western boreal conservation initiative

l'initiative de conservation boréale de l'ouest

WESTERN BOREAL CONSERVATION INITIATIVE 2003-2008:

Towards the Conservation of Canada's Boreal Forests

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Towards the Conservation of Canada's Boreal Forests

Photos generously provided by:

Benoît Audet, Jeff Ball, Erin Bayne, Mark Bidwell, Ducks Unlimited Canada, Jason Duxbury, Darcy Falk, Kevin Hannah, Matt Hanneman, Keith Hobson, Kevin Kardynal, Chris Kolaczan, Garry Kramer, Larry Neel, Craig Machtans, Glenn Mack, Julienne Morissette, Bryn Polytilo, Stuart Slattery, Samantha Song, Steve Van Wilgenburg

Library and Archives Canada Cataloguing in Publication

Western Boreal Conservation Initiative 2003-2008:
Towards the Conservation of Canada's Boreal Forests [electronic resource].

Issued also in French under title:
L'initiative de conservation boréale de l'Ouest 2003-2008 :
Vers la conservation des forêts boréales du Canada.

Electronic monograph in PDF format.
Issued also in printed form.

ISBN 978-1-100-11887-1
Cat. no.: En14-10/2009E-PDF

1. Taiga ecology--Canada.
2. Taigas--Conservation--Canada.
3. Taigas--Canada--Management.
4. Biodiversity conservation--Canada.
5. Forest conservation--Canada.
6. Forest management--Canada.
7. Western Boreal Conservation Initiative (Canada).
I. Canada. Environment Canada II. Title.

QH541.5.T3 W47 2009 577.3'70971 C2009-980053-5

Aussi disponible en français

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INTRODUCTION

The Canadian boreal forest is vast, complex, and one of the largest relatively intact ecosystems on earth. It is also fragile, and over the past few decades has come under increasing pressure from both environmental change and resource development. The Western Boreal Conservation Initiative (WBCI) was established to support sound decision-making, adaptive management, and best practices to facilitate conservation and sustainable development in the western boreal forest. With a vision towards "a healthy and intact boreal forest ecosystem in Canada that maintains its natural range of biodiversity and supports forest-dependent communities", WBCI was implemented at a regional scale to serve as the foundation for a future national initiative. Recognizing the efforts of others, WBCI was based on partnerships with leading organizations that share its commitment to conservation.

This report summarizes five years (2003–2008) of WBCI efforts towards the conservation of boreal forests and their biodiversity. Reflecting upon the Strategic Initiatives and Action Plan developed for the WBCI, it also describes ongoing challenges and future priorities with respect to Environment Canada's mandates in the boreal region.

Further information about WBCI can be found on our website at www.pnr-rpn.ec.gc.ca/boreal or by contacting us at boreal@ec.gc.ca or 780-951-8600.

MESSAGE FROM THE REGIONAL DIRECTOR

I am pleased to share the Western Boreal Conservation Initiative (WBCI) five-year report, 2003–2008. This initiative was conceived with the vision of a healthy and intact boreal forest ecosystem in Canada that maintains its natural range of biodiversity and supports forest-dependent communities. WBCI was based in Environment Canada's Prairie and Northern Region with linkages to conservation across Canada's boreal forest. This document summarizes efforts to facilitate conservation and protection of western boreal forest ecosystems and their biodiversity as well as support sustainable development of natural resources.

WBCI worked with partners in industry, other governments, academia, non-governmental organizations, and communities to conduct a range of projects over five years. These strategically leveraged partnerships maximized the available funding to achieve several primary objectives: to address knowledge gaps in baseline data and provide new information; to develop partnerships that engaged decision-makers and affected parties in conservation; and to create awareness of the boreal forest, the biodiversity that depends upon it, and Environment Canada's conservation goals.

A highlight of WBCI was the partnership approach that encouraged data sharing, maximized resources, and coordinated expertise. This resulted in significant advances in science and practice, in forms including models and maps for resident and migratory birds and their habitat; baseline information to inform future monitoring efforts; best practices for management of migratory birds and boreal forests; and contributions to land management plans and conservation policies.

The report before you summarizes the major projects and results along with lessons learned and recommendations for future engagement by Environment Canada in the conservation of Canada's boreal forest. Although this initiative has concluded, many challenges remain for the protection and conservation of this vital landscape, its biodiversity, water, carbon, and the people that depend upon them, now and in the future. Environment Canada will continue to seek partnerships with those who share its conservation mandate and concern for the future of our northern forests.

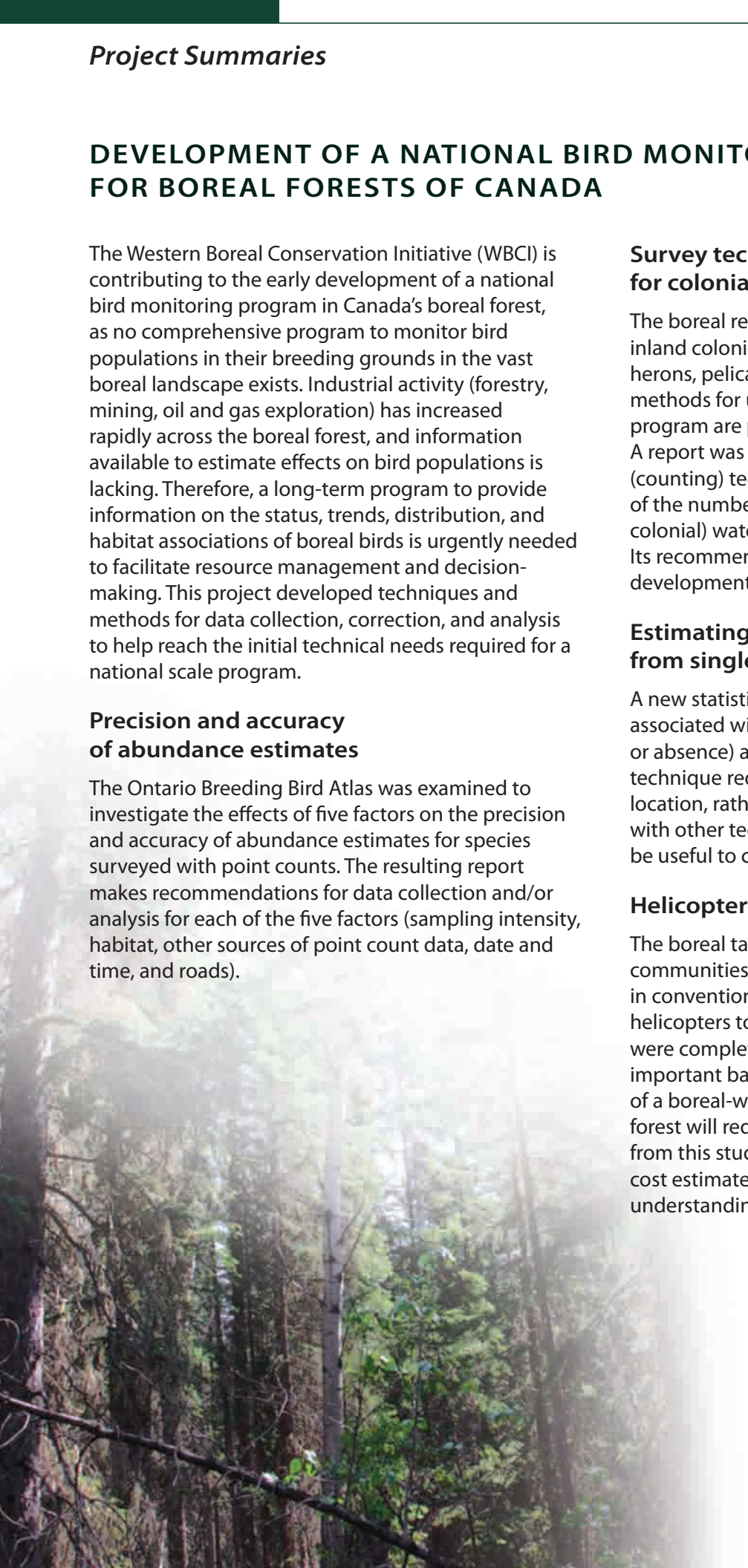
Dave Duncan
A/Regional Director
Prairie and Northern Region
Environment Canada

DEVELOPMENT OF A NATIONAL BIRD MONITORING PROGRAM FOR BOREAL FORESTS OF CANADA

The Western Boreal Conservation Initiative (WBCI) is contributing to the early development of a national bird monitoring program in Canada's boreal forest, as no comprehensive program to monitor bird populations in their breeding grounds in the vast boreal landscape exists. Industrial activity (forestry, mining, oil and gas exploration) has increased rapidly across the boreal forest, and information available to estimate effects on bird populations is lacking. Therefore, a long-term program to provide information on the status, trends, distribution, and habitat associations of boreal birds is urgently needed to facilitate resource management and decision-making. This project developed techniques and methods for data collection, correction, and analysis to help reach the initial technical needs required for a national scale program.

Precision and accuracy of abundance estimates

The Ontario Breeding Bird Atlas was examined to investigate the effects of five factors on the precision and accuracy of abundance estimates for species surveyed with point counts. The resulting report makes recommendations for data collection and/or analysis for each of the five factors (sampling intensity, habitat, other sources of point count data, date and time, and roads).



Survey techniques for colonial waterbirds

The boreal region is important for many species of inland colonial waterbirds (e.g., gulls, terns, grebes, herons, pelicans, and cormorants), but survey methods for use in a multi-species monitoring program are poorly developed for these species. A report was developed that proposes census (counting) techniques to yield reasonable estimates of the number of nesting pairs of colonial (or semi-colonial) waterbirds at sites in the boreal forest. Its recommendations will be used to inform the development of a national monitoring program.

Estimating occupancy from single visit surveys

A new statistical method for correcting issues associated with estimating bird occupancy (presence or absence) at field sites has been developed. The technique requires only a single visit to a given survey location, rather than the three or more visits needed with other techniques. The new technique may also be useful to correct historical data.

Helicopter-based surveys

The boreal taiga shield is remote and bird communities are consequently underrepresented in conventional sampling programs. Surveys using helicopters to access a grid of nine sample areas were completed, with the resulting data providing important baseline information for use in the design of a boreal-wide sampling scheme. Much of the boreal forest will require the use of helicopters and the data from this study can be used to generate detailed cost estimates for working in the north, and a better understanding of practical logistic considerations.

Omni-directional microphones

The uses and limitations of omni-directional microphones for surveying forest birds were investigated. Using field sites in Alberta and the Northwest Territories, data were collected to determine to what extent bias associated with distance (from bird to microphone) could be reduced. While variation between habitats was small, detection distances were quite variable within and between species. The typical maximum detection distance was calculated under various environmental conditions: birds with quiet songs (e.g., Bay-breasted Warbler) were detectable only out to 100–125 m; "medium" volume singers (e.g., Magnolia Warbler) were detectable to 125–150 m; and "louder" singers (e.g., Swainson's Thrush) were detectable as far away as 150–200 m. Wind gusts, wind speed, and singing height of the bird were important variables affecting detection distance. These results will be used to create an "area-sampled correction factor" for point counts recorded using omni-directional microphones.

Long-term recordings made at a small number of sites are being used to determine correction factors required to reduce bias due to inherent variation in bird song cues (by species, by latitude, by date, by time of day). Continuous, daily recordings made in different habitats spanning the whole month of June created a unique record of bird activity. Early analyses indicate daily variation is minimal within the first four hours of sunrise, but thereafter singing activity declines rapidly. This specific pattern can now be used to correct counts conducted outside the optimal time window. Seasonal variation indicates a quieter period in mid-June, likely coincident with tending of nestlings by adult birds.

External tones were used to determine the apparent detection by observers of varying frequencies. High frequencies (8 kHz) were least detected and almost inaudible past 126 m, while the lowest frequency (1 kHz) was detectable at all distances tested. In the future, these external tones may be used as a method to quantify the ambient noise on each recording. Observations during the field trials indicate variation in headset volume, recording volume, and differences between what a microphone detects versus "by ear" point count methods will be important in designing a standardized monitoring protocol that uses recording devices to collect and archive field data.

COLLABORATORS

Craig Machtans, Environment Canada
Mike Norton, Environment Canada
Lindsay Armer, Environment Canada
Kevin Hannah, Environment Canada
Erin Bayne, University of Alberta
Subhash Lele, University of Alberta

PROJECT PARTNERS

Environment Canada
University of Alberta

BOREAL AVIAN MODELLING PROJECT

The Boreal Avian Modelling (BAM) Project, formerly the National Boreal Bird Habitat Modelling Project, was initiated to address the lack of information on birds and their habitats across Canada's boreal forests. This collaborative effort amongst researchers and agencies has compiled data from a critical mass of studies to develop spatially explicit (map based), predictive models that will identify habitat conditions influencing bird species abundance and distribution. These results can be incorporated into decision-making and environmental management actions including conservation planning, identification of priority habitats, environmental assessments, and monitoring efforts. They may also be used to address regulatory requirements. The main goal of the project is to facilitate proactive conservation of bird populations and habitats in this vast region, which supports a major share of North America's migratory landbirds.

"The value of this project lies in its ability to model bird populations over large scales to provide a scientific background for legal and policy decisions."

Andrew DeVries, Forest Products Association of Canada

Bird data assembly

This project has endeavoured to develop a comprehensive database of all systematic, spatially referenced, observational bird data that have been collected in boreal Canada. Data-sharing agreements have been established with over 50 partners to date, including boreal researchers from academic institutions, consulting firms, ENGOs (environmental non-governmental organizations), federal and provincial agencies, and forest, mining and energy sector companies. BAM's spatial database now includes 557 610 data points from 36 911 point count stations stretching from the Yukon to Newfoundland. To better represent the many areas that remain poorly sampled, data from selected Breeding Bird Survey routes and supplemental point counts will be incorporated into the database. Due to the variability noted among point count survey methods used by different researchers, a standardized point count survey protocol is being proposed for all landbird surveys in Canada's boreal forest.

Biophysical data assembly

Based on three satellite-based land-cover datasets, an extensive library of biophysical variables has been compiled, including national cartographic data (e.g., streams, rivers and lakes, land use); spatially interpolated climate data; fire history and fire regime data; and remotely sensed measures of productivity and land or vegetation cover classes. However, the remote-sensed habitat data available at a boreal-wide scale do not include forest age, canopy height, or tree species composition, yet these factors are known to influence habitat selection by birds. To address this shortfall, all digital forest resource inventory (FRI) data available for Canada have been assembled. While standardizing the data at this scale poses major technical challenges, the resulting forest data are more detailed and will enable better habitat modelling.

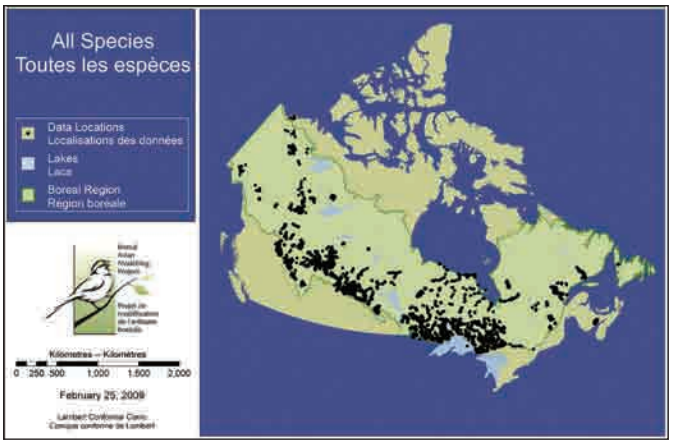


Figure 1: Locations of point count records held in the BAM database

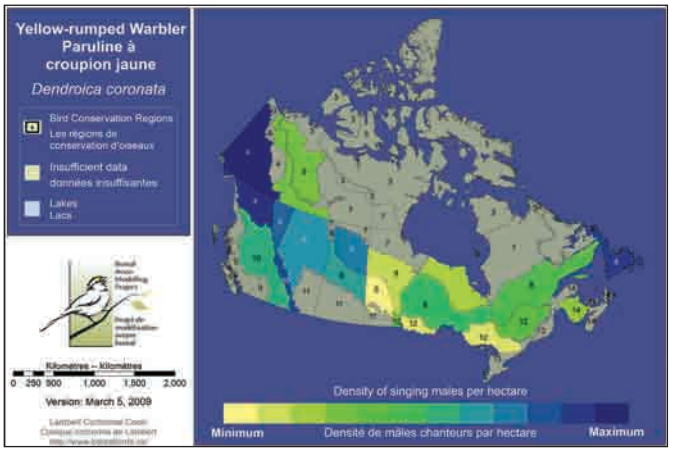


Figure 2: Estimates of relative population density of Yellow-rumped Warbler across Bird Conservation Regions and jurisdictions in Canada

Models of bird species distributions and abundances

Initial abundance models (based on regression tree approaches) were developed for approximately 60 songbird species in western Canada. National abundance models have been developed for a subset of species, and more are in progress. These predictive maps of relative abundance describe the potential environmental niche of a species. These models represent the first time data-driven predictions of landbird distribution have been available across the extent of the Canadian boreal forest. Methods to assess the reliability of the predictions, based on spatial weight simulation, offset estimation, and bootstrap simulations (a statistical method based on repeated random sampling to generate variance estimates) have also been employed. Maps of the predicted reliability of the models provide guidance on where additional data collection efforts should focus over the short to medium term, and help to characterize the structure of geographic ranges of individual bird species. Following the development of correction factors to standardize for several factors that influence bird counts, the project has now progressed to being able to estimate bird densities, enabling actual population estimates.

Outcomes

The results of this project are providing critical support for conservation planning and management in the ecologically important, yet poorly understood, boreal forest. Predictive models will enable the creation of decision-support tools for end-users engaged in boreal conservation and forest management planning. Some results have already been used in regional modelling exercises in the Mackenzie River Basin to predict future trends of boreal forest birds in relation to land use. Map-based products have also been produced as prototypes for use in species-at-risk assessments and in Bird Conservation Region (BCR) plans. Population estimates have been computed for 100 species as further support of BCR planning.

Next steps

The project's next phase will focus on completing these bird population estimates (a long-standing, complex challenge for ornithologists), on analyses of bird species richness across the boreal forest, and on development of sophisticated predictive models to identify natural and anthropogenic factors that determine boreal bird distributions and abundances. These models will be utilized for analyses of a variety of future management scenarios facing the boreal forest.

The project website is now accessible in English and French at www.borealbirds.ca.

COLLABORATORS

Erin Bayne, University of Alberta
Steve Cumming, Université Laval
Fiona Schmiegelow, University of Alberta
Samantha Song, Environment Canada
Kara Lefevre, Université Laval
Trish Fontaine, University of Alberta
Matt Carlson, Canadian Boreal Initiative
John Cosco, Timberline Natural Resource Group
Shoufan Fang, University of Alberta
Kevin Hannah, Environment Canada
Bénédicte Kenmei, Université Laval
Zhong Li, Environment Canada
Kim Lisgo, University of Alberta
Melanie-Louise Leblanc, Université Laval
Sheila MacLeod Potter, Blue Chair Designs
Lisa Mahon, University of Alberta
Dan Mazerolle, Parks Canada
Paul Morrill, Web Services
Pierre Racine, Université Laval
Stephanie Topp, Environment Canada

TECHNICAL COMMITTEE

Peter Blancher, Environment Canada
Marcel Darveau, DUC/Université Laval
André Desrochers, Université Laval
Jean-Luc DesGranges, Environment Canada
Andrew DeVries, Forest Products Assoc. of Canada
Pierre Drapeau, Université du Québec à Montréal
Charles Francis, Environment Canada
Keith Hobson, Environment Canada
Craig Machtans, Environment Canada
Julienne Morissette, Ducks Unlimited Canada
Rob Rempel, Ontario Ministry of Natural Resources
Phil Taylor, Acadia University
Stuart Slattery, Ducks Unlimited Canada
Steve Van Wilgenburg, Environment Canada
Lisa Venier, Canadian Forest Service
Pierre Vernier, University of British Columbia
Marc-André Villard, Université de Moncton

FUNDING PARTNERS

Environment Canada, Canadian Wildlife Service
Boreal Ecosystems Assessment for Conservation Networks (BEACONs), University of Alberta
Canada Foundation for Innovation
Canada Research Chairs Program
Canadian Boreal Initiative
Ducks Unlimited Canada
Environmental Studies Research Fund
Fonds québécois de la recherche sur la nature et les technologies
Forest Products Association of Canada
Natural Sciences and Engineering Research Council of Canada
University of Alberta
Université Laval
United States Fish and Wildlife Service

DATA PARTNERS

Numerous individuals and institutions generously provided or facilitated provision of data to BAM:

Individuals:
J. Ball, E. Bayne, P. Belagus, S. Bennett, R. Berger, M. Betts, J. Bielech, A. Bismanis, R. Brown, M. Cadman, D. Collister, M. Cranny, S. Cumming, L. Darling, M. Darveau, C. De La Mare, A. Desrochers, T. Diamond, M. Donnelly, P. Drapeau, C. Duane, B. Dube, D. Dye, R. Eccles, P. Farrington, R. Fernandes, D. Fortin, K. Foster, M. Gill, R. Hall, S. Hannon, B. Harrison, J. Herbers, K. Hobson, L. Imbeau, P. Johnstone, V. Keenan, S. Lapointe, R. Latifovic, R. Lauzon, M. Leblanc, J. Lemaitre, D. Lepage, B. MacCallum, P. MacDonell, C. Machtans, L. Morgantini, S. Mason, M. McGovern, D. McKenney, T. Nudds, P. Papadol, M. Phinney, D. Phoenix, D. Pinaud, D. Player, D. Price, R. Rempel, A. Rosaasen, S. Running, R. Russell, C. Savingnac, J. Schieck, F. Schmiegelow, P. Sinclair, A. Smith, S. Song, C. Spytz, P. Taylor, S. Van Wilgenburg, P. Vernier, D. Whitaker, J. Witiw, S. Wyshynski, M. Yaremko

Institutions:
Acadia University, Alberta Biodiversity Monitoring Institute, Alberta-Pacific Forest Industries Inc., Alberta Research Council, AMEC Earth & Environmental, AREVA Resources Canada Inc., AXYS Environmental Consulting Ltd., Bighorn Wildlife Technologies Ltd., Bird Studies Canada, Canadian Forest Service-Natural Resources Canada, Canadian Natural Resources Ltd, Canfor Corporation, Daishowa Marubeni International Ltd., Ducks Unlimited Canada, Environment Canada, Global Land Cover Facility, Golder Associates Ltd., Government of British Columbia, Government of Ontario, Government of Saskatchewan, Government of Yukon, Hinton Wood Products, Hydro-Québec Équipement, Kluane Ecosystem Monitoring Project, Komex International Ltd., Louisiana Pacific Ltd., Manitoba Hydro, Manitoba Model Forest Inc., Manning Diversified Forest Products Ltd., Matrix Solutions Inc., MEG Energy Corp., Mirkwood Ecological Consultants Ltd., Newfoundland and Labrador Hydro, Numerical Terradynamic Simulation Group, Ontario Ministry of Natural Resources, OPTI Canada Inc., PanCanadian Petroleum Limited, Petro Canada, Principal Wildlife Resource Consulting, Rio Alto Resources International Inc, Shell Canada Limited, Suncor Energy Inc., Tembec Industries Inc., Tolko Industries Ltd., Université du Québec à Montréal, Université du Québec en Abitibi-Témiscamingue, Université Laval, University of Alberta, University of British Columbia, University of New Brunswick, University of Northern British Columbia, URSUS Ecosystem Management Ltd., West Fraser Timber Co. Ltd., Weyerhaeuser Company Ltd., and Wildlife Resource Consulting Services MB Inc.

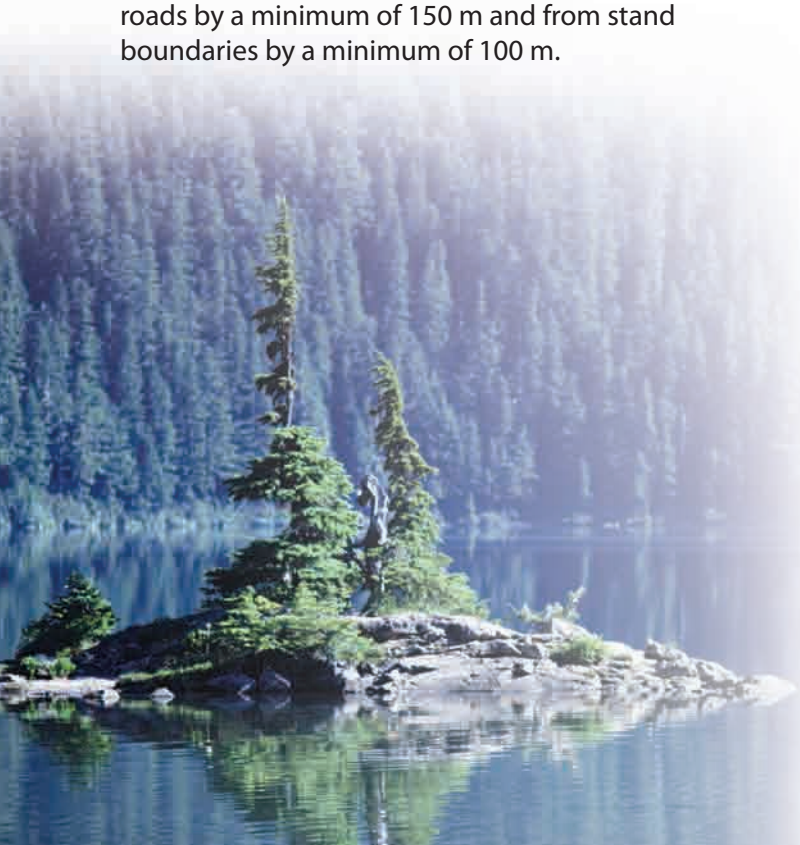
DEFINING BOREAL AVIFAUNAL REGIONS: COMPARISON OF SONGBIRD COMMUNITIES BETWEEN BOREAL PLAINS AND SHIELD

Bird Conservation Regions (BCR) form the bounded units upon which conservation planning for bird populations in North America is based. These units are defined under the North American Bird Conservation Initiative, established by the Commission on Environmental Cooperation, and are largely derived from ecological land classification systems based on gradients of geological, soil nutrient, hydrological, and other information. However, in other forums, the boreal forest is frequently represented as a contiguous ecosystem, stretching from coast to coast. This project assessed whether the boundary between Boreal Softwood Shield (BCR 8) and Boreal Taiga Plains (BCR 6) acts a meaningful boundary for bird conservation planning by determining whether bird communities in these two BCRs were ecologically distinct.

Data for this study were collected with the primary goal of augmenting data gaps within the Boreal Avian Modelling Project, which created the opportunity to address additional ecological questions. Point count surveys for breeding songbirds were conducted in northern Manitoba (2006, n=401) and northern Saskatchewan (2007, n=375), and were distributed in both BCR 6 and BCR 8 from the BCR boundary up to 250 km on either side. Survey stations were a minimum of 250 m apart and were set back from roads by a minimum of 150 m and from stand boundaries by a minimum of 100 m.

Avian communities in both boreal shield and boreal plains were strongly structured (~95% of variation) by habitat type, where habitat was characterized by leading tree species (e.g., white spruce, jack pine). Analyses controlling for habitat type (partial canonical correspondence analyses) demonstrated significant differences in the boreal shield and boreal plains communities, but these differences only described ~5% of observed variation. For example, Orange-crowned Warbler, Northern Flicker, and Olive-sided Flycatcher were strongly associated with the boreal shield (BCR 8); different species were notable in the more species-rich boreal plains (BCR 6), including Canada Warbler, Rose-breasted Grosbeak, and Mourning Warbler, among a host of others. Also documented were apparent shifts in habitat associations of species such as the Cape May Warbler.

Given habitat type had the strongest effect on the composition of avian communities, planning units that capture major habitat differences should also be meaningful for songbirds. Boreal plains and boreal shield BCRs appear to provide useful units for partitioning communities in the prairie provinces, but units that describe habitat variation, for example smaller sub-units that capture major shifts in vegetation cover, are likely also relevant.



COLLABORATORS

Samantha Song, Environment Canada
Kevin Hannah, Environment Canada
Kathy St. Laurent, Environment Canada
(In collaboration with the Boreal Avian Modelling Project)

BOREAL FOREST RIPARIAN BIRD COMMUNITIES: EFFECTS OF LOCAL- AND LANDSCAPE-LEVEL PROCESSES

The boreal forest contains some of the highest densities of water and wetland habitats in Canada, comprising as much as 20–50% of the landscape in some areas. Riparian areas, or the transition zones between water and uplands, are abundant, varied, and can be among the most biologically diverse boreal forest habitats. Despite the presumed ecological importance of riparian areas, bird communities in these areas are poorly understood. Surveys were conducted at approximately 2 075 wetlands in the three prairie provinces to fill three key knowledge gaps outlined below regarding riparian- and wetland-associated bird communities.

Factors influencing bird community composition at boreal wetlands

Wetlands and riparian zones were characterized according to the Canadian Wetland Classification System. Even in broad categories such as bog, fen, marsh, swamp, and open water, clear patterns in bird community composition emerged. Habitat characteristics such as vegetation composition and habitat structure remain important drivers of bird community composition, but wetland classification schemes are providing a useful mechanism to characterize and map wetland and riparian areas. The most distinctive bird communities were in treed vs. shrubby or grassy wetlands. Riparian bird communities also appear to be a blend of wetland-associated birds and early successional species.

Bird community responses to fire and forestry

Progressive boreal forestry companies have begun to adopt a harvesting philosophy modelled on natural disturbances such as fire. Consequently, management guidelines requiring treed buffer strips along riparian areas of rivers, lakes, and some wetlands have come under review (e.g., Alberta, Saskatchewan, Manitoba). This study compared bird community composition in early post-disturbance riparian habitats (burned vs. harvested) as well as in riparian habitats before and after experimental harvest.

Overall, this study shows fire and forest harvesting in boreal shoreline forest and riparian areas result in different bird communities. Both fire and forest harvesting appear to have less effect on riparian birds than on upland birds. Importantly, post-fire sites had a high natural range of variability of bird communities compared to post-harvest sites. This result emphasizes the importance of burned forests in the ecology of riparian birds and the need to maintain fires on the landscape as an integral part of forest management. In a separate experiment, experimental harvesting within riparian buffers did not appear to negatively impact riparian birds. Abundance of two riparian associated species increased within post-harvest treatments with low (5–35%) and high (>75%) retention, yet remained stable in the moderate (35–75%) harvest treatments and reference sites and riparian community composition was not significantly different in unharvested compared to harvested buffers. Forest management adjacent to riparian areas should approximate the natural range of variation found in post-fire sites to provide habitats suitable for all species, both upland and riparian. This may include applying various buffer widths at single wetlands or across the landscape, or prescribing fires for sites with buffer strips. Forest management strategies to satisfy a larger number of bird species (both riparian and upland) should be tested and more research on the effects of changes to harvesting practices on other riparian-associated values is warranted.

Bird community responses to multiple stressors at local and landscape scales

Five boreal wetlands were sampled in 113 landscapes (25 km^2 each), stratified along an intensity gradient of human disturbance in northeastern Alberta (77 landscapes) and the Duck Mountains of Manitoba (36 landscapes).

Results suggest the structure of boreal wetland bird communities is altered by human disturbance, which accounts for up to 60% of the changes seen in bird communities in Manitoba and 40% in Alberta. At the relatively low level of total landscape disturbance due to harvesting studied (20%), harvesting had little effect on riparian and wetland associated bird communities measured at a landscape scale. The largest bird community changes were seen in landscapes partially converted from forest to agriculture; these changes were evident with conversion levels as low as 25%. The biggest differences occurred following >57% conversion to agriculture, with a shift in the bird community to one more typical of prairie and parkland regions (e.g., Northern Shoveler, Yellow-headed Blackbird) and substantial decreases in the occupancy or abundance of species more typical of forested, boreal wetlands (e.g., Common Loon, Palm Warbler). Overall, the largest differences were observed in waterbird and forest-dependent community composition; birds typically considered as riparian species appeared less sensitive to multiple stressors. These results indicate

"[This] project has provided Louisiana Pacific with some new understanding as to how forest birds are responding to variable harvest treatments along riparian areas in softwood, mixedwood, and hardwood stand types."

Donna Kopecky, Louisiana Pacific Canada Ltd.

landscape changes due to human disturbances (especially agriculture and linear disturbances such as roads) affect bird communities at wetlands despite the protection provided by current policies.

COLLABORATORS

Keith Hobson, Environment Canada/ University of Saskatchewan
Julienne Morissette, Ducks Unlimited Canada
Kevin Kardynal, University of Saskatchewan
Erin Bayne, University of Alberta
Stan Boutin, University of Alberta
Eric Butterworth,Ducks Unlimited Canada
Rob Rempel, Ontario Ministry of Natural Resources
Samantha Song, Environment Canada
Steve Van Wilgenburg, Environment Canada

PROJECT PARTNERS

Alberta Conservation Association
Alberta-Pacific Forest Industries Inc.
Ducks Unlimited Canada
Environment Canada
Fisheries and Oceans Canada
L&M Wood Products Ltd.
Louisiana Pacific Canada Ltd.
Manitoba Conservation
Mistik Management Ltd.
Ontario Ministry of Natural Resources
Saskatchewan Environment
Saskatchewan Forestry Centre (Forest Development Fund)
Saskatchewan Wildlife Federation
Sustainable Forest Management Network
University of Alberta
University of Saskatchewan
Weyerhaeuser Canada Ltd.

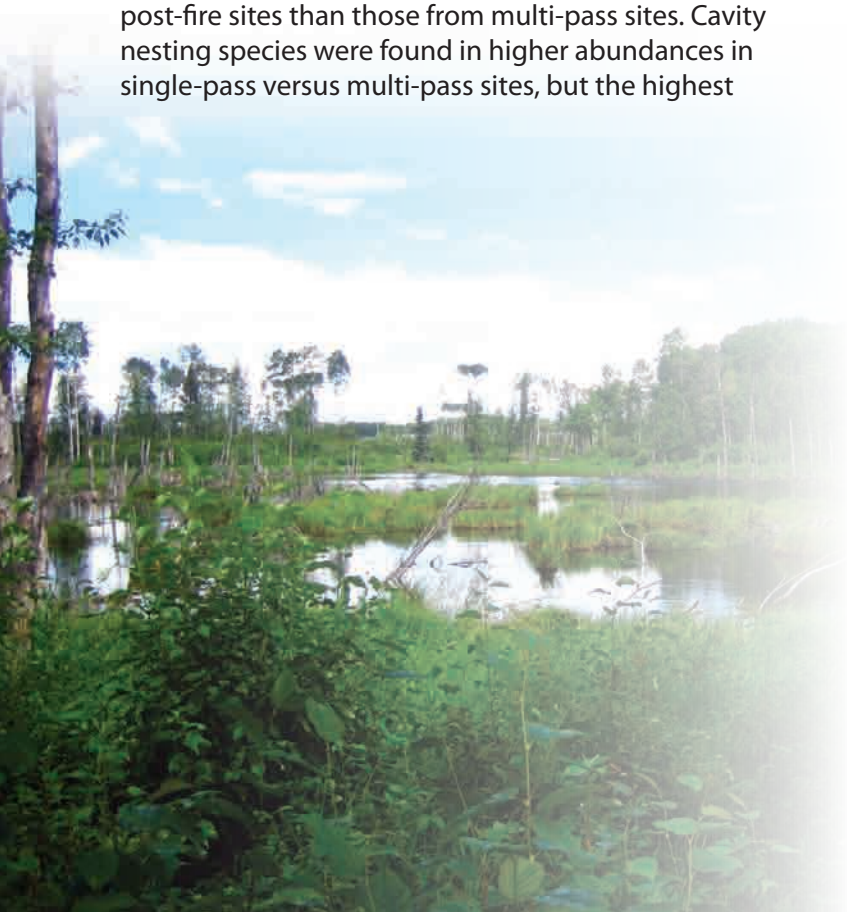
ASSESSING SINGLE-PASS HARVESTING AS A MEANS TO MEET SUSTAINABLE HARVESTING OBJECTIVES FOR BOREAL FOREST BIRDS

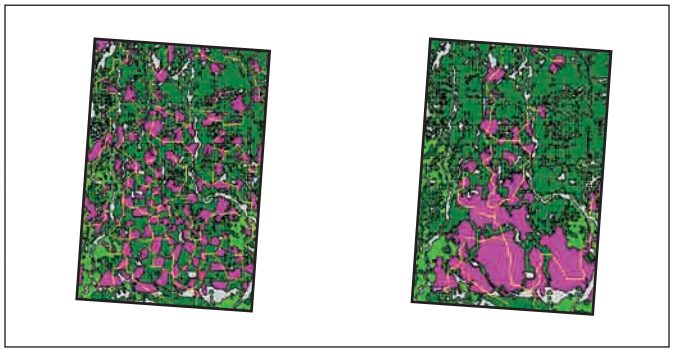
In an attempt to better approximate natural disturbances such as forest fires, some forestry companies have recently been experimenting with alternative forest harvesting methods. In traditional multi-pass harvesting, many small cuts occur over a 10–30 year time frame. In contrast, single-pass harvesting involves larger cutblock areas, with all cutting done in a relatively short (1–5 year) time frame. In comparison to multi-pass harvest approaches, single-pass plans designed to harvest the same volume of wood involve larger disturbances, presumably more similar to those resulting from fire, and leaves the broader landscape less fragmented, creating fewer roads, limiting human access, allowing more variability in the number of live trees retained within the disturbance, and presumably reducing any negative effects of forest edge. Using forest birds as indicators, this project investigated whether areas harvested by the single-pass technique have bird communities more similar to naturally disturbed areas (fire) than in areas harvested by multi-pass methods.

"The project examined concepts that are very fundamental with respect to management based on landscape scale disturbance and patterning after fire. The outcomes definitely strengthened our management plan package submitted to the province of Saskatchewan for approval."

Roger Nesdoly, Mistik Management Ltd.

Survey data indicate bird communities from single-pass harvested sites did not match those from fire-disturbed areas, but were more similar to post-fire sites than those from multi-pass sites. Cavity nesting species were found in higher abundances in single-pass versus multi-pass sites, but the highest abundances were found at post-fire sites. These results suggest single-pass harvests may provide an improvement for bird communities compared with multi-pass methods. Some forest companies in Alberta and Saskatchewan have adopted recommendations based on these results and shifted toward single-pass harvesting. However, none of the harvest treatments provided an ecological match to early post-fire sites, highlighting the importance of post-fire sites for conserving numerous species during the immediate post-disturbance phase. Prescribed burning after harvest could be evaluated in future research as a method to improve the match between post-harvest and post-fire sites.





Single-pass scenario
2 678 ha harvested in 31 blocks
Average patch size = 84 ha
(1–1 104 ha range)
Total disturbance edge = 167 km
50 km of roads

Multi-pass scenario
2 680 ha harvested in 129 blocks
Average patch size = 21 ha
(3–65 ha range)
Total disturbance edge = 326 km
122 km of roads

Figure 1: Maps of single-pass versus multi-pass landscape scenario (harvest blocks in pink)

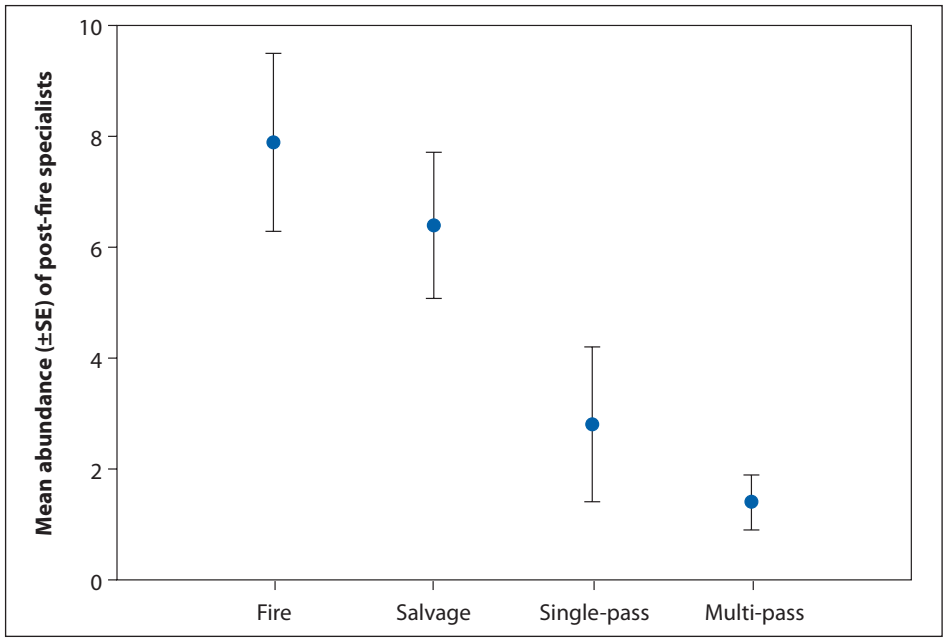


Figure 2: Mean abundance of post-fire specialist woodpeckers (Black-backed [*Picoide arcticus*] and Three-toed [*Picoides dorsalis*] woodpeckers) in fire-disturbed and harvested landscapes

The degree of similarity between bird communities was influenced not only by the harvest methods but also by the amounts of non-forested habitat (e.g., wetlands) and residual (uncut) trees left within the plots. Results suggest future harvesting plans should incorporate non-harvestable habitats within planning units and an increased range of residual retention. A model developed to determine quantitative targets for optimizing avian community similarity to naturally disturbed areas suggested a target range of 5–19% of cutblock area should be retained as within cutblock residuals. Through collaborative efforts to demonstrate its utility, the model has been used to help Mistik Management Ltd. assess how well their 2007 Twenty Year Plan will meet conservation objectives for migratory birds.

COLLABORATORS

Steve Van Wilgenburg, Environment Canada
Keith Hobson, Environment Canada/
University of Saskatchewan
Kevin Hannah, Environment Canada
Samantha Song, Environment Canada

PROJECT PARTNERS

Alberta-Pacific Forest Industries Inc.
Environment Canada
Mistik Management Ltd.
Saskatchewan Environment
Saskatchewan Forestry Centre (Forest Development Fund)
Weyerhaeuser Canada Ltd.

WATERBIRD COMMUNITY STRUCTURE AND DEMOGRAPHY IN SOUTHERN BOREAL MIXEDWOOD FOREST: RELATIONSHIPS WITH NATURAL DISTURBANCE GRADIENTS AND ANTHROPOGENIC IMPACTS

Boreal forest wetlands and surrounding uplands are used annually by millions of waterbirds for nesting and rearing their young. Some boreal waterbirds, such as scaup, scoters, and wigeon, are experiencing rapid population declines for reasons that are not fully understood, and boreal forests are widely recognized as being important habitat for these species. Natural disturbances, such as forest fires, are principal drivers of boreal ecosystem dynamics, particularly in areas around wetlands. This project aims to determine how waterbirds are affected by both natural (fires) and human (forest harvesting) disturbances, and to recommend alternatives for improving forest harvest practices.

From 2005 to 2007, aerial surveys were conducted on a 115 000 km^2 study area in northeastern Alberta and northwest Saskatchewan, about half of which is managed for hardwood fibre production. A total of 584 sites (each 625 ha in area) was surveyed, with about 40% of sites being affected by fire, forestry, or both (disturbed sites), and 60% providing data to represent the natural range of variation in time since disturbance (reference sites). Aerial surveys detected 32 species of waterbirds, including ducks, geese, grebes, rails, loons, cranes, pelicans, and shorebirds. The surveys also revealed that many waterbirds used small wetlands, especially linear features such as beaver-influenced areas. As not all wetlands are visible in available satellite imagery, a new technique was developed to quantify all available wetlands within the study sites using GPS mapping during aerial surveys with subsequent GIS analysis. This method has been refined to determine the accuracy and precision of aerial vs. ground measurements of wetland size as well as the influence of wetland characteristics on these estimates.

"[H]aving interested stakeholders involved from the beginning, including developing the key questions, . . . has helped ensure the outcomes from the project [will] be relevant to all partners."

Glenn Mack, Ducks Unlimited Canada

Overall, preliminary results suggest waterbird abundance is lower in disturbed landscapes compared to reference sites. Although total waterbird abundance was similar in burned and logged landscapes, results suggest disturbances by fire and forestry affect waterbird communities differently, depending on nest-habitat guild. For example, cavity-nesting waterbirds were less abundant in burned areas relative to reference landscapes, but overwater nesters were less abundant in logged areas. Abundance of ground-nesters did not vary between disturbance and reference landscapes. Analyses of data collected during this project are ongoing, the results of which will inform the development of mitigation strategies for reducing negative impacts of forest harvest operations on waterbird communities in boreal mixedwood forests.

COLLABORATORS

Mark T. Bidwell, University of Saskatchewan
Eric Butterworth, Ducks Unlimited Canada
Robert G. Clark, Environment Canada/ University of Saskatchewan
Elston H. Dzus, Alberta-Pacific Forest Industries Inc.
Glenn G. Mack, Ducks Unlimited Canada
Stuart M. Slattery, Institute for Wetland and Waterfowl Research, Ducks Unlimited Canada

PROJECT PARTNERS

Alberta Conservation Association
Alberta-Pacific Forest Industries Inc.
Alberta Sustainable Resource Development
Ducks Unlimited Canada: Western Boreal Program
Ducks Unlimited Canada: Institute for Wetland and Waterfowl Research
Environment Canada
Mistik Management Ltd.
Natural Sciences and Engineering Research Council of Canada
North America Waterfowl Management Plan (Alberta)
Saskatchewan Environment
University of Saskatchewan

MIGRATORY SONGBIRD RESPONSE TO LEVELS OF SALVAGE LOGGING OF FIRE LANDSCAPES: THE HOUSE RIVER FIRE STUDY

Forest companies frequently try to recoup economic losses resulting from fire by salvage harvesting fire-killed timber. Recent studies show migratory bird communities associated with early post-fire habitats are altered dramatically with salvage harvesting at a forest stand scale, but whether these effects are evident at a landscape scale is unclear.

In the spring of 2002, the House River fire burned over 248 000 hectares in northeastern Alberta, providing an opportunity to investigate the landscape-scale response of migratory bird communities to varying levels of post-fire salvage loggin in boreal mixedwood stands. Large 625 hectare (2.5 × 2.5 km) experimental units were randomly selected to provide baseline information and to study the response of migratory birds at a landscape scale. Each of the experimental units included a wide range of forest stand types. Seventeen units had undergone salvage harvesting that comprised 2–31% of the unit's total area. Six units remained unsalvaged.

In the two years following the fire and salvage harvesting, there was little evidence of effects of salvage harvesting on abundance and community composition of migratory birds measured at the landscape scale. This lack of detectable effect was suspected to reflect a combination of factors including the relatively low levels of habitat loss due to salvage harvesting, a focus on the migratory songbird community, which was dominated by habitat generalists, and the stronger effect of other intact habitat types as determinants of songbird response. The high availability of intact forest regionally, as well as the proximity of experimental units to the fire boundary, may also have dampened any potential effects of salvage logging experienced at the stand level from being detected at the landscape scale.

"This project helped fill a knowledge gap with respect to salvage logging, and its landscape level focus was important for ensuring the relevance of the results."

Elston Dzus, Alberta-Pacific Forest Industries Inc.

Naturally occurring habitat gradients characterized by moisture gradients (upland–lowland), structural complexity, and stand age remained the strongest predictors of community structure at the landscape scale. Burn severity was also a significant predictor of bird communities. Both of these results are consistent with prior studies in the boreal forest.

This study was part of a larger multidisciplinary project that also examined resident birds, beetles, and plants within the area burned by the House River fire. All results have been presented to the Alberta government and Alberta-Pacific Forest Industries Inc., and provided as input for the proposed revision of Alberta's forest management planning rules.

COLLABORATORS

Mike Norton, Environment Canada
Kevin Hannah, Environment Canada
Daniel Mazerolle, University of Alberta
Samantha Song, Environment Canada

PROJECT PARTNERS

Alberta Conservation Association
Alberta-Pacific Forest Industries Inc.
Alberta Research Council Inc.
Alberta Sustainable Resource Development
Environment Canada
University of Alberta

INFLUENCE OF PARTIAL AND AGGREGATED (SINGLE-PASS) HARVEST OF THE BOREAL MIXEDWOOD FOREST ON CAVITY-USING SPECIES

Many forest companies are investigating new types of forest harvesting that approximate the patterns and structures of natural disturbances such as fire. This has included the adoption of large single-pass cutblocks with patches of live tree (structure) retention as well as experiments with partial harvesting of riparian buffers. Cavity-using wildlife are one of the most sensitive groups to intensifying human disturbance in the boreal forest as many are resident species. For nesting and foraging, cavity users often depend upon elements such as large, dead, or dying deciduous trees that are present in older forests, fire-killed forests, or riparian forests. This project aims to characterize the cavity-using community in landscapes and riparian buffer strips in the mixedwood boreal forest, and determine the effects of harvesting designed to approximate patterns left after natural disturbance (fire).

Cavity-user community

Cavities are generally produced by strong primary excavators and used by secondary cavity users. Field observations indicated the dominant primary excavator in aspen-dominated boreal mixedwood forests is the Yellow-bellied Sapsucker, producing over 60% of the cavities in the landscapes surveyed. The Hairy Woodpecker, Pileated Woodpecker, and Northern Flicker were identified as keystone species (those who create the majority of cavities used by other species); their cavities were 5, 19, and 25 times more likely to be reused than cavities of Yellow-bellied Sapsuckers, respectively. Cavities were reused by squirrels, insects, as well as a variety of bird species including ducks and owls.

Key features of cavity trees and stands used by cavity users

Aspen was used most often as a cavity tree, and several species (Yellow-bellied Sapsucker, Hairy Woodpecker, Pileated Woodpecker) used aspen exclusively. Most species selected older (>125 yr) aspen stands for their territories, except for Three-toed Woodpeckers that used white and black spruce. Characteristics of trees and surrounding patches used for cavities varied by excavator species, but decay class, tree diameter and height, presence of fungal conks, and tree density were important predictors.

Impacts of harvesting on cavity-using communities

In both buffer strips and single-pass harvest landscapes, cavity-using communities appear to be fairly resilient in the short term to harvest with structural retention. In single-pass harvest landscapes, sapsuckers became less abundant due to the overall loss of forest cover, while the more open habitat attracted more flickers and introduced additional species (e.g., American Kestrels) to the community. All cavity excavators nesting in the intact landscapes were also found nesting in the harvested landscapes, and cavity reuse rates were similar in both intact and harvested landscapes. The results of this project suggest a mix of small and large diameter dead or decaying aspen are important for maintaining all excavators. In particular, larger-diameter dead or decaying trees should be retained for keystone species. Forest planners should leave large patches of old (>125 yr) aspen stands to retain the dominant cavity producer: the Yellow-bellied Sapsucker. To meet future nesting needs of all excavators, a supply of trees to ensure recruitment into the selected size and decay classes must also be retained.

With respect to riparian buffers, medium (33–66%) and high (>66%) retention buffers supported similar communities, while low (0–33%) retention buffers differed from both. High retention buffers had communities dominated by Brown Creeper, an old-growth species. Low retention buffer communities were dominated by Tree Swallows, a more open-country species. When the landscape surrounding the buffers was considered, only Boreal Chickadees were negatively affected by the amount harvested. Partially harvested buffers appear to serve the needs of most cavity-nesters and thus seem to be an appropriate management approach, at least at levels of medium to high tree retention. However, project results suggest that areas of burned riparian forest should be maintained, and harvested buffers should vary in both the amount and composition of forest retained.

"This project uses nest webs to link biodiversity to stand structural attributes. The results of this project will contribute to developing science based structural retention guidelines."

John Stadt, Alberta Sustainable Resource Development

COLLABORATORS

Heather Clarke, University of Alberta
Hilary Cooke, University of Alberta
Susan Hannon, University of Alberta
Samantha Song, Environment Canada

PROJECT PARTNERS

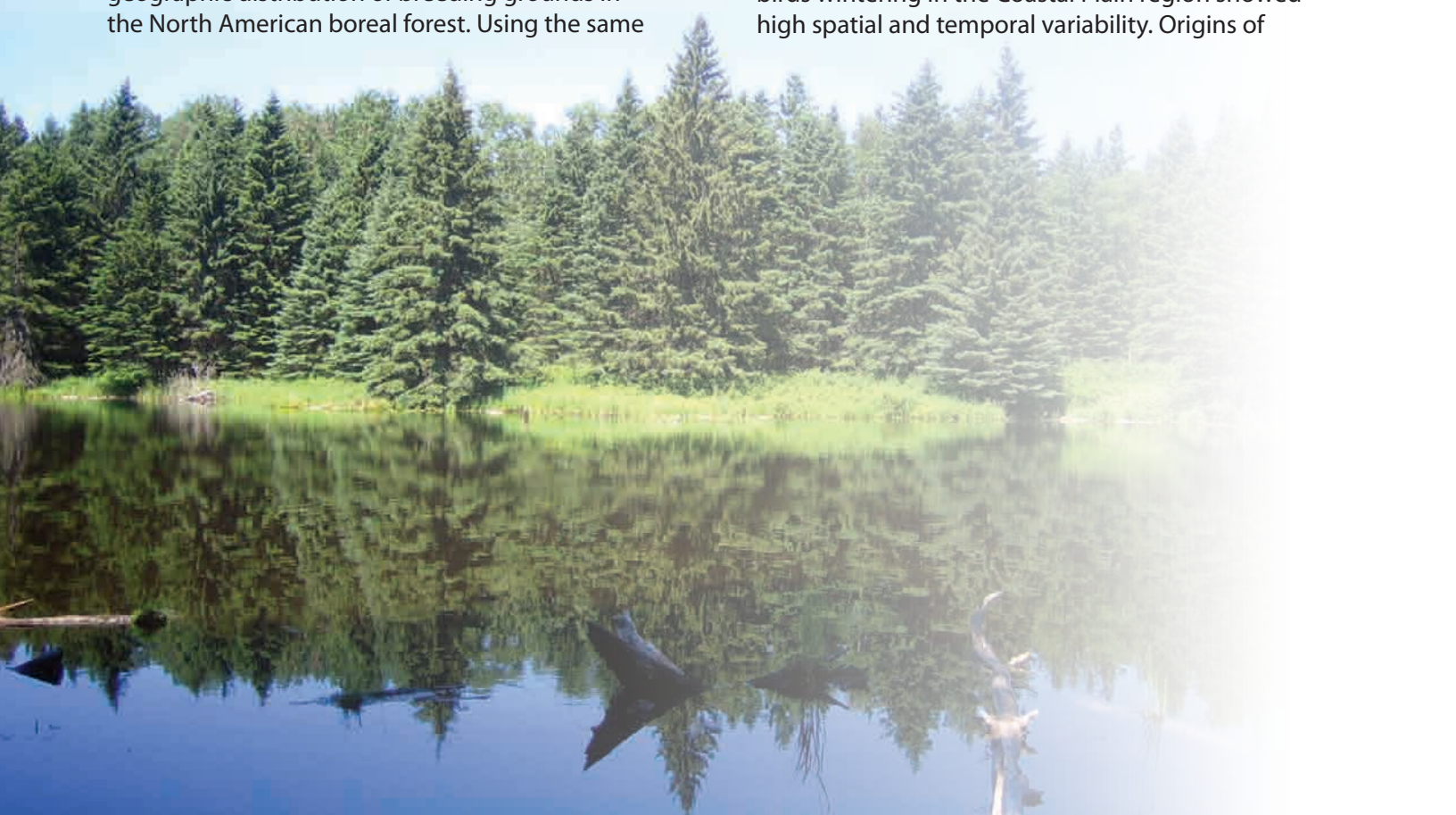
Alberta Sport, Recreation, Parks, and Wildlife Foundation
Alberta-Pacific Forest Industries Inc.
Alberta Sustainable Resource Development
Canadian Circumpolar Institute
Ducks Unlimited Canada
Environment Canada
Louisiana Pacific Canada Ltd.
Mistik Management Ltd.
Natural Sciences and Engineering Research Council of Canada
Sustainable Forest Management Network
University of Alberta
Weyerhaeuser Canada Ltd.

LINKING WINTERING AND BREEDING POPULATIONS OF RUSTY BLACKBIRD (SPECIES OF CONCERN): A FORENSIC ANALYSIS USING STABLE ISOTOPES

The Rusty Blackbird breeds almost exclusively in wooded wetlands of boreal North America. Since the 1960s, their population has declined by over 90%, a trend which is mirrored in other boreal wetland-associated species. The cause for the catastrophic decline is not clear, but the Rusty Blackbird is suspected to be particularly vulnerable to habitat loss or alteration. Due to the relative inaccessibility of much of its breeding ground, how these birds are affected by activities in the boreal forest is currently unknown. Whatever the cause, too few demographic data exist to develop appropriate conservation measures for this species. In particular, it is not currently known how this species is distributed across the North American boreal forest.

This project used stable-hydrogen isotope analysis of feathers collected from wintering Rusty Blackbirds collected in the Mississippi Alluvial Valley (n=255 birds) and the Coastal Plain of South Carolina and Virginia (n=281 birds), 2005–2009, to estimate origins of birds wintering west and east of the Appalachians, respectively, to determine the geographic distribution of breeding grounds in the North American boreal forest. Using the same technique, historical patterns of distribution were established by analyzing feathers from museum specimens (1879–1990; n=190). Current and historical distributions were then compared to identify where population declines have occurred in the boreal forest.

Results suggested little change in the origins of modern and historical populations, but origins of birds wintering in the Coastal Plain region showed high spatial and temporal variability. Origins of



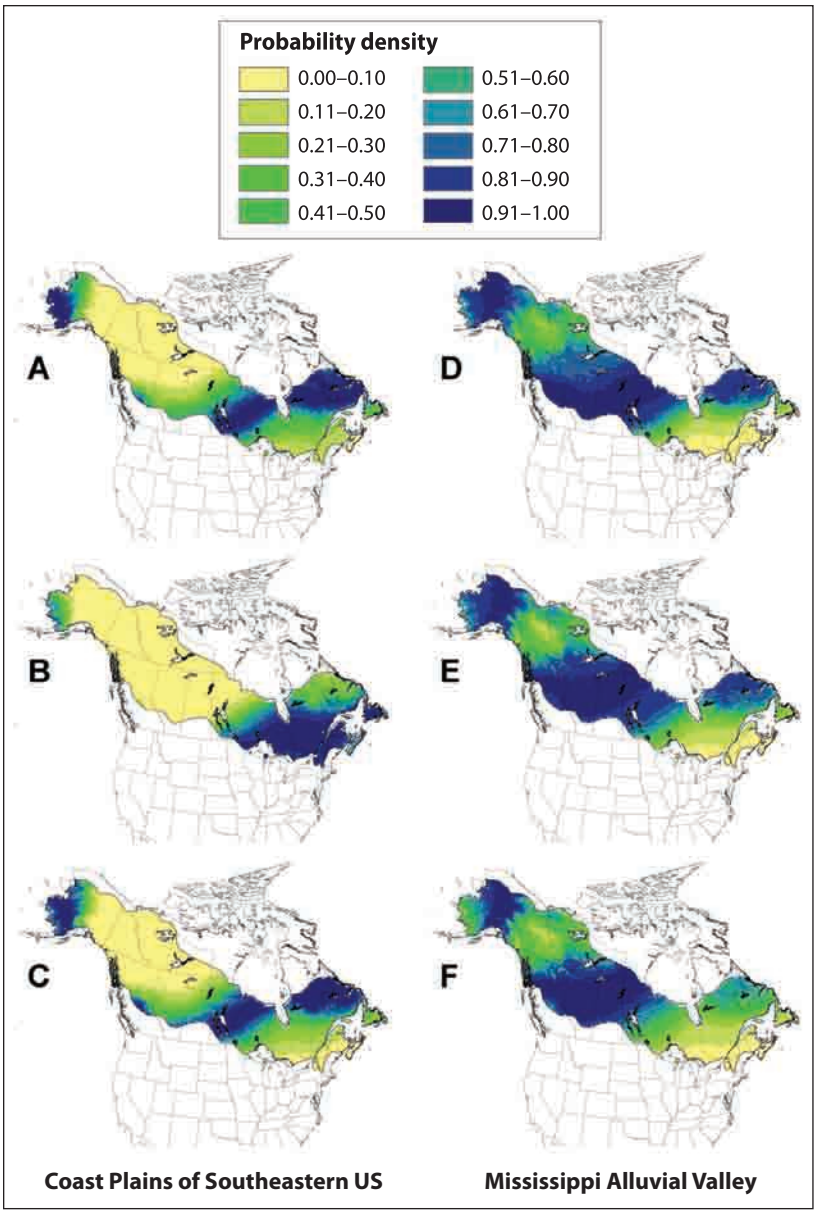


Figure: Probable origins of Rusty Blackbirds samples collected on the wintering grounds along the Coastal Plain of the southeastern United States from a) museum specimens, b) winter 2007, c) winter 2008–2009 and samples collected along the Mississippi Alluvial Valley from d) museum specimens, e) winter 2007, and f) winter 2008–2009

Rusty Blackbirds differed between the Mississippi Alluvial Valley and the Coastal Plain region, with birds wintering in the Mississippi Alluvial Valley originating from substantially further north than birds wintering in the Coastal Plain. Differences in the breeding ground origins of birds wintering east and west of the Appalachians suggest that management efforts should be tailored to eastern and western sub-populations both on the breeding and wintering grounds. This project has provided the first quantitative evidence for regional wintering ground population structure, and will support more targeted conservation efforts for the management and possible restoration of this species.

COLLABORATORS

Keith A. Hobson, Environment Canada/ University of Saskatchewan
Russell Greenberg, Smithsonian Institution
Claudia Mettke-Hoffman, Smithsonian Institution
Steve Matsuoka, United States Fish and Wildlife Service
Len Wassenaar, National Water Research Institute, Environment Canada
Paul Hamel, United States Department of Agriculture, Forest Service
Steve Van Wilgenburg, Environment Canada
Al Smith, Environment Canada
Pam Sinclair, Environment Canada

PROJECT PARTNERS

Environment Canada
Smithsonian Institution
United States Department of Agriculture, Forest Service
United States Fish and Wildlife Service

A POLICY ANALYSIS TO SUPPORT CONSERVATION AND LOCAL BENEFITS FROM FORESTS IN NORTHWESTERN SASKATCHEWAN

To effectively address the social and ecological risks playing out in Canada's boreal forests, this project examined how conservation strategies must consider Aboriginal communities who occupy forest areas. Northwest Saskatchewan is home to numerous Métis communities, whose mixed economies feature a strong local component associated with subsistence activities (e.g., use of forests for hunting, fishing, medicinal and food plant use) and localized entrepreneurship (e.g., commercial fishing/processing and small sawmill operations). However, recent large-scale resource development in forestry, mining, and the energy sector in the region has affected both the boreal ecosystem and the ability of these communities to maintain and support traditional forest-based livelihoods.

Members of three Métis communities (Pinehouse Lake, Buffalo Narrows, and La Loche) were interviewed to examine the perceived linkages between conservation, local economic benefits, and decision-making regarding natural resource management. Despite different local issues, members of all three communities expressed a sense of powerlessness regarding management of their traditional territories and the perception that most environmental governance-related processes reaffirmed this lack of control. However, interviews also revealed the impact of the shifting political economy and environmental governance varied considerably among the communities, and was influenced by their proximity to large-scale resource development, socio-economic circumstances, and outcomes of prior governance processes. The outlooks of community members for the future were mixed.

Results from this project demonstrate the need for further research to investigate governance models that support community stability and involvement of Métis communities in natural resource management. In the short term, investments at the community level could support both capacity-building in environmental monitoring and surveying skills as well as training and development of community leaders who can participate effectively in natural resource planning and management processes. Encouraging smaller resource-based initiatives within communities would foster resilience to the boom and bust cycles of large-scale non-renewable resource-based economic development. Governments and corporations should invest in efforts to learn about Métis peoples, the history and culture of their communities, and the unique dynamics of individual communities. This is a necessary step to build long-term relationships with community leaders, understand the perspectives of communities, meaningfully resolve conflicts, and develop effective mechanisms to respectfully engage Métis peoples in natural resource management on an ongoing basis.

COLLABORATORS

Samantha Song, Environment Canada
Naomi Krogman, University of Alberta
Debra J. Davidson, University of Alberta
Bryn Politylo, University of Alberta
Brian Joubert, University of Alberta

PROJECT PARTNERS:

Environment Canada
Métis National Council
Northwest Saskatchewan Métis Council
Social Sciences and Humanities Research Council of Canada
(Community-University Research Alliance)
University of Alberta
University of Saskatchewan

SUSTAINABLE FOREST MANAGEMENT NETWORK

The Sustainable Forest Management Network (SFMN) brings together scientists, forest managers and practitioners, Aboriginal peoples, federal and provincial government agencies, non-governmental organizations and industry leaders to address known and emerging challenges to forest sustainability across Canada. The SFMN supports research, information synthesis, knowledge exchange, networking, and training across social, economic, and ecological disciplines. WBCI supports the governance and delivery of SFMN initiatives: WBCI was a program partner, served on the Partners Committee (Chair), and was an active member of various supporting committees.

Partnership with the SFMN, its members, and researchers facilitated the delivery of WBCI's mandates for biodiversity conservation through projects that draw across disciplines. Through this partnership, WBCI has addressed priorities for biodiversity conservation beyond its existing capacity and into areas such as social sustainability and fiscal incentives for sustainable forest management. Specifically, WBCI supported partnered projects that contribute to Environment Canada's/WBCI's mandate in the boreal forest, such as:

- Determining critical caribou habitat and economic and ecological tradeoffs for management
- Developing best practices for migratory bird management
- Developing wildlife indicator species
- Determining impacts of forest development on water and wetlands
- Developing alternative management strategies (integrated resource management)
- Evaluating cumulative impacts of forest development
- Exploring climate change mitigation, vulnerability, and adaptation
- Incorporating protected areas in sustainable forest management
- Evaluating tradeoffs amongst timber, biodiversity, carbon, and public preference
- Exploring fiscal incentives for biodiversity conservation
- Conducting natural capital and ecosystem valuation
- Integrating traditional ecological knowledge in sustainable forest management
- Evaluating governance, social values, and social sustainability

Details on the SFMN and a complete list of the projects it supports are available at www.sfmnetwork.ca.

ALBERTA BIODIVERSITY MONITORING INSTITUTE

The Alberta Biodiversity Monitoring Institute (ABMI) supports natural resource decision-making by providing relevant, timely, and credible scientific knowledge on the state of provincial biodiversity. ABMI is an effective partnership between governments, forestry, energy, and not-for-profit sectors. WBCI participates as a funding partner and has also actively supported AMBI governance.

The scientifically rigorous ABMI monitoring program tracks more than 2000 species, 200 habitat elements, and 40 human footprint variables using remote sensing and field sampling protocols over a grid of 1656 sites throughout Alberta. The resulting data and knowledge products (e.g., maps) are value neutral, arms-length, and publicly accessible, and therefore provide a consistent, scientifically credible means to evaluate the trends in biodiversity. The information gathered by the ABMI can be used to detect early biodiversity changes and provide insight into potential relationships between trends and underlying factors. Importantly, gaps in the understanding of relationships associated with changes in biodiversity can also be identified. ABMI provides proactive risk management tools that enable resource managers to make informed land-use decisions.

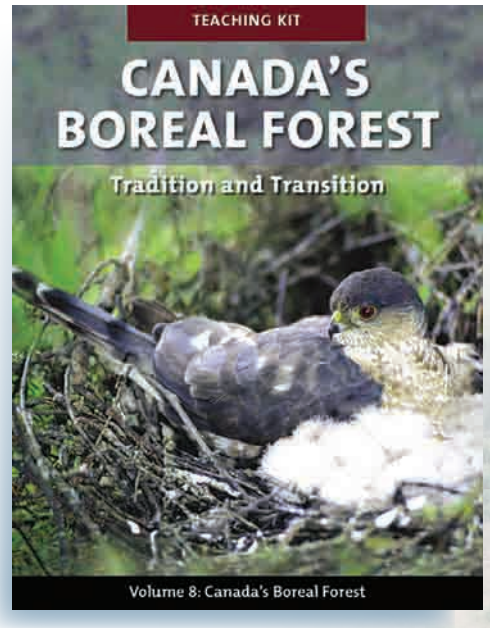
More information about the ABMI, including access to biodiversity data collected to date, is available at www.abmi.ca.

BOREAL FOREST POSTER AND TEACHING KIT

WBCI produced *the Boreal Forest is more than trees*, a full colour poster that was widely distributed as well as made available on the WBCI website. The purpose of the poster was to raise awareness in a variety of target audiences (e.g., the general public, forest sector organizations) regarding biodiversity conservation in Canada's boreal forests, highlighting bird species.

WBCI also actively participated in the development of *Canada's Boreal Forest: Tradition and Transition*, the eighth teaching kit in the Canada's Forests series produced by the Canadian Forest Association (CFA). The kit highlights the dependence of Canadians on forest resources, and explores the many values people place on the boreal forest with respect to income, recreation, spirituality, and cultural traditions, as well as the inherent value of intact natural habitat. Lessons in this volume highlight the conservation and management of birds in boreal forests, new approaches to forest management such as using natural disturbance as a model for harvesting, and the value of utilizing the traditional knowledge from Aboriginal peoples in parallel with science to manage boreal forests. Primarily targeting students in grades five to eight, the activities in the kit are designed to build interest in forest biology, forest issues, and forest-related careers. Several lessons are also suitable for senior students. Through the activities, teachers and students can explore Canada's vast boreal forest, discover the significance of its habitat to all living things, and realize the vital connections between the natural resources it contains and our modern lifestyles. The teaching kit was distributed to 35 000 schools across Canada and included a second printing of WBCI's *the Boreal Forest is more than trees* poster.

The entire Canada's Forests teaching kit series is available in English and French, in print and in electronic format, on the CFA website at www.canadianforestry.com/kits/english/index.html.



PROGRESS TOWARDS CONSERVATION OF BOREAL BIODIVERSITY

Knowledge needs

The Western Boreal Conservation Initiative (WBCI) was conceived, in part, in response to the recognized needs for knowledge regarding basic ecological patterns and processes in the boreal forest and how they are affected by human activity. Such information is becoming increasingly important to support decision-making and management within boreal forests to manage biodiversity effectively.

A core focus of WBCI to date was the support of projects that directly addressed recognized gaps in baseline data on resident and migratory birds and their habitats. Several projects gathered field data for specific bird species (e.g., cavity nesters, waterbirds) and at relevant scales (e.g., stand vs. landscape), with some projects providing vitally needed data for priority bird species. Baseline bird habitat data were also collected, with a specific attention paid to undisturbed areas and areas naturally disturbed by fire. Substantial advances were also made working collaboratively with numerous data partners (such as in the Boreal Avian Modelling Project) or ongoing programs (such as the Alberta Boreal Monitoring Institute) towards the development of comprehensive and national-scale monitoring initiatives. A further contribution of WBCI was developing and improving techniques and methods to survey songbirds and to correct for shortcomings in the survey design during data analysis. Combined, these efforts by WBCI were successful in addressing some basic needs with respect to baseline information and monitoring in the boreal region. However, knowledge needs with regard to advancing biodiversity conservation remain an ongoing priority, and due to the sheer size of the boreal forest and the considerable remaining gaps, will require the continued cooperative efforts of all stakeholders.

Beyond these basic needs, numerous applied studies supported by WBCI gathered information on bird community responses to human activity. The majority of these studies evaluated the ability of harvesting techniques to approximate natural disturbances such as fire. Importantly, these projects directly contributed to the development of best management practices (BMPs) for forest harvesting. Project results are providing a scientific basis for the review or establishment of guidelines in three areas that have come under review in various jurisdictions: salvage harvesting, riparian harvesting, and retention of trees within cutover areas.

Conservation action

The WBCI-supported advances in methodologies, baseline data, and data revealing response to human activity have laid a groundwork for land management planning being considered or adopted in numerous jurisdictions. WBCI also has provided capacity and resources to land use planning efforts by multi-stakeholder groups (e.g., Cumulative Environmental Management Association) and individual tenure holders, and has contributed to the delivery by other programs of Environment Canada mandates for wildlife associated with environmental assessment, protected areas (e.g., through collaboration with Boreal Ecosystems Analysis for Conservation Networks [BEACONs, a science initiative looking at ecological benchmarks]), Bird Conservation Plans, and the conservation of migratory bird populations in general.

Notably, WBCI's contribution has included the development of predictive models of habitat-association for birds as well as maps depicting the distribution and abundance of several boreal bird species and their response to forest harvest. Through the compilation of an extensive national-scale data set, researchers in the Boreal Avian Modelling Project can now produce bird density estimates, and in turn, population estimates. These data-driven estimates are superior to previous efforts, and have wide applicability within Bird Conservation Region Plans. In addition, the modelling work has progressed to include not only density estimates by habitat type but also predictive habitat associations. The model outputs will continue to improve with further refinement of the data set and modelling methodologies. Already, modelling results have been employed in regional planning exercises, Bird Conservation Region plans, and for the evaluation of forest management plans. Numerous existing models have also been supported by data from WBCI projects. Modelling efforts are progressing towards scenario analysis, with predictions or impacts or risks associated with variables such as management actions, development scenarios, and cumulative disturbance. Ultimately, the success of modelling and land use planning will be evaluated through continued monitoring efforts aimed at measuring management impacts for biodiversity and other indicators of ecosystem integrity.

Policy

WBCI was actively involved in providing science-based input to the review or creation of policy to support biodiversity conservation in sustainable forest management. Several projects included components to evaluate innovative operational practices for forest harvesting. Project results also directly fed into efforts by various provincial governments to develop or review forest harvest guidelines in areas including salvage harvest and riparian harvest.

WBCI also provided technical and strategic advice to national initiatives, such as review of Canadian Standard Association's Sustainable Forest Management Standard for forest certification, and supported multi-stakeholder efforts at developing conservation policy for boreal forests including the National Round Table on the Environment and the Economy, and the Forest Sector Sustainability Tables. Through joint initiatives with other programs, WBCI was also able to integrate aspects of economic and social sustainability with its primarily ecological focus.

Recognizing that many policies relevant to boreal conservation are still in the conception phase, WBCI undertook research on policy development. In partnership with a Community-University

Research Alliance, WBCI demonstrated the need for further research and development of governance models that support community stability and involvement of Aboriginal communities in natural resource management. In partnership with the Sustainable Forest Management Network, WBCI supported research on governance mechanisms for integrated land management, public participation, fiscal incentives, valuation of natural capital, forest certification for sustainable management, economic/ecological tradeoffs, and the impact of climate change on forest management.

Importantly, WBCI was able to act as a source of expertise on biodiversity conservation issues to inform policy development within Environment Canada while concurrently supporting conservation efforts by other organizations. Moreover, the WBCI program was a positive mechanism by which Environment Canada could directly or indirectly influence policy development in areas outside of its jurisdiction (e.g., migratory bird habitat on non-federal lands). Maintaining partnerships with all key players in policy development is critical for WBCI's continued exploration of the interplay between conservation science and policy. In continued efforts to translate scientific findings into conservation action, WBCI continued to support innovative projects and partnerships that inform and guide policy and the design of institutional arrangements that foster biodiversity conservation.

Partnerships

A recurring theme through all WBCI initiatives was partnerships. From 2003–2008, a wide breadth of partners was engaged, including governments, academia, industry, ENGOs, and Aboriginal communities resident in the boreal forest. Some partnerships were based upon the sharing of data, knowledge, or expertise. Project partners were engaged in both project development and execution, and this commitment to active partner input ensured the research was not only relevant but the resulting knowledge products were directly applicable by end users. Strategic partnerships were initiated with progressive forest companies, national scale research and monitoring initiatives, and conservation organizations. Founding WBCI on partnerships not only allowed the program to leverage funds (overall leverage of WBCI investment estimated at 21:1), and address numerous priorities outside its own capacity in a cost effective manner, but it also brought Environment Canada expertise to initiatives with broad potential impact. Working in partnership is an essential strategy to achieve conservation goals as the stakeholder groups in the boreal forest are numerous and diverse. Future efforts should continue to build on strengths of academic and forest industry partnerships to broaden links with other sectors (oil and gas, mining, agriculture). Efforts were also made to engage boreal communities who both affect and are affected by decision-making related to management of boreal forests. Our initial efforts to work with these communities and build capacity for effective partnerships demonstrated the clear need for more effective engagement strategies with these groups.

Communications

Fostering communications amongst partners was a priority from the launch of WBCI. Individual projects held regular face-to-face workshops, and numerous internal initiatives served to foster communication of experience and knowledge by partners and other interested parties to WBCI, thus informing priorities and activities. Importantly, WBCI developed a presence for Environment Canada in the boreal forest as its formal partnership-based program targeting boreal conservation. Numerous initiatives

including development of a program symbol, poster, website, public release documents, and presentations for public advisory groups as well as national and international conferences have improved awareness and appreciation of boreal conservation efforts. WBCI also made major contributions to the communications efforts of others, including a Canadian Forestry Association teaching kit distributed to 35 000 schools across Canada, a Hinterland Who's Who Web page focusing on the boreal forest, and *The State of Canada's Forests 2004–2005*. While these efforts, as well as the partnerships described above, successfully exposed WBCI expertise to a varied and wide audience, web-based media and a defined role in environmental education were only nominally explored. The role of Environment Canada and other organizations with respect to educating the public and, in particular, instilling conservation values in younger generations, will be important to include in future initiatives.

Capacity building

WBCI was designed to support the development of sufficient capacity and project resources to fulfill Environment Canada's mandate towards biodiversity conservation in the Prairie and Northern Region and provide the foundation for a future national initiative. Internal capacity was built through establishment of a boreal science program in the Edmonton office of the Canadian Wildlife Service. Enhancements were made to our Saskatchewan and Northwest Terrotories offices through project funding and capital equipment. The boreal science capacity within Environment Canada nurtured through the WBCI program was instrumental in fostering external capacity, such as fruitful partnerships as well as heightened awareness and engagement of the public. Preserving and fostering this capacity is critical to the success of future boreal-focused initiatives.

At its outset, WBCI focused on the western boreal forest where pressures were highest. Recognizing the connectivity of the boreal and the presence of conservation pressures across its spatial extent, the program was expected to evolve to a coordinated national effort. Towards this end, WBCI successfully engaged avian researchers across Canada, developed a draft national strategy for boreal bird monitoring, developed national scale bird-habitat models, engaged in strategic partnerships, and engaged in communications efforts at a national scale. In 2007, WBCI hosted a national Environment Canada workshop to assess the need and strategic direction of a national boreal ecosystem initiative. More recently, WBCI provided support to the development of Environment Canada's Priority Ecosystem Initiatives Management Framework. Through a comprehensive process to assess all ecosystems, this framework has prioritized future Environment Canada investment in Canada's Ecosystem Initiatives as well as determining the location, scale, and priorities for action. Within the boreal forest, the Boreal Shield and the Boreal Plains ecoregions have been selected as priorities; the coast of Hudson's Bay Lowlands, the Mackenzie Delta and Valley, and the area overlying the oilsands deposits in Alberta are also priority "hotspots." Plans for further action on these priority areas are anticipated in 2010–2011.

Progress towards strategies outlined in WBCI's Action Plan

STRATEGY 1: Develop knowledge to address priority information needs related to boreal biodiversity conservation	
1.1 Support science that furthers understanding of ecological pattern and process in boreal forest to support biodiversity conservation, and viability of wildlife populations and community	• Baseline data gathered at numerous scales (nest, territory, stand, landscape) - on boreal songbirds, waterbirds, riparian birds, and cavity nesters - on boreal bird habitats - in undisturbed and naturally disturbed (fire) areas • Predictive models of boreal birds and habitat associations developed • New techniques for surveying, monitoring, and data analysis developed • Other programs providing baseline information on pattern and process supported (e.g., ABMI, SFMN)
1.2 Support science that will facilitate the assessment of human activity in boreal forests, the development of best practices for biodiversity conservation, and the design of conservation frameworks including protected areas	• Bird community response to human activity assessed with respect to: - partial harvesting in riparian areas - single- vs. multi-pass harvest techniques - post-fire salvage harvest - degree of cumulative landscape disturbance • Best management practices developed: - single-pass harvest preferable to multi-pass harvest - riparian buffers should approximate natural range of variation of width and retention level - fire should be maintained on the landscape in general and in riparian buffers - residual retention targets (%) for planning units - specific residual retention targets for cavity-nesting species • Design of conservation areas supported through contributions to: - required groundwork (e.g., through collection of baseline information, impact assessment, monitoring) - land management planning efforts by others (e.g., BEACONs, CEMA, forestry companies, Aboriginal communities)
1.3 Lead the development and implementation of a national boreal bird monitoring program and contribute to development of monitoring programs in support of biodiversity conservation	• Draft national strategy for boreal bird monitoring developed • National-scale bird-habitat models developed • Science on monitoring methodologies furthered • Environment Canada Avian Monitoring Review supported • Partnership with ABMI established
1.4 Support the collection of baseline information on the status of priority species and their habitats, including those in significant decline or under threat	• Information on distribution, population size, and habitat associations for priority landbird species produced • Current and historical distributions determined for the Rusty Blackbird (under assessment by Committee on the status of EndangeredWildlife in Canada (COSEWIC) • Other programs collecting baseline information supported (e.g., ABMI, SFMN)

ACRONYMS
ABMI: Alberta Boreal Monitoring Institute
AlPac: Alberta-Pacific Forest Industries Inc.
BEACONs: Boreal Ecosystems Analysis of Conservation Networks
CEMA: Cumulative Environmental Management Association
CFA: Canadian Forestry Association
CFS: Canadian Forest Service
CSA: Canadian Standards Association
CURA: Community-University Research Alliance
EC: Environment Canada
LP: Louisiana Pacific Canada Ltd.
NRC: Natural Resources Canada
SFMN: Sustainable Forest Management Network

STRATEGY 2: Support directed activities to achieve conservation action		
2.1	Support development of a conservation framework for the conservation and protection of boreal forests that includes (a) participation in the development of protected areas strategies for boreal forests, including definition, identification, and implementation of protected areas sites or networks, and (b) participation in the implementation of existing protected areas strategies such as the Northwest Territories Protected Areas Strategy	• Through partnership with BEACONs, efforts to design a protected areas/conservation framework for the boreal forest in Canada supported • Through partnership with SFMN, role of protected areas in achieving sustainable forest management examined • Through other EC programs, three new National Wildlife Areas sponsored and three more under consideration, with aim to have six sites by 2013
2.2	Engage in integrated resource management and/or planning efforts that support conservation of boreal birds and their habitats	• Models and other research products developed and used for - regional planning exercises (e.g., Northwest Territories Protected Areas Strategy) - species-at-risk assessments (e.g., Canada Warbler) - Bird Conservation Region plans (e.g., BCR 6, 7, 8 plans in progress) - assessment of forest management plans (e.g., Mistik, LP, AlPac) • Data supplied to advance efforts by other programs (e.g., BEACONs, ABMI, CEMA) • Through participation in CEMA, land use planning in regional municipality of Wood Buffalo supported • Through participation in an Integrated Land Management Coalition, initial development of ILM policy approaches supported
2.3	Contribute to recovery of species-at-risk in boreal forests through activities identified in action plans and not currently delivered under other existing programs. Specific needs include: definition and protection of critical habitat for boreal species-at-risk such as woodland caribou	• Support for science on economic and ecological trade-offs of strategies for conservation of woodland caribou (through partnership with SFMN) • Through other Environment Canada programs, definition of critical habitat for boreal woodland caribou underway
2.4	Promote (or encourage) a stewardship program for the boreal region	• Served as the only formal federal partnership-based program to facilitate conservation and protection of Canada's western boreal forest ecosystems and its biodiversity • Independent stewardship program not pursued separate from WBCI

STRATEGY 3: Provide information to policy-makers and support policy research relevant to management of boreal forests		
3.1	Provide leadership and guidance to Environment Canada for policy development on biodiversity conservation in boreal forests	• Technical and strategic advice provided to national initiatives relevant to boreal conservation, including - National Round Table on the Environment and the Economy report *Boreal Futures: Governance, Conservation and Development in Canada's Boreal Forest* - Forest Sector Sustainability Table - Environment Canada divisions responding to boreal conservation issues
3.2	Support research and consultation on policy and institutions to support biodiversity conservation through work in (a) governance issues related to integrated landscape management, best management practices, and democratic decision-making, (b) market mechanisms such as incentive policies and certification, and (c) the intersection of these issues	• Guidance for review or development of best management practices and/or guidelines provided for: - cumulative effects management - salvage harvesting guidelines - riparian harvesting • Recommendations to enhance Métis engagement in land use management and conservation initiatives provided • Participated as technical committee member to review CSA forest certification standard (Z809-02) • Through partnership with SFMN, projects supported in areas including: - Development of integrated land management ILM policies - Public participation in sustainable forest management - Fiscal incentives for meeting conservation objectives - Natural capital and ecosystem valuation as a tool for sustainable forest management - Impact of sustainability policies on market value of timber
STRATEGY 4: Communication of conservation knowledge and technical expertise on boreal forests		
4.1	Develop a comprehensive communications package for the WBCI that targets internal and external communications	• Information about WBCI and partner activities circulated through internal distribution list • Program website developed and launched (www.pnr-rpn.ec.gc.ca/boreal) • Public release documents prepared, including: - Strategic Plan, Backgrounder and Action Plan - Program updates - Poster *The Boreal Forest is more than trees* • Project-level communications fostered through workshops, factsheets, and reports • Major contributions to relevant communications efforts by others, including: - *Canada's Boreal Forest: Tradition and Transition*, a CFA teaching kit distributed to 35 000 schools across Canada - Hinterland's Who's Who Web page focusing on the boreal forest: www.hww.ca/hww2.asp?id=354 - *The State of Canada's Forests*, an annual report from CFS/NRC that in 2004–2005 focused on the boreal forest • Displays and presentations at national and international forums held by groups including: - World Forestry Congress - National Forestry Congress
4.2	Improve project-level communication with partners and affected parties by integrating partner input into the design and reporting of projects	• Project criteria regarding partnering developed and strictly applied • Input from partners sought during project development and execution • Input from partners sought regarding preferred types of research products • Incorporation of technical/steering committees to oversee project direction and ensure scientific credibility

STRATEGY 5: Develop partnerships to achieve conservation results		
5.1	Ensure that projects sponsored by WBCI are partnered such that, collectively, the program works with partners who affect decision-making and partners who are affected by decision-making	• Over 120 partners engaged through individual projects, the SFMN and the ABMI, representing - Canadian and US federal government agencies and programs (11) - provincial and territorial governments (8) - research institutions (42) - industry and industry associations (15) - non-governmental organizations (8) - Aboriginal governments and organizations (12) • Approximately 50 other partner agencies engaged through advisory committees and as data contributors
5.2	Choose partners strategically, recognizing that appropriate partnerships are needed to realize conservation results, and that the most effective suite of partners will vary with the nature and objectives of each project; involvement by all partners contributes to the success of the project	• Strategic partnerships initiated with: - forest companies leading research on and implementation of sustainable practices beyond requirements of provincial or federal regulations - national scale forest biodiversity research and monitoring initiatives - conservation organizations focusing on public awareness and education • WBCI mandates furthered by - expanding range and breadth of partnerships - extensive leverage of WBCI funds - addressing numerous priorities outside WBCI capacity in a cost effective manner - bringing WBCI expertise to land management planning initiatives, national standards review, and other initiatives with broad potential impact - extending reach of communications efforts
STRATEGY 6: Build the capacity for biodiversity conservation in boreal forests both within Environment Canada (PNR) and externally		
6.1	Build the capacity of Environment Canada's Prairie and Northern Region to engage in biodiversity conservation issues in boreal forests, through (a) securement and re-direction of existing efforts, (b) application of existing resources, and (c) securement of new resources (leverage)	• Engagement of Environment Canada Boreal Science Group to implement WBCI Action Plan • Technical and research capacity built in three Environment Canada regional offices to deliver WBCI program • Extensive partnering facilitated leveraging of substantial cash and in-kind contributions. Between 2003–2008 - Contributions from WBCI to partnered projects leveraged approximately $33.733M in cash contributions - Estimated leverage on WBCI contributions is 21:1
6.2	Promote the development of a national initiative that can deliver Environment Canada mandates in support of conservation of boreal forests across Canada	• Evolution of WBCI focus from western to national scope in initial five years, with several national scale projects • Through strategic partnering with SFMN, access to research spanning all areas of the boreal increased • Support provided to evaluate potential to expand ABMI nationally • National meeting of Environment Canada boreal staff to discuss potential for national boreal conservation initiative held • Support provided to the Priority Ecosystems Initiative Management Framework, to evaluate future investments in Canada's ecosystems by Environment Canada
6.3	Facilitate coordination and team-building for Environment Canada boreal staff through annual workshops	• Annual workshop of boreal science group convened • Program communications augmented with regular conference calls and emails
6.4	Invest in and work with Aboriginal and forest-dependent communities to build capacity for effective partnerships for conservation of boreal forests: in the longer term, conduct a needs assessment; in the shorter term, work through opportunities defined through partnerships	• Projects partnered with Aboriginal peoples • Through partnering with other initiatives (CURA, SFMN), extensive capacity-building for Aboriginal communities supported • Expertise provided to Environment Canada's development of a strategic framework for engagement with Aboriginal peoples

KEY ACCOMPLISHMENTS

Reflecting on the first five years, WBCI succeeded in delivering in three key areas. First, recognizing that the lack of sufficient information to support decision-making threatens the sustainability of boreal ecosystems, the program successfully delivered science in the form of new knowledge as well as expertise in the form of technical and strategic advice to relevant national initiatives. Second, acknowledging that goals regarding biodiversity conservation in boreal forests are shared by others, WBCI's partnership-based approach capitalized on the unique opportunities provided by joining forces with other organizations and programs. Third, the program established a presence and role for Environment Canada with regard to broad boreal conservation goals. The legacies of these key accomplishments are multifaceted, national scale, and far reaching: new best management practices, scientific background for policy and guideline development, lasting partnerships for conservation action, and increased awareness of boreal conservation issues.

LESSONS LEARNED

The strengths of the WBCI program reflect the approach taken. Enduring and meaningful engagement of partners ensured the relevance of research questions and applicability of results. The cost efficiencies realized through data sharing, coordinated efforts, and partnering with other initiatives leveraged not only funds but also expertise and results and thus added value to both individual projects and the program as a whole. Consequently, WBCI had a much wider reach than could ever have been achieved as an independent effort. The internal efforts to create a boreal science team and engage staff from different offices and departments created a focal point for the exchange of ideas and the formulation of strategic goals and objectives for boreal conservation within Environment Canada. Furthermore, the ecosystem approach allowed flexible and broader engagement in conservation issues where Environment Canada has an interest but not necessarily the jurisdiction. WBCI from its outset endeavoured to include non-traditional drivers that influence conservation, such as social and economic factors, recognizing that cross-disciplinary approaches are required to properly address the impact of the multiple pressures upon the boreal forest. Despite the successful realization of national-scale impacts, the magnitude of the boreal forest and the challenges it faces were well beyond the capacity of the WBCI program. It will be necessary in the future to expand partnering initiatives in sectors including energy, mining, and boreal communities as well as continue to employ partnerships as a mechanism to maximize program resources and more adequately address the scope of boreal issues.

FUTURE DIRECTIONS

The threats to the boreal forest outlined in the WBCI Strategic Plan and Backgrounder published in 2003 continue to persist today. Grave threats from the rate and extent of industrial activity still exist, but a much stronger focus on addressing global threats from climate change is now also evident. Increasing impacts of insect outbreaks are a direct correlate of our changing climate. The pressure on boreal forests is anticipated to continue expanding due to energy extraction and transport, but also from forestry and agricultural demands as well as new sectors such as biomass which utilize trees and other plants for energy production. Shifting habitats and species adaptations in response to future climate scenarios also have the potential to create management challenges.

While threats continue, significant conservation gains have been made for wildlife in the boreal forest since 2003. Announcements to protect large tracts of forest have been made in the Northwest Territories through the Northwest Territories Protected Areas Strategy (NWT PAS); in Ontario with the Far North Planning Initiative; and in Quebec. Momentum is building for protected areas in other areas, such as east of Lake Winnipeg in Manitoba. Land-use planning is underway in many jurisdictions across western Canada, with the mandate for sustainable development at its core. Increased efforts to improve awareness of the need for conservation of boreal forests have also been undertaken, particularly by environmental non-governmental organizations.

While a large focus of WBCI was to increase our knowledge for boreal forest management, Environment Canada's Canadian Wildlife Service was also undertaking regulatory activities relevant to boreal forest conservation. In particular, a massive effort to deliver the recovery strategy for the boreal population of Woodland Caribou (*Rangifer tarandus caribou*) is continuing, with expected delivery in 2011. In connection with the NWT PAS mentioned above, Environment Canada has sponsored three protected areas and plans to have six sites sponsored by 2013. Environment Canada has also moved to increase available compliance options around the incidental take of migratory birds, a contravention under the *Migratory Birds Convention Act* and associated regulations. That effort is likely to result in the availability of a permit for certain circumstances of incidental take of migratory birds, nests or eggs, with permit conditions that support the long-term conservation of populations.

Clearly, the need to address threats to wildlife in the boreal forest will remain in the near future. Under Environment Canada's recent assessment of Priority Ecosystems, both the Boreal Shield and the Boreal Plains are identified as priorities. Thus, a role remains for further engagement and partnering in this ecosystem, where an integrated effort across jurisdictions and mandates is necessary to achieve conservation outcomes.

A recommended avenue for conservation action is through the development of a conservation framework that includes direct engagement of resource users, provision of science, and coordination and collaboration among federal, provincial, territorial, and Aboriginal governments, research institutions, non-governmental organizations, industry, and others with complementary conservation interests.

Under the recommended boreal conservation framework, an expanded range of priorities linked the Environment Canada mandates could be addressed:

1. Protect and conserve boreal wildlife

An ongoing need exists to monitor the status, trends, and habitat associations of migratory birds in boreal forests, to understand causes of declines, and to develop best practices and other conservation actions for the management of these populations. Environment Canada is currently completing Bird Conservation Plans across the boreal region, and implementation of these plans will be contingent on effective engagement of the full range of stakeholders in the boreal forest. Environment Canada is completing a Risk Management Framework and defining compliance options for the management of incidental take, and a partnership-based initiative has a role to support ongoing science needs associated with regulatory compliance. Monitoring to ensure identification of species that may be at risk will be an ongoing need. The efficacy of actions to conserve wildlife and their habitats, such as the identification and protection of ecological benchmarks, will need to be evaluated and assessed, and will benefit from a cooperative approach.

2. Ensure water quality and quantity

Environment Canada programs to monitor water quality and quantity within the western boreal forest have benefited from past ecosystem initiatives, including the Northern Rivers Basins Study, Northern Rivers Ecosystem Initiative, and Northern Flood Agreement, among others. A renewed investment to assess habitat alteration as well as loss of water quality and quantity on federal lands and at transboundary sites is required to ensure the sustainability of boreal lakes, rivers, streams, and wetlands. Programs should focus on development of water quality and quantity objectives, expansion of the monitoring network to additional watersheds, and implementation of biological monitoring programs, such as the Canadian Aquatic Biomonitoring Network (CABIN). Appropriate monitoring for status and change in trends as well as engagement of interested parties should be undertaken to address conservation and protection of water—one of our most precious resources.

3. Ensure clean air

With increasing industrial development in the western boreal region, an important role for Environment Canada is to continue to work with partners to ensure pollutants, acid deposition, and visibility effects from emissions are minimized.

4. Understand and address climate change

To date, limited efforts have been made to predict the effects of climate change on natural systems, integrate those predictions across wildlife, habitats, watersheds, and airsheds, and to understand the potential for adaptation to and mitigation of these effects. Given the enormity of the effort required and the implications across the range of affected parties, a partnership-based approach to define and respond to climate change is required for the boreal forest.

5. Increase awareness and appreciation of boreal forests and their biodiversity

The impact of information and knowledge about the conservation of boreal forests is directly related to the ability to communicate that information to decision-makers, those affected by decisions, and those who influence decision-makers. Increased investment is required towards a dedicated effort to develop educational materials for a range of audiences, to support conservation organizations that facilitate education, and to communicate outcomes of results of conservation efforts in formats appropriate for end-users.

The vast extent of the boreal forest and the range of institutions with mandates that affect boreal conservation necessitates a partnership-based approach to the development and implementation of a boreal conservation framework. Environment Canada, with strong mandates for migratory birds, species-at-risk, habitat protection, water quality and quantity, and air quality, is well-positioned to bring its expertise and interests to such an effort and would benefit from cooperative planning and coordination of resources towards mutually held priorities. The boreal forest still retains a large degree of intactness and an amazing wealth of resources; efforts to facilitate proactive approaches towards its conservation on behalf of current and future generations of Canadians are merited.

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