S&E SCIENCE AND THE ENVIRONMENT BULLETIN S&E
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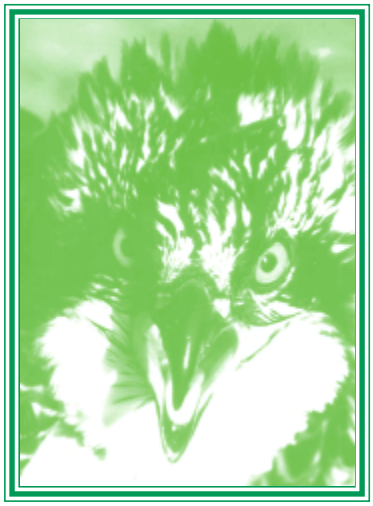
HIGH-ALTITUDE POPS AND ALPINE PREDATORS

Studies of glacial ice cores and fish caught in alpine lakes in the Rocky Mountains show that levels of persistent organic pollutants (POPs) generally increase with elevation, and that many small lakes and reservoirs fed by glacial runoff contain concentrations high enough to affect wildlife at the top of the food chain.

Chemical contaminants invade these seemingly pristine environments because they can move long distances in the atmosphere. Prevailing winds carry them to colder climates, where they condense out and are trapped in the snow or ice until they are released into the ecosystem in the spring melt. To determine the degree to which domestic and international sources are contributing to increased levels of high-altitude contamination, and how POPs bioaccumulate in organisms and are passed up through the food web, scientists at Environment Canada are measuring contaminants in Osprey eggs and nestling blood samples, and in their fish diet.

Since the birds are migratory, satellite transmitters are also being attached to Ospreys with elevated contaminant concentrations in their eggs so they can be tracked to their wintering sites in Central America. Mexican biologists are assisting in locating the birds, determining their feeding areas and diet, and collecting fish samples for analysis. The three-year study, funded by the federal Toxic Substances Research Initiative, is part of a broader effort to detect human and wildlife health concerns through fish sampling.

Ospreys are being used as an indicator species for several reasons. First, because these large raptors feed exclusively on fish, they are directly exposed to pollutants in the aquatic ecosystem. Second, they are a common breeding species in British Columbia, where the study is taking place, and typically lay an extra egg that is rarely fledged and can therefore be removed with minimal effect. They are also sensitive to the effects of chlorinated hydrocarbons such as pesticides on shell quality and embryonic viability, as proven in earlier studies of the impacts of contaminants on breeding success. Osprey eggs collected from 120 nesting sites in the Columbia and Fraser drainage basins between 1991 and 1997 showed that roughly a quarter had concentrations of the pesticide DDE that exceeded four parts per million: the threshold associated with reduced hatching success.



Ospreys are exposed to bioaccumulative pollutants in lakes and other bodies of water because they feed exclusively on fish.

The sites for the current study include lakes and drainage areas at a wide range of altitudes, as well as sites with known agricultural outputs, such as the South Okanagan. Over the past two summers, fish sampling has progressed as planned, and eggs have been collected from some 50 nests at low and mid altitudes, as well as some high-altitude glacial lakes in the Rocky Mountains and reservoirs on the Upper Columbia River.

Unfortunately, this year's very cold, wet spring caused many nest failures and poor productivity, particularly at high elevations, so fewer eggs were collected from these key sites than planned. The absence of chicks also made it more difficult to lure adults to their nests for trapping and tagging, so only three of five transmitters were successfully deployed.

Despite these difficulties, data have yielded some interesting results. One is that, so far, the fish with the highest contaminant concentrations — including any caught in Mexico — are from tiny lakes at the highest altitudes of the Rockies' Selkirk Mountains. Another is that a surprising concentration of DDE has been detected in Ospreys in some glacial-fed reservoirs and in areas like the South Okanagan, where past pesticide use was heavy.

Next summer, Environment Canada scientists hope to sample more nests at high-altitude lakes, attach more transmitters, and ensure that samples of Osprey eggs, nestling blood, and prey fish are taken from common sites. This will mean collecting more fish at sites where Osprey nests have already been found, and possibly installing Osprey nest platforms on lakes with contaminated fish. The study may also expand to the mountainous areas of the southwest Yukon, where fish have already been shown to have relatively high levels of chemical contamination. S&E

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CANADA'S ENDANGERED DESERT COUNTRY

Dramatic shifts in the earth's crust, retreating glaciers and the relentless rush of the Okanagan and Similkameen rivers have combined forces over thousands of years to create a tiny pocket in south-central British Columbia that is unlike any other place in the world.

The South Okanagan-Similkameen valley is just two-thirds the size of Prince Edward Island, yet it is one of the few areas on earth where four very different habitats exist in close proximity. A combination of coniferous forests, desert-like grasslands, wetlands, and rocky cliffs make this one of the richest ecosystems in Canada. Nearly half the bird species in the country are found here, along with many plants and animals that exist nowhere else in North America or, in some cases, the world. The South Okanagan-Similkameen watersheds also act as a corridor for species migrating between the dry grasslands of the BC interior and the desert areas of the western United States.

Unfortunately, rapid urbanization has also turned the area into one of the most endangered regions of the country. The reduction and fragmentation of habitat due to housing, agriculture and other human activities has resulted in an intense concentration of species at risk: 23 species of plants and animals currently listed as nationally threatened, endangered or of particular concern, and one-third of provincially red-listed species, make their homes here. Over half of these depend on grassland and shrub-steppe habitat, which is one of the most dramatically altered.

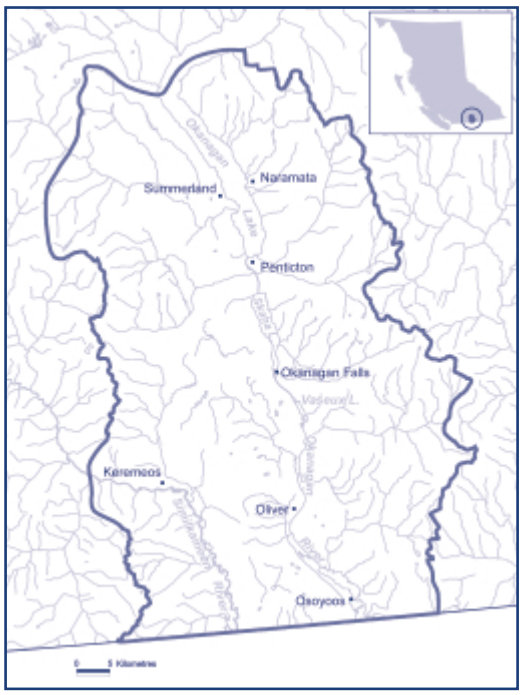
Science and Habitat Conservation

This article is part of an ongoing series on Environment Canada's role in preserving important habitats across Canada. In this issue we explore the unique South Okanagan-Similkameen region of British Columbia — one of our country's richest yet most endangered ecosystems.

What attracted these species to the region in the first place? Sheltered from the rain by the coastal mountain range, the South Okanagan and Similkameen valleys have a dry climate with temperatures moderated by the open waters of the Okanagan lakes. At the cooler, higher altitudes are coniferous forests; at the hotter, lower altitudes, grassland and shrub-steppe habitat that typically receives less than 30 centimetres of rain a year. Also at these lower elevations are wetlands and a rugged terrain of sheer cliffs, boulder fields and talus slopes.

Many species rely on the proximity of these habitats to survive. For example, certain species of toads and salamanders spend most of their year in the grasslands, but need the small alkaline lakes nearby for breeding. Fifteen of the 20 species of bats found in Canada hang out in the Okanagan Valley, hiding in the cracked cliffs on hot summer days and emerging at night to feed on insects buzzing over the wetlands. The threatened Pallid Bat, whose only Canadian home is in the South Okanagan, has even more specific needs: it is the only bat that hunts for insects on the ground among the sagebrush of the grasslands.

Scientists with Environment Canada and the province of British Columbia began studying the Okanagan in the late 1960s, and in the early 1970s some land in the area was purchased for the Vaseux-Bighorn National Wildlife Area. It wasn't until 1985, however, that the first concerted effort was made to conserve habitat with the introduction of the South Okanagan Conservation Strategy. Under this Strategy, the habitat area was mapped, status reports were prepared for species at risk, and species recovery teams were launched. In the years since, efforts have focused on managing Crown land, acquiring priority habitat, and encouraging stewardship on privately owned property.



Boundary of South Okanagan-Similkameen Conservation Program in southern British Columbia.

As the shared habitat needs of many species at risk have become more apparent, there has been a gradual shift away from individual species recovery efforts to a more ecosystemic approach that focuses on habitat restoration. The rationale behind the new approach is that individual recovery teams were duplicating efforts, because many species share the same habitat needs. At the same time, some were acting at cross-purposes, because altering any ecosystem to benefit one species without considering the needs of others could have a potentially harmful effect on other species in the area.

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This summer, 19 conservation organizations and government agencies agreed to adopt a holistic approach with the formation of the South Okanagan-Similkameen Conservation Program (SOSCP). Environment Canada is a founding member of the program, along with the BC Ministry of Environment, Habitat Conservation Trust Fund, Nature Trust of British Columbia, Nature Conservancy of Canada, and Land Conservancy of British Columbia.

In addition to promoting stewardship and negotiating the acquisition of priority habitats (which comprise about one-third of the region's area), the program is also expanding community involvement. This summer, Environment Canada announced that it will contribute $1 million from its Habitat Stewardship Program to fund a variety of SOSCP activities that will be carried out by non-government organizations, private landowners, conservation groups and local governments.

A remarkable diversity of habitats exist in close proximity in the South Okanagan-Similkameen.

Photo: Jeffrey P. Shatford

Since it is the most important habitat for species at risk in the region, grassland/shrub-steppe ecosystems are a priority for restoration efforts. These savannah-like areas are dotted with mostly low-lying vegetation, such as tussock-forming grasses, sagebrush and other shrubs with long root systems, as well as scattered stands of old-growth Ponderosa pines. These trees are vital habitat for the White-headed Woodpecker, a threatened species whose only Canadian home is southern BC and, in particular, the Okanagan and Similkameen valleys. The woodpecker relies on these mature trees not only for nesting, but also for their large seeds, which are an important source of food in winter.

Unfortunately, logging activities and the subsequent suppression of fires, which have historically played an important part in the life cycle of the grasslands, have greatly altered this ecosystem over the past 50 years. Not only have many older-growth Ponderosa-pine stands been replaced by thick stands of young pine and fir, but invasive weeds have spread rapidly through the grasslands, endangering some native plant species.

In taking an ecosystemic approach to conserving biodiversity in the region, the conservation project is considering the needs of a number of species at risk in the area, including the White-headed Woodpecker and the California Bighorn Sheep — a provincially blue-listed species that suffered a catastrophic decline last winter. One aspect of its plan is a weed management program that involves removing weeds, harvesting seeds from wild plants, and reseeding damaged habitats. A new program will also be launched to carry out selective burns to create better conditions for Ponderosa pines, and to thin stands so that young pines will be able to grow faster and older pines will have more room to flourish.

Multi-species issues are also a concern in the conservation of wetland and riparian habitat in the South Okanagan-Similkameen. This habitat is the most naturally productive in the region, since many species depend on it for part or all of the year. One of these is the threatened Yellow-breasted Chat, a member of the warbler family that nests in lowland riparian thickets and is found primarily in the South Okanagan and Similkameen valleys. A portion of the Okanagan River is also home to one of only two viable sockeye salmon runs in the entire Columbia River watershed.

These areas have suffered massive degradation due to the effects of agriculture and commercial and industrial development on shoreline ecosystems. To tackle the problem, the conservation project has developed a program to secure, rehabilitate and enhance riparian habitat along the Okanagan River that includes planting vegetation and fencing creeks on private ranchlands. The latter, which could entail providing alternate water supplies, will help to prevent cattle from causing further damage and allow riparian plant communities to bounce back.

In addition to these hands-on rehabilitation efforts, Environment Canada is working with other partners to develop a planning tool for the South Okanagan-Similkameen region that will allow users to predict the impact of various land uses on different habitats. The Osoyoos Indian Band has already expressed interest in using the tool to manage the undeveloped areas of its reserve — a good sign, since the Okanagan First Nation as a whole is the region's largest private landowner.

Although the SOSCP's projects are still in their infancy, they mark an important step toward restoring the fragile habitat of the South Okanagan-Similkameen region — and through this habitat the diversity of plant and animal species that cling to life in Canada's vanishing desert country. SE

ATLAS MAPS MOVEMENTS OF BANDED BIRDS

Like sending winged messages in bottles, Canadians have been banding birds and keeping records of where and when they're found for almost a century. Although fewer than five per cent of the 50 million birds banded in North America since 1905 have ever been encountered, these efforts have yielded a surprising amount of information about the routes and destinations of many species.

White-crowned Sparrow. Photo: Bird Studies Canada

This summer Environment Canada's Canadian Wildlife Service (CWS) published a 400-page report summarizing, for the first time, results for all the small landbirds banded or encountered in Canada. The publication, *Canadian Atlas of Bird Banding, Volume 1: Doves, Cuckoos and Hummingbirds through Passerines, 1921-1995*, was compiled over the past 25 years by an amateur bander in Guelph, Ontario, and by CWS scientists in Ottawa and Saskatchewan.

Environment Canada coordinates the Canadian arm of the North American Bird Banding Program, which sees approximately 220 000 birds banded in Canada each year. Some 900 licensed banders, including a large number of volunteers, contribute to the effort by netting or trapping birds, attaching numbered identification bands to their legs, and recording data such as age, sex, location, date and state of health. If a banded bird is encountered — that is, spotted, captured or found dead — more information is taken. The results are useful not only to banders and researchers interested in bird ecology, movement, productivity, survival and migratory patterns, but also to wildlife managers and conservationists interested in knowing more about the winter destinations and migration routes of Canada's birds.

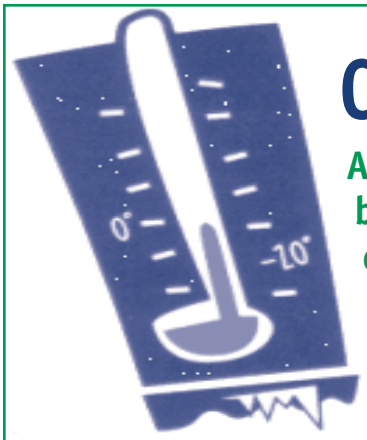
The atlas provides a full account for each species with at least one record of an individual moving more than 100 kilometres — in this volume, 133 of the 227 species of small landbirds banded in Canada. Each account discusses movement patterns, recaps previously published analyses, and summarizes statistics on encounter rates and mean distances moved. It also provides fascinating details about some individual encounters, such as the White-throated Sparrow that flew 673 kilometres in a single day, and the tiny Bank Swallow that was banded in Saskatchewan and found years later in Bolivia, nearly 8 000 kilometres away.

Special maps show movement between banding and encounter locations, as well as the frequency of banding by species and geographic location — the latter never having been published before. Although independent analyses of the movement of some species of banded birds have been carried out in the past — particularly for birds of economic importance, such as waterfowl, or species that cause agricultural damage — most of the results for rarely encountered species appear for the first time in this atlas.

Comparisons among more frequently encountered species reveal geographic differences in movement patterns that are consistent across many species. For example, many landbirds migrate south toward the Gulf of Mexico, but take very different routes to get there. Generally speaking, landbirds west of the Rockies head due south along the Pacific coast each fall, while those from the prairies and northern British Columbia head southeast. Maritimes landbirds head southwest, parallel to the Atlantic coast, some of them crossing paths with individuals from western populations over the Great Lakes. Birds in Ontario and Quebec also tend to head due south.

One of the many applications of this information was illustrated earlier this year, when CWS was asked to provide expert advice on the potential for migrant birds to carry the West Nile Virus from New York City into Canada. Although the atlas shows that over 200 species migrate through the area, migration dates show that they head north before mosquito season each spring, making it unlikely that they would pick up anything en route. While the virus could be caught on their fall migration south, it is uncertain whether birds can carry the virus more than a week — let alone over the winter. In addition to focusing surveillance efforts along the Atlantic coast, banding studies revealed that the greatest threat likely occurs when young birds disperse prior to fall migration.

Over the next several years, CWS also hopes to publish banding atlases for raptors, waterbirds, seabirds and shorebirds. The first volume of the *Canadian Atlas of Bird Banding* is available in hard copy and on the web at [www.cws-scf.ec.gc.ca/nwrc/bbo/atlas/index.html]. S&E



CHILLING OUT

Anyone who has ever waited at a bus stop or taken a walk on a blustery winter day knows that when the wind blows it feels colder than it really is. Although the sensation of wind chill is nothing new, recent studies show that many people are still confused by what it means, and that the formula we use to determine it may be exaggerating its effects.

What makes wind chill so hard to get a handle on is that it can't be measured by an instrument. It simply describes a sensation: the way we *feel* as a result of the combined cooling effect of temperature and wind. Normally our bodies warm up a thin layer of air close to our skin that protects it from external temperatures. In cold weather, when the wind blows it takes this layer with it, and replaces it with cold air. Your body then has to work harder to warm up a new protective layer. If these layers keep getting blown away, your skin temperature will drop — something that could lead, in below-zero conditions, to frostbite.

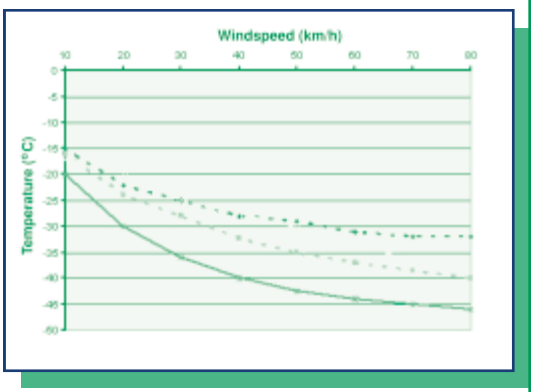
The formula most commonly used to determine wind chill (known as the Siple-Passel formula) was devised more than 50 years ago by Antarctic explorers who measured how long it took for a plastic cylinder of water to freeze at various temperatures and wind speeds. There are several inherent flaws in the formula — including the fact that the human body produces its own heat and that wind speeds are measured at weather stations 10 metres above ground, where they are generally faster than at body height. As a result, the method may be estimating wind chill as colder than it really is.

In addition, the lack of a standard way of reporting wind chill, even within Canada, has led to some confusion. Although meteorologists support the use of wind-chill factor, which describes the rate of heat loss in watts per square metre, many people don't understand the meaning of the numbers in the scale — which range from 800 to over 2000. The media and most members of the public prefer equivalent temperature, which likens the way it feels to the temperature on a calm day. Problem is, people may confuse equivalent temperature with actual temperature and believe there is a danger of freezing water pipes or plants, even when the actual temperature is above zero — something that is physically impossible unless evaporative cooling from a wet surface is involved.

As one of only four countries that issue wind-chill information operationally (the United States, Great Britain and Finland are the others), Canada took the lead in the debate over wind chill when Environment Canada's Meteorological Service of Canada held the first-ever international workshop on wind chill this past April. The workshop, which took place over the Internet, had over 400 registrants from 35 countries.

Most participants agreed on the need for an international standard for measuring and reporting wind chill, but ideas about exactly what it should measure are split into two camps. Supporters of a whole-body model believe apparent temperature should combine the effects of ambient temperature, humidity, wind, solar radiation, and metabolic heat production on an average person to determine the amount of clothing needed to equate heat loss with heat production. Proponents of a facial-cooling model, on the other hand, argue that the effect of wind chill is felt primarily on the face, so that measures should focus on exposed skin. Opinions are also divided about whether wind chill should be expressed in terms of temperature units or a non-dimensional scale or set of categories.

As a result of the workshop, the International Society of Biometeorology has struck an international commission of 14 scientists to prepare recommendations for a Universal Thermal Climate Index, in which index ranges could be predicted using the necessary variables, from the hottest to the coldest ends of the scale. The commission, which is co-chaired by Environment Canada, will present its findings to the World Meteorological Organization in the spring of 2001, with an eye to having a new wind-chill formula in place by the winter of 2002. SE



Graph showing wind chill equivalent temperatures calculated using Siple-Passel formula (solid line) and two other more recent methods (dotted lines) at an actual temperature of -15° C.

CRYOSPHERE AND CLIMATE CHANGE

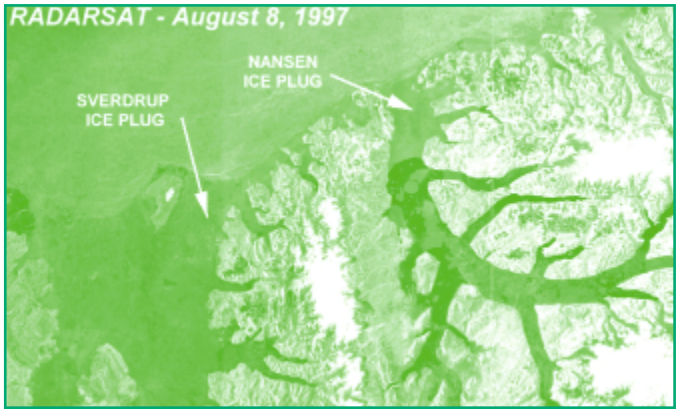
Few countries in the world are as drastically affected by their frozen regions, or cryosphere, as Canada is. Subtle changes in our snow cover, lake, river and sea ice, glaciers and permafrost have a profound effect on everything from floods and droughts to water supplies, tourist operations, and the flow of commerce along our shipping routes. On a global scale, the cryosphere influences the world's surface energy, water cycle, and atmospheric and oceanic circulation.

For more than 20 years, scientists with Environment Canada's Meteorological Service of Canada have used satellite information to monitor and forecast changes in our cryosphere. Now, as the lead in a new Canadian Space Agency (CSA) initiative, it is working closely with the university community, private sector and other government agencies to develop, demonstrate and validate space-based systems for studying the cryosphere and its response to climate change. The new initiative builds on a decade of collaborative research on variability and change in the cryospheric system in Canada, known as CRYSYS — one of three Canadian contributions to the US National Aeronautics and Space Administration (NASA) Earth Observing System (EOS).

Although observations of the cryosphere have been made from ground, ship and aircraft for many decades, they cover small areas at a time — leaving large, often uninhabited areas uninvestigated. Satellites, on the other hand, can look at larger areas and at scales from metres to kilometres. Also, since all elements of the cryosphere are very dynamic, measurements made by satellite on a daily or weekly basis can detect changes that are overlooked by less frequent methods.

Data collected in space can be used for everything from monitoring the movement of pack ice to estimating the amount of water that will come from a seasonal snow melt. One of the greatest challenges facing scientists at present is to find a way to gauge ice thickness from space, something that is essential to understanding how climate change affects the cryosphere. Data from submarine observations indicate a dramatic thinning of sea ice in certain regions of the world — a phenomenon scientists say must be taken into consideration in modelling the future impacts of climate change.

The three-year CSA initiative is designing science and validation projects for sensors and data from Canada's RADARSAT and NASA's EOS *Terra* satellite, launched in 1999, and its cousin *Aqua*, set to head into space next summer. These will involve collecting ground and airborne measurements below the satellite's flight path to verify data, and analyzing and interpreting the results. European Space Agency satellites and products, such as the scatterometer, which detects ground freeze and thaw, are also being considered for future study. Frozen ground and permafrost play a role in the carbon cycle and may release greenhouse gases, such as methane and carbon dioxide, when they melt. The initiative is also working to establish a Canadian Cryospheric Information Network to link databases and provide public outreach.



These thick sea-ice plugs at the entrance to Sverdrup Channel and Nansen Sound, in the extreme northern region of the Arctic Islands, opened for the first time since 1962 during the extremely warm summer of 1998.

Studies show that the cryosphere is responding quickly to changes in the climate system. In western Canada not only has there been a decrease in the depth of spring snow-cover of up to one centimetre per year for the past 30 years, but also the snow has disappeared about one day earlier per year — a trend that has serious implications for ground freezing and thawing, as well as water supply. In 1998, when temperatures were uncommonly high, some sea-ice plugs in the Arctic archipelago opened for the first time in decades, creating the most open water since 1962. Many glaciers showed significant melting the same year, including the Athabaska Glacier, where ice-measuring stakes had to be redrilled twice as often. Other high-latitude glaciers showed more melt this year, when temperatures were cooler — an indication of lags in the system. Similar lags are being felt on large northern lakes, such as Great Slave Lake, which experienced a domino effect from a record early ice break-up and late freeze-up in 1998.

The cryosphere is a highly variable, dynamic system with complex linkages to the climate system. Improving the use of space-based systems to monitor the cryosphere will help scientists better understand the role our frozen regions play in the global climate system, and provide more accurate information for studying the impacts of changes to this system on our environment and our economy. SE

EARLY MORTALITY SYNDROME IN SALMONIDS

Early mortality syndrome (EMS) is an international problem that affects various species of salmon and trout and can cause catastrophic losses of very young fish. In the Great Lakes Basin, for example, salmonids have suffered a post-hatch mortality of up to 90 per cent, depending on the year, species and location.

Salmon eggs are fertilized in the laboratory, exposed to chemicals such as vitamins, vitamin antagonists or contaminants, and then incubated until swim-up to monitor for early mortality syndrome.

The exact cause of the syndrome is not well understood, but scientists at Environment Canada's National Water Research Institute (NWRI) are working with fishery and resource managers in Canada and the United States to study the interactions among contaminants, thiamine deficiency and antioxidant vitamins — work they believe will shed new light on the problem.

Symptoms of EMS appear between hatching and first feeding, and include loss of equilibrium, lethargy, swimming in a spiral pattern, hyper-excitability, hemorrhaging and death. The species affected include coho and chinook salmon, and rainbow (steelhead), brown and lake trout. Atlantic salmon in the Finger Lakes of New York State and the Baltic Sea experience similar early life-stage mortality syndromes, called the Cayuga Syndrome and M74 respectively.

Thiamine deficiency in eggs is a common link among these three syndromes, and treatments of thiamine on eggs or fry have been shown to enhance survival and reverse their effects. Although the cause of this deficiency is not known, it appears to result from thiamine-degrading enzymes in the salmonids' diets. In the Great Lakes, certain salmonids feed on non-native fish species, such as alewife and smelt. Quantities of thiamine-degrading enzymes in these species have been documented at up to a hundred times that of native species, and implicate them as a likely cause in the development of thiamine deficiency.

The fact that EMS and M74 are more common in contaminated ecosystems points to the possibility of thiamine- or thiaminase-contaminant interactions. Contaminants may increase the thiamine requirements of salmonids, or the effects of contaminants may only show up when the environmental availability of thiamine is low. In Finland, researchers discovered higher concentrations of dioxin-like contaminants called planar halogenated hydrocarbons (PHHs) in the muscles of female salmon that had M74 appear in their offspring.

So far, no link between any particular contaminant and EMS has been established in North American studies, but research to date has been short-term. Longer-term investigations are needed to determine whether salmon stock with elevated PHHs and low thiamine levels experience an increase in the syndrome's occurrence.

Another line of inquiry is a possible link between the thiamine deficiency and antioxidant vitamins. In a Lake Ontario study, researchers analyzed female lake trout for antioxidants and found that adults whose offspring developed EMS had lower vitamin E (an antioxidant) levels compared to those whose offspring did not. More work is needed now to clarify the link between thiamine deficiency and other factors like antioxidant vitamins.

NWRI scientists and their partners in Fisheries and Ocean Canada, the United States Geological Survey, the Michigan and Wisconsin departments of Natural Resources, the United States Fish and Wildlife Service and the Chippewa-Ottawa Treaty Fishery Management Authority are undertaking a broad range of activities as part of their research. These include quantifying the thiamine and thiaminase in the food web, determining the extent of the syndrome in salmonids, improving procedures for thiamine therapy, developing a laboratory model, and testing a large range of chemicals and contaminants to see if they act synergistically with thiamine deficiency.

Other areas to be explored are the long-term effects on fish surviving EMS, whether other species that consume alewife and smelt experience reproductive difficulties related to thiamine deficiency, and whether blue-green algae may act as a source of thiaminase. The findings will help to protect self-sustaining fish populations and to rehabilitate degraded populations of native species in the Great Lakes. SOE

COMMERCIAL CHEMICALS UNDER EVALUATION

There are more than 23 000 chemicals in commercial use in Canada — from paint ingredients to pesticides — and each year, more than 900 new substances try to join this list. To ensure that none pose a risk to human or environmental health, scientists are conducting a preliminary review that, by 2006, will make Canada the only country in the world to have examined every chemical in domestic use.

The reviews, which are required under the *Canadian Environmental Protection Act, 1999* (CEPA 1999), are an important component of the new federal pollution prevention strategy and are conducted jointly by experts at Environment Canada and Health Canada. Chemicals are evaluated by examining their properties to determine if they are persistent or bioaccumulative and inherently toxic to humans or other organisms. Depending on the outcome of the review, further assessment may be carried out to determine if the chemical in question poses a risk to humans or the environment. If this is the case, appropriate risk management measures are developed.

CEPA's New Substances Notification Regulations came into effect for chemicals and polymers in 1994, and for biotechnology products in 1997. The Regulations require that the importers or manufacturers of all substances new to Canadian commerce, including living organisms, submit detailed information on the uses and effects of these substances for verification and assessment. The chemicals are assessed not only based on specified volumes and uses, but also taking into consideration changes in use patterns in the future. Since 1994, more than 10 000 new substances notifications have been received in Canada — three times the number originally expected. In 1999, over 1300 notifications were received, and that number is expected to rise with each coming year thanks to ever-increasing advances in technology, research and development.

Canada's program to assess new substances is not unique: the United States, Australia and other member countries of the Organisation for Economic Co-operation and Development are all involved in similar efforts. What is unique is that Canada is the only nation in the world that also requires the chemicals on its original Domestic Substances List (DSL) — which were in commerce between 1984 and 1986 and whose entry into the environment was then unrestricted — to undergo a review.

Since the chemicals on the original list were used without restriction, little information exists on their potential effects. As a result, Environment Canada and Health Canada base their evaluations on a combination of public and in-house data, surrogate information on similar substances, and expert prediction models. By the time the categorizations are completed in 2006, it is estimated that 1000-3000 of the 23 000 chemicals on the original DSL will have been identified as candidates for risk assessment.

Substances that fall into this category will then undergo further screening to determine whether they pose a risk to the environment or human health and, if so, to recommend ways to manage them under CEPA. A variety of methods, including regulations, voluntary actions and economic instruments may be used. Risk assessments will be published in the *Canada Gazette* for public comment before a Ministerial decision is made. Toxic chemicals of particular concern will be added to CEPA's List of Toxic Substances, and those that are persistent and bioaccumulative will be recommended for phase-out or virtual elimination.

This summer, a multi-stakeholder group made up of experts from industry and from public advocacy and environmental groups was struck to evaluate the effectiveness of the New Substances Notification Regulations and to suggest ways to improve them. The group will make its recommendations to Environment Canada by the end of January 2001. S&E

ALL ABOUT **S&E Bulletin**

This bi-monthly publication is produced by Environment Canada to provide information on leading-edge environmental science and technology to Canadians.

Find out more about the subjects in this issue and previous ones by visiting our S&E Web site at [www.ec.gc.ca/science]. The on-line version of the *Bulletin* often contains additional information and graphic material and provides links to other relevant sites and documents. Many departmental publications mentioned in the *Bulletin* are posted on Environment Canada's Green Lane at [www.ec.gc.ca], or can be ordered from the Inquiry Centre at 1-800-668-6767.

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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