IMPACT

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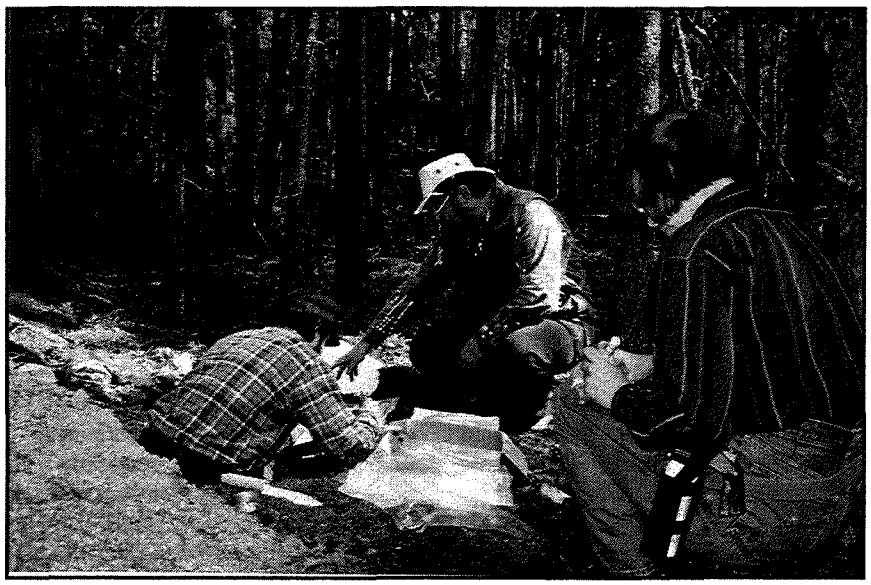
Portable system collects tree respiration data

Trees consume some of the carbon acquired by photosynthesis to produce energy for growth and survival. However, some carbon dioxide is returned from the tree to the atmosphere (respiration). Understanding what controls the rates of tree respiration will help scientists predict the consequences of climate change on forests.

Maritimes Forestry Centre scientist Dr. Mike Lavigne is among the first tree physiologists to assemble a portable system to measure tree respiration in the field. Wires and tubes connect tree stems to a data logger, a laptop computer and an infrared gas analyzer. The trees are monitored day and night for four days and then he and research assistant Troy Riche pack all the equipment and move to another site.

They are collecting measurements at a number of spruce, pine, and aspen sites in the southern BOREAS study area. Dr. Lavigne is collaborating with Dr. Mike Ryan of the U.S. Forest Service, who is making similar measurements at the northern BOREAS sites.

Dr. Lavigne constructed his portable tree respiration system during 1992 and made initial field tests that continued during the 1993 field season. "Each year we made some improvements to this respiration system," he said. "We are very pleased with how well it performs and are excited about the new insights we are acquiring into what is controlling respiration rates."



Overview - Ongoing climate change research augments BOREAS study

The study of climate change is global and involves many hundreds of scientists around the world. The Canadian Forest Service's climate change research team is an active partner in this effort and is involved in a number of different national and international research projects. One such experiment, called BOREAS (the Boreal Ecosystem Atmosphere Study), is a large international collaborative study involving scientists from many different countries and agencies.

A number of CFS researchers were involved in BOREAS, which was an intensive short-term study of forest-climate interactions in the boreal forest. Although the datas collection phase of BOREAS is now over, CFS scientists will continue to study ecological processes in the boreal forest over the long-term to augment the data collected during the BOREAS experiment.

Later this year, Dr. Lavigne will analyze the data collected for the BOREAS experiment to estimate respiration budgets for spruce, pine, and aspen stands. "The respiration budgets from the northern and southern BOREAS locations

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Natural Resources Canada / Ressources naturelles Canada
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CANADA'S GREEN PLAN
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Portable system collects tree respiration data

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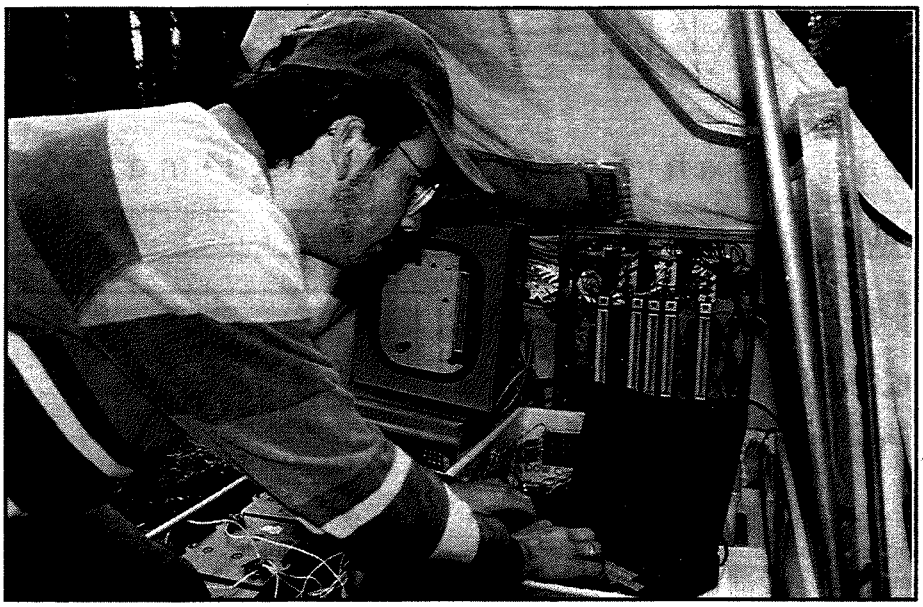
will be contrasted to investigate what environmental conditions control respiration and how they may be influenced by changes in the climate," he said. Dr. Lavigne's research results will be shared with other researchers involved in BOREAS.

Respiration data needed to calculate carbon budget.

The tree respiration data collected by Dr. Lavigne will provide other Canadian Forest Service researchers with some of the data needed to complete a computer model that calculates the total carbon storage for the Canadian boreal forest (see story IMPACT #2).

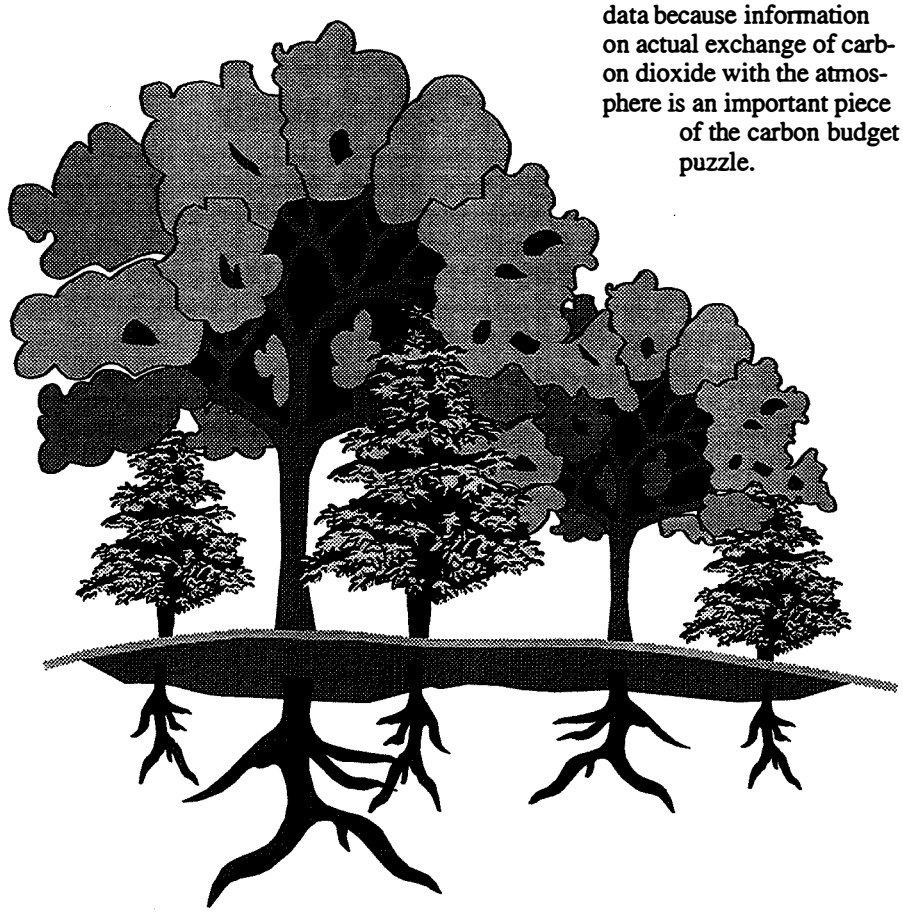
Calculating the carbon budget for the entire Canadian forest sector today, and predicting how it might change 100 years into the future, is a complicated accounting procedure that attempts to integrate all available data on carbon found in vegetation, soils, wetlands, and forest products plus the changes in these pools with time and changing conditions. The carbon budget model accounts for the role of disturbances, such as fire and insect infestations.



Troy Riche, student of Mike Lavigne with recording equipment.

Northern Forestry Centre scientists Dr. Mike Apps and Dr. David Price are interested in Dr. Lavigne's data because information on actual exchange of carbon dioxide with the atmosphere is an important piece of the carbon budget puzzle.

"By working with experimentalists like Mike Lavigne and others, both within the CFS and outside, we will be able to refine our models to include up-to-date information on all the important climate-sensitive ecosystem processes," explained Dr. Apps. "We can then use these models to make better assessments of the responses of Canadian forests under different climate scenarios."



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Conifer regeneration affected by dry climate

Preliminary results from research being done in Saskatchewan suggests that a drier climate will affect conifer regeneration and growth. Northern Forestry Centre researcher, Dr. Ted Hogg, says the two-year study was designed to help scientists predict what may happen to the boreal forest if the climate becomes warmer and drier, which is what climate change scientists theorize will happen.

"This study gives us an idea of how much the climate has to change to cause complete regeneration failure," he explained. "We can then speculate what will happen to spontaneous regeneration at the southern end of the boreal forest. What is now forest may eventually become parkland and then grasslands where no trees grow."

Dr. Hogg, and Dr. Art Schwarz, of the University of Alberta's Canadian Circumpolar Institute, have been surveying abandoned farms and shelterbelts in Saskatchewan over the past two summers. They have looked at about 100 sites across a climate gradient stretching from the grassland to the boreal forest.

"Basically we're looking at seedlings that haven't been planted," Dr. Hogg said. "People generally plant trees in rows, if a seedling is off on its own, it generally came up spontaneously."

International scientists study the work of Canadian Forest Service researchers

Dr. Ian Campbell, another scientist at the Northern Forestry Centre, is assisting with tree ring analyses of tree cores taken from some of the sites. This information together with the data Dr. Schwarz is gathering will provide information on how conifers grow and regenerate in the drier climate on the prairies.

"The critical stage is when the seedlings are small," said Dr. Hogg. "Once the trees are established they grow reasonably well."

Conference

A recent field tour organized as part of the International Boreal Forest Research Association (IBFRA) conference was of great interest to scientists from Russia and other countries with boreal forests. About 200 researchers attended the three-day conference, held in Saskatoon, Saskatchewan. The Canadian Forest Service organized the conference, under the direction of researchers Dr. Mike Apps and Dr. David Price. This was the first time IBFRA has held their annual conference in Canada.

Forest composition data important to researchers

Records of the biological characteristics of a forest provides important data for many kinds of climate change research. Measurements of forest structure and composition (biometry and allometry) help scientists to determine the relationships between forests and climate.

During the summers of 1993 and '94, a team of Canadian Forest Service (CFS) researchers and summer students scouted through the woods in northern Saskatchewan and Manitoba charting the number of trees, types of vegetation, soils, and debris found on a number of sites. They have visited more than 84 sites, some of them several times. Measurements are taken at three locations on each site.

This biometry and allometry study is being done as part of BOREAS, a large international research project being conducted on forest-atmosphere relationships.

"Collecting data of this type is important for any project looking at biological processes whether those are animal and plant relationships or, as in this case, forest and climate relationships," explained Dr. David Halliwell, the Northern Forestry Centre's BOREAS Field Officer. "The information we are gathering will assist BOREAS researchers who are collecting measurements by satellite and airplane because it will tell them what is actually there in the forest."

Who's who in Canadian Forest Service's climate change research

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Some of these Canadian Forest Service climate change studies are linked with other regional, national and international climate change research initiatives, including the Global Energy and Water Exchange Experiment (GEWEX), the Arctic Environmental Strategy (AES), the Boreal Forest Transect Case Study (BFTCS), the Northern Biosphere Observation and Modeling Experiment (NBIOME) and the Boreal Ecosystem Atmosphere Study (BOREAS).

Forest composition data important to researchers

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Measurements of trunk diameter, tree age, and tree height plus tree health and insect and disease damage are all being looked at as part of the biometry study. The allometry study takes this further. Selected trees are literally dissected and weighed, down to the last leaf. As well, tree ring width and wood density are being assessed and correlated with historical climate records to see how much the trees have grown under various conditions.

There is a standardized method for taking the measurements but Dr. Halliwell notes that the data is never as complete as scientists would like it to be. "We have been sending the crew to take repeat measurements but that only tells us how reproducible the data are, not how accurate," he said. "Many of the methods we are using have been used for years and in many different studies so they are considered reliable."

All the data collected will be stored on computers and will be accessible over INTERNET. In addition, the Canadian Forest Service has been issuing reports on the data collected and will continue to do so as more data becomes available.

"The biometry and allometry measurements together will give us information on carbon storage and carbon fluxes, which are carbon dioxide exchanges between the atmosphere, trees, and soil," said Dr. Mike Apps, team leader of the CFS climate change program. "We know that human use of fossil fuels is adding carbon dioxide to the atmosphere at an alarming rate: Do forests add to this build up of greenhouse gases or help to offset it? Are our forests part of the problem or part of the solution?"