H.R. 1337: Saving America's Pollinators Act of 2019

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Executive Summary

This report examines the Saving America's Pollinators Act of 2019 (H.R. 1337), including the problem it addresses, that pollinators are decreasing in numbers due to the use of neonicotinoids, and the solutions it proposes, to ban neonicotinoids and monitor pollinator populations. The report introduces the background of the bill, which is guided by over a decade's worth of scientific research by the Department of Agriculture and independent researchers on the economic and agricultural importance of pollinators and declining pollinator populations. The bill seeks to ban neonicotinoid-containing pesticides in the United States. The report also discusses the agricultural and economic importance of pollinators. The report focuses primarily on commercial honey bees, as they pollinate approximately 30 percent of the food produced in North America and account for $15 billion out of the $24 billion in services provided by pollinators every year. According to the Department of Agriculture, without sufficient number of bees, food supply and security will be severely jeopardized with potential consequences such as increase in food prices or change in diets.

In addition, the report analyzes the problems pollinators and more specifically bees face by examining the science behind the issue. Neonicotinoids have detrimental effects on bees and precipitate an impending food crisis resulting from precarious pollinator populations. Neonicotinoids can weaken the bee's immune system response to diseases and reproduction abilities and lead to higher than usual bee colony collapses year after year.

Drawing on neonicotinoid bans in the European Union and Canada, this report will explain the three solutions proposed by H.R. 1337, including an immediate ban on neonicotinoid pesticides, establishing the Pollinator Protection Board within the Environmental Protection Agency and continuing comprehensive research and monitoring on bees and other pollinators. Next, the report analyzes stakeholder viewpoint including pesticide producers, farmers, beekeepers, and advocacy organizations and scientists to evaluate the feasibility of the act. Finally, this report will discuss the main goals of the Act, which are to stabilize colony loss rate, reduce cumulative stressors to pollinators, and produce more research on native bees, before discussing next steps for implementation.

Introduction

"According to scientists at the Department of Agriculture, current losses of honey bee colonies are too high to confidently ensure the United States will be able to meet the pollination demands for agricultural crops."[1]
Saving America's Pollinators Act of 2019

Food security is essential to support the global population. Since the agricultural revolution, humans have actively managed crops by wielding natural processes and developing new tools in order to support growing demand. However, mechanization nor any other artificial means are yet able to replicate certain natural processes at a scale comparable to nature. Pollination, one of those processes, is an essential step in the proliferation of plant species, and is consequently a vital component of the global agricultural system. Transportation of pollen spores from a male plant to a female plant's stigma enables seed production and population growth. While both wind and animals facilitate pollination, animals provide the vast majority of these services, efficiently transporting pollen between plants of the same species while they feed on nectar.[2] Some flowering plants are capable of self-pollination, but the vast majority rely on animal pollination: 78 percent of species in temperate climates and 94 percent of species in tropical climates are dependent on pollinators.[3] As seen in Figure 1, countries around the world depend on pollination services for varying proportions of their agricultural production.

[1] United States. Cong. House of Representatives. Saving America's Pollinators Act of 2019., 116th Cong. 1st sess. HR 1337. Congress.gov. Online. https://www.congress.gov/bill/116th-congress/house-bill/1337.
[2] Rech, et al. "The macroecology of animal versus wind pollination: ecological factors are more important than historical climate stability." Plant Ecology & Diversity, Volume 9, 2016 - Issue 3. September 9, 2016. https://doi.org/10.1080/17550874.2016.1207722.
[3] Ollerton, Jeff, Rachael Winfree and Sam Tarrant. "How many flowering plants are pollinated by animals?" Nordic Society Oikos, 22 October 2010. doi: 10.1111/j.1600-0706.2010.18644.x

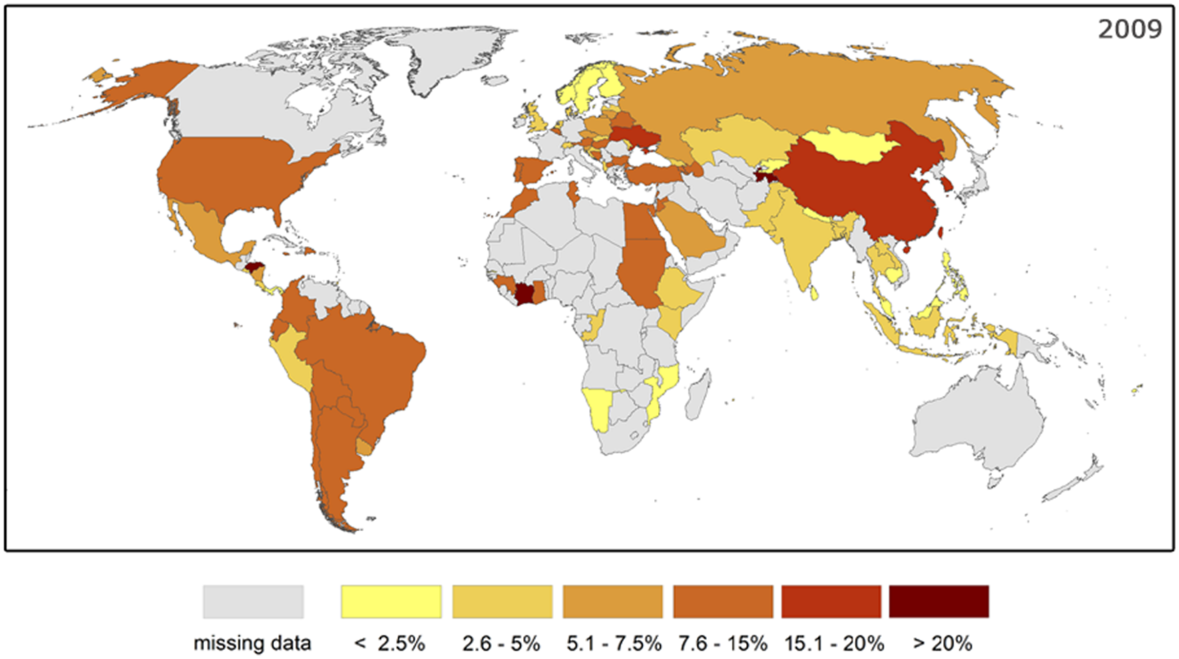

Figure 1: Spatial pattern of agricultural vulnerability. The maps show the national dependency of the agricultural GDP on pollination for the year 2009 as an indicator of the vulnerability of agriculture in the different countries.[4]

Any species that transports pollen between plants is considered a pollinator, the most notable of which are insects, birds, bats, and even humans. Bees, however, are the single most important pollinators for the US agricultural system, and their invaluable role has led humans to commercialize apiculture, or beekeeping. Commercialized honey bees and wild native bees cumulatively pollinate 30 percent of the food currently produced in North America.[5] Although bees are the most critical pollinators, their populations, along with other pollinator species, are decreasing globally. The decline of bees and other pollinators are notably linked to pesticide use in their habitats and food sources. Without reliable animal pollination, food security is compromised.

Scientists from the United States, European Union and Canada have linked the increased use of neonicotinoid pesticides to declining pollinator populations and other negative impacts to pollinator health. The commercial honey bee population in the US peaked in 1947 at 5.9 million colonies. While the net total population has declined over time, annual loss rates of bee colonies were generally between 10 and 15 percent. However, the recorded annual loss rate spiked in 2007 to 32 percent and has

[4] Lautenbach, Sven, Ralf Seppelt, Juliane Liebscher, and Carsten F Dormann. "Spatial and Temporal Trends of Global Pollination Benefit." PLOS ONE 7, no. 4 (April 26, 2012): e35954. https://doi.org/10.1371/journal.pone.0035954.
[5] United States. Cong. House of Representatives. Saving America's Pollinators Act of 2019., 116th Cong. 1st sess. HR 1337. Congress.gov. Online. https://www.congress.gov/bill/116th-congress/house-bill/1337.

not returned to previous levels.[6] [7] This spike in loss rates correlates with the introduction of three now-common neonicotinoids into the US market between 2003 and 2006. With neonicotinoids contributing to record US bee mortality, and some beekeepers reporting 100 percent annual losses, application of pesticides pose a significant danger to the multibillion dollar pollination services bees provide.

Figure 2: Three most popular neonicotinoids' usage increase, highlighting the decrease in honey production over the same time period.[8]

As pollinator populations decrease across the board, the US food system risks losing one of its most fundamental production processes. Because humans have yet to artificially replicate pollination at the scale of natural services, losing natural pollinators presents severe risks for food and economic crisis. Without pollinators, consumers would experience shortages of a startling number of fruits and vegetables. Indeed, this would have a direct impact on household food budgets, which are, on average, a home's third highest expenditure. On a macro level, a food crisis would negatively affect agriculture's $1 trillion contribution to US GDP and 21.6 million jobs.[9] A commercial bee deficit of over 1 million has already affected California's almonds

[6] VanEngelsdorp, Dennis & Meixner, Marina. (2009). A Historical Review of Managed Honey Bee Populations in Europe and the United States and the Factors that May Affect Them. Journal of invertebrate pathology. 103 Suppl 1. S80-95. 10.1016/j.jip.2009.06.011.

[7] Beeinformed, "Honey Bee Colony Losses 2018-2019: Preliminary Results. June 19, 2009. https://beeinformed.org/results/2018-2019/.

[8] Kiger, Patrick. "Buzz Kill". Sierra Club, 7 May 2015, www.sierraclub.org/sierra/2015-2-march-april/feature/buzz-kill.

[9] United States Department of Agriculture Economic Research Service. "Ag and Food Sectors and the Economy." 2018. https://www.ers.usda.gov/data-products/ag-and-food-statistics-charting-the-essentials/ag-and-food-sectors-and-the-economy.aspx

industry, which is the state's largest exporting sector and supplies 80 percent of the world's almonds.[10]

H.R. 1337, or The Saving America's Pollinators Act of 2019 (SAPA), seeks to reduce the harm done to bees and other pollinators by examining the effect of certain pesticide chemicals on pollinators and their habitats. The bill was introduced by Representative Earl Blumenauer (D-OR), and is the fifth version of SAPA since 2013. The bill builds upon previous versions of SAPA by including a provision that would require the administrator of the Environmental Protection Agency (EPA) to establish a board that would be authorized to review, for registration, pesticides that pose a threat to pollinators and their habitats. The bill would be a significant legislative action following previous presidential and judicial mandates to reduce harm and increase bee populations.

With its reintroduction, H.R. 1337 ultimately seeks to stabilize bee mortality by ceasing further application of neonicotinoids. Without additional introduction of the chemical into the environment, current accumulations would be able to degrade over time. The absence of neonicotinoids in bee habitats would protect populations from the lethal and sublethal effects that leave them susceptible to colony collapse, disease, reproduction difficulties, and parasites. In addition, the bill aims to improve understanding of the agricultural and ecological services that bees and other pollinators provide—these data have been difficult to substantially quantify because those populations are not actively managed like commercial bees. A concentrated, interagency effort will hopefully enhance understanding of these populations and inform future policy concerned with conservation and food security.

[10] Kathy Garvey, "Troubling Honey Bee Shortage in California Almond Orchards. University of California Davis Department of Entomology and Nematology. February 8, 2013. http://entomology.ucdavis.edu/News/Troubling_Honey_Bee_Shortage_in_California_Almond_Orchards/.

The Importance of Pollinators

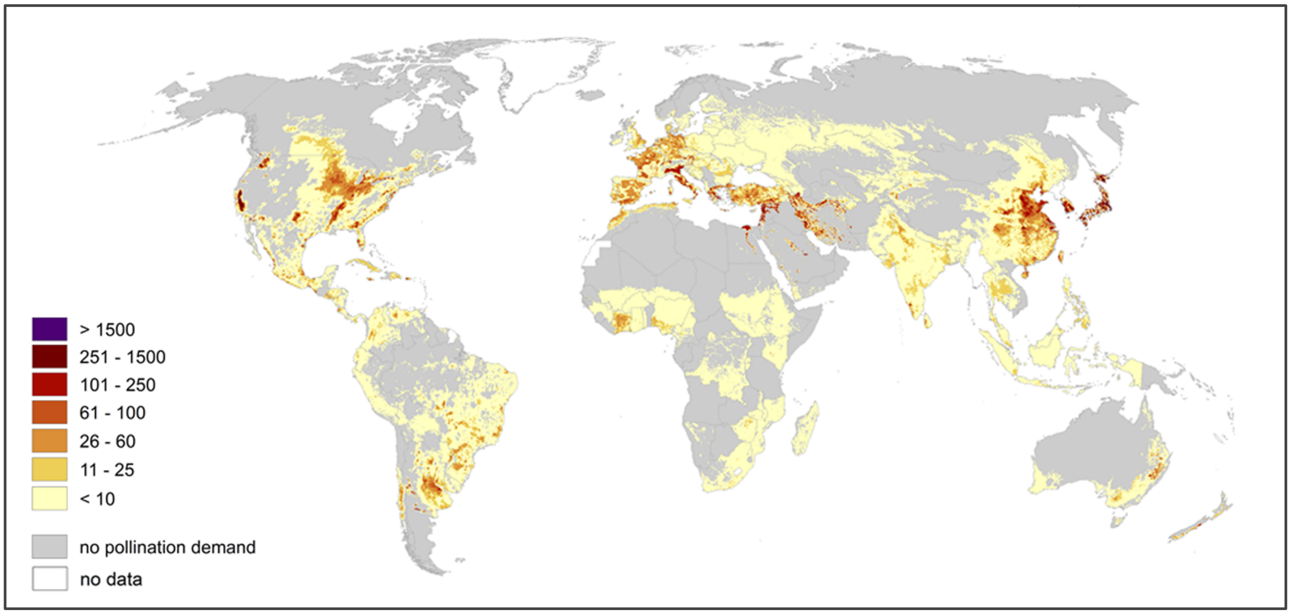

Figure 3: Global map of pollination benefits. Values are given as adjusted USD per hectare for the year 2009.[11]

As demonstrated in Figure 3, pollinators are an irreplaceable part of the food system and agricultural economy. In a world without pollinators, or with significantly fewer pollinators, the global agricultural sector would face serious production capacity and economic consequences.

[11] Lautenbach, Sven, Ralf Seppelt, Juliane Liebscher, and Carsten F Dormann. "Spatial and Temporal Trends of Global Pollination Benefit." PLOS ONE 7, no. 4 (April 26, 2012): e35954. https://doi.org/10.1371/journal.pone.0035954.

Bee Pollination as an Ecosystem Service

Figure 4: Bee mechanisms for gathering pollen. Left: A commercial honey bee gathering pollen from an almond blossom. The two yellow balls on either side of the bee are its corbiculae, which help it to gather high quantities of pollen.[12] Right: a sweat bee collecting pollen on its body.[13]

As shown in Figure 4, bees have evolved to gather and transport pollen. Both the pollen and nectar of flowering plants serve vital food sources for all bee colonies. Nectar is converted to honey which provides carbohydrates, and pollen is provides the colony with protein, minerals and fats. Bees gather these substances and bring them back as nourishment for their communities. Their electrostatic force attracts pollen grains, which is a unique feature among the pollinators, and pollen is stored on the body or in corbiculae, or pollen sacs. The pollen is then carried to other plants for pollination, or back to their hive for sustenance. While working to gather their food, bees carry pollen from one plant to the next, distributing pollen throughout the ecosystem, fertilizing plants, and propagating future generations of these plants.[14]

[12] Photograph by Michael Maloney, featured in May, Meredith. “Commercial bees’ tough life on the road.” San Francisco Chronicle, 2 May 2013, https://www.sfgate.com/homeandgarden/honeybeechronicles/article/Commercial-bees-tough-life-on-the-road-4483576.php#photo-4547169.

[13] Photograph by Alex Wild. https://www.alexanderwild.com/Insects/Stories/Portfolio/i-7c5Q9j6/L

[14] Hoover, Shelley E, and Lynae P Ovinge. “Pollen Collection, Honey Production, and Pollination Services: Managing Honey Bees in an Agricultural Setting.” Journal of economic entomology, vol. 111,4 1509–1516. 9 May. 2018, doi:10.1093/jee/toy125

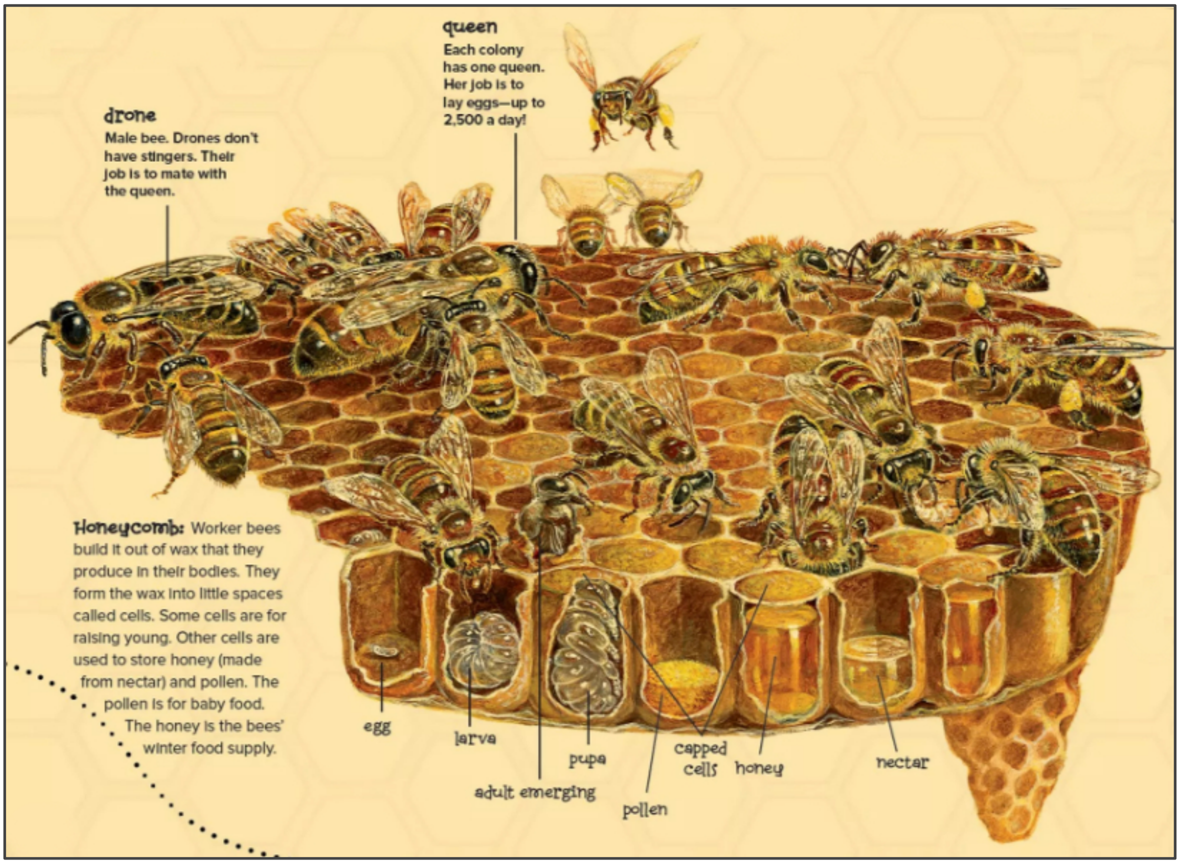

Figure 5: Diagram of a native bee hive.[15]

In the wild, bees construct hives to house their food stores and larvae, and protect their queen. After the pollen and nectar are brought back to the colony and are consumed by worker bees, these bees convert the sugar from the nectar into a wax that is used to build more honeycombs and increase the size of the hive. The same enzyme used in this process also facilitates honey production. [16] Honey, nectar, and pollen are stockpiled in the hive to provide continued energy to the hive.

There is no artificial substitute for any of these compounds, and they are essential for the survival of all bee colonies. Commercial bee hives mimic the natural structures relied upon by bees to allow for the stockpiling of these vital resources. Commercial hives are constructed to house managed bee colonies that provide pollination services for crops and produce honey for human consumption. As seen in Figure 6, commercial beekeepers build intricate structures using a series of boxes that facilitate fundamental bee processes. These structures are then placed in agricultural lands, and the resident bees assume their natural evolutionary roles and begin to gather and retrieve pollen and nectar for their colony.

[15] National Wildlife Federation. "Busy, Buzzy Bees." May 2016. https://rangerrick.org/ranger_rick/busy-buzzy-bees
[16] Lambremont and Wykle. "Wax synthesis by an enzyme system from the honey bee," Comparative Biochemistry and Physiology Part B: Comparative Biochemistry. vol. 63-1,1979, pp. 131-135. https://doi.org/10.1016/0305-0491(79)90245-1.

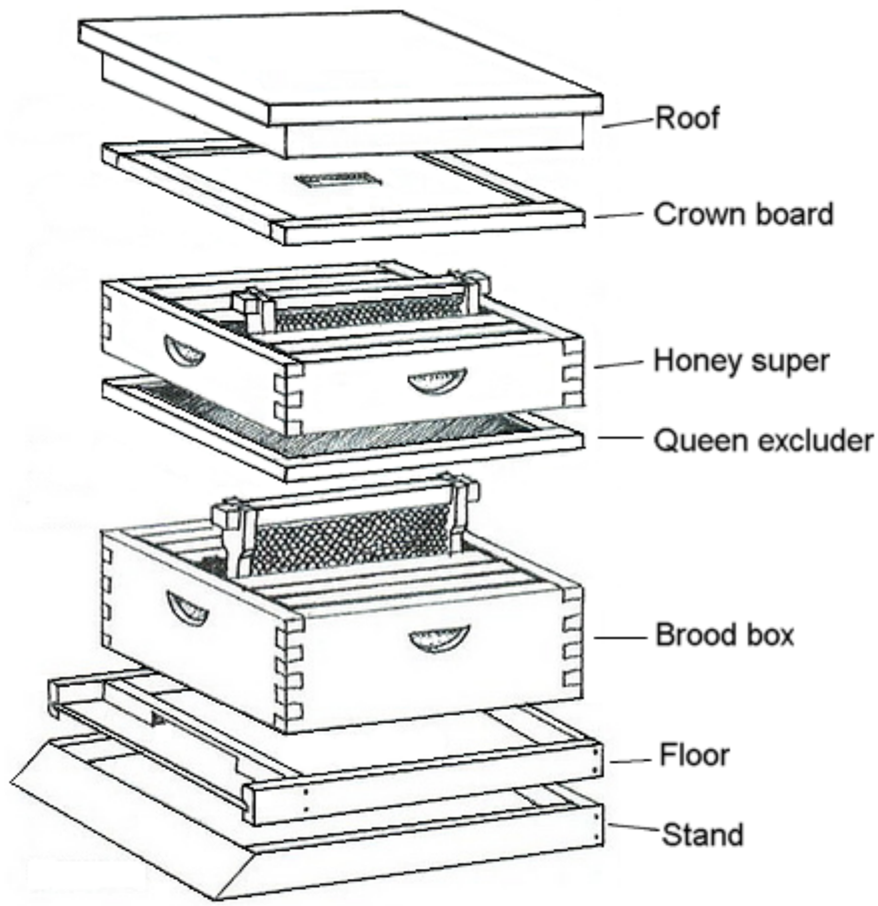

Figure 6: Components of a commercial beehive.[17] *The roof and crown board provide protection for the hive. The honey super serves as a storage for honey, nectar and pollen, while the queen excluder and brood box provide habitat for the queen and worker bees respectively.*

Regardless of whether a bee resides in a native hive or managed colony, the intricacies of their food production and storage processes can threaten the beehive as a whole when these food sources are contaminated. Bees' ability to store pollen and nectar is essential to their role as a vital global pollinator, but it also renders them vulnerable to toxic pollutants that persist in their environments. As discussed in later sections of this report, neonicotinoid pesticide treated plants produce contaminated nectar and pollen that are ultimately transported to these colonies by unsuspecting bees. This contaminated food is consumed by the members of the colony and can eventually contribute to weakened colony health and even total collapse.

Economic Importance of Commercial Bees

Bees contribute largely to people, plants and the planet. Commercial honey bees help maintain healthy ecosystems upon which large-scale agriculture depends, and the

[17] Barnsley Beekeepers Association. "Keeping Bees - The Beehive." http://barnsleybeekeepers.org.uk/hive.html.

rapid decline of bees threatens the food system. Commercial bees are responsible for pollinating 30 percent of food in North America, including nearly 100 types of fruits and vegetables.[18] Across the world, approximately 73 percent of cultivated crops—such as cashews, squash, mangoes, cocoa, cranberries and blueberries—are pollinated by some variety of bees.[19] The commercial bee industry have been estimated to provide over $15 billion in crop production annually. Native bees, which are not actively managed, provide an additional $3 billion worth of crops to the United States.[20] [21]

Bees are both essential to maintaining healthy ecosystems and pollinating crop species around the world, of which three quarters depend on pollinators, especially honey bees.[22] They are critical in providing food and reducing global food insecurity, which can threaten sustainable development.

Farmers actively use bees—either by keeping their own hives or by renting hives specifically for pollination from commercial apiarists—as a critical tool in agriculture to ensure the production and reproduction of vast quantities of crops.[23]

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18 Saving America's Pollinators Act of 2019, H.R.1337, 116th Congress. (2019).
19 Kleinschmit, Jim. "Unknown Benefits, Hidden Costs." Institute for Agriculture and Trade Policy, 5 Aug. 2015, www.iatp.org/documents/unknown-benefits-hidden-costs.
20 Hopwood, Jennifer, et al. "How Neonicotinoids Can Kill Bees: The Science Behind the Role These Insecticides Play in Harming Bees." The Xerces Society for Invertebrate Conservation. 2016, www.xerces.org/wp-content/uploads/2016/10/HowNeonicsCanKillBees_XercesSociety_Nov2016.pdf
21 Saving America's Pollinators Act of 2019, H.R.1337, 116th Congress. (2019).
22 Kleinschmit, Jim. "Unknown Benefits, Hidden Costs." Institute for Agriculture and Trade Policy, 5 Aug. 2015, www.iatp.org/documents/unknown-benefits-hidden-costs.
23 "Pollinators: The Endangered Species Program." U.S. Fish and Wildlife Service, June 2018, www.fws.gov/pollinators/Programs/Endangered.html.

Figure 7: Commercial honey bee hives being treated by beekeepers to defend against pathogens.[24]

Honey bee colonies are collapsing so quickly that the US may not be able to meet pollination demands for agricultural crops, according to the US Department of Agriculture (USDA).[25] Pollinator protection requires government intervention to maintain pollinator populations and food security in the United States.

Other Pollinators

Approximately 80 percent of the 100 crops that make up the majority of the world's food supply are pollinated by animals other than honey bees.[26] Commercial honey bees are absolutely essential, but a wider issue with all pollinators is looming.

There are nearly 4,000 species of native bees in the United States. The lifestyle of native bees ranges vastly and is much different than commercial bees. Often, native bees live a solitary lifestyle. These bees do not create hives or cooperate with other

[24] Photograph by Jamie Hooper, featured in McCoy, Berly. "Are commercial honeybees making wild bees sick?" PBS, 26 June 2019, https://www.pbs.org/newshour/science/are-commercial-honeybees-making-wild-bees-sick.
[25] United States. Cong. House of Representatives. Saving America's Pollinators Act of 2019., 116th Cong. 1st sess. HR 1337. Congress.gov. Online. https://www.congress.gov/bill/116th-congress/house-bill/1337.
[26] About Pollinators, U.S. Fish and Wildlife Service. https://www.fws.gov/pollinators/PollinatorPages/AboutPollinators.html. (2019).

bees in any way; they live in nests alone.[27] A study by United States Geological Survey found neonicotinoids in 46 percent of native bees between 2013 and 2014[28] and, as of 2017, the bumble bee was listed as endangered due to an estimated population decline of 91 percent over the past 20 years.[29]

In 39 studies, insects other than bees comprised 39 percent of the visits to crop flowers.[30] Although more research is needed, insects as a group may be declining. A German study showed a seasonal decline of 76 percent of flying insect biomass in protected areas over a 27 year period. They could not link the decline to weather, habitat type or characteristics, or land use.[31] An additional longitudinal study over 33 years in Britain showed that one third of the wild bee and hoverfly species, both important species of pollinators, declined.[32] The population decline of insect pollinators is correlated with declines of crops and crop values.[33] Particularly, fruits, vegetables, and stimulant supply is not estimated to meet demand in a world without insect pollinators. Nuts are the most vulnerable insect-pollinated crops across the world, followed by fruits and vegetables.[34]

Another important pollinator, bats are critical (and sometimes the only) animal pollinator of many tropical fruits. Currently, more than 30 percent of North American bats can be qualified as "vulnerable, imperiled, or critically imperiled"[35] and without North American bats the estimated agricultural losses are more than $3.7 billion/year.[36] Butterfly species are also in peril, including the iconic Monarch Butterfly, which has an extinction risk of approximately 50–75 percent within 20 years and 65–85 percent within 50 years.[37] Their populations have undergone an 80 percent reduction in the eastern United States, with similarly dire news in the western US. As of January 2019, monarchs have experienced a decline of 99.4 percent in coastal California.[38]

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[27] The Xerces Society. "Native Bee Biology." The Xerces Society, https://xerces.org/pollinator-conservation/native-bees/
[28] U.S. Geological Survey. "Native Bees Are Exposed to Neonicotinoids and Other Pesticides." Toxics.usgs.gov, 27 June 2018, https://toxics.usgs.gov/highlights/2015-11-04-pesticides_bees.html
[29] Graham, K. "Beyond honey bees: Wild bees are also key pollinators, and some species are disappearing." The Conversation. https://theconversation.com/beyond-honey-bees-wild-bees-are-also-key-pollinators-and-some-species-are-disappearing-89214. May 22, 2018.
[30] Rader, Romina, et al. "Non-bee insects are important contributors to global crop pollination." Proceedings of the National Academy of Sciences113.1 (2016): 146-151.
[31] Hallmann, Caspar A., et al. "More than 75 percent decline over 27 years in total flying insect biomass in protected areas." PloS one 12.10 (2017): e0185809.
[32] Powney, Gary D., et al. "Widespread losses of pollinating insects in Britain." Nature communications 10.1 (2019): 1018.
[33] Gallai, Nicola, et al. "Economic valuation of the vulnerability of world agriculture confronted with pollinator decline." Ecological economics 68.3 (2009): 810-821.
[34] Ibid.
[35] Hammerson, G. A., et al. "Strong geographic and temporal patterns in conservation status of North American bats." Biological Conservation 212 (2017): 144-152.
[36] Boyles, Justin G., et al. "Economic importance of bats in agriculture." Science 332.6025 (2011): 41-42.
[37] Schultz, Cheryl B., et al. "Citizen science monitoring demonstrates dramatic declines of monarch butterflies in western North America." Biological Conservation 214 (2017): 343-346.
[38] The Xerces Society. Monarch Conservation. https://xerces.org/monarchs/. 2019.

Cherished and charismatic hummingbirds are also in trouble. Rufous hummingbird populations on the west coast have declined by an average of 2.67 percent per year from 1966-2013. Allen's and broad-tailed hummingbirds have also been noted to be in decline.[39]

Pollinators play a major contributing role to the U.S. food system, and their ecosystem services are estimated to be worth approximately $171 billion globally, or about 9.5 percent of the total world agricultural value in 2005.[40] Insect pollination services are worth about $56 billion for fruits and vegetables each.[41] The production value of non-pollinated crops is estimated to be $170 per metric ton, while the production value of pollinated crops is estimated to be $852 per metric ton.[42] One study estimated pollinator losses to contribute to economy-wide losses of $334 billion.[43]

Crop categories	**Relative production surplus before pollinator loss**	**Relative production surplus after pollinator loss**
	% of consumption	
Stimulant crops	18	– 24
Fruits	12	– 12
Vegetables	19	– 6
Spices	11	8
Nuts	29	16
Edible oil crops	75	40
Pulses	60	54

Figure 8: Relative crop production surplus before and after pollination losses. Stimulant crops such as coffee and cocoa stand to face the greatest losses, followed by fruits and vegetables.[44]

[39] Breeding Bird Survey Summary and Analysis, version 2015.0. https://www.mbr-pwrc.usgs.gov/bbs/specl15.html. 2015.
[40] Gallai, Nicola, et al. "Economic valuation of the vulnerability of world agriculture confronted with pollinator decline." Ecological economics 68.3 (2009): 810-821.
[41] Ibid.
[42] Ibid.
[43] Bauer, Dana Marie, and Ian Sue Wing. "Economic consequences of pollinator declines: a synthesis." Agricultural and Resource Economics Review 39.3 (2010): 368-383.
[44] Gallai, Nicola, et al. "Economic valuation of the vulnerability of world agriculture confronted with pollinator decline." Ecological economics 68.3 (2009): 810-821.

The Problem Bees are Facing

Bees provide an irreplaceable ecosystem service to humans. Humans have commercialized this ecosystem service through commercial beehives strategically deployed to specific croplands that rely on pollination. However, they are deployed to environments in which they interact with toxic chemicals in the form of pesticides. Pesticides strive to protect plants from pests. Pests are a socially-constructed category of animals that pose a potential threat to agriculture by feeding on and damaging crops, or by carrying disease-causing microorganisms such as parasites and bacteria. Pest is a subjective term, which may differ depending on the source.[45] Pesticides are any substances used to prevent, destroy, repel and control pests, and insecticides are pesticides designed to kill insects.[46] Farmers began to use pesticides in the United States in the late nineteenth century, though these early forms were largely unsuccessful. Following World War II, chemical pesticides, such as DDT, use became widespread. In 1962, Rachel Carson published *Silent Spring* to expose the deleterious health and environmental effects of pesticide use. Following this, pesticide research and pesticide use shifted towards pesticides targeted towards specific pests and that did not affect humans or mammals. As pesticide use increased, pests became resistant to pesticides, and thus higher doses were required to ward off pests.[47] Honey bees are not considered pests in the agricultural sector, but frequently come into contact with the same chemicals targeting other insects. These pesticides have an indiscriminate impact on their environment, potentially harming any organism with which they come into contact.

Neonicotinoid Pesticides

Neonicotinoids were developed and first patented in 1985, reaching widespread usage in the 1990s.[48] They are now the most common class of insecticide in the world, and get their name from being chemically similar to nicotine. Neonicotinoid pesticides are used to grow nearly all of the corn and one third of the soy grown in the United States,[49] comprising 150 million acres of farmland in America. They are used on common staple crops, and other commonly grown fruits and vegetables to control aphid and other insect populations.[50] [51] The USDA has found that neonicotinoids are often used to grow common vegetables and fruits including apples, strawberries,

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[45] "What is a pest?" Australian Government Department of Health. https://www.health.gov.au/internet/publications/publishing.nsf/Content/ohp-enhealth-manual-atsi-cnt-l~ohp-enhealth-manual-atsi-cnt-l-ch5~ohp-enhealth-manual-atsi-cnt-l-ch5.1

[46] "What is a Pesticide?" United States Environmental Protection Agency. https://www.epa.gov/minimum-risk-pesticides/what-pesticide

[47] Delaplane, Keith. "Pesticide usage in the United States: History, benefits, risks, and trends." (1996).

[48] Tomizawa, Motohiro, and John E. Casida. "Neonicotinoid insecticide toxicology: mechanisms of selective action." Annu. Rev. Pharmacol. Toxicol. 45 (2005): 247-268.

[49] "Neonicotinoid Pesticides and Adverse Health Outcomes." National Institute of Environmental Health Sciences, U.S. Department of Health and Human Services. ntp.niehs.nih.gov/pubhealth/hat/selected/neonicotinoid/index.html. Mar. 2019.

[50] Ibid.

[51] Craddock, Hillary A., et al. "Trends in neonicotinoid pesticide residues in food and water in the United States, 1999–2015." Environmental Health 18.1 (2019): 7.

lettuce, and potatoes.[52] In 2011, neonicotinoids were applied to 34-44 percent of soybeans and 79-100 percent of maize hectares in the United States.[53]

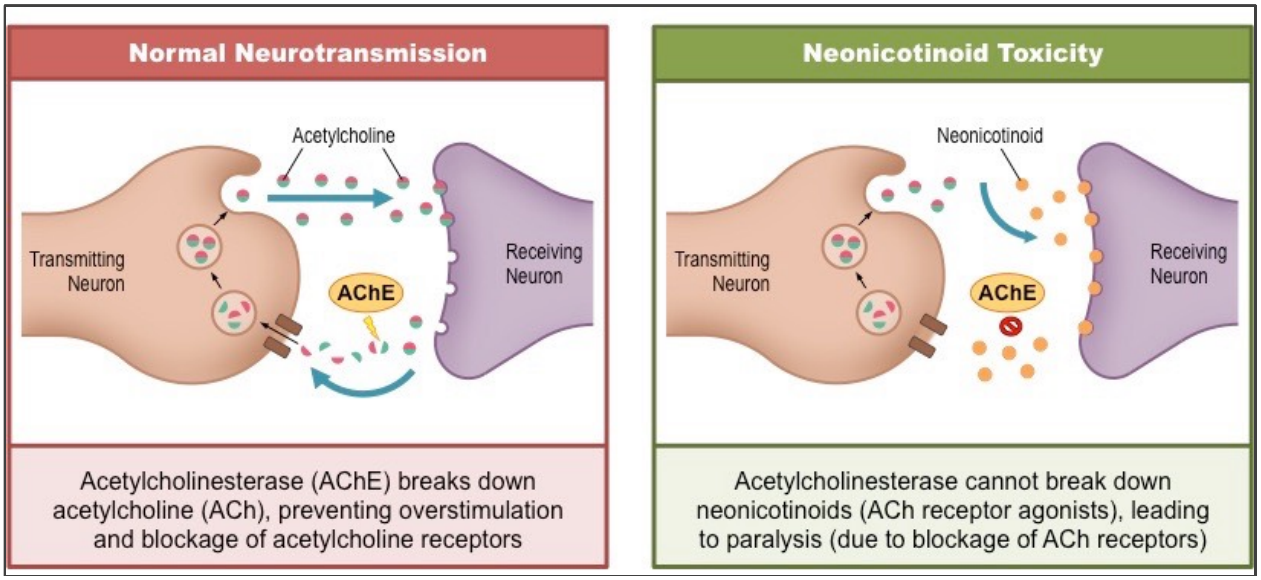

Figure 9: Chemical mechanisms of the effects of neonicotinoids on neurological processes.[54]

Neonicotinoids operate by disrupting neural transmission in the central nervous system of organisms. Neonicotinoids are sprayed on plant surfaces, coated on plant seeds and injected in plant roots and stems.[55] They are systemic and are therefore absorbed and transported throughout the plant, including its pollen, nectar, guttation water. Following contamination, the chemicals will indiscriminately come into contact with both target and non-target species, including critical pollinators such as bees. The target species are insects that are considered pests, which in the US are primarily aphids that can chew and suck on crops to the point at which the crops die. The very definition of a pest s both anthropogenic and anthropocentric: it is defined by humans based on their own agricultural needs, not based on ecosystem services or biological taxonomy.

Neonicotinoids are popular in large part because they are easily applied, transport throughout the entire crop, are relatively safe to mammals compared with sprayed pesticides, and are not easily susceptible to resistance from target pests. Neonicotinoids' systemic, water-soluble, and indiscriminate nature also make them highly dangerous to non-target species like bees, butterflies, hummingbirds, and others.

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[52] Ibid.
[53] Jeschke, Peter, et al. "Overview of the status and global strategy for neonicotinoids." Journal of agricultural and food chemistry 59.7 (2010): 2897-2908.
[54] BioNinja. "Neurotransmitters." https://ib.bioninja.com.au/standard-level/topic-6-human-physiology/65-neurons-and-synapses/neurotransmitters.html
[55] Kleinschmit, Jim, and Ben Lilliston. "Unknown Benefits, Hidden Costs." Institute for Agriculture and Trade Policy (2015).

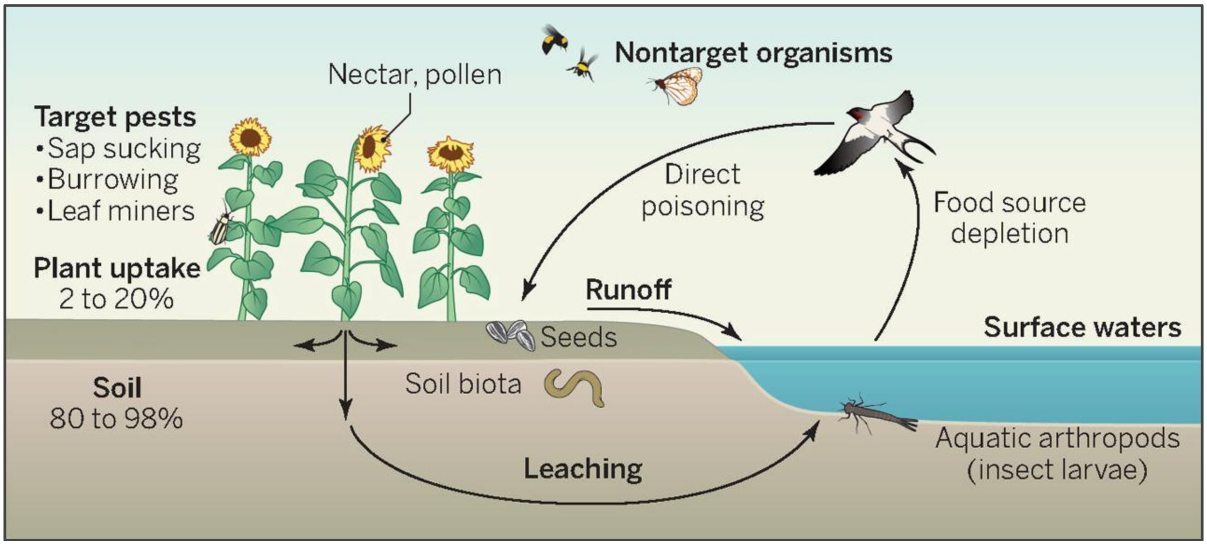

Figure 10: Neonicotinoid transport. Illustration of the fate of neonicotinoids in surrounding environments and the pathways they take to reach non-target organisms.[56]

Neonicotinoids are also found in soil fields where they are not directly applied because neonicotinoid-containing pollen or dust could be blown by the wind to nearby regions. In addition, because neonicotinoids are coated on plant seeds and injected in plant roots and stems, up to 90 percent of the active substances can enter and accumulate in soil; because it is highly water-soluble, it can travel with and contaminate runoff and groundwater.[57] Its long half-life can allow the substance to persist in soil for more than 1000 days and reside in plant tissues for more than a year, allowing the pollinators to be exposed to the chemical for extended periods of time.[58] Combined with other chemical substances, such as agricultural fungicides, the toxic potency of neonicotinoids can magnify by more than 1000-fold.[59] Further scientific research could be done to explore the chemical's impact on non-target organisms' chronic exposure and metabolism functions to complex mixtures of multiple neonicotinoids.

There is a growing body of evidence supporting the notion that neonicotinoids pose serious risks to ecosystem functioning, resilience and the services and functions provided by terrestrial and aquatic ecosystems. Because neonicotinoids are water soluble, they are very likely to leach into waterways; during periods of heavy rain in treated areas, a portion of the neonicotinoids wash off plant surfaces into nearby groundwater and waterways, where they threaten aquatic insects similarly to the way they impact bees. The current neonicotinoid contamination in US water systems are

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[56] Sánchez-Bayo, Francisco. "The trouble with neonicotinoids." Science 346.6211 (2014): 806-807.
[57] Hopwood, Jennifer, et al. "How Neonicotinoids Can Kill Bees: The Science Behind the Role These Insecticides Play in Harming Bees." The Xerces Society for Invertebrate Conservation. 2016, www.xerces.org/wp-content/uploads/2016/10/HowNeonicsCanKillBees_XercesSociety_Nov2016.pdf
[58] Michelle L. Hladik, Anson R. Main, and Dave Goulson. "Environmental Risks and Challenges Associated with Neonicotinoid Insecticides" Environmental Science & Technology 2018 52 (6), 3329-3335. DOI: 10.1021/acs.est.7b06388
[59] Ibid.

significant, with concentrations well above the threshold to kill most aquatic invertebrates.[60]

Colony Collapse Disorder

Bees come into contact with neonicotinoids when they pollinate, consume guttation water from, and otherwise interact with contaminated plants. When bees consume neonicotinoids via these media, the neonicotinoid can block a chemical pathway that transmits nerve impulses in a bee's central nervous system. A lethal amount (depending on the kind of neonicotinoid and the type and size of the bee) will paralyze and kill a bee.[61] Sublethal amounts of neonicotinoids can disrupt a bee's cognitive and communication abilities by impairing its ability to learn, navigate and forage, but are not high enough to kill the bee immediately.[62] Bees risk the health of their hive when they return covered in neonicotinoids or carrying contaminated pollen.

Commercial bees become particularly exposed and vulnerable when they are employed to pollinate crops on which neonicotinoid pesticides had been applied. When a neonicotinoid is present in a beehive, likely contaminated by neonicotinoid-polluted bees and pollen, it can reduce the viability of sperm stored in queen bees, increase the chances of breed failures, suppress the immune system response to viruses, diseases, and parasites and eventually delay or cease the growth of colonies, leading to colony collapse as the bees die out.[63] [64] Colony collapse disorder (CCD) is the name given to the phenomenon of the increase in recorded annual colony loss since 2006 and the increasing number of beekeepers experiencing high rates of loss.[65] Rather than being a specific disease, therefore, it describes widespread increased annual population declines. Colony collapse can occur when there is "an insufficient number of bees to maintain the amount of brood," or the eggs, larvae, and pupae, "in the colony," for example.[66]

Several studies have replicated beehives and observed how control hives survived in comparison to bees being fed imidacloprid sugar water. An *in situ* replication study focusing on honeybee colony collapse disorder as it relates to neonicotinoids was conducted by the Department of Environmental Health at the Harvard School of Public Health. This study lasted 23 weeks with 16 "neonicotinoid-treated hives" and 4

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[60] Fischer, Johannes, et al. "Neonicotinoids interfere with specific components of navigation in honeybees." PloS one 9.3 (2014): e91364.
[61] Saving America's Pollinators Act of 2019, H.R. 1337, 116th Congress. (2019).
[62] Goulson, Dave. "An overview of the environmental risks posed by neonicotinoid insecticides." Journal of Applied Ecology, 2013, 977–987. https://doi.org/10.1111/1365-2664.12111
[63] Saving America's Pollinators Act of 2019, H.R. 1337, 116th Congress. (2019).
[64] Ibid.
[65] Ellis, James D., Jay D. Evans, and Jeff Pettis. "Colony losses, managed colony population decline, and Colony Collapse Disorder in the United States." Journal of Apicultural Research, Vol. 49 No. 1, 2010, 134.
[66]Ibid.

control hives. Over this timespan, 15 out of 16 neonicotinoid-treated hives collapsed, between 13 and 18 weeks, while only 1 out of 4 of the control hives collapsed, which took 21 weeks.[67] There was no quantification of how many bees died in these “colony collapses” but they were described and measured through the hives being “empty besides stores of food and pollen left on the frames and dead bees scattered on the snow in front of hives.” The researchers concluded that deaths were not attributed to disease, as these hives were considered healthy before the collapse and, even if there were other stressors on the bees, the control hives were able to stand them much better than the treated ones for the duration of this study. (*Figures below are from this study.*)

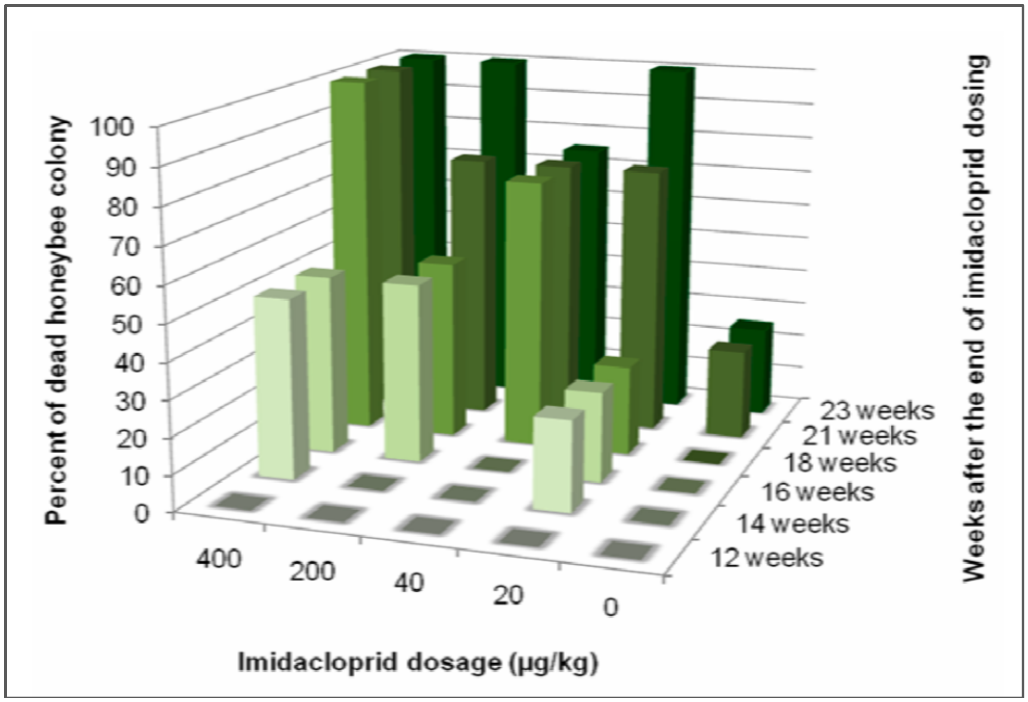

Figure 11: Neonicotinoid dosage and honeybee colony loss. Study conducted by L. U. Chenshung et. al, visualizing the correlated relationship between increasing neonicotinoid dosage (imidacloprid) and colony loss over time.[68]

[67] Chensheng, L. U., Kenneth M. Warchol, and Richard A. Callahan. "In situ replication of honey bee colony collapse disorder." Bulletin of Insectology 65.1 (2012): 99-106.
[68] Ibid.

Figure 12: "Dead hive (ID# 4-4) treated with 20 µg/kg of imidacloprid which shows the abundance of stored honey and some pollen, but no sealed brood or honey bees. Photo taken on February 24th, 2011."[69]

Figure 13: "Control hive (ID# 2-5) which shows a cluster of honey bees, some stored honey and uncapped larvae, but no sealed brood. Photo was taken on March 4th, 2011."[70]

[69] Chensheng, L. U., Kenneth M. Warchol, and Richard A. Callahan. "In situ replication of honey bee colony collapse disorder." Bulletin of Insectology 65.1 (2012): 99-106.
[70]Ibid.

Scientific Consensus

Neonicotinoids pose negative impacts on pollinators, in soil and water systems that have far-reaching consequences that extend into ecosystems, biodiversity, the food supply chain, and human health. In 2015, 42 percent of bee colonies in the US collapsed, and on average, two-thirds of beekeepers experienced loss rates greater than the established acceptable winter mortality rates.[71] [72] Due to the systematic nature of these neonicotinoids, bees are exposed to neonicotinoids through pollen, nectar, and guttation water of the plants. Guttation water has been found to contain concentrations around 717,000 ng/g of the neonicotinoid clothianidin. With an oral acute toxicity, LD_{50}, of 3.8 ng/g, a honeybee would need to drink 0.005 µl to consume this lethal dose. Considering that bees can drink between 1.4 mL - 2.7 mL, honeybees would easily reach this level.[73] Neonicotinoids have been linked to declines in production of queens. Bumble bees exposed to field-realistic levels (low = 6 ng/g, high = 12 ng/g) of imidacloprid experienced an 85 percent reduction of queen production, when compared to the untreated control colonies.[74] (*Figure* 15).

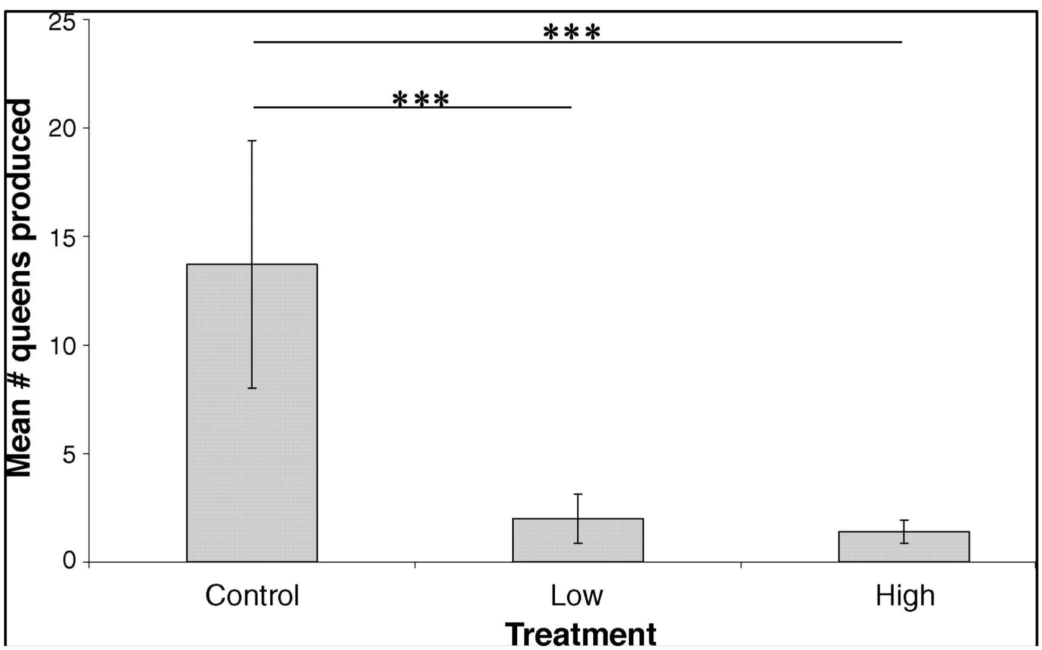

Figure 14: Queen bees and neonicotinoid treatment. Queens produced with respect to the amount of neonicotinoid given to the study colonies (treatment). Any treatment involving neonicotinoids, regardless of strength, shows a significant difference in the average amount of queens produced.[75]

[71] Saving America's Pollinators Act of 2019, H.R.1337, 116th Congress. (2019).
[72] Zissu, Alexandra. "The Buzz About Colony Collapse Disorder." NRDC. www.nrdc.org/stories/buzz-about-colony-collapse-disorder. 4 Oct. 2017.
[73] Wood, Thomas James, and Dave Goulson. "The environmental risks of neonicotinoid pesticides: a review of the evidence post 2013." Environmental Science and Pollution Research 24.21 (2017): 17285-17325.
[74] Whitehorn, Penelope R., et al. "Neonicotinoid pesticide reduces bumble bee colony growth and queen production." Science 336.6079 (2012): 351-352.
[75] Ibid.

Having confirmed their toxicity towards pollinators and underlying negative consequences on food production and security in Europe, the EU banned neonicotinoid use in 2013, followed by Canada, reaching a consensus that neonicotinoids are detrimental to bees.[76] Despite substantial scientific evidence confirming their lethal effects and numerous international bans, neonicotinoids are still unregulated in the US. Neonicotinoids do not affect mammalian nicotinic acetylcholine receptors in the same manner, so insects are at a much higher risk for the toxic side effects. Research on neonicotinoids in produce has shown 90 percent of honey, 72 percent of fruit, and 45 percent of vegetables tested in the study were positive for one or more neonicotinoids.[77] The range of concentrations varied from 0.1 ng/g to 7.2 ng/g. While these low concentrations have not been shown to cause adverse health effects in humans, the range of these values is higher than the LD_{50} for bees. These neonicotinoids cannot simply be washed off produce and they accumulate in soil over time. Untreated sunflowers grown in soil of crops that were previously treated with neonicotinoids, were found one year later to contain neonicotinoids.[78]

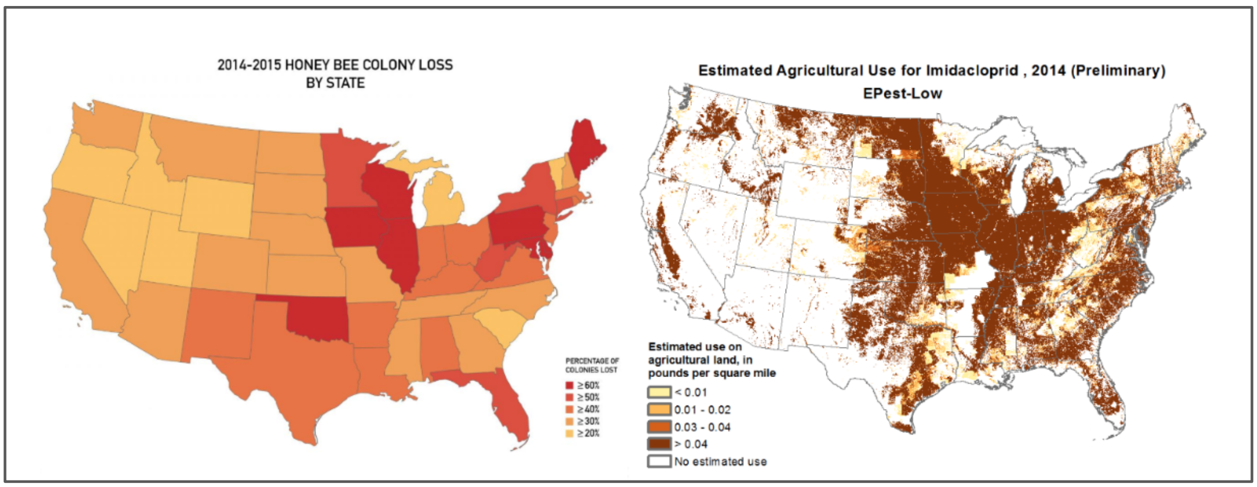

Figure 15: 2014-2015 honey bee colony loss compared to the estimated usage of imidacloprid. Darker areas of each map correspond to high levels of colony loss and high levels of pesticide usage, respectively.[79] [80]

[76] Ribeiro, Susana De Almeida. “Neonicotinoids.” Food Safety - European Commission, 10 Sept. 2018, ec.europa.eu/food/plant/pesticides/approval_active_substances/approval_renewal/neonicotinoids_en.
[77] Chen, Mei, et al. "Quantitative analysis of neonicotinoid insecticide residues in foods: implication for dietary exposures." Journal of agricultural and food chemistry 62.26 (2014): 6082-6090.
[78] Ibid.
[79] University of Maryland. Loss Map. Bee Informed Partnership/University of Maryland/Loretta Kuo. https://www.eurekalert.org/multimedia/pub/91682.php?from=296073. 2015.
[80] USGS. Estimated Annual Agricultural Pesticide Use. Pesticide National Synthesis Project. https://water.usgs.gov/nawqa/pnsp/usage/maps/show_map.php?year=2014&map=IMIDACLOPRID&hilo=L. 2014.

H.R. 1337: Saving America's Pollinators Act

Legislative Background

The Saving America's Pollinators Act of 2019 (H.R. 1337) was introduced in February 2019 by Representative Earl Blumenauer (D-OR). The bill aims to establish a board within the Environmental Protection Agency (EPA) that would study and review all pesticides that pose a threat to pollinators, cancel the registration of existing pesticides containing eight common neonicotinoids, and mandate regular monitoring of pollinator population health conducted by the EPA, US Department of Agriculture (USDA), and the US Department of the Interior (DOI).

This is the fifth version of H.R. 1337 since 2013. Its reintroduction could likely be attributed to the rising urgency and public awareness of bee health. Indeed, this is reflected by a recent EPA decision to cancel the registration of 12 pesticide products that are known to harm pollinators, some of which contain neonicotinoids.[81]

US precedent for similarly minded policy includes a Federal Pollinator Health Task Force established by President Obama. In addition, the US Fish and Wildlife Service banned neonicotinoids in national wildlife refuges due to the harmful effects on nontarget species - this ban was lifted in 2018 by the Trump administration.[82] Additionally, there are already 22 states in the US with pollinator protection bills that go much farther than current federal policy regarding this issue. [83]

H.R. 1337 also takes inspiration from international neonicotinoid bans. The European Union and Canada have both banned neonicotinoid usage after finding the pesticide deleterious to insects, the ecosystem, and human health.[84] [85] A 2018 report from the European Food Safety Authority, following up on 2013 research, confirmed a link between bee death and neonicotinoid use.[86] Health Canada's Pest Management

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[81] Federal Register. Product Cancellation Order for Certain Pesticide Registrations. https://www.federalregister.gov/documents/2019/05/20/2019-10447/product-cancellation-order-for-certain-pesticide-registrations. May 2019.

[82] "Trump Administration Lifts Ban on the Use of Dangerous Pesticides at U.S. Wildlife Refuges." Union of Concerned Scientists. www.ucsusa.org/center-science-and-democracy/attacks-on-science/trump-administration-lifts-ban-use-dangerous. 4 Sept. 2018.

[83] NCSL. Pollinator Health. http://www.ncsl.org/research/environment-and-natural-resources/pollinator-health.aspx. 2018.

[84] "Health Canada Releases Final Pollinator Re-Evaluation Decisions for Neonicotinoid Pesticides ." Government of Canada, www.canada.ca/en/health-canada/news/2019/04/some-cancellations-and-new-restrictions-to-protect-bees-and-other-pollinators.html. 11 Apr. 2019.

[85] Stokstad, Erik. "European Union Expands Ban of Three Neonicotinoid Pesticides." Science. www.sciencemag.org/news/2018/04/european-union-expands-ban-three-neonicotinoid-pesticides. nh7. 27 Apr. 2018.

[86] Ippolito, Alessio. Environmental Risk Assessment of Neonicotinoid Insecticides for Bees: a Retrospective Analysis of the Problem Formulation. www.efsa.europa.eu/sites/default/files/event/180918-conference/presentations/19-2_09_Ippolito.pdf. 2018.

Regulatory Agency agreed in 2018 after a reevaluation of neonicotinoid use and is in the process of banning three of the main pesticides in question.[87]

Despite being banned in numerous other countries and previous legislative attempts, the use of neonicotinoids is currently unregulated in the US at the federal level. Still, H.R. 1337 builds on previous federal legislation and policies, including the 1996 Federal Insecticide, Fungicide, and Rodenticide Act; the 2008, 2014, and 2018 farm bills; and the 2014 Pollinator Health Task Force. H.R. 1337, partially in contrast to some of these earlier measures, requires the immediate cancelation of the registration of neonicotinoids until it is proven that they do not cause “unreasonable adverse effects on pollinators.”[88] H.R. 1337 would also foster communication between a diverse group of stakeholders with various skill sets and expertise, including bees and other pollinators, toxicology, and conservation.

Legislative Strategies

H.R. 1337 would limit the impacts of neonicotinoids health of pollinators through three main mechanisms: the creation of the Pollinator Protection Board, a ban on current and future neonicotinoid pesticide sales, and enhanced monitoring of both commercial and native bees.

Pollination Protection Board

First, H.R. 1337 would establish a board within the EPA, known as the Pollinator Protection Board, to study and review pesticides that threaten pollinators.

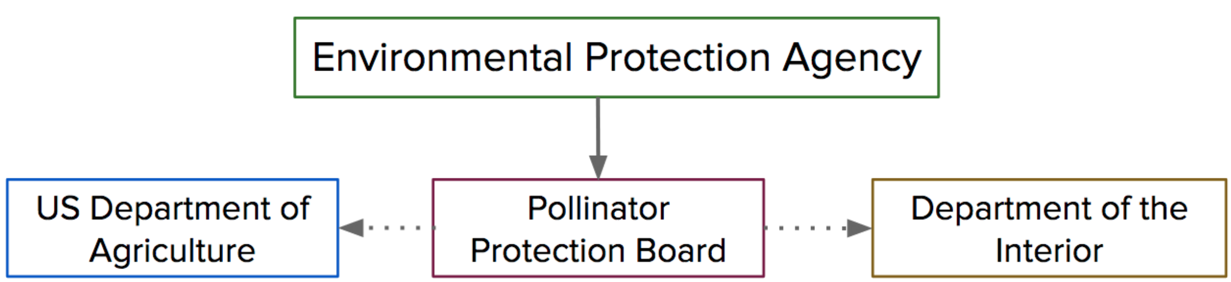

Figure 16: Pollinator Protection Board. A diagram illustrating the governance structure of the proposed Pollinator Protection Board within the EPA and working laterally with the USDA and DOI.

[87] “Re-Evaluation Note REV2017-03, Re-Evaluation of Neonicotinoid Insecticides: Update on Pollinator Risk Assessments.” Government of Canada, Health Canada. www.canada.ca/en/health-canada/services/consumer-product-safety/reports-publications/pesticides-pest-management/decisions-updates/reevaluation-note/2017/evaluation-neonicotinoid-insecticides-update-pollinator-risk-assessments-rev2017-03.html. 25 Jan. 2017.
[88] Saving America's Pollinators Act of 2019, H.R.1337, 116th Congress. (2019).

The Board will be made up of 15 relevant and important stakeholders, including:

- *Scientists*: Four scientists, of which at least 1 shall have expertise in native bees, will contribute expertise on pollinators, toxicology, and ecosystems, as well as the ability to efficiently read, analyze, and communicate scientific data related to pollinators.
- *Beekeepers*: Three beekeepers—one commercial, one chemical-free, and one hobbyist—will provide first-hand experience with the effects of pesticides on their own bees and the recent increases in commercial colony collapse (up to 100 percent[89] hive loss in some cases).
- *Organic and non-organic farmers*: Two certified organic farmers and two non-organic farmers will bring knowledge of how neonicotinoid use (or lack of) has and could both positively and negatively impact future agriculture and food production.
- *The conservation representatives and the commercial enterprise*: Three representatives of environmental, conservation, or resource organizations and one representative of a commercial enterprise that protects bees will assist in advocating and promoting protection and conservation of pollinators and the broader ecosystem from pesticides.

These expert perspectives will strengthen the Board's ability to interpret, generate, and communicate empirical information regarding neonicotinoid usage and bee colony health. Additionally, the Board would research alternative products (other chemicals e.g. pyrethroids)[90] and pest control practices being developed, including non-chemical methods (e.g. microorganisms).[91]

The Board's expertise would empower it to judiciously approve or deny a pesticide registration application following examination of peer-reviewed data on its effects on pollinators; current law differs by requiring applicants to produce their own data that affirm their product's safety, rather than peer-reviewed literature.[92] Recommendations would be decided upon two-thirds of the votes cast, with the chairperson retaining equal voting authority as other members. By requiring the Board to use peer-reviewed literature rather than industry funded application studies and authorizing it to approve or deny the registration, the bill goes further than previous versions in creating a long term solution to limit circulation of neonicotinoids in pollinator ecosystems.

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[89] Saving America's Pollinators Act of 2019, H.R.1337, 116th Congress. (2019).
[90] "Alternatives for Neonicotinoids in a Range of Agricultural Crops." Pesticide Action Network Europe. http://www.savehoneybees.info/images/documents/Chemical_and_non-chemical_alternatives_to_neonicotinoids.pdf.
[91]Jactel, Hervé, et al. "Alternatives to neonicotinoids." Environment international 129 (2019): 423-429.
[92]"About Pesticide Registration." Environmental Protection Agency. https://www.epa.gov/pesticide-registration/about-pesticide-registration. 2019.

Monitoring Commercial Bees and Banning Neonicotinoids

Second, H.R. 1337 would cancel the registration of existing pesticides containing eight common neonicotinoids, prohibiting the use of thousands of currently registered pesticides.[93] The bill would not allow the EPA to issue any new registrations for any seed treatment, soil application, and foliar treatment on bee-active plants treats and cereals until the Board has deliberated on the safety of said pesticides. It also would make additional registrations conditional upon an evaluation and field study conducted by the Board. Exemptions for pesticide registrations would be authorized in the event of an emergency pest outbreak. By immediately canceling registrations without an appeals process, it quickly reduces the amount of new pesticides accumulating in the environment and thus lowers the exposure risk to bees and pollinators.

Commercial bees are widely studied and easier to monitor than wild bees and other pollinators. These bees also face a much greater threat from neonicotinoids than native bees, as commercial bees are often used to pollinate crops on fields treated with neonicotinoids. Since neonicotinoids stress the nervous and immune system, commercial bees feel stronger effects of other stressors. A study from Dalhousie University analyzed pollen from commercial bee hives placed next to corn fields grown with neonicotinoid-treated seeds ("conventional") in comparison to hives on organically-grown corn fields where no pesticides were used. Neonicotinoids were detected in all pollen samples from the treated fields, but not the organic fields (*Figure* 18). Significantly fewer worker bees from hives on neonicotinoid-treated fields (96 ± 15 workers) versus organic fields (127 ± 15 workers).[94] This study exemplifies that commercial bees near fields treated with neonicotinoids are subjected to higher concentrations than bees further away from neonicotinoid seed treatments. Additionally, commercial bees exposed to neonicotinoids have a lower survival rate.

[93] Saving America's Pollinators Act of 2019, H.R.1337, 116th Congress. (2019).

[94] Cutler, G. Christopher, and Cynthia D. Scott-Dupree. "A field study examining the effects of exposure to neonicotinoid seed-treated corn on commercial bumble bee colonies." Ecotoxicology 23.9 (2014): 1755-1763.

Field	Clothianidin (ng/g)	Thiamethoxam (ng/g)
Conventional 1	0.8	<0.1[a]
Conventional 2	0.4	<0.1
Conventional 3	0.1	<0.1
Conventional 4	0.3	<0.1
Organic 1	<0.1	<0.1
Organic 2	<0.1	<0.1
Organic 3	<0.1	<0.1
Organic 4	<0.1	<0.1

[a] Limit of detection = 0.1 ng/g

Figure 17: Residue levels of two neonicotinoids (ng/g) on 4 conventional seeds and 4 organic seeds.[95]

Researchers from the Harvard School of Public Health, in conjunction with the Worcester County Beekeepers Association, completed an analysis of neonicotinoid-treated and untreated commercial honeybee colonies through the various seasons. This study took place from July 2012 to April 2013. Though the hives progressed similarly in summer and fall, the neonicotinoid hives were unable to recover after the winter. (*Figure below*) The researchers described the treated colonies as having symptoms resembling colony collapse disorder and, while only one of six control colonies collapsed, six of the twelve treated colonies collapsed.[96] This data strengthens the link between neonicotinoid application and CCD. With an increasing rate of climate change, bees are at an even higher risk for colony loss during the longer and harsher winter seasons. Thus, a ban on the use of neonicotinoids is predicted to greatly reduce colony loss rates and CCD. Continual monitoring of bee populations would help determine if the desired outcomes of a neonicotinoid ban were achieved.

[95]Cutler, G. Christopher, and Cynthia D. Scott-Dupree. "A field study examining the effects of exposure to neonicotinoid seed-treated corn on commercial bumble bee colonies." Ecotoxicology 23.9 (2014): 1755-1763.
[96] Chensheng, L. U., Kenneth M. Warchol, and Richard A. Callahan. "Sub-lethal exposure to neonicotinoids impaired honey bees winterization before proceeding to colony collapse disorder." Bulletin of Insectology 67.1 (2014): 125-130.

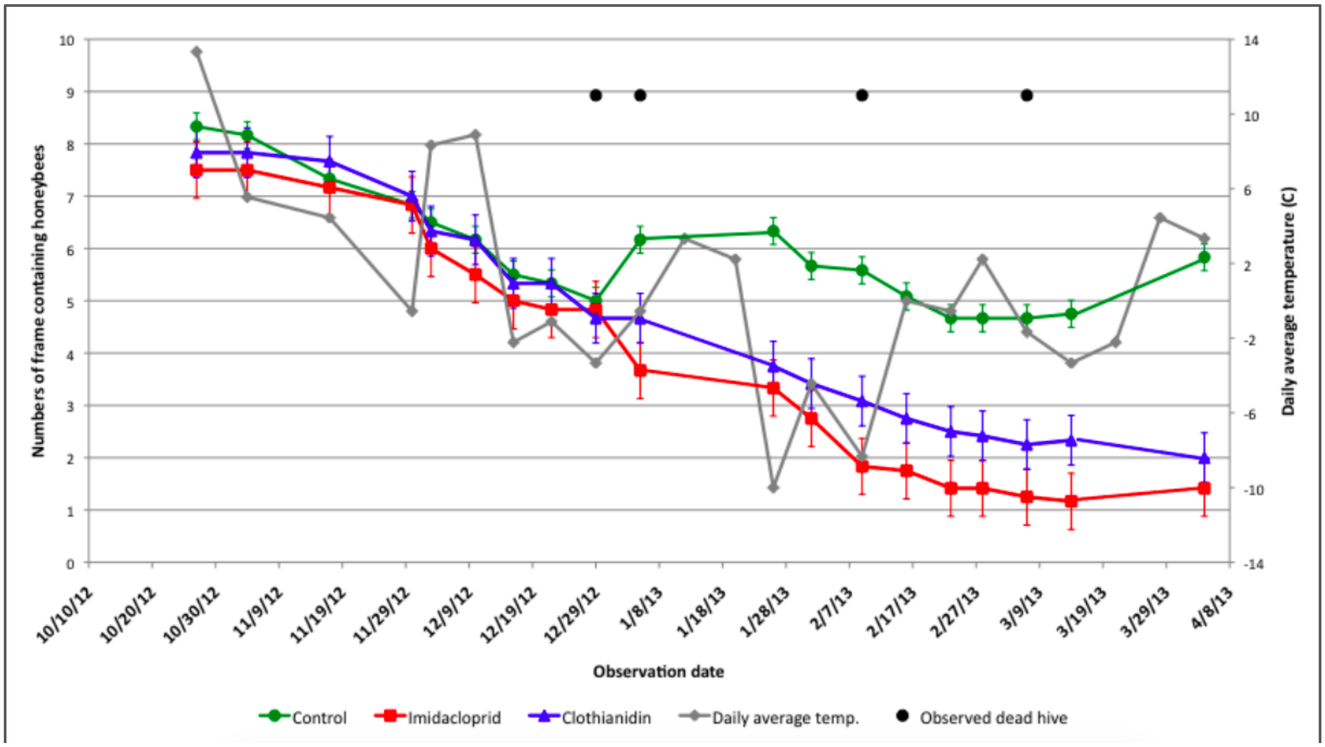

Figure 18: Neonicotinoid usage in relation to daily temperature and hive frames containing honey bees in study colonies.[97]

Monitoring of Native Bees

Finally, H.R. 1337 would require the EPA and the Departments of Agriculture and the Interior to conduct regular monitoring of pollinator population health. Those agencies would submit and publish an annual report discussing their findings. Wild and native bees are incredibly difficult to monitor due to their solitary nature. Coordinating resources between government agencies will improve understanding of the health of wild bee populations, guiding future action.

Despite the extreme difficulty in tracking and producing research on native bees, a study conducted in Sweden found evidence linking neonicotinoid seed coatings and declining native bee density. Bumblebees and solitary bees were found in lower numbers near flowering oilseed rape fields when compared to a paired landscape that served as the untreated control as seen in Figure 20.[98]

[97] Chensheng, L. U., Kenneth M. Warchol, and Richard A. Callahan. "Sub-lethal exposure to neonicotinoids impaired honey bees winterization before proceeding to colony collapse disorder." Bulletin of Insectology 67.1 (2014): 125-130.
[98] Rundlöf, Maj, et al. "Seed coating with a neonicotinoid insecticide negatively affects wild bees." Nature 521.7550 (2015): 77.

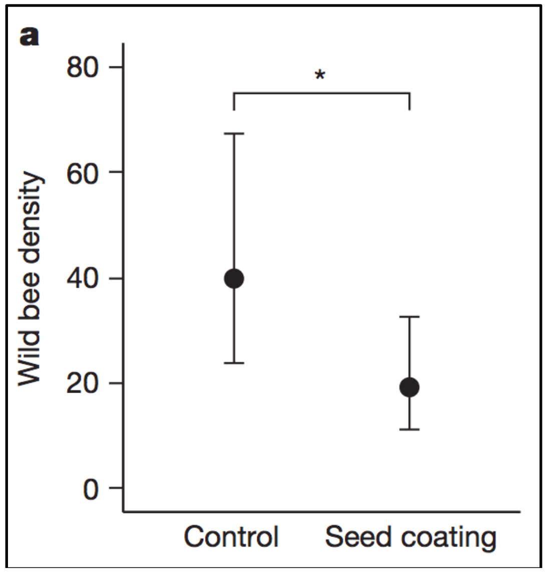

Figure 19: Density of wild bees in areas with seeds coated with neonicotinoid versus a control group.

Native bees significantly contribute to pollination services. Though they are more difficult to quantify, they are no less valuable to the ecosystem, agriculture, and economy. Monitoring of native bees helps determine the impacts of neonicotinoids and other stressors on native bees and is another metric to quantify the success of a neonicotinoid ban.

While the bill seeks to prevent future colony collapse, it does not address remediation of past damage to bee and pollinator communities. Apiaries affected by colony collapse will not receive government assistance for past damage from this bill. In addition, it does specifically address the health of wild bees due to paucity of data. How climate change impacts this issue is largely unknown, and merits further research.

The Science Behind the Bill

When introducing the Saving America’s Pollinators Act on February 25, 2019, bill sponsor Rep. Earl Blumenauer made the following statement:

> “The peer-reviewed journal Biological Conservation recently published a scientific analysis that paints a terrifying picture for the future of insects and our planet. This analysis concluded that largely because of intensive agriculture, and specifically heavy use of pesticides, over 40 percent of insect species are threatened with extinction. Furthermore, this analysis found that around 41 percent of all insect species have seen their populations decline over the last 10 years, and that 3.5 million of the United States honeybee colonies have been lost since 1947. These alarming statistics foretell a catastrophic

> collapse of nature's ecosystems. Already are seeing the impacts of the climate crisis wreak havoc on our natural world, public health and, importantly, our food system. Pollinators and other insects are vital to our economy and our livelihoods. One of every three bites of food we eat is from a crop pollinated by bees. This analysis is a call to action to do all we can to protect these valuable insects, particularly in the face of climate change. That's why today I am introducing the Saving America's Pollinators Act. This legislation will suspend the use of certain insecticides until they are thoroughly assessed and determined to be safe for pollinators. Furthermore, it establishes a monitoring network for native bees, and clarifies the emergency exemption powers that this Administration is afforded under current law."[99]

The cited report was released just one month before the bill was introduced in the US House of Representatives. Rep. Blumenauer's remarks and the introduction of the new version of this bill represent years of research; the substance of this bill has evolved along with the scientific community's understanding of the issue as have the proposed strategies. The solutions proposed by H.R. 1337 are the most extensive to date, which reflects the growing appreciation among policymakers for the urgency of declining pollinator health and food security.

The US Department of Agriculture and the Environmental Protection Agency monitor commercial bee colonies and pollinator health respectively. The USDA, while serving as the leading source for commercial beekeeping statistics in the US, is not currently mandated to study native bees. Commercial beehives are an agricultural commodity, and beekeepers report colony numbers and loss rates to the USDA similarly to how commercial farmers report crop yields. The USDA's Agricultural Research Service releases annual, public facing reports with statistics on commercial colonies, and has been highlighting increasing loss rates among these colonies for the past 10 years.[100] The Environmental Protection Agency is charged with monitoring qualitative impacts to pollinator health, and has been researching the impacts of pesticides and other stressors on commercial colony loss rates as well as on wild pollinator populations. The EPA is not currently equipped to monitor or measure specific figures for pollinator populations, and has focused its efforts on risk assessment and species conservation.[101] Both agencies acknowledge the rise of colony collapse disorder and the threat it poses to commercial pollination and the viability of this sector.

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[99] Representative Earl Blumenauer (OR). "Introduction of the Saving America's Pollinator Act." Congressional Record E206 (25 February 2019). Online. Accessed 11 August 2019. https://www.congress.gov/116/crec/2019/02/25/CREC-2019-02-25-pt1-PgE206-4.pdf

[100] Agricultural Research Service. "Honey Bee Health and Colony Collapse Disorder." US Department of Agriculture. 29 May 2019. https://www.ars.usda.gov/oc/br/ccd/index/#losses

[101] "Pollinator Protection: How We Assess Risks to Pollinators." Environmental Protection Agency. https://www.epa.gov/pollinator-protection/how-we-assess-risks-pollinators

H.R. 1337 is based primarily on two Congressional Research Service reports entitled, "Bee Health: Background and Issues for Congress" (2015) and "Bee Health: The Role of Pesticides" (2012). Both reports reflect previous attempts by lawmakers to analyze the role of neonicotinoid pesticides in colony collapse disorder, and include syntheses of peer-reviewed literature, USDA data, and reports from the Environmental Protection Agency. Ultimately, these reports identify several gaps in understanding of this issue that would also be barriers to implementation. While some of these challenges are directly addressed by the solutions proposed in the bill, others may require additional legislative efforts or funding, discussed in a later section of this report. For example, both the EPA and USDA would need to be financially and politically empowered to play a more active role in pollinator monitoring and protection for H.R. 1337 to succeed.

Stakeholder Viewpoints

H.R. 1337 acknowledges that there are controversies related to this problem and its proposed solutions. That the Pollinator Protection Board would be made up of a diverse array of stakeholders is borne out of the existence of those controversies and lack of complete consensus on this issue. Further, because this issue is inherently economic—dealing with food production, industrial agriculture, and livelihoods—the stakes are high for many, including the very manufacturers of neonicotinoids, farmers, beekeepers, and advocates.

Pesticide Manufacturers

This bill, particularly its ban on neonicotinoids, would directly affect the bottom lines of the agrochemical industry and the manufacturers of neonicotinoid pesticides. Neonicotinoids are worth at least $1.9 billion globally and represent "25 percent of the agrochemical market."[102] Bayer, the original developer of neonicotinoids, purchased Monsanto in 2018, another multinational corporation known for its work on genetically modified organisms (GMOs).[103] The acquisition formed the "world's largest agricultural corporation, holding one-third of the global market for commercial seed and a quarter of the market for pesticides."[104]

Bayer's Bee Care Program states its mission is to tackle "some of the main threats and opportunities facing pollinators and pollination," which the company believes to be

[102] Black, Scott Hoffman, David Biddinger, Aimee Code, Jennifer Hopwood, Eric Lee-Mäder, Celeste Mazzacano, and Matthew Shepherd, "How Neonicotinoids Can Kill Bees: The Science Behind the Role These Insecticides Play in Harming Bees," Xerces Society for Invertebrate Conservation, 4, https://www.xerces.org/wp-content/uploads/2016/10/HowNeonicsCanKillBees_XercesSociety_Nov2016.pdf.
[103] "After a $66 billion merger, Monsanto is disappearing — sort of." Business Insider, June 2018. https://www.businessinsider.com/monsanto-beyer-merge-drop-monsanto-name-2018-6.
[104] "Monsanto and Co: From seven to four – growing by shrinking." Heinrich Boll Stiftung The Green Political Foundation, October 2017. https://www.businessinsider.com/monsanto-beyer-merge-drop-monsanto-name-2018-6.

varroa mites and climate change.[105] They claim the ineffectiveness of miticides applied to hives to fight varroa mites is harming bees by not exterminating this hive-dwelling ectoparasite. Bayer and Monsanto have also pointed to climate change as a driving factor in the loss of wildflowers, a bee nutrition source, due to altered seasonal temperature variation and precipitation rates, and they encourage farmers to let wildflowers grow instead of reducing neonicotinoid usage.[106] [107]

H.R. 1337 is a direct challenge to the pesticide industry; the Pollinator Protection Board and the bill's required regular monitoring and research could potentially further solidify the link between neonicotinoids and pollinator mortality, thus nullifying the credibility of these manufacturers' claims and driving down their sales. Following the bill's passage, neonicotinoids would only be permitted during "emergency" situations to protect vital food crops from aphids.

There is controversy in the science cited by agrochemical companies and even the EPA. The primary study that the EPA used when approving the original neonicotinoid registration application was funded by Bayer.[108] This is a glaring conflict of interest, as the study being used to approve a pesticide registration was funded by the very company seeking that registration. This is not an isolated conflict of interest. An often-cited study by AgInformatics, for example, was funded by Bayer, Syngenta, and Valent, another agrochemical company.[109]

Currently, the manufacturers of neonicotinoids oppose the link between the proper use of neonicotinoids and pollinator health[110] and believe that the pesticides in questions are a vital part of pest management.[111] Although manufacturers have been criticized for not sharing their in-house data to back up their assertions,[112] their public statements imply that any harm found from use of neonicotinoids is due to improper use.[113] Additionally, they believe a ban on neonicotinoids would result in farmers using more of older pesticides by weight, increase of general pesticide use, and negative

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105 The Great Honey Bee Venture." Monsanto. Accessed 18 July 2019. https://monsanto.com/company/sustainability/biodiversity/articles/honey-bee-venture-varroa-mites/

106 "What to Know: Neonicotinoids." Bayer Bee Care, 2019. https://beecare.bayer.com/what-to-know/pesticides/neonicotinoids.

107 "Honeybee Health". Monsanto. https://monsanto.com/company/sustainability/supporting-biodiversity/why-are-bees-important/

108 Gibbs, Mark, "Bayer: Pesticide Profits or Bees?," Forbes, 26 April 2012, https://www.forbes.com/sites/markgibbs/2012/04/26/bayer-pesticide-profits-or-bees/#4ba28179723b.

109 Maulsby, Darcy, "Untold Benefits," Syngenta Thrive, Spring 2015, http://www.syngenta-us.com/thrive/research/untold-benefits.html.

110 Monsanto. Comment on "Why doesn't Monsanto recognize that neonicotinoids are a persistent vector to our honey bee populations. Without honey bees, no farms." Monsanto Conversation, 2 May 2018, https://monsanto.com/company/sustainability/q/why-doesnt-monsanto-recognize-that-neonicotinoids-are-a-persistent-vector-to-our-honey-bee-populations-without-honey-bees-no-farms/.

111 Syngenta. "Neonicotinoids Are Key to IPM Solutions." Syngenta Thrive, www.syngenta-us.com/thrive/research/neonicotinoids-ipm-solutions.html.

112 Carrington, Damian. "Insecticide Firms in Secret Bid to Stop Ban That Could Save Bees." The Guardian, Guardian News and Media, 27 Apr. 2013, www.theguardian.com/environment/2013/apr/28/europe-insecticides-ban-save-bees.

113 "Bayer, Syngenta Respond after EU Ban on Neonicotinoids." AGDAILY, 30 Apr. 2018, www.agdaily.com/news/bayer-syngenta-eu-ban-neonicotinoids/.

effects on beneficial insects such as lady beetles which are unaffected by neonicotinoids.[114]

Farmers

The development of cost effective and efficient synthetic pesticides and fertilizers is revered as "the answer to world hunger."[115] Responsible for innovative high-yield crop seeds, fertilizers, and pesticides, the agrochemical industry is trusted by many farmers due to the effectiveness of their wide range of products that address nearly every disease, condition, or pest that troubles their crops.

Large-scale agriculture can both benefit from and be harmed by neonicotinoids, which is why views on H.R. 1337 differ based on the scale and type of farming operations, specifically comparing conventional and organic farming and comparing farming of self-pollinating crops and crops that require bees and other pollinators for reproduction. When considering controversies brought up by conventional farmers, it is important to consider why neonicotinoids are used and why they are so popular. Neonicotinoids are easier and more efficient to apply and safer to humans than previous pesticides such as organophosphates, which usually were sprayed on crops. Using neonicotinoids takes less time and reduces the risk of exposure to humans and megafauna. When calculating alternative solutions, costs can be much cheaper. Integrated pest management, which relies primarily on natural solutions, estimated cost is about $7-$14 per 'unit', with a unit of soybean seeds, for example, being about 140,000 seeds.[116] [117] There is room for approximately 160,000 seeds per acre of farmland, depending on how close you decide to create rows in your field.[118] With the average size of a farm in America being 443 acres,[119] this would call for 70,880,000 seeds, translating to 473 units. Neonicotinoids do not necessarily improve crop yields, that is only taking into account the upfront purchase cost, not the cost of lost crop yield and time. This approach can be about $4,000-7,000 cheaper than applying neonicotinoids to this size farm, with thiamethoxam, a popular neonicotinoid, priced at $22.67[120] per acre in most cases.

[114] Bayer AG Communications. "Neonicotinoid Ban: a Sad Day for Farmers and a Bad Deal for Europe." Neonicotinoid Ban: a Sad Day for Farmers and a Bad Deal for Europe - Bayer News, media.bayer.com/baynews/baynews.nsf/id/Neonicotinoid-ban-a-sad-day-for-farmers-and-a-bad-deal-for-Europe.
[115] A Short History of Pest Management. Penn State Extension. https://extension.psu.edu/a-short-history-of-pest-management
[116] "How Much Does an IPM Program Cost?" Stop Pests in Housing, 2018, p. 2019, http://smallbusiness.costhelper.com/interpreters.html.
[117] "Pioneer Soybeans to Be Sold by Seed Counts, Not Weight." FarmProgress, 2012, pp. 1–2, https://www.farmprogress.com/soybean-varieties/pioneer-soybeans-be-sold-seed-counts-not-weight.
[118] Robinson, Andrew P., and Shawn P. Conley. "Plant Populations and Seeding Rates for Soybeans." Purdue Extension, 2007, pp. 1–3, https://www.extension.purdue.edu/extmedia/ay/ay-217-w.pdf.
[119] "Average Farm Size in the United States from 2000 to 2018 (in Acres)." United States Department of Agriculture; Economic Research Service, vol. 2018, 2019, pp. 2018–20, https://www.statista.com/statistics/196106/average-size-of-farms-in-the-us-since-2000/.
[120] Mossler, M. A. Florida Insecticide , Miticide , and Nematicide Pricing And. no. Table 1, 2006, http://edis.ifas.ufl.edu/pdffiles/PI/PI17200.pdf.

Neonicotinoids are typically applied prophylactically, meaning to all crop areas regardless of evidence of pests, whereas when spraying a farmer needs to be more aware of pest-prone areas and spray there only.[121] For large-scale, conventional farmers, neonicotinoid pesticides are the least expensive option among similar pest-control products per acre and one of the most effective. Aphids (the main pest targeted by neonicotinoids) do not build up a tolerance or resistance to this chemical, and the chemical is not toxic to humans save for extremely high doses. About 150 million acres cropland in the US (mostly hosting staple crops such as soy and corn) are currently treated with neonicotinoids out of the total 253 million.[122] This is in part due to their effectiveness and cost, but also because the top 20 recommended seed treatments for insects contain neonicotinoids, illustrating the little amount of choices farmers have when selecting an effective insecticide.[123] The ban on neonicotinoids proposed in H.R. 1337 could increase operating costs and potentially hurt crop yields, contributing to the controversy regarding how the ban would affect farmers and commercial agriculture. Farmers in the United Kingdom estimate that the neonicotinoid ban in the EU has cost them £22 million, or about $26 million,[124] and in the US corn and soybean farmers estimate the value of neonicotinoids at $12 an acre.[125]

Organic farmers could stand to benefit from H.R. 1337, and may play a crucial role in restoring pollinator populations, as synthetic pesticide use is prohibited in organic farming operations. Research shows that organic agriculture is one solution to the global pollinator problem, as it can increase pollinator habitat and biodiversity, but contamination from nearby conventional farms can still occur via runoff, neonicotinoid dust, and transport by bees and other insects.[126]

Farmers of crops that require pollination by bees specifically also could stand to benefit from the bill, as the ban would help to protect the fundamental ecological and biological process that they rely on for crop reproduction. The cost of a beehive for almond pollination, for example, rose from $50 in 2003 to $150-175 in 2009.[127] Of the approximately 100 crops pollinated by bees, however, 15 are treated with neonicotinoids—including apples, beets, broccoli, peas, potatoes, tomatoes, and

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[121] Goulson, Dave. "An overview of the environmental risks posed by neonicotinoid insecticides." Journal of Applied Ecology, Vol. 50, 2013, 984.

[122] Why it's time to curb widespread use of neonicotinoid pesticides." The Conversation. June 2018. http://theconversation.com/why-its-time-to-curb-widespread-use-of-neonicotinoid-pesticides-96620

[123] "When is Seed Treatment Worth It". Farm Journal. https://www.agweb.com/article/when-is-seed-treatment-worth-it-NAA-sonja-gjerde

[124] Amelinckx, Andrew, "Ban of Neonicotinoids in UK Cost Farmers Millions," Modern Farmer, 11 September 2015, https://modernfarmer.com/2015/09/neonicotinoids-ban-uk/.

[125] Maulsby, Darcy, "Untold Benefits," Syngenta Thrive, Spring 2015, http://www.syngenta-us.com/thrive/research/untold-benefits.html.

[126] Misiewicz, Tracy, and Jessica Shade. "The Role of Organic in Supporting Pollinator Health," 2015. https://www.organic-center.org/wp-content/uploads/2015/06/The-Role-of-Organic-in-Supporting-Pollinator-Health.pdf.

[127] The White House Office of the Press Secretary, "Fact Sheet: The Economic Challenge Posed by Declining Pollinator Populations," 20 June 2014, https://obamawhitehouse.archives.gov/the-press-office/2014/06/20/fact-sheet-economic-challenge-posed-declining-pollinator-populations.

canola—highlighting the tension between the need for bees and the perceived need for neonicotinoids.[128]

Another potential controversy related to farmers is that nearly all of H.R. 1337's 29 sponsors are from urban or suburban areas, not from areas with high percentage of farm acreage. Some are from states where neonicotinoids are used in large numbers, but some not. The Pollinator Protection Board proposed by the bill would include two conventional farmers, as well as two organic farmers, among a total body of 15 individuals, so they would be represented, but there still is a perception that the sponsors are attempting to legislate on an issue or topic with which they are not in touch.

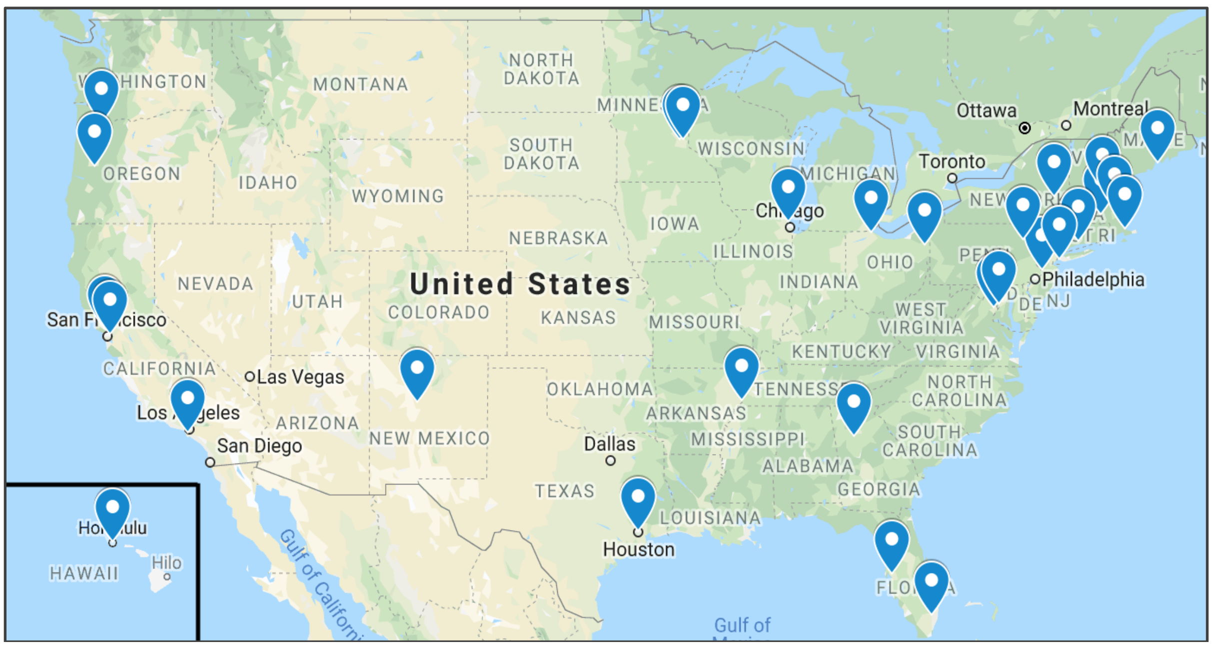

Figure 20: The geographic distribution of H.R. 1337's sponsors.[129]

[128] Douglas, Margaret R., and John F. Tooker. "Large-scale deployment of seed treatments has driven rapid increase in use of neonicotinoid insecticides and preemptive pest management in US field crops." Environmental science & technology 49.8 (2015): 5088-5097.
[129] See https://drive.google.com/open?id=198wx_3kwzK3DIvqazplLC4oQHMzpSrhW&usp=sharing for an interactive version of the map, which we created using Google Maps.

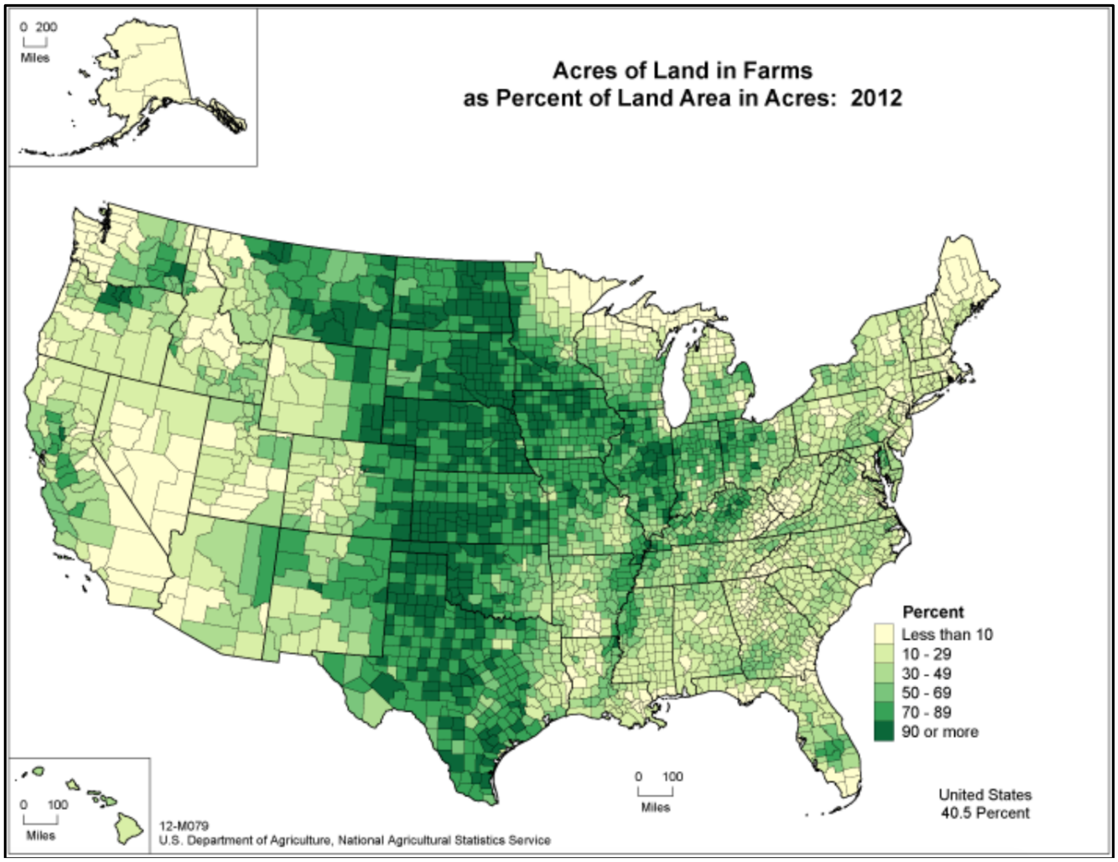

Figure 21: Acres of land in farms as a percentage of land area in acres, per county, in 2012.[130]

Commercial Beekeepers

Collectively, US beekeepers have lost 10 million hives worth about $200 each, or a total of $2 billion in collapsed hives between 2007 to 2013.[131] They are feeling the economic effects of colony collapse firsthand. As discussed previously, colony loss rates have been about three times higher than normal across the country since at least 2006 and in 2015, 42 percent of colonies collapsed, compared to the expected and acceptable historical (pre-1990s) rates of 10 to 20 percent. This is lost profit and lost livelihood for beekeepers. The ban on neonicotinoids is expected to, over time, reduce the loss rates that have been recorded since 2006, from between 30 percent and 60 percent to between 10 and 20 percent.

For beekeepers whose livelihoods are at stake, the bill does not go far enough to protect bees, as it does not require active remediation and requires a long period of time for the potential effects of the bill to be seen.

[130] U.S. Department of Agriculture National Agricultural Statistics Service, "2012 Census of Agriculture," https://www.nass.usda.gov/Publications/AgCensus/2012/Online_Resources/Ag_Atlas_Maps/Farms/Land_in_Farms_and_Land_Use/12-M079.php.

[131] The White House Office of the Press Secretary. "Fact Sheet: The Economic Challenge Posed by Declining Pollinator Populations." https://obamawhitehouse.archives.gov/the-press-office/2014/06/20/fact-sheet-economic-challenge-posed-declining-pollinator-populations. 20 June 2014.

Advocacy Organizations and Scientists

These groups believe this bill does not go far enough. Cancelling registrations, monitoring pollinator health, and discussing solutions with other stakeholders does not involve any active remediation efforts for the damage already done to pollinators and their ecosystems. There is also concern whether, due to the persistence of this chemical, the bee population would even recover, or how quickly it would recover. This could give opponents of the bill opportunity to call into question the monitoring that would be conducted if the bill were implemented. Furthermore, the definition of the problem in the bill is anthropocentric and directed toward the human food supply rather than pollinator health in and of itself.

It is also worth considering how apolitical the Pollinator Protection Board could be, and under what emergency circumstances neonicotinoid application will be allowed. The Board is housed within the EPA, whose administrator is appointed by the President, a partisan figure. The Board will have a diverse makeup of farmers, beekeepers, scientists, and advocates and will be somewhat separate from the rest of the agency, but it still is subject to politics, particularly given the regulatory capture the EPA has experienced at the hands of companies like Bayer.

Legislative Goals and Metrics

Canceling pesticide registrations containing neonicotinoids would reduce the amount of neonicotinoids in the environment and decrease pollinator exposure. Despite the addition of over 2 million colonies to the US system in 2017, the year resulted in a net loss. These negative outcomes have been attributed to neonicotinoid use and persistence.[132] Cancellation of neonicotinoids will not have an immediate effect as these highly water soluble chemicals are taken up by the entire plant. They cannot be easily washed off and degrade slowly in sunlight.[133] Neonicotinoids are transported throughout the ecosystem, contaminating soil, water, other plants and poisoning non-target organisms. The half-life of neonicotinoids is up to 1,155 days and these chemicals have accumulated in reservoirs in soil and water over time; it takes almost three years to fall to just half concentration in these environments[134] and it takes five half-lives for a contaminant to be fully cleared.

[132]United States Department of Agriculture. "Honey Bee Colonies." August 1, 2018.
[133]Beaudry, Frederic. "What Is the Problem with Neonicotinoid Pesticides?" ThoughtCo, 30 May 2019, www.thoughtco.com/neonicotinoids-and-the-environment-1204115
[134]Linda S. Gribko. "Beautiful Death: Neonicotinoids Unmasked." 16 July 2017, milkweedrising.com/neonicotinoids-pollinator-garden

TABLE 3.1: Half-life in Soil of Neonicotinoids

Neonicotinoid	Half-life in Soil*
Acetamiprid	1–8 days[1]
Clothianidin†	148–1,155 days[2]
Dinotefuran	138 days[3]
Imidacloprid	40–997 days[4]
Thiacloprid	1–27 days[5]
Thiamethoxam†	25–100 days[6]

Figure 22: Popular neonicotinoids' half-life in soil medium.[135]

With the other stressors pollinators face, including rising temperatures and habitat loss due to climate change, parasites and disease, studies in the European Union have not yet shown data correlating an increase in bee health to the recent ban of neonicotinoids, but policymakers are focused on the long term.[136] Because bees repopulate quickly, the queen can lay between 1,500 and 2,000 eggs per day, population numbers should rise again if exposure is limited.[137] It will take years of intensive research to definitively detect a significant change in neonicotinoid concentrations and a subsequent effect on pollinators, but the precautionary principle should be applied in the face of so many negative trends and growing threats to food production. Use of neonicotinoids would only be permitted by the Board in emergency situations that pose a risk to endangered species, quarantine of invasive species, or protection of public health.

Continual monitoring of pollinator populations will improve comprehension of the current state of pollinator health and the efficacy of ongoing regulations. There is evidence of declines in both managed bees and wild pollinator populations in the US, European Union, and Canada, but it is difficult to pinpoint a singular cause including neonicotinoids when there are other factors such as habitat loss.[138] Studies have focused on feeding bees realistic doses of neonicotinoids in laboratories, but comprehensive, real-world field studies are needed. This lack of definitive consensus allowed pollinator protection regulations to be stalled by political processes for

[135] Hopwood, J. et al. "How Neonicotinoids Can Kill Bees." The Xerces Society. https://xerces.org/wp-content/uploads/2016/10/HowNeonicsCanKillBees_XercesSociety_Nov2016.pdf. 2016.
[136]Blacquière, Tjeerd, and Jozef JM van der Steen. "Three years of banning neonicotinoid insecticides based on sub-lethal effects: can we expect to see effects on bees?." Pest management science 73.7 (2017): 1299-1304.
[137] Moore, A. Philip. "Honey Bee Queens: Evaluating the Most Important Colony Member." Department of Entomology and Plant Pathology, The University of Tennessee, Knoxville. August 18, 2015. https://articles.extension.org/pages/73133/honey-bee-queens:-evaluating-the-most-important-colony-member
[138] Xerces Society for Invertebrate Conservation. "Pollinator Conservation Strategy." November 2009. https://www.xerces.org/wp-content/uploads/2010/01/yolo-nhp_pollinator-strategy_xerces.pdf

years.[139] Monitoring will confirm that these losses are attributed to neonicotinoid use, track population recovery, and inform political and agricultural decisions. Indicators of recovery in commercial bee populations would include:

- More resilient hives and a reversal in the spread of colony collapse disorder.
- Stabilization of bee populations and a return to 2006 population levels and loss rates (10 percent - 15 percent).
- Ability to meet domestic commercial bee pollination demand in agricultural sector

By bringing together data from multiple agencies and scientists, the Board will also have a deeper understanding of wild bee populations. Monitoring will focus on multiple habitats within twelve defined regions to provide systematic data on country-wide bee populations. Indicators of recovery in wild bee populations would include:

- Precise surveying of bee populations allowing for enhanced data and understanding
- A stabilization in wild bee populations and diversity

Upon the passage of H.R. 1337 by the US Congress and after full implementation of its stipulations, the following outcomes would be expected to be achieved:

Immediate Reduction in Neonicotinoids Applied

Neonicotinoids are applied on over 150 million acres of cropland and crops including corn, cotton, sugar beets, among many others, in the United States, with usage peaking in 2014 at 4 million kilograms applied.[140] [141] H.R. 1337 would require the EPA to cancel current neonicotinoid registrations within 180 days. Over 1,500 commercial and household products on the market contain neonicotinoids, and would be subject to the ban in the bill.[142] State agencies are responsible for the permitting of neonicotinoid usage, and would no longer be allowed to do so under federal law, representing an immediate discontinuation of the use of the roughly 4 million pounds of neonicotinoid pesticides currently used for crop pest management in the US.[143]

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[139]Blacquière, Tjeerd, and Jozef JM van der Steen. "Three years of banning neonicotinoid insecticides based on sub-lethal effects: can we expect to see effects on bees?." Pest management science 73.7 (2017): 1299-1304.
[140] Tooker, John F., Margaret R. Douglas, and Christian H. Krupke. "Neonicotinoid seed treatments: limitations and compatibility with integrated pest management." Agricultural & Environmental Letters 2.1 (2017).
[141] Honig, Lance. “Prospective Plantings of Grain and Rice Stocks, Executive Summary.” U.S. Department of Agriculture, National Agricultural Statistics Service https://www.nass.usda.gov/Newsroom/Executive_Briefings/2018/03-29-2018.pdf
[142] Center for Environmental and Regulatory Information Systems. “National Pesticide Information Retrieval System.” Purdue University. http://npirspublic.ceris.purdue.edu/default.aspx
[143]Lu, Chensheng, et al. "Neonicotinoid residues in fruits and vegetables: An integrated dietary exposure assessment approach." Environmental science & technology 52.5 (2018): 3175-3184.

Degradation of Neonicotinoid Accumulation Over Time

While the long half-life of neonicotinoids allows the chemical to persist in soil for more than 1000 days, immediately ending neonicotinoid application puts contaminated habitats on a recovery path.[144] With current data outlining geographic application rates of neonicotinoids, stakeholders can estimate the incremental reduction of pesticide concentrations. As accumulation reaches safer thresholds, commercial beekeepers can employ their colonies more confident that bees will not return to the hive with contaminated nectar and increase the risk of colony collapse.

Reduction in Cumulative Stress

A colony can be affected by stressful conditions at any given time and magnitude—low stress, for instance, may not immediately lead to colony collapse, but it can forecast its potential and lower productivity.[145] The presence of varroa mites and other pests, diseases, habitat loss, rising temperatures due to climate change and pesticides are all common bee colony stressors.[146] However, pesticides are particularly dangerous because their lethal and sublethal effects can exacerbate the effects of other stressors. When bees' immunity and resiliency as a species are compromised due to exposure to neonicotinoids, they are less capable of fighting off naturally occurring threats such as disease and mites. A bee experiencing sublethal effects of neonicotinoid exposure such as disorientation is impaired, and is less likely to adapt to habitat loss.

Stabilization of Loss Rates & Declines in Colony Collapse

Since the rise in annual colony loss rates between the 1990s and early 2000s, some beekeepers reported 100 percent colony losses, and some states experienced average colony losses of up to 60 percent.[147] [148] The recent high loss rates offset population additions. For example, 2017 began with 2.64 million bee colonies, but ended with 2.63 million despite over 800,000 colony additions.[149] Additionally, current bee colony numbers are not sufficient to meet the expected increase in agricultural demand. Recovery efforts, however, are not necessarily aimed at reversing historical trends and creating a long-term net increase in population. Rather, according to Professor

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[144] Michelle L. Hladik, Anson R. Main, and Dave Goulson. "Environmental Risks and Challenges Associated with Neonicotinoid Insecticides" Environmental Science & Technology 2018 52 (6), 3329-3335. DOI: 10.1021/acs.est.7b06388
[145] Jamie Ellis, "Biotic Stressors of Honey Bee Colonies." American Bee Journal, July 1, 2016. https://americanbeejournal.com/biotic-stressors-honey-bee-colonies/
[146] National Agricultural Statistics Service. "Honey Bee Colonies, 2018." https://downloads.usda.library.cornell.edu/usda-esmis/files/rn301137d/jq085n95f/mc87pt22m/BeeColonies-08-01-2018.pdf.
[147] Beeinformed, "Honey Bee Colony Losses 2018-2019: Preliminary Results. June 19, 2009. https://beeinformed.org/results/2018-2019/
[148] Johnson, Renee. Honey Bee Colony Collapse Disorder . 2010, fas.org/sgp/crs/misc/RL33938.pdf.
[149] National Agricultural Statistics Service. "Honey Bee Colonies, 2018." https://downloads.usda.library.cornell.edu/usda-esmis/files/rn301137d/jq085n95f/mc87pt22m/BeeColonies-08-01-2018.pdf.

Reed Johnson, a professor of Entomology at Ohio State University, the efforts enshrined in H.R. 1337 seek to maintain population numbers at current agricultural demand of 2.6 million colonies available for pollination and stabilize loss rates at approximately 20 percent.[150] While 20 percent is higher than historical averages, it is 10-30 percent lower than current rates, and is therefore a reluctantly accepted threshold if the historical average remains unfeasible.

Monitoring of Native Bees

Entomologists estimate that there are 4,000 native bee species in North America alone.[151] Multiple studies have shown that wild bees and bee diversity improves crop yields regardless of the presence of commercial honey bees, and that a decline in wild bees will negatively affect agriculture.[152] There is also preliminary data showing negative effects of neonicotinoids on wild bees, even when exposure was below USDA detection rates. However, current data on wild bees is limited. According to Aimee Code, Pesticide Program Director for Xerces Society, "Unlike managed bees, we don't have good baseline data on our native bees nor do we have beekeepers caring for them."[153] This lack of

H.R. 1337 would require the Board, in conjunction with other federal agencies, to monitor wild bee and pollinator populations and habitats. In addition, they would be required to submit an annual report on native bee health and populations, providing a better understanding of current and future action may affect the services they provide. New data and information in the annual reports will aid in understanding population losses and wild bees' contribution to the food system, ultimately allowing for new policy that can stabilize wild pollinator populations.

There are fewer studies concerning wild bees, but their importance cannot be overestimated. As many wild bee species also do pollination work, studies of honey bees provide a sobering picture of the potential future for wild bees, whose abundance in North America are estimated to have declined 23 percent between 2008 and 2013.[154] Numerous studies have shown that wild bees are essential for pollination, and that the richness of bee species diversity is positively linked to both crop yields[155] and fruit setting,[156] regardless of the number of honey bees[157] or the percentage of

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[150] Johnson, Reed. Personal Interview. July 22, 2019.
[151] Food and Agriculture Organization of the United Nations. Why Bees Matter: The Importance of Bees and Other Pollinators for Food and Agriculture, www.fao.org/3/i9527en/i9527en.pdf.
[152] Garibaldi, Lucas A., et al. "Wild Pollinators Enhance Fruit Set of Crops Regardless of Honey Bee Abundance." Science, American Association for the Advancement of Science, 29 Mar. 2013, science.sciencemag.org/content/339/6127/1608.full.
[153] Interview with Aimee Code, Pesticide Program Director for Xerces Society. July 25, 2019.
[154] Koh, Insu, et al. "Modeling the status, trends, and impacts of wild bee abundance in the United States." Proceedings of the National Academy of Sciences 113.1 (2016): 140-145.
[155] Halinski, Rosana, et al. "Influence of Wild Bee Diversity on Canola Crop Yields." Sociobiology 65.4 (2018): 751-759.
[156] Blitzer, Eleanor J., et al. "Pollination services for apple are dependent on diverse wild bee communities." Agriculture, Ecosystems & Environment 221 (2016): 1-7.
[157] Ibid.

flower visits.[158] Wild bees potentially have advantages over honey bees - studies indicate that their pollination produce larger and more abundant fruit yields.[159] Wild bees are also being exposed to and negatively affected by neonicotinoids. Research on wild bees in Britain posits neonicotinoids as a cause in the loss of bee diversity, showing that bumblebees fed on treated commercial crops and suffered negative effects.[160] Exposure to neonicotinoids has been show to damage wild bee colonies in numerous ways, including:

- Reducing the survival of queen and male bees,
- Changing expression of genes involved with locomotion, reproduction and immunity, and
- Causing bees to be less social and spend less time nursing larvae.[161] [162]

The combination of these effects can have a serious effect on the health of a hive. Troublingly, research also found sublethal effects at exposures so low that the USDA laboratory could not measure the amount of pesticide in provided samples.[163] The Saving America's Pollinator Act of 2019 would reduce the threats to native bees posed by pesticides, and comprehensive monitoring of these species following a ban on neonicotinoid pesticides should eventually highlight increases to their populations and improved overall resiliency.

Conclusion

The Saving America's Pollinators Act of 2019 is the most comprehensive piece of legislation the United States has seen regarding colony collapse, pollinator protection and the resulting potential food security crisis. As this report discusses, neonicotinoid use and regulation are complex issues, and the solutions are equally as complicated to implement. Competing priorities among stakeholders, specifically the interests of pesticide manufacturers and commercial farmers versus those of beekeepers and conservationists, create friction around the solutions proposed by the bill. The presence of all perspectives on the Pollinator Protection Board will work to alleviate some of this tension, but the bill is likely to face opposition as it moves forward and

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[161] Mobley, Melissa W., and Robert J. Gegear. "One size does not fit all: Caste and sex differences in the response of bumblebees (Bombus impatiens) to chronic oral neonicotinoid exposure." PloS one13.10 (2018): e0200041.
[162] Crall, James D., et al. "Neonicotinoid exposure disrupts bumblebee nest behavior, social networks, and thermoregulation." Science. 362.6415 (2018): 683-686.
[163] Ibid.

following its potential passage. A deficit of exhaustive research on this topic, as well as gaps in collective understanding of the nuances behind bees and pollinators more broadly has already impeded the ability of lawmakers to make progress. These issues will continue to hamstring future efforts, although the bill itself aims to solve some of the problems surrounding the science and data behind this issue.

The current political climate in the United States is not ideal for this legislation, or any environmental regulation. The Trump Administration has waged three years of attacks on environmental policies, and continues to question and refute once-endorsed scientific studies and proposed solutions. The passage of H.R. 1337 would not only indicate a commitment to collaboration across the various groups represented in this issue, but it would also represent bipartisan support for environmental protections. Republicans and Democrats alike would need to agree on the way the problem is framed in the bill, the urgency of the impending food crisis due to decreased pollination, and compromise on the specific solutions outlined. One major challenge to implementation lies within the EPA itself: current EPA Administrator Andrew Wheeler is a former coal lobbyist with a professional track record of putting the needs of industry before those of citizens.

The bill does not authorize a specific funding amount for the bill's implementation and adoption, instead authorizing what funds are necessary. Indeed, while the actual ban on neonicotinoid pesticide sales would not cost much on its own, the federal government should expect costly legal challenges from the pesticide industry and commercial farmers. The creation of the Pollinator Protection Board would consume additional federal resources within the EPA. Monitoring wild bee populations in a meaningful way would be an expensive and complicated endeavor that would likely require grants to be made to state agencies and universities to allow them to conduct technically intricate and labor intensive studies. For H.R. 1337 to succeed, it would need not only a supportive majority in the House of Representatives and Senate, but also considerations made during federal appropriations and budgeting processes.

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