

**FEDERATION OF ASIAN & OCEANIA
PEST MANAGERS ASSOCIATIONS**

MAGAZINE

JULY 2019



Contents

EDITORIAL	1
PRESIDENT REPORT	2
FEATURES	
Climate Change Challenges	13
Julia Stoess, Insect Model Maker	20
Viruses & Fire Ant Management.....	30
The History of Termite Baiting	32
The Pest Summit FAOPMA History	36
Management of Sewer and Fruit Flies.....	39
Pyrethroid Mode of Action	44
EVENTS	
FAOPMA-Pest Summit, Korea 2019.....	3
Singapore Urban Pest Management Forum.....	46
ICUP 2020: Date and Venue Announced	81
Rapid EduCON 2019	82
PMANZ	84
PestWorld	86
Events Calendar	88
BOOK REVIEW	
<i>Insects of Stored Products</i>	50
NEWS	
FAOPMA Member News	52
News Items from the Media	62
New Publications from Academia	77
EVENT CALENDAR	48
NAME THIS PEST	
Last Issue Name This Pest	89
Pest Fact Sheet	90
New Name This Pest	92
CONTRIBUTE	
Contribute to the FAOPMA Magazine.....	93
FAOPMA EXECUTIVE COMMITTEE	94
ASSOCIATION PRESIDENTS	96
FAOPMA-PEST SUMMIT MEMORIES	99

Front Cover: Julia Stoess from Germany produces the most extraordinary life-like creations of insects. Here she is putting the finishing touches to a mosquito model. Read more about Julia's story on page 20. Image courtesy J. Stoess.

Let's Meet!

Guess which country was voted the number one most innovative nation in the world during 2019? South Korea!

With global corporations that include Samsung, LG, Hyundai, and Kia, such a ranking is perhaps hardly surprising. South Korea is also well known for their innovations in pest control, having long ago developed remote monitoring for a variety of pests such as rodents and flies. They also lead the world in producing mosquito traps that can automatically count and even identify the species captured.

Thus it is with some excitement that the upcoming **FAOPMA-Pest Summit Meeting** will be held in **Daejeon, South Korea over 24-27 September 2019**. Expect to see an extraordinary trade display, with many unique management solutions that should benefit your business. Some 110 exhibitors from 55 companies will be in attendance and so no matter what services your company provides, you will be well catered for. Furthermore, there are many world renowned speakers presenting, with a variety of topics covered that includes termites, cockroaches, rodents, bed bugs, ants, mosquitoes, fumigation, baiting, and business related talks. Some ten pages are devoted to the meeting in this issue. If you have not been to South Korea before, it is an exciting, beautiful country as well as being extremely safe for tourists. I have no doubt your expectations will be well surpassed as mine were when I first visited.

The meeting that is now called 'FAOPMA-Pest Summit' has only been in existence since 2016 and represents a merger of two great bodies; Pest Summit Alliance and FAOPMA. The merger has led to a stronger working relationship and a new degree of cooperation between the pest management associations in the region, the culmination being the greatest annual pest management event on the Asia-Oceania calendar. Dr Raymond Lee details the story behind the merger and the small team of dedicated individuals that made this happen.

This issue contains many wonderful feature stories, including the impacts of climate change on pest populations, how virus affects fire ants making them harder to detect and control, the history of termite baiting, sewer and fruit fly control, how pyrethroids work, and an inspirational story from Mdm Huang, the President of FAOPMA. Plus there are the usual features; Book Reviews, News Items, and a mystery pest for you to work out.

However, my personal highlight is the interview with Julia Stoess. Julia makes the most realistic models of insects and her work graces many museums across the world. Julia provides insights into the painstaking processes involved in creating such exquisite masterpieces and the final product is astounding as you will see in the images provided.

I look forward to seeing you in Daejeon. ■

Stephen Doggett (Chief Editor)

I Care

Message from Huang Xiaoyun, President FAOPMA



People care because we all have feelings. We care about the people with whom we have a relationship, about the things of which are relevant to our lives, and about past or future experiences. We care about our country because it is where we were born and raised, and where our culture and values are passed down through the generations. We voluntarily make sacrifices to our motherland if calamity falls upon it, and we proudly salute our flag after winning an international sporting competition. We care about our family because blood is always thicker than water, and we share honour, and endure hardship as one. We care about our friends because they are our indispensable companions along our journey; friendship will make us strong when the going gets tough and sharing the happy moments with our friends will even make the memories more sweet.

We not only care deeply about our family and friends, but we also care about the effort we go to in order to protect them. I care about the fact that

many people around me don't know there is a group of people who dedicate their careers to deal with the pests so that they don't have to. I care about the fact there are still many people who underestimate the threat to public health and food safety caused by pests. I also care about having our voice heard so this world we all live in will be better off because of our efforts.

We pour our love and care into this incredible FAOMPA Magazine, and we trust you could feel how much we genuinely care about your health and wellbeing; it would mean the world to us if you appreciate what we do. With time and persistence, our care will become your care and it will become the fabric, which will bond us together for the great journey ahead. Lastly, I care about your input and feedback about our magazine, because that is the only way to make it better than ever. Care will lead to long-lasting friendship, meaningful progress and general happiness in life; I have no doubt in my mind our industry will embrace a brighter future because **WE CARE!** ■

www.faopma2019korea.org



NE HEALTH

FAOPMA-Pest Summit 2019 Daejeon, Korea

Approx. 35 invited speakers

110 Exhibition booth of 55 companies

from 20 countries

CESCO & Seoul, History Tour (Jeonju, Gongju, Buyeo)

Social Events with K-Culture & K-Food

Harmony & Business Networking

of Participants from 25 countries

The biggest summit of all



INVITATION



The FAOPMA-Pest Summit 2019 will be held in Daejeon, Korea, the center of science that leads national administration, traffic and the 4th industrial revolution, 24 - 27 September, 2019.

During the FAOPMA-Pest Summit 2019, the latest research and technologies on pest management and disease control, exhibitions and social events for promoting and achieving the advancement of related industries are to be demonstrated.

More than 3,000 delegates are expected to be participate with many attention and support Korea CDC and Daejeon City. We will make this year's event to be the biggest and joyful for the participants.

Especially, the exhibition for the world wide pest management industries will be run from 24 to 26 September during the conference for 3 days. This would be the center networking area full of business meetings & consulting for the exhibitors, sponsors and the main participants from the industries all around the world.

Your attention and participation to the FAOPMA-Pest Summit 2019 Daejeon, Korea would be warmly welcomed and appreciated more than ever.

Sincerely,

General Chair of FAOPMA-Pest Summit 2019
President of KPCA
Won Soo Hong

FAOPMA-Pest Summit 2019 Daejeon, Korea

DATE

Summit) 24(Tue) - 27(Fri) September, 2019
Exhibition) 24(Tue) - 26(Thu) September, 2019

TITLE

FAOPMA-Pest Summit 2019 (Daejeon, Korea)

VENUE

DCC (Daejeon Convention Center), Daejeon, Korea

ORGANIZED BY



KPCA (Korea Pest Control Association)

IN ASSOCIATION WITH



Federation of Asian & Oceania Pest Managers Association

THEME

ONE HEALTH

PROGRAMS

EXCO, AGM, Welcome Dinner, Keynote Speech, Lunch, Banquet, Exhibition, Tours, AIB training (Basic Level)

※ Infectious disease vector exhibition by KCDC (Korea Center for Disease Control & Prevention)

PARTICIPANTS

6,000 delegates

(Domestic participants: 5,000 delegates, International participants: 1,000 delegates)

※ KCDC, public administrators of pest management department from national states, provinces, cities, military prevention of epidemics, industrial leaders and professionals, students and professionals from academic societies, relating enterprises (Pest management product, drugs, chemicals)

Beautiful Korea



The Republic of Korea (herein after Korea) is a country visited by approximately ten million international travelers every year. With its long history in culture and tradition, the country has a lot to offer to travelers. Continue reading to learn general information about Korea before visiting.

The Korean peninsula, roughly 1,030 km long and 175 km wide at its narrowest point, is located in Northeast Asia. With Seoul as its capital city, Korea's total land area is 100,033 km². Korea's neighbors include Japan to the east, China to the west, and Democratic People's Republic of Korea (North Korea) across the northern border.

Beautiful Daejeon

Daejeon is one of South Korea's administration hubs with the Daejeon Government Complex (Other administrative hubs: Seoul, Gwacheon and Sejong). The Korean administration in the 1980s decided to relocate some of its functions from Seoul,

the national capital, to other cities. Currently, 12 national government offices.

There are eight popular places for sightseers which are designated by city government. Those eight sights include the mountains Sikjongsan, Bomunsan, Gubongsan, Jangtaesan, and Gyejoksan, the lake Daecheongosu, as well as Yuseong Spa, and Expo Science Park.

Most of the cultural centres and sightseeing places are located in Yuseong-gu district with the exception of Ppuri park and Daejeon Zoo.

Daejeon O-World, Daejeon's local amusement park, consists of Daejeon Zoo, Joy Land and Flower Land. Opened on May 1, 2009 the park is home to 160 species of 600 animals, 17 rides and themed gardens including Sounds garden, Herb Garden, and Rose Garden.



Program at a Glance of FAOPMA 2019

Date & Time	September 24(Tue)	September 25 (Wed)	September 26 (Thu)	September 27 (Fri)	
9:00	Registration	Registration	Registration	Registration	
10:00		Opening Ceremony	Invited Sessions	AIB Training	
11:00		Keynote Speech	Exhibition	Coffee Break	Culture Tour
12:00		Lunch		Invited Sessions	
13:00		Lunch		Lunch	
14:00	Invited Session	Invited Sessions			
15:00	Coffee Break	Coffee Break			
16:00	AGM	Invited Session	Invited Sessions	AIB Training	
17:00	-	-	-	-	
Evening	Welcome Reception	Gala Dinner	Closing Ceremony	-	

How to register FAOPMA 2019

For online-registration

please visit www.faopma2019korea.org and make online registration following the steps under the menu "Guideline for registration".

If you would like to register as a group

Contact at registration@faopma2019korea.org for detailed explanation for the process

Payment information

Through online, credit card payment is available. For deposit, please use the information as below.

Account Holder: KOREA PEST CONTROL ASSOCIATION

Account Number: 033- 556164- 01-010

Bank Address

79, EULJI-RO, JUNG-GU, SEOUL, SOUTH KOREA

Bank Name: Industrial Bank of Korea

SWIFT/BIC Code: IBKOKRSE / IBKOKRSEXXX

※ For credit card payment, please visit our website

Registration Fee

Pre-registration (1 June ~ 31 August, 2019)

Regular

\$400

Group (Over 10 – 29)

\$350

Group (Over 30)

\$330

※ The Early-Bird Registration due date is over

On-site registration

Regular

\$500

Group (Over 10 – 29)

\$450

Group (Over 30)

\$400

AIB Training



AIB training will be demonstrated in Korea as well. World renowned lecturer, **Jennifer Tan** will give lectures with the material exclusively made for FAOPMA-Pest Summit 2019.

AIB IPM Training (Basic Level) will be delivered in the room 201(2F) of DCC on 27 September, 2019.

How to apply for the training

For AIB training application, please check AIB training when making registration.

AIB training

Pre-registration (~31 August, 2019)

\$200

On-site registration

\$250

Technical Session

The world is facing challenges like never before in environmental pollution, pest problems and exponential growth of injurious insects. The natural order that was once accepted without any doubt is starting to collapse before our eyes.

Thus, the key to overcome such state of pandemonium is through collective intelligence. Since its inception in 1989, the FAOPMA has devoted itself to sharing knowledge with the belief that it is the sole way to ensure the common prosperity of nature and humanity.

“ONE HEALTH” is a word to collaborate the concepts of each related topics and field to protect the earth”

Session Titles

I. Infectious Diseases and ONE HEALTH

II. Surveillance, Prevention and Control of Vector-borne Diseases

III. Pest Control on Livestock, Pets, Wild Animals and Quarantine

IV. Climate Change Response and the Importance of Natural Ecosystem

V. Antimicrobial Resistance(AMR) and ONE-HEALTH

VI. Zoonosis: Changes and New Emergence

VII. Cases of Pest Control/Management & PCO Safety

Keynote Speaker



MD. Greg C. Gray, USA
Duke University

Keynote Speaker



MD. Moran Ki, Korea
National Cancer Center

Invited Speaker



Dr. Stephen Doggett, AU
Westmead Hospital of Sydney



Dr. William Robinson, USA
B&G Equipment



Prof. Brian T Forschler, USA
Georgia Univ.



Mr. Mark Reader, UK
Rentokil Initial



Ms. Jennifer McCaw, Germany
Biogenets AG



Dr. How Yee Fatt, Singapore
Bentz Jaz Singapore Pte Ltd



Dr. Dini Miller, USA
Virginia Tech University



Dr. Faith Oi, USA
University of Florida



Dr. Chin-Cheng Scotty Yang, Japan
Kyoto University



Dr. David Lilly, AU
Ecolab

Invited Speaker



Prof. Han Sang Yoo, Korea
Seoul National University



Mr. Erik Meurling, Sweden
Anticimex International



Dr. Gu Xiang, China
Shanghai Mintai Environment and Sanitary Service



Prof. Francois Meurens, France
Oniris-Nantes Atlantic National College of Veterinary Medicine



Mr. Ujjwal Kumar, India
United Phosphorus Ltd.



Prof. Paule Vasseur, France
University of Lorraine



Mr. Loke BoonEng
Rantokil Initial



Mr. Young-Cheol Yang
Korea Beneficial insect Laboratory (KBIL)



Prof. LIU, Qiyong
China CDC

More than 40 speakers are getting ready to give lectures on their specialties

FAOPMA 2019 Exhibition

FAOPMA2019 exhibition will be one of the biggest one from previous events. 108 booths are almost reserved. Expand your networks and find the new opportunity through FAOPMA-Pest Summit 2019 exhibition.

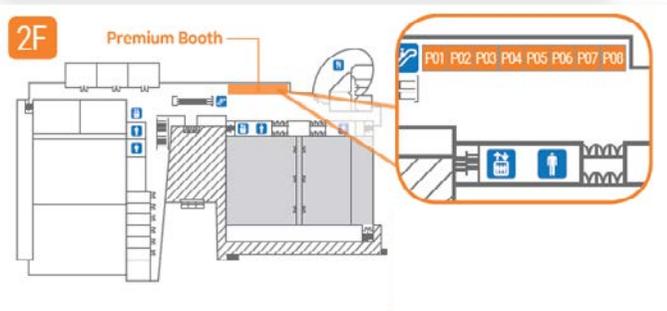
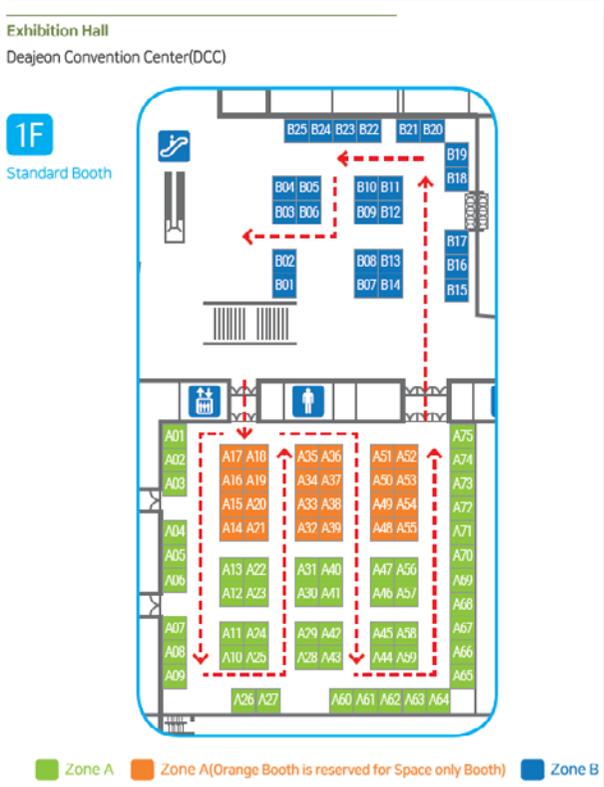
Exhibition Overview

Date: 25 – 26, September, 2019
Time: 9:00 ~ 17:00
Place: 1F exhibition hall of DCC (Standard)
 2F Lobby of grand ballroom (Premium)

Exhibition Fee

Booth type
Standard Booth
\$5,000
Premium Booth
\$3,000

To find out more, please feel free to contact at exhibition@faopma2019korea.org.



SCADA Engineering Co., Ltd

AND MORE
(Over 100 booths)

More than 110 booths are waiting to meet the delegates.

Please hurry!

There are not many booths left.

Tour

KPCA gladly arranged the technical and cultural tours for those who are attending from far away. Please do not miss the chance to enjoy beautiful Korea and its legacy.

For more details, Please contact the secretariat at tour@faopma2019korea.org.

CESCO & Seoul Tour

- **Date:** 24/26/27 September, 2019
- **Tour Site:** CESCO & Seoul
- **Course**

CESCO touch center, Test Lab center ▶ Seoul city

• Time distribution

Plan		Time	Note
24 Sep (Tue)	Group 1	07:30 ~21:00	Capacity 40
	Group 2		Capacity 40
26 Sep. (Thu)	Group 1		Capacity 40
	Group 2		Capacity 40
27 Sep. (Fri)	Group	Capacity 40	

UNESCO Heritage Tour, Gongju & Buyeo

- **Date:** 26/27 September, 2019
- **Tour Site:** Gongju, Buyeo
- **Course**

Magoksa Temple
Gongsanseong Fortress
Baekje Cultural Heritage Complex
Buyeo National Museum
Gunnamji Pond



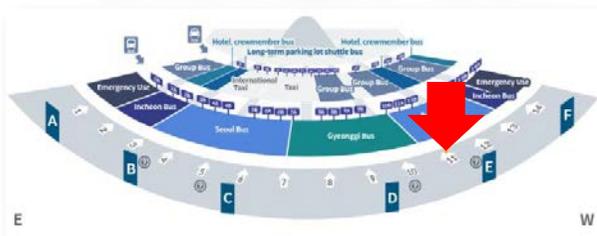
How To Get to the Venue

From Incheon International Airport to Daejeon, the venue city. The direct transportation is using Airport limousine bus.

1. Arrival at Incheon International Airport

After the arrival, please buy a bus ticket to Daejeon at the ticket box and be at the bus stop refer to below pictures for locations of ticket box and bus stop.

- 1) If you arrive at the terminal 1, you can take the bus to Daejeon at 1 Floor No.11.



- 2) If you arrive at the terminal 2, you can take the bus to Daejeon at Transportation center basement 1 No.5.

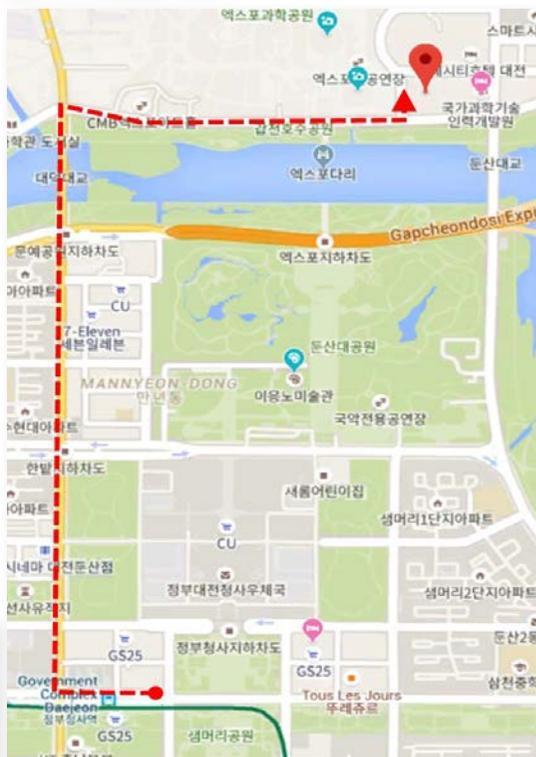


2. The route of the bus

Incheon Int'l Airport T 2
Incheon Int'l Airport T 1
North Daejeon IC
Doryong
Government Complex Daejeon (Destination)
Daejeon Terminal Complex

3. Getting to Daejeon Convention Center

The distance from Government Complex Daejeon to DCC (Daejeon Convention Center) is approximately 3 km.



- 1) **By bus**
 - Fare: KRW 1,400
 - Duration: 25 minutes
 - Bus Number: 911, 618
 - Payment method: Cash or local transportation card
- 2) **By taxi**
 - Fare: Approx. KRW 5,000
 - (Basic rate: KRW 3,300)
 - Duration: 10 minutes
 - Payment method: Cash or credit card

If you need to ask direction to locals, please show the cards.

대전컨벤션센터로 가주세요
**Please go to
Daejeon Convention Center**

See you in Korea!

 **NE HEALTH**
FAOPMA-Pest Summit
2019 Daejeon, Korea

FAOPMA Pest Summit
Daejeon, Korea

FAOPMA
PEST SUMMIT
SHENZHEN 2018

Handover Ceremony of
FAOPMA Pest Summit



Climate Change Challenges: the Influence of Temperature on the Future of Urban Pest Control

What will the future hold with rising temperatures?

Partho Dhang

Temperature has an enormous influence on the efficacy of all pest control activities. Although little is known on how temperature can affect the quality of insecticides and its application, research is showing that it has significant impact. Pyrethroid and organophosphate insecticides show sensitivity to temperature; pyrethroids have a negative, and organophosphates, a positive temperature coefficient, respectively. In addition to the direct impact of temperature on the efficacy of insecticides, temperature can also influence a number of tools and methodologies which make use of insecticides, such as long-lasting insecticidal nets (LLIN), insecticide residual spray (IRS), and odour-baited traps. It can be safely concluded that climate change and the resulting temperature increases will have profound influence on the quality of future urban pest control.

INTRODUCTION

Climate change is linked to an increase in temperature among other parameters, so it is imperative that effect of temperature on insect pests is given much consideration (IPCC 2007). Temperature is considered as the primary indicator used to determine changes

in climate. Temperature also influences all cold-blooded living forms on earth, including insects. Nearly every aspect of an insect's life is influenced by temperature, such as kinetics of enzymatic reactions, physiological functions, behaviour, (Lee 1991), metabolic rate (Hawkins 1995), and it controls nearly all physiological and biochemical processes (Huey & Berrigan 2001). In addition, a large number of experimental data on temperature and its influence is available, which is useful for interpretation.

Cockroaches particularly, the German cockroach *Blatella germanica*, are the most common indoor household pests and may not be exposed directly to climate change due to houses having a relatively stable environment. However, under natural conditions, cockroaches are influenced by temperature changes. *Blatella germanica* has been shown to almost double its growth rate with a 3°C increase in temperature (Noland *et al.* 1949). Similarly, storage pests sheltering indoors show increased growth and development, such as the Indian meal moth, *Plodia interpunctella*, at 5°C above ambient temperature (Cox & Bell 1991). Child (2007) noticed that pests such as Webbing cloth moth, *Tineola bisselliella*, the wood boring



Figure 1: Climate change can trigger the formation of stagnant pools in unexpected times.

furniture beetle, *Anobium punctatum*, and the death watch beetle, *Xestobium rufovillosum*, complete their larval stages in appreciably shorter time due to higher temperatures.

Outdoor pests such as mosquitoes and flies are also likely to respond to changes in the climate, especially to temperature. Mohammed (2011) showed in the dengue mosquito, *Ae. aegypti* a near complete hatching after 48h at 24–25°C and 80% relative humidity, but the rate significantly declined as temperatures increased from 29°C to 35°C. Similarly, Hemme *et al.* (2009) reported the absence of *Ae. aegypti* matures in the containers in which water temperatures exceeded 32°C. The development time (from first instar to adult stage) for *Ae. aegypti* reared under the diurnal temperature regimen was 7–10 days at 25°C and 7–9 days at 30°C. At 35°C, the development time dropped to 6–7 days, showing that as temperatures increases, the mosquito development time is reduced (Mohammed 2011). Apart from development time, morphological characteristics such as size of wings in adults showed a strong

negative correlation with temperature suggesting a direct relationship between temperature and size of adults. So higher temperatures produced significantly smaller adults (Mohammed 2011). The same study also found a modification in the male to female sex ratio, with larvae reared at 33°C and 35°C producing M/F ratios of 0.9 and 0.79, respectively, which was significantly lower than the M/F ratios found at the lower temperatures.

There are number of similar studies on the effect of temperature on mosquito growth and development. The variation in the data is mostly in the strain of the insect selected and the geography of the test (Carrington 2013). The overall results suggest that as the climate changes, mosquitoes may become efficient vectors with an alteration in body size, have a change in sex ratio, and have a shortening of extrinsic incubation period for arbovirus development, plus may expand their geographic range. All of these parameters thus increase their propensity to affect humans.



Figure 2: Rains can also bring flooding indoors and will require pest intervention.

CLIMATE AND TEMPERATURE CHANGE ON QUALITY OF PESTICIDES AND PEST CONTROL

A change in climate will trigger changes in pest dynamics in urban areas, and some pests, if not most, will require an alteration in the existing pest management strategy. Pesticides are often the single most important management method in pest control. Urban pest control currently uses insecticides to prevent the impact of pests on humans but also to keep nuisance pests away from the vicinity. Pesticides are also incorporated in paints, furnishing, furniture, screens, and other household items to manage pests.

The efficacy of a pesticide is largely determined by its active ingredient. The active ingredient is usually formulated with other materials and this is the product as sold, but it may be further diluted for application. The formulation improves the properties

of the insecticide for handling, storage, application, and may substantially influence the effectiveness and safety of the product. However, various chemical and physical properties of insecticides such as stability, vaporization, penetration, activity, and degradation are dependent on temperatures at the time of use. A review of the literature shows that the effect of insecticides are more rapid on insects at higher temperatures, although they do not always show a linear relationship with temperature (Uddin & Ara 2006). Temperature has shown a positive effect on organochlorines, organophosphates and carbamates in general, but has shown negative effect on the pyrethroids (Uddin & Ara 2006; Weng & Shen 2007).

The effects of temperature on the efficacy of insecticides on various urban pest species is available, however, detailed analyses is lacking. A few studies have made an effort to evaluate the subject with relevance to climate change,

particularly against vectors. It is however considered that climate change and a rise in temperatures could significantly affect the efficacy of insecticides and alter the result of a pest control program. Temperature will influence storage, transportation, application and efficacy of most insecticides. The examples discussed below indicate that the temperature has significant synergic influence on the efficacy of insecticides against various urban pests.

COCKROACHES

Cockroach control in urban environment is the most common pest control activity throughout the world irrespective of geographical location. The proximity of the cockroach to food and its cryptic nature often requires careful application of insecticides. It has been shown that temperature can affect the toxicity of most insecticides (Rust

1995). Insecticide gel baits, which have grown popular in managing cockroaches, have shown variation in efficacy, dependent on storage temperatures. Oz *et al.* (2010) found that cockroach mortality was greater when the gels were stored at 30°C compared to at 23°C. The authors concluded that this is possibly due to the increased concentration of the active ingredients in the formulations, resulting from increased evaporation of the gel moisture at the higher temperature.

Surface sprays using pyrethroids are a common method used for cockroach control, and ambient temperature during the application, could influence efficacy of the insecticide. Toxicity of DDT and pyrethrins when applied topically, reduced with an increase in temperature (Guthrie 1950). The toxicity of two pyrethroid insecticides, S-bioallethrin and cypermethrin, was investigated over time at 12, 25 and 31°C



Figure 3: The efficacy of pesticides applied outdoors will be tested with an increase in temperature.

in susceptible and *kdr* insecticide resistant strains of *B. germanica* by Scott (1987). Both strains showed a greater kill with decreasing temperature for *S*-bioallethrin. The susceptible strain had a negative temperature coefficient for knockdown, but a positive temperature coefficient for mortality towards cypermethrin. The resistant strain had a negative temperature coefficient towards cypermethrin at all times. Resistance to *S*-bioallethrin was generally greatest at 25°C initially, although the difference between temperatures and the level of resistance diminished with time. Resistance to cypermethrin was significantly less at 12°C than at 25 or 31°C. A similar negative temperature coefficient of toxicity (greater toxicity at lower temperature) toward λ -cyhalothrin was observed for the Orlando but not the *kdr*-type resistant cockroaches (Valles *et al.* 1998).

Values of LC₅₀ were negatively related to temperature when ten different pyrethroids were tested by topical application of male German cockroaches, *B. germanica*. Temperature-toxicity responses of five of seven alpha-cyano pyrethroids were similar, possibly indicating qualitatively identical but quantitatively different levels of detoxification enzymes (Wadleigh *et al.* 1991).

FLIES

Worldwide, insecticides are used commonly to control house flies. Outdoor areas such as breeding sites and resting surfaces are sprayed with insecticides to manage fly population. Studies have shown that efficacy of insecticides could be affected by the prevailing environmental conditions, particularly temperature. Khan & Akram (2014) showed that within a temperature range of 20–34°C, the toxicity of chlorpyrifos, profenofos, emamectin, and fipronil increased with temperature. Whereas, the toxicities of cypermethrin, deltamethrin, and spinosad decreased, showing negative temperature coefficient.

TERMITES

Termites are mostly controlled by soil treatment and the performance of termiticide is dependent on a number of soil parameters, including moisture and temperature (Kamble & Saran 1995). The review of Wiltz (2012) clearly highlights the importance of temperature on the efficacy of soil termiticides. The review states that soil temperature affects termiticide

bioavailability through the influence on solubility and adsorption. Temperature also has an effect on the physical and chemical properties of the pesticide and the rate of microbial degradation. Several studies have demonstrated that temperature affects adsorption of pesticides to soil, but it is notable that the nature of this effect varies between pesticides. In general, termiticides will remain more efficacious and persistent in soils with low temperatures and low moisture contents. Warm soil temperatures and moist conditions can enhance the activity of insecticide-degrading microorganisms, thereby increasing degradation of the compound (Kamble & Saran 1995).

In addition to physical and chemical degradation of termiticides due to weathering and soil, certain biological functions with the active ingredient may also be influenced by temperature. Studies suggest that temperature is one of the key factors affecting the rate of uptake and subsequent horizontal transfer of [¹⁴C] Fipronil in *Reticulitermes flavipes* (Spomer *et al.* 2008). Non-repellent termiticides function by the principle of horizontal transfer and this study showed that the highest level of uptake occurred by termites held at 22 to 32°C, and decreased at lower temperatures.

MOSQUITOES

Insecticides evaluated against mosquitoes have shown a temperature dependent relationship. Das and Needham (1961) studied the effects of a change in temperature ranging between 15–28°C on the toxicity of DDT to larvae of *Ae aegypti*. An increase in temperature during exposure to DDT (0.02 ppm for about 1 hr) resulted in an increased toxic action. When larvae were left in the suspensions for the duration of the test (3 hr - 4 days), an increase in temperature throughout the test decreased the toxic action of a very low concentration of DDT (0.002 ppm), but had no effect with higher concentrations (0.1–0.2 ppm). Toxic action was greater in larvae held at a low temperature than in larvae held at a high temperature after treatment (0.025 ppm for 3 hr). However, such toxic action was reversible, a change from high to low temperature increased paralysis, and the larvae, paralyzed at a low temperature, recovered when the temperature was raised.

Temperature can also influence the resistance of mosquito larvae to insecticides. Karen *et al.* (2012) examined the effects of increasing

larval rearing temperatures on the resistance status of Trinidadian populations of *Ae. aegypti* to organophosphate (OP) insecticides. The study showed a positive association between resistance to OP insecticides and increased activities of α - and β -esterase in larval populations reared at $28 \pm 2^\circ\text{C}$. Although larval populations reared at higher temperatures showed variations in resistance to OPs, there was a general increase in susceptibility. However, increases or decreases in activity levels of enzymes did not always correspond to an increase or decrease in the proportion of resistant individuals reared at higher temperatures (Polson *et al.* 2012).

It is thus evident that populations of mosquitoes could only be classified as susceptible or resistant to a given chemical, depending on the temperature at which the mosquitoes were exposed. Glunt *et al.* 2014 in their research showed that lowering the exposure temperature from the laboratory standard 26°C , strongly reduced the susceptibility of female *Anopheles stephensi* to the WHO resistance-discriminating concentration of Malathion. The susceptibility of these mosquitoes to the resistance-discriminating concentration of permethrin was not as strongly temperature-dependent. For permethrin especially, the thermal history of the mosquito was important in determining the ultimate outcome of insecticide exposure for survival. This led the authors to conclude that investigations on the performance of insecticides under different temperature conditions is very important to better understand the epidemiological significance of insecticide resistance and for selecting the most effective products (Glunt *et al.* 2014).

CONCLUSION

Temperature, which is the primary indicator commonly used to determine climate change, has significant influence on pest biology and behaviour. Temperature also influences the efficacy of all pest control activities. The efficacy of an insecticides varies considerably depending on the method of usage, dosage, the application device, level of training of the operator, and the environmental conditions. All of these critical components, which are dependent on human input, can be modified and improved, except the environment. Although less is known how the environment can affect the quality of insecticides and their application, research is showing it has

significant impact, which has largely remained unaddressed (Glunt *et al.* 2014).

Pyrethroid and organophosphate insecticides are the most used insecticide classes in urban pest management. Both classes show sensitivity to temperature; pyrethroids have a negative and organophosphates, a positive temperature coefficient, respectively (Musser & Shelton 2005). However, some studies also revealed variation in the toxicity within a given insecticide class (Muturi *et al.* 2011; Scott 1995) between insect species and the temperature range tested (Muturi *et al.* 2011). Therefore, a generalization of the temperature-toxicity trend could be misleading within a given class, and for different insect species (Khan & Akram 2014).

In addition to the direct impact of temperature on the efficacy of insecticides, temperature can also influence a number of tools and methodologies which make use of insecticides, such as insecticide treated nets (ITN), long lasting insecticidal nets (LLIN), insecticide residual treatment (IRS), and odour-baited traps. It can be safely concluded that climate change and the resulting temperature changes will have profound influence on urban pests and their management. ■

This is an excerpt from the book, '*Climate Change Impacts on Urban Pests*' (2016), edited by Partho Dhang, CABI, UK.

Dr Partho Dhang is an Independent Consultant, Manila, Philippines.

REFERENCES

Carrington L.B., Armijos M.V., Lambrechts L., Barker C.M. & Scott T.W. (2013). Effects of fluctuating daily temperatures at critical thermal extremes on *Aedes aegypti* life-history traits. *PLoS One* **8**(3).

Child R.E. (2007). Insect damage as a function of climate. in Padfield, T. and Borchersen, K. (eds.) *Museum Microclimates*, National Museum of Denmark, pp 57-60.

Cox P.D. & Bell C.H. (1991). Biology and ecology of moth pests of stored foods. in Gorham, J.R. (ed) *Ecology and Management of Food Industry Pests, US Food and Drug Administration Technical Bulletin, N. 4*, 181-193.

Glunt K.D., Paaijmans K.P., Read A.F. & Thoma M.B. (2014). Environmental temperatures significantly change the impact of insecticides measured using WHOPES protocols. *Malaria Journal* **13**, 350.

Guthrie F. (1950). Effect of temperature on toxicity of certain organic insecticides. *Journal of Economic Entomology* **43**, 559-560.

Hawkins A.J. (1995). Effects of temperature change on ectotherm metabolism and evolution: Metabolic and physiological interrelations underlying the superiority of multi-locus heterozygotes in heterogeneous environments. *Journal Thermal Biology* **20**, 23-33.

Huey R.B. & Berrigan D. (2001). Temperature, demography, and ectotherm fitness. *American Naturalist* **158**, 204-210.

IPCC (2007). Climate Change 2007: Working Group II: Impacts, Adaptation and Vulnerability. Available at https://www.ipcc.ch/publications_and_data/ar4/wg2/en/ch6s6-es.html (Accessed 15th October, 2015).

Kamble S.T. & Saran R.K. (2005). Effect of concentration on the adsorption of three termiticides in soil. *Bulletin of Environmental Contamination and Toxicology* **75**, 1077- 1085.

Karen A.P., Brogdon W.G., Rawlins S.C. & Chadee D.D. (2012). Impact of environmental temperatures on resistance to organophosphate insecticides in *Aedes aegypti* from Trinidad. *Review of Panam Salud Publica* **32**, 212-214.

Khan H.A.A. & Akram W. (2014). The effect of temperature on the toxicity of insecticides against *Musca domestica* L.: implications for the effective management of diarrhea. *PLoS One* **9**.

Lee Jr R.E. (1991). Principles of insect low temperature tolerance. in Lee, R. (ed). *Insects at Low Temperature*. Springer US. pp 17-46.

Mohammed A. (2011). Effects of different temperature regimens on the development of *Aedes aegypti* (L.) (Diptera: Culicidae) mosquitoes. *Acta Tropica* **119**, 38-43.

Musser F.R. & Shelton A M. (2005). The influence of post-exposure temperature on the toxicity of insecticides to *Ostrinia nubilalis* (Lepidoptera: Crambidae). *Pest Management Science* **61**, 508-510.

Muturi E.J., Lampman R., Costanzo K. & Alto B.W. (2011). Effect of temperature and insecticide stress on life-history traits of *Culex restuans* and *Aedes albopictus* (Diptera: Culicidae). *Journal of Medical Entomology* **48**, 243-250.

Noland J.E., Lilly J.H. & Bauman C.A. (1949). A laboratory method for rearing cockroaches and its application for dietary studies on the German cockroach. *Annals of Entomological Society of America* **42**, 63-70.

Oz E., Cetin H., Cilek J.E., Deveci O. & Yanikoglu A. (2010). Effects of two temperature storage regimes on the efficacy of 3 commercial gel baits against the German cockroach, *Blattella germanica* L. (Dictyoptera: Blattellidae). *Iranian Journal of Public Health* **39**, 102-108.

Rust M.K. (1995). Factors affecting control with insecticides. in: Rust M.K., Owens J.M. & Reiersen D.A. *Understanding and controlling the German cockroach control*. Oxford University Press, USA, pp 149-170.

Scott J.G. (1987). Effect of temperature on the toxicity of S-bioallethrin and cypermethrin to susceptible and kdr-resistant strains of *Blattella germanica* (L.) (Dictyoptera: Blattellidae). *Bulletin of Entomological Research* **77**, 431-435.

Scott J.G. (1995). Effects of temperature on insecticides toxicity. in Roe, R.M., and Kuhr, R.J. (eds.), *Reviews in Pesticide Toxicology* **3**, 111-135.

Spomer N.A., Kamble S.T., Warriner R.A. & Davis R.W. (2008) Influence of temperature on rate of uptake and subsequent horizontal transfer of [¹⁴C]fipronil by eastern subterranean termites (Isoptera: Rhinotermitidae). *Journal of Economic Entomology* **10**, 902-908.

Uddin M.A. & Ara N. (2006). Temperature effect on the toxicity of six insecticides against red flour beetle, *Tribolium castaneum* (herbst). *Journal of Life Earth Science* **1**, 49-52.

Valles S.M., Sánchez-Arroyo H., Brenner R.J. & Koehler P.G. (1998). Temperature effects on λ-cyhalothrin toxicity in insecticide-susceptible and resistant German cockroaches (Dictyoptera: Blattellidae). *Florida Entomologist* **81**, 193.

Wadleigh R.W., Koehler P.G., Preisler H.K., Patterson R.S. & Robertson J.L. (1991). Effect of temperature on the toxicities of ten pyrethroids to German cockroach (Dictyoptera: Blattellidae). *Journal of Economic Entomology* **84**, 1433-1436.

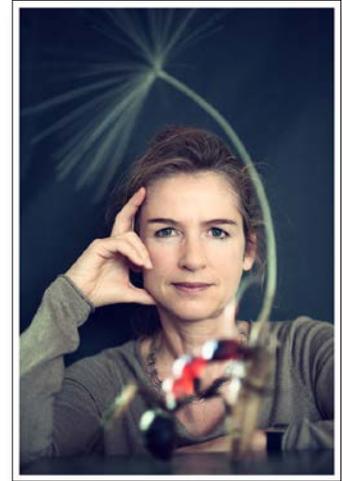
Wang X-Y. & Shen Z-R. (2007). Potency of some novel insecticides at various environmental temperatures on *Myzus persicae*. *Phytoparasitica* **35**, 414-422.

Wiltz B.A. (2010). Laboratory evaluation of effects of soil properties on termiticide performance against Formosan subterranean termites (Isoptera: Rhinotermitidae). *Sociobiology* **56**, 755-773.

Julia Stoess, Insect Model Maker *Par Excellence*

Insights from the most talented insect model maker in the world today (and possibly ever!)

Interview by Stephen L. Doggett



Julia Stoess hails from Hamburg in Germany and has the most unique skill; she produces the most extraordinary life-like models of insects. Julia is a costume designer who spent 15 years working in the TV and film industry before she gave all that up to work on her passion; insect models. Her work appears in museums and galleries all around the world. This interview focuses on Julia's career and her special skills.

***SLD:** Tell me a little about yourself and your path to producing insect models? Your dedication to your work suggests a great love of natural history. When did this passion start and how were you exposed to the natural world as a child? Why the love for insects?*

JS: I grew up in the countryside, 30 km from Hamburg and spent every free minute outside as a child. I always loved to watch animals, especially ants. For hours I would lay in a meadow or sat in front of an anthill and watched the bustle. So my fascination for these little animals and their hidden world began. Even today I love to sit in the middle of a meadow and just wait. At first it seems like nothing is there, but gradually you discover that all around you, pure life is raging: Sex and Crime and Rock'n Roll.

It may sound a bit strange, but to me these silent observations are not just meditative, but also spiritual. You are sitting there on the ground, and when you scratch a bit on the surface of the earth and realize that all which is now sediment once lived and that everything is subject to the eternal cycle of growth and decay, that this has something extremely reassuring and comforting. These are beautiful moments of experiencing the eternal cycle of creation. And a beautiful moment of acceptance, as far as one's own becoming and passing away are concerned.



Making a negative form of a mosquito wing.



Mosquito thorax.

My love for nature and especially for the insects, of course, has aroused the curiosity to learn more about these incredibly fascinating animals. The more I learned, the more fascinated I was about the abilities, survival strategies, shapes and colors of this group of animals.

As a teenager, I began to draw and model insects and spiders, but not yet with the goal of working scientifically.

After graduation I decided to turn my second passion into my profession: I studied Costume Design at the University of Applied Sciences (HAW) in Hamburg with the aim of becoming a costume designer for historical costumes.

After graduating, I worked for 15 years as a costume designer for film and television. In my free time, I continued to study insects.

At some point I had the ambition to make a scientifically accurate insect. It should be a rose beetle (*Cetonia aurata*). I bought a good binocular and modelled the beetle in a scale of 30:1. By coincidence at that time Hamburg ran an insect exhibition, where I could exhibit my beetle model.

When Dusseldorf Natural History Museum wanted to buy the model, I was surprised and happy at the same time.

Perhaps there is a need, I thought, and decided to visit the important natural history museums in Germany and to research if there were scientifically

accurate models of insects.

That was in 2000.

At that time, I did not have a computer, and research of any kind was still very difficult and time-consuming.

SLD: *While in Berlin around five years ago, I visited the Museum für Naturkunde (the Natural History Museum). In the museum there are many examples on display of the great insect model maker, Alfred Keller, who worked through the 1930s-50s. Our laboratory is also fortunate to own several of his models. Did Alfred Keller inspire you in any way and what did you learn from his work? [More of Alfred Keller's work can be seen at [https://en.wikipedia.org/wiki/Alfred_Keller_\(sculptor\)](https://en.wikipedia.org/wiki/Alfred_Keller_(sculptor))]*

JS: As part of this research, I also went to Berlin. I had heard of Alfred Keller, and it was a bit like a pilgrimage when I first wanted to look at his models in the original. Like you said: Alfred Keller worked as a taxidermist at the Museum of Natural History in Berlin from the 1930s to the 1950s and created many wonderful and unique insect models.

Considering the limited material and technical possibilities he has designed these highly detailed replicas with, he is indeed the pioneer of scientifically accurate insect modelling. He worked on a model for up to three years and set the bar for all successors with his work.

I was thrilled and at the same time inspired and motivated: Alfred Keller became my role model and master! My research also revealed that apart from the models of the late Alfred Keller there were very few good models of insects in the museums and there seemed to be an unoccupied niche.

SLD: *Why do you think the general public needs to see insects and how do you think your models will change the attitudes of people towards insects?*

JS: Insects and spiders – yuck! That's how many people react when you mention these creatures. The most successful of all animal groups has been judged, very unfairly, by the few "harmful" ones.



Maybug
Melolontha melolontha



Varroa mite



Tiger moth
Eilema pygmaeola

Asian tiger mosquito
Aedes albopictus



House fly
Musca domestica



Asian bush mosquito
Aedes japonicus

Most humans are not aware of and seldom appreciate the amazing ways of life, beautiful shapes and colours, as well as the huge importance of these creatures.

Insects and spiders are often very small and difficult to observe with the naked eye.

Who actually knows exactly what an ant or a mosquito looks like? Even though these are the little creatures we are surrounded by every day.

I have made it my job to recreate these fascinating creatures many times larger than life and faithful to the original. Museum visitors should have the opportunity to take an all-round look at a mosquito, for example, that has been enlarged 100x.

Sometimes I experience that a visitor of my exhibition comes to me and says: "These models opened my eyes. I did not know that these animals are so fascinating and beautiful."

If this happens I am happy that my work might make a small contribution to a better image of the insects and thus contribute to their protection.

SLD: *Do you think that it is coincident that the two greatest insect model makers are both German? Or is there something special in the German psyche that ensures a greater level of excellence? With companies like Zeiss, Mercedes, Porsche and BMW, Germany certainly has a history of quality!*

JS: Of course, this question is very flattering, but I would not classify myself and my work at the level of the companies mentioned. You could certainly write a thesis (and I bet there are many!) about the quality label "made in Germany" and the German psyche.

I can only say that I am patient, have a certain passion for what I do and like to get to the bottom of things. And these are of course many people of all nationalities. Maybe it's just the luck to have had the right idea at the right time. And if the external conditions are favourable, as in a country like Germany, it is certainly easier to establish a start-up, as in an unstable, less prosperous country.

There are so many incredibly talented people in the world who, unfortunately, for a variety of reasons, fail to develop. So I am all the more thankful that

my business idea of building enlarged scientifically accurate insect models for natural history museums has developed so well.



Mosquito model body parts.

SLD: *Can you describe the process of producing a model, from the beginning to the end? How do you ensure that the models are accurate?*

JS: My work is a mixture of high tech and old school handicraft. It is based on very precise studies, generally of living creatures.

A master model is generated with the assistance of Scanning Electron Micrographs (SEM) photos, extreme close-ups with focus stacking, MicroCT, and 3D printing, and this forms the basis for the modelling and casting work that follows.

After that come the finishing touches, such as colouring, or adding hair and scales to the model.

What is important during the whole design process is the associated communication with scientists and experts of the animal species to be recreated.

By working closely with entomologists, various research establishments, and the Center of Natural History in Hamburg (CENAK), I ensure that my models are scientifically accurate.

The careful selection of materials (resistant to ageing and to UV) is specially orientated towards use in permanent exhibitions in museums.

My aim is to produce a result that is as identical as

possible to the living creature.

The viewer should find it hard to distinguish between the model and the original, apart from the size, of course.

SLD: *How long does it take to produce one insect? Over this time, do you work on several models or just devote all your time to this one creature? Thus how many could you produce in a year? To what extent do modern computers and 3D printers make your work easier?*

JS: Making a model takes about 3 months at a minimum. Of course it depends on the species I create, if it has wings (which is very time consuming), or if it is covered with little scales like mosquitoes, or very hairy like bees. Also, the bigger the client wants a model, the more detail I have to consider, and the more expensive it is.

Because the demand is constantly growing, a few years ago I decided to start a cooperation with

my Danish colleague, Esben Horn, and his team, www.10tons.dk

This cooperation brings along a lot of inspiration and new ideas for projects and in addition supports our technical and artistic development.

Meanwhile, some of our models are produced by this kind of shared labour, so that each of us contributes his/her special talents and particular technical skills. In this way we can ensure that our customers always receive first class and lifelike models.

In addition, it is just more fun to work with dedicated and similarly passionate modelmakers.

SLD: *How much do the models cost?*

JS: The prices for one model vary between USD\$9,800 to \$38,900.



Putting scales and little hairs on a mosquito model.

SLD: *How do you decide on what to work on next? Is this from commissions?*

JS: Usually I get an order, mostly from a natural history museum. But sometimes I just feel like making something for which I do not yet have an assignment for. Right now for example, I am working on a metamorphosis of a butterfly. I create all stages: egg, caterpillar, pupa, and the adult butterfly. All 50 times enlarged and scientifically accurate. Although I do not have a client for this yet, I am sure that one will be found in the future.

SLD: *One of the many aspects that I admire about your work is that the insects appear alive; they are doing something and in the process some of their behaviour is captured. In my opinion, this sets your work way above anyone who has come before you. Is this a conscious decision and how do you decide which behaviour to capture?*

JS: My models should enable museum visitors to see the world of insects and spiders in a new light and, ideally, make people realize that these creatures are worth protecting.

Especially with the rather unpopular arthropods, the manner of presentation is a crucial tool for attracting the interest of the museum visitor and touching their emotions.

An aesthetic presentation, coupled with an appealing dramatic composition will attract the viewer to the cabinet, arouse their curiosity and better prepare them to get to grips with the creature on display, its way of life and its importance in the ecosystem.

What is particularly attractive is creating scenarios that tell little stories from the lives of arthropods.

That could be the last tenth of a second of a cockchafter before it flies away or the moment when spiders are mating just before the female kills the male.

As well as scientific accuracy, the special challenge of this enactment lies in capturing and depicting the movement and suspense of this moment.

SLD: *In taking so long to make the one model, does an affinity grow with the creature you are working on? I imagine at the end of the journey, it must be hard to part with something that you have put so much of your life, soul, and love into!*

JS: There are both sides, on the one hand, of course, I am happy when a model is ready and the customer is satisfied. If I then also see that the model is well staged and placed in the museum, I am happy.

Sometimes, especially when I sell a model as a unique piece, it hurts a bit when I have to give it away.

SLD: *Do you give the models special nicknames while working on them? (our Alfred Keller Anopheles mosquito model is affectionately called 'Anna'!) If so, what are some of the names?*

JS: Yes, I often do. For example, when my sister was pregnant with her first son Johan, I was working on my lacewing model, which I named Johanna.

SLD: *Many of your models depict arthropods of medical or economic importance such as mosquitoes, house flies, Varroa mite, urticarial (hairy) caterpillars, and ants. Are you especially interested in such groups, or is this more of a commercial reality as this is what museums are after for their displays?*

JS: In most cases, these are specific requests from museums for a specific type that is desired as a model. Often it is animals surrounding us in everyday life, which everyone knows and just does not know. Or animals that have any relevance to us humans, either positively, such as the honeybee, which supplies us with honey and incidentally works as a pollinator. Or negatively, as for example mosquitoes which can transmit diseases.

I prefer to model arthropods that I find particularly interesting and / or animals that I find particularly bizarre and beautiful.

In the near future, for example, I will design the model of a feather bird (*Pentadactyla pterohorus*). I fell in love with this magical insect when I first saw it in nature many years ago. I could not believe that this strange, beautiful creature lives here in our

immediate vicinity.

But I also find mosquitoes very fascinating.

SLD: *Where can people see your models?*

JS: My models can be seen in 45 Natural History museums in Europe and Canada and of course on my website: www.insect-models.com

SLD: *Do you have any plans to hold an exhibition of your work anywhere in the Asia-Pacific region?*

JS: I have plans to build up a new traveling exhibition with my models in the next few years.

SLD: *If any of our readers would like to commission a model, how do they contact you?*

JS: You are welcome to get in contact with me over my website or:

julia-stoess@insect-models.com

SLD: *Thank you Julia for the interview and your contribution in capturing the natural world so effectively and beautifully.*

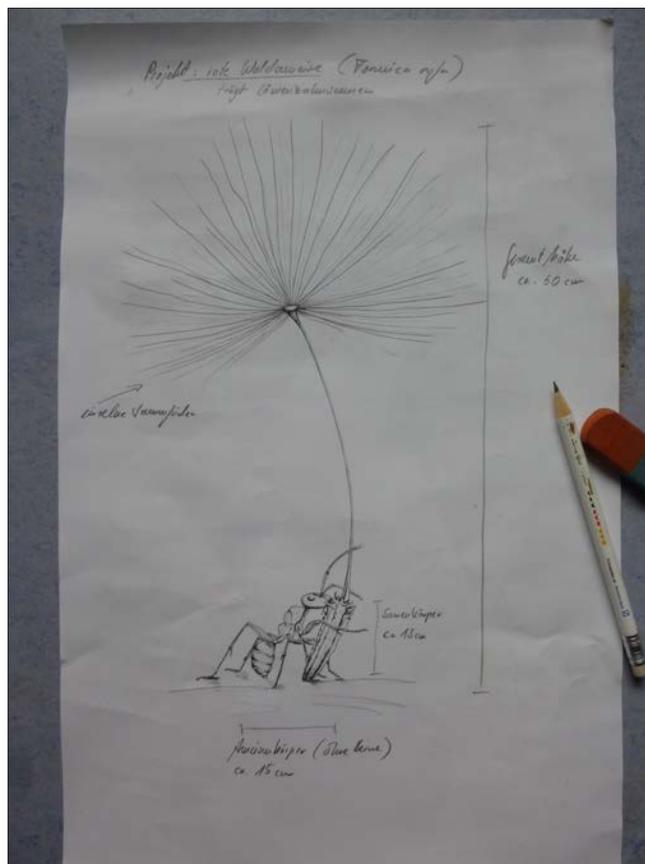
JS: Thank you very much for giving me a chance to talk about this fascinating subject and for presenting my work! My best personal regards, Julia. ■

All images provided by and copyright to Julia Stoess. See an interview with Julia at:

www.dailymotion.com/video/x5b08lc

plus more of her work at:

www.insektenmodelle.de/en/models.php



Project 'Red Wood Ant'. All models begin with a concept sketch.



The final model, many weeks later!

Broad body chaser
Libellula depressa



Ground beetle hunting snail

Tiger moth adult
Eliema pygmaeola



House fly
Musca domestica



Wasp spiders mating
Argiope bruennichi



The Role of Viruses in Fire Ant Management



Natural virus infections in fire ants hinder their control

Chin-Cheng Scotty Yang

Originating from South America, red imported fire ants (*Solenopsis invicta*, hereinafter referred to as 'fire ants') were accidentally introduced into the United States during the 1930s. Subsequently, they have expanded their territory to infest more than 15 states. Since 2000, fire ants have been reported in numerous countries including Australia, New Zealand, Taiwan, China, and more recently Japan and South Korea. As part of the rapid response to the fire ant invasion, the Japanese Ministry of the Environment in conjunction with the Japanese Pest Control Association, implemented a nationwide surveillance campaign using food lures in an attempt to determine the extent of the infestations. The results showed that most fire ant colonies are currently in port areas or in locations where cargo containers are unloaded, suggesting that the invasion of fire ants in Japan remains at a very early stage. However, the surveillance results may need to be interpreted with a degree of caution. The main reason is that conventional food lures may result in underestimating actual ant numbers due to a previously overlooked factor; a *virus*.

Prior knowledge of the food preference of a target pest ant plays a key role in determining the efficiency of the surveillance and control program. This is because dissimilar ant species possess different dietary requirements. Even for the same ant species, the food preference is governed by various factors including, colony status (e.g. the presence of queen or larva), nutritional requirements, nutrition history, and seasonal effects. Furthermore, the physical property of the food lure (and bait) such as the formulation (liquid, gel, paste,

or granule), and particle size, also has significant effects on the ants' foraging tendency. Historically, pathogen infection within ants has received limited attention regarding the potential impacts on the ant monitoring scheme. However, a recent study by Hsu and colleagues (2018) described how viral infections within fire ants affected their behaviour.

"...Virus infection in fire ants affect foraging behaviours... this can impact monitoring and control programs..."

Fire ants are a lipid-preferring ant species and food lures containing oil as the main macronutrient, from such sources as potato chips or hot dog slices, have been widely utilized as a field surveillance/monitoring attractant in the United States, Australia and other countries. Hsu and colleagues (2018) however, reported that virus-infected fire ant colonies display 1) a significantly reduced foraging intensity, 2) loss of interest in lipid-rich foods, and 3) an apparent shift in dietary preference to carbohydrate-rich foods. The observed virus-induced behavioral changes pose an immediate challenge to the existing lure-based monitoring system. This is because false negative results can arise from a reduced foraging response of fire ants to lipid-rich lures if the virus is prevalent in the colony. In other words, the absence of fire ants at a

lure station is not necessarily indicative of fire ants being absent. It could simply be a result of reduced foraging or alterations in food preference with the virus-infected fire ants.

The virus known as *Solenopsis invicta* virus 1 (or SINV-1) is a positive-sense, single-stranded RNA virus (such information is important taxonomically). Like its relatives infecting other arthropods, this virus is believed to persist in the host as a chronic infection that produces no symptoms. The virus can rapidly replicate and become deadly to its host when a colony is under some form of stress. A recent survey on the field prevalence of this virus showed that most of the recent infestations of fire ant (from California, Taiwan, and China) harbour high rates of SINV-1 infection.

Given that most fire ant colonies in Japan and South Korea originate via container traffic from China, the field viral prevalence of SINV-1 in China is then a critical issue. Thus the concern is that one should expect virus-infected fire ants would be common in Japan as SINV-1 prevalence in fire ants from China can be up to 70%. These infected fire ants may not respond to conventional food lures as expected with non-viral infected ant strains. This could mean that there could be a cryptic invasion of ants, despite an adequate surveillance effort. Hence, there is the possibility of an underestimation in the size of the fire ant infestation in Japan and South Korea, due to the reduced sensitivity of conventional food lures.

The use of low-toxic baits for fire ant control requires that the ants consume a sufficiently lethal quantity. The presence of the virus in the ant population can alter foraging behaviour and alter macronutrient preference. For example, virus-infected fire ants display less interest in conventional baits where soybean oil is impregnated as the phagostimulant

(a phagostimulant encourages feeding). As a result, a reduced bait intake will lead to lower control efficiency. Thus the virus can disrupt fire ant foraging and food preferences to prevent the consumption of a lethal dose of bait. In fact Tufts and colleagues (2014) reported that virus-infected fire ants are significantly less susceptible to two commercially available baits compared with non-infected ants.

Numerous researchers have demonstrated that the virus alone can impact fire ant populations and that integration of the virus as a biocontrol agent may be a promising option to manage invasive fire ants under area-wide management. The rationale behind the concept is to exploit possible synergetic effects of the bait and virus. However, we need to be cautious in case the opposite effect occurs. While no empirical study exists to date to characterize how and to what extent the virus would interfere in fire ant management, lessons can be learned from the current status of fire ants in Australia. Low-toxic bait has been the major control means in all recent fire ant infestations, including Australia, and interestingly control efficiency is remarkably better in Australia than in other nations. This may be attributable, at least partially, to the fact that the fire ant population in Australia is virus-free, where they are not elsewhere in the world. However, a more comprehensive comparative study is needed in fire ant populations across the world to confirm this.

The early detection of fire ants through monitoring by food lures and the use of low-toxic baits, are a top priority for countries that are attempting to prevent or slow the spread of fire ants. An understanding of the virus that affects these ants and how we could turn the virus into an ally may well be essential for future control programs. The first step toward successful fire ant eradication may lie in a redesign of the monitoring/management strategy especially when the virus is present. ■

Dr Chin-Cheng Scotty Yang is from the Research Institute for Sustainable Humano-sphere, Kyoto University, Japan.

Email: ccyang@rish.kyoto-u.ac.jp

References

Hsu H-W., Chiu M-C., Shoemaker D. & Yang C-C.S. 2018. Viral infections in fire ants lead to reduced foraging activity and dietary changes. *Scientific Reports* **8**, 13498.

Tufts D.M., Hunter W.B. & Bextine B. (2014). *Solenopsis invicta* Virus (SINV-1) infection and insecticide interactions in the red imported fire ant (Hymenoptera: Formicidae). *Florida Entomologist* **97**, 1251-1254.



A major worker, along with several minors, trying to break a mealworm into smaller pieces.

Walking Through the History of Termite Baiting

Baits are one of the mainstays of termite control today, but what is the origin of this technology?

G. Veera Singham



For more than 20 years, commercial termite baiting systems have been in the pest management industry targeting

subterranean termites. Although relatively a newcomer in the industry in managing pest termites, when compared to a long-standing approach using soil termiticides, termite baiting systems have rapidly becoming the greener choice in eliminating a subterranean termite infestation. Now let's take a look at the development of the baiting system, walking through the principles of termite baiting, the behaviour of termite foraging, and how this all happened and where it currently stands. Termite baiting systems are one of the best examples of how scientific input on termite biology and ecology, has led to the discovery of a simple but destructive technology in combating termite infestations.

THE TERMITES

Only 2.6% (79 species) of the 3,000 known termites are considered pests, and subterranean termites account for 83.5% of the pest species. This suggests two important points: 1) termites are mostly beneficial and only a handful of them are pests, and therefore 2) termite control strategies should be target specific towards the subterranean pest species without harming the non-targets. The termite baiting system fits this context ideally. Subterranean termites from the genus *Coptotermes* and *Reticulitermes*, particularly *C. formosanus*, *C. gestroi*, and *R. flavipes* are by far the most destructive and invasive pest termites in many regions worldwide. These species are responsible for 80%

of the global economic impact caused by termites amounting to annual cost of around US\$40 billion.

EARLY APPROACH TO SUBTERRANEAN TERMITE CONTROL (EARLY 1900S)

Subterranean termite control in the early 1900s is largely based on a non-targeted approach through broad applications of chemicals such as arsenic dust. This was initially thought to be transferable to nest mates via grooming, only later was found ineffective. The suggestion that the dust was transferable was an unfortunate shortcoming of the lack of information on the properties of arsenic dust. Arsenic dust is fast acting and mainly efficacious upon direct contact, with limited secondary transfer to effect a colony dramatically.

Since subterranean termite enters the house from the soil, some claimed that application of an insecticide to the soil subsurface should eradicate termites. This idea gained popularity among the termite control industry whereby the soil was injected with insecticides commonly available at the time such as sodium arsenate, sodium fluosilica, and orthodichlorobenzene. By the 1950s, these chemicals had switched to the chlorinated hydrocarbon pesticides such as DDT, dieldrin, chlordane, and aldrin. Chlordane later became the pesticide of choice owing to its efficacy, persistence, and regulatory approval for more than 30 years.



Reticulitermes sp. Photo credit: Katja Schulz, Rock Creek Park, Washington, DC, USA, published under [Creative Commons Licence](#).

SUPPRESSION VS ELIMINATION (1930S -1960S)

While soil termiticide treatments garnered widespread popularity in the termite control community, an independent group of scientists began to discover the structure and extent of termite underground galleries through extensive excavation projects during the 1930s – 1960s. Their discoveries led to the information that a termite nest was far extensive than previously believed and this challenged the perceived efficacy of soil termiticide treatments for eradicating termites. For instance, a partially excavated *C. formosanus* colony extended 50m and as removed at a depth of 30-300 cm. Surviving termite colonies of *C. formosanus* can continue to infest nearby untreated houses, which created an even heavier reliance on soil termiticide application (especially chlordane) as colonies were not eliminated. This was later regarded the main reason for the establishment and spread of this invasive species from four isolated port cities in the 1960s to the entire south-eastern USA by 2001 (Su 2003).

THE RISE OF BAITING SYSTEMS (1960S - 1970S)

As early approaches using soil termiticides only served as a temporary solution in suppressing termite colonies instead of targeting colony elimination, there was a need for a better alternative in controlling subterranean termite infestations. The concept of baiting exploits the natural food sharing behaviour in termites known as 'trophallaxis'.

To achieve colony elimination, a toxicant should be readily and effectively transferred to the majority of the termite colony. Transfer of the toxicant through food sharing would therefore be more effective in social insects, than via other means such as grooming, as was expected with arsenic dust. Learning from past mistakes, the bait toxicant has to be slow acting so that it can be spread by intoxicated foraging termites to nestmates over a distance.

The bait toxicant should also be non-repellent to allow foraging termites to continuously feed on the toxic bait to allow efficient transfer to colony

members. Mirex, a dechlorane impregnated wood, was among the first methods developed for baiting, during the 1960s. While Mirex successfully suppressed termite infestations as observed by decline in number of infested baits in treated plots, few monitoring bait stations remained active with termite infestations. Despite being slow acting and non-repellent, the ineffectiveness of Mirex baits in achieving colony elimination was not known at this point of time.

METABOLIC INHIBITORS AS BAIT TOXICANTS (1980S)

By the 1980s, laboratory studies had identified many other slow-acting, non-repellent toxicants such as hydramethylnon, avermectin, sulfuramid, and A-9248 that are classified as metabolic inhibitors. Despite higher efficiency, field trials with hydramethylnon, A9248, or sulfuramid, however, only resulted in the suppression of baited *C. formosanus* termites and even after a year of continuous baiting, no colony elimination was observed. This result resembled the Mirex studies. Su and colleauges (1995) later concluded that the failures were due to 'dose-dependent lethal time'.

DOSE-DEPENDENT LETHAL TIME

Despite being slow-acting (at a laboratory tested concentration) and non-repellent, lethal times

(the time required to kill a termite) for metabolic inhibitors depends on the dose ingested by the termites (i.e. individuals who ingest larger doses are killed faster and vice-versa). Toxicant concentration in baits can be made to be non-repellent (or acceptable) to termites, but the amount of bait consumed cannot be manipulated (Su 2019). As such, individuals consuming a large quantity of these metabolic inhibitors may have been killed too quickly to satisfy the slow-acting requirement for colony elimination.

CHITIN SYNTHESIS INHIBITORS (1990S)

Lessons learned, the focus shifted in finding bait toxicants that are 'lethal time dose independent', while being slow acting and non-repellent at the same time. Insect growth regulators (IGR) offered this solution. Chitin-synthesis inhibitors (CSI) are a type of IGR that interrupts the termite moulting process. Termites ingesting a lethal dose are not affected until onset of ecdysis (moulting) and this time can be as long as 45 days (the 'intermoult' time) for *C. formosanus*. This time duration is long enough for the majority of foragers to feed directly on baits and to distribute the CSI to nestmates. Su and Scheffran (1993) reported the potential of a CSI, hexaflumuron, as a bait toxicant, and after several months baiting, all baited colonies were successfully eliminated (Su 1994). This marked the development of the first successful commercial termite bait using a CSI in achieving termite colony elimination.



Reticulitermes flavipes. Photo credit: Judy Gallagher, Julie Metz Wetlands, Woodbridge, Virginia, USA, published under [Creative Commons License](#).

WHY ARE CSIs THE MOST SUCCESSFUL INSECTICIDES FOR COLONY ELIMINATION?

CSIs satisfy the three attributes of an effective bait system: 1) slow-acting, 2) non-repellent, and 3) lethal-dose independent. Most importantly, a recent discovery found that termite workers move back to the central nest in order to moult. Hence, CSIs affected termites dying in the royal chamber would induce the royal pair to move away from cadavers, only to be surrounded by another group of CSIs affected

termites and subsequent cadavers. This forces royal pairs moving again and again until the entire colony collapses (Kakkar *et al.* 2018). This feature is unique to CSIs and explains why baits using these compounds have proven successful in eliminating termite colonies.

COMMERCIAL BAITS AND EVOLVING TECHNOLOGY

The 'dual step' monitoring-baiting protocol was adopted by the Sentricon system, which was first commercialized in 1995. Using an evaluation protocol developed by Lai (1977), during 1995-2003, 34 field studies were undertaken with hexaflumuron and 96% (158 of 165) of colonies baited were eliminated. This covered 13 species of subterranean termites in the USA and seven other countries (Su 2003, Su 2019).

Early termite bait products contained metabolic inhibitors such as sulfuramid (FirstLine) and hydramethylnon (Subterfuge). Currently, only CSIs are used in commercial baits in the USA, including noviflumuron (Sentricon), diflubenzuron (Advance, Isophthor), hexaflumuron (Shatter, Terminate), and novaluron (Trelona). In Australia and Asia, CSIs baits that uses hexaflumuron (Sentricon), chlorfluazuron (Exterra), and bistrifluron (Xterm) are available. Initially in the form of in-ground bait stations, above ground bait stations are also commercially available for use indoors. More durable baits such as Sentricon Recruit HD and Trelona ATBS have been formulated with the former displayed a very long-lasting active ingredient in the bait matrix, which can be placed in the soil for at least five years (Eger *et al.* 2014). This technology was created to bypass the monitoring step in the conventional baiting approach.

THE FUTURE OF BAITING SYSTEMS

Baiting systems are undoubtedly one of the greenest solutions in eliminating subterranean termite infestations. While the conventional termite management business model protects a house within the contract, control efforts do not extend beyond the property boundary. Area wide management of insect pests are deemed more efficient than site specific efforts, but often disregarded especially due to the feasibility and high cost associated in conducting the project.

Future business models should incorporate joint efforts from private and public sectors in targeting wide scale approach of termite management. Baiting systems also face challenges in terms of time taken to achieve colony elimination due to the slow acting properties of CSIs. This may be overcome by increasing the number and/or size

of baits stations, as well as by using attractants to reduce the interception time. Phagostimulants may be incorporated to shorten bait toxicant acquisition time, whereas moult-accelerating active substances such as ecdysteroids and ecdysone agonists, can be used to speed up the elimination process. ■

*A more comprehensive review of this topic can be read from: Su N-Y. (2019). Development of baits for population management of subterranean termites. *Annual Reviews of Entomology* **64**, 7.1-7.16.

G. Veera Singham is the Principal Research Scientist and Senior Lecturer at Centre for Chemical Biology, Universiti Sains Malaysia, Penang, Malaysia.

Email: veerasingham@usm.my

REFERENCES

- Eger JE, Hamm RL, DeMark JJ, Chin-Heady E, Tolley MP, *et al.* (2014). Durability of a novel durable bait for control of subterranean termites (Isoptera: Rhinotermitidae): results of five-year field aging studies. *Journal of Economic Entomology* **107**, 1201–5.
- Kakkar G, Osbrink W & Su N-Y. (2018). Molting site fidelity accounts for colony elimination of the Formosan subterranean termites (Isoptera: Rhinotermitidae) by chitin synthesis inhibitor baits. *Science Reports* **8**, 1259.
- Lai PY. (1977). Biology and ecology of the Formosan subterranean termite, *Coptotermes formosanus*, and its susceptibility to the entomogenous fungi, *Beauveria bassiana* and *Metarrhizium anisopliae*. PhD, dissertation, University of Hawaii, Honolulu.
- Su N-Y. (2003). Overview of the global distribution and control of the Formosan subterranean termite. *Sociobiology* **41**, 7–16.
- Su N-Y, Scheffrahn RH & Ban PM. (1995). Effects of sulfluramid-treated bait blocks on field colonies of the Formosan subterranean termite (Isoptera: Rhinotermitidae). *Journal of Economic Entomology* **88**, 1343–48.
- Su N-Y & Scheffrahn RH. (1993). Laboratory evaluation of two chitin synthesis inhibitors, hexaflumuron and diflubenzuron, as bait toxicants against Formosan and eastern subterranean termites (Isoptera: Rhinotermitidae). *Journal of Economic Entomology* **86**, 1453–57.
- Su N-Y. (1994). Field evaluation of a hexaflumuron bait for population suppression of subterranean termites (Isoptera: Rhinotermitidae). *Journal of Economic Entomology* **87**, 389–97.



The FAOPMA-Pest Summit History – the Long Journey of Integration

Read how the world's largest pest association was formed

Raymond Lee

The Federation of Asian and Oceania Pest Managers' Association (FAOPMA) has a long 29 years of running international conventions. While for the PEST SUMMIT Alliance (comprising the South East Asian nations of Thailand, Singapore, Malaysia, Indonesia, and Philippines), there have been seven highly successful Pest Summit conventions in the past. By merging both, member countries can now speak and represent the pest management industry in Asia and Oceania as ONE VOICE.

The role of FAOPMA is to promote and develop the professional pest management industry throughout the regions in the Asia-Oceanic territories. The most effective way to promote this with **ONE VOICE**



is through the gathering of the best people and brands in the industry as a way of sharing the latest technological products, techniques, methods of pest treatments, exchange of information, sharing of knowledge and experience regarding specific issues in the region. Thus the annual FAOPMA-Pest Summit convention is is the most important event of the year that is hosted in the region. This extraordinary convention is now a yearly event and is tailor-made for the pest management business owner and their staff; chemical and equipment providers; food-processing industry personnel and their staff, QC/QA personnel, and other related businesses.

As President Huang Xiaoyun (President of FAOPMA) has rightly pointed out recently, the annual FAOPMA-Pest Summit convention is part of the efforts in building a platform to cooperate and work with one another. The goal of this platform is for our industry to interact, to understand and learn from one another. This platform brings new ways of thinking, innovative ideas and cutting-edge technologies, and research to everyone in the region. This will create synergies enabling the industry to rise to a higher level. The annual convention should also serve as a forum in which we can all come together to cement old friendships, to form new alliances, and to develop productive networks for mutual corporation.



The signing of the Memorandum of Agreement. All the five Presidents of the Pest Summit Alliance and Dr Raymond Lee (Hon. Secretary FAOPMA) were present, and was witnessed by the Pest Summit advisors, Prof Chow-Yang Lee (Malaysia), Mr John Ho-O’Hara (Singapore), and Mr Su-Chart Lee (Thailand).

The Journey of Integration Begins...

My first recollection of the process towards the integration of the two great Pest Management Associations in Asia was initiated in 2012 at the Adelaide Convention Centre, Australia. This was proposed by Mr Junichuro Katayama (Hon Treasurer, FAOPMA), together with Ms. Catherine Yan (FAOPMA, Hong Kong Secretariat), Mrs. Deanne Ong (EMAS, Singapore), and Mr Andrew Chan (SPMA, Singapore). This casual meeting of FAOPMA officials was later discussed with the conveners of the 2015 Pest Summit Alliance, notably Mr John Ho-O’Hara (Singapore), Mr Su-Chart Lee (Thailand), and Prof Chow-Yang Lee (Malaysia), in Bangkok (February, 2016).

The discussions focused on the possible routes that would make integration a reality, which would be for the common good for the future of the Pest management industry in the Asia-Oceanic region. Some of the outcomes from the discussion included the amendments to the FAOPMA Constitution to suit the country membership criteria with more than one Association and alternative representation to include voting rights for the Pest-Summit Alliance.

Subsequently, the FAOPMA Executive Committee met in Hangzhou, China in March 2016 and acceded to some of the discussion points raised by the Pest Summit Alliance with the goal to achieve a win-

win situation and ultimately for the FAOPMA and Pest Summit integration to become a reality. It was agreed then by FAOPMA that a Final Meeting was to be held in Singapore during Pest Summit 2016. The Memorandum of agreement (MOA) was drafted by Prof Chow-Yang Lee and signed by all the five Presidents of the Pest Summit Alliance to commemorate the success of the FAOPMA and Pest Summit Integration.

It was mutually agreed by all that the Main Objective of the integration of FAOPMA and Pest Summit Alliance was; ONE VOICE for the Pest management industry in the Asia Oceania Region. It was a joyous occasion to be able to personally witness the signing of the Agreement in Singapore. August 18, 2016 was a very special day and one to remember! The many years of hard work and discussions had finally cumulated in the integration of FAOPMA and Pest Summit alliance, with the following benefits:

- (a) Major sponsors had been under stress to sponsor both FAOPMA and Pest Summit for a similar kind of event every year. With two organizations merging, both FAOPMA and Pest Summit will have a louder voice to attract a bigger audience and more sponsorship.
- (b) FAOPMA agreed that after the integration of both FAOPMA and Pest Summit – the united organization would become stronger.



Historic occasion in Singapore for the Asian Pest Management industry with the signing of the MOA officially signifying the FAOPMA and Pest Summit Integration.

(c) It is expected that with the success of the integration of FAOPMA-Pest Summit this will set the pace for future conventions and meetings.

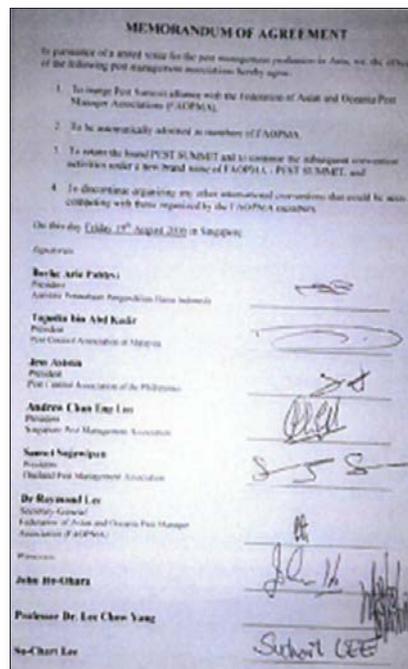
With the official signing of the Memorandum of Agreement (MOA), the FAOPMA and Pest Summit Integration has enabled a greater collaboration, more coordination, and a stronger working relationship among the Asia and the Oceanic Pest Management Associations.

At the signing ceremony of the Memorandum of Agreement in pursuance of ONE UNITED VOICE for the pest management industry in Asia, all five Presidents of the Pest Summit Alliance signed, along with myself (Dr Raymond Lee, FAOPMA Secretary), signing on behalf of FAOPMA. The occasion was witnessed by Prof Chow-Yang Lee (Malaysia), Mr John O'Hara (Singapore), and Mr Su-Chart Lee (Thailand). It was also agreed that the Pest Summit Alliance will no longer hold international conventions that could compete with those organised by FAOPMA members. It was encouraging to note that all the Pest Summit Alliance members joined FAOPMA as members.

With the success of the FAOPMA and Pest Summit integration, we can now look forward to a greater direction for the Pest Management industry to the future. Allow me to paraphrase the wise comment of Huang Xiaoyun (President of FAOPMA), while we all understood the important role that cooperation played in the past, such as the integration of

FAOPMA and Pest Summit, it is ever more imperative moving forward. The effort and success of the integration can be attributed to the teamwork from both organizations, and a special acknowledgement is given to all those that helped the merger.

Dr Raymond Lee is the Honorary Secretary, Federation of Asian and Oceania Pest Management Association (FAOPMA), Room 901, 18 Hysan Avenue, Causeway Bay, Hong Kong.
Email: raylee@pc.jaring.asia



Innovations in the Management of Sewer and Fruit Flies



This is a summary of the presentation delivered at the Singapore Pest Management Forum 2019 held at Orchid Country Club, Singapore

Chong Chin Heo

Flies, which are or scientifically known as 'Diptera' (Greek: Di means two while ptera means wings) are important players in the ecosystem, either as pollinators or nutrient recyclers. Examples of Diptera include mosquitoes, sewer flies, fruit flies, black flies, sand flies, blow flies, house flies, and biting midges. The members of Diptera have what is termed a 'complete' life cycle (also called 'holometabolous'), which indicates the presence of pupal stage in their development, as well a worm-like larvae (or grub) that is very different in appearance to the adult.

Another important characteristic of Diptera is the presence of halteres, which are reduced hind wings (due to evolution) and are used as balancing organs during flight. It is also well known that some Diptera species (e.g. *Anopheles* and *Aedes* mosquitoes) transmit deadly diseases such as malaria and dengue, which are especially common in the tropics.

Sewer Flies

Sewer flies are also known as 'drain' flies or 'moth' flies (see Fact Sheet on Moth flies from last issue of the FAOPMA Magazine). They belong to the family

Psychodidae. The adults are generally harmless but can cause annoyance. The larval stage contains four instar (stages) and last between 9 to 15 days depending on the species and surrounding temperature. The larvae feed on algae, fungi, and bacteria in sewage and organic sludge. The pupal stage does not feed and lasts between 20 to 40 hours and remains submerged near the water surface. After eclosion (adults emerging from the pupal stage), the adults are often found around sewage treatment plants and public washrooms. The adults are weak fliers, only covering few meters at a time. They feed in polluted water and on flower nectars.

A hospital in Germany was infested by sewer flies, *Clogmia albipunctata*, where they were found in shower and rest rooms in patient wards, cellar storage rooms, and restrooms in hospital kitchens. Further investigations revealed the preferred breeding sites included hair-clogged sinks in patient shower cubicles, toilets and urinals that were seldomly used, as well as water sources stemming from neglected leaking pipes (Faulde & Spiesberger 2012).

The same researchers also conducted another study



Sewer (moth) fly, *Clogmia* sp. ~3mm in length

on the possible roles of moth flies as mechanical vectors of bacterial pathogens in the hospitals. Among 271 *C. albipunctata* adults collected, 45 species bacterial species from 40 genera were isolated and identified, these included *Acinetobacter baumannii*, *Aeromonas hydrophila*, *Bacillus cereus*, *Escherichia coli*, *Klebsiella pneumoniae*, and *Pseudomonas aeruginosa*. The authors concluded that sewer flies are potential mechanical vectors of bacterial pathogens associated with nosocomial infections (i.e. hospital-acquired infections) (Faulde & Spiesberger 2013).

Other than infestations within buildings, a case of intestinal myiasis (i.e. infestation of live fly larvae in living tissues) has been reported in a 41-year-old female Malaysian patient by larvae of *C. albipunctata*. The larvae were passed out in the patient's faeces and the species were confirmed by a modern molecular bases test known as DNA barcoding (Mokhtar *et al.* 2016). Note that it is possible that environmental contamination could take place when sewer fly larvae are recovered from

faeces collected in toilet bowls or from the floor.

Fruit Flies

Fruit flies (Diptera: Drosophilidae) are also called 'vinegar' flies or 'pomace' flies. This family consists of approximately 4,000 species and around 80 genera. These should not be confused with another group of fruit flies which is placed under the family Tephritidae, which contain many species of economic important as they attack fruit yet to be harvested (Tephritidae can be differentiated from the family Drosophilidae by having distinct wing patterns such as stripes or spots).

The drosophilid fruit flies are relatively small in size, between 2.5-4.5 mm. The eyes of the adults are usually red,

and they are frequently found around decaying vegetation and fruits. These fruit flies are primarily nuisance pests and have been incriminated as mechanical vectors to contaminate food with bacteria and other pathogenic organisms (Ramirez-Camejo *et al.* 2017; Black *et al.* 2018; see also the story from the last issue of the FAOPMA Magazine by Lilly & Barcay).

Fruit flies have been reported as the causative agents in myiasis cases. One case from Turkey reported a human nasal myiasis by *Drosophila melanogaster* larvae in a 33-year-old man (Aydin *et al.* 2006). Another case was reported in a female neonate (new born) who experienced swelling and reddening around the right eye. The neonate was then admitted to the hospital and within 6 hours of admission, movement was noted in the pustules at the periorbital skin and 46 larvae between 3-4 mm long were seen and removed from the pustules. The larvae were subsequently identified as *Drosophila* based on morphological characteristics. In this case,

the presentation of myiasis resembled that of sepsis and fortunately, the baby was discharged in good health after four days in hospital (Clark *et al.* 1982).

Classical Control Methods

Considering the health impacts attributed by sewer and fruit flies in the urban environment, it is necessary to control and manage their population to ensure human safety and hygiene. The classical control methods for sewer flies are (i) elimination of breeding sites (e.g. bathroom drains); (ii) cleaning of pipes and traps to remove accumulated slime; (iii) remove the organic film within the drain by hard bristle brushes and drain cleaners; (iv) using mesh screen that is placed over building openings including air vents, and ensuring that all windows should be screened; (v) lights should be placed away from doors or other building openings to reduce fly access to the interior of building; (vi) chemical control is considered to deliver only a temporary relief unless larval breeding sites are located and removed; (vii) application of non-residual chemicals such as pyrethrin. These can be formulated as ultra-low volume (ULV) fogs or space sprays and may provide immediate control of adult flies. However for long-term control, insecticide applications should be combined with the removal of larval development sites. Insecticides may also be utilized when the flies are produced off-site or larval development sites cannot be eliminated. In these cases, treatment with a residual pesticide applied to resting surfaces may provide some immediate effect. The insect growth regulator (e.g. methoprene) can be used in wastewater treatment facilities (as long as it is registered in the country intended for use).

The principal control for fruit flies is sanitation. This includes (i) elimination of larval food and development sites; (ii) keeping fruit in the refrigerator; (iii) rinsing and draining bottles and cans that are to be recycled; (iv) using a baited trap (e.g. yeast, juice or rotting fruit, apple cider vinegar); (v) windows and doors should be equipped with tight-fitting screens; (vi) in fruit farms, fruit fly traps such containing an attractant lure such as methyl eugenol can be used; (vii) hydroprene can be applied to potential fruit fly breeding sites to prevent the development of adult fruit flies; (viii) using a pyrethrin spray or aerosol to knock down adult fruit flies for immediate control; (ix) liquid residual of cyfluthrin can be applied to exposed surfaces, and (x) the use of commercial sticky traps.

Innovations

Although classical controls are usual practices within the pest control industry, utility innovations are needed to improve efficacy in the control and management of these pest insects. One interesting study by Cai and colleagues (2019) showed that protein bait derived from spent brewer's



Fruit fly, *Drosophila* sp. ~2mm in length

yeast is much more attractive than traditional baits for the spotted-winged fruit fly, *Drosophila suzukii*, a major pest of soft-skinned fruits such as strawberries, blackberries, and blueberries. The results showed that this protein bait capturing significantly more female and male adults than the other baits. Moreover, the protein bait with 20% vinegar added attracted significantly more adult flies than other baits. However, when combined with a 0.05% concentration of the insecticide spinosad (originally derived from soil bacteria) the insecticide reduced its attractiveness to adult flies. The authors concluded that spent brewery yeast could be a promising alternative candidate in fruit fly monitoring and management and could serve as a novel component in integrated pest management.

Artificial sweeteners, or sugar substitutes, are chemicals added to some food and beverages to make them taste sweet without the negative side effects (e.g. hyperglycaemia in diabetic patients and less calories). O'Donnell and colleagues (2016) found an artificial sweetener, particularly erythritol, was toxic when ingested by fruit flies, *D. melanogaster*. Results demonstrated that the adult fruit flies when fed on erythritol had reduced longevity compared to the controls. Other sugar compounds did not reduce longevity. In addition, D-mannitol was found to weaken and reduce female (but not male) longevity significantly when fed to adult flies. One may worry if artificial sweeteners are safe for human consumption when looking at the toxic effects on insects! However, according to the authors, all compounds tested have been vetted to be human-safe, thus, excessive worrying about its safety for human consumption is not necessary.

Interestingly, another study was published during the following year (2017) that investigated the survival of the house fly (Diptera: Muscidae) on Truvia, a brand of stevia-based sugar substitute, and survival was reduced when the flies fed on this compound. The data showed that house flies may prefer a high calorie diet when given a choice and that house fly longevity likely increases as calorie content increases. Furthermore, no significant differences in longevity were observed between the water only control (zero calories) and erythritol treatments (this is in contrast with fruit flies where erythritol has a significant impact on *Drosophila* survival). This suggests that decreased survival

rates and death could be the result of starvation rather than any possible insecticidal activity (Fisher *et al.* 2017). In other words, the house flies are not poisoned by sweeteners, but they die of malnutrition.

We know that insects such as fruit flies are naturally attracted to sugar (i.e. the energy source), be it natural or artificial sugars. A group of researchers found that by adding sucrose to insecticides, the mortality of *D. suzukii* was enhanced in the laboratory and in semi-field and field tests. In the laboratory, 0.1% sucrose added to an insecticidal spray solution enhanced *Drosophila* feeding. Flies died 120 min earlier when exposed to spinosad residues enhanced with sucrose. The authors suggested that this works because the sucrose acts as a phagostimulant (a substance that encourages feeding). Because of this, flies are attracted to the insecticide and as a consequence, they ingested more of the poison, making the spinosad (the active ingredient of the insecticide) more effective. In fact, the researchers found similar results when sucrose was added to other pesticides. Thinking about future developments, the next question to ask is whether artificial sweeteners could be added to insecticides to achieve similar outcomes?

Moving Forward

Innovation in the management of sewer and fruit flies can be in the form of chemical (organic or inorganic pesticides), physical/mechanical (traps), biological (new predators, endosymbionts or parasites), genetics (gene modification), ecological (behavioural modification), and environmental manipulation (elimination of breeding habitats). In addition, innovation can be targeted towards the specific developmental stage of the flies (eggs, larvae, pupae, or adults). Here are some examples of innovations that can be developed for future use: (i) sticky traps combined with fruit fly-preferred colour and scents; (ii) a device that combines movement, light refraction, ultrasounds, and smell to expel adult fruit flies; (iii) an automatic adult fly catcher equipped with a timer and a vacuum; (iv) laser technology combined with an ultrasound detector to detect the location of a flying insect (e.g. a house fly) by detecting its wing beat frequency and then shooting it with a beam of laser light. The objective

is not to kill but to expel the adult fly from entering the building. Thus, these laser devices should be installed at the entrance of a building.

With the advent of unmanned aerial vehicles (e.g. drones), it is possible to install an insecticide sprayer on a drone to perform targeted aerial spray at difficult-to-access areas such as on rooftops or to trees. Furthermore, the on-the-drone insecticide sprayer can be interchanged for a smoke emitter or hot-air emitter, depending on the targeted insect species (in the case of honey bee or hornet nest colonization). Most importantly, an online platform should be made available for all pest control operators to contribute data on pest infestation problems (e.g. pest species identification and distribution, severity of infestation, insecticide used, resistance status, the prevention and control measures taken, results, analyses, and a discussion on future implementation) in the particular areas they are treating. The overall data could be useful for better understanding of the complete problem and provide possible solutions through discussion and collaborations among pest control practitioners, researchers, and academics.

Summary and Conclusion

Sanitation and the elimination of breeding sites is the principal rule in the management of sewer and fruit flies. For pest control operators, there is a need to diversify and integrate multiple control measures for each targeted species and all its life stages. For University or R&D researchers, continuous research and innovations must carry on to determine the best method or practice in the detection, monitoring, control and management of sewer and fruit flies. Last but not least, human beings should have a holistic view on the roles that insects play in the ecosystem (i.e. not to see all insects as pests and killing all of them). By understanding the ecology and behaviours of insects, then only then can we manage pest insects. ■

Dr Chong-Chin Heo is a Senior Lecturer of Entomology at the Universiti Teknologi MARA, Malaysia. For more information on his latest contact address and published work, please visit: <https://heochongchin.weebly.com/>

References

- Aydin E., Uysal S., Akkuzu B. & Can F. (2006). Nasal myiasis by fruit fly larvae: a case report. *European Archives of Oto-Rhino-Laryngology and Head & Neck* **263**, 1142-1143.
- Black E.P., Hinrichs G.J., Barcay S.J. & Gardner D.B. (2018). Fruit flies as potential vectors of foodborne illness. *Journal of Food Protection* **81**, 509-514.
- Cai P., Yi C., Zhang Q., Zhang H., Lin J., Song X., et al. (2018). Evaluation of protein bait manufactured from brewery yeast waste for controlling *Drosophila suzukii* (Diptera: Drosophilidae). *Journal of Economic Entomology* **112**, 226-235.
- Clark J.M., Weeks W.R. & Tatton J. (1982). *Drosophila* myiasis mimicking sepsis in a newborn. *Western Journal of Medicine* **136**, 443.
- Faulde M. & Spiesberger M. (2012). Hospital infestations by the moth fly, *Clogmia albipunctata* (Diptera: Psychodinae), in Germany. *Journal of Hospital Infection* **81**, 134-136.
- Faulde M. & Spiesberger M. (2013). Role of the moth fly *Clogmia albipunctata* (Diptera: Psychodinae) as a mechanical vector of bacterial pathogens in German hospitals. *Journal of Hospital Infection* **83**, 51-60.
- Fisher M.L., Fowler F.E., Denning S.S. & Watson D.W. (2017). Survival of the house fly (Diptera: Muscidae) on Truvia and other sweeteners. *Journal of Medical Entomology* **54**, 999-1005.
- Mokhtar A.S., Braima K.A., Chin H.P., et al. (2016). Intestinal myiasis in a Malaysian patient caused by larvae of *Clogmia albipunctatus* (Diptera: Psychodidae). *Journal of Medical Entomology* **53**, 957-960.
- O'Donnell S., Baudier K. & Marena DR. (2016). Non-nutritive polyol sweeteners differ in insecticidal activity when ingested by adult *Drosophila melanogaster* (Diptera: Drosophilidae). *Journal of Insect Science* **16**, 47.
- Ramírez-Camejo L.A., Maldonado-Morales G. & Bayman P. (2017). Differential microbial diversity in *Drosophila melanogaster*: are fruit flies potential vectors of opportunistic pathogens? *International Journal of Microbiology* **2017**, 8526385.

Active Insight: Pyrethroid Mode of Action

In this series, the chemistry of major insecticide groups will be examined

Steve Broadbent



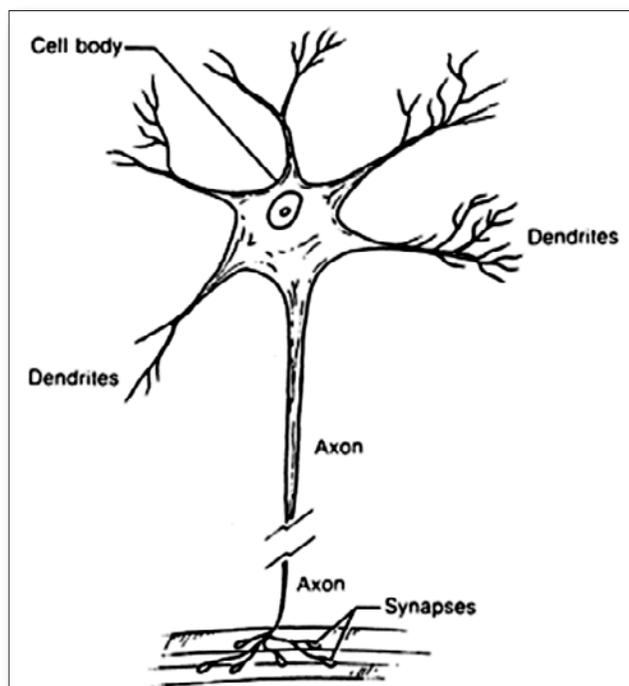
To understand how the pyrethroids kill insects we need a basic understanding of the insect nervous system.

The nerve cell or neuron consists of a cell body from which processes called dendrites spread, like the branches of a tree. In addition to the dendrites, there is the axon, which is like a long, thin wire, also ending in treelike branches. At the ends of the axon, the branches end in small bulblets. The bulblets of one neuron approach close to the dendrites of the next neuron, almost touching them. This point of near contact is called a synapse.

Each neuron receives an impulse which it passes on to the next neuron. Through a chain of chemical reactions, the dendrites pick up an impulse that is then transmitted along the axon as an electrical impulse, before being transmitted to the next neuron as another chemical reaction. The entire impulse passes through the neuron in about seven milliseconds — faster than a lightning strike!

Pyrethroids interrupt this process when the message is travelling along the axon as an electrical impulse.

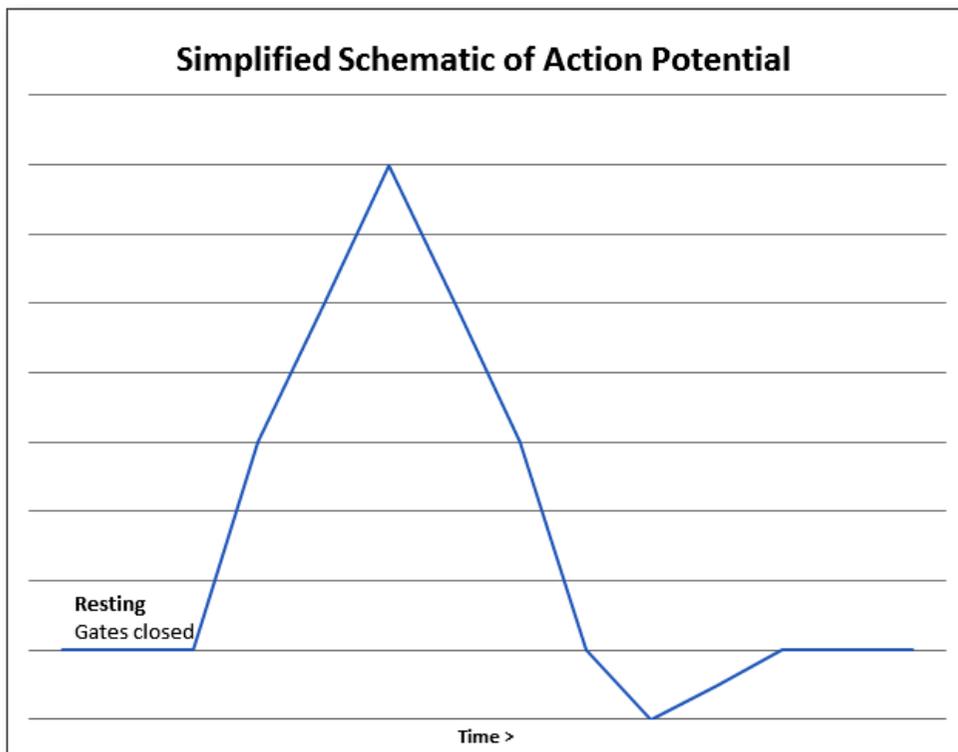
Each axon has an outer cell membrane. When the neuron is resting, this is polarized, with a positive electrical charge on the outside of the membrane, and a negative charge on the inside. This is because the outside of the cell has an abundance of sodium ions, while the inside of the cell has an abundance of potassium ions.



When a stimulus reaches a resting neuron, 'gates' in the axon membrane open suddenly, and the sodium ions rush into the cell. This makes the inside of the cell positively charged too. An electrical action potential is then created as sodium gates are opened sequentially along the entire length of the axon.

After the inside of the cell is flooded with sodium ions, gates on the inside of the membrane open to allow the potassium ions to move to the outside. This restores the electrical balance, although it's now

Simplified Schematic of Action Potential



the opposite of the resting potential, with a negative electrical charge on the outside, and a positive charge inside.

Immediately after the potassium gates open, the sodium gates close, and after this the potassium and sodium ions return to their original sides, (sodium on the outside and potassium on the inside). This occurs through sodium/ potassium pumps. Thus, the nerve returns to its original resting potential until another impulse comes along.

So, the message travels along the nerve axon as an electrical impulse until it reaches a synapse, the small gap between two nerve cells. When the electrical impulse reaches the end of the axon, a calcium gate opens and calcium ions enter the cell. This causes a chemical called a neurotransmitter to be released into the synapse. The neurotransmitter (e.g. acetyl choline) moves across the synaptic gap and binds to proteins on the next neuron. These proteins are called receptors, and different proteins serve as receptors for different neurotransmitters. But that is a story for when we look at other insecticides!

So, what happens when a pyrethroid gets into the system?

Pyrethroids are axonic poisons. They cause paralysis of an insect by keeping the sodium gates open. When

the pyrethroid keeps the sodium gates open, the nerve cannot return to its resting state (potential) since the sodium ions keeps pouring in. This causes the insect to go into convulsions. Eventually the insect is 'knocked-down', or paralysed. At this point the insect may not always be dead. Technically we refer to this as Knockdown (KD). Pyrethroids may be detoxified by enzymes and the insect may later recover. This is why it is important to use products at the correct label rate.

Pyrethroids are less toxic to people for a number of reasons. Pyrethroids bind more strongly with the

sodium channels at low temperatures than at high temperatures. The insects' ambient temperature is approximately 25° C compared to 37° C in mammals. Mammalian sodium channels are also at least 1000 times less sensitive to pyrethroids than insect sodium channels and they recover more quickly from depolarization than do insect sodium channels. They are also more likely to detoxify pyrethroids before they reach their target site than is the case in insects. The nerve axon in humans, and many other higher animals, is protected by a fatty coating known as a myelin sheath. This makes it harder for the pyrethroids to penetrate to the axon and block open the sodium gate.

It is important to note though that, while dogs are able to detoxify pyrethroids; cats are more susceptible and can suffer tremors, twitching, convulsions, and even death if pyrethroids are misused. ■

This article first appeared in *Professional Pest Manager*.

Steve Broadbent is the Regional Director, Australia, SE Asia, South Africa & Gulf Region, Ensystem, Australia.

Email: SBroadbent@Ensystem.com

Singapore Urban Pest Management Forum 2019

A world class event that embraces the future of pest management

Stephen L. Doggett



The world is facing a series of human created challenges to the future; uncontrolled population growth, wanton habitat

destruction, climate change and associated global warming, an over reliance on non-renewal resources, a burgeoning growth in rubbish, and increasing urbanisation. For the most part, politicians are largely unwilling to tackle these major issues, and who have benefitted the most? Pests!

For many years the mainstay in controlling pests, be they vertebrates such as rodents, or invertebrates including cockroaches and termites, have been chemicals. From insecticides to baits, these products have effectively controlled pest populations for years...but the pests are fighting back through resistance. Just about every pest that you can think

of has developed some form of resistance and certain species have developed many types.

Thus in recent years we have seen such things as the global return of bed bugs, bait avoidance in cockroaches, and the continuing growth of deadly vector-borne diseases such as dengue virus and Lyme disease. For many pest managers, all they have done is to use more insecticides, some of which are extremely detrimental to our health, even fatally so. The over use of insecticides have resulted in environmental contamination and the death of non-target species. Plus insecticide misuse has even led to the more rapid development of resistance.

Consequently we humans need to become smarter and go back to the fundamentals of pest control by ensuring that we are employing Integrated Pest Management (IPM) procedures more to the future. IPM involves the minimal use of insecticides, or even none, and is thus considered 'Green' and is ultimately better for the environment and human health, and more likely to result in a positive management outcome. Green pest control is sustainable and not likely to lead to the further development of resistance.

To this end, it was inspiring to see that the theme of the recent Singapore Urban Pest Management Forum was 'Towards Innovative, Smart & Green Pest Management'. The meeting was held over 24-25 April 2019 at the Orchid Country Club in Singapore. The Singapore Pest Management Association



Opening the meeting.



The SPMA organizing committee.

(SPMA) organized a superb meeting with a series of excellent speakers, a quality trade exhibit, and even great food! The SPMA meeting should inspire other pest management associations to focus more on this crucial theme.

The meeting was opened by Mr Andrew Chan, the President of SPMA. Andrew talked about the need for sustainability in the industry, the necessity to adopt smarter new technologies, and the requirement for innovations. He also focused on the many challenges that the industry faces, which includes a customer base that now has a much higher expectation for quality. This presentation was followed by the Guest of Honour, Mr Masagos Zulkifli, Minister for the Environment and Water Resources. The Minister gave a personal account of the change he has seen in Singapore through his life time. What was once a very polluted and dirty city with poor sanitation, has now become the envy of Asia. In just a single generation, every home has toilets and running water, and there is an excellent waste disposal system. Plus as everyone who has visited the country in recent years would have

observed, Singapore is probably the cleanest city in the world. However, pest problems continue such as dengue virus, plus emerging threats including climate change. The lesson being that Singapore (and the world) cannot afford to be complacent.

Regarding the invited speakers, there were many outstanding presentations. Perhaps one of my favourites was a talk by Dr Christina Liew from the Corporate Communications Department in National Environmental Agency (NEA), Singapore. Her presentation was titled, 'Public Communications & Engagement for Project Wolbachia – Singapore'. *Wolbachia* is an intracellular bacteria that can aid in population suppression of the dengue mosquito, *Aedes aegypti*. As *Wolbachia* does not normally exist in mosquitoes, it is necessary to infect mosquitoes with the bacteria first and then release these infected mosquitoes. Of course who in the world would want more mosquitoes in the environment as they are responsible for spreading so much disease? Thus it was Christina and her team at the NEA who had to engage with the public to show that the bacteria was safe, that only male mosquitoes were



SPMA President, Mr Andrew Chan.

to be released that do not bite, and the whole program posed no health threat to the community, only benefits. Of course many in the public are very wary of government claims, but through the sharing of information, public educational lectures, and other forms of community engagement, there has been an extraordinarily high acceptance of the program, around 90%. This figure is testament to the terrific effort achieved by Christina and the NEA. The resulting pilot program where Wolbachia-infected mosquitoes were released in a small number of areas has seen a decline in adult mosquito numbers by up to 50%.

Dr Ary Faraji, Director of the Salt Lake City Mosquito Abatement District provided insights into the surveillance and control of invasive *Aedes* in the USA. The main invasive mosquitoes of concern include the dengue vector, *Aedes aegypti*, and the Asian Tiger Mosquito, *Aedes albopictus*, the latter having a much wider distribution in the US. These mosquitoes are of particular concern due to their propensity to transmit a range of important viruses beyond dengue, including Zika and Chikungunya virus. The big challenge with these species is that they inhabit a variety of disparate small containers making control a huge nightmare. A full length article on how the US battle against these species will be in the next edition of the FAOPMA Magazine.

Of course a conference in Asia would not be the same without the living legend, Prof. Chow-Yang Lee (and many of his former students!). This was one of the last conference presentations in the region by Chow-Yang before his move to the US. Chow-Yang reviewed recent innovations in the science of baiting urban pests, focusing on the minimal (or no) use of insecticides. For example, recent

studies have found that many insects will feed on artificial sweeteners, which is subsequently fatal to them. Monosodium glutamate, more commonly known as MSG, improves the attractiveness of baits to ants. Chow-Yang also touched on the future of pest control, with a move towards an 'Uber' style approach in booking pest services by the public. This very theme was discussed in great detail by David Gay in the most recent edition of the FAOPMA Magazine.

A fascinating presentation was given by Dr Chin-Cheng (Scotty) Yang from the Research Institute for Sustainable Humanosphere, Kyoto University in Japan. Scotty has been working on fire ants and found that a natural virus that infects some strains in the wild affects foraging behaviour. These strains forage less and prefer carbohydrates over protein-rich baits as per fire ants without the virus. As a consequence, eliminating virus infected strains becomes more difficult and even monitoring fire ants become more challenging without knowing if the virus is in the ant population under study (see article in this edition by Scotty).



Dr Christina Liew, NEA.

Certain fly species receive little attention at pest management meetings yet are extraordinarily common and can cause a lot of worry for the home owners. Dr Chong-Chin Heo from the Department of Microbiology and Parasitology, Universiti Teknologi in Malaysia discussed two of these flies, notably moth and vinegar flies. Moth flies are also known as 'sewer' or 'filth' flies, while 'vinegar' flies are often incorrectly called 'fruit' flies. Moth flies tend to be found in polluted environments and feed on decomposing organic matter. Vinegar flies are often

seen in kitchens and can act as mechanical vectors of pathogens. Control involves eliminating breeding sites, physical and chemical control. Monitoring is also important to reveal when populations reach pest levels. Newer technologies for the control of these flies includes biorational insecticides (e.g. plant extracts and hormone analogues), various biological methods and genetic technologies, that can suppress pest populations.



Mr Won Soo Hong, President of the Korean Pest Control Association with his daughter, Ms Jimi Hong, in traditional dress, promoting the upcoming FAOPMA meeting in Korea.

There were a number of talks from company representatives, but without a question the most astounding of these was by Chi Ming Loh, from the company Gnowbe in Singapore. Chi Ming is working in partnership with Bayer to produce training modules for the industry. The mobile phone will be the platform by which these are delivered. Chi Ming presented a clear vision on how these modules are to be structured and presented to the pest manager. Clearly online training via mobile phones is the way of the future and Bayer and Gnowbe must be congratulated for their efforts.

I was also invited to chair a session and to provide a presentation at the forum. My talk was titled, 'Non-chemical and less toxic control strategies against bed bugs'. I began by discussing the need for non-chemical control solutions, notably the development of resistance. In fact few insects on the planet have developed such a high level of resistance as these creatures. For example, research undertaken by my Associate Editor, David Lilly, while

undertaking his Master's degree in my laboratory, found one field strain over 1.2 million times more resistant for permethrin than a susceptible strain. With no insecticide being totally effective in controlling bed bugs, this has forced the pest control industry to look for non-chemical control solutions. This may include discarding infested items, the installation of mattress encasements, monitors that can trap bed bugs, vacuuming, and extremes in temperatures. What was discussed is that all of these methods have their limitations and a thorough knowledge of these weaknesses is necessary to prevent control failure.

As noted above, the world is changing and regarding the environment, sadly not always for the better. In order to survive and maintain relevance, the pest management industry needs to embrace new innovations, be encouraged to use green technologies, and ensure that all pest control technicians are appropriately trained in these new methods. Most importantly, we need to be constantly analysing and reviewing what we do in order to preserve the world for future generations, while protecting those that currently inhabit our planet. Being smarter and greener should not solely be the focus of the SPMA, but all associations and pest managers across the globe. ■

Stephen L. Doggett is the Director, Department of Medical Entomology, NSW Health Pathology (ICPMR), and the Chief Editor of the FAOPMA Newsletter, Westmead Hospital, WESTMEAD NSW 2145, Australia.

Email: Stephen.Doggett@health.nsw.gov.au



Staff from Agrofog enjoying the trade display.

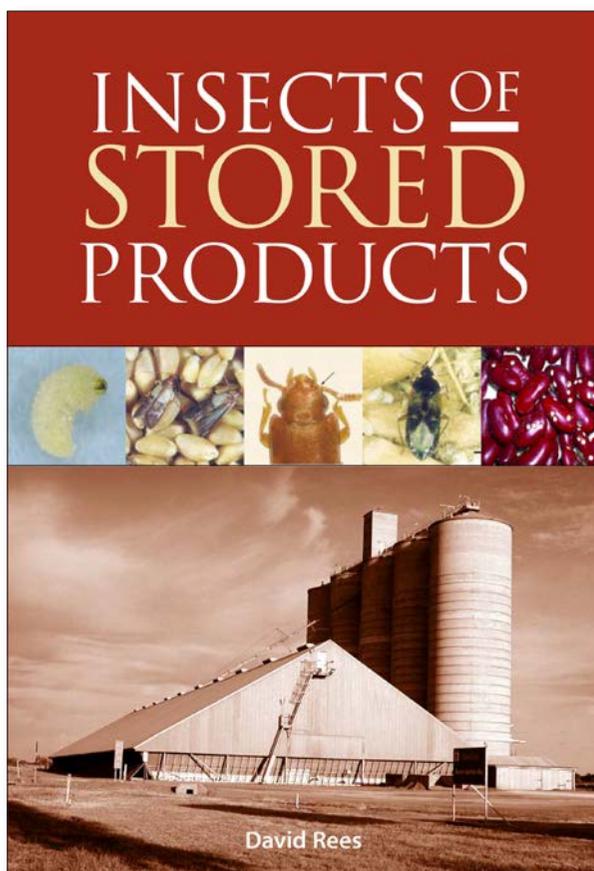


Insects of Stored Products

David Rees

Book review of a past classic by David Lilly

Professional pest managers face many challenging pests in their work today, from bed bugs and termites, to rodents and cockroaches. But perhaps one group of pests that are beginning to have an increased focus are stored product pests. This includes the beetles, moths, and psocids that attack or infest grain and other stored commodities.



The reasons that stored product pests are increasingly crossing over to the professional pest management 'world' are likely numerous and complex. However, these may include the fact that pest managers today are more involved at the frontline of grain storage and processing, plus their customers (i.e. the manufacturers that use such grain products) are under immense pressure to maintain production levels. This means that they may integrate infested products into their processing lines, where once such products would have been rightfully rejected. Added to this has been the evolution of insecticide resistance in many pest species, and the loss in some countries of previously-effective insecticides, such as dichlorvos, through the introduction of more stringent regulations.

In many situations, a pest manager must more than ever rely on the foundations of integrated pest management (IPM) as a means to understand and respond to the situation they are faced. This is especially the situation when the incidence of a particular pest changes, or the service practices that have previously been effective are no longer permitted. And, as everyone would know, the foundation to effective IPM is identification and an understanding of biology and ecology.

Fortunately, when it comes to these two principles of IPM for stored product pests, professional pest managers are well served by the *Insects of Stored Products* (2004) by David Rees. This book is, in this author's opinion, simply on the best 'pest' reference books ever published in the field. It should be

considered a must-have for any entomologist or professional pest manager involved in the management or identification of stored product pests.

The book is logically organized, with beetles, moths, psocids, bugs (Hemiptera), and parasitic wasps all comprehensively dealt with under their respective Family groups. The book is also clear in what it omits, which includes many arthropods which might occasionally appear in stored product environments, but which themselves don't meet the strict sense of a 'stored product pest' (e.g. cockroaches or silverfish). Dichotomous keys at the start of the book provide a reference point for the identification of insects that might be found in and amongst stored products. Another key is provided for the adult beetle Families. Even more impressive is that for each insect family, a key is also provided for identifying the major pest species found. All of the keys are written in clear, accessible language and would be understood even by those relatively new to the industry.

Complementing the keys are photographs by Vanna Rangsi of actual specimens. The images highlight key identifying features, and the types of commodity and damage associated with the pest. The photographs alone must surely have taken a considerable length of time to compile, with well over a hundred high quality images in the book. These images are a component that contributes immensely to the overall value of the book.

Under each insect Family, sections are devoted to classification and identification, the life cycle, physical limits (e.g. temperature and humidity) and rates of multiplication, the economic importance, types of damage and symptoms, ecology, monitoring, and geographic distribution. The sections on physical limits, monitoring, and ecology are particularly useful for those involved in stored product pest management. These factors can point to areas of suppression or control that could be achieved without resorting to the use of insecticides, an option that is becoming increasingly valuable in today's market.

My one complaint (there is always one...), is simply that this book has been allowed to slide into being an item of rarity. The only primary way to obtain the book today is to hunt the secondhand market. The publishers have released an e-book version, but as many would know, e-books and field work

rarely combine well. The one upside is that a 'pocket reference' version of the book was also produced in 2007. However, this again is out of print but is more frequently for sale on secondhand book stores and eBay. Perhaps the field of those working in stored product pest management has simply dwindled too far (as with many areas of entomology) to make a re-release viable. A shame nonetheless, but all the more reason to maintain tight control on the lucky few copies in circulation today. ■

Insects of Stored Products was published in 2004 by CSIRO Publishing. Currently out of print, but readily available second-hand for between USD\$40-100

Dr David Lilly is a Lead Entomologist for Ecolab's Global Pest Elimination - RD&E Division, and Associate Editor of the FAOPMA Magazine.

Email: david.lilly@ecolab.com

90 | Insects of stored products

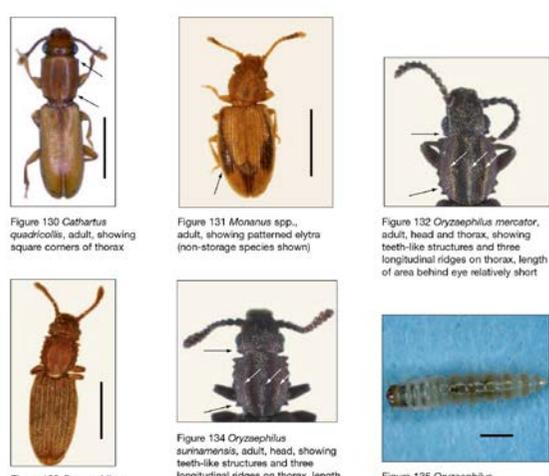


Figure 130 *Cathartus quadricollis*, adult, showing square corners of thorax

Figure 131 *Monanus* spp., adult, showing patterned elytra (non-storage species shown)

Figure 132 *Oryzaephilus mercator*, adult, head and thorax, showing teeth-like structures and three longitudinal ridges on thorax, length of area behind eye relatively short

Figure 133 *Oryzaephilus surinamensis*, adult

Figure 134 *Oryzaephilus surinamensis*, adult, head, showing teeth-like structures and three longitudinal ridges on thorax, length of area behind eye relatively long

Figure 135 *Oryzaephilus surinamensis*, larva

Key to the major silvanids associated with stored products

1	Side of prothorax decorated by six tooth-like projections (Figure 132), colour dark brown to dark grey (<i>Oryzaephilus</i> species) (Figures 132–134)	2
	Sides of prothorax without six tooth-like projections, colour light brown (Figures 128–131)	3
2	Length of the temple – the area of the head behind the eye long (Figure 134)	<i>Oryzaephilus surinamensis</i>
	Length of the temple – the area of the head behind the eye short (Figure 132)	<i>Oryzaephilus mercator</i>
	Elytra marked midway across with a broad brown to black lateral patch or band (Figure 131)	<i>Monanus</i> spp.
	Elytra not so marked	4
3	Pronotum with somewhat curved sides and an obvious tooth like structure at each front angle, sides of abdomen somewhat curved (Figure 129)	<i>Ahasverus advena</i>
	Pronotum with parallel sides, angles of pronotum square, sides of abdomen straight and parallel-sided (Figure 130)	<i>Cathartus quadricollis</i>

An example of the contents.

FAOPMA Member News

The latest in happenings and events from the associations in our region

Please send your report to [Stephen L. Doggett](#) or [David Lilly](#)

CHINA

World Pest Day Activities in China, June 6th, 2019.

On June 6th, 2019, the Chinese Pest Control Association (CPCA) and Tianjin Pest Control Association jointly hosted a celebration of World Pest Day 2019 in the city of



Tianjin. The theme for this year's celebration is "Healthy Community and Pest Management". There were more than 300 participants at this event, among them were government officials, industry experts, representatives from local organizations, and members of media. The President of FAOPMA and the Director of the Chinese Pest Control Association, Ms. Xiaoyun Huang, gave the keynote speech at the ceremony. The event invited the top experts in the pest management industry to hold an education seminar around the theme of



"Healthy Community and Pest Management". A short animation film titled "War Against Mosquitoes" also premiered at this event. Interactive sessions included a free consultation with pest management professionals, live demonstration of pest control





techniques, and educational sessions for the members of media as well as the general public.

During the June 6th World Pest Day celebration, Shanghai, Guangzhou, Shenzhen, Chongqing, Chengdu, Hefei, Nanjing, Fuzhou, and more than forty Chinese cities organized public events to commemorate World Pest Day. These events included press briefings, consumer education classes and exhibits, interactive sessions at school campuses, and free pest treatment for low-income families. As China is ramping up its efforts to be part of the World Pest Day celebration, CPCA also tries to encourage local communities to develop its own approach to better address the local pest issues. News about World Pest Day was reported by People's Daily, Xinhua News Agency, China Radio International, China National Radio, China News Network, Sohu, Netease, Phoenix Network, Tencent.com, and Sina.com, along with 120 other media outlets. ■



INDIA

PCA observed World Pest Day on June 6 in five Indian cities including Mumbai, Delhi, Lukhnow, Bangaluru and Kolkata, in order to build awareness on the importance of pest control
The Indian Pest Control Association (IPCA), the peak body of pest control professionals in India, observed June 6, 2019 as World Pest Day 2019. The aim was to generate awareness about the importance of pest control for the protection of our food, homes, families, lives, and businesses.



World Pest Day is a multinational event established to raise awareness among the public, government and media about the work that pest control professionals do on a daily basis to ensure public health and safety.

The Indian Pest Control Association (IPCA) is a member of the Global Pest Management Coalition (GPMC). According to Mr Jaldhi Trivedi, President of the IPCA (pictured above), this is an international body of pest management associations aiming to provide a unified voice around the globe in fighting





pests.

Observing World Pest Day in India will help raise awareness of the possible health risks associated with pests such as cockroaches, rodents, mosquitoes, and flies. Plus improved knowledge is required on the increasing threat of biting insects that spread a range of diseases. It is estimated that mosquitoes are responsible for causing one million deaths each year, making them the world's deadliest animal.

Pests are much more than just a household nuisance, capable of transmitting sometimes fatal diseases or may cause significant property damage if left unchecked. "We strongly encourage homeowners to work with qualified pest control professionals to prevent and protect against pests", stated Mr Trivedi.

World Pest Day is observed worldwide to raise the awareness on the role of pest management professionals, as they represent a thin line of defence against some of nature's most harmful creatures. Beyond the spread of diseases, pests have the potential to contaminate homes and workplaces, damage belongings, and infest foodstuffs. Insects, rodents, and birds can easily contaminate food and work surfaces with their excreta, hairs, and body parts. Parasites carried by pest species can also be

passed on to humans causing disease.

The ICPA provided several suggestions to reduce pests around the home. This included eliminating sources of standing water around the house, such as from bird baths and clogged gutters, to reduce biting mosquito populations. Cracks on the outside of the home should be sealed with a silicone-based caulk, particularly utilities and pipes go into the home, as these could provide an entry point for rodents and birds. Ensure that tree branches and shrubbery are well-trimmed and away from the house, as overhanging branches can act as highways into the home. Garbage should be sealed in sealed containers and disposed of regularly.



Local Training, a report by Mr Vishal Shetty.

PCA organizes Level 1 and Level 2 training sessions across India to enhance the knowledge of Pest Control Operators. The training programmes are open to members of the IPCA and to non-members. Level 1 is a basic two day course comprising of pest biology, habits and habitats, and their control measures focusing more on principles of pest management. Various modules are used for different pest issues, and codes of conduct. At the end of the training, the participants sit down for a written exam followed by an oral assessment. Only when the score is 60% or beyond, are certificates awarded.



Level 2 comprises a two day session on a single pest that covers theory in the classroom and on site training on site.

The most recent Level 1 training session was held in the IPCA office in Mumbai on the 2nd and the 3rd of February 2019. The participants were trained on IPM approaches such as exclusion etc. This was followed by pest biology and behaviours of various pests such as rodents, bed bugs, and cockroaches. This was followed by a session on codes of conduct ,after which participant sat down for their written exam followed by the oral assessment. ■



PHILIPPINES

Report by Dr Raymond Lee, Hon Secretary (2017-19), FAOPMA

It is a great honour to be part of this Great Event tonight on March 27, 2019, Wednesday and to share in the 57th Anniversary Celebration of the Pest Control Association of the Philippines (PCAP) at the Kalayaan Hall, Club Filipino, Green Hill San Juan City, Manila.



First, allow me to congratulate the two outstanding associations from the region, the Pest Control Association of Philippines (PCAP) and the Pest Exterminators Association of Philippines (PEAP). They have come together and put aside business rivalry by forming The United Pest Management Association of the Philippines (TUPMAPHILS). This is an achievement that FAOPMA can be very proud of and a milestone that shows true friendship and maturity in leadership for the common good of the pest management industry in the Philippines.



Almost four years ago, the FAOPMA Secretariat office asked me to go to Manila. I was there to encourage the two organizations to work together. It was not easy, but I had to start by having the leaders of the two associations to sit at the same table in order to start discussions. We then all met the following year in Beijing, China (June 2016), this time for the Inaugural World Pest Day. I remember talking to main leaders; Jess Asistin (Past President of PCAP

& Chair of the Organizing Committee of FAOPMA-Pest Summit 2020), Hector Binwick (Past President of PCAP), and Job Dayandante (Past President of PEAP), about the required team work for the common good of the country, and that Philippines will be hosting the FAOPMA-Pest Summit 2020 in Manila. Thus the two organizations needed to work more closely together to ensure a successful meeting.

Associations are always very proud to be the host of FAOPMA-Pest Summit as a quality meeting is a source of national pride. We made considerable progress as the leaders from both associations showed maturity, and in 2017 during the FAOPMA-Pest Summit 2017 at Chiang Mai, Thailand, the leaders of the two Philippine associations signed the Memorandum of Agreement. Thus now we can witness history in the making with the formation of The United Pest Management Association of the Philippines (TUPMAPHILS). It was a long journey for me personally in order to see the teamwork happen and am very proud. Thus on behalf of FAOPMA, I would like to say well done and congratulations for such a great achievement!

As we commemorate the 57th anniversary of the PCAP, it gives us a sense of joy to celebrate and an opportunity to look back at how far we have journeyed. This is an achievement that we can be very proud of and a great celebration. This is one



great association has surpassed the half century mark; a milestone that shows leadership for the common good of the pest management industry in Philippines.

It is also a time to reflect on what PCAP has become during these 57 years. But to be truthfully honest, for any association to be able to survive and sustain for 57 years must mean something. There must be many stories to tell on what makes PCAP so special to be able to survive through many years of challenges. One cannot deny that in large measure what makes an association so effective at meeting the needs of its members, lies in great leadership, which has well served the association over the years. It is the leaders and the executive committee who motivate



the members around them to build relationships that create trust and a distinctive care of all members within the PCAP. It is thus appropriate that all the past leaders of the organization are recognised and honoured for their contributions over the years.

The past leadership has demonstrated great vision for the future of the association and these leaders inspire the members to change and getting them to be actively be involved in building and supporting the process of bringing PCAP to greater heights. I can share many stories of industry leaders who served their national associations voluntary and sacrificially – often paying a price that many members are not aware of. These leaders often experienced losing out on business opportunities, and their own company business suffers economically and financially.

In reality, their hard work and efforts for their associations are often seen but at times not appreciated. Speaking from experience, I urge members of association to give your support to the leaders who make your association great for the common good of the pest management industry. Remember, it is NOT just great leaders that provide the visionary directions to make the association great but great associations are comprised of dedicated individuals' who support the elected leaders. Greatness is an aspiration and a very honourable one. But no association is perfect, even if it survives year after year. Greatness must be experienced by the members and its associates, such as Government agencies and strategic business partners or suppliers, who support the industry.

When the association is great, and the industry grows, your customers respect you and treat the industry with a high sense of professionalism. Government agencies will want to collaborate with you and help the industry grow. Most obviously, your strategic business partners or suppliers are most happy when the industry prospers!

On behalf of FAOPMA, I urge the industry leaders of The United Pest Management Association of the Philippines (TUPMAPHILS) to cultivate the team work to make your association great, so that the industry will play its part to advance the professional pest management industry and most important to make Philippines the proud host of the FAOPMA-Pest Summit 2020 (Manila). ■

MALAYSIA

25th Anniversary of the Pest Control Association in Malaysia (PCAM)

This article is written and contributed by President NoHisham and Jason Jee (Executive Committee of PCAM).

In April 2019, the Pest Control Association of Malaysia (PCAM) celebrated their 25th anniversary. This gives us a sense of joy to celebrate and an opportunity to look back at how far we have journeyed. This is an achievement that we can be very proud of and is a great celebration. This is one great association that has surpassed the quarter century mark, a milestone that shows leadership for the common good of the pest management industry in our country. One cannot deny that in large measure what makes an association to be able to sustain 25 years in meeting the needs of its members lies in the great leadership that has served the association over the years.



To commemorate the 25th anniversary, PCAM organised the National Conference on Urban Pests, better known as NCUP 2.0. The event was held at the Sunway Putra Hotel, Kuala Lumpur on 9 & 10 April 2019. Some of the issues related to incidental and seasonal pests such as wild primates, spiders, bats, amongst other pests. These are quite common in Malaysia and local pest managers must manage them using the most practical and logical techniques.

The theme of NCUP was "Current Challenges & Strategies in Urban Pest Management in Malaysia" and is timely in view of the current economic and social outlook of Malaysia. The event was officiated

by the Secretary of Urban Wellbeing, Ministry of Housing & Local Government, the Honourable Dato' Muhamad Musa.



Keynotes presentations were given by the PCAM President, Mr. Nor Hisham Badri, and Professor Chow-Yang Lee who both highlighted issues on managing the millennial worker, technologies, and challenges in managing pests in the urban environment. The NCUP 2.0 Technical Advisor, Associate Professor Dr. Abdul Hafiz Ab Majid, brought together 16 academic papers from the Universiti Sains Malaysia, Universiti Kebangsaan Malaysia (UKM), Universiti Malaysia Sarawak, and Universiti Malaysia Terengganu.

The event was sponsored by Make Safe Australia (Platinum sponsor), and Bayer Environmental Science (Gold sponsor). A total of 22 Exhibitors and 268 participants from the pest management industry, government sector, students, and members from Thailand Pest Management Association and Singapore Pest Management Association attended the event.



Students from the local universities were able to present posters of their research during the event. PCAM also moderated a round table discussion to bring together groups involved in pest management. Stakeholders that participated in the discussion included the Malaysia Crop Protection Association (MACPA), Public Health Entomologist Association (PEKA), Entomology Society of Malaysia (ENTOMA), and the Universiti Sains Malaysia.

In conjunction with the event, PCAM celebrated its 25th Silver Jubilee during the Gala Dinner. PCAM was formed on August 3, 1994 and extended its appreciation to all that has contributed to what the association is today. The event was graced by the Honourable Mr. Mohammad Nazrul Fahmi Abdul Rahim, Secretary, Pesticide Board. The theme was Black Tie, and everyone dressed up for the occasion.



The dinner honoured Past Presidents of PCAM including, Haji Hussein Kamal Omar, Mr. Stephen Liu, Mr. Richard Ng, Mr. Ang Tang Loong, Mr. A. Mohan, Mr. Johnny Ooi, and Mr. Tajuddin Ab Kadir. The past leadership has demonstrated great vision for the future of the Association. These leaders are an inspiration to the members to encourage them to evolve the association and to be actively involved in building and supporting the process of bringing PCAM to greater heights.

The PCAM President, Nor Hisham Badri together with the Deputy President, Ms. Carol Lam exchanged gifts with Professor Lee Chow Yang in honour of his contribution to the Malaysia pest management industry. Prof Lee is a pioneer in the field of Urban Entomology in Malaysia. His research contributed to improving the management and control of urban pests and public health importance, while at the same time advocating the minimal use of

pesticides in the human environment. Prof Lee used his extensive networks of contacts, to enlist speakers from abroad, who ventured to Malaysia and talk to PCOs about their research. His own students, he encouraged, to seek a career in the Pest Management field. He was instrumental in working with the association to establish the HH Yap Award, and the PCAM Scholarship. In the early years of the PAL licensing, he compiled large sections of the Manual to be used in the Pesticide Applicator License (PAL) scheme.



A special presentation on the upcoming FAOPMA-Pest Summit 2019 that will be held in Daejeon, Korea was delivered by the President of the Korean Pest Control Association, Mr. Sang Hyun Park. Dinner guests were having so much fun especially winners of the lucky draws. The highlight of the dinner was the cake cutting ceremony and all the delegates offered a toast to PCAM's success to the future.

In 25 years, PCAM has become a notable industry organization on the international stage. Our local pest experts and scientists have gained international recognition, and PCAM has enjoyed mutual respect from ASEAN regional associations and our executive committee member has been elected to serve in international Board of FAOPMA.

This has been possible because of the contributions of its distinguished past Presidents and Committee Members who have labored tirelessly. They have continually focused their attention on improving the welfare, and developing and growing the pest management industry. This has been a partnership with the local suppliers and businesses whose commitments to the Association have been most notable. ■

THAILAND

Images of recent events, provided by Mr Su-Chart Lee, Chairman King Service Centre.



President Supanut Kiatyingpracha, Chief Advisor Su-Chart LEE, and Former President Niran Siriaphorntham, having a great time attending Singapore Conference. April, 2019.



King Service Center Ltd, the brand new Office Building, the new Head Quarter situated on Number 9 KrungThep Greeta Soi-20 Sub-10, Bangkok 10250, May 2019.



Our great friends and oversea guests, lead by Prof Dr LEE Chow-Yang and SPMA President Andrew Chan, at the lobby of the newly opened King Service Center Ltd, 20 May 2019.



Su-Chart LEE lecturing for four hours on Termite Biology and Control Class, for Thai-FDA Pest Control Licensing Course, at Kasetsart University to the crowd of 71 new class attendants, 11 June 2019.



TPMA (Thailand Pest Management Association) monthly meeting, the top topic of this meeting was "to recruit participants, as much as possible, to join FAOPMA-Pest Summit 2019 in Korea", 12 June 2019.



Group Photo of overseas guests, lead by Prof Dr LEE Chow-Yang and SPMA President Andrew Chan, and TPMA Members lead by President Supanut Kiatyingpracha and Former President Niran Siriaphorntham, at the lobby of the newly opened King Service Center Ltd, 20 May 2019.



Some of our behind-the-scene, hard-working Reception Team, during the grand opening ceremony of King Service Center Ltd, 20 May 2019.

News Items

A Compendium of Pest Management News Items from the Media Relevant to
FAOPMA Member Countries

Compiled by Stephen L. Doggett and David Lilly

NEPAL: MAJOR DENGUE ACTIVITY

In the Chitwan district of Nepal, some 26 patients have contracted dengue virus over the last 11 months. Those with the disease tend to be from urban areas. Recommendations are that people sleep under bed nets and avoid mosquito breeding around the home.

Source: *Nepal24hours.com* (19/Jun/2019), <https://www.nepal24hours.com/26-contracted-with-dengue-in-11-months-in-chitwan-nepal/>

NEW ZEALAND: EVEN MORE RODENT PROBLEMS

Rat populations are expected to increase dramatically in New Zealand forests during the warmer months of spring. Currently rats are being detected at rates of 58% above normal and it is expected that the rodent increase will cause a huge toll on all native species, including both flora and fauna. Conservationists believe little can be done at this stage to prevent the problem from occurring and will have to initiate rodent control measures when the population rises.

Source: *Sunlive* (16/Jun/2019), <https://www.sunlive.co.nz/news/212000-rat-numbers-set-to-explode-nz-for-ests.html>

BED BUG SMOKING HOAX

An online hoax was created suggesting that grinding up bed bugs and smoking or injecting them could create a 'high'. It was intimated that bed bugs had known hallucinogenic properties. It was even suggested that the insect contains a chemical called PH417 that stimulates pleasure centres of the brain. Considering this was released as a video on April Fool's day, few people noticed the hoax. It is hard to imagine people would smoke or inject bed bugs,

when it is obviously a very bad idea.

Source: *Weird* (16/Jun/2019), <https://www.okwhatever.org/topics/selfie/smoking-bed-bugs-hoax>

THAILAND: POLICE SEIZE ILLEGAL MOSQUITO REPELLENTS

Factories producing illegal and potentially dangerous mosquito repellents have been raided by the Consumer Protection Police Division and the Food and Drugs Administration (FDA). The repellent seized is a type of mosquito coil that was not registered for use by the FDA. It was found that the repellent was coated with a chemical that can affect human health causing confusion, headaches, nausea, vomiting, seizures, and loss of consciousness.

Source: *The Thaiger* (16/Jun/2019), <https://thethaiger.com/news/north-east/police-seize-illegal-mosquito-repellents-and-fake-nutritional-supplements>

REUNION: STERILE MOSQUITOES RELEASED

The small island of Reunion in the western Indian Ocean has authorised the release of sterile male *Aedes albopictus* with the aim of combatting mosquito-borne diseases in the long-term. Initially a small scale release of 3,000 mosquitoes will be undertaken in the district of Duparc, in the north of the island to examine the behaviour of the sterilised mosquitoes. Reunion has had 14,000 dengue cases this year, which is very high considering the population is under 900,000. In 2006, there was a massive outbreak from Chikungunya virus, with over 255,000 residents affected.

Source: *Outbreak News Today* (15/Jun/2019), <http://outbreaknewstoday.com/reunion-dengue-authorization-to-release-of-sterile-mosquitoes-in-the-municipality-of-sainte-marie-34057/>

THE LIFE OF AN URBAN ENTOMOLOGIST

An interesting article published on the web site Gizmodo details some of the work of urban entomologists. This include bed bug research by Zachary DeVries from North Carolina State University. Zach has worked on many aspects related to bed bugs and cockroaches, particularly on their allergens.

Source: *Gizmodo* (14/Jun/2019), <https://www.gizmodo.com.au/2019/06/blood-feasts-and-roach-vacuums-the-life-of-an-urban-pest-scientist/>

KENYA: MARATHON RUNNER BANNED AFTER TESTING POSITIVE FOR RAT POISON

A 23-year old marathon runner has been suspended after testing positive for Strychnine following the 2018 Singapore marathon. He claims he used herbal medicine that had been tainted with the banned compound. Strychnine is one of the first performance enhancing drugs used by cheating athletes and its use in sports dates back to 1904. An athlete in the marathon at the 1904 Olympic Games had two injections of Strychnine during the race; it nearly killed him but he won the Gold medal. Strychnine allows nerves to fire faster and hence the reason it is banned.

Source: *Insidethegames* (13/June/2019), <https://www.insidethegames.biz/articles/1080548/kenyan-marathon-runner-banned-after-testing-positive-for-rat-poison>

AUSTRALIA: PARTIAL RAT FOUND IN LETTUCE FROM ALDI

A professional boxer was traumatised after finding a severed body part of a skinned rat in a bag of spinach leaves. The man had already consumed half the bag of leaves earlier in the day and wondered if he had eaten the other part of the rodent (he blends the leaves into a smoothie). Upon returning the bag to the store, they offered a refund of AUD\$2.20. He is now seeking \$AUD15,000 (USD\$10,000) in damages through the legal system.

Source: *News.com.au* (14/Jun/2019), <https://www.news.com.au/lifestyle/food/eat/traumatising-discovery-inside-aldi-spinach-bag/news-story/b0be96874b9b8ccd426afb97ba45ff29>

NEW ZEALAND: RATS THE SIZE OF CATS

The community of Titirangi in Auckland, New Zealand is being overrun by rats, some which locals are claiming to be as big as cats. The rodents are feeding on food left out for the local wild chicken population. The rodents are not shy of humans even appearing during daylight hours (SLD: it seems little point complaining about a pest if everyone is leaving food around for the rodents to feast on!)

Source: *Stuff* (14/Jun/2019), <https://www.stuff.co.nz/national/113383545/part-of-auckland-infested-with-rats-the-size-of-cats-that-are-not-scared-of-humans> and <https://www.stuff.co.nz/environment/113485797/>

[rat-invasion-in-auckland-as-pest-control-experts-report-surge-in-calls](#)

TERRIFIED NY COMMUTERS AS RAT JUMPS ON TRAIN

A video has been posted online of commuters on a train shrieking in fear as a rodent comes on board a subway in New York. The clip has been viewed more than 1.5million times on Twitter. Eventually the rat departed when he arrived at his stop of 42nd Street.

Source: *Daily Mail Australia* (10/Jun/2019), <https://www.dailymail.co.uk/news/article-7122657/Hilarious-video-shows-New-York-subway-riders-freaking-rat-joins-train.html>

NEW ZEALAND: BED BUGS ON THE RISE

There has been a surge in bed bug infestations in health care facilities in Auckland, New Zealand. Last year there were 17 incidents up from two from the year before.

Source: *Stuff* (7/June2019), <https://www.stuff.co.nz/national/health/113105904/maggots-at-childcare-centres-bed-bugs-on-the-rise>

ISRAEL: LASER TARGETING MOSQUITOES

The Israeli company Bzigo has developed a device that detects biting insects in a room. It scans the room and if it detects that the insect has landed, a laser beam is pointed at it and an alert is sent to the mobile phone. This enables the mosquito to be more easily detected and killed. The device is expected to go on sale in 2021.

Source: *Ynetnews.com* (7/Jun/2019), <https://www.ynetnews.com/articles/0,7340,L-5520371,00.html>

ANTS RIPPING APART SPIDER WEB TO SAVE SIBLING

Desert Harvester ants (*Veromessor pergandei*) will rescue their comrades if caught in a spider web by ripping apart the webbing. It is thought that the captured ants release a pheromone to alert their siblings. A video of ants saving their sibling can be seen in the web page below.

Source: *Science* (7/Jun/2019), <https://www.sciencemag.org/news/2019/06/watch-ant-rip-apart-spiderweb-rescue-sibling>

SIR LANKA: COMBATting DENGUE SAVES LIVES AND MONEY

In 2016 there were over 55,000 cases of dengue in Sri Lanka, which prompted health authorities to start a war against mosquitoes. The effort involved the joint forces of the health department, the military and the police. House to house surveillance was undertaken to find and eradicate mosquito breeding locations. This program resulted in a 57% drop in dengue numbers and would have prevented around 22,000 new cases. The added benefit was a cost saving from fewer people being hospitalised. An overall win-win for the nation.

Source: *News Medical Life Services* (6/Jun/2019), <https://www.news-medical.net/news/20190606/War-against-mosquitoes-saves-lives-and-money-in-Sri-Lanka.aspx>

ELEVEN THINGS THAT MOSQUITOES LIKE

In an amusing Readers Digest online article, 11 things are highlighted which mosquitoes would not want you to know. These include: 1) Mosquitoes like beer (a study found that one beer makes people more attractive to mosquitoes). 2) Leggings are good (mosquitoes can bite through tight fitting clothes). 3) No perfume please (see story below that Victoria Secret's Bombshell repels mosquitoes...but many other perfumes attract!) 4) Certain plants repel mosquitoes (well they got the story a bit wrong here as most don't!) 5) Mosquitoes need standing water to breed (just a couple of millilitres is enough for some of the container breeders). 6) Certain repellents work (notably DEET, picaridin, and oil of lemon eucalyptus). 7) Fly screens keep mosquitoes out of the home. 8) Mosquitoes do not like smoke. 9) Only females bite (this it to gain protein for egg production). 10) O type blood is preferred. 11) Stinky sweat attracts mosquitoes

Source: *Readers Digest* (6/Jun/2019), <https://www.rd.com/home/gardening/prevent-mosquito-bites/>

TAIWAN: MORE CASES OF JAPANESE ENCEPHALITIS

Japanese Encephalitis is a potentially lethal virus transmitted by mosquitoes. Two new cases were reported from the Eastern District of Chiayi City and the Zuoying District of Kaohsiung City. Interestingly, both patients were 50-years old but had no direct link. Both patients are located close to rice fields where typically this disease occurs.

Source: *Promed-ahead Digest* (6/Jun/2019), Vol. 83(10).

IRAN: FATAL CASES OF CRIMEAN-CONGO HAEMORRHAGIC FEVER

Crimean-Congo Haemorrhagic Fever is a deadly virus spread via ticks. Since the beginning of the Iranian year (21/March) 12 people have been diagnosed with the condition, with two deaths. This number is down upon the previous year. People who are at most risk are those that keep stock or work in abattoirs.

Source: *Promed Digest* (6/Jun/2019), Vol. 84(15).

INDIA: MAN RECEIVES RS70,000 COMPENSATION AFTER INSECT FOUND IN MCDONALDS BURGER

A Delhi man who found an insect in his burger in 2014, finally received compensation to the sum of Rs70,000 (USD\$1,000). The burger was a McAlloo Tikki burger, a variety made especially for India. Following seeing the insect, the man was immediately sick and vomited uncontrollably. The burger was sent for testing and it was deemed unsafe (for human consumption). He failed to state if the insect improved the taste of the burger!

Source: *LatestLY* (5/Jun/2019), <https://www.latestly.com/social-viral/insect-found-in-mcdonalds-burger-delhi-man-to-get-rs-70000-compensation-5-years-later-903431.html>

CHINA: ANTI-MOSQUITO CAMPAIGN LAUNCHED IN SHANGHAI

Dengue brought in via patients travelling to different regions and overseas, resulted in a small (3) number of local infections. Shanghai has a risk of dengue due to high mosquito numbers around homes. Thus authorities began a campaign across the city of targeting mosquito breeding sites.

Source: *Shine* (5/Jun/2019), <https://www.shine.cn/news/metro/1906056148/>

TOP BED BUG CITIES IN THE US

The large pest control firm, Terminix, released a list of the top 50 cities in the USA for bed bugs, based on the number of treatments. Number one was Philadelphia. The top ten included, in order, New York, Dallas, Indianapolis, Cincinnati, Los Angeles, Cleveland, Washington DC, Chicago, and Boston. Remember these locations when you are next travelling to the US and make sure you check your hotel room!

Source: *WTAJ* (5/Jun/2019), <https://www.wearecentralpa.com/news/list-of-the-top-50-bed-bug-cities-in-america/2054851917>

GROWTH IN BED BUG SERVICES

In 2018, the bed bug market was estimated to cost globally USD\$1.58 billion and by 2025 this is forecasted to reach USD\$2.79 billion.

Source: *Digital Journal* (5/Jun/2019), <http://www.digitajournal.com/pr/4335812>

NEW ZEALAND: COCKROACHES DOMINATE AUCKLAND'S FILTHIEST RESTAURANTS

In a series of disgusting images, Auckland's most filthy restaurants have been documented. Typically restaurants are rated and a ranking of 'D' or 'E' is a serious problem for the eatery concerned. A 'D' ranking means that there were serious issues, while the dreaded 'E' means that there are serious safety issues and the establishment will be immediately closed. Pest issues such as a major cockroach infestation will result in closure. The images show filth, poor food storage and serious cockroach problems. Interestingly, the majority of the 'E' rated restaurants were Indian, which reflects poorly on the local community.

Source: *Newshub* (3/Jun/2019), <https://www.news-hub.co.nz/home/lifestyle/2019/06/auckland-s-filthiest-e-grade-restaurants-revealed-in-gut-churning-photos.html>

WHY CONTROL TERMITES WHEN YOU CAN EAT THEM!

In Kenya during the wet season, there are huge emergences of winged black-bellied termites from

the ground, which are then collected by the locals. They are then fried and sold as snacks. Hotels and hawkers sell them, and they are extremely popular with the locals. A plate of termites will cost around USD\$0.68. During the termite season there can be so many emerge that the sky looks grey.

Source: Star (3/Jun/2019), <https://www.the-star.co.ke/counties/2019-06-03-tasty-termites-a-rainy-season-treat-in-embu/>

NEW ZEALAND: COCKROACH OUTBREAK IN JUDGES COMMON ROOM

New Zealand courthouses have been suffering from a range of pests over the last two years. This included an outbreak of cockroaches in a judge's common room and staff area. The particular building concerned was barely ten years old and thus one must question the hygiene standards within the site.

Source: Stuff (3/Jun/2019), <https://www.stuff.co.nz/national/113065331/cockroach-outbreak-in-judges-common-room-fruit-flies-in-toilets>

PESTICIDES MAY INCREASE MOSQUITO NUMBERS

Research has shown that mosquitoes in Costa Rica are highly resistant to a range of insecticides, however their predators are not. The result has been that chemical applications has allowed mosquito populations to increase beyond normal. In these regions, insecticide applications have been going on continuously for more than 20 years in orange plantations. It was found that mosquito numbers were twice as high as in forests with no insecticide control.

Source: National Geographic (2/Jun/2019), <https://www.nationalgeographic.com.au/nature/how-pesticides-can-actually-increase-mosquito-numbers.aspx>

SINGAPORE: 4TH DEATH FROM DENGUE FOR 2019

A 63-year old man has died from dengue virus infection, making this the fourth person to die from the disease in Singapore during 2019. The man did not reside in an area of known dengue activity, however vector control initiatives were undertaken around his home. The overall number of dengue cases to June 2019 has already surpassed last year's total.

Source: Channel News Asia (1/Jun/2019), <https://www.channelnewsasia.com/news/singapore/fourth-person-dengue-fever-mosquito-63-hougang-11585956>

VECTOR-BORNE ILLNESSES ON THE RISE!

A disturbing report from the Centers for Disease Control and Prevention, highlights the rise in vector-borne disease across the USA. Disease from mosquitoes and ticks has tripled from 2004 to 2016. Nine new pathogens transmitted by ticks or mosquitoes have been discovered since 2004.

Around 80% of vector control organizations lack control capacities. The report highlights how many more people are at risk now, due to people travelling, and diseases and vectors spreading.

Source: CDC (May/2019), <https://www.cdc.gov/vitalsigns/vector-borne/>

BED BUGS ON THE RISE IN IRELAND

Holiday makers in Ireland are being warned to watch out for bed bugs following a report by Rentokil than numbers are up by 61% this year. Dublin is the city where most bed bug treatments are undertaken followed by Galway and Cork.

Source: The Irish Sun (30/May/2019), <https://www.thesun.ie/news/4155969/bed-bug-warning-irish-holidaymakers-infestations/>

INDIA: DRONES FOR MOSQUITO MANAGEMENT

A start-up company in Hyderabad, Marut Drones, is using drones for the control of mosquitoes in the city. The use of drones have the potential to undertake the job much more quickly than humans and with reduced labour costs. The drones will also be used to apply weedicides for the control of water hyacinth, which can block river systems. One drone can treat 5-6 acres per hour, treating around 25 acres per day. (SLD: drones are cost effective for the treatment of small areas and locations within 500m of homes where helicopters cannot fly. For larger water bodies, helicopters can treat an area much more quickly, however multiples drones can now be programmed to work together. Drones are being used more frequently [including by myself] to both survey and treat mosquito habitats.)

Source: The News Minute (29/May/2019), <https://www.thenewsminute.com/article/how-hyderabad-based-startup-using-drone-technology-curb-mosquito-menace-102625>

UK: RAT REMOVAL SEES BIRD NUMBERS GROW ON REMOTE ISLAND

A conservation project to remove rodents on a small island off the coast of South Wales has been highly successful, with bird numbers undergoing a huge boost. The island is a known breeding location for many seabirds including puffins and numbers fell to only 10 breeding pairs when rodents were at their peak. A total of £50,000 (USD\$63,000) was spent to eradicate some 40,000 rats, with the project beginning in 2003. This is another example of how rodent control can help to preserve the world's wildlife for future generations.

Source: ChinaDaily (29/May/2019), <http://global.chinadaily.com.cn/a/201905/29/WS5ced637ba3104842260be538.html>

CHINA: NEW TICK-BORNE DISEASE DISCOVERED

A new virus has been discovered in north eastern China that has caused febrile illness (fevers) in



Stephen L. Doggett

Puffin populations have grown dramatically following a successful rodent program on an offshore island in the United Kingdom.

some 86 patients. Researchers suspect that it is transmitted by ticks and has been termed Alongshan virus (ALSV). This pathogen was found following a patient presenting with symptoms similar to another tick-borne disease, tick-borne encephalitis, however he tested negative for this condition. The region where the virus was identified was Inner Mongolia and Heilongjiang Province. Most of the patients were men, either farmers or forestry workers, with a history of tick bite.

Source: *Promed Digest* (29/May/2019), Vol. 88(96) and <https://www.nejm.org/doi/full/10.1056/NEJMoa1805068>

ISRAEL: MOSQUITOES WITH THE DEADLY WEST NILE VIRUS IDENTIFIED

West Nile virus (WNV) is a potentially deadly mosquito-borne virus that can cause encephalitis and permanent brain damage in people who develop the disease, although most people infected will have no symptoms. Routine testing of mosquitoes is undertaken by the Ministry of Environmental Protection and a WNV infected mosquito was found in the Central Arava Regional Council of Israel. Health authorities are recommending mosquito control in the region and warning the public to undertake personal protection

measures.

Source: *Israel National News* (28/May/2019), <http://www.israelnationalnews.com/News/News.aspx/263810>

AUSTRALIA: AUD\$20,000 PENALTY OVER RAT POOP

A famous bar in Brisbane Australia that caters to the gay community was fined AUD\$20,000 (USD\$14,000) after rat faeces was found in the kitchen. The heavy fine was inflicted due to a series of breaches over the years and the bar was found guilty of eight counts of food safety non-compliances. The findings of the rat faeces was indicative of a lack of hygiene and cleaning, and poor pest control practices.

Source: *Daily Mail Australia* (28/May/2019), <https://www.dailymail.co.uk/news/article-7077053/Gay-bar-history-cockroach-infestation-fined-20-000-RAT-FAECES-kitchen.html>

MIDDLE EAST: ANOTHER PHOSPHINE DEATH

In recent years there have been a series of deaths related to the use of phosphine in homes. In some cases they have been due to people buying the product over the internet, in other situations by pest managers using this deadly chemical in apartment complexes. The latest death occurred in the United

Arab Emirates, when a 10-year old boy died as a result of a neighbour using this banned pesticide. At least two other family members were affected, with the sister of the deceased in a serious condition with heart damage. (SLD: sadly people use this dangerous chemical as it is very cheap).

Source: *Promed-ahead Digest* (28/May/2019), Vol. 82(66) and <https://www.khaleejtimes.com/nation/sharjah/Banned-pesticide-caused-death-of-Sharjah-boy-Police>

WHERE TO BUY INSECT REPELLENT? VICTORIA SECRETS (WHERE ELSE!)

The biggest selling perfume by Victoria Secrets, Bombshell, was also found very good at repelling mosquitoes. In fact a group of researchers from New Mexico University found it almost effective as DEET, repelling mosquitoes for up to two hours. This is a surprising finding considering that floral scents are often used to *attract* mosquitoes. Thus don't go out and expect your favourite perfume to protect you from mosquito bites, it may do the opposite!

Source: *Mentalfloss* (27/May/2019), <http://mentalfloss.com/article/582843/victorias-secret-bombshell-fragrance-mosquito-repellent>

CHINA: COCKROACHES IN SHANGHAI BURGER KING

Images of cockroaches in the Shanghai branch of Burger King have gone viral. The photographs shows a roach walking along the kitchen food shelves with the staff failing to note this, while continuing to serve food to customers. The chain claims that they have pest control every month, but will increase the frequency of the service. Many people are saying that they will no longer eat at the store, but as one smart person pointed out, if you found a cockroach in your own home, would you stop eating there?

Source: *That's* (27/May/2019), <http://www.thatsmags.com/china/post/28055/cockroaches-spotted-on-food-shelves-at-shanghai-burger-king>

CHINA: ATTEMPTING TO FRAUD A RESTAURANT WITH A DEAD RAT

A man claimed he found a dead rat in his meal demanded 5 million yuan (USD\$72,000) in compensation from the restaurant. The particular restaurant, Haidilao Hot Pot has more than 190 outlets in China, as well as a number overseas. The food chain went to the police and the man pleaded guilty to extortion and sent to jail for three years.

Source: *Shanghaiist* (27/May/2019), <https://shanghaiist.com/2019/05/27/fraudster-who-dropped-dead-rat-in-haidilao-hot-pot-sentenced-to-3-years-in-prison/>

INDIA: NEW WORLD RECORD! (FOR THE MOST NUMBER OF COCKROACHES EATEN...)

A man from Chennai has set a new world record for the consumption of cockroaches; 28 in 38 seconds. He claims that he started eating them when 12 years

old and continued to do so to annoy his friends. In spite of his gastronomic desires, he claims that they are not tasty at all. Furthermore, one time he even became seriously ill and was admitted to hospital in a critical condition. Anyone else wish to beat this record? (SLD: sadly the species of cockroach was not stated, thus we do not know if they are crunchy little German cockroaches or nice and fatty American cockroaches.)

Source: *News Today* (26/May/2019), <https://newstodaynet.com/index.php/2019/05/26/chennaiite-earns-record-for-eating-cockroaches/>

MORE CALLS TO BAN GLUE TRAPS!

It is well recognised that rodents are vermin; the animals can destroy food stuffs and transmit pathogens to humans. However, many are questioning certain forms of control, notably glue traps, which are far from humane. As the journalist in the article states, "glue traps immobilize mice and rats, leaving them to slowly dehydrate, suffer and die" and that no living creature deserves to die in this fashion. Now some animal protection groups are taking certain retailers of glue boards to court, in order to ban such devices. With many images appearing on line of birds, frogs, reptiles, and even pets, getting caught in these traps, presumably it will be only a matter of time before many countries ban them.

Source: *CBC News* (26/May/2019), <https://www.cbc.ca/news/opinion/glue-traps-1.5149294>

AUSTRALIA: DENGUE FEVER IN ROCKHAMPTON

The first case of local transmission of dengue virus for many decades occurred in central region of Rockhampton, Queensland. This prompted local health authorities to undertake a full response, going house to house, to examine for and control the *Aedes aegypti* mosquito that transmits the virus. Public messages have been issued, warning the people of the dangers of these mosquitoes, to reduce breeding around the home, and how to protect oneself from mosquito bites.

Source: *ABC News* (21/May/2019), <https://www.abc.net.au/news/2019-05-24/first-locally-acquired-case-of-dengue-fever-in-central-qld/11144996>

VIETNAM: COCKROACH IN EAR

A man in Vietnam complaining of unbearable pain in his ear visited a medical clinic in the Bar Giant Province. The doctor found a live cockroach walking around the inside of the patient's ear canal. The doctor tries to dislodge the cockroach with a probe, but the cockroach just runs away. Eventually the medical practitioner had to use a saline rinse injected with a syringe to remove the offending roach. Video of the incident can be viewed in the link below.

Source: *Daily Mail* (21/May/2019), <https://www.>

dailymail.co.uk/news/article-7053367/Skin-crawling-moment-cockroach-discovered-creeping-inside-mans-ear.html

HONG KONG: RAT ERADICATION CAMPAIGN

Following the recent deaths in Hong Kong due to rat hepatitis (see story below), a three month campaign has been initiated to eradicate rats in the island province. Naturally such an aim in a city as large as Hong Kong appears overly optimistic, however the local government will be taking multiple steps in a bid to establish a rodent-free city.

Source: *ejinsight* (20/May/2019), <http://www.ejinsight.com/20190520-govt-launches-three-month-campaign-to-eradicate-rats-in-hk/>

AUSTRALIA: RATS RAMPAGING IN SYDNEY ELITE SUBURB

Potts Point in Sydney is one of the most affluent suburbs in the world, with homes selling for tens of millions of dollars. However in recent weeks, rat sightings in the suburbs are on the increase. Brazen rodents are appearing on the sidewalks in the middle of the day and locals are posting such images to social media. Complaints to the local Council have proved fruitless, according to some residents. It seems that much of the problem stems from a build-up of garbage and the failure of the local government to adequately clean the streets.

Source: *News.com.au* (20/May/2019), <https://www.news.com.au/national/nsw-act/news/residents-say-rats-are-everywhere-in-sydney-suburb-as-rubbish-overflows-from-bins/news-story/05062a8c643d60e0ca666e046417b2d4>

BED BUGS EVOLVED MORE THAN 100 MILLION YEARS AGO

Research undertaken in association with Prof. Mike Siva-Jothy from the University of Sheffield, UK, has shown that bed bugs have been around for a long time and even date back to the days of the dinosaurs. Bed bugs date back more than 50 million years before bats, many people believing that these were the first hosts of the insect. It is probable that the early precursor of the modern bed bug lived in bird nests or animal burrows.

Source: *The University of Sheffield News* (16/May/2019), <https://www.sheffield.ac.uk/news/nr/bedbugs-parasites-evolved-millions-years-dinosaurs-trex-1.843890>

HONG KONG: RAT HEPATITIS IN HUMANS

A virus of rodents, known as 'rat hepatitis E', has infected a number of humans recently in Hong Kong. So far three people have been affected, with one death. The three patients lived in different districts of Hong Kong including Kowloon City, Southern and Tuen Mun. Two cases occurred last year in the city and these were the first recorded cases in the world. People are being advised to maintain high standards of food hygiene and cleanliness in their homes.

Source: *South China Morning Post* (15/May/2019), <https://www.scmp.com/news/hong-kong/health-environment/article/3010226/hong-kong-health-authorities-find-three-new-cases>

AUSTRALIA: ROOF CRASHES DOWN FROM TERMITE DAMAGE

In the sleepy town of Adelaide, the capital of South Australia, a roof in a suburban home came crashing down due to termite attack. The moment was captured on security camera. Fortunately the family were not in the affected room at the time and no one was injured. It is expected that the damage will cost many thousands of dollars to repair.

Source: *7News* (13/May/2019), <https://7news.com.au/news/sa/termite-infestation-a-familys-warning-after-ceiling-comes-crashing-down-c-108524>

PAKISTAN: OUTBREAK OF LEISHMANIASIS

There is a new outbreak of leishmaniasis in the regions of Shewa and Speen Wam in northern Pakistan involving thousands of cases (exact number not stated). This is an endemic region for the disease, and as a consequence of the outbreak, health authorities have set up treatment centres providing free medical care to those affected. Unfortunately, fake drugs have been circulating in the region, which has potentially put patients at risk (SLD: leishmaniasis is caused by a protozoan parasite that is transmitted by phlebotomine sandflies.)

Source: *Promed-ahead Digest* (13/May/2019), Vol. 82(27).

INDIA: DEVICES SET UP TO KILL MOSQUITOES

Vijayawada Municipal Corporation has installed mosquito devices with the aim of curbing mosquito-borne diseases. The devices from a company called 'Moskeet' are claimed to attract and kill mosquitoes in a 250m radius (SLD: the mosquito traps from this company have yet to be tested for their efficacy by independent researchers and so such data is not currently available in peer-reviewed journals, nor is there any data on the company web site. Authorities should be very careful in selecting new products for mosquito control without any independent claims of efficacy).

Source: *The New Indian Express* (12/May/2019), <http://www.newindianexpress.com/cities/vijayawada/2019/may/12/vmc-launches-fragrance-war-to-kill-mosquitoes-in-10-localities-in-city-1975721.html>

UK: BED BUG INFESTATION IN MATERNITY WARD

A maternity hospital in London is the latest medical institute to be hit by bed bugs. King's College Hospital in South East London has had a number of infestations forcing staff to wear protective clothing. New mothers are being advised about bed bugs and what to do if an infestation is suspected (SLD: bed bugs in health care facilities is a growing problem and this is not the first report within a maternity

hospital. I wrote a chapter on bed bug management in health care facilities in *Advances in the Biology and Management of Modern Bed Bugs*.)

Source: *The Telegraph* (9/May/2019), <https://www.telegraph.co.uk/news/2019/05/11/london-maternity-hospital-suffers-bedbug-outbreak/>

COCKROACH ON PHILIPPINE PRESIDENT DUTERTE DURING PRESS CONFERENCE

While holding a press conference, a cockroach was seen to walk up the shirt of the Philippine President, Rodrigo Duterte. An aide than swatted it away. Quick thinking on the behalf of the President, he quipped that the opposition plant it on him.

Source: *Yahoo Philippines* (9/May/2019), <https://ph.news.yahoo.com/cockroach-crawls-philippines-duterte-during-042357234.html>

MONGOLIA: DEATHS FROM THE PLAGUE

A couple in Mongolia have died from bubonic plague after consuming a local rodent known as a marmot. Generally the plague is contracted via the bites of certain fleas, however consuming infected rodent meat is another means of becoming infected. There is a misguided belief that eating the rodent organs is good for the health, which was certainly not the case in this situation.

Source: *SBS* (8/May/2019), <https://www.sbs.com.au/news/plague-deaths-quarantine-lifted-after-couple-die-of-bubonic-plague>

CHIKUNGUNYA UPDATE FOR 2019

Indonesia: 17 cases in Ratujuaya subdistrict.

Taiwan: 1 imported case from Indonesia

India: 6 cases from Karnataka state, 250 cases from Tamil Nadu.

Thailand: 3,141 cases to date for the year.

Maldives: 790 cases.

Source: *Promed-ahead Digest* (8/May/2019), Vol. 82(14).

ALTERNATIVE TO TOPICAL REPELLENTS – RE-ENGINEER THE SKIN MICROBIOME

Research has shown that the human skin exudes a range of different compounds, in fact several hundred. The presence of some of these components are important in attracting insects that blood feed on us, such as mosquitoes. However, some compounds can also repel insects (yes some people are naturally repulsive!). This suggests perhaps the skin microbiome (the bacteria that occur on the skin) could be altered in a way that the skin becomes less attractive to biting insects. The US based military research group, DARPA (Defence Advances Research Projects Agency) is exploring this very avenue by trying to make soldiers more repellent to mosquitoes. Read more at the official press release: <https://www.darpa.mil/news-events/2019-05-03a>

INDIA: COCKROACH ALLERGENS COMMON IN INDIAN HOMES

The English manufacturer of a range of household electrical goods, notably vacuum cleaners - Dyson, recently undertook a survey of the allergens that occur in Indian homes. Dust mite and cockroach allergens were found to be widespread through the home, including in areas where people sit and sleep. Much of this research was to demonstrate how Dyson vacuums with HEPA, or High Efficiency Particulate Air filters, can remove and trap most of the allergens that occur in the homes. A reduction in such allergens can reduce the amount of triggers present that can initiate allergic reactions such as rhinitis and asthma.

Source: *News18* (7/May/2019), <https://www.news18.com/news/tech/dyson-did-a-study-of-hidden-dust-in-our-homes-and-we-have-a-cockroach-and-dust-mite-problem-2131253.html>

AUSTRALIA: RODENT PROGRAM TO BEGIN ON LORD HOWE ISLAND AMID TENSION

The first rodent eradication program on an inhabited island is due to start. Lord Howe Island is off the east coast of Australia and contains unique flora and fauna that has been decimated by introduced rodents. Incredibly there has been huge resistance to this program by the locals and the decision to initiate the control regimen only just passed the vote by 52%. Thus there is still a lot of tension amongst the locals regarding the program. What is extraordinary, is that tourism is the number one income earner for the island and visitors want to see the unique animals on the island. One of the main opponents of the program claimed that the program was not the idea of the locals but "came from public servants and people in New Zealand". (SLD: this comment adequately sums up the reasons behind the opposition; stupidity. Wherever successful rodent eradication programs have been undertaken, the outcome has been extremely positive for the local flora and fauna. This is a program that must proceed, and succeed. Since this time there has been a High Court challenge to stop the rodent baiting program. A radio story on the Lord Howe Island rodent program can be listened to at: <https://www.abc.net.au/radio/programs/pm/rats-and-mice-threatening-lord-howe-islands-delicate-ecosystem/11196254>)

Source: *The Guardian* (7/May/2019), <https://www.theguardian.com/australia-news/2019/may/07/a-nasty-place-at-the-moment-lord-howe-island-tense-as-rat-baiting-begins>

MURDEROUS CAMEL SPIDERS

One of the most aggressive creatures on the planet are camel spiders. While possessing eight legs, strictly speaking they are not spiders but belong to a group of invertebrates called 'Solifugids'. How they received their common name was based on

the legend that they would nip at the stomachs of camels until their intestines fell out, and then the solifugid would lay eggs in the camel's stomach. While this is a complete myth, their aggression is almost unparalleled in the animal world. Take for example this YouTube video from two years back; https://youtu.be/gvcWH_FNBk, here a camel spider is seen to randomly and brutally attack an ant nest, killing every insect in its path. A trail of dead insects is left behind. The other aspect about these creatures is their speed and their killing rate is evident in the YouTube video.

Source: *Howstuffworks* (7/May/2019), <https://animals.howstuffworks.com/arachnids/camel-spiders.htm>

FRANCE: FLEA INVASION CLOSES PARIS POLICE STATION

An ongoing flea infestation has caused a police station in Paris to be closed. The Union is demanding that the infestation is closed before members return to work. Unfortunately it is not stated what species of flea it is or how they have come to infest the station, however they have made working conditions intolerable for staff. Apparently the same site had an outbreak of fleas and lice back in 2017. (SLD: it is suggested that the fleas may have been brought in by someone detained by the police, however considering how many wild cats there are in Paris, I think these animals are a more likely source.)

Source: *ABC News* (7/May/2019), <https://www.abc.net.au/news/2019-05-07/paris-police-station-infested-with-fleas/11086466>

SCARED OF BUGS: THEN WATCH SUPER BUG MOVIES

Researchers have found that people with entomophobia, or a fear of insects, can be treated by watching movies that feature superhero bugs. Movies such as *Spiderman* and *Antman* and being used to cure the fears of those that are terrified of insects and spiders. Such treatments have reduced the fear of spiders by 20 percent in these patients.

Source: *Herald Sun* (6/May/2019), <https://www.herald-sun.com.au/news/scientists-discover-superhero-movies-are-a-cure-for-phobias-of-spiders-and-ants/news-story/e618f48de3c6a0042f575b3d7e3f613d>

AUSTRALIA: COCKROACH FOUND IN BREAD

A shopper in Melbourne found a live cockroach in a loaf of bread that he purchased from Coles, a major supermarket chain. The man was just about to make lunch for his children only to find the roach running around the inside of the plastic bag housing the bread. The company has stated that they will review their quality control procedures.

Source: *Yahoo News* (6/May/2019), <https://au.news.yahoo.com/dads-surprise-to-find-live-cockroach-in-coles-bread-loaf-065000836.html>

LATEST CRAZE: COCKROACHES ON THE FACE

The latest fad for teenagers is for them to place cockroaches on their face, take a selfie, and post it to social media. Naturally such behaviour comes with a risk – who would want to be seen near someone with a cockroach on their face!!! (double yuk).

Source: *Says* (6/May/2019), <https://says.com/my/news/teens-are-putting-cockroaches-on-their-face-and-in-their-mouth-in-a-new-internet-challenge>

FIRE ANTS SPREAD THROUGH SAMOA

Fire ants have appeared in several parts of Samoa, after being identified in just the one location. Attempts are now being undertaken to eradicate the infestations. It was thought that the ants had been on the island for three to four years before anyone had identified them.

Source: *RNZ* (6/May/2019), <https://www.radionz.co.nz/international/pacific-news/388573/tracking-down-little-fire-ants-plaguing-american-samoa>

CLIMATE CHANGES CAUSING TICK VECTORS TO SPREAD

In Canada, an important tick vector that spreads several diseases to humans, is spreading north due to climate change. The tick, *Ixodes scapularius*, is spreading north at a rate of 35-55km per year. In the past it was too cold for the tick population to be sustained, but with increasing global temperatures the tick has become well established in many areas. As a consequence, there has been a dramatic rise in tick-borne diseases such as Lyme disease. More than 2,000 cases were reported in 2017, which more than doubled the previous year.

Source: *GlobalNews* (5/May/2019), <https://globalnews.ca/news/5231593/ticks-canada-locations-2019/>

NEW ZEALAND: MASS RAT CONTROL PLANNED

Kahurangi National Park in the north west of the southern island of New Zealand, has experienced a massive growth in rodent populations, which is threatening native wildlife. In response, aerial application of 1080 baits will begin. This product will also help to control stoats, another introduced pest that kills native species. A dose rate of 1.5kg of 1080 bait will be applied per hectare.

Source: *Stuff* (2/May/2019), <https://www.stuff.co.nz/environment/112339865/doc-gearing-up-for-kahurangi-national-park-1080-drop-to-hit-rats>

CHINA: SPIDER FOUND IN EAR

A patient from China complained about a severely itchy ear and doctors were surprised when they found a live spider in his ear canal. The spider had even spun a web inside the patient's ear and had probably been living there for some time. Saline was injected into the ear and the spider flushed out. The patient suffered no permanent injuries.

Source: *Daily Mail Australia* (2/May/2019), <https://www.>

WORLD'S LARGEST ANT FARM

The pest control company Terminix, received Guinness Book of Records recognition by producing the largest ant farm in the world. The farm measures 4 by 3 feet and is 3 inches wide. The display is being used to hold Western Harvester ants, which is in a gel matrix for ease of observation.

Source: PCT (1/May/2019) <https://www.pctonline.com/article/terminix-service-ant-farm-guinness-world-records/>

GLOBAL PEST MARKET FORECAST TO RISE BY 5.04%

In a new report released by Research and Markets, the pest control industry is forecast to grow at a

compound annual growth rate of 5.04% to 2025. By then it is predicted that the pest control market will be valued at USD\$27.5 billion. Much of this growth relates to expansion in human populations, increasing urbanisation, and an increasing demand for pest control services. The full report can be purchased from the link below at USD\$5,650.

Source: Research and Markets (1/May/2019), <https://www.researchandmarkets.com/reports/4768800/pest-control-market-by-pest-type-insects>

NEW VIDEO GAME; A PLAGUE TALE: INNOCENCE

Who doesn't wish to play a video game that features rats? Rats are everywhere in the new game called 'A Plague Tale: Innocence'. The rats prove to be both friend and foe. The game launches on 14 May 2019 and a YouTube trailer can be seen at: <https://youtu.be/2w-k5iScmdw>

Source: TSA (29/Apr/2019), <https://www.thesixthaxis.com/2019/04/29/a-plague-tale-innocence-gameplay/>

FIJI: WOLBACHIA RELEASE

Mosquitoes deliberately infected with the intracellular parasite, *Wolbachia*, are being used to fight mosquito-borne diseases. To date such efforts are against the dengue mosquito, *Aedes aegypti*, which can also transmit a range of other viruses such as zika and chikungunya. By releasing *Wolbachia* infected *Aedes aegypti*, the local mosquito population becomes resistant to transmitting these viruses. The first successful release occurred in northern Queensland in Australia, whereby local



Stephen L. Doggett

Aedes aegypti is the main vector of dengue, yellow fever, chikungunya and zika viruses. Many programs are underway to prevent the spread of disease by this species.

dailymail.co.uk/news/article-6981369/Doctors-shocked-spider-weaving-webs-inside-mans-ear.html

ENGLAND: BRITISH PARLIAMENT OVERRUN WITH PESTS

No we are not talking about the political variety, but true pests such as rodents. Mice will run over desks during the daylight hours and old paperwork provides nesting materials. Many report that mice have run over their feet while dining, and many mice will even stop to nibble on the crumbs. In the five years preceding 2018, over 500,000 pounds were spent on rodent control. Moths are also a problem and are threatening antique furniture and upholstery. A major restoration project will begin in 2020 and it is hoped that many of the pest problems will be addressed.

Source: Bloomberg (2/May/2019), <https://www.bloomberg.com/news/articles/2019-05-02/of-mice-and-moths-u-k-parliament-s-battle-against-vermin>

US: ATTEMPTS TO BAN RODENTICIDES

Following several incidents, including the latest whereby a mountain lion was poisoned, California is looking to ban second generation rodenticides. This follows a spate of wildlife deaths, including other large cats such as pumas. As a consequence of these events, public campaigns have urged law makers to ban these compounds.

Source: The Acorn (1/May/2019), <https://www.theacorn.com/articles/assembly-bill-steps-up-war-against-rat-poison/>

dengue transmission has virtually ceased. The first release in western Fiji occurred on 28/Apr/2019. It is believed this work could save hundreds of lives.

Source: *Fiji Sun* (29/Apr/2019), <https://fijisun.com.fj/2019/04/29/wolbachia-mosquitoes-released-in-the-west/>

MUMBAI, INDIA: DENGUE A GREATER THREAT THAN MALARIA

Local authorities found significant more breeding of the dengue mosquitoes than *Anopheles* that transmit malaria in Mumbai. Over 3,100 breeding locations of *Aedes aegypti* were found.

Source: *DNA* (29/Apr/2019), <https://www.dnaindia.com/mumbai/report-mumbai-faces-greater-threat-from-dengue-than-malaria-2744100>

DENGUE UPDATE: ASIA & PACIFIC

Cook Islands: 30 cases so far for 2019.

East Timor: An outbreak in the capital Dili, has seen over 500 cases with 5 deaths for 2019.

Indonesia: 875 residents from East Sumba have been diagnosed.

La Reunion: there have been almost 5,000 cases for the first three months of 2019.

Malaysia: up to 7/Apr, over 38,000 cases and 59 deaths have been recorded. Around 60% where from the state of Selangor.

Maldives: over 1,700 cases have been reported of dengue and chikungunya.

Mauritius: 75 cases have been reported for 2019.

Pakistan: more than 1,000 cases have been reported across the country this year, with close to 400 cases from Karachi.

Philippines: cases are almost 60,000 to date for this year with 237 deaths. This is 245% higher than the same period in 2018. The region with most cases is central Visayas with 6,587 cases and 38 deaths. Manila has had 5,504 cases and 18 deaths. Caraga has had 5,224 with 15 deaths.

Singapore: there has been almost 2,100 cases and three deaths this year.

Sri Lanka: in the first four months of 2019 over 15,400 dengue cases were reported with 15 deaths in 2019. Over 3,400 cases were reported from the Colombo district.

Taiwan: this year has seen 2,000 infections of dengue with southern Taiwan affected the most.

Thailand: 27 people have died from dengue this year.

Vanuatu: there have been over 200 suspected dengue cases.

Source: *Promed Digest* (26/Apr/2019), Vol. 82(85) & *Promed Digest* (13/May/2019), Vol. 83(38).

WHY DEET IS SO EFFECTIVE

The repellent DEET has long been known to be highly effective at repelling mosquitoes, however why this has been the subject of great debate amongst scientists. New research suggests that

DEET affects how mosquitoes taste us via their feet, making us 'less tasty' and hence repellent.

Source: *Livescience* (26/Apr/2019), <https://www.livescience.com/65334-how-does-deet-work-mosquitos.html>

CHINA GIVES PNG 600,000 MOSQUITO NETS

The People's Republic of China has donated 600,000 mosquito nets to the government of Papua and New Guinea for World Malaria Day, which is typically celebrated on 25 April. Mosquito nets have been found to be highly effective at reducing the incidence of malaria, especially in children. The nets were given to all the schools in the national capital of Port Moresby.

Source: *Post Courier* (25/Apr/2019), <https://postcourier.com.pg/port-moresby-settlements-receive-mosquito-nets/>

SINGAPORE: SMOKING COCKROACHES?

A cockroach was filmed in Singapore running off with a cigarette – perhaps its day was just too stressful!

Source: *Yahoo News* (24/Apr/2019), <https://sg.news.yahoo.com/oh-nothing-just-cockroach-running-081949966.html>

SYDNEY, AUSTRALIA: MAN AND PET RAT REUNITED

A homeless man was separated from his pet rat when a pedestrian picked the animal off the street and took it home. Security cameras recorded the event enabling the person to be identified, who had innocently picked up the animal as she thought it was alone. Man and rat were reunited with a heart-warming rub of whiskers!

Source: *The Things* (23/Apr/2019), <https://www.thethings.com/homeless-man-pet-rat-reunited/>

PENANG, MALAYSIA: RESTAURANT CLOSED AFTER RAT FAECES FOUND

A well-known establishment in George Town has been forced to close after rat droppings were found in the restaurant. State Health Authorities found the droppings during a routine inspection. Furthermore, cooks failed to wear proper clothing during food preparation and had not undertaken mandatory government training.

Source: *New Straits Times* (23/Apr/2019), <https://www.nst.com.my/news/nation/2019/04/482145/penang-eatery-ordered-closed-after-rat-droppings-found-nsttv>

ADELAIDE, AUSTRALIA: BAKERY INFESTED WITH COCKROACHES

A bakery in Adelaide will face court after a food inspection uncovered a number of breaches, including the finding of a cockroach infestation in a device that had been used to house cooked cakes. Other breaches were noted including a lack of

adequate staff training in food hygiene.

Source: *Cruise123* (23/Apr/2019), <http://www.cruise123.com.au/newsroom/adelaide-bakery-cockroaches-infested-holden-hill-northern-suburbs>

NEW ZEALAND: RODENTS DETECTED ON ENVIRONMENTALLY SENSITIVE ISLAND

Mokoia Island in New Zealand is the breeding ground of a number of endangered local species including the famed flightless bird, the Kiwi. Ongoing monitoring on the island to ensure it remains rodent free has uncovered several signs of rats and mice including footprints and tunnels. Unfortunately the rodents were not trapped. An incursion response has been initiated to rapidly eradicate the rodents.

Source: *NZHerald* (23/Apr/2019), https://www.nzherald.co.nz/nz/news/article.cfm?c_id=1&objectid=12224389

SINGAPORE: THREE FOLD INCREASE IN DENGUE CASES

The first three months of this year saw a threefold increase in the number of dengue reports compared with same period in 2018, including three deaths. The National Environmental Agency launched the National Dengue Prevention Campaign in early April, hosting more than 10 dengue prevention related events.

Source: *The Straits Times* (22/Apr/2019), <https://www.straitstimes.com/singapore/need-for-vigilance-amid-spike-in-dengue-cases-khor>

MALAYSIA: RESTAURANTS CLOSED DUE TO PEST PRESENCE

Two unhygienic restaurants were shut down in Subang Jaya Municipal Council during a series of random inspections. Cockroach and rodent droppings were found, and the facilities were closed for 14 days and ordered to clean up their premises. The restaurants will be again checked and if they receive the all clear, can recommence operations.

Source: *The Star Online* (20/Apr/2019), <https://www.thestar.com.my/metro/metro-news/2019/04/20/closed-due-to-cleanliness-violations/>

COCKROACH FARMING IN CHINA

In Southwest China, cockroaches are farmed for human consumption. A restaurant nearby fries them up in spicy Sichuan sauce. Supposedly, they are good for various human ailments such as stomach ulcers, respiratory issues, and for use as a tonic. The roaches are fed on an all-natural diet of a mixture of corn, fruit and vegetables. The cockroaches are harvested every three months by being dropped into a vat of boiling water, and then dehydrated. A half pound of dried cockroaches costs between USD\$15-90. With so many restaurants being closed due to cockroach contamination – perhaps this is one case where diners will be surprised if a roach

did not turn up in their meal.

Source: *Global Village Space* (19/Apr/2019), <https://www.globalvillagespace.com/papa-roach-chinese-farmer-breeds-bugs-for-the-table/>

PLEAD TO REMOVE COCKROACHES IN A HUMANE MANNER

A vegan woman pleaded on Facebook for solutions to rid her home of cockroaches in a humane manner without killing them. She was concerned that her landlord was going to have the infestation sprayed with insecticides and preferred to release them unharmed. The Pest Controller contacted said that there was no way to remove them unharmed and they must be eradicated for they spread diseases (SLD: how do you deal with customers like this? A lack of control of a pest in one apartment then poses a great pest risk for all the apartments in the complex).

Source: *Yahoo News* (18/Apr/2019), <https://au.news.yahoo.com/vegan-woman-pleads-help-get-rid-cockroaches-humane-way-001055625.html>

VIDEO OF RAT CLIMBING MANS LEG IN RESTAURANT

A video has emerged in social media of a rat climbing the leg of a diner in Portrush in Northern Ireland.

Source: *Video Irish News Video* (17/Apr/2019), <https://www.independent.ie/au/videos/irish-news/video-footage-shows-rat-leaping-onto-customers-leg-in-restaurant-38025320.html>

INDIA: COMPENSATION FOR SERVING DEAD ROACH

A restaurant in the Punjab region of India has been ordered to pay Rs75,000 (around USD\$1,000) for serving a dead cockroach to a customer. The woman had eaten two courses of the meal when she found the dead arthropod in a salad. She subsequently felt dizzy, vomited, and was hospitalised.

Source: *Newsd* (15/Apr/2019), <https://newsd.in/punjab-eatery-to-pay-rs-75000-compensation-for-serving-dead-cockroach-to-a-customer/>

NINJA RAT TAKES ON RATTLESNAKE

A video has emerged of a Kangaroo Rat defending itself against a rattlesnake with a series of well-timed kicks and avoidance manoeuvres. High speed photography captures the key moments of the wannabe Bruce Lee rodent.

Source: *RSANews* (15/Apr/2019), <https://www.2oceansvibe.com/2019/04/15/please-enjoy-this-video-of-a-kangaroo-rat-ninja-kicking-a-rattlesnake/>

LISTENING TO MUSIC COULD REDUCE MOSQUITO BITES?

A study undertaken by researchers from Malaysia and Thailand, published in the journal *Acta Tropica*

suggests that certain music could reduce mosquito reproduction. The music called 'dubstep', in particular a piece by the band Skrillex, may effect various behaviours related to reproduction. The researchers examined the influence of electronic music on the dengue mosquito *Aedes aegypti*, and found that they took longer to feed when the music from Skrillex was playing and were less likely to mate. It is known that mosquitoes respond to sound and perhaps the music is interfering with the wing beat frequency that the species normally responds to. To hear the music that was played to the mosquitoes, go to: https://www.gentside.co.uk/music/listening-to-music-by-this-artist-could-help-protect-you-from-mosquitoes-this-summer_art3267.html

Note that other mosquito researchers have doubts about the findings, see: <https://www.nbc4i.com/news/inside-edition/does-electronic-dance-music-prevent-mosquito-bites-expert-says-probably-not/1915055262>

Source: *Gentside* (12/Apr/2019), https://www.gentside.co.uk/music/listening-to-music-by-this-artist-could-help-protect-you-from-mosquitoes-this-summer_art3267.html

WHAT RAT ARE THEY TRYING TO CATCH IN THE WHITE HOUSE?

Following the announcement that a series of rat traps were set up in the White House, Twitter became a buzz, with some asking if the traps can hold 6'3" 239lb rat, with a bad hair do? Perhaps a Big Mac could be used as bait! On a more serious note, rats are currently a major problem in Washington D.C. and the city has allocated almost an extra USD\$1million towards rodent control.

Source: *Bustle* (12/Apr/2019), <https://www.bustle.com/p/the-white-house-has-rat-traps-set-up-twitter-cant-contain-itself-17032427>

CHINA: JOURNALIST WINS PRESTIGIOUS AWARD OVER COCKROACH FARM REPORT

South China Morning Post journalist Liu Yujing won the Citi Journalistic Excellence Award for story on a facility that breeds more than 6 billion cockroaches for medicine and other uses. In researching the story, she also made the brave move of eating a deep-fried cockroach.

Source: *South China Morning Post* (10/Apr/2019), <https://www.scmp.com/business/companies/article/3005596/scmp-wins-citis-2019-journalistic-award-story-about-sich-uans>

CLIMATE CHANGE MAY CAUSE MOSQUITOES TO EVOLVE MORE RAPIDLY

Researchers from the UK and China have suggested that rising levels of carbon dioxide, associated with climate change, could lead to an increase in the speciation of mosquitoes. This could result in new species moving into areas not seen previously.

The scientists examined data from over the last 195 million years and found a strong correlation between carbon dioxide levels and speciation rates. Potentially we could see diseases return to regions where they were once eradicated.

Source: *Yale Climate Connections* (10/Apr/2019); <https://www.yaleclimateconnections.org/2019/04/climate-change-could-foster-rapid-mosquito-evolution/>

USA: INVASIVE TICK

Stories of invasive ticks continue as highlighted below. Recently the Asian Longhorned tick, *Haemaphysalis longicornis*, was found in the US. The latest research that numbers of this tick have increased 12-fold between 2017 and 2018 in New York parks. The concern is that this tick is known to transmit a range of pathogens, although to date none have been detected yet in the tick.

Source: *ProMED Digest* (10/Apr/2019), Vol. 82(37).

ENGLAND: INVASIVE TICK

A tick that is normally found in parts of Africa, Asia and southern Europe was discovered in the Dorset region of the UK. The tick, *Hyalomma rufipes*, was found on a horse. This tick species is capable of transmitting the deadly Crimean-Congo Haemorrhagic Fever virus and poses a serious threat to the community if it becomes established. It is thought that the tick may have arrived via migratory birds that are known to nest in horse stables. With the warming weather associated with climate change, it is feared that this may become a more frequent occurrence.

Source: *ProMED-ahead Digest* (10/Apr/2019), Vol. 81(26).

SHANGHAI STARBUCKS CLOSES DUE TO COCKROACHES

The famous American chain, Starbucks had to close its Shanghai store after cockroaches were found in one of the cake display cabinets. The roaches were seen walking over the food. All food will be destroyed and pest control activities will be enhanced.

Source: *ECNS* (9/Apr/2019), <http://www.ecns.cn/news/cns-wire/2019-04-09/detail-ifzhaszu6981699.shtml>

ALLERGIES TO COCKROACHES MORE COMMON THAN CATS

In the US, research has indicated that people on average are more likely to exhibit cockroach allergies, than allergies to cats. Between 17-41 percent of the population are allergic to cockroaches and 17 percent to cats. Furthermore, cockroaches are everywhere and there is a higher chance of individuals becoming sensitised to these insects. One of the biggest problems for allergic children is schools.

Source: *Washingtonian* (8/Apr/2019), <https://www.washingtonian.com/2019/04/08/>

[more-people-are-allergic-to-cockroaches-than-to-cats/](#)

THE DANGERS OF GLUE TRAPS TO WILDLIFE

The indiscriminate placement of glue traps was again highlighted. A fully grown Kookaburra was caught in one such trap in Queensland, Australia. It was thought that the bird was attracted to the cockroaches caught on the mat. The Kookaburra was so badly injured in its attempt to escape that it had to be euthanized (SLD: this is why so many animal welfare groups wish to ban such traps- they must always be placed in locations where wildlife cannot access them.)

Source: *Yahoo News* (8/Apr/2019), <https://au.news.yahoo.com/sticky-situation-proved-fatal-naive-kookaburra-062942144.html>

INDIA: DENGUE ON THE RISE IN MUMBAI

The first three months of 2019 saw a big increase in dengue cases in Mumbai compared to 2018, with more than double this year for the same period. Experts are blaming the weather (presumably it has been wetter than average, which has led to more vector breeding, but the report was not clear on this).

Source: *hindustantimes* (7/Apr/2019), <https://www.hindustantimes.com/mumbai-news/dengue-is-on-the-rise-in-mumbai-time-to-clean-mosquito-breeding-sites-near-you/story-5fte56apljXo64DBSU3dCO.html>

HOW MANY RATS IN HONG KONG?

In a metropolis of over seven million people, probably lots! Recently a journalist posed this very question and reflected on the 'Four Pest' campaign of Mao Zedong. It was reported that over 1.2 billion rats were killed along with a billion sparrows, 220 million tonnes of flies and 24 million tonnes of mosquitoes. The latter equates to around 10,000,000,000,000,000 mosquitoes (I hope they were counted twice for accuracy!). Apparently there are around 8 million rats in Paris and up to 100 million in New York, while the UK has 81 million, and China has around 2 billion. As to Hong Kong, the best estimate is around 10 million, give or take a few hundred thousand. Is there a point to such a story? I guess this highlights just how surrounded by pests we are and the risks of pestilence these creatures can impose on humanity.

Source: *South China Morning Post* (7/Apr/2019), <https://www.scmp.com/business/article/3005007/how-many-rats-are-there-hong-kong-their-prosperity-reflects-our-human>

SINGAPORE: MORE THAN 2,000 DENGUE CASES IN FIRST QUARTER OF 2019

Dengue cases were up three fold during the first three months of 2019 compared with the preceding year, according to the National Environmental Agency (NEA), with more than 2,000 cases. These increases occurred in spite of a drop in *Aedes aegypti*

numbers. However, no clear indication as to why the dramatic rise in human disease has occurred, although it was noted that adjoining nations also saw a dramatic jump in cases. The NEA has deployed around 50,000 gravid traps to monitor mosquito numbers and begun Phase 3 in Project Wolbachia.

Source: *CNA* (7/Apr/2019), <https://www.channelnewsasia.com/news/singapore/dengue-aedes-mosquito-cases-reported-first-quarter-11420048>

OMAN: ANTI-DENGUE DRIVE TO CURB MOSQUITOES

A two week campaign to control *Aedes aegypti* mosquitoes has seen a decline in dengue cases. During this time, over 60,000 premises were inspected. It was hoped that the intensive campaign increased people's awareness of the mosquito and to ensure that they did not breed the insect in and around their home.

Source: *Times of Oman* (6/April/2019), <https://timesofoman.com/article/1093174/Oman/Anti-dengue-drive-curbs-spread-of-vector-mosquitoes>

COCKROACH MILK – THE NEW SUPERFOOD?

A type of cockroach, the Pacific Beetle Cockroach, produces protein infused crystals. These crystals contain a high amount of energy, around three times that of cow milk. Some are suggesting that this cockroach 'milk' could be a food alternative in the future.

Source: *Las Vegas Review Journal* (6/April/2019), <https://www.reviewjournal.com/life/health/cockroach-milk-might-sound-gross-but-could-be-next-super-food-1634930/>

MORE BED BUGS ON BA FLIGHTS

Over the last few there years have been multiple reports in the press of bed bug infestations in aircraft, especially on British Airway flights. The latest incident involved a flight from Canada to Slovakia, where a 7-year old girl received multiple bites to her legs. The mother of the child noticed bed bugs on the seat in front and saw a bed bug emerge from behind a TV monitor. The flight crew were alerted but no spare seats were available. The mother received bites on the hands, waistline, neck and other areas.

Source: *The Epoch Times* (7/Apr/2019), https://www.theepochtimes.com/7-year-old-boy-and-mom-says-bed-bugs-invaded-their-flight_2831945.html

RATS FOR GOOD!

So much of our time involves *controlling rodents*, but did you know that some species are being used to benefit humanity? The African Giant Pouch Rat is being used to detect a range of smells, including that of explosives, wildlife (to combat trafficking), and infectious diseases such as tuberculosis. In landmine detections, they have been employed in

multiple countries, including Cambodia, Angola, and Mozambique. Plus they are very speedy in doing this; what would take a human four days to inspect for mines, they can do this in 20 minutes! One good aspect is that the rodents are too light to trigger the mines, making them a perfect detector.

Source: *Treehugger* (4/April/2019), <https://www.treehugger.com/animals/amazing-life-saving-talents-gambian-giant-pouched-rat.html>

INDIA AND THE USA: PREDATORY PUBLISHING HOUSE OMICS INTERNATIONAL RECEIVES MULTI-MILLION FINE

In recent years, companies have started to prey on academics and other researchers by starting up journals that have similar names to well established, respected journals. These 'imposter' journals are very poor yet charge huge amounts to publish an article. Typically they will accept any piece of work, as long as the person submitting pays. The quality is substandard, with many mistakes evident. Often such journals appear legitimate by listing well known scientists on the editorial board, often without their permission. Such companies also hold conferences, again preying on the community – these events are also poorly organized but registration costs are high.

One of the worst offenders is Omics International based out of Hyderabad in India. This company publishes hundreds of journals across a range of disciplines. This year, the Federal Trade Commission in the US has won a \$50 million court judgement against Omics for their deceptive business practices. Furthermore, a judge in Nevada also ordered the company to halt their deceptive business practices.

Omics is considered one of the worst predatory organizations in the world and is considered 'the evil empire' of them all. These fines are the first step in stemming these illicit practices who are degrading science for all humanity.

Source: *The New York Times* (3/Apr/2019), <https://www.nytimes.com/2019/04/03/science/predatory-journals-ftc-omics.html>

AUSTRALIA: KUNJIN VIRUS IN THE NORTHERN TERRITORY

The Department of Health in the Northern Territory of Australia have advised travellers on the risk of Kunjin virus following widespread detections of the virus. Travellers are advised to undertake personal protection measures to prevent the bite of mosquitoes (SLD: Kunjin virus is a flavivirus that belongs to the encephalitic group, which is carried by mosquitoes, notably *Culex annulirostris*. Symptoms include severe headaches, fever, drowsiness, tremors, and seizures. Kunjin occurs in most Australia states and is related to West Nile virus.)

Source: *ProMED-ahead Digest* (3/Apr/2019), Vol. 81(6).

PAKISTAN: CRIMEAN-CONGO HEMORRHAGIC FEVER

A 19-year old patient has died of the deadly Crimean-Congo Hemorrhagic fever at Jinnah Postgraduate Medical Centre on 1 April 2019, bringing the death toll to 3 this year at this medical facility.

Source: *ProMED-ahead Digest* (3/Apr/2019), Vol. 81(4).

NEW FACT SHEET ON THE LONG-TAILED SILVERFISH

Silverfish are seen as an emerging pest in the Scandinavian countries and pest management companies are earning a considerable income in treating for the pests. The Norwegian Institute of Public Health has now released a very thorough 43 page new fact sheet on these fascinating insects, which is available in the link below. A pdf of the fact sheet can be obtained from: <https://www.fhi.no/globalassets/dokumenterfiler/rapporter/2019/long-tailed-silverfish-ctenolepisma-longicaudata--biology-and-control.pdf>

The fact sheet covers identification (with a taxonomic key), biology and ecology, behaviour, and integrated pest management.

Source: *Norwegian Institute of Public Health* (2019), <https://www.fhi.no/en/publ/2019/skjeggkre--biologi-og-rad-om-bekjemping/>

RE-ENGINEER MOSQUITOES SO THEY DO NOT BITE

Researchers in the US have discovered a gene in the mosquito antennae that helps in the detection of humans as a blood source. If this gene could be disrupted, altered or removed, then humans would less likely be bitten, resulting in a dramatic decline in the occurrence of mosquito-borne diseases.

Source: *Aljazeera* (1/Apr/2019), <https://www.aljazeera.com/news/2019/04/mosquito-scent-discovery-change-billion-lives-190401082408931.html>

US: DISGRACEFUL HUMAN RIGHTS ABUSE OVER BED BUGS

A 70-year old man in Los Angeles, USA was arrested for arson after he set his mattress alight in a desperate attempt to rid himself of an infestation of bed bugs. The fire burnt out quickly and no one was injured but the man is facing a maximum three year jail term and USD\$3,000 fine over the incidence. (SLD: it disgraceful to think that an older member of the American community had to resort to desperate measures to exterminate a bed bug infestation, and is then threatened incarceration as a consequence! It is time legal authorities chase the real culprits – those that allow bed bug infestations to go untreated in the socially disadvantaged.) ■

Source: *Nola.com* (13/Mar/2019); <https://www.nola.com/crime/2019/03/arrested-metairie-man-set-mattress-ablaze-while-battling-bedbugs-jpso.html>

News from Academia

A compendium of new scientific publications relevant to the pest management industry

Compiled by Stephen L. Doggett and David Lilly

BED BUGS HAVE DIFFERENT DEGREES OF INSECTICIDE RESISTANCE DURING THE DAY

A paper just published titled "Circadian rhythms in insecticide susceptibility, metabolic enzyme activity, and gene expression in *Cimex lectularius* (Hemiptera: Cimicidae)" show how the common bed bug varies in its degree of susceptibility to insecticides over a 24-hour period. It appears that when the insect is most active it increases the production of metabolic detoxification genes. This makes sense as it is when it is active that it will more likely be exposed to deadly insecticides. Thus insecticide efficacy can vary tremendously during a 24-hour period.

Source: *PLOS One* (17/Jun/2019), <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0218343>

TIMING OF INSECTICIDE BARRIER TREATMENTS FOR THE MANAGEMENT OF THE ASIAN TIGER MOSQUITO

Barrier treatments involve the spraying with insecticides of vegetation and other areas where mosquitoes may rest. This form of treatment is undertaken for the control of a number of mosquitoes, including the Asian Tiger Mosquito, *Aedes albopictus*. Researchers from Rutgers University in the US examined when was the best time to apply insecticides for the suppression of the mosquito, as the mosquito over-winters in the cooler temperate climate of New Jersey. It was found that barrier treatments were most effective when mosquito numbers peaked. In contrast, early seasonal barrier treatments, before mosquito numbers rose substantially, offered little benefit.

Source: *Journal of Economic Entomology* (June/2019), <https://academic.oup.com/jee/article-abstract/112/3/1337/5320678?redirectedFrom=fulltext>

USING FUNGUS TO KILL MALARIA CARRYING MOSQUITOES

With numerous insects have developed resistance, research continues to search for novel ways to control insect pests. For many years naturally occurring fungal pathogens have been investigated for the control of mosquitoes. An engineered fungus, *Metarhizium pingshaense*, that produces a spider venom was able to completely eradicate mosquitoes in an artificial environment within 45 days. The concern will be what affect it has on other insect species.

Source: *Science* (31/May/2019), <https://science.sciencemag.org/content/364/6443/894>

NEW ENVIRONMENTALLY SENSITIVE TOXIC BAITS FOR THE CONTROL OF MOSQUITOES AND SANDFLIES

In recent years, the use of toxic sugar baits as gained much attention as such an approach obviates the need for area-wide adulticiding of biting flying insects such as mosquitoes. Thus such an approach has less non-target impacts and a reduced environmental impact. Recently it was found that artificial sweeteners are toxic to a range of nuisance flies (see article in this edition on the control of sewer and fruit flies on page 39). New research has tested the effect of Sodium Ascorbate (SA), a naturally occurring substance in fruits and vegetables, on the longevity of mosquitoes and sand flies from the family Psychodidae. Concentrations of over 8% significantly reduced mosquito survival, although was not so effective against sand flies. This approach may prove to be effective where there are minimal competing natural sugar sources.

Source: *Journal of Medical Entomology* (28/May/2019), <https://academic.oup.com/jme/advance-article/>

[doi/10.1093/jme/tjz079/5499088](https://doi.org/10.1093/jme/tjz079/5499088)

ENHANCING THE EFFICACY OF INSECTICIDES AGAINST THE DENGUE MOSQUITO, *Aedes Aegypti*

With resistance being widespread in the dengue mosquito, *Aedes aegypti*, and the promise of new actives unlikely, there is a need to look at new formulations of existing products to see if efficacy can be enhanced. Recently it was discovered that the addition of some essential oils, can substantially

improve the efficacy of pyrethroids, suggesting a synergistic effect. A group of researchers looked at eight different plant derived compounds to enhance the toxicity of a variety of pyrethroids. It was found that Geranium, patchouli and Texas cedarwood oils produced the highest improvement in efficacy. Interestingly, some oils were antagonistic, reducing the efficacy of the insecticides. Such research may help to prolong the market life of pyrethroids where resistance to this class has been demonstrated.



The common bed bug (*Cimex lectularius*) varies in its susceptibility to insecticides during the day.

Source: *Medical and Veterinary Entomology* (17/May/2019), <https://onlinelibrary.wiley.com/doi/10.1111/mve.12380>

FAILURE OF TOTAL RELEASE FOGGERS DUE TO RESISTANCE

It is well known that total release foggers (insecticide 'bombs') are ineffective at controlling a range of insect species including cockroaches. However these products are favoured by the home owner as a cheaper alternative to using the services of a pest manager. The question posed by a group of researchers from the US was, "why do these products fail"? In the region of the US where tested, it was found that the local cockroach population was resistant to pyrethroids (the main component of 'bombs') and that they possessed knockdown resistance. Thus resistance is one of the main reasons for the failure of insect bombs (SLD: the insecticide also fails to penetrate insect harbours).

Source: *Journal of Economic Entomology* (23/May/2019), <https://academic.oup.com/jee/advance-article-abstract/doi/10.1093/jee/toz120/5497829?redirectedFrom=fulltext>

IS DEET SAFE?

Adverse reactions associated with the use of the repellent *N,N*-diethyl-*meta*-toluamide (DEET) tend to be the result of misuse or gross overuse. In a paper titled "Is DEET a dangerous neurotoxicant?" a review of the deleterious reports of DEET are documented. Most adverse reactions involve skin reactions, which normally resolved with no further issue. DEET does not affect developing foetuses. In the US, both the Centers for Disease Control and Prevention and the Environmental Protection Agency endorse the use of DEET in the prevention of vector-borne diseases.

Source: *Pest Management Science* (8/May/2019), <https://onlinelibrary.wiley.com/doi/10.1002/ps.5476>

CHINA: INSECTICIDE RESISTANCE IN THE MALARIA VECTOR, *ANOPHELES SINENSIS*

Anopheles sinensis is an important vector of *Plasmodium vivax* (a variety of malaria) in China. Up until recently nothing was known of its insecticide resistance status. Studies revealed that it poses knockdown and metabolic resistance, and thus multiple resistance mechanisms. This is important information when it comes to control programs.

Source: *Journal of Medical Entomology* (May/2019), <https://academic.oup.com/jme/article-abstract/56/3/803/5305038?redirectedFrom=fulltext>

PAKISTAN: RESISTANCE IN *Aedes Aegypti*

Following reports of treatment failures against the dengue vector *Aedes aegypti* in the Punjab region of Pakistan, a research project began testing field strains for resistance to a variety of insecticides, including pyrethroids and an organophosphate. Variable levels of resistance to all compounds were found, from low to high resistance. Synergism

studies suggest that target-site resistance (kdr) is probably involved along with metabolic resistance.

Source: *Journal of Medical Entomology* (27/Apr/2019), <https://academic.oup.com/jme/advance-article-abstract/doi/10.1093/jme/tjz057/5480658?redirectedFrom=fulltext>

A SWEET DEATH: KILLING MALARIA VECTORS

Insecticide treated bed nets and indoor residual sprays, have become the mainstay for malaria control campaigns. However, insecticide resistance means that such measures are becoming less effective. An alternative approach is to provide sugar meals in the environment, on which mosquitoes feed, which contains some compound toxic to them. In this case, crystals of *Bacillus thuringiensis* var. *israelensis* (Bti) are being mixed with the sugar. Bti is one of the main bioinsecticides being used for larval control today. In laboratory trials, insecticide resistant mosquitoes were fed on the Bti/sugar mixture and high mortality was recorded. Perhaps this method may be included into integrated programs for malaria control into the future.

Source: *Journal of Medical Entomology* (27/Apr/2019), <https://academic.oup.com/jme/advance-article-abstract/doi/10.1093/jme/tjz058/5480702?redirectedFrom=fulltext>

METOFLUTHRIN EFFECTS ON *Aedes Aegypti*

Metofluthrin is a common active in spatial repellents that can very effectively prevent mosquito from biting. Recently a group of researchers from Florida investigated the effects of sublethal exposure to metofluthrin in a variety of *Aedes aegypti* strains, including a pyrethroid resistant variety. For the susceptible mosquito strains (and to some extent, the resistant strains), those individuals exposed to metofluthrin, had reduced egg laying, fewer eggs, lower egg viability, and reduced larval survivorship in the eggs that did hatch. The studies show that even low levels of metofluthrin can reduce mosquito populations

Source: *Journal of Medical Entomology* (16/Apr/2019), <https://academic.oup.com/jme/advance-article-abstract/doi/10.1093/jme/tjz048/5466258?redirectedFrom=fulltext>

COLLECTING MOSQUITO POO TO DETECT PATHOGENS

Testing vectors such as mosquitoes for the presence of human and veterinary pathogens poses many logistical challenges; the research is both time consuming and generally very expensive. A novel approach undertaken by researchers in Australia has been to test the faeces of the insect for the presence of various viruses that cause disease in humans. This allows for the testing of many insects rather than a few, hopefully resulting in a more sensitive system that can alert the public to the dangers of human pathogens circulating in the environment.

Source: *Journal of Medical Entomology* (4/Apr/2019), <https://academic.oup.com/jme/advance-article/>

[doi/10.1093/jme/tjz031/5420403](https://doi.org/10.1093/jme/tjz031/5420403)

INDONESIA: PYRETHROID RESISTANCE IN *Aedes Aegypti*

Insecticide resistance in the dengue vector *Aedes aegypti* is widespread. Resistance to the pyrethroids have been well documented in Indonesia. One form of resistance is 'knockdown' resistance (*kdr*), caused by genetic mutations. Molecular assays can detect these mutations, and a number of *kdr* mutations have been identified. Such research can help assist in developing effective mosquito control programs.

Source: *Journal of Medical Entomology* (3/Apr/2019), <https://academic.oup.com/jme/advance-article-abstract/doi/10.1093/jme/tjz035/5426653?redirectedFrom=fulltext>

BED BUGS IN AN OFFICE ENVIRONMENT

Bed bug infestations have been reported from a vast range of locations, including in offices. However, up until recently, infestations in the latter situation have not been well studied. A group of researchers from eastern USA investigated bed bugs in an office environment where repeated reports of bed bugs occurred over a two-year period. In spite of the bed bugs found to be highly concentrated, it took an extraordinary 69 days to eradicate the infestation. A combination of monitors, dry ice traps, and limited insecticidal dust treatments were used to eliminate the insects.

Source: *Journal of Medical Entomology* (2/April/2019), <https://academic.oup.com/jee/advance-article-abstract/doi/10.1093/jee/toz108/5481624>

BED BUGS: NEW APPLICATION FOR FUNGAL BIOINSECTICIDE

In the US, the fungal pathogen *Beauveria bassiana* is registered for the control of the common bed bug, *Cimex lectularius*. Researchers tested the effectiveness of the fungus when applied to mattress covers with and without permethrin impregnation. The permethrin impregnated cover reduced spore activation by 10%, however high mortality was still achieved in the bed bugs tested. Unfortunately in none of the treatments undertaken was a complete kill achieved. (SLD: there will be the question as to if people would want their bedding sprayed with fungal spores).

Source: *Journal of Economic Entomology* (April/2019), <https://academic.oup.com/jee/advance-article-abstract/doi/10.1093/jee/toz135/5496991?redirectedFrom=fulltext>

KOREA: CURRENT STATUS OF TICK-BORNE DISEASES IN SOUTH KOREA

Ticks are known to transmit a range of pathogens including viruses, bacteria, protozoa, and rickettsia. A review of the incidence and distribution of tick-borne diseases in Korea was undertaken from government data. A number of diseases appear to be increasing including Lyme disease, Q fever, and severe fever with thrombocytopenia syndrome

(SFTS). A variety of other tick-borne diseases were also recorded.

Source: *Vector-Borne and Zoonotic Diseases* (27/Mar/2019), <https://www.liebertpub.com/doi/pdf/10.1089/vbz.2018.2298>

TAIWAN: MODELLING THE POTENTIAL DISTRIBUTION OF *Aedes Aegypti* WITH CLIMATE CHANGE

The dengue vector, *Aedes aegypti*, has the potential to enlarge its present distribution with climate change. To understand the possible future expansion of this species, modelling was undertaken to help determine the extent of this possible expansion. It is predicted with climate change that the species could expand its current distribution and management attempts should be undertaken to limit this happening.

Source: *Pest Management Science* (27/Mar/2019), <https://onlinelibrary.wiley.com/doi/10.1002/ps.5424>

PAKISTAN: RESISTANCE IN *MUSCA DOMESTICA*

Recently resistance to permethrin in the house fly, *Musca domestica* was reported in the Punjab province of Pakistan. In selective breeding for resistance, it was found that in just a few generations that permethrin resistance increased very rapidly. The study highlights the need to rotate insecticide classes to avoid the development of high levels of resistance.

Source: *Pest Management Science* (14/Mar/2019), <https://onlinelibrary.wiley.com/doi/10.1002/ps.5409>

EUROPE: REVIEW OF INFECTIOUS AGENTS CARRIED BY RODENTS

In an effort to determine the range of pathogens carried by rodents, a review of the literature was conducted spanning the years 1995-2016. Some 53 different pathogens were recorded, with 48 carried by brown rats (*Rattus norvegicus*) and 20 by the black rat (*Rattus rattus*). Generally pathogens were more common in rural areas rather than urban regions. Some of the microbes reported were very widespread across Europe. The review highlights the importance of rodents acting as reservoirs of various human diseases. ■

Source: *Infection Ecology & Epidemiology* (27/Feb/2019), www.tandfonline.com/doi/full/10.1080/2008686.2018.1553461





ICUP 2020: Date and Venue Announced for

Held once every three years, the dates and venue for the next International Conference on Urban Pests (ICUP) have been announced by the organisers.

The conference is, once again, to be held in Europe and will take place from 29 June to 1 July 2020 at the prestigious Pompeu Fabra University, in Barcelona, Spain.

The 2020 organising team, is chaired by Dr Rubén Bueno from Laboratorios Lokímica based in Alicante, Spain. Dr Rubén Bueno explains: "Since the close of the previous ICUP 2017 in Birmingham, our 2020 Organising Committee has been working hard laying the foundations for what promises to be another stimulating and productive event."

As at previous ICUP conferences, the programme will address the science and management of a wide variety of urban pests and vectors, including those of hygiene, structural and medical importance. Pests of rising significance, which have caused researchers to evaluate management practices and the future direction of urban pest control will be addressed. The impact of regulatory and stewardship challenges will also be included.

In addition to the main conference sessions, there will be break-out sessions and workshops, as well as the ever popular conference dinner.

Equally important are the informal networking times when views are freely exchanged between delegates and friendships formed.

This highly popular, non-profit, conference is the leading international forum for sharing information and ideas on the impact, biology and control of pests in the urban environment. It is attended by entomologists, pest management professionals, and academic and government scientists from around the world. Uniquely, this event can boast a band of very loyal delegates, many of whom have attended either all, or virtually all, of the events since its formation in 1993.

Details regarding delegate registration and how to offer a paper for consideration by the organising committee will be announced in the near future when the ICUP 2020 website goes live.

Presentations from the previous conferences can be found on the central ICUP website at www.icup.org.uk.

This will be the tenth in the series of ICUP conferences. The previous conferences have been held in Cambridge, England (1993), Edinburgh, Scotland (1996) Prague, Czech Republic (1999), Charleston, USA (2002), Singapore (2005) Budapest, Hungary (2008), Ouro Preto, Brazil (2011), Zurich, Switzerland (2014) and Aston, Birmingham, UK in 2017. ■



Rapid Solutions Conference
presents

8-11th August
RACV Royal Pines, Gold Coast, Australia



Bringing together experts, professionals, suppliers and supporters of the pest management, building inspection, cleaning services and agricultural pest industries.

- **Connect, Inspire and Learn**
- **World Class Presenters**
- **Internationally Renowned Key-note Speaker**
- **Award-winning Gala Dinner Emcee & Comedian**
- **Located on the Beautiful Australian Gold Coast**

We look forward to welcoming you in August 2019!

Book today at rapidsolutions.com.au/educon



EduCON 2019 Program

THURSDAY 8TH AUGUST

17.00 - 19.00 **WELCOME RECEPTION** - Sponsored by Syngenta - Poolside Deck and Pool Area

FRIDAY 9TH AUGUST

09.15 - 09.30 **CONFERENCE WELCOME** - Belinda Smith - Monarch/Marquis

09.30 - 10.30 **KEYNOTE** - Craig Rispin - Monarch/Marquis

10.30 - 11.00 **MORNING TEA** - Royal Benowa Foyer/Prince

11.00 - 11.45	DARYLE SWARTZ Bayer Environmental Science Formulation Technology	DR DON EWART Consulting Entomologist Doing Spiders Better With Less	KAREN CONSTABLE HACCP HACCP Compliance In Pest Management
11.45 - 12.30	DAVID HELMERS An Initiative by Australian Men's Shed Association Spanner In The Works Program A Fun & Informative Insight To Men's Health	CHRIS RYAN Rapid Training Uncommon Household Pests	JAMES HOTTEN Syngenta Utilising Digital Innovation to Build Your Reputation
13.30 - 14.15	ANDREW MACKIE-SMITH Building Pro Managing Pre-Sale Building & Pest Inspections	WADE GRUNDEN The Sales Squad Strategies & Tactics for Growing A Business	RAPID TRAINING Sneak Preview of Exciting New Product
14.15 - 15.00	Professional Women in Australian Pest Management PWAPM Panel Session & Networking Afternoon Tea	DAVID LILLY Ecolab Rodent Welfare and Food Safety: How do we balance the risks?	STEPHEN SPENCER & TRADEMUTT Mental Health & Well-Being
15.30 - 16.15	MATT HUCKERBY Moray & Agnew Avoid Litigation & Common Legal Pitfalls	JAY TURNER Rapid Training Tips, Tricks & Bloody Great Ideas	TRICIA MACKIE-SMITH Building Pro Business Tips: Free PR & Digital Marketing
16.15 - 16.45	KEITH FARROW Keith Farrow Consulting Topic Coming Soon	DON DIXON D&D Dixon Building Consultant Opportunities in the 2020's For Inspection & Report Writing	PAUL COMMERFORD GREENZONE Greenzone Perimeter Barrier & More!
16.45 - 17.30	BRENDON SPENCER Active Oxy Limited Ducted Ozone Systems In Pest Management	DR DON EWART Consulting Entomologist Complying with Australian Standards / Meet the Finalists - AEPMA Awards Panel	JIM'S AWARD PRESENTATION Private Function

19.00 - 23.00 **GALA DINNER** - Sponsored by BASF - Monarch/Marquis

SATURDAY 10TH AUGUST

08.00 **EXHIBITION OPENS**

09.00 - 09.45	RAPID SOLUTIONS Launch TimberSecure	AEPMA Code Of Practice Rodents	MARK WILSON BASF The Termite Product Pipeline
09.45 - 10.30	MATT HUCKERBY Moray & Agnew Protecting Your Business Against Trademark Infringement	PETER MCCARTHY Ratsense/Pest IT Internet Of Things Rodent Sensor Systems	RAPID SOLUTIONS Hottest 10 Claims Stories - Including Lessons Learnt
11.00 - 11.45	ANDREW MACKIE-SMITH Building Pro Managing Relationships With Real Estate Agents	JOHN MURRAY Flick Anticimix Cert III Urban Pest Management Upgrade + New Units Of Competency for Cert IV	DECON SYSTEMS Topic Coming Soon
11.45 - 12.30	ANDREW USHER Catand Mergers and Acquisitions	RAPID SOLUTIONS Report Writing Insights & Advice On Writing Reports	BRAD WYNTER (Pest Register) Emerging Approaches To Building A Best Practice Pest Management Business
13.30 - 14.15	JASON NEWMAN Gilchrist Connell How Not To Get Sued (& What To Do If You Do!)	RAPID SOLUTIONS New Product Launch The New & Improved Report Writer Is Now Available!	STEPHEN DOGGETT NSW Health Pathology Bed Bugs & Deltiology DON DIXON How To Reach New Customers & How Do Most Find You?
14.15 - 15.00	MARK SHEPPARD Pest Education Cockroach Integrated Pest Management In Commercial Settings	DR PHIL RIDLEY The Bug Doctor Pest Detective Challenge - Test Your Speed & Knowledge!	DAVID WILSON Rapid Training How to Stay Ahead of the Game

SUNDAY 11TH AUGUST

07.30 - 12.30 **GOLF**- Sponsored by Moray & Agnew

09.00 - 13.00 **CHAMPAGNE HIGH TEA PAMPER SESSION** - Sponsored by Sherwood Chemicals



PMANZ 2019 Biennial Conference and AGM



Where: Waipuna Hotel and Conference Centre, Auckland

When: 22nd – 23rd August 2019

Be there...

Have you registered yet?

Registration Form is on the Next Page

COME HEAR

Robert (Bobby) Corrigan, PhD, Urban Rodentologist

Bobby has been active in the science of urban pest management for over 25 years. He serves a consultant who specializes in rodent pest management programs on a national and international scale and also as a part time research scientist with The City of New York's Department of Health.



Cor Vink PhD, MSc, Curator Natural History, Canterbury University.

Cor's main research interest is the systematics and taxonomy of New Zealand spiders, but he also worked on spider ecology, biosecurity and biological control. Cor is an Adjunct Senior Lecturer in the Ecology Department at Lincoln University.



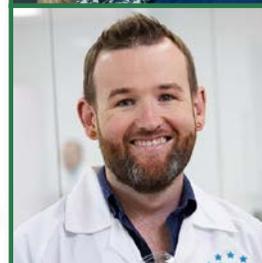
Helen Blackie, PhD, MSc, Boffa Miskell, Biosecurity Consultant

Prior to joining Boffa Miskell in 2014, Helen was Associate Director at the Centre for Wildlife Management and Conservation (Lincoln University), where she led a nationwide team of experts in engineering, creative design, animal behaviour, toxicology and ecology.



David Lilly, PhD, MEnt, Principal Entomologist, Ecolab Global RD&E

David is responsible for developing and supporting innovative pest management solutions for the larger Pest Elimination division. I have 15 years' experience in urban pest management, including both the auditing and/or development of tailored pest management solutions, and providing qualified technical support to high-needs customers.



PMANZ Conference 2019 Registration Form

1. Please print clearly
2. Forward completed form and payment to address below, or email and pay by internet banking
3. A cancellation fee of \$100 per delegate will apply, or your registration may be transferred to another person
4. Invoices (paid) will be issued as confirmation for your account records
5. Please retain a copy of this form for your records
6. Purchase orders will be accepted by way of confirmation.
7. Hotel accommodation is the responsibility of each delegate. Refer to Accommodation Guide under Conference 2019 on the PMANZ website: [click here](#)
8. The PMANZ council reserves the right to make changes to the published programme

PMANZ Members (includes GST)		Non-PMANZ Members (includes GST)	
Full Registration (includes Thursday dinner)	\$248.00	Full Registration (includes Thursday dinner)	\$350.00
Registration for Thursday (incl. dinner)	\$215.00	Registration for Thursday (incl. dinner)	\$275.00
Dinner (for those not attending Thursday)	\$ 92.00	Dinner (for those not attending Thursday)	\$ 92.00
Registration for Friday	\$120.00	Registration for Friday	\$180.00
Registering on the day	\$350.00	Registering on the day	\$350.00

Delegate PMANZ Member Non-Member

Title: _____ First Name: _____ Surname: _____

Name for ID Badge: _____

Address: _____

Tel: Bus: _____ Mob: _____

Email: _____

Privacy Act - I authorise the conference convener to disclose my name on the conference delegate list

I wish to register for the following:

- Full registration including Thursday dinner \$ _____
- Thursday sessions only (includes dinner) \$ _____
- Friday sessions only \$ _____
- Guest for Thursday dinner (\$92.00) \$ _____
- Name of guest _____ **Total \$** _____

Post or email to:

PMANZ
P O Box 133215,
Eastridge 1146,
Auckland, New
Zealand

Phone 0800 476 269
 Email: peter@pmanz.nz

Attach a cheque
 or

Direct Credit to Account:
02 0271 0185027 000

PAYMENT IS REQUIRED BY FRIDAY 26th JULY 2019



The National Pest Management Association presents

PEST WORLD 2019

OCTOBER 15-18, 2019
SAN DIEGO
CALIFORNIA

Every year, NPMA gathers thousands of pest management professionals from across the globe to offer opportunities for information sharing, provide access to the latest products, services, and technologies in the 100,000 square foot exhibit hall, and generate critical thinking in world-class educational sessions.

For more information, visit
www.PestWorld2019.org





OPENING GENERAL SESSION FEATURING RICHARD P. MONTAÑEZ

Sponsored by 
Agriculture Division of DowDuPont™

INDUSTRY AWARDS AND GENERAL SESSION FEATURING ROBERT RICHMAN

Sponsored by 



EDUCATIONAL PROGRAM HIGHLIGHTS

World Pest Day: Global Perspectives on Pest Control

Pascal Cai, Chinese Pest Control Association, Beijing, China; Moisés Capetillo, ANCPVAC, Mexico; Raju Parulkur, Pestokem, Mumbai, India

Diversity in Pest Management: Results from An Industry-Wide Study

Dan Moreland, PCT Magazine, Valley View, OH

A Panoramic Global View of Mosquito Management Opportunities: from Residential to Large-Scale Control Programs

Gene White, BCE, Rentokil Steritech, White Lake, MI

Rodent Management Short Course—Part 1, 2 & 3

Bobby Corrigan, Ph.D., RMC Pest Management Consulting, West Lafayette, IN

Join us for one
or more of these
great Optional Tours
during PestWorld:

- Little Italy Cultural Tour
- USS Midway Docent-Led Tour
- San Diego Zoo: Behind the Scenes Tour
- Kayaking La Jolla Cove
- Trolley n' Taps Downtown Brewery Tour

Additional fee required to add one of these events.

REGISTER EARLY! RATES WILL INCREASE SEPTEMBER 2!

VISIT WWW.PESTWORLD2019.ORG FOR MORE INFORMATION AND TO REGISTER.

Events Calendar

Upcoming pest management events from across the globe

Is yours missing? Send details to [Stephen Doggett](#) or [David Lilly!](#)

Educon 2019 (Rapid Solutions)

8-11 August 2019

RACV Royal Pines

Gold Coast, Qld, Australia

www.rapidsolutions.com.au/our-story/our-conference

PMANZ 2019 Biennial Conference and AGM

22-23 August 2019

Waipuna Hotel and Conference Centre
Auckland, New Zealand

www.pmanz.nz/2019-conference-and-agm.html

FAOPMA-Pest Summit 2019

24-27 September 2019

Daejon Convention Center
Daejon, Korea

www.faopma2019korea.org

PestWorld (NPMA)

15-18 October 2019

San Diego, California

www.pestworld2019.org

Third EuroAsian Pest Management Conference 2019

9-11 September 2019

Hotel Astrus

Moscow, Russia

www.pestmanagement.su

International Conference on Urban Pests (ICUP)

29 June - 1 July 2020

Pompeu Fabra University
Barcelona, Spain

www.icup.org.uk

Future PestWorld Events

2020: 13-16 October, Nashville

2021: 2-5 November, Las Vegas

2022: 11-14 October, Boston

2023: 17-20 October, Honolulu

2024: 22-25 October, Denver

2025: 21-24 October, Orlando

2026: 20-23 October, Grapevine

Name This Pest!

Worked out what this is from the last issue? Find out on the next page!



Stephen L. Doggett

Hint: while it is obviously a flea, can you name the species? This was once very common and extremely widespread, but in some countries has not been seen for decades.

Human Flea

Also known as 'House Fleas'

Text by Marilyn J. Geary



The human or house flea is probably the only flea species in history that has brought applause and accolades from human

audiences for its unique appearances in flea circuses around the world. As the species name implies, *Pulex irritans*, the flea is much better known for its nuisance value as well as its vector status in relation to humans and their health. This flea is medically significant as it has the capacity to move disease causing pathogens between wild reservoir hosts to domestic pets and rodents, and then ultimately to the human population. In developed countries it is now less commonly associated with human habitation due to better housekeeping practices, efficient cleaning devices and effective insecticides. However, small populations of this flea may still be present in a range of coarse coated mammals close by to human settlements

ADULTS

Pulex irritans adults are a rusty red brown in colour, shiny and measure between 2.0-3.5mm in length, the male always being smaller. They are strongly flattened laterally and have a scattering of backward pointing spines and hairs that assist them in their parasitic ways. Each adult flea has six, five segmented legs with large coxae to enable sudden propulsion (i.e. jumping). The flea's head is short but well equipped with antennae, ocelli and other sensory organs to assist in locating a suitable host through light variation, carbon dioxide detection, changing air currents, odours, and vibrations. Once a suitable host is detected, the flea's efficient piercing and sucking mouthparts enable easy access to the host's blood capillaries.



Human fleas were often dressed up as people. Source: Wikipedia, CC licence



Flea Circus. Source: Wikipedia, CC licence

metamorphosis. It is known to live well in excess of a year and can breed throughout that time. Adult fleas exhibit no mating rituals or illustrate any parental care. Both sexes of the flea require a blood meal, but for the female flea it is vital for the production of viable eggs. Flea eggs and other immature stages provide a ready food supply for a range predators that include beetles, mites, pseudoscorpions, and ants. Given the adult flea's ability to rapidly jump vertically it has a perfect escape mechanism to avoid predation, although many hosts can dislodge this parasite through grooming and constant scratching.

IMMATURE STAGES

The female flea has the capacity to lay 400 eggs during her life span. Each egg is white, oval in shape and can be laid directly on the host or on the immediate substrate. Hatching occurs within 4-6 days of deposition, or can be delayed. The legless pale coloured larval stage has 13 segments, is extremely active with a distinct head, with no eyes. Its cylindrical body has a sparse covering of strong hairs that point backwards and a pair of sclerotized hooks that are found on the larva's final body segment. Throughout the three instars or growth stages, the larvae are nonparasitic and feed only on a diet of environmental debris or faecal material from the adult fleas. After 2-3 weeks, the mature larva spins a loosely woven ovoid cocoon of silk from its salivary glands. The freshly spun silk attracts fine particles to the surface of the cocoon, that aids in camouflage. The pupation stage can be as short as several weeks but will be dependent on other factors such as temperature and host availability.

DISTRIBUTION

This flea has been recorded worldwide with the exception of polar regions.

HABITAT

The different life stages of *Pulex irritans* fleas are found in close proximity to their chosen host. As this flea will blood feed on most large mammals, wild and domestic, the potential habitat is vast. This flea does particularly well in animal sheds as the continuous supply of manure, and a readily available blood source, ensure optimal conditions for survival.

BIOLOGY

The human flea undergoes complete

MEDICAL IMPORTANCE

Pulex irritans is a known vector of several important pathogens associated with plague, murine typhus, and rickettsia. This flea is an intermediate host for parasitic worms that include the dog tapeworm and the dwarf tapeworm. Bite reaction in humans often results in irritation and a papular rash. An allergic reaction may have additional symptoms of swelling, burning or redness at each raised itchy bite site. Flea bites can appear in small clusters and may persist for several weeks. Individuals that suffer from excessive bites have been known to develop anaemia and secondary skin infections.

TREATMENT & CONTROL

In order to achieve effective control of this pest species it is imperative to treat both animal hosts and their immediate environment. This may include removal of infested bedding material and treatment of animal shelters, kennels and sheds, in addition to an anti-parasitic treatment for any domestic pets and infested livestock. Domestic dwellings must be treated in conjunction to external structures if extermination is to be achieved. Good housekeeping practices should be undertaken on a regular basis to eliminate potential habitat for this flea. Insecticides utilised for control must have residual properties to work towards achieving elimination of this insect pest. ■

Merilyn J. Geary runs the pathology service at the Department of Medical Entomology at Westmead Hospital, Sydney, Australia.

Name This Pest!

Find out what this is in the next edition

Stephen L. Doggett



Stephen L. Doggett

Hint: this spiky little fellow can produce nasty skin irritations with those spines. You may think you know what this is, but guess again as it is not the most commonly seen species in this group. Length around 10mm.

New Story, New Research, New Product, New Event, New Ideas?

Then why not share all this new stuff with the rest of the World!

Contributions to the FAOPMA Magazine are welcome

AIMS AND SCOPE

The FAOPMA Newsletter is published quarterly and aims to provide highly quality and science based information pertaining to the pest management industry for FAOPMA members.

Submissions must be relevant to the regions covering FAOPMA members (see www.faopma.com for a list of associations and the respective countries they serve). Submissions may include: original articles based on new research; new products; new events; conference reviews; news items; opinion pieces; stories on industry icons; tributes to past colleagues; book reviews; general articles on pests, pest science, or pest management; and articles relevant to new laws, regulations or other legal issues pertaining to the pest management industry. **Advertorials offend and will not be accepted; our members crave real science!**

CONTRIBUTION GUIDELINES

Contributions are to be in Microsoft Word. DO NOT EMBED IMAGES, send as separate files (see below). For conference flyers and announcements, Adobe PDF format is acceptable.

CONTRIBUTION FORMAT

Title (3-10 words): provide a succinct but eye catching title.

Summary: provide a short summary of the submission in no more than 20 words

Authors: list authors by First name, Surname, include middle name/s as initials. Please also include title, affiliation and email if you wish to be contacted. The affiliations will appear at the end of the formatted submission.

Body of text: 600-1,500 words. Please include subheadings. Large articles may be considered at the discretion of the Editors.

Tables: if possible, avoid using tables.

References: no more than 10.

Images and Figures: (as noted above, do not embed in Word

files). Images are to be full colour and jpg format. If the file size is more than 5MB, then compress the image (i.e. decrease image quality in a photo editor such as Photoshop). Please send several images, but usage of the images will be dependent on publication space. Include a short caption describing the images/figures.

Copyright: it will be assumed that you own the copyright of the information and images submitted, or have written permissions to use these. **Failure to adhere to international copyright laws is your responsibility.** The Editors will only use your information and images for the submitted article, unless otherwise requested. However, articles may reappear online, in print, or in other media. They may be translated and then reprinted in the respective FAOPMA member newsletters.

Acknowledgments: include any potential conflict of interests and sources of funding (if relevant). If acknowledging colleagues, include their full name, position, company or employer, city and country.

Language: English. Write in plain language and avoid complex scientific terms. Avoid dot points and use correct grammar (send to a professional editing service if in doubt).

Galley Proofs: for articles and larger manuscripts (of more than one page) a galley proof of the typeset article will be sent to authors for review. Please annotate the PDF and return to the editors within 48 hours. A nil response will be seen as acceptance of the manuscript.

Review: if the Editors are in doubt about the quality of a submission, then the manuscript may be sent for external peer review. Such reviewers will remain anonymous to the authors.

Access and Sharing: authors are permitted to make their paper available on any platform, such as ResearchGate.

Submissions will be published at the discretion of the Editors.

Editorial contacts are listed on the following pages. ■

FAOPMA Executive Committee

The leaders behind the Association



Ms. Huang Xiao Yun (President)
Chinese Pest Control Association (CPCA)

Ms. Huang is a trained medical Dr. and served as a director of public health in the Ministry of Transportation from 1983 to 1993. She is the founder of the Chinese Pest Control Association. She currently serves as the President of FAOPMA and the CEO of the Chinese pest control association. She is also the original proponent of "World Pest Day".

Mr. Suchart Leelayouthyotin (Vice President)
Thailand Pest Management Association (TPMA)

ExCom of Pacific Rim Termite Research Group (PR-TRG).
Chief Advisor of Thailand Pest Management Association (TPMA).
Regular Speaker of Thai-FDA Pest control Licensing Course.
Chairman and Founder of King Service Center, since 1977.



Dr. Raymond Lee (Honorary Secretary)
The Pest Control Association of Malaysia (PCAM)

Dr Lee has been involved in the Pest management Industry since 1986 and is the founder of PEST DYNAMICS (M) SDN BHD, Malaysia. His involvement in the Malaysian Pest Control Industry also includes being the founder member and Protem COMMITTEE (1993/94) . He has been an Executive Committee member of FAOPMA since 2013 and currently, serves as Honorary Secretary of FAOPMA.

Mr. Junichiro Katayama (Vice Treasurer)
Japan Pest Control Association (JPCA)

Junichiro was born in 1965 in Osaka. He has been involved in FAOPMA since 2001 and served as President over 2007-2009. He has been president of Semco since 2000 which is the largest distributor for the professional pest management industry in Japan and an exporter of the WHO certified residual sprayers. Junichiro loves sports such as water polo, full marathon, and recently competed in triathlon!





Mr. Vasili Tsoutouras (President Elect)

Australian Environmental Pest Managers Association Ltd. (AEPMA)

Vasili Tsoutouras is the CEO of Allstate Pest Control, a family-owned and operated business. He has a great passion for the business and the pest management industry that has led him to be appointed to the position of South Australian Director of the AEPMA and he also sits as the President of the National Board, President Elect of the FAOPMA and President of the Global Pest Management Coalition.

Mr. Won Soo Hong (1st Reserve Member)

Korea Pest Control Association (KPCA)

Mr. Won Soo HONG studied agricultural chemistry at the Konkuk University in Seoul. He is the founder of Pestco Co.,Ltd in 1984 and has been the representative until today. In 1999, he became a director of KPCA(Korea Pest Control Association) and from 2015 he has been the President of KPCA. Mr. Won Soo HONG is also the 1st Reserve Member of FAOPMA.



Mrs. Theresa Villegas (2nd Reserve Member)

Pest Exterminators Association of the Philippines (PEAP)

Wife of the late Mr. Villegas Past President of FAOPMA. General Manager of Macodyn, inc with almost 50 years of experience in the Pest Control Business in the Philippines. Distributor of Chemicals and Equipment of the following companies: Jardine Distribution, Syngenta Philippines, Leads Environmental Health.

Miss Catherine Yan (Administrator)

Hong Kong Pest Management Association (HKPMA)

Catherine has been working in the environmental services industry for 34 years and was the President of Hong Kong Pest Management Association during 1989-1990 and 2008-2018. Currently, she is the Honorary President for the Association. Catherine joined FAOPMA as the Administrator in 2011 to run the secretariat office.



FAOPMA Contacts

Address: Room 901, 18 Hysan Avenue, Causeway Bay, Hong Kong

Tel: (852) 3112 0993

Fax: (852) 2577 7858

Email: info@faopma.com

Website: www.faopma.com

Editorial Contacts

Stephen Doggett:
Stephen.Doggett@health.nsw.gov.au

David Lilly:
David.Lilly@ecolab.com

Association Presidents

The leaders from the member associations that make up FAOPMA



Mr. Vasili Tsoutouras (Australia)

Australian Environmental Pest Managers Association Ltd. (AEPMA)

Vasili Tsoutouras is the CEO of Allstate Pest Control, a family-owned and operated business. He has a great passion for the business and the pest management industry that has led him to be appointed to the position of South Australian Director of the AEPMA and he also sits as the President of the National Board, President Elect of the FAOPMA and President of the Global Pest Management Coalition.

Ms. Huang Xiao Yun (China)

Chinese Pest Control Association (CPCA)

Ms. Huang is a trained medical Dr. and served as a director of public health in the Ministry of Transportation from 1983 to 1993. She is the founder of the Chinese Pest Control Association. She currently serves as the president of FAOPMA and the CEO of the Chinese pest control association. She is also the original proponent of "World Pest Day".



Mr. Choi Ping Yin (Hong Kong)

Hong Kong Pest Management Association (HKPMA)

Mr. Yin has been working in the pest control services industry for 43 years. He joined the Hong Kong Pest Management Association in 2000, and has been a member of the Executive Committee since 2014. He has taken up various functions such as Chairman of Training Sub-Committee, Honorary Treasurer, and Public Relations Officer. Currently, he is the elected President of HKPMA for the term 2018-2019.

Mr. Jaldhi Rajnikant Trivedi (India)

Indian Pest Control Association (IPCA)

After completing a BSc in 1985, Mr. Trivedi joined his family pest management company, Elite Corporation. He strengthened his knowledge by attending various short courses at several Government of India institutes. In 2012, he was selected as a Master Trainer for Methyl Bromide Fumigation. In 2018, he joined the Global Pest Management Coalition to help attain a safer pest free environment for future generations.





Mr. Boyke Arie Pahlevi (Indonesia)
Indonesia Pest Control Association (ASPPHAMI)

Mr. Pahlevi has been President since 2015, is an active member of the Indonesian Chamber of Commerce, and the founder of Riztra Pest Control. He actively promotes the development of the pest management industry in Indonesia. He was instrumental in establishing 'Pest Academy', a national conference and exhibition first held in 2017. This is a biennial event and will be held again in 2019.

Mr. Kenjiro Yamaguchi (Japan)
Japan Pest Control Association (JPCA)

Mr. Yamaguchi founded Yokohama Sun-Self Co., Ltd. in 1970. He became a member of the board of directors, Kanagawa Prefecture Pest Control Association in 1988, and a member of the board of directors, Japan Pest Control Association in 1998. Mr. Yamaguchi became the chairman of the Japan Pest Control Association in May, 2018.



Mr. Won Soo Hong (Korea)
Korea Pest Control Association (KPCA)

Mr. Won Soo HONG studied agricultural chemistry at the Konkuk University in Seoul. He is the founder of Pestco Co.,Ltd in 1984 and has been the representative until today. In 1999, he became a director of KPCA(Korea Pest Control Association) and from 2015 he has been the President of KPCA. Mr. Won Soo HONG is also the 1st Reserve Member of FAOPMA.

Mr. Nor Hisham Badri (Malaysia)
The Pest Control Association of Malaysia (PCAM)

Mr. Badri studied economics at West Texas A&M State University. He was formerly the Honorary Secretary for PCAM (2013-2015), Vice President (Projects, 2011-2013), and Vice President (Communications, 2001-2003). He was member of the Working Group in developing the National Occupational Skills Standard (NOSS) in 2015. He was also instrumental in the development of Malaysian Standard (MS 1849) on Termite Management in 2005.

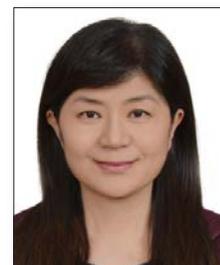


Mr. Andrew Chan (Singapore)
Singapore Pest Management Association (SPMA)

Mr. Andrew Chan is the President of Singapore Pest Management Association (SPMA). He has been the President since 2006 and is actively involved in promoting the pest management industry in Singapore and the region, working closely with all the former Pest Summit partners in Indonesia, Malaysia, Philippines and Thailand respectively. He was actively involved and successfully organized five Pest Summit events since 2003.

Prof. Hsiu-Hua Pai (Taiwan)
Taiwan Environmental Pest Management Association (TEPMA)

Prof. Pai is currently engaged in the prevention and control of mosquito-borne diseases and the efficacy test of insecticides against various pests. She hosts a qualified insecticide efficacy testing laboratory certified by the Taiwan Environmental Protection Administration. Regularly Prof. Pai meets with professionals in the environmental pesticide manufacturing, retailer and vector control industries to discuss professional issues and provide expert advice.





Mr. Supanut Kiatyingpracha (Thailand)

Thailand Pest Management Association (TPMA)

Mr. Kiatyingpracha has a MBA in Operation Management and a BSc from Kasetsart University. He is the Director of Thai Sky Clean. Previously, he was the Business Manager for BASF (THAI), and Service Manager, Pest Control Department, Property Care Services Ltd. He was the Chairman of Sponsors and Exhibitors at FAOPMA-Pest Summit 2017 and currently a member of the Thailand Pest Management Association Executive Committee, 2017-2019.

Mr. Danilo L. Magpantay (Philippines)

The United Pest Management Association of the Philippines (TUPMAPHILS)

Mr. Magpantay is an entomologist from the University of the Philippines, and a technical and former branch manager of Rentokil Philippines for over 14 years. Currently he operates his own Bugkil Pest Management business offering extermination and fumigation services. Mr. Magpantay is the President of The United Pest Management Association of the Philippines (TUPMAPHILS) for the ensuing year 2019-2020.



Mr. Nguyen Bao Son (Vietnam)

Viet Nam Association of Fumigation

To be provided.

Mr. Eitan Amichai (Israel – Associate Member)

Eitan Amichai Pest Management IPM Ltd

Founded the company in Israel in 1963, is still active in its management. Israel's largest and leading pest control company. The world's first company that has developed and operates digital pest control in thousands of plants and food businesses in Israel and around the world.



Memories from FAOPMA-Pest Summit



See you in Daejeon, 24-27 Sep 2019
www.faopma2019korea.org