Beyond Pesticides: Protecting Health and the Environment with Science, Policy, and Action

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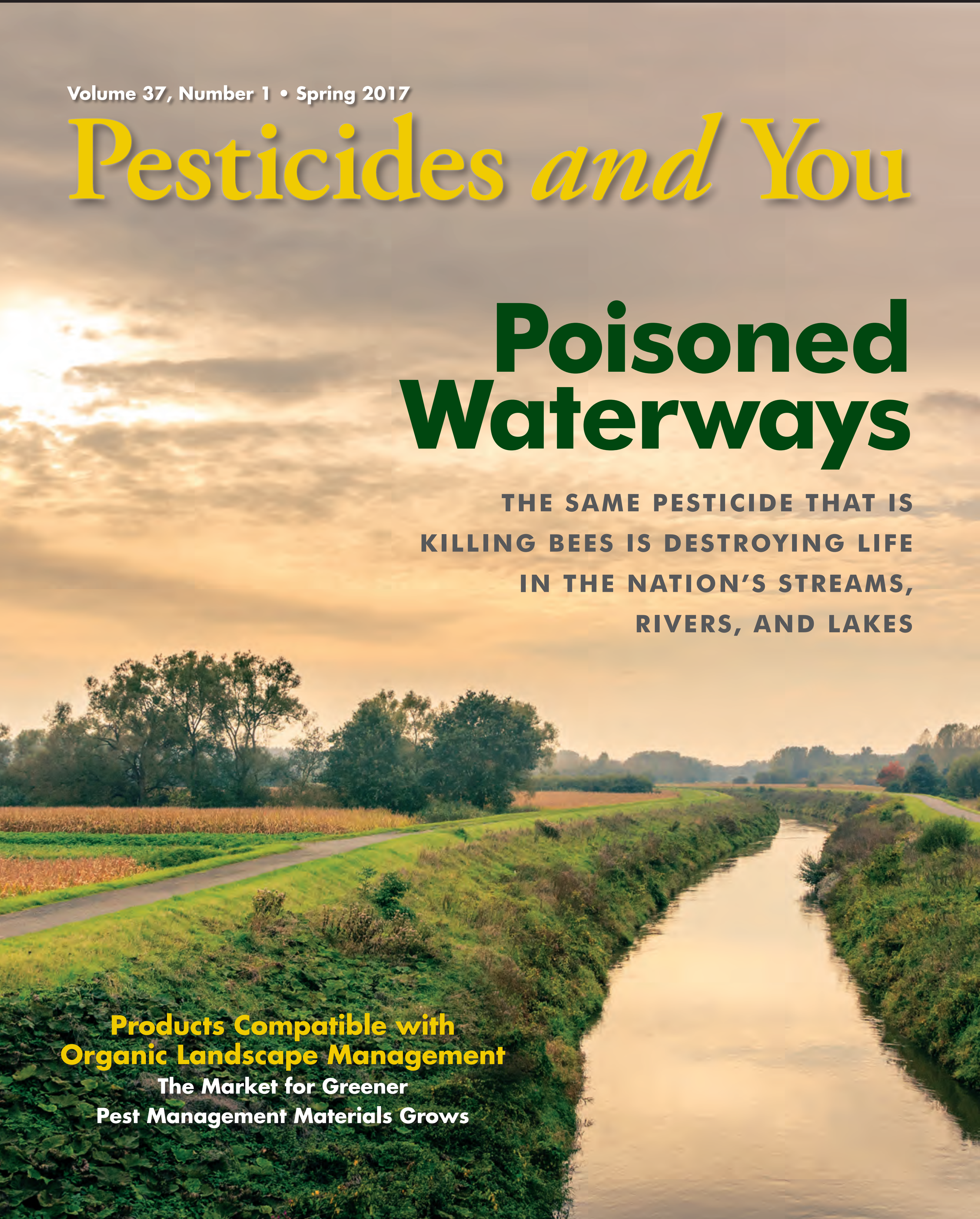
Pesticides *and* You



Poisoned Waterways

THE SAME PESTICIDE THAT IS KILLING BEES IS DESTROYING LIFE IN THE NATION'S STREAMS, RIVERS, AND LAKES

Products Compatible with Organic Landscape Management

The Market for Greener Pest Management Materials Grows

Protecting Life in Our Waterways

Taking a holistic view of what we don't see

We continue to look holistically at the impact of pesticides in the environment, with a particular focus, in this issue, on aquatic organisms—easy to ignore since we don't see them on a daily basis. We may notice that there are fewer or no bees, butterflies, or birds, but it is unlikely that we will notice that mayflies in their aquatic stage, worms, and other essential aquatic invertebrates are in decline.

A holistic view and response

There is a tendency for environmental regulators and environmental organizations to focus on the threat of individual pesticides and a set of specific endpoints of concern. While it is an understandable approach in the midst of a crisis—decline of the eagle population due to pesticide-caused eggshell thinning associated with DDT use in the 1960's, we tend to see the solution in the regulation of a single chemical (or chemical family) culprit. The takeaway from this issue of PAY is a deeper understanding that while a family of chemicals—in this issue, we focus on neonicotinoid (neonic) insecticides—is linked to adverse impacts on aquatic organisms, the solution requires broader thinking about the systems of pest, landscape, and agricultural management that continue to be dependent on toxic chemicals.

The recognition that we have a neonic problem in waterways has been emerging at the U.S. Environmental Protection Agency (EPA), as the pesticide's residues are now detected in rivers, streams and lakes in 29 states. In a 2017 EPA risk assessment document on one of the most widely used neonics, the agency found, "[C]oncentrations of imidacloprid detected in streams, rivers, lakes and drainage canals routinely exceed acute and chronic toxicity endpoints derived for freshwater invertebrates."

The independent science makes a good case for banning neonicotinoids—and this issue unveils a body of knowledge that certainly should motivate action in town, city and county councils, state legislatures and agencies, and at the federal level. This issue and the pieces we publish daily on our website's Daily News inform action that supports a shift away from pesticide dependency and to systems that "restore, maintain and enhance ecological harmony," which is the definition of organic as adopted by the National Organic Standards Board, in implementing the Organic Foods Production Act.

Products Compatible with Organic

We juxtapose the problem with the solution. Check out in this issue our latest information source, *Products Compatible with Organic Landscape Management*, which identifies the emerging products that are available to lawn and landscape managers and residents managing their land organically. Because the use of toxic materials undermines the organic system by harming the soil microbial life, identifying compatible products is an essential component of the system. While the systems-based approach that we advocate is not product-dependent, products, if essential, may be used that do not harm soil biology and biodiversity.

Communicating Hazard

There is too often a disconnect between our scientific knowledge, or the uncertainties, and governmental support for status quo pesticide-dependency in managing lawns and landscapes, and farm fields. We recently told EPA officials that their current risk communication suggests to the public and state and local decision makers that mosquito adulticides are completely safe, and, as a result, many communities put insufficient emphasis on tools that are essential to an effective mosquito management program (e.g., larviciding, education, source reduction). Same could be said about the neonics. Why bother avoiding neonics or consider transitioning to organic methods if current practices are problem-free? The agency's current risk communication has the effect, in too many cases, of supporting pesticide use that presents a public and environmental harm, is not effective, and leads to insect and weed resistance, which escalates the problem. The cycle of dependency that supports pesticide use gets a boost from EPA every time it states that a pesticide can be used "without posing risks of concern to the general population or to the environment when applied according to the pesticide label."

Action of the Week

In this time of political change, Beyond Pesticides has added a new weekly campaign, *Action of the Week*, to suggest to public health and environmental advocates one concrete action each week that speaks to governmental action or inaction that are harmful to the environment and public and worker health, increase overall pesticide use, or undermine the advancement of organic, sustainable, and regenerative practices and policies. Topics may include toxic chemical use, pollinator protection, organic agriculture and land use, global climate change, and regulatory or enforcement violations. To see recent actions, go to Beyond Pesticides' website.

We look forward to strengthening our united voice.

Jay Feldman, executive director of Beyond Pesticides

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From: Rosi-Marshall EJ , et al. (2007). "Toxins in transgenic crop byproducts may affect headwater stream ecosystems." Proc Natl Acad Sci USA 104:16204–16208. © 2007 National Academy of Sciences, U.S.A.

FEATURES

DEPARTMENTS

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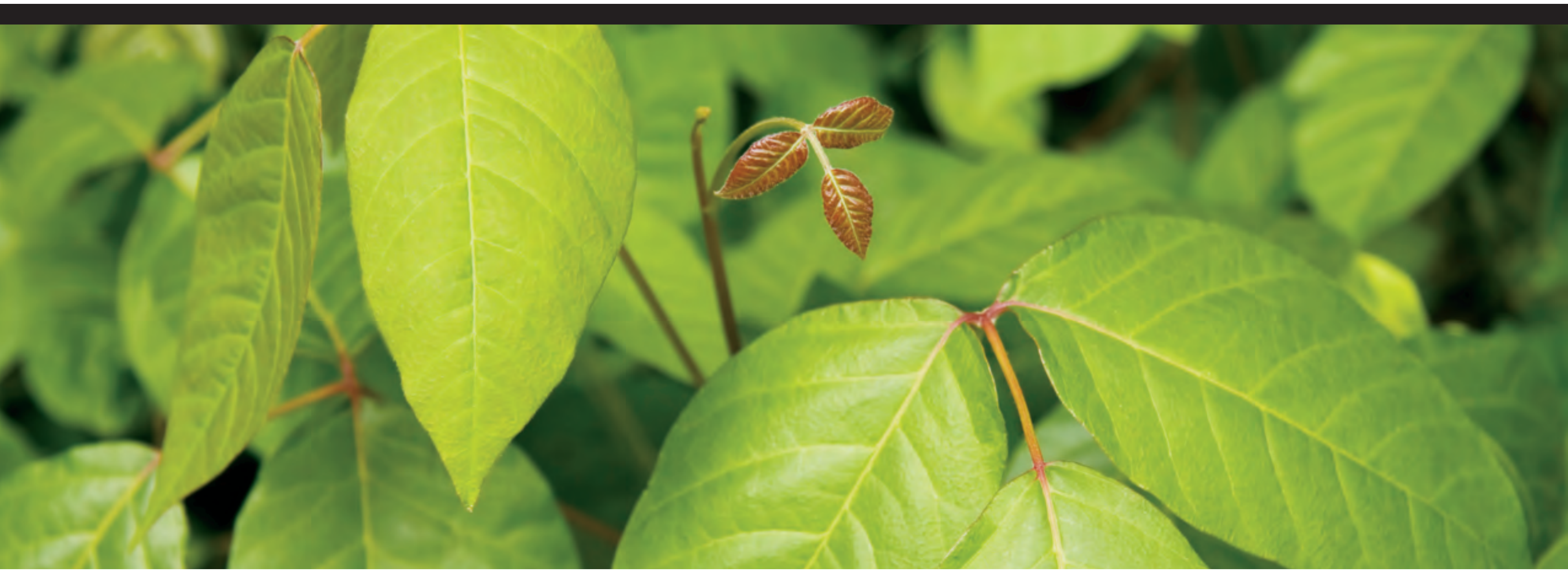

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Controlling Poison Ivy without the Poisons

Beyond Pesticides,

I've got a patch of poison ivy in the back of my property that's getting large. I think it needs to go, but I'm very hesitant to take the advice of my neighbors and douse the area with Roundup. Can you provide some alternatives?

Linda, Connecticut

Linda,

Controlling poisonous and stinging plants and insects without toxic chemicals is challenging, but it can be done. An important point to remember before you start is that herbicides like Roundup will not actually solve your poison ivy problem. Yes, it will kill the plant, likely only after multiple applications, but you'll still have a dead poison ivy plant in your yard that you will probably want to remove if you want to use the area. And then you're risking exposure to both urushiol (the oil that causes poison ivy rash) *and* the residues of a toxic pesticide.

For smaller areas of poison ivy, manual removal can work if you take proper precautions. The best time to pull poison ivy is after a heavy rain, so the ground is soft and you can pull up more of the root system. Outfit yourself with protective clothing (thick fabric, long sleeves and pants), heavy-duty disposable gloves, and goggles. When pulling and removing poison ivy, be extremely careful not to touch anything other than the poison ivy plant—not clothes, other outdoor equipment, exposed skin, and especially not your face. Pulled plants can be placed in a yard waste bag (consider double-bagging with a clean bag if those picking up may actually handle it). Wear your protections the entire time, from pulling to disposal. And be very careful when removing your protective gear, as it may still contain urushiol oils. Again, don't touch anything that you may touch again in the future—urushiol oils can remain active for up to an entire year. Immediately place your protective clothes in the washing machine, and get into the shower to make sure you get any oil off your skin. Use cold water. If you do end up getting urushiol oils on you, don't panic, but act quickly. You have roughly 20 minutes to wash the oil off before a rash begins to develop. Cold water is all you need to remove urushiol.

Even if you're careful, you're likely to leave behind at least some roots in the soil. For small pop-ups after a big removal, our list of *Products Compatible with Organic Landscape Management* later in this issue of the journal (see p.18) should be a good resource to find a least-toxic herbicide for spot spraying. If the area is small enough, black plastic, dark heavy fabric, or a heavy application of mulch should also prevent any additional growth.

If your patch is relatively large, your safest method of poison ivy removal is to hire goats. Yes, goats will eat poison ivy. No, they won't get sick. They will, however, get the job done without you risking exposure to toxic herbicides or urushiol oils. For a more in-depth look at how to address poison ivy on your property, visit our ManageSafe page: *http://bit.ly/managesafe.*

SHARE WITH US!

Beyond Pesticides welcomes your questions, comments or concerns. Have something you'd like to share or ask us? We'd like to know! If we think something might be particularly useful for others, we will print your comments in this section. Mail will be edited for length and clarity, and we will not publish your contact information. There are many ways you can contact us: Send us an email at *info@beyondpesticides.org*, give us a call at 202-543-5450, or simply send questions and comments to: 701 E Street SE, Washington, DC 20003.

Precautions for Emerald Ash Borer

Beyond Pesticides,

A few friends and I own a plot of land that has a healthy ash tree population. We have heard that there is a higher threat of attack from emerald ash borer (EAB), and want to know the best way to go about getting rid of an infestation, if there is one, or preventing one in the first place.

Laura, Iowa

Laura,
Ash trees are widespread in the U.S., and all 16 native ash species are susceptible to attack. EAB is a significant threat to our urban, suburban, and rural forests, as it kills both stressed and healthy ash trees. EAB is so aggressive that ash trees may die within two or three years after they become infested. Ash trees are as important ecologically as they are economically in the forests of the eastern U.S. They fill gaps in forests and are highly desirable for urban tree planting. Ash wood is valued for flooring, furniture, sports equipment (e.g., baseball bats, hockey sticks, and oars), tool handles, and supplies for dairies, poultry operations, and beekeepers. Ash trees and ash wood are also significant to Native American cultures for traditional crafts and ceremonies.

There are some good pest prevention practices to follow in order to avoid infestation:

- Don't move firewood. EAB larvae can survive hidden in the bark of firewood. Remember: if you buy firewood locally, burn firewood locally.
- Inspect your trees. If you see any sign or symptom of an EAB infestation, contact your state agriculture agency to confirm. Signs include dieback at the crown (top) of the tree, extensive woodpecker activity, vertical splits in bark, and sprouting of new branches at the base of the tree. You may also see D shaped emergence holes caused by the metallic green insects. Note that ash trees with low EAB population densities may exhibit few symptoms.
- Talk to friends, neighbors and co-workers about EAB and what they should be aware of on their trees.
- Encourage biodiversity. Woodpeckers hunt for both the larvae and pupae, the last life cycle stage before the insect turns into an adult beetle, emerges from the tree, and starts all over again.

Since 2007, the release of stingless wasps has shown promise as a long-term management strategy. USDA researchers conclude, "At present, the most sustainable and long-term approach to reducing EAB populations and conserving ash in forested areas of North America is biological control. Efforts are ongoing to find and evaluate additional biological control agents.

Unfortunately, these biological control options are not widely available to the public (individual homeowners). Municipalities can reach out to the Animal Plant Health Inspection Service (APHIS) to see whether their city can become part of a release program.

Even use of highly toxic systemic insecticides, such as the neonicotinoids, are only likely to delay the inevitable loss of an ash tree. If delay is your aim, however, we suggest a product like TreeAzin, which uses azadirachtin, a least-toxic insecticide and extract of neem tree seeds. If your trees become thoroughly infested, removal of ash trees is the most effective control method to stop the spread of the pest to other areas. Ash trees can be replaced with an appropriate native species.

For a more in-depth look at how to protect ash trees from emerald ash borer, or to prevent infestation in the first place, visit our ManageSafe page: *http://bit.ly/managesafe*.

FROM THE WEB

Beyond Pesticides' Daily News Blog features a post each weekday on the health and environmental hazards of pesticides, pesticide regulation and policy, pesticide alternatives and cutting-edge science, www.beyondpesticides.org/dailynewsblog. *Want to get in on the conversation? "Like" us on Facebook, www.facebook.com/beyondpesticides, or send us a "tweet" on Twitter, @bpncamp!*

Excerpt from Beyond Pesticides' original blog post (01/30/2017): American Chemistry Council Attacks Independent Science Conducted by International Agency. The International Agency for Research on Cancer (IARC), the World Health Organization's (WHO) cancer research branch, is again under attack.

Routt comments via Facebook: The line we're supposed to buy is that all independent scientists and the EU and IARC are dishonest, and only Monsanto bought scientists should be trusted. Does anybody find this odd?

Excerpt from Beyond Pesticides' original blog post (02/24/2017): Oak Park and Evanston, Illinois Act to Repeal Preemption, Assert Local Authority to Restrict Pesticides. Over the last two weeks, both Oak Park and Evanston, IL have taken steps to repeal preemption of local authority to restrict community-wide pesticide use in the state of Illinois.

Pollinator Project, Rogue Valley, OR via Facebook: The tide is turning. Now, how many cities in Oregon will act?

Neurotoxic Flea Collar Pesticide Upheld, EPA Issues Warning on Children's Exposure

On January 4, the U.S. Environmental Protection Agency (EPA) announced it was allowing the continued use of the neurotoxic insecticide, tetrachlorvinphos (TCVP), to which children are widely exposed through pets' flea collars and other flea treatments. TCVP, like other organophosphates (OP), causes poisoning by inhibiting the enzyme acetylcholinterase, which is necessary for the transmission of nerve impulses. The inhibition leads to the accumulation of acetylcholine and ultimately toxicity to the central and peripheral nervous system. Organophosphates are nerve poisons that cause numbness, tremors, nausea, incoordination, blurred vision, difficulty breathing or respiratory depression, slow heartbeat, and disorientation.

In December 2016, EPA released its human health risk assessment for TCVP and acknowledged that it does not have all the data it needs to assess the effect of children's exposure and therefore has applied an additional tenfold (10x) margin of safety factor. Advocates have disputed the EPA decision to allow children's exposure when the data on TCVP's effects is not complete, and given children's vulnerability to the OPs' neurotoxic effects. In a previous human health risk assessment, completed in December 2015, EPA identified elevated risks, exceeding the agency's level of concern, for adults and children in residential settings who are exposed to dusts/powder products and pet collars, as well as workers applying TCVP.

In the latest announcement, EPA advises consumers to take precautions when handling TCVP products, such as not allowing children to play with TCVP pet collar products, and washing hands with soap and water if handling does occur. Advocates have raised concerns related to similar decisions on flea collars in the past in which EPA has issued warnings to mitigate risks, despite its inability to ensure children's safety. Children typically come into close contact with pets and their flea collars that cannot be controlled by the type of warning EPA is issuing.

Lawsuit Charges that Monsanto and EPA Colluded to Stop Agency from Reaching Cancer Finding for Glyphosate (Roundup)

Plaintiffs in a lawsuit against Monsanto, charging that its product Roundup caused their non-Hodgkins lymphoma, have cited the EPA collusion with the company to block the agency from concluding that the manufacturer's product, Roundup (glyphosate), causes cancer, according to investigative reporter Carey Gilliam, writing in the Huffington Post. The filing states that EPA made an effort "to protect Monsanto's interests and unfairly aid the agrichemical industry."

The filing asks the court to compel the deposition of Jess Rowland, who served as deputy division director in EPA's Office of Pesticide Programs and directly managed the work of scientists charged with assessing the human health effects of exposure to pesticides, including glyphosate. The motion accuses Mr. Rowland of playing "political conniving games with science" in favor of Monsanto's interests, and argues the agency's willingness to promote industry interests over protecting public health. According to the motion, "The Plaintiffs have a pressing need for Mr. Rowland's testimony to confirm his relationship with Monsanto and EPA's substantial role in protecting the defendant's business." It goes on to claim that, "Mr. Rowland operated under Monsanto's influence to cause EPA's position and publications to support Monsanto's business…"

Monsanto sought unsuccessfully to keep documents associated with this case secret, having asked the federal judge presiding over the case to block plaintiffs' attorneys from including documents they receive during the discovery process from being used as exhibits in court filings, so as to keep them out of the hands of the public and the media.

The judge rejected Monsanto's claims and unsealed the documents. Monsanto claims that releasing these documents may be an effort to "try this case in the court of public opinion," an act the company claims "is not in the public interest," despite the fact that millions of people around the world are exposed to glyphosate on a daily basis. Advocates maintain that they have a right to know what kind of relationship the company has with the government agency that is supposed to look out for its health and safety.

EPA Announcement on Bee-Toxic Pesticides at Odds with Latest Independent Science on Neonicotinoids

EPA, on January 12, released major risk assessment documents on pollinator exposure to bee-toxic neonicotinoid insecticides, finding no significant risks, despite the large and growing body of science identifying the pesticides' hazards. In the documents, EPA identifies risks posed to bees by several neonicotinoid insecticides, but suggests that no restriction on uses are imminent. In another decision meant to protect bees from acutely toxic pesticides, the agency is scaling back its original proposal in deference to chemical-intensive agricultural interests.

Just prior to the EPA announcement that several neonicotinoid insecticides "do not pose significant risks to bee colonies," the preprint version of a new review of neonicotinoids identified the range of lethal and sublethal effects of the chemicals on non-target organisms. The review, *The Environmental Risks of Neonicotinoid Pesticides: A review of the evidence post-2013*, authored by Dave Goulson, PhD, and Thomas James Wood, a PhD candidate, concludes that studies published since the 2013 European Food Safety Agency (EFSA) risk assessments show even greater risks. The EFSA assessment, which led to a moratorium on neonicotinoid uses in the European Union, found that certain neonicotinoids on specific flowering crops pose a high risk to bees.

The review also delves into areas of study that were not considered by EFSA, such as the impact of neonicotinoids on environmental health. The researchers compile a range of risks to non-target organisms, including the death of beneficial predator populations, the persistence of neonicotinoids in soils, which leads to constant contamination and accumulation over time, and a higher sensitivity of aquatic organisms to neonicotinoids. The authors and the European Commission say that, due to the new evidence demonstrating elevated risk to bees and the environment, the current moratorium on imidacloprid, clothianidin, and thiamethoxam in Europe should be extended. The authors urge that the partial ban be expanded to other neonicotinoid uses.

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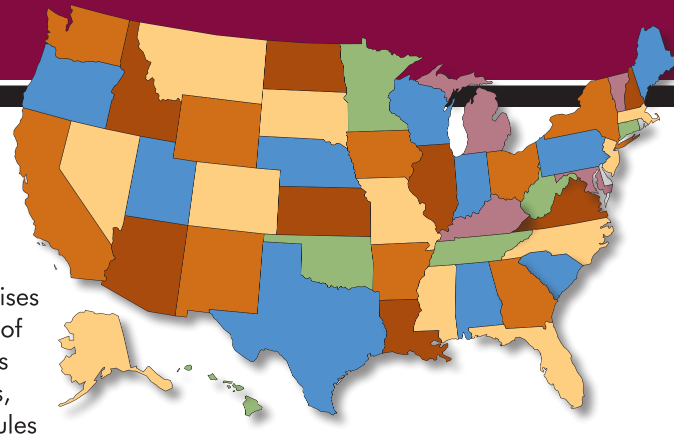
EPA Finds Widely Used Pesticides Could Harm 97 Percent of Endangered Species

In late January, EPA released its final Biological Evaluations of Three Chemicals' Impacts on Endangered Species, which finds that the organophosphate (OP) insecticides chlorpyrifos and malathion likely have detrimental effect on 97 percent of all species listed and protected under the Endangered Species Act (ESA), while diazinon adversely affects 78 percent. According to EPA's release on the subject, this is the "first-ever draft biological evaluations analyzing the nationwide effects" of these registered chemicals on endangered species after decades of widespread use. The evaluations stem from a legal settlement with the Center for Biological Diversity (CBD) after CBD sued EPA in April 2014 for its failure to comply with ESA, which requires the agency to carry out consultations with federal wildlife agencies when registering or reviewing pesticides.

The next step in this settlement involves both the National Marine Fisheries Service and the U.S. Fish and Wildlife Service. Along with the evaluations from EPA, the two agencies must issue biological opinions and determine steps to protect these endangered species from agricultural pesticide use. In accordance with the legal settlement, these biological opinions must be finalized by December 2017. Additionally, last year EPA was considering phasing out the use of chlorpyrifos in food production. It was taken off the market for residential uses in 2000.

The implicated OPs are derived from World War II nerve poisons that are a common class of chemicals used as pesticides. Public health advocates say the widespread adoption of organic management is necessary to protect consumers and the environment in the long-term. Certified organic production does not allow the use of toxic synthetic pesticides, such as OPs, and advances a viable, scalable path forward for growing food.



Death of Four Texas Children Linked to Inadequately Regulated Pesticide, Follows Other Deaths

Early this year, the first pesticide-related tragedy occurred when four children, ranging in age from 7–17, died from a toxic pesticide treatment to their house in Amarillo, Texas. The pesticide at issue, aluminum phosphide, was illegally applied under a mobile home, where at least ten people were living. The chemical, classified by EPA as a restricted use pesticide (RUP), is limited to use by certified applicators (and those under their supervision) and it is a violation to use it within 100 feet of residential structures.

The incident demonstrates the deficiency of managing risks of highly toxic chemicals by labeling them "restricted use." It has been Beyond Pesticides' position that chemicals with aluminum phosphide's level of toxicity should not be available on the market, even with restrictions. In making regulatory determinations on pesticide allowances, advocates have urged EPA to calculate the reality of misuse and accidents, instead of assuming 100% compliance with product label instructions. With this approach, the agency would not register pesticides as highly toxic as aluminum phosphide. Similarly, Beyond Pesticides has argued that the registration of chemicals like aluminum phosphide is "unreasonable" under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), given the availability of alternative methods and products for rodent control.

In recent years, EPA has taken steps to try and address the clearly inadequate regulations regarding phosphide fumigants, but the recent death of these four children indicates that the agency needs to revisit the current rules. In 2010, EPA imposed new restrictions on aluminum and magnesium phosphide products in an attempt to better protect people, especially children, from dangerous exposures. However, the latest incident raises concerns about the adequacy of the pesticide's label restrictions to actually protect human lives, and the enforceability of the rules to prevent violations.

Judge Rules Against Monsanto, Allows California to List Glyphosate Products as Cancer Causing

A California judge ruled in March that the state may require Monsanto to label any products containing glyphosate as cancer causing. The final ruling was issued one year after Monsanto sued the California Environmental Protection Agency's Office of Environmental Health Hazard Assessment over its notice of intent to add glyphosate to the state's Proposition 65 list of cancer-causing chemicals. Monsanto, the manufacturer of glyphosate and its Roundup brand, will now be required to place a cancer warning label on its products.

California proposed to list glyphosate as a carcinogen after a 2015 determination of the International Agency for Research on Cancer (IARC) that the chemical is a cancer-causing agent for humans based on laboratory studies. Monsanto refutes these claims and, since the determination, has worked directly and through proxy organizations to discredit and attack IARC, as well as individual scientists that participated in its decision making process.

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Observers see Monsanto's efforts as an attempt to scuttle the science of independent researchers in order to protect its bottom line. California, in its court filing, called IARC's monographs the "gold standard" for determining the carcinogenicity of chemicals in the environment. Many people who believe their exposure to glyphosate resulted in their cancer diagnosis are applauding the court ruling.

Advocates feel that California's cancer listing for glyphosate is a step in the right direction and are calling for a ban to protect the public's health. Being the number one agricultural producing state, California's action may help to move glyphosate off the market, and would protect the low-income communities in the southern part of the Central Valley that are exposed to glyphosate at higher levels than the general population.

North Miami Takes a Step Forward

In early February, North Miami City Council moved to reduce pesticide use in the community. The Council adopted an Integrated Pest Management (IPM) policy modeled after a plan developed by San Francisco in the mid-90's. The plan does not ban insecticides and herbicides, but instead aims to educate residents and county workers on least-toxic pest management strategies with the goal of eliminating toxic pesticide use on city property. The IPM plan does not address pesticide use on private property, due to state preemption of local authority.

City staff will now be asked to give preference to available, safe, and effective non-pesticide alternatives and cultural practices. As stated in the resolution's IPM Program Guidelines, the goal of the policy is "to eliminate the application of all Toxicity Category I and Category II pesticide products by January 2018." In addition to eliminating certain pesticide categories, the resolution also calls for staff training and expert consultants, both of which have the potential to help facilitate the transition in pursuit of the 2018 goal. Priority will be given to efforts to reduce or eliminate pesticide use near waterways or riparian areas. However, as with most IPM plans, the success of the program will likely rely on strict oversight of implementation, as this is often a downfall of ordinances that do not incorporate complete bans or stringent guidelines for organic management practices with allowed products.

Supporters of the resolution have responded to critics concerned about the additional cost and manpower it might require by pointing out the benefits of cutting down on overall pesticide use. According to the *Miami Herald,* supporters believe that the change will be worthwhile if it can prevent harmful effects often caused by pesticides, including reducing the impact of pesticides on the city's waterways and canals and limiting human exposure.

Rusty Patched Bumblebee Listed as Endangered

The U.S. Fish and Wildlife Service (FWS) on March 21 officially listed the rusty patched bumblebee under the *Endangered Species Act* (ESA), after months of turmoil due to the Trump Administration's temporary freeze on federal regulations adopted at the end of the Obama Administration. This listing stands as a landmark decision, marking the rusty patched bumblebee as the first bumblebee species, and first bee overall in the continental United States, to officially be declared endangered by FWS. In 2016, seven species of bees were listed as endangered in Hawaii. The decision to list the rusty patched bumblebee came at the very end of President Obama's term, on January 11, to take effect in February.

There is a substantial body of scientific research demonstrating that neonicotinoid insecticide use is a major contributor to the decline of bee populations. According to FWS, "Causes of the decline in rusty patched bumble bee populations are believed to be loss of habitat; disease and parasites; use of pesticides that directly or indirectly kill the bees; climate change, which can affect the availability of the flowers they depend on; and extremely small population size. Most likely, a combination of these factors has caused the decline in rusty patched bumble bees." Neonicotinoids are widely used in agriculture and lawn and garden pesticide products in the U.S., while the European Commission is proposing to turn its temporary agricultural ban into a permanent measure his year.

Ruling Affirmed in Colorado Pesticide Trespass Case

After years of legal battle, the Colorado Court of Appeals affirmed in February a ruling that Colorado rancher James Hopper must serve two days in jail and pay a $7,500 fine for spraying pesticides that drifted onto his neighbor's farm in violation of a 2012 court order protecting his neighbors. In 2012, organic farmers Rosemary Bilchak and her husband Gordon MacAlpine were granted a permanent injunction prohibiting pesticide applications within 150 feet of the property line in order to reduce pesticide drift. The decision bolsters a legal precedent that wafting pesticides can constitute trespass against which adjacent landowners and people with chemical sensitivities are protected.

The legal battle began in 2011 when Mr. Hopper obtained his Colorado pesticide applicator's license and applied the adulticide Fyfanon, which contains the organophosphate insecticide malathion, to kill mosquitoes on his property. However, the pesticide drifted onto Ms. Bilchak and Mr. MacAlpine's organic vegetable farm. In 2012, a District Court Judge ruled that they have a right not to have their property invaded by other people or things, and prohibited Mr. Hopper from fogging for mosquitoes within 150 feet of his neighbor's property or allowing the pesticides to drift, considering this to be a form of trespass. Nevertheless, Mr. Hopper ignored the ruling and continued fogging. Court records show he persisted through August 2015. Last year, a state judge sentenced him to jail and imposed a $7,500 fine for violating the court order. After months of appealing the ruling, Mr. Hopper will face his sentence.

"This is very important to us," Ms. Bilchak said. Mr. MacAlpine, diagnosed with leukemia before moving to Colorado, had been told by his doctor to avoid pesticide exposure and was registered with the Colorado Department of Agriculture as a sensitive resident. "It is important for us personally, for his health condition, and because we also set a precedent that pesticide drift is a trespass," she said.

Oak Park and Evanston, Illinois Act to Repeal Preemption, Assert Local Authority to Restrict Pesticides

In February, both Oak Park and Evanston, IL took steps to repeal preemption of local authority to restrict community-wide pesticide use in the state of Illinois. The Village of Oak Park has approved a Resolution in Support of the Repeal of the State Pesticide Preemption, and the City of Evanston has approved a Resolution Urging the State of Illinois to Repeal Preemption of Local Regulation of Pesticides. Both of these actions urge the state of Illinois to repeal state law that preempts local government regulation of pesticides and resestablish the right of local home rule governments to adopt pesticide restrictions on public *and* private land within their jurisdiction, as they deem appropriate. Preemption is the ability of one level of government to override laws of a lower level. Currently, 43 states restrict local government's authority to regulate pesticide use further than state law.

Passionate residents and activists pushed for the passage of these resolutions. For the Village of Oak Park, a local advocacy group, Go Green Oak Park, reached out to Beyond Pesticides for assistance in talking to its local board about these issues. Peggy Mcgrath, a member of Go Green Oak Park, said about the issue: "Big corporations are calling more and more of the shots. To protect our government 'Of The People,' we need grassroots involvement to encourage and support our representatives to do the right thing for our children and our one sacred earth." Evanston also galvanized forces through its local activists. Leslie Shad, a board member of Citizens' Greener Evanston, stated to The Daily Northwestern, "Our own community should be able to manage the health and welfare of our own citizens. . . . It should be possible for the community to make some decisions for itself on the use of pesticides."

Health Canada Will Begin Pesticide Testing of Cannabis after Recalls and Consumer Exposure

The failure of the U.S. pesticide regulatory system to protect users of medical and recreational marijuana was highlighted as Health Canada announced in February that it would begin conducting random pesticide residue testing of cannabis products to ensure that only registered products are being used in medical marijuana production. This comes on the heels of voluntary recalls in 2016 by two licensed Canadian cannabis producers due to the presence of the prohibited pesticides bifenazate, myclobutanil, and pyrethrins in or on marijuana products. Especially concerning is the detection of myclobutanil, a powerful fungicide that, when heated, converts to the hazardous gas hydrogen cyanide. The detection of these toxic chemicals in medical marijuana products is problematic since many users have compromised immune systems or health conditions that make them particularly vulerable to toxic chemicals.

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Moves by several states in the U.S. to curb illegal pesticide use in marijuana production, in the absence of federal regulatory registration of any pesticides for cannabis production, contain significant pitfalls and loopholes that allow contaminated cannabis to enter the market, where it threatens public health. Without an examination of residues in inhaled, ingested, or absorbed cannabis, the user's health is not protected by pesticide registration addressing other uses. In addition, environmental impacts associated with growing practices are generally ignored.

Several states, including New Hampshire, Vermont, and Maine, have adopted policies that prohibit all federally registered pesticides —that is, those not considered "minimum risk" or exempt from registration—in the absence of federal oversight. Other states have taken the position that state policy is unnecessary, since EPA, due to cannabis's narcotic status by the federal government, has not registered any pesticides for marijuana production, and unregistered pesticide use is illegal. The solution: as more states legalize marijuana use, require that growing standards use a systems-based organic approach.

Poisoned Waterways

THE SAME PESTICIDE THAT IS KILLING BEES IS DESTROYING LIFE IN THE NATION'S STREAMS, RIVERS, AND LAKES

NICHELLE HARRIOTT AND TERRY SHISTAR, PHD

Water is essential to life, supporting the food web and habitat for much of Earth's wildlife. Pesticides often contaminate U.S. waterways and threaten aquatic organisms, from invertebrates (worms, molluscs, insects, and zooplankton) to vertebrates (fish and amphibians), and microorganisms (bacteria, fungi, protozoa, algae, and phytoplankton), as well as those that depend on them.

SUMMARY

Neonicotinoid insecticides are detected regularly in sampling of the nation's waterways (Hladik, 2016) at concentrations that exceed acute and chronic toxicity values for sensitive organisms. Neonicotinoids are a family of chemicals that include imidacloprid, clothianidin, thiamethoxam, dinotefuran, and acetamiprid. While the impact of neonicotinoids on pollinators, like honey and native bees, has been widely discussed, other organisms, like those in aquatic environments, are also at risk. Scientific knowledge on the aquatic impacts of neonicotinoids is growing, and research finds that neonicotinoids have direct and indirect impacts on aquatic communities. Neonicotinoid contamination, detected in rivers, streams, and lakes in 29 states, poses detrimental effects to keystone aquatic organisms as well as result in a complex cascading impact on ecosystems.

In the regulatory arena at the U.S. Environmental Protection Agency (EPA), alarms began to go off when the agency found in its 2017 risk assessment for the most widely used neonicotinoid, imidacloprid, that, "[C]oncentrations of imidacloprid detected in streams, rivers, lakes and drainage canals routinely exceed acute and chronic toxicity endpoints derived for freshwater invertebrates." The agency evaluated an expanded universe of adverse effects data and finds that acute (short-term) and chronic (long-term) toxicity endpoints are lower (adverse effects beginning at 0.65 μg/L (micrograms per liter)-acute and 0.01 μg/L-chronic effects) than previously established aquatic life benchmarks (adverse effects from 34.5 μg/L-acute and 1.05μg/L-chronic effects). In its 2017 risk assessment, EPA finds risks from imidacloprid exposure to ecologically important organisms not previously evaluated as part of its regulatory review. Despite its acknowledgement that current benchmarks are not adequately protective, EPA describes its review process as requiring studies of the most sensitive organisms and a range of publicly available environmental laboratory and field studies.

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Corn in Chesapeake Bay Watershed

Summary of Findings

- Neonicotinoids are regularly detected in U.S. waterways at concentrations that cause harm to sensitive aquatic organisms and ecosystems.
- Imidacloprid in particular is persistent in aquatic environments under certain conditions. EPA states that levels of this chemical in waterbodies regularly exceeds toxicity endpoints for freshwater invertebrates.
- Detections generally follow land use patterns: agricultural regions have the highest, most frequent detections of clothianidin due to use in corn and soybean fields, while urban areas find imidacloprid most frequently.
- Aquatic insects and crustaceans are highly sensitive to neonicotinoids, with the mayfly identified as the most sensitive.
- Impacts on aquatic invertebrates can have cascading effects on food webs and healthy ecosystem function. Low level, sublethal exposures can result in decreases in species abundance, altered predator-prey relationships, reduced water filtration, and nutrient cycling.
- Current federal aquatic life benchmarks for neonicotinoids are potentially underestimating risks. Experts find that standard test organisms used by EPA to establish these benchmarks are orders of magnitude more tolerant of neonicotinoid exposure than other vulnerable species, and recommend water levels to be well-below the benchmarks set by EPA.
- Chemical mixtures and potential synergistic effects are not considered in aquatic risk assessments, resulting in unknown risks to species.
- Stronger action is need to restrict neonicotinoid contamination of waterways.

This report summarizes the available scientific literature on the effects of neonicotinoids in waterways and the life that they support, lending support to long-standing calls for suspending their use. With these aquatic effects, continued neonicotinoid use raises broad implications for the health of biodiversity, which is critical to the sustainability of wildlife and humans alike.

NEONICOTINOIDS HAVE SERIOUS ADVERSE EFFECTS ON AQUATIC ORGANISMS

Neonicotinoids affect the nervous system of insects by interfering with their nicotinic acetylcholine receptors (nAChRs)—a mechanism that shows higher toxicity to invertebrates than vertebrates. Neonicotinoids are known for their action on non-target terrestrial insects, like domesticated and native bees, but they also exert neurotoxic activity in aquatic invertebrates in waterways.

Studies investigating the impacts of neonicotinoids on aquatic organisms find that these pesticides can have devastating impacts on aquatic communities and the higher trophic organisms that depend on these communities. A 2013 comprehensive assessment of the effects of imidacloprid in surface water reports a wide variety of aquatic invertebrates adversely harmed by imidacloprid residues in water. Even at low sublethal levels, the effects of imidacloprid on certain aquatic organisms are wide-ranging and include impaired growth and larval development (blue crab), significant reduction in abundance (zooplankton), dramatic reduction in survival (stonefly), reduced feeding (mayfly), and behavioral changes (cranefly) (Van Dijk, 2013).

Acute and Chronic Direct Effects

Tests show that low levels of neonicotinoids affect aquatic insects, with acute toxicity estimates (LC50 or lethal concentration) as low as 0.65 μg/L (Alexander, 2007). Chronic toxicity is seen at concentrations as low as 0.03 μg/L (Roessink, 2013). Ephemeroptera (mayfly), Trichoptera (caddisfly), and several Diptera (fly), especially Chironomidae (chironomid midges) are considered the most sensitive aquatic species, exhibiting adverse effects below 1.0 μg/L. For amphipods (crustaceans), low doses of imidacloprid (14.2 μg/L) are sufficient to induce adverse effects (Bottger, 2012). The aquatic worm, *Lumbriculus variegatus*, is immobilized by concentrations of imidacloprid of 6.2 μg/L. Formulated imidacloprid products have also been observed to have increased toxicity to certain amphipod species *(Hyalella azteca)* compared to imidacloprid itself.

Studies show that imidacloprid decreases species abundance of several types of organisms, including crustaceans, true flies, mayflies, and snails in concentrations as low as 0.03 μg/L. Benthic communities (organisms that live in the sediment of waterways, including worms, clams, crabs, lobsters, and sponges) see reductions in abundance (Hayasaka, 2012).

Immune Suppression

Similar to sublethal effects in honey and native bees, where neonicotinoids can suppress the immune system and make the bee smore susceptible to disease and parasites, so too have researchers hypothesized immune suppression in other organisms—including amphibians and fish—after low level neonicotinoid exposure (Mason, 2013).

Fish

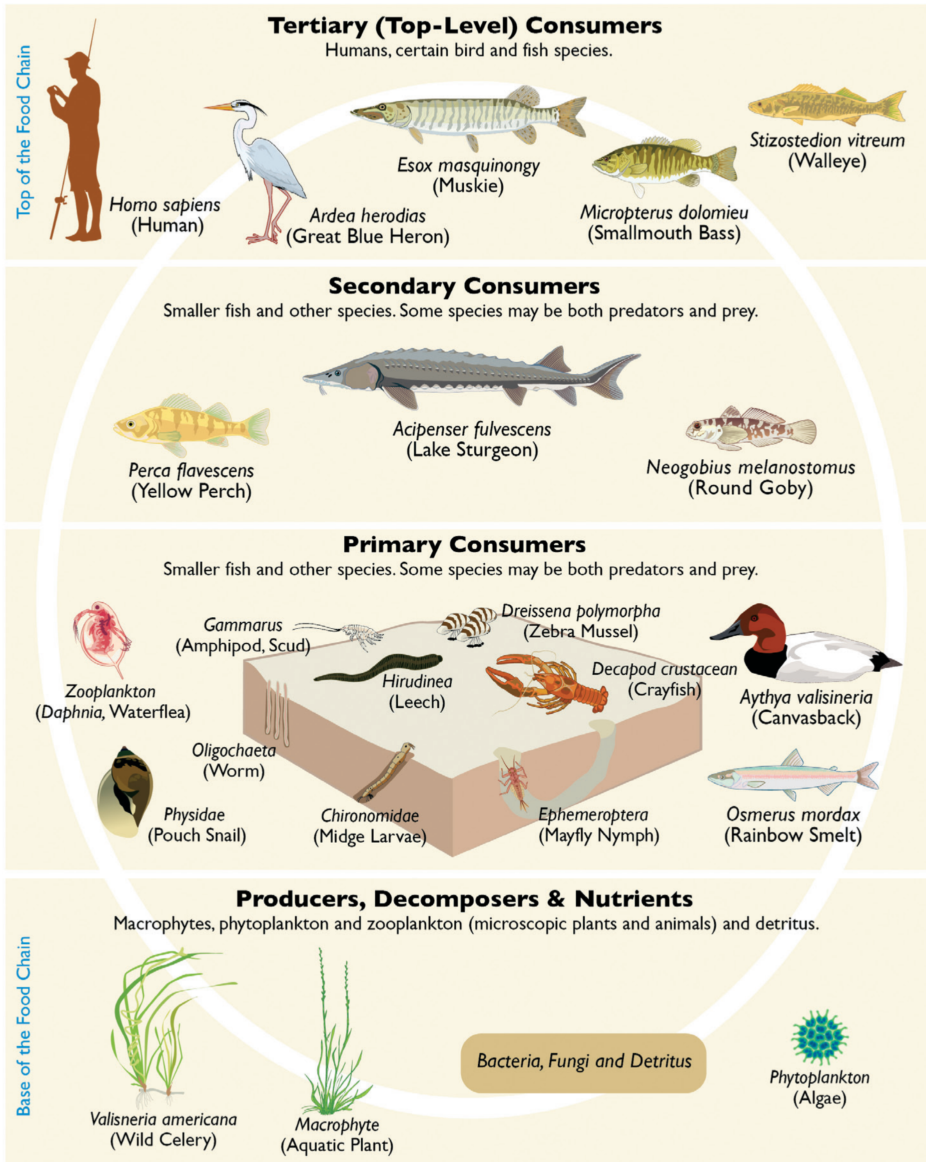
Imidacloprid and clothianidin have been linked to lethal and sublethal effects in fish, both directly and indirectly. Studies report decreased viability and hatching success, concluding that imidacloprid is more toxic to fish in early developmental phases, even at low concentrations (Tyor, 2016). Some of the impacts are due to reductions in prey species. In zebrafish, imidacloprid has been found to increase oxidative stress, which in turn decreases antioxidant enzyme activity. Increased DNA damage is also observed over time with increasing imidacloprid concentrations (Ge et al., 2015).

Plant Communities

Algal communities have also been observed to be affected by neonicotinoids in water, although they are several orders of magnitude less sensitive than aquatic invertebrates. Algal growth is observed to be significantly suppressed by chronic exposure to a formulated imidacloprid product and imidacloprid's breakdown product, 6-Chloronicotinic acid, and formulated products are more toxic than imidacloprid itself (Malev, 2012).

Aquatic Food Web

The Detroit River and Lake Saint Clair are part of the Great Lakes basin that provides an important food source for the region and the country. Below are sample species in the Great Lakes Aquatic Food Web.



Used with permission. Adapted from *The Life of the Lakes*, MICHU09-400, Michigan Sea Grant, *www.miseagrant.umich.edu*.

Marine Environment

There is generally little data for marine aquatic organisms, but studies find that growth of Mysid shrimp (*Americamysis bahia*) is impaired at 0.163 µg/L imidacloprid (USEPA, 2017). Opossum shrimp (*Mysidopsis bahia*) exhibit mortality at 13.3 µg/L imidacloprid, while the 48-hour LC_{50} for brine shrimp, Artemia spp., is 361,000 µg/L Pisa, 2015). Based on impacts on post-larval crabs, the imidacloprid LC_{50} for blue crabs is 10 µg/L. Based on data submitted by registrants, EPA considers the Eastern oyster to be much less sensitive to imidacloprid, with a LC_{50} of over 145,000 µg/L (USEPA, 2017).

Trophic and Ecosystem Impacts

Aquatic ecosystems experience direct and indirect effects, imbalance, and cascading effects on many trophic levels (food web) as a result of exposure to imidacloprid concentrations as low as 0.6 µg/L (Colombo, 2013). In these ecosystems, aquatic invertebrates play an important role. Thiacloprid has been found to affect trophic interactions, which in turn affect ecosystem functions. Predation by gammarid crustaceans increases with thiacloprid concentrations up to 1 µg/L, as a result of impaired avoidance behavior of mayflies. This corresponds with decreased leaf litter consumption by gammarids, affecting decomposition and ecosystem function. Similarly, populations of the snail *Radix sp.* increase with decreased competition for food as the

EPA Confirms Serious Aquatic Risks from Imidacloprid

Aquatic insects are among the most vulnerable to imidacloprid exposures, according to EPA's 2017 preliminary assessment of imidacloprid's aquatic risks (USEPA, 2017). Specifically, EPA identifies mayflies as the most sensitive aquatic invertebrate to imidacloprid exposure. As critical members of the aquatic food web, aquatic insects are important for maintaining fish populations and the health of aquatic ecosystems.

Foliar spray and a combination of other application methods have "the greatest potential risks for aquatic invertebrates. . . ." Freshwater invertebrate species that are listed under the Endangered Species Act (ESA) are at elevated risk from foliar applications of imidacloprid. Moreover, runoff from soil applications also result in chronic concerns for both freshwater and saltwater invertebrates, according to EPA.

EPA did not find direct risks to fish or amphibians, but the agency acknowledges that "the potential exists for indirect risks to fish and aquatic-phase amphibians through reduction in their invertebrate prey-base."

Although its assessment is based on agricultural and non-agricultural uses, EPA does not include the harm from the mechanical planting of neonicotinoid coated seeds that creates a contaminated dust, which drifts into waterways. EPA notes that it does not have "standardized methods for quantitatively modeling dust . . ." from the planting of coated seeds. As of March, 2017, EPA has not formally published its assessment on this subject to the docket for public comment.

survival and abundance of other species decrease (e.g., mayflies and midges), after the introduction of low level imidacloprid concentrations (0.6–40 μg/L).

With reductions of aquatic invertebrate species, the availability of food for fish, amphibians, and others, like birds that prey on these organisms, is adversely affected. These disruptions associated with indiscriminate neonicotinoid exposure have long-term cascading effects on food webs and habitats in or near aquatic environments.

FEDERAL WATER QUALITY BENCHMARKS OFFER INADEQUATE PROTECTION

Pesticides are in waterways of the U.S. at levels that impact aquatic organisms and other wildlife that depend on these species. Despite this, only a handful of pesticides have any kind of water quality standard or benchmark. These standards are set threshold values that can be compared with real-world water monitoring information to determine whether water contaminants, like pesticides, impact aquatic life. Pesticide concentrations that exceed these thresholds put aquatic organisms at risk for adverse effects, despite well documented testing inadequacies.

Benchmarks fail to consider exposure to chemical mixtures

Typically, pesticide exposure values allowed by law are derived from various toxicity tests of individual pesticides to determine certain ecological endpoints, such as survival, and reproduction. However, in the aquatic environment, as in other contexts, pesticide exposures occur as mixtures and may have additive and synergistic effects in combination. The effects of pesticide mixtures are not evaluated, resulting in an underestimation of the potential hazards to aquatic wildlife.

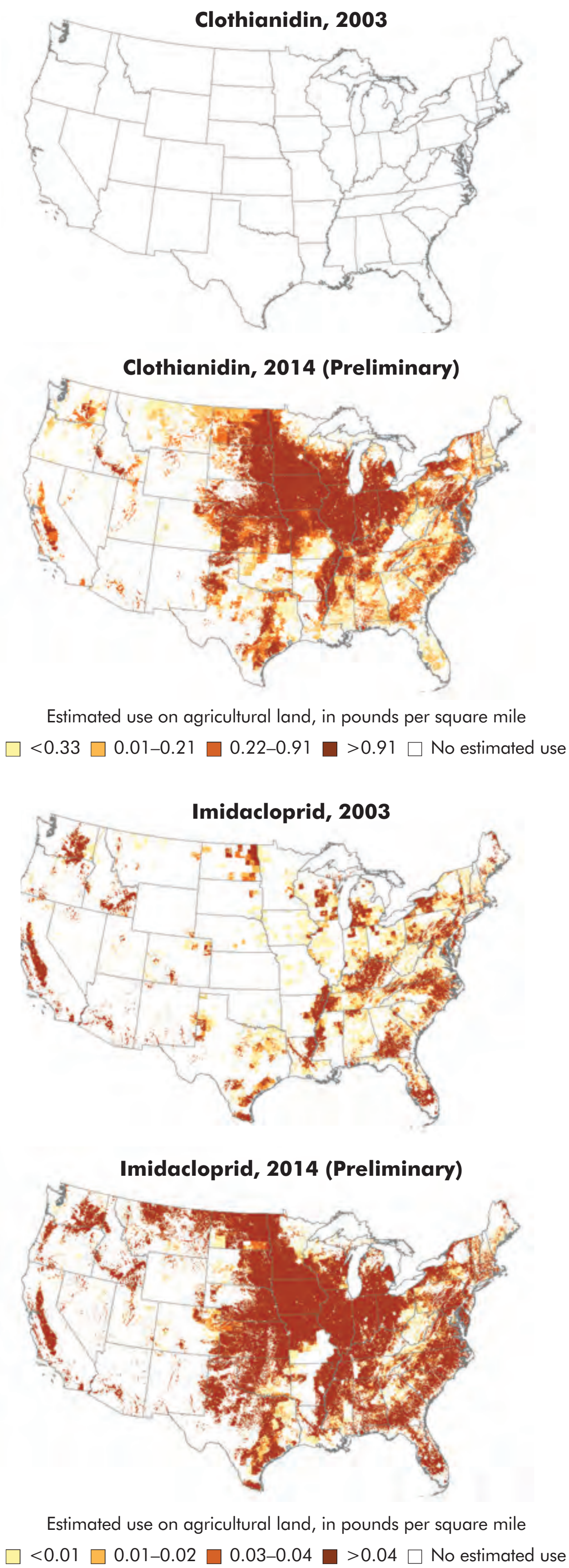
According to U.S. Geological Survey (USGS), water-quality benchmarks are estimates of "no-effect levels," meaning that real-world concentrations below the benchmarks are expected to have a low likelihood of adverse effects, while concentrations above a benchmark have a greater likelihood of adverse effects, which generally increases with concentration.

Benchmarks not based on effect to sensitive species

For the neonicotinoids, there are some aquatic life benchmarks for fish, invertebrates, and aquatic plants. In addition to limitations in assessing the effect of chemical mixtures, these benchmarks are derived from standardized laboratory testing of specific aquatic organisms, which many researchers have critiqued as not sensitive enough to pesticide exposures. Scientists note that the water flea *Daphnia magna*, which is used as a standard aquatic test organism, appears to be approximately 100,000 times less sensitive than other aquatic invertebrates, such as Ephemeroptera, Trichoptera or Diptera species (Morrissey, 2015). *If D. magna is more tolerant of neonicotinoids than other aquatic invertebrates, then its use in testing the aquatic toxicity of neonicotinoids, or other pesticides, results in benchmarks that are not protective of more sensitive species.*

The U.S. acute and chronic aquatic life benchmarks for invertebrates exposed to imidacloprid are 34.5 μg/L and 1.05 μg/L, respectively. However, studies summarized in this report find acute and chronic effects to aquatic organisms and communities at levels as low as 0.65 μg/L and 0.01 μg/L for imidacloprid, respectively (Alexander, 2007) (Morrissey, 2015). Meanwhile, levels of harm are exceeded in numerous monitoring studies, especially at peak levels. Mean peak neonicotinoid water levels have been reported at 0.63 μg/L and average neonicotinoid levels at 0.13 μg/L (Morrissey, 2015). While USGS has detected average imidacloprid in streams at levels up to 0.14 μg/L, others report detections of imidacloprid levels ranging from 0.001–320 μg/L, with clothianidin at 0.003-3.1 μg/L and thiamethoxam at 0.001–225 μg/L,

FIGURE 1: **Estimated Agricultural Use for Clothianidin and Imidacloprid, 2003 and 2014**



Source: USGS, National Synthesis Project, August 2016.

and as high as 3.29 μg/L in a California study (Starner, 2012). These findings establish that real-world levels currently exceed the benchmark "no effect" standard that would protect sensitive species.

SYNERGISTIC EFFECTS NOT CONSIDERED BY REGULATORS

Neonicotinoids in combination with other chemical classes can have additive and synergistic effects on exposed organisms. Some pesticide combinations, such as certain fungicides combined with either pyrethroid or neonicotinoid insecticides, increase toxicity synergistically. Imidacloprid has been found to act synergistically with inert ingredient mixtures, resulting in reduced population size of *Ceriodaphnia dubia* compared to imidacloprid alone. Feeding rates are observed to decrease in *Daphnia magna* when exposed to a mixture of imidacloprid and thiacloprid (Van Dijk et al., 2013).

Multiple pesticide combinations are found in U.S. waterways and it is possible that synergistic effects between these chemicals occur in the environment. However, little is known about the mechanisms associated with these synergistic interactions and their impact on aquatic invertebrates and ecosystems.

Neonicotinoid Use Is Widespread

Neonicotinoids are some of the most widely used pesticides in the U.S. and are contained in many readily available and widely used agricultural, lawn, and garden products. Neonicotinoid use increased rapidly between 2003 and 2014, as a result of growing prophylactic applications as seed coatings (Figure 1). It is estimated that 34–44% of soybeans and 79-100% of corn fields are treated with neonicotinoids in the U.S. Residential lawn and garden use, including vegetable and flower seeds and seedlings, is also ubiquitous. Neonicotinoids are also widely used on pets in flea collars and flea and tick treatments.

With the variety of applications and the treated acreage, neonicotinoids make their way into waterways from surface runoff from agricultural fields, lawns and gardens, as well as from spray drift and contaminated dust drift from coated seed plantings, and residential down-the-drain disposal.

Neonicotinoids are highly water-soluble and are mobile and persistent in the environment. Imidacloprid, one of the oldest neonicotinoids in commercial use, is persistent in water and does not easily biodegrade (Van Dijk, 2013). Half-lives in water are generally more than 30 days, with some reports ranging 30–162 days. Aquatic half-lives for thiamethoxam range 7.9 to 39.5 days; acetamiprid 34 days; dinotefuran 1.8 days; and clothianidin at less than one day. However, local water/environmental conditions can influence the persistence of these chemicals in water.

NEONICOTINOIDS IN THE WATERS

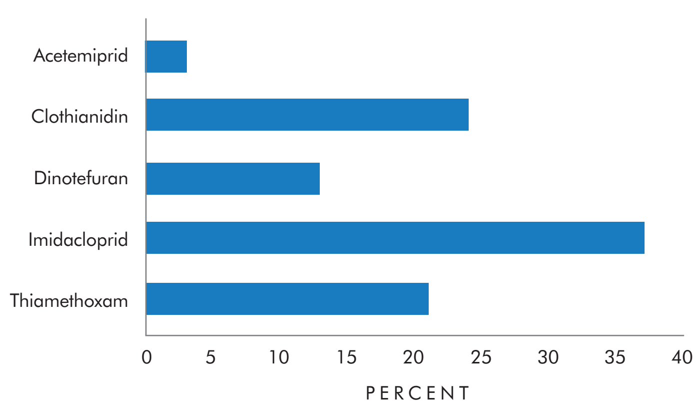
Looking at one of the neonicotinoids, in the 2017 "Preliminary Aquatic Risk Assessment to Support the Registration Review of Imidacloprid," EPA found," [C]oncentrations of imidacloprid detected in streams, rivers, lakes and drainage canals routinely exceed acute and chronic toxicity endpoints derived for freshwater invertebrates." EPA summarizes a large collection of monitoring data from several sources: USGS monitoring to give representative national data, USGS monitoring of storms and floods, California Department of Pesticide Regulation, and monitoring data reported in the scientific literature. Waterbodies monitored include drainage ditches and canals, streams, rivers, lakes, wetlands, and estuaries. Most studies could not detect imidacloprid below 0.002 to 0.02 μg/L. Since the most sensitive species tested are harmed above 0.01 μg/L, any detected imidacloprid is likely to have an impact on those sensitive species. In summarizing the data from USGS nationwide monitoring, EPA found imidacloprid was detected in 61% of samples from drainage canals and ditches, 13% of stream samples, 5% of river and lake samples, 8% of wetlands, and 67% of estuary samples. In this untargeted dataset, concentrations ranged as high as 7.94 μg/L. Higher detection rates and concentrations have been found in studies targetingareas where the pesticide is ued and problems are expected (USEPA, 2017).

USGS Baseline Survey

NATIONAL RESULTS

USGS' 2015 study, *First national-scale reconnaissance of neonicotinoid insecticides in streams across the USA,* found that neonicotinoids "were frequently detected in streams across the USA, with 63% of the 48 streams sampled having a detection of at least one neonicotinoid." The study samples from streams in 24 states and Puerto Rico between November 2012 and June 2014 identify levels that exceed acute and chronic toxicity values for sensitive organisms. The six neonicotinoids analyzed include acetamiprid, clothianidin, dinotefuran, imidacloprid, thiacloprid and thiamethoxam. Imidacloprid is the most frequently detected, followed by clothianidin and thiamethoxam (Figure 2). Of the neonicotinoids, thiamethoxam was found at the highest levels at 0.19 μg/L and acetamiprid the lowest at 0.04 μg/L (Hladik, 2016).

FIGURE 2: **Detection Frequency for Five Neonicotinoids Found at 38 Sites in a Nationwide Study, 2012–2014**



Source: Hladik and Kolpin, 2016.

URBAN VERSUS AGRICULTURAL

Water contamination with neonicotinoids reflect their use patterns. According to the USGS study, "Clothianidin and thiamethoxam concentrations were positively related to the percentage of the land use in cultivated crop production, and imidacloprid concentrations were positively related to the percentage of urban area within the basin." Sites in Iowa, where neonicotinoids are widely used on corn and soybeans, especially through treated or coated seeds, contain concentrations of clothianidin ranging from 0.025–0.132 μg/L. Additionally, clothianidin and thiamethoxam frequently co-occur in these agricultural regions.

An earlier 2014 regional USGS study analyzes stream concentrations of neonicotinoids in the Midwest cornbelt (Hladik, 2014). Similar to the more recent study, levels are detected in waterways near treated fields, resulting in high levels of clothianidin and thiamethoxam, with detection rates of 75% and 47%, respectively. Samples with multiple detections of neonics (76%) contain clothianidin most frequently, due to its heavy use as a seed coating in the region.

CHESAPEAKE BAY

Fifty percent of Chesapeake Bay watershed samples, taken from streams that feed into the bay, contain neonicotinoids, with clothianidin being the most frequently detected. According to the results, "The thiamethoxam and imidacloprid detections were all found in the presence of clothianidin."

These residues are attributed to agricultural runoff from farms in the region. Antietam Creek, MD, Big Pipe Creek, MD, and Chillisquaque Creek, PA watersheds for instance, range from 42–68% agricultural land use, including cropland. Not surprisingly, agricultural land use in these regions influences the levels of neonicotinoids found in these streams, and the concentrations of clothianidin increase with the proportion of land in agriculture (Hladik, 2016).

For the Chesapeake Bay, a sensitive watershed with federal and state mandates to reduce pollution and restore habitats, local stream concentrations with clothianidin (0.062 μg/L) approach the highest levels found nationally (0.066 μg/L). These residues, which could make their way to the Chesapeake Bay, pose risks to the unique species of the bay where already 75% of tidal waters are considered impaired as a result of chemical contamination.

From: Rosi-Marshall EJ , et al. (2007). "Toxins in transgenic crop byproducts may affect headwater stream ecosystems." Proc Natl Acad Sci USA 104:16204–16208. © 2007 National Academy of Sciences, U.S.A.

CALIFORNIA

A 2012 California Department of Pesticide Regulation study using 2010 and 2011 surface water monitoring data from three agricultural regions in the state finds imidacloprid in 89% of the samples collected, with maximum concentrations ranging 1.38–3.29 μg/L). In the three agricultural regions studied, imidacloprid was detected 85% in Salinas, 93% in Imperial Valley, and 100% in Santa Maria Valley. These levels exceed currently established chronic aquatic benchmark concentrations (Starner, 2012).

GLOBAL DETECTIONS

Elsewhere in the world, neonicotinoids are also widely detected. In Canada, average thiamethoxam concentrations in surface runoff are as high as 0.4 μg/L, with maximum concentrations of 2.2 μg/L are detected following a high rain event after coated seeds were planted in the nearby agricultural region.

A review of 29 water monitoring studies from nine countries, reports the presence of neonicotinoids in streams, rivers, puddled water, wetlands, and irrigation channels, finding levels ranging 0.003–3.1 μg/L for clothianidin, 0.001-225 μg/L for thiamethoxam and 0.001-320 μg/L for imidacloprid. Australian samples taken from agricultural regions contain multiple neonicotinoids with imidacloprid levels reaching 4.6 μg/L. Concentrations of 55.7 μg/L clothianidin and 63.4 μg/L thiamethoxam (Morrissey, 2015) were found in puddles in the corn growing regions of Quebec, Canada. Imidacloprid has been in the top three detected water contaminants for several years in the Netherlands, with levels as high as 320 μg/L reported, exceeding the country's maximum allowed environmental concentration (Morrissey, 2015).

CASE STUDIES

The Poisoning of Willapa Bay and Grays Harbor

In 2015, the State of Washington's Department of Ecology ("Ecology") approved a permit to allow the spraying of imidacloprid on 2,000 acres in Willapa Bay and Grays Harbor to control burrowing shrimp—considered a pest by commercial oyster growers—on 2,000 acres of tidelands. Local residents raised the concern that the use of imidacloprid would contaminate the oyster beds and the oysters that the state was trying to protect. Consumers, environmental organizations, and prominent local chefs spoke out against the spraying. An environmental assessment conducted by Ecology found that, "The proposed use of imidacloprid to treat burrowing shrimp in shellfish beds located in Willapa Bay and Grays Harbor is expected to have little or no impact on the local estuarine and marine species. . . ," and imidacloprid is "safer" than the alternative, the carbamate insecticide carbaryl.

Opponents note the need for caution, citing Ecology's failure to consider information on fate and transport, efficacy, and persistence of imidacloprid, as well as the existing published research on the wide-ranging ecological damage from imidacloprid use, and the potential to damage the rich marine ecosystems of Willapa Bay and Grays Harbor. Central to the concern is imidacloprid's adverse effect on key species whose loss can cause a cascading trophic effect, harming the fish, birds, and other organisms that rely on them.

The National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) also weighed in, pointing to unknowns regarding impact, to other aquatic and terrestrial biota. NMFS finds that the native burrowing shrimp play an important role in the natural ecosystem, and voiced concern that the green sturgeon—a "species of concern" under the Endangered Species Act (ESA—could be affected by reduced food sources in its designated critical habitat. The shellfish industry eventually requested the permit be withdrawn in response to public outcry.

In 2016, oyster growers from the Willapa Grays Harbor Oyster Grower Association applied for a new pesticide permit for imidacloprid to control the burrowing shrimp—aimed at treating smaller acreage than the 2015 proposal, with application to be conducted from boats or ground equipment rather than aerial spraying.

Native ghost shrimp, *Neotrypaea californiensis,* and mud shrimp, *Upogebia pugettensis,* have an important function in this ecosystem, but are blamed by shellfish growers for their declining industry. According to an analysis conducted by the Xerces Society, "The benefits from these species are likely to include ecosystem services such as substrate bioturbation, improving water quality and nutrient availability." Other species, like migratory birds that depend on shoreline aquatic invertebrates, can also be significantly affected.

What are the regulators up to?

The U.S. Environmental Protection Agency's (EPA) Office of Pesticide Programs regulates pesticides under the *Federal Insecticide, Fungicide and Rodenticide Act* (FIFRA) with its "unreasonable adverse effects" standard, conducts Ecological Risk Assessments, and proposes risk mitigation measures. It coordinates with the Office of Water under the *Clean Water Act*, which seeks to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters . . . for the protection and propagation of fish, shellfish, and wildlife."

EPA's 2017 preliminary risk assessment of the neonicotinoid insecticide imidacloprid, which identifies toxicity endpoints, challenges its 2008 decision on allowed levels (benchmarks) in water that the agency now finds are not adequate to protect sensitive aquatic species. The agency says, "[C]oncentrations of imidacloprid detected in streams, rivers, lakes and drainage canals routinely exceed acute and chronic toxicity endpoints derived for freshwater invertebrates." EPA is scheduled to make a final decision on continued imidacloprid use in 2018.

Historically, ecological risk assessments do not fully evaluate: (i) **sensitive species**; (ii) **ecosystem or habitat impacts**; (iii) **foodweb impacts** (to determine effect of keystone species impact on higher trophic members of the aquatic ecosystem); (iv) **secondary or non-target effects**; (v) **sublethal or low pesticide doses**; and (vi) **pesticides** registered conditionally, like neonicotinoids, without full understanding.

The Canadian Pest Management Regulatory Agency, in 2016, announced its proposal to phase out imidacloprid because, "Based on currently available information, the continued high volume use of imidacloprid in agricultural areas is not sustainable." Uses proposed for phase out: trees (except when applied as a tree trunk injection), greenhouse uses, outdoor agricultural uses (including ornamentals), commercial seed treatment uses, and turf (such as lawns, golf courses, and sod farms).

Chesapeake Bay: Blue Crabs and America's Imperiled Estuary

Despite the latest *State of the Bay* report (2016) declaring the health of the Chesapeake Bay improved, over 75% of the bay is categorized as impaired by chemical contaminants, including pesticide runoff from surrounding agricultural and residential sites. Habitat, fisheries, and nutrient pollution indicators have improved since federal and state efforts were organized to restore the health of America's largest estuary. This unique ecosystem is home to a range of aquatic wildlife. The blue crab, *Callinectes sapidus*, is the most identifiable habitant of the bay, considered one of its keystone species because it provides food for other wildlife and consumes benthic organisms, thus helping to keep the bay clean. Annual commercial harvest of blue crab is valued $78 million, but over the years, populations have declined to levels that threaten the viability of the crab.

Agricultural runoff drains into tidal creeks that are important habitats for juvenile and adult stage blue crabs. Female blue crabs, after mating in spring and summer, migrate downstream and out of the estuary to release larvae. Larvae develop offshore then return onshore in their post-larval stage (megalopae) in late summer and fall to develop into the juvenile stage. The blue crab's juvenile stage is the most likely age group to be directly affected by agricultural runoff, as they tend to live in shallow waters, including drainage areas that collect contaminated pesticide runoff or spray drift.

A 2012 study conducted on blue crabs in North Carolina by Duke University researchers finds that the imidacloprid-formulated product, Trimax, is highly toxic to juvenile and post-larval blue crabs (LC_{50} 816.7 μg/L and 312.7 μg/L, respectively), second in toxicity to the pyrethroid insecticide lamda-cyhalothrin (Osterberg, 2012). Imidacloprid, however, is 100-fold more toxic to post-larval crabs compared to juveniles (LC_{50} 10.04 μg/L for post-larval crabs vs. 1112 μg/L for juveniles), according to the study. Post-larval crabs are found to be the most sensitive developmental stage to imidacloprid and its formulated product overall. Adverse effects include significant reduction in molting of post-larval crabs and increased mortality. Interestingly, the study notes that post-larval blue crabs are more sensitive to imidacloprid than the small crustacean, *Daphnia magna*, which is an organism recommended by federal guidelines for testing the aquatic toxicity of pesticides.

Molting, which occurs several times in young crabs, is an important developmental process that causes post-larval and juvenile crabs to be very sensitive to environmental chemicals. Juvenile crabs can molt as frequently as once a week, thus increasing their sensitivity to chemicals. The authors conclude that molting blue crabs are "at an elevated risk of pesticide toxicity beyond what is suggested by LC_{50}s alone." The authors note that further evaluation of the sensitivity of blue crabs to mixtures must be conducted.

Like the blue crab, other inhabitants of the bay are also affected by pesticides, but limited information exists on the effects of specific pesticides on these organisms. There are some data regarding contaminant exposure to waterbird species like the ospreys, waterfowl, and black-crowned night-herons. These birds feed on many benthic and aquatic species whose populations are directly affected by neonicotinoid contamination. Other bay organisms, including grass shrimp, have been found to experience increased toxicity in pesticide mixtures containing imidacloprid, demonstrating the additive effects of chemical mixtures on aquatic organisms (Key et al., 2007).

ACTION TO ENSURE HEALTHY ECOSYSTEMS

Protection of the nation's waterways is fundamental to healthy ecosystems. The importance of the mayfly to aquatic habitats is demonstrated by its ability to convert sediment nutrients into food for many species of fish and others when they are eaten. Without this critical keystone species, an important food source and nutrient recycler would be lost. With the disruption or loss of important aquatic ecosystem functions, such as nutrient cycling, water filtration, and a host of other functions, including providing habitat, adverse effects are felt throughout both aquatic and terrestrial systems.

In 2014, the International Union for the Conservation of Nature (IUCN Task Force) published the first report examining the impact on biodiversity and ecosystems as a result of growing neonicotinoid use. After reviewing numerous peer-reviewed scientific studies, the Task Force found that neonicotinoids are in the environment "at levels that are known to cause lethal and sublethal effects on a wide range of terrestrial (including soil) and aquatic microorganisms, invertebrates and vertebrates" (Van der Sluijs). The report concludes that increasing use of neonicotinoids is not sustainable and poses a threat to important invertebrates and the diversity and stability of ecosystems.

In light of the presented evidence of risks to individual aquatic invertebrates, species abundance, and ecosystem functioning, suspension of neonicotinoid insecticides is imperative. As observed with the decline of pollinators, like honey and native bees, whose perilous state is linked to pervasive neonicotinoid use, action must be taken to protect vulnerable waterways from neonicotinoid contamination. The frequency of detections in U.S. waterways cannot be overlooked. Such routine detections, even at low levels, indicate that our waterways are being overloaded with mobile and persistent chemicals at highly elevated concentrations, whose long-term impacts on aquatic health has been documented, but not fully understood.

Thus far, little action has been taken to restrict the use of these chemicals in response to the independent scientific literature and EPA risk data that identify direct threats to aquatic invertebrates, as well as indirect threats to higher trophic organisms of the most widely used neonicotinoid, imidacloprid. Other neonicotinoids in its class will likely be found to have similar impacts on aquatic species. Federal benchmarks based on testing on insensitive species are not protective of more sensitive species. Given the toxicity of this class of insecticides to non-target, beneficial invertebrates, and the regulatory deficiencies, it is imperative that action be taken to limit their use and presence in waterways in the U.S. and worldwide.

From: Rosi-Marshall EJ , et al. (2007). "Toxins in transgenic crop byproducts may affect headwater stream ecosystems." Proc Natl Acad Sci USA 104:16204–16208. © 2007 National Academy of Sciences, U.S.A.

For fully cited version of this article is available online at *bit.ly/pesticidesandyou*.

Action Steps

- Call on Congress and EPA to suspend the use of neonicotinoids and other systemic pesticides.
- Plant habitat with organic seeds and manage with organic practices.
- Adopt local policies that require organic land management of all public lands, and, where possible, private property.
- Repeal preemption of local authority to restrict pesticides in your community.
- Start an organic garden.
- Buy organic food.

Products Compatible with Organic Landscape Management

THE MARKET FOR GREENER PEST MANAGEMENT MATERIALS GROWS

Organically managed playing field in Marblehead, Massachusetts.

With communities across the country adopting organic landscape management practices and policies for lawns, playing fields, and parks, identifying products that are compatible with the sustainable approach is a central concern for managers and residents. Organic systems nurture soil biology to support the natural cycling of nutrients, resulting in resilient turf systems and plants. Because the use of toxic materials undermines the organic system by harming the soil microbial life, identifying compatible products is an essential component of the system. To assist communities in identifying products and complying with local laws, where they exist, that restrict products to organic compatible materials, Beyond Pesticides has developed the *List of Products Compatible with Organic Landscape Management*.

The List is based on two established lists of materials and products: (i) the National List of Allowed and Prohibited Substances of the Organic Foods Production Act (OFPA), passed by the U.S. Congress in 1990 and overseen by a stakeholder board created by the statute, the National Organic Standards Board (7 C.F.R 205.601 and 602), and (ii) the U.S. Environmental Protection Agency's list of exempt pesticides, Section 25(b) of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) (40 C.F.R. 152.25).

BACKGROUND ON UNDERLYING LIST

In creating the National List, the authors of OFPA recognized the (i) inherent safety of most natural materials that results from a long history of exposure and adaptation, and (ii) need to assess synthetic chemicals that may cause harm to health and ecology. Thus, the National List allows natural materials to be used in organic crop production unless found to be harmful, but prohibits synthetic materials unless recommended by the NOSB and codified. Three criteria are applied in deciding whether a material should be allowed on the National List: no adverse effects to humans or the environment, need for the material (essentiality) in an organic system, and compatibility with organic practices. OFPA outlines a number of impacts that must be considered in this evaluation.

Because continuous improvement is a principle in the organic law, the National List is under a five-year sunset and review cycle to evaluate new information about environmental and health impacts, which may require a change in a listing. A petition process allows the NOSB to evaluate proposed additions or adjustments to the National List.

Tying the *List of Products Compatible with Organic Landscape Management* to the National List allows communities to take advantage of the evaluation, and regular re-evaluation, performed by the NOSB's public process. The list of organic landscape management products also incorporates EPA's list of active ingredients that do not need to be registered as pesticides. This is a short list of materials, most of which are nonsynthetic and are allowed in organic production.

Beyond Pesticides encourages residents to advocate in their community for pesticide policies with the above criteria. The list can be used as a guide for inputs in all organic lawn care practices community-wide. Organic turf management is not a product-based approach, and since all products have some degree of risk, Beyond Pesticides urges that all products are used as a last resort. For assistance in adopting an organic landscape management policy and practices in your community, visit *bit.ly/ToolsForChange* and contact Beyond Pesticides at *info@beyondpesticides.org* or 202-543-5450.

Contributors to this article include Drew Toher, Terry Shistar, PhD, and Jay Feldman. See chart at bit.ly/OrganicCompatible.

List of Products Compatible with Organic Landscape Management

Note that there may be other formulations of a product under a similar brand name (e.g., many brands sell both ready to use and concentrate versions of their products). The allowed list describes: (i) active ingredient in product; (ii) product name; (iii) pesticide category [i.e., insecticide, herbicide, fungicide, etc.), and (iv) regulatory status [organic or exempt from EPA registration, 25b).

TABLE 1: Fungicides

Active Ingredient	Product Name	Regulatory Status
Fungicide		
Bacillus subtilis GB03	Companion Liquid Biological Fungicide	Organic
Bacillus subtilis QST 713 strain	Rhapsody	Organic
Bacillus subtilis QST 713 strain	Serenade Garden Disease Control RTU	Organic
Bacillus subtilis QST 713 strain	Natria Disease Control RTU	Organic
Essential Oil (Cinnamon/Clove)	Blizzard Organic Fungicide	25b
Essential Oil (Clove/Cinnamon)	Bravado Organic Fungicide	Organic
Gliocladium catenulatum Strain J1446	Prestop Biofungicide Powder	Organic
Oil (Cottonseed, Corn, Garlic)	Mildew Cure	Organic
Potassium Bicarbonate	Greencure Fungicide	25b
Potassium Bicarbonate	Kaligreen	Organic
Potassium Bicarbonate	Bi-Carb Old Fashioned Fungicide	Organic
Potassium Bicarbonate	Carb-O-Nator	Organic
Pythium oligandrum DV 74	Polyversum	Organic
Streptomyces lydicus	Actinovate Lawn and Garden Fungicide	Organic
Trichoderma harzianum Rifai strain T-022	Rootshield Seed Treatment	Organic
Trichoderma harzianum Rifai strain T-22 and Tricho-derma virens strain G-41	TurfShield PLUS WP Biological Fungicide	Organic
Trichoderma spp.	Tenet WP	Organic

TABLE 2: Herbicides, PGRs

Active Ingredient	Product Name	Regulatory Status
Herbicide		
Acetic Acid	SummerSet AllDown	Organic
Acetic Acid	Vinagreen Natural Non Selective Herbicide	Organic
Acetic Acid, Citric Acid	Black Jack 21	25b
Ammoniated Soap of Fatty Acids	Final-.San-O	Organic
Ammonium Nonanoate	Mirimichi Green Pro Con-centrate	Organic
Ammonium Nonanoate	Emerion 7020 Concentrate	Organic
Ammonium Nonanoate	Emerion 7020 Concentrate	Organic

TABLE 2: Herbicides, PGRs (CONTINUED)

Active Ingredient—Herbicide	Product Name	Regulatory Status
Herbicide		
Ammonium Nonanoate	Mirimichi Green Effective Earth Solutions Grass & Weed Control Ready To-Spray	Organic
Ammonium Nonanoate	BioSafe Weed Control	Organic
Ammonium Nonanoate	AXXE	Organic
Caprylic Acid, Capric Acid	Suppress Herbicide EC	Organic
Citric acid, Essential Oil (Clove), Malic Acid	Phydura	25b
Corn Gluten	Concern Weed Prevention Plus	25b*
D-limonene	Avenger Weed Killer	Organic
Essential Oil (Clove/Cinnamon)	JH Biotech Weed Zap	Organic
Essential Oil (Clove/Cinnamon)	Safer Grow Weed Zap	Organic
Eugenol, Essential Oil (Clove)	Halo	25b
Oil (Soybean)	EcoBlend Weed and Grass Burndown	Organic
Oil (Soybean)	Preem	25b
Potassium Salt of Fatty Acids	Safer Brand Weed and Grass Killer	Organic
Potassium Salt of Fatty Acids	Safer Brand Fast-Acting Weed and Grass Killer Concentrate	Organic
Sodium Chloride	A.D.I.O.S	Organic
Sodium Lauryl Sulfate, 2-Phenethyl Propionate	EcoSmart Weed and Grass Killer	25b
Mossicide/Algaecide		
Ammoniated Soap of Fatty Acids	Quik-Fire	Organic
D-limonene	Monterey Moss Stopper	Organic
D-limonene	Moss Melt Concentrate	Organic
Oil (Cottonseed, Garlic), Essential Oil (Clove)	No Moss	Organic
Potassium Salt of Fatty Acids	Safer Brand Moss and Algae Killer and Surface Cleaner	Organic
Plant Growth Regulator (PGR)		
Gibberelic Acid	GibGro 4LS	Organic
Gibberelic Acid	N-Large Plant Growth Regulator Solution	Organic

* Only corn gluten that is not derived from genetically engineered corn may be used in organic production.

TABLE 3: **Insecticides, IGRs, Repellents**

Active Ingredient	Product Name	Regulatory Status
Animal Repellent		
Coyote/Fox Urine	Shake-Away Coyote/ Fox Urine Granules	Organic
Dried Red Pepper and Dried Blood	Uncle Ians Dog and Cat Repellent	Organic
Dried Red Pepper and Dried Blood	Uncle Ians Mole and Gopher Deer Rabbit and Squirrel Repellent	Organic
Piperine/Oil of Black Pepper/Capsaicin	Havahart Critter Ridder	Organic
Porcine/Bovine Dried Blood	Plantskydd Granular Repellent for Rabbits and Small Critters	Organic
Porcine/Bovine Dried Blood	Plantskydd Granular Repellent for Deer, Rabbits, and Elk	Organic
Putrescent Whole Egg Solids/Capsacin/ Garlic	Deer Off Deer and Rabbit Repellent	Organic
Insect Growth Regulator (IGR)		
Azadirachtin	Neemix 4.5	Organic
Azadirachtin	Azatin O	Organic
Insecticide		
Bacillus thuringiensis	Safer Brand Garden Dust and Caterpillar Killer	Organic
Bacillus thuringiensis	DiPel® PRO DF Biological Insecticide Dry Flowable	Organic
Bacillus thuringiensis	Thuricide BT Caterpillar Control	Organic
Bacillus thuringiensis	Summit Biological Caterpillar and Webworm Control	Organic
Chromobacterium subtsugae	Grandevo	Organic
Citric Acid	Flying Skull Nuke 'Em Insecticide	Organic
Diatomaceous Earth	Perma-guard	Organic
Diatomaceous Earth	Safer Brand Ant and Crawling Insect Killer	Organic
Diatomaceous Earth	Desect Diatomaceous Earth Insecticide	Organic
D-limonene	Orange Guard Fire Ant Control	Organic
D-limonene	Orange Guard Ornamental Plants Inseticide	Organic
Essential Oil (Blend)	Dr. Earth Yard and Garden Insect Killer	Organic
Essential Oil (Blend)	Mantis Botanical Insecticide/Miticide	Organic
Essential Oil (Cedar)	CedarGuard	Organic
Essential Oil (Cedar)	CedarCure	25b

Active Ingredient	Product Name	Regulatory Status
Insecticide		
Essential Oil (Cedar), Oil (Soybean)	EcoShield Botanical Insecticide	Organic
Essential Oil (Clove/ Cinnamon)	Aramite Organic Acaricide–Insecticide	Organic
Essential Oil (Rosemary/ Peppermint)	Ecotec	Organic
Essential Oil (Thyme)	HumaGrow Proud3	Organic
Iron Phosphate	Garden Safe Slug and Snail Bait	Organic
Iron Phosphate	Miracle-Gro® Nature's Care Slug & Snail Control	Organic
Iron Phosphate	Whitney Farms Slug and Snail Killer	Organic
Iron Phosphate/ Spinosad	Brandt Antixx Plus Ant and Crawling Insect Killer	Organic
Iron Phosphate/ Spinosad	Sluggo Insect, Slug, and Nail Pellets	Organic
Milky Spore	St Gabriel Organic Milky Spore Granular	Organic
Neem Oil	Safer Brand Garden Defense	Organic
Nematodes: Steinernema carpocapsae	Ecomask Topdressing	25b
Nematodes: Steiner-nema carpocapsae and Heterorhabditis bacteriophora	Grub Guard	Organic
Nematodes: Steinernema feltiae	Scanmask Topdressing	25b
Nematodes: Steinernema glaseri	Environmental Factor Inc	25b
Oil (Cottonseed)	Safer Gro PestOut	Organic
Oil (Cottonseed)	AntOut	Organic
Potassium Salt of Fatty Acids	Safer Insect Killing Soap	Organic
Potassium Salt of Fatty Acids	Safer Brand Grub Killer	Organic
Potassium Salt of Fatty Acids/Neem Oil/Natural Pyrethrin (without PBO)	Safer Brand End ALL Insect Killer	Organic
Spinosad	Green Light Garden Spray	Organic
Spinosad	Seduce Insect Bait	Organic
Spinosad	Conserve Naturalyte Insect Control	Organic
Spinosad	Monterey Garden Insect Spray	Organic

TABLE 3: **Insecticides, IGRs, Repellents** (CONTINUED)

Active Ingredient	Product Name	Regulatory Status
Nematicide		
Paecilomyces lilacinus	Bio-Nematon	Organic
Quillaja saponaria saponins	Brandt Nema-Q	Organic
Quillaja saponaria saponins	Montery Nematode Control	Organic

Active Ingredient	Product Name	Regulatory Status
Insect Repellent		
Garlic Extract	Biolink Insect and Bird Repellent	Organic
Garlic Extract	Garlic Barrier AG Insect Repellent	Organic

TABLE 4: **Multi-Category**

Active Ingredient	Product Name	Category	Regulatory Status
Azadirachtin	AzaSol	Insecticide/Miticide/Fungicide	Organic
Azadirachtin	SoluNeem	Insecticide/Miticide/Fungicide	Organic
Azadirachtin	Azatrol	Insecticide/Miticide/Insect Growth Regulator	Organic
Azadirachtin	Molt-X	Insecticide/Nematicide	Organic
Azadirachtin	Safer Brand BioNeed	Insecticide/Repellant/Insect Growth Regulator	Organic
Azadirachtin	Amazin 1.2 ME	Insecticide/Repellant/Insect Growth Regulator/Nematicide	Organic
Bacillus amyloliquefaciens strain D747	Monterey Complete Disease Control Brand RTU	Fungicide/Batericide	Organic
Bacillus amyloliquefaciens strain D747	DoubleNickel LC Biofungicide	Fungicide/Batericide	Organic
Essential Oil (Clove), Oil (Cottonseed, Garlic)	Pest Out	Insecticide/Miticide	Organic
Essential Oil (Thyme)	HumaGrow Promax	Nematicide/Fungicide	Organic
Essential Oils (Various)	EcoSmart Brands	Insecticide/Herbicide/Fungicide	25b
Fats and Oil, Azadirachtin	Debug Tres Emulsifiable Concentrate Antifeedant, Insect Repellent, Insecticide, Miticide, Fungicide & Nematicide	Insecticide/Miticide/Nematicide/ Fungicide	Organic
Horticultural Oil (may be listed as mineral oil on label)	Civitas Turf Defense Pre-Mixed	Fungicide/Insecticide/Disease Suppression	Organic
Horticultural Oil (may be listed as mineral oil on label)	Civitas Turf Defense Ready-2-Mix	Fungicide/Insecticide/Disease Suppression	Organic
Neem Oil	70% Neem Oil	Insecticide/Fungicide	Organic
Neem Oil	Bayer Natria Neem Oil	Insecticide/Fungicide	Organic
Neem Oil	Triact 70	Insecticide/Miticide/Fungicide	Organic
Neem Oil	Trilogy	Insecticide/Miticide/Fungicide	Organic
Neem Oil	Monterey Neem Oil RTU	Insecticide/Miticide/Fungicide	Organic
Neem Oil	Triple Action Neem Oil	Insecticide/Miticide/Fungicide	Organic
Neem Oil	TerraNeem EC	Insecticide/Miticide/Nematicide/ Fungicide	Organic
Neem Oil/and Natural Pyrethrin (without PBO)	Monterey Rose & Flower Spray Plus Broad Spectrum Insecticide, Fungicide, and Miticide	Insecticide/Miticide/Fungicide	Organic
Oil (Sesame)	Organicide 3 in One	Insecticide/Fungicide/Miticide	Organic
Potassium Salt of Fatty Acids	MPEDE	Insecticide/Fungicide	Organic
Potassium Silicate	Sil-Matrix	Insecticide/Fungicide	Organic
Sulfur	Sulfur DF	Fungicide/Miticide	Organic
Sulfur	Kumulus DF	Fungicide/Miticide	Organic

by Carla Curle and Terry Shistar, PhD

Lentil Underground

RENEGADE FARMERS AND THE FUTURE OF FOOD IN AMERICA

Liz Carlisle
New York: Gotham Books, 2015, 298pp.

The power of farmers to stand up to agribusiness is rarely depicted as vividly as it is in this book. In the summer of 2011, author Liz Carlisle, a UC Berkeley PhD student working on her dissertation, journeyed to Missoula, Montana to meet an organic farmer about whom she had heard compelling stories. Dave Oien, the organic farmer, started Liz on a journey to uncover the history of the organic farming movement in Montana and the Great Plains, while at the same time answering many of her questions about feeding the world without destroying it in the process.

The book opens with a depiction of Mr. Oien's trials and tribulations in the late 70s in converting his family's fossil-fuel based grain farm into a "self-supporting diversified farm that ran on manure." It goes on to describe the underlying hardships that Mr. Oien and many other farmers in this region were experiencing—from low grain prices to drought to pests. But, instead of continuing to subscribe to the "get big or get out" mentality perpetuated by Secretary of Agriculture (1971–76) Earl Butz's agricultural model, these farmers "saw an opportunity—and an imperative-to change the paradigm."

The author skillfully portrays the struggles and successes of this renegade group of farmers that eventually came together to establish Timeless Seeds, an organic lentils and specialty grains company. The four founding organic farmers, Dave Oien, Bud Barta, Jim Barngrover, and Tom Hastings, were all committed from the beginning to building soil health, reducing erosion, and creating natural fertilizer. Their original crop was black medic, a relative of alfalfa and a regionally adapted nitrogen-fixing legume. However, Mr. Orien soon realized that "biological wealth was not going to pay the bills. He needed a crop that farmers could use to build their soils—but also sell as food." Lentils were the answer.

This story captures the complexities between humans and the land on which our lives depend. By nurturing the soil, we nurture ourselves. As the author so eloquently states in the closing chapter, "To build biological fertility is to build community—to accept interdependence with other creatures and foster a common benefit."

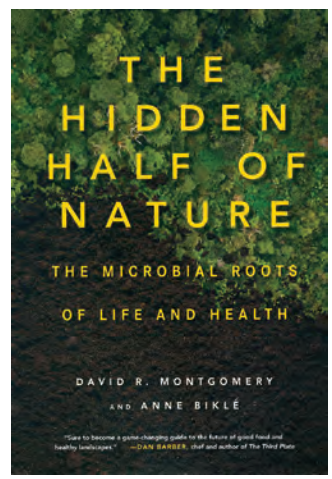
Lentil Underground engrosses readers in an account of an unconventional sustainable food movement where farmers challenge corporate power and succeed in reconnecting with their roots, both above and below ground. — *Carla Curle*

The Hidden Half of Nature

THE MICROBIAL ROOTS OF LIFE AND HEALTH

David R. Montgomery, PhD and Anne Biklé
New York: W.W. Norton and Company, 2016, 309pp.

Geologist David R. Montgomery, PhD and his coauthor and wife, biologist Anne Biklé, understand the importance of microbiota to the human organism and to the soil. Their book grows out of the authors' experience developing healthy garden soil and fighting Ms. Biklé's cancer, and becoming "intrigued by the parallel roles of microbes in maintaining the health of plants and people."



The authors describe their journey to understanding the emerging science connecting life at macro and micro scales. The topic of microbes in the human gut is introduced by Ms. Biklé's moving account of her experience with cervical cancer—a cancer caused by the human papillomavirus, which led her to investigate the roles of microbes in the human body and the influence of diet. The authors began to understand the gut as an ecosystem—or a "planet with a rich palette of ecosystems, as different as the Serengeti and Siberia, each hosting multitudes of microbes."

In both the human gut and the soil, microbes assist their hosts with their nutritional needs. In both cases, microbes participate in symbiotic relationships with their hosts. Bacteria in the human gut manufacture amino acids, vitamins, and other essential compounds that we cannot extract directly from our food. Bacteria provide plants with nutrients—most notably nitrogen through the process of nitrogen fixation—and they and mycorrhizal fungi extend the reach of plant roots. Besides helping plants and animal hosts (like humans) obtain the nutrition they need, microbes, especially bacteria, play an active role in the functioning of the immune system of their hosts. Soil bacteria coat the roots of plants and exude chemicals that protect plants from disease and herbivores. Similarly, bacteria coat the guts of mammals and produce compounds that enhance the immunity of their hosts.

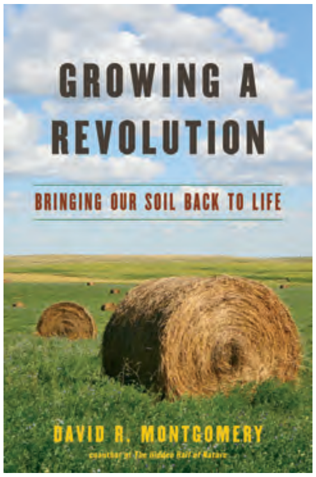
The authors compare the human colon, with bacteria "shoulder-to-shoulder" with our own cells, to a plant root, with mycorrhizal fungi squeezed between plant cells. "In both cases, the quality of the soil at the invisible frontiers of root and gut, and whether we poison, neglect, or cultivate it, are central to the health of plants and people." *— Terry Shistar, PhD*

Growing a Revolution

BRINGING OUR SOIL BACK TO LIFE

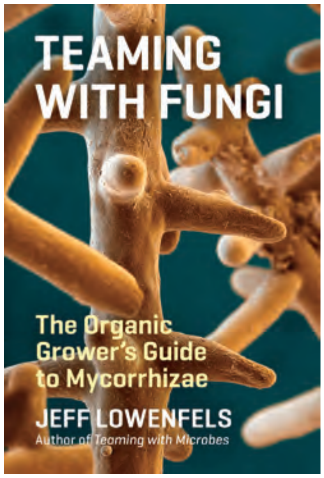
David R. Montgomery, PhD
New York: W.W. Norton and Company, 2017, 309pp.

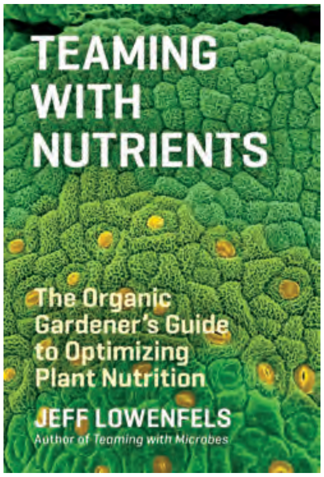
In this book, Dr. Montgomery takes readers in a practical direction. He begins by outlining the problem of soil degradation, which erodes global crop production capacity and contributes to pollution of air and water. Soil degradation has led to the collapse of civilizations—from the Roman Empire to Easter Island—and may threaten our own. Notably, soil depleted of microbiota results in its inability to sequester carbon, which contributes to global climate change. Restoring carbon to the soil, the author argues, "can help address the fundamental challenges of water, energy, and climate, as well as a number of important environmental and public health problems." As the author explains, plowing disturbs microbial communities and exposes them to faster decay and erosion by wind and rain. It also leads to pollution, as fertilizers and pesticides run off into streams or are carried by wind. Thus, protecting and growing soil biota depend on minimizing disturbance by plowing.



Research for the book took Dr. Montgomery across the globe to see examples of "conservation agriculture," which is defined by three principles: (i) minimum soil disturbance, (ii) growing cover crops and keeping crop residue so that the soil is always covered, and (iii) use of diverse crop rotations. He found many different versions, most of which did not incorporate all three practices, and identified a number of practices for building soil health and curing the addiction to agrichemicals, including no-till, intensive rotational grazing, perma-culture, mulch, integration of crops and livestock, and use of biochar, compost, and microbial inoculants.

Although I would challenge the author's statement, "Organic agriculture is as unsustainable as conventional farming when tillage is a regular practice," Growing a Revolution demonstrates the need for conservation agriculture and, importantly, the benefits in yield and income that can be gained by any grower incorporating all three principles into an agricultural system. *— Terry Shistar, PhD*





Teaming with Nutrients

THE ORGANIC GARDENER'S GUIDE TO OPTIMIZING PLANT NUTRITION

Jeff Lowenfels
Portland, Oregon: Timber Press, 2013, 250pp.

Teaming with Fungi

THE ORGANIC GARDENER'S GUIDE TO MYCORRHIZAE

Jeff Lowenfels
Portland, Oregon: Timber Press, 2017, 172pp.

Once upon a time not so long ago, no one—not even organic gardeners and farmers—had much of an idea of how and why organic practices work. Organic practitioners spoke of the soil as being alive and knew that chemical pesticides and fertilizers kill the soil. They spoke about "feeding the soil to feed plants." We now have a much better understanding of what living soil is and how it feeds plants—knowledge that comes from science like that presented by David Montgomery and Jeff Lowenfels, and the practical on-farm research like that reported and used by Rodale Institute's Jeff Moyer (see below).

Teaming with Nutrients follows and expands upon the author's previous book, *Teaming with Microbes*, written with Wayne Lewis. Like the previous book, the illustrations—especially the scanning electron micrographs—are worth the price of the book. The author offers clear explanations of cell biology and biochemistry, and give us a greater understanding of fertility in organic systems, starting with two laws:

- **Von Liebig's Law of the Minimum**—plant growth is limited by the least abundant (relative to the plant's needs) mineral; and
- **Sir Howard's Law of Return**—plant and animal wastes must be recycled in order to keep the system healthy.

Coupled with an understanding of the symbiotic relationship between plants and soil organisms, the two laws explain how fertility happens in organic systems. Microbial and other soil organisms actively feed plants, who in turn feed soil life. Some, perhaps most, of the minerals needed by plants and soil organisms are abundant in the soil and are available under favorable conditions. Nitrogen can be replaced by legumes and their symbiotic microbes. Phosphorus, though plentiful, can be locked up in the soil unless freed by bacteria or mycorrhizal fungi. Iron and other micronutrients are made more available by microbial action. The task of the organic farmer or gardener, then, is to feed and create a favorable environment for the soil organisms, who make nutrients available to plants. Cover crops—especially when turned into mulch—provide a particularly good way of doing both. Nitrogen, the nutrient that receives the most attention, is also the easiest to replace by growing cover crops.

Teaming with Fungi is the third book in the Teaming trilogy. This book focuses on mycorrhizal fungi. Fungi may be grouped according to how they get nutrition. Saprophytic fungi, such as commercially-available edible mushrooms, assist in the decay of non-living organic matter. Parasitic fungi eat living organisms. Lichens are symbiotic relationships between fungi and algae. Endophytes live within plant tissues. Mycorrhizal fungi associate with plant roots, gaining carbon in exchange for other elements and colonizing plant roots, which greatly expands their effective surface area, thus increasing the plant's uptake of water and nutrients. Mycorrhizae also improve soil structure.

Fungal hyphae have a much higher surface area to volume ratio than root hairs and can extend into tiny pores in the soil to get nutrients. Mycorrhizae greatly increase access to phosphorus and nitrogen, especially when these nutrients are in short supply.

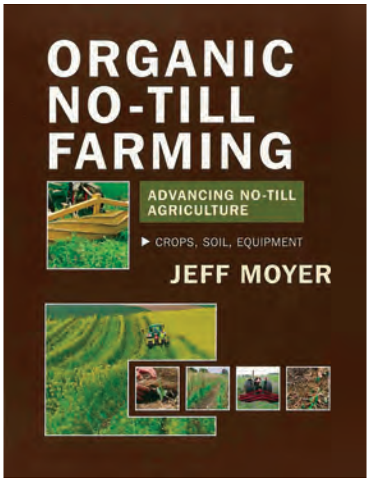
Organic farmers capture all these benefits, including increased nutrient availability to their crops, as well as greater (i) resistance to drought, pathogens, and other environmental stresses, (ii) biomass, and (iii) reproductive success. Organic crop production—especially practices like organic no-till—help to preserve mycorrhizae. Inoculants containing mycorrhizal fungi are available commercially, and this book also contains a chapter on growing mycorrhizal fungi. Conversely, in chemical-intensive farming, mycorrhizae are killed or inhibited by pesticides, fertilizers, and excessive tillage or compaction. *— Terry Shistar, PhD*

Organic No-Till Farming

ADVANCING NO-TILL AGRICULTURE

Jeff Moyer
Austin, Texas: Acres U.S.A., 2011, 204pp.

Jeff Moyer brings his 30-plus years of working on Rodale Institute's Farm Systems Trials to this book, which is a great companion to the books reviewed above. While loaded with research from around the globe, the author offers information for practitioners. Until recently, "no-till" meant using herbicides for soil preparation. It was, therefore, a system that was not used by organic farmers. Chemical no-till offers greater resistance to erosion than conventional tillage because crop residues remain on the surface, but actually contributes to groundwater contamination by facilitating the percolation of agricultural chemicals through the soil. Chemical no-till can also lead to surface water pollution, especially with chemicals like atrazine that move in solution, rather than attached to soil particles. As explained by Mr. Moyer, organic no-till is more properly called "rotational tillage" because tillage may be used as seedbed preparation for the cover crop.



Cover crops are the key to organic no-till. In organic no-till, a dense cover crop is grown, then killed mechanically—the favored device is a roller-crimper. The cash crop is sown or transplanted into a slit in the thick blanket of mulch—sometimes at the same time as the rolling operation. For the organic farmer, the method helps to solve several perennial challenges, offering almost complete control of weeds, reducing the need for fertility inputs, and building soil organic matter. It does all of these things while reducing the number of passes over the field to 2–3 per year, thus greatly reducing fuel usage. *— Terry Shistar, PhD*

The Buzz for Pollinator Week 2017

(#NPW2017)

JUNE 19–25, 2017 • CELEBRATE, EDUCATE, CHANGE

National Pollinator Week is a time to increase public awareness of the critical contribution pollinators—bees, butterflies, birds, bats, and other organisms—make to plant health, crop productivity, and the preservation of natural resources, as well as the threat to their existence from pesticide contaminated habitat. Pesticides have consistently been implicated as a key contributor to dramatic pollinator declines, not only immediate deaths, but as a result of low-level exposure causing adverse effects to bee reproduction, navigation and foraging, and their vulnerability to disease and parasites.

Please join us in our BeeProtective campaign for Pollinator Week 2017!

MADE BY POLLINATOR CAMPAIGN: Speak to the important role pollinators play in our food system. By partnering with local restaurants that promote local, organic and sustainable practices, we educate through menu displays or a weekly special featuring foods dependent on pollinators for production. Get a restaurant in your community to participate.

FACEBOOK LIVE Q&A: Join us live on Facebook to ask questions of an expert panel of beekeepers and bee activists and learn more about the critical role pollinators play in our ecosystem. Watch for the date.

THE WELL-STOCKED HARDWARE STORE: Get your local hardware store and nursery to go bee-friendly by carrying products and tools that support organic land management. Use our video *Making the Switch* (*bit.ly/WellStockedHardwareStore*).

BECOME PART OF THE CLOVER–ALL–OVER CAMPAIGN: Encourage ScottsMiracleGro to stop labeling clover, which serves as pollinator habitat, as a weed and instead promote the growth of Clover–All–Over.

BeePROTECTIVE IN YOUR COMMUNITY: Plant nontoxic pollinator habitat and eliminate bee-toxic pesticide use within your community!

FOLLOW BEYOND PESTICIDES' website, twitter, and Facebook for more ways to get involved in celebrating pollinators, and use the hashtag #NPW2017 to share your actions!

For more information, see Beyond Pesticides' BeeProtective Pollinator Week 2017 webpage at *bit.ly/nationalpollinatorweek*.

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MAKE YOUR YARD, LOCAL PARK, AND SCHOOL A "PESTICIDE FREE ZONE"

Display a Honey Bee or Ladybug yard sign

Show your neighbors that pesticide-free lawns are important for the health of your family the environment and the community. At eight inches in diameter, these painted metal signs will not rust and will retain their bright colors for years. The sign comes with valuable information on organic lawn and garden management, pollinators, and how to talk to your neighbors about pesticides. Signs are available for $13 each ($10 plus shipping for ten or more) at **bit.ly/BeyondPesticidesStore**.

Distribute doorknob hangers

The Safe Lawn Door Knob Hanger is a tool to help spread the word about the dangers of lawn pesticides and the ever-increasing availability of alternatives. It's an easy, non-confrontational way to approach neighbors that may be using pesticides. You can request a free pack of 25 doorknob hangers by emailing your name and address to **info@beyondpesticides.org**. You can order more from our online store. Learn more at **bit.ly/lawnsandlandscapes**.

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Adopt organic land management in your town

Help your town, city or county adopt organic land management practices and a policy –protect and nurture soil biology, save the pollinators by preserving and improving biodiversity, use less water, and sequester carbon to reverse global climate change. Work with Beyond Pesticides at **bit.ly/ToolsForChange**.

Learn more at www.beyondpesticides.org/lawns.