Climate Change, Nectar Flows, NASA, And You

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You can play an important role in measuring Climate Change and Nectar Flows – Here's How.

Just a few years ago the Southeast was experiencing the worst drought in more than a century. Lakes, which supplied water to nearby towns and cities were losing water so rapidly that fears about available drinking water in the near future began to surface. Strict rations and bans on outdoor watering became mandate around the state. Homeowners watched as their newly planted lawns, gardens and shrubbery turned brown and withered. Nurseries hit with restricted water use, and the inability to move vegetative stock (since nobody was planting), closed their doors forever. Car washes, swimming pools, and water parks were forced to turn the water off. Farmers watched as their crops wilted and died and the ground dried and cracked and blew away. Local and state governments started panicking when it became obvious that the taps would soon run dry. Even lawsuits erupted over which states had access to water usage from two river basins – the Alabama-Coosa-Tallapoosa and the Apalachicola-Chattahoochee-Flint.

Now let's fast-forward two years into the future. What do we see – the southeast experiencing record rainfall. Below are rainfall totals for 1999-2009. These amounts were recorded in Peachtree City, Georgia, south of Atlanta. The 2009 totals, which don't include a total for December, are double that which fell in 2007. Yet, so far this December we have already surpassed our monthly average of 3.71 inches of rain. Hopefully, 2010 will be a Goldilocks' year and be just right.

Year	Rainfall Totals (inches) (Peachtree City, Ga)
1999	38.86
2000	35.56
2001	38.40
2002	47.82
2003	52.90
2004	53.60
2005	56.43
2006	48.46
2007	**31.85**
2008	41.43
2009	**62.33**

With all this torrential rain, come swollen creeks, over-flowing rivers and streams. What used to be a dry creek bed one day can become a raging torrent of water the next. If you are at all concerned, check your hives. Several beekeepers were taken by surprise this year when a non-threatening stream quickly turned into what resembled the Mississippi river and in a matter of seconds years of hard work were swept down stream. One in particular, Bob Brachman, a Russian queen producer, lost a significant number of breeder colonies when an unusual August thunderstorm dumped inches of rain in a few short hours.

So is all this due to normal climatic changes or global warming? A recent study from Columbia University examined the 2005-2007 drought that brought the south to its knees and concluded that it was not global warming but instead population growth that ran the lakes dry. Between 1990 and 2007 Georgia's population increased by 3.06 million people but the water supply or storage capacity had not kept up with the growth. Therefore, the severe water shortages were a result of over population more than changing rainfall patterns.

Now, regardless of your stance on global warming (whether you're a card carrying environmentalist, global warming supporter or a Limbaugh-Hannity following, global warming basher), the earth is experiencing worldwide climate changes. For example, the 20th century was the hottest century for the past 400 years. And at this point the Arctic is experiencing some of the most dramatic affects. But these pages are not

P. Lefebvre photo


T. Wilson photo

intended to discuss the facts or fictions of global warming, but instead to visit how climate change may be altering our beekeeping calendar. Currently, Dr. Wayne Esaias, a NASA scientist, is heading a research project exploring this issue.

Since 1979 Dr. Esaias has worked for NASA as a biological oceanographer at the Goddard Space Flight Center in Maryland. His earlier work examined the abundance and occurrence of phytoplankton in the oceans and how this related to climatic systems. In 1992, Dr. Esaias became a beekeeper when his son's Boy Scout leader had to find a new home for several hives (and a scale). At first Dr. Esaias was a bit wary of any kind of bee since he had once been hospitalized due to an allergic reaction after being stung multiple times by ground hornets. But once the bees arrived they quickly settled in and became part of the family routine. The colonies produced surplus honey, which was sold, plus they were perfect candidates for upcoming 4-H projects. For Dr. Esaias, the bees became a welcomed relief from his day-to-day schedule.

But soon the beekeeping successes departed and the colonies started to wane. Numerous swarms produced weakened colonies, which eventually perished. Blaming himself for being a bad beekeeper, Dr. Esaias couldn't get a handle on what he was doing wrong. Had he not read every book he could get his hands on about bees and beekeeping? Hence he began to think outside the box and started exploring other causes. That particular season in Maryland had been much warmer and wetter than normal which was typical of an El Nino year (unusually warm ocean temperatures in the Equatorial Pacific). The bees, which were not behaving in their usual manner, were reacting to the climatic changes brought on by this El Nino. Warm, wet Springs (precursors to earlier nectar flows) can trigger colonies to swarm sooner and more often.

Then an idea came to his mind. How can honey bees be utilized as climate data collectors? Bees are already excellent environmental samplers so one just needs to tap in on this tremendous resource. They're already doing the work for us. But how??? Then it dawned on him: scale hives! By weighing colonies each day (which are continually sitting on an industrial scale) these individual data points over time can quantify the amount and pinpoint the exact timing and duration of nectar flows. Scale hive data. But the bigger picture here is this: how does this tie into climate change? Because of his question, two years ago Dr. Esaias made the transition from sea to land in order to investigate a possible correlation between nectar flows and climate change. He wrote a grant, was funded by NASA and has since been trying to put the pieces together.

One of NASA's primary functions/objectives for earth sciences is to understand how climate change impacts our home planet. There's the physical climate, such as temperature and rainfall, which is simply measured over time. So far the data shows that significant changes are occurring. Yet, how do these physical changes impact the earth or more specifically ecosystems? And going one-step further how do these changes affect plant/pollinator interaction? Then the bottom line of course: how does this affect humans on the planet?

Being a NASA employee Dr. Esaias has resources available to him. Because his question is sought to unravel something so complex, he felt that large-scale satellite data would be needed to help. There are just too many plants, too many pollinators, too many different ecosystems all interacting and not enough hours available in someone's lifetime to explore each one.

So how is all this data collected, correlated, crunched, analyzed and then understood? Let's start by looking to the skies. Sensors, such as MODIS (Moderate Resolution Imaging Spectro Radiometer) located on NASA's Aqua and Terra satellites, are continually snapping detailed images of the planet. Because of the rotation of the earth, within eight days (some areas may be under cloud cover) an entire image of the earth's surface is available. Overtime these recorded images show the earth "greening up" (when the earth wakes up from its long winter slumber and vegetation begins to sprout new leaves) and then "browning down" (when vegetation looses its leaves). Dr. Esaias takes these space satellite images of the earth's greening and compares them with the nectar flow data collected from the scale hives. They corresponded nearly perfectly. But recently something unusual was detected; it seems the Northern US is "greening up" a half a day earlier each year. "In total, since the 1970s, the nectar flow also has moved forward by about one month in Maryland" says Esaias.

Unable to be everywhere each day, Dr. Esaias has conscripted a network of citizen-scientist-beekeepers across the country who volunteer their time to collect hive weights. At this point, there are 87 data collection sites, mainly concentrated in the state of Maryland, though there are also sites scattered across 20 other states. The south and west, however, is especially void of these experimental sites. The data is sent to Dr Esaias through a web site set up specifically for this project: HoneyBeeNet (honeybeenet.gsfc.nasa.gov). As the data flows in scientists are able to better understand how climate is affecting the dynamics of incoming nectar overtime. And beekeepers get a better picture of what is happening in their apiary.

So how does this information help me, the beekeeper?

By placing colonies on a scale and weighing them each day, data records the ebbs and flows of the season. A rapid increase in hive weight indicates nectar intake, a steady decrease in weight indicates a nectar dearth, hence a colony loses weight as food stores are being depleted. So far the most weight Dr. Esaias has seen a colony gain in one day is 25 pounds in Maryland. As a

colony gains weight brood is being reared, comb drawn out, and honey stored. But something else may be happening as well. Colonies may be preparing to swarm. If all of a sudden a colony loses over three pounds in a day something has obviously happened: a swarm perhaps? Most beekeepers aren't aware that their colony has swarmed, but with this sort of data it would help reduce the amount of time the colony is queenless. This kind of data is a great help in hive management.

Such data could also help us forecast when or if Africanized honey bees (AHBs) will be encroaching upon an area. At this point, theoretical models, which are too unstable and unpredictable, project AHBs advancing all the way to Canada. But based on climate and vegetation patterns are these northern areas suitable for AHBs? There are two factors largely responsible for keeping AHBs contained to the western part of the U.S. and Florida: temperature and food availability. For instance, when AHBs crossed the border into Texas they headed north then tracked west ending up in California. They did make a small presense in the Western portion of Louisiana, but didn't venture any farther east. The most likely reason: no fall nectar flow. From east Texas to Georgia plants and nectar flows are dramatically different. However, Florida and Arizona both have Fall nectar flows, which resemble nectar flows in Africa. Scale hive data in the gulf states would give us a better knowledge of nectar flows which might tell us whether AHBs could survive there.

This data will also be beneficial to commercial beekeepers. A certain percentage of commercial beekeepers move colonies to follow nectar flows. They may be moving south for the Winter to take advantage of early blooming crops or north to the Dakotas for clover. With climate change comes a whole host of issues, which impacts blooming dates, which in turn affects nectar flows. They may come earlier or later. They may be more or less productive. With this information at hand, areas predicted to be less productive could be avoided while more productive areas can be accessed. It could also help beekeepers know when they should be feeding to avert colony starvation. Overtime such data would provide a more reliable idea of when to expect a nectar flow in a given area. It could help us predict good years, or bad years and on a larger scale, agriculturally speaking, it could predict possible times of crop failure leading to famines.

But????? Wouldn't it be beneficial for the bees if Winters were warmer and nectar flows earlier? Perhaps, but lets explore the downside to this. If plants are blooming earlier each year, will the pollinators be able to keep up with this forward motion or will they fall out of sync with the plants? Overtime pollinators and plants have become in sync with one another since they both rely on the other for survival. Most plants need pollination in order to produce seeds and they accomplish this by luring the pollinator in with nectar. Both benefit and both survive. But, if plants bloom too early when the pollinators aren't there, the plants lose the benefit of pollination and when the pollinators finally do arrive the flowers are no longer in bloom and they lose the nectar. Hence, system failure. Another thought, earlier flows could mean longer times an area experiences a summer dearth (areas that see summer dearths). The bees eat more than usual because the temperatures are still warm, but nothing is coming in the front door. By the end of Summer, early Fall, when colonies should still have plenty of stores, colonies are starving when they should be beginning to raise Winter bees. Not good for overwinter survival.

As climate changes, how are our bees/pollinators coping with these shifts? Scale hive data is focusing in on the timing of this pollinator/plant interaction, which to a degree has never been explored before. This data gives us a picture so that we may be better prepared in the future. Climate prediction models don't include blooming dates and how they relate to nectar yields as a function of climate. As climate change continues ranges will shift. First the most obvious is when the nectar flow begins and ends. With this information scientists can extrapolate when the nectar flows are occurring across the nation in accordance with the wall-to-wall coverage of the satellite imagery.

L. Kish photo

Another long term goal of this project is to come up with a map of the US with nectar flow dates and variability. Right now the resolution of this information is very course but as more data is collected and analyzed the clearer the picture will become.

How do I become a volunteer?

First you go to the **http://honeybeenet.gsfc.nasa.gov/** web site and nose around. Get your GPS (latitude and longitude) coordinates. Then you will answer a short questionnaire. Citizen-scientist-beekeepers will need to purchase an industrial sized scale to weigh their colony each day. Data is then entered and sent directly to Dr. Esaias through the HoneyBeeNet site. The best possible scenario is if the colony could be weighed each and every day. But we all have lives and sometimes are not around to take such measurements. So every few days will work also. Since these scales cost around $300 new, (sometimes used for $20-60) I think it would be an appropriate use of local or state beekeeper's association funds. If a local/state club set up a scale hive members could rotate responsibilities weighing the colony so no one is carrying the entire burden.

As proven climate change is occurring. Now whether or not we are contributing to that change doesn't really matter, does it? What does matter is we could be and should be better stewards of this planet and to our bees.

Whether the weather be cold,
Or whether the weather be hot.
We'll weather the weather,
Whatever the weather,
We'll weather it, like it or not!
See Ya! BC

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