



# The Killing

Ground-breaking research reveals that a class of agricultural pesticides is the likely culprit in the deaths of hundreds of millions of birds. Worse still: Canada continues to market neurotoxic chemicals with the full knowledge of their impact.

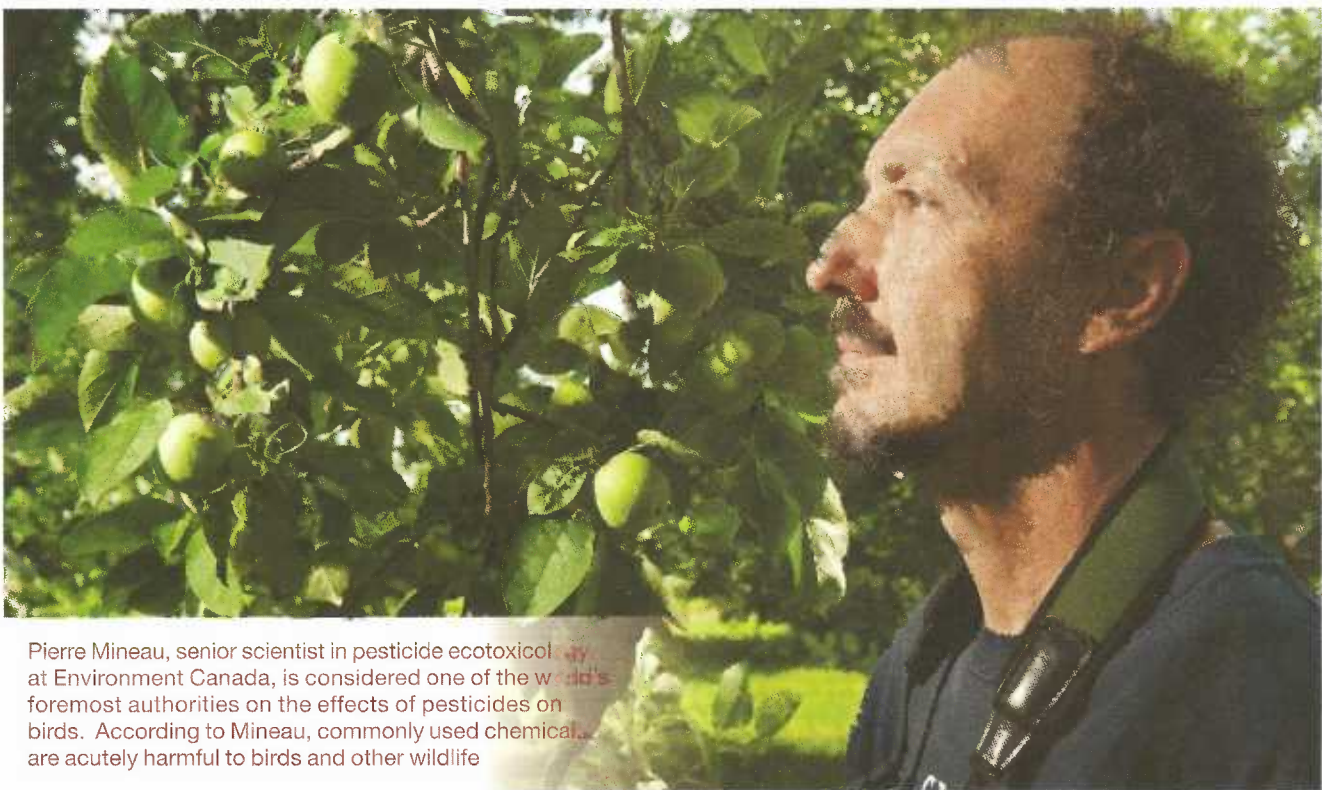
By Paul Webster





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Pierre Mineau, senior scientist in pesticide ecotoxicology at Environment Canada, is considered one of the world's foremost authorities on the effects of pesticides on birds. According to Mineau, commonly used chemicals are acutely harmful to birds and other wildlife

**T**he cormorant's brilliant green eye is flecked with yellow pinpoints, and just above the pupil, a shimmer of cerulean blue reflects the early summer sky over Hamilton Harbour. Braced in the crook of Shane de Solla's arm, the large black waterbird seems calm. But de Solla, a wildlife biologist with Environment Canada, has studied big birds long enough to know better than to relax his hold, especially not when taking a blood sample. To do so, de Solla has to push back the downy black feathers under the cormorant's wing to reveal a tiny patch of pink skin. Once a few millimetres of blood have been extracted

## Bad chemistry

When the U.S. Environmental Protection Agency (EPA) banned the pesticide Carbofuran in May, lovers of migratory birds cheered. Carbofuran is in a class of pesticides that act as neurotoxins, inhibiting brain activity. The chemical has been widely used in North America since the 1970s on crops such as corn, barley, onions, peppers, raspberries and strawberries.

Studies have long suggested Carbofuran is linked with the devastation of bird populations in North America, which have caused wildlife researchers to call for bans. Now that the United States has done so, Health Canada seems poised to follow.

The word "bird," however, does not appear in the 104 pages of tightly reasoned scientific justification the EPA provided for the ban (see [www.epa.gov/oppsrd1/reregistration/carbofuran/carbofuran\\_noic.htm](http://www.epa.gov/oppsrd1/reregistration/carbofuran/carbofuran_noic.htm)). The main reason cited is that the levels of Carbofuran in drinking water and food represent a risk to infants and children.

**Paul Webster**

using a syringe, Jim Quinn, a McMaster University molecular ecologist collaborating with de Solla's research team, says the bird looks thirsty. "Some Gatorade might be in order," he suggests.

Quinn and de Solla are spending several months here this year and next as part of a study probing the impact of air-borne toxins on cormorants. The work is painstaking, but wildlife researchers across Ontario say such field research is increasingly urgent. In recent decades, populations of migratory birds have declined dramatically around the province, which traditionally hosts billions of birds during the summer months. Three songbird species were added to Canada's list of species at risk last year alone, notes Bridget Stutchbury, a York University biologist specializing in birds that migrate between Central America and North America. And although lab studies have shown elevated exposure to pollutants such as pesticides, solvents and flame retardants to be lethal, their real-world impact remains poorly understood. Recently, attention has focused in particular on a class of pesticides that some scientists are fingering as likely culprits in the deaths of hundreds of millions of birds.

Perhaps the most vigorous voice in this group is that of Pierre Mineau, the Canadian government's top expert on pesticides and birds. Through research going back to 1978, he has helped prove that many pesticides used in the past were wreaking ecological havoc on wildlife – especially on large migratory species that consumed smaller prey contaminated with the chemicals. But, as regulators in Canada, the United States and Europe stepped in to ban compounds such as DDT, Mirex and Chlordane, chemical companies introduced a new generation of products.

These pesticides, with names such as Carbofuran,

Fonofos, Diazinon and 2-4D, are based on smaller chemical components that degrade faster in the environment. Governments anxious to phase out DDT and its more persistent brethren approved these pesticides for sale, says Mineau, who spent 1982 to 1996 reviewing the new chemical formulations for Environment Canada. The great majority of safety studies limited their focus to how laboratory rats reacted to eating the chemical pellets. "Unfortunately, they were required to do only limited testing on birds," says Mineau. Since then, research by Mineau and others has shown that these new compounds are acutely harmful to birds and other wildlife. Birds appear to be "exquisitely sensitive" to the pesticides, which scramble their nervous systems. And yet, he says, "we went on marketing and developing these neurotoxic chemicals with the foreknowledge they were very toxic to birds."

Reviewing pesticide applications in Environment Canada laboratories in Ottawa, Mineau grew increasingly worried about the lack of data on the new chemicals' effects on wildlife in the fields and forests sprayed with them. So, in the early 1990s, he decided to head back into the field. In a dazzlingly prolific series of studies – he has produced about 100 publications since 1990 – he went on to report disturbing findings about these chemicals and their effects on birds, as well as insects.

In the case of the pesticide Carbofuran, made by Philadelphia-based FMC Corporation and used on crops ranging from potatoes to canola, Mineau estimated that, at the peak of its use in the 1980s, the chemical killed as many as 90 million birds, comprising some 45 species, every year in the United States alone. In the same decade, Mineau estimated, the chemical caused between 244,000 and 1.3 million songbird deaths in western Ontario per year. Carbofuran (along with the insecticides Fonofos and Terbufos) was also implicated in a large number of bird deaths in British Columbia's Fraser Delta in the 1980s and 1990s.

Researchers not only saw evidence of birds dying after ingesting pellets of the chemicals, they also uncovered more subtle effects, seemingly the result of mere contact with sprayed pesticides. Neurological changes appeared to be reducing the ability of birds to feed themselves and their young, eventually resulting in death. In a 2000 study in southern Ontario led by one of Jim Quinn's PhD students, Christine Bishop, where Mineau sat on the academic committee, it was found that tree swallows in apple orchards were starving, because the chemicals both exterminated the insects that the birds feed on and depressed the birds' brain activity, diminishing their ability to hunt. The study linked pesticides to a drop in the number of eastern bluebird and tree swallow nestlings that survived to maturity and found thyroid, endocrine and immune system damage in young birds exposed to pesticides in the orchards.

The focus on apple orchards was deliberate. According to Mineau, of all the agricultural lands in the province, the 12,000 hectares devoted to growing fruit are treated with the greatest number of types and applications of pesticides – including such new-generation insecticides as Azinphos-

methyl, Diazinon, Phosalone and Phosmet. As the 2000 study revealed, individual nests of bluebirds and tree swallows, which commonly breed and forage in apple orchards, were exposed to as many as seven pesticide applications and up to five pesticide mixtures. By focusing on these two species in orchards, Bishop was able to establish that pesticide use depressed mature birds' brain activity by about 40 percent. Nestlings' brains were even harder hit. The scientists found that the chemicals did not kill the birds directly. Instead, they were losing the ability to find food and raise their young.

Mineau has not limited his investigations to Canada and the United States. In Central and South America, he found that chemicals used for the intensification of field crops such as sunflowers were decimating several bird species. He helped document incidents such as the killing of 20,000 Swainson's hawks – large birds that eat grasshoppers, which farmers often target with intensive pesticide use – by the insecticide Monocrotophos in a small area of the Argentine pampas in 1995.

By the mid-1990s, Mineau's work began to attract international attention. Michael Fry, head of advocacy for the American Bird Conservancy, calls him "one of the world's most important scientists investigating pesticide impacts on birds," and says scientists have relied heavily on Mineau's research during their two-decade battle to have imported food containing Carbofuran traces banned in the United States. They ultimately succeeded: in late May, the U.S. Environmental Protection Agency agreed to a ban. Days later, Health Canada said that they would be proposing a phase-out (see "Bad chemistry," page 24).

As he probed pesticide use in orchards, fields and forests, Mineau came to the conclusion that the methods by which chemicals like Carbofuran were safety tested were seriously flawed and underestimated their impact on birds. He became convinced that direct contact with skin – especially the dermal areas on the feet of birds and beneath the soft downy feathers under their wings – was contributing significantly to the rising body count, yet government reviewers failed to study it. In a recent internal report, Mineau informed Environment Canada that "dermal toxicity, or at least dermal penetration potential, *must* be considered in avian impact assessments." He would like to see this done for all new pesticides before they are approved for the market, as well as for pesticides already available. "We will possibly be able to direct manufacturers to provide dermal exposure research," he says, adding that scientists may now have enough information to base pesticide usage restrictions on actual field research rather than just on studies of exposure through ingestion.

Government scientists, ever wary of angering their political masters, tend to avoid criticizing regulations. During the research for this article, few scientists in the public sector were permitted to speak on the record (though some provided background information). But Mineau, senior scientist in pesticide ecotoxicology at Environment Canada, says he is willing to stick his neck out and directly challenge the status quo because bird populations are crashing. "We've now got a substantial body of research that suggests



## What you can do

### Get informed

- Bridget Stutchbury's book *Silence of the Songbirds* presents a detailed and passionate survey of the disaster befalling North American migratory songbird populations.
- The Committee on the Status of Endangered Wildlife in Canada, created in 1977, is a federal advisory body for designating endangered species under the Species at Risk Act. The organization's website ([www.cosewic.gc.ca](http://www.cosewic.gc.ca)) reports on endangered birds and other species.
- *Atlas of the Breeding Birds of Ontario 2001-2005* assesses how bird distributions have changed since the first atlas, which covered the period from 1981 to 1985, was issued. Reporting 1.2 million individual breeding bird records across the province, the newest atlas ([www.birdsontario.org/atlas](http://www.birdsontario.org/atlas)) shows the relative abundance of all the species in the province.
- *The U.S. State of the Birds Report 2009* ([www.stateofthebirds.org](http://www.stateofthebirds.org)) reveals some troubling population declines over the past 40 years among the roughly 800 species inhabiting the United States. At the same time, according to the report, "we see heartening evidence that strategic land management and conservation action can reverse declines of birds." Regarding the boreal forests, which are mostly in Canada, the report notes "a generally declining [bird population] trend over the first 25 years, and then a general increase more recently."

### Join a bird count

- The Ontario Forest Bird Monitoring Program ([www.on.ec.gc.ca/wildlife/newsletters/fbmp06-e.html](http://www.on.ec.gc.ca/wildlife/newsletters/fbmp06-e.html)), which the Canadian Wildlife Service coordinates, began in 1987. The objective of this program is to document bird population trends and the relationships between birds and their habitat during the breeding period. Volunteers use point counts to survey birds in both large forest areas and forest fragments.
- The Canadian Migration Monitoring Network ([www.birdscanada.org/birdmon/cmmn/main.jsp](http://www.birdscanada.org/birdmon/cmmn/main.jsp)) tracks populations of migratory passerines at a series of 25 stations across Canada. Fall migration, in particular, can reveal population trends for birds breeding in the boreal forest and farther north, as they move from their northern breeding grounds to their southern wintering grounds. At the stations, staff band birds and make daily visual counts of birds during spring and fall migration periods, among other activities.

- The Audubon Society launched the Christmas Bird Count on Christmas Day in 1900 as an alternative to traditional Christmas bird hunts. Over the decades, tens of thousands of birders have built a database on bird population trends unmatched by any other wildlife census. Last year, more than 100 communities in Ontario participated. Under the sponsorship of the Toronto Ornithological Society, 118 volunteers spent a combined 236 hours on December 14 tallying sightings of 89 species in Toronto. Christmas Bird Count results are available at [http://cbc.audubon.org/bccurrent/current\\_table.html](http://cbc.audubon.org/bccurrent/current_table.html).

### Support efforts to reduce pesticide use

- Environmental groups including Environmental Defence, the Sierra Club, Greenpeace and the David Suzuki Foundation all have campaigns to reduce pesticide use. The Canadian Association of Physicians for the Environment has been pressing for municipal bans on pesticides used for cosmetic purposes (see [www.cape.ca/toxics/pesticides.html](http://www.cape.ca/toxics/pesticides.html)).
- Growing food without pesticides will ease pressure on birds, and many people who are concerned about birds and the environment choose to buy organic food whenever possible. Studies from Ontario and Europe have found that bird populations are far more abundant on organic farms than on farms that use chemicals. And since Ontario migratory bird populations are now threatened, and pesticide use in Central and South America has increased almost fivefold since the 1980s, food from these regions should be given special scrutiny.

### Support habitat protection

- Because the Canadian boreal forest is by far North America's most important bird sanctuary, its protection is crucial. At 5.9 million square kilometres, it represents almost a quarter of the world's intact forest ecosystems, even more than the Brazilian Amazon. Nearly half of all North American birds – 325 species – rely on it. The Boreal Songbird Initiative ([www.borealbirds.org](http://www.borealbirds.org)) heads up the conservation efforts with Ontario Nature, as its provincial partner, taking the lead here.

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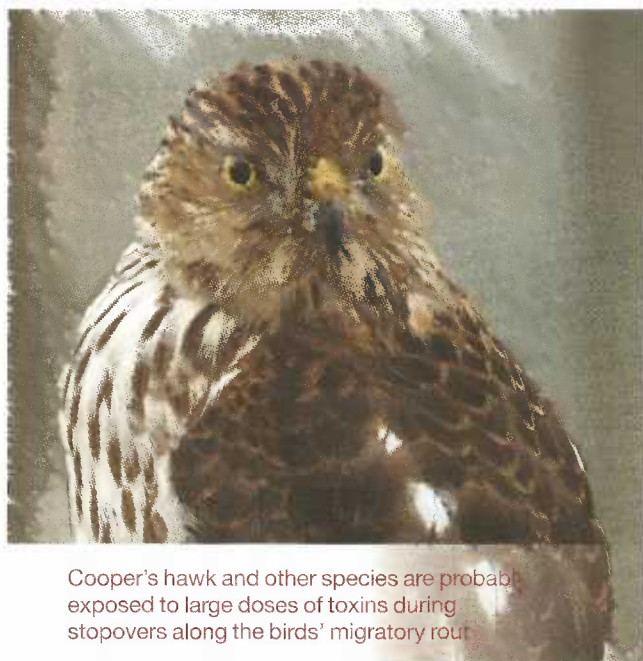
we cannot ignore dermal exposures," he says.

Mineau's conclusion raises concerns about the impact of agricultural chemicals used in intensively farmed Ontario counties such as Essex, Haldimand-Norfolk and Niagara, where grape, apple, corn and soybean fields are home to 138 species of birds. Although some, such as song sparrows, European starlings and horned larks, nest in these areas of intensive chemical use, many species are passing through during their annual migrations to and from the boreal forest. During their stopovers in agricultural zones, birds such as ospreys, merlins and Cooper's hawks may be exposed to far larger doses of toxins than government safety analysts ever anticipated.

Still, after three decades at Environment Canada, Mineau

knows that "regulatory procedures are glacially slow to change." While pushing for government action is important, he believes the most effective pressure will probably come from individuals who have become increasingly alarmed by wildlife decimation. But, as the experience with DDT shows, pesticide bans generally happen only after the harm has been done.

Other researchers across the province are expanding on Mineau's work. By midday at Hamilton Harbour, de Solla and his crew have taken samples from three fledgling cormorants and one adult. The team, which operates out of the Canada Centre for Inland Waters, a massive Environment Canada station on the edge of the



Cooper's hawk and other species are probably exposed to large doses of toxins during stopovers along the birds' migratory route.



Research has linked the drop in eastern bluebird numbers with intensive pesticide use in southern Ontario's apple orchards.

harbour, works gingerly with its study subjects. Each adult tested gets a boat ride to a field lab on an artificial island built for bird research, where hundreds of cormorants are raising families in nests made of sticks, mud, plastic bags and other garbage the birds have scavenged from the harbour.


As the scientists approach, the mature birds flee. To capture new specimens, de Solla and a pair of assistants set up chicken-wire traps that hold the birds without harming them. The researchers then motor back out into the harbour and wait for the birds to return to the island. With a little luck, the researchers will find an adult in the trap when they return half an hour later. By the end of the nesting season in July, Quinn and de Solla hope to have banked blood samples from about 100 birds, some also from a site on Lake Erie. Next year, they will be back for another season of laborious sampling. "It's not the most glamorous job in the world and you need a strong stomach," says de Solla as he steps around a pile of fish regurgitated minutes before by a fleeing bird. "But mostly, you need plenty of patience."

The plan, says Quinn, is to use the blood samples to examine the birds' DNA profiles. By comparing DNA from cormorants in hyper-polluted Hamilton Harbour with that from their counterparts on the less polluted site on Lake Erie, Quinn and de Solla hope to reveal whether the local airborne pollutants are causing intergenerational changes in the birds by permanently altering their genetic makeup. If Quinn and his colleague Carol Yauk's findings of genetic damage in herring gulls due to their exposure to toxic chemicals are anything to go by, it is likely that these changes could permanently harm the birds' ability to survive and reproduce.

Numerous other chemicals shown in laboratories to be harmful at high levels to birds – including heat-resistant silicone, stain-repelling perfluorinated compounds and brominated flame retardants used in carpeting, mattresses and furniture – also await investigation in the field. All these

chemicals have been released in massive volumes in wastewater, smokestack emissions and landfills for decades. As with newer pesticides, they are causing growing alarm, and the Canadian government is belatedly moving to ban some of them.

Wildlife toxicologist Kim Fernie, a colleague of de Solla at Environment Canada, discovered, for example, that brominated flame retardants adversely affect kestrels' ability to reproduce. "Kestrels are in decline across North America," says Fernie, who is now looking at the chemicals' effect on tree swallows living near sewage outflows in Hamilton Harbour. Preliminary findings suggest that the growth of these birds is retarded by exposure to these chemicals before they hatch, but Fernie says these findings should be interpreted cautiously. Whether the flame retardants are contributing to the plummeting populations of migratory birds across Canada remains unclear, she says. Three decades after regulators allowed plastics manufacturers to use compounds like brominated flame retardants, their impact on wildlife "is at the beginning stages," says Fernie.

As poorly studied pesticides and industrial chemicals continue to pollute our fields and forests, Mineau worries that their use in every region along bird migration routes – combined with other factors such as habitat loss – has tipped the balance against many species' chances of survival. Such a development would bode ill for numerous ecosystems – including, ironically, pesticide-soaked orchards – that depend on birds to spread seeds and hold insect populations in check. "We've crossed over a threshold with lots of species," says Mineau. "You kill enough of them and they'll have a hard time compensating." 

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