plants. Pollinators are essential to the environment. Without them, we would lose many plants species, ecosystems and the animals that rely on those plants. Plants also provide nutrients to the soil and energy in different ways. When they are consumed by herbivores, they are converted into microorganisms or consumed by carnivores. When the carnivores die they are recycled as energy back into the soil supplying nutrients to the plants.

When pollinators produce an increase in plants, they in turn increase oxygen production and carbon dioxide consumption. This carbon dioxide is converted into carbohydrates, a key resource for honey bees. Without this consumption of carbon dioxide the climate would change and the planet would become inhospitable.

Without plants there is a greater risk of soil erosion leading to carbon being released from the soil. More plants equals less soil exposure and carbon retention. This is known as Carbon Sequestration, defined by the USDA as "the process by which atmospheric carbon dioxide is taken up by trees, grasses and other plants through photosynthesis and stored as carbon in biomass (trunks, branches, foliage and roots) and soils." With the plants dependent upon honey bees for pollination and plants disappearing, there is a clear connection to the increase of carbon in the atmosphere. According to Lewis Ziska, a plant physiologist at the U.S. Department of Agriculture's (USDA) Research Service in Maryland, "the increase in CO_2 will also reduce the protein content in leaves so insects will need to eat more leaves to get the same amount of protein."

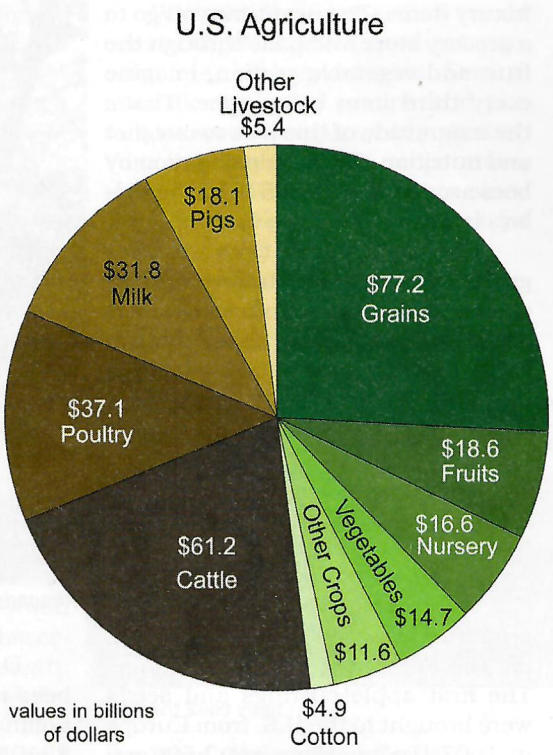
Bees need pollen to provide the protein they need. However, unlike insects that can consume additional leaves, bees cannot control the quality of pollen and consume more. A poor quality of pollen will lead to a shorter lifespan of the bees and could lead to a collapse of the colony.

Effect of Honey Bee Loss on Food Supply

Let's take an imaginary trip to a world without honey bees and see what would happen to our global food supply.

Honey Will Disappear

Humans have been harvesting honey for about 9,000 years. In the U.S. there are about 120,000 beekeepers, also known as apiarists. Americans use an average of about 1.5 lbs. of honey per person annually. About 35 percent of this is consumed in homes, restaurants and institutions. The remaining 65 percent is used in the production of baked goods, cereals, beverages and processed foods. Although there are over one hundred thousand beekeepers in the U.S., this honey production only meets about half of the U.S. demand, leading to honey importation. Honey is also used for its medical, dietary and cosmetic properties. Worldwide, honey production is over four billion gallons per year. It takes 12 honey bees working their entire lives to produce one teaspoon of honey, so annual honey production would require approximately 315 trillion bees.



Honey is the only food source produced by an insect that humans eat. Worker honey bees gather floral nectar and transform it into honey by reducing the moisture through a dehydration process. When a foraging bee returns to the hive with nectar, it is passed through approximately 200 bees who process the nectar in their honey corps (small nectar gathering stomach), and in the process they add enzymes to reduce the disaccharides (sucrose) and monosaccharides (fructose and glucose) turning the nectar into honey. This process known as hydrolysis, takes one water molecule to convert each sucrose molecule, demonstrating the bees need of a fresh water source.

China annually produces the largest amount of honey in the world – approximately 24%. Although they are the largest producer of honey, their honey has been banned from the European market by the European Union since 2002. Their honey has been tainted with poisonous agricultural contaminants such as pesticides, antibiotics, heavy metals and adulteration with industrial sugars. The antibiotic China used has been banned in food by the U.S. Food and Drug Administration when it was demonstrated to cause DNA damage in children. In some cases, honey from China was contaminated with lead from improper storage containers.

Chinese honey brokers have been known to create a counterfeit product made of a mix of sugar water, malt sweeteners, corn or rice syrup, jaggery (a type of unrefined sugar), barley malt sweetener or other additives with a bit of actual honey.

Chinese labor costs are approximately $15/person/day making it difficult for U.S. beekeepers to compete. The U.S. has imposed various tariffs to level the playing field. In order to get around the banning and tariffs, Chinese honey is generally labeled "made in Thailand", the Philippines, Russia, India, and more recently Vietnam and traditional laundering points in Asian countries.

Many Fruits, Vegetables and Nuts will No Longer be Available.

Back to looking at the global food supply. One hundred crops that supply 70% of the world's food supply, are pollinated by bees. Without bees helping to produce these crops, supermarkets would have tremendous trouble filling the produce section. If you could find fruits and vegetables, they would be very expensive. Everyday items today would turn into

luxury items. The next time you go to a grocery store and pass through the fruit and vegetable section, imagine every third item being gone. That's the magnitude of this loss to our diet and nutrition. Globally, pollination by bees accounts for 235-577 billion dollars in annual food production sales.

The most valuable cash crop fruit grown in the United States, as far as cash crops go, is the orange. Oranges are the most cultivated fruit tree in the world. Christopher Columbus brought the first orange seeds to the New World in 1493. Over 70 million tons, or 224 trillion oranges, are grown annually worldwide. The top orange producing countries by millions of tons are Brazil: 35.6, USA: 15.7, China: 14.4 and India: 10.8.

The second most valuable cash crop fruit grown in the United States is "The Forbidden Fruit," the apple. The first apple cuttings and seeds were brought to the U.S. from Europe in 1607. Today, there are 2,500 varieties of apples grown in the United States. In the U.S., there are approximately 8,000 apple growers with orchards covering 430,200 acres. Apples require cross-pollination with other varieties. Without bees, the cross-pollination would need to be done by humans. China is the leading producer of apples with over 1.2 billion bushels. The United States produces 240 million bushels a year.

Broccoli, carrots, pumpkins and other squash-type vegetables would become extremely hard to produce without bee pollination. Like many of your favorite fruits, they would just become too rare and expensive to use everyday, so it would be likely that they would disappear completely.

No bees, no... almonds, which are one of the most nutritious and versatile nuts. Also almond milk, almond oil, almond extracts, shampoos and almond bakery goods would no longer be available. Eighty percent of the world's almonds are produced in California. Approximately 800,000 acres are planted with almond trees in California. In late February and early March, the almond tree begins to produce blossoms that are ready for pollination. Each year approximately 20,000 beekeepers bring in honey bee colonies on semi-trucks loaded with 400 to 500 colonies each, to pollinate the blossoms. This pollination requires more than a million colonies, or 50 billion honey bees.

Almonds

Depending on the number of bees in the hive, beekeepers charge pollination fees ranging from $165 to $240 per colony.

After the almond bloom is over, the beekeepers move colonies up through the Pacific Northwest pollinating apples and other Spring-blooming crops. By May, the colonies are moved to North Dakota to produce honey and pollinate clover, canola and sunflowers.

Other crops that are ninety percent dependent upon honey bees are avocados, blueberries, blackberries, grapes, raspberries, melons, peaches, cherries and cranberries.

Several varieties of coffee, such as Robusta, are dependent on pollinators. Of the worldwide coffee production, Robusta accounts for around 40% of all coffee production. The presence of bees can improve the quality and size of coffee beans. Without bees, the viability of coffee would be difficult and expensive.

Hand pollination

Pollination by Humans, Robots and Drones

Hand Pollination

Without honey bees, pollination would need to be done by humans. One way to pollinate would be by hand. First, understand that the flowering stage to pollinate a plant lasts only about two to three weeks, so the pollination would need to be done quickly. Pollination by hand requires a person to use a brush to 'paint' the feminized pollen on the developing buds. In a study done on this process, it was determined that in the U.S., to hand pollinate two acres would cost about seven thousand dollars in labor alone. To pollinate the nations almonds fields it would take tens of thousands of people at cost of over 2.8 billion dollars.

Hand pollination is performed in the Hanyuan county in China, known as the "world's pear capital." This hand pollination became necessary after farmers started using more pesticides, causing a complete loss of the bee population.

Robot Pollination

Robotic Pollination is another area being researched. The University of West Virginia has created a moving pollination machine called "The BrambleBee". It uses state-of-the-art localization and mapping techniques and tools that enable visual perception, path planning, motion control and manipulation.

The BrambleBee