Beepocalypse Myth Handbook: Assessing claims of pollinator collapse

Myths and truths about bees: There is no ‘catastrophic decline’ in the global honeybee population and the use of pesticides is not driving health problems challenging wild bees, as many environmental groups continue to claim. In fact, honeybee hive populations are rising in North America and globally, and they have been growing in number for years. The companion claim — that a class of pesticides known as neonicotinoids (or neonics for short) are fostering a global honeybee pollinator crisis is also not accurate. However, honeybees and perhaps bumble bees (whose wild nature make them difficult to catalogue) do face a range of health threats that are serious cause for worry, and those issues need to be addressed.

What are the facts?

Colony Collapse Disorder

The honeybee population did face what appeared to be a crisis in the mid-2000s when some United States’ beekeepers, mostly in California, began discovering that their honeybees had mysteriously abandoned many of their colonies, leaving behind the queen bee, attended by too few, immature worker bees to sustain the colony, yet with ample viable brood and stored food. The first report classified as CCD was in mid-November 2006 by a Pennsylvania beekeeper overwintering in Florida. By February 2007, large commercial migratory beekeepers wintering in California, Florida, Oklahoma, and Texas had reported heavy losses associated with CCD, with losses ranging from 30% to 90% of their bee colonies. This phenomenon was dubbed Colony Collapse Disorder (CCD). What made CCD’s appearance in the United States stunning and alarming was that episodes were being reported from widely separated states across the continent.

Image not found or type unknown At first, genetically modified crops and later neonicotinoid pesticides were fingered by environmental groups and some entomologists as the presumed causal agents. But when the bee colonies were examined, the CCD diagnosis emerged, scientists quickly dispensed of the GMO argument, as each GM crop is different and there is no plausible explanation why a phenomenon noted in one region of the US would not also show up in other regions or countries using similar modified crops.

Did the use of pesticides or neonics in particular cause or contribute to CCD in 2006? The scientific consensus now firmly says ‘no.’ CCD is a historically common occurrence that predated the introduction of genetically modified crops and modern pesticides. Upon further investigation, CCD was shown to be a centuries-old, periodic phenomenon that, by other names, has occurred periodically for centuries. in specific locales. Limited occurrences resembling CCD were fully documented as early as 1869 and on the Isle of Wight in the UK in 2006, and also in other parts of Europe and in Egypt. There were reports of similar bee behavior in hives in the US in 1918 and 1919, and thereafter. It eventually became more

widely known as “disappearing disease.”

The focus on neonicotinoids as a contributing factor is more complicated. Neonics are a class of systemic pesticide introduced in the early 1990s and popular in the US, Australia, Europe and elsewhere to protect corn, soy, cotton and canola farmers. They have been embraced as a less toxic replacement of organophosphate pesticides (which can be either natural of synthetic), which are known to kill bees and wildlife, and have been linked to health problems in workers. Applied to the soil, sprayed on the crop or, most commonly, used as a seed treatment, neonics are absorbed into the plant, which is ingested by insects, discouraging pests from wreaking havoc on crops. The seed treatment lowers the amount of the neonic used 10- to 20- fold, decreasing the need for open spraying of the plant, a genuine sustainability benefit.

Many in the media and activist critical of conventional agriculture often conflate bee health problems linked to CCD with the health issues encountered by the wild honeybee population. From 1972 to 2006, serous reductions in hives were documented among feral honey bees in the US, and recent studies, though fragmentary, appear to show scattered declines among wild bees.

The precise causes of the most recent CCD incident remains undetermined. Most likely, the combinations of factors that affect honeybee colony health more generally (discussed below) are involved. But CCD has now come and gone, as it has many times over the centuries. According to the University of Maryland’s Dennis van Engelsdorp (who was part of the team that coined the modern term “CCD”), no case of CCD has been reported from the field for the last eight years.

Are honeybees in decline?

Said simply: Honeybees are not on the verge of extinction or irreversible decline and the world will not face mass starvation. That’s scare rhetoric. As the Washington Post reported in two separate features in 2015 — ‘Call Off the Bee-pocalypse: U.S. Honeybee Colonies Hit a 20-Year High’ and ‘Believe It of Not, the Bees Are Doing Just Fine’ — advocacy group claims amplified in thousands of news stories, but not all, are wrong. But the direction of the media narrative, like the path of a 250,000 ton ocean liner, was established in the late 2000s, and does not turn that around easily, particularly when the it serves an ideological conclusion that conveniently helps in fundraising for those who promote it. Despite claims to the contrary, according to the independent Bee Informed Partnership, overseen by van Englesdorp, overwinter mortality of honeybees has steadily declined since the 2006 CCD peak.

In fact, honeybee populations aren’t declining anywhere in the world, despite many media headlines; they’re rising. According to statistics kept by the US Department of Agriculture, Statistics Canada and the UN Food and Agriculture Organization, honeybee populations in the United States, Canada and Europe have been stable or growing for the two decades neonics have been on the market. Furthermore, the worldwide trajectory for bee colonies has been on an upward trajectory for over half a century. Here are a few charts that illustrate the upward global trends that overlap the introduction and use since the mid 1990s of neonics, the central target of anti-chemical environmental groups.
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Data produced by the EU, US and independent global agencies have not dissuaded many environmental groups from their fund-raising campaigns featuring vulnerable bees. For example, over much of the past decade, the Sierra Club (while requesting donations) sent out flyers highlighting the ‘fact’ that neonics kill honeybees.

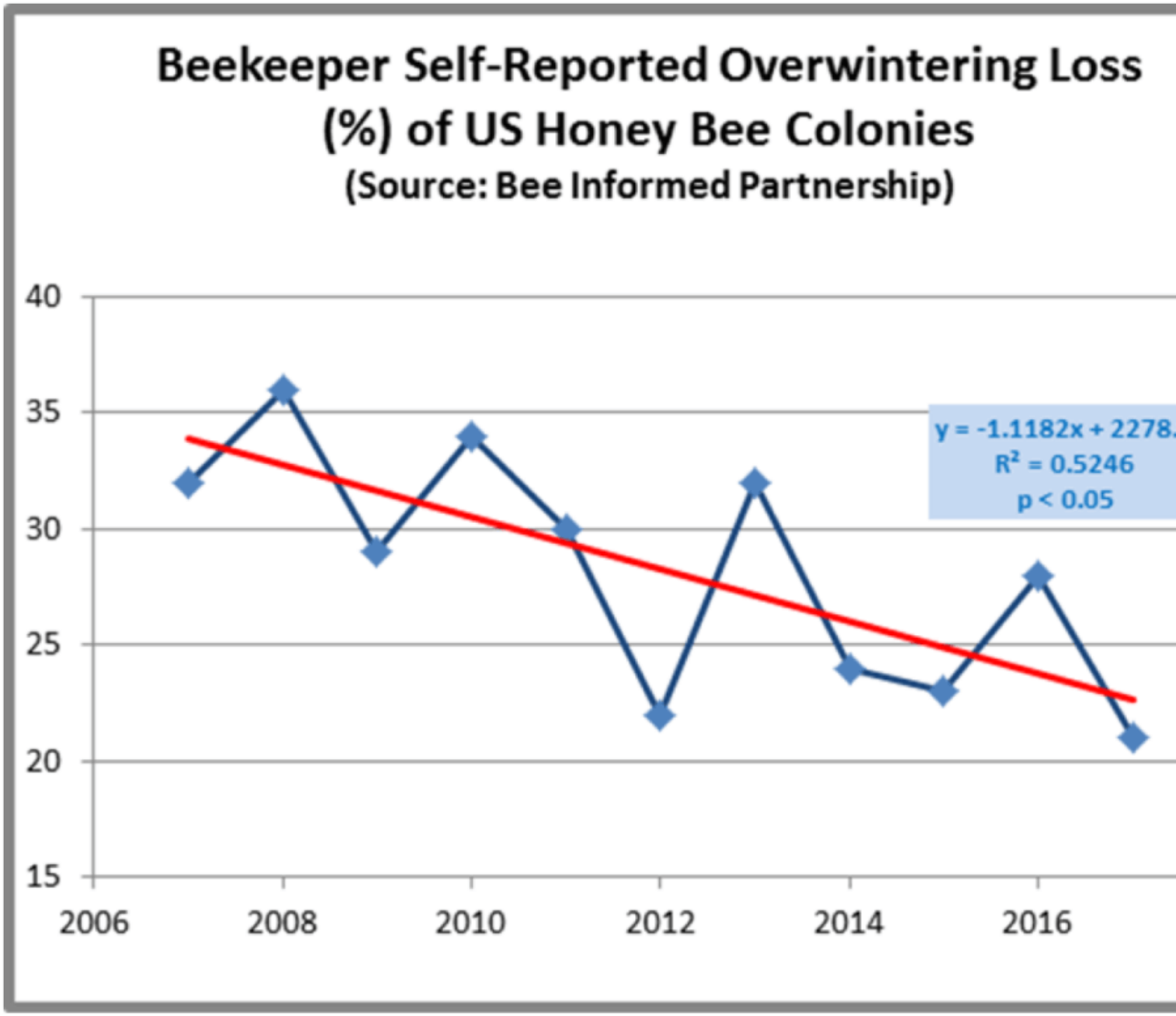
> Bees had a devastating year. 44% of colonies killed…and Bayer and Syngenta are still flooding your land with bee-killing toxic ‘neonic’ pesticides—now among the most widely used crop sprays in the country.

Finally, after multiple scolds from entomologists, Sierra Club retreated, doing a Gish Gallop, acknowledging that while honeybees are fine, wild bees are under siege, an unchallengeable hypothesis since by their very nature wild bee populations cannot be accurately tracked or measured, (See this GLP analysis of threats to the wild bee population.) posting a different message on its blog:

> Honeybees are at no risk of dying off. While diseases, parasites and other threats are certainly real problems for beekeepers, the total number of managed honeybees worldwide has risen 45% over the last half century.

What about overwinter and summer losses?

The sharp spikes in honeybee losses in some parts the world that were seen a decade ago are now mostly a thing of the past, although because of variances in nature, there will always be one region or another with higher than normal losses. It is completely normal for beekeepers to lose a percentage of their hives every year, especially in the winter time, due to weather, disease or the exhaustion of stored food supplies. (It also is entirely normal for the number of bee hives to fluctuate annually as individual beekeepers make decisions about how many colonies they will maintain in light of changing market demand for different types and grades of honey.) However, misrepresentations of *over-winter* bee losses, or the adding together of winter and summer loss numbers, makes it seem as if the mid-2000s CCD event is ongoing. In fact, as van Englesdorp's team has reported, overwinter losses have steadily declined since the 2006 CCD-related surge.



Over-winter losses are made up each spring, as bees reproduce rapidly. Each queen lays more than 1,000 eggs per day and a worker bee's lifespan is six weeks in warm weather months. Moreover, beekeepers can split their healthy hives in the spring, adding a new queen bee (purchased for about $25). Soon, as the bees build up from foraging on spring flowers, there are two hives where formerly there was only one. While making up for over-winter losses adds *cost* and *work* for beekeepers, this is an economic challenge for beekeepers, and not an economic or ecological crisis.

Typical wintertime losses were in the neighborhood of 10 to 15 percent before 1987, when the US was hit by the *varroa* mite, a deadly parasite that decimates hives and vectors in over a dozen viruses and diseases into honeybee hives. After an extended period of decline, honeybee health has been rapidly improving for more than a decade, and is continuing. In the most recent USDA report, released in August 2020, honeybee colonies of 5 or more were up 8% from the year before, extending the uptrend. The primary stressor, USDA found confirming the conclusions of virtually every entomologist in North America, is *varroa*. As much as 42% of hives were infected.

Honeybee health problems are multi-factorial, with *varroa* mites the most significant

Honeybees are not native to the US, and are in effect a form of livestock used to pollinate many crops. Some industry apologists claim that bees are not troubled, noting that hive numbers are up, implying that all bee problems are behind us. That's not accurate. No serious beekeeper or farmer and certainly no scientists believe honeybees are as healthy as they should. Stressors abound, including pesticides used by organic and conventional farmers alike, which after all are designed to repel or kill pests, including insects.

Bees are under serious stress. Citing the growing number of beehives in North America or globally does not speak directly to the issue of bee health, and can be misleading. The honeybee industry is coping with the situation, but health challenges are real and in need of solutions. A number of wild bumblebee species also may be in decline, but there is so far no clear evidence of a widespread threat, considering that the status of so many species is unknown and little tracking data exists. There is increasing concern that wild bees are in fact facing epidemics spread by commercial honeybee populations. According to the USDA, by far the number one problem is the *varroa destructor* mite, which the agency calls "the single most detrimental pest of honey bees.."

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> Since the 1980s, honey bees and beekeepers have had to deal with a host of new pathogens from deformed wing virus to nosema fungi, new parasites such as Varroa mites,

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pests like small hive beetles,

> nutrition problems from lack of diversity or availability in pollen and nectar sources, and possible sublethal effects of pesticides. These problems, many of which honey bees might be able to survive if each were the only one, are often hitting in a wide variety of combinations, and weakening and killing honey bee colonies. CCD may even be a result of a combination of two or more of these factors and not necessarily the same factors in the same order in every instance.

The parasite poses unique challenges to beekeepers and scientists. It sucks bees' liver-like organ called the 'fat body', compromises their immune system, and vectors more than a dozen viruses into bee colonies, making diseases virulent that would normally be controllable. Making matters worse, *varroa* rapidly develop resistance to different mite treatments, making control difficult. Resistance in turn prompts the wide use of bee-toxic mite-control pesticides—the most prevalent chemicals found in beehives—where they accumulate in beeswax. In virtually any residue analysis of bee bread or beeswax these days in any country with varroa, the most prevalent toxins are the beekeeper-applied varroacides."

A study by Purdue University scientists indicates that European honeybees may face a new and more dangerous *varroa* threat in the near future. Another species—*varroa jacobsoni*, up to now solely a predator of the Asian honeybee (*Apis ceranae*)—has demonstrated the ability to switch hosts to the European honeybee (*Apis mellifera*), just as the *varroa destructor* mite did 60 years ago. So far, this genetic adaptation of the *varroa jacobsoni* mite has been observed only in Papua New Guinea. But the *varroa destructor* scourge also originated in Asia and, thanks to global commerce, spread rapidly to every continent except Australia, sending honeybee populations plummeting and blighting the beekeeping industry worldwide for at least three decades now.

Other pathogens, notably the gut fungus *Nosema ceranae,* are also major health challenges to honeybee hives. Recent research by a team led by Kristin Traynor and including van Engelsdorp and the USDA's Jeff Pettis has demonstrated that *varroa* are more prevalent in US bee colonies than previously believed. As van Engelsdorp has explained, "We knew that *varroa* was a problem, but it seems to be an even bigger problem than we first thought. … Moreover, varroa's ability to spread viruses presents a more dire situation than we suspected."

Environmental activists focus single-mindedly on pesticides. But, of all the agricultural chemicals detected in honeybee hives, including the miticides beekeepers use to control *varroa* infestations, neonics are generally among the lowest trace amounts detected. Other factors—poor nutrition, stemming from diminishing availability of varied, clean forage; the dwindling genetic diversity of European honeybees; and almost three dozen other parasites, viruses, bacteria and diseases—all make it difficult to sustain healthy honeybee hives.

Statistics compiled by France's Ministry of Agriculture underscore the multi-factorial sources of bee health problems. The most frequent causes of bee loss reports received were found to be: 'pathogenic infections' (diseases)—by far the largest source of which was *varroa*; bad beekeeping practices; starvation; and phytosanitary products. Probable or definite pesticide 'intoxication' were among the least frequent loss reported causes—and, of course, neonics are only one of many classes of pesticides to which suchlosses can be attributed.

The French Agriculture Ministry's statistics point to another neglected source of bee health complications: modern beekeeping practices. The United States is the only nation in the world that annually transports half or more of all its honeybee colonies (60+%) to a single location—California's Central Valley–where they pollinate the lucrative almond crop. From January through March, bees are trucked in from around the country, and mostly from distant Florida. The bees, which have barely emerged from their winter cluster, are often stressed to the breaking point. Then bee hives from various parts of North America are sent to farm fields all around the country where they are combined, ensuring that diseases that surfaces in one part of the country soon spread to California and beyond.

These stresses have been highlighted by the USDA and other oversight bodies, and the research, although preliminary, suggests bee management practices are a key health concern. A 2016 paper by a Swiss-Dutch team led by Peter Neumann and Tjeerd Blacquiere maintains that current beekeeping practices interfere with the process of natural selection and are weakening managed honeybees' resistance to diseases. They specifically point to practices such as combating varroa mites with pesticides and culling drones for varroa control as inhibiting the development by natural selection of bees more resistant to varroa and its infections, as well as to weakening honeybees genetic diversity.

Lab vs. Field: Realistic studies and real-life experience demonstrate pesticides and bees co-exist

What about the dozens of studies that have come out over the past dozen years linking neonics and other pesticides to large-scale bee losses. Important research is being done, both in the field and in laboratories. What is the consensus? While neonics have been implicated in numerous labs studies, scientists view those studies as informative but not definitive. The state-of-the-art are field research. There have been more than a dozen large-scale field studies, mostly focused honeybees but several on bumble bees, all foraging in neonic-treated crops—four in Canada, one in the UK, and eight in Europe—most using Good Lab Practices. They all reached similar conclusions: there are no conclusive observable adverse effect on bees at the colony level from field-realistic exposure to neonicotinoid-treated crops.

At least two other recent field-type studies led by scientists known for their sharp criticism of the use of neonics support these findings. Their studies aimed to document ever more subtle sub-lethal effects on either honeybees or bumble bees foraging in neonic treated crops, including learning, navigation and motor function impairments in *individual* bees. But both studies also reported no observable adverse effects at the *colony level* to field-realistic neonic exposure.

Almost all of the research purporting to show that neonics are negatively impacting bees were conducted

in artificial environments, often in the laboratory in what are called ‘caged-bee’ studies. Most of these studies grossly overdosed bees. Mikael Henry, the French researcher whose study was cited by the EU when it enacted its ban, recently acknowledged, “We have no real clues of what proper, realistic dose you should use in such an experiment,” and, “The dose we have used might overestimate the dose on the field.”

These field study findings have been reinforced by at least four reviews of the scientific literature—by J.S. Cresswell et al. (2011); Randy Oliver (2012); Ann Fairbrother et al. (2014. and Carreck & Ratnieks (2014)—each concluding that neonics are unlikely to be responsible for the health challenges plaguing managed bee populations in recent years. The conclusions were further reinforced by the 2015 University of Maryland/USDA study on the effects of one nenonic pesticide, imidacloprid, on honeybee colony health. That study found negligible effects on colony health from the most likely high range field-relevant neonic exposures encountered by bees in seed-treated crops—again indicating that neonics are unlikely to be a significant cause of bee colony losses.

What other factors might explain why problems show up in the lab but not in the field? Scientists believe this is because the bee hive constitutes what amounts to a super-organism: the various specialized functions of the hives tens of thousands of individual bees endows it with detoxifying and new brood producing capabilities that overpower potential negative impacts on individual insects. In other words, low-level exposures by bees is unlikely to have a serious deleterious effect on bees or overall colony health

Real world experience coincides with large-scale field study results. Aside from Antarctica, Australia is Earth’s last varroa-free continent. A government report has confirmed that honeybees are thriving despite the widespread and increasing use of neonics in agriculture. In western Canada, honeybees are thriving despite annually pollinating Canada’s 19 million acres of 100 percent neonic-treated canola.

As the “bee-pocalypse” narrative has run up against reports of stable, recovering or even rising honeybee populations, advocacy environmentalists have upped the ante, branding neonics the new DDT and claiming that they are responsible for widespread ecological collapse. The cited foundation for this claim is largely the work of the European IUCN Task Force on Systemic Pesticides. It helped spawn two congressional letters to the EPA—one signed by 60 members of the House, the other by 10 Senators–that prominently cited IUCN findings among the reasons for an immediate ban on neonics.

But the IUCN Task Force’s credibility has been challenged by a scandal now known as “Bee-Gate.” A report in the *London Times* and numerous other publication quoted a leaked memo from Task Force scientists conspiring to fabricate their studies as part of a “campaign” to have neonics banned.

Wild bee populations appear stable, but should be monitored as hard evidence remains scant

There are no reliable population numbers on wild bees. There are more than 20,000 wild bee species worldwide — some 4,000 or more in North America alone. Hundreds of these known species have not even been named. Apart from classifying and naming most of them and establishing where they are found and their likely ranges, we know practically nothing about most (about 99%) of them. Consequently, there

are less bothersome data about actual wild bee populations to contradict claims of pesticides' harm to wild bees and the impending catastrophe of extinction.

Except for a handful of species — some bumblebee and honeybee species in addition to the ubiquitous European honeybee, *Apis mellifera* — few wild bee species live in hives or colonies like honeybees. For anti-pesticide campaigners and their allies, this meant that those wild bees wouldn't enjoy the limited defenses of the *colony* against adverse pesticide effects, so the prospect of dire consequences was perhaps more plausible. But data have simply never been collected at that level of detail, in the US or around the world. Most of these species are usually peculiar to a specific locale and are highly specialized in feeding from and pollinating non-crop plants found there. This paucity of data has opened the door to abundant speculation—and some research—into wild bee health.

The declines observed in individual wild bee species have been ascribed to three primary causes: disease, habitat loss and climate change. Various studies and articles — ranging from a study published in the Journal of Applied Ecology to a Sierra Club essay and a study published in 2019 by researchers at the University of Vermont — have shown that there is spread, or "spillover," of viral diseases from

managed honeybees to wild bee populations. The University of Vermont researchers demonstrated that this comes from bumblebees foraging among flowers previously visited by infected honeybees.

There were also reports linking some pesticides, including, neonics to adverse impacts on wild bee species in the UK in a study published in 2016. Researchers at the UK's Center for Ecology and Hydrology correlated patchy sightings of wild bees that amateurs had submitted to a website with the usage pattern of primarily one neonic pesticide. The authors then crunched this data in a model—not made public—and then produced a complicated correlation of large data sets. The data are troubling but not conclusive. Most media failed to note that the study collected no actual observational or experimental evidence. Apart from the fact that 'correlation is not causation,' no effort was made to account for the numerous other circumstances, including changes in land use, pathogens and other environmental factors that could also have accounted for, or contributed to, the estimates of wild bee population decline that their model produced.

Two of the field studies on bees in Europe mentioned above led by Swedish researcher Maj Rundloff also included data on bumble bees and wild bees. The first, conducted in 2015, found no adverse effects on honeybees at the colony level from field-realistic neonic exposure. A separate part of the experiment did note adverse effects from neonic exposure on bumble bees, solitary bees and wild bees. This part of the study, however, was criticized at the time for a lack of robustness due to a very small sample size.

In response, the team attempted to repeat of the same study a year later. That second study confirmed the previous 'no observable adverse effect' result for honeybees at the colony level. However, the bumble bee experiment failed, yielding inadequate data, and no results have yet been reported for solitary and wild bees. While inconclusive at best, at least these studies attempted to obtain some actual *data* about neonics' effects on wild bees—which is more than another study that has gained widespread attention.

The growing agricultural footprint of honeybees may also be an issue. Two studies conducted by the Swedish researcher noted above, Maj Rundloff, have demonstrated that *managed* honeybee hives are one of the primary threats to wild bees, including bumblebees, and other insects. The first study found that honeybees "outcompete wild bees by depleting common resources," while the second study found that the adverse impact on the surrounding ecosystem is even more widespread: "We demonstrate that honeybee addition depresses the densities of wild insects (bumblebees, solitary bees, hoverflies, marchflies, other flies, and other flying and flower-visiting insects) even in a massive flower resource such as oilseed rape."

Are the problems facing will bees tantamount to a crisis? They are worrisome, but the available, fragmentary data that does exist suggest not. A 2013 study published in the *Proceedings of the National Academy of Sciences* looked at US native bee populations over a 140-year period. Of the 187 native species analyzed individually, only three declined steeply, likely due to the introduction of a pathogen. A 2015 study of wild bees' contribution to crop pollination concluded that only 2% of wild bee species accounted for 80% of all crop pollination attributable to wild bees–and that these 2% of wild bee species, which of course would come into the most extensive contact with neonics—were the most ubiquitous and widespread of wild bees, showing no signs of population decline or endangerment. Moreover, yields of agricultural crops that are the most dependent on wild pollinators are not declining, contrary to what would

be expected if the wild bees that pollinate them were themselves becoming scarce. We can't be simultaneously in the midst of a pollinator crisis threatening our ability to grow food and see continually rising yield productivity among those crops most sensitive to pollination.

Experts studying wild bees are not in panic mode, but are pushing for more data. According to US Geological Survey's Sam Droege, one of the foremost authorities on native bees in the US, most wild bees appear to be doing fine. Despite the reassuring evidence about both managed and wild bee populations, and given the critical role that pollinators play in nature and agriculture, the government is wise to continue closely monitoring the honeybee , bumble bee and wild bee population in the coming years.

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