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THE LEADER OF THE PACK

Motorcycles make up less than two per cent of registered motor vehicles and account for under 0.5 per cent of total emissions from on-road transportation sources in Canada. Overall, they are not significant contributors to air pollution in Canada. However, recent tests conducted at Environment Canada's Environmental Technology Centre (ETC) show that individually, motorcycles can emit considerably higher levels of air pollutants than cars and light-duty trucks.

A motorcycle mounted on a dynamometer undergoes emissions testing at the Environmental Technology Centre in Ottawa.

The ETC tests were carried out last year on five motorcycles, two hybrid gasoline-electric automobiles, and 10 light-duty cars and trucks using special dynamometers to simulate urban and highway driving conditions. While the vehicles were in operation, their emissions were sent to a constant volume sampler that diluted the exhaust and routed it to various precision gas analyzers.

The motorcycles—three 4-cylinder and two 2-cylinder models with engines ranging in size from .8 to 1.5 litres—produced an average of ten times as much carbon monoxide as the other gasoline-powered vehicles, and more than 80 times as much as one of the gas-electric hybrids on a per-kilometre basis. For nitrogen oxides and hydrocarbons, the bikes emitted an average of three and 14 times as much pollution, respectively, as the other gas-powered vehicles. The one major area where the bikes outperformed some of the larger vehicles was in reduced emissions of the greenhouse gas carbon dioxide. Such emissions are directly related to fuel consumption, so more fuel-efficient vehicles, such as motorcycles, produce less carbon dioxide.

Beginning with model-year 1998, Canada aligned its motorcycle emission standards with those of the U.S. Environmental Protection Agency (EPA). However, emission-control technologies on motorcycles have not kept pace with the technologies found on today's cars. Few motorcycles are equipped with catalytic converters, and most have carburetors instead of fuel injection systems. As a result, they release more incompletely combusted compounds into the atmosphere.

Recognizing that many of the new technologies used to clean up car emissions could be adapted for use on motorcycles, Environment Canada has expressed its intent to work with the motorcycle industry to develop updated emissions standards for motorcycles in conjunction with the U.S. EPA. Revised standards are likely to be in place in the model-year 2005-08 time frame. This will result in per-kilometre emissions from new motorcycles being cut by at least 50 per cent.

In the meantime, the ETC is expanding its emissions research on a variety of vehicles to include the characterization of other air pollutants, such as fine particles as small as half a micron in diameter. These inhalable particles have been linked to respiratory problems in humans.

The Centre has also begun testing vehicles under more aggressive driving conditions—with fast starts and stops and higher cruising speeds—to see how they affect emission levels. Although results vary depending on specific test conditions, they show that such changes in driving patterns can cause a significant increase in pollution from all types of vehicles.

Increased public awareness about environmentally friendly technologies and driving practices can help to reduce emissions and, consequently, their impact on human health and the environment. S&E

INSIDE

TECHNOLOGIES TURN MANURE INTO FERTILIZER, ENERGY AND WATER

The growing number of concentrated hog-feeding operations that have sprung up across Canada in recent years has increased concerns over the environmental impacts of pig manure. Photo: Charles Ebbs

Primary agriculture is responsible for more than 10 per cent of the total greenhouse gas emissions caused by human activities. It is estimated that up to 40 per cent of these farming-related emissions come from the production of livestock, including manure stored in open-air earthen storage areas or applied to the land as fertilizer. Untreated sewage that is used as fertilizer may also contaminate groundwater and nearby lakes and rivers.

The growing number of concentrated hog-feeding operations that have sprung up across Canada in recent years—particularly in the prairies and central Canada—has increased concerns over the environmental impacts of pig manure. In 2000 alone, approximately 20 million hogs were slaughtered in Canada, and the market opportunity exists for the industry to triple in size over the next decade.

To help hog producers tackle these issues, a group of federal, provincial and private-sector partners is demonstrating some simple and cost-effective manure treatment technologies on farms in Western Canada. The $800,000 program, which involves assessing the impact of new technologies on odour, emissions, soil and water quality, nutrient retention, and volume reduction, is managed by the Canadian Environmental Technology Advancement Corporation—a not-for-profit corporation established by Environment Canada to help small and medium-sized enterprises commercialize environmental technologies. Nearly 25 per cent of the funding is being provided by the Technology Early Action Measures component of the federal Climate Change Action Fund.

A liquid-solid separation system implemented last December has resulted in a noticeable reduction in odour at one test site. Manure is drawn along a conveyor belt over a screen, and rotating paddles are used to separate the solids from the liquids. The solids are then composted and the liquids can be treated and used to flush barn storage areas. Flushing helps prevent the manure from decomposing anaerobically or without oxygen—the process responsible for creating odour and greenhouse gas emissions. The next step will be to quantify the results through sampling and analysis.

In October 2000, a continuous agitation system was put in place at another test site that uses electrically powered mills to circulate liquid manure. The mills float on the surface of a manure storage lagoon, and have impellers below that rotate the solids in the slurry. This prevents the solids from settling on the bottom and introduces oxygen into the top layers—thus speeding aerobic decomposition. Consistent solid suspension also allows the manure to be more readily removed for application to the land. Now that the ice on the surface of the lagoon has melted, scientists will conduct a profile of nutrients, bacteria and solids at different levels, to determine the mills' effectiveness.

Tests carried out last fall confirmed the usefulness of a new mobile near-infrared spectroscopy instrument that can determine quantities of 22 different nutrients in hog manure in about two minutes—a vast improvement over previous methods in which samples were analyzed in a laboratory, with results available in a week to 10 days. Knowing these values enables producers to match nutrients with soil requirements, and helps to prevent possible over-fertilization.

Pilot projects will soon be launched to test two enclosed digestor systems —an aerobic system that reduces volume, odour and emissions and produces potable water, and an anaerobic system that creates methane for the production of heat or electricity. Still under formulation is a closed-loop system that separates solids and liquids, removes the ammonia and potassium nutrients, treats the water for drinking and other uses, dries the solids, and re-adds the nutrients to enrich the fertilizer value.

If the use of such technologies becomes more widespread and is applied to cattle, sheep and other livestock as well as hogs, scientists estimate that current greenhouse gas emissions from livestock manure could be reduced by as much as 50 per cent, or 320 kilotonnes per year. S&E

REDUCING RISKS TO WATER QUALITY

An estimated 20 million kilograms of pesticides are applied to crops on the Canadian Prairies every year. Their positive effects on crop yield are well-documented, but much less is known about how they migrate from their intended target, and what impacts they have on water quality.

Researchers at Environment Canada's National Water Research Institute (NWRI) are investigating the pathways agricultural chemicals take as they move through and over soil. The idea is to help develop practices that reduce contaminant migration and minimize damage to prairie water quality.

The contamination of groundwater by herbicides is a threat to the prairie environment. Soil scientists agree that certain preferential flow routes, such as fractures in the ground, wormholes and other pathways, can cause herbicides to leach more rapidly into groundwater than might be inferred from their physical and chemical properties. To better understand how this occurs, NWRI recently conducted a study in which several pesticides were applied simultaneously to a field irrigated by sprinklers and tile-drained at an average depth of two metres.

An NWRI technician installs piezometers—instruments used to measure the magnitude or direction of pressure—near Elstow, Saskatchewan, as part of a project to monitor prairie water quality.

Researchers monitored differences in the natural leaching rate of the chemicals, and tested the effect of a single tillage pass in reducing their movement through soil pathways into the groundwater. In analyzing the drain effluents, they found that almost all of the herbicides tested leached through preferential flowpaths. The tillage reduced the flow of water to tile-drain depth only slightly, but it substantially reduced the amount of herbicides transported, especially in the case of more soluble, readily leached herbicides. This suggests that groundwater contamination could be reduced by tillage; however, the soil erosion caused by excessive tillage must also be considered if tillage is to take place.

The trend toward larger-scale hog operations has led to waste disposal difficulties, and using nutrient-rich manure as fertilizer is a possible solution. What is not clear, however, is how much can be used without causing other problems. If more nutrients are applied than a crop requires, they may travel to surface water through runoff or to groundwater through leaching, and possibly harm water quality. To address these concerns, NWRI researchers are in the third year of a six-year project to establish whether manure can be applied to agricultural fields without adversely affecting water resources, and to determine sustainable rates of application. They are working at the landscape scale in drainage basins ranging in size from one to seven hectares, and comparing two rates of application—7000 and 10 000 gallons per acre—with a control plot treated with an inorganic fertilizer.

Preliminary results showed that levels of phosphorus and ammonia in snowmelt runoff were higher in the drainage basin receiving the 10 000-gallon treatment than in the control basin. They also showed elevated concentrations of ammonia in the runoff from the 7000-gallon treatment. However, there was no indication that using hog manure as fertilizer led to higher coliform counts in runoff. Work will continue in the fall to see if different methods of applying the manure will make a difference to the surface runoff water quality.

This research, along with another four-year study investigating the leaching of inorganic fertilizer and pesticides to groundwater under intensive crop irrigation, is giving scientists a clearer picture of the effects of current agricultural practices on the environment, and leading the way to better methods of protecting Canada's water quality. S&E

STAGED SPILL SHEDS LIGHT ON BEACH CLEAN-UP

Swath of oil applied to a beach test site in the Svalbard islands, north of Norway.

Images of a shoreline after a marine oil spill are often of birds and other wildlife struggling to survive with oil-coated bodies. But there is another longer-term image many people never see: a beach still contaminated years later with sticky black residue. Oiled shorelines pose a major challenge for clean-up crews—particularly if beaches are a porous mix of sand and pebbles or cobbles. To learn more about on-site methods of removing oil from such mixed sediments, an international team of scientists staged an experimental spill on a remote Arctic island some 800 kilometres north of Norway.

The experiment was conceived and coordinated by Environment Canada and sponsored by spill response agencies from Canada, the United States, the United Kingdom, Sweden, and Norway. It replicated the effect of an actual spill event by applying 5500 litres of oil to a three-metre-wide swath in the upper intertidal zone at three beach sites on the island of Spitsbergen. Various *in-situ* treatments were applied a week later—to simulate the response time for a remote location—and the quantity of oil at each plot was monitored over the first 60 days, and again one year later. Changes in the physical character of the beach, oil penetration and movement, toxicity and biodegradation were also noted.

When beaches are oiled, the physical action of the waves washes the oil off the surface of the sediment and into the water column, where it disperses and eventually biodegrades. Oil that is stranded above the normal active intertidal zone, where it only gets wet once in a while, or that penetrates deep below the surface can persist for decades. The latter situation is of particular concern in Canada, because porous coarse and mixed sediment beaches are common on both the east and west coasts, and are difficult to clean up.

The treatments tested were, therefore, aimed at increasing the exposure of oiled sediment to the natural processes of wave action and biodegradation—both in the water column and in the sediment itself. They included moving the oiled sediment closer to the wave action by using a small bulldozer; tilling it with a plow; and applying soluble and slow-release fertilizers to stimulate microbial activity. The three methods were also compared to no treatment —that is, leaving the sediment to natural cleaning processes.

Oil biodegradation occurred in both the oiled sediment and the fine oil-mineral aggregates washed into the water by waves. None of the techniques elevated toxicity in the nearshore environment to unacceptable levels or resulted in the oiling of the nearshore sediment. There were, however, other significant differences.

Sediment relocation significantly accelerated the rate of oil removal, and reduced oil persistence by at least one year in a relatively high wave-energy environment where oil was stranded above the level of normal wave activity. It also sped the short-term rate of oil loss on relatively low wave-energy shorelines where the stranded oil was in the zone of wave action. Following treatment, the quantity of oil bound in the oil-mineral aggregates—an important natural process that helps remove oil from sediment—also increased three-fold as a result of the increased availability of fine mineral particles.

Bioremediation was also proven an effective treatment, doubling the rate of natural biodegradation. Changes in total oil loading from sediment tilling, on the other hand, were small—however, results suggest that mixing the shoreline sediment made it substantially more permeable to seawater and air for at least 10 days after tilling, which could lead to enhanced microbial activity.

In untreated areas, the natural removal rate of oil stranded in the active intertidal zone was relatively rapid in the first 10 days, but slowed dramatically after that. Four to five per cent of the original oil residue remained in the intertidal zone after a year, and a significant quantity of oil stranded above the normal intertidal zone was present after the same period.

These results prove the effectiveness of sediment relocation as a viable tool for removing oil from coarse or mixed sediment shorelines—particularly in remote or sensitive areas, where the removal of sediment for off-site treatment is not feasible. They also improve our understanding of natural oil removal processes and their application as a response option. S&E

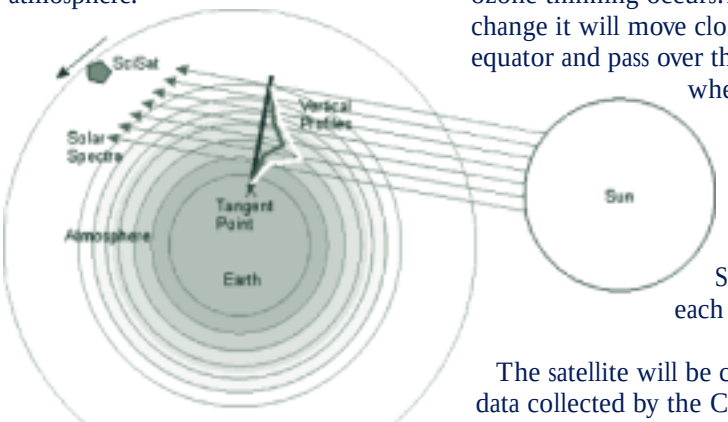
MAESTRO TO LEAD OZONE RESEARCH

From space, the atmosphere surrounding earth looks remarkably thin and fragile. Yet, without this ethereal envelope of gases to regulate temperature and protect us from the harmful rays of the sun, life on our planet would cease to exist. In the fall of 2002, the Canadian Space Agency will launch SCISAT-1—its first science satellite in nearly three decades—to learn more about how human activity is altering the delicate chemical balance in our stratosphere and troposphere.

One of the main components of the two-year Atmospheric Chemistry Experiment mission will be to measure ozone depletion over the high Arctic using a new instrument developed by Environment Canada's Meteorological Service of Canada (MSC) in partnership with the University of Toronto. The shoebox-sized spectrophotometer—called MAESTRO (Measurements of Aerosol Extinction in the Stratosphere and Troposphere Retrieved by Occultation)—is the most advanced in a long line of MSC instruments that have flown on balloons, high-altitude research aircraft and space shuttle missions over the past 10 years.

MAESTRO and other spectrophotometers operate on the principle that different gases absorb different wavelengths of light, ranging from short, ultraviolet (UV) rays to long, near-infrared ones. Each gas, therefore, has its own "fingerprint" or distinct spectrum of absorption. This makes it possible to identify which gases are present from changes in the brightness of sunlight at different wavelengths between light coming directly from the sun and light that has passed through the atmosphere on the way to the spectrophotometer. Ozone, for example, absorbs UV light and is, therefore, essential to preventing high levels of these rays from reaching the earth's surface.

As the sun rises and sets, its rays slice through different layers of the atmosphere and out into space. MAESTRO will be equipped with more than 2000 separate detectors to record the full spectrum of wavelengths emitted by direct sunlight and by sunlight travelling through these layers. These data will then be analyzed to provide precise measurements of gases and aerosol particles at different heights in the atmosphere.



As the sun rises and sets, MAESTRO will record changes in the wavelengths of solar radiation passing through the atmosphere. This will enable scientists to create a vertical profile of the earth's atmospheric chemistry and determine differences in ozone content at different heights.

While similar in concept to its predecessors, MAESTRO is the first to have two separate spectrophotometers operating simultaneously to cover the full spectral range. Earlier instruments had to change filters to switch between the UV and visible parts of the spectrum, a process that used up valuable observing time. In order to obtain a complete vertical profile of the atmosphere as the sun is rising and setting, MAESTRO will collect information on the full spectrum corresponding to a given height in just one third of a second. This will allow scientists to detect details in the vertical profile of gases as fine as one kilometre in altitude.

SCISAT-1 will orbit the earth 15 times a day at a height of 650 kilometres, allowing MAESTRO to take measurements of 30 sunrises and sunsets every 24 hours. It will pass over the high Arctic during late winter—the time of year when severe ozone thinning occurs. As the seasons change it will move closer to the equator and pass over the Antarctic, where a major ozone hole develops during the Austral spring in September of each year.

The satellite will be controlled and data collected by the Canadian Space Agency at its ground stations in St. Hubert, Quebec, and Prince Albert, Saskatchewan. Additional data from Environment Canada's ground-based ozone-monitoring network will verify the accuracy of the space observations and add horizontal resolution. MAESTRO's data will be processed at the University of Waterloo and interpreted by MSC and the University of Toronto in near-real time.

Atmospheric scientists with MSC and the University of Toronto will also work closely with York University and Environment Canada's Canadian Meteorological Centre in Montréal to develop the capability to use MAESTRO's observations in models for forecasting chemical constituents—and ozone in particular—in the stratosphere and troposphere. SE

FORECASTS ASSIST ALLERGY SUFFERERS

Nothing is more joyful, after a long cold winter, than the sight of lush green grass, and fields and forests bursting into bloom. What is a sight for sore eyes for some, however, simply means sore eyes and other nasty symptoms for those who suffer from pollen and spore allergies.

In Nova Scotia, an area prone to elevated levels of airborne pollutants due to the direction of prevailing winds, about one third of the population is sensitive to fungal and mould spores or pollen from trees, weeds and grasses. To enable sufferers to avoid outdoor exposure when a heavy pollen or spore load is expected, Environment Canada's Meteorological Service of Canada (MSC)—Atlantic Region, Saint Mary's University, and the Lung Association of Nova Scotia conducted an experimental pollen and spore forecast research program for the Halifax area from May 1 to August 31, 2000.

The Weather Network has broadcast summer pollen forecasts for Halifax, Moncton, Saint John, Charlottetown and St. John's since 1997 using a forecast methodology based on a statistical model. The experimental forecast program, however, incorporated daily pollen and spore counts using a special device mounted on the rooftop at Saint Mary's University to trap airborne allergens. The trapped allergens were analyzed and quantified in the lab, and correlations were made with weather and climatic conditions for the same time period.

Using this information, scientists were able to combine 24-hour weather forecasts provided by MSC's Maritimes Weather Centre with the most recent pollen and spore counts to produce a daily forecast of pollen released from trees, weeds and grasses and of fungal and mould spores. The forecasts took into consideration such factors as variations in pollen release by time in the growing season, recent and expected moisture input, temperature, sunshine, and wind speed and direction. Temperature and sun are significant triggers for pollination, while high winds can lower concentrations and spread them over a larger area. Rain can trigger the dispersal of mould spores and wash pollen out of the air.

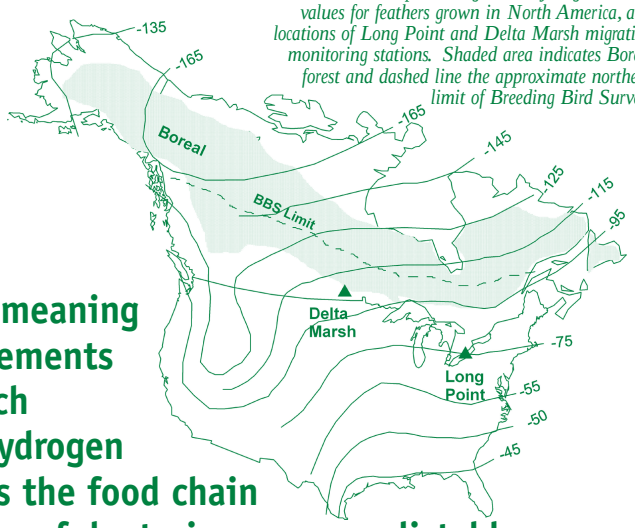
Common ragweed is a major cause of seasonal hay fever. Its inconspicuous flowers produce large quantities of light pollen that can be carried in the wind for distances of over 200 kilometres.

Conditions were deemed low, medium or high, depending on concentrations of grains or spores in the air, and values for suburban and rural areas were estimated by multiplying urban values by two and four, respectively. The forecast in the summer of 2000 proved most accurate in the low category, which also occurred the most often, with diminished accuracy in the higher categories. This trend is also very common in weather forecasting, in that rare events are more difficult to predict. Environment Canada assisted with the public distribution of the forecasts via an Internet Web site and the Maritimes Weather Centre's automated telephone answering system.

In addition to providing weather forecasts for the research project again this allergy season, Environment Canada is expanding its involvement to include an international literature search on other pollen and spore forecasting methods for potential use in North America. It has also purchased two new pollen and spore traps that are being set up in a suburban area of Halifax and a rural region of the Annapolis Valley to more accurately reflect grass-pollen levels along highway margins, fields and farmlands—and to determine the validity of past estimates. Comparisons in the ratio of pollen reported from the two traps and the urban site may be used later to extrapolate real-time detailed Halifax pollen counts to suburban and rural areas.

MSC is investigating the possibility of conducting a focus group study to determine how people respond to the forecasts, and whether or not they use them. With concerns growing over possible correlations between allergy symptoms and co-factors related to pollution, this and other research projects dealing with aero-allergens will be of increasing importance. S&E

ISOTOPES LINK BIRDS TO BREEDING AND MOULTING AREAS



Contour map showing stable hydrogen isotope values for feathers grown in North America, and locations of Long Point and Delta Marsh migration monitoring stations. Shaded area indicates Boreal forest and dashed line the approximate northern limit of Breeding Bird Survey.

The saying "you are what you eat" has new meaning since the discovery that certain chemical elements in animal tissues are linked to diet. One such element is deuterium, a stable isotope of hydrogen that occurs naturally in rainwater and enters the food chain through the tissues of plants. Concentrations of deuterium vary predictably across the continent, with lower amounts occurring in north-western regions of North America and higher amounts in southeastern regions.

Scientists at Environment Canada's National Water Research Institute and Prairie and Northern Wildlife Research Centre in Saskatoon are world leaders in stable-isotope analysis. They have developed a method of measuring stable-hydrogen isotopes in the wing tissue of butterflies and birds as a means of determining origins. Experts at these facilities have recently expanded the application of this new technique to several projects related to the conservation and protection of bird species. The technique is being adopted by American and European researchers in studying animal migration.

One recent project was to determine the breeding and moulting areas, also known as catchment areas, being sampled by two migration monitoring stations. Scientists analyzed stable-hydrogen isotope values in feathers of Swainson's Thrush moving through monitoring stations at Delta Marsh in Manitoba and Long Point in southern Ontario to verify that population counts at the two locations cover individuals from a large geographic area. Such information is vital to linking population declines to specific regions, and thereby focusing conservation efforts on these areas.

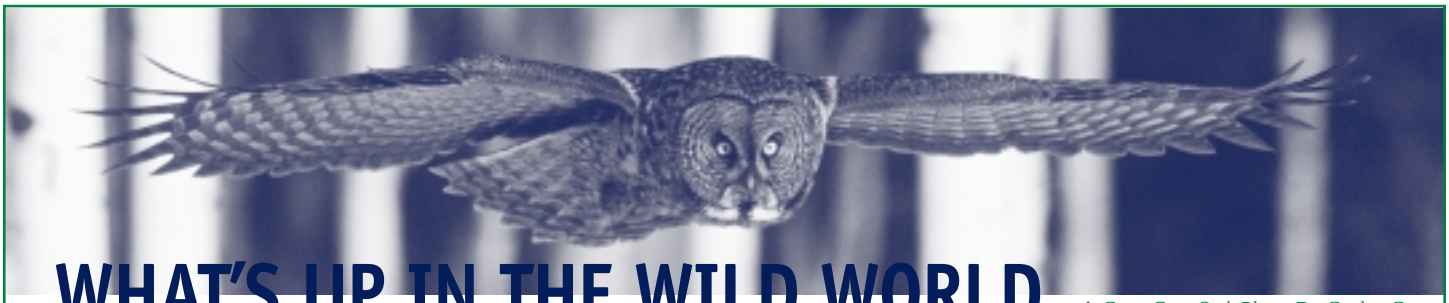
Stable-hydrogen isotope signatures provided useful catchment area information. Results showed both monitoring stations sampled birds from broad regions of the Canadian Boreal forest, but that birds moving through Delta Marsh were clearly from more northwesterly origins compared to Long Point. The catchment area of the Delta station was northwestern Manitoba to northwestern Alberta, while the catchment area of the Long Point station extended from north-central Ontario and Quebec into western Canada.

Since the isotope composition of birds' feathers reflects their diet at the location where feathers are grown, feathers sampled from young-of-the-year as they migrated southward indicated breeding ground location, while those taken from after-second-year adults heading north indicated their moulting region from the previous year. Stable-hydrogen isotope values for adult feathers differed from those of the young, supporting results from previous studies that noted delayed moults in migrating adult Swainson's Thrushes during the fall. This indicates that southern portions of the Boreal forest represent important stopover habitat for this species.

The isotope study confirmed that dedicated avian migration monitoring stations in southern Canada are an appropriate way to quantify relative changes in population sizes for Swainson's Thrush and, likely, for other Boreal-nesting species as well.

A second project involving stable-hydrogen isotopes is being conducted in collaboration with the U.S. Fish and Wildlife Service and Ducks Unlimited Canada. Since 1999, scientists with Environment Canada have been analyzing isotopes in wings of hatching-year Lesser Scaup, a diving duck species killed by hunters in the United States during the ducks' migration south and on wintering areas. Lesser Scaup are on the decline in many parts of their core breeding range in the Boreal forest of western Canada. Determining hatching origins of harvested Scaup will enable scientists to tell whether or not the problem is linked to differential rates of harvest in certain areas or environmental changes in breeding areas. The data will also enable scientists to test the theory that Scaup breeding farther north generally travel farther south to winter.

In another stable-isotope project, Environment Canada scientists examined stable-nitrogen isotopes in feathers from flightless Mallard ducklings at 17 locations in western Canada. High nitrogen isotope values were found in the feathers of ducklings born in agricultural areas, reflecting the entry of excess nitrogen into local water-bodies. This is the first evidence that nitrogen isotope values in duckling feathers may record long-term nitrogen loading of surface waters in agricultural areas, and thereby provide another means of monitoring non-point-source nitrogen inputs into landscapes and food webs. SE



WHAT'S UP IN THE WILD WORLD

A Great Gray Owl. Photo: Dr. Gordon Court

Are snakes slipping in Saskatchewan or birds burgeoning in Alberta? How are Canada's ferns and fish faring, and what's new with newts? The answers to these and other pressing questions about the status of 1600 species of Canadian plants and animals reside in the recently released *Wild Species 2000* report.

The report responds to commitments made by the provincial, territorial and federal ministers responsible for wildlife under the 1996 *Accord for the Protection of Species at Risk* to identify species that may be in trouble, those for which more information is needed, and those that require a formal status assessment or additional management attention. Simply put, it tells us what there is, where it occurs, and how it is doing. It establishes for the first time a common method for examining the status of species in Canada and a baseline against which future changes in distribution and abundance can be measured.

Environment Canada's Canadian Wildlife Service co-led the joint federal-provincial/territorial working group that chose the eight groups of species to be assessed—namely, ferns, orchids, butterflies, freshwater fishes, amphibians, reptiles, birds and mammals. Regional and national evaluations were based on information about population size, trends, distribution and threats gathered from a diverse range of sources, including government biologists, amateur naturalists, museum specialists and holders of traditional ecological knowledge. The status of each species was then ranked as extirpated/extinct, at risk, may be at risk, sensitive, secure, undetermined, not assessed, exotic or accidental.

The 50-page report provides an overview of each group's characteristics (e.g., number of species and distribution in Canada), and summaries of its status ranks. Species-specific information is featured on the CD-ROM dataset that accompanies the report, as well as on the Web at [www.wildspecies.ca].

Among the many interesting findings contained in the report is the fact that approximately 65 per cent of the species covered are considered secure at all geographic scales. At the national level, the majority of ferns, orchids, birds and mammals are deemed secure, and have a relatively low percentage of species at risk. Although 53 per cent of freshwater fish are also ranked secure, 17 per cent are ranked undetermined—signaling the need for further study. A significant gap in information also exists for butterflies, whose regional average is 45 per cent secure and 37 per cent not assessed. Habitat loss is a major factor in the ranking of 22 per cent of amphibians as either at risk or may be at risk. Nearly 25 per cent of all reptiles have also been ranked as at risk. On a regional scale, Nova Scotia and Manitoba contain the highest proportion of secure species, and British Columbia and the Yukon the lowest.

Despite the magnitude of this report, it is an initial effort and still represents only a fraction of the more than 70 000 described species of plants and animals that are currently found in Canada. Additional species and groups will be covered in *Wild Species 2005* and subsequent reports, and new data will be incorporated into the 2005 report to fill in gaps and determine trends for species that have already been assessed. S&E

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For more information on a subject, you can search all of the on-line resources available from Canada's four natural resource departments — including *S&E Bulletin* — by using the CanExplore search engine at [www.canexplore.gc.ca].

Media representatives and others interested in conducting further research may obtain contact information from the *Bulletin*'s editor, Paul Hempel, at Paul.Hempel@ec.gc.ca, or (819) 994-7796. Readers' comments and suggestions are also welcome.

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