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Pollinators are Essential Workers

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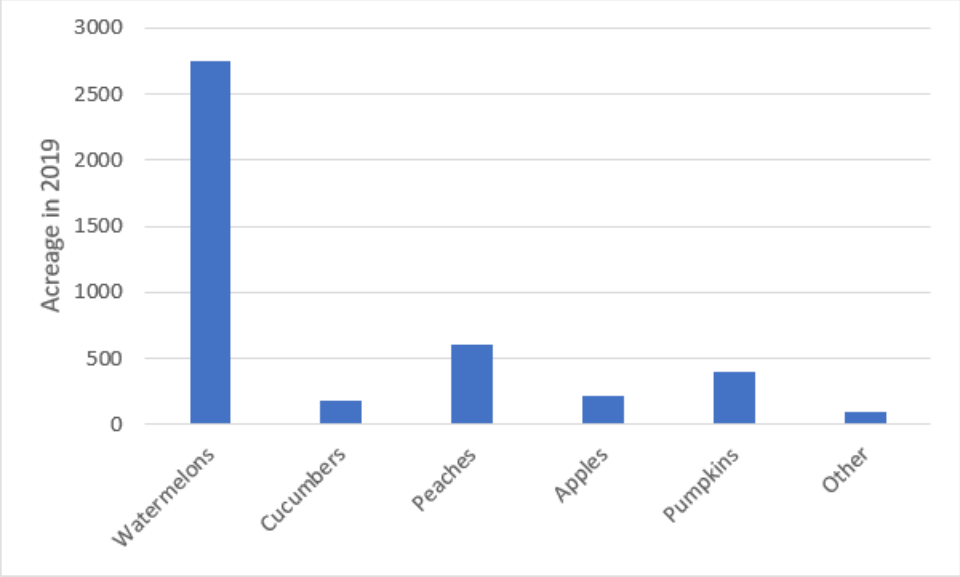
Agriculture in the United States is largely a system of large-scale monocultures. This means that fields requiring bee pollination are food deserts for bees when crops aren't blooming. As a result, the landscape does not sustain enough pollinators to provide sufficient crop pollination. To meet this demand, commercial beekeepers truck hives around the country. Beekeepers move hives by loading trucks at night or in the early morning, when bees are inside the hives and not flying. In 2012, the pollination industry was valued at $15 to $29 billion per year.[1]

The seasonality of bloom periods for crops throughout the country has resulted in a pollination circuit for commercial beekeepers. Two-thirds of the nation's commercial hives (roughly 2 million hives) spend the month of February in California, where they pollinate more than 1.3 million acres of almonds. Large influxes of hives also go to Florida for orange pollination; the Northeast for blueberry, cranberry, apple, and vegetable production; and West coast states for apple, cherry, and plum production. North and South Dakota, the nation's top honey-producing states, also receive huge influxes of hives to their rangeland for summer honey production.[2]

In Delaware, over 300 registered beekeepers manage the approximately 2,000 bee colonies that reside in Delaware year-round. Most of these beekeepers are hobbyists with fewer than ten hives. Delaware does not have enough commercial beekeeping operations to fulfill crop pollination requirements. Approximately 1,500 hives are moved into Delaware each summer for commercial pollination contracts, largely for watermelon production. These migratory hives come from New Jersey, Maryland, Pennsylvania, Florida, and Louisiana. In 2019, Delaware had over 4,000 acres of crops requiring bee pollination, including more than 2,700 acres of watermelons (Figure 1). The remaining acreage primarily consisted of cucumbers, peaches, apples, and pumpkins.[3]

Figure 1. Acreage of crops directly dependent on bee pollination in Delaware in 2019[3]



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The importance of bee pollination is often framed as a food security issue. However, none of the starchy staple crops that provide 90 percent of the world's caloric intake (rice, corn, wheat, barley, millet, rye, sorghum, teff, and root and tuber crops), require bee pollination. Rather, bee pollination improves diet quality by adding flavor, color, and nutrients to our diets in the form of fruits, vegetables, nuts, and seeds. Some self-fertile crops, such as oranges, almonds, and blueberries, experience higher yields and larger fruits with bee pollination. Crops such as watermelons, squash, and cucumbers will not bear fruit without bee pollination. Crops that are directly dependent on pollinators require pollinators to produce a fruit. Indirectly dependent crops require pollinators to set seed, but not to produce the crop itself. Indirectly dependent crops include carrots, onions, celery, beets, cabbage, alfalfa, and others. Meat, dairy, and eggs rely indirectly on bee pollination, because livestock are fed alfalfa.

Apiary Program

The Apiary Program at the Delaware Department of Agriculture provides both education and regulatory services. All apiaries in Delaware must be registered, including those of hobbyist beekeepers with just a few hives. The State Apiarist manages two teaching apiaries for hands-on beekeeping workshops, and gives presentations on best management practices to local beekeeping groups. To reduce the spread of bee pests and pathogens, hives are inspected by the Delaware Department of Agriculture Apiary Program prior to transport. Hive equipment is also surveyed for hitchhiking pests such as fire ants or spotted lanternflies. Our Apiary Program inspects all operations that sell bees to ensure that hives are free of any regulated pests or pathogens. In addition to inspecting hives for transport and sale, the Apiary Program aims to inspect apiaries managed by a third of all registered beekeepers each year.

During inspections, any pests or pathogens observed in hives are recorded. Delaware beekeepers contend with numerous hive pests, including *Varroa* mites, small hive beetles, and wax moths. Problematic pathogens include American and European Foulbrood bacteria, *Nosema* and chalkbrood fungi, and numerous viruses, including Deformed Wing Virus, Sacbrood Virus, and many others.

The Apiary Program also conducts research projects. Every year, the State Apiarist collects samples for the National Honey Bee Survey, which provides a comprehensive study of disease and pest loads. In addition to tracking endemic pests and diseases, the National Honey Bee Survey monitors hives for global threats to honey bees not currently found in the United States. These threats include the *Tropilaelaps* mite, which feeds on developing brood stages, Slow Bee Paralysis Virus, which paralyzes the front two legs of adult honey bees, and exotic honey bee species such as the Asian Honey Bee *Apis cerana.* The State of Delaware is also monitoring for invasive bees and wasps such as the Asian Giant Hornet *Vespa mandarinia,* which was recently detected in Washington State. Both the National Honey Bee Survey and the Bee and Wasp Survey are funded by the United States Department of Agriculture Animal and Plant Health Inspection Service (USDA-APHIS).

Varroa Mites

The *Varroa destructor* mite is the most damaging honey bee pest in the United States. *Varroa* mites have a worldwide distribution and are widespread everywhere in the United States, with the exception of some of the Hawaiian Islands. *Varroa* mites reproduce on developing brood and feed on the fat body of developing brood and adults. *Varroa* mites hitch rides on foraging bees,

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and are transmitted to other bees while foraging on flowers. Foragers may also drift into neighboring hives or attempt to rob resources from other hives. Movement of bees into nearby hives is a major source of *Varroa* transmission. Part of the reason *Varroa* mites are so damaging is their body size. A similarly large parasite in humans would be roughly the size of a Chihuahua. In addition, *Varroa* mites transmit viruses such as Deformed Wing Virus, which causes shriveled wings. Bees with deformed wings are unable to fly and die when only a few days old. In addition to viruses directly transmitted by *Varroa* mites, mite infestation weakens hives and makes them more susceptible to other diseases, such as European Foulbrood and Sacbrood virus.

Beekeepers manage *Varroa* mites through cultural techniques and miticides. Cultural techniques include creating breaks in the honey bee brood development cycle to prevent mites from reproducing on developing brood, selecting queens with genetic resistance to mites, and removing drone brood (Figure 2). Male honey bees develop on drone brood, and their large body size and longer developmental time favors greater mite reproduction. Since female honey bees perform all of the tasks in the hive, and males are only necessary for mating with the queen, drone brood can be removed without weakening the colony. Chemical control for *Varroa* mites involves using organic acid, synthetic chemical, or essential oil treatments to kill mites. These miticides must be applied in compliance with the product's label directions, because misuse could cause damage to the hive or contamination of honey.

Figure 2. The State Apiarist demonstrates how to check for *Varroa* mites at a workshop at the Delaware Department of Agriculture's teaching apiary at Blackbird State Forest.

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American Foulbrood

American Foulbrood (AFB) is caused by the spore-forming bacterium *Paenibacillus larvae*. The disease is found throughout the United States and has a worldwide distribution. Currently, American Foulbrood is the only regulated apiary pathogen in Delaware. Hives with confirmed AFB infection are required to be destroyed. Brood infected with AFB appears coffee-colored and has a ropy texture and foul odor. AFB is regulated because the disease is deadly, incurable, and has spores that can survive up to 40 years. The biggest risk factor for AFB is use of contaminated equipment. Robbing behavior, when bees steal honey from other hives, can also spread AFB. While there are antibiotics approved to treat AFB, these antibiotics do not kill the long-lived spores. If a beekeeper ceases treatment with antibiotics, the disease can recur.

European Foulbrood

European Foulbrood (EFB) is caused by the bacterium *Melissococcus plutonius.* European Foulbrood is not a regulated disease in Delaware because it lacks the long-lived spore stage. EFB also has a worldwide distribution. Unlike AFB, hives can recover from EFB infection. EFB tends to be more prevalent under conditions of stress, such as locations with nectar or pollen dearths. EFB can often be managed through cultural techniques such as providing supplemental nutrition, replacing the queen, and replacing old equipment to prevent pathogen build-up. Even without a spore stage, EFB bacteria can remain on equipment for a year or more. Some more virulent strains of EFB may not resolve without antibiotics. Treatment with antibiotics requires a veterinary feed directive (VFD) from a veterinarian. A VFD is similar to a prescription, and it prevents antibiotics from being used unnecessarily or incorrectly. Overuse of antibiotics can lead to antibiotic resistance, and misuse could lead to contamination of honey.

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Winter Losses

According to the Bee Informed Partnership's annual management survey, hive losses in Delaware from 2010 to 2020 have ranged from 30.0 to 64.2 percent.[4] These losses have tracked closely with national averages. Common causes of winter losses include high *Varroa* mite infestation loads and starvation due to insufficient stored honey. Educational workshops performed by the Apiary Program aim to improve the health and survival of Delaware's bee colonies.

Broader Importance of Pollinators

Describing pollination services solely in terms of their importance to agriculture and the economy understates their importance. About 80 percent of the world's flowering plants rely on pollinators to reproduce. While commercial pollination is largely performed by honey bees, there are over 4,000 species of native bees in the United States. Flies, wasps, moths, beetles, butterflies, birds, and bats also pollinate plants. While unmanaged pollinators contribute to crop pollination, their impact on the broader ecological community is far greater. Without pollinators, the structure of plant communities would change, altering ecosystems and food webs in unpredictable ways.

How You Can Help Pollinators

The biggest step anyone can take to help pollinators to plant flowers. Our heavily managed landscapes of grassy lawns, developed hardscapes, regularly mowed roadsides, and weed-free farm fields provide little benefit to bees. By planting flowers, you will provide nectar and pollen sources for managed honey bees, our native wild bees, and other pollinators. Even if you only have space for a few potted plants, you can have a small pollinator garden. The following resources are helpful guides on planting habitat for pollinators in the State of Delaware.

Books:

- Hendy, J., & Evans, A. (2014). *Encyclopedia of garden plants for every location*. NY, NY: Dorling Kindersley Limited.
- Lee-Mäder, E. (2011). Attracting native pollinators: Protecting North America's bees and butterflies: The Xerces Society guide. North Adams, MA: Storey Pub.
- Lindtner, P. (2014). *Garden Plants for Honey Bees*. Kalamazoo, MI: Wicwas Press, LLC.
- Sarver, M. (2007). *Delaware native plants for native bees*. Dover, DE: USDA NRCS and Delaware Dept. of Agriculture.

Websites:

- The Xerces Society: https://www.xerces.org/
- Penn State Extension: https://extension.psu.edu/planting-pollinator-friendly-gardens
- University of Delaware Extension: https://www.udel.edu/academics/colleges/canr/cooperative-extension/environmental-stewardship/master-gardeners/garden-helpline/

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- Pollinator Partnership Ecoregional Planting Guides: https://www.pollinator.org/guides
- Lady Bird Johnson Wildflower Center: https://www.wildflower.org/plants/

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