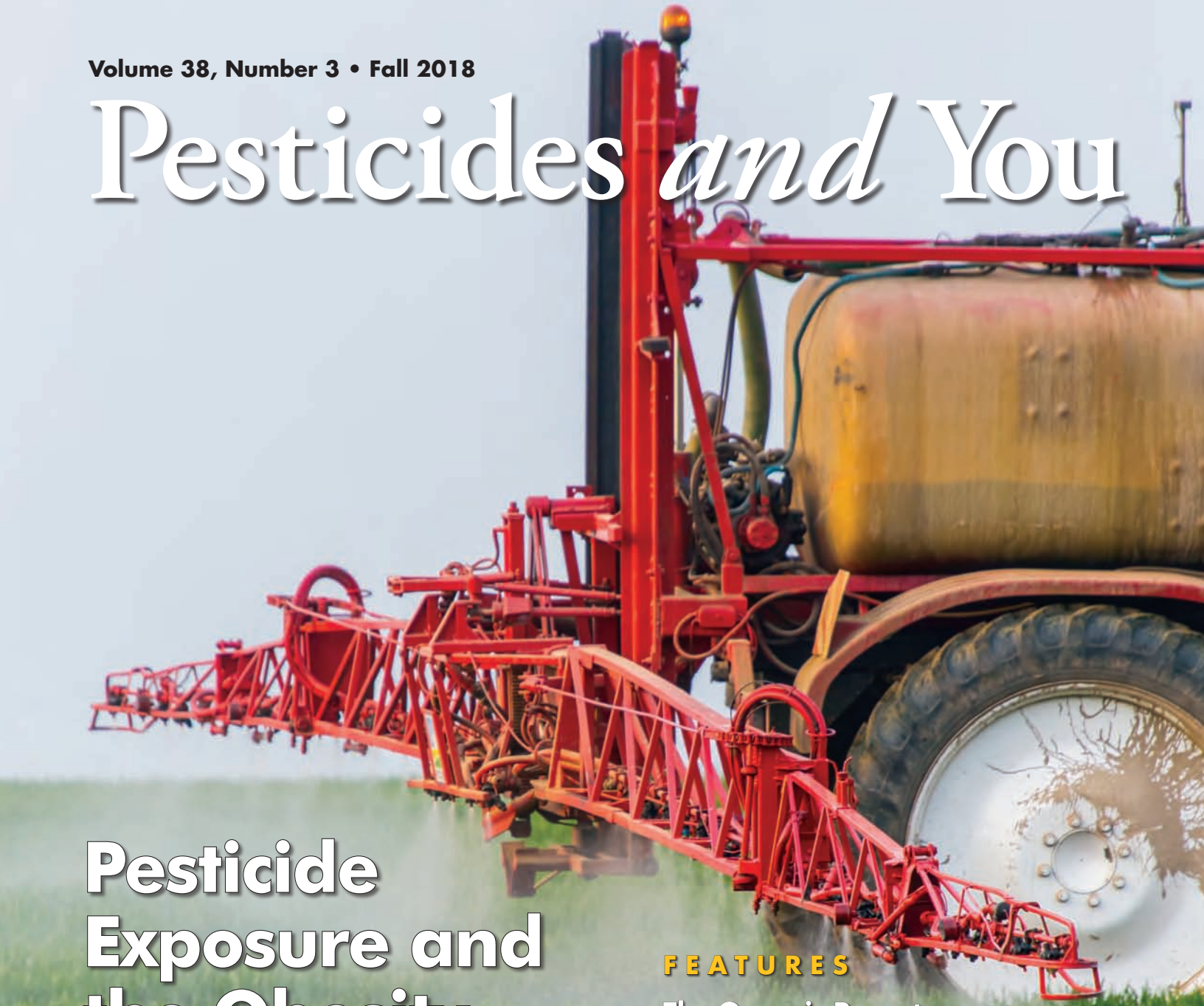
Beyond Pesticides: Protecting Health and the Environment with Science, Policy, and Action

Volume 38, Number 3 • Fall 2018

Pesticides *and* You



Pesticide Exposure and the Obesity Pandemic

Exposures to endocrine disrupting pesticides echo down the generations

FEATURES

Disappearing Insects—A Call for Urgent Action

We elevate the public debate about the hazards of pesticides from a human and environmental perspective in the context of a clear solution to the pesticide problem. I start with my conclusion: We can eliminate hazardous pesticides with alternative practices and products that are compatible with organic systems. How we advance both an understanding of the problem and how we frame the solution is critical to the ultimate outcomes and the speed with which they are achieved. We are living at a time when the urgency for integrating our work into the big picture of human survival gains clarity every day. So, we draw the interconnections between the indiscriminate destruction of living organisms caused by pesticides, habitat loss, and global climate change.

Bringing it to the mainstream

To do this, we do need to articulate the problem by bringing to the public arena new scientific discussions that are often buried in the scientific literature. That is why Beyond Pesticides spends so much of its resources evaluating science and translating it into language that is accessible to the general public. Our objective is to take the analysis and reporting in this journal, and the information in our factsheets, *Daily News*, and databases to community discussions at town, city, and county council meetings, as well as school boards and park commissions, and with neighbors, family, and editorial boards of local media.

The insect apocalypse

So, you can imagine how important it was in late November for the *New York Times* magazine to publish its front page article, *Insect Apocalypse*. This piece clearly explains the current crisis of disappearing insects and the devastating biodiversity decline. The author, Brooke Jarvis, brought to the mainstream media the disturbing news that readers of this journal have been following.

As Ms. Jarvis says, "[T]here were documented downward slides of well-studied bugs, including various kinds of bees, moths, butterflies and beetles. In Britain, as many as 30 to 60 percent of species were found to have diminishing ranges. Larger trends were harder to pin down, though a 2014 review in *Science* tried to quantify these declines by synthesizing the findings of existing studies and found that a majority of monitored species were declining, on average by 45 percent." She continues: "Ornithologists kept finding that birds that rely on insects for food were in trouble: eight in 10 partridges gone from French farmlands; 50 and 80 percent drops, respectively, for nightingales and turtledoves. Half of all farmland birds in Europe disappeared in just three decades. At first, many scientists assumed the familiar culprit of habitat destruction was at work, but then they began to wonder if the birds might simply be starving."

Bringing science to the mainstream

Various studies have found reductions of up to a factor 60 over the past 40 years–there were 60 times as many insects in some locations in the 1970s. Over 75% of insect abundance has declined over the last 27 years, according to research published last year by European scientists in *PLOS One*. The dramatic drop in insect biomass has led to equally dramatic pronunciations from highly respected scientists and entomologists. "We appear to be making vast tracts of land inhospitable to most forms of life, and are currently on course for ecological Armageddon," study coauthor David Goulson, Ph.D. of Sussex University, UK, told *The Guardian*. "If we lose the insects then everything is going to collapse."

As we discussed when he published his book, *A Sting in the Tale* (2014), Dr. Goulson writes, "We need worms to create soil; flies and beetles and fungi to break down dung; ladybirds and hoverflies to eat greenfl[ies]; bees and butterflies to pollinate plants to provide food, oxygen, fuel and medicines, and hold the soil together; and bacteria to help plants fix nitrogen and . . . cows to digest grass. . . . [Yet] we often choose to squander the irreplaceable, to discard those things that both keep us alive and make life worth living."

Where must we be headed with all this?

What do we want to achieve? Certainly, we do not want to spend our lives on the treadmill of banning pesticide after pesticide that are used in land and building management systems because underlying pest conducive conditions are not fixed or prevented. How would we define a preventive approach that avoids the problems that lead to pesticide use and pesticide dependency, that create resistant organisms requiring more potent chemicals to control, that are fossil fuel dependent, use fracking water, destroy the soil and aquatic food webs, and contribute to global climate change or, conversely, does help to manage carbon?

With organic systems, we are well on our way to eliminating the toxic pesticides that wreak havoc with life. However, a lot more urgency is needed. *Best wishes for healthy and organic new year!*

Jay Feldman, executive director of Beyond Pesticides

CONTENTS

© iStockphoto/JMichl

FEATURES

DEPARTMENTS

Pesticides and You © 2018 (ISSN 0896-7253) is published four times a year by Beyond Pesticides. Beyond Pesticides, founded in 1981, is a voice for health and the environment, promoting protection from pesticides and safe alternatives; donations are tax-deductible.

NATIONAL HEADQUARTERS
701 E Street, SE Washington DC 20003
ph: 202-543-5450 fx: 202-543-4791
email: *info@beyondpesticides.org*
website: *www.beyondpesticides.org*

Articles in this journal may be reproduced without Beyond Pesticides' permission unless otherwise noted. Please credit Beyond Pesticides for reproduced material.

BEYOND PESTICIDES STAFF

Jay Feldman, *Executive Director*

Drew Toher, *Community Resource and Policy Director*

Larissa Mark, PhD, *Science and Regulatory Director*

Barbara Dale, *Marketing and Public Education Manager*

Garret White, *Events Coordinator and Information Assistant*

Terry Shistar, PhD, *Science Consultant*

Debra Simes, *Editorial and Digital Support*

Gina Navarro, *IPM and Health Care Facilities Project Director*

Autumn Ness, *Hawai'i Organic Land Management Project, Organizing Consultant*

Duane Sparkman, *Hawai'i Organic Land Management Project, Technical Consultant*

Max Etheart, *Community Network and Office Support*

PESTICIDES AND YOU

Jay Feldman, *Publisher, Editor*

David Gerratt, NonprofitDesign.com, *Design*

Bruce Blumberg, PhD, Terry Shistar, PhD, Drew Toher, Debra Simes, Garret White, *Contributors*

BOARD OF DIRECTORS

Routt Reigart, MD, *president*, Medical University of South Carolina, Charleston, SC

Paula Dinerstein, *vice president*, Public Employees for Environmental Responsibility, Washington, DC

Terry Shistar, PhD, *secretary*, Lawrence, KS

Caroline Cox, *treasurer*, Center for Environmental Health, Oakland, CA

Chip Osborne, *at-large*, Osborne Organics, Marblehead, MA

Rella Abernathy, PhD, City of Boulder IPM Program, Boulder, CO

Colehour Bondera, Kanalani Ohana Farm, Honaunau, HI

Jay Feldman, Beyond Pesticides, Washington, DC

Melinda Hemmelgarn, RD, Food Sleuth, LLC, Columbia, MO

Warren Porter, PhD, University of Wisconsin, Madison, WI

Affiliations shown for informational purposes only.

Cover photo: © iStockphoto/i-stockr

Printed on 100% post consumer waste with soy inks.

Safely Disposing of Pesticides

How do people get rid of pesticides that they don't want? I inherited a house from some relatives and they have a whole shed full of nasty chemicals I want out. There must be a central location to dispose of these products, right?

Camille, New York, NY

Hi Camille,

Generally, pesticide applicators are encouraged to purchase and mix only what they intend to use. The U.S. Environmental Protection Agency (EPA) asks homeowners and applicators to "avoid disposing of pesticides whenever possible," and even suggests individuals ask their neighbors if they have a similar pest problem that could use their extra pesticide. We strongly advise against taking that recommendation.

The best option to get rid of unwanted pesticides is to attend a pesticide disposal event. In the U.S., state agencies (states are the primary enforcement agent for federal pesticide law) will generally sponsor these events, set a date, publicize it, and invite applicators, dealers, homeowners, ranchers, farmers, etc. to bring their unwanted pesticide products. This is similar to events that ask individuals to discard their old or unwanted medications. However, depending on where you live, these events can be few and far between.

If there is not a disposal event close by or scheduled anytime soon, check with your state and local pesticide enforcement agencies. Beyond Pesticides provides a list of state agency contacts here if you have any trouble finding out the particular agency in your state (*bp-dc.org/statepages*). If you cannot find resources that way, we suggest you conduct a google search for hazardous waste disposal collection companies, and ask if they are capable of handling pesticide refuse. EPA lists a number to call for resources, 1-800-CLEANUP or earth911.com, but we found the website lacking and the number to be out of service.

Given the lack of local, state, and federal resources for pesticide disposal, combined with EPA's encouragement that the solution to pesticide pollution is continued use, it may not be surprising that there are some concerns about improper pesticide disposal. Back in 2013, we covered in our journal the story of a Utah family that had to move from their home after their neighbor, who ran a pesticide business out of his home, appeared to be using his backyard as a pesticide dumping ground (*bp-dc.org/poisoneddreams*). Pesticides should never simply be dumped into the ground, and especially not into street drains where they can make their way into local waterways and cause irreparable harm to aquatic life. These chemicals should also never be disposed of down the sink, toilet, or drain, as water utilities are not prepared to filter pesticide residue. It can be surprisingly tricky to get rid of unwanted pesticides, but proper disposal is critically important for public health and the environment.

© iStockphoto/hroe

Putting Out Fire Ants

Fire ants are invading the baseball and soccer fields my kids play on. I have spoken with landscapers, and they indicate they're using a product containing acephate. It looks very toxic and I don't want it anywhere near children. Do you have least-toxic options I could forward to them?

Marie, Miami, FL

Hi Marie,

Fire ants are becoming an increasing concern throughout the southern U.S. As they continue to expand their range, we have recently heard residents as far north as Maine dealing with infestations. The risk fire ants pose to public health makes this a relatively tough question. Even in communities with very progressive pest management policies, there are usually exemptions for stinging or biting insects. But ultimately, every decision to use a pesticide should be made with input from community members like yourself. And even when we have these exemptions, that does not mean we should not still first look to nontoxic and least-toxic options to manage dangerous pest infestations.

An integrated approach to fire ant management is likely to achieve the best results. We don't recommend most of the available broadcast baits on the market, as, like the

SHARE WITH US!

Beyond Pesticides welcomes your questions, comments, and 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.

neurotoxic organophosphate acephate, they are toxic and likely to put children that use these fields at risk of chronic health impacts. Acephate, in particular, has been linked to reproductive impacts, and is classified as a possible human carcinogen by EPA. These pesticides will also reduce soil biological health and kill predatory and native ant species that could compete with fire ants.

We would recommend the use of a boric acid baiting system targeted around the mound, rather than broadcast application of a synthetic insecticide. Past research from USDA indicates that solutions of 1% boric acid can achieve 90% colony reduction. Many common boric acid baits on the market will contain higher levels of boric acid (usually around 5%). The problem with this concentration is that it will kill ants before they are able to get it to the queen. The more diluted amounts will allow the ant to survive long enough to share the bait with the queen and rest of the colony. Sugar or greasy food integrated into a 1% boric acid mixture in a bowl or even a soaked paper towel placed near a colony will cause them to swarm the bait and hopefully bring it back to the queen. If this is not feasible, spinosad is an organic compatible insecticide that can be used, but this is one of the more toxic organic ingredients on the market. We'd only suggest its use if boric acid did not work, and, if used, we strongly suggest only applying it in and around the mounds, and not broadcast applying the product. A quick note that these baits are unlikely to work if fire ants are not actively foraging. You can place some food by the mound to make sure they are. Boric acid baits should be replenished about once a week for roughly six weeks.

The second step of an integrated approach is to address individual mounds, generally after at least several days of letting the bait do its work. You can drench the mound with hot, boiling water, dig up the mound with a shovel (be very careful!), or dust diatomaceous earth over the colony. You may also want to consider using the least-toxic insecticide d-limonene and gauge its effectiveness. This product is applied by saturating the fire ant mound. The Organic Materials Review Institute (OMRI) lists two organic compliant products to manage fire ants—Antixx Fire Ant Bait containing spinosad, and Orange Guard Fire Ant Control containing d-limonene.

Fire ants have gotten out of control in many areas because, as a species native to South Africa, there are few natural predators in the environment that can put a check on their populations. USDA is attempting to address this issue through the introduction of phorid flies. In their native range, phorid flies parasitize fire ants and can knock down populations quickly. Three of the six species USDA introduced have now established themselves and begun to expand their range. USDA is also working to establish a microsporidium fungi that has been known to infect fire ants and reduce the reproductive rate of fire ant queens.

It is also worth noting that organic lawn care practices can be effective in eliminating fire ant habitat, and preventing their further spread. The species like to colonize bare patches of turf, so management techniques that utilize core aeration to break up soil and improve compaction and pore space, proper watering, and regular overseeding with the correct grass seed can help fill in spaces that may otherwise become occupied by fire ant mounds.

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 Action of the Week (6/4/2018): Monarch Population Loss Tallied at 80% since 2005. Monarch butterflies are in the midst of a staggering decades-long population decline that has rapidly accelerated since 2005, research published by an international team of scientists and the University of Florida last month indicates.
Eric comments: I used to see monarch butterflies all the time as a kid in the 1960s and 1970s. They were the most common butterfly around. Even a trip to Jones Beach (NY) would visually produce hundreds of them swarming around. Twenty years ago, I would still see a bunch of them swarming around and feeding off my tomato plants blossoms and other garden plants in the summer here on Long Island. In the last decade, I have seen only a handful of them; actually finding more praying mantises on my garden plants than any butterflies, period! This year I can't even recall seeing one monarch butterfly in my backyard! This is so sad! Hopefully we can do something to help bring back the monarch butterfly population again!
Melissa reviews Beyond Pesticides via Facebook:
I live in Maine and there are already several towns and cities (and more attempting to follow) that have passed ordinances that prohibit the residential use of pesticides. It's been no small accomplishment to get these ordinances passed and it is so upsetting to hear that this important work may potentially be reversed [not included in the final proposed Farm Bill]. Maine is already experiencing ongoing problems in our harbors and lakes with deadly algae blooms due to run off containing excess nitrogen carried down river from fertilizers, not to mention the damage caused to our waterways from the excessive use of pesticides. Being a beekeeper and seeing firsthand the negative effects that pesticides have on our bees is utterly scary and sad. The greed in Washington has to stop!

Off-Label "Emergency" Pesticide Use Unchecked

The risks to human health and the environment are not adequately measured when the U.S. Environmental Protection Agency (EPA) allows off-label uses of pesticides under its emergency exemption program, according to a September report of EPA's Office of the Inspector General (OIG). The inspector general recommends that EPA "develop and implement applicable outcome-based performance measures to demonstrate the human health and environmental effects of the EPA's emergency exemption decisions." EPA disagreed with the recommendation, leaving the issue of chronic overuse of the emergency exemptions unresolved. Under Section 18 of the *Federal Insecticide, Fungicide, and Rodenticide Act* (FIFRA), EPA has the authority to approve the temporary emergency use of unapproved pesticides if the agency determines the pesticide is needed to prevent the spread of an unexpected outbreak of crop-damaging insects, for example. OIG's report finds "significant deficiencies in the OPP's online database management, in its draft Section 18 emergency exemption standard operating procedure and application checklist, and in its reports to Congress and the Office of Management and Budget."

Beyond Pesticides has found a growing number of Section 18 requests from states over the last ten years for emergency exemptions and the use of pesticides to control various resistant weed and insect pests that either do not meet the criteria for "non-routine" or "emergency" conditions set forth in FIFRA, or whose pesticide use would pose elevated risks to the environment. A recent Center for Biological Diversity, *Poisonous Process*, finds, as of 2017, EPA had granted 78 "emergency" exemptions for sulfoxaflor, a highly bee-toxic insecticide similar to a neonicotinoid on more than 17.5 million U.S. acres.

Efforts to Ban Chlorpyrifos Move Ahead

Court Orders Action

EPA was ordered by a Federal Court in August to finalize its proposed ban of the neurotoxic insecticide chlorpyrifos, based on undisputed findings that the pesticide is unsafe for public health, and particularly harmful to children and farmworkers. The ruling comes in a lawsuit brought by a coalition of labor and health organizations, represented by Earthjustice. EPA's appeal, filed in October, is pending.

Chlorpyrifos is a dangerous nerve agent organophosphate pesticide that can damage the developing brains of children. Prenatal and early life exposure to chlorpyrifos is linked to lower birth weight and neurodevelopmental harms, including reduced IQ, loss of working memory, attention disorders, and delayed motor development. It is also acutely toxic to farmworkers—routinely sickening workers and sending them to the hospital.

The pesticide, produced by Corteva Agriscience (formerly Dow AgroSciences), is widely used on apples, oranges, broccoli, and dozens of other crops, and is registered for use on golf courses and for public health mosquito spraying. It was banned from home use in 2000 because of the hazards to children. The court ruling comes after former EPA Administrator Scott Pruitt in March 2017 reversed EPA's own proposal to ban this pesticide.

California Finds Contamination

In July, the California Department of Pesticide Regulation (CDPR) released its scientific assessment concluding that chlorpyrifos should be listed as a Toxic Air Contaminant (TAC) in the state based on evidence of its neurological effects and exposure risks of concern. Legislation has been introduced in Congress to ban chlorpyrifos and similar pesticides nationwide.

Scientists Weigh In

A group of leading toxics experts, who published a paper, *Organophosphate exposures during pregnancy and child neurodevelopment: Recommendation for essential policy reforms*, in the journal *PLOS Medicine* on their research on organophosphate pesticide exposure during pregnancy and impacts on child development, are calling for a ban on the chemical.

Meanwhile, U.S. and European scientists, who evaluated the underlying science used by regulators to allow widespread use of chlorpyrifos for decades, found serious flaws in the analysis produced by industry-contracted laboratories. The independent review indicates that the regulators' conclusion was based on averaging impacts to the brain, rather than looking at the cerebellum, the specific brain region affected. Regulators had previously identified "inappropriate and inconclusive manipulation of data," but allowed its use.

Glyphosate/Roundup: Problems in Science and Law

© iStockphoto/AwakenedEye

Jury Verdict Against Monsanto

In a stunning legal victory for a man who contracted non Hodgkin lymphoma (NHL) after using the herbicide glyphosate (Roundup), school groundskeeper Dewayne (Lee) Johnson won a $289 million jury verdict against the chemical's manufacturer, Monsanto, now a part of the chemical company Bayer. The jury on August 10, 2018 awarded the 46-year old $39 million in compensatory damages, and $250 million in punitive damages. The jury found that Monsanto acted with "malice or oppression." The judge reduced the total award to $89 million and now Bayer announced it is appealing. Over 8,000 similar lawsuits are pending in U.S. courts.

Congress Threatens Local Authority to Restrict Pesticides

Meanwhile, more than 50 jurisdictions across the country have stopped glyphosate use on public property and in some cases, when not prohibited by state law, banned use on private property. Over 60 local officials from across the country sent a letter to Congress opposing a provision to take away local authority to restrict pesticides in the Farm Bill passed by the U.S. House of Representatives in June. At this writing the bill is under consideration.

More Science Findings of Harm

New Zealand scientists, publishing in the journal *PeerJ*, have found that the combination of herbicides (including glyphosate and dicamba) and antibiotics, both found widely in the environment and food supply, contributes to the escalation of widespread bacterial resistance. Scientists found that a combination of herbicide and antibiotic exposure results in the development of offspring that requires higher amounts of antibiotics to control. E. coli exposed to Roundup (glyphosate) and Kamba (dicamba), in combination with either tetracycline or streptomycin, ultimately led to microbial populations that required higher amounts of antibiotics to control. Author Jack Heinemann, PhD, said, "Such combinations can be like trying to put out the raging fire of antibiotic resistance with gasoline."

Residues More Widespread

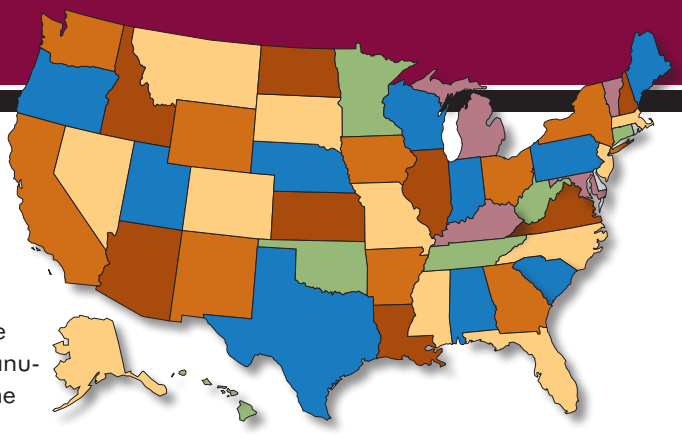
The number of food products found to contain glyphosate residues is increasing monthly, from bread, honey, beer, to children's cereal. Most recently, the Environmental Working Group found high levels of glyphosate residues in Cheerios and other popular oat-based food products. This adds to earlier findings of glyphosate in General Mills' Nature Valley bars, which the company labeled as "natural," and was the subject of litigation by Beyond Pesticides, Organic Consumers Association, and Moms Across America. General Mills agreed to remove from its product label "Made with 100% Natural Whole Grain Oats."

Litigation and local action to ban glyphosate and adopt organic practices are critical tools in the absence of federal action to eliminate the pesticides use. Use Beyond Pesticides' website or contact the organization at info@beyondpesticides for assistance.


© iStockphoto/THEGIFT777

Going Backwards on Bees

The Trump administration has reversed a 2014 U.S. Fish and Wildlife (FWS) decision to ban neonicotinoids on National Wildlife Refuges. When the ban was originally adopted, FWS stated, "We have determined that prophylactic use, such as a seed treatment, of the neonicotinoid pesticides that can distribute systemically in a plant and can potentially affect a broad spectrum of non-target species is not consistent with Service policy. We make this decision based on a precautionary approach to our wildlife management practices . . . ," introducing precaution to pesticide policy.



Treated Utility Poles and Railroad Ties Raise Continuing Concern

A lawsuit first filed nearly a decade ago over dioxin contamination released from the storage of chemical treated utility poles was settled in September in U.S. District Court in San Francisco between California utility company Pacific Gas & Electric (PG&E) and the Ecological Rights Foundation (ERF). The settlement commits PG&E to identifying storage yards holding treated poles, and implementing technologies that reduce dioxin levels through the year 2026. The utility poles of concern were treated with the wood preservative pentachlorophenol, which is regulated as a pesticide by the U.S. Environmental Protection Agency (EPA), and is known to produce dioxin as a byproduct of its manufacture. "Dioxins are among the most toxic chemicals known to science," noted ERF attorney Fredric Evenson.

Meanwhile, residents in the town of Great Barrington, MA raised concerns this fall about the health effects that could result from creosote-coated railroad ties stored in their neighborhood by the Massachusetts Department of Transportation (MDOT), according to a report in the *Berkshire Eagle*. Creosote is identified as a probable human carcinogen by EPA and the International Agency for Research on Cancer (IARC) of the World Health Organization, and is listed as a carcinogen by the European Union and under California's prop 65. The chemical has also been linked to organ damage, reproductive toxicity, and certain chemical compounds in the creosote mix, such as benzopyrenes and phenols, are considered endocrine (hormone) disruptors. Similar to another wood preservative, pentachlorophenol, banned as a persistent

Bees and Ecosystems at Risk

Reproductive Failure in Bumblebees, Adverse Behavioral Effects in Frogs

Adding to the large body of science, male bumblebees exposed to field-realistic doses show reduced sperm production and 50% mortality at the lowest doses in a *PLOS* published study by researchers at Worcester Polytechnic Institute in Massachusetts. Noting the significant adverse effects of neonic toxicity to the life cycle of wild bees, the consequences of exposure are greatest during bumblebees' mating and nesting phases. Neonicotinoids, like clothianidin, could be dramatically impacting bumblebee populations by lowering the number of reproducers in late summer and, consequently, the number of queens establishing new colonies the following spring. "[Neonicotinoids] pose a potential hazard to wild bumblebees at every stage of their annual life cycle," says Robert Gegear, PhD, coauthor of the study, in an interview with *Mass Live*.

Mosquito Spraying Harms Bees

A study published in the *Journal of Apicultural Research* finds significant numbers of U.S. honey bees at risk after exposure to hazardous synthetic pesticides used for spraying mosquitoes. With many beekeepers rarely given warning of insecticide spraying, researchers say the risk of losing colonies increases. Advocates say spraying for Zika, West Nile Virus, and other mosquito-borne illnesses results in counterproductive insecticide spraying that adds further stress to managed and native pollinators already undergoing significant declines due to habitat loss.

Researchers found 13 percent of U.S. beekeepers at risk of losing colonies from Zika spraying. In addition, it was determined that many regions of the U.S. best suited for beekeeping are also those with favorable conditions for Zika-prone mosquitoes to proliferate. These regions include the southeast, the Gulf Coast, and California's Central Valley. "[Considering] all the threats facing bees," says study lead author Lewis Bartlett of the University of Exeter's Center for Ecology and Conservation in a university press release, "Even a small additional problem could become the straw that broke the camel's back." In its 2016 report, *Mosquito Control and Pollinator Health: Protecting Pollinators in the Age of Zika and Other Emerging Mosquito Diseases,* Beyond Pesticides found, "The U.S. Environmental Protection Agency (EPA) has identified 76 pesticide chemicals that are highly acutely toxic to honey bees." Beyond Pesticides cites this threat in addition to lack of spray efficacy in urging that more serious attention be given to mosquito prevention strategies by the Centers for Disease Control and Prevention (CDC) and local communities.

Amphibians Threatened

New research finds that the ill effects of neonicotinoids also extends to amphibian populations. Scientists at the National Wildlife Research Center in Ottawa, Canada found that chronic exposure to real-world levels of the neonicotinoid imidacloprid limits the ability of juvenile wood frogs to escape a predator attack. This research adds additional evidence that neonicotinoids are harming aquatic food chains, and reinforces calls for U.S. regulators to follow the science and adequately restrict these toxic pesticides.

organic pollutant by the Stockholm Convention, EPA and U.S. regulators have failed to take action, despite the availability of recycled steel, cement, and composite materials for utility poles.

Pesticides Found in All Household Samples in NY

The indoors of rural homes in New York are contaminated with pesticides used outdoors, according to a study published by Cornell University researchers in *JSM Health Education & Primary Health Care*. The study is a warning, especially to households with young children who are at increased risk of health effects from even minute levels of pesticide exposure. "Numerous health problems occur from exposure to pesticides, such as cancer, birth defects, and ocular [vision-related] toxicity, among a number of other health issues," said Joseph Laquatra, PhD, coauthor of the research. "Households with crawling toddlers should be concerned, as toddlers will accumulate pesticide residues on their hands and then ingest them due to hand-to-mouth behaviors." Researchers found a range of pesticides in all 132 tested households that agreed to test for pesticide residues. Wipe samples were collected from both carpeted and non-carpeted areas, and tested for pesticides used commonly as part of agricultural production in the region. The pesticides analyzed included 15 compounds ranging from organophosphates, like chlorpyrifos and malathion, to synthetic pyrethroids, like resmethrin, the triazine herbicide atrazine, and the widely used herbicide 2,4-D.

Management of Pesticide Waste a Global Threat

The unsustainable life cycle management of pesticides during the past seven decades has created huge stockpiles of these (and other toxic) chemicals

© iStockphoto/PeopleImages

More Urgency to Go Organic

Lower Cancer Risk. A population-based cohort study of 68,946 French adults finds that greater consumption of organic food—as opposed to food produced with chemical-intensive practices, which use toxic pesticides and synthetic fertilizers—is associated with a reduction in overall cancer risk, and reduced risk of specific cancers, namely, postmenopausal breast cancer and lymphomas. The *NutriNet-Santé Prospective Cohort Study* was published in October in the journal *JAMA Internal Medicine*.

Increased Productivity and Profitability. The benefits of organic extend to farms, their productivity and profitability. Ecologically-based farming systems contain far fewer pests and generate much higher profits than their conventional, chemical-based counterparts, according to research published in the journal *PeerJ* earlier this year by scientists at South Dakota State University and the Ecdysis Foundation. The study supports calls to reshape the future of agriculture, as "regenerative" farms, which avoid tillage and bare soil, integrate livestock, and foster on-farm diversity. These farms are found to represent an economically viable alternative to overly simplified, pesticide and fertilizer-dependent cropping systems. Given the study's focus on corn cropping systems, such a shift is possible for thousands of farmers throughout the U.S. Researchers looked at roughly 75 fields on 18 farms, measuring the organic matter in the soil, insect pest populations, corn yield as well as profit. Farms using pesticide treatments, which in corn fields is represented primarily by the use of neonicotinoid-coated seeds, have ten times higher pest levels than regenerative farms.

A Call for Organic Transformation. The Chief Minister of the Sikkim state in northeast India, Pawan Chamling, addressed a news conference in the Italian Parliament in October to issue a call for a complete, global transition to organic agriculture by 2050. Citing the increasing dangers of climate disruption and its impacts, Mr. Chamling said that such conversion to pesticide- and petrochemical-free practices would reduce carbon emissions by 50%.

© iStockphoto/NNehring

across much of the globe, primarily Eastern Europe, Africa, the Middle East, and Latin America. The journal *Environmental Science and Pollution Research* has published a special series of articles and reports from the International HCH & Pesticides Association (IHPA), entitled *The legacy of pesticides and POPs [persistent organic pollutants] stockpiles—a threat to health and the environment*. Stockpiles have accumulated because some products have been banned for health or environmental reasons by governments and international treaty, leaving containers of stocks that deteriorate and migrate to contaminate the environment and put people at risk.

Shareholders Ask General Mills to Reduce Pesticides

Nearly one-third of General Mills shareholders called on the company in October to improve product stewardship and eliminate pesticides, like bee-toxic neonicotinoid insecticides or the probable carcinogenic weed killer glyphosate, from its supply chain. The proposal was put forward by the nonprofit organization As You Sow, and Green Century Equity Fund (GCEF), a mutual fund. This is the latest public shareholder action GCEF has made regarding corporate pesticide reform, with the company previously putting pressure on the Dr. Pepper Snapple Group for its allowance of pesticides within its supply chain. While the actions are encouraging, some advocates are urging shareholder groups to go beyond increased accountability and transparency and push companies to focus on sourcing organic to ensure that no pesticides contaminate the environment or food products.

The shareholder proposal ultimately garnered support from 31% of General Mills shareholders. "Shareholders believe the company can, and should, do more to protect the health of their supply chain and the public from toxic pesticides," said Christy Spees, environmental health program manager at As You Sow to the *Star Tribune*.

The proposal states, "While the company asserts that it is currently 'document[ing] continuous improvement' concerning environmental impacts from its supply chain for multiple crops, including corn, it has so far not demonstrated that it is measurably tracking and reporting pesticide use reduction."

Although additional transparency could help shed light on the toxic pesticides making their way into popular General Mills products, sourcing only organic would eliminate any need for such tracking, as organic certification requires all synthetic inputs are vetted under organic standards. As a government program, this approach would provide more accountability through inspections than a third-party certification or an internal corporate tracking process.

Monarch Butterflies in Steep Decline

Monarch butterflies are in the midst of a staggering decades-long population decline that has rapidly accelerated since 2005, research published by an international team of scientists and the University of Florida in October indicates. The study, *A long-term survey of spring monarch butterflies in north-central Florida*, found that monarchs making their way to central Florida after emerging from their breeding grounds in Mexico have declined by 80% over the last decade and a half. This is roughly the same time frame that beekeepers began to see precipitous declines in honey bee colonies. Researchers point to industrial development and increasing pesticide use as factors that have accelerated the decline.

"A broad pattern is that 95 percent of corn and soybean products grown in the U.S. are Roundup Ready crops that resist glyphosate," said study coauthor Earnest Williams, PhD, of New York's Hamilton College. "That has a national impact. What's really needed are patches of native vegetation and nectar sources without pesticides. It's not just for monarchs, but all pollinators."

Pesticide Exposure and the Obesity Pandemic

Exposures to endocrine disrupting pesticides echo down the generations

BRUCE BLUMBERG, PHD

Ed. Note: This piece is taken from a talk that Bruce Blumberg, PhD, professor of Developmental and Cell Biology, University of California, Irvine, gave to the 36th National Pesticide Forum, "Organic Neighborhoods: For healthy children, families, and ecology," April 13-14, 2018 in Irvine, California. The full talk, Effects of Prenatal Obesogens: Exposure Echo Down the Generations, in the session Cutting Edge Science, is available on Beyond Pesticides YouTube channel. This talk summarizes the science in Dr. Blumberg's book The Obesogen Effect—Why we eat less and exercise more but still struggle to lose weight. *The book includes a section on "what you can do," which is not included in his talk to the Forum. The book also includes more details on the science behind the obesity problem in the U.S. and its link to exposure to endocrine disrupting chemicals, including pesticides.*

Thank you for introducing the general topic of how pesticides and chemicals in the environment are bad for our health. Today, I want to talk about a specific example of something that you may or may not have heard about. I want to tell you that the environment influences health and disease.

There are such things as obesogens and we believe they contribute to the current obesity pandemic. It is worldwide. It is not limited to any one location. I want to show you that the effects of these exposures are heritable. So, the results I am going to briefly summarize actually go to this generation and the next generation. In human terms, if a woman was exposed while she was pregnant, her children, her grandchildren, her great grandchildren and her great, great grandchildren will show an effect. That is something we have never really thought about before.

BOX 1

Main Points

- Environment greatly influences health and disease.
- Obesogens exist and contribute to obesity epidemic.
- Effects of obesogen exposure are heritable.
- Obsesogen exposure modifies response to diet and fasting.
- Prenatal tributyltin exposure leads to heritable epigenetic changes that alter susceptibility to obesity.

© iStockphoto/i-Stockr

BOX 2

Non-Communicaable Diseases on the Rise

© iStockphoto/yystom

Non-communicable diseases
Now #1 cause of death in the world (WHO).

Leukemia, brain cancer
Over 20% increase since 1975.

Asthma
Doubled between 1980 and 1995, stays elevated.

Difficulty in conceiving and maintaining pregnancy
40% more women in 2002 than in 1982 (doubled in women aged 18–25).

Autism diagnosis
Increased 1,000% over the past three decades.

Obesity
Increased three-fold in U.S. over past 40 years, doubled worldwide in last 20 years.

The exposure that a woman had affects the response of the descendants to diet and exercise. We think that is because this exposure has led to heritable changes in the epigenome that permanently alter susceptibility to obesity.

Noncommunicable diseases are on the rise; that is, diseases that are not caused by bacteria, viruses, and fungi. (See Box 2.) They are now the number one cause of death in the world. That is pretty amazing to contemplate. We really do not know why that is, but we have some clues.

THE OBESITY PANDEMIC

I want to talk to you about the obesity epidemic, or the obesity pandemic. The latest statistics, just out, say that 39.6% of the U.S. population are clinically obese; that is, have a body mass index (BMI) greater than 30 (BMI > 30). It is disproportionately higher in females, which surprises my eyes, to be honest. It is even more prevalent in the minority population. In African American and Hispanic females, more than 50% are obese.

We care a lot about this because obesity adds a great amount of cost both in human misery and also to the health care system. The last number was around $200 billion a year. These costs are associated with increases in metabolic syndrome—Type 2 diabetes, cardiovascular disease, heart attacks, stroke, and hypertension. Forty percent of all cancers occur in obese people. There are lots of ways that these costs are passed on to society.

DIET AND EXERCISE

Of course, we all know how we get obese. We eat too much and we exercise too little.

Here is how doctors view the population [pointing to a cartoon of a doctor examining an obese patient]: "Any history of diet or exercise in your family?" That is true to some extent. You cannot get fat by breathing the air. You have to actually consume calories if you want to put on weight. But, there is a lot of data that says it is a lot more complicated.

In the study *Canaries in the coal mine: a cross-species analysis of the plurality of obesity epidemics* (2010), David Allison, PhD and his colleagues looked at animal populations around the world. They looked a large number of 200,000 animals from 24 different populations. These were, yes, our cats and dogs, but also wild rats, feral rats living in cities, and animals living in research colonies: monkeys, rats, mice. They found that they all became obese over the last 30 years, as well. So, of course you can say I probably feed my cat too much, and I probably do. But, how about the feral rats? How about the rats and mice and monkeys that live in our research colonies that get every speck of food from us? Their diets are strictly controlled. How are *they* possibly becoming obese? So, something about living with people is making animals fat as well.

Another great study, *Secular differences in the association between caloric intake, micronutrient intake, and physical activity with obesity* (Brown et al., 2016), came from an examination of data from the National Health and Nutrition Examination Study (NHANES). To summarize, the authors looked over time and they could show that, between 1988 and 2006, the frequency of leisure time activity increased 47% in men and 120% in women. Alright, so we are not just sitting on our butts not doing anything. We are trying hard not to become obese. And for a given amount of caloric intake

and exercise, for the same calorie intake and exercise expenditure, the BMI was 2.3 higher in 2006 than it was in 1988.

THAT SAYS TWO THINGS:

1. It is not true that we are lazy and not trying hard to not become obese. Physical activity is increasing, and
2. The energy balance model—diet and exercise, calories in/calories out—cannot explain the rise in BMI.

Something else is going on, in addition to eating.

MULTIPLE FACTORS

We know there are other factors. We know that, for example, stress is associated with obesity. We know that disrupted circadian rhythms—from not sleeping enough—is a factor. There are genes that have some role in obesity. You have probably heard that the microbiome, the bacteria that live in your intestines, has some role in obesity.

But, what about prenatal experience? There are great studies from David Barker, M.D. and his colleagues at the University of South Hampton, UK. Dr. Barker proposed what he called the Barker hypothesis, or the "thrifty phenotype hypothesis"—that prenatal under-nutrition predisposed babies to get fat later in life. There is a lot of data to support that idea. Dutch studies of the "Hunger Winter" support that conclusion. We know that, if Mom smokes while she is pregnant, her baby will be born small for gestational age and will be predisposed to become obese later in life. More than 35 epidemiological studies from different countries around the world all show the same thing.

IS THERE A ROLE FOR CHEMICALS?

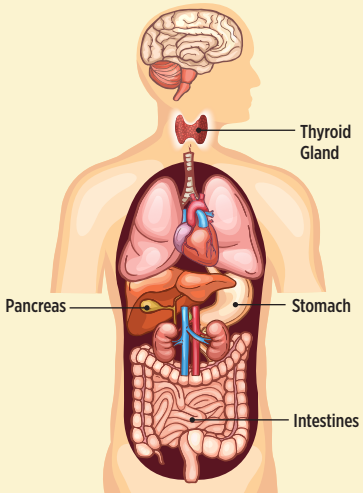
Paula Baillie-Hamilton, M.B. [UK equivalent of an M.D. in the U.S.], PhD, in a paper *[Chemical Toxins: A Hypothesis to Explain the Global Obesity Epidemic* (2002)] and subsequent book [*The Detox Diet: Eliminate Chemical Calories and Restore Your Natural Slimming System* (Penguin Books, 2002) after having children and experiencing weight gain, and reading about hormonal effects in animals of chemicals in the environment] writes that you will lose weight by following her detox diet. While that is not correct, it led Jerry Heindel, PhD, at the National Institute of Environmental Health Sciences (NIEHS) to write a paper about endocrine disrupting chemicals and the obesity epidemic, *Endocrine Disruptors and the Obesity Epidemic* (2003). This was in 2003—way before we even worked on this problem. Dr. Heindel had the insight that many of these chemicals that are in the environment have effects on the endocrine system. Yes, there are lots of toxic pesticides that damage various things, but these endocrine disrupting chemicals work at much lower levels than the so-called toxic levels and modify how our hormonal systems function.

FIGURE 1

Hormonal Control of Weight

Hormonal control of appetite and metabolism

- Leptin (fat), adiponectin, ghrelin are key players
- Leptin (fat), adiponectin—adipocytes
- Grehlin—(stomach)
- Thyroid hormone/receptor
  - Sets basal metabolic rate



Hormonal control of fat cell developmental and lipid balance

- Regulated through nuclear hormone receptors RXR, PPARy
- PPARy—master regulator of fat cell development
  - Increased fat cell differentiation
  - Increased storage in existing cells
  - Increased insulin sensitivity

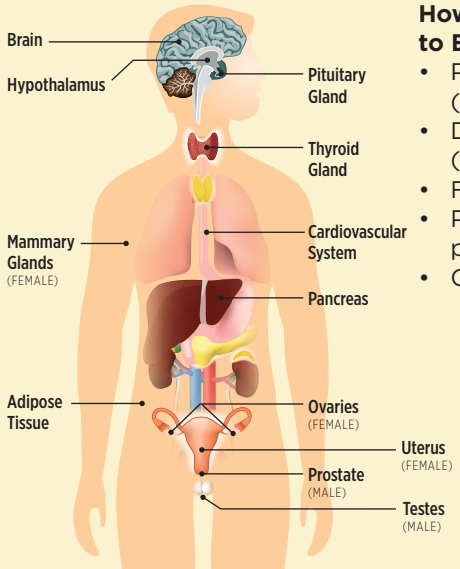
© iStockphoto/ONYXprj

FIGURE 2

Endocrine Disrupting Chemicals (EDCs) Affect Many Organ Systems

"**Endocrine disruptor**—an exogenous chemical, or mixture of chemicals, that interferes with any aspect of hormone action." — THE ENDOCRINE SOCIETY, 2012

- Wrong signal, loss of signal, wrong place at wrong time
- Hormones work at low concentrations and so do EDCs



How are we exposed to EDCs?

- Persistent pollutants (food, water)
- Dietary components (pesticides)
- Food packaging
- Personal care products
- Cleaning materials

© iStockphoto/ttsz

BOX 3

Endocrine Disrupting Chemicals (EDCs)

HERBICIDES

2,4,-D
2,4,5,-T
Alachlor
Amitro
Atrazine
Linuron
Metribuzin
Nitrofen
Trifluralin

INSECTICIDES

Aldicarb
Beta-HCH
Carbaryl
Chlordane
Chlordecone
DBCP
Dicofol
Dieldrin
DDT and Metabolites
Endosulfan
Heptachlor/H-epoxide
Lindane (gamma-HCH)
Malathion
Methomyl
Methoxychlor
Oxychlordane
Parathion
Synthetic pyrethroids
Transnonachlor
Toxaphene

FUNGICIDES

Benomyl
Ethylene thiourea
Fenarimol
Hexachlorobenzene
Mancozeb
Maneb
Metiram-complex
Tributyltin
Vinclozolin
Zineb

INDUSTRIAL CHEMICALS

Bisphenol-A
Polycarbonates
Butylhydroxyanisole
Cadmium
Chloro- & Bromo-diphenyl
Dioxins
Furans
Lead
Manganese
Methyl mercury
Monylphenol
Octylphenol
PBDEs
PCBs
Pentachlorophenol
Penta- to Nonylphenols
Perchlorate
PFOA
p-tert-Pentylphenol
Phthalates
Styrene

KEY

- Testosterone synthesis inhibitor
- Estrogen receptor agonist
- Thyroid hormone disruptor
- Androgen receptor antagonist

THE ROLE OF HORMONES

You probably know that weight in your body is under the control of hormones. There are key ones (see Figure 1), for example, leptin, which is the satiety hormone that tells your body you have enough energy. The thyroid hormone/receptor (which is a member of the family of receptors that I work on) sets the basal metabolic rate—how many calories your body needs to sustain itself. Basically, it is how many calories your body burns while you are sleeping. The biggest expenditure that your body makes in calories is that resting metabolic rate. If you change that, you totally change the amount of calories that you use.

FALL CELL DEVELOPMENT

It is also true that the development of fat cells themselves is under the control of hormones, and three receptors, which have the terrible name "peroxisome proliferator-activated receptors" (PPAR) are the key players here. That name is an artifact of history. These are actually fatty acid receptors. I discovered this when I was a post-doctoral student at UCLA almost 30 years ago.

This receptor, PPAR-gama, is called the master regulator of fat cell development. If you express this receptor in a stem cell, that stem cell is now a pre-fat cell, and if you activate it, that pre-fat cell now becomes a fat cell. And if you activate it in a fat cell, it accumulates triglycerides from the blood. So, it is a very important player in the whole process.

ENDOCRINE DISRUPTING CHEMICALS

You have heard the term endocrine disrupting chemicals. Endocrine disruptors, according to the Endocrine Society, are exogenous chemicals or mixtures of chemicals that interfere with every aspect of hormone action. And we have a little bit of a war with the toxicology community because they would say, "and causes adverse effects." For an endocrinologist, disrupting how hormones work is adverse *per se*, adverse in and of itself. This could be the wrong signal, or the absence of the signal, or the right signal at the wrong place at the wrong time. The key point is that hormones work at very tiny concentrations. For all the women in the room, the estrogen receptor in your body is fully saturated at one part per billion of estradiol. That is an incredibly tiny amount—and it does not take much of an environmental chemical to disrupt that balance.

EXPOSURE TO ENDOCRINE DISRUPTORS WIDESPREAD

How are we exposed? We're exposed from pollutants, the diet, food packaging, and personal care products. We live in a sea of endocrine disruptors.

Box 3 is just a partial list from of endocrine disruptors from NIEHS. You have heard of many of these chemicals. Here is our friend, the weed killer 2,4-D. DDT is on the list. There are quite a lot. For some of them, we know the mechanisms of action. For some of them, we do not.

An important point to note here is that there are probably about 1,000 endocrine disruptors known, but that must be an understatement because there has been no systematic attempt to identify endocrine disruptors. We have learned about these by accident.

Endocrine disruptors are everywhere. Box 4 identifies the kinds of categories: agrichemicals, pesticides, solvents, industrial flame retardants, industrial byproducts, surface protectors, sunscreens, plastics, plasticizers, cosmetics, etc.

There are quite a few of them. We willingly expose ourselves to endocrine disruptors all the time. Most personal care products are full of endocrine disruptors, like parabens and benzophenones—all kinds of chemicals like that.

One argument would be that we are not really exposed—you put the cream on your skin, but it does not really get inside. Well, if you believe that, I recommend this book with a very silly name, *Slow Death by Rubber Duck: How the Toxic Chemistry of Everyday Life Affects our Health* (2009). It is actually a very serious book. The authors, Rick Smith and Bruce Lourie, used themselves as guinea pigs. They had their blood levels of a whole bunch of chemicals—phthalates, perfluoridated compounds, etc.—measured and then they sat in a room. They sprayed scotch guard on the couch and they sat there and watched television. And they had the levels measured again. Sure enough, as you might expect, the chemicals were taken up into their body. Using the products as intended, in just the way you should experience them, causes the chemicals to be in your body.

The data I want to talk to you about has to do with whether endocrine disrupting chemicals are disturbing how the body functions and leading our kids to become obese. If you travel the world, you will see that in the U.S. we have lots and lots of obese kids. You will not see that in many other countries. A really big problem is kids that are fat very frequently turn into adults that are obese. Once a person becomes obese, it is virtually impossible to successfully maintain weight loss. Data say that 83% of people who successfully lose a large amount of weight, gain it back. That is a very, very big problem.

How does this happen?

THE OBESOGEN HYPOTHESIS

About 15 years ago now, my colleagues and I developed what we called the *obesogen hypothesis*. I define obesogens as chemicals that inappropriately stimulate the development of fat cells or the storage of fat into those cells, either directly by fiddling with how the cells work, or indirectly altering appetites tied to metabolism.

Was there any evidence before we did this work? The answer: yes. My friend, Retha Newbold, of the National Institute of Environmental Health Sciences, exposed a mouse for five days after birth with five parts per billion of a synthetic estrogen (that you may have heard of) called diethylstilbestrol. At ten months old, the animal became morbidly obese compared to the animal that was not exposed—and that is a very, very tiny dose.

© iStockphoto/MattZ90

BOX 4

Categories of Consumer Products in Endocrine Disrupting Chemicals (EDCs)

Pesticides	Surface Protectors
Herbicides	Sunscreens
Fungicides	Plastics
Solvents	Plasticizers
Flame Retardants	Cosmetics
Industrial Byproducts	Over 1,000 EDCs

We know that there are drugs that have the side effect of making people fat. There is a kind of drug with a terrible name, thiazolidinediones. You may have heard the brand name Avandia. These are diabetes drugs that make people fat. Yes, they make them insulin sensitive, but they also make them fat. These drugs act on our friend PPAR-gamma.

We know that there are quite a number of chemicals for which levels of the chemical can be linked to obesity in people. Of course, that does not prove that the chemical causes obesity. But it suggests that maybe somebody ought to study that. With an animal model, we can directly study cause and effect. With humans, you can make associations and you can make some inference about whether or not there is a causal effect, but in animals, you can prove it without a doubt.

We know there are bunches of chemicals that cause cells in culture to become fat cells. We take cells growing happily in a dish and treat them with these chemicals, and they become fat cells.

So, the existence of obesogenic chemicals was plausible even before we did the work that I'm going to tell you about.

A PESTICIDAL OBESOGEN, TRIBUTYLTIN

Here is our favorite obesogen, tributyltin (TBT). This is something we discovered completely by accident. Tributyltin, for a long time, was very famous as an endocrine disruptor because it was the only chemical for which there was absolutely no controversy. They exist in the environment in parts per billion, and in parts per billion it adversely affects mollusks. Gastropod mollusks are hermaphrodites, they have both sexes, but they do not mate with themselves.

They mate with other animals. In animals exposed to tributyltin, the penis grows to gigantic size, and, as you can imagine, parts do not fit anymore. So, these animals become sterile.

I confess, I am a vertebrate developmental biologist, I do not care so much about snails, except that they taste good when they are not contaminated.

© iStockphoto/ChristinLola

I was in a meeting in the south of Japan sleepily listening to presentation after presentation in Japanese, and one of them was in English. Professor Shinsuke Tanabe, PhD got up and said that tributyltin could sex reverse genetically female flounders, a population of fish that would become 100% female if he exposed them to tributyltin, and 30% became male. That got my attention. So, I called back to the lab and I said, "Guys, will you test which of the 48 hormone receptors that we know about and have in the lab are activated by organotins?" I was thinking that it would be a sex hormone receptor because, if you want to change sex, you should fiddle with an estrogen or a testosterone receptor. Instead, we found that tributyltin activated, again, our friend, PPAR-gama and its partner, which is called RXR. These two receptors work together as a heterodimer [molecule with different subunits] and they control the development of fat cells.

There was only one way to go with these data. This was not something we were working on, and not something that I ever contemplated studying, but here we were with this observation: This chemical activated a receptor that regulates the development of fat.

TAKING IT TO THE LABORATORY

So, we asked the question: What happens in cell culture? We found that it made cells in culture become fat cells. We found that prenatal exposing pregnant mice made the mice get fat, and we could show that this exposure reprogrammed stem cells in the body to become fat cells. That was very interesting to us, as you can imagine.

The next thing we asked: Were these exposures heritable? And, of course, we asked this question because Michael Skinner, PhD at Washington State University had shown that the effects of some kinds of chemical exposures were passed on many generations later. So we asked: Are these chemicals similar? Unlike Dr. Skinner, we decided to use levels that are relevant to all of us. The magic word in toxicology is NOAEL, no observed adverse effect level. It is magic because that is the number that you use to set allowable human exposure. So, some relationship between the NOAEL and human exposure is always inferred. We exposed these mice throughout pregnancy. We took the babies, assayed some, and bred them out to the F3 [third] generation.

If you see an effect in the first two generations, that is called a multigenerational effect. That is distinguished from a transgenerational effect because the first and second generations were exposed. If a pregnant mom is exposed to a chemical, the baby is exposed. But, inside the baby are the germ cells to make the next generation, and they are exposed also. So, the first two generations have been exposed. The third, F3, and beyond have never been exposed to the chemical.

We saw that the animals were not heavier, but they were fatter. They had more fat cells, bigger fat cells, the brown fat [brown adipose tissue] did not work normally, and they had fatty livers and lots of other problems.

Then we repeated the experiment because we wanted to know how this happened? What changes did we cause in these animals? And because we wanted to know more, we went to the F4 generation—the great-great-grandchildren of the exposed animal.

The first thing we did was to test all the same parameters we saw before—and we got the same results. Then we did a diet challenge to these animals, and that gave a very interesting result. The animals remained on a normal low fat diet up until 19 weeks of age. Then we switched it to a slightly higher fat diet, not even double—from 13% to 21%. That is still a low fat diet. We kept them on that diet for six weeks, then switched them back.

The first thing we asked was: What happens when we fast the animals? Did they respond to the fasting? Normally, fasting mice lose weight really quickly. If you fast them for four hours, they lose some. If you fast them overnight, they lose as much as 10% of their body weight. The animals that had been exposed four generations before to tributyltin lost a little less fat, but in the overnight fast, they lost a lot less fat. So, these animals did not metabolize the fat. Is not this every dieter's

FIGURE 3

Obesogens—Just the Tip of the Iceberg?

© iStockphoto/Oria

lament? "I don't eat and I still do not lose weight." So, keep that one in mind.

Second, we tracked body weight and body composition over time. We monitored the females and the males, and those animals exposed four generations ago. No real difference in the weight between males and females was found. But, if you look at the fat in the males, you can see that at 19 weeks they are already a little bit fatter. Immediately, when you change the diet, these animals get obese in one week. They continue to gain that weight and, when you put them back on the normal diet, they keep the weight on.

These animals are predisposed to respond differently to the diet than the control animals. That also means that body weight is not an acceptable surrogate for obesity. A lot of times in the literature, you will read: "These animals did not gain any weight, so they must not be fat." These animals did not gain any weight, but they gained fat. They gained fat and they lost something else—they lost lean muscle and bone mass.

Next, we asked the question: What genes are changing in expression? I will not bore you by going through biochemical pathways that you memorized in biology class. The key player is leptin—the satiety hormone, the energy-balance hormone. Leptin was elevated in the F4 males, so the messenger RNA that encodes leptin was elevated, and circulating levels of leptin in the blood were elevated. In the clinic—and the doctors in the room may agree with me, if you see obesity and elevated leptin levels, that means the individual is leptin-resistant. So, we created animals that four generations after their mom's exposure had a leptin-resistant thrifty phenotype.

What we think happened is that we changed the way DNA is in the nucleus. In the nucleus of a cell, the DNA is like a bowl of spaghetti. But, that spaghetti has a structure. There are parts that always like to be next to other parts and separate from different parts.

In the obesogen-exposed animals, this structure is disturbed, and that leads to heritable changes in which genes are expressed. This altered structure is inherited, and that leads us to get this leptin-resistant thrifty phenotype four generations later, as published in *Ancestral perinatal obesogen exposure results in a transgenerational thrifty phenotype in mice* (Chamorro-Garcia, et al, 2017).

HOW MANY OBESOGENS ARE THERE?

We have studied just the tip of the iceberg. I have shown you data on tributyltins, there is good data for phthalates and perfluorinated chemicals. There is really strong data for estrogens. There is really strong data for nicotine and air pollution. Who has heard Robert Lustig, MD shouting from the rooftops about fructose? And sugar? There are quite a number of other chemicals. You have heard of organophosphates.

FUNGICIDES

We have found in a different study that many fungicides are obesogens. Here are six different classes of fungicides. Where are we exposed to fungicides? Ladies and gentlemen, in fruits and vegetables, in general. Tributyltin and triflumizole we know are obesogens in animals. Tributyltin, triflumizole, zoxamide, and quinoxyfen activate PPAR-gamma, so they are for sure going to be obesogens. Flusilazole activates the PPAR-gamma partner, RXR. It is going to be an obesogen. And, fludioxonil, we have no idea what it activates.

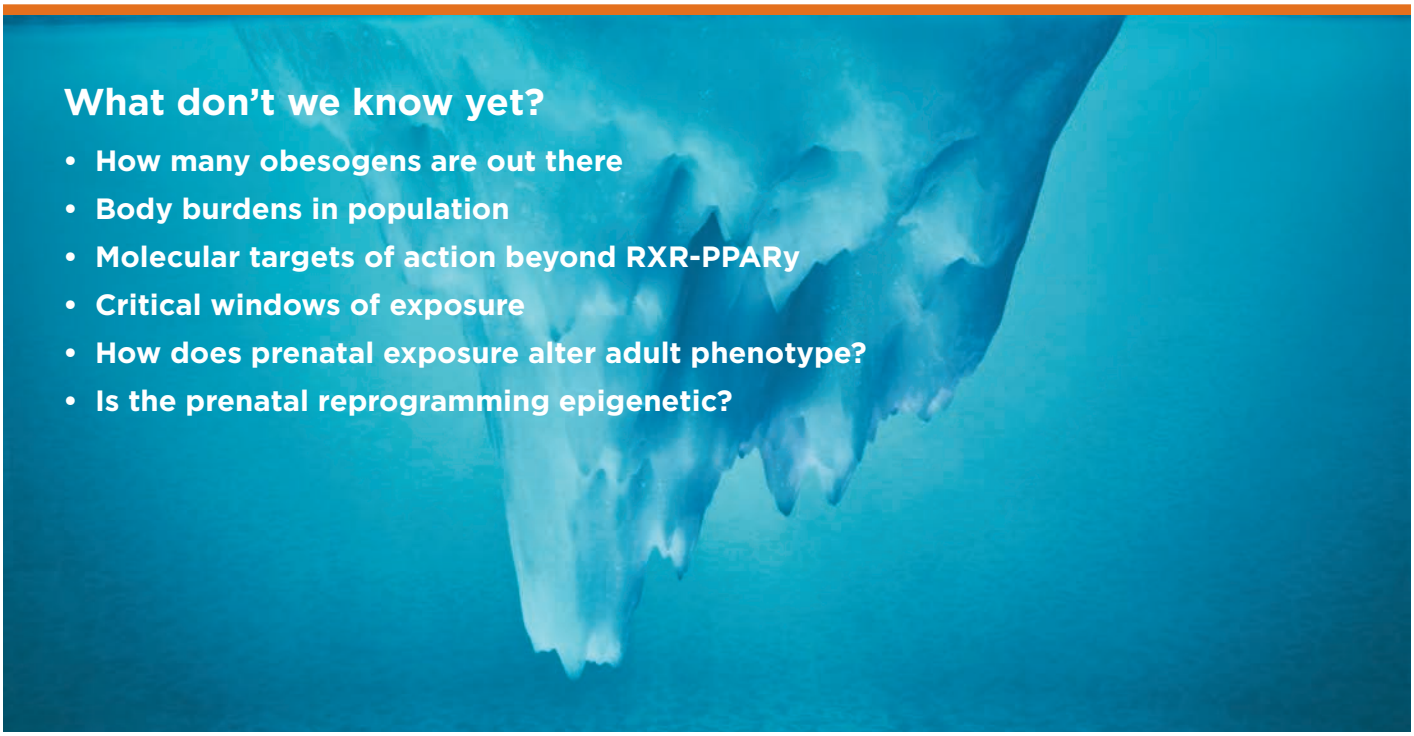
CONCLUSION

We do not know many things yet. We do not know how many are there? We know about 50 obsesogens. Are there 500? 5,000? We simply do not know.

We do not know what the body burdens are in us for any of these chemicals. They are not on the monitoring list. We do not know what all the targets are. We know some of the targets in which they work, but certainly do not know all of them. We do not know much about how this prenatal

FIGURE 4

Obesogens—What Lies Beneath?



© iStockphoto/Oria

exposure heritably changes the phenotype. We have some ideas in our model. Does that apply to all the other ones?

So what are the implications for human health? What is the take-home message?

First is that diet and exercise by themselves do not explain the obesity pandemic. We know this because there are pharmaceutical obesogens. Even if you do not believe what I have told you about chemical obesogens, there are prescription drugs that we take that have the side effect of making people obese.

Thiazolidinediones, the anti-diabetes drugs and all kinds of atypical anti-psychotics, anti-depressants make people fat. **So, if drugs have the side effect of making people fat, why would not chemicals that target the same pathways have the same effect? That would be an unreasonable conclusion to draw**. And we know quite a few of those.

We know that this prenatal exposure reprograms the animals and their descendants that have been exposed to become fat. We know that there are some epigenetic changes and changes in the three-dimensional structure of how the DNA is packed in the nucleus that lead to this predisposition.

In one of my favorite cartoons, "Damn you, epigenome," the obese character interacts with his butter pecan ice cream to make him fat—just exactly like my mice. This is exactly the same thing.

Seriously, the existence of obesogens says we need to shift the paradigm. We need to *prevent* kids and adults from becoming obese rather than trying to cure people who have already become obese with an 83% failure rate.

And, we know how to do it. We need to reduce exposures, we need to optimize nutrition, we need to feed kids organic contaminant-free fresh food. I do not need to tell that to this audience, but somehow the public health community is not getting it.

Another favorite cartoon has a regulator–pick your favorite from FDA, EPA, USDA—saying to a child eating a meal, "We do test for the safety of pesticides in your food. It's kind of long-term test." And it is! We are the subjects and you see the results. The results are quite clear. Chronic diseases are on the rise, and people are not as healthy as they once were. I think that what to do next is quite clear.

Bruce Blumberg, PhD is professor of Developmental and Cell Biology, University of California, Irvine. *Dr. Blumberg thanks his students, post-doctoral assistant Raquel Chamorro-Garcia, PhD, research assistant Carlos Diaz-Castillo, PhD, and researchers Riann Egusquiza, Victor Hung, Bassem Shoucri, Gin Wang, Sigal Willner, former lab members, other collaborators, and NIEHS.*

The Organic Report

Monitoring the organic standard setting process

The National Organic Standards Board (NOSB) meeting in October, 2017, held in St. Paul, Minnesota, was marked by a high degree of unity among board members and an effort to hold the National Organic Program (NOP) accountable to the principles, values, and letter of the national organic law, the *Organic Foods Production Act* (OPFA). This meeting reflected the value of the participatory decision making process, engaging a diverse standards board that includes the full range of organic stakeholders and a public opportunity to bring issues and information before the board. Ironically, this meeting was held as Congress considers in the 2018 Farm bill amendments (at this writing) that will undermine important and critical strengths of OFPA.

THE PAPER POTS MEETING

"What do you think about paper pots?" was a question addressed to almost every speaker who did not already speak on the issue. In August, 2018, NOSB received a revised petition from Small Farm Works—a self-described "business committed to small-scale, sustainable farming practices and tools, seeking the allowance of an ingenious, low-tech system for growing vegetables by transplanting in paper pots that are chained together and planted with a planter pushed by hand. It is a technology especially important to small farmers because of the time savings that it provides. However, while some certifiers allowed the use of paper pots under organic standards, others did not. NOP agreed with the certifiers that prohibited the pots and told all certifiers that it would prohibit their use after the 2018 growing season. The decision to prohibit paper pots was based on several factors—unapproved synthetic adhesive, the use of virgin paper, and the fact that its use is neither mulch nor a compost ingredient, as permitted by law.

Beyond Pesticides has expressed concerns about the many additives in paper, which include adhesives, such as those used in the paper pots. However, In terms of the characteristics of the pot as planted, these pots are no worse than the paper currently allowed in mulching systems.

Since the paper pots issue emerged, the Crops Subcommittee (CS) of the board issued a discussion document on the subject and has requested a technical review (TR) to address issues related to the composition of the materials used. The Maine Organic Farmers and Gardeners Association (MOFGA) requested delaying the prohibition at least until after the 2019 growing season to allow the petition process to unfold. A number of speakers commented on the inconsistency of NOP's allowance of hydroponics and concentrated animal feeding operations—used by large-scale operations—while prohibiting this system used by small-scale vegetable growers.

© iStockphoto/JMichl

© iStockphoto/beklaus

The NOP's decision to discontinue paper pots was not on the NOSB's agenda as an action item, but it garnered a lot of support from users, and NOSB members were sensitive to the benefit it provided to small farmers. In the end, the NOSB unanimously passed a resolution calling for an extension of the deadline for using the pots. Less than two weeks after the meeting ended, NOP announced that it would allow use of the pots until the NOSB reviews the petition and rulemaking proceeds.

A number of issues will have to be considered by the NOSB in addressing the petition. NOP regulations currently allow recycled newspaper and other non-glossy paper without colored inks. The requirement that such paper be recycled is a resource conservation issue, but the recent technical review of recycled paper reveals many additives that no one would have guessed would be present in paper—such as acrylonitrile, polyethylene (LDPE), styrene, butadiene, vinyl acetate,

Paper Chain Pot Transplanting System: A History

Oregon Tilth, a certifier, issued comments that provided context on the use of paper pots in certified organic production. Below are Oregon Tilth's comments:

As an organic certifier who has reviewed different types of biodegradable pots requested for use by our certified organic producers, Oregon Tilth appreciates the complexity and nuance of this topic and the questions raised by the CS. The petition for this product states ". . . [paper pots] has been historically allowed for the past 12 years by some organic certification agencies. . . ."

We believe that some historical context around certifier allowance of these types of products may be helpful to the NOSB.

- Oregon Tilth has historically prohibited the use of pots made from new (not recycled) biodegradable paper, including transplanting pots, such as EllePots and paper chain pots.
- Inconsistencies around paper pots have been ongoing since 2013 when ACAs (Accredited Certifying Agents) were polled to comment on whether they allow or prohibit such paper pots.
- Several ACAs as well as the Organic Materials Review Institute (OMRI) confirmed that they would not allow these products for use in organic crop production due to prohibited synthetics, such as binders and poly fibers.
- In 2017, we became aware of operations "certifier shopping," e.g., searching for certifiers that would allow the use of paper pots.
- In early 2018, the USDA NOP (National Organic Program) provided additional clarification that synthetic binders used in the production of many types of paper pots were not allowed.

Oregon Tilth supports the petition to allow synthetic paper production aids to 205.601(o) for the following reasons:

- Organic agricultural producers require additional resources. Oregon Tilth has received many requests from farmers to use paper chain transplanting pots and other types of biodegradable paper pots.
- Paper planting pots reduce producers' dependence on plastic, fossil fuels, and intensive labor needed for planting transplants, thereby increasing the sustainability of organic farming practices.

Paper planting aids made from biodegradable paper use special technology to manufacture the biodegradable fibers and in some cases require the use of specialty equipment that appears to be fairly unique compared to other products on the market. Oregon Tilth certifies 15 clients using OMRI–approved nonsynthetic fiber pots—Jiffy Pot and Fertilpot—that are used to grow transplants that must be planted by hand. Paper chain pots allow one person to transplant hundreds of seedlings in minutes using their proprietary transplanter, a cost-savings critical for farm viability. We are in support of allowing operations, who have been approved to use these products by their certifier, to continue using them until a final determination is made via the petition process. It is important to note that the petition process can be time-consuming and we encourage the USDA NOP to continue to allow the use of paper pots already approved during this stage of the process.

and polyvinyl chloride (PVC)—so the discussion of the petition will be complex.

FAIRNESS IN ORGANIC DAIRY

Because of a loophole in the law, large dairy operations are allowed to bring conventionally managed animals into their operations on a continuous basis. A fix for this problem, an Origin of Livestock rule, was proposed by USDA in 2015, but the agency now appears to have no plans to finalize the rule.

OFPA requires organic milk and dairy products labeled as organic to come from dairy cows continuously managed as organic from the last third of gestation. Because of the short supply of organic dairy breeder stock when the law was passed in 1990, a one-time conversion of conventional dairy cows to organic was allowed, as long as they are managed organically. Despite this, NOP has allowed two interpretations of this provision, allowing the problem to persist.

The NOSB recognized that it is unfair to allow large organic dairies to profit at the expense of smaller dairies that follow the spirit of the law. In another demonstration of unity, the NOSB unanimously passed a resolution urging the Secretary of Agriculture to issue a final rule that will close the loophole.

ONE SYNTHETIC SUBSTANCE REMOVED FROM THE NATIONAL LIST IN SUNSET VOTE, PETITIONS FOR MORE SYNTHETICS, NON-ORGANIC INGREDIENTS REJECTED

Sucrose octanoate esters, listed to control varroa mites in bees and crop insect pests, was voted off the National List in view of a lack of support. In other materials votes, the petition to allow chlorine dioxide gas made from sodium chlorite for food handling was rejected by a vote of 6 yes, 9 no. [A decisive vote, or two thirds of the board, is required to list a synthetic substance for use in organic food production.] Chlorine dioxide gas is registered for use by EPA in conventional food production as an anti-microbial pesticide, sanitizer and/or disinfectant for the direct treatment of fruits and vegetables during storage, transportation, and food preparation.

The board voted unanimously to send the petition for the antibacterial agent silver dihydrogen citrate back to the Handling Subcommittee. The board unanimously rejected petitions to allow non-organic Japones and Ethiopian peppers to be used in organic processed foods, but approved by a vote of 11–4 the petition to allow the use of non-organic tamarind seed gum. The petition for allyl isothiocyanate as a fumigant was sent back to the Crops Subcommittee. The motion to allow sodium citrate as an anticoagulant in the production of blood meal to the National List passed unanimously. The NOSB found the petitioned antimicrobial natamycin to be a non-synthetic, then voted to list it as a prohibited nonsynthetic in crop production.

BOARD ACTS ON FRAUD AND SUPPORTS FURTHER INVESTIGATION OF MARINE MATERIALS

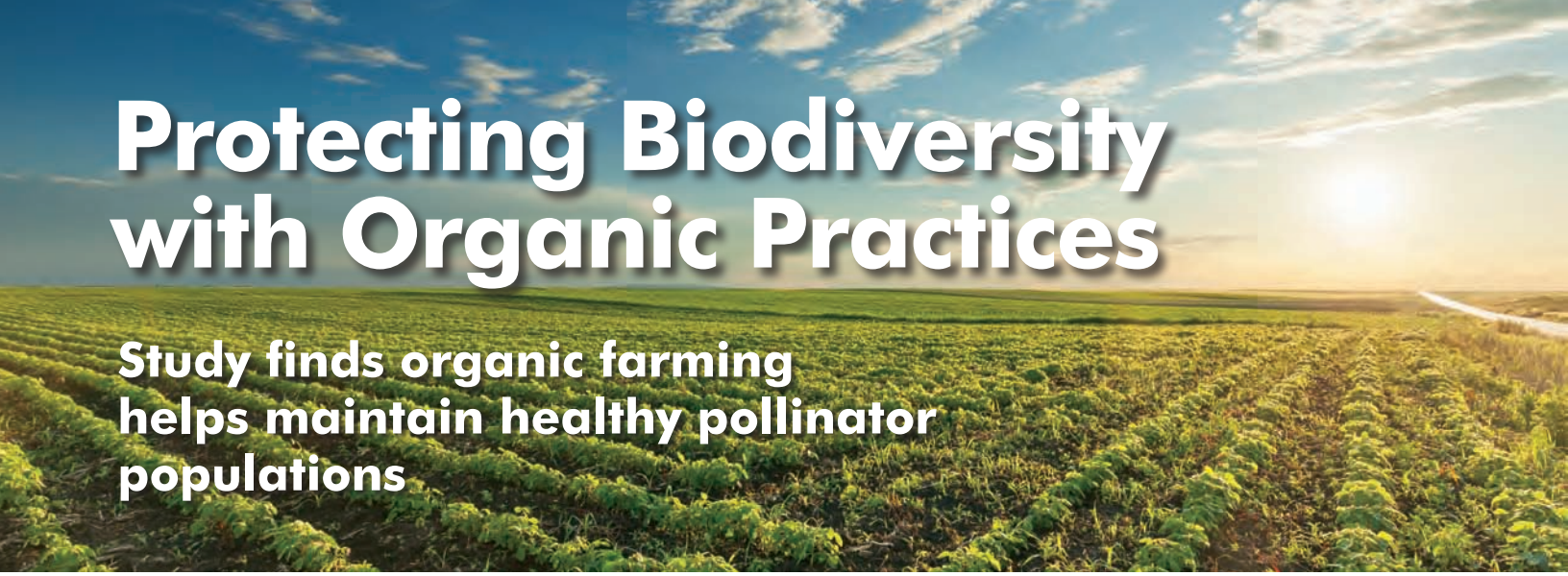
The NOSB adopted unanimously two proposals to fight fraud in organic commerce. The board approved an outline of factors that should be considered by NOP in targeting oversight of USDA-accredited certifiers. Oversight includes audits of certifier activities and inspection procedures. The list of factors for assessing the risk that a certifier might be involved in fraudulent activities was developed by the Compliance, Accreditation, and Certification Subcommittee, based on input from stakeholders, the organic community, and NOP. It addresses fraud anywhere in the production and supply chain. In addition, the board recommended improvements in the inspector qualifications and training proposal that was passed at the Spring 2018 NOSB meeting.

The NOSB devoted a good deal of time to a discussion document on marine materials used in organic production and whether it is appropriate, as suggested by the Materials Subcommittee, to require that inputs from marine plant sources in organic production be made from organic seaweeds, certified organic according to wild crop standards. The board supported the suggestion by the subcommittee that a working group be convened to help develop guidance for harvesting marine plants.

© iStockphoto/8vFanI

Protecting Biodiversity with Organic Practices

Study finds organic farming helps maintain healthy pollinator populations



© iStockphoto/Rasica

Healthy, stable populations of bees and butterflies are best preserved in farm fields that are certified organic, according to an extensive, three-year study conducted by Swedish researchers at Lund University. The research, *Organic farming supports spatiotemporal stability in species richness of bumblebees and butterflies,* published in September, 2018 in the journal *Biological Conservation,* highlights the benefits that organic farms provide pollinators by improving floral resources and forgoing the use of toxic pesticides. The data continues to support the need for a broadscale conversion to more sustainable organic practices in the U.S. and internationally.

ORGANICS PROTECTS SPECIES RICHNESS

The study adds to the existing body of literature on the subject, including a meta-analysis that compared biodiversity on organic and conventional farms, *Land-use intensity and the effects of organic farming on biodiversity: a hierarchical meta-analysis (Journal of Applied Ecology,* 2014). The study found that, "On average, organic farming increased species richness by about 30%." According to the authors, "This result has been robust over the last 30 years of studies and shows no sign of diminishing. Organic farming had a greater effect on biodiversity as the percentage of the landscape consisting of arable fields increased, that is, it is higher in intensively farmed regions."

"[The Swedish study] is the first large-scale study over the course of several years to show that organic farming has a consistent, stabilizing effect on pollinator diversity," says Romain Carrié, PhD, a postdoctoral researcher at the Centre for Environmental and Climate Research.

Researchers recorded observations of bumblebees, butterflies, and flowering plant species at ten organic and nine conventional farms throughout Sweden for three years. Farms were compared across type, including cereal fields, temporary grasslands, and semi-natural grasslands. The study observed the spatio-temporal aspects (continuity of the number of different species in space and time) of pollinators and flowering species in these fields.

FLORAL, BEE, AND BUTTERFLY DIVERSITY

Results of the study found that, overall, organic farms had and sustained a higher rate of floral, bee, and butterfly diversity than conventional farms. The continuity of flowering species had the most significant impact on the number of bee and butterfly species observed by researchers. "This strongly suggests that both flower-enhancing management options and a reduced use of insecticides can help reverse pollinator declines," Dr. Carrié concludes.

A 2011 study, *Assessing the effect of the time since transition to organic farming on plants and butterflies (J Appl Ecol)*, found that a transition from conventional to organic farming rapidly improves the number of plant and butterfly species on a farm. In addition, a study published in 2012, *Organic Farming Improves Pollination Success in Strawberries (PLOS One),* found that organic farming practices improve the pollination success of strawberry farming.

DRAMATIC DECLINE IN INSECTS

Recent research has found dramatic drops in overall insect abundance, with leading entomologists identifying steep declines in insect populations. Various studies have found reductions of up to a factor 60 over the past 40 years—there were 60 times as many insects in some locations in the1970s. Over 75% of insect abundance has declined over the last 27 years, according to research published by European scientists last year in *PLOS One*. "We appear to be making vast tracts of land inhospitable to most forms of life, and are currently on course for ecological Armageddon," study coauthor David Goulson, PhD of Sussex University, UK, told *The Guardian*. "If we lose the insects then everything is going to collapse."

Meanwhile, the U.S. Environmental Protection Agency continues to allow the use of synthetic herbicides in a manner that kills off floral diversity and pollinator habitat, and systemic insecticides, which kill bees directly as the treated plants take in the insecticide and express it in pollen, nectar, and guttation droplets that the plant produces. In the U.S., only roughly one percent of farmland is certified organic, while the rest subjects pollinators and the plants that depend on them to regular chemical contamination.

Hidden Ingredients in Glyphosate Are the Most Toxic

SECRET "INERT" OR "OTHER" INGREDIENTS TARGET ORGANISMS

TERRY SHISTAR, PHD

The ingredients not listed on a pesticide product nor fully reviewed for their adverse effects may be the most toxic chemicals in the formulation. Recent research, *Toxicity of formulants and heavy metals in glyphosate-based herbicides and other pesticides* (*Toxicology Reports* 5, 2018), by Defarge, de Vendômois, and Séralini, demonstrates the need to disclose and test all ingredients in pesticide products, as well as the full formulation. The research tested the toxicity of the herbicide glyphosate, so-called "inerts" in glyphosate-based herbicides (GBH), and the pesticide formulations—looking at toxicity to target organisms, toxicity to human cells, and endocrine-disrupting activity. In addition to the GBH products, they studied a number of other pesticides.

The scientists found that for GBH products, glyphosate was not the major toxic component—to either plants or human cells—and that formulations, as well as glyphosate alone, are endocrine disruptors at low concentrations. Glyphosate alone did not show herbicidal effects on tomato plants for five days following application. Formulations that included POEA (polyethoxylated tallowamine) are the most toxic to plants and human cells, and POEA itself is highly toxic to plants and animals. GBH formulations are no more toxic to plants than the formulants ("inert" ingredients). The researchers concluded, "Hence G [glyphosate] did not appear to be the main active substance of the herbicide, but rather the formulants."

The researchers also identified a number of other toxic substances in the products, including arsenic, chromium, cobalt, nickel, and lead. Arsenic was present in almost all samples.

PESTICIDE REGISTRATION FAILURES

This research calls into question the fundamental principles embodied in federal pesticide law, the *Federal Insecticide, Fungicide, and Rodenticide Act* (FIFRA), which distinguishes "active" ingredients, those ingredients in pesticide products for which pesticidal activity is claimed, from "inert" ingredients, now labeled "other ingredients." "Inert" ingredients receive minimal review (to establish tolerances), compared to "active" ingredients, and are protected from disclosure on the product label as proprietary manufacturer information.

Beyond Pesticides has long worked for transparency in pesticide registration, which would allow the hazards of "inert" ingredients to be recognized and regulated. In 2014, Center for Environmental Health, Beyond Pesticides, and Physicians for Social Responsibility, represented by Earthjustice, filed a legal complaint against the U.S. Environmental Protection Agency (EPA) for failing to complete rulemaking that would require pesticide manufacturers to disclose the inert ingredients on their pesticide product labels. A federal judge in California agreed with EPA that it has no responsibility under federal pesticide law to complete rulemaking on the disclosure of hazardous ingredients in pesticide products, so EPA will be allowed to keep the public in the dark on the full list of toxic ingredients in pesticides registered by the agency. U.S. District Judge William Orrick stated in his ruling, "The EPA has no mandatory duty to require disclosure of "inert" ingredients in pesticides, even if those ingredients qualify as hazardous chemicals under separate statutes." Advocates have said for decades that people and communities cannot make informed decisions on pesticide products without full disclosure of all product ingredients and that the stated proprietary interests of chemical manufacturers is bogus, given the burgeoning market of "minimum risk" pesticide products exempt from registration under the FIFRA 25(b) provision, which are required to disclose all ingredients.

INERTS COMPRISE HIGH PERCENTAGE OF PESTICIDES

According to a 2000 report produced by the New York State Attorney General, *The Secret Ingredients in Pesticides: Reducing the Risk,* 72 percent of pesticide products available to consumers contain over 95 percent inert ingredients and fewer than 10 percent of pesticide products list any inert ingredients on their labels. The report also found that more than 200 chemicals used as "inert" ingredients are hazardous pollutants in federal environmental statutes governing air and water quality, and a 1995 list of inert ingredients identifies 394 chemicals as active ingredients in other pesticide products. For example, naphthalene is an inert ingredient in some products and listed as an active ingredient in others.

"Inert" ingredients are allowed in pesticides used in organic production as well. The National Organic Program (NOP) allows "inerts" formerly listed on EPA's List 4, "inerts of minimal concern," as well as a few formerly listed on List 3, "inerts of unknown toxicity," to be used in organic production. The National Organic Standards Board has voted overwhelmingly to require review of all individual "inerts" used in organic production, but NOP has refused to move forward.

TRACKING BIODIVERSITY

DRAGONFLIES

GARRET WHITE

Focus on Biodiversity

Why focus on biodiversity. In her book, *Silent Spring*, Rachel Carson alerted the public and government regulators to the importance of protecting complex biological communities. The interrelationship and interdependency of organisms is critical to ecological balance and human survival. With broad spectrum pesticide use, and indiscriminate poisoning with systemic pesticides, an ecological imbalance is created, sacrificing the benefits of nature and escalating pest problems.

In its aquatic stage of life, when they are living in the water, dragonflies eat mosquito larvae, thus playing an integral role in an ecological-based approach to mosquito management.

Immature dragonflies (nymphs) live in water. The nymphs of some dragonfly species may live in aquatic environments as long as five years before becoming adults. Though their six legs cannot walk very well, they allow nymphs to perch on large rocks and cross stones when in search of prey. Nymphs propel themselves rapidly through the underwater landscape, using a jet-like ejection of water from their bodies. Such impressive speed allows nymphs to consume all kinds of small underwater creatures. The nymph's enormous mouthparts, being scoop-like, encompass the majority of the lower half of the nymph's head. The nymph's body is between one-quarter- to two-and-a-half-inches long and molts several times before its final molt into adulthood.

Dragonfly adults are voracious aerial predators. With wrap-around compound eyes composed of up to 30,000 facets (ommatidia) transmitting ten thousand angles all at once, they are able to reach target insects in midair more than 95 percent of the time. Research suggests that dragonflies may be the most effective hunters in the animal kingdom.

The aerial acrobatics necessary for seemingly tireless hunting require neurons to select one moving target from a frenzy of possibilities, and the dragonfly does not disappoint. Its brain retains the retinal image of the target prey even as the target gets closer. The combination of incredible neurocapacity, retinal retrieval, and wrap-around eyes allows the dragonfly to track a moving target, calculate a trajectory to intercept that target, and subtly adjust its flight path as needed.

© iStockphoto/anna

Mating pairs fly together, in tandem, resembling well-choreographed dancers. Dragonfly females usually fly low over the water, depositing eggs on logs, aquatic plants, or directly on the watery surface covered loosely in floating vegetation. In late summer, eggs are laid in warm freshwater, such as ponds, slow-moving tributaries, or marshy areas where the waters are less turbulent. Once dragonfly eggs hatch, the emerging nymphs will develop and feed as long as food is available within the surrounding aquatic environment.

Thus, aquatic environments provide suitable habitat for an impressive range of insect and animal species, offering countless examples of harmonious coexistence and interdependence.

ANCIENT LINEAGE AND SPECIES ORDER

Dating to the Carboniferous period, some 300 million years ago, dragonfly ancestors had wingspans the length of one human arm. Primordial Earth's atmosphere was high in oxygen, enabling insects, animals, and assorted mega-fauna to grow to enormous sizes as compared to today's standards.

The dragonfly's order, *Odonata*, meaning "toothed ones," is not a very species-rich group, encompassing only some 7,000 species worldwide (its species list includes the related damselflies, which, unlike dragonflies, can fold their wings back against their bodies). This list of 7,000 species is low when compared with hundreds of thousands of beetle and butterfly species–many of which may share, at least temporarily, the same aquatic ecosystems as dragonflies.

ECOLOGICAL ROLE, HUNTING AND HABITAT

Nymphs are commonly found near bunched aquatic vegetation, reeds, grasses, and submerged tree roots where they lie in wait for prey. When a potential meal swims or ambles by, the nymph's extendable jaws flash outward to snatch and draw in the food.

Conversely, the four transparent, exceptionally flexible wings of adults are attached to the thorax by distinct muscle groups. Each wing, though rigidly projecting outward on the body, can be maneuvered independently, aiding the dragonfly's extraordinary range of flight options. Dragonfly mandibles are notably serrated, enabling them to crush prey, easing digestion and allowing for swift consumption.

Dragonfly adults can migrate across regions to maximize breeding opportunities. This allows adults flexibility in finding warm, fresh waterbodies in which to safely lay their eggs. The migration of some dragonfly species spans vast distances each year—for instance, swarms of green darner dragonflies (North America's most common dragonfly) migrate each fall and spring between the northern U.S. and southern Mexico.

FROM PREDATOR TO PREY

In addition to their respective role as predators, dragonfly adults and nymphs alike play an additional role as important food sources for other living species, such as fish, larger aquatic insectivores, and birds able to hunt underwater, including the Great Blue Heron. In this way, dragonflies, and the species that rely on them, encompass a broader ecosystem, all elements interwoven and dependent upon the health of their surroundings. When the interconnections of an ecosystem are disturbed, when a species is displaced, when a food source or familiar habitat becomes contaminated, support for a sustainable living system falls apart.

Quick Facts

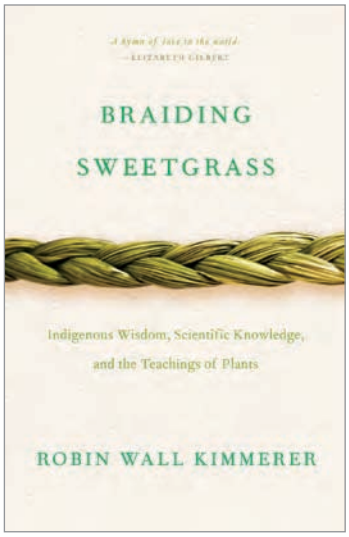
- Dragonflies spend up to 5 years (most often 1–2 years) as underwater nymphs.
- They cannot hear well, and their stubby antennas are of little use for smelling or detecting pheromonal flirtations. However, dragonflies have amazing eyesight and this makes them expert fliers, able to hover, dive, fly backwards and upside down, pivot 365 degrees, and reach speeds of 30 miles per hour.
- Both as flying adults and as aquatic nymphs, dragonflies are important mosquito predators, as their ceaseless search for food routinely regulates the insect's numbers.
- Dragonfly nymphs prey on the aquatic developmental stages of target insects, including the larvae of mosquitoes, mayflies, midges, and other small insects. They will also prey on tadpoles and small fish. In some instances, nymphs might even snatch prey from the claw of a crayfish.

Dragonfly eating mosquito

© iStockphoto/PavolKlimek

Reviewed by Terry Shistar, PhD

Science and an Indigenous Worldview



Braiding Sweetgrass: Indigenous Wisdom, Scientific Knowledge, and the Teaching of Plants
Robin Wall Kimmerer, PhD
Milkweed Editions, 2013

Robin Wall Kimmerer is a mother, scientist, teacher, and member of the Citizen Potawatomi Nation, which, along with the Ojibwe and Odawa, are part of the three fires council known as Anishinaabe. In the chapters of *Braiding Sweetgrass*, all of these aspects of her life come to the fore. In particular, her identity as Potawatomi requires her to treat the earth as a living being. Her training as a biologist teaches her to ask questions that can be answered with the tools of science. For some, the scientist may seem incompatible with the indigenous perspective, but the consciousness that she finds by weaving together the two perspectives is one that will prove essential for the continuation of humans as part of Earth.

Her writing is beautiful and personal. The book begins with the story of Skywoman falling—how humans came to inhabit the earth and how Earth came to be home. It is a story of giving and gratitude, and shapes the Potawatomi worldview. Among Skywoman's gifts were plants, including sweetgrass. The book continues with stories of the more recent past—when her family moved to Oklahoma, settling in a pecan grove. The pecan grove provides a lesson linking indigenous wisdom—"In the beginning, the trees talked to each other—and the new scientific knowledge that trees do communicate and share the wealth provided by mycorrhizal fungi. That message—that giving and gratitude are woven into the fabric of the world—is a constant thread in the book.

But all is not well. The children of Eve did not come from a tradition of giving and gratitude, but one of a broken relationship between humans and Earth. Children of Eve were cast out, to wrest a living from the land.

Early chapters of the book are filled with personal relationships with the land, as seen through the lens of science and an indigenous worldview, and played out in the practice of mothering, gardening, making maple syrup, and teaching. Then we meet Windigo.

Windigo is the legendary monster of the Anishinaabe—a human who has become a cannibal, turning others into cannibals with its bite. More than a monster created to scare children, Windigo is "a human whose selfishness overpowered their self-control to the point that satisfaction is no longer possible." Our economy has created a breed of Windigo that consumes "not for need but for greed."

In contrast with the beauty of the early chapters, the later part of the book shows Windigo's footprints—toxic waste sites, clear cuts, oil spills, industrial agriculture, diamond mines—the signs of insatiable consumption driven by greed. Those chapters are difficult to read. I had to put the book down and go for a walk.

When we finally get to the chapter "Defeating Windigo," it is clear that a solution to our environmental problems must start with a change of worldview. As Daniel Quinn wrote, "There's nothing fundamentally wrong with people. Given a story to enact that puts them in accord with the world, they will live in accord with the world. But given a story to enact that puts them at odds with the world, as [this culture's] does, they will live at odds with the world. Given a story to enact in which they are the lords of the world, they will act as the lords of the world. And, given a story to enact in which the world is a foe to be conquered, they will conquer it like a foe, and one day, inevitably, their foe will lie bleeding to death at their feet, as the world is now."

The culture of greed—Windigo—must be replaced by a culture of giving and gratitude for Earth's gifts. "Gratitude for all the earth has given us lends us courage to turn and face the Windigo that stalks us, to refuse to participate in an economy that destroys the beloved earth to line the pockets of the greedy, to demand an economy that is aligned with life, not stacked against it."

For some, the scientist may seem incompatible with the indigenous perspective, but the consciousness that she finds by weaving together the two perspectives is one that will prove essential for the continuation of humans as part of Earth.

LET EVERYONE KNOW YOUR YARD IS ORGANIC

"Organic Landscape" yard sign is eight inches in diameter. This aluminum enameled sign will not rust and will retain its bright colors for years. There are two small holes on the sign that can be used to nail to posts or to a fence.

Order your Organic Landscape sign at bp-dc.org/organicsign.

ORGANIC LANDSCAPE
www.pesticidefreezone.org
www.beyondpesticides.org

— $13.00/sign —

Beyond Pesticides – Donate Today

bp-dc.org/donate

Get your community off the toxic treadmill. We're here to help!

Did you know that we assist thousands of people each year through our website, by phone, email, and in person?

Sign Up and Donate

Your support enables our work to eliminate pesticides in our homes, schools, workplaces, communities, and food supply.

Have a pest problem?

bp-dc.org/pests

Tools for Change

bp-dc.org/tools

Action Alerts

bp-dc.org/alerts

Membership to Beyond Pesticides includes a subscription to our quarterly journal, *Pesticides and You*.

Join Beyond Pesticides

Membership Rates

$15 low-income • $25 individual
$30 all-volunteer organization
$50 public interest organization
$100 business

Two Easy Ways to Join

Donate Online
bp-dc.org/donate

Donate by Mail
Beyond Pesticides, 701 E St, SE
Washington, DC 20003

Questions? Give us a call at 202-543-5450 or send an email to info@beyondpesticides.org.

BEYOND PESTICIDES
701 E Street, SE, Washington, DC 20003
202-543-5450 phone • 202-543-4791 fax
info@beyondpesticides.org • beyondpesticides.org

NONPROFIT ORG
US POSTAGE
PAID
Washington DC
Permit No 345

Printed on 100% post-consumer waste paper with soy inks. Cover on Quest™, 100% non-deinked, non-rebleached, post-consumer waste paper.

Fall 2018 ■ Vol. 38, No. 3

Member of EarthShare

SAVE THE DATE
APRIL 5–6, 2019 NEW YORK CITY

© iStockphoto/PageLightStudios

Organic Strategies for Community Environmental Health: Eliminating pesticides where we live, work, learn, and play

Bringing together speakers and workshops on science, policy, and action to protect the environment and people from toxic pesticides and advance policies and practices for a healthy community.

BEYOND PESTICIDES

Convened by Beyond Pesticides and the Children's Environmental Health Center of the Icahn School of Medicine at Mount Sinai

Icahn School of Medicine at Mount Sinai

Children's Environmental Health Center