National Bee Pest Surveillance Program (NBPSP) Review and Redesign

1. Introduction

The National Bee Pest Surveillance Program (NBPSP) is one of the world's leading surveillance programs for bee pests. It is a key biosecurity preparedness program comprising several surveillance activities, to protect the broad honey bee community, hobbyists and professionals and pollination-reliant industries of Australia. It is also an important tool in providing the evidence of absence information from bee pests and pest bees, which assists maintaining market access.

Honey bees in Australia remain free of many serious pests and diseases that affect the honey bee industry world-wide, however exotic threats come in a variety of forms. The NBPSP utilises several different methodologies to provide comprehensive surveillance for high-priority exotic threats to the industry.

2. Surveillance Methodologies

Seven methodologies are required to provide adequate coverage against the various exotic threats to the honey bee industry. No single methodology can provide adequate coverage for all pests and as such a unified approach is required for the program. The methodologies employed are standard catchboxes, remote surveillance catchboxes, sentinel hives, floral mapping and sweep netting, surveillance for Asian honey bees, surveillance for viruses and surveillance for Asian hornet. A description of each methodology is given below.

Standard catchboxes

Catchboxes positioned in high risk port areas provide a means of early detection of exotic species of *A. mellifera* including Africanised honey bees (*A. m. scutellata*) and Cape honey bees (*A. m. capensis*). Newly arriving swarms of European honey bee (i.e. inadvertently imported on cargo/vessels), as well as the local *A. mellifera* population may also be picked up using catchboxes and can subsequently be sampled for exotic mites on a regular basis. Catchboxes are not used to detect giant honey bee (*A. dorsata*) or red dwarf honey bee (*A. florea*) as these species are not cavity nesting. In response to the review of the previous program, a greater focus on catchbox location and the potential for the use of lures and baits will be considered to improve their effectiveness.

Remote surveillance catchboxes

A remote surveillance catchbox (RCB) is an empty hive with a mobile phone camera and sensors that can detect when honey bees are present in the hive. The phone captures an image at frequent intervals and performs image analysis to determine the presence of a swarm. The phone uploads an image daily or if image analysis detects activity. Power to the phone is provided by a solar panel and batteries in the catchbox lid. An electronic door on the catchbox entry can be triggered remotely to close and open the hive door. Remote surveillance catchboxes are positioned in locations that are remote, not easily and frequently accessible, but are of high risk concern for exotic threats. Similar to standard catchboxes, RCB target exotic species of *A. mellifera* including Africanized honey bees (*A. m. scutellata*) and (*A. m. capensis*). Newly arriving swarms of European honey bee (i.e.

inadvertently imported on cargo/vessels) as well as the local *A. mellifera* population may also be picked up using catchboxes and all swarms captured are subsequently tested for exotic mites.

It is proposed that several technology improvements be made to the remote catchboxes in the next phase of the NBPSP and that they be trialled prior to a national rollout. As with the standard catchboxes, the location and potential for lures and baits will need to be considered to optimise effectiveness.

Sentinel hives

Hives of European honey bees (*Apis mellifera*) of a known health status that are maintained at ports believed to be of high risk throughout Australia. These hives are tested every six weeks using an acaricide (miticide) to provide a further means of detection for external mites. Additionally, samples of adult bees are sent to laboratories to assess for internal mites.

Surveillance for Asian honey bees

Asian honey bees present a major threat to the environment due to competitive nesting behaviour and the pollination and honey bee industry as they are frequently detected at ports and are carriers of *Varroa* mites and other bee diseases. The nesting biology of Asian honey bees differs from that of European honey bees, and as such catchboxes specifically designed to be attractive to Asian honey bees will be implemented as part of the next phase of the NBPSP.

Floral mapping and sweep netting

Floral mapping and sweep netting are a means of detecting pest bees such as Asian honey bee or bumble bees. First, areas around ports with high quality floral resources are mapped to determine which areas pest bees are most likely to be foraging in. Then at peak foraging times, inspectors sample these floral resources by sweep netting to determine whether exotic bees are present in the area.

Strong engagement with surveillance operators will be key in ensuring optimal execution for this technique.

Surveillance for viruses

Viruses have significant trade implications for the honey bee industry and can exacerbate the damage caused by *Varroa* mites. It is proposed that within the new program, surveillance for 5 priority exotic honey bee viruses be included once the diagnostic method has been established and key capability developed. Once this has been achieved, samples will be taken from sentinel hives and screened for viruses biannually.

Funding for this activity is being negotiated with the Department of Agriculture and Water Resources.

Surveillance for Asian hornet

Asian hornet is a serious work health and safety threat and pest of honey bees and is highly invasive in Europe and the UK. It is proposed that trials of Asian hornet traps will be carried out

at key ports (Darwin, Brisbane, Sydney and Melbourne, as Perth and Adelaide environments are less conducive for establishment) in the new program. The traps include a volatile lure to attract and trap hornets that are hunting bees near hives.

Data capture and management

Real time capture of surveillance data is also proposed for the new program, enabling a greater opportunity to consolidate both industry and government data, providing a national picture of the surveillance carried out at our highest risk ports, in apiaries around Australia and at potentially higher risk sites including key pollination events (eg almond pollination in spring that requires hives from several states).

3. Current and future programs

Four models for the NBPSP are presented in this paper. Model 1 is the current program, which has been in place from 2013. Model 2 is the new program, which is due to commence in December 2016 and will continue until 2021. The 14 high risk ports covered by this program account for 95 % of the total import volume (in tonnes) of trade into Australia. Industry support for the program has grown significantly, with the Commonwealth contribution to legacy innovations currently under consideration. Model 3 is an enhanced program that proposes greater coverage across Australian ports. Model 4 is a completely comprehensive program that enhances Model 3 and significantly increases the application of remote catch boxes.

Model 2 is the model that has been developed for the NBPSP for 2016-2021. This model includes a number of enhancements: virus diagnostics and surveillance (pending commonwealth funding), use of Asian Honeybee specific catchboxes, increase in the number and sensitivity of standard catchboxes (129-170), upgrade and deployment of a further 40 Remote catchboxes (pending Commonwealth funding), increase in number of sentinel hives (167-174) to meet the optimal design recommendations, floral weep netting to be increased to all high risk ports and inclusion of Asian Hornet surveillance.

Model 3 describes further enhancement to increase port coverage (32-54 ports, 174-278 hives) covering more of the medium and low risk ports, virus surveillance carried out at more ports (32ports = 64 samples annually), less standard catchboxes (170-150) because of a significant increase in remote catchbox deployment (40-210), Asian honey bee catchboxes increase across more ports (260-345), floral sweep netting extended to medium risk ports as well. These improvements would be more timely once the sensitivity of methodologies developed in model 2 is evaluated.

Model 4 describes an increase of sentinel hives to be at the optimum design at all ports irrespective of risk rating, an increase in virus surveillance (54 ports = 108 samples), removing standard catchboxes and replacing with remote catchboxes at all ports (201-580), Asian Honey Bee catchboxes at all ports (345-580) and floral sweep netting at all ports irrespective of risk rating (at 54 ports). Whilst it may seem ideal to have all ports covered in an optimal way there should be some consideration of value of such effort and would rely on sensitivity information to determine such value.

4. R&D Gaps

While rigorous statistical analysis of the sensitivity of sentinel hives has been carried out, an equivalent level of analysis for the other methodologies presented here has yet to be performed. These data will be necessary to truly assess the efficiency of the program and where modifications should be made. Additionally, both standard and remote surveillance catchboxes have yet to be optimised. Further research is necessary to determine how to make them more attractive to honey bee swarms and whether pheromone or floral lures may be useful. Finally, some Australian ports still have unknown risk ratings, and detailed risk analysis of these ports and airports is required to determine the best way to direct the NBPSP.

		(Model 1) Current Program 2013-2016		(Model 2) New Program 2016-2021		(Model 3) Enhanced Version		(Model 4) Comprehensive Version	
		Number	Total cost	Number	Total cost	Number	Total cost	Number	Total cost
Port number		39		32		54		54	
Number of ports at four risk ratings		(H:13, M:9, L:2, U:15)		(H:14, M:9, L:3, U:6)		(H:16, M:15, L:20, U:3)		(H:16, M:15, L:20, U:3)	
Method	**Annual cost ($) per unit**								
Sentinel Hive									
Inspection, diagnostics, maintenance	$2,973.59	167	$496,589.53	174	$517,404.66	278	$826,658.02	324	$963,443.16
Tracheal mite diagnostics	$198.00	167	$33,066.00	174	$34,452.00	278	$55,044	324	$64,152.00
Virus diagnostics	$514.20	-	-	38	$19,539.60	64	$32,909	108	$55,533.60
Standard catchbox									
Establishment - one off	$50	129	$6,450.00	170	$8,500.00	150	$7,500	-	-
Inspection, diagnostics, maintenance	$392.00	129	$50,568.00	170	$66,640.00	150	$58,800	-	-
Additional diagnostics (tracheal mite)		-	-	-	-	-	$55,440	-	-
Remote catchbox									
Establishment - one off	$1,000.00	20	$20,000.00	40	$40,000.00	210	$210,000	580	$580,000.00
General maintenance old (annually per unit)	$630.00	20	$12,600.00	-	-	-	-	-	-
Diagnostics and maintenance new (annually per unit)	$1,414.00	-	-	40	$56,560.00	210	$296,940.00	580	$820,120.00
Additional diagnostics (tracheal mite)		-	-	-	-	-	$55,440	-	$171,072
Asian honey bee catchbox									
Establishment - one off	$25.00	na	na	260	$6,500.00	345	$8,625	580	$14,500.00
Inspection, diagnostics, maintenance	$392.00	na	na	260	$101,920.00	345	$135,240.00	580	$227,360.00
Floral sweeping									
Establishment - one off	$986.00	11	$10,846.00	15	$14,790.00	32	$31,552.00	54	$53,244.00
Floral sweeping within mapped areas (annually)	$3,552.00	11	$39,072.00	15	$53,280.00	32	$113,664.00	54	$191,808.00
Asian hornet surveillance									
Establishment of 40 traps	$405.00	-	-		$405.00		$405.00		$405.00
New lures annually (for 40 traps)	$227.00	-	-		$227.00		$227.00		$227.00
In kind labour contribution from DAWR									
Cost			***$669,191.53***		***$920,218.26***		***$1,888,443.82***		***$3,141,864.76***

1 Port risk ratings dependent on Caley et al., (2013), H: high, M: medium, L: low, U: unknown; 2 Figures based on the assumption of catchboxes "catching" high volume swarms in eastern states, 35 ports, 2 detections/catches each week for 8 peak weeks, 560 catches annually, @$198 per sample for diagnostics