Letter from Washington

Chemical Sensitivity Demands Accommodation for Bees and Humans

If anyone needs evidence of the extremely urgent need to stop hazardous pesticide use, just have them read about the disappearance of the bees. This issue of Pesticides and You is a good start. Yes, this crisis is a complex issue, but a little digging on the issue brings us directly to the fact that our pesticide policies do not adequately protect sensitive species, with bees at the top of the list.

Colony Collapse Disorder

We devote much of this issue of PAY to the crisis of colony collapse disorder (CCD) in the honeybee population. CCD is an increasingly widespread phenomenon of bees disappearing or abandoning their hives. There are, of course, numerous theories that involve pesticides, viruses, and pathogens. Bayer CropScience, the manufacturer of one of the implicated pesticides, imidacloprid, dismisses the pesticide connection. But countries, including France, Germany and Italy, have taken steps to limit its use, along with other pesticides like fipronil. The National Union of French Beekeepers brought the problem to national attention and forced their government to restrict these pesticides. The U.S. lags behind, outside the glare of public outrage and protests that have been seen in Europe.

The pesticide link to bee poisonings is not new. And, the lack of an adequate regulatory response is as old as our 1972 federal pesticide law and all its revisions. What we are seeing today is an escalation of a problem that has been building for decades. Bees support our environment, pollinating half the flowering plant ecosystem and one-third of agricultural plants.

Problems Escalate Under Risk Assessment Standards

The disappearance of the bees alerts us to a fundamental and systemic flaw in our approach to the use of toxic chemicals –and highlights the question as to whether our risk assessment approach to regulation will slowly but surely cause our demise without a meaningful change of course. Michael Schacker, the author of *A Spring Without Bees: How Colony Collapse Disorder Has Endangered Our Food Supply*, reviewed in this issue of PAY, identifies humans' anthropocentric worldview as justifying our manipulation of nature to the brink of destruction. The bees should serve as a warning because our very existence depends on theirs.

The bee problem, which is not new just more frightening than it has ever been, should be a wake-up call. It should force a rethinking of how we approach policies that allow the management of "pests" with a war-like mentality and the continued use of chemicals for which there are safe alternatives. While admittedly uncertain and filled with deficiencies, risk assessments establish unsupported thresholds of acceptable chemical contamination of the ecosystem, despite the availability of non-toxic alternative practices and products. In fact, the only acceptable policies in this crisis are those that eliminate toxic pesticide use. The only acceptable legislative reform proposals are those that eliminate unnecessary toxic chemical use. For example, why do we allow chemical-intensive practices in agriculture when organic practices that eliminate the vast majority of hazardous substances are commercially viable? Risk assessments, supported by environmental and public health statutes, in effect prop-up unnecessary poisoning.

The Human Connection

An unhealthy ecosystem adversely affects the health of all those living in it. So, it comes as no surprise that people, along with other species, suffer environmental illness.

It is not a far stretch, then, to focus on environmental illness in humans. The same neurotoxic impacts on bees are being diagnosed in humans. So, as we write about in this issue of PAY, it is time for the Justice Department in implementing the Americans with Disabilities Act (ADA) to recognize chemical sensitivity (CS) or environmental illness as a disability that requires accommodation at work, school, in housing, and recreation areas --all public areas to which access is denied because of toxic pesticide use. Beyond Pesticides, with groups across the country, submitted comments this summer, published in this issue, urging the department to recognize that chemical exposure "substantially limits one or more of the major life activities of such [chemically sensitive] individuals," qualifying those adversely affected for protection under the law. In light of the availability of alternative approaches to pest management that do not rely on toxic chemicals, we believe it is reasonable to expect such protection. The time for this is long overdue.

If bees could speak to us, they would probably say what Linda Baker, a former teacher and coach from Kansas, wrote in our ADA comments about those with CS. "[L]ack of accommodation caused their illness to progress to the point where they could no longer work." She continues, "CS takes a huge toll on individual lives and results in unnecessary loss of productivity." Author Michael Schacker asks whether we are really facing "Civilization Collapse Disorder."

Solutions Are Within Our Reach

Solutions to the loss of bees and human productivity are clearly within our reach if we engage our communities and governmental bodies. A little outrage will help. We know how to live in harmony with the ecosystem through the adoption of sustainable practices that simply do not allow toxic pesticide use. Whether we are talking about managing buildings or landscapes, it can be done. It must be done. Our survival depends on it.

- Jay Feldman
Executive Director of Beyond Pesticides

Pollinators and Pesticides

Escalating crisis demands action

by Natalie Lounsbury

Blueberry growers in New Brunswick were rudely awakened to the damaging potential of pesticides on pollinators in the 1970's. Spraying fenitrothion for spruce budworm so drastically affected native pollinators in the forests adjacent to their blueberry fields that the crop production was abysmal. In the last few years, the negative impacts that pesticides have on beneficial insects have come to light again with severe honeybee hive losses known as colony collapse disorder (CCD), a devastating epidemic in which pesticides have been implicated. The pollinators' decline has occurred in the context of pesticide regulations that are criticized by safety advocates for their lack of attention to sublethal effects of pesticides, individually and in combination, on beneficial insects like bees.

The food system and almost all terrestrial ecosystems depend on pollination. Recent economic analysis has estimated the global value of insect pollination alone on agricultural crops at €153 billion, which is 9.5% of the total value of world agricultural production. Facing risks from pesticides, introduced pathogens, habitat destruction and fragmentation, the future for pollinators is shaky. Agricultural and land management practices on all scales that do not use pesticides and that provide habitat for wild pollinators may hold the key to restoring the health and viability of diverse pollinator communities—both managed and wild.

Wild pollinators

Pollinators are "a bellweather for environmental stress as individuals and as colonies." Honeybees (*Apis mellifera*) are perhaps the best known pollinators in the world and the primary managed pollinators, but they are by no means solely responsible for the pollination of all flowering plants. Both in non-agricultural settings and in agricultural crops, wild, native pollinators play an essential role in plant reproduction and food production. While honeybees are undeniably important and rightly deserve the present concern over their survival, this attention should not overshadow the critical survival of all pollinators.

The decline of wild pollinators received increased attention in the late 1990s when researchers identified the need for action to understand and protect them, though others warned of the threat earlier. Wild pollinators, which include non-Apis species of bees, wasps, beetles, flies, butterflies, moths, birds, bats, and even some non-flying mammals, have suffered "multiple anthropogenic insults" in the last several decades. These include habitat destruction and fragmentation, pesticide use, land management practices and the introduction of non-native species and pathogens, all of which collectively threaten their existence.

What was dubbed a "major pollination crisis" in the 1990s has only become more pressing with the current increased threat to both honeybees and wild pollinators. Pollination is a reminder that ecosystems, including agricultural ecosystems, are comprised of a series of interdependent relationships. A response to this crisis necessitates a balanced approach to addressing the threats to both honeybees and wild pollinators, and undeniably one of these threats is pesticide use.

What is threatening the wild pollinators?

Entomologists suspect that lethal and sublethal effects of pesticides are one of the many "anthropogenic insults" threatening wild pollinators. Pesticide risk mitigation measures intended to protect honeybees do not always constitute risk mitigation for other pollinators such as bumblebees because they have different foraging practices, social structures and genetics. Minimal research on pesticide toxicity for wild pollinators indicates that many pesticides currently in use do have deleterious effects on pollinator populations such as bumblebees, but "hard data are largely lacking" (Goulson, 2008).

Spraying pyrethroid insecticides in the early morning or late afternoon, when honeybees are less likely to be foraging, is considered a risk mitigation measure for honeybees, but it actually endangers wild pollinators such as bumblebees. These times, when the temperatures are lower, are exactly when bumblebees forage. Bumblebees are particularly important in light of the current honeybee crisis because at sufficient densities they can very efficiently pollinate many of the crops that honeybees do. In order to protect all pollinators, these distinct differences must be taken into account when considering pesticide risk assessments and risk mitigation measures.

In 1998, researchers suggested that an ideal program to study non-Apis bees and other invertebrate pollinators would include "multi-year assessments of sublethal and lethal effects of pesticides and herbicides [sic] on wild invertebrate pollinator populations in and near croplands" (Allen-Wardell, 1998). Such a research undertaking is challenging given the numerous factors that could possibly affect wild pollinators ranging from pesticide use to habitat destruction, weather, pathogens, or other uncontrolled events. Recent studies, however, have revealed the drastic impacts that crop and land management strategies have on wild pollinator diversity and abundance.

Natural management benefits bees

One study in Canada analyzing wild bee abundance and pollination deficit (the extent to which the flowers were or were not completely pollinated) in organic, conventional and genetically modified (GM) canola fields (a crop that relies on wild bee pollination—the researchers found less than 2% honeybees) found that organic fields had both the highest bee abundance and the lowest pollination deficit. GM canola had the lowest bee abundance and greatest pollination deficit. The researchers note that the organic fields in the study were smaller, which may have affected the results, but the GM and conventional fields were the same size, indicating that different cultural practices contribute to bee abundance and pollination deficit. Organic fields were also located farther apart from one another, which provided more "natural" habitat for wild bees.


A wild beehive in Maui, Hawaii

While it is impossible to attribute the increased abundance of wild bees in organic fields in this study solely to the lack of pesticide usage, the results underscore that organic agriculture encompasses more than just what it is not used in production since it is a whole approach to farming. Good organic practices incorporate ecological principles that recognize the importance of maintaining habitat areas for wildlife, including wild pollinators. A German study looked at bee diversity with respect to farming practices, landscape composition and regional context, and found that organic farming practices had a significant positive effect on bee diversity (Holzschuh, 2007). The lack of herbicides used in organic land management led to greater floral abundance, which is essential to providing a continuous supply of food for pollinators.

These findings are echoed in research looking at the management of roadsides and bee abundance and diversity. In Kansas, native bee diversity and abundance was compared in "conventionally" managed roadsides, which use herbicides, frequent mowing and non-native grasses, and roadsides that had been restored to native plants. Bee abundance and diversity is much greater in roadsides with native plants.

Pollination

In flowering plants (angiosperms), pollination is the transfer of pollen grains from the anther (male structure) of a flower to the stigma (female structure) of a different or the same flower (some flowers are unisexual, containing only anther or stigma, while other flowers contain both). This process leads to fertilization, and the production of seeds. Plants have evolved with different mechanisms for pollination, and many of them have coevolved with animals that aid in the pollen transfer. It is estimated that 75-90% of the nearly 250,000 species of angiosperms in the world today rely on pollination by animals, especially insects. Even some plants that are "self-pollinating," such as soybeans, have been shown to benefit greatly from the help of insects in the pollination process. The number of flower-visiting species of animals worldwide is estimated at nearly 300,000. The remaining angiosperms rely on abiotic forces such as wind, gravity and water for pollination.

Bees

Among all animal groups, bees pollinate the most plants. The majority of over 20,000 species of bees rely on flowers for food. According to the Xerces Society, native bees, of which there are 4,000 species in North America, are the most important group of pollinators on this continent. Over 70% of them are ground nesting, while 30% make their homes in old beetle tunnels or similar locations. Humans can help encourage native bees by creating suitable nesting sites for them, and planting appropriate flowers. For more, see page 17.

The most common managed bee species is the honeybee (*Apis mellifera*), which enables the pollination of over 90 crops and contributes an estimated $15 billion annually to the U.S. economy. Other species are also managed explicitly for pollination, such as alfalfa leaf-cutter bees (*Megachile rotundata*), and various bumblebees (*Bombus sp.*). The introduction of managed species can have deleterious effects on native populations, if appropriate screening and considerations are not made. Because bumblebees can be very efficient pollinators, there has been increased interest in bombiculture, or the management of bumblebee species, particularly in greenhouses. This has contributed in some instances to the decline of native populations because of introduced pathogens. Some viruses may be more virulent in bumblebees than honeybees, for example. More research on the cross-infectivity between various bee species is necessary. Other reasons for the documented decline of native bumblebees include pesticide use and habitat destruction.

Flowers pollinated by bees have distinctive characteristics such as a "landing platform," a scent, and frequently distinctive patterns that are adapted to be recognizable to bees and optimize the bee's attributes. They are never pure red, as bees cannot perceive the color red. Some important examples of agricultural crops pollinated by bees include almonds, apples, blueberries, melons, and many more. Some plants, such as tomatoes (which do not produce nectar), are better suited to "buzz" pollination, for which bumblebees are particularly well-suited.

Moths and Butterflies

Flowers pollinated by butterflies and moths share some visual and scent characteristics with bee-pollinated flowers, but they can be red, and generally are adapted for the moths' and butterflies' long, sucking mouthparts. Along with pollinating many wild plants, moths pollinate tobacco. Protecting migratory habitat for pollinating butterflies is particularly important to their survival. Research has shown organic farming methods to support higher abundance and species diversity for butterflies compared to conventional chemical-intensive farming.

Beetles, Flies, Wasps and Other Insects

Many tropical crops are pollinated by insects other than bees. Oil palm, for instance, is pollinated by weevils, cacao is pollinated by midges, and mango is pollinated by flies and other insects.

Bats and Other Mammals

Bats and flying foxes pollinate cacti and agave, rain forest canopy trees, durians, wild bananas, neem trees (an important source for natural pesticides) and palm trees. There is "unequivocal evidence" of dramatic declines in many species of pollinating bats. The reasons for these declines are not entirely understood, but include habitat destruction and possibly environmental contamination. In addition to the pollination services some bats provide, bats play other important roles in the ecosystem, which include eating many agricultural pest insects and mosquitoes.

The importance of lemurs, monkey, and tree squirrels as pollinators is not well documented though many of these species are frequent flower visitors, but some documented cases of obligate (necessary for survival) pollination exist. For example, the black and white ruffed lemur is the only known vertebrate with the ability to open the bracts of the plant known as the traveler's tree in order to effect pollination.

Birds

Most hummingbirds are not obligate pollinators of particular plants, but they contribute to a heavy fruit set. Some hummingbird species are threatened. Perching birds not well understood in their role for pollinating, but at least some plants rely exclusively on them for cross-pollination. Birds also play an additional role in plant reproduction through their scattering of seeds.

In addition to adding a continuous supply of food for pollinators, natural habitat and increased floral cover can also encourage beneficial insects, which in turn reduce the "need" for pesticides. For example, in the 1960s it was shown that the incidence of ichneumonoid (wasp) parasitism of codling moth in apple orchards increased if floral resources, such as weeds, were present.

Indicating the importance of natural habitat in promoting bee diversity and abundance, researchers in New Jersey and Pennsylvania found that native bees made up more than half of the bee visitations to tomato and watermelon flowers on similarly sized conventional and organic farms with natural habitat nearby (Winfree, 2008). In this study, bee visitation rates did not differ significantly between conventional and organic farms. The results led the authors to conclude that features generally associated with organic farming but not exclusive to it, such as natural habitat inclusion and smaller field size, have a significant effect on pollination or pollinators.

These results do not exclude the possibility that certain pesticides used in conventional farming negatively affect pollination and pollinators, as the insecticides used on the farms in this study are not representative of the broad range of pesticides to which many bees are exposed. In particular, the farms did not use pesticides in the neonicotinoid family, which are highly toxic to bees. The authors raise the point that pesticides approved for organic production may also affect bee health. The natural insecticide spinosad, for example, has been shown to have sublethal effects on bumblebees at realistic exposure levels.

Apis mellifera, the honeybee

Recent research has shown that landscape management that allows for nesting sites and plenty of floral resources can play a role in encouraging wild pollinators and thus reducing dependence on honeybees, but as of now, "we have relied entirely too much on a single introduced generalist pollinator, the European honeybee, to carry out the bulk of agricultural pollination" (Allen-Wardell, 1998). In the U.S., it is estimated that the value of honeybees as pollinators of over 90 crops is $15 billion annually. Over two million honeybee colonies are rented annually in this country for pollination, and many of them are transported long distances to meet crop demand in disparate places from Florida to California.

The current food system relies heavily on the hard working honeybee. However, the appearance and widespread devastation of CCD clearly indicate that efforts to protect the treasured pollinator and honey producer have fallen short.

Colony Collapse Disorder (CCD)

The name itself, Colony Collapse Disorder, describes the latest threat to honeybees as it manifests itself, but provides no hint as to the cause of the malady. Though first reported in 2006, cases probably indicative of CCD were documented as early as 2004 in the U.S. CCD is unlike other ailments that have affected honeybees in the past because worker bees simply disappear rapidly, never returning to the hive where the queen still lives with a small cluster of bees amidst pollen and honey stores in the presence of immature bees (brood). It has been reported that losses of honeybee colonies across 21 states in the winter of 2007-8 averaged 35%, with a high degree of variability. Large declines of honeybee colonies were also experienced in select European countries, where average losses were 26% (USDA, 2006).

Many indications point to CCD potentially being induced by pesticides in the neonicotinoid family, including imidacloprid and clothianidin, in combination with other pesticides, pathogens, nutritional deficits and environmental stresses. Continued debate about the cause of CCD threatens to induce "paralysis by analysis" in a situation that necessitates action.

Previous honeybee declines and CCD

Although CCD manifests itself differently than any honeybee malady in the past, honeybees have suffered from various insults throughout the last several decades. In the 1980s, two mites, *Varroa destructor* (vampire mite) and *Acarapis woodi* (tracheal mite) caused large die-offs and led to the continued widespread use of miticides, such as tau-fluvalinate and coumaphos, in hives. Bacterial infections such as Paenibacillus larvae have also led to widespread use of antibiotics to treat bees.

Analysis of microbes in CCD-affected colonies show that while affected and unaffected hives contain a similarly diverse array of bacteria and fungi, a particular virus is strongly correlated with CCD-affected hives. Researchers determined that although a causal relationship between Israeli acute paralysis virus (IAPV) of bees and CCD could not be proven, IAPV is nonetheless a significant marker for CCD. Why this relationship exists is unclear, but indicates the potential for multiple mechanisms in inducing CCD.

Genetics of the honeybee

Some insects rapidly evolve to defend against the barrage of toxic chemicals intended to kill them, and develop resistance. Companies developing pesticides respond with new pesticides in different chemical classes. Unlike other insects, no major metabolic resistance mutations have been documented for honeybees. Pesticides in multiple classes, including carbamates, organophosphates, synthetic pyrethroids, chlorinated cylcodienes and chloronicotines (neonicotinoids), are all highly toxic to honeybees.

After analyzing the recently decoded honeybee genome, scientists believe that honeybees' extreme sensitivity to insecticides and lack of mutations leading to resistance may be a function of limited genes (in comparison to other insects) associated with detoxification of xenobiotics (chemicals foreign to the organism, including insecticides). Toxicological assessments for honeybees on both the lethal and sublethal effects of pesticides alone and in combination (additive and synergistic effects) are paramount given their extreme sensitivity and essential role in agriculture.

Analysis of pesticide residues in pollen loads in France reveals that real-world pesticide exposure for honeybees includes a wide variety of chemicals, the most common of which include imidacloprid (appearing in nearly 50% of samples) and fipronil, along with their metabolites. All of these chemicals have been shown to have effects at sublethal doses on learning and memory in honeybees. Reports indicate that data is forthcoming on the analysis of pesticide residues in pollen and honey for the U.S., which may shine light on the particular pesticide exposures of U.S. honeybees and how that contributes to CCD.

Imidacloprid and the neonicotinoids: Regulatory deficiencies and flawed manufacturer data

While not dismissing the possibility that CCD is a result of myriad factors including pathogens, a closer look at neonicotinoid pesticides is nonetheless warranted in light of rapid increased usage and high bee toxicity. Imidacloprid was the first insecticide in this class to be approved by the Environmental Protection Agency (EPA) when Bayer registered it in 1994. For more information on how imidacloprid works, please see the factsheet on page 18.

The case of the neonicotinoids exemplifies two critical problems with current registration procedures and risk assessment methods for pesticides: the reliance on industry-funded science that contradicts peer-reviewed studies and the insufficiency of current risk assessment procedures to account for sublethal effects of pesticides (in particular systemic pesticides that bees ingest via pollen and nectar).

A discourse analysis of the debate that took place in France following massive bee die-offs like CCD provides an interesting perspective from which to look at the discussion underway in the U.S. regarding the neonicotinoids. According to scientists there, Bayer used studies flawed in both design and execution to create a sense of uncertainty in France surrounding imidacloprid's toxicity to bees. Bayer produced reports that were not peer-reviewed indicating that bees would not be adversely affected by imidacloprid. Peer-reviewed studies showed effects of imidacloprid at much lower levels than Bayer acknowledged.

The situation created what the researchers dubbed "manufactured

How do pesticides affect pollinators, especially bees?

The full ramifications of how pesticides affect pollinators, in particular bees, are not thoroughly understood. However, here is a brief overview of the effects.

Lethal effects

Many pesticides are acutely toxic to bees and result in death. Representative pesticides in the following classes are considered highly toxic to bees (causing death for over 1000 bees per hive per day at expected exposure levels): carbamates, organophosphates, synthetic pyrethroids, chlorinated cylcodienes and chloronicotinoids (neonicotinoids).

Sublethal effects

Pesticide levels that do not kill bees at statistically significant rates may nonetheless have effects on performance that inhibit tasks such as olfactory learning, foraging, and reproduction, which in turn affect hive survival. Reduced learning after 11 days exposure to sublethal doses has been documented for imidacloprid, fipronil, deltamethrin, endosulfan, and perchlorate.

Synergistic effects

Often pesticides have more toxic effects in combination than alone. Imidazole fungicides and pyrethroid insecticides have documented synergistic effects on honeybees at doses that did not elicit reactions when used alone.

Food availability

Herbicides used in fields, along rights-of-way, and in forests tend to reduce the number of flowering plants. This reduces the amount of food available for native pollinators, making their survival more difficult. This has effects throughout the food chain, as reduced flowering and pollination leads to reduced fruit set for plants on which birds and other creatures depend. Beekeepers avoid this problem by moving their hives, making sure there is a food source, and even providing additional food to their honeybees. However, as the survival of wild pollinators becomes increasingly important in light of the troubles of the honeybees, the issue of floral/food availability will need to be addressed.

International actions to protect honeybees

France, where beekeepers initially noticed mysterious bee die-offs in 1994, was the first country to act against the insecticide imidacloprid, which beekeepers and scientists linked to the losses. Although controversial, after years of heated public debate and a strong network of advocacy spearheaded by beekeepers, French authorities stopped the use of imidacloprid on sunflowers in 1999 and on corn in 2003. When Bayer applied for French registration of clothianidin, which is in the same neonicotinoid family as imidacloprid, it was denied.

Other countries throughout Europe have also experienced drastic reductions in their honeybee populations and taken action. In May 2008, Germany suspended the use of eight insecticides toxic to bees, including clothianidin and imidacloprid, following a massive bee die-off. In September 2008, Italy followed suit and suspended the use of clothianidin, imidacloprid, fipronil and thiamethoxam for seed treatments of rapeseed oil, sunflowers, and corn.

uncertainty" posing as scientific uncertainty about imidicloprid's toxicity. The manufactured uncertainty then prolonged the debate about what was causing the bee malady and whether officials should take action against imidacloprid.

France eventually suspended the use of imidacloprid on sunflowers in 1999 and corn in 2003, and did not approve the use of clothianidin. Immediately following the suspension, an increase in bee survival was not observed, but anecdotal evidence indicates that bees began to return to full health in 2005 after fipronil, another pesticide highly toxic to bees, was also restricted. In 2008, Germany and Italy suspended pesticides associated with bee toxicity. See box above.

With discussion of the possible connection between neonicotinoids and CCD in the U.S., scientists argue that the risk assessment process for pesticides is unsuitable for systemic pesticides because it fails to take into account the chemicals' sublethal effects, which can have devastating implications for colonies. Data strongly suggest that neonicotinoids affect behavior of bees at very low, sublethal doses. Given this information and the incredible importance of honeybees to the economy and food systems, this is a prime opportunity to follow the example of France and take action, despite what might be considered scientific uncertainty.

Conclusion

The forces affecting both honeybees and wild pollinators are numerous and complex. A multi-faceted approach to ensure a healthy and diverse pollinator community, which will in turn contribute to a sustainable food system, must look at the effects of pesticide use on pollinators. From the use of neonicotinoids that are implicated in CCD, to the synergistic effects of certain pesticides on honeybees and the reduced food availability for native pollinators as a result of herbicide use, pesticides have taken a toll on both honeybees and wild pollinators. The situation necessitates a multi-pronged strategy to address honeybee health and encourage native pollinators —from planting backyard gardens that encourage pollinators and getting neighborhoods to stop using toxic pesticides to fixing a flawed federal pesticide regulatory process. The CCD crisis provides the perfect opportunity to exercise what many have long advocated as the proper approach to pesticide regulation —the precautionary principle. CCD may well be the result of a combination of factors, but certain pesticides' documented toxicity to bees calls for severe caution.

For more information on the impact of pesticides on pollinators, contact Beyond Pesticides. Information on pesticide toxicity to bees and other organisms is available on Beyond Pesticides' Gateway on Pesticide Hazards and Safe Pest Management at www.beyondpesticides.org/gateway. Alternative factsheets are available at www.beyondpesticides.org/alternatives/factsheets.

A fully cited version of this article is available online at www.beyondpesticides.org/infoservices/pesticidesandyou.

Encourage pollinators at home and in your community

1. Choose nonchemical solutions to insect and weed problems. Many insecticides are highly toxic to pollinators, especially bees, and using them in your house and yard can affect populations. Not using herbicides will benefit pollinators as it can provide them with more food sources.

2. Create habitat for encouraging native bees. According to the Xerces Society for Invertebrate Conservation, 70% of native bees are ground nesting, and 30% make their nests in old snags or similar locations. To encourage ground nests (away from where people may commonly be!), a bare patch of ground is necessary in a sunny, well-drained spot. Many bees will build nests in old rodent holes. To encourage snag-nesting bees, leave snags on trees unless they pose a risk. You can also create nesting blocks to encourage these bees. Common sense precautionary measures such as looking out for bee nests and avoiding them can eliminate the majority of concerns about bee stings, as most bees will only sting if provoked.

3. Plant a pollinator garden. Planting even small patches of flowers, especially native flowers, can provide important food sources for native bees and butterflies. It is best to choose an assortment of flowers that will bloom throughout the season, creating a continuous food supply. Research has shown that planting in clumps works best to attract bees. Even small urban backyard gardens are important sources of food for native pollinators. For more information on appropriate plants for pollinators, contact your local native plant society or extension service.

4. Provide water for pollinators. As long as water is changed daily to avoid creating mosquito habitat, providing water and even mud (an important nesting material for some bees) can greatly help bees, butterflies and other beneficial insects when times are dry.

5. Keep honeybees. To face the challenges and rewards of keeping honeybees, look for a local beekeeping society and classes. Although the agricultural census numbers for beekeeping do not keep track of hobby beekeepers, these beekeepers contribute significantly to the pollinator force (and honey is delicious!).

6. Buy local, organic produce and honey. Organic farming does not allow those pesticides that are most toxic to bees, and organic farms often have smaller field sizes and more floral diversity (weeds) than conventional farms.

7. Support land conservation practices that maintain pollinator habitat. Get involved in local land trust or conservation efforts to maintain both wild and agricultural areas in ways that are conducive to pollinator success. This includes encouraging practices on farms such as planting flowering native plant borders, and maintaining natural habitat areas adjacent to fields. In conserved "wild" areas, the use of herbicides should be discouraged as it can reduce the amount of food available to pollinators.

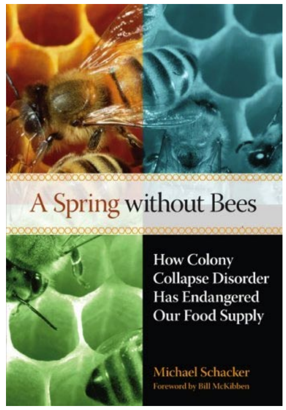
8. Encourage the planting of native plants in your community. Golf courses, roadsides and parks all offer places to plant patches of flowers that will provide food sources for pollinators and will add beauty to the community. These areas require less mowing than many introduced species of plants.

Sources:
Xerces Factsheets: Plants for Native Bees in North America, Nests for Native Bees, www.xerces.org; University of Maine Cooperative Extension: Understanding Native Bees, Bulletin #7153

A Spring Without Bees

How Colony Collapse Disorder Has Endangered Our Food Supply

(Michael Schacker, The Lyons Press, 2008, pp.292. $24.95) Humanity's best friend among the insects. That is how author Michael Schacker describes the honeybee, *Apis mellifera*. Inspired by honeybee colony collapse disorder (CCD), the increasing widespread phenomenon of bees disappearing or abandoning their hives, the book is a warning to us. Our environmental policies are disconnected, trying to establish acceptable standards of poisoning without ever fully taking into account the complexity of our ecosystem and all that inhabit it. Even policies built on standards intended to protect children themselves are not sensitive enough to protect the delicate balance of the ecological systems on which the child and everyone else depend.



Mr. Schacker writes, "On a deeper level, are the bees telling us we are unaware of a deep systemic problem threatening our own species, are we missing the big picture here? Could our own human colony come undone through some kind of "Civilization Collapse Disorder"? Succinctly put, "[T]he bee is not only the prime insect responsible for the creation of the world today, it is critical to maintaining the fragile balance of half the flowering plant ecosystem, as well as one-third of all agricultural plants."

The author cites the Honeybee Genome Sequencing Project, a collaboration of scientists worldwide with funding from the National Human Genome Research institute, the National Institutes of Health, and the U.S. Department of Agriculture. The honeybee, it turns out, has a lower number of genes governing detoxification and, when compared to other insects, about one-third fewer genes associated with insect immunity, making them particularly vulnerable to pesticides, viruses, and pathogens. The bee's evolution over 60 million years is no match for recently invented synthetic insecticides. The Genome Project finding: Honeybees have 10 times fewer protein coding genes linked to insecticide resistance than either the mosquito or the fruit fly.

Poor Regulation

Bee sensitivity to pesticides has long been documented, as have the associated regulatory failures. Take, for example, methyl parathion, an organophosphate insecticide whose fruit and vegetable uses were discontinued in 1999, allowing its use on alfalfa and other crops to continue. Registered in 1954, EPA itself acknowledges, "[F]ield incident data over 20 years indicate that methyl parathion poses risks to honeybees." Still, EPA in 2006 allowed agricultural methyl parathion to continue with a warning: "This product is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees are visiting the treatment area." This is an example of regulation gone amok, given the realities of drift, lack of enforcement, chemical residues, and insect biology.

Native Bees

Pesticide hazards extend to wild bees and in the case of alfalfa the native alkali bee "is the best species for getting high yields." Native bees are essential to pollinating 130,000 types of flowering plants, species that are critical to regional ecosystems and whole ecosystems are dependent on plants needing bees, bats, hummingbirds, and butterflies to reproduce and flourish.

New Pesticides Create New Hazards

A new synthetic pesticide in the neonicotinoid family, imidacloprid, is being linked to CCD. As the author explains, neonicotinoids work by adversely affecting the nervous system. There are sublethal effects, not evaluated by EPA, which can disrupt bees' ability to feed and forage, diminishing learning and organization skills, which are critical considering a bee will typically forage 12,000 acres.

With outrage and protests organized by the National Union of French Beekeepers in 1999, France banned imidacloprid's use on sunflowers and later more broadly. The author traces the pollen contamination and soil retention research and politics of Bayer CropScience's unsuccessful defense of its product in France. Then the French turned their attention to the insecticide fipronil, another neurotoxic insecticide. With the suspension of imidachloprid and fipronil in France, a declining bee population has revived. Germany and Italy followed with a suspension of imidacloprid.

In the U.S. research is proceeding very slowly and regulatory action is at a standstill. While Penn State University has a CCD Working Group, the author points out that Bayer has donated millions of dollars to the university.

The Organic Solution

Mr. Schacker ties the book together with solutions, pointing to the success of organic farmers and protection from poisoning that organic beekeepers have enjoyed. He warns us of "anthropocentric thinking" and invokes the words of Rachel Carson, who begins *Silent Spring* with a "Fable of Tomorrow," predicting bee disappearance: "The apple trees bloomed but no bees droned among the blossoms, so there was no pollination and there would be no fruit. . ."