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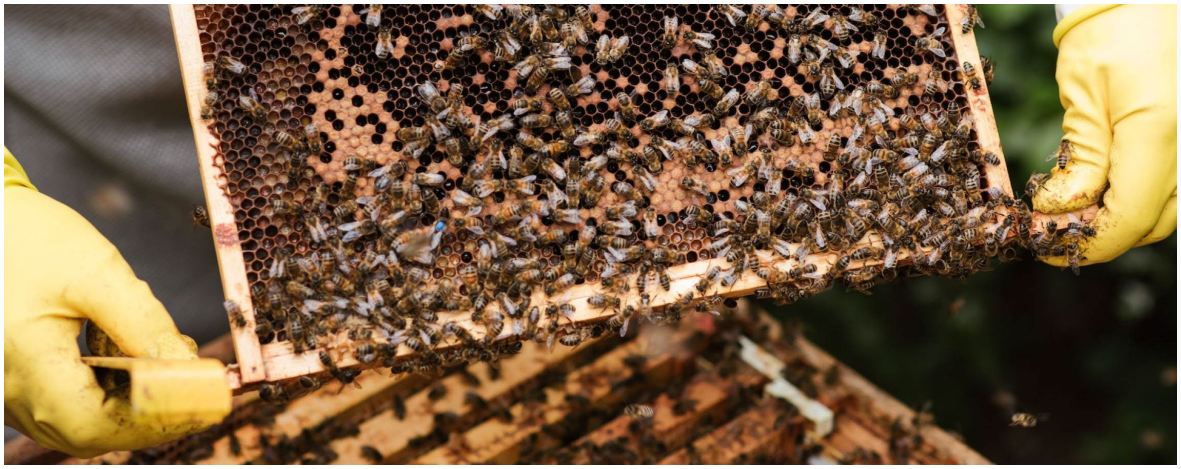
PennState

Honey bee colony loss in the U.S. linked to mites, extreme weather, and pesticides

Gail McCormick

30 January 2023



About one-third of the food eaten by Americans comes from crops pollinated by honey bees, yet the insect is dying off at alarming rates. In one year alone, between April of 2019 and April of 2020, one study reported a 43% colony loss in honey bees across the United States.

A new study led by Penn State researchers provides preliminary insight on the potential effects of several variables, including some linked to climate change, on honey bees. Their findings show that honey bee colony loss in the U.S. over the last five years is primarily related to the presence of parasitic mites, extreme weather events, nearby pesticides, as well as challenges with overwintering. The study took advantage of novel statistical methods and is the first to concurrently consider a variety of potential honey bee stressors at a national scale. The study, published online in the journal Scientific Reports, suggests several areas of concern to prioritize in beekeeping practices.

“Honey bees are vital pollinators for more than 100 species of crops in the United States, and the widespread loss of honey bee colonies is increasingly concerning,” said Luca

Insolia, first author of the study, a visiting graduate student in the Department of Statistics at Penn State at the time of the research, and currently a postdoctoral researcher at the University of Geneva in Switzerland. “Some previous studies have explored several potential stressors related to colony loss in a detailed way but are limited to narrow, regional areas. The one study that we know of at the national level in the United States explored only a single potential stressor. For this study, we integrated many large datasets at different spatial and temporal resolutions and used new, sophisticated statistical methods to assess several potential stressors associated with colony collapse across the U.S.”

The research team, composed of statisticians, geographers, and entomologists, gathered publicly available data about honey bee colonies, land use, weather, and other potential stressors from the years 2015 to 2021. Because these data came from a variety of sources, they varied in resolution over both space and time. The weather data, for example, contained daily data points for areas only few square miles in size, but data on honey bee colonies was at the state level for a several-month period.

“In order to analyze the data all together, we had to come up with a technique to match the resolution of the various data sources,” said Martina Calovi, corresponding author of the study, a postdoctoral researcher in the Department of Ecosystem Science and Management at Penn State at the time of the research, and currently an associate professor of geography at the Norwegian University of Science and Technology. “We could have just taken an average of all the weather measurements we had within a state, but that boils all the information we have into one number and loses a lot of information, especially about any extreme values. In addition to averaging weather data, we used an ‘upscaling’ technique to summarize the data in several different ways, which allowed us to retain more information, including about the frequency of extreme temperature and precipitation events.”

The researchers used the resulting integrated resolution-matched dataset—which they have made available for use by other researchers—alongside sophisticated statistical modeling techniques that they developed to assess the large number of potential stressors at the same time.

The research team found that several stressors impacted honey bee colony loss at the national level, including the presence of nearby pesticides, frequent extreme weather events, and weather instability. Colony loss was also related to the presence of parasitic mites, Varroa destructor, which reproduce in honey bee colonies, weaken the bees, and potentially expose them to viruses. The researchers also found that losses typically occurred between January and March, likely related to challenges with overwintering, but that some states do not follow this pattern.

“Our results largely reinforce what regional studies have observed and confirm that regional patterns around these stressors are actually more widespread,” said Insolia, a beekeeper himself. “These results also inform actions that beekeepers could take to help circumvent these stressors and protect their colonies, including treatments for the Varroa mite, especially in areas of weather instability. Beekeepers could also consider strategies to move their colonies to areas with high food availability or away from nearby pesticides or to provide supplementary food during certain seasons or months with frequent extreme weather events.”

The researchers note that having data about beekeeping practices and colony loss at a finer resolution would allow validation of their results and a more nuanced look at honey bee stressors.

“It would be incredibly beneficial to explore beekeeping practices at a finer scale than the state level,” said Calovi. “In many cases, beekeeping associations and other organizations collect this data, but it is not made available to researchers. We hope our study will help motivate more detailed data collection as well as efforts to share that data—including from smaller organizations such as regional beekeeper associations.”

The research team also found a strong relationship between colony loss and a broad category of beekeeping practices noted on a USDA survey as ‘"other,’" which contained everything from hives being destroyed to food scarcity to queen failure. They noted that collecting this data in more detail and breaking up this catch-all type variable would improve their ability to connect particular stressors to colony collapse.

“A changing climate and high-profile extreme weather events like Hurricane Ian—which threatened about 15% of the nation’s bees that were in its path as well as their food sources—are important reminders that we urgently need to better understand the stressors that are driving honey bee colony collapse and to develop strategies to mitigate them,” said Francesca Chiaromonte, professor of statistics and the holder of the Lloyd and Dorothy Foehr Huck Chair in Statistics for the Life Sciences at Penn State and a senior member of the research team. “Our results highlight the role of parasitic mites, pesticide exposure, extreme weather events, and overwintering in bee colony collapse. We hope that they will help inform improved beekeeping practices and direct future data collection efforts that allow us to understand the problem at finer and finer resolutions.”

In addition to Insolia, Calovi, and Chiaromonte, the research team includes Roberto Molinari, Lindsay Visiting Assistant Professor of Statistics at Penn State at the time of the research and currently an assistant professor of statistics at Auburn University; Stephanie Rogers, assistant professor of geosciences at Auburn University; and Geoffrey Williams, associate professor of entomology and plant pathology at Auburn University.
The study authors were supported in part by the Scuola Normale Superiore in Italy, the Sant’Anna School in Italy, and the Penn State Huck Institutes of the Life Sciences.

https://science.psu.edu/news/Chiaromonte1-2023

USDA ARS Agricultural Research Service

Metabolic Pathway in Honey Bees Discovered with Strong Connections to Winter Colony Losses

Contact: Kim Kaplan
Email: Kim.Kaplan@usda.gov
January 19, 2023

Agricultural Research Service scientists and their Chinese colleagues have identified a specific metabolic pathway that controls how honey bees apportion their body's resources such as energy and immune response in reaction to stresses such as winter's cold temperatures, according to recently published research.

This cellular pathway has the strongest connection yet found to the large overwintering colony losses that have been plaguing honey bees and causing so much concern among beekeepers, and farmers, especially almond producers, during the last 15 years, said entomologist Yanping "Judy" Chen, who led the study. She is with the ARS Bee Research Laboratory in Beltsville, Maryland.

The "signaling" pathway governs the increased and decreased synthesis of the protein SIRT1, one of a family of proteins that help regulate cellular lifespan, metabolism and metabolic health, and resistance to stress.

"In honey bees merely exposed to a cold challenge of 28 degrees C (82.4 degrees F) for five days, we saw almost three-fold lower levels of SIRT1 and significantly higher levels of colony mortality compared to bees maintained at 34-35 degrees C (93.2-95 degrees F), which is the optimal core temperature of a honey bee cluster inside a bee hive in winter," Chen said.

The researchers also found that bees under cold stress were associated with an increased risk of disease infections, which in turn led to an increased likelihood of colony losses.

For example, when honey bee colonies were inoculated with the intracellular microsporidia parasite Nosema ceranae, and kept at 34 degrees C, they had a survival rate of 41.18 percent while the mortality rate of the colonies exposed to the cold stress of 28 degrees C for 5 days was 100 percent.

"So that showed it is primarily cold stress that the SIRT1 signaling pathway is responding to rather than pathogens," Chen said. "Our study suggests that the increased energy overwintering bees use to maintain hive temperature reduces the energy available for immune functions, which would leave overwintering bees more susceptible to disease infections; all leading to higher winter colony losses."

Chen points out this research also offers a promising avenue for new therapeutic strategies to mitigate overwintering and annual colony losses. One way could be by raising the production of the SIRT1 protein by treating honey bees with SRT1720, a specific SIRT1 gene activator being experimentally used as an anti-inflammatory and anti-cancer treatment.

The Agricultural Research Service is the U.S. Department of Agriculture's chief scientific in-

house research agency. Daily, ARS focuses on solutions to agricultural problems affecting America. Each dollar invested in U.S. agricultural research results in $20 of economic impact.

https://www.ars.usda.gov/news-events/news/research-news/2023/metabolic-pathway-in-honey-bees-discovered-with-strong-connections-to-winter-colony-losses/

Food.

Honey imported into the US found to be adulterated

By Vikki Davies

January 30, 2023

The FDA says that 10 per cent of imported honey samples that it recently assessed were found to be adulterated with undeclared added sweeteners.

The US Food and Drug Administration (FDA) has released data from a sampling assignment carried out in 2021 and 2022 to test imported honey for economically motivated adulteration (EMA).

EMA occurs, for example, when someone intentionally leaves out, takes out, or substitutes a valuable ingredient or part of a food or when a substance is added to a food to make it appear better or of greater value.

The sampling was designed to identify products that contained less expensive undeclared

added sweeteners, such as syrups from cane and corn. The agency collected and tested 144 samples of imported honey from bulk and retail shipments from 32 countries. The FDA found 14 samples (10%) to be violative. The agency refused entry of violative shipments into the US and placed the associated company and product on an import alert.

A spokesman for the FDA said in a statement: "The FDA routinely assesses imported honey products to ensure accurate product labelling and otherwise help keep consumers from being deceived.

"The agency will continue to test honey for EMA under the agency's import sampling and risk-based import entry screening programme.

"Violative samples are subject to agency action, such as recall and import refusal, consistent with the agency's mission to ensure that food is safe, wholesome and properly labelled. When appropriate, the agency may consider pursuing criminal investigations.

"The FDA also collaborates with international counterparts to detect and combat EMA related to imported products, including honey."

https://fooddigital.com/articles/some-honey-imported-into-the-us-found-to-be-adulterated

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Bee Culture
The Magazine of American Beekeeping

Parasitic Mites' Biting Rate

Parasitic Mites' Biting Rate May Drive Transmission Of Deformed Wing Virus In Honey Bees

By Eurasia Review

Varroa destructor is an ectoparasitic mite that can cause European honey bee colonies to collapse by spreading Deformed wing virus as they feed. A study published in PLOS Pathogens by Zachary Lamas and colleagues at the USDA-ARS and the University of Maryland suggests a relatively small number of mites can contribute to a large number of infected bees.

Arthropod disease vectors transmit pathogens while feeding on susceptible hosts. However, little is known about how the feeding dynamics of Varroa spread viruses in adult honey bees. In order to better understand Varroa mite parasitism on honey bees, researchers conducted a series of experiments. First, they used fluorescent microspheres to test if Varroa were feeding on adult bees each time they entered a known feeding position. They next determined whether microspheres could be transferred from a Varroa to an adult bee via Varroa feeding by allowing Varroa to feed on bee pupae which had been injected with fluorescent microspheres. In the third experiment, researchers observed mites switching from adult bee host to host. The researchers then observed how a single mite could spread pathogens by feeding on multiple bees and calculated the relative risk of Varroa parasitism on adult workers.

Mites with high virus levels and which switched the most frequently contributed to the highest mortality in adult honey bees. Varroa are promiscuous feeders and switch hosts at a high rate. Mites switching hosts at the highest frequency were responsible for nearly three times as many parasitized hosts as their lower switching counterparts. Future studies are needed to better understand the mechanisms driving mites to switch hosts.

According to the authors, “Our work shows that viral spread is driven by Varroa actively switching from one adult bee to another as they feed. Relatively few of the most active Varroa parasitize the majority of bees. The ability to parasitize and infect multiple adult bees provides the best explanation to date for the maintenance and subsequent host-to-host spread of viruses among the long-lived worker bees common in these crowded and

vulnerable colony populations".

We are here to share current happenings in the bee industry. Bee Culture gathers and shares articles published by outside sources. For more information about this specific article, please visit the original publish source: https://www.eurasiareview.com/20012023-parasitic-mites-biting-rate-may-drive-transmission-of-deformed-wing-virus-in-honey-bees/

Raw Honey from Argentina, Brazil, India, and Vietnam Injures U.S. Industry, Says USITC

May 11, 2022
News Release 22-058
Inv. No. 731-TA-1560-1562 and 731-TA-1564 (Final)
Contact: Jennifer Andberg, 202-205-1819

Raw Honey from Argentina, Brazil, India, and Vietnam Injures U.S. Industry, Says USITC

The United States International Trade Commission (USITC) today determined that a U.S. industry is materially injured by reason of imports of raw honey from Argentina, Brazil, India, and Vietnam that the U.S. Department of Commerce (Commerce) has determined are sold in the United States at less than fair value.

Chair Jason E. Kearns, Vice Chair Randolph J. Stayin, and Commissioners David S. Johanson, Rhonda K. Schmidtlein, and Amy A. Karpel voted in the affirmative.

As a result of the Commission's affirmative determinations, Commerce will issue antidumping duty orders on imports of this product from Argentina, Brazil, India, and Vietnam.

The Commission made a negative critical circumstances finding with regard to imports of this product from Argentina. The Commission made an affirmative critical circumstances finding with regard to imports of this product from Vietnam.

The Commission's public report *Raw Honey from Argentina, Brazil, India, and Vietnam* (Inv. Nos. 731-TA-1560-1562 and 731-TA-1564 (Final), USITC Publication 5327, May 2022) will contain the views of the Commission and information developed during the investigations.

The report will be available by June 20, 2022; when available, it may be accessed on the USITC website at: *http://pubapps.usitc.gov/applications/publogs/qry_publication_loglist.asp*.

UNITED STATES INTERNATIONAL TRADE COMMISSION
Washington, DC 20436

FACTUAL HIGHLIGHTS
Raw Honey from Argentina, Brazil, India, and Vietnam
Investigation Nos.: 731-TA-1560-1562, 1564 (Final)

Product Description: Honey is a sweet, viscous fluid produced from the nectar of plants

and flowers which is collected by honeybees, transformed, and combined with substances of their own, and stored and left in honeycombs to mature and ripen. Raw honey is honey as it exists in the beehive or as obtained by extraction, settling and skimming, or straining.

Status of Proceedings:

1. Type of investigation: Final antidumping duty investigations.
2. Petitioners: American Honey Producers Association ("AHPA"), Bruce, South Dakota; and Sioux Honey Association ("SHA"), Sioux City, Iowa.
3. USITC Institution Date: Wednesday, April 21, 2021.
4. USITC Hearing Date: Tuesday, April 12, 2022.
5. USITC Vote Date: Wednesday, May 11, 2022.
6. USITC Notification to Commerce Date: Tuesday, May 31, 2022.

U.S. Industry in 2020:

1. Number of U.S. producers: approximately 30,000 to 60,000.
2. Location of producers' plants: North Dakota, South Dakota, California, Texas, Montana, Florida, Minnesota, and Michigan
3. Production and related workers: 1,360.
4. U.S. producers' U.S. shipments: $302 million.
5. Apparent U.S. consumption: $690 million.
6. Ratio of subject imports to apparent U.S. consumption: 42.8 percent.

U.S. Imports in 2020:

1. Subject imports: $296 million.
2. Nonsubject imports: $93 million.
3. Leading import sources: Argentina, Brazil, India, Vietnam.

https://www.usitc.gov/press_room/news_release/2022/er0511ll1935.htm

What does this mean for beekeepers?

The decision will be transmitted to the Commerce Department, which will issue antidumping duty orders shortly. In addition, the Commission reached an affirmative critical circumstances determination against Vietnam. This means that U.S. Customs will collect antidumping duties on entries going back an additional 90 days prior to the preliminary antidumping duty determination—from August 28, 2020, forward. This is an important additional finding, and one that the Commission rarely makes.

These results should continue to ensure that the American honey producer gets the fair prices they deserve.

We truly appreciate all of the donations that we have received to cover legal fees.

The good fight isn't over yet, however, and we still need your support.

To donate to the Antidumping Fund, please contact
Cassie Cox: cassie@ahpanet.com
281-900-9740

Or donate on our secure website: https://www.ahpanet.com/donations-1

American Honey Producers Association

AHPA App

As AHPA continues to work on behalf of all beekeepers, one of our initiatives is advocating with the FDA in Washington D.C. to update honey labeling guidelines. As part of this effort, we need your help to collect pictures of honey labels from around the United States. Our goal is primarily to find honey that is mislabeled according to current FDA guidelines. Secondarily, we need examples of any labels which misrepresent country of origin or are purposefully confusing to consumers so that we can advocate for positive changes and updates.

Search the App Store or Google Play for "AHPA app". We need to collect as many pictures from honey on the store shelf as possible. Please take a few minutes to help collect this data.
