REPORT TO THE TWENTY-FIFTH LEGISLATURE
REGULAR SESSION OF 2010

Report on the Study, Control and Mitigation of the Bee Mite Infestation

Prepared by:

THE STATE OF HAWAII
DEPARTMENT OF AGRICULTURE
DIVISION OF PLANT INDUSTRY
PLANT PEST CONTROL BRANCH

In response to proviso in ACT 162, SLH 2009, section 6

December 2009

Table of Contents

PURPOSE:

Act 162, SLH 2009, section 6, provided for a $2,000,000 ceiling on expenditures for Plant, Pest, and Disease Control (AGR 122) to control and treat the infestation of the Varroa mite. The proviso in Section 6 of ACT 162 stated:

"SECTION 6. Provided that of the special fund appropriation for plant, pest, and disease control (AGR 122), the sum of $2,000,000 or so much thereof as may be necessary for fiscal year 2009-2010, and the sum of $2,000,000 for fiscal year 2010-2011, shall be expended to study, control, and mitigate bee mite infestation in the state; provided further that these funds shall be expended only in the amounts provided by the federal government and deposited into the pest inspection, quarantine, and eradication fund for this purpose; provided further that the funds shall be expended for no other purpose; provided further that the department shall prepare a report that shall include but not be limited to the status of the bee mite infestation and steps to control and treat the infestation; and provided further that the department submit the report to the legislature no later than twenty days prior to the convening of the 2010 and 2011 regular sessions."

No federal money earmarked for varroa mite control has been placed in the pest inspection, quarantine, and eradication fund as this fund is administered by the Plant Quarantine Branch (PQ) which does not conduct varroa mite control work. Response, control, and eradication of pests is conducted by the Plant Pest Control Branch (PPC). PPC received $370,078 this year for varroa mite control. This was placed in a special fund entitled "Varroa Mite Control in Hawaii". This report is provided to meet the conditions of the Section 6 proviso for the submission of a report on the status of varroa mite in Hawaii and steps to control the infestation.

BACKGROUND:

Origin of varroa mite.

Varroa mites (*Varroa destructor*) originated in Southeast Asia where they are parasites on the Asian honeybee, *Apis cerana*. The mites and the Asian honeybee coexist well, with the mite rarely causing death of honeybee colonies.

In 1963, the mite jumped to hives of the European honeybee, *Apis mellifera*, which were being kept in managed bee hives by beekeepers in the area. The mite then rapidly spread to the Philippines, Japan, Vietnam, and Russia through movement of bees by the beekeeping industry. As *Apis mellifera* had not evolved with this mite, it had not developed resistance as had *Apis cerana*. The result was massive die-offs of bee colonies throughout the world. The mite has continued to spread and can now be found in Asia, Europe, North and South America, Africa, New Zealand, and most recently Hawaii. Australia is currently the only area free of varroa mite.

Impact of varroa mites on bees and beekeeping.

Adult varroa mites are tiny 1-1.5 mm reddish-brown, crab-shaped, flattened mites. They are external parasites which attack adult honeybees, larvae, and pupae. They use their piercing-sucking mouthparts to feed on the haemolymph (blood) of bees. The life cycle of the varroa mite is synchronized with that of the honeybee. The female mite lays eggs in developing bee brood comb cells. After hatching, the developing mites feed on the honeybee larvae. The pregnant adult female mites emerge from the cells along with their bee host and seek another

cell to repeat the cycle. The mites can only reproduce on honeybee brood (larvae and pupae) and not on other species of insects. Severe infestations of the mite will cause malformed adult bees, decline of bee colonies, and if not treated, eventual death of the colony. The mites disperse from hive to hive by hitchhiking on adult honeybees and in this way can infest mite-free hives. Although varroa mites have been seen on other insects, this occurs only after these insects have visited flowers that were recently visited by an infested honeybee. The mites can only survive for about 5 days when not in contact with honeybees.

Figure 1. Varroa mite on adult honeybee.

The mite's negative effect on honeybees comes about either by feeding on the haemolymph of the adult or by feeding on the bee brood in the cells. The direct effect from blood feeding on adults due to loss of blood appears minimal but has the potential to vector virus diseases which are more serious. The effect of mite feeding on the brood has been shown to cause decreased body weight of bees, smaller royal jelly-producing glands, reduced lifespan of adult bees, and the introduction of pathogenic viruses. According to the Ministry of Agriculture and Forestry in New Zealand, their experiences, in general, show that the effects on individual bees can result in a rapid reduction in the number of adult bees in a colony, abnormal brood, and hive abandonment by the bees. The final outcome, unless a treatment is used to reduce mite populations, is usually colony death. However, when mite populations are monitored and treated properly, pollination and honey production are rarely affected.

Varroa mite populations can gradually increase in a bee colony throughout the year without causing any noticeable effects. Studies in Russia, the mainland US, and Canada have shown that honey production is not significantly different among colonies with different levels of mite densities ranging from 7-33%. However, after honey production, beekeepers that did not treat their hives for mites experienced greater losses of hives through the winter than those that did treat for mites. The greatest recent losses occurred during the 1995-1996 winter, which was exceptionally long. Beekeepers that did not treat their hives for mites lost between 30-50% more hives than those that did treat.

There has been little research on the effects of the mite on pollination. There is no doubt that feral (wild) hives have decreased in areas after the mite has become established but the numbers vary. It is estimated that up to 90% of the feral colonies died off in southern Florida and about 75% in California. However, the mite has not eliminated feral bees in areas it has invaded and the number of feral colonies has begun to increase in some areas after the initial decline. In areas that rely on managed honeybee colonies for pollination, the impact of the mite has been minimal due to the effective control of the mite by the beekeepers, although at an

increased cost to the beekeepers. We don't know of any research on the impact of the loss of feral bee populations in areas that rely on feral bees for pollination but expect that the impact could be significant.

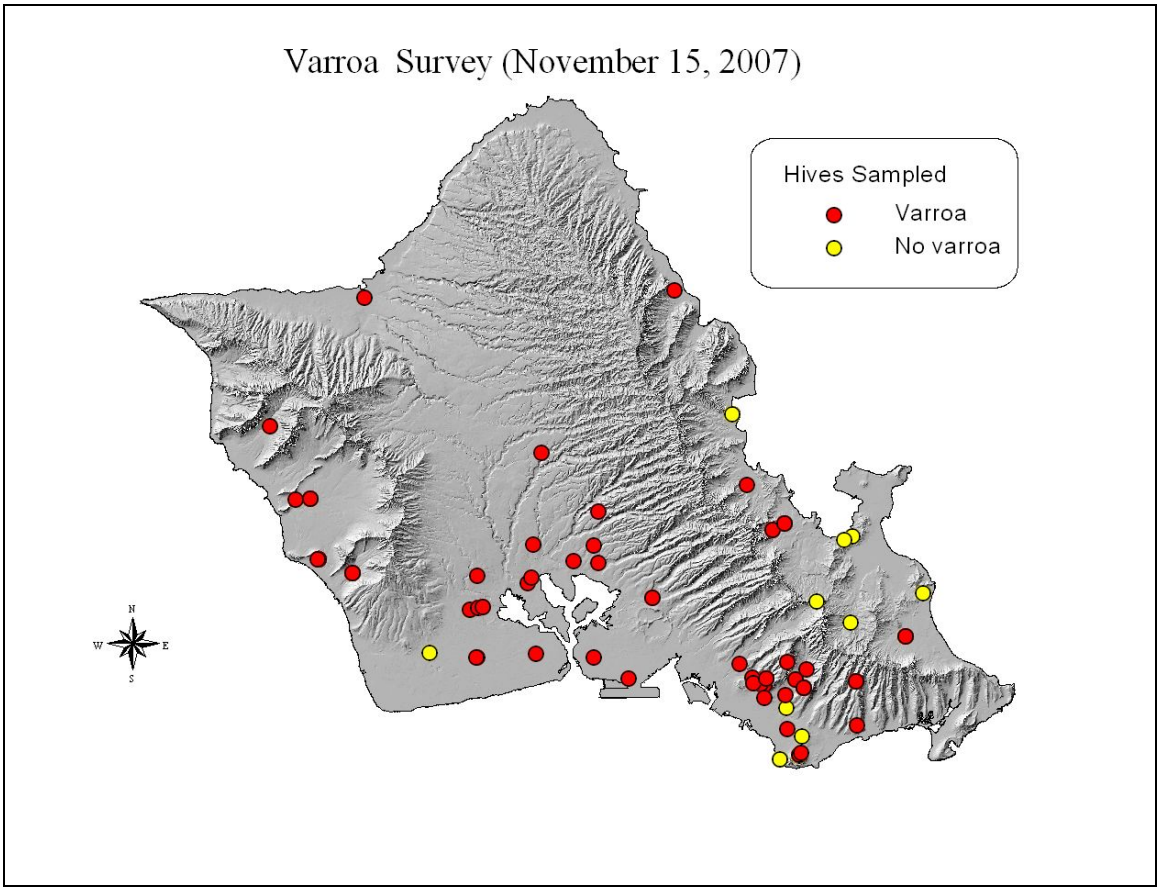
Varroa in Hawaii.

2007 and 2008 Efforts:
Initial State-wide Response.

Varroa mites were first found in Hawaii in April 2007 in a beekeeper's managed hives in Makiki, Oahu. To this day, we do not know how the mites arrived into the State. The Hawaii Department of Agriculture's Plant Pest Control Branch (PPC) responded to the sighting by working with the beekeeper to destroy the infested hives. Concurrently, PPC initiated delimiting surveys (i.e., surveys designed to determine distribution of a pest) throughout Oahu which were expanded over the following weeks to the islands of Hawaii, Maui, Molokai, Lanai and Kauai. The purpose of these surveys was to determine the extent of the varroa mite infestation in the State. These surveys included the collection of data on mite distribution, rates of infestation, backtracking to determine origin of the infested hives, and forward tracing to determine where infested hives were moved to. All feral hives that were found infested with mites were destroyed. HDOA recommended to beekeepers that they destroy their infested hives. Not all did and HDOA worked with those beekeepers to control the mite infestation.

HDOA surveys managed hives.

Surveys of feral hives



These surveys continued over the following months and demonstrated that the mite was restricted to the island of Oahu, until August 2008, when varroa mites were discovered in Hilo. No varroa mites have been found on Kauai, Maui, Molokai or Lanai.

The initial surveys also showed that at the time of the first find in April 2007, the mite was already widely distributed throughout Oahu, including in feral bee hives. These survey results demonstrated that the mite had been on Oahu for at least a year and likely longer. Due to its wide distribution throughout the island and its prevalence in the majority of sampled feral hives, it was apparent that eradication was not a viable option. Eradication of the mite would require the destruction of every managed and feral honeybee hive on Oahu. The survival of one feral hive, inadvertently missed in an eradication program, would allow for the survival and eventual spread of mites throughout the island as that missed colony split off and spread to form new colonies. There are no tools or techniques available for the removal of the thousands of feral bee hives in the Koolau and Waianae mountains that would not also have a catastrophic effect on native insects and other biota. An effective tool such as poison baiting would kill honeybee hives as the foraging bees bring the poisoned bait back to the hive, however, other native insects would also be attracted to the bait as well as to the tainted honey and dead bees in the killed colonies.

The majority of Oahu beekeepers are hobbyists, a few produce honey for sale, and a couple provide pollination services to farmers. It is estimated that there are anywhere from 600 to 1,000 managed hives on Oahu. The exact number is not known because beekeepers are not regulated in Hawaii and there is no organization that formally represents every active beekeeper in the state. Managed hives on Oahu are spread throughout the island and are managed by

many different beekeepers. Most are hobbyists and do not associate with other beekeepers or beekeeping associations. There are fewer hives on the other islands compared to Oahu, the exception being the Big Island. The heart of Hawaii's beekeeping industry is in Kona where some beekeepers have up to 3,800 hives for honey production. Four other Big Island beekeepers have thousands of hives each and are major suppliers of queen bees for the rest of the state, the mainland, and internationally. The establishment of the mite on the Big Island would cause economic hardship for most of the beekeepers, in particular for the queen producers and organic honey producers. The exact figure for the value of the Kona queen bee industry is not known but it is estimated to be a multimillion dollar business which has created many jobs in the region. The impact of the mite on the queen bee industry could be devastating causing some queen producers to go out of business.

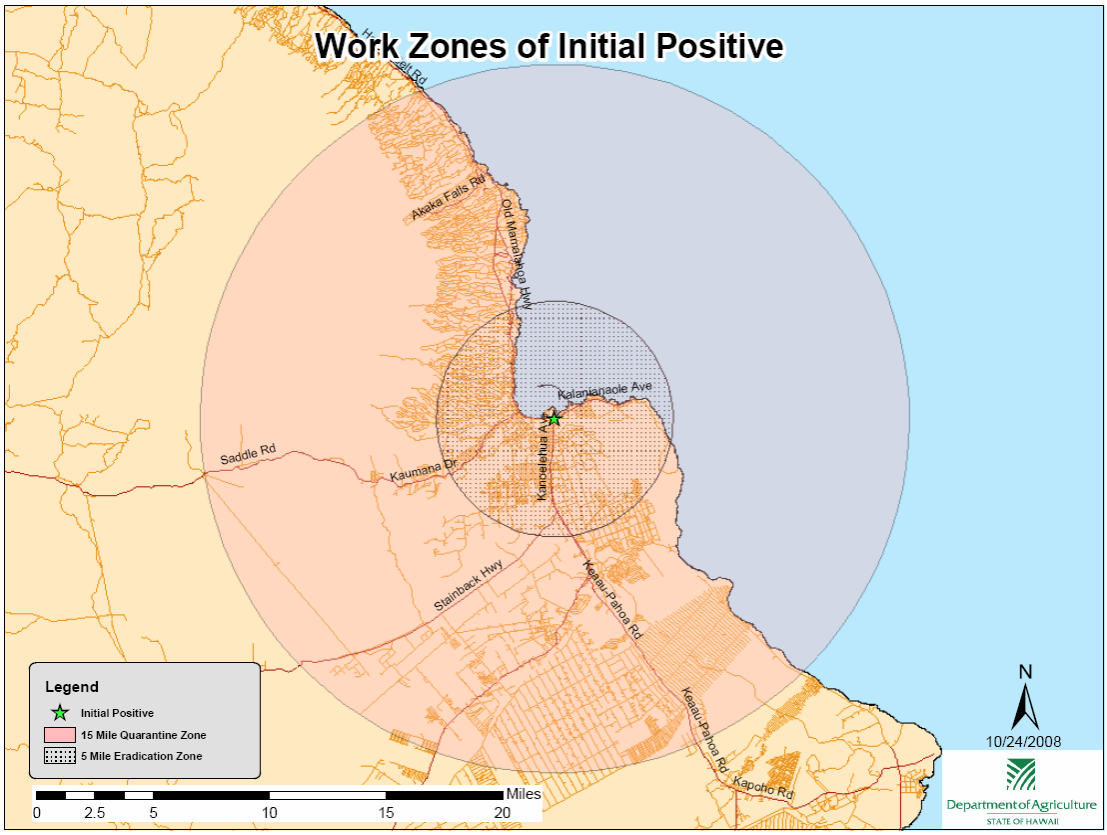
HDOA developed a strategy to address the mite infestation in the State with the goal of preventing the mite from moving off of Oahu and from becoming established on other islands. A draft of this strategy was presented to the 2007 Legislature as part of a budget breakdown (**Attachment 1**). This was revised and presented as a draft plan to beekeepers in June 2007 (**Attachment 2**). The objectives of this plan were to:

1. Contain the mite on Oahu
2. Reduce mite populations on Oahu
3. Detect and respond to infestations on mite-free islands.

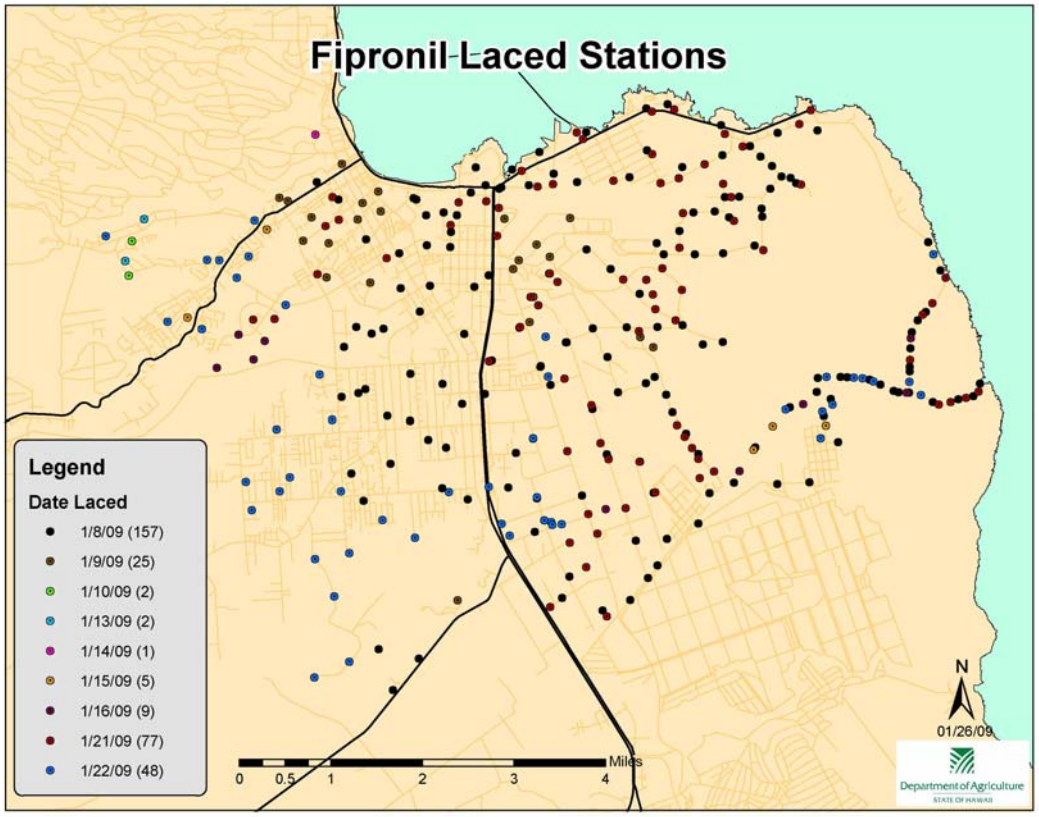
Containment of the mite on Oahu was attempted through quarantine action, port buffer zones, and monitoring and detection surveys. Details on these actions were reported in the 2007 Report to the Legislature. These actions have helped in slowing the spread of the mite to other islands but did not prevent its spread to Hilo.

Response to Hilo Infestation:

On August 22, 2008 bees collected from an HDOA swarm trap near Hilo Harbor tested positive for varroa. This swarm trap was set as part of the early detection program and response plan (**Attachment 3**). An Incident Command System (ICS) was initiated to respond to the detection. Participating agencies included HDOA PPC Branch, HDOA PQ Branch, HDOA Pesticides Branch, HDOH Vector Control Branch, USDA APHIS and the University of Hawaii. In accordance with the Varroa Mite Response Plan, a 5-mile containment zone was established around the positive find. All known managed hives in this zone were sampled and found to be varroa-negative. An extensive public outreach program was also initiated to obtain the public's help in the identification of wild hives in the area. Since honey bee colonies would harbor, breed, and spread the mite, the goal was to identify all wild hives in the 5-mile zone and destroy them. With the cooperation of and assistance from the public, more than 100 feral hives within the containment zone were identified, sampled and destroyed. Of the feral hives tested, 12 were positive for varroa. Additionally, more than 180 swarm traps were placed in the containment zone to attract and catch roaming swarms. All swarm traps were monitored at weekly intervals. Each swarm captured this way was tested for varroa and other bee pests, and then destroyed. Bees from traps were destroyed because movement of these swarms to other areas increased the risk for spreading the mite into uninfested areas.

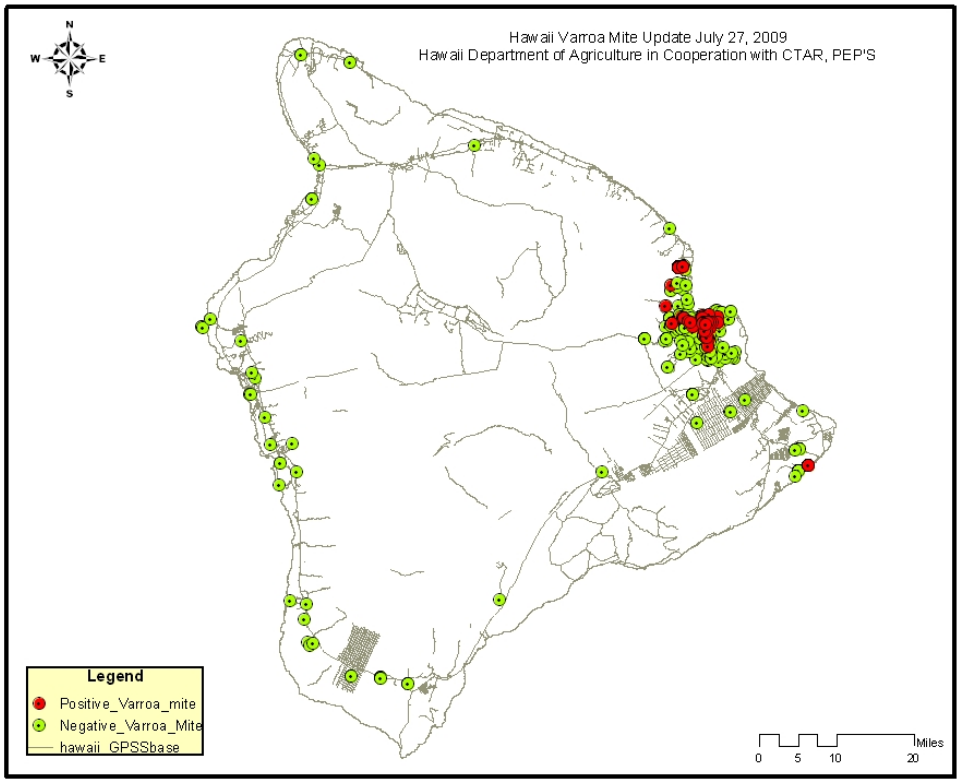


All feral bee colonies in an area cannot be found through visual searching. In order to eliminate these unreported hives, HDOA developed baiting strategies to attract bees to pesticide-laden feeding stations. This management strategy had been researched in New Zealand but never deployed anywhere in the world before so HDOA was breaking new ground. Trap and baits that worked in New Zealand did not work under Hawaii conditions. However, within a few weeks PPC developed a trap and bait for Hawaii conditions that was attractive to bees at the densities required to be successful. However, no toxicants were legally approved for this use and we needed to work with the Environmental Protection Agency (EPA) and the Fish and Wildlife Service (FWS) to gain their approvals for a toxicant that would be safe to the public, staff, and not have any negative effects on nontarget insects, particularly endangered and threatened species. A number of toxicants were tested from October through December and approval was finally granted for the use of fipronil over a ten day interval. These fipronil-laden bait traps were deployed throughout Hilo in early January 2009. However, the bait stations had mixed effectiveness because of the delays in gaining the regulatory approval. By the time the approvals were granted, macadamia trees had begun blooming and were more attractive to bees than the bait traps. Feral bee colonies were successfully eliminated in areas without the competing macadamia trees but had limited success where macadamia was flowering.



At this time, PPC was informed that a beekeeper had moved his hives out of the containment area into Onomea (about 8 miles to the North) and to Puna (about 20 miles to the South). This occurred despite assurances from all beekeepers that they would not move their bees out of the area. Follow-up by PPC on these hives verified that they were infested with varroa mite and were already in the wild bees in these areas. Thus the distribution of the mite had been expanded to such a degree that eradication was no longer feasible in the Hilo area. The objectives for varroa mite mitigation on the Big Island were adjusted to focus on control and management on the Hilo side and detection and response on the Kona side based on this new information.

On the Big Island, the mite was restricted to the Hilo side in January 2009. PPC surveys from swarm traps, feral hives, and managed bees could not find mites on the Kona side.



However, it was apparent that the mite would move to Kona naturally with the help of feral bees in a matter of a few years and that more likely it would be moved accidentally to the Kona side by beekeepers within a few months. PPC's objective at this point was to work with beekeepers to delay the movement of bees out of the infested areas and to detect and respond to any new infestations. This would give beekeepers in the uninfested areas time to adjust management practices to be able to survive with varroa mite.

2009 Efforts:

In early 2009, varroa mite was present on Oahu and the Hilo side of the Big Island. All other islands were free of mite infestations. PPC's efforts focused on three main objectives:

1. Contain the mite on Oahu and Hawaii
2. Detect and respond to infestations on mite-free islands.
3. Work with beekeepers to reduce mite infestations in managed hives.

In October 2009, varroa mite was detected in the Captain Cook area in managed beehives. This was attributed to the movement of infested bees by beekeepers from the Hilo side. The area requiring aggressive management expanded from Oahu and east Hawaii to include the Kona districts on Hawaii island.

Containment of Mites.

Mite containment on Oahu and Hawaii was carried out by decreasing honeybee densities in port areas and in managed hives on the islands. Honeybees were removed from port areas when

detected. This was achieved either through the use of swarm traps or by visually detecting a nest and removing it. This decreased the risk that infested honeybees would hitchhike on a ship or aircraft and spread the mite to uninfested islands. Additionally, PPC worked with beekeepers to remove their managed hives that were close to port areas and to assist them in developing mite management techniques to decrease mite populations in their operations.

Detect and Respond to Infestations on Mite-free Islands.

Techniques described in the 2007 Legislative Report were continued for the detection and response of mites on uninfested islands. These included the use of swarm traps in port areas, removal of feral colonies from port areas, and working with beekeepers to remove their managed hives from port areas. All collected swarms and feral colonies were tested for varroa mite, tracheal mite, tropilaelaps mite, Africanized bee traits, and small hive beetle. All 2009 samples from mite-free islands were negative for these honey bee pests.

Work with Beekeepers on Management of Varroa and other Honey Bee Pests.

PPC secured a federal grant in 2009 from USDA for the control of varroa mite in Hawaii. The development of the work plan for this grant was initiated by PPC with beekeeper and grower input throughout the process. Drafts of the proposal and work plan were presented to and discussed with the Big Island Beekeeping Steering Committee which was setup to discuss varroa mite and other beekeeping issues. The first draft was discussed with the group in May and continued in meetings through June and July. A final proposal was presented to USDA in August after obtaining support from beekeepers and other stakeholders on the proposal. The grant for $370,078 was approved in September and the first funds arrived in November.

The objectives of the grant are:

- Establishment of a Hawaii Apiary Program which will provide extension, outreach, and certification functions.

- Bring in expertise from outside the state to conduct workshops, work in the field with beekeepers, and share knowledge on current techniques to enhance production

- Implement the USDA national honey bee pest survey protocols for varroa mite and other honey bee pests that, when present with varroa, can cause hive collapse.

- Develop and implement techniques and procedures to prevent the spread of varroa mite to uninfested islands.

Apiary Program: An Apiary Specialist will be hired in the third quarter of FY 10. The Apiary Specialist will have practical field experience with honey bees and varroa mite and will be able to rapidly develop a certification, extension, outreach, and education program that will begin to aid beekeepers in the management of varroa mites in their bee yards within the second quarter. The certification activities will aid beekeepers with exports of queens and packaged bees. The apiary program will address all beekeepers, statewide, including honey producers, queen producers, pollinators, and growers dependent on bee pollination.

Outside Expertise: A contract will be initiated with a nonprofit organization to hire a coordinator and to bring in outside expertise to tour the islands and give hands-on demonstrations, lectures, and disseminate information to beekeepers and growers on the latest issues, techniques, and experiences with varroa and other honey bee pests and how these are being addressed.

The coordinator will be hired to conduct periodic meetings among beekeepers and growers to discuss and develop solutions within the industry to their specific issues in maintaining their businesses with varroa established in Hawaii.

Honey Bee Surveys: USDA/APHIS/ARS has developed a survey protocol for honey bee pests. Some of these pests, such as viruses, have never been systematically surveyed for in Hawaii. These other pests, particularly certain viruses, have been shown to be directly linked to varroa mite impacts on honey bee colonies. Initial setup and testing of this protocol began in July 2009. These survey protocols will subsequently continue to be tested, modified, and adapted to Hawaii's particular conditions and beekeeping practices throughout the remainder of the grant. This will enable Hawaii to follow a national standardized survey protocol to ascertain which pests are present that may have a synergistic effect with varroa mite.

Prevention of Spread of Varroa: The Hawaii Department of Agriculture (HDOA) currently has 215 swarm traps positioned at all major ports throughout the islands. They are distributed throughout the major islands with 47 on Oahu, 66 on Kauai, 25 on Maui, 10 on Lanai, 17 on Molokai, and 50 on Hawaii. This, along with elimination of all bee colonies (managed and feral) within 2 miles of the ports, is part of a statewide strategy to reduce the risk of varroa spreading to uninfested islands. These funds will be used by the Apiary Program with assistance from other HDOA staff to expand and maintain this barrier. The objective is to slow down the spread of varroa and possibly prevent its establishment on uninfested islands.

Swarm traps baited with pheromone lures are a proven system for capturing bee swarms. Cone style traps made of reinforced paper pulp material that mimics the hollow of a tree will also be used. The pheromone lure releases a special scent that attracts the swarms to the trap. A lure vial will be fastened inside the trap and replaced every three months. The same lure attracts Africanized honey bees. Traps will be placed at airports, harbors, and other possible pathways of entry and will be serviced routinely for swarms. Feral bee populations will be trapped and samples will be checked for varroa and other bee pests. The objective is to increase the swarm traps in ports that are in or near areas infested with varroa. In addition, all hives in these port areas will be destroyed. These actions will create buffer zones around ports, which is crucial for rapid detection and destruction of varroa-infested bee swarms which may travel from Oahu or the Big Island to the neighbor islands.

A two year budget was set up to meet these objectives as follows:

Apiary Specialist	$146,286
Travel	$21,000
Equipment	$42,819
Supplies	$52,300
Contractual	$91,204
Indirect costs	$16,469
Total	$370,078

This budget is detailed in Attachment 4.

Hosting Visiting Experts.

PPC collaborated with Dr. Robyn Rose (USDA/APHIS, APHIS National Program Coordinator), Dr. Jeff Pettis (USDA/ARS, Director USDA Beltsville Honeybee Laboratory) and Dennis vanEngelsdorp (Penn State University, President of the Apiary Inspectors of America, and Acting State Apiarist for the Commonwealth of Pennsylvania) to come to Hawaii to work with PPC and for site visits with beekeepers. They were in Hawaii from July 22-30, 2009.

The objectives of this visit were:

1) to field test a newly developed sampling protocol used to determine the presence/absence of honey bee diseases and parasites.

2) provide guidance on Varroa monitoring and control strategies; as well as highlight potential impacts of the mites spread and establishment in Hawaii.

Their trip report with recommendations is attached (**Attachment 5**).

Dennis vanEngelsdorp was hosted by PPC for a second visit from October 25 through November 7, 2009. The primary purpose of this trip was for him to conduct site visits with individual queen bee and honey producers and growers on the Big Island and Oahu to assess their operations and help them implement integrated pest management strategies against honey bee pests in their operations. In addition, he gave presentations open to all beekeepers on his findings on the Big Island and Oahu. The report for this trip has not been completed to date; however, beekeepers and growers have given PPC positive feedback on this trip, feeling that it was very helpful to their operations.

PPC is working with Dennis vanEngelsdorp, Dr. Pettis, and other honey bee experts on the mainland to continue this integrated pest management outreach. There are plans to set up two or three of these trips in 2010 and to extend them to Maui and Kauai. This is being funded by the USDA grant.

Attachment 1. Budget plan presented to legislature in May 2007.

Background:

The mite, *Varroa destructor*, was previously not known to occur in Hawaii until it was first found in the State on Oahu on April 5, 2007. The Department of Agriculture (DOA) responded immediately to this discovery by sending staff to sample the hive to verify the find. After the presence of the mite was confirmed, the next objective was to discover the extent of the infestation in the State. If the infestation was limited, it may have been possible to eradicate the mite from Hawaii. After destroying the infested hive, DOA staff conducted extensive surveys of commercial, backyard, and feral hives throughout Oahu. These island-wide surveys indicated that the mite was already widely distributed throughout Oahu. The wide distribution in feral colonies eliminated the possibility for eradication of the mite from the island of Oahu. DOA is continuing to sample hives throughout the State to determine the density of mite infestations and possibly the origin of the initial infestation. The sampling by DOA is not limited to *Varroa* mite but also includes sampling for two other mites not known to occur in the State.

Surveys for the mites have also been conducted on Kauai, Maui, Molokai, and Hawaii. The surveys on the other islands are not completed but to date have all been negative for the mites. All four of Hawaii's queen bee exporters, which are in the Kona area, are free of the mites. Based on the preliminary results, it is assumed that the *Varroa* mite is currently restricted to Oahu.

Short Term Plan:

1) Contain the *Varroa* mite on Oahu by preventing its spread to other islands. Based on data we have to date, DOA is in the process of implementing an interim rule that will establish an inter-island quarantine to prevent the movement of honeybees and bee equipment off of Oahu. This quarantine should contain the mite infestation to Oahu as it is unlikely that infested bees could fly to another island. The interim rule will be effective for one year and will be followed with a permanent rule as detailed in the long-term plan;
2) Complete surveys on all islands. The purpose of these surveys is to:
    a) ensure that the other islands are free of *Varroa* destructor and if not, assess the potential for eradication for the island;
    b) ensure that all islands, including Oahu, are free of other mites and other honeybee pests that are not known to occur in the State;
    c) determine infestation rates and distribution of *Varroa* destructor on Oahu.
3) Determine which pesticides are legally available in the State and to secure licenses for their use in Hawaii to control mite infestations.
4) Work with University of Hawaii extension and honeybee keepers in the State to educate them on current tools available to manage mite infestations.

Long Term Plan:

Based on DOA's experience with honeybees and conversations with researchers in Canada, US, and New Zealand who have worked with honeybees and *Varroa* mite, it is believed that the mite cannot be eradicated from Oahu at this point but can be contained on the island. Beekeepers on Oahu will need to manage their hives to keep the mites at low densities so that they can economically produce honey and pollinate crops.

DOA's long term plan is to quarantine Oahu by implementing and enforcing an inter-island quarantine that would prevent the movement of honeybees and used bee equipment from Oahu to other islands. We also plan to develop a honeybee pest and disease survey and monitoring program, a bee pest management program, a colony recovery program, and a public awareness program. We plan to create an Advisory Panel composed of HDOA personnel and commercial beekeepers to discuss and collaborate on the refinement and implementation of this plan.

These programs will be funded by this appropriation from the Legislature and supplemental federal funding. To date, all survey and control efforts have been funded with federal grant money that was received specifically for this purpose.

The $650,000 appropriated by the Legislature will be used by the Department of Agriculture for:

1) Detection and monitoring survey program - $350,000
2) Pest Management Program - $140,000
3) Colony Recovery Program - $125,000
4) Inter-island Quarantine Program - $5,000
5) Public Awareness Campaign - $30,000

These can be broken down as follows:

1) Detection and Monitoring Survey Program - $350,000
   This program will involve the continuation of the ongoing efforts at detection and monitoring for the mite pests of honeybees on all islands. We would like to expand this to include the detection and monitoring for other pests and diseases of honeybees which could have as devastating or an even greater effect on the bee industry as the *Varroa* mite does. This program will require money for inter-island travel for surveys, mainland travel for training of Department of Agriculture staff and University of Hawaii extension agents at the United States Department of Agriculture (USDA) bee research lab in Maryland, to learn to identify different pests and diseases and hive management and pest control techniques which can be passed on to local beekeepers by HDOA staff and extension agents. The training will also include a program that will certify HDOA as apiary inspectors. We currently certify Kona beekeepers which export queens but do not have any staff that is officially certified by USDA for apiary inspections. The training will be a week-long course conducted by USDA bee lab trainers on the mainland and is estimated to cost $6,000 for 12 individuals, including airfare, per diem, and other training expenses. Equipment and supplies for lab and field work will be required to carry out the detection and monitoring.

Costs:	Interisland travel:	38,000
	Equipment:	90,000
	Supplies:	150,000
	Training:	72,000

2) Pest Management Program - $140,000
   This program will be based on discoveries from the survey activities. Infested hives will need to be either treated, pests managed or hives destroyed. This money will be used for the purchase of chemicals, supplies, equipment used to help the beekeepers, and registration/licensing of new chemicals. Currently only one product is licensed for use in Hawaii.

3) Colony Recovery Program - $125,000
   This program will be set up to aid the beekeeper in the recovery of destroyed hives. Replacement of a queen and workers costs about $50. Replacement of 2,500 hives will cost approximately $125,000.

4) Inter-island Quarantine Program - $5,000
   The establishment of an inter-island quarantine will be accomplished by establishing a permanent rule. This will need to go through a public hearing process which typically costs $5,000-$8,000. Costs over $5,000 will be covered by other funding sources within the Plant Quarantine Branch.

5) Public & Industry Awareness Campaign - $30,000
   The effectiveness of quarantine will be dependent on the awareness of the public and the beekeepers about the requirements of the quarantine and the knowledge that bees should not be moved from one island to another. DOA and the HBA will work closely on this campaign as its success will directly affect the success of the other programs.

Attachment 2. Draft plan presented to beekeepers on June 20, 2007.

Varroa Mite Plan (draft)
6/20/07

I. Oahu Infestation

Extent of Infestation:

Surveys on Oahu have demonstrated that the mite is widespread throughout the island. Infestations have been found in managed colonies as well as feral colonies. Based on its wide distribution and infestation levels in hives, it is estimated that the varroa mite has been present on Oahu for at least one to two years. The Australia bee pest plan for eradication and control determined that an incursion undetected for more that 2 weeks is most probably no longer eradicable. The strategy for Oahu should be focused on control and not eradication for these established populations.

Goal:

The goal is to decrease mite populations to very low levels to decrease the risk that they will move to other islands.

Objective:

1. suppress mite population to levels as low as possible
2. prevent movement of mites off of Oahu

Strategy:

1. Suppress mite population to levels as low as possible
    - Beekeepers should monitor their hives for varroa infestation.
    - HDOA will provide training and materials (Apistan and sticky boards) to beekeepers so they can monitor for varroa.
    - HDOA currently recommends that beekeepers destroy all infested hives and treat all hive boxes and equipment associated with that hive. HDOA will establish a contract with a Pest Control Company for the destruction of the infested hives. (HDOA has recommended in the past that beekeepers should destroy hives that are heavily infested with mites but treat lightly infested hives. However this strategy will still allow for mite populations to remain at low levels in hives thus increasing the risk for their movement off island.)
    - HDOA is in the process of developing a program to compensate beekeepers that have destroyed infested hives. The money for this program will be available to the HDOA after July 1, 2007.
        - The compensation program will require an HDOA employee to witness the destruction and to confirm that the destroyed hive was infested with mites.
        - Compensation will include the replacement of bees and funds for associated losses.
        - Replacement bees will be provided from a source off of Oahu (to be arranged).
2. Prevent movement of mites off of Oahu.
    - HDOA will create a bee-free buffer around airports and harbors on Oahu. This will be accomplished with swarm traps and poison baits.
    - HDOA will establish an interisland quarantine that will restrict the movement of bees and bee equipment off of Oahu.

II. Uninfested Islands:

Extent of Infestation:

Surveys on Kauai, Molokai, Maui, and Hawaii have not found any varroa on those islands. These survey results are in support that varroa has not yet made it to these islands despite being present on Oahu for at least a year. These surveys have covered wide areas on the other islands but the number of surveyed hives needs to be increased in order to detect a recent infestation before it can spread.

Goal:

Ensure that varroa does not become established on uninfested islands and detect an infestation early.

Objective:

1. Establish a quarantine to prevent mite movement off of Oahu
2. Detect new varroa incursions as early as possible before they have spread
3. Eradicate new infestations

Strategy:

1. Establish a quarantine to prevent mite movement off of Oahu.
    - HDOA will establish an interisland quarantine that will restrict the movement of bees and bee equipment off of Oahu.

2. Detect new varroa mite incursions as early as possible before they have spread.
    - It is essential that extensive periodic surveys are conducted to detect new infestations of varroa as early as possible before they have a chance to spread.
    - Beekeepers should sample their hives using the "whole-of-colony acaricidal knockdown" technique as described in the Australian Veterinary Emergency Plan. This involves placing a mesh covered sticky board on the hive floor and two Apistan strips in the brood nest. The Apistan should be removed after 48 hours. The sticky board can also be removed and checked for mites. The honey can still be sold but will not be marketable as organic.
    - HDOA will provide the training, Apistan and sticky boards and monitor the results.
    - (An alternative non-toxic sampling technique would be to use bottom sticky boards but this technique will be less effective in detecting low populations of mites. We need to find effective non-toxic sampling techniques for organic honey producers)

3. Eradicate new infestations
    - All infested hives should be immediately destroyed (HDOA will contract with a Pest Control Company for the destruction of infested hives)
    - HDOA will work with beekeepers to sample all apiaries within 5 miles of the infested hive for varroa mites twice a year for one year using the "whole-of-colony acaricidal knockdown". The number of hives in an apiary that need to be sampled will vary with the size of the apiary and should be based on the Australian sampling requirements.

Attachment 3. Varroa response Plan

VARROA MITE RESPONSE PLAN

Prepared by:

THE STATE OF HAWAII
DEPARTMENT OF AGRICULTURE
DIVISION OF PLANT INDUSTRY

October 22, 2007

Table of Contents

I. Purpose:

The purpose of this document is to establish a plan for HDOA and its collaborators when responding to the presence of varroa mites in managed and feral honeybee colonies when the varroa mites are found outside the Island of Oahu or in other previously uninfested areas of the State. The goal is to have a rapid response, with effective containment, eradication, or control of varroa mites. When a positive confirmation is made outside of Oahu or other previously infested area, the HDOA shall use this plan to guide its actions, partner's actions, and to recommend a pest control program to the owner or person in charge of the property. These procedures and control methods are subject to change due to changing circumstances and as new methods become available. They will be modified when appropriate.

II. Detection:

It is critical that any new incursion into previously uninfested areas is detected early before the mites have a chance to become established and disperse. HDOA and beekeepers on each island need to monitor for the presence of varroa mites in all established hives.

The following methods can be used to detect varroa mites in hives. No single method is 100% effective in discovering mites especially when the mites are at low densities. It is recommended that a combination of these methods be used to increase the probability for mite detection.

A. Visual Inspection:

Field inspections of hives should be carried out to detect any signs of varroa mite infestations. Newly emerged adult bees at the hive entrance with deformed wings, legs, and abdomens are an indication of a possible mite infestation. Patchy brood patterns may be evident in heavy infestations. The dark brown adult female mites may also be seen on adult bees and within brood cells in heavy infestations.

B. Brood cell cap removal:

Varroa mites spend most of their life cycle within the sealed brood cells. They prefer the drone brood cells. This is the most likely place to find mites during a hive inspection.

Pupae can be removed from their cells with a forceps and examined for the presence of mites. The brown mites will be easily observed on the white pupae. A comb rake can also be used to rupture the caps and expose many worker and preferable drone pupae for inspection. It is recommended that at least 100 pupae be examined in each hive.

C. Sticky Bottom Boards:

Mites move freely throughout the hive and drop to the bottom of the hive. An effective tool for detection of mite presence is to place cardboard sheets coated with an adhesive material on the bottom of the hive. The sticky bottom board is covered with an 8-12 mesh screen which allows mites to pass through but not honeybees. The boards should be placed in the hives for 48 hours and then removed. The number of mites on the board should be counted and recorded. Boards should be placed in a minimum of 10% of the hives in a bee yard at least 4 times per year.

The use of acaricide strips such as Apistan in combination with the sticky bottom boards is a much more effective detection tool than the use of the boards alone. This acaricide-knockdown technique involves the use of two strips of Apistan which should be suspended in the brood nest, one on either side of the center of the brood rearing area. It is essential that the strips be hung centrally in the bee space between the frames so the bees can walk on the sides of the strips. Apistan will kill the mites on the bees. The dead mites will drop to the bottom of the hive and adhere to the sticky bottom boards. The Apistan should be left in the hive for a minimum of 24 hours and preferably for 48 hours before removal for more effective results. The acaricide-knowdown method should be used once per year.

D. Alcohol Shake:

The alcohol shake method for sampling of honeybees for varroa mites consists of retrieving a 500 bee sample from designated hives. The bees can be collected by shaking a frame over a tray or large cardboard funnel and placing the bees in a one quart jar. Care should be taken that the queen is not collected. The jar should then be filled half way with 70% ethanol. The contents of the jar are then shaken for 5 minutes to dislodge the mites from the adult bees. After shaking, the bees and alcohol should be passed through an 8-12 mesh screen to remove the bees. The solution should then be passed through a 30 mest screen or a white cotton cloth which is then examined for mites. The number of mites and number of bees needs to be recorded to determine infestation level.

III. Response and Containment:

When an incursion of varroa mite is detected in a previously uninfested area, the following steps should be taken:

A. Quarantine:

The movement of all live or dead bees and used bee equipment will be prohibited from the infested area and all managed hives within the area will be inspected. The infested area will extend for a 15 mile radius surrounding the infested hives or a distance determined by the Board of Agriculture.

B. Delimiting Survey:

It is critical that the extent of an infestation is determined when an incursion is detected. These delimiting surveys should initially focus on managed colonies, because their

movement results in a greater potential for rapid spread of mites. Managed hives are also more readily accessible for sampling than feral colonies. All managed hives within the quarantine zone should be samples. All feral hives within 5 miles of the incursion should be identified and sampled. A smaller radius is applied to feral colonies as these are not capable of being moved.

The quarantined area will expand to a 15 mile radius surrounding each new find of varroa mite in the delimiting surveys.

A simple randomized sampling technique should be applied to each apiary. The number of hives to be sampled per apiary will vary according to the sensitivity of the field test being used.

To determine the boundaries of an infested area, a rate of sampling that will provide a 95% confidence of detection of prevalence of infestation in 2% or more hives within an apiary is recommended. Such rigorous accuracy required intensive sampling (see Table 1) but provides good confidence of accurately identifying both infested and non-infested apiaries. Application of acaricides for a 48-hour period is recommended when sampling apiaries in which infestation, if present, is likely to be at a very low prevalence (eg. when exposure to mites is likely to have only occurred in the previous six months). Repeat sampling of apiaries at intervals of 6 to 1 months should be conducted to confirm freedom from infestation.

Table 1 Sampling requirements for detection of intra-apiary prevalence of 2, 5, 10, 20 and 40% (at the 95% confidence interval), using intra-hive application of Bayvarol strips (flumethrin) for 24 hours (test sensitivity = 80% approx.)

	Number of hives to be sampled (based on hypergeometric probability distribution)				
No. of hives in apiary	**2%**	**5%**	**10%**	**20%**	**40%**
10	10[a]	10*	10*	10	6
20	20[a]	20*	20	13	7
30	30[a]	30	24	14	8
40	40[a]	39	26	15	8
50	50[a]	47	28	16	8
60	60[a]	49	29	16	8
80	78	53	31	16	8
100	97	56	32	17	8
120	111	59	32	17	8
140	117	60	33	17	8
160	118	62	33	17	8
180	126	63	34	17	8
200	132	64	34	17	8
250	141	66	34	17	8
300	147	67	35	17	8
350	152	68	35	17	8

400	156	69	35	17	8
450	159	70	35	17	8
500	161	71	35	17	8

a Required confidence level cannot be achieved for this sized apiary even when every hive is tested. Repeat testing should be applied in 6 to 12 months to confirm freedom from infestation.
Source: Data derived using Survey Toolbox software — Angus Cameron, Ausvet Animal Health Services.

Depending on the prevalence of infestation, the sampling needed to detect an infestation in an apiary may be less intensive that that required to demonstrate freedom from infestation.

C. Trace Forward and Trace Backward:

Trace-forward investigations should be conducted to all apiaries and beekeepers that have received risk materials from the infested apiary or beekeeper, using the estimated date of the initial mite introduction. Also, trace-back investigations should be conducted identify potential sources for the infestation.

IV. Control and Eradication:

The decision by HDOA to initiate a control versus an eradication program will depend on the results from the delimiting surveys. If it is determined that the varroa mite infestation is widespread throughout managed and feral colonies then the decision for a mite management and control program would be more appropriate. An eradication program should be attempted if it is determined that the mites are present in a localized area or restricted to managed colonies.

A. Eradication:

When the decision to eradicate the mites from an infested area has been made, the following procedures should be implemented:

- When an infested colony is identified in an apiary, bees, combs, and all hive components in that apiary are to be destroyed. However, isolation of some beekeeping equipment and honeybee products in bee-proof facilities for a specified period to prevent reinfestation may result in their being cleared of the infestation. HDOA-approved treatments of bee equipment to kill mites may also be used to avoid destruction of equipment.

- All feral nests within 5 miles of each detection site should be destroyed.

HDOA will perform, supervise and/or contract out the task of destruction of varroa-infested honeybee hives. The property owner will be apprised of treatment options and HDOA will coordinate the initial treatment and verify the varroa infestation has been eliminated. HDOA will use or provide advice on products to use that are licensed for use by the HDOA Pesticides Branch to destroy varroa mite-infested honeybee hives. HDOA maintains a list of licensed pest control operators in Hawaii who have stated an interest in doing bee control work on a hired basis.

B. Control:

When the decision for control rather than eradication is made then the role of HDOA will be to assist beekeepers in the management of varroa mites in their hives. This will be accomplished through training, education, and treatment recommendations.

V. Approved treatments:

A. Chemical treatment for varroa mites in bee hives:

1. Mite-Away II (formic acid) EPA #75710-1
2. Apiguard (thymol 25%) EPA #79671-1
3. Zoecon Apistan Anti-varroa mite strips (tau-fluvalinate) EPA #2724-406

B. Mechanical treatment for varroa mites in bee hives:

1. sticky boards
2. HappyKeeper bottom boards

VI. Authority:

The Hawaii Department of Agriculture (HDOA) has the authority to conduct control and eradication programs of designated pests under Chapter 141, Hawaii Revised Statutes, and Chapter 4-69A, Hawaii Administrative Rules. HDOA also has the authority under Chapter 150A to regulate the movement of commodities that harbor or are at high risk of spreading pests.

Chapter 141-3.6, HRS, provides the authority for the HDOA to enter private property to control or eradicate designated pests. This section establishes the criteria and procedures required for HDOA personnel to enter private property. Under this section, the department of agriculture shall give at least five days notice to the landowner and occupier of any private property of its intention to enter the property for the control or eradication of a pest. The notice shall set forth all pertinent information on the pest control program and the procedures and methods to be used for control or eradication. Under Chapter 4-69A, HAR, the varroa mite and honeybee are listed in the HDOA "List of Insects, Mites, Other Pests, and Plant Diseases Designated as Pests for Control or Eradication Purposes by the Hawaii Department of Agriculture."

VII. Acknowledgements:

This plan is based on and adapted from the Australian Veterinary Emergency Plan, (AUSVETPLAN, Version 3.0, 2006) a technical response plan for Honeybee diseases and pests produced by the Primary Industries Ministerial Council, Canberra, ACT. (www.animalhealthaustralia.com.au).

Attachment 4. USDA Grant Financial Plan

DETAILED FINANCIAL PLAN
VARROA MITE CONTROL IN HAWAII
HAWAII DEPARTMENT OF AGRICULTURE (HDOA)
09-8510-1237-CA
AUGUST 1, 2009 – JULY 31, 2010

(Financial plan must match the SF-424A, Section B, Budget Categories--ROUNDED to the nearest dollar)

ITEM	**APHIS FUNDS** (provided by agreement)	**STATE FUNDS**	**TOTAL**
PERSONNEL			
Apiary Specialist, 100% time (2 years)	$104,000		$104,000
Hawaii Island Entomologist, 5% time		$5,000	$5,000
Maui Island Entomologist, 5% time		$5,000	$5,000
Survey Entomologist, 5% time		$5,000	$5,000
Chemical Mechanical Section staff member		$5,000	$5,000
a. Subtotal	**$104,000**	**$20,000**	**$124,000**
FRINGE BENEFITS:			
(40.66% of permanent employee's salary)		$8,132	$8,132
Apiary Specialist	$42,286		42,286
b. Subtotal	**$42,286**	**$8,132**	**$50,418**
TRAVEL:			
Inter-island travel to conduct work on all affected islands. Includes plane fare ($200 ea), per diem ($90/day, 2.5 days), ground travel ($75), 24 trips.	$12,000		$12,000
U.S. Mainland travel to attend workshops / training conferences. Includes registration fee ($300), plane fare ($2000), per diem ($145/day, 4 days), ground travel ($120); 3 staff members.	$9,000		$9,000
c. Subtotal	**$21,000**	**$0**	**$21,000**

EQUIPMENT (over $1000; State Government inventory):			
Four wheel drive vehicle	$40,000		$40,000
computer and software (1@$2819)	$2,819		$2,819
d. Subtotal	**$42,819**	**$0**	**$42,819**
SUPPLIES (items under $1000):			
Supplies or items related to the project (office, computer-related paraphernalia, GPS, mapping software, photography, PPE, field-collecting items, bee boxes, chemicals)	$52,300		$52,300
e. Subtotal	**$52,300**	**$0**	**$52,300**
CONTRACTUAL:	$91,204		$91,204
See following page for details			
f. Subtotal	**$91,204**	**$0**	**$91,204**
TOTAL DIRECT CHARGES:	**$353,609**	**$28,132**	**$381,741**
(sum of a - f)			
INDIRECT COSTS:	**$16,469**	**$2,110**	**$18,579**
[7.50% x (sum of a-c, e)]			
TOTAL	**$370,078**	**$30,242**	**$400,320**

DETAILED FINANCIAL PLAN
VARROA MITE CONTROL IN HAWAII
HAWAII DEPARTMENT OF AGRICULTURE (HDOA)
Coordinator and Visiting Experts
AUGUST 1, 2009 – JULY 31, 2010

(Financial plan must match the SF-424A, Section B, Budget Categories--ROUNDED to the nearest dollar)

ITEM	**APHIS FUNDS** (provided by agreement)	**STATE FUNDS**	**TOTAL**
CONTRACTUAL:			
Coordinator (14 wks @ $500/wk)	$7,000		
Fee and other expenses for visiting experts (12 trips @ $3,000)	$ 36,000		
TRAVEL for visiting Experts:			
Inter-island travel to meet with growers and beekeepers on all affected islands. Includes plane fare ($400 to visit 3 islands), hotel (7 nights @ $150 =$1,050), ground travel ($450), 12 trips.	$22,800		$0
Travel from U.S. Mainland to conduct workshops / training meetings. Includes plane fare ($2117); 12 trips.	$25,404		$0
TOTAL	**$91,204**		

Attachment 5. USDA Trip Report (July 22-30, 2009)

Honey Bee Health Outreach Initiative with State of Hawaii
Funded by APHIS and ARS
Summary Report and Recommendations from Field Site Visit

Dr. Jeffery Pettis – USDA-ARS. Beltsville Bee Lab
Dr. Robyn Rose – USAD-APHIS.APHIS National Program Coordinator
Dennis vanEngelsdorp – PDA, President of the Apiary Inspectors of America and
Acting State Apiarist for the Commonwealth of Pennsylvania

Prepared on: August 21, 2009
Revised on: October 3, 2009
This report summarizes outreach and technology transfer accomplishments during a site visit to the Islands of Oahu and Hawaii in the State of Hawaii from July 22 through 28th.

The objectives of this visit were:
1) to field test a newly developed sampling protocol used to determine the presence/absence of honey bee diseases and parasites.
2) provide guidance on Varroa monitoring and control strategies; as well as highlight potential impacts of the mites spread and establishment.

Objective:

Field test a newly developed sampling protocol used to determine the presence/absence of honey bee diseases and parasites.

Background:

In anticipation of funding for a national survey of honey bee pests and pathogens, a sampling protocol was developed which permits the detection of various honey bee diseases/parasites in the US. Of particular concern is determining the presence/absence of the parasitic mite, *Tropilaelaps clareae*, in the US. Since *Tropilaelaps* occurs in Asia, APHIS supported work conducted in September 2008 in Thailand to develop an apiary-level screening protocol. The streamlined sampling protocol developed in Thailand included the collection and shipment of live bees, bees preserved in alcohol, and hive debris. The resulting samples will be tested and examined for:

1. Viruses present (Deformed Wing Virus (DWV), Sac Brood Virus (SBV), Acute Bee Paralysis Virus (ABPV), Kashmir Bee Virus (KBV), Israeli Acute Paralysis Virus (IAPV), Black Queen Cell Virus (BQCV), Slow Bee Paralysis Virus (SBPV))
2. Nosema incidence and species
3. Varroa mite infestation load
4. Honey bee tracheal mite presence and level
5. Tropilaelaps mite presence

Approach:

Sampling kits were provided to a team (on Oahu) of state employees who were trained on the methods of sample collection and to a "naïve" team who received written instructions but no training. The teams were asked to sample colonies according to the protocols and then meet afterwards to discuss their experience.

Outcome:

As a result of the exercise, valuable feedback regarding the clarity of the protocol was highlighted. Suggestions included:

1. Improving the justification for why/how the "knocking method" works to detect Tropilaelaps.
2. Sampling protocol would be better explained if made into a training video
    a. A training video describing how to open an hive and manage the bees
    b. A step by step demonstration of how to collect, package and ship samples
3. Specific information explaining how "positive" detections of pathogens not thought to be endemic in the US will be addressed.
4. Specific improvements to the written protocol included:
    a. Clean the funnel between samples
    b. Improve the explanation of what to expect and how to knock frames for Tropilaelaps samples
    c. Improve the explanation of how to record levels of disease infection in examined colonies (ie. # of colonies with chalkbrood)
    d. Clearer instructions on how to make mailing cages more "bee proof" in order to prevent escapes.
    e. Use of clear binding tape rather than masking tape for sealing the bee box
    f. Include a return address label for alcohol bottle box
    g. Provide the alcohol in a separate container to avoid spills
    h. Replace the coffee filter with a nylon filter in filtration process

These suggestions will be incorporated into a final sampling protocol to be used in a pilot survey this year. This field test was also conducted to evaluate the state of samples received by the ARS Beltsville BeeLab. Seven samples were sent to ARS from the following islands: Oahu n= 5; Kauai n=1; Hawaii n=1

The live bee shipments arrived on average in 2.5 days after shipping (range 2 – 5 days), and the percentage of bees alive in each sample box was 65% (range 35 – 95%).

Ongoing/Future Activities:

1. The received samples will be processed according to the following:
    a. Live bees: A subset of the sample will be processed to extract RNA and DNA and then analyzed to determine the presence of viruses, (list); bacteria, fungi (nosema species), honey bee species (A. ceranea) and subspecies (scutillata, capsensis); and parasites (HBTM, etc). Samples of Varroa mite will also be processed in an attempt to determine the haplo type and potentially the point of origin.
    Responsible agency: USDA_ARS
    b. Filtrate: A combined sample for each Apiary will be examined for the presence of mites and other invertebrates particularly Tropilaelaps spp.
    Responsible agency: USDA_ARS
    c. Bees in Alcohol: A combined sample from each Apiary will be processed for parasite presence and quantification (Varroa, Nosema spores, amoeba, HBTM).
    Responsible agency: PDA
2. After samples have been analyzed, results will be summarized in reports sent to cooperating beekeepers and agencies
3. An additional 14 "modified" sample kits will be sent to the Island for additional sample collections on Maui (5). Hawaii (9), Kauai (4).

Recommendations:

1. Subsamples of each collection should be archived and stored for long term preservation
2. Suggestions made by participant feed back should be incorporated into revised sampling protocol procedures
3. A sampling scheme similar to this should be implemented in HI every year for at least the next ten years to document changes in pathogen – specifically viral – prevalence. As Varroa infests new areas the viral loads and colony tolerance of Varroa mite loads would be expected to change over time.
4. Sequencing of detected viruses to document potential changes in virulence expected to occur with the presence and spread of Varroa

Objective:

Provide guidance on Varroa monitoring and control strategies; as well as highlight potential impacts of the mites spread and establishment

Background:

Varroa mites were first detected in Oahu in 2007.Then found in Hilo on August 2008
The devastating impact of Varroa mite parasitism on honey bee colonies is well documented. The mite crossed from its original host *Apis cerana* onto *A. mellifera* sometime in the 1950's. From there it spread to Europe in the 1970s and to the continental U.S. in the late 1980's. While direct parasitism by Varroa mites on developing and mature honey bees can cause colony collapse, the impact of the mite is exacerbated by the presence of honey bee viruses which they can vector and/or activate.

Approach:

To better appreciate the present and potential impact of Varroa mites on the Hawaii agricultural and apicultural community specifically the following activities were arranged:

1. meeting with HDOA concerning past and present activities as well as determine desired outcome(s)
2. meeting with UH to facilitate increased networking and potential collaborations, learn of current and future research efforts
3. meeting with Mr. Jefts concerning impact of honey bee losses on agricultural production
4. visit with queen producing and organic honey producing operations to better assess potential impacts, and permit development of informed monitoring and control strategy recommendations
5. participated in a beekeeper/stakeholder meeting organized by the Varroa mite Steering Committee to discuss producer concerns and present basic Varroa mite monitoring and control information.

Outcome:

As a result of these informative meetings the following general issues/concerns/conclusions were drawn:

1. The greatest threat Varroa mites pose is the potential collapse of feral honey bee populations which would result in severe reductions in production of pollinator dependent crops.
2. As on the mainland, the apicultural community in HI is diverse and each group has different needs. Consequently, different Varroa control plans need to be developed for each different sub-group of the industry (i.e. organic honey producers (large and small), queen producers, small beekeepers, pollinator dependent stakeholders).
3. The historical experience of other beekeeping communities with Varroa mite invasion provides great insight into what HI beekeeping should expect, as well as what control strategies should work over the long term, and on how to minimize (and potentially

capitalize on) the Varroa mite's presence. This information should be communicated to stakeholder groups, *but* done so with the caveat that HI conditions are unique to HI (and indeed unique to each island if not different eco-zones within each island).

4. There is an immediate need to have a diverse set of Varroa control products/strategies appropriate for tropical conditions available to the HI beekeeping community

Recommendations:

1. A proactive program to monitor for mites on "mite free" islands needs to be sustained, and a rapid response plan outlining how to respond to a positive detection needs to be developed.
    a. Implement a regimented Varroa monitoring system around likely points of entry on unaffected islands such as ports and airports.
    b. Through consultation with beekeepers, determine if eradication should be attempted or not attempted for a specific island.
    c. Have a plan in place which could quickly assess the extent of a new invasion.
    d. Have an eradication protocol and method which can be quickly implemented.
2. The role of honey bees in HI agriculture as pollinators should be formally assessed.
    a. Consulting historical agricultural statistical information lists of all crops likely to be impacted by the absence of honey bees and quantify these using published documents (e.g. Free, Insect Pollination of Crops) as a guide.
    b. Determine if the collapse of honey bees on Oahu has had a demonstrable effect on pollinator-dependent agricultural production.
    c. Predict potential impacts of honey bee losses on the Big Island for producers of pollinator dependent/benefiting crops.
3. A plan to meet the pollination needs of HI producers should be developed and a means of facilitating communication between producers and beekeepers should be fostered.
    a. Methods to provide sufficient pollinating units to producers who need them should be aggressively developed and tested. Transportation of bees from "colony rich" islands to "colony poor" islands should be explored.
    b. Training a new generation of Varroa savvy beekeepers who can help meet pollinations demands should be considered.
4. Information about Varroa biology, anticipated impacts, monitoring methods, and control strategies should be developed and presented to beekeepers and stakeholders.
    a. A series of workshops that provide in-depth coverage of Varroa biology and control strategies should be developed and implemented. These workshops should include HI specific data and foster communication between participating parties. These workshops should also be structured in a way that allows feed back to guide HI specific research needs, and potentially requires participants to assist in testing and monitoring of control strategies specific to HI and individual operational needs.
5. Aggressive and operational specific mite control strategies need to be developed with close co-operation and involvement of all stakeholders.
    a. Close and in-depth site visits with different operations should be conducted to help develop individualized monitoring and control plans. Beekeepers participating in developing these plans should be encouraged to provide feedback on results and share experiences with other beekeepers. Generic control plans should then be made available which heavily incorporates beekeeper experience and comments.
6. Make available several mite control products to HI beekeepers.
    a. Test registered mite control products under HI conditions to determine efficacy and impact.

    b. Seek emergency or special local need registrations of mite control products with modified labeling to allow hot weather treatment. This should be done after assessing impact on colony strength and mite control of the products.
7. Demonstrate the use of control methods and make available the tools needed to implement these.
    a. Demonstration sites which implement drone removal, screen bottom boards, colony manipulations etc as Varroa control strategies are established.
    b. Equipment needed to implement these should be sourced and readily available to beekeepers.