitude, frequency, duration, timing and rate of change of flows are what create the conditions for the patchwork of different habitats available for a wide range of species (Steen et al. 2006, LeRoy Poff et. al. 1997). The plants and animals dependent on riparian habitats are adapted to the specific flow regimes that have been present over thousands of years in the river system they live in. When these flows are disrupted, resulting habitats favour only a few species, which are habitat generalists. The remaining species are habitat specialists and are at this time greatly reduced or lost from the ecosystem (LeRoy Poff 1997). It is estimated that riparian areas under changed flow regimes require centuries to reach a new dynamic equilibrium, and in the case of anthropogenic flow regimes, "may never reach a new equilibrium as they are always recovering from the latest flood" (LeRoy Poff 1997).

Flow regimes in the Upper Nelson River are in many years under regulation. Historically, peak flows were highest in mid-summer and lowest in mid-winter (Manitoba Hydro CEC submissions Appendix 5). Currently, highest flows may be late in winter and lowest flows in mid-summer (Manitoba Hydro CEC submissions Appendix 5). Operations for electricity generation flush unnatural amounts of water through the system at odd times, disrupting daily needs of plants and animals (LeRoy Poff et al. 1997). This has profound impacts on downstream ecosystems. The effects of the LWR can create a shoreline that is more uniform across large areas, reducing the mosaic effect of eons of natural lake and river evolution. Appendix six of the Manitoba Water Power Act License CEC Submission, reports of "high water levels in the fall and low water levels in the spring (as having)… a "severe" effect on waterfowl habitat by converting productive marsh habitat into mudflats."

The specific changes to habitat in Pimicikamak territory that affect birds include loss or degradation of marshes and wetlands bordering the large lakes, mudflats formed by ice scouring from unnaturally high winter water flows, increased erosion and turbidity and loss or change of small islands. The diversity of niches available for the critical phases in birds' lives is likely vastly reduced. Unusual water patterns cause changes in vegetation type and density that likely preclude nesting in select species (Lindgren 2001, LeRoy Poff et. al. 1997).

Winter ice scouring from unnaturally high winter water levels degrades lake-shores, leaving mud flats (Manitoba Hydro CEC submission appendix 5 2014). This obstacle for hatchling waterfowl increases predation because they must cross this in order to accommodate the three vital life needs of thermal cover, safety from predators and foraging. Productiveness of habitat is decreased due to many factors including higher turbidity (which reduces oxygen saturation) (Manitoba Hydro CEC submission appendix 5 2014, LeRoy Poss et. al. 1997). Disruption of life cycles of the food sources (fish, crustaceans, molluscs, invertebrates) in LWR affected waterways affects foraging opportunities for many species of birds (LeRoy Poss et. al. 1997). Species dependent on relatively stable rocky small islands for nesting, such as gulls and terns are likely lost or greatly reduced in abundance.

Some specific examples of birds affected

Loss of breeding success is thought to be responsible for the decline of Lesser Scaup

Lesser scaup are one of the most abundant diving ducks in North America. About 66% of the population nests in Canada's boreal forest (Boreal Songbird Initiative 2014). For nesting they require wetlands with high quantities of emergent and submerged vegetation that provides forage and cover (Ducks Unlimited Canada 2014). Primary nesting habitat has been characterized as permanent wetlands 0.85 ha to 2.0 ha with at least 50% of the shoreline bordered by trees and shrubs (Allan A 1986). Lesser scaup populations have declined markedly in the last twenty years (Austin et al. 2000, Ducks Unlimited Canada 2014). Evidence points to declines in nest success, since surveys have shown a decrease in numbers of female and juvenile ducks (Austin et al. 2000). It is thought that industrial activities in the boreal forest are responsible for the changes in nest success, but more data is required to discern exactly what is causing the decline of the Lesser Scaup (Austin et al. 2000). Changes in the flooding regime have degraded many riparian wetlands fringing the lakes of the Upper Nelson River area (pers. comm. A. Luttermann Jan 2015). Therefore, there are likely to be declines of Lesser Scaup in Pimicikamak territory.

Dams and diversions have influenced the complete disappearance of piping plovers from traditional nesting sites in Manitoba.

Although many species of bird are affected across a wide array of families, the influence on the loss of piping plover nesting habitat by changed water levels is a stark example. Piping plovers require open sandy beaches for nesting (All About Birds 2011/USFWS 2014). The nest is a scrape (small hollow) on the sand (All About Birds 2011/Boreal Songbird Initiative 2014). Plovers rely upon camouflage for survival of eggs and chicks (All About Birds 2011, Boreal Songbird Initiative 2014). While one IUCN listed threatened population of piping plover nests on ocean beaches in Eastern Canada and northern US states, a second IUCN listed endangered population nests on the beaches of inland lakes (All About Birds 2011, USFWS 2014).

There are many threats to piping plover breeding success. In populated areas, nests are lost when trampled by unsuspecting people on foot or in vehicles and the flightless chicks are chased and often killed by dogs (USFWS 2014). Nesting habitat is also lost to commercial, residential and recreational development (USFWS 2014). In their final stronghold on remote beaches, loss of habitat due to changes in water regulation has reduced their habitat to the point where, in Manitoba, they no longer nest. To maintain beaches wide enough to nest, wide fluctuations in water level are needed, both high and low. High water years to flood out vegetation that otherwise would encroach on the beach and low water years to expose wide beaches for nesting. The LWR operates within a +/- one standard deviation. This is not enough to provide the habitat that piping plover need for successful nesting (personal email from Christian Artuso program manager for Bird Studies Canada in Manitoba March 1st 2015). The LWR could potentially be used in a very dry year to allow water levels to fall significantly enough for piping plover to nest (Artuso C. personal email 2015).

Abundance and Rarity

Birds are important to people. Their intrinsic, social and economic value is illustrated by the existence of government legislation to protect them. Canada is legally bound to protect migratory birds (Migratory Birds Convention Act 1994, Govt. of Canada 1994) as well as rare species (Species at Risk Act, Govt, of Canada 2002). By the time species have reached rare or endangered status, many measures must be taken in order to prevent species from going extinct, which can very expensive (Wiens and Gardali 2013). Once a species is rare, the vagrancies of chance play a much bigger role in whether or not that species survives. One catastrophe can take out the remaining members of a population. Recent studies have focused on the importance of protecting abundance as well as rarity (Wiens and Gardali 2013). When abundance is protected then species can take care of themselves and no expensive mitigations are necessary.

"Most songbird and waterfowl breeding in the boreal forest occur in low densities over very large areas (Wells et al. (2) 2014, Wells and Blancher 2011). This means that conservation efforts must act on a landscape scale as opposed to a micro scale (Wells et al. (2) 2014). Modern comprehensive conservation plans identify protection targets between 25% and 75% of the landscape (as opposed to outdated models of 10-12%) (Wells et al. (2) 2014). Indeed, the International Boreal Conservation Science Panel recommends that at least half of the boreal forest must be protected in order to maintain current levels of biodiversity (IBCSP 2013). In addition to this, the panel recommends that industrial disturbance, including hydro-electric schemes, must be held to the highest environmental standards possible.

Riparian habitat along the Upper Nelson River lakeshores represents a large proportion of available habitat for breeding and migrating birds in Pimicikamak territory. Since all of the shores bordering the main stem of the river are subjected to unnatural water flows, a significant quantity of habitat for birds has been degraded. Since birds do not exist without their habitats, this may represent a significant loss of diversity across many avian families in Pimicikamak territory. There has been little assessment of the status of bird populations and habitat in this region directly affected by the LWR.

Natural flow regimes and restoring ecological integrity

LeRoy Poff et.al. in 'The Natural Flow Regime: A paradigm for river conservation and restoration' suggest that, "[N]atural flow regimes are considered critical for maintaining ecological integrity of river systems, however current management approaches often fail to recognize this fundamental principle in regards to ecological maintenance and restoration of habitat" and, "…that restoring natural flow regimes in managed rivers is a useful goal that can be implemented incrementally." (LeRoy Poff et al. 1997). They recommend recognizing the five components to natural variability to water flow - magnitude, frequency, duration, timing and rate of change- in flow regimes and the importance of each of these attributes in maintaining or restoring the variety of natural habitats necessary to support all species. Each of these components of the flow regime affects a different aspect of natural habitat. All five components must be considered in order to sustain biological diversity in downstream effects of the LWR.

Natural timing, magnitude, frequency, duration and rate of change of flows present difficulties when maximization of electricity generation and flood control are the primary determinants of when and how water is released. To return a measure of ecological integrity to the Upper Nelson River watershed, the needs of the wide range of plants, animals and people must be considered alongside these values.

LeRoy Poff et. al. (1997) list a number of managed river systems in which meaningful changes in flow regime have been proposed and in some cases brought about significant benefits to downstream ecosystems. In the Oldman River and tributaries in Southern Alberta, for example, increased summer flows that mimic natural flows in wet years have restored riparian habitat, in this case cottonwoods, for 500kms downstream and also restored cold-water trout fisheries (LeRoy Poff 1997, Rood et. al. 1995). In the Kissimmee River in Florida, changes to flow regimes that mimic magnitude, duration, rate of change and timing of high and low flow periods has restored the floodplain inundation to recover wetland functions and re-established in-channel habitats for fish and other aquatic species (LeRoy Poff 1997, Toth 1995). In Rush Creek, California increased minimum flows has restored riparian vegetation and habitat for waterfowl and fish (LeRoy Poff 1997, LADWP 1995).

Increasing industrial development now threatens one of the world's last great wildernesses, the boreal forest of Canada (IBCSP 2013). Gone are the days when large areas of habitat can be written off because there is enough remaining habitat elsewhere to compensate. Today, among other things, the sum total of lost habitat is having detrimental effects on populations of birds in the boreal forest. In order to maintain an intact boreal forest that supports the historical array of species with enough of a buffer to ensure their long-term survival, strict environmental standards must apply to both existing and future projects. The International Boreal Conservation Science Panel recommends protecting at least half of the North American boreal forest, and in addition, that all industrial and general development be held to the highest environmental standards available.

In order to ensure the maximum health of bird habitat in Pimicikamak territory possible in the Upper Nelson River, new research and monitoring efforts should be pursued to determine the current state of habitats downstream of LWR, and to explore what may be feasible in terms of improving conditons. Incorporating a water regime in the LWR that mimics natural flows as much as possible would greatly benefit the ecology of downstream watersheds in the Upper Nelson River (LeRoy Poff 1997, TSWS 2006).

Granted, there are practical and economic impediments to doing this, however, acknowledging this to be true does not preclude making significant and important efforts to enhance habitat for birds downstream of the LWR. This striking of a balance between all values for the waters of the Upper Nelson River sits well with Manitoba Hydro's mandate for high environmental standards.

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