

The Combined Effects of Climate Warming and Other Human Activities on Freshwaters and Wetlands of Western Canada

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Abstract

A variety of scientific studies show that climate warming will have adverse effects on western Canadian freshwaters and wetlands. Climate warming will affect the availability of water, the timing of river flows, and water yields from mountain snowpacks and glaciers. Many wetlands will disappear. Habitats for coldwater fishes and other organisms will be reduced. These direct insults will interact with overexploitation of fisheries, dam building and diversion, habitat destruction, the spread of non-native species, water pollution and irrigation use by agriculture, urban and industrial development, and the drainage of wetlands to deplete and degrade our freshwater resources.

Decreased water flows will cause increased algal growth in waters that receive point sources of nutrients. For many lakes and streams, climate warming will exacerbate the effects of acid precipitation and other airborne pollutants. Groundwaters and wetlands will be especially vulnerable as increasing temperatures cause evaporation to increase more rapidly than precipitation in most areas. Decreased inputs of colored dissolved organic carbon (CDOC) will cause lakes to become more transparent, with higher penetration of solar radiation, including harmful UVB wavelengths.

Cooperative planning at watershed scales is needed to reverse the trends in freshwater degradation. Without such planning, freshwater problems in western Canada will reach crisis proportions within a few decades.

This abstract was provided by Dr. David Schindler and is posted with permission to www.AlbertaWilderness.ca.

BIOGRAPHY

DR. DAVID SCHINDLER

Dr. David W. Schindler is the Killam Memorial Professor of Ecology at the University of Alberta, Edmonton. From 1968 to 1989, he founded and directed the Experimental Lakes Project of the Canadian Department of Fisheries and Oceans near Kenora, Ontario, conducting interdisciplinary research on the effects of eutrophication, acid rain, radioactive elements and climate change on boreal ecosystems. His work has been widely used in formulating ecological management policy in Canada, the USA and in Europe. More recently, he has studied the effects of alien fish stocks, airborne contaminants and other human impacts in lakes of the Rocky Mountains.

Dr. Schindler received his doctorate from Oxford University, England, where he studied as a Rhodes Scholar. During his career, he has headed the International Joint Commission's Expert Committee on Ecology and Geochemistry, and the US Academy of Sciences' Committee on the Atmosphere and the Biosphere. He has served as President of the American Society of Limnology and Oceanography, and as a Canadian National Representative to the International Limnological Society.

Author of over 240 scientific publications, Dr. Schindler has received a number of research awards, including the 1984 Outstanding Achievement Award of the American Institute of Fisheries Biologists, the 1984 Frank Rigler Award of the Canadian Limnological Society, the 1985 G.E. Hutchinson medal of the American Society of Limnology and Oceanography, and the 1988 Naumann-Thienemann medal of the International Limnological Society. He was the Baldi Lecturer at the 1987 International Congress of Limnology in Hamilton, New Zealand. He is a Fellow of the Royal Society and the Royal Society of Canada. He has received honorary Doctor of Science degrees for his ecological work from North Dakota State University (1978), the University of Victoria (1990) Athabasca University (1992) and Brock University (2001) and an honorary Doctor of Laws degree from Trent University (1995).

In August of 1991, Dr. Schindler was presented with the Stockholm Water Prize by the Queen of Sweden for his research on the acidification and eutrophication of lakes. His more recent awards include the Manning Award of Distinction for innovation in science in Canada (1993), the first Romanowski Medal of the Royal Society of Canada (1994), the Volvo Environment Prize (1998); the J. Gordin Kaplan Award for excellence in research (1999), the ASTech (Alberta Science and Technology) Award for "Outstanding Leadership in Alberta Science" (1999), the NSERC Award of Excellence in Research (2000), and the Canadian Nature Federation's Douglas H. Pimlott Award for Conservation (2001).

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Thank God This Man is Smiling

Because that means David Schindler still thinks there's a chance we can save our lakes and forests

by Andrew Nikiforuk

David Schindler wants to show me the future of the boreal forest, so he's taking me on a short drive in his Subaru 4x4 to Alberta's Pembina River. The route from his home in Wildwood, Alberta, some 100 kilometers west of Edmonton, passes through a forest fragmented by an assortment of roads, seismic lines, oil wells and power lines. It's not a scenic tour. Every time we drive by another chunk of mangled forest, Schindler clinically waves his arm at it. "This whole country is shredded," he says.

The Boreal Forest has thrived for 65-Million years, but David Schindler says it hasn't got much time left.

Along the way we see neither bird nor beast. Most creatures, it seems, don't like to live on industrial edges where they make easy fodder for predators. At the river, Schindler walks briskly through a swath of cut forest and sits on a sawn poplar log. A black-and-white sigh warns us that we are sitting in a right-of-way for a high-pressure oil pipeline. Bullet holes riddle the sign.

Schindler studies the scene and then announces we have arrived at the future. It's a pretty dim destination for Canada's largest ecosystem. "Unless we do something, this is the best-case scenario for the boreal," he says.

If anyone should know, it's David Schindler.

David Schindler may be one of Canada's premier scientists, but he's well, a different sort of scientist. In the 10 years I've known him, I've never seen him wear a white lab coat. He has farmer's hands and a wrestler's muscles. At the age of 59, he can still handle a 10-dog sled team and easily mush 5 000 kilometers over a winter. He can track a moose, set a duck blind and outwalk most trappers. He has portaged so many Canadian lakes and rivers with 160-pound packs that he now has one artificial hip made of chrome. ("The voyageurs all had hip trouble," he explains.) Meeting Schindler is like encountering a three-foot-diameter white spruce in the northern boreal: you have to look up to the man because you know there aren't many of his stature left.

Among friends his strength and courage are matters of legend. When a Cessna 185 once plunged Schindler and the pilot into a cold Ontario lake during a forest fire, he emerged from the bloody mess with a broken arm, pelvis and collarbone. He then saved the pilot, a non-swimmer, by cradling him in his good arm until help arrived. The next day Schindler showed up at work because, he says, "I hate hospitals."

David Schindler is also the world's greatest living freshwater ecologist. For the last 30 years he has studied boreal lakes with uncompromising devotion. His startling and groundbreaking research on acid rain, eutrophication and climate change has forced governments on two continents to enact a string of fish-saving and water-cleaning legislation.

These achievements have been duly noted outside of Canada. In the last decade, the Swedes, for example, have awarded him the equivalent of two Nobel Prizes: the Stockholm Water Prize in 1991 and the Volvo Environmental Prize in 1998. And if there had been a Nobel Prize for ecology he would have won that too. "I don't think there is a scientist in fresh-water ecology who has had a bigger influence or is more highly regarded in the world than Schindler," says Andy Hamilton, a senior scientist with NAFTA's Commission for Environmental Cooperation. "He's always at the cutting edge."

That edge has now gone beyond lakes to include the future of the entire boreal landscape, trees and all. The boreal, of course, is Canada's essential ecosystem. It supports the world's largest assortment of lakes and wetlands. It is also uniquely efficient. The boreal manages to do everything the teeming Amazon does but with only a fraction of the flora and fauna. With just 100 000 species, the boreal builds soil, filters water, captures carbon and produces oxygen. Unlike the Amazon, it is also a fine moose maker. Canada could not have been Canada without its boreal furs, water and timber. But though the boreal has thrived for 65-million years, Schindler now says it hasn't got much time left. He gives it just 50 years.

Schindler says that a poorly regulated industrial assault on the boreal combined with a cascade of stressors from acid rain to climate change is now degrading the forest so fast that only a few northerly parts may survive intact. And with this wilderness will go much wildlife: woodland caribou, lynx, wolverine, cougar and grizzlies. Lake trout will be too toxic to eat and most lakes will be fishless. "The call of loons, the chatter of kingfishers and the melodious notes of migratory songbirds will be much rarer," says Schindler, now a professor at the University of Alberta. "Drinking directly from boreal lakes and streams as I have done for my entire life will be a thing of the past."

Just about everyone who has ever worked with Schindler says he is not a pessimist or a doomsayer. He's just "a no bullshit guy" says his former boss at the Winnipeg-based Freshwater Institute, Jack Vallentyne. Digby McClaren, a renowned paleontologist and former president of the Royal Society of Canada, readily supports that assessment. He sees Schindler as a realist who just talks about what he sees. "He is a fearless man. I love him. If Schindler sees a house on fire, he'll tell you and that's not pessimism. And if he is saying Canada's house is on fire, he's got the case to support it."

Schindler's boreal journey began oddly enough on bald prairie. He grew up the first of four siblings in a family of second-generation German immigrants in Barnesville, Minnesota. His father and uncles ran a potato wholesale business, a 1 200-acre farm, a gas station and a beer depot. His mother, a college girl, taught music. Whenever Schindler had a free day, he headed north to the nearby lake country to fish and hunt. "I thought lakes were the be all and end all," says Schindler.

At school he was the type of kid who corrected the teachers, taunted the bullies and knew all the math answers. "He was always brilliant," says his brother Richard, a family physician in Austin, Minnesota. "Dave could always see the solution to things that the rest of us might spend half our lives pondering."

When not mucking about outdoors, Schindler often got lost in the popular novels of James Oliver Curwood. During the 1920's the best-selling novelist wrote adventure tales that mostly took place in Canada's boreal forest. With macho titles like *The Wolf Hunters*, *The Flaming Forest* and *Kazan, Wolf Dog of the North*, they left Schindler with a burning desire: "Boy, I wanted to see that country."

The day he turned 15, Schindler and his dad's hired hand (an older man who also loved to fish) headed north to explore some of Curwood's novel locales in northern Ontario. The two adventurers got as far as Teggau Lake, the deepest lake in that part of the province. Fourteen years later, Schindler would return to the very same portage trail on Teggau Lake as the project leader for a scientific team.

Although Schindler initially went to university to study engineering, he quickly gravitated towards biology. At the age of 23, he published his first paper in the prestigious American journal *Science*- a feat that still astonishes his 30-year-old doctoral students. Later, as a Rhodes Scholar, he studied under Charles Elton, then the world's pre-eminent ecologist at Oxford University. Elton, who fretted about the threats of biological invaders such as starlings and Dutch elm disease, was so impressed by the young man that he gave him the keys to his private library.

Schindler's sense of right and wrong also made a strong impression at Oxford. On the very day of his arrival a group of fellow students arrived at his room and asked him to sign a petition protesting the Bay of Pigs invasion. Schindler politely declined: he knew nothing about the issue. When the group said they would not leave until Schindler signed, a pushing match ensued. "I shoved one guy and a whole bunch tumbled down the stairs. I was hauled into the Master's office and given a lecture on civil behavior."

After Oxford, the young scientist decided to take a teaching job at Trent University in Peterborough, Ontario. "There just wasn't enough wilderness left in Minnesota," says Schindler. He became friends with an older colleague, Jim Nighswander, a skilled canoeist, and spent a lot of time at Nighswander's cabin at Clear Lake in the Haliburton Highlands. (Clear Lake, a unique postage-stamp size lake some 100 feet deep, was one of the first lakes outside of Sudbury to be soured by acid rain.) These working trips just hooked Schindler again on the singular beauty of the forest of the Precambrian Shield.

Those who've worked with Schindler say he's not a Doomsayer. He's just a "no bullshit guy," says a former boss.

At about this time, federal scientists at Winnipeg's Freshwater Institute decided to do a series of experiments on whole lakes-in a corner of northwestern Ontario called the Experimental Lakes Area (ELA)-to discover why algal blooms were strangling Lake Erie and other Canadian waters. Turning a lake into a large laboratory to test how pollutants could undermine an entire ecosystem was a revolutionary idea.

Jack Vallentyne, who then ran the eutrophication project, knew of Schindler's incredible credentials but had been unsuccessful in wooing the young researcher to the Freshwater Institute. So Vallentyne asked another ELA recruit, Andy Hamilton, to give it a try. After meeting Schindler, Hamilton wrote the young scientist a long letter. "I said that ELA was probably the best place to change the world." Hamilton added another temptation: an invitation to hunt moose with his family in northern Saskatchewan. "I don't know if it was the good science or good moose hunting that won him over."

Aware of Schindler's gung-ho attitude, Vallentyne then offered him the directorship of the entire program the day before he departed to Kenora. "I'll think about it and let you know one I get there," replied Schindler. Recalls Vallentyne: "Then he just railroaded the operation from there on in. We just knew he was going to be effective."

When Schindler arrived at ELA he found the new wilderness research camp in total disarray. Sleeping bags and outboard motors had been unpacked into pools of mud. The ATCO trailer required three kilowatts of light but the generator produced only two and a half. And the cook was chasing an undergraduate student around with a meat cleaver. "He didn't like students," recalls Schindler. "We found out the man had a history of poisoning and starving people in logging camps. I fired him." Within two weeks Schindler had the camp up and running.

That summer he also picked and surveyed the 46 lakes that would make up the Experimental Lakes Area-a political project that required negotiating with the federal and Ontario governments as well as two logging companies with cutting rights in the region. He also located a permanent home for the ELA camp.

After spending the first summer on an island in a tent, where his four-month old son had an echo-sounder crate for a crib, Schindler had a cabin built for his family near the station. For six months of every year for the next two decades, Schindler's family lived and played in the boreal. It had a pretty direct impact on the children: all three grew up to become aquatic ecologists.

Under Schindler's command, it didn't take long for what is now the world's longest-running experiment on whole lakes to produce some astounding results. By 1974, Schindler and his "mosquito bite brigade" conclusively proved that phosphates from detergents and farm fertilizers produce oxygen-robbing algae growth. Until then there had been suspicions but no proof.

The final phosphate experiment was deceptively simple: Schindler's team divided Lake 226 in two halves using a plastic curtain. They added nitrogen and carbon to both halves of the lake but phosphates to only one half. The side contaminated with phosphates exploded into a teeming green soup within weeks. The ELA team took a picture of the ecological drama from the air, which quickly made Lake 226 something of

a celebrity. (The photograph eventually appeared in more than 400 publications.) "That picture was very effective in making people realize the damage phosphates can cause," says Schindler.

In the ELA's formative years, Schindler earned a reputation for being a bastard to work for. He pushed everyone to their limit. All the time. He demanded the most accurate measurements, the hardest work (all equipment had to be portaged in), the longest days and the finest thinking. He also treated technicians like scientists and scientists like voyageurs. Within short order, about 80 per cent of the staff resigned.

The grumbling, however, eventually turned to excitement as new staff came on board. Many have now worked at the project for 20 years and include the likes of Dave Findlay. Schindler hired the high-school dropout because he was gutsy and liked science: "Now he has more publications with his name on it than most scientists," says Schindler. "It was easy to be a good coach when all the players were Wayne Gretzkys."

Like anyone associated with ELA, Findlay agrees that "Schin," or "DWS" as staff called him, is a remarkable force of nature. "There is no doubt that he's a driven man and you played his game or not at all," notes Findlay, now a phytoplankton ecologist. "But he was a great leader. He never asked anyone to do anything that he wouldn't do himself." Schindler set a demanding standard: he often worked until midnight in the field only to rise at 4 a.m. to write research papers.

Staff soon got used to the idea that working at ELA routinely meant collecting lake-water samples on empty stomachs amid clouds of black flies at 8 o'clock in the evening. "They just knew that a point on a graph would appear on a paper with Schindler's name on it, and that his uncompromising drive would make that work important," says Vallentyne.

The next major ELA breakthrough came with acid rain-what Schindler considers his finest work. By adding sulfuric and nitric oxides in different quantities to boreal lakes, the scientist discovered that even slight acidification could damage a lake's food chain. Until then, scientists had just focused on acid rain's direct fish killing properties. (Boreal lakes have low alkalinities and are extremely sensitive to acids.) The acids, in fact, prevented the reproduction of crayfish, crustaceans and minnows favored by young trout. Once three or four key food species disappeared, the trout literally starved to death.

"My hypothesis was that if you killed off just a few species in a boreal lake, which has on average between 300 and 400 main species, you changed the whole ecosystem. And we showed that at ELA again and again." In other words he proved that Canada's major ecosystem just hasn't got a lot of fat to spare.

Armed with powerful data on killer pH levels (anything below six generally spells trouble), Schindler presented the case for pollution controls on smelters and power stations to both the Canadian Parliament and U.S. Congress throughout the seventies and eighties. "He has a voice that is deep and sonorous and his words were very convincing," notes Vallentyne. "Whenever Schindler sees the facts and government policy going in opposite directions, he just has to sort it out."

Despite bitter political resistance in the U.S. (Canada was easier to convince), Schindler's lobbying helped to win a 50 percent reduction in sulfur emissions. (Nitrogen oxides, another key acidifier, have been regulated in Europe but largely ignored here.) At the time, Schindler predicted that such a cutback would only help about half of the lakes sterilized by acid rain. Later research proved him 100 percent right. "You didn't have to be a rocket scientist to figure that one out," says Schindler. More than 100 000 lakes and surrounding forests in an area greater than the United Kingdom are still being corroded by acid rain or show no signs of recovery. Hundreds of thousands more may have lost some aquatic life. To Schindler, acid rain is an ecological gangster still on the loose.

Schindler, however, didn't limit his political savvy and direct speech to acid rain. During an international conference of limnologists (fresh water ecologists) in Winnipeg in 1975, ELA's project leader drew up a petition challenging Manitoba's Churchill-Nelson River diversion project. The two rivers, which drain one

of the largest watersheds in North America, supported five aboriginal nations and lucrative fisheries of walleye and whitefish. Schindler and many other scientists foresaw their demise if the project proceeded. Despite their strong scientific objections, the project was built with disastrous effects for a fifth of Manitoba's environment, including widespread mercury contamination and the erosion of permafrost along thousands of kilometers of shoreline on South Indian Lake—a process that may last 300 years.

Schindler keeps 62 dogs and does some of his best thinking while sledding.

After the acid rain battles, research at ELA highlighted a new threat: climate change. Schindler didn't expect this ecological curve ball but warm weather and drought dramatically descended on northern Ontario in the 1970's and 1980's. Average annual air temperatures rose by 1.6 degrees and that accelerated water loss in the forest around ELA by 50 percent. (Thanks to cool short summers, the boreal appears wet but in reality it receives little rainfall.) A drier landscape soon invited massive fires that over a period of 10 years scorched the same land base twice. (It was during one of those fires that Schindler's plane crashed.) As a consequence, a mature boreal forest of jack pine and black spruce was not only wiped out but failed to recover due to drought and more fire. Now bare bedrock lies exposed in an area once covered with mossy mats 8 to 20 inches deep. In fact, much of the area around the ELA no longer looks boreal—it resembles aspen parkland.

The warming spell also amplified the effects of acid rain and ozone depletion in a variety of ways. It slowed recovery of lakes and streams from acid rain by releasing sulfur stored in wetlands and lake sediment. Other lakes actually became clearer as less-dissolved organic matter from drying wetlands found its way into the water. (Acidification also exacerbated this effect.) This, in turn, made the lakes more transparent to solar radiation, which warmed deeper layers of the lake—a development that affected all kinds of aquatic creatures. In Lake 239, lake trout, a cold-water lover, slowly disappeared while pike replaced them. Meanwhile, increasing ozone depletion meant more harmful UV radiation penetrated into the lakes. Schindler was watching the boreal change before his very eyes.

His take on climate warming remains pretty pragmatic. "Look, it doesn't matter if a 20-year warming trend is caused by greenhouse gases or a natural cycle. But the warming is pushing the boreal system to the edge with burning forests and by amplifying the effects of acid rain and ozone holes and logging. We have to adapt our management schemes to give it enough slack to adapt." Canada, of course, is not doing that. The boreal ecosystem is not only over-allocated to logging (more than 80 percent in some provinces), but remains one of Canada's least-protected spaces.

By the 1980's Schindler had witnessed more than just a biological and chemical transformation of the ELA. When he started, a man could canoe for days there without crossing a road or entering a clear-cut. "Now there are people and clear-cuts everywhere." Fishing, once a joy, has become an exercise in masochism. Logging companies that once swore that they had no plans to log anywhere near the ELA for 100 years now ring most of the region. Countless logging roads and skidder trails give snowmobiles and ATV's access all year long with the result that both wildlife and fish are being hammered. "It was like waking up with cancer everyday," says Schindler. "But it wasn't in me but in all my surroundings."

"Burned out" and disenchanted with his superiors at the Department of Fisheries and Oceans (they had little interest in the Fresh Water Institute and almost closed ELA a few years ago), Schindler left the project in 1989 to take up a teaching job at the University of Alberta. The change in scene did not result in a change of pace. He immediately became embroiled in a huge political fight over the allocation of a fifth of Alberta's forest to Japanese multinationals. He embarrassed the federal and provincial governments into funding a study of the impacts of pulp mills on northern rivers, but neither public protests nor honorable science could stop the megaproject. Schindler, however, just foresaw what politicians and multinationals refused to see. Now pulp mills combined with oil and gas activity have reduced Alberta's boreal wilderness to a nine percent refuge mostly in and around Wood Buffalo National Park.

In recent years, Schindler has been putting together the pieces of an increasingly toxic puzzle to learn how Canada's entire boreal is faring. "He is in a synthesis mode now and deriving all kinds of

conclusions from a variety of sources,” notes long-time friend Andy Hamilton. “He is proving how integrated this world is.” And how fast the boreal is unraveling.

Drawing on both his scientific and traditional knowledge, Schindler now views the boreal increasingly as a patient with a bad case of the flu who just might die from all kinds of bacterial and neurological complications. For starters, climate warming has dried the forest across the entire country so dramatically that more and more of it is going up in smoke. (Alberta, alone, spent \$300 million on fire control in the last two years.) At the same time, clear-cut logging continues to muddy and warm up boreal waters. And in addition to acid rain, airborne pollutants such as mercury and pesticides are increasingly contaminating boreal lakes.

A couple of years ago, Schindler clearly saw the future of Canada’s boreal when he took a trip to Finland. This boreal nation cut down its natural forest two or three generations ago. In Finland, trees now grow in neat plantations that look like cornfields. The Finns even log, drain and fertilize the boreal to produce wood products. “I saw nothing but conifers in their forests; there were no orchids, no mosses and no flowers,” says Schindler. In addition to losses in biodiversity, the second- and third-generation plantation forest was also struggling on the quality front; they just weren’t producing hardy wood. After a tour of the future, the Finns then invited Schindler to view a part of their past; a small park with walkways over top it. “That was all they had left of the boreal.”

Schindler, who can see solutions as clearly as he can see problems, doesn’t want Canada’s boreal to end that way. Not surprisingly, his prescription for reform is blunt and farsighted. For starters, he strongly supports the 1999 Canadian Senate Report called *The Boreal Forest At Risk*. Although hardly a newspaper reviewed the study, it tabled some very radical recommendations. It concluded, for instance, that governments should set aside 20 percent of the boreal for intensive timber production, another 20 for parks and wildlife reserves and then manage the remainder “with the preservation of biodiversity as the primary objective.” As Schindler notes, Canada is now doing the exact opposite.

Schindler would also like to see a national boreal institute that focuses on both trees and lakes. “Canadians still don’t think of themselves as a boreal people yet they won’t remain a wealthy people unless they do.” He says boreal living really means two things; “Keep it small and keep it diverse. The boreal is not a landscape that can support large populations.”

To support the creation of a boreal ethic, he thinks immigrants should be taught a basic course in northern ecology as part of their citizenship training. “We need to teach new immigrants a land ethic and soft-peddle all the ancient political stuff about the names of the prime ministers.” Without this kind of education he predicts that Canada won’t be able to support 10-million people let alone trout or caribou within 200 years.

He also thinks that hunters and anglers, a community that has produced many of the best conservationists in North America, should get positively angry about the boreal’s ailing health. Anglers, in particular, should press for better management of fresh water fisheries—already an ongoing disaster in Alberta, Manitoba, Saskatchewan and southern Ontario. “People seem to be awfully happy fishing for four-inch perch in Wisconsin,” warns Schindler. “If Canadians are that adaptable, that’s what we’ll end up with too.”

Last but not least Schindler asks for a little humility from scientists and managers. The boreal is more complicated than an open session of Parliament and a lot less manageable, he says. “What we call management is like putting a watch chain on an elephant’s ear. We can walk along with it and claim to manage it, but our delusions disappear as soon as someone pokes the elephant with a stick.”

In the community of Wildwood where Schindler lives, few people know of him as a world-class scientist or as a man with a realistically grim vision of their backyard. Most locals, in fact, just regard Schindler and his wife Suzanne Bayley, a formidable wetland ecologist in her own right, as “the dog people.” Schindler, who does everything of a grand scale, keeps 62 sled dogs in his backyard, “I do some of my best scientific thinking behind a dog sled,” he says. Whenever the weight of science gets too heavy, Schindler

just goes sledding or hiking. He'd love to go fishing or hunting, but he won't take up either in Alberta until conditions for wildlife improve.

Although the results of Schindler's methodical science are sobering, the man retains a distinct Midwestern resolve that even bad odds can be beaten by good will. This can-do attitude and dogged respect for the facts distinctly separates Schindler from cynical environmentalists or most urban tree huggers. (For the record, Schindler loathes cities and openly prefers the company of rural people.) In fact, friends mostly describe Schindler as "a happy warrior," who still believes that science can make a difference.

And they believe that if anyone can help make the boreal something better than "a best-case scenario" of industrialized fragments, he can. His long-time friend Jack Vallentyne calls Schindler an "eco-catalyst." "Schindler is the kind of guy who make natural reactions happen much faster." This is, after all, what Schindler's research and presence helped do for eutrophication and acid rain. With a little help from the rest of us, the farm boy from Minnesota just might do the same for our endangered boreal.

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