S&E
SCIENCE AND THE ENVIRONMENT
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ARE WE LISTENING TO OUR RIVERS?

The Brunette, Salmon and Sumas rivers each form a watershed* and ecosystem in the Lower Fraser Valley near Vancouver, British Columbia. Long-term studies of these three bodies of water, which drain into the Fraser River, are telling us that a rapidly growing population of more than 2 million people and increasingly intensive agricultural practices are degrading the Lower Fraser ecosystem. This is putting soil-based agriculture and quality of life at risk.

The results of collaborative research efforts by the University of British Columbia, Environment Canada and Fisheries and Oceans are helping to form the backbone of the Fraser River Action Plan.

The highly urbanized Brunette River Watershed is exposed to emissions from major transportation corridors such as the Trans-Canada Highway which degrade air and water quality. Twenty-seven per cent of the land in this area is paved, or otherwise covered, as roofs, streets, and parking lots. Rainwater can no longer slowly seep into the land and streams. Instead, it runs rapidly off the paved land into storm sewers, from there pouring into rivers and streams within several hours.

The run-off picks up pollutants from exhaust, chimneys, and industrial activity, from fertilizers and pesticides, and from oil that has leaked from cars. These contaminants are carried to streams and rivers, where they degrade fish and wildlife habitats, as well as recreational areas.

Intensification of agriculture in the Sumas River Watershed, where farms produce more than 50 per cent of British Columbia's farm revenue on four per cent of its total farmland, is also resulting in more paved land, as farming becomes less soil-based and more industrial. Intensifying production on a finite land base is leading to excessive nutrient run-off to streams, lowering oxygen concentrations in

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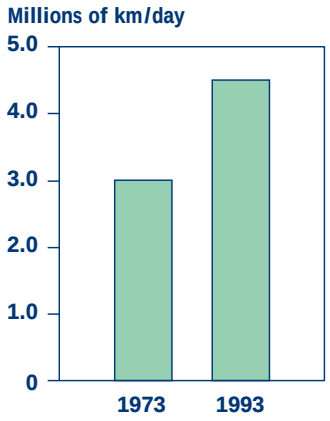
The average combined kilometres driven each day by all motorists in the Brunette Watershed increased by approximately 45% between 1973 and 1993.



**A watershed is an area of land within which rainfall eventually drains into a single stream.*

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these streams at certain times of the year to levels insufficient for fish and young amphibians.

Filtering of nutrients into groundwater has led to elevated nitrate levels in the Abbotsford (British Columbia) aquifer that supplies drinking water to some residents in the area and neighbouring U.S. counties.

Some residents of the Salmon River Watershed are finding the source of their drinking water affected by pollutants from septic systems, commercial farms, and hobby farms. The endangered Salish sucker has disappeared from all but a few streams in this watershed. Pollution, changes in stream flow and loss of cover and shade have degraded this fish habitat. High fecal coliform levels – an indication of animal or human fecal wastes in water – are a problem in all three watersheds.

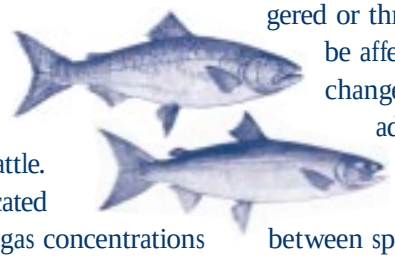
Scientists advise that more sustainable lifestyles, land use practices and growth management strategies will be needed to maintain the quality of life that has attracted so many people to the Lower Fraser Valley in the first place.

Action is making a difference. In the Brunette River Watershed, lead concentrations have decreased in stream sediments and stormwater run-off; in the Salmon River Watershed, landowners are being educated about the importance of stream habitats and septic tank maintenance; and measures have been taken to help migratory fish move safely from tributaries into the Fraser River with little risk of damage.

THE COLUMBIA RIVER BASIN AND CLIMATE CHANGE

Climate change could lead to changes in water demands for agriculture, fisheries, forestry, and hydroelectricity generation in the Columbia River Basin. This could pose a challenge for water management in the future. The Columbia River Basin, in the northwest United States, is one of the largest river systems in North America and one of the most highly managed, with many dams and reservoirs.

Environment Canada scientists have conducted a preliminary survey of water resources managers and stakeholder groups to determine their views on how a warmer climate could affect the area. Survey participants were asked to respond to a scenario of climate change impacts provided by the University of Washington, Seattle. This scenario indicated that if greenhouse gas concentrations continue to increase in the atmosphere, the region would experience warmer temperatures, lower water levels in the summer and an earlier spring peak due to climate change. Respondents indicated that this scenario could result in conflicts among the different sectors which depend on the Columbia River for their water supply.



For instance, the survey determined that a longer growing season for agriculture would mean increased demand for irrigation. The forestry sector would also experience a longer growing season and this, together with lower water levels, would result in increased risk of fire.

These increased needs for water could lead to conflicts with fisheries managers, who would want to maintain water levels and flows in the rivers and streams throughout the Columbia River Basin in a manner that would protect coldwater species of fish. These fish would be at risk from warmer water temperatures and lower summer flows. As other water users adjust to these changes, endangered or threatened fish stocks would be affected directly by climate change and indirectly through adjustments in water management and use. This could lead to conflict between sport fishery and advocates of an ecosystem approach.

In addition, demand for hydroelectric power generation is expected to rise in summer because of increased need for summer cooling and irrigation.

This preliminary survey of the implications of climate change for the river basin was carried out by Environment Canada scientists for the North American Commission for Environmental Cooperation. The work was a collaboration with the National Center for Atmospheric Research, in Boulder, Colorado. Its findings will help water managers adapt to the impact of climate change and minimize the costs of adaptation while maximizing opportunities. The study will also help to develop a more rigorous assessment of the impact of climate change on this important water resource.

Global Climate Change

MEASURING SMOG IN OUR CITIES – AND DOWNWIND

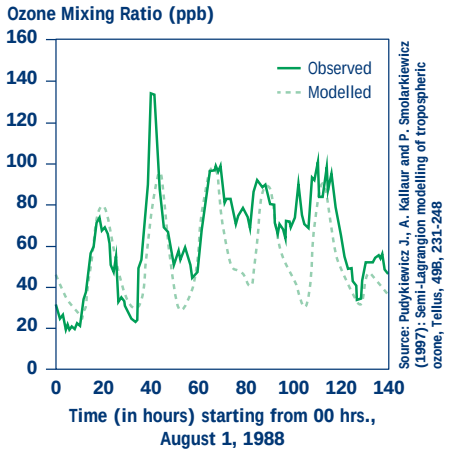
Smog is not just a city problem. Wind carries it downwind into other regions of the country – and even across national borders. Smog in the Windsor-Quebec City corridor and in the Southern Atlantic Region, for instance, originates in large part from distant sources in the United States.

Environment Canada's Air Quality Research Branch is developing and refining models to predict how smog is formed and transported, with the ultimate goal of developing control strategies. In doing so, it has to take account of factors such as the effect of complex sea breeze circulations in the Lower Fraser Valley in British Columbia.

No one model can apply across the country. The success of attempts to control nitrogen oxides and volatile organic compounds, the two primary ingredients for smog formation, will vary in different regions, with controls on the first being more effective in some areas, while controls on the second are more effective in other areas. Models for each region have to take these differences into account so that control strategies can work.

In the Windsor-Quebec City corridor, Environment Canada researchers have developed sophisticated models that can predict how smog will form for a wide range of weather conditions and emission sources. Predicted and actual levels of ground-level ozone in a two-week period correspond quite closely. Researchers are now working to use the models for seasonal applications.

Ozone concentrations as predicted with a model, compared with actual measurements taken at Egbert, Ontario



Stormwater Management

Every raindrop falling over urban areas picks up various pollutants from the air and on contact with parking lots, streets, roofs, fields, gardens – almost anything it touches. In newer urban areas, stormwater running off these surfaces enters storm sewers and is transported and discharged to the nearest receiving waters without any treatment. Such discharges can seriously affect receiving waters through flooding and water pollution.

Stormwater management helps reduce generation of stormwater in urban areas, balance its flows to match the capacities of the existing drainage systems, and enhance the stormwater quality by various physical, chemical and biological processes.

At Environment Canada's National Water Research Institute, work is under way on developing stormwater management methods, including removal of pollutants from stormwater by such treatment facilities as stormwater ponds, constructed wetlands, biofilters, and oil and grit separators. Stormwater management is featured on Earth Tones, a series of vignettes on Environment Canada science, on the television program *@Discovery.ca* (check local listings).

Photo: Experimental Mini-Wetlands Used for Stormwater Treatment

Facts & Figures: The '98 Ice Storm

- Four million people – 900,000 households in Quebec and 100,000 households in Ontario – lost their electricity at some point during the storm.
- The freezing rain brought down millions of trees, 120,000 km of power lines and telephone cables, 130 major transmission towers, and about 30,000 wooden utility poles.

CANADA'S FORESTS:
PRESERVING BIODIVERSITY

The presence of roads leads to activities that affect both the types and ages of trees in Canada's forests, according to Environment Canada's Environmental Indicator Bulletin on Forest Biodiversity.

In accessed forests (defined as forests within 10 km of a road) in the Pacific Maritime ecozone, for instance, there is an even mix of cedar and Douglas fir, while in non-accessed forests, there is significantly more cedar. In the Boreal Shield ecozone, birch and other hardwoods are more predominent in the accessed forest, while spruce and pine are abundant in the non-accessed forest.

Roads have also resulted in a greater proportion of younger trees (those aged 21-100 years) in both these ecozones. Age-class distribution, as this indicator is known, is determined primarily by the occurrence of natural disturbances such as fire or insect infestation. But human disturbance is also a factor.

Thus, in the Pacific Maritime ecozone, where natural disturbances are rare, trees older than 100 years occupy 68 per cent of the accessed area, and 87 per cent of the non-accessed area. In the Boreal Shield ecozone, trees older than 100 years occupy only 18 per cent of the accessed area, compared to 47 per cent of the non-accessed area. Because of the frequency of fire, forests older than 140 years are rare in this ecozone.

One-half of Canada's total forest area is accessible by road. Roads affect forest ecosystems by introducing human activity, such as urbanization, agriculture, forestry, and mining and energy projects. Roads may also encourage the spread of non-native species, and can facilitate recreational activities such as hunting, to the benefit of some species and the detriment of others. It is the activities that road access allows, rather than the road itself, that are responsible for effects on types and ages of trees.

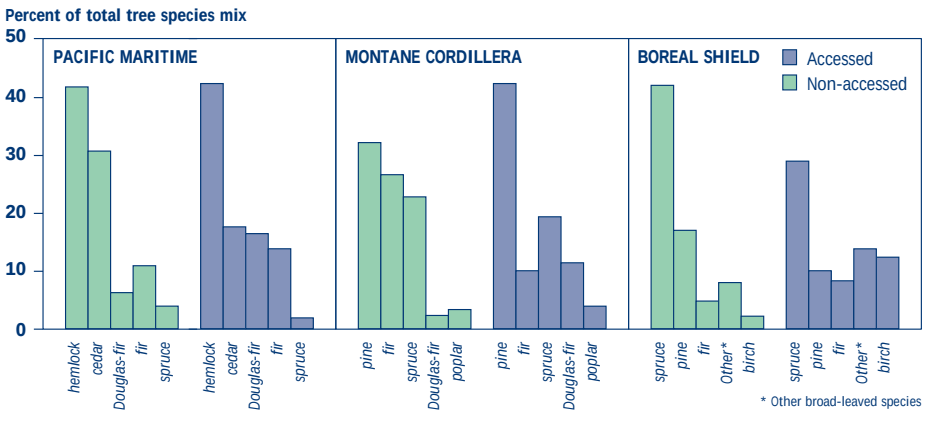
Canada contains about 10 per cent of the world's forests, about 35 per cent of the world's boreal forests, and 20 per cent of the global temperate rain forest.

Forests sustain our commercial forest industry, provide food and medicines, support communities, and offer places for recreation. Forested areas provide the habitat for two thirds of Canada's wildlife, ranging from mammals and birds, reptiles, amphibians and fish, to insects, plants, and microorganisms.

Conserving native forest biodiversity depends on conserving a diversity of forest types, age structures, functions, and patterns across the landscape.

The indicator bulletin on Forest Biodiversity is part of Environment Canada's National Environmental Indicator Series.

Tree species mix in accessed versus non-accessed timber-productive forest (1991)



Facts & Figures: The '98 Ice Storm

- Between January 5 and 10, 1998, more than 100 mm of freezing rain and ice pellets fell on Montréal. Ottawa received 85 mm and Kingston received 73 mm.
- More people were directly affected by the ice storm than by any previous weather event in Canadian history.