

SOME NOTES FROM THE MCAA CONFERENCE IN SURFERS PARADISE 5 – 9 SEPTEMBER

Plenary Session - Gordon Patterson

Professor Gordon Patterson is a Medical Historian from the USA who has specialised in mosquitoes and their impact on mankind. His presentation was entitled “Meditation on the challenges facing mosquito control in the 21st Century” with specific reference to:

- Medical entomology
- Waging War on the Mosquito Menace
- Living in Zika Latitudes



Gordon Patterson

Professor Patterson’s address could only be described as “Corinthian” as his discourse ranged across the centuries pinpointing the seismic shifts that have occurred in the space that man and mosquito have occupied since the Columbine Exchange. He observed the rise of medical entomology that was soon to drive the initial campaigns to eradicate mosquitoes. He noted the three different eras of mosquito control techniques these being described as:

- **Era Mechanical Control.** Driven by the work of such luminaries as Gorgas, Reed, Soper and Watson
- **Era of Chemical War 1940 – 1978.** The impact of Muller’s discovery of dichlorodiphenyltrichloroethane and the subsequent global eradication campaigns that commenced with tremendous success but succumbed when the species adapted to the chemical onslaught
- **Era of Globalisation.** The failure of the “silver bullet” (DDT) and the realisation that mosquito control was a holistic process that required multiple tools to be used with full recognition of the ecological consequences

Globalisation has meant the quantum leap in the movement of people (3 Billion + air passengers per year) and of cargo (150+ million containers per year). These dynamics has had the inevitable consequence of the rapid spread of communicable diseases including the medical vectors for illnesses such as Dengue, Malaria, Chikungunya, ZIKA and West Nile Virus.

Drone Technology

This Session was led by Dr Randy Gaugler from Rutgers University. His address considered the amazing pace of the development of autonomous unmanned aerial vehicles or drones that has engaged the attention of the entire mosquito control community. The technology is evolving so fast that PH authorities recognise that early adoption of the technology might be an expensive error if they are to invest heavily in a technology that is quickly rendered obsolete by another as yet unknown innovation.

First generation drones required “operators” to fly them. The current generation of drones are capable of autonomous flight, i.e. they can be pre-programmed to conduct their sorties without the need to have a “pilot”. Certainly drone technology has shown it can be applied to a range of control and surveillance activities with drones now capable of:

- Collecting larvae
- Collecting adults
- Taking underwater photographs
- Delivering treatment products
 - Liquid formulations
 - Granular formulations
 - Treatment Briquettes
- Mapping habitat



As drone development continues payloads and flight duration are being increased. The industry has been quick to adopt the technology with its precision controlled targeted delivery systems. The use of clusters to saturate sites is a benefit as is reducing the need for employment of expensive pilots. A major headwind is the slow evolution of aviation law to accommodate drone operations.

Novel technique to disseminate Insect Growth Regulator

One technique being developed relies on the presence of Hetero-specific cohabitating species to deliver an Insect Growth Regulator, (IGR). The product is Pyriproxyfen IGR. This is highly effective against the target species, *Ae aegypti*, at very, very low dilutions. Trials have been successful in using chromomids which are used to distribute the IGR into mosquito larval habitat with up to 90% effectiveness.

GM Technology to Suppress Adult Mosquitoes

The Oxitec approach to insect control is similar to Sterile Insect Technique (SIT) and is attractive for use in Integrated Pest Management because of its species-specificity and low environmental impact. Insect predators are also left in the field to provide natural pest control and use of insecticides is reduced or eliminated.

Oxitec has for the past six years been trialling GM technology to suppress *Ae aegypti*. Using advanced genetics and molecular biology Oxitec has developed a new solution to controlling the *Aedes aegypti*. The presentation covered the development of a genetically engineered mosquito - specifically *Ae aegypti* which are released into the environment. Oxitec's environmentally benign OX513A male mosquitoes are precisely engineered with a self-limiting gene that expresses a non-toxic and non-allergenic protein to prevent their offspring from surviving to adulthood. In five separate efficacy trials across three different countries, releases of Oxitec OX513A mosquitoes led to a greater than 90% reduction in the resident *Aedes aegypti* populations

The advantages is that the risks of product resistant mosquito populations is avoided as well as the need to apply chemicals in urban areas where there may be opposition to such products. Oxitec has deployed the GM Technology Latin America, (Brazil, Panama and the Cayman Islands) with good success. Further trials are planned for Florida although there is some public resistance to this product.

A New Method of Bio surveillance Detection of exotic Mosquito DNA in Water Sources

This paper detailed how researchers were able to demonstrate the presence of exotic mosquitoes by analysing the water column that had been infested by their larvae and pupae. The experiments showed that it was possible to detect the presence of the target species (*Ae aegypti*) three weeks after the individuals were removed. Apparently the DNA remains detectable in the water column for up to four months. This promising surveillance tool for species such as *Ae aegypti* and *Ae albopictus* would be a useful, if operationalised, for complementing other surveillance technology, (adult and larval traps) at points of entry and transitional facilities.

Use of DNA Analysis to determine the origin of Incursions

Recently the Australian aviation Points of Entry, (POEs) have experienced a number of incursions. Of particular concern has been the high number of detections of exotic mosquitoes at Perth International Airport. This POE has had a significant number of interceptions, some 37 between November 2015 and March 2106. This figure was well above the rate of detections at other Australian POEs. A number of hypotheses were considered including both internal transfer (from Queensland) of *Ae aegypti* and the possibility of local breeding. Intensive sampling and DNA analysis have confirmed that the point of origin of these mosquitoes was from SW Asia and not from within Australia.

The technique used was “*next generation sequencing to characterise the genome wide single nucleotide polymorphisms (SNPs)*” in *Ae aegypti* detected at airports. These samples were then compared with samples from targeted overseas locations. These individuals were also genotyped

for known synthetic pyrethroid resistance alleles as a possible explanation of why control methods (e.g. disinsection) may not have been effective. The use of this technology has obvious benefits in terms of determining the point of origin of exotics detected at POEs. The question is whether NZ should adopt this capability or would it be more effective to utilise the Australian capacity.

Note:

1. Bali is a popular tourist destination for Australians with up to 10 direct flights a day between Perth and Denpasar. Sydney has (4), Melbourne (4) Brisbane (4), Adelaide (3), and Darwin (2)
2. By comparison NZ is considered fortunate in that it has only two direct flights to Denpasar every week

Note: There is some concern amongst regulators that the recent increase in the numbers of carriers flying into Australia has tested the Aircraft Disinsection program, comment on this is discussed in the observations section of this Report.

The ZIKA Phenomena. The current arboviral infection that has captured the attention of Public Health professionals has been the ZIKA Virus. This phenomena has yet to play out as successive communities become infected with subsequent impacts on both public health and the economy. The original assessment of ZIKA as being a somewhat “less malignant” arbovirus (in comparison with Dengue) has been overturned as studies have shown the linkages with microcephaly and Guillain-Barre Syndrome. New Zealand has an advantage in that its mosquito exclusion strategies have prevented the establishment of competent vectors of ZIKA. Australia has a raised threat profile because North Queensland has endemic the primary ZIKA vector, *Ae aegypti*. Modelling has been done that shows that assuming favourable weather conditions and absence of vector control, ZIKV could be locally transmitted in North Queensland, (Cairns & Townsville).

The response would seem to be the adoption of a global approach with the utilisation of new technologies in the areas of diagnostics, information management and surveillance to mitigate these risks. The mantra is “...get the right information to the right people, on time in order to make the best evidenced based decisions”

Zika Virus Vectors - Competence of Australian endemic Mosquitoes

An assessment has been conducted of the competence of a range of Australian Mosquitoes to vector ZIKA virus. The results of this research was presented at the Symposium data was as follows:

- Refractory to infection *Cx Annulirostris* and *Cx Sitiens*
- Of the *Cx quinquefasciatus* tested only 7% became infected
- *Ae notoscriptus* and *Ae vigilax* achieved 50% infection rates but did not transmit the virus
- *Ae aegypti* was the only species capable of being infected (50%) and transmitting the virus (27%)

Note: For New Zealand these results are encouraging since it confirms that our resident mosquito species are not vector competent for ZIKA