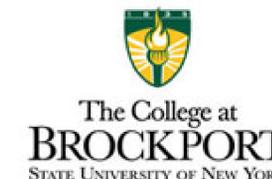


POLLINATOR APOCALYPSE

Elizabeth Bean, Ryan Kirkpatrick, Abby Lanterman, Tucker Griffin, Jacob Kearney
Department of Environmental Science and Ecology, The College at Brockport, Brockport, NY 14420



Background:

40% of all insect species are in decline

- Many areas report 10-75% declines in insect abundance⁷

Declines due to:

- Pesticide, herbicide, fungicide, and insecticide usage (Figure 3), habitat loss, climate change, agricultural expansion, invasive species, disease, and parasites, like varroa mites on bees (Figure 2)⁷

Who's in trouble:

- Butterflies (Figure 1), solitary bees, honeybees, beetles, moths, flies, and wasps⁷

75-95% of all crops rely on pollinators

- Estimated 1 of every 3 bites of food we take in the US is from pollinators²

Pollination is a vital interaction allowing genetic material to transfer from plant to plant for reproduction¹¹

Ecological Importance

- Insects are the primary pollinators of flowering plants.¹¹
- Bees pollinate 88% of all plants worldwide.¹²
- Native plant populations will decrease as pollinator populations decrease.¹⁴
- Insects themselves are a food source for other animals and a major component of food webs.¹⁰
- If insect populations continue to decline, we may witness a complete ecosystem collapse.¹⁰

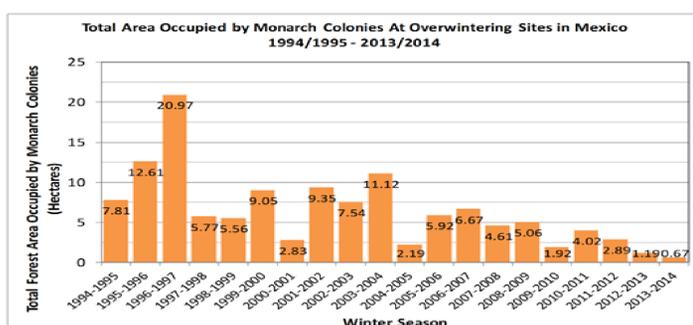


Figure 1: Shows the area occupied in overwintering grounds by Monarch butterflies from 1994 to 2014.¹⁵

Politics and Pollinators

FIFRA- Federal Insecticide, Fungicide, and Rodenticide Act regulates usage of pesticides and other chemicals

In 2017 US implemented policy protecting bees from pesticide applications¹

- Halt approval of new outdoor neonicotinoid pesticides¹
- Develop new bee exposure and effect testing for new pesticides¹
- Develop risk management approach for monarch butterfly and protect milkweed¹

As of 2019, 28 states have enacted pollinator protection laws⁹

There has been a big push for new laws protecting pollinators, but there is a severe lack in research on native pollinators to support such legislation¹³

Consequences of Pollinator Loss

Native plant maintenance and pollination will decrease¹³

- 80% of wild plant species depend on insects for pollination¹³
- Fewer native plant species will also result in fewer food sources for pollinators¹³

Decrease in crop production¹³

- Insect pollinators are required for 75% of food crops¹³
- Decreased variety in foods available¹³

Decrease in biodiversity¹³

- Plants will have a lower regeneration rate and rare plants will go extinct¹³
- Animal populations dependent on insect-pollinated plants will decline¹³

Social and Cultural Aspects of Pollinators

- National Pollinator Week raises awareness about the importance of pollinators
- Artificial bee houses in home gardens
- A large social stigma exists about insects
 - Many people consider them to be nuisances especially bees, but not all bees are aggressive and sting, people are still afraid of them and want to kill anything that acts or looks like a bee
- Non-native species and diseases, usually due to human transportation of foreign fauna and flora, harm pollinators
- During the 1990's, North American bumble bee colonies were often being exported to Europe for rearing⁵
 - many were unknowingly infected with parasites
 - bees can escape greenhouses and infect native bees



Figure 2: Image shows Varroa mites, an external parasite, on a honeybee. These mites are one of the greatest threats to bee colonies.¹⁷

References

- (1) Environmental Protection Agency. 2020. Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and Federal Facilities. [Online.] Available at: <https://www.epa.gov/enforcement/federal-insecticide-fungicide-and-rodenticide-act-fifra-and-federal-facilities>. Accessed March 2020.
- (2) Farah, T. 2018. While we worry about honeybees, other pollinators are disappearing. [Online.] Available at: <https://www.discovermagazine.com/environment/while-we-worry-about-honeybees-other-pollinators-are-disappearing>. Accessed March 2020.
- (3) Fernandez-Cornejo, J., C. Ostera, R. Nohring, and S.J. Wechsler. 2014. Pesticide use peaked in 1981, then trended downward, driven by technological innovations and other factors. [Online.] Available at: <https://www.ers.usda.gov/amber-waves/2014/june/pesticide-use-peaked-in-1981-then-trended-downward-driven-by-technological-innovations-and-other-factors/>. Accessed March 2020.
- (4) Gallati, N., J.M. Sallés, J. Sentele, B.E. Vaissière. 2009. Economic valuation of the vulnerability of world agriculture confronted with pollinator decline. *Ecological Economics*. Elsevier. 68: 810-821.
- (5) Great Pollinator Project. 2014. Major Threats to Pollinators. [Online.] Available at: <http://greatpollinatorproject.org/conservation/major-threats-to-pollinators>. Accessed March 2020.
- (6) Great Pollinator Project. 2014. Food resources. [Online.] Available at: <http://greatpollinatorproject.org/management/food-resources>. Accessed March 2020.
- (7) Main, D. 2019. Why insect populations are plummeting – and why it matters. [Online.] Available at: <https://www.nationalgeographic.com/animals/2019/02/why-insect-populations-are-plummeting-and-why-it-matters/>. Accessed March 2020.
- (8) Modern Agriculture. 2018. THE BEE ECONOMY: ECONOMICS AND INSECT POLLINATION The Economics of Insect Pollination. [Online.] ModernAg. Available at: <https://modernag.org/biodiversity/economics-economic-value-pollination>
- (9) National Conference of State Legislatures. 2020. Pollinator Health. [Online.] Available at: <https://www.ncsl.org/research/environment-and-natural-resources/pollinator-health.aspx>. Accessed March 2020.

Economics:

Upwards of \$500 billion worth of global food production relies on the direct contribution of pollinators annually.⁸

- Honey bees alone contribute nearly \$20 billion to the value of U.S. crop production.⁸

In 2005, the economic value of insect pollination for worldwide agriculture was approximately \$163 billion.⁴

Beef and dairy products rely on the seed production of forage legumes such as alfalfa.⁴

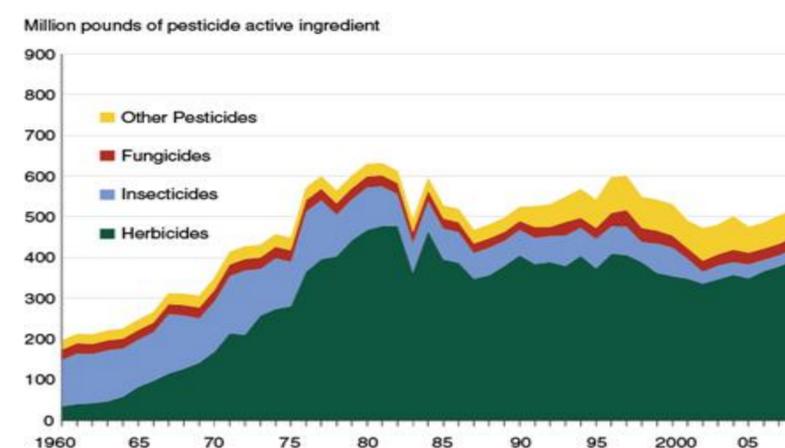
- Accounts for about 80% of the economic value of insect pollinators (~ \$213 billion dollars).⁴

Some crops, including blueberries and cherries, are 90% dependent on honey bee pollination.⁸

- Almonds depend entirely on the honey bees for pollination.⁸

Native bees provide pollination services for free!

Pesticide use in U.S. agriculture peaked in 1981 (21 selected crops, 1960 -2008)



Source: USDA, Economic Research Service using USDA, National Agricultural Statistics Service and proprietary data.

Figure 3: Various pesticide usage in the United States from 1960 to 2008.³

Solutions to Pollinator Loss:

Removal of invasive species⁶

- Attract pollinators to inferior food sources, crowd out native pollen and larval food sources⁶

Reduce pesticide and insecticide usage¹⁶

- kill more than just targeted pests¹⁶
- Bees can bring back pesticides to hive and kill the entire colony¹⁶

Spray pesticides at night and avoid spraying on blooms¹⁶

Create stricter laws surrounding pesticide usage¹⁶

Increase public awareness about the importance of pollinators and their decline¹³

Establish wildlife refuges to protect habitat¹³

Plant a pollinator garden⁶

- (10) The Pennsylvania State University. What Are Pollinators and Why Do We Need Them? [Online.] Available at: <http://ento.psu.edu/pollinators/resources-and-outreach/what-are-pollinators-and-why-do-we-need-them/>. Accessed March 2020.
- (11) Pollinator Partnership. 2019. Pollinators need you. You need pollinators. [Online.] Available at: <https://www.pollinator.org/pollinators>. Accessed March 2020.
- (12) Pollinator Partnership. What Are Pollinators. [Online.] Available at: <https://www.pollinator.org/pollination>. Accessed March 2020.
- (13) Potts S.G., J.C. Biesmeijer, C. Kremen, P. Neumann, O. Schweiger, and W.E. Kunin. 2010. Global pollinator declines: trends, impacts, and drivers. *Trends in ecology and evolution* 25: 345-353.
- (14) United States Department of Agriculture. The Importance of Pollinators. [Online.] Available at: www.nrcs.usda.gov/wps/portal/nrcs/detail/pa/plants/animals/?cid=nrcs142p2_018171. Accessed March 2020.
- (15) United States Department of Transportation Federal Highway Administration. Literature Review: Pollinator Habitat Enhancement and Best Management Practices in Highway Rights-of-Way. [Online.] Available at: https://www.environment.dhs.gov/sites/default/files/pollinator_reports/pollinators_BMPs_in_highway_ROW.aspx. Accessed April 2020.
- (16) University of Georgia. 2019. Protecting pollinators from pesticides. [Online.] Available at: <https://bees.caes.uga.edu/bees-keeping-pollination/pollination-protecting-pollinators-from-pesticides.html#preventing>. Accessed March 2020.
- (17) University of Texas A&M Agrilife Research. Varroa Mites. [Online.] Available at: <https://txbeesinspection.tamu.edu/varroa-mites/>. Accessed April 2020.