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# Forest Health & Biodiversity News

Canadian Forest Service

## Canadian Forest Ecosystem Classification Update

The Canadian Forest Ecosystem Classification (CFEC) can be thought of as a "dictionary" of forest and woodland ecosystems in Canada. It will integrate knowledge of vegetation communities in relation to environmental gradients, such as regional climate and site-specific moisture and nutrient regimes. The CFEC initiative, led by the Canadian Forest Service, is the forest component of the Canadian National Vegetation Classification (CNVC), a project co-ordinated by NatureServe Canada. The CNVC will be compatible with the International Classification of Ecological Communities, a vegetation classification developed and maintained by NatureServe and various natural heritage, research, and land management partners in the United States. The CFEC will be effective for a broad range of applications, from exchanging forest management information across provincial and territorial boundaries, to identifying ecosystems with high potential for biodiversity conservation.

Currently, provincial and territorial forest ecosystem classifications identify and describe more than 4 000 forest and woodland community types in Canada. However, because each classification is specific to its jurisdiction, direct comparison across jurisdictional boundaries is not possible. The objective of the CFEC is to remedy this situation by correlating the provincial and territorial classifications into a common national system. As well, the adoption of internationally standardized definitions will allow correspondence of forest community type (or association) names and descriptions across the Canada – United States border. Forest and woodland ecosystems across Canada and the United States will be described in common terms and communication of species and community-level ecological information will be facilitated within Canada and internationally.


*For more information visit:*
*www.glfc.cfs.nrcan.gc.ca/CFEC/*

Building the CFEC is a large undertaking that requires compilation of data from many sources, analysis of plot data in some cases, "crosswalking" between existing classifications, and sponsorship of workshops involving experts from different jurisdictions to ensure that each identified forest or woodland association is a real entity. Work is proceeding in several parts of Canada with collaborators from provincial resource departments and Conservation Data Centres.

Forest ecological classification data from British Columbia, Yukon, Alberta, and Saskatchewan have been standardized into a common data format. Empirical analyses are underway to produce forest and woodland associations for western Canada. A workshop is planned for early spring 2003, to review the

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# Biological Collections at th

## What is in those cabinets?

The Canadian Forest Service (CFS) is home to a number of large biological collections located in its research centres across the country. Each CFS research centre houses an arthropod collection and a mycological herbarium of dried fungi; some centres also have a botanical herbarium and a living collection of fungal cultures. Many of these specimens date back to the beginnings of the CFS more than one hundred years ago. However, the bulk of the collections were obtained during the Forest Insect and Disease Survey (FIDS) era (1936–1996). The resulting collections of specimens and associated data, together with the Canadian National Collection of Insects have provided Canada with arguably the most comprehensive national forest biodiversity dataset in the world. Many specimens continue to be acquired through current forest health and biodiversity research.

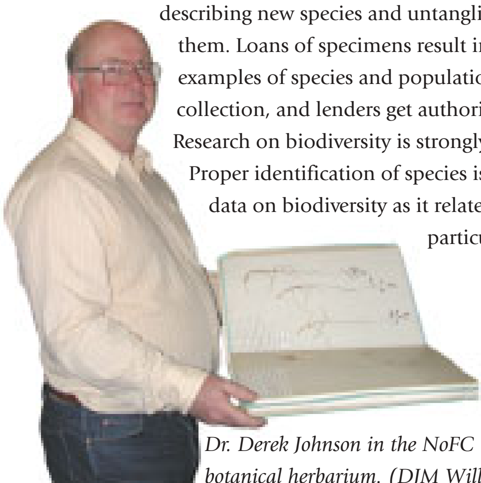
## How biological specimens are being used today

To the casual observer, these collections are little more than an interesting stop for the curious public during an open house. But they are the backbone of much of our biological work at the CFS. They are vibrant reference libraries, complete with loans, acquisitions, catalogs, and databases.

## A wealth of biological information

To the modern researcher, the specimens represent historical records of what lived at a given place and time. Virtually all of these specimens have associated data, including the identity of the organism and the date and place of collection. In many cases this can be quite detailed, particularly for the FIDS specimens that have associated information on host tree condition and forest stand structure. Many of the insect specimens were reared in the lab, so they also have information on associated host plants, feeding behavior, and timing of life stages. Parasites that emerged during rearing become extremely valuable specimens, providing candidates for biological control.

Collectively, many thousands of specimen records can give us a detailed picture of the geographic range of a particular species, its habitats, and its associated tree species. The curators of these collections are in the process of converting this information into electronic format. Specimens in the CFS collections are often sought by taxonomists around the world, who are describing new species and untangling the evolutionary relationships among them. Loans of specimens result in mutual benefits - borrowers get access to examples of species and populations which may not exist in any other collection, and lenders get authoritative identifications on our specimens. Research on biodiversity is strongly supported by the biological collections. Proper identification of species is crucial to meaningful interpretation of data on biodiversity as it relates to species richness and abundance at a particular research site.



*Dr. Derek Johnson in the NoFC botanical herbarium. (DJM Williams)*

Specimens are stored in a variety of ways, depending on the type of collection. In the arthropod collections, insects may be pinned, preserved in vials of 70% ethanol, or placed in a mounting medium on glass slides. Fungal specimens are dried or living. The dried specimens are stored on cards or in envelopes or boxes and the living cultures are grown on agar-based media in test tubes. These cultures must then be stored just above freezing and require re-culturing on fresh media every few years to keep them viable. Plants and their parts are dried and glued to sheets of cardboard or stored in small boxes or envelopes. Most specimens can last indefinitely if they are properly cared for.

Within each collection, all individuals of the same species are usually stored together and grouped hierarchically with others of the same genus, tribe, family, and order. Keeping track of the nomenclature system of the estimated 300,000 species of organisms occurring in Canada is no simple matter. Of the 200,000 species that may be found in our forests, fewer than half have been recognized, formally named, and described. If that isn't daunting enough, our concepts of known species and of higher taxonomic groups are not static. The more we learn about them, the more variation we discover, resulting in new species being split off, or old species being lumped together, and in new arrangements of species within higher taxa. To keep the collection up to date, specimens must continually be re-examined and rearranged as more information is acquired, names change, and new arrangements of species proliferate.

*PFC technician John De*
*from the Pathology H*

*Compacting system for i*
*Martineau Insectariun*

*Ground Beetle specim*
*Collection.*

**Holotype** – a single specimen to which the species name is permanently linked. If a previously recognized species turns out to be a mix of species, its holotype needs to be re-evaluated against the new findings. The original name will be applied to the newly recongnized species to which the holotype belongs. The other newly recognized species will be re-named.

### Plant collection coughs up valuable disease specimens:

When Pat Crane, a post-doctoral research fellow at the Northern Forestry Centre (NoFC), recently carried out some taxonomic research on spruce rust fungi of the *Chrysomyxa ledi* complex, she required specimens from a wide range of localities. These rust fungi are important pathogens of spruce trees, capable of causing severe defoliation, defects, growth loss, and mortality. These fungi generally have complex life cycles involving primary hosts, chiefly *Picea* spp., and alternate hosts including labrador tea (*Ledum* spp.), rhododendrons (*Rhododendron* spp.), and other plants in the family Ericaceae. Besides being important tree pathogens, some species cause economically important diseases of cultivated rhododendrons. Knowledge of species delineations, relationships among species, and life cycles was lacking. Dr. Crane set out to redescribe the species and sort out their evolutionary relationships (Crane, P.E. 2001. The Canadian Journal of Botany 79:957–982). These organisms are very similar, but can be distinguished microscopically on the basis of spore morphology. Dr. Crane required a large number of specimens from all over the world to make comparisons and sort out these very similar species. In her quest for material, she checked through Ericaceae samples in the NoFC Botanical Herbarium. It turned out that several specimens were infected with *Chrysomyxa*. Among these samples, she discovered new locations for the species *C. cassandrae*. Subsequent field collections extended the known distribution of this rust on spruce to the prairie provinces for the first time. She also found a *Chrysomyxa* infection with unusual spores on a specimen of *Ledum* housed in the herbarium. This turned out to be a new species, which she described as *Chrysomyxa reticulata*. Using the collection data from this specimen, she collected fresh material to use as the holotype and to study the life cycle.

# he Canadian Forest Service

## I'll vouch for that

Museum voucher specimens are irreplaceable; each is an individual, a unique organism. The species may have been extirpated, either locally or globally, or it may have undergone a structural, physiological, or genetic change over the years since the sample was collected. In many cases, the sites from which these specimens were collected have been significantly altered, either by humans or by natural events. So, museum voucher specimens provide a look into the past at what lived in a particular forest at a particular time. This can be important information for studies of the effects of habitat degradation and climate change; in many cases it is the only baseline information we have.

ennis and some specimens
erbarium. (B. Callan)

Voucher specimens are also important for indicating where and when an exotic species was first introduced and how fast it has spread. When legal action or trade sanctions are pursued, voucher specimens collected from packaging or trade goods can provide proof that a given organism has been intercepted.

Specimens can also function as vouchers to ensure the future value of our past and present research. For any organism-based study, it is important to set aside and preserve a few representative specimens of each species examined. These specimens can then be consulted in the future, in light of new species concepts, to determine exactly the object of the study.

nsect cabinets, in the Rene
n at LFS. (C. Germain)

For example, our concept of what exactly comprises the spruce budworm, *Choristoneura fumiferana* (Clem.) has changed several times over the years. What was once considered one species is now considered to be a group of closely related species, each with a distinct biology, host plant complex, and economic impact. Besides the spruce budworm, these new species include the jack pine budworm (*C. pinus* Freeman), the western spruce budworm (*C. occidentalis* Freeman), and the two-year-cycle budworm (*C. biennis* Freeman), all unrecognized until the 1950s and 1960s. In eastern Canada, recent DNA work has also shown that spruce budworm and jack pine budworm have hybridized in nature. (DeVerno, L.L., Smith, G.A., and Harrison, K.J. 1998. Annals of the American Entomological Society. 91(3):248-259). By examining voucher specimens from old spruce budworm studies, we can determine which species was actually being looked at, and thus retain the value of the research. It is much cheaper to maintain that voucher collection than it is to redo a costly and time consuming experiment to elucidate life histories and develop management plans.

ens in the GLFC Insect
(K. Nystrom)

## Diagnostic tools

Our collections also provide essential support for diagnostic work. Getting a correct identification on a sample brought in to the lab can be critical; an incorrect species determination can result in costly pest management applications to a non-pest species or failure to detect a new outbreak in the early stages. To make those determinations, diagnosticians need the proper tools, including keys, descriptions, and photographs, although there is no substitute for a comprehensive synoptic collection. Most of us are familiar with popular field guides to birds and mammals. However, those groups represent only a tiny slice of the diversity of life. Most of the less conspicuous species are not nearly as well known, so there are few guides to their identification. Many species have never been illustrated; often a species is known only from a brief description published over 100 years ago. Thus for diagnostics we rely on properly identified museum specimens — often specimens identified by the original describer of the species. These specimens can be consulted and compared to incoming material to make reliable determinations. Thus the museum itself functions as a constantly expanding "identification guide" to the organisms living in our forests.

**voucher specimen** - a specimen put into the collection as an example of the organism examined in a particular study. These specimens form a permanent archive to be consulted in case of changing species concepts or questions concerning the validity of the original determinations.

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### Fungus cultures provide a new tool in the BSLB eradication program

Ken Harrison of the Atlantic Forestry Centre (AFC) has been developing a novel diagnostic tool in the fight against the Brown Spruce Longhorn Beetle (BSLB). This beetle, a native of Europe, which presumably arrived in the port of Halifax, Nova Scotia on wood packing materials, has been killing red spruce trees in the Halifax Regional Municipality for a number of years. It is the subject of an eradication program led by the Canadian Food Inspection Agency's BSLB Task Force. The CFS has been part of the Task Force since its creation in early 2000. In a study of the fungi associated with the BSLB, Harrison isolated a fungus from the beetles and from beetle-infested trees and collaborated with an international team led by Dr. Karin Jacobs of South Africa who ultimately identified it as *Ophiostoma tetropii*. This fungus was identified by use of a combination of morphological and molecular methods by comparison with living cultures from international culture collections. *O. tetropii* was previously unknown in North America. Harrison reports that the determination would have been impossible without having living cultures from Halifax to compare with other *Ophiostoma* species from international culture collections. In the course of this work, Harrison discovered that *O. tetropii* was in fact easier to detect in attacked trees than the beetles themselves. For much of the year, detection of the beetles is time consuming and difficult, since sections of the suspected infested trees must be reared in controlled laboratory conditions for up to 7 months to produce an identifiable insect. To compound the problem, the insect larvae and other life stages are difficult or impossible at times to distinguish from other similar native species. In contrast, *O. tetropii* can be isolated and identified in about one month, and it is a reliable indicator that BSLB has been or is present in an area. So, *O. tetropii* can be used to help focus the survey and eradication effort. The development of this tool was dependent on access to living culture collections such as those maintained by CFS, and the close collaboration between local, national, and international mycologists and entomologists.

*Ophiostoma tetropii growing in culture at AFC.*

## China - Part of the Canadian Forest Service Stewardship Agenda

Forest sector issues may cross international boundaries more than those of any other natural resource. Economic considerations are central to many of the issues, given the global trade in forest products, but our forests are also biological entities. Forests respond to stress from afar, like air pollution, or delivered at their doorstep, such as insects and diseases. At the same time, forests contribute to the maintenance of the global atmosphere and climate by cycling nutrients and gases, and filtering pollutants.

Canadian forest health has been challenged by both trade in goods and the movement of people. Traditionally, this has resulted from more than 400 years of ties with Europe and our close proximity with the United States. Now globalization has opened new possibilities from Asia, especially China. Why China? With 1.3 billion people, 420 times the population of Canada, China has entered the global trading forum in full force, especially with their entry into the World Trade Organization. We are now the recipients of a vast array of materials from Chinese factories, often shipped in wood packaging. At the same time we have open to us a huge market for our forest products. What implications will this have for the health of forests both here in Canada and in China?

The Canadian Forest Service cooperates with China to address the fitness of our forests in two areas: the movement of non-native pests and programmes to improve forest sustainability.

**Non-native Pests**

The introduction of exotic pests poses a huge risk to our forests. Natural controls for exotics are absent so, these non-native pests can cause damaging outbreaks and the displacement of native species, thus changing our forest ecosystems forever. For example, Chestnut Blight has virtually eliminated American chestnut from eastern North America, gypsy moth has changed stand composition and structure and Dutch Elm Disease along with its introduced vector, the European elm bark beetle, has effectively eliminated elms from many urban landscapes.

*Staff of the Jilin Academy of Forestry Science, Bajiazi Forestry Bureau and Huanggou Forest Farm with Lee Humble (CFS) and Steve Burke at trapping site for Ips typographus in eastern Jilin Province.*

Knowledge of the biology and ecology of invasive species is critical to the development of risk assessments and detection, containment, or eradication strategies. The recent discoveries of forest pests from northeast Asia, such as the emerald ash borer in Michigan and Ontario and the Asian longhorned beetle in Chicago and New York, have re-emphasized the need for a better understanding of pest dispersal as a result of international trade.

Imports from China to Canada have increased five-fold in the last decade leading to a significant increase in the risk of invasive species. Similarities between the physical environments and tree species of Canada and China coupled with differences in the diversity of forest pests between the regions, suggest that Chinese pests could have significant impacts. Conversely, these conditions in combination with wood imports from North America also put China's forest resources at risk. Indeed, three of the top six forest pests in China originated from North America.

Canada and China are initiating collaborative research projects to address these issues. To support the early detection of unwanted exotics in Canada, Lee Humble (PFC), in collaboration with Gao Changqi of the Jilin Provincial Academy of Forest Sciences, has been testing detection systems for bark and wood boring beetles in northeastern China. Their goal is to determine the effectiveness, in China, of Canadian trap and lure systems used here for the capture of bark and wood boring pests in quarantine surveillance of port areas and forests. This research has benefited the foresters of Jilin Province and eventually all of China through the introduction of new pest management and detection tools.

Collaboration also supports ongoing diagnostic research: Gao and Humble are providing specimens to Georgette Smith (AFC) for the development of DNA-based identification tools for engraver beetles of the species *Ips*. Future collaboration with the Chinese Academy of Forestry and the Chinese Academy of Science may include: evaluation of quarantine risks associated with particular species in China, such as the North American red turpentine beetle, examination of native forest pests in Chinese plantations that are affecting North American tree species established there, and basic research on wood borers native to northeastern China, such as the emerald ash borer.

**Non-native Trees and Tree Improvement**

China has vast areas where forests have been removed or severely degraded. The ubiquitous 'human footprint' has recently caused flooding, wind erosion, loss of production, and inadequate function in ecological systems. The good news is that following these crises, new national commitments for the environment have been made

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# Workshop Report: Impacts of Forestry Practices on Biodiversity

From 25-27 September 2002, the Canadian Forest Service (CFS) hosted a facilitated workshop on the "Impacts of Forestry Practices on Biodiversity" in Edmonton that brought together 36 participants from the CFS (all Centres and HQ), Environment Canada, provincial governments (Saskatchewan, Ontario, Nova Scotia), industry (Weldwood, Tembec, Abitibi), and the University of Alberta.

This workshop topic represented one of the research themes in the Forest Health and Biodiversity Network (FHBN); over the last 15 years, CFS activities within this theme have been numerous, diverse, and valuable. Despite the good work that has occurred, this is a theme that was deemed by CFS Management and by a recent Peer Review Panel to be unfocused and lacking in national vision and cohesion. To examine this problem, a workshop was convened to consider national priorities related to this theme and to identify CFS work that addresses critical national needs, offers excellent opportunities for results and products of high impact and visibility, and engages CFS strengths in a national cohesive effort. The expected outcome of the workshop was the development of a short list of priorities for the CFS for the next five years that could enhance the next Strategic Plan for the FHBN. The workshop also endeavoured to identify alliances needed to deliver on priorities.

Several presentations set the stage for the workshop on the first day. There was discussion about realistic expectations for the next five years (phrased in terms of research questions). Next, participants gave short presentations and expressed insight on emerging issues and opportunities for partnerships, and provided opinions concerning the role of the CFS. The second day focussed on revisiting expectations and developing an initial list of objectives and products for the next five years. The first two days were facilitated, and an electronic decision tool called "Optionfinder" allowed everyone to rate all ideas raised. On the third day, CFS Scientists and Managers met in separate non-facilitated sessions to refine the list of products and objectives from the previous days and to prepare a workshop post-mortem. Both groups came together at the end of the morning to exchange ideas.

**Recommendations**

Four areas of work were identified, each of which has (at least potentially) three types of activities: research, syntheses (reviews, meta-analyses, etc.), and facilitation (bringing stakeholders together to focus on issues and products):

**1) Research Needs for Biodiversity Monitoring and Assessment**

This includes work that is focussed on development and assessment of biodiversity indicators of sustainable forest management as well as development and validation of biodiversity monitoring protocols. One suggested product is a synthesis of biodiversity indicators of sustainable forest management in Canada. It was suggested that a task group would be required to scope out and coordinate the delivery of this product, which might include a report on assessment methods, tools, and indicators.

**2) Forest Types At Risk**

This work would include identification of forest types at risk, assessment of land management practices that contributed to this state, and the development of recommendations for improvement of practices. One suggested product is a report that synthesizes these factors. This report could be delivered by a national task group, possibly led by the CFS. Research recommendations include focussing on threat assessment, providing science input into restoration, and assessing the threat of loss of old-growth forest types.

**3) Benchmarks and Thresholds**

For this area of work, benchmarks and thresholds are intimately tied to the development of biodiversity indicators of sustainable forest management. Indicators of high utility, as identified through the proposed syntheses in (1) and (2), require a threshold or management objective that, if not achieved, could indicate a potential problem and a possible need for investigation and correction, thus requiring an assessment of the natural range of variability. Research to identify reasonable thresholds for the selected indicators could involve a pre-planned experimental approach or retrospective studies.

**4) Effects of Current Regional Forestry Practices on Biodiversity**

This work includes assessing and reporting of current conditions, describing assessment protocols, and evaluating high impact forestry practices, which requires research, syntheses, and development of predictive models. One suggested product is a synthesis of the impacts of forestry practices on biodiversity at different scales, which requires a task group for scoping and coordinating this product. This activity will serve to identify gaps and establish research priorities. Anticipated research products could be predictive models to project biodiversity responses under different management scenarios and protocols for assessing the impacts of forestry practices on biodiversity.

In addition, although not directly related to the Workshop, it was recommended that a National Forest Biodiversity Working Group be established. This Working Group would be co-chaired by the CFS and have representation from the pertinent federal departments, industry, and provinces. The Working Group would provide general guidance to a national forest biodiversity program, irrespective of

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western boreal forest and woodland associations.

In Ontario, forest ecological classification data are being re-analyzed by provincial partners to combine four regional classifications and produce one provincially standardized list of forest and woodland associations. A similar process is underway in Quebec with plot data from the provincial forest ecosystem classification.

Forest ecology data have already been re-analyzed in the three Maritime provinces and synthesized into an initial set of 58 proposed forest and woodland associations; these were reviewed at an expert workshop in December 2002. In Newfoundland and Labrador, provincial forest ecosystem classification data should be collated and ready for conversion to the national data standard by the end of March 2003.

Once forest and woodland associations have been defined in all the regional component analyses, an east-west and north-south rationalization process will be undertaken to ensure that the associations are consistent across provincial, territorial, and international borders. The process is being overseen by a CNVC technical committee that consists of representatives from the CFS, NatureServe, and major provincial partners. The forest and woodland associations will eventually be combined with wetland and other

*Black spruce - Trembling Aspen / Dwarf Raspberry Forest*

non-forest associations in the broader CNVC.

A unified vegetation classification system for Canada will be useful for many applications, such as providing a framework for reporting on ecosystem variables across jurisdictional borders. These include criteria and indicators of sustainable forest management or descriptions of successional changes in the composition and structure of forest and woodland plant communities following natural and human-caused disturbances such as climate change. The unified system will also provide a mechanism for linking, across multiple scales, ground-derived ecological attributes to spatial information products derived from remote sensing, and for identifying and delimiting habitat for conservation of biodiversity. The CFEC will provide a mechanism for extrapolating research results and forest management protocols from one region of Canada to another and will offer benchmark descriptions of ecological characteristics of forest and woodland ecosystems. Finally, the CFEC will provide a standardized capability for communicating ecological information about forest and woodland ecosystems within Canada and between Canada and the United States.

*Ken Baldwin and Judy Loo*
*Great Lakes Forestry Centre and Atlantic Forestry Centre*

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jurisdiction, and aid greatly in the direction of the CFS program.

**Next Steps**

The recommendations from the workshop are being considered by Senior Management in determinating a course of action. Activity in the short term will likely focus on identifying task groups or teams to scope and coordinate delivery of specific products. The results of this workshop and the proposed areas of work and products will contribute to the new FHBN Business Plan for the next five years. Other workshop are planned by the FHBN and other CFS S&T Networks to similarly develop specific work plans for the future.

*David Langor*
*Northern Forestry Centre*

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## Bits of DNA on pins and cards

The advent of modern DNA extraction and analysis techniques have led many researchers to look at the specimens in our collections in a new light. No longer are they simply old dried bugs, mushrooms, and plants, they are priceless bits of DNA on pins and cards. It is now possible to extract DNA from decades-old museum specimens, to make identifications, determine the country of origin, examine genetic variation, and trace evolutionary relationships. An example of this work is a recent study by Dr. Felix Sperling of the University of Alberta, in conjunction with Drs. Art Raske (retired from the Newfoundland Forestry Centre, now part of the AFC) and Imre Otvos of the Pacific Forestry Centre (PFC). They examined the genetic variation of the hemlock looper (*Lambdina fiscellaria* (Gn.)), an important defoliating moth. Forest managers and researchers were never certain if the various populations that defoliate oak in southwestern British Columbia, hemlock and Douglas fir in the west, and fir and hemlock in the east were the same species. No reliable morphological features separated them, but they behaved differently on the various hosts in different regions.

The research team gathered specimens from a number of research collections, including all the regional CFS collections, and extracted DNA to examine genetic relationships across the geographical and host range of the species. They determined that the oak feeding populations of southwestern BC were not genetically distinct from the conifer feeding populations there. They concluded that genetic differences between western and eastern populations of conifer feeders represent genetic polymorphism within one species, rather than multiple cryptic species.

DNA analysis was also used by PFC researchers in their gypsy moth (*Lymantria dispar* (L.)) work on the West Coast. Specimens from the PFC collection provided the DNA standards required to identify the source of gypsy moths that were being intercepted in the Vancouver area. When they compared the DNA of intercepted moths to that of European and Asian moths from the collection, it was clear that they were dealing with the Asian strain.

For more information on the CFS collections, please consult the list of curators and websites found in the sidebar.

*Gregory R. Pohl*
*Northern Forestry Centre*

### ARTHROPOD COLLECTIONS

**Pacific Forestry Centre Arthropod Collection**

Curator: Dr. Lee Humble (lhumble@nrcan.gc.ca)

145,000 pinned specimens, 5000 vials of preserved specimens, 20,500 slide mounted specimens.

**Northern Forestry Centre Arthropod Collection**

Curator: Greg Pohl (gpohl@nrcan.gc.ca)

website: http://nofc.cfs.nrcan.gc.ca/

120,000 pinned specimens, 5000 vials of preserved specimens, 5000 slide mounted specimens.

**Great Lakes Forestry Centre Insect Collection**

Curator: Kathryn Nystrom (knystrom@nrcan.gc.ca)

165,000 pinned specimens, several thousand vials of preserved specimens.

**René Martineau Insectarium**

Curator: Georges Pelletier (gepellet@nrcan.gc.ca)

website: http://www.cfl.forestry.ca/

200,000 pinned and preserved specimens.

**Atlantic Forestry Centre Insect Reference Collection**

Curator: Georgette Smith (gesmith@nrcan.gc.ca)

100,000 pinned specimens, 3000 vials of preserved specimens.

**Insect and Spider Collection - AFC Corner Brook**

Curator: Rosie Feng (rfeng@nrcan.gc.ca)

33,000 pinned specimens, 17,000 preserved specimens

### MYCOLOGICAL COLLECTIONS

**Pacific Forestry Centre Forest Pathology Herbarium**

Curator: Dr. Brenda Callan (bcallan@nrcan.gc.ca)

website: http://www.pfc.forestry.ca/

35,300 specimens

**Northern Forestry Centre Mycological Herbarium and Culture Collection**

Curator's position vacant; contact David Langor for information (dlangor@nrcan.gc.ca)

25,000 dried specimens, 2000 living cultures

**Great Lakes Forestry Centre Mycological Herbarium**

Curator: Chuck Davis (cdavis@nrcan.gc.ca)

20,000 specimens

**The Laurentian Forestry Centre René Pomerleau Herbarium**

Curator: Pierre Desrochers (pidesroc@rncan.gc.ca)

website: http://www.cfl.scf.rncan.gc.ca/

20,000 fungus and disease specimens

**Atlantic Forestry Centre Mycological Herbarium and Culture Collection**

Curator: Ken Harrison (kharriso@nrcan.gc.ca)

8300 dried specimens, 230 living cultures (the latter to be decommissioned by 2004)

**Forest Pathology Herbarium - AFC Corner Brook and Newfoundland and Labrador Culture Collection - AFC Corner Brook**

Curator: Gary Warren (gwarren@nrcan.gc.ca)

1840 dried specimens, 550 living cultures

### BOTANICAL COLLECTIONS

**Northern Forestry Centre Herbarium**

Curator: J. Derek Johnson (dejohnso@nrcan.gc.ca)

27,000 vascular plants, 5000 bryophytes, 4000 lichens

**Great Lakes Forestry Centre Vascular Plant Herbarium**

Curator: Ken Baldwin (kbaldwin@nrcan.gc.ca)

11,800 vascular plant specimens, unknown number of cryptogams

**The Laurentian Forestry Centre René Pomerleau Herbarium**

Curator: Pierre Desrochers (pidesroc@rncan.gc.ca)

website: http://www.cfl.scf.rncan.gc.ca/
10,000 specimens

**Newfoundland Forest Research Centre Botanical Herbarium - AFC Corner Brook**

Curator: Doyle Wells (dwells@nrcan.gc.ca)

3500 specimens

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which are impressive enough to serve as world models. An immense task of restoration remains ahead for China, requiring inventive means of replacing forests on the landscape and increasing productivity.

One part of China's solution to forestry is the use of non-native tree species. Many Chinese agencies have already acquired genetic material from Canada and around the world. We have adopted the approach of working with Chinese researchers to evaluate Canadian tree species in China, thereby assuring a coordinated approach. The CFS National Tree Seed Centre (AFC) is providing seed for this purpose. At the same time, such collaboration allows us to promote a philosophy of safeguarding native biodiversity or re-establishing ecological processes in many sites that are completely devoid of their traditional flora and fauna. Our approach assures that Canadian species will be evaluated with related Chinese species and that they will be targeted for a specific ecological use or wood production in plantations. The evaluations, lead by Yill Sung Park (AFC), Ben Wang (consultant), Bruce Pendrel (AFC), and Steve D'Eon (GLFC), are presently operating under a wide variety of Chinese environmental conditions from drought stress to agricultural impacts. The information gleaned about our own species growing in a distant environment may add to our knowledge and thus be useful back here in Canada.

Adaptation is a process under strong genetic control. Our aspiration, and that of our Chinese colleagues, is to assure that forests are appropriate to a local ecology. Our collaboration has evolved from evaluating Canadian species to proposing a Cooperative Tree Improvement project for native Chinese species, following the successful model demonstrated in parts of eastern Canada. Our goal then is to find those species, native or non-native, that are adapted to withstand the range of difficult conditions that exist in China and that will allow forest productivity to improve. This coming year, new discussions will centre on the creation and conservation of biologically diverse forests. Alex Mosseler (AFC) will lend his expertise, and the management of damaging insect pests will benefit from the expertise of Ed Kettela (AFC) and Imre Otvos (PFC).

The two focal areas of work described above fall under a Memorandum of Understanding between the CFS and the State Forest Administration of China. It does not escape us that on one hand we are managing difficult exotic pests while on the other we are aiding the movement of exotic trees. However, by infusing science and considerations for forest health and biodiversity, we hope to achieve improved international forest sustainability while respecting the realities of our shared planet.

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