Volume 4, No. 2, Summer 2000

Network News
Forest Health & Biodiversity
Canadian Forest Service

Forest Bird Studies in Ontario

Forest bird research has a long history in the Canadian Forest Service (CFS). In the 1950s and 1960s researchers considered the role that woodpecker species played in reducing infestations of wood boring and bark beetles in commercially important softwood species. Damage to trees by various finches and woodpeckers was also studied. Later, in the 1970s and 1980s, the impact of insecticides on forest songbirds became a major issue for Canadians and a priority area of research for the CFS. Scientists also examined the role of bird predation on spruce budworm. Recently, however, most toxic chemical insecticides have been replaced in forestry by more benign products, and concern has diminished. Today, the CFS research program on forest birds is concerned more with issues related to biodiversity, indicators of sustainable development, and forest health. A healthy and sustainable forest environment is key to CFS research priorities in the 1990s and beyond.

The Great Lakes Forestry Centre has had one or more staff ornithologists since the late 1970s. Currently, two research programs at the Centre involve forest birds. One study is determining the effects of selection harvesting on forest songbirds near Stokely Creek, about 35 km north of Sault Ste. Marie. This area is typical of the northern tolerant hardwood forests of Ontario. Originally a diverse mix of species (sugar maple, yellow birch, red oak, white pine, white spruce, and eastern hemlock, along with associated flora and fauna), it has been degraded by repeated high-grade harvesting since before the turn of the century. Today, what remains for the most part is an impoverished forest of sugar maple and red maple that is inferior to previous stands in terms of species diversity, genetic diversity, and function. Such forests are common throughout much of the northern mixedwood and tolerant hardwoods of Ontario and Quebec, and are a concern because of their associated low biodiversity and productivity. A key role of modern-day forestry is to restore degraded ecosystems to levels of productivity and diversity that would be expected under a more natural state of the forest.

Black and white Warbler

Timber improvement cutting has been suggested as a means of restoring the tolerant hardwood forest ecosystem. The selection system practiced at the CFS Stokely research area involves the removal of individual trees, or small groups of trees, to promote a multi-aged forest. Particular attention is paid to the removal of diseased, deformed, and defective trees. The intent is to emulate natural disturbances (gap phase processes or moderate intensity understory burns), protect and stabilize the site by maintaining constant forest cover, promote regeneration of shade-tolerant species (e.g., sugar maple) and mid-tolerant species (e.g., red oak, yellow birch and white pine), preserve aesthetics, and restore productivity. The songbird research is assessing the effects of these practices in

Continues on page 2

Contents

Publication Sales Agreement
#1569007
Return Address
Atlantic Forestry Centre
P.O. Box 4000
Fredericton, N.B., Canada
E3B 5P7

continued from page 1… Forest Bird Studies in Ontario

restoring the diversity of species, and assessing the role of birds as indicators of forest productivity in these forest systems.

The study design calls for a combination of single tree and group selection harvesting to be conducted in three large (>80 ha) blocks in three successive years (1997, 1998 and 1999). A fourth block (the control) will be left undisturbed. Within each block, 25 points are being censured before and after harvest to generate indices of bird species diversity, richness and abundance during the breeding season. Vegetation is being sampled on permanent sample plots centered on these points. These data will provide information on how post-harvest changes in vegetation structure and diversity influence bird community composition.

Another key aspect of the study is to determine species' reproductive success, site fidelity (the tendency for adult birds to return to breed in a site previously used for hatching or rearing of their young), and use of the area by birds that did not breed there. To accomplish this, birds are being mist-netted in one of the treatment blocks (harvested in 1998), and in the control block where no cutting was done. Mist nets are fine mesh (30 mm) nylon nets, 12-m long and 2.6-m high. On seven sampling dates each year, 10 mist nets are set at pre-determined locations within an 8-ha core area of each block. Birds caught in the nets are banded so that they can be identified on subsequent captures. They are also aged and sexed. A comparison of mist-netting results from the harvested and control blocks will provide information on the effects of selection harvesting on age-specific survival rates, productivity, and population structure of selected songbird species, thereby allowing inferences about breeding success.

Although this is a long-term study and the final results will not be available for several years, certain short-term trends are already apparent. As might be expected, forest interior species (e.g., Ovenbird, Hermit Thrush, and Veery) tended to decline in harvested blocks, while early successional species (e.g., White-throated Sparrow, American Robin, Mourning Warbler, Indigo Bunting) increased. These changes simply represent responses to the habitat alteration that results from timber harvesting, and are fairly well understood. However, and less predictably, it appears that some songbirds, including some forest interior species, may actually prefer harvesting-created habitats later in the breeding season after family groups have dispersed. Possibly, the greater amount of ground layer vegetation and shrubs, as well as the slash left over from harvesting operations, is providing more food and better cover in these areas, than is available in forests with a dense canopy of trees. The question of bird movements into and out of harvested blocks will be addressed in future years by following color-banded birds and by attaching small radios to birds and following their movements.

A second forest bird study being conducted by Great Lakes Forestry Centre scientists is part of a broader program assessing the role that old-growth white pine forests play in maintaining regional biodiversity. This work is being done at the Rushbrook Lake old-growth forest study area, in the Lower Spanish Forest northwest of Sudbury. This area is along the transition zone between boreal forest and northern Great Lakes-St. Lawrence forest biomes. The Rushbrook Lake site is recognized as one of just a handful of areas with significant old-growth white and red pine forests remaining in eastern Canada.

Here, researchers have begun a program that will assess the role that woodpeckers play as keystone species affecting the distribution of other wildlife species. Woodpeckers are keystone species because they excavate cavities in trees that are subsequently used by a variety of other forest wildlife, including owls, bats, flying squirrels, wasps, and several songbird species. Old forests may contain more suitable habitat (i.e., large dead and dying trees) for woodpeckers and secondary-cavity-using species. Hence there is a possibility that old forest habitats are important for many species of cavity-users.

Of key interest to this study is what aspects of the forest system might limit woodpecker populations: food, feeding substrates, available nesting habitats, forest patch sizes, competition, or nest predation. Results will have implications for managing forests to maintain old-growth characteristics, during selective harvests, or in long-term planning to maintain forests of a certain age, species composition, and size across a landscape. Researchers count woodpeckers on plots by playing woodpecker calls during the breeding season and looking for birds that respond. Nests are located and followed through to fledging to measure breeding success. Other cavity-users are located either by playing sounds to attract them, or by searching the forests for old woodpecker nesting holes in trees, and determining whether or not the cavities are being used by other species. Insect ecologists are also assessing populations of wood-boring insects and ants, which are the main foods of woodpeckers.

These two studies, conducted at the Great Lakes Forestry Centre, represent a continuation of a long history of forest bird research within the CFS. They form part of a federal commitment to help industry use forests in a sustainable manner, while protecting the forest environment over the long-term.

By Steve Holmes and Dr. Ian Thompson, Great Lakes Forestry Centre

The René Martineau Insectarium: An essential tool for the study of biodiversity among the forest insects of Quebec

On 13 January 1999, the Laurentian Forestry Centre welcomed over a hundred guests for the inauguration of the René Martineau Insectarium and the René Pomerleau Herbarium. The event was an occasion for paying tribute to these two pioneers of the Laurentian Forestry Centre.

René Martineau (1915–1998) headed the Quebec forest insect survey program known as the FIDS (Forest Insect and Disease Survey); specimens gathered in the course of that survey constitute approximately 65 percent of the Insectarium's present collection. After graduating from Laval University, the University of Illinois, and Yale University, he subsequently worked for 13 years at the Quebec Department of Lands and Forests, and then joined the Canadian Forest Service as a research scientist in May, 1952. Mr. Martineau was well-published, but particularly notable was the publication of *Insects Harmful to Forest Trees* (1984, Multiscience Publications Ltd.), which is still a leading reference work in the field of forest insects. During the years when FIDS was at the height of its activity, Martineau was coordinating the efforts of a Quebec team of approximately 25 members. His supporting team was integral in the development of a rigorous inventory and research program on insects, in both natural forests and plantations.

Specimen drawer (above) and Collections Room (below) found at René Martineau Insectarium.

The collections that now constitute the René Martineau Insectarium were assembled in three phases. The oldest specimens, which date from the 1930s, were collected by Lionel Daviault, who subsequently became the Centre's first Director. His research left the collection with substantial numbers of insects, including not only forest species but also species found in open habitats. The Daviault collection accounts for approximately 10 percent of the Insectarium's specimens.

The second phase of specimen acquisition (1952–1988) was associated primarily with a building that was known, even then, as the insectarium. The building housed the premises of the FIDS team, and insects that were collected in the field were kept and raised there. As there are practically no identification keys for insect larvae, the specimens were photographed at frequent intervals during their development. When the adult stage was reached, an accurate identification could be made. As a result of this procedure, a library containing some 40 000 slides illustrating over 900 species of insects was gradually built up. It is one of the largest collections of photographs of forest insects in Canada. It is used extensively by scientists for lecture purposes, but it is also an educational resource, not only for CEGEPs and universities, but also for primary schools.

Continues on page 7

Red spruce: An indicator for old-growth forests in eastern Canada

Ecologists generally recognize "old-growth" forest as a mature stage of forest development with large old trees and an accumulating amount of dead wood. In order to focus conservation attention on forest types most vulnerable to forest harvesting practices, a more restrictive definition may be more useful. For instance, late successional forest types are normally those at most risk from harvesting practices such as clearcutting. These forest types are dominated by species associations adapted to shaded, cool, moist, and relatively undisturbed forest canopy conditions, in which natural regeneration and recruitment occurs under an established forest canopy or in small gaps left by fallen trees rather than after large-scale fire or insect disturbances. Complete removal of the forest canopy changes the environmental conditions that support late-successional tree species associations, and will normally result in regeneration by tree species different from those found in the old-growth forest. These forests require harvesting practices based on partial cutting to maintain their character and structures.

In eastern North America, red spruce (*Picea rubens*) is one of the species characteristic of late-successional, old-growth forest types. The presence of a significant component of red spruce indicates a forest type able to perpetuate itself in the absence of major disturbances such as fire or large-scale wind damage. Thus, red spruce indicates old-growth forest or the potential for the development of self-perpetuating old-growth forest. While red spruce appears to be able to regenerate naturally following complete removal of the forest canopy (clearcutting) in coastal areas (e.g., the "fog" belt of southwestern Nova Scotia or southeastern New Brunswick) as one moves into drier, more continental parts of its geographic range, successful natural regeneration is adversely affected by clearcutting. Dependence on high levels of atmospheric humidity has made red spruce a rare species in central Canada after the extensive clearcutting of the past 150 years.

Natural regeneration in gaps created by fallen trees in an old-growth forest dominated by red spruce and eastern hemlock at Rossignol Lake, NS.

Red spruce-dominated forests also have tremendous commercial value because of the size and quality of their timber. While adapted to shaded conditions, red spruce responds very well to increased light levels, provided that high atmospheric moisture conditions can be maintained. By harvesting these forests using such partial cutting systems as single-tree, strip-felling, or group selection, most of the old-growth features of these forest can be preserved.

The centerpiece of Canada's efforts to assure good stewardship of its forests has been the development of a national set of criteria and indicators (C&I) for measuring, assessing, and monitoring sustainable forest management (SFM). However, we need to develop some practical or operationally useful indicators for monitoring and managing biodiversity at the forest management unit level. One of the six SFM criteria is conservation of biodiversity at all scales (e.g., communities within landscapes, species within communities, and genes within a species). Unfortunately, there are few operationally useful indicators at the community level of organization. However, the presence of species such as red spruce, eastern hemlock (*Tsuga canadaensis*), and of shade-tolerant hardwood species (e.g., sugar maple, beech, yellow birch) provides simple yet effective indicators for monitoring progress towards the rebuilding and maintenance of old-growth forest communities in eastern Canada. Species such as western red cedar (*Thuja plicata*), western hemlock (*Tsuga heterophylla*), and subalpine fir (*Abies lasiocarpa*) would represent indicators of late-successional, old-growth coniferous forest types in western Canada.

The presence of these trees provides operational indicators at the community level that would help resource managers and policy

Continues on page 6

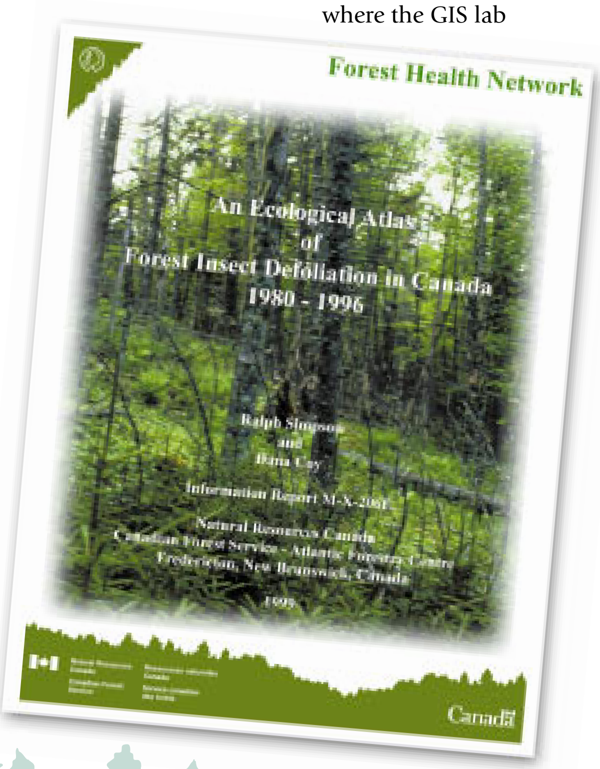
Forest Insect Defoliation in Canada: A new view

The health of Canada's forests is paramount to most Canadians. The Canadian Forest Service's (CFS) Forest Health Network is a key source for forest health information. Insect defoliation data provide key information, important for understanding disturbances and changes in the health of our forests. Translating data on insect disturbances into usable information, including maps, is fundamental to making informed decisions and policies for the maintenance of sustainable forest ecosystems. Responding to the need for maps of national insect defoliation in an ecological framework, Ralph Simpson and Dana Coy of CFS-Atlantic Forestry Centre have produced *An Ecological Atlas of Forest Insect Defoliation in Canada 1980–1996*.

Historically, nationally compiled insect defoliation data were limited to a single view or presentation of the information, reported using provincial and territorial boundaries. Individuals interested in these data view the information in an arbitrary geographic presentation outlined by provincial and territorial maps. In 1992, the Canadian Council of Forest Ministers signed Canada's Forest Accord and initiated a new, multi-use perspective for forest management issues. Looking at more than just fiber and timber, the Ministers recognized the growing need for information that transcends political boundaries.

As technology advances, new tools for analyzing and interpreting insect defoliation data has permitted a unique presentation of map information. Thanks to geographic information systems (GIS), CFS has re-invented the way national insect defoliation data are presented. Using an ecological framework, CFS is reporting national data in an innovative, interpretative, and analytical format using ecozone and ecoregion classifications. *An Ecological Atlas of Forest Insect Defoliation in Canada 1980–1996* presents defoliation coverages for five major forest pests: eastern spruce budworm (*Choristoneura fumiferana*), forest tent caterpillar (*Malacosoma disstria*), jack pine budworm (*Choristoneura pinus pinus*), hemlock looper (*Lambdina fiscellaria fiscellaria*), and mountain pine beetle (*Dendroctonus ponderosae*). These insects have the ability to generally defoliate and intermittently cause mortality over vast areas of Canada's forests.

The provinces and territories continue to collect insect defoliation data on an annual basis and CFS regional centres (Victoria, Edmonton, Sault Ste. Marie, Ste-Foy, Fredericton/Corner Brook) then take these data and produce regional coverages. This information is forwarded to the CFS - Atlantic Forestry Centre in Fredericton, where the GIS lab produces national compilations. Without the collaborative work of all the provinces, territories, and CFS regional centres, the nationally presented data would not be possible.



The Atlas not only presents annual and multiple-year maps, but greater detail of insect disturbances is provided using a variety of tables and histograms. Defoliation data presented in the ecozone and ecoregion format are considered to have a greater interpretive value and analytical potential for other issues concerning the forest community and forest industry. In the future, trend analysis could also be linked with climate change scenarios, multiple stress factor analysis, pest outbreak frequencies or duration relative to atmospheric pollution or forest management practices. The ecological atlas is a first step in a long-term plan to continue building data and metadata to broaden and advance the availability of historical information, including the geographic extent of insect defoliation. By promoting the use and development of insect defoliation coverages with partners across Canada, future efforts may include the acquisition of coverages for forest diseases, human intervention, and abiotic forest conditions for GIS maps and information.

To view *An Ecological Atlas of Forest Insect Defoliation in Canada 1980–1996*, or for more information, please visit the national Forest Health Network web site at:

http://atl.cfs.nrcan.gc.ca/fhn/atlas_e.html or contact Ralph Simpson at CFS - Atlantic Forestry Centre, in Fredericton (506) 452-3500; e-mail: rsimpson@NRCan.gc.ca.

By Shirley Pegler
Science Communications Officer
Atlantic Forestry Centre

continued from page 4… Red Spruce: An indicator for old-growth forests…

makers assess conditions, trends, and the achievement of specific biodiversity conservation goals, such as protecting ecologically representative samples of habitat. An important biodiversity conservation objective in both the Boreal and Temperate Zone forests of Canada is the maintenance of a certain proportion of old-growth and/or mature coniferous forest habitat for the protection of species dependent on these forest types. Furthermore, red spruce is in decline and becoming increasingly rare throughout most of its geographic range in eastern North America. Its rarity enhances its usefulness as an indicator for the restoration of a threatened or vulnerable forest community.

Whether a species is a useful indicator of biodiversity at the community level is determined by its effect on the compositional, structural, and functional aspects of biodiversity. As the dominant species in their ecosystem, trees such as red spruce obviously create much of the structural component of forest biodiversity through the formation of various age cohorts. For instance, red spruce is capable of producing a multi-aged forest canopy from regenerating seedlings to trees over 400 years old. Red spruce and other late-successional species are adapted to and maintain the shaded, high atmospheric moisture conditions that create the physical environment or the functional components (e.g., ecological processes) that affect and determine the presence of associated species in old-growth forests (e.g., the compositional component of biodiversity). As an easily identifiable and dominant feature of its characteristic habitat red spruce has many of the traits of an operationally useful indicator for identifying an increasingly rare forest type that needs to be considered as ecologically significant and worth conserving.

More examples of natural regeneration in gaps created by fallen trees in an old-growth forest dominated by red spruce and eastern hemlock at Rossignol Lake, NS.

Recent results from CFS studies in some of the remnant old-growth red spruce forests of Nova Scotia have demonstrated important aspects of genetic diversity associated with stand age. Significant positive relationships have been observed between tree age and reproductive fitness. For instance, seedling progeny derived from old-growth stands showed superior growth performance in greenhouse trials. As red spruce stands age, the inbred component of these populations appears to be slowly eliminated over time, resulting in a more genetically diverse (heterozygous) population. Similar genetic relationships have also been observed among the different age cohorts in forests of the southwest USA.

Old forests in the Canadian Maritimes also contain a very high component of lichens, mosses, and fungi reminiscent of the temperate rain forests of coastal British Columbia. Unfortunately, very few old-growth red spruce forests remain unaltered by human activities. Beautiful examples of old-growth red spruce/eastern hemlock forests can be observed within the Liscomb Game Sanctuary at Abraham Lake and within protected areas maintained by the Bowater Mersey Paper Company along the shores of Rossignol Lake and in the St. Margaret's Bay area of Nova Scotia. New Brunswick also contains some younger remnants of this type of forest in the steep gorges of the Fundy Highlands and in the upper St. John River watershed. Such exceptional examples of relatively undisturbed old-growth forest are extremely rare and deserve protection. However, the presence of natural red spruce regeneration in many younger, mixedwood stands that still contain scattered remnants of older red spruce trees can be used as an indicator of the potential to increase this old-growth forest component that once dominated much of the pre-settlement forest of eastern Canada.

by Alex Mosseler and Ian Thompson
Atlantic and Great Lakes Forestry Centres

continued from page 3… The René Martineau Insectarium

The slide library is also much in demand for publications, including gardening guidebooks and other books, calendars, and the like.

Formerly, this collection provided material for studies on forest pests and phytophagous insects, but today it constitutes the basis of our research program on insect biodiversity, underway since 1992. Thanks to a number of projects involving various partners (Laval University, UQAM, Parks Canada, the Quebec Department of Natural Resources, the Quebec Department of the Environment and Wildlife, Sépaq, and others) some 1 800 species have been added to the collection in the course of the past six years, resulting in an expanded Insectarium.

At the present time, the René Martineau Insectarium possesses 200 000 specimens of nearly 5 000 insect species, or approximately 30 percent of all species known to occur in Quebec, including 50 percent of its terrestrial species and 65 percent of its forest species. The Lepidoptera, Coleoptera and Hymenoptera are the orders that are most extensively represented.

The collection has been completely reclassified in accordance with the most recent nomenclature. It is divided into four sections: Lepidoptera, Hymenoptera, Coleoptera, and other orders. Within each order, families and subfamilies are classified phylogenetically. Genera and species are classified in alphabetical order. In the years ahead, the collection will continue to be enriched from the numerous projects that are currently under way.

Order	Family	# of Species	% in Quebec	Undescribed
Hymenoptera		1 584		
	Ichneumonidae	1 143		284
	Tenthredinidae	91	35	
	Braconidae	72		1 600
	Formicidae	58	70	
	Eulophidae	49		
Coleoptera		1 500	43	
	Carabidae	250	50	
	Chrysomelidae	135	48	
	Curculionidae	120	45	
	Carambycidae	115	65	
	Elateridae	72	45	
	Scolytidae	64	80	
	Buprestidae	46	57	
	Scarabaeidae	48	44	
Lepidoptera		1 158	45	
	Noctuidae	350	50	
	Geometridae	174	60	
	Tortricidae	156	37	
	Pyralidae	79	30	
	Gelechiidae	58	55	
	Notodontidae	38	73	
Other Orders				
Heteroptera		189	35	
Homoptera		146	25	
Diptera		215		
	Syrphidae	125		

Continues on page 8

continued from page 7… The René Martineau Insectarium

Moreover, this year we received donations from three different collectors, amounting about 2 500 specimens.

Like all scientific collections, the René Martineau Insectarium contains substantial quantities of data on the distribution, activity periods, habitat, host plants and relative abundance of each species. It is also a reference collection that can be used to confirm the identification of specimens gathered in the course of various projects. In conjunction with a data management system, it affords a means of monitoring changes in the situation of species over time. It can also be used as a source of rigorous information in the context of the Criteria and Indicators for Sustainable Development initiative. Lastly, the René Martineau Insectarium will also constitute a gigantic memory bank holding, for reference, insects that have been used for the publication of scientific articles and reports.

A catalogue of all insects collected and all 35-mm slides taken up to 1988 (during the period of FIDS) is available at the Insectarium's web site. All accumulated data from our biodiversity projects are to be put into a data bank within the next two years.

In addition, the René Martineau Insectarium, following the example of the Montreal Insectarium, has become a monthly meeting-place for the amateur entomologists of the Quebec City region. While the Insectarium is not meant to be a tourist attraction, one aspect of its function is to promote scientific knowledge among non-scientists and encourage young people to study insect life.

by Georges Pelletier, M.Sc. and
Christian Hébert, Ph.D.
Laurentian Forestry Centre

CFS S&T Networks

Forest Health Network
Lead Centre: Atlantic Forestry Centre, Fredericton, NB
Network Manager:
Thomas Sterner
Tel: 506-452-3500

Forest Biodiversity Network
Lead Centre: Atlantic Forestry Centre, Fredericton, NB
Network Manager:
Bruce Pendrel
Tel: 506-452-3500

Climate Change Network
Lead Centre: Northern Forestry Centre, Edmonton, AB
Network Manager:
Dennis Dubé
Tel: 403-435-7210

Pest Management Methods Network
Lead Centre: Great Lakes Forestry Centre, Sault Ste. Marie, On
Network Manager:
Errol Caldwell
Tel: 705-949-9461

Fire Management Network
Lead Centre: Northern Forestry Centre, Edmonton, AB
Network Manager:
Dennis Dubé
Tel: 403-435-7210

Socio-economic Research Network
Lead Centre: Northern Forestry Centre, Edmonton, AB
Network Manager:
Steve Price
Tel: 403-435-7210

Landscape Management Network
Lead Centre: Pacific Forestry Centre, Victoria, BC
Network Manager:
Jim Wood
Tel: 250-363-0600

Effects of Forestry Practices Network
Lead Centre: Pacific Forestry Centre, Victoria, BC
Network Manager:
Gary Hogan
Tel: 250-363-0600

Forest Ecosystem Processes Network
Lead Centre: Laurentian Forestry Centre, Sainte-Foy, PQ and Great Lakes Forestry Centre, Sault Ste. Marie, ON
Network Managers:
Bill Meades (GLFC) and
Denis Ouellet (LFC)
Tel: 418-648-5847 (PQ) and 705-949-9461 (ON)

Tree Biotechnology & Advanced Genetics Network
Lead Centre: Laurentian Forestry Centre, Sainte-Foy, PQ
Network Manager:
Ariene Plourde
Tel: 418-648-5847

FYI

Volume 4 No. 2 - Summer 2000
ISSN 1206-7210

Network News is published regularly by the Atlantic Forestry Centre for the Forest Biodiversity and Forest Health Networks of the Canadian Forest Service and its partners and collaborators.

Correspondence and article submissions may be directed to:
Canadian Forest Service
Atlantic Forestry Centre
P.O. Box 4000
Fredericton, N.B., Canada
E3B 5P7

http://www.atl.cfs.NRCan.gc.ca

Printed in Canada on
San Remo Plus + Gloss
a 50% recycled paper containing
10% post-consumer waste.