WIPE OUT!

Larry **Connor**

The Big Island In Crisis

Walking in an 18-acre avocado field with trees planted in the lava rock and managed by Rob Huelskamp of Keaau, HI (southwest of Hilo, on the western side of the Big Island of Hawai'i), I was struck by the absence of honey bees on the flowers. In a large open area there are empty hive stands and stacked metal corrugated metal sheeting that many Island beekeepers use as protection from the tropical rains. There is a sole colony of honey bees that has survived the massive attack, and it does not look that strong. Next to the decimated apiary site is fire pit of smoldering hive and frame ash where 79 colonies were burned. The ground crunched as I walked down slope past the fire, still smoking from the day's last sacrifice to the beetle gods; I had stepped on a thick layer of solidified beeswax that had been melted by the fire and poured into the lava and thin topsoil. In places the wax was several inches thick.

Huelskamp is understandably depressed that the colonies that have for 30 years pollinated his tropical fruit trees have been killed and slimed by the small hive beetles. He saw his first beetles just last Summer, and he took this nearly complete loss in just a few months. At the time the beetles first appeared he was busy picking and selling his avocado crop – he packs tons of fruit to ship to Honolulu for market within the state. He may ship three tons at a time of the ten varieties of these large green and black beauties, working with only his wife and two sons. Like many farmers on the Island, they

A mac nut grower who walks the trees every day looking for pollinators keeps five colonies of hives. She combines oil traps, beetle barns and open space above the hive for worker bees to patrol. There are screened vent holes on the side (which were completely propolized shut) and an upper entrance. She finds geckos in the top of the hive and sees them eating small hive beetles.

A oil based stew of beetles and beetle larvae.

Mixture of beetle adults, larvae and bees captured in a plastic tray filled with oil.

live simply and somewhat remotely in the southwest corner of Hawai'i. He is not too far from the area where a lava flow cut off the road around the lower part of the island and still flows into the Pacific Ocean. He has a modern honey house where he previously extracted tropical honey from his hives, bottling and selling it locally. People sought his unique tropical sources of honey – now there is nothing to extract.

I was there in late February, and the impressive, 30-year-old avocado trees were in bloom. There were newly pollinated avocados on the early blooming flowers, giving Rob some hope that there will be at least a partial crop to sell in 2011. I saw green bottle flies, and a few Lepidoptera – the most noticeable were some sphinx moths (hawk moths) that were flying about the trees at twilight. Unique Island spiders, crab-like garden spiders, build enormous webs between trees to catch pollinators as they fly tree to tree. Heulskamp picked up a six foot stick to carry in front of him like a light saber, catching the abundant webbing as we moved around the trees. The spiders only appear at blooming time, he said.

Pollination research on avocado pollination has been done in California and Florida but not much in Hawaii, perhaps because of the abundant supply of managed and feral honey bee colonies, an abundance of large black carpenter bees (*Xylocopa*), yellow jacket wasps, pollinating bird species like hummingbirds, and generally small field sizes. A review of the pollination needs of avocado flowers (in S.E. McGregor's *Insect Pollination of Cultivated Crop Plants*) reveals that the flowers go through two phases. The first phase is when the stigma is exposed and receptive and the second phase is when the stigma is non-receptive but the anthers are releasing pollen. This makes it impossible for the flower to self-pollinate. Because the flowers have an open structure they are easy for pollinators to visit. In pollination cage studies, the cages without honey bees (and without other pollinators I assume), produced just four or five fruit, but when honey bees were in the cage, between 120 and 284 fruit were produced. Pollination is necessary, therefore, but just which animals are pollinating the flowers in Heulskamp's field is unclear.

The beetles have also killed feral colonies, estimated by old-time Hawaiian beekeepers at 800,000 before the attacks. Indeed, the abundant and unmanaged feral colonies may have been a huge source of the massive numbers of beetles. But small hive beetles are highly reproductive, and the colonies killed in Rob Huelskamp apiary may have produced millions of beetles to fly miles to other colonies. Clusters of hundreds of the eggs can be seen in the corners and cracks of the hives, and the larvae develop very quickly in the tropics.

With 18 acres, Huelskamp has a larger field than many of the small fields and orchards owned and operated independent growers, often small family farming operations run by those who selected the Island as a place to be away from many social pressures. Some are living off the grid, no electricity, phone or other modern attachments. Some of these farms are owned by beekeepers, or where beekeepers keep their hives. With a seasonal temperature range of 60s at night and high 70s and low 80s during the day, most of the people I have met on a quickly arranged 12 day visit to the Big Island are folks who live with their bees, walk the trees to count the pollinators, and understand the role of bees in the pollination of the crops they produce. They are old Hippies, folks escaping to a remote Paradise, and some who have been successful in another business who have voluntarily picked the good life in Hawaii.

On the Big Island of Hawaii, 55% of the colonies are dead, 34% of the beekeepers have lost all their bee colonies

Perhaps Huelskamp is an extreme case, but certainly not alone with his colony losses. In the Big Island Beekeeping Association (BIBA) and the Honey Bee Education Project Survey of 2010 Colony Losses on Hawaii Island, (Revised February 27, 2011), "Respondents reported losing 2,535 honey bee colonies or 55 percent of the total number of colonies reported at the beginning of the year . . . Altogether 90 percent of the respondents reported losing at least one colony in 2010. Thirty-four percent of the respondents reported no colonies at the end of 2010. (These beekeepers were wiped out.). The majority of survey respondents attributed their colony losses to Small Hive Beetle (80 percent) or a combination of varroa and Small Hive Beetle (29 percent)."

One beekeeper described the situation as a "Perfect Storm" where small hive beetles, *Varroa*, Nosema and perhaps drought (on the leeward side of the Island) have combined to

kill so many bees. It is unclear if the survey included numbers from any of the Island's major queen producers, who are friendly but not sharing a lot of data. They are all private operations. Next month I will discuss visits to two of the queen producers and to two honey producers while during my visit. The many beekeepers who have lost colonies have been those who kept bees in a mite-, beetle- and disease-free environment older Mainland beekeepers recall from the 1960s and 1970s. For many colony management consisted of making increase colonies, letting the bees raise their own queen, supering the hives and harvesting the honey. There is no Winter losses to contend with in this lush tropical environment, and many beekeepers harvested honey 10 months out of the year; some removed an average of 40 pounds a month during significant nectar flows. The beekeepers sold honey at local farm markets and online. They got a premium price for their honey.

That is now changed. Many beekeepers are using one or more types of beetle traps to reduce the level of beetles in the colonies. In early February the beekeepers in Hawaii received news that the Mitaway Quick Strips (MAQS) were able to ship from Canada after the U.S. government gave Hawaiian beekeepers permission to use the chemical for *Varroa* control. A few of the beekeepers are checking their bees for Nosema levels. One of the duties that the new State Apiary Specialist will be offering soon is training programs for Nosema monitoring. One of the local macadamia (called mac nuts by the natives) nut growers has offered laboratory space, a compound microscope and accessibility for beekeepers to come in and check their bee samples for the midgut parasite. For the well informed, proactive beekeepers on the Island the tools seem to be available for the control of these three pests, but most of the beekeepers I met have not reached that level of intensity of activity. A few are still waiting to see what the government will do for them.

New State Apiarist

This puts enormous pressure on newly hired State Specialist in Apiculture for Hawaii, Danielle Downey. She has been on the job since December 1, 2010, after a long delay in hiring. In February she addressed the Hawaii Board of Agriculture with an update on the honey bee situation. It was an open meeting I attended. She presented an overview of beekeeping history in Hawaii. According to Downey, honey bees were first introduced from California in 1857. The industry grew, and by the 1890s the large cattle industry needed honey bees for the pollination of kiawe, a mesquite relative that requires bees for pollination and is a valuable nectar source. Importation of various bee stocks was allowed until 1909. Since then the border has been closed to importation, with the exception of bee semen. There is widespread speculation about how the *Varroa* mites and small hive beetles arrived on the Islands, including some conspiracy theories, but the reality of regulation of every tourist who flocks there is a daunting task for Hawaiian officials.

Ron Hansen and Danielle Downey at a beach in Hilo, HI (it was the closest I got to the ocean during my trip).

Downey reported that from 1918 to 1941 over a million pounds of honey were produced each year, but in the 1930s American foulbrood spread throughout the islands. The spore-forming bacillus requires that beekeepers burn infected equipment. In 1952 there were 11,900 beehives in the state with 25 commercial beekeepers. There is no registration or colony census at present, but some estimate that there are about 500 beekeepers on the islands.

In April of 2009 the *Varroa* mite (*Varroa destructor*) was found on the island of Oahu. This mite has been in the United States since 1985. It kills colonies and is associated with various viruses, including the deformed wing virus, which renders the worker bee useless to the colony. "The colony will just throw her out of the hive," Downey said. *Varroa* was found in April of 2010 on the Big Island, is now widespread on both islands.

The small hive beetle was first found near Hilo in April 2010 and then in Oahu in November of 2010. A relative of the sap beetles, the beetle is elusive and may not be seen by the beekeeper until larvae are present and the colony is close to being slimed. These wet combs are repellant to bees, who leave the colony. While in other areas the SMH is considered a secondary pest, in Hawaii it a lot more destructive, and may be a primary pest. The beetles live in feral hives and are suspected of feeding on Hawaiian fruit. They carry a yeast the causes honey to ferment and produce the slime, making the equipment unusable. For most beekeepers this means that the hive bodies and frames must be burned. Beekeepers with plastic frames scrape the frames, power wash the plastic, and recoat with new wax. Some include a bleach bath before recoating. Unfortunately, the plastic frames are made in such a way as to harbor beetles when the frames are in the hive and many beekeepers are abandoning them for wood frames where there are fewer places for beetles to hide.

We really don't know when the

Macadamia nuts bloom several times a year, so there are large green nuts and flowers on the trees at the same time. I observed many 7 to 10 nut racemes in older nuts, but only one or two in recently pollinated nuts, suggesting that something (rain, lack of pollinators) interfered with successful pollinations.

midgut parasite *Nosema ceranae* first appeared according Danielle Downey, who worked last in Utah. She has been hired on a one-year contract. She has found spore counts in foragers of 15 million, but the colonies continue to live. There are high mite numbers too, four and five thousand per colony, yet they continue to live, says Dr. Ethel Villalobos, Associate Researcher and Coordinator for the Honeybee *Varroa* Project of the Dept. of Plant and Environmental Protection Sciences at the University of Hawai'i at Manoa. This greatly exceeds the mite levels found on the Mainland for non-systematic colonies.

Invitation to visit

Last November Pahoa beekeeper Ron Hansen attended the Southern New England Beekeepers Assembly in Hamden, Connecticut. He heard the three speakers – David Miksa of Groveland, Florida, Medhat Nasr of Alberta, Canada, and myself give lectures. A few weeks after that I was invited to visit the Big Island. I agreed to visit in February, hosted by Hansen and the Big Island Beekeepers Association (BIBA). Cary Dizon, a small scale beekeeper who had four hives but now only has one, is BIBA president, and there was a lot of 'discussion' on how various aspects of the visit would be structured. When I agreed to wave any fee it meant that I got a working vacation in Paradise. Ron made sure he got his money's worth.

Hansen has lost about one hundred colonies, having somewhere between and 40 and 50 alive colonies when I visited. Beekeeping is a sort of retirement business for Hansen, one where he works nearly full time. In his and other beekeepers hives I saw a lot of beetles, adults in the hives, larvae on the combs and even more in traps designed to trap and kill both forms. Hansen and others use screened bottom boards furnished with screen covered oil traps. Cooking oil is put into the traps (level the colony hive stand first). The bees are aggressive toward the beetles, and seem to drive them out of the combs and into the traps when they have the chance. Especially in the Hilo-Pahoa area where rainfall is measured at 200 to 300 inches per year and the vegetation is extremely tropical, there were more beetles and *Varroa* mites in the oil traps at enormous numbers. Stories of buckets of beetles come from this, as the beekeepers empty the polluted oil in beetle filled traps into buckets and then refill the traps with fresh oil. If not checked the level in the trap gets so full that the beetles can crawl out and back into the brood nest.

There is a debate about the ability of a the small hive beetles to be able to kill a colony if it has a large population. Some recent Island visitors like Jerry Hayes say no, that the beetles are only secondary to the varroa and Nosema infections. But Drs Ethel Villalobos and Lilia de Guzman (USDA, ARS, Baton Rouge Bee Lab) state "things are different in Hawaii."

Certainly any strong hive that undergoes swarming or a queen change will get an enormous beetle invasion. The absence of a strong queen is one of the triggers that appears to be at work with beetle invasions. Ray Olivarez (Olivarez Honey Bees, Inc) told me that he has taken a queen out of a strong colony that contained no beetles and returned the next day to find many beetles filling the colony. When he placed a queen back in the hive, "the beetles went away."

This frustrates Hansen, who tries to keep colonies strong, but then has them swarm and the beetles move in the colony and do enormous damage, even killing the hive if not monitored twice a week.

The oil trays on screened bottom boards on many hives I saw impressed me. They were a way of trapping adult beetles and also a predictive tool for the beekeeper to see which colonies that were about to die from the beetles. There are lots of *Varroa* mites floating on and in the oil too, so both pests may be monitored proactively. Many colonies had a thin coating of freshly secreted beeswax flakes floating on the oil that caught the mites. Others fell through, as did the adult beetles and the beetle larvae.

Some colonies had traps containing hundreds of the dark beetles and there were some with thousands. But the larvae, from those ready to crawl out of the hive to the soil for pupation to the tiny ones that just hatched from the flood of eggs deposited by beetles in the cracks and burr comb of the hives were also in the oil. For the Island beekeepers the appearance of adult beetles was a desired result of the oil traps, but the presence of a large number of larvae predicted the rapid sacrifice by fire of the hives to the beetle gods before the beetles were able to complete their lifecycle and infest other colonies.

It is well known that the small hive beetle is very adaptive in its ability to hide inside the hive. When I worked hives with Hansen, I noticed that the plastic frames provided an ideal place for the beetles to hide from the worker bees. The adult beetle's objective is to mate and lay eggs in these places inside the hive where bees do not have bee space. The bees jump on the beetles and chase them – it is fun to watch in a perverse sort of way, cheering on the attacking bee but knowing the beetles will outnumber them with their larvae. But the real challenge is to develop hives that have no areas where the bees cannot move. Now beekeepers move side frames away from the side of the hive, and position the division board feeder so bees access both sides. Hansen is adamant that there cannot be any place for the beetles to hide. He spaces his feeders and frames so the bees are able to reach every space. He is looking at changing the cover/inner cover design so

the bees have full access to the tops of the hives and no cracks at the tops of the frames. Bottoms boards with screens and oil trays collect the beetles as they enter the hive. He was getting loss of adult bees in the oil in his home-made traps, and was planning modifications.

We visited one macadamia (mac nut) grower near the lava flow and saw how important the bee space is to keeping beetles out of healthy hives. The farmer, Sandy, and her husband have given hives a four inch space at the top of the hives to allow the bees to patrol over the inner cover (these must be carefully watched during the nectar flow or the bees will fill them with burr comb). Sandy also feels that the open space allows local and abundant geckos to occupy the space where they feed on the beetles. A number of other animals occupy the space as well, adding to my vision of 'hive ecology.'

This tiny beetle larva is on a slimed comb of honey. This comb has been removed and will be left out in the rain by the beekeeper.

Importance of Queens from Hawaii

Queen bee production is a critical part of North American colony management and pollination of important crops. Hawaii was one of the last places in the world to get the *Varroa* mite. Due to the climate, Hawaiian queen producers supply queens to many parts of the world in both early and late season when other queen producers cannot. Demand exceeds supply. One producer said that they could produce ten times the number of queens and still not fill the need. Since the producing firms are privately owned, we can only guess about production numbers, but it seems clear that the numbers are a million queens per year or more – perhaps much more. It seems possible that individual firms are doing that number.

There is a 30 plus year history of production of early and late season queens from the Big Island of Hawai'i. Most of the queen rearing is done in an area overlooking the bay where Captain Cook had his fatal encounter with the Island's natives. Located near Kona, the center of coffee production, the queen producers are sandwiched into an area where it is quite likely that you have another beekeeper's colonies close by, but due to the thick tropical vegetation and narrow roads up and down the volcanic rock, you may never know they are there unless someone tells you.

This may be a pretty good way to insure an adequate drone supply for queens as they leave mating nucs – my math suggests that this area needs to produce hundreds of millions of sexually competitive drones each year to mate with queens. The queen producers are acutely aware of the need to produce abundant drones, and keep detailed records to trace back any reports of poor mating. As Ray Olivarez (Olivarez Honey Bees, Inc) said to me, "the last thing we want is for our beekeeper customers to have drone layers from the queens we ship them. I keep extensive production data so we can trace back any performance issues."

Queen rearing can be successful all twelve months of the year, but most of the operators set up in January and February for the new season using a variety of nucleus sizes. These colonies require a lot of bees, shaken into large boxes and then dipped to make up nuclei with a spam can or a slightly larger container, depending on the size of the nucleus. In the tropical environment queens are often mated and laying in 10 to 12 days, filling the global demand for early and late season queens. In North America there are many beekeepers who purchase early season Hawaiian queens for use in nuclei assembly in Southern states from February on. More northerly beekeepers do the same thing, later in the season, but by April, and before they can produce queens of their own with any level of success. Canadians, like the Alberta beekeepers I visited last June, rely on tens of thousands of Hawaiian queens for expansion of their successful honey production and pollination services. Under the

Ron lets his chickens pick over plastic combs filled with beetles. They like the larvae.

Coffee benefits from bee pollination by resulting in larger and earlier ripening cherries, which contain the beans. Volcano side coffee produces the best quality coffee.

leadership and encouragement of Dr. Medhat Nasr, Alberta has dramatically expanded colony numbers in less than a decade. The use of Hawaiian queens has been key in making this possible.

No single group of beekeepers is more dependant on these queens than a enormous range of beekeepers who move bees to California for almond pollination. I am not sure anyone fully comprehends the number of colonies that are made up in the Fall for the move to the almond orchards. And again about March 1st, when the almonds are loosing their petals, there are a huge number of beekeepers who split the hives moved out of almonds for increase. Yes, there are queen cell producers like Dave and Linda Miksa of Groveland Florida who help with this demand, but these are not mated queens. I used nuclei made with Hawaiian queens while living in Connecticut. The queens allowed the beekeepers to make early season splits as described in my book *Increase Essentials*.

What would happen if Hawaii lost its queen production for even one season? At this time I doubt anyone fully comprehends this level of impact. But here are considerations one must include in making statements about the economic impact of these queens:

1. Commercial honey producers would need to make up colonies later in the season and may not have late season queens for Fall splits going to almonds;
2. Pollination interests for almonds and other crops would have a shortage;
3. Canadian pollination and honey production would suffer from a shortage of queens;
4. The pollination services to U.S. and Canada almonds, canola (oil seed rape), fruit trees, and other crops would be at risk.

When we add crop values, we include billions of dollars of food, oil and fiber production dependant (sometimes indirectly) on a few Hawaiian queen producers and the health of their colonies.

Next month I'll complete this story with visits to two larger queen producers and two honey producers, and report how they are dealing with this "Perfect Storm." BC

Having seen enough dead beehives in Hawaii, I returned to find many of my hives dead in late February, the cost of being chemical free during a severe winter. So April will be a month of rebuilding and perhaps changing directions with my small scale beekeeping operation in Michigan. That will be useful for a return visit to the Big Island for the Western Apicultural Society meeting in September where I am scheduled to conduct a workshop on 'Rebuilding the apiary after losses.' It will be fresh material to share with WAS participants. Read or reread Increase Essentials *available at* ***www.wicwas.com***.