Why Are Our Natural Pollinators in Decline?

The loss of biodiversity is a worldwide, urgent crisis. Plant biodiversity is closely connected to insect biodiversity because pollinators assist the plants with reproduction and genetic variation. Research shows that commercial honey bee populations (various species) have decreased in the United States by 30-40% since 2006. Since the majority of food production relies on honey bees, it is important to determine the causes of these changes and implement the necessary solutions, such as reducing pesticide use on crops and implementing more organic agricultural practices. As consumers, our choices directly impact the environment, because many environmental issues are connected to the mass production of food and other goods. Sometimes we do not know about these issues until it is too late to fix them.

Pollinator Decline

The process used to detect declines in insect pollinator populations is very challenging, expensive, and time-consuming. It can take up to 20 years of monitoring to detect a small decline per year in some species such as birds, fish, and plants. With insects, it can take even longer due to the necessary sample sites, and long-term studies to determine the abundance and diversity of species, and it can be difficult to identify specimens to the species level. Although it would require a large investment to establish accurate pollinator monitoring programs at the regional, national or international level, it is worth the investment.

Agricultural and Ecological Value of Pollinators

The value of worldwide insect-pollinated crops is estimated around $200 billion per year. Insect pollination increases the size, quality, and quantity of fruit and/or seeds for the majority of our major crops worldwide. Global agricultural production will decrease significantly if pollinators drastically decline in number, requiring extensive investment to increase their numbers. If too many pollinator species were to go extinct, it would also require the use of alternative pollination techniques in order to maintain current food production rates. This would increase prices for consumers because other pollinating methods, hand or mechanical, are very expensive. It would be advisable to proactively prevent the decline of pollinators before the declines reach crisis levels.

Most of the insect decline research has been focused on “managed” honey bee colonies that are raised by beekeepers. However, there are not many programs that monitor the status of native bees and other wild pollinators such as flies, wasps, moths, and butterflies, which actually can be more effective pollinators of crops than managed honey bees.

In addition to pollinating crops, approximately 75 to 90 percent of all flowering plants are pollinated with the help of insects and other animals. Insects and flowering plants also serve a vital role as a food source for many species within ecosystems around the world. The ecological value of the insects and the plants they pollinate cannot truly be quantified, but it exceeds the contributions to agriculture.

Organic Certification

One potential solution to pollinator species decline would be

an increase in organic agricultural practices. Overall, these practices are safer for pollinators and other wildlife. The United States Department of Agriculture (USDA) has a certification process for organic products. In order to qualify for certification, crops must meet a strict set of criteria established by the National Organic Program (NOP) which preserve natural resources and biodiversity (see USDA under “sources” for details). In general, USDA organic crops cannot be exposed to:

- Radiation
- Sewage
- Prohibited pesticides
- Synthetic fertilizers
- Genetic modification

Organic livestock regulations include:

- No antibiotics
- No growth hormones
- Fed 100% organic diet
- Have access to the outdoors
- Meet animal health and welfare standards

If a multi-ingredient product is labeled USDA organic, it must contain at least 95% organic ingredients. Residue testing is done on an annual basis by accredited certifying agents. The USDA Organic Seal is a leading global standard in organic agriculture.

Colony Collapse Disorder

The causes of pollinator decline are still being researched. Although there has been a decline in pollinators for many years, colony collapse disorder (CCD) was first reported in the U.S. in 2006, when whole colonies of adult honey bees began mysteriously dying. Studies have linked CCD to viruses, bacteria, fungi, mites, herbicides, fungicides, insecticides,

habitat loss and cross-country transport. Pollinators also become malnourished as their habitat is destroyed, and as climate change leads to changes in flowering seasons.

Impacts of Chemicals Used in Conventional Agriculture

Herbicides

Although honey bees have received the most attention, species such as the monarch butterfly have also drastically declined since 2012. As herbicides destroy their larval food source, milkweed, they experience nutritional deficiency and habitat loss. Monarchs are known for their long migrations, and they require sufficient nutrition to survive such journeys. Pollinators are dependent on vegetation, just as vegetation is dependent on pollinators. When herbicides kill targeted plants, there are unintended consequences on many other plant species and the animals that rely on their presence. One example of this is the monarch butterfly, which has been negatively affected by the loss of milkweed. Many species of insects rely on very specific plant species for nectar, pollen, and nesting material. Applying herbicides can reduce the abundance of arthropods in general, which includes butterflies, moths, true bugs, flies, and bees among many others. Not only does this reduce insect biodiversity, but the other animals that feed on them, such as birds are also affected. Overall, it is important to minimize the areas of herbicide exposure, especially to native habitat surrounding croplands. It is also important to use selective herbicides that will not affect non-targeted plant species.

Fungicides

Some studies have shown that fungicide presence can contribute to CCD in honey bees. In contrast, other studies have shown

that a fungal gut infection, could be the cause of the collapse in bee populations and that a fungicide could reduce CCD. It most likely depends on the type of fungicide used, and whether it is applied to crops or given directly to hives to treat a fungal infection. Because CCD is so complex, continued research is necessary to determine whether a fungicide is one potential solution, but it appears there are positive and negative effects.

Insecticides

A class of insecticides called neonicotinoids have been linked to immune suppression in honey bees, which allows for an increase in fungal infections. The European Commission has banned three neonicotinoids while further research is conducted; however, it is known that neonicotinoids can remain in the environment for at least six years. Although the Environmental Protection Agency (EPA) conducted studies on the residues of neonicotinoids in agricultural environments, there have not been very many studies focused on the levels existing in water sources, due to insecticide runoff. Most species rely on natural water sources for survival, in which case, these chemicals could potentially be found in many animal species.

Two types of neonicotinoids are major pesticides used to treat corn and soybeans in the United States. In addition, plants used for backyard landscaping, that are sold in commercial nurseries, may also have been grown using these pesticides. The toxicity for oral exposure in bees is much higher than contact exposure. For instance, according to the calculated LD50 (lethal dose, and the amount it takes to kill half of an adult hive in 24 hours), and the quantities applied to corn fields, the amount of neonicotinoid in one corn kernel would be enough to kill an entire colony. These findings suggest that testing the drinking water of bees is an important factor when determining the level of toxicity, which typically is underreported. The repeated exposure to various pesticides in

nectar, pollen and drinking water, have a direct effect on the decline of bees and other insects.

The costs of neonicotinoids outweigh the benefits which the EPA may have overestimated. They may increase the yield of some crops, but have the potential to reduce biodiversity, negatively impacting species at multiple levels in ecosystems. Ultimately, a growing human population increases the demand for pollinator-dependent crops to meet worldwide consumer needs, yet pollinators continue to decline. This imbalance between supply and demand would most likely cause a food shortage, increasing the price of food for consumers.

Fertilizers

The use of synthetic nitrogen fertilizers instead of manure-based methods can cause significant nitrate contamination of nearby freshwater systems. The use of synthetic nitrogen fertilizers allows farmers to continually grow crops on the same land without waiting for nutrients to return naturally. This appears to be a practical solution to feeding a growing human population; however, studies also show that there is enough food produced annually to feed the current population, it is just an issue of distribution and waste. While issues surrounding food distribution and waste production are very complex, the simple solution of overusing synthetic fertilizers is having negative long-term effects on the environment. Runoff from agricultural land can cause “dead zones” in bodies of water where the oxygen is depleted due to eutrophication (algal bloom, death, and decomposition). This leads to the collapse of local ecosystems and loss of biodiversity because species, such as fish and other invertebrates can die from a lack of oxygen.

Organic methods have a lower yield than conventional methods, which is partially due to the prohibited use of synthetic fertilizers. However, the price we pay for ecosystem damage caused by excess nitrogen is tremendous. One potential

solution is the use of leguminous cover crops, such as beans, peas, and clover, to perform nitrogen fixation at a sufficient rate to increase crop yield. Legumes are known for attracting nitrogen-fixing bacteria to their roots. When used as a cover crop (planted over the soil in the offseason), they can help to add nutrients and organic matter to the soil for future crops while also reducing erosion.

Crop yield and GMOs

Reducing wasted food is key to meeting the food demands of the world. Americans waste 215 meals per person, per year. Some argue that in order to use organic farming methods to produce enough food for the world, it would require more land to produce the same amount of food, which would lead to further deforestation and biodiversity loss. Another argument is that genetically modified organisms (GMOs) help us provide enough food for the world, and genetic modification is not permitted by USDA organic certification. However, organic agriculture could produce enough food for the current population, and a potentially larger population without increasing the land use, partially through the use of leguminous cover crops for nitrogen fixation. Organic agricultural methods around the globe do have a lower yield than conventional; however, it depends on the context, and can range from 5 to 34 percent lower. It depends on the crop type, growing conditions and standard of organic practices. Perennial plants, fruit trees, legumes and oilseed crops are the best candidates for high output under organic conditions. Growing a diverse selection of crops, that are grown without insecticides or genetic modification, can protect pollinator populations while maximizing crop yield.

Instead of debating crop yield between conventional and organic agriculture, the focus should be shifted to how much food is wasted, and learning how to be more resourceful with our food, in order to supply enough nutrition worldwide. In

this way, we can utilize safer farming methods that support biodiversity while still providing food for a growing human population.

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Conclusion

It is estimated that organic food sales have increased by approximately 20 percent each year since 1990. As consumers continue to become more educated about organic certification and the ways it can affect the environment and their health, the demand will most likely increase. From a long-term environmental perspective, we cannot afford to continue to use conventional agricultural practices. The price premium on organic products today should be considered an investment in the future for our planet and our ability to feed the world.

If insecticides, herbicides, fungicides and synthetic fertilizers have been shown to negatively affect pollinators and many other species, it can be assumed that the use of USDA organic standards in agriculture could be one way to decrease the rate of decline in wildlife populations, and preserve biodiversity. The majority of worldwide crops rely on pollinators for efficient yield. If pollinator populations continue to decline, there will be a significant reduction in food production and an increase in prices for consumers. Purchasing organic foods directly supports an industry using methods found to be safer for bees and other pollinator species. It also meets the demand for higher standards in production and health. If consumers demand certified organic garden and landscaping plants, or at least plants grown without neonicotinoid pesticides, they can assist local pollinator populations with a safe food source. As a result of this demand, the agriculture and retail industries will respond, and organic options will become more affordable and

readily available.

Sources:

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