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Bugged by Bugs



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From the **Dean**

The second semester for academic session 2013/2014 has nearly reached the end. I am truly indebted to all the academic, administrative and technical staff of the School of Biological Sciences for their untiring efforts in sustaining and increasing our school Key Performance Index (KPI) for 2014. I am pleased to announce that during the 49th convocation on April 26th 2014, a total of 19 PhD and 31 MSc candidates graduated from our school. Congratulations to all of them.

This year also witnessed the appointment of Professor Siti Azizah Mohd. Nor as the new Director of Centre for Research Initiative (CRI) in Life Sciences and Associate Professor Amirul Al-Ashraf Abdullah as our new Deputy Dean of Research. I would also take this opportunity to congratulate Professor Siti Azizah Mohd. Nor for successfully chairing the Asian Fish Biodiversity Conference in February this year. This Conference was co-organized by our School.

My two deputy deans have made the School proud when their inventions were awarded recognition in two different competitions: Associate Professor Amir Hamzah Ahmad Ghazali who won a Gold Medal in the 25th International Innovation and Technology Exhibition (ITEX) in May 2014, and Associate Professor Amirul Al-Ashraf Abdullah had secured a Bronze Medal in Invention and Innovation Awards, Malaysia Technology Expo in February 2014.

In this second issue of Bio-Bulletin 2014, I wish to highlight that we are going to miss two of our prominent professors who are retiring this semester. Throughout their careers, both emerged as internationally recognized researchers and lecturers in their specific fields: Professors Baharuddin Salleh in *Fusarium* research and Chan Lai Keng in Plant tissue culture. Their valuable contributions are highly appreciated and we wish them the best in their future undertakings.

Two Memorandum of Understanding (MoU) had been signed this year, the first one was on the 6th of February with the Rubber Industry Smallholders Development Authority (RISDA) and the second one was with the Indonesian Institute of Limnology, Jakarta, on March 14. I would like to highlight that the School will be hosting the 9th IMTGT Uninet Conference 2014 which will be held at Bayview Hotel Georgetown, Penang, from 3-5 November 2014. On behalf of the Organizing committee, it is my pleasure to extend the invitation to all readers of Bio-Bulletin to participate in the Conference.

Finally, I would like to express my sincere gratitude to all the staff of the School of Biological Sciences for their continuous co-operation and support to ensure that the standard of our academic education, research, teaching, facilities, and student care are of the highest order.

Associate Professor Ahmad Sofiman Othman
Dean, School of Biological Sciences



From the **Editor-in-Chief**

A few months ago, I started noticing numerous red spots on my lower legs. Initially the symptoms were mild, infrequent and the spots faded off within a week. So I ignored it and thought it was just a skin rash. However, the symptoms got worse and more frequent until I had to go see a dermatologist at the hospital one day when I noticed the rash on my arms as well. I was told by the skin specialist that the red spots were caused by insect bites. Thus begin a very stressful time of cleaning, vacuuming, spraying, washing and bagging all my stuff but the symptoms persisted. Eventually I gave up and called in the professional pest control people. To cut a long story short, they eventually managed to trace the problem to an infestation of cat fleas in my office at the School of Biological Sciences. The indiscriminate discard of food wastes by students and staff into the wastebaskets placed along the office corridors has attracted numerous stray cats that carry fleas. My office room has now been sprayed and fogged with chemicals to kill off the cat fleas but the stray cats continue to roam the corridors... Thus, the inspiration for this second issue of the Bio-Bulletin, "Bugged by Bugs"!

Whether it is cat fleas or mosquitoes, cockroaches, ants, termites, bed bugs, etc., many of us have experienced being greatly inconvenienced by these bugs and some of them are vectors of deadly human diseases. It is therefore not surprising that bugs are a subject matter of great research interests. The Entomology and Parasitology group at the School of Biological Sciences has the highest number of faculty members and the School also houses the internationally accredited Vector Control Unit. Some of the insect research being conducted by our staff are highlighted in this issue of the Bio-bulletin and includes the human health hazards of rove beetles and the amazing ability of mosquitoes to adapt to new man-made surroundings. Innovative research in exploring the use of local plant extracts as bio-larvicides for the *Aedes* mosquitoes are also highlighted. The increasing prevalence of bugs infesting our homes, offices and public spaces has made pest control a very dynamic and lucrative industry. Students graduating from the School of Biological Sciences with specialization in entomology and vector control are in high demand by pest control companies. In this magazine issue, we highlighted the success story of one of our former student who started her own pest control company. She shares how her training in USM had benefitted her in her career and the various issues of controlling pests in the homes and offices in Malaysia.

This issue of Bio-Bulletin also highlights the research on various plant-related topics such as the new discovery of local plant extracts with anti-tuberculosis properties, the rattan resources of Penang, the lucrative potential of agarwood as well as the world of mycorrhizas; the latter two topics highlighting the interesting relationship between plants and fungi. Articles with an environmental and aquatic biology theme include sea turtle conservation, an Ocean Awareness Week organized by USM students and my recent trip to the Great Barrier Reef.

Congratulations to Nethia, one of our editors, for the birth of her new baby girl!

Happy reading and thank you for your support of the Bio-Bulletin magazine.

Professor Ng Wing Keong, FASc



Human health hazards caused by **Rove Beetles**

Wan Fatma Zuharah and Maryam Sufian

Bugs! They are fascinating little creatures that move by creeping, crawling, slithering, sliding and fluttering around your home. Some of these bugs or certain species of insects are potentially dangerous to human beings. For example, the rove beetles *Paederus fuscipes*.

Rove beetle from the family Staphylinidae is a large family of insects found all over the world with over 47,744 described species in 3,847 genera and 31 subfamilies. About 650 described species of the *Paederus* rove beetles, subtribe Paederina, are extensively disseminated globally.

These rove beetles are commonly known as the 'Beetle Tomcat', 'Skirt and Blouse Beetle' and locally recognized as 'Semut Semai', 'Semut Kayap' or 'Charlie'. Rove beetles such as the *P. fuscipes* are mainly distinguished by their slender elongated body with short elytra that leave more than half of their abdomens exposed. These insects are normally 7 to 13 mm in length, brightly coloured with metallic blue or green elytra and has black and bright orange or red on the pronotum and the basal segment of the abdomen. This specific colour pattern with bright colours on their body may be an example of aposematic which is a caution sign that give a word of warning towards potential predators.



The adult *Paederus fuscipes* rove beetle.

Habitats of *Paederus fuscipes* beetles

Beetles of the genus *Paederus* can be found dispersed in all temperate and tropical continents, north and south of the equator, throughout the North, Central and South America, Europe, Africa, Asia and Australasia, with the exception of Antarctica. In Malaysia, the prevalent species of *Paederus* is *P. fuscipes* which are mainly found distributed throughout the country in marshes as well as in the paddy fields. Interestingly, even though they are insects of public health concerns, it also plays an important role as bio-control agents in controlling other insect pests. These rove beetles usually prey upon leafhoppers, thrips, planthoppers and other rice pests in the paddy fields which are found predominantly on the western part of Peninsular Malaysia. Other habitats which *Paederus* spp. beetles can be found are the freshwater lakes, marshes, riverine areas, crop fields and other moist terrestrial environment.

Paddy fields are the natural habitat of *Paederus fuscipes* beetles.



Public health concerns

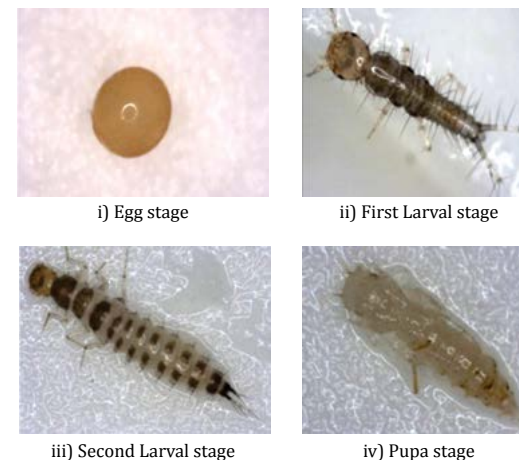
The beetle species, *P. fuscipes*, was first reported in 1981 in Java (Indonesia) when a Anjet-Kidoel lighthouse personnel was found to be a victim of dermatitis. Since the 1990's, the *P. fuscipes* beetle has become a public health concern after many outbreaks was reported worldwide. Human dermatitis is widely reported in the world and has caught public interest whenever these rove beetles infested human settlements. *Paederus* beetles infestations have been reported in many countries and had cause dermatitis outbreaks in the world including Australia, Japan, China, Malaysia, Iran, Iraq, India, Sri Lanka, Pakistan, Sierra Leone, etc. In Malaysia, *P. fuscipes* has been reported as the dermatitis causing agents for the outbreak cases in Terengganu, Kelantan and in Penang, especially in the areas of Permatang Pau and Kepala Batas.

Generally, rove beetles are harmless creatures. From about 50,000 staphylinids species found around the world, only the genus of *Paederus*, *Paederidus* and *Megalopaederus* are of public health concerns. These beetles have an unusual habit of raising the tip of their abdomen in a way that resembles a scorpion whenever they feel threatened. This intimidating behavior led people to assume that these beetles are far more harmful than they really are. The adult beetle of *P. fuscipes* does not bite nor sting. Nevertheless, these beetles are dangerous if they are unintentional brushed against or crushed over the human skin as this will release its coelomic fluid that contains a powerful toxin called pederin which circulates in their hemolymph. Once in contact with human skin, pain occurs.

Effects of pederin on humans

The toxin known as pederin ($C_{25}H_{45}O_9N$) is an amide with two tetrahydropyran rings and makes up approximately 0.025% of the *P. fuscipes*'s body weight. It has been confirmed that the production of pederin depends on the

activities of an endo-symbiont bacteria (*Pseudomonas* spp.) within the *Paederus*'s body. The tail of this insect is known to contain the highest pederin concentration compared to other body parts. Even in the immature stages of *P. fuscipes*, pederin do exist in the egg and pupa stages. The manufacture of pederin is largely restricted to adult female beetles. However, the larvae as well as the males can store pederin obtained maternally such as through eggs or by ingestion.



Immature stages of the *Paederus fuscipes* beetle.

Consequently, those in contact with the *P. fuscipes* beetles might be a victim of paederus dermatitis (PD) which is a characteristic skin irritation that occurs if one of the beetles is accidentally crushed against the human skin. PD which is also known as linear dermatitis or blister beetle dermatitis is a peculiar irritant contact dermatitis categorized by erythematous and bullous lesions of abrupt onset on exposed areas of the body. Other names given to PD include 'spider-lick', 'whiplash dermatitis' and 'Nairobi fly dermatitis'. The affected areas are mainly on the face, neck, thorax, arms, forearms, thighs, hands, legs, abdomen, ears and even the eyes which sometimes can cause temporally blindness. Rarely affected areas are the palms and feet soles. Infected skin areas will turn red, itchy and eventually become swollen after 24 to 48 hours from first contact. A few days later, visible scars will appear. It will take a few more weeks or sometimes months for the scar to be totally cleared. Sometimes secondary infections can occur if scratching causes extensive exfoliating as well as ulcerating dermatitis which requires hospitalization.



Paederus dermatitis on affected areas such as elbow, neck and face.

Prevention of *Paederus* dermatitis

The principal way of preventing pederin-based skin trauma is to prevent human-beetle contact. However, if a *P. fuscipes* beetle lands on the skin, there is no cause for alarm. Avoid handling the beetle directly and do not crush the beetle against exposed areas of the skin; just remove it gently by blowing it away. They will only release pederin when they feel threatened. To be safe, immediately wash contact area of the skin with water. If contact with pederin did occur, it will slowly penetrate the skin and by washing shortly after exposure with soap and water, this will remove most of the toxin before it has time to penetrate into the skin. Since these beetles are attracted to lights at night, switching off the lights will reduce entry of beetles into buildings. Similarly, by closing the doors and windows as well as using fine mosquito netting will also reduce the risk of beetles entering our homes and offices. Medical attention should be sought if there is a severe skin reaction.

Research on rove beetles in USM

Not much research has been done in Malaysia on the *P. fuscipes* beetle as an insect of public health importance. One area of research currently being conducted in USM on these rove beetles is the exploration of the potential factors that may have caused the increasing intrusion of *Paederus* spp. into human living areas from their usual habitats in the paddy fields. Firstly, food/prey shortages in the rice fields subsequent to disturbance by human activities during rice harvesting such as straw cutting and burning can cause these beetle predators to search for food from areas nearby since they no longer have their usual food supply to support their population. Secondly, mass dispersal towards human habitations may also be due to their attraction towards bright lights from the cities. The *Paederus* spp., especially the adults, is active during the day in search of prey and are attracted by luminescent and fluorescent lights at night which bring them into contact with human beings. Thirdly, suitable environmental factors may be the cause that triggers the beetles to disperse from the paddy fields towards human habitations. Further compounding the problem is the intensive and unmonitored usage of herbicides, fungicides and insecticides by the farmers which may create chemical-resistant beetles thereby contributing to the current massive explosion of *P. fuscipes* populations in Malaysia. By studying the ecology, biology and behavior of these rove beetles, we hope to generate scientific data that can help us to control their population and movements in order to prevent or reduce the human health threats and prevent us from being a victim of PD in the future.



Dr. Wan Fatma Zuharah Wan Musthapa is a medical entomologist and her research focuses on arthropods of public health importance. Her research emphasizes on the ecology, biology, and control of insects and it's interaction with humans.

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The mysterious life of the London Underground

Nur Faeza Abu Kassim

Discovery of an exotic mosquito

New research has shed light on a mysterious species of mosquito in Australia that can live and breed in underground environments and can lay eggs without a blood meal. Commonly known as the London Underground Mosquito, *Culex molestus* is thought to have been introduced into the Australian continent in the 1940s. The mosquito is thought to be the only Australian species that will refuse a blood meal if they are yet to lay their eggs. The discovery of this species of mosquito is said to be important as it may affect the designing of subterranean water storage systems in cities to ensure limited access for mosquito populations. The mosquitoes are usually found in the infected tanks or in the unused storm water pipelines rather than breeding in ponds, pools or wetlands. The discovery of the *Cx. molestus* has been published in the Journal of Vector Ecology, Australian Journal of Entomology and Journal of American Mosquito Control Association. I was privileged to be one of the researchers involved in the discovery and the study of *Cx. molestus*, in collaboration with Dr. Cameron E. Webb and Professor Richard C. Russell of the University of Sydney, Australia.



An example of a mosquito trap used for research.

potential human health concerns caused by this species of mosquito, much focused research is still needed with the aim of filling gaps in our knowledge to prepare for the future as more and more cities and underground transportation systems are constructed around the world.

Special characteristics of *Culex molestus*

Collecting this mosquito for research was not easy. Instead of wandering through pristine wetlands, we were going around storm water drains and other polluted structures. Finally, the toilet blocks in urban parklands were where we really found large populations of this mosquito. The disused septic tanks associated with these structures are where this mosquito is commonly found. Once we were able to collect enough specimens, we were able to study the various biological traits of this underground-dwelling mosquito over a four year period. Our research shows that people in cities need to take the mosquito's amazing adaptability into account when designing water storage systems. We observed that the female mosquitoes use a process called autogeny to lay eggs. While the majority of pest mosquitoes require a blood meal before laying their eggs, "autogenous" mosquitoes such as *Cx. molestus* make use of nutrients stored during their immature development stages instead of blood for laying eggs. The breakthrough discovery from our study is that female mosquitoes will not bite even when offered a blood meal until its first batch of eggs is laid. Soon after laying eggs, the female mosquitoes will hunt for a blood meal and can become a severe nuisance-biting pest. We believe this is the only Australian mosquito species to exhibit this behavior.

History of the London Underground Mosquito

Culex molestus is thought to have been introduced into southern Australia in the 1940s, hitching a ride into the country with travelling American military personnel and their equipments. This species of mosquito is known in other countries for the spread of the West Nile virus. The mosquito has been found in all states and territories in Australia except in Queensland and the Northern Territory. Where exactly the mosquito came from is still a mystery, but it may have its origins from cities in the USA or Europe. The mosquito became famous during the bombing of the United Kingdom in the Second World War (the Blitz) where Londoners sleeping in the underground shelters was a ready source of blood meal for these mosquitoes which is the reason why it is commonly referred as the London Underground Mosquito. *Culex molestus* belongs to a group of internationally known mosquitoes that may be important vectors implicated in the spread of diverse diseases including Eastern equine encephalitis virus, Japanese encephalitis virus, St. Louis encephalitis virus and Western equine encephalitis virus. Due to the many

Culex molestus

Mosquito



Storm water drain areas are sites with large populations of mosquitoes.

Cryptic urban habitats

It is not known why the London Underground mosquito ignores the offer of blood meal, but given the absence of suitable animals to feed on in underground tanks and pipes, this biological adaptation ensures the mosquito can exclusively exploit these habitats not just during the summer season but throughout the year. Although closed systems like disused underground pipes and septic tanks appear closed from the surface to us, we presumed the existence of fissures and small openings caused by the earth movement over time which would have opened these closed-up spaces to the mosquito populations. Through the centuries, mosquitoes have adapted to most aquatic environments so their adaptability to man-made subterranean habitats should perhaps not be too surprising. In the case of *Cx. molestus*, the lack of fish and other predators in its underground lair is an obvious advantage. Some mosquitoes require sunlight to dry their chitinous wings before they can fly. However, *Cx. molestus*, which spends much of its life underground, may have found some way to do so without the presence of sunlight in this process.

Conclusions

There is a lot of information we still do not know about this mosquito. One of the major implications from our research data so far is that we must be mindful of the mosquito risks when designing subterranean water storage systems in our cities to avoid creating new mosquitoes breeding sites. Ensuring water storage structures are screened or designed to limit the

opportunities for mosquito access is crucial. Perhaps more importantly, when assessing the risks of mosquito-borne diseases, these underground habitats should not be ignored. With climate change and expected warming of south eastern states of Australia, there is also a risk of migration of tropical mosquitoes and their diseases, including those that carry dengue fever (*Aedes aegypti* and *Aedes albopictus*) and malaria (notably the *Anopheles mosquito*).

This study has highlighted the importance of understanding the basic biology and ecology of local mosquitoes. While many important pest and vector mosquitoes have been well studied, it is highly possible there will be important breakthroughs in the control of diseases mosquito-borne diseases when we learn new things in terms of the biological and ecological traits of some of our less well known mosquito species.



Dr. Nur Faeza Abu Kassim is a medical entomologist specializing in mosquito-borne diseases. Her work focuses on the biology, ecology, genetics and control of vector mosquitoes. She is currently working on a range of projects designed to assess the change in vector mosquito populations associated with the dynamics of container breeding sites.

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Mycorrhizas: the amazing fungi

Rosnida Tajuddin

Mycorrhizas are formed by the mutual association between fungi and plant roots and this partnership has been studied for over a century since the late 1800's. There exist a symbiotic association between plant roots and the fungi. Mycorrhizal fungi acquire carbon from plants to grow and in return, they assist in increasing the host plants' nutrients absorption capabilities. Mycorrhizas were previously grouped into two broad subdivisions: a) ectomycorrhiza and b) endomycorrhiza.

Ectomycorrhiza

Ectomycorrhiza is characterized by the formation of mantle, Hartig net or fungal sheath enclosing the plant roots. Ectomycorrhizal fungi have different types of sporocarps such as thin, crust-like (resupinate), coral-like (clavarioid), cantharelloid, and agaricoid as well as boletoid structures. These fungi are mainly from Basidiomycota and Ascomycota, and as many as 10,000 fungal species and 8,000 plants species may be involved in this symbiosis globally. The symbiosis is economically important because these fungi form mutual symbiosis with mostly woody plants such as timber trees from Pinaceae, Cupressaceae, Fagaceae, Betulaceae, Salicaceae, Dipterocarpaceae and Myrtaceae families.

Ectomycorrhizal root tips of *Paxillus involutus* (red arrows) on *Pinus sylvestris* root system



Endomycorrhiza

Endomycorrhiza is characterized by the growing of fungal hyphae not only covering the root of the associated plant but they can penetrate into the root cell walls. These fungi can also form symbiosis with herbaceous plants such as banana and oil palm. These endomycorrhizas have been further classified into five groups; a) arbuscular b) orchid c) ericoid d) arbutoid and e) monotropoid. Here, I would like to focus only on arbuscular and orchid mycorrhizas because they are more significantly related to our flora communities.

a) Arbuscular mycorrhiza

An association between Glomalean fungi with the roots of most vascular plants is called arbuscular mycorrhiza. This association is usually characterized by the formation of arbuscules; branched hyphae that involved in nutrient exchange, intraradical hyphae, extraradical mycelium that connects the plant roots to the soil and the presence of spores in the extraradical mycelium. Arbuscular mycorrhizas do not produce an obvious change in the plant's root system and to observe the distinguishing characteristics, one has to use various microscopic methods. Meanwhile, for ectomycorrhizal root tips, they can be easily visualized with our eyes without using a microscope. The arbuscular mycorrhizal fungi have a broad range of host plants, including some non-vascular plants such as ferns, seedless vascular plants (gymnosperms) such as conifers, and angiosperms plants such as corn, banana, oil palm and cocoa. Glomalean fungi that belong to *Glomus*, *Paraglomus* and *Gigaspora* genera are obligate mutualists, which mean they can only propagate in association with the host plant roots.

b) Orchid mycorrhizas

Orchid mycorrhizas can be defined as a symbiotic association between root of plants from the Orchidaceae family with mycorrhizal basidiomycete fungi. Either the orchid plants are chlorophyllous or achlorophyllous as adults; all orchid plants are reliant upon mycorrhizal fungi at some point of their life cycle. The association of orchid mycorrhizal fungi with the host plants started during the embryo stage; when the embryo emerges and produces a few hairy roots. The mycorrhizal fungi will then rapidly colonize these roots. The hyphae also penetrate the host plant embryo to form hyphal coils (pelotons) in the embryo cells. The success of this association will result in the germination of the orchid seeds. Orchid seed is very small and contains an undifferentiated embryo that is lacking of root and shoot apical meristem, making the



Mycelia network of *Suillus variegatus* colonizing *Pinus sylvestris* root system. The age of this microcosm is one year old.

Ectomycorrhizal fungi *Russula* sp.

seed must first be colonized by appropriate mycorrhizal species. The species will provide necessary carbohydrates to aid the development of embryo into a structure called a protocorm. The protocorm will eventually initiate a shoot apical meristem. An example of orchid mycorrhizal fungus is *Rhizoctonia* sp.

The importance of mycorrhizas

Mycorrhizas are important because they:

- can increase nutrient uptake from the soils to their associated host plants;
- can be used as bio-fertilizer in which they are useful in the restoration of degraded sites;
- can also be used as bio-control agent to control pathogenic fungi and nematodes;
- are useful as bio-remediation tools because some of mycorrhizal fungi can bind to heavy metals, extract them out from the soils and protect the plants from the toxicity of these substances;
- also have a positive effect in influencing the establishment of plant communities above ground;
- can improve soil structure, increase water infiltration and retention, and also reduce risk of soil erosion;
- are essential for seeds germination and seedlings establishment in orchid plants;

- are a food source (e.g. fruit bodies of cantherelles, *Lactarius*, *Boletus* and other species) and some fruit bodies of mycorrhizal fungi are among the most expensive of natural foods (e.g. truffles).

Conclusion

Mycorrhizal fungi have been long known for their various benefits, especially in enhancing nutrient uptake of the host plants. Malaysia is well known for the diverse flora and fauna in the Lowland Dipterocarp Rain Forest. Dipterocarpaceae family of plants dominates the forest and these high quality timber trees are known to form ectomycorrhizal symbiosis. Apart from that, we are also a major key player in palm oil production and the palm also forms arbuscular mycorrhiza. These are just a few examples highlighting the importance of mycorrhizal symbiosis in our forests and for crop production. More studies are needed to understand the community, distribution and efficiency of mycorrhizal fungi in our forests and soils.



Rosnida Tajuddin research interests are concerned with the identification of mycorrhizal fungi, understanding ectomycorrhizal fungi community and their distribution in the Malaysia rainforest and the nutrient transportation in ectomycorrhizal and arbuscular mycorrhizal symbioses.

Umami: the infamous fifth sense

Chew Bee Lynn

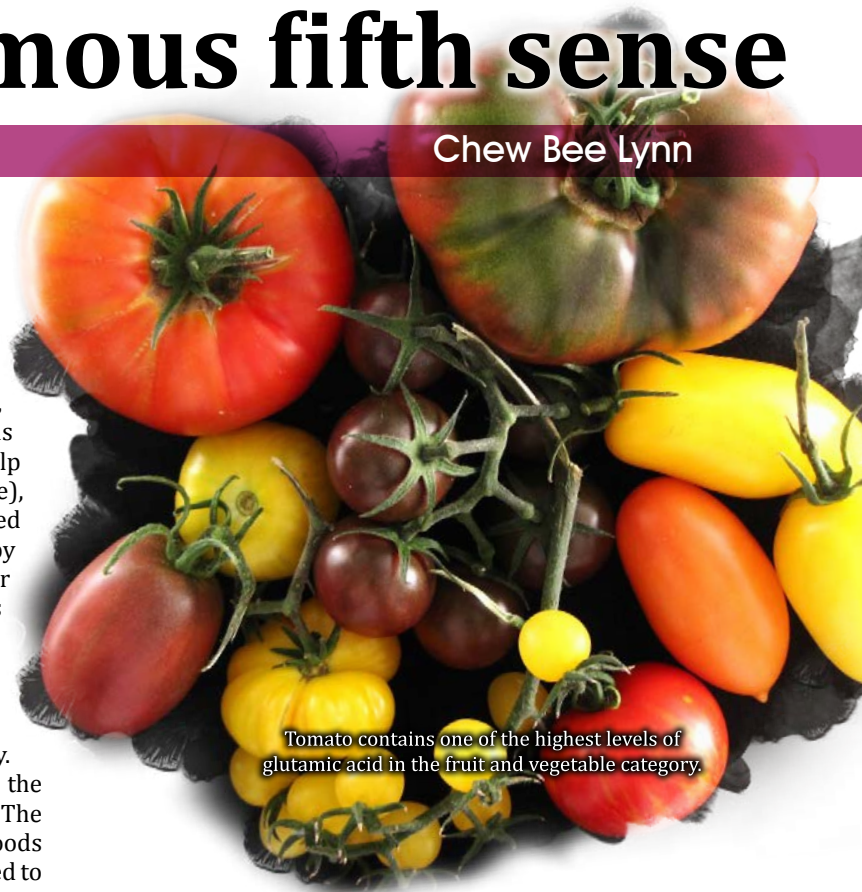
The discovery of Umami

Most of us are aware of our four senses in our tongue namely sweet, salty, sour and bitter but not all of us are aware about the existence of the fifth sense providing us the perception of the savoury flavour better known as 'umami'. In 1908, a Japanese scientist, Kikunae Ikeda, discovered and further studied on this flavour from 'dashi' - a cooking stock made of dried kelp (a large seaweed that belongs to class Phaeophyceae), traditionally used in Japanese cooking. Ikeda discovered a distinct taste quality which could not be explained by any of the four basic senses. He noticed this peculiar taste in 'dashi' and later found that this flavour was caused by glutamate in the kelp itself. He then named this flavour "umami". There is not any Western term that could define the exact word for umami due to its distinctive taste and the closest we can describe this is using the terms relating to meaty, savoury or brothy. The most prominent difference that could describe the umami flavour is its property in enhancing flavour. The addition of this flavour in other foodstuffs makes the foods more acceptable and palatable. Glutamic acid is reported to have a sour, insipid taste and it is the salt form of glutamate that produces the unique umami taste. Yamaguchi and Kimizuka in 1979 showed that the palatability of soup is enhanced after the addition of monosodium glutamate (MSG). Further studies discovered other substances that could greatly enhance the umami flavour that includes 5'-ribonucleotides like inosine monophosphate (IMP) and guanosine monophosphate (GMP). Scientists have also discovered the umami taste receptors on the tongue and also in the human gut, which suggested the importance and the existence of this unfamiliar flavour.

Monosodium glutamate in food

Most of us are afraid of the word MSG and presume that this substance has caused much health detrimental effects when present in food. MSG is in fact safe to be consumed. MSG is actually a salt form of glutamic acid where glutamic acid is an amino acid. It is categorized in the same category as vinegar by the US Food and Drug Administration (FDA). The use of fermented fish sauce by the Greeks and Romans, cheese, tomato and pizza by the Italians, meat stock and ham by the French, seaweed and other sauces by the Asians are foods rich in natural MSG. The combination of these food ingredients used worldwide has been impacting on the human taste perception and palatability for a long time but not being acknowledged until now.

Glutamic acid is part of food proteins in both animals and plants. This amino acid is present naturally and abundantly in most foods such as meat, seafood, vegetable, fruit



Tomato contains one of the highest levels of glutamic acid in the fruit and vegetable category.

and mushroom. The ripening process of many fruits and vegetables is in fact related to the accumulation of glutamic acid for the enhancement of flavour properties. The process of cheese maturation that involves the breakdown of proteins into free amino acids also increases the glutamic acid content. The same applies to cured ham where the fermentation process induces the flavour development. Interestingly, a significant amount of glutamate is being detected in the human breast milk and its presence may have greatly influenced the acceptability and palatability of this flavour since we were born.

Monosodium glutamate is produced by the fermentation of natural ingredients such as sugarcane, corn and tapioca where the salt form of glutamic acid is being purified for commercial purposes. The addition of MSG as a food enhancer has to be at very specific quantities in order to prevent the undesired side effects. Enhancing the umami taste of foods can give positive benefits not only to flavour but also to reduce salt addition. A low intake of sodium in our daily diets has always been emphasized to promote healthy living. It is usually the case that reduced palatability is the result when less sodium is being added into cooking and foodstuffs. Food becomes less flavourful when it is less seasoned with salt and this is where umami plays a part in enhancing food palatability. Japanese researchers discovered in 1984 that the addition of MSG in their Japanese clear soup model (with reduced levels of salt) has been able to maintain its palatability. The desire for saltiness can be reduced through the addition of umami



Pizza consists of a mixture of naturally occurring glutamate rich ingredients.

substances in food and this is indeed a healthier option without having to compromise on tasteless foods. It is in fact proven by various findings that the addition of MSG in diets given to elderly patients did improve their appetite, increase the food intake and improve their health and nutritional status when compared with subjects fed with the same diet without MSG.



The maturation of cheese is a process where glutamate accumulates to provide the well loved savoury flavor.

The Chinese Restaurant Syndrome

The Chinese Restaurant Syndrome is frequently associated with the high consumption of MSG and the ensuing symptoms of thirstiness, headache, sweating, skin flushing and nausea. A researcher in 1986 has demonstrated through several experimental studies and surveys that this association is invalid and in fact failed to prove that MSG is the culprit in evoking these symptoms. They concluded that the so called Chinese Restaurant Syndrome could affect those who are unfamiliar with the exotic foods and the surroundings. Some would therefore argue that if we were to claim that addition of MSG is unhealthy, how can Japanese foods that contain among the highest levels of glutamate are often considered the healthiest diet in the world? There are even many food advertisements claiming what is being sold do not contain MSG when clearly the product contains umami rich ingredients and this is clearly misleading labeling. Many health conscious people are not aware of these facts and claim to others that they do not consume MSG in their diets. In fact, many natural foods we consume already contain natural glutamate compounds that enhance their flavor.



Dr. Chew Bee Lynn specializes in plant biotechnology, specifically in genetically modified organisms, tissue culture and the umami flavor taste modalities. She is currently working on projects regarding transgenic crops and tissue culture on medicinal plants.

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Learning about the Bugs

I received my B.Sc. (Zoology) degree from Universiti Sains Malaysia (USM) in 2001. I completed several specialized courses in Entomology during my undergraduate studies and also conducted an honors degree dissertation entitled 'Insecticide susceptibility in various stages of field-collected German cockroaches, *Blattella germanica* (L.) (Dictyoptera: Blattellidae)' under the supervision of Professor Lee Chow Yang of the School of Biological Sciences.

After graduation, I worked with a major pest control company in Kuala Lumpur as an operation executive and have had a good exposure working with insects in the urban environment such as cockroaches, ants, stored product pests and subterranean termites. With the technical knowledge I gained from the Entomology Lab of USM, I successfully managed to help my company introduce termite baiting system to the commercial market. This activity helps to reduce the use of conventional liquid termiticide treatment in favor of a more environmental-friendly way in termite management.

In April 2004, I joined an international pest control company as Regional Technical Manager to focus on designing pest management programs that are fully compliant with food safety for F&B establishments and the food manufacturing environment in Southeast Asia. This position provided me with a great platform to explore

different urban pest behaviors and development of control methods. Detail documentation, precise pest trending and non-chemical applications are critical to ensure end products are safe to consume by humans.



Pest awareness talks to Schools and various public forums on pest management.

Pest control programs play an important part in food processing and it is not merely dependent on chemical application. To design a good pest program for food related establishments, first we have to understand the different food processing environment and proper pest identification. Secondly, to evaluate the condition of their sanitation and housekeeping as that will directly affect pest infestation in the surrounding environment. Following the initial assessment, there needs to be scheduled monitoring activities and documentation for future pest trending analysis. If the number of pests is above the threshold limit, chemical application may need to be introduced into the infested environment but only selected approved pesticides can be used. However, if the infestation can be managed by cleaning and sanitation activities, pesticide application is not necessary. In urban integrated pest management (IPM), regular monitoring is carried out to determine if and when a treatment needed. It employs physical, mechanical, cultural, chemical, biological and educational programs to keep pest populations low enough to prevent intolerable damage or annoyance.

After working for more than 10 years with pest control companies, I started my own company, Ecogreen Pest Management, in Penang. Ecogreen focus more on eco-friendly pest management where we use less pesticide in our services and emphasizes on monitoring, sanitation and pest exclusion activities. We started off with pest awareness and educational talk to schools, colleges, residence associations and at press conferences. These activities provide useful pest information and the latest technology in pest control industry to the public.

Pest Control in Malaysia

In Malaysia, the pest control industry is regulated by the Pesticide Board under the Ministry of Agriculture. Various rules and regulations have been promulgated and implemented to ensure that the objectives of the Malaysian Pesticide Act are achieved. Under the amended Pesticides Rules 2004, a person carrying out any of the following activities or engage in the business of applying pesticide to the property of another person must at any time possesses the relevant license issued by the Pesticide Board. These activities include:

- ✓ General household pest control;
- ✓ Termite and other wood destroying organisms control;
- ✓ General public weed control; or
- ✓ Control of pests affecting public health.

There are three types of license issued by the Pesticide Board. To qualify for these licenses, a person shall be subjected to examination requirements.

Pest Control Operator License

The license enables a person to own, operate and manage a pesticide application business which is engaged in applying pesticides on the property of another. To qualify for this license, the operator must either possess or employ at least a licensed pesticide applicator.

Pesticide Applicator License (PAL)

Any person who is licensed by the Pesticide Board can perform or supervise the application of any pesticide

in major pest control jobs on the property of another. An applicant must at least complete a minimum educational level of Form Five or its equivalent or have at least three years working experience.

Assistant Pesticide Applicator License (APAL)

A person who possesses this license is certified to carry out pest control under the supervision of a licensed pesticide applicator, accept for minor pest control jobs where no supervision is required. Minor pest control job includes general household pest control in private dwelling and general public weed control. An applicant must possess at least a pass in Standard Six or two years working experience as a worker in a pest control company.

Some of the regulations enacted under the Malaysian Pesticide Act include providing a detail written report to the client regarding the pest control activities using a form designed by the Pesticide Board upon the completion of pest control services on the premise by the PAL or APAL. The written report shall be kept by the licensed pest control operator for a period of two years from the service date to which the report refers, and shall be made available for inspection by the Pesticide Board when required. We at the Ecogreen Pest Management works closely with the Pesticide Board Malaysia and Pest Control Association Malaysia (PCAM) on this to share important information to the public to ensure that the public are following the rules and regulation when it comes to selecting a certified licensed pest control operators.

With the wide availability of the internet and social media, the general public nowadays tends to understand pest control better compared to previous decades. Customers will usually browse through the internet before they consider hiring a pest controller to manage their pest issues. It is therefore crucial that modern day pest controllers be highly professional and well informed of the latest techniques in pest management. The basic requirements for a professional Pest Control Operator in Malaysia should fulfill the following criteria:

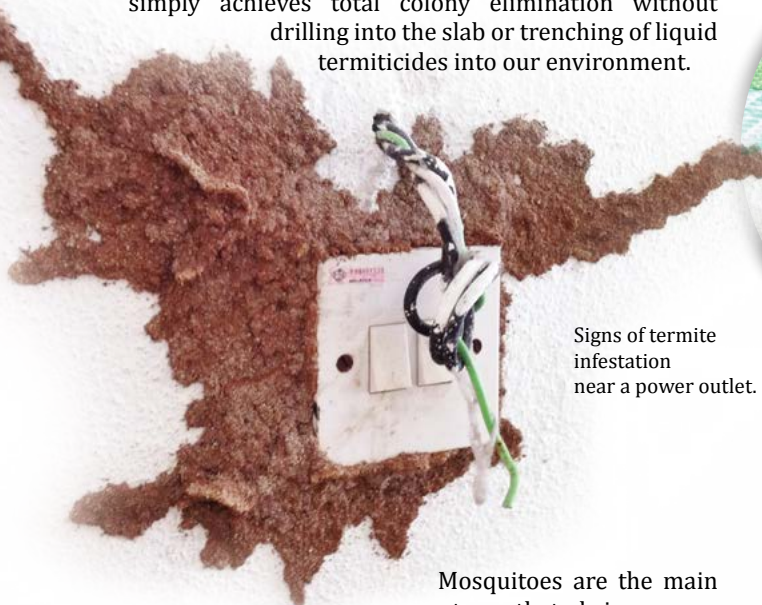
- Valid Pesticide Application License
- Wearing uniform with company logo
- Carry proper tools
- Conduct thorough inspection
- Pest Identification
- Recommendation options
- Used registered products in original containers with label
- Emphasis on public health and safety
- Provides detail service report with detail chemical usage after services.

Life of a Pest Exterminator

Over the last 4 years, Ecogreen Pest Management has been servicing more than a thousand premises in the northern region of Peninsular Malaysia in Penang, Kedah and Perak. Generally, the type of pests targeted here are subterranean termites, cockroach, ants, rats, mosquitoes and the occasional invading pests. With the massive growth in construction activities and human population especially in Penang, the environment will serve as a good breeding ground for many urban pests if serious comprehensive preventive measures are not taken.

Subterranean termites are the most important economical pest in this part of the world. They can be found in both old colonial period buildings and newly constructed premises.

Conventionally, infestations of subterranean termites are treated using arsenic powder dusting or liquid termiticides by spraying or trenching but not all termite colonies can be eliminated using these methods due to the complicated social behavior of these subterranean termites and the condition of the surrounding environment they are in. Thus, we introduce "Termite Baiting Technology" to our customers whenever subterranean termite infestation is found. This method simply achieves total colony elimination without drilling into the slab or trenching of liquid termiticides into our environment.



Signs of termite infestation near a power outlet.

Mosquitoes are the main vectors that bring many diseases such as dengue fever, filariasis and malaria. Aedes mosquitoes are important species that can breed easily in both artificial containers and natural containers like coned leaves or vegetation containing clear water, especially after rain. Ecogreen Pest Management encourages home owners to conduct self-inspection at home on weekly basis to eliminate mosquito breeding sources and consider environment modification to prevent mosquito activities in their area. A combination of chemical control (larviciding and space treatments) and other methods incorporating Integrated Pest Management should be implemented for overall mosquito management strategies.

Cockroaches, ants and rats are commonly found in urban environments especially when the sanitation condition is bad. In Malaysia, most of the control methods rely heavily on insecticides application



German cockroach hiding underneath a restaurant kitchen table.

and residual spraying which are frequently carried out by professional pest controller against these pests. In contrast, we prefer to use baiting systems in controlling these pests after the level of infestation and species are properly studied. Furthermore, it should be noted that perimeter treatment is also essential in the general pest control program to prevent external pests entering the premises from the exterior.



Blood sucking bed bugs hiding in the bed seams of a bedroom.

Recently, bed bug infestations are on the increase in Malaysia. In the Northern region, we quite frequently detect this blood sucking insect. Bed bugs are hard to eliminate and can rapidly spread from one infested room to the other. Early detection and prompt action are essential in bed bug management. From experience, we find that being thorough is the key to success in both inspection and treatment. Scheduled treatments are necessary to completely eradicate bed bugs that have reached critical population levels. Sometimes, bed frames and mattresses may need to be discarded to achieve total elimination.



Part of the Ecogreen Pest Management team at a trade exhibition in Malaysia.



Regine Lim is a former undergraduate student at the School of Biological Sciences, graduating with a degree in Zoology. She is now the Operation Director and owner of Ecogreen Pest Management Sdn Bhd in Penang. www.ecogreenpest.com.my

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COCKROACHES RATS BED BUGS

ANTS FLIES TERMITE

Coastal Morning Glory: a potential mosquito bio-larvicide

Wan Fatma Zuharah and Ahbi Rami Rattanam

Coastal morning glory

Coastal morning glory (*Ipomoea cairica*) is also known as the "Mile-a-minute" or "Railway creeper" and is a vigorous, fast-growing perennial creeper. The leaves are dark green, 4-5 cm long and deeply divided into 5-7 lobes. The trumpet-shaped flowers are produced year round with lavender, pink or whitish-pink, with a deeper coloured throat. Together with hairless stems and readily set roots when in touch with the ground, coastal morning glory grows rapidly, sometimes climbing 4-6 meter into the canopy. The plant reproduces by seed dispersal mostly by water or garden refuse during removal.

Ipomoea cairica is used in folk medicine for treatment of rheumatism and inflammations. Drinks made from crushed leaves of this plant are used for treatment of rashes, especially those accompanied by fever. Also, it was reported to show antioxidant, anti-inflammatory, anti-rheumatism, antinociceptive effects and inhibition of HIV replication.



Leaves of the *Ipomoea cairica* creeper plant climbing on a fence.

Distribution of coastal morning glory

Coastal morning glory, as its name implies, occurs mostly in coastal areas and wastelands, often near the sea. It is also an occasional urban weed found in waste land, rubbish dumps, car yards and hedges. *Ipomoea cairica* comprises the largest number of species within the Convolvulaceae family and can be found in almost all tropical regions. The plant is widespread in the tropical areas of the world such as the West Indies and Asia.

Ipomoea cairica is an invasive plant and can colonize and replace other native flora particularly along the riverbanks. This species tend to creep along the ground even in the absence of supporting structure due to its twinning growth habit. Significant infestations of this weed may kill the native flora and lead to a reduction in natural biodiversity. This in turn may lead to the displacement of certain native animals due to the destruction of their natural habitat.

Cytotoxicity and mosquitocidal properties

Anti-herbivore defences have been reported in the genus of *Ipomoea*, which makes this plant suitable to be used in insect pest control programmes. Chemical studies of *I. cairica* extract has led to the isolation of major constituents such as alkaloids, coumarins scopoletin, umbelliferon, lignans, arctigenin, matairesinol and trachelogenin. The coumarin presents anti-edema properties and is also an immuno-stimulant and exhibit cytotoxic activity. Arctigenin was reported to be the most cytotoxic compound in this plant.

Even though this plant has been known as an invasive and rampant weed, the extract from *I. cairica* may become an effective means of killing mosquito larvae. Bio-prospecting for botanical insecticides has become a main focus for research due to their high level of eco-safety. Our study in the School of Biological Sciences was designed to test the biological activities of *I. cairica* crude extract on *Aedes* mosquitoes in terms of larvicidal, sublethal, oviposition repellent and ovicidal properties. The crude extracts from *I. cairica* were obtained by using Soxhlet extractor with two different solvents, methanol and acetone. Crude extracts from *I. cairica* leaf produced highest larvicidal activity compared to the flower or stem parts from the same plant. This indicated that more bioactive compounds are located

in the leaves of this plant. Acetone extracts of all the plant parts produced higher mosquito larval mortality compared to methanol extracts with 100% mortality at 300 ppm concentrations.

Since acetone extracts of *I. cairica* leaves produced the most effective larvicidal activity, this fraction was chosen to conduct subsequent experiments. Exposure of larvae to sublethal concentrations of acetonic *I. cairica* leaf extracts was found to reduce fecundity by 34.46% and 16.61%, and fertility at 49.06% and 18.55% in first generation of *Aedes albopictus* and *Ae. aegypti* mosquitoes, respectively. Larval head capsule width and wing length were also found to be significantly smaller in both *Aedes* species when compared to the normal mosquitoes. *Ipomoea cairica* leaf extracts was further evaluated for oviposition deterrent and ovicidal activity. It was evident that the plant extract produced excellent oviposition deterrent with 100% repellency at 100 ppm and 100% ovicidal activity which prevented the hatching of the eggs of *Ae. aegypti*.

The mosquito larvae exposed to *I. cairica* extracts showed severe morphological deformities. The larvae exposed to high concentrations of this extract showed severe deformities that caused death with darkening or blackening of larval abdomen and malformed larval-pupal intermediate.



Aedes larvae with blackened abdomen after the exposure to morning glory extracts

Purple flowers of morning glory are produced year round and bloom in the morning.

The results from our research project indicated that this plant extract could be an important source of bio-control agent to be incorporated into integrated pest management programmes for the control of aedines. Lethal and sub-lethal properties of this plant could provide broader application in various field conditions. Since the plant is widely distributed in Malaysia and is considered an invasive plant, the commercial exploitation could provide an important step in the development of new plant based insecticides. It has the potential to be a more cost-effective and cheaper option to the conventional expensive and environmentally harmful chemical insecticides.



Death occurs during malformed larval-pupal intermediate stages.



Dr. Wan Fatma Zuharah Wan Musthapa is an entomologist that specializes in medically important insects. Her research focuses on the ecology, distribution, behaviour and control (bio-control and integrated management) of medically important insects including mosquitoes and rove beetles.

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New discovery of Malaysian plants with Anti-tuberculosis properties

Suriyati Mohamad

Ageratum conyzoides

Screening for anti-tuberculosis compounds

The global tuberculosis (TB) burden underscores the importance of developing new effective anti-TB drugs. Since plants are a proven template for the development of new scaffolds of drugs, they have received considerable attention as potential sources of anti-TB agents. Nowadays, development in high throughput screening, combinatorial chemistry, structure-based drug design, TB genomic tools, and the innovative systems biology approach have enhanced TB drug discovery efforts from plants. These new technologies have opened the methodological possibility to investigate complex plant mixtures even at an advance level. Leveraging on the huge potential of Malaysian rich biodiversity, it is aptly appropriate to initiate a dedicated anti-TB research in the anticipation that the findings can point to relevant sources of potential compounds as drugs for the treatment of TB.

This article highlights the preliminary findings of an ongoing TB research project, pertinent to its primary aim of identifying Malaysian plants with anti-TB properties. Seventy two plant species belonging to different genera and families were investigated based on their ethnobotanical uses in relation to TB disease. *In vitro* anti-TB activity screening of the plant methanol extracts was carried out against a standard virulent strain, *Mycobacterium tuberculosis* H37Rv ATCC 25618, utilising a colorimetric tetrazolium microplate assay (TEMA) method. More than half (38 species) of these plants exhibited anti-TB activity within the test concentration range of 1600 - 200 µg/mL. Among the 38 active plants, 30 species have not been reported in scientific literature for their anti-TB activity indicating novel findings based on plant species (Table 1). Nine plant species (*Ageratum conyzoides*, *Cananga odorata*, *Costus speciosus*, *Cymbopogon citratus*, *Eurycoma longifolia*, *Labisia pumila*, *Pluchea indica*, *Psidium guajava*, and *Tabernaemontana coronaria*) were selected for further investigations based on their high anti-TB activity and their importance in the local traditional medicine.

The methanol extracts of these active plants were sequentially partitioned using different solvents with

increasing polarities to afford five main fractions (see schematic Figure). A detail evaluation of the anti-TB activity of these partitioned plant fractions by means of minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) determinations revealed promising results. With regards to solvent types, the non-polar fractions of n-hexane and chloroform were more active, indicating that more bioactive constituents against *M. tuberculosis* could have been extracted by these solvents. These results also inferred that the active constituents could be lipophilic in nature. The fractions of *L. pumila* (root) n-hexane and chloroform, and *P. indica* (leaf) n-hexane were the most active with MIC/MBC values of 50/100 µg/mL. Other plant fractions that possessed good anti-TB activity with MIC of 100 µg/mL were *A. conyzoides* (whole plant) n-hexane and chloroform; *C. speciosus* (stem-

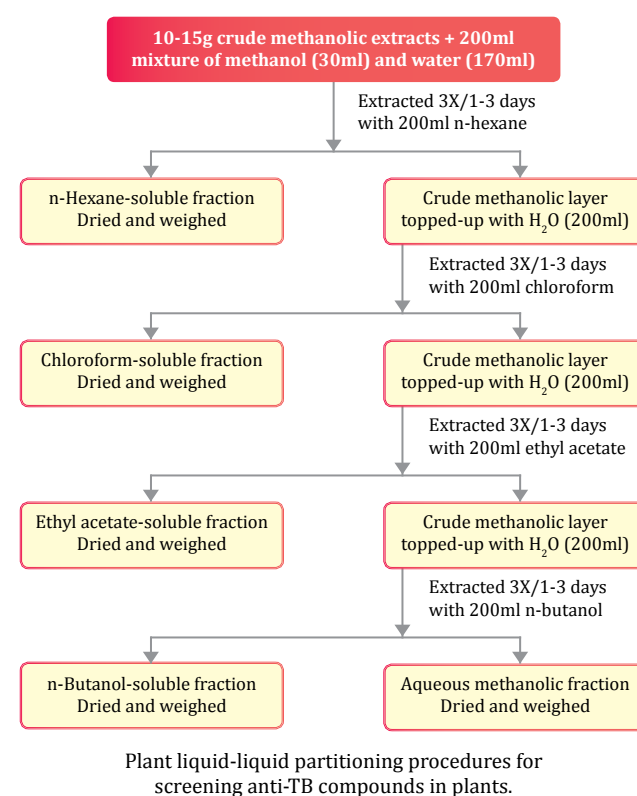


Table 1. Malaysian plants with anti-tubercular properties.

No	Scientific names	MIC* (µg/mL)	Previous studies
1	<i>Ageratum conyzoides</i>	1600	Nil
2	<i>Allium odorum</i>	1600	Nil
3	<i>Aloe vera</i>	1600	Reported
4	<i>Alpinia galanga</i>	1600	Reported
5	<i>Amaranthus tricolor</i>	1600	Nil
6	<i>Angiopteris evecta</i>	400	Nil
7	<i>Averrhoa bilimbi</i>	1600	Nil
8	<i>Capsicum annum</i>	1600	Nil
9	<i>Catharanthus roseus</i>	1600	Nil
10	<i>Ceiba pentandra</i>	1600	Nil
11	<i>Centella asiatica</i>	1600	Reported
12	<i>Citrus microcarpa</i>	1600	Nil
13	<i>Clerodendrum indicum</i>	1600	Nil
14	<i>Clitoria ternatea</i>	1600	Nil
15	<i>Colocasia esculenta</i>	1600	Nil
16	<i>Costus speciosus</i>	800	Nil
17	<i>Eurycoma longifolia</i>	1600	Nil
18	<i>Ficus carica</i>	1600	Nil
19	<i>Flemingia strobilifera</i>	1600	Nil
20	<i>Hibiscus rosa-sinensis</i>	1600	Nil
21	<i>Jasminum sambac</i>	1600	Nil
22	<i>Jatropha curcas</i>	1600	Nil
23	<i>Justicia gendarussa</i>	1600	Nil
24	<i>Labisia pumila</i>	200-400	Nil
25	<i>Lepisanthes rubiginosa</i>	1600	Nil
26	<i>Licuala spinosa</i>	1600	Nil
27	<i>Morus alba</i>	1600	Nil
28	<i>Passiflora foetida</i>	1600	Nil
29	<i>Phyllanthus acidus</i>	1600	Nil
30	<i>Piper nigrum</i>	1600	Reported
31	<i>Piper sarmentosum</i>	800	Reported
32	<i>Pistia stratiotes</i>	1600	Nil
33	<i>Pluchea indica</i>	800	Nil
34	<i>Selaginella plana</i>	1600	Nil
35	<i>Sesbania grandiflora</i>	1600	Reported
36	<i>Solanum torvum</i>	1600	Reported
37	<i>Tabernaemontana coronaria</i>	800	Nil
38	<i>Zingiber officinale</i>	1600	Reported

*Minimum inhibitory concentration.

flower) n-hexane; *L. pumila* (leaf) n-hexane, and *T. coronaria* (leaf) n-hexane.

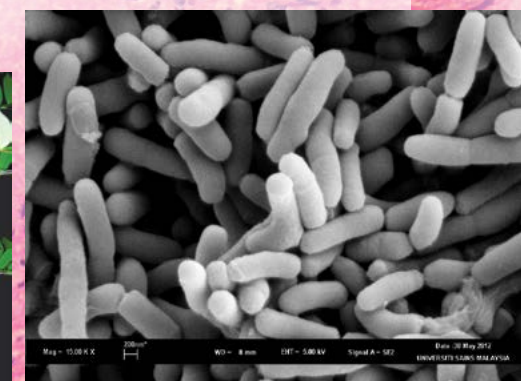
Potential sources of anti-TB compounds

The killing dynamics of the most active fractions were subsequently studied based on their effects on the growth kinetics of *M. tuberculosis* H37Rv at lower growth rate in simulation of latent stage TB. The cidal rate of a drug in relation to the time of exposure at dormant state is an important characteristic for therapeutic efficacy in latent TB infection to prevent development of resistance. The results revealed that six fractions could be potential sources of anti-TB agents for latent infection as indicated by their high killing capacity after only one day of exposure. These fractions were *A. conyzoides* (whole plant) n-hexane and chloroform, *C. speciosus* (stem-flower) n-hexane, *L. pumila* (leaf) n-hexane, *T. coronaria* (leaf) n-hexane, and *E. longifolia* (leaf) n-hexane. Cidal effect of ≥ 99 % killing was fully achieved by these plant fractions.

The roadmap of TB drug development follows endless diverse routes, that reaching any landmark is a progress by itself. So far, this research study stands up with pride for its exciting outcomes especially as landmark findings in Malaysian TB research. These findings have indicated potential sources of anti-TB drug compounds from Malaysian medicinal plants. The tubercular plant species identified in this study, particularly, *A. conyzoides*, *C. odorata*, *C. speciosus*, *C. citratus*, *E. longifolia*, *L. pumila*, *P. indica*, *P. guajava*, and *T. coronaria* are indeed worthy of further investigations. Furthermore, this study had also provided scientific evidences on the possible use of these active plants to produce alternative forms of TB remedy.



Eurycoma longifolia



Mycobacterium tuberculosis H37Rv ATCC 25618



Dr Suriyati Mohamad specializes in anti-tuberculosis drug discovery from natural resources.

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Karas Trees + Fungi = Agarwood + Money

Baharuddin Salleh

Introduction

Karas is a group of tropical trees from *Aquilaria* and *Gyrinops* species and native to South and Southeast Asia. When the trees are infected or challenged with incitants/inducers/intruders, especially microbes, agarwood (dark resinous heartwood) is formed. Agarwood oil is an expensive product from distillation of karas wood chips. Agarwood is therefore a disease symptom and known under many names such as *chénxiāng* (Chinese), *cham heong* (Cantonese), *trâm hương* (Vietnamese), *jinkō* (Japanese), oud (عود) (Arabic), and *gaharu* (Indonesia and Malaysia).

seeds. Seedlings raised through tissue culture techniques are getting less popular due to a peculiar problem because the seedling is without a tap root and gets easily up-rooted.

The establishment of karas plantations is getting very popular in Southeast Asia, including Malaysia, especially when our Malaysian government is trying to promote this tree as a new crop that can bring more income to the country. The plantations can also serve well in eco-, agro-, and edu-tourism industries. It is not uncommon to plant karas trees between main plantation crops such as oil palm and rubber. In certain areas of Indonesia, young oil palms were replaced with karas trees as it was more profitable to do so.



Agarwood/gaharu (dark resinous wood) is formed on *Aquilaria malaccensis* heartwood as a result of artificial inoculation with fungi.

Agarwood has been much sought after for perfumeries, incenses, medicinal, and religious/ritual purposes. The trees are now recognised as natural/botanical sources of incenses, perfumes, pharmaceuticals, and cosmeceuticals. Large international companies are investing into agarwood and oil as part of their perfumeries business. Currently, new business opportunities have emerged in the use of the leaves and other parts of the trees; being developed into high value health products such as tea and cookies. Therefore, karas is being developed as a new and emerging forest plantation with high economic values in Southeast Asia, potentially with better economic return than rubber and oil palm plantations. Unfortunately, due to the very high demand, the population of naturally grown karas trees are being depleted, and the trees are consequently listed in the CITES (Convention of International Trade of Endangered Species). *Aquilaria malaccensis* is one of the 15 species of genus *Aquilaria* in the Indo-Malesian Archipelago that is of great interest to commercial plantation entrepreneurs.

Cultivation of karas trees

The cultivation of karas trees is now becoming more common for the people who used to be gatherers of wild agarwood. Like most forest trees, karas is raised from

Karas seedlings raised from seeds.



Inoculation of fungi to induce agarwood

Agarwood will not be formed if the karas trees are growing happily without any external disturbances. Therefore, agarwood production in a plantation system must be induced by suitable microbes and accompanied by suitable production/inoculation techniques which, in many cases, can be costly. A few decades ago, a scientific method was developed to stimulate the formation of agarwood by artificial wounding. Based on his experiments in Vietnam, Dr. Richard Blanchette has patented the methods. The process of inoculation is only carried out on 10-cm diameter or at least 4 year-old trees. Holes are drilled and the microbes, especially fungi, are introduced. However, we were able to induce agarwood in 1 year-old seedlings. Our recent studies showed that the most common fungi isolated from artificially- and naturally-formed gaharu were *Fusarium* spp.

Uses of Karas

Karas, especially the products such as gaharu, has been valued, used and traded internationally for more than 2,000 years. It attracts more investors from many countries as domesticated karas are becoming more important and more productive in a very short period (7-10 years). At present, some companies have started to manage and offer a contract farming system in *Aquilaria* plantations. We therefore propose to get Malaysians to start planting or be involved in contract farming of karas trees. The income is becoming even more attractive with side income from the harvesting of karas leaves for beverages such as tea and other products.



Successful inoculation of fungi on a mature tree to stimulate agarwood formation.

Comments from the Editor-in-Chief:

Prof. Baharuddin Salleh will be retiring in July 2014 from the School of Biological Sciences after decades of exemplary service to the School and USM. He will be missed. In my opinion, one of his significant legacies to the university was the introduction of transparent standardized criteria for academic promotion during his tenure as the Deputy Vice Chancellor of Academic Affairs. Unlike in the past when the promotion of faculty staff was based on subjective and ambiguous criteria, the introduction of standardized application forms and criteria made this exercise more objective, transparent and merit-based. This was truly an example of "Kami memimpin" (We lead) as imprinted in the USM logo as many other local universities soon followed suit. Bio-Bulletin would like to wish Prof. Baha a restful and meaningful retirement.



Prof. Baharuddin Salleh research specialization is focused on non-pathogenic, pathogenic, and toxic species of *Fusarium* on agricultural crops.

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Seven Life Lessons

we can learn from Sea Turtles

Aini Hasanah

I stepped down from the car and here I am again in Setiu for the umpteenth time. The last time I was here was in 2010. I was then an intern with the World Wide Fund (WWF) Malaysia for their Turtle and Terrapin Project. Setiu is home to many species of endangered flora and fauna, of which among them are the green sea turtle (*Chelonia mydas*), painted terrapin (*Batagur borneoensis*) and river terrapin (*Batagur baska*). One of Terengganu's hidden gem, Setiu has in its vicinity, rivers, mangroves, lagoons, long stretches of sandy beach, and forest.

My first 'encounter' with Setiu was a short and sweet event in my life. It was an inspiring time. A dear former colleague once said to me that the most fundamental thing about doing conservation work is not only passion but also creativity, perseverance and most of all, it takes sincerity. I found myself nodding blindly at that time because I thought you can do almost everything with passion alone. I learned a valuable lesson back then.

This time around, Setiu would be more than a place to gain experience. I came here with two objectives. Other than assisting WWF for the turtle and terrapin conservation work, I was there collecting research data for my Master degree studies. Upon completion, I felt that I had accomplished more than I had anticipated. During my seven months stay in Setiu, I've learned seven important life lessons. All I can say is that these take-home lessons are anecdotes that I learned from watching our flipper friend.

Lesson #1: Team work versus being independent

Female sea turtles will lay eggs by the beach, hide the clutch and return back to the sea. There is no parental care for the hatchlings upon her return back to the sea, regardless the size of the clutch. Hence, the turtle hatchlings are on their own once they hatch. No parents to guide their way to the sea. Even if they crawled up from the nest together in a clutch, once they emerged, they will be on their own in the huge ocean.

A female adult turtle nesting at the Setiu beach.



Even though I know that team work is important and oftentimes needed to accomplish goals, nevertheless, there are times when we are on our own with no one to depend on. Just like the tiny hatchlings, we are also capable to be independent, carry on our own way and make our own path in life to explore the sea of opportunities. If we persevere, we shall conquer.

First lesson learned.

Lesson #2: Be a good navigator

Sea turtles are good navigators. After reaching adulthood and become sexually mature, sea turtles would return to its natal beach. Sea turtles are able to detect the earth magnetic field and use it as a directional cue. They can receive positional information from two magnetic elements, which are the inclination angle and intensity. These two elements differ across sea borders and endow different geographic areas with unique magnetic signatures. During the sea turtle hatchlings' first crawl to the sea, the magnetic field of the hatchlings natal beach is imprinted in the turtle's memory. Amazing!

As humans, there are days we find ourselves lost and wandering on a bleak path. But remember the sea turtles that have to navigate through the brutal, relentless waves, and merciless predators. Not all wanderers are lost. Just hold on, we can find our way home too.

Lesson #3: Of being committed and responsible

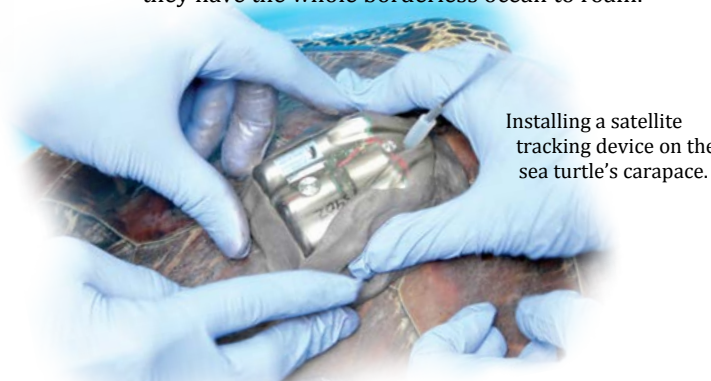
Turtles are gentle and calm creatures. They never bite humans and the only aggressive behaviour they show is when they flip their flippers ferociously after finishing laying their eggs. The only reason they do that is to protect and provide camouflage for the eggs so that the eggs cannot be seen by predators (which include humans). Other than that, I do not remember when or why turtles can be dangerous to us. Funny thing is that we, consciously or not, are the main cause to its destruction. We poach their eggs, create disturbance by causing too much noise and light near their nesting site, destroy their habitat and the list goes on.

Nature and its bounty can be shared among us humans, animals and plants. However, it will take commitment, effort and responsibility. Archie Carr, a prominent turtle scientist, once said, "For most of the wild things on earth, the future must depend upon the conscience of mankind".

So lesson number three, let us be more committed and responsible to the conservation of our environment, including our precious sea turtles.

Lesson #4: Be well travelled

With no reservations and passports, sea turtles may be the luckiest ambassadors. I once experienced assisting the turtle conservation team in tagging a turtle with a satellite tracking device. The sea turtle was tracked and travelled from Setiu to Johor, and the last signal detected was from the Philippines. Female green sea turtles will land every alternate year to nest during the nesting season. During the nesting season itself, they will land about five to six times to lay eggs. After that, they have the whole borderless ocean to roam.



Installing a satellite tracking device on the sea turtle's carapace.

It's okay to be away from home, just to take a breather. It's okay to learn new places and faces, for we will expand our horizons. It might be scary and intimidating at first, but if we don't brace ourselves for the first step, then we will not know.

Lesson #5: Courage and perseverance

Once hatched from the clutch, turtle hatchlings will navigate to the sea on their own, by using moonlight as

cue. Sea turtles might move awkwardly and slow on land, but generally they are brilliant swimmers. Did you know that only 1 out of 1,000 hatchlings will survive after being released to the sea? Hence, the struggle to save this species is indeed vital.



Turtle hatchlings fresh from the egg clutch waiting to be released.

Once the small turtle hatchlings are in the big ocean, who knows what lies ahead; boats waiting to catch and boil the hatchlings into hot pots, nets that are drifting in the ocean that can entangle them or natural predators such as fish and crabs. But these hatchlings swim through anyhow and anyway, regardless of the odds that are stacked against them. If they lose, they lose. If they survived, they will return back to the same spot they originated. Whatever happens, they will never give up.

There is a saying, 'You can never cross the ocean, until you have the courage to lose the sight on the shore.'

Lesson #6: Age gracefully

Turtle functions to stabilize the food web interaction in the marine ecosystem. Their dietary habit can control the population of other organisms in the coral reef. For example, leatherback turtles feed on jelly fishes, while green sea turtles feed on algae and sea grasses. Sometimes, sea turtles work together with other organisms for mutual benefits. Their symbiotic relationship with yellow tang fishes ensures that the latter will get more food by using less energy. In return, the fish would keep the carapace clean from any external parasite and make it lighter for the sea turtles to move since the carapace surface will be smoother (reduces drag).

Turtles' body parts are exploited, their eggs and meat for consumption, and carapace for ornamental purposes. In a non-consumptive manner, turtles are used as an icon for culture in certain regions such as in Terengganu, Indonesia and China. Turtles can symbolize longevity and strength due to its long lifespan. These days, as traditional beliefs fades away, turtles are more linked to eco-tourism and provide socio economic growth to the locals. However, there are Standard Operating Protocols that must be followed, so that the balance between conserving turtles and gaining monetary profit can be achieved.

Turtles might be a living proof that nature does not simply exist just for the sake of existence. The ecological role turtles play are huge and not limited to the marine environment. Humans too derive benefits from sea turtles. Let us keep the turtle population sustainable and allow them to age gracefully.



Lesson #7: Be at ease in your own shell

Sea turtles can be differentiated based on different physical features. Every species is basically covered by a hard bony carapace, except for leatherbacks which has a cartilaginous carapace. Hawksbill turtle has a narrow hawk-like beak, hence the name. Green turtles have vertebral and costal scutes on its carapace, and its flesh is green. Each of the features is special and distinct, and provides benefit to the species.

Similar to a sea turtle, we too are special and distinct in our way. A successful person is someone who might not be the best in everything, but he/she makes the best out of everything. Contentment and comparison rarely occupy the same mind, so choose wisely. Choose to be content instead. And just as we are at ease in our own shell, we will be a better person. Perhaps like a sea turtle too, we would be able to roam a wider and borderless sea of life challenges.

Final lesson learned.



The practice of community-based conservation is important to enhance livelihood and gain awareness regarding conservation efforts. This includes interacting with the local community such as providing tuition classes for their children.



Aini Hasanah recently received her Masters degree in Environmental Biology from Universiti Sains Malaysia. Her research involved nesting ecology and behaviour of green sea turtles, variation of carapacial scute and the level of public awareness of turtle conservation at Setiu, Terengganu.



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The Rattan

resources of Penang

Wan Nur Fasihah Zarifah Wan Rozali and Asyraf Mansor

Rattan is derived from the Malay word “rotan”, the local name for spiny climbing palms with scaly fruits. Rattan is a significant source of income for local people, especially to those living near the forests. This particular palm group is mainly distributed throughout South-East Asia, the Western Pacific region and in the humid areas of Africa. In the recent global assessment of rattan, about 600 species in 13 genera were identified. However, only about 50 species are commonly and commercially used by the local communities.

Rattan inventory is a way of evaluating the status of rattan resources in the forest. It is an important step towards proper management of these depleting resources. An inventory of available rattan resources is also very important in order to tag their location and to identify their distributional pattern. The main objective of rattan inventory is to provide baseline information on rattan composition and distribution in Malaysia since Malaysia was once known to have abundant resources of rattan. At present, there is limited compiled scientific data available on the collection of rattan in the country. Therefore we initiated a study to compile data on rattan resources in Malaysia, initially focusing on the forest reserves of Penang.

A recent survey in four forested areas; namely Bukit Panchor Reserve, Bukit Mertajam Reserve, Penang Hill Reserve and Penang National Park, revealed a total number of 5482 individuals representing five genera of rattan species and 21 species were recorded from all four sampling sites. *Calamus dieffenhorstii* is the dominant species in Penang National Park followed by *Plectocomia griffithii* and *Daemonorops lewisiana*. Other species which were found in lower total individuals in the Penang National Park are *Daemonorops calicarpa*, *Calamus penicillatus* and *Calamus castaneus*. For Penang Hill, there were ten species found and *P. griffithii* showed the highest abundance. The least recorded individuals are from *D. lewisiana* and *C. penicillatus*. Other rare species are the *Calamus castaneus*, *D. calicarpa*, *Korthalsia scaphigera*, *Calamus calospathus* and *Calamus javensis*.

The fruits of the rattan *Daemonorops calicarpa*

Calamus castaneus

The fruits of *Calamus castaneus*

Across the Straits of Malacca to the mainland of Penang, different rattan compositions and abundance are recorded with Bukit Panchor being dominated by *Calamus radulosus* followed by *Daemonorops geniculata*. A low density of *D. calicarpa*, *Daemonorops grandis*, *Calamus densiflorus*, *Korthalsia hispida* and *Daemonorops hystrix* were also recorded in Bukit Panchor. As for Bukit Mertajam, *D. geniculata* was recognized as the dominant species followed by *D. calicarpa*.



The spiny stems of *Calamus densiflorus*

In conclusion, the endemism of *Calamus penicillatus* only to Penang Island, specifically at the Penang National Park and the Penang Hill forest, but not found on the Penang mainland sites surveyed, is the most interesting findings obtained from this study to date.



Dr. Asyraf Mansor has focussed research expertise in forest ecology.

Wan Nur Fasihah Zarifah Wan Rozali is currently a postgraduate student.

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Bio-monitoring using aquatic insects

Suhaila Ab. Hamid

Construction of dams and barrages may change the stream flow and riparian biota population.

Water is vital to life. Protection of streams is important to ensure that an adequate supply of high-quality water can last for a long time. One great threat to the stream biota is the construction of dams and barrages that affect the regulation and diversion of river flow. The species richness of stream fauna is strongly influenced by anthropogenic disturbances that may lead to loss of fauna.

Monitoring of water quality

Assessing ecological quality of rivers using macro-invertebrate fauna including aquatic insects is an expanding global science due to the conflicting pressure of human demands on water supply and the needs of freshwater biota. Monitoring water quality by conventional chemical methods can tell us very little about the effects of pollution on aquatic life. The impact of pollution will directly influence organisms that live within the affected area. Therefore, bio-indication is important in aquatic systems as a parameter to monitor water quality. A routine chemical analysis can only be done for a few selected toxic chemicals and it is becoming more expensive to buy the required chemical reagents and hire the technical staff required to analyze the water samples.

Bio-indication or bio-monitoring

Bio-indication or bio-monitoring is the science of applied ecology using organisms (bio-indicator) that live within natural ecosystems to monitor any changes or disturbance in the ecosystem and the data collected used in the management of these ecological systems. Bio-indicator or indicator taxa can be defined as a species or

group of species that readily reflects the abiotic or biotic status of an environment which represents the impact of environmental change on a specific habitat, community or ecosystem. In other words, evaluation of ecosystem health can be measured quantitatively using biological organisms found in the habitat. A taxon that responds to any environmental disturbance or changes in the environmental situation is a good candidate to be used in the bio-monitoring process.

The presence, absence and/or trend in population of macro-invertebrate species in a particular environment in a water body provide a measure of aquatic ecosystem health. Multiple groups of organism such as macro-invertebrates, fish, plankton and algae are usually used as bio-indicators to evaluate aquatic ecosystem health. Aquatic insects have been used effectively as biological indicators to determine environmental conditions of stream ecology. Biological monitoring using aquatic insects has many advantages. Aquatic insects have limited mobility or are sedentary and therefore they can become good assessors of pollution impact on a specific habitat. The existence of many different taxa of aquatic insects with regard to their sensitivity to environmental changes is due to different aquatic insects that live in different microhabitats and can occur very close together. Furthermore, biological methods using aquatic insects as bio-indicator is environmental friendly, less expensive and less time consuming. Aquatic insects are usually abundant and have relatively short life spans making them suitable to be studied as there are usually no ethical constraints in insects sampling.

Aquatic insects and pollution

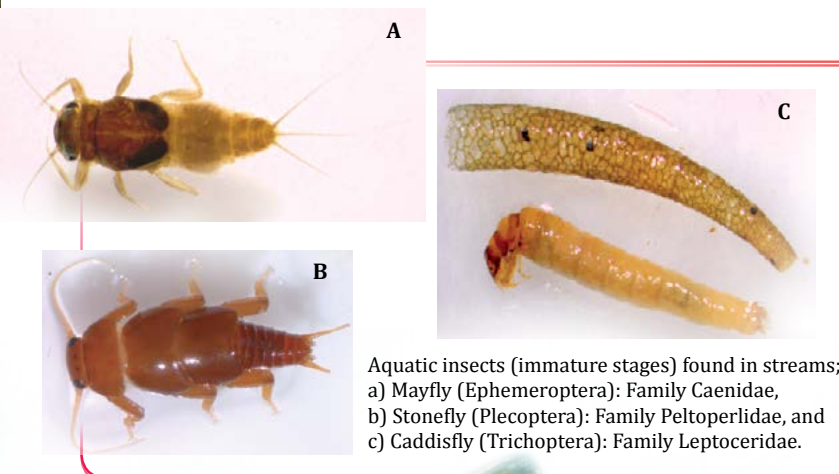
Aquatic insects are not only numerous but also divergent in their taxonomic composition consisting of the orders Ephemeroptera (mayflies), Odonata (dragonflies, damselflies), Plecoptera (stoneflies), Blattodea (cockroaches), Trichoptera (caddisflies), Hemiptera (water bugs), Megaloptera (alderflies, fishflies, dobsonflies), Neuroptera (spongillafly, owlflies), Coleoptera (beetles), Lepidoptera (moths), Hymenoptera (wasp), some Diptera (midges) and semi aquatic Orthoptera. Aquatic insects' assemblages are made up of species that constitute a broad range of trophic levels and pollution tolerances thus providing strong information for interpreting cumulative effects.

Among all insect groups, Ephemeroptera, Plecoptera and Trichoptera (EPT) are good indicators of environmental conditions in streams. Interestingly, EPT species vary in sensitivity to organic pollution and thus their relative abundance has been used to make inferences about levels of pollution. These insects' groups of EPT reach their maximum development in streams and contain families that are entirely or almost confined to running water. The concept of biological indicator using EPT is based on their diversity, abundance and the distribution in relation to the physical and chemical conditions of the habitats.



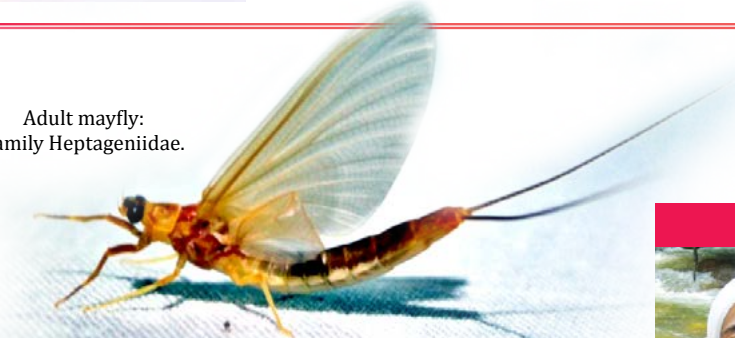
Sampling activity to collect biological and physical data in the stream.

(DOE) of Malaysia has not considered using aquatic insects as bio-indicators of pollution for river pollution studies. The DOE principally uses Water Quality Index (WQI) based on physico-chemical water parameters for monitoring water quality purposes. It is hoped that with more formal training opportunities and refined analyses especially on species identification, the application of aquatic insects, especially the EPT, as potential bio-indicators can be extensively used in bio-monitoring of aquatic ecosystem health and thus can benefit Malaysian in the future.

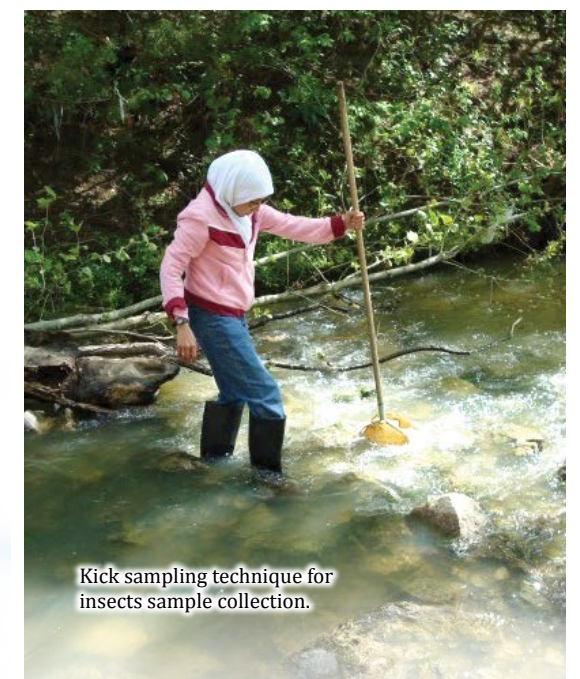


Aquatic insects (immature stages) found in streams; a) Mayfly (Ephemeroptera): Family Caenidae, b) Stonefly (Plecoptera): Family Peltoperlidae, and c) Caddisfly (Trichoptera): Family Leptoceridae.

Adult mayfly:
Family Heptageniidae.



Nonetheless, the use of aquatic insects for bio-indication seems less popular in the Asian region although this technique provides a cheaper option to monitor aquatic ecosystem health without the need of high-technology tools. The obstacles include lack of knowledge of the macro-invertebrates fauna in Malaysia and limited government understanding and support. Currently, the Department of Environment



Kick sampling technique for insects sample collection.



Dr Suhaila Ab. Hamid is a senior lecturer in School of Biological Sciences. Her research interests are taxonomy, biology and ecology of aquatic insects in freshwater ecosystems. She had investigated aquatic insect fauna in various rivers in Penang and other states in peninsular Malaysia.

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Remembering the Past...

the Bio School Reunion Dinner

Mashhor Mansor

The academic and technical staff of the School of Biological Sciences held a reunion dinner at the end of 2012 at a Chinese restaurant in Penang. The event was attended by Bio staff from the 1970s /80s and was a nostalgic event and brought back many fond old memories. It was a great time of meeting and catching up with old friends again. We have not been in contact with many of these pioneering members of the Bio School family for many years, some whom we have lost contact for more than 30 years. A few of them had come from as far as Australia and England.



Sitting, from left Dr. Kam, Prof. Abu Hassan, Dr. Leong, Dr. Lim, Dato Ishak Kechik, Dr. Tan, Dr. Marcus Chamber. Standing, from left Dato Liong, Mr. Adrin, Prof. Mashhor, Dr. Khiew, Dr. Kamaruzaman, Dr. Wong, Dr. Lim, Dr. Ong and others (not listed in sequence).



The four former deans of the School of Biological Sciences were happy to pose for this photograph. Sitting, from left, Prof. Dato' Wong Tat Meng the 3rd Dean. On the right is Prof. Dato Ho Sinn Chye the 9th Dean. Standing, on the left is Prof. Abu Hassan, the 14th Dean and Prof. Mashhor Mansor, the 13th Dean. We all had a great time sharing our bitter-sweet experiences of administrating a large and challenging School in USM.

Dr. Lim Boo Liat, the first PhD student graduated from the School of Biological Sciences is the recipient of the prestigious MERDEKA Award in 2013. Apart from the recognition accorded by the award, the Merdeka award also comes with a cash award of RM500,000. Dr. Lim graduated in 1977 with a PhD in Zoology from USM. Dr. Lim is still active in his zoological research although he is more than 80 years old. Dr. Goon Wooi Khoon and I were privileged to share a private moment of conversation with him.



Dr. Lim was awarded the Merdeka Award 2013 in the Environment category. He was honoured for his outstanding contribution to the conservation of Malaysia's biological diversity through the study, understanding and control of vector-borne diseases and the relationship between diseases and the environment; and for advocating the protection of our natural heritage. (Text and photo adapted from www.merdekaaward.my)

Cairns and the Great Barrier Reef

Ng Wing Keong

The 16th International Symposium on Fish Nutrition and Feeding (ISFNF) was recently held at the coastal town of Cairns in Queensland, Australia from 25 to 30 May, 2014. Cairns is perhaps best known as the departing point for visits to the magnificent Great Barrier Reef. Cairns is a relatively small tourist town but has most of the amenities of big city life. Sandwiched between the sea and a mountain range, it has spectacular scenery and I immediately felt very relaxed upon entering the town center from the airport. There is a man-made sea lagoon and artificial sandy beach constructed within the town center which truly reflects the laid-back way of life that seems to permeate through this town.

About 360 participants, from both academia and the aquafeed industry, from 38 countries attended this premier fish nutrition symposium that is a biennial event. Delegates to the symposium was kept updated to the latest trends in aquatic animal nutrition research through a total of about 88 oral, 3 keynote and 180 poster presentations. Despite the phrase "Fish" in the title of this series of Symposium, scientific presentations covers a variety of aquatic species including shrimp, lobsters, abalone, microalgae, seahorses, etc., albeit, the major focus of most presentations were on teleost fish of commercial importance. All presentations must consist of research data that are new and have not yet been published in scientific journals. As is the tradition of ISFNF, there are no concurrent oral presentation sessions and all delegates attend the same highly informative presentations and ensuing discussions. Eminent scientists, graduate students and technical personnel in the aquafeed



Photo taken with Asian-based technical managers from the Behn-Meyer Group of Companies and Novus International. Higher management level personnel from the aquafeed industry were well represented at this Symposium.

industry are therefore similarly informed of any new findings in this field of research. I was privileged to be chosen as an oral presenter for this symposium and decided to speak on my latest research on the use of organic acids as a functional feed additive in marine shrimp feeds. Our research in USM discovered that a special blend of organic acids was able to not only enhance shrimp growth but also boost their immune response and resistance to bacterial diseases. Considering the prevalence of global shrimp diseases and the huge financial losses suffered by shrimp farmers these days, the presentation was timely and very well received by the symposium delegates. Together with my collaborators from Turkey and Australia, we presented another paper on the impact of rising water temperatures on fatty acid metabolism and lipid nutrition of European sea bass.



I was the only oral presenter representing Malaysia at the International Symposium on Fish Nutrition and Feeding in Cairns. My trip was sponsored by an industry-based development grant.



Waiting at the Reef Terminal for our day trip to the Great Barrier Reef. On the far left is Douglas Tocher (University of Stirling) who was one of the keynote speaker and on the far right is Brett Glencross (CSIRO), the local organizing committee chairman of the Symposium.

Deviating from tradition, a gap day was inserted into the symposium program for tours to nearby areas and a symposium dinner so that delegates had ample time for more informal networking and catching up with colleagues from around the world. Most delegates chose to visit the Great Barrier Reef, the world's largest coral reef system and living structure. The cruise boat took us to the outer edge of the Great Barrier Reef where delegates can choose to snorkel, scuba dive or visit the various facilities on the multi-level reef activity platform which included a semi-submerged viewing station. For those who can snorkel or scuba dive, a spectacular and colorful underwater world of marine life and corals exploded into view.

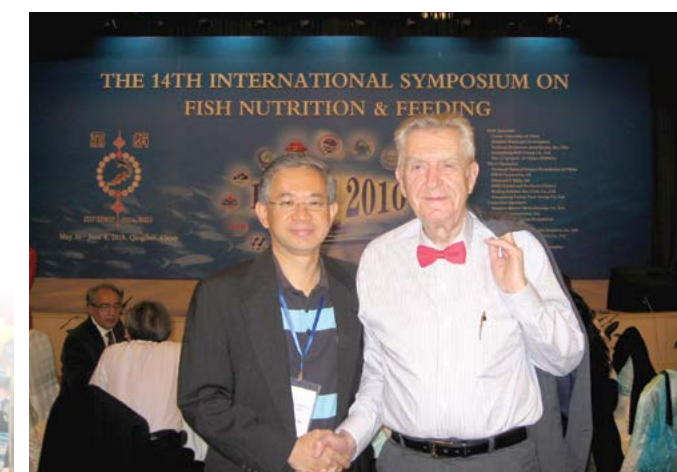


The giant humphead wrasse is a coral fish commonly sighted in these waters at the outer edge of the Great Barrier Reef (underwater photo courtesy of Brett Glencross).

Fish nutrition research has come a long way since the 1960s and have contributed much to the development of the ever expanding global aquaculture industry. It was therefore timely and appropriate that the Symposium started off at the opening ceremony to acknowledge the significant contributions of some of our colleagues that have recently passed away. Kevin Williams (Australia), Colin Cowey (United Kingdom) and John Halver (United States) were given honorable mention at the start of the symposium. The first keynote presentation was given by Ronald Hardy, the chairman of the International Scientific Committee of the ISFNF who spoke on the topic "John Halver Oration: Accidental Fish Nutritionist Who Changed Everything" and highlighted all the major achievements of John Halver who is widely regarded as the "Father of Fish Nutrition". John Halver passed away

on October 24, 2012 at the age of 90. It was very interesting to see the role John Halver played in making Fish Nutrition a legitimate scientific field. We were also taken on a journey of how fish nutrition research has progressed over the years from basic monitoring of the effects of diet on parameters such as growth and feed intake to the measurement of biochemical parameters to enzyme analysis and the pioneering efforts in making formulated pelleted feeds. We have much to thank John Halver for the advances currently made in this thriving field of research. Even in his 80s, Halver continued to be active in research and traveled the world attending conferences. At ISFNF conferences, he will always sit on the front row and will not hesitate to make comments (negative or positive) on the presentations. At ISFNF 2004 in Phuket, Thailand, as I was making my way down from the stage after giving my oral presentation, he gave me the thumbs up and commented "Excellent presentation", which made my day! I last met Halver at the ISFNF 2010 conference in Qingdao, China.

Attending these highly specialized conferences is critically important as a venue to highlight our research, make the world take notice of our work and to establish linkages with colleagues from both the academia and industry. Through both formal and informal meetings at these conferences, very successful research ideas and collaborations can be forged. Over the years, these conferences have played a large role in my own career development. I sincerely hope more young researchers from Malaysia will make better use of their attendance at these highly specialized conferences of their own subject matter to establish international contacts, to highlight their research and to make an impact on the global stage.



John Halver, the "Father of Fish Nutrition" at the conference in Qingdao, China, in 2010.

Some of the Symposium delegates trying out the snorkeling gear during the Great Barrier Reef day trip.



Ng Wing Keong is a Professor of Aquaculture Nutrition. He has specialized interests in developing new lipid and protein ingredients as well as functional additives in the feeds of commercially farmed fish and shrimp to enhance sustainability and profitability of aquaculture.

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Sign board at the Kg. Batu Ring jetty to commemorate the community program.



Zarul Hazrin Hashim

Kampung Batu Ring, with a population of about 200 people, is located in a secluded area in Lenggong, Perak, and is a typical small village in Malaysia. The unique characteristic of this village is that the only access into the village is by boat, via the Perak River. There are three main jetties where people can take the boat ride to get to Kg. Batu Ring: jetty of Kg. Cherakoh, jetty of Kg. Pipit and the jetty at Tasik Raban. The boat ride usually takes 20 minutes by using a long wooden boat powered with a propeller-generator. Using boats as daily transportation is a way of live for the locals, including school children to go to nearby schools.

Surrounded by a green mountain range and next to the Perak River and Tasik Raban, this unique scenery has quite often been chosen by producers as their location for filming movies and commercials. Among the movies and commercials are *Anna and the King*, starring Chow Yun Fat and Jodie Foster, and a Hari Raya commercial by Petronas directed by the late director, Yasmin Ahmad. The mountains, river and lake also provide lots of opportunity for biological diversity studies, especially to field researchers from the School of Biological Sciences, USM. Research and education programs conducted in Kg. Batu Ring and its nearby area include wildlife, trees and fish inventories, water quality studies and other university programs. Frequent visits by students and lecturers to Kg. Batu Ring for research purposes have indirectly created a bond between the researchers and the villagers.

In order to further strengthen this bond, a community service program organized by the School of Biological Sciences was held at Kg. Batu Ring from 12-13 April 2014. Twenty nine staff including lecturers, supporting staff and administrators took part in this program. Very early in the morning, participants gathered at the Kg. Cherakoh jetty for the boat ride to Kg. Batu Ring. Upon arrival, the program started with a prayer recital followed by speeches from the village head, Mohd Alias Md Arshad or more famously known as *Pak Yeh* and the dean of Bio School, Assoc. Prof. Dr. Ahmad Sofiman. After a light tea-break, Bio School participants together with the villagers started to clean the surrounding area. Six plants each of cloves and tamarind were planted along the walkway from the jetty to the *balairaya*. A special sign board was installed near the jetty to commemorate this program.

In any community program, one of the enjoyable activities is tasting the local cuisines. Pickled fish, grilled tilapia, fish head curry, jackfruit curry together with mango studs and salads were served at lunch by the villagers. In the afternoon, each participant was

assigned to their respective family to experience the livelihood of the local villagers via the home-stay concept. Kg. Batu Ring, which at the moment is already well-known for her home-stay program, is the only village in the area that offers guests to stay together with the home owner. Participants were then given a chance to rest, relax and bond with their 'new' family. Most of them were taken to the nearby waterfall by their new family members. Those who love fishing made use of this time to fish at the jetty.

The opportunity to visit Kg. Batu Ring was fully utilized by our fisheries group. My colleagues and I had the chance to set several sets of gill nets to fulfill part of our fish diversity and distribution research project in these areas. As a result, the satisfactory catch became one of our lunch menus once the needed data were recorded. The species, number and the size of captured fish can directly indicate the fisheries status in the area.

By late afternoon, the villagers and the participants once again work together to prepare a delightful menu for the feast in the evening that included a barbeque. A stag weighing 8 kg was used for this purpose. Besides barbeque, the meat was also prepared for *rendang* and soup. The feast is the peak event of the program as it involved all villagers. The night continues with a lively karaoke session with active participation from staff of Bio School.

Overall, the objectives of this community program have been successfully achieved and the participants acquired valuable community outreach experience.



The participants from Bio School and the villagers of Kampung Batu Ring.



Dr. Zarul Hazrin Hashim is a senior lecturer at the School of Biological Sciences. His research mainly focused on water nutrient dynamics and the diversity, ecology, biology and management of freshwater fishes.

Ocean Awareness Week at Universiti Sains Malaysia

Quek Yew Aun

Ocean Awareness Week (OAW) is an event organised by the Scuba Diving Club of Universiti Sains Malaysia (USM) to advocate the importance of the marine ecosystem among students and staff of USM. The event was initiated by a few passionate first year undergraduate students from the School of Biological Sciences and the inaugural OAW was successfully carried out in May 2013. This year, the event was held from 3 to 10 May.

The 35 committee members for OAW 2014 were made up of undergraduate students from various Schools in USM with 20 students from the School of Biological Sciences.



The committee members of the Ocean Awareness Week 2014.

During OAW, exhibition booths were set up in front of Dewan Tuanku Syed Putra and included involvement from various government and non-governmental organizations as well as private companies interested in being involved in marine ecosystem management and conservation. OAW 2014 was co-organized by Pacific West Malaysia, a renowned value added seafood brand in Malaysia. Other organizations involved included the Marine Stewardship Council, Centre for Marine and Coastal Studies, Universiti Kebangsaan Malaysia, MareCet, Save Our Seahorses, Reef Check Malaysia, Malaysia Nature Society and the Malaysian Society of Marine Sciences.

Activities carried out before, during and after OAW 2014 included:

CinemOcean (26 to 28 March)

OAW 2014 kick-started with a movie screening event aptly named CinemOcean. The event featured six movies that depicted the beauty of the ocean. The six movies comprised of three animations (Finding Nemo, Seefood, Happy Feet) and three motion pictures (Dolphin Tale, Big Miracle, Free Willy). One animation and one motion picture were screened every night for

three nights. Participants of the event were provided with myCSD points and popcorn. The event was a great success, attracting about 620 students from all the 14 Schools in the main campus.



Participants of the "Run for the Ocean" charity event at the starting point of the route in USM main campus.

Run for the Ocean (26 April)

One of the themes for OAW 2014 was endangered marine species. True to this theme, a charity run was organised in support of two non-governmental organizations (NGO) that carry out research on endangered marine species. MareCet is a local NGO that does research on cetaceans (dolphins, whales and porpoises) while Save Our Seahorses focuses on seahorse conservation. Part of the funds collected from this run was channelled to the respective NGO to support their research and conservation of these amazing marine species.

The event targeted not only USM students and staff but also the general public. The participants were asked to choose between running for the dolphins or the seahorses and received a limited edition "Run for the Ocean" T-shirt themed after the species that they supported.

Presentations and Talks (6 to 9 May)

This part of OAW 2014 allowed direct contact of students with people involved in the conservation and preservation of marine ecosystems. The event hosted several talks in a span of 5 days and included presentations given by Ms. Vivian Kuit-So (MareCet) on "What's the big deal with marine mammals?", Mr. Kanda Kumar (Malaysian Nature Society) on "Sea pollution from domestic waste", Ms. Charlotte (Marine Stewardship Council, Australia) on "MSC in a seashell: safeguarding seafood supplies for this and future generations", Ms. Serina Rahman (Marine Society of Marine Sciences) on "Student engagement for the community in Sungai Pulai coastal environment" and Ms. Cynthia (Reefcheck Malaysia) on the topic "Coral reefs: why should you care?".



Some of the participants at a talk given by Ms. Charlotte of the Marine Stewardship Council, Australia.

Documentary Screenings (6 to 9 May)

Four documentaries were screened in conjunction with OAW 2014. These included *Blackfish*, an expose documentary about the consequences of keeping large marine mammals in captivity; *Sharkwater*, a Canadian documentary about how the shark hunting industry is driving this species to extinction; *Plasticized*, an eye-opening story about the effects, reality, and scale of plastic pollution around the world and *Garbage Island*, a Texas-sized island made entirely of our trash in the middle of the ocean. All screening were free and free popcorn was given to all attendees.



USM students and staff as well as people in Penang concerned about the cleanliness of our beaches at the beach clean-up event.

Beach Clean-up (10 May)

The other theme for this year's Ocean Awareness Week was marine debris. Penang island is surrounded by many beautiful beaches. Sadly, only a few beaches with potential to attract tourists are well kept and cleaned regularly. The rest are littered with marine debris. OAW 2014 organised a beach clean-up in several beaches. Students and staff of USM as well as the Penang public participated in this event. The event reminded us all that whatever we throw into our oceans will come back to us.

Turtle Release Program (24 May 2014)

Beaches of Penang island are nesting sites for two species of the world's marine turtles, green turtle (*Chelonia mydas*) and the critically endangered Hawksbill turtle (*Eretmochelys imbricata*). OAW14 highlighted the importance of conserving these flagship species by organising a visit to the Kerachut Beach turtle sanctuary that is managed by the

Fisheries Department of Malaysia. The aim of this visit was to spread awareness regarding the status of turtle conservation in Malaysia. The program involved a hike into Kerachut Beach, briefing on turtle conservation by the officers, release of turtle hatchlings and finally a boat ride back to the entrance of Penang National Park.

Due to the success of the past two events, Ocean Awareness Week has now become the flagship programme for the Scuba Club of USM. Hence as long as Scuba Club USM exists as an active society, the OAW programme will run every year. This will ensure the sustainability of the programme. With USM as the host, OAW could transform into something more meaningful by targeting not only USM but the rest of the universities throughout Malaysia. We hope to continue to attract sufficient sponsorship and exhibitors to the event to ensure its financial viability. We hope that this event could be an annual affair that everyone interested in the marine environment in USM and in Malaysia could look forward to.

This event is a great avenue to train young leaders who are environmentally conscious and also equipped with the know how to carry out environmentally friendly events. Although the students of USM come from different courses, the knowledge that they gain from this event be it by being a part of the committee or being a participant of the events, will be of use to make informed decisions related to the marine environment and its protection. All of our current committee members are youths (age 19-23) and many of them are first or second year undergraduate students. These are the people who will take over the reins of this event when the time comes. Long live OAW!



The turtle release event at Kerachut Beach in the Penang National Park.



Quek Yew Aun is currently a second year Aquatic Biology student in the School of Biological Sciences. He chaired the committee of OAW 2014. His decision in choosing to study in USM was due to the strong Aquatic and Environmental Biology program available and his interest in Marine Biology.

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Articles should include at least 3 to 4 good quality color pictures (digital images) along with any tables and figures that can enhance understanding of the subject matter. All figures and tables should be placed at the end of the article, one per page. Photos should be sent as separate jpg or tif files (not embedded within the text). Photos and graphics are very essential to illustrate articles published in *Bio-Bulletin* and should be at the highest resolution possible.

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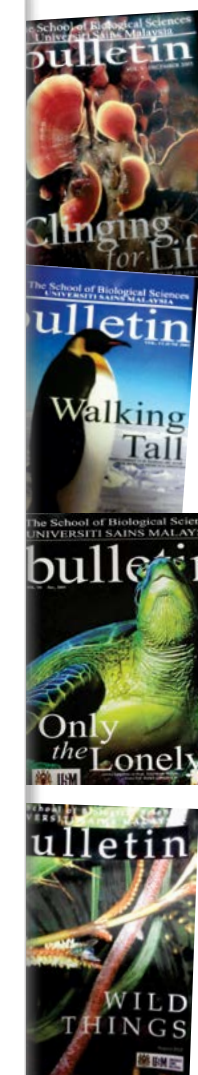
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Editor-in-Chief,
Professor Ng Wing Keong, FASc

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