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# Wild Ones®

NATIVE PLANTS, NATURAL LANDSCAPES

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Celebrating natives
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## Where have all the insects gone?

**One parking space worth of dead bumbleees**

By Maryann Whitman

Do you remember the bug-spattered car windshields and radiator grills, when you were a kid? After a ride in the country, the insect guts and gore had to be scraped and scrubbed off the windshield. The radiator grill captured larger insects that didn't bounce off. It was clogged with big, black beetles, mantids, moths and butterflies—you could start an insect collection there was so much variety. Some clever marketer invented a "Bug Screen" for your car radiator. If your father drove anything fancier than a Chevy pickup, your family car might have had one.

Stories that start with "do you remember when?" usually draw bored groans. But the fact is that some events are actually part of an extended, very long-term process. You have to have been around a while to notice the progression, the creeping change in once common events.

We have no need for Bug Screens anymore. The gradual change is no more. Now, something new is happening—the insect disappearance that once may have been a long term process has recently reached a crescendo.

In June of 2013, in a Target parking lot outside of Portland,

55 neonic sprayed blooming Linden trees being covered with netting to prevent bee access; Wilsonville, OR; 2013

Oregon, occurred what has been called the largest single, bee die-off on record. Biologist, Rich Hatfield, of the Xerces Society for Invertebrate Conservation, estimated that 50,000 wild bees were killed.

Fifty-five linden trees had just been sprayed with dinotefuran (trade name *Safari*), by qualified technicians (it was a legal spraying). *Dinotefuran* is in a class of insecticides known as *neonicotinoids* (also called *neonics*). It was sprayed on the trees to control aphids. "They [the aphids] don't harm the tree, but they secrete sticky honeydew that's a nuisance," explained Aimee Code, pesticide program coordinator for the Xerces Society. The trees were in bloom, and covered with swarms of feeding bees, looking for nectar and pollen. Code added that the vast majority of bee die-offs that happen *are not recorded*, as they are not the result of misuse, as set by the limits on the label, or illegal use.

Sample jars of dead bees collected by Xerces scientists in a Target parking lot.

The Xerces Society has offices in Portland so their biologists were able to be on the scene. Being familiar with the effects of neonicotinoids, they quickly organized crews to cover all the trees with netting, to prevent bee-access to the nectar and pollen during the entire blooming period, thereby preventing further pollinator deaths.

There were seven other such events recorded in Oregon, each one involving a neonicotinoid insecticide being sprayed on a blooming linden tree. At the request of the Oregon Department of Agriculture, the state legislature passed a rule that makes it illegal to spray blooming lindens, basswoods and their relatives with any product containing dinotefuran, imidacloprid, thiamethoxam or clothianidin. These four, popularly used neonicotinoids, travel under a number of brand names, that represent "insect control": Admire, GrubZ-Out, Ortho Bug B Gone Year-Long Insect Control, Bayer All-in-One Rose Care, Amdro Lawn and Landscape Insect Killer, Safari, and one with a long name, that covers several bases—Ortho Tree and Shrub Insect Control PLUS Miracle Grow Plant Food. These are the brand names you might see in your local hardware store. The brand names used in large quantities by professional applicators, are different. The brand names of identical products in other countries may also be different.

A number of cities in Oregon and Washington (e.g., Eugene, Portland, Seattle, Spokane) have banned the use of all neonicotinoid insecticides on city properties. The United States Fish and Wildlife Service (USFWS) will phase-out (by 2017) use of these insecticides onWildlife Refuges in Hawaii, Idaho, Oregon and Washington. The USFWS has allowed crop-farming on wildlife refuge land for decades, with the aim of keeping the land under cover, while maintaining open habitat for wildlife. The ban will affect approximately 9000 acres of farmed, USFWS land.

In 2015 the U.S. Environmental Protection Agency issued a moratorium that will restrict the use of new neonicotinoid pesticides as this class of pesticides has been implicated in declining bee populations. The policy does not apply to products currently on the market.

More dramatically, the European Union passed a two-year ban in 2013 on three of the most frequently used neonicotinoid insecticides. *This action was recommended by a Commission of scientists after they had reconsidered data collected in 800 research papers on the effects-in-the-field of neonicotinoid insecticides.*

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Soil dust carries neonics off the field to wild areas.

## What are Neonicotinoid Insecticides? What should we know about them?

Since their introduction in the late 1980s, neonicotinoid pesticides have become the most widely used class of insecticides worldwide, representing more than a quarter of the global market share. In various preparations they are intended to be used to control whatever insect damage may cause a decrease in crop yield. The most frequently used application is neonic dusted seed, prepared and sold to the farmer for planting. Neonics may also be sprayed onto plants and onto soil, drilled into trees, injected into the soil, applied as pellets to the soil and onto fish-farming ponds.

*Neonics are typically used on such field crops as corn, canola, dry beans and peas, soybeans and farm cropped fruits and vegetables. But they are also available at high concentrations for spraying around our homes, schools, and city landscapes.*

These are the names to look for on labels, if you should wish to avoid using neonicotinoids: imidacloprid, clothianidin, thiamethoxam, thiacloprid, acetamiprid, dinotefuran, and nytenpyram.

## How Neonicotinoids work

Neonicotinoids are water soluble and as such are absorbed into the cellular structure of plants as they grow; into their leaves, into their flowers, into their fluids, into their seeds and fruits.

What makes neonics different from other pesticides is that they enter into and become part of the plant structure for the entire growing season, and, in many cases, part of the harvest. Since neonicotinoids become a part of the affected plants they are referred to as "*systemic insecticides*". **They may not be washed off by rain or by scrubbing; they cannot be peeled off fruits or vegetables. They are persistent in the plant, remaining effective over prolonged periods of time.**

Thus, they are *intended* to kill *arthropods* that feed on plant leaves and roots and burrow into their stems and trunks.

What organisms are arthropods? The main assemblages include *insects* (e.g., bees, beetles, bugs, earwigs, ants, termites, butterflies, moths, crickets, roaches, fleas, flies, mosquitoes, lice, centipedes, dragonflies, mantids, grasshoppers, etc.,), *arachnids* (e.g., spiders, scorpions, ticks, mites, etc.,) and *crustaceans* (e.g., crabs, lobsters, crayfish, shrimp, etc.,). While not arthropods, earthworms and fresh water mussels are also killed by exposure to neonics.

Like many pesticides the neonics kill arthropods by disrupting their nervous systems. They cause confusion, seizures and ultimately death. Some of the neonics are applied in conjunction with another systemic insecticide that also kills by disrupting the nervous systems of insects: fipronil; doubling the effect.

## Effect of Neonicotinoids on Crop Yield

The intention behind the use of neonics is to kill the specific insects that feed on crops, thereby increasing crop yield. It would be interesting to find out if "the gains in yield justify the costs generated by the unintended damage resulting from the use of neonics on millions of acres of cropland?"

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It should be pointed out that the use of *neonicotinoids is prophylactic*. The pesticides have been applied with the seeds, and are there, in the plants, ***whether any noxious insects show up or not***.

It appears that no systematic records of crop yields were collected by the EPA before issuing permits for the introduction of the currently used neonics. We can only wait to see what this year's harvests in the European Union will show us after their two year ban on neonicotinoids. The outlook at this point is that the harvest will be a good one.

## Alternatives to Neonicotinoid Insecticides

At the top of this list is Integrated Pest Management (IPM). IPM has probably been practiced since the beginning of agriculture.

It is an interconnected system of pest management that relies on attention and timely action from the grower. EPA on their website outlines four important steps:

1. Action Threshold: Sighting a single pest does not always mean control is needed.
2. Monitoring and Identifying Pests: Many organisms are innocuous or beneficial. Not every weed and bug needs to die.
3. Prevention: For field crops this primarily involves rotation of crops[1] (e.g., soy beans this year, corn the next).
4. Control: Evaluate the proper control method both for effectiveness and risk. Effective, less risky pest controls are chosen first, including highly targeted chemicals, such as repellants and specific attractants (pheromones disrupt pest mating), or mechanical control, such as trapping or weeding.

*Broadcast spraying of non-specific pesticides is a very last resort.*

Growers using organic methods are required to be much more stringent in their choice of methods of control.

## Unintentional Consequences of Neonicotinoid Use and Effects on Ecosystem Services

Because of the chemical structure of neonicotinoids, they break down slowly and are persistent in the soil. The plants that were treated at the beginning of the season die at the end of the season, depositing their remaining, potentially still potent, dose onto the soil. The half-life (the period of time it takes for half of the product to break down) of imidacloprid (patented by Bayer in 1985, and now globally the most frequently used neonicotinoid insecticide) in the soil is 1,091 days. At the end of the growing season, when the dead plants have deposited their dose, potentially 2/3 of the imidacloprid is available to the soil. The following season's application augments this remaining dose, and so on. Neonicotinoids can accumulate in the soil when applied repeatedly, year after year, and logically can be taken up by plants, at higher doses than intended, or picked up from the soil by plants not intended to be treated with *any* insecticide.

Grasshopper sparrow with grasshopper tghat might have eaten a neonic treated leaf. Photo: Carl Kurtz

This interaction of events is complicated by winter temperatures (think of crop fields in North Dakota and in Saskatchewan). The colder the winter temperatures, the longer the neonicotinoids last in the soil and water.

The dose carried by seeds drilled into the soil (as they are intended to be), is what is supposed to limit the effect to invertebrates/arthropods while protecting vertebrates, like humans. However, it has been observed that some treated seeds that fall on the ground during planting time and are not 'drilled in', carry a sufficient *cumulative* dose (from a number of treated seeds) to affect birds.

The *neonicotinoids are intended* to target specific insects that lower crop yield by feeding on the treated plant leaves and roots, and burrow into their stems and trunks. The *unintended effects of neonics,* in general, are long-term and are difficult to quantify, but critically important as they affect ecosystem services.

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They *kill exposed, non-target, potentially desirable insects* that collect and feed on treated pollen and nectar, or sip on any fluids that the plants might release (guttation), or eat (recycle) the dead plant material at the end of the season.

Examples of these more desirable insects are the predatory beetles, detritus processing beetles, some parasitic wasps, and insects that feed on pollen and nectar such as many butterflies, moths and domesticated honey bees, bumblebees and all sorts of other wild native bees. While the effect on the domesticated honey bee has been intensively studied, it appears that bumblebees and other wild bees are also affected in a similar manner.

Neonics have been found in the pollen and nectar in a large proportion of bee hives. Systematic measurement of this sort is not possible with wild bees. Honey bee death and disappearance have been reported by estimated body counts at hives. These occurrences are typically countered by pointing to infestation by varroa mites and nosema disease in honey bees. Researchers, however, indicate that neonics weaken the honeybees making them more vulnerable to the external mites and gut disease.

It is further hypothesized that the effect of neonics on both honey bees and wild bees is "*sublethal*". That means that while the bees suffer the nervous system effects other arthropods do, they do not die immediately. What is affected is their weight gain, and through disruption of their nervous systems, their ability to learn and remember pathways home and to new foraging fields. Death may occur after repeated exposure to toxic pollen and nectar. It would follow that *beehive and wild colony health and resilience* would also be affected.

The effects on wild pollinators such as native bees, moths and butterflies, and on insect eating bats and birds (think of caterpillars that are a dietary staple of most nestlings), must be carefully monitored.

Further, loss of pollinators will likely disrupt another chain of events that begins with seed production—another ecosystem service. Endangered plants will likely have a crucial stake in this pollinator service.

It has been pointed out that  the dust raised while treated seed is being planted, settles on wildflowers in hedgerows and nearby fields. In fact, neonics have been recorded in dandelions. These and other wildflowers then are capable of delivering small but repeated doses to pollinators, and potentially failing to set seed when the pollinator numbers drop.

The fact that neonicotinoids are water soluble and thus enter the soil raises the question of their effect on soil arthropods, some of them microscopic, occupying spaces between soil particles. A large study has shown that the soil populations of arthropods are dramatically changed. Some of the creatures go deeper into the soil, some disappear entirely. This demonstrates that this ecosystem service as well, is compromised.

Solubility also permits the neonics to enter our surface waters, affecting susceptible populations there. Killing insects and other invertebrate-life in our ponds and drainage ditches[2] has the potential to disrupt entire food chains and their ecosystem services.

## Conclusion

This is a complicated set of circumstances that has emerged over time.

These systemic insecticides are applied to commercial field and vegetable crops, fruit orchards and vineyard grapes. Nurseries sell garden plants that are treated with neonicotinoids in the original growing nursery. Neonics are also readily available for use in home flowerbeds, vegetable gardens and lawns, and around golf courses, schools and city landscapes.

It is critically important that we educate ourselves, so we can make the best decisions for our stewardship toward a sustainable Earth

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[1]Crop rotation means that the same crop is not planted in the same field more frequently than every third year. It is a practice that farmers have been using for centuries. It disrupts plant disease cycles and the life cycles of insect pests. It also prevents the depletion of nutrients.

[2]This refers to the practice of installing drain tiles under the soil in wet fields. The tiles are connected collect excess water and empty into created ditches, which carry the water off the field and eventually to our creeks and rivers.

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