# SURVEY OF HONEY BEE DISEASES in SAMOA

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## 1. EXECUTIVE SUMMARY

Samoa has an estimated 39 beekeepers operating 467 hives on [1]70 apiaries. The annual honey crop is approximately 8 tonne per year most of which is consumed within Samoa (Dean, 2009).

Honey and other bee products entering New Zealand must be accompanied by a zoosanitary certificate issued by the veterinary authority of the exporting country which certifies that:-

- The honey originates from that country;
- The country is free from European foulbrood caused by *Melissococcus pluton*[2].

European foulbrood (EFB) is a bacterial disease that affects the developing brood and is controlled in many countries by feeding antibiotics to beehives. EFB-causing bacteria can be transmitted in bee products, especially honey and pollen.

This bee disease has never been detected in Samoa or New Zealand but regular surveys by competent personnel and reporting are required to confirm this status. Similarly honey exported to the EU must come from apiaries of known disease history, which usually means an apiary database is being maintained, annual bee disease surveys are being carried out and beekeepers are reporting on the presence of listed bee diseases.

MAF Biosecurity New Zealand (MAFBNZ) revised the Import Health Standard for Specified Processed Bee Products in June 2009 and published a draft standard at:

http://www.biosecurity.govt.nz/files/biosec/consult/draft-beeproic.all.pdf

However, this standard is on hold while issues with a similar import health standard (IHS) for bee products from Australia are resolved. The IHS from 2006 remains in force in the meantime.

http://www.biosecurity.govt.nz/imports/animals/standards/beeproic.all.htm

The Government of Samoa's Ministry of Commerce, Industry and Labour provided funds through its Private Sector Support Facility (PSSF) for a bee disease survey. This was carried out by Murray Reid, AsureQuality Limited, New Zealand, in July 2009. Reid was assisted by Cliff Van Eaton, a former apiculture officer and colleague, local beekeepers and staff from the Ministry of Agriculture and Fisheries (MAF; www.maf.gov.ws )[3]. Previous bee disease surveys of Samoa were undertaken by Reid and Cory (Niue Honey Company) in 2005 and Reid and Driscoll of AgriQuality Limited in 1996.

The team inspected 129 beehives for bee diseases and pests, in particular European foulbrood (EFB). No cases of EFB or American foulbrood (AFB), another serious bacterial disease of bee larvae were found. The survey in Samoa achieved a hive inspection rate of 28%, from a population of approximately 467 hives. New Zealand has a target inspection rate of around 2% of hives under its exotic honey bee disease surveillance program. In addition, all hives in New Zealand must be inspected for American foulbrood disease each year by an approved beekeeper.

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[1] A number of beekeepers share apiaries but these were still counted as separate apiaries as per the register maintained by the Beekeepers' Association of Samoa Inc. (BASI).

[2] Now renamed *Melissococcus plutonius*

[3] The Samoa Ministry of Agriculture (MAF) has gone through changes in its name during the past 10 years and was initially known as MAFFM, then MOA and currently MAF.

The survey team inspected 22 apiaries out of 70 (31%) compared to New Zealand's target surveillance rate of 3%. European foulbrood disease has never been reported in Samoa and no evidence of this disease was found during this survey or past surveys. Thus, Samoa should be able to claim country freedom from European foulbrood disease and continue to export bee products to New Zealand under the current import health standard.

Other minor diseases like chalkbrood, sacbrood and bee paralysis virus were re confirmed, as were both the greater and lesser wax moths, all of which exist in New Zealand. Various species of ants, cockroaches, centipedes and lizards living in or around hives were also found.

No cases of notifiable external or internal mites or the Small Hive Beetle were found. There was no evidence of the African honey bee, the Cape honey bee or the Asian honey bee. These diseases or pests are not transmitted through honey. This means Samoa has one of the highest bee health situations of any of the Pacific Island Countries (PIC's).

The risk pathways into Samoa for an exotic honey bee disease or pest are considerable with regular shipping and air flights from a number of countries, plus visiting yachts, which usually have honey on board. The number of tourists visiting Samoa is growing but hopefully most will come from countries with a high awareness of quarantine risks and will not bring in risk bee products. X-rays of all accompanied luggage is carried out at the airport and this should detect undeclared biosecurity risk products (www.samoaquarantine.gov.ws).

However, honey is still occasionally imported without a permit by merchants and cases of honey from the USA, New Zealand and India were found in retail shops by members of the Beekeepers' Association of Samoa Inc. (BASI) in 2008. This is despite the adoption of the Bee and Bee Products Prohibition Order [4]1999, which was enacted under the Customs Act 1977. The Prohibition Order prohibits the entry of packaged bees, and second hand or used bee supplies and bee equipment or clothing used for beekeeping. Honey and queen bees or queen cells can be imported subject to an import permit being issued by the director of MAF.

MAF staff who received limited training on bee disease recognition and survey methods on the last bee disease survey are no longer available. The chief meat inspector received some training on the current mission, as did Tulia Molimau, a scientist from the Scientific Research Organisation of Samoa (SROS). The latter organisation should be able to test suspect bee material using microscopy, culture or PCR techniques following standard published methodologies or after training at a recognised laboratory in New Zealand or Australia. SROS could also carry out water tests as well as residue tests on honey if markets in the EU were developed. Staff from the University of the South Pacific were consulted on the survey and could also assist with future honey bee disease surveys.

Fortunately the majority of the hives in Samoa are owned by a few expert and experienced beekeepers. In addition, management and staff from Saleimoa Apiaries look after a large number of hives on behalf of other beekeepers and sell hives to new beekeepers. This increases the likelihood of an exotic bee pest or disease being discovered reasonably early after its introduction, with hopefully enough lead time to contain or eradicate the disease. BASI maintains an apiary register that was last updated in 2007.

If bee products are to be exported to New Zealand, the Import Health Standard for Specified Processed Bee Products must be complied with as well as relevant Overseas Market Access requirements (OMAR's) and the Official Assurance Program (OAP) if Samoan bee products are

[4] Came into effect 9 th March 2000.

to be re-exported from New Zealand. Samoa will have to show it has adequate legislation and a competent authority capable of reporting on and undertaking, regular bee disease surveys and issuing Export Certificates.

## 2. ACKNOWLEDGEMENTS

The author wishes to thank the Government of Samoa's Ministry of Commerce, Industry and Labour for funding the survey and Raymond Voigt of The Samoa Umbrella for Non Governmental Organisations Incorporated (SUNGO) and the Beekeepers' Association of Samoa Incorporated (BASI) for his initiative and efforts in finalising the proposal for the survey and securing funding. A special vote of thanks goes to Cliff Van Eaton, a former apiculture colleague who came on a 'working holiday', and did more than his share of hive inspections and assisted with training. Leicester Dean (BASI) selected the apiaries to be inspected after being given the required apiary risk profiles and also helped with getting the proposal approved. Leicester Dean and Fa'alele from Saleimoa Apiaries, assisted with hive inspections and sampling. I also wish to acknowledge the support of Oscar and Rhonda Mauff, who provided the best accommodation in Upolu.

I wish to thank Tiatia Faleupolu Tevita from the Ministry of Agriculture and Fisheries (MAF) for his continuing support for beekeeping in Samoa and the loan of a vehicle and Tony, Chief Meat Inspector for driving us and assisting with sampling hives. Tulia from the Scientific Research Organisation of Samoa (SROS) assisted with sampling and may be able to provide expert lab facilities for testing for bee diseases and honey residues in the future. Staff from USP could also assist with ongoing disease surveys.

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## 3. BACKGROUND

A honey bee disease survey was carried out by Reid and Bettesworth in 1987, which found no major bee diseases present. Reid and Driscoll completed another survey in 1996 under the auspices of the Food and Agriculture Organisation (FAO). Subsequent hive inspections carried out by Driscoll and Reid in 1997 and Reid and Corey (Niue Honey Company) in 2005 confirmed the very high bee health status of the Samoan bee population.

While there are potential markets for Samoan bee products, such as honey and propolis, in New Zealand, Australia and the EU, these countries require evidence of Samoa's bee health status before permitting importations of bee products. MAF Biosecurity New Zealand (MAFBNZ) reviewed its import health standard (IHS) for bee products in 2003 and again in 2005. A revised general standard was issued in November 2006.

http://www.biosecurity.govt.nz/imports/animals/standards/beeproic.all.htm

MAFBNZ had prepared a risk analysis for bee products entering New Zealand with a view to drafting an Import Health Standard for honey from Australia. The risk analysis was published in December 2004.

http://www.biosecurity.govt.nz/files/regs/imports/risk/ira-bee-products.pdf

An Import Health Standard for honey from Australia was subsequently issued in August 2006. http://www.biosecurity.govt.nz/imports/animals/standards/beeproic.aus.htm

However, this standard was successfully challenged by New Zealand's beekeeping industry but subsequently quashed by the Court of Appeal. Legislation was then passed which reinstated the import health standard, but required a suspension on imports until an independent review panel had reported to MAFBNZ and the latter had made a determination on whether any amendments to the rules were required. The report was received from the panel in June 2009 and pointed to some areas in which the scientific evidence has evolved since the original risk analysis for the standard was undertaken. In particular the presence or absence and effects of some new pathogens were raised. These included *Paenibacillus alvei*, *Nosema ceranae* and Israeli Acute Paralysis Virus. *P. alvei* is a bacterium associated with European foulbrood, while *Nosema ceranae* is a protozoan that has jumped species from *Apis ceranae,* the Asian honey bee. *N. ceranae* is believed by some researchers to be the cause of significant bee losses and even the cause of Colony Collapse Disorder (CCD), (Higes et.al. 2009). Israeli Acute Paralysis Virus has only recently been isolated from bees and is also associated with CCD.

The existing 2006 standard was also reviewed in the meantime and some minor changes were proposed e.g. replacing the word honey with bee products where appropriate to allow products like propolis to be treated the same as honey. However, this revised standard was put on hold until the import standard for Australian honey is finalized. This means the 13 November 2006 Import Health Standard for Processed Bee Products remains the current operational standard.

In order to export bee products to New Zealand Samoa will need to demonstrate the following;

> 7.6 Honey from *Niue, Samoa, Solomon Islands, Tonga and Tuvalu* may be given a biosecurity clearance provided all of the following requirements are met:
>
> i. The product must be accompanied by zoosanitary certification issued by the veterinary authority of the exporting country which certifies that:-
> - The honey originates from that country;
> - The country is free from European foulbrood caused by *Melissococcus pluton*[5].

http://www.biosecurity.govt.nz/imports/animals/standards/beeproic.all.htm

Pitcairn Island has negotiated its own IHS for honey into New Zealand and is required to certify freedom from American and European foulbrood. Samoa could do the same if required, as neither bee disease has been found in Samoa. Since the IHS for Australian honey was reviewed, MAFBNZ has asked Pitcairn authorities for new information regarding checks/tests on Pitcairn bees for *Paenibacillus alvei*, *Nosema ceranae* and Israeli Acute Paralysis Virus.

Plant and Food Research Ltd are currently investigating establishing diagnostic capabilities for these three organisms in New Zealand. As no surveys have been done for these pathogens in New Zealand it is not possible to confirm their presence or absence at this time. This means they would most likely be regarded as new organisms and any suspect samples would need to be tested in an approved facility. Alternatively they could be tested by an approved laboratory offshore.

Beekeeping in Samoa continues to develop with some local beekeeping enterprises expanding to around 100 hives. The annual honey crop is mostly consumed locally and is estimated at 8 tonnes per year (Dean, L 2009). This includes honey sold through various outlets as well as consumed at point of production. The local market may be close to matching demand with supply so any increase in production will need to be exported.

Demonstrating a high bee health status and maintaining this status will greatly assist an expanding beekeeping industry and should give potential aid donors and local government departments the confidence to continue investing in beekeeping. Bee disease surveys not only help to facilitate the export of bee products from Samoa but also allow the maintenance of the Bee and Bee Products Prohibition Order 1999 (enacted on March 2000) which controls the entry of risk goods. Bee products and used beekeeping equipment could introduce exotic bee diseases which if established could threaten the well being of the Samoan beekeeping industry.

## 4. HISTORY OF BEEKEEPING ON SAMOA

Black strains of the honey bee *Apis mellifera* were introduced by early settlers and missionaries in the 19th century. A Samoan American Bee Company (SABCO) began operating in 1978 and increased hive holdings to 900 hives. SABCO sold many tonnes of honey on the local market and exported large shipments of honey to Germany from 1981-83.

[5] Now renamed *Melissococcus plutonius*

The company was reformed as the Samoan Bee and Honey Company (SABHO) in 1985 with European partners.

This company increased to around 1800 hives and exported many tonnes of honey to Germany before suffering management and financial problems. The company was effectively abandoned in 1989. Severe cyclones in 1990 and 1991 as well as local villagers destroyed most of the hives. The 18 remnants of these hives, plus the many hundreds of wild or feral hives that occupied houses and trees have been used to re establish village-based and commercial beekeeping. The Women in Business Development Inc. (WIBDI) and also the Beekeepers' Association of Samoa Inc. (BASI) supports many of these beekeepers. Three private entrepreneurs now own around 300 colonies between them and secure a significant income from beekeeping.

## 5. SIZE OF THE INDUSTRY

During the bee disease survey in 1987 Reid and Bettesworth reported that SABHO operated 1500 hives, which they subsequently increased to 1800 (Rudnik, T. pers. com). There were two other hobby beekeepers with 8 hives and no feral or wild bee colonies were found. However, the bee disease survey carried out in 1996 found the situation was completely reversed from 1987 i.e. only 14 managed beehives plus 8 rotten hives were found but there were lots of feral colonies in the walls of houses and in trees.

The survey in 2005 reported there were 37 beekeepers operating 467 hives on 54 apiaries. Currently there are 39 beekeepers, 467 hives and 70 apiaries recorded on a database maintained by BASI. A number of apiaries are shared by beekeepers but the current estimate of apiaries is based on beekeepers and recorded locations for their hives whether on a shared site or not. Thus, a number of locations will be counted more than once.

## 6. BEE DISEASE STATUS IN SAMOA

Bee disease surveys of Samoa were carried out by Reid and Bettesworth (1987) and Reid and Driscoll in 1996 (FAO 1996). Reid and Driscoll also inspected many hives during training workshops carried out in 1997 and 1998, which were funded by FAO and NZ Foreign Affairs (NZODA). Driscoll reviewed the beekeeping industry and inspected some hives in 2000 and Reid and Cory (Niue Honey Company and owner of 85 hives in Samoa) inspected a large number of hives during a private visit in 2003 to evaluate the potential for the Niue Honey Company to invest in commercial beekeeping in Samoa. Reid and Cory carried out a further bee disease survey in 2005, funded by the Ministry of Finance and the Canada Fund, and inspected 294 out of 467 hives (63%) on 35 apiaries (65%).

**Table 1 Comparison of the status of honey bee pests and diseases in Samoa, New Zealand and Australia**

| Common name | Scientific name | Agent | Samoa | New Zealand | Australia |
|---|---|---|---|---|---|
| American foulbrood | *Paenibacillus larvae* | Bacteria | Absent | Present | Present |
| European foulbrood | *Melissococcus plutonius* | Bacteria | Absent | Absent | Present |
| *P. alvei* | *Paenibacillus alvei* | Bacteria | Absent | Believed to be absent | Present |
| Varroa Mite | *Varroa destructor* | Mite | Absent | Present | Absent |
| Asian Bee Mite | *Tropilaelaps clareae* | Mite | Absent | Absent | Absent |
| Tracheal Mite | *Acarapis woodi* | Mite | Absent | Absent | Absent |
| Small Hive Beetle | *Aethina tumida* | Insect | Absent | Absent | Present |
| Asian honey bee | *Apis cerana* | Undesirable genotype | Absent | Absent | Present-Queensland |
| Africanized honey bee | *Apis mellifera scutellata* | Undesirable genotype | Absent | Absent | Absent |
| Cape honey bee | *Apis mellifera capensis* | Undesirable genotype | Absent | Absent | Absent |
| Nosema | *Nosema apis* | Protozoan; microsporidia | Present | Present | Present |
| Nosema | *Nosema ceranae* | Protozoan; microsporidia | Unknown | Unknown | Present |
| Amoeba | *Malpighamoeba* | Amoeba | Present | Present | Present |
| Sacbrood | | Virus | Present | Present | Present |
| Chronic bee paralysis | | Virus | Present | Present | Present |
| Black queen cell virus | | Virus | Unknown | Present | Present |
| Kashmir bee virus | | Virus | Unknown | Present | Present |
| Bee virus X | | Virus | Unknown | Present | Present |
| Bee virus Y | | Virus | Unknown | Present | Present |
| Israeli Acute Paralysis Virus (IAPV) | | | Unknown | Unknown | Absent |
| Colony Collapse Disorder (CCD) | | Unknown but varroa and viruses implicated | Absent | Unknown | Absent |

## 7. METHODS

The survey concentrated on visual inspections for brood diseases likely to impede the entry of bee products into New Zealand and the EU. Many of the serious bee diseases and pests that affect adult bees are not of a quarantine concern for extracted honey packed in honey drums or retail packs. Raw bee products like propolis, pollen or beeswax can harbour pests such as wax moths and Small Hive Beetles but are usually treated by freezing or fumigation. The term 'bee disease' is used in this report to refer collectively to all bee diseases and exotic pests of the honey bee as well as undesirable genetic strains.

### 7.1 Location of Colonies

The selection of apiaries for inspection and sampling was based on an assessment of risk of contacting an exotic bee disease or pest, and follows the method used in New Zealand. Apiaries

deemed to be of high risk are those near ports, airports, garbage dumps and tourist and population centres.

### 7.1.1 Upolu

The survey team visited 15 apiaries belonging to 7 beekeepers on Upolu and inspected and or sampled 93 hives.

### 7.1.2 Savai'i

The survey team visited 7 apiaries belonging to 4 beekeepers on Savai'i and inspected and/or sampled 36hives.

## 7.2 Collection of Specimens

Approximately 200 adult bees were collected from each hive inspected, and stored in 70% ethyl alcohol for more detailed examination in New Zealand of the microsporidian parasite *Nosema ceranae,* if deemed necessary and when a reliable test method is developed. Samples could also be screened for the external mites *Varroa* and *Tropilaelaps.*

## 7.3 Field Observations

Colonies were opened and all brood frames and bees were examined for clinical (visual) symptoms of:

- American foulbrood (bacteria)
- European foulbrood (bacteria)
- Half-moon Syndrome or Disorder (nutritional / genetic disorder)
- Colony Collapse Disorder (CCD)
- Parasitic Mite Syndrome (PMS)
- Chalkbrood (fungus)
- Sacbrood (virus)
- Chronic bee paralysis (virus)
- Varroa and *Tropilaelaps* (external mites)
- Small Hive Beetle (insect)
- Africanized honey bee, Cape honey bee and the Asian honey bee (undesirable genetic strains)
- Wax moths and other pests

Observations were also made on colony temperament, and genetic diversity of bee stocks.

# 8. RESULTS

### 8.1.1 American foulbrood AFB (Bacterium)

No colonies with obvious field symptoms were found nor were any suspects seen that required sampling and further laboratory examination. American foulbrood has never been found in Samoa.

### 8.1.2 European foulbrood EFB (Bacterium)

No colonies with obvious field symptoms of EFB were found nor were any suspects seen that required sampling and further laboratory examination. Half-moon Disorder (HMD)

and Parasitic Mite Syndrome (PMS) can be confused with EFB as clinical symptoms are similar.

### 8.1.3 Half-moon Disorder or Syndrome (HMD)

Half-moon Disorder is believed to be a nutritional effect caused when developing queen bees are under-nourished (Anderson, 1988). No cases of HMD were seen.

### 8.1.4 Colony Collapse Disorder (CCD)

Colony Collapse Disorder (CCD) is a phenomenon that was first described in the USA in late 2006. It describes a sudden population loss in a colony with few, if any associated dead bees in front of, or inside the hive. Brood combs contain brood of all ages and in some cases, plenty of food. Similar observations have been made in several countries throughout Europe.

Recently a team of researchers in the USA used whole genome microarrays to compare cells from the stomachs of bees as this is the primary site of pesticide detoxification and immune defence (Johnson et. al, 2009). Previous theories for CCD have included pesticide poisoning, miticides and mite infestation.

However, genetic analysis of the bees' stomachs failed to reveal elevated levels of pesticide response genes. In addition, genes involved in immune response showed no clear expression pattern despite the increased prevalence of viruses and other pathogens in CCD colonies. The guts of the CCD bees had an abundance of fragments from the ribosome which makes cell proteins. This finding suggests that protein production is likely to be compromised in bees from CCD hives.

Previous research showed that picorna-like viruses such as deformed wing virus and Israeli Acute Paralysis Virus (IAPV) attack the ribosome and instead of making honey bee protein they make virus proteins.

No evidence was seen of CCD in Samoa.

### 8.1.5 Parasitic Mite Syndrome (PMS)

PMS is caused by viruses associated with heavy infestations of varroa mites, but no evidence of this syndrome or varroa were seen.

### 8.1.6 Chalkbrood (fungus)

Chalkbrood was found at low levels in some apiaries but many hives were apparently free of the disease. Chalkbrood was found on all previous surveys but at low levels.

### 8.1.7 External mites

No *Varroa destructor* or *Tropilaelaps* were seen in the hives and these mites have not been detected in past surveys either during hive inspections or following subsequent laboratory screening.

### 8.1.8 Internal mites

No evidence of tracheal mite, *Acarapis woodi,* were seen in the colonies and have not been detected in past surveys either during hive inspections or following subsequent laboratory dissections of adult bees.

### 8.1.9 Sacbrood virus

Only a few hives were found with infected larvae but the number of cases per hive was very low and reconfirmed previous reports of this disease.

### 8.1.10 Chronic bee paralysis (Virus)

This virus can be seen in adult bees but only a few cases were found. The virus has also been detected on previous surveys.

### 8.1.11 Nosema spp. (Protozoan)

The microsporidian nosema is a fungus-related microbe that produces spores that bees consume when they clean out infected cells. The spores germinate in the bees' digestive tract and cause an infection that spreads to other tissues. Nosema is probably the most common honey bee disease in the world and can be found in just about every hive. *Nosema apis* was the leading cause of microsporidia infections among domestic bee colonies until recently when *N. ceranae* jumped species from the Asian honey bee to the European honey bee.

*N. ceranae* appears to be more virulent than *N. apis* in European honey bees. Researchers in Spain have shown that it may be the cause of CCD in that country (Higes et al, 2009). Colonies were being wiped out or lost much of their strength within weeks of being infected.

*N. apis* has been found in Samoan bees on previous surveys. In 2005 spore levels ranged from 0 to 1,283,333 spores per bee but all hives tested were infected. The nosema spore levels from some of the hives were possibly high enough to have an adverse economic effect on the hives. Regular comb replacement, requeening and good protein nutrition is generally recommended to help reduce the effects of nosema.

No signs of either nosema species were seen although confirmation is usually by microscopic or PCR diagnosis. Samples taken during the survey can be tested for *N. ceranae* if a test is developed by Plant and Food Research Ltd. SROS may also be able to test for nosema species at a later date if deemed necessary.

### 8.1.12 Africanized Honey Bee, Cape Honey Bee and Asian Honey Bee (Undesirable genotypes)

Most hives examined were hybrids of the Italian strain *(Apis mellifera ligustica)* and the black European strain of honey bee *(Apis mellifera mellifera).* There was no evidence of the African or Africanized honey bee (sometimes called the killer bee) or of the Cape honey bee. There were no reports of the Asian honey bee which has recently spread in the Solomon Islands and has destroyed beekeeping there by out-competing the European honey bee.

### 8.1.13 Small Hive Beetle (Insect-beetle)

No Small Hive Beetles (SHB) or beetle larvae were seen. SHB larvae infest hives and consume pollen and honey stores. In the process they infect honey combs with yeast, which creates a noxious slime all over the frames and makes the honey inedible. Small Hive Beetles are present in Australia.

### 8.1.14 Other pests or diseases

The lesser wax moth larvae (*Achroia grisella*) and the greater wax moth (*Galleria mellonella)* were found as were ants, lizards and cockroaches. These had all been recorded before.

### 8.1.15 Genetic Base

The honey bees in Samoa are a reasonably homogeneous strain of the Italian bee *Apis mellifera ligustica*. However, the strain is showing signs of reverting to the black bee (*Apis mellifera mellifera*). The black bee is a very hardy strain, and capable of living without human assistance as feral colonies. Since black bees therefore predominate as the background population in Samoa, drones of this stock are more likely to mate with virgin queens flying from managed colonies. Over time, this results in hybridization of the strain of bees in managed colonies, and the eventual reversion to black bees.

Black bees are much more aggressive than the Italian strain, and run excessively on the comb, making finding queen bees very difficult. They are therefore not the preferred strain for commercial beekeeping.

During the survey, no conclusive signs of inbreeding (patchy brood pattern and mutant eye colour) were found. Patchy or irregular brood patterns were observed in some hives, but old queens, pollen deficiencies, nosema infections and chalkbrood disease could also cause this.

Queen bee cells from selected Italian breeding stock were imported from New Zealand in 1998 and 1999 to arrest a decline in temperament that was becoming evident 6 years after the demise of SABCO. This stock still dominates but the trend towards a darker more aggressive strain will continue unless breeder selection and matings are better controlled. Alternatively importation of queen cells from varroa-free areas or artificial insemination using select drone semen could be considered. The latter option is the most expensive and involves a slight risk of introducing viruses. However, it may be preferable to letting the bee stock in Samoa degenerate into an aggressive strain that creates issues for landowners.

**Table 2 Location of hives surveyed in Samoa during July 2009**

| Beekeeper | Land owner | Apiary location | No hives present | No hives inspected & sampled | Comments |
|---|---|---|---|---|---|
| **UPOLU** | | | | | |
| MAF-Niue | MAF Dairy | Vailima/Avele | 4 | 4 | shared site |
| Niue-Saleimoa | Helesoe L | Papaloloa | 11 | 9 | shared site |
| Niue Honey Co | Bartley R | Le Lata | 4 | 3 | |
| Niue-Saleimoa | Hogerty G | Letogo | 11 | 11 | shared site |
| Niue Honey Co | Meti Soap Factory | Letogo | 6 | 5 | |
| Saleimoa Apiaries-Cook | Dean | Saleimoa | 8 | 6 | |
| Saleimoa Apiaries-Vi | Dean | Saleimoa | 7 | 7 | |
| Niue Honey Co | Dean | Saleimoa | 14 | 5 | |
| Mauff | Annadale | Tanumapua | 4 | 4 | road side |
| Westerlund | Westerlund | Aleisa | 10 | 8 | market garden |
| Westerlund | Westerlund | Tanumapua | 6 | 5 | by house |
| Mauff | Mauff | Lotopa | 6 | 4 | |
| Voigt | Voigt | Pesega | 16 | 6 | home |
| Moore | Moore | Vaivase tai | 18 | 8 | |
| Niue Honey Co | Malietoa | Fagalii | 15 | 8 | airport |
| **7 beekeepers** | | **15 apiaries** | **140** | **93** | |
| **SAVAII** | | | | | |
| Niue Honey Co | MAF Compound | Salelologa | 6 | 6 | |
| Wetzell | Wetzell | Lata | 5 | 5 | |
| MAF-Tiatia | Tiatia | Gataivai | 5 | 3 | |
| Newton K | Newton K | Vaia'ataa # 1 | 97[6] | 5 | |
| Newton K | Newton K | Vaia'ataa # 5 | 0 | 7 | |
| Newton K | Newton K | Vaia'ataa # 4 | 0 | 5 | |
| Schwalger | Schwalger | Patamea | 5 | 5 | |
| **4 beekeepers** | | **7 apiaries** | **118** | **36** | |

| Total Samoa | Beekeepers | Apiaries | Hives | Hives sampled |
|---|---|---|---|---|
| | 39 | 70 | 467 | |
| **Total inspected/sampled** | 11 | 22 | | 129 |
| **% inspected/sampled** | 28% | 31% | | 28% |

## 9. SUMMARY AND CONCLUSIONS

In Samoa, 129 beehives out of a total of 467 available were inspected for bee diseases and pests, and in particular European foulbrood (EFB). This is a hive inspection rate of 28% compared to the target surveillance rate of around 2% in New Zealand. Biosecurity NZ contracts AsureQuality Limited to inspect and sample 350 apiaries each year using AsureQuality staff or

[6] 97 hives accommodated under 6 lean-to sheds.

warranted beekeepers, and to collect samples from another 300 apiaries that supplied live bees for export. The latter are inspected for internal and external mites only.

In Samoa 22 apiaries were inspected out of 70 (31%) compared to New Zealand's target surveillance rate of 3%.

No cases of European foulbrood or American foulbrood, Colony Collapse Disorder, Parasitic Mite Syndrome, Half-moon Disorder or *Paenibacillus alvei* were found.

No field evidence was found of the Small Hive Beetle or the very aggressive African strain of honey bee or the Cape bee or the Asian honey bee.

Some cases of chalkbrood disease, sacbrood and chronic bee paralysis virus were found but these were not obviously affecting colony performance.

Wax moths, cockroaches and lizards were also reasonably common as were several species of ants. None of these appear to be causing a problem to the hives.

## 10. EXISTING LEGISLATION & QUARANTINE SYSTEMS FOR BEES AND BEE PRODUCTS

Samoa continues to have one of the highest bee health situations of any Pacific Island Country (PIC) especially since varroa was found in Tonga. This situation can change at any time after accidental or deliberate introduction of risk goods such as bee products and live bees. The industry needs government protection by way of import controls and border quarantine and inspection, ongoing field surveillance and an ability and willingness to respond to an outbreak of a serious honey bee disease.

### 10.1 Acts and Regulations

A degree of protection was given to the industry when the Bee and Bee Products Prohibition Order 1999 (enacted 9th March 2000) was issued under the Customs Act 1977.

### 10.2 Quarantine Systems

The Samoan quarantine service has been much improved over the past few years following an institutional strengthening program funded by AusAID. Samoa is reasonably high risk for bee diseases given its proximity to American Samoa and frequent aeroplane and ship services to New Zealand and Australia and other Pacific Islands. Honey was regularly imported from the USA, China, New Zealand and Australia until the prohibition order was enacted in March 2000. This imported honey could potentially introduce the serious bacterial diseases American and European foulbrood as well as a more malignant strain of the fungus disease called chalkbrood. Honey from New Zealand, Australia and the USA, at least, has been seized under the prohibition order (J Burton, Samoa Quarantine 2005 pers. com).

All baggage from airline passengers is X rayed at the airport so this should reduce the risk of prohibited bees and or bee products entering the country. However, risk items on yachts, cruise ships and containers represent an unknown risk. Small quantities of honey from the USA, India and New Zealand got through the border and were found in retail shops in 2008 by members of the Beekeepers' Association of Samoa.

There is limited movement of beehives within each of the two main islands of Samoa so any outbreak of an exotic bee disease or pest could be contained and hopefully eradicated. Movement between Upolu and Savai'i is relatively easy to control so an outbreak on one island could be contained on that island.

### 10.3 Honey Bee Disease Survey and Response Systems

In the past bee disease surveys were carried out in Samoa approximately every 5 years. New Zealand's revised import health standards may require equivalence with New Zealand standards, which could mean an annual bee disease survey. Such surveys in New Zealand are the responsibility of MAF Biosecurity New Zealand (MAFBNZ) as the competent authority. MAFBNZ contracts AsureQuality Ltd, who in turn sub-contracts beekeepers warranted as Authorised Persons Level 2, to carry out the field work.

A senior meat inspector from Samoa MAF assisted with the current survey as did a scientist from SROS. A case could possibly be made for a Samoa MAF or SROS officer to take any samples deemed suspect by beekeepers. Staff from the USP could also assist.

Currently all the beekeeping expertise in Samoa resides with six or so main beekeepers. Hopefully they will recognize an exotic bee disease if one should become established and alert Samoa MAF. International expertise could be brought in to help in the first instance if necessary.

In the past bee disease reference laboratories have been used in New Zealand and Fiji to provide differential diagnosis for suspect exotic samples. Under the Hazardous Substances & New Organisms Act 1996 (HASNO), New Zealand restricts the entry of organisms that are not already in the country. This includes suspect specimens of European foulbrood (EFB). Currently samples of bees stored in alcohol can be brought in for testing for external mites and *Nosema spp.* and presumably smears of larvae suspect for American foulbrood can also be sent to a reference lab, as New Zealand has this disease. Fiji has similar restraints on importing suspect exotic honey bee disease material. Samples of suspect EFB may be able to be sent to an Australian animal health laboratory or tested at SROS.

Fortunately in the absence of varroa mites, which can lead to Parasitic Mite Syndrome (PMS) and Colony Collapse Disorder (CCD), both American and European foulbrood have reasonably conclusive visual or clinical symptoms. American foulbrood and European foulbrood can be confused with sacbrood and Half-moon Syndrome respectively.

Information on bee diseases, including colour photographs, has been left with Samoan beekeepers and authorities on a number of occasions, including the current mission.

### 10.4 Industry Prospects and Export Considerations

Four beekeepers own most of the hives on Samoa (range 20-100) but expansion plans identified during the previous survey appear to be on hold for the time being. Plans for a mobile extracting unit are being promoted over a purpose-built honey processing factory. The issue of mobile extractors being acceptable to the EU is still under negotiation between the EU and the New Zealand Food Safety Authority.

The potential for bee hives in Samoa is still estimated at 2000 or more.

Export markets will be vital if any marked expansion occurs as the local market can probably only absorb around 7-8 tonnes per year (FAO, 1996 and Dean, L 2009). Exports to New Zealand are currently permitted with an export certificate from Samoa stating the honey is from Samoa and the country is free of European foulbrood (EFB). Once New Zealand's revised bee product import standards are in place this automatic right of entry could be replaced with a requirement to get an import permit.

The conditions on the permit are likely to demand demonstrated freedom from EFB, which will probably mean regular surveys of hives by a competent authority. How frequently the surveys need to be carried out and by who will need to be negotiated with the New Zealand authorities and could be from 1-3 year intervals provided the existing quarantine and bee health status doesn't change.

Similarly, qualifications of staff that should carry out the survey work will be subject to negotiation. Suitably trained local personnel, or accredited experts from overseas, could do this work or New Zealand authorities may accept qualified beekeepers inspecting their hives and making declarations as to disease freedom. A competent authority will also be required to issue Export Certificates and the level of competency required will be negotiated with New Zealand authorities. Further training in New Zealand or Australia may be needed for MAF Officers and or scientists/technicians from SROS.

If the Samoan honey is to be consumed within New Zealand then it must have been processed in premises approved for the purpose by local health authorities and the operator should ideally have a documented Food Safety Program (FSP) or a Risk Management Program (RMP). If the Samoan honey is likely to be re-exported from New Zealand as Samoan honey, or blended with other bee products from New Zealand or elsewhere, then the operator must have an RMP and meet all Overseas Market Access Requirements (OMAR's). AsureQuality Ltd carries out the majority of the RMP audits for New Zealand honey processors. See web site below for more information;

http://www.nzfsa.govt.nz/animalproducts/subject/bee-products/index.htm

To enable subsequent export of the Samoan bee products, they must also be inspected at the New Zealand border by MAF Biosecurity NZ staff, who will attest to the integrity of the product and the country of origin.

http://www.nzfsa.govt.nz/animalproducts/publications/omar/01-172.htm?print

If the bee products for human consumption or use are likely to be exported directly to the European Union (EU), or be re-exported from New Zealand, then Samoa must have an annual residue-testing program in place. These requirements can be found at;

http://www.nzfsa.govt.nz/animalproducts/publications/omar/eun/requirements/index.htm

Pitcairn Island has an accredited New Zealand lab carryout its residue tests at an annual cost of approximately NZ$1200 Alternatively SROS may be able to carry out the testing. The EU also requires that supplier countries be listed with them as approved suppliers.

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