The World According to Bees and Other Pollinators

Friday, Oct. 13, 2017

For Quest Club

Jane M Gerardot

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"A swarm of bees in May is worth a bale of hay; but one in July isn't worth a fly."

I awaken early. I am surrounded by congestion and activity, for today is the day we travel. Today, we swarm! As queen, I will depart with about one-half of my colony to find a new home. We have become too successful, as there is abundant nectar, too much honey, and we're overpopulated. We're too crowded to function efficiently, and we're all stressed. Several days ago, my workers put me on a diet to prepare for flight, and I have seen them constructing new "queen cells" where the future queen is being nurtured. I am being replaced in this colony, and I must start over.

We fly into the morning sun and my scouts search for a new home: a hollow log, a wall cavity, or perhaps a vacant hive. We rest as one massive swarm high in a tree until my scout returns and puts on a showy waggle dance to inform us of our new location.

We are honey bees. You call us Western Honey Bee or Apis Mellifera. Now we're eager to get on with the work of building a new colony and storing honey for the winter. Meanwhile, I know what's happening in my former home. A young virgin queen will soon emerge from a queen cell I left behind. Just as I did two years ago, she will exit the hive and begin her mating flight. Mine was impressive. I flew fast and high, higher than 100 feet in the air, so that only the strongest males could reach me for I wanted to produce healthy stock. My insemination occurred during that one flight, when as many as 15 or 20 drones mounted me. The exertion of the flight and copulation

caused each drone to explode and die with ejaculation, for the sole work of the drone is to inseminate the queen. A drone is smaller than me, and lives only about 5 weeks, unless his life is shortened by mating with a queen. I am the largest bee in the colony and hope to live several more years to see many more descendants during my reign.

Let me tell you about the rest of my family and how we organize. You should know first, that of the many thousands of bee species, we are unique in that we live in a colony, stockpile resources, survive the winter, and make a honey of such exquisite quality that it lasts for many years. We live in a colony as one organism, which means no one of us can survive alone. Every individual bee action is attributable to a stimulus or situation in the hive, and we all use all our senses to transmit and receive information about the needs of the colony. As the only queen, I must ensure the sufficiency of the hive population, for I alone lay the eggs. I alone determine how many will be male and female. During high season, I will lay 1000 to 2000 eggs per day, most of them fertilized by the sperm I release from my abdomen. These are the sperm from my mating flight. My fertilized eggs produce females, the workers of the colony. The females are made and kept sterile by the pheromone I continuously release to suppresses their ovaries. My unfertilized eggs grow into males, or drones, and we need fewer of them. In a colony of 60-100,000 bees, there will be only a few thousand drones. During times of food shortage or stress, drones will be the first to be eliminated from the hive, as they only drain our resources, and do not contribute to our productivity. They are mostly just flying sperm banks.

The female worker bees are the smallest in the colony, perhaps ½ inch long compared to my 1 inch. They have the shortest life span, living only 4 or 5 weeks. In those few weeks, each worker passes through a series of roles depending on age and colony need. Initially, they work indoors, feeding and protecting the larvae, cleaning and maintaining the hive, building cells,

making honey, storing food. At about 2 to 3 weeks, they leave the hive to learn the landscape, and finally begin to forage, led by scout bees. Foraging is the most dangerous of all tasks due to predators and pesticides. It is also laborious, for each bee carries as much as or more than half her weight in bounty, consisting of nectar and pollen. Her wings beat 250 times per second as she flies at a speed of 20 mph back to the hive, only to disgorge her load there and make another round trip. By the end of her short life, her wings will be tattered and broken. However, if she is fortunate enough to begin life at the end of the honey season, she will probably live through the winter, helping to heat and maintain the colony until spring when we gear up for another busy season.

Worker bees are the defenders of the colony. Consider 60,000 warriors ready to die for me, their queen, and colony! We are under constant threat of attack or robbing, not only for our valuable stores of honey, wax, and pollen, but our own bodies and those of our brood. We are a ready source of protein for hungry predators. Bears, badgers, skunks, birds, mice, hornets and yellow jackets, and many other insects seek entrance, and so we post guards at our door to detect a predator. A wasp inside the hive will be closely surrounded by a mass of bees who generate such great heat that the invader will quickly die. This is known as "balling." The only other weapon we have is the stinger. Drones have no stingers, so they are useless at defense. But we sting only for self-protection, or when we are provoked by smell, noise, movement or vibration. Stinging a human or other tough-skinned animal is deadly for the worker bee, as the stinger is torn from her abdomen and causes immediate death. In rare cases, a sting may also be deadly for the human. Dr. David Golden of Johns Hopkins University, estimates that between one and three percent of humans may have a systemic reaction to insect stings, and a much smaller proportion may have a life threatening reaction, called anaphylaxis. The latter, if they are aware of their allergy, will carry EpiPens to counteract a sting. But a smaller number use "VIT" or "venom immunotherapy," a

treatment available for the past 40 years, where small doses of venom are injected under the skin to reduce a person's sensitivity. This year, one of only two manufacturers of bee venom in the U.S. went out of business, causing a severe shortage. As a result, allergists were forced to modify the regimen so that all those seeking treatment were adequately covered. Once the venom is again available, Dr. Golden plans to begin a campaign to increase awareness of VIT as he believes only about 10% of affected people are aware of this option. With the availability of such treatments, fewer than 100 persons die of insect stings in this country each year and fewer than half of those deaths are from honey bees.

Those of you who live in Fort Wayne may recall the 2004 death of the founder and former director of the Fort Wayne Children's Zoo, Earl Wells. He died after he was stung a reported 1000 times by yellow jackets, not bees, when he disturbed their underground nest by falling from a ladder while cleaning windows at his home. Even if he had no allergy, it is likely that so many yellow jacket stings would have been fatal for any person. Yellow jacket wasps are considerably more aggressive and their venom more toxic than honey bees, and each can sting a person repeatedly. Multiple stings, known as "mass envenomization" will quickly result in renal and other systemic failure. The lethal dose of honey bee venom in humans is about 9 stings per one pound of body weight, or about 1300 stings for a 150 pound person. Where African "killer" bees are established (Florida, Texas and southern California) the immediate medical treatment of choice for multiple stings is renal dialysis, not epinephrine. African bees are the most aggressive and temperamental of all bees, and need no provocation at all for the entire colony to attack.

But, for my worker bees, defense is a lesser role. They focus mainly on feeding and nurturing the colony and storing food for the winter. Little do they know that their foraging results

in a phenomenon essential to your well-being and to the survival of your plant world: pollination. It is a symbiosis made in heaven!

Let me give you a primer on pollination. Plants have two main goals: 1) to grow, and 2) to produce seed for new plants. Many plants produce their seed inside fruit, which, as you know, grows from a flower that has been pollinated, or fertilized. From the center of each bloom protrude small reproductive structures: the stamen, or anther, produces pollen, the male part of the plant; the stigma is the female organ of the plant, usually located in the center of the flower. Fertilization occurs when pollen is transferred from the stamen to the stigma. It can happen by self-pollination, when the stamen comes in contact with the stigma. But the best and strongest seeds are produced when the pollen comes from a separate plant of the same species. For example, most apple trees can only bear fruit if pollinated from a different tree, or variety, of the same species. This produces the best quality and size of fruit. The best pollen transporters for this purpose are insects, and the best of these is the honey bee.

To collect food, a bee approaches a flower center and inserts her proboscis into the base of the stigma to withdraw nectar. While pursuing the nectar, her body brushes against the multiple flower stamen. This activity releases many tiny particles of pollen. Some pollen clings to the bee's furry body, some is released into the air, and some falls into pollen baskets on her hind legs. She visits the next flower, and the next after that, repeating the process. At each site, she unwittingly leaves collected pollen on or near the stigma of her current fascination, completing pollination.

After visiting as many as 1500 small flowers, or one very large flower, the bee's nectar stomach is filled, as are the pollen baskets on her legs. She returns to the hive where the pollen is collected from her leg baskets by other bees and is either fed to developing larvae as their protein source, or stored in the comb for future use. The nectar she regurgitates into the mouth of another

worker bee who will further process it internally to make honey and store it in the comb. This "stored" honey in the case of "kept" bees, is what comes to your table. Five bees worked their entire lifetimes to produce your one teaspoon of honey. Your one pound of honey came from bees flying more than 50,000 miles to visit (and pollinate) over one million flowers!

Honey bees are such good pollinators that we are the only insects used in the commercial pollination industry. For example, in the state of Montana, one of the nation's top honey producers, in 2014, commercial beekeepers produced 14 million pounds of honey valued at more than 29 million dollars. But their biggest profit that year came from pollination services. Truckloads of bee hives travel to California each February to pollinate the almond crop, then move on to Oregon and Washington to service the cherry and apple crops. These rented colonies must be carefully guarded, for they are valuable and frequently stolen. Honey bees have the unique trait of constancy or fidelity. This means that we finish foraging one species of plant before moving on to the next, thus increasing the reliability, and value, of the pollination. Such "managed" (commercial) hives pollinate more than 100 crops in the U.S., from watermelon in Florida, to California's 1.1 million acres of almonds, but still account for only one-third of pollination needed for your crops.

Honey bees are not the only pollinators. More than 200,000 other animal species perform this service, including vertebrates and invertebrates: insects, birds, bats, possum, lemurs, lizards, geckos, and basically any animal attracted to flower nectar. Together, they are known as Keystone Species, because they have a disproportionately large impact on other species in our plant and animal kingdoms. The fates of plants and animals all over the landscape are linked to each other, and thus, inextricably, to your own fate.

Pollinators are in decline, some threatened by extinction. The impact is more than just a possible shortage of honey; it threatens the crops you depend on for sustenance. According to the

U.S. Department of Agriculture, creatures pollinate one of every three bites of food you consume. Most of your vitamins and minerals come from insect-pollinated crops.

In recent years, the honey bee population has been dropping 30 to 40% annually, and the bumblebee population declined more than 50% overall. Some of the causes include habitat destruction, viral and parasitic invasion, pesticides, and climate and agricultural changes. Domesticated as well as feral or "wild" bees are affected. When my ancestors arrived in North America from England in the early 1600's, we thrived. Our diets were varied, wild flowers were plentiful, and our colonies were disease-free. Beekeepers continued bringing bees from other foreign countries, but each new arrival introduced a potential disease. In 1922, seeing the damage to European bees caused by mite infestations, the U.S. Congress passed the Honey Bee Restriction Act, forbidding the importation of honey bees. Your law kept us disease free until 1984 when tracheal mites were first detected in the United States, and three years later, the Varroa mite invaded. These parasites feed on our brood, and invade our own bodies, weakening our immune systems and making us susceptible to other parasitic, fungal, viral and bacterial infections. Mites are now a major threat to bee colonies in the United States. Other hive threats include the hive beetle and the nosema fungus. The rampant infestations are so widespread in some areas that many beekeepers find it essential to use chemicals inside their own hives, further complicating the issue. Recently, apiary research has sequenced the honey bee genome, giving beekeepers a new tool, a breeding tool, to make a disease-resistant bee. Though the Bee Restriction law is still in place, the United States Department of Agriculture has allowed and even encouraged importation of honey bee stock from Russia and other countries in the belief that certain stock is tolerant of or resistant to some of the infestations. And due to the shortage of domestic pollinators for the almond crop

in California, the United States allows disease-free Australian honey bees to be brought in annually for that purpose.

But disease is not our only problem. In the 1990's, industrial farmers further threatened our environment in two significant ways. First, they introduced "monoculture:" planting vast fields in one single crop. This deprives us of a varied diet and leaves us weakened and malnourished. Next, they began using severely toxic insecticides, one of which is the controversial group of neonicotinoids, or "neonics." These impair our ability to navigate, communicate, and reproduce. Though banned in Europe, neonics continue to be a main ingredient in many garden and farm insecticides here in the U.S.

"Colony Collapse Disorder" is a term frequently used to describe a range of colony disorders, from moderate impairment, to complete destruction. It is the aggregation of all our threats and as far as known, is not attributable to any one certain cause. But, it is a warning that human society threatens our existence on a global scale. Making safe environments for us is a crucial step towards future sustainable agriculture. Honey bees can adapt to minor changes, but like you, we need a varied diet to be healthy; we need wildflowers at the side of your roads, clean water, and natural places to build our homes. In Han yuan, China, the world's pear capital, we see a meaningful lesson, for there, human beings with feather dusters pollinate the crops, as their natural pollinators have all been eliminated.

Efforts have been initiated to address the problem here in the United States. In May of 2015, the Obama administration created the National Strategy to Promote the Health of Honey Bees and Other Pollinators. There are two intended protections of this program: 1) your GDP, for honey bee pollination alone adds more than $15 Billion in value to agricultural crops each year; and, 2) the plentitude of fruits, nuts and vegetables in your diets. Part of the comprehensive strategy

is to create seven million acres of corridors of pollinator friendly habitat over five years, including along Route I-35 from Texas to Minnesota, the general route of the Monarch butterfly. In October of that first year, the Department of Agriculture granted more than Four Million Dollars to farmers in six western states to plant food for bees. Some not-for-profit organizations are also paying farmers to plant parcels of bee-friendly flowers, just as everyday gardeners all across the Midwest are doing the same in small patches. Crucially, just this year, the Environmental Protection Agency implemented policies to limit the agricultural use of neonics when bees are present.

Early data suggests the strategy may be effective. The United States Department of Agriculture, which tracks only "kept" or managed bees, reports that in the first quarter of 2017, Colony Collapse Disorder losses are 27% fewer than in the same quarter of 2016. And the losses for hobby beekeepers (those with fewer than five hives) in 2016 were 40% less than those lost to Colony Collapse Disorder in 2015, an especially bad year. These numbers are better than what was projected or hoped for and may indicate the beginning of a reversal of the losses recorded over the past two decades. Perhaps even small efforts can be meaningful. The White House in Washington, D.C. maintains a colorful pollinator-friendly garden, to feed us, and to inspire you!

Now it is October. My colony and I have settled in our new home and completed a successful season, with honey and pollen bread put up for the winter. When the temperature falls below 57 degrees, we cluster together in the center of the hive for warmth and this is how we'll survive winter. When the days start getting longer and temperatures rise, I will begin laying eggs to renew the honey cycle. Dandelions will be the first target of our spring forage.

On some future day, my workers will sense when my reign is done. They will select several young larvae (my daughters!), as possible queens, and fill these brood cells with royal jelly, for royal jelly is what made me a queen.

APIS (HONEY BEE) FAMILY TREE

Bees and Wasps share the following classification:

Kingdom: Animal

Phylum: Arthropoda: insects, spiders, crustaceans

Class: Hexapoda (six footed) or Insecta

Order. Hymenoptera (membrane winged): bees, wasps, ants, sawflies, horntails

Suborder. Apocita (referring to narrowing or constriction of the abdomen): bees, wasps, and ants.

Bees diverge from wasps at the superfamily level.

Superfamily. Apoidea: bees. Wasps and ants are in the Vespoidea superfamily.

Genus. Apis: honey bees

Species. Mellifera: Western honey bee

Various "Neonics" or Neonicotinoids

Imidacloprid, Clothianidin, Dinotefuran, Thiomethoxam

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