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The Ecosystem, Landscape and Heritage of Universiti Sains Malaysia

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The
**Ecosystem,
Landscape and
Heritage** of Universiti Sains Malaysia

Editors

**Professor Asma Ismail
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FOREWORD

It is a pleasure for me to contribute a few words to this monograph. This monograph represents a collection of research work which has been carried out at Universiti Sains Malaysia in commemoration of the university's 40th anniversary.

In 2008, USM was honoured to be Malaysia's first APEX university, which we believe was in recognition of the university's readiness and ability to transform higher education for a sustainable tomorrow.

Towards that end, the writing in this monograph is primarily focused on the environment, including recent discoveries on the flora and fauna within the university. It is these discoveries that leave us with sense of awe at the intricate creations found here, while at the same time, we are reminded of our responsibility to ensure the sustainability of these life forms.

Within a historical sense, this monograph represents a form of documentation to see how much the university has grown and developed since its inception some 40 years ago.

Academically, this monograph is a significant indication that the researchers at USM are continually striving for, and in pursuit of, excellence. Indeed, the articles contained within illustrate their great interest to pursue the discoveries of new knowledge and a deeper understanding on matters related to the environment.

On behalf of the university, I would like to extend my appreciation to the authors and editors for their tireless efforts and dedication in producing this monograph.

Prof. Tan Sri Dato' Dzulkifli Abdul Razak
Vice Chancellor
Universiti Sains Malaysia

June 2009



The
**Ecosystem,
Landscape and
Heritage** of Universiti Sains Malaysia

Professor Asma Ismail



The Ecosystem, Landscape and Heritage of Universiti Sains Malaysia



Background

Universiti Sains Malaysia (USM) is the second oldest university in Malaysia. Established in the year 1969, its main emphasis is in the teaching and research of the sciences.

Located in four campuses, USM's main campus is located at Minden on the island of Penang. The other three campuses are the following: the engineering campus at Sri Ampangan, the health campus at Kelantan and the medical campus at Bertam.

Since its inception forty years ago, USM has come a long way. Today, it is recognised as a research-intensive university. This recognition has been firmly acknowledged in its recent award of the APEX (accelerating towards excellence) status presented by the Malaysian government. The main campus of the university, covering 252.7 hectares of lush greenery, is often lauded a university in a garden.

Introduction

It is proposed that a series of workshops be convened to discuss USM's ecosystem, landscape and heritage. In discussing this important topic, groups of relevant personnel would be brought together to harness their expertise to ensure that the university's ecosystem, landscape and heritage be safeguarded, sustained and perpetuated for the future. The personnel include experts, decision makers and implementers, scientists, engineers and personnel from the development sector as well as officers from the treasury division. A sector not to be excluded would be student representatives as their input to forthcoming discussions would be very valuable and make an impact on ensuing resolutions and proposals.

The ecosystem, landscape and heritage of USM are a three-pronged issue, the discussion of which is timely as the university celebrates its fortieth anniversary in 2009. Learning, appreciating and respecting nature and its bounty is a journey for all and for the residents of USM, it should be a journey both of exposure and appreciation. It is exposure to the best that nature can offer and appreciation that a balance of the micro ecosystem, (the university), is a reflection of the macro ecosystem outside its walls. Indeed, the campus is a vista of magnificent landscaped heritage where old colonial-style buildings blend together with new ones, where lush greenery is nurtured amidst rolling slopes and interspersed with waterbeds, an aesthetic feast that is second to none in the island of Penang.

The landscaping of the campus is not - and should never be - a haphazard collection of buildings and silos constructed on a need basis and rushed through time. Structures should therefore not be erected or pulled down on management by surprise; rather, construction and development should be thought through and suggestions and solutions that are sought and implemented, should be both sustainable and effective.

In the arena of heritage, USM is not lagging behind the rest of the endeavours on the island to preserve and conserve its treasures. The 252.7 hectares of the campus is a prized natural treasure. The campus authorities have accordingly thought through the concept of the university being a garden. Presented with this vision, they have scrupulously and diligently enhanced every possible feature to make this a reality. Thus flora, fauna, water and land all exist harmoniously, the beauty of the whole a feast for the eyes and an enduring conversational piece for all visitors.

Objectives

It is therefore imperative that the following objectives be achieved:

- The documentation of the heritage of USM - its ecosystem, landscape and heritage buildings.
- The identification and management of potential threats against the preservation of this heritage.
- The monitoring and sustaining of the heritage.
- The preparation of a road map and a plan of action.



The campus and its heritage

Where USM is concerned, the three perimeters of its ecosystem, landscape and heritage merge together into one entity, one affecting yet supporting the other. The intertwining nature of the campus encompasses the following:

- the heritage buildings
- the landscape
- the marine bounty
- water and the lakes
- plants and trees
- natural elements
- flora and fauna

Problems to be addressed

Four main problems confront the campus authorities in their endeavours to preserve the delicate balance of ecological systems; these have to be addressed with urgency. The primary concern is to ensure that there is no compromise when it comes to the conservation of the best nature has to offer.

The immediate problems are as follows:

- buildings
- termites and vectors
- lakes
- trees



Buildings

The campus authorities will begin by identifying the heritage buildings and enact the stories behind them. However, the real problem lies in their maintenance, stressing primarily on issues like water leakages (which contribute to fungus growth), termite infestations and the presence of undesirable animals especially snakes.

Termites and vectors

The campus has a history of termite and ant infestations and probable susceptibility to mosquitoes and flies. Their undesirable presence not only mars the beauty of the landscape but worse, presents potential endangerment to the structures of buildings. Insufficient and ineffective control can lead to disastrous wastes as age-old trees are attacked (especially by termites) and prematurely die as a result.

Lakes

The campus lakes are drying up and dying. There is urgency to pinpoint the root causes of this degenerating scenario and address it with long-term solutions. The lakes are a life source for water life such as fish, frogs, birds (especially the herons) and iguanas and drying-up lakes means an increasing deprivation for these animals. In this area, the university looks to the River Engineering and Urban Drainage Research Centre (REDAC) to identify the problems and suggest remedial measures. Turning towards the marine station at Muka Head, there is also urgency in addressing existing problems in marine aspects.

Trees

Without its trees, USM would lose a great amount of its beauty and of course, its greenery. Currently, many trees are not well maintained and are in danger of dying from various causes, for example, termite infestation, inadequate fertilisation, planting of unsuitable species of trees, undue over-crowding, etc. Intensive research must be conducted to study what these causes are and address them.

It is conceivable that clear guidelines regarding tree maintenance are not listed out to guide the work of the personnel involved in the physical development and maintenance of the campus grounds. Clearer terms of reference may ensue in more judicious pruning and felling and overall efficient management.

The support team

In its efforts to achieve its various objectives, the university looks to the following for support and commitment:

- IT computer experts
- R&D and GIS
- The development office
- The bursary
- The security division
- The USM students
- Experts from the various schools and centres of excellence

The support of all these personnel and departments is crucial to the success of the plans and proposals that will be mooted during the series of workshops.



Conclusion

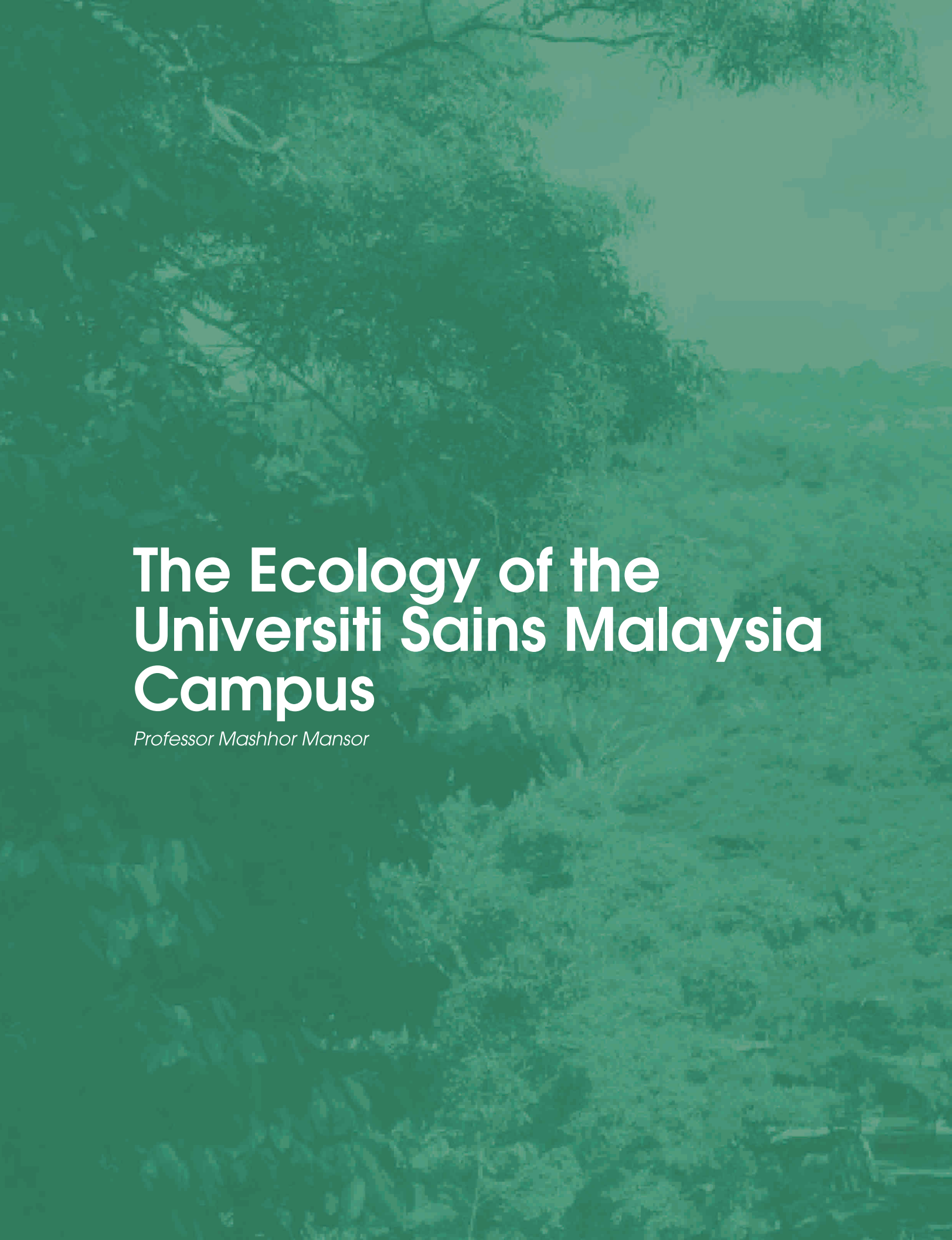
A general call is accordingly made to all parties concerned to come forward with concrete plans/project suggestions that would guide the decision makers at the university to preserve its heritage. All sectors with the establishment - the development office, the bursary, the staff and students - have roles to play towards the conservation of the *university in a garden*. Necessary budget requirements could then be presented.

As a result of the various discussions, the ECO Team USM has been formed, operating from the newly refurbished ECO Hub; this team will spearhead and promote on-going ecological programmes and activities. Its first issue of the ECO Bulletin with its tagline of "working together towards a sustainable future" promises a move in the right direction.

Feasible projects that enhance appreciation for the green environment will accordingly be encouraged. The mapping of various eco-trails has been commissioned to open up further avenues of exploration, appreciation and ultimately, physical and social health, for the campus community at large. It is nevertheless cautioned that suggestions of solutions to issues should be holistic in nature rather than isolated piecemeal remedies.

With the above in mind, this commemorative monograph has been prepared. The first paper, *The Ecology of the Universiti Sains Malaysia Campus*, gives an overview of the importance of sustaining the *green lung* of the campus. The second paper, *Marine Ecology: Studies Conducted at the Muka Head Centre for Marine and Coastal Studies*, extends this general emphasis by illustrating the richness of marine resources that are available at the university's marine research station while pinpointing several issues. The two papers that follow, *The Birds of the Universiti Sains Malaysia Campus* and *Subterranean Termites of Universiti Sains Malaysia* detail the often-ethereal beauty of the birds gracing the campus vis-a-vis a suffocating threat that has to be addressed for the sustenance of its flora and fauna.





The Ecology of the Universiti Sains Malaysia Campus

Professor Mashhor Mansor

Introduction

The Universiti Sains Malaysia (USM) campus at Minden in Penang is a composite of various ecological components. An area of 252.7 hectares with pockets of green areas where big trees with large canopies thrive as well as historic buildings left by the British Army, the campus landscape can be categorised as a semi-disturbed ecosystem which is influenced by human activities. With the presence of intellectual groups with scholarly attitudes, it is a suitable site for ecological activities based on knowledge-oriented programmes. For the future sustainable development of the campus, it is hoped that the USM community can initiate a beneficial project based on sound ecological knowledge particularly with the application of an ecological concept.



The USM campus, one of the most beautiful campuses in this part of the world.



The Chancellery is the centre of USM administration. A few trees have been planted to beautify the area.

It should be noted that our campus resembles a park and garden, where trees with beautiful architectural structures dot the campus landscape. They give character to the campus. One cannot dispute that the campus is one of the unique and attractive sites not only on Penang island, but throughout the entire nation.

For example, the rolling hill slopes filled with coconut trees facing the sea on the east and the hills as a background on the west are attractive vistas; therefore, it is not surprising that most visitors, including prominent professors from overseas, have rated the USM main campus as one of the most beautiful university campuses in this part of the world.

From the ecological viewpoint, the campus has not only provided suitable habitats for plant communities, but has also attracted varieties of residential and migratory bird species. One of the green lungs remaining in the campus is the *Durian Valley*. Although it is a secondary forest, it still harbours some native plant species. With an area of two ha, it remains a green space in the campus. It has been recognised as a bird sanctuary since the 1980s. Although the tree compositions in the vicinity are not that rich, the *Valley* has attracted several bird species.

In the campus, two man-made lakes which have been built - with the main function of flood mitigation - are another attraction. Tasik Harapan with an area of 0.8 ha and Tasik Aman with an area of 0.6 ha have been leisure sites for students over the years. Especially in the evenings, large crowds of students are spotted around the lakes, some of them jogging, others strolling by the side. In addition, the lakes seem to attract birds and other wildlife. Currently, the populations of monitor lizards (*Varanus salvator*) seem to be on the increase. The presence of the monitor lizards has brought more excitement; however, if their population becomes too high, it poses an ecological hazard. If this population goes beyond the carrying capacity, it can spell trouble to other wildlife species. These lizards are not only known as predators, but they are scavengers as well.

Issues

There are three main issues to focus and elaborate on: the environment, biodiversity and human element which are termed the crucial components of an ecosystem study. The environmental factors cover essential aspects such as space and time. Space will be focused on the plant communities which are generally represented as green areas, semi-disturbed and disturbed sites. All factors leading to the sizes of the areas have been accounted for. Time is based on the earliest date USM was built (in 1969). Currently, the university has reached 40 years of existence and massive changes have taken place especially those pertaining to its campus ecosystem.

The growth of the student population is on an exponential scale. The built-up areas to cater to their increasing numbers are limited due to the allocation of a relatively small space especially on an island where land is scarce. Some of the green sites have been sacrificed to make way for new buildings to cater for lecture theatres and other amenities, including residential hostels. An ecological study on student populations is one of the crucial parameters which will, directly or indirectly, impact the status of the campus ecosystem. For instance, the human population is extremely high during the convocation period. In fact, the whole campus appears to take on the status of a small town during this time.

Biodiversity is an issue where human requirements are always in conflict with conservation efforts. Wildlife habitats are destroyed in the name of development. Some areas have to be modified and built upon even though they may be within a sensitive ecological zone. Invariably, sensitive breeding and nesting areas are seldom considered as a strategic ecological zone where a number of native species habitats will be displaced. Human elements, especially the activities of human beings, have resulted in degradation of the ecosystem.

The relationship between these components plays a very crucial role in determining whether the ecosystem is balanced or otherwise. A balanced ecosystem will provide goods and services based on sustainable development. The study of ecology is a very important subject particularly in this new era where biology has been a core subject for human development. Research in the numerous biological aspects which impact the ecological systems should be studied both intensively and extensively.

The environment

The environment consists of all the perimeters found within time and space and encompasses elements such as *the green* representing the vegetation sites, *the brown* representing the utilised sites including buildings and road network systems and *the blue* representing water including the lakes, canals and surrounding sea. It should be noted that the main campus is surrounded by hills on the west side while facing the sea on the east side. The picturesque landscape provides a panoramic view from the Vice-Chancellor's rock; it overlooks one of the longest bridges (13.6 km) in Asia which connects the mainland and Penang island; in turn, the island with its well planned marinas and coastal zones has provided the USM campus with a unique and beautiful surrounding.



Big trees lining the USM campus and football fields act as an ecotone between the campus and surrounding areas. The tall buildings have over-shadowed our campus.

Where USM is concerned, development has taken place in various phases beginning with its inception in 1969. During the initial phase from 1969 to 1979, the campus was extremely green and rich in its ecology. There were only a few students and most of the buildings used were those already in place, especially the majestic buildings used by the British military forces. Further developments took place during the following two phases (between 1979 - 1989 and 1989 - 1999). The fourth phase is 1999 - 2009. This is a very crucial phase where campus activities are planned and projects are initiated. Without an ecological input, the impact on the campus environment cannot be reduced and strategised accordingly.

However during the colonial period when the campus was a cluster of British military barracks, the landscape was relatively different. Some portions were planted with trees originating from other parts of the world; therefore, plant species such as the Araucaria, pine trees, frangipani and several palms were intentionally introduced to beautify the landscape. Other plants, such as the noxious weedy species like *Mimosa pigra*, were accidentally introduced. The ecological characteristics gradually changed with the

times. The magnitude of the changes has been largely dependent on the intensity of human activities.



A row of pine trees at a part of the campus landscape where trees are uniformly planted.

The biodiversity

The biodiversity of the USM campus is extremely rich; it boasts of the presence of microbiology, fauna and flora in variety and importance far surpassing any other biodiversity generally found in most campuses around the world. The soils, birds and pests as well as the plant community that exist within the grounds are indicative of this

rich biodiversity. A campus in the tropical belt is undoubtedly relatively rich in biodiversity. Most probably, this is a plus sign for USM that many are unaware of. As the USM campus is located in the tropical belt, this phytogeographic region of Malaysia is floristically the richest region of the Indomalaysian sub-kingdom which includes Peninsular Malaysia.

The tropical island of Penang was once not only rich in spices but also in economical plants such as those from the Dipterocarpaceae family. There are about 26 endemic Dipterocarp species in Peninsular Malaysia and some of them are present in Penang island. Unfortunately, most of these Dipterocarp species no longer exist in the campus. Some species still thrive in Pulau Jerjak, an island adjacent to the campus and at the Penang National Park. Perhaps most timber species found on Pulau Jerjak were once abundant in the USM campus. Since the campus is near the sea, some species such as ketapang (*Terminalia catappa*) are high in population density.

The high populations of coconut palm (*Cocos nucifera*) and pinang palm (*Areca catechu*) found in the campus indicated that the campus was once a Malay *kampung*. There are also left-over fruit trees such as durian (*Durio zibethinus*) and banana (*Musa sp*) growing in the campus. Several species of ficus have been recorded. Some of their colonies are beautifully patterned along the roadsides. It should be noted that ficus is a genus of 850 species. The genus of ficus belongs to the Moraceae family. Their fruits are food sources for frugivores including birds and bats. Perhaps some parts of the campus can be considered as ficus belts and their canopies not only considered as attractive sites but to provide natural shades for parking areas.

The frangipani trees are common in residential sites in the campus. Two species - the red frangipani (*Plumeria rubra*) and the white frangipani (*Plumeria obtusa*) - were mostly planted during the British era. The palms, such as royal palm (*Roystonea regia*), sealing wax palm (*Cyrtostachys lakka*), Bismarck palm (*Bismarckia nobilis*), were also then planted. The traveller's palm (*Ravenala madagascariensis*) has been widely cultivated. The chine pine (*Araucaria araucana*), with its needle leaves has attracted the red sea eagles to build their nests. Trees belonging to the cassia family, such as the flame of the forest (*Delonix regia*) and the tamarind (*Tamarindus indica*) both of which originated from Madagascar, are widely distributed within the grounds. The mango (*Mangifera indica*) and the neen tree (*Azadirachta indica*), which has medicinal value, continue to grow. One of the popular food trees in the campus is the petai (*Parkia speciosa*). The campus has an Ariod garden with a large collection of Araceae species.

There are more than 300 bird species recorded on Penang and some of them are also recorded in USM. One of the interesting species is the Brahminy kite (*Haliastur indus*) which has been observed to nest in the campus. Perhaps the predator has selected the campus as a safe site to nest. Most of our bird species are protected under the Malaysian wildlife law. Unfortunately, their habitats throughout the country have been encroached upon and highly disturbed. The campus may then be providing a refuge for some of our bird species.

Currently, the merbuk (*Geopelia striata*), tekukur (*Streptopelia chinensis*), murai batu (*Copsychus malabaricus*) and common myna (*Acridotheres tristis*) are familiar birds spotted in the campus. Especially in the morning, when the songbirds such as the murai kampung or magpie robin (*Copsychus saularis*) and black-naped oriole (*Oriolus chinensis*) are serenading, the campus comes alive. The white-breasted waterhen (*Amaurornis phoenicurus*) is a common sight in the wetland and bush sites. Among the snakes, the ular sawa (*Python reticular*) and ular tedung selar (*Ophiophagus Hannah*) are commonly recorded. The frog *Bufo melanostictus* populations are also relatively high in the campus.

The human element

The human element covers the social-economic aspect. The activities of human beings greatly influence the life of the campus ecosystem. This human factor is a crucial element affecting the campus surroundings. The administration of the campus under the purview of the Vice-Chancellor and the Deputy Vice-Chancellor of Research and Innovation generally monitors the activities that involve the issues of environment especially the development of the campus landscape. The development department, with officers and labourers, deal with the day-to-day running of the campus landscape activities. It is appropriate if some of the workers have certain ideas of ecology. This can help as they are involved in the implementation of ecological concepts in campus ecological activities.

The core group is the teaching staff and the students. They are the ones whose activities will directly or indirectly affect the changes in the campus ecosystem. The frequent visits by eminent scholars and also other dignitaries have an impact on the campus standing - thus their expert suggestions and ideas should continue to be heeded. As an ecologist who has spent more than three decades at the university, I note numerous significant changes made especially to the campus landscape within the period. I taught subjects related to the environment including ecology courses with field training being conducted at the Muka Head field station, which is now a national park.



The Durian Valley is the green lung of the campus. It is a secondary forest.



Part of the School of Biological Sciences where unique and special plant species are cultivated.

In the early 1980s, there were more green sites. Most large green areas were cleared in order to make way for the large increase in the student population. In the early 1980s, the build-up areas were relatively small, but as more schools were introduced, more space areas were needed. Although the areas were expanded arithmetically, the student population growth increased exponentially. The surrounding areas have gradually developed and many tall buildings have been erected in the vicinity of the campus.



The Kampung House in front of the School of Housing, Building and Planning. The presence of fruit trees, including coconuts, indicate that the USM campus was once a Malay kampung.



The residential hostels and the secondary forest behind the hostels. The secondary forest was once a rubber estate.

Perhaps the campus is becoming an isolated protected zone in the midst of tremendous developments. It should be noted that ecology does not cover only nature, but communities, populations and organisms dealing with man-made or human-induced environments such as plantation forests, rice fields and nature reserves. The consequences of human activities have influence on nature such as pollution and global climate change. Currently, environmental issues are getting more and more attention with great and grave concerns not only expressed by the general public but also by policy makers. Indeed, ecologists are required to assume a more active role in safeguarding our only planet.



An old tree provides a good habitat not only for birds but also other epiphytic plants.



Some of the trees shed leaves during the dry spell particularly in the month of February. Like other parts of Malaysia, the campus only experiences dry and rainy months.

The aesthetic value of the ecosystem of USM

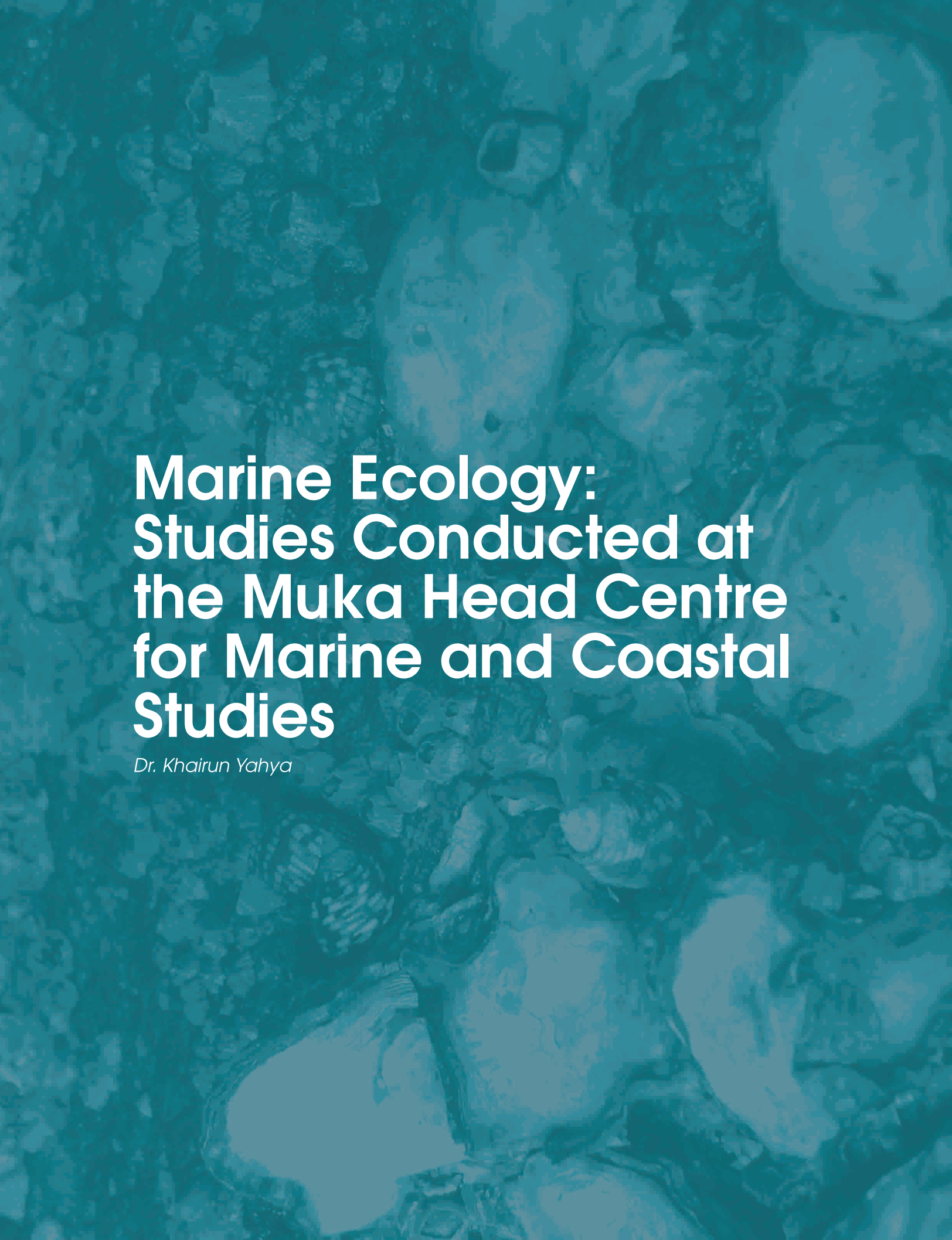
The aesthetic value of the USM ecosystem should be appreciated. It resembles a forest that is a park and a garden. Sanctuaries exist within its vast perimeters for animal life of all types - birds, fish and insects. It is thus a reference point for the discussion of ecological principles and concepts and the mapping of an ecological management plan for the entire premise will augur well for its preservation and conservation.

Indeed in certain parts of the campus, well-laid trees and plants grown in harmony with walkways and buildings are like studies in the symmetry of knowledge and walking along them is like walking along corridors of fame and history. From being a kampung shrouded in unmapped growths of greenery during the early British days, USM has emerged as a beautiful campus, arguably the most attractive in Malaysia.

The landscaping in the campus is to enhance the beauty of the campus environment. In this endeavour, most of the plant species with beautiful flowers are uniformly planted especially along the roads and the main buildings. Most of the species are from the legume family and they provide an attractive landscape especially during the blooming months. A biological clock based on the flowering season can be formulated.

Conclusion

Notwithstanding the attractions of the grounds, precaution must be taken in the maintenance of the health of the campus. While it is a green lung, care has to be exercised to ensure that trees of age and history are carefully tended, pollution reduced and catchment areas maintained and protected. There are suggestions that new buildings be constructed using degradable materials. Wooden materials should be largely utilised for housing and residential projects.



Marine Ecology: Studies Conducted at the Muka Head Centre for Marine and Coastal Studies

Dr. Khairun Yahya

Introduction

Marine ecology is the scientific study of marine life habitats and the interactions between existing organisms and their surroundings. The marine ecosystem encompasses the oceans, estuaries and salt marshes, coral reefs, mangroves and coastal regions such as lagoons, sea grass beds and intertidal systems including the rocky, sandy and muddy shores.

The marine ecosystem is accordingly home to a host of different species ranging from tiny planktonic organisms (these being phytoplankton and zooplankton) that comprise the base of the marine food web to large marine mammals like the dolphins and others.

The Centre for Marine and Coastal Studies (CEMACS)

The Centre for Marine and Coastal Studies (CEMACS) is located at Muka Head at the northwestern tip of Penang and is part of the Penang National Park. This national park is currently the world's smallest



The CEMACS jetty.



Chthamalus & Siphonaria.

national park with an estimated area of 1,181.94 hectares of forests and 1,381.01 hectares of wetlands. Once a forest reserve, it was legally gazetted as a national park on 4 April 2003 under the National Park Act 1980. Under this Act, emphasis is given for the “preservation and protection of wildlife, plant life and objects of geological, archaeological, historical and ethnological and other scientific and scenic interest and through their conservation and utilisation to promote the education, health, aesthetic values and recreation of the people”.

Since CEMACS is part of the Penang National Park, it has taken an initiative to conduct research on marine biodiversity in the region and to record any changes in the biodiversity in relation to any environmental degradation in the marine environment.

Studies conducted at CEMACS Muka Head

Many studies have been conducted on the marine ecology existing at CEMACS. A checklist on this research on the diversity of the marine species in the region was recently prepared.

This research has been categorised into two sections:

- studies on the intertidal area
- studies on the coastal waters of the Penang National Park

Intertidal area studies

In front of CEMACS lies a beach known as Teluk Aling with an area of about 2.5 km² and a slope of about 10 ° on the sandy beach; the slope on the rocky beach is extremely variable. The substratum of the sandy

beach consists of medium to fine sand with less than 5% silt and clay while granite boulders and bed rock form the rocky beach. This ecosystem is home to a host of different species of marine organisms. However, there is very little documentation on the species abundance or the diversity of these marine organisms in the ecosystem.

The distribution of intertidal organisms around the shores of Teluk Aling, Penang

A total of 46 species of organisms has been recorded on the sandy shore while only 13 species has been recorded on the rocky sections. Four taxa have been recorded on the sandy shore including Mollusca, Polychaeta, Crustacea and Echinoderm with Mollusk showing the highest abundance at 89.4%. *Umbonium vestiarum* was the most abundant species on the sandy shore during both sampling periods. On the rocky sections, an assemblage of Crustacean, Mollusk, Cnidarians and Echinoderm was recorded but here, Crustacean was the dominant taxon with an abundance of 95% of the total organisms. Here, *Chthamalus* sp. was the dominant species.

The highest diversity measured by the Shannon-Weaver index, H' (0.951 for the first sampling (on 4/8/2007) and 1.422 for the second sampling i.e. 11/9/2007) and evenness, J' (0.207 and 0.314 respectively) was observed at the middle zone of the sandy shore. In contrast, the lower zone of the rocky sections appeared to be more diverse compared to other zones with $H' = 1.738$ for the first sampling and 2.309 during the second sampling; J' was recorded at 0.673 and 0.769 respectively.

This study also showed that particle size distribution and organic matter along the intertidal gradient influenced the distribution pattern of intertidal organisms on the sandy shore. Based on the Pearson correlation analysis, the organic content showed a significant negative correlation with particle size ($p < 0, 01$). The lower zone has finer sand and the highest percentage of organic content can therefore sustain numerous numbers of species compared to the sterile upper zone which consists of coarse sand and less organic content. The isopod *Eurydice* sp was the only species that could withstand the unstable conditions to thrive within this zone. The rocky sections showed a more striking zonation pattern compared to the sandy shore where there were considerable overlaps of species in their zonation along the intertidal gradient although the organisms may remain quite separate in the sand column.



A rocky beach.



Morula sp.



A sea star.



Littorina scabra.



Matuta sp.



Pachygrapsus sp.

A preliminary study on the abundance and diversity of benthic organisms of Teluk Aling, Penang

Infauna organisms are a very important component group of organisms in the ocean. Most of them are deposit feeders or scavengers but some are carnivorous. They act to break down decaying organisms and are a very important food source for a variety of fishes, crustaceans and echinoderms, among others (Fincham, 1984). Most of these organisms are sessile and are susceptible to changes in physico-chemical as well as biological changes in the sea or the sediment where they reside. Hence, they form an integral part of Environmental Impact Assessment studies that seek answers for impacts on organisms due to development (EIA 2005).

The organisms found on the sandy and rocky shores of Teluk Aling have been extensively studied by the undergraduate students of the School of Biological Sciences and Tay (2008) provided a good analysis of the abundance and distribution of the intertidal organisms on both beaches. However, the abundance or the diversity of the infauna organisms off Teluk Aling is largely ignored in spite of their importance as stated above.

The aim of this study was to document the abundance and diversity of benthic macro-infauna organisms that inhabit the sediment off Teluk Aling. These baseline data could provide guidelines for future EIA studies or as reference for any changes in the seabed environment in future years.

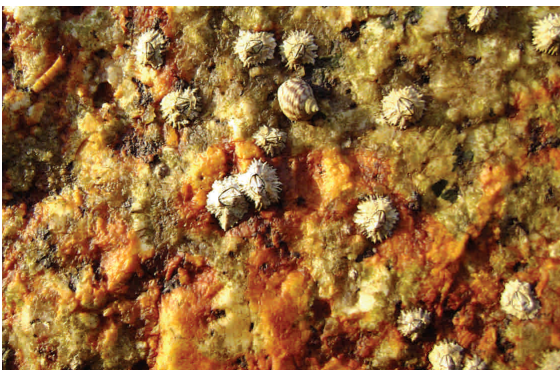
Results from this study indicated that the Crustaceans is the most dominant phyla at all stations, ranging from 69.38% - 85.37% in total contribution; Annelid (Polychaeta) the second most dominant at between 10.0% - 26.25%, while Mollusk is the third most dominant at 0% - 3.12%. Other benthic organisms include the Echinoderm and the Sipuncula, ranging from 0% - 2.44%.

An analysis of the Shannon-Weaver index indicated that the benthic macroinfauna in Teluk Aling ranges from 2.192 - 2.940. Such indices are considered "a little disturbed" by Pielou (1975) who argued that Shannon-Weaver indices for pristine undisturbed areas should be about 4. The Pielou's Evenness indices ranged from 0.790 - 0.865, a condition considered "skewed" which means that the animals are not equally represented in the samples.

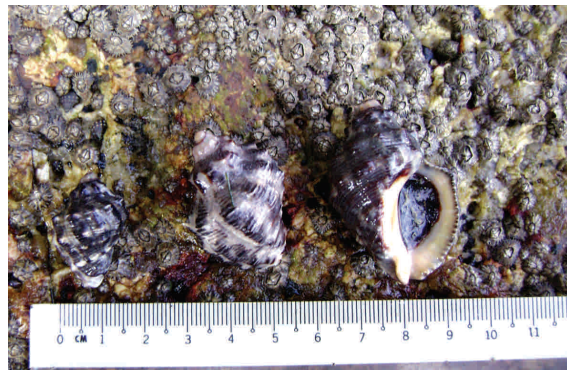
Effects of the Trochacean Gastropod *Umbonium vestiarium* (L.) on the seasonal distribution of the sand dollar *Echinodiscus truncatus* and other echinoderm benthos in the intertidal area of Teluk Aling, Penang

Research on the effects of the Trochacean Gastropod *Umbonium vestiarium* on the seasonal distribution of the sand dollar, *Echinodiscus truncatus* and other echinoderm benthos recently started in August 2007 located at the intertidal area of Teluk Aling, Penang and will be continued until January 2010. The estimated 2½ year sampling period will be significantly enough to investigate the overall process on the predatory activities between *E. truncatus* and the other echinoderm benthos on *U. vestiarium*.

Sampling was done using the 300 m transect line which lies in the intertidal area along the coastal line in Teluk Aling. Ten 1.0 m² quadrates were set beside the transect line at intervals of 30 m. A number of sand dollar and other echinoderm benthos specimens found were recorded and collected.



Littorina and Chthamalus.



Thais.

0.25 x 0.25 x 0.10 m³ sand inside the 1.0 m² quadrates was sieved using a 0.5 mm sieve to collect the *U. vestiarius*. The total number and total wet weight of *U. vestiarius* in each 0.25 x 0.25 x 0.10 m³ of the quadrates were recorded. 20 individual voucher samples of *U. vestiarius* were randomly selected from each quadrate for the measurements of length and weight.

The biometric parameters (height, width, thickness, margin thickness, lunule, radius, petaloid and total wet weight) of sand dollar *E. truncatus* were measured and recorded in the laboratory to study the seasonal population patterns of this species as well as to understand the natural roles of this dominant benthos animal inhabiting the area.

Physical parameters (temperature, salinity, dissolved oxygen, conductivity, pH, the total suspended solid and turbidity) and chemical parameters (chlorophyll-a level, phosphate, nitrate and ammonia) of the sea water around the sampling site were also collected and measured in each sampling. We aim to determine the effects of exogenous environmental factors on the seasonal distribution of *U. vestiarius*, *E. truncatus* and other echinoderm benthos beside the predatory relationships. Measurements of salinity, dissolved oxygen, conductivity and temperature were recorded *in situ* while the rest of the parameters would continue to be analysed in the laboratory from the water samples collected.

The sampling results are still in the process of analysis. However, a survey trip conducted in 4 June 2007 showed that the total number of 142 samples was collected in a 300 m² area. The maximum height recorded was 9.3 cm in diameter and the total wet weight was 21.34 g. 15.49% of the samples recorded were in the juvenile stage while 30.99% collected naturally matured. Another survey trip was undertaken on 30 June 2007 with the objective of calibrating the sampling methods based on the number of samples. The results showed that 429 sand dollar specimens were collected in only 150 m² of the area. The richer resources of sand dollar samples in the intertidal area of Teluk Aling are still undiscovered and more research will be conducted.

Studies along the coastal waters of the Penang National Park

Impact of human activities around the coastal waters of the Penang National Park based on E. coli studies

Various human activities that take place around the coastal area of the Penang National Park can bring about some environmental degradation to the ecosystem. A preliminary study was carried out to determine the level of *E. coli* as an environmental indicator to identify the level of bacteria pollution in a water quality study. Water samples from eight stations along the National Park were collected, that is, from Teluk Bahang, Teluk Aling, Teluk Duyung, Teluk Ketapang, Pantai Kerachut, Teluk Kampi, Pantai Mas and Ujung Batu.



The intertidal area at low tide.



Polychaete tubes.

The results from July 2007 until February 2008 indicated that the *E.coli* from the Teluk Bahang area were 16000, 280, 2400 and 330 MPN/100 ml respectively on July 2007, August 2007, October 2007 and November 2007. These values exceed the standard level allowed by the Department of Environment, Malaysia. Teluk Bahang is a fishing village that has been heavily impacted and it receives domestic discharge as well as discharge from mariculture activities.

Pantai Mas is another area which showed high levels of *E.coli* with 1600, 540, 350, 460, 540 and 340 MPN/100 ml respectively on most of the sampling months from September 2007 until February 2008. Pantai Mas constantly receives effluent that flows into the sea from a pig farm.

However, the areas which are considered less polluted (Teluk Aling, Pantai Kerachut and Teluk Kampi) showed elevated *E.coli* during three subsequent months, that is, 2400, 170 and 930 MPN/100 ml (October 2007), 2400, 350, 350 MPN/100 ml (November 2007) and 2400, 350 and 220 MPN/100 ml (December 2007). This condition was probably due to the changes in the water current that brought along the discharge from other activities such as dredging and the accumulation of sediment outside the coastal area of the park.

Monthly distribution and abundance of jellyfish (*Medusae*) species in the coastal waters of the Penang National Park

The state government of Penang and the public are concerned with the high numbers of jellyfish now found in Penang waters as this affects the beach activities along the coastal areas. Penang, and more specifically the Penang National Park at Teluk Bahang, has high tourist visitation and these numbers are expected to rise over the coming years. The high infestation of poisonous jellyfish in the waters is detrimental to the tourism activities here and has also received wide press attention. Following this concern, a study has been undertaken to look at the seasonal distribution and abundance pattern, identify the jellyfish species and provide the information to the public.

We started frequent monthly sampling studies with the complete data of the monthly distribution and abundance of each jellyfish species to discover their seasonal population patterns in the National Park waters. With the water qualities collected from the sampling locations, we hope to determine and understand the associated environmental factors leading to the jellyfish blooming mechanism. This preliminary study also aims to provide complete and useful information for the local authority and tourists so as to decrease the cases of jellyfish stings in the park.



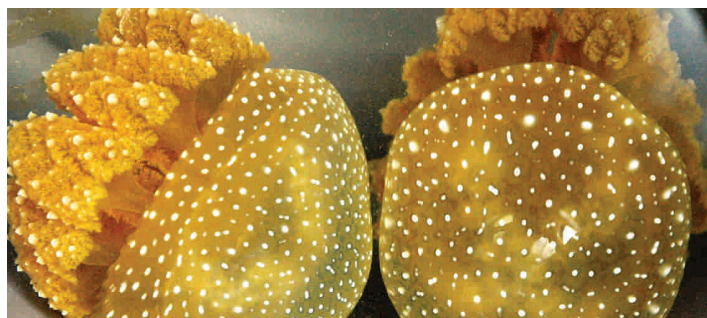
Jellyfish.



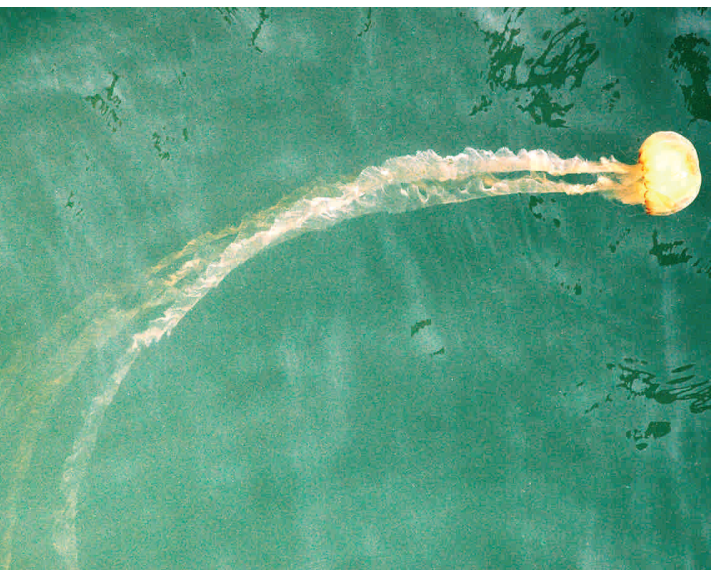
Sand dollar.



Sea anemone.



Jellyfish.



Eight sites (Teluk Bahang, Teluk Aling, Teluk Duyung, Muka Head, Teluk Ketapang, Pantai Kerachut, Teluk Kampi and Pantai Mas), which are located around the coastal waters of the Penang National Park, were selected as the sampling sites. Physical and chemical parameters of sea water around the sampling sites were collected and measured at a depth of 1.0 m to determine the effects of exogenous environmental factors on the monthly distribution and abundance of the jellyfish species in the coastal waters of the park.

Five species of jellyfish were recorded during the first eight-month sampling period and the overall number of specimens found increased from July to December 2007. The dominant species found from July 2007 till February 2008 was *Chrysaora* sp.1 (average = 16.25+16.98 individual per month). *Nemopilema* sp. was considered the rare species in the area. The total number of jellyfish recorded during the eight months sampling period was 272 individuals.

Most of the jellyfish species were collected from Pantai Kerachut ($\Sigma = 151$ individuals) and Pantai Mas ($\Sigma = 34$ individuals) while only a few numbers of specimens were found in Teluk Kampi ($\Sigma = 4$ individuals) and Teluk Bahang ($\Sigma = 9$ individuals). The rare jellyfish species *Nemopilema* sp. was only recorded in Teluk Ketapang, Pantai Kerachut and Pantai Mas. Both chemical and physical water qualities collected from the eight different sampling locations around the coastal waters of the National Park during the sampling periods were in the normal range but chlorophyll-a ($\mu\text{g/L}$), dissolved oxygen (mg/L), temperature ($^{\circ}\text{C}$), salinity (ppt) and conductivity (mS) showed negative correlations with the total numbers of jellyfish species recorded during the sampling period. We hope to determine and understand the associated environmental factors leading to the jellyfish blooming mechanism. This preliminary study also aims to provide complete and useful information for the local authority and tourists so as to eliminate or minimise the cases of jellyfish stings in the Penang National Park.

Conclusion

It is evident that marine habitats can suffer from degradation. Pollution, for instance, will cause a deterioration in water quality while coastal developments of all kinds will lead to loss of marine habitats and biodiversity. There can also be biofouling as a result of the presence of seawater pumps, ship hulls and other structures as well as the problem of corrosion.

Although studies on various aspects of the marine ecology at CEMACS Muka Head are being actively pursued, it is therefore clear that further and continuing research is important. Furthermore, future plans to make CEMACS a marine ecopark with programmes such as those focusing on environmental conservation and awareness will hinge on the capabilities of the Centre in all aspects and especially in research and development.



The
**Birds of the
Universiti Sains Malaysia
Campus**

Mohamed Hifni Baharuddin

Introduction

The Universiti Sains Malaysia (USM) main campus in Minden, a site of approximately 252.7 hectares (formerly a military barracks), is located on the south-western coast of Penang Island. Well maintained and well landscaped, USM is one of the most beautiful university campuses in the region. The mixture of new and old buildings, together with a green landscape lined by tall shady trees, renders it attractive, appealing and interesting. Since its establishment in 1969, university development policies have always emphasised the maintenance and enrichment of its surroundings. Although the campus is small in terms of acreage, it is rich in that its ecosystem is able to support and protect many types of vegetation and animals. The open soccer field, which is part of the university infrastructure, together with the small stretches of forested areas, makes it a conducive and preferable habitat for many animal species. The habitat is continuously being enriched by the planting of selective trees and plants while the presence of lakes, streams, monsoon drains and hills enables further diversification of the ecosystem.

Factors encouraging the presence of birds

The rows of big, tall angasana and rain trees along the main road (Jalan Utama) around the campus make it serene. The selected local and exotic plant species decorate and bring colour to the campus surroundings especially during the flowering season. The flame of the forest tree with its brilliant red flowers is a good example and can be found at various locations. The presence of many fig trees (*ficus* sp.) (naturally replacing the old and dead trees), produces rich and delicious fruits that attract animal life especially birds.



Desa Harapan lakes.



The Durian Valley.

The Durian Valley is a secondary forest; formally a durian orchard (hence its name), it has been left undisturbed and the vegetation has been naturally enriched by birds. Although it is small in terms of size, the valley contains varieties of plant life, ranging from forest trees to aroids and gingers.

The lakes around the student hostel, Desa Harapan, are actually retention ponds meant to control flooding; they represent another important unique part of an ecosystem that supports animal life. The fishes, monitor lizards, local bird species and more importantly, the migratory birds, find refuge in these areas. Yearly, some of the migratory birds that fly thousands of kilometres - egrets, herons and plovers - frequent the lakes. They attract the attention of the campus community and fascinate the bird lovers.

Positioned in the heart of the tropical belt and located by the coast of Penang Island, the campus has been able to support a fairly large number of bird communities. Nevertheless, being a small island, the variety of bird species is always less than that found on the adjacent mainland areas. The presence of a comparatively high variety in the campus area is probably due to the diverse habitats mentioned above. In comparison, the nearest surrounding areas bordering the campus are mostly housing, commercial and industrial areas which somehow limit the presence of birds. The presence/existence of mangroves, parks, gardens, forests, farming and rural areas on the island as a whole does contribute towards the continued presence of the birds in the campus.



The bordering sea-shore.

The coastal habitat, including the sea-shore bordering the campus, is a very unique area which forms the interface between land and sea. The habitat it offers to birds is extraordinary and found in no other place. The mudflat below the Penang Bridge, located on the shorelines of Penang Island not far from the campus (and also on the mainland shores), provides food for a large number of mud-dwelling organisms including shorebirds. Many of the shorebirds are passage migrant or winter visitors and during high tides, they will seek resting and roosting refuge in the campus and surrounding areas.

Species of birds found in the campus

Ibrahim and Hifni (1990) recorded **81 species** of birds while Ibrahim and Sharul (2003) enlarged the cumulative species list to **106 species**. After years of observation and at the time of writing of this monograph, **114 species** have been recorded. The eight additional “first” time recorded species are the white-rumped munia, *Lonchura striata*, the streaked-weaver, *Ploceus manyar*; the Tickell’s blue flycatcher, *Cyornis tickelliae*, the Malaysian hawk cuckoo, *Hierococcyx fugax*, the chestnut-breasted malkoha, *Phaenicophaeus curvirostris*, the thick-billed green pigeon, *Treron curvirostra*, the little egret, *Egretta garzetta* and the Malayan night heron, *Gorsachius melanolopus*. The white-rumped munia, *L. striata*, a local species more closely associated with padi fields and rural areas, is now frequently found in the gardens and open areas around the USM nursery. The streaked weaver, *P. manyar*, is a recently introduced species to this country; believed to be able to adapt to our local environment, an increasing number is making its way into the campus. The Tickell’s blue flycatcher, *C. tickelliae*; the Malaysian hawk cuckoo, *H. fugax*, and the chestnut-breasted malkoha, *P. curvirostris* are resident species while the little egret, *E. garzetta*, and the Malayan night heron, *G. melanolopus*, are migrants. All species may have been here for some time but probably escaped notice. The vagrant and solitary Malayan night heron, *G. melanolopus*, which is rare, shy and skittish, has been spotted occasionally roosting in the Durian Valley.

The diverse mixture of bird species found in the USM campus can be generally grouped as the common birds of parks and gardens, forests, mangroves and coastal, farming and rural areas. Most of these birds are resident birds that nest and breed in the campus surroundings while some may be daily visitors, coming in during the day and roosting elsewhere at night. Every year, the passage migrant or winter visitors will come and use the campus areas for a few days before going further on their journey. They usually arrive here in August or early September through to November and again in March to late May. Some of these winter visitors that may not be able to continue their journey will join the local species and breed here.



The white rumped munia.



The pink-necked pigeon.

The common birds of parks and gardens found in the campus include the brown-throated sunbird, *Anthreptes malacensis*, the olive-backed sunbird, *Nectarinia jugularis*, the Eurasian tree sparrow, *Passer montanus*, the common minor, *Acridotheres tristis*, the common iora, *Aegithina tiphia*, the yellow-vented bulbul, *Pycnonotus goiavier*, the black-naped oriole, *Oriolus chinensis*, the dark-necked tailorbird, *Orthotomus artogularis* and the blue-tailed bee-eater, *Merops philippinus*. Their presence in various shapes and colour together with their sweet and delightful voice or song really make the campus more colourful and lively.

The fast flying, slender and tapering shape bee-eaters - considered one of the most attractive and colourful birds in Southeast Asia - can be seen either perching on dead branches of trees and bamboo stems or flying in the air above the campus canopy and open areas, searching for insects. They usually catch insects on the wing, and return to the perch to swallow them. The ideal place to watch them is around the lakes of Desa Harapan. They also can be easily spotted on bamboo bushes scattered around the campus. The brightly yellow coloured small common iora, *A. tiphia*, produces soft and sweet sounds that fascinate many and can be seen on trees around the Dewan Syed Putra and lecture hall buildings especially among the mistletoe plants; it is said to be fond of mistletoe berries. The bigger black-naped oriole, *Oriolus chinensis*, also yellow in colour, is fairly common as well. This handsome bird, which is widely distributed throughout tropical Southeast Asia, is arboreal (but not a forest bird) and breeds in the campus where it is a resident bird. The yellow-vented bulbul, *P. goiavier*, and the common minor, *A. tristis*, are considered aggressive pest species frequently found in the campus. They are omnivorous, feeding on fruits, seeds, nectar and insects. The latter will eat anything edible and adapt well to human presence. Lately, this species has been associated with garbage and dumping sites and categorised as a nuisance. Another exotic species is the house pigeon, *Columba livia*, which is starting to establish itself and has been found nesting on campus buildings. This species is known to terrorise big cities and urban areas, causing problems to cities like Kuala Lumpur, Georgetown and Malacca.



The Brahminy kite.



The scarlet-backed flowerpecker.



The streak weaver.

The scarlet-backed flowerpecker, *Dicaeum cruentatum*, is a tiny bird usually seen on tree tops in the campus. The striking bright red coloured crown of the male and red rump of the female contrast sharply with their blackish bodies and glossy blue blackish wings, making them very attractive. They produce high-pitched, metallic six note trills, the “tick”, “tick”, “tick” sound descending in scale as they fly. They seem passionately fond of the Rhododendron fruit, *Melastoma malabathricum*, and are believed to be spreading these parasitic plants from tree to tree. The Philippine glossy starling, *Aplonis panayensis*, is another successful species and is usually seen in large flocks, congregating on fig and tembusu trees. The birds feed mainly on the fruits in bushes and trees, especially fig and ornamental trees. They are gregarious even during nesting seasons and nest in cavities in trees and buildings. The pink-necked pigeon, *Treron vernans*, the thick-billed pigeon, *Treron curvirostra*, and the little green pigeon, *Treron olax*, are seen in flocks on the campus fig trees during the fruiting season. They are birds from the secondary forest nearby and their presence in the campus areas is a hunt for food only. They roost and breed somewhere else. The barn swallows, *Hirundo rustica*, and the pacific swallows, *Hirundo tahitica*, that are common in open areas can be seen flying, perching and resting over the electric wires above the lakes of Desa Harapan. The swallows are resident birds and are fast and elegant fliers. They build nests on vertical surfaces from small pellets of mud collected from nearby puddles and river banks. The nests can be located on several buildings in the campus. The Asian brown flycatcher, *Muscicapa dauurica*, is also commonly seen in tree canopies, hopping from branch to branch looking for insects.

The kingfisher is a brightly-coloured bird with metallic blue and orange colours dominating its plumage and a strong beak for capturing prey. In the campus, the kingfishers are represented by the white-throated kingfisher (*Halcyon smyrnensis*), the black-capped kingfisher, *Halcyon pileata*, the common (small) kingfisher, *Alcedo atthis*, and the stock-billed kingfisher, *Halcyon capensis*. These species are commonly only seen near water (lakes of Desa Harapan and streams) but the white-throated kingfisher, *H. smyrnensis*, can be found everywhere. The kingfishers are colourful birds and always fascinate bird lovers especially the photographers.



The white breasted kingfisher.

The spotted dove, *Streptopelia chinensis*, and the peaceful dove, *Geopelia striata*, are commonly seen in pairs. The spotted dove, *S. chinensis*, belongs to a feral population; a common bird found in farming and rural areas, it flourishes in the campus probably because of the abundant food resources, shelter and cover. The peaceful dove, *G. striata*, is much smaller and slender; it sings remarkably, rolling a whistled “coo” sound, usually repeated six to eight times and loved and highly prized by bird lovers. Both species are popular cage birds.



The white bellied seaeagle.

The dollarbird, *Eurystomus orientalis*, common in open areas in the campus, can be seen resting in pairs on dead branches. It is a striking bird - while flying, the species displays a bluish-white “dollar” sign. The brown shrike, *Lanius cristatus*, is a resident and commonly found in open spaces compared to the migrant tiger shrike, *Lanius tigrinus* which prefers a more enclosed habitat and forest edges, for example, the Durian Valley and the nursery grounds. Both are medium sized birds with large heads and strong bills, preying

on insects, small reptiles, rodents and other birds. The magpie robin, *Copsychus saularis*, also known as “murai”, is a territorial garden bird, adapting well to parks and garden environments and can often be heard singing from fence poles and roof tops. Its song is a melodious whistle; in fact, it is so melodious that the bird often ends up in cages as a pet! This practice threatens the population.



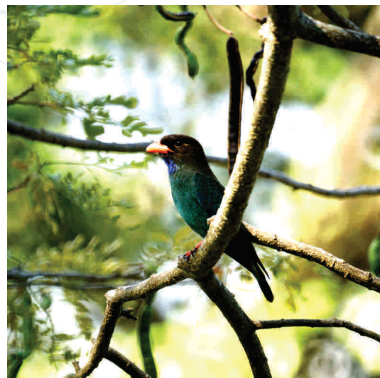
The magpie robin.

The greater coucal, *Centropus sinensis*, and also the lesser coucal, *Centropus bengalensis*, are usually seen in the Durian Valley and the forested area near the Chancellory. They are relatively big birds and produce calls that can be heard far away. Not strong flyers, they usually fly low from one long grass or scrub area to another. These species belong to the cuckoo family but they do not parasitise the nests of other birds. The white-breasted waterhen, *Amaurornis phoenicurus*, a delightful member of the rail family, is a very common sight in undergrowths especially near the lakes and streams of Desa Harapan and the stream/monsoon drain of the nursery ground near Desa Gemilang. It is a shy bird and when alarmed, it will make a headlong charge for cover. The male produces a remarkable vocal repertoire “uwak-uwak”, a monotonous call at dawn and dusk. The common golden woodpecker, *Dinopium javanense* and the olive-backed woodpecker, *Dinopium rafflesii*, are spectacular and arboreal species. Woodpeckers live mainly on ants and insect larvae that they pry out of barks with their strong bills. They produce notable knocking sounds while pecking the tree trunks and branches searching for insects. Although very commonly seen a few years ago around the lakes of Desa Harapan and also the Durian Valley, both species are hardly seen today.

The streaked-weaver, *P.manyar*, is an exotic species and a pair was spotted in the tall grasses of the nursery grounds. This species has recently been recognised and is believed to have been released from captivity (cages); it appears to be able to flourish in our campus environment. However, it has to be established whether these birds are nesting in the campus. The search is thus on to locate their nests. In flocks of ten and more, the scaly-breasted munia, *Lonchura punctulata*, the white-bellied munia, *Lonchura leucogastra*, and the white-headed munia, *Lonchura maja*, are seen in tall grasses around the aquaculture complex and animal house as well as in the open areas behind the main lecture theatre complex and nesting on the *araucaria sp.* trees.



The little egret.



The dollarbird.



The little heron.

The little egret, *E. garzetta*, together with the black-crowned night heron, *Nycticorax nycticorax*, and the little green heron, *Butorides straitus*, usually arrive in colonies to the lakes and streams of Desa Harapan where they prey on fish. The little egret, *E. garzetta*, has a thin black bill and is a non-breeding winter visitor. On the other hand, the black-crowned night heron, *N. nycticorax* and the little green heron, *B. straitus* do breed in this country and their young (juvenile and sub-adult) can be observed at the lakes. They breed in mangroves and use the campus to rest and roost. While the black-crowned night heron, *N. nycticorax*, is gregarious and arrives in colonies, the little green heron, *B. straitus*, is solitary and usually seen alone or in pairs. The cinnamon bittern, *Ixobrychus cinnamomeuss*, and the Malayan night heron, *G. melanolopus*, are rare vagrants with the latter species being the latest “first” time recorded species added to the campus bird list.

The species (lone and juvenile bird) was spotted in early February 2009 in the Durian Valley. The Malayan night heron, *G. melanolopus*, has a stockier appearance and a short stubby bill. Its neck and breast are bright rufous in colour. Its last citing in Penang was reported five or six years ago in Penaga. It is very secretive, preferring swampy areas, streams, secondary growths and forests and feeding only at night. The other shorebirds that frequent the campus are the grey plover, *Pluvialis squatarola*, and the common sandpiper, *Actitis hypoleucos*.

Many of the birds in the campus grouped under the common birds of mangroves actually originate from the nearby mangroves that grew along the shoreline of adjoining Jelutong, Batu Uban, Sungai Nibong and Kampong Java. Following reclamation for housing and industrial developments, small patches remained, from Kampong Permatang Damar Laut to Batu Maung and through to Balik Pulau and Kampong Acheh. These mangrove patches have really helped to sustain the remaining mangrove bird species. Currently, the mangroves are returning to the reclaimed shore via natural processes. The mangrove birds are seen returning and frequenting the campus. Some of these bird species do reside in the campus surrounding.

The large-billed crow (or jungle crow), *Corvus macrorhynchos*, and especially the pest, exotic house crow, *Corvus splendens*, are seen scavenging around the campus area. They are intelligent, adaptable birds and do very well in disturbed environments.



The Malayan night heron.



The common mynah.



The black-crowned night heron.



The Tickell's blue flycatcher.

The latter, *C. splendens*, are a nuisance urban species closely associated with the mangrove habitat. However, although they nest and breed throughout Penang Island, the presence of a parasitic bird species, the common koel, *Eudynamys scolopacea*, prevents them from nesting and roosting in the campus. Thus, they are only day time visitors, seen in big flocks on the soccer field especially after rain, searching for worms and insects together with the common minor, *Acridotheres tristis*. They roost and nest on trees outside the campus. The large-billed crow, *C. macrorhynchos*, on the other hand, is a native solitary species and present in the campus in singles or pairs. It can usually be spotted on tall trees and seldom seen low on the ground. It produces a much deeper pitch call compared to the house crow. This species has been mistakenly labelled a pest but in fact, it does not cause problems to human beings.



The Malaysian hawk cuckoo.

The cuckoo is an interesting relatively big sized mangrove bird that has the habit of brood parasitising and it is represented by nine species in the campus. The common koel, *E. scolopacea*, mentioned earlier is a territorial bird and the male produces a very loud “ko-el” territorial call. The male has a glossy blue-black plumage, a stout apple green beak and distinguished red eyes. The female, on the other hand, is considered a shy bird with overall blackish-brown and heavy whitish streaks, spots and bars on the body. This species nests in the Durian Valley. The Malaysian hawk cuckoo, *H. fugax*, is another “first” time recorded species and typically secretive and difficult to observe. The body consists of variable white markings on the sides of the nape and is creamy white underneath with blackish streaks from the lower throat to the belly and flank. This cuckoo can be seen around the Durian Valley. Another cuckoo that can be observed in the campus is the plaintive cuckoo, *Cacomantis merulinus*, also known as the “brain-fever bird”. This bird looks hawk-like and is often mobbed by smaller birds.

The black-bellied malkoha, *Phaenicophaeus diardi*, the raffles’ malkoha, *Phaenicophaeus chlorophaeus*, the chestnut bellied malkoha, *Phaenicophaeus sumatranus*, and the “first” time recorded species, the chestnut-breasted malkoha, *P. curvirostris*, usually seen in pairs, can all be observed in the Durian Valley. Unlike the “true” cuckoos, they are not nesting parasitic. The first three species have hardly been seen lately. The chestnut-breasted malkoha, *P. curvirostris*, is a beautiful and colourful bird with a long tail and unmistakable dark chestnut under part. It is very secretive and moves silently inside the top forest canopy and middle storey of large trees; it also climbs about like a squirrel in creepers and dense foliage. You are considered lucky with your camera if you can get a clear shot of the bird. The other two species of cuckoos are the greater coucal, *C. sinensis*, and the lesser coucal, *C. bengalensis*, mentioned earlier.

The small dark-necked tailor bird, *Orthotomus artogularis*, is easily encountered if someone is looking for birds in the campus. It is restless, vocal and constantly moving. Its song is rather monotonous, a repeated “chwee-o” that from a distance, sounds just as one note, “chweep-chweep-chweep”. This fascinating bird gets its name from its method of constructing a nest with the edges of a large leaf pulled together and held by plant fibres as if sewn. The bird does nest and breed in the campus.

The common birds of the forest which are present in the campus are laterally average in term of species numbers. Being of the secondary forest types, their continuous presence can be considered significant. The white-rumped sharma, *Copsychus malabaricus*, one of our finest songbirds - its song is powerful yet melodious - is easily spotted in the Durian Valley. The bird sings late in the morning and even in the middle of the day. Its existence is being threatened because of its high market value. Another forest bird that can really flourish in secondary surroundings is the greater racket-tailed drongo, *Dicrurus paradiseu*. This species is known as “cecawi” in Malay and also “hamba kera” (macaque’s slave) because of its habit of following troops of long-tailed macaques through the forest. Interestingly, in the campus especially in the Durian Valley, this same species seems to follow the malkohas instead. Its has metallic black plumage with the outer feathers on each side of its tail greatly elongated with an oval or “racquet” form at both tips.



The thick-billed green pigeon.

The bird has a distinct varying raucous voice and is an extremely good mimic of voices or sounds of a whole range of other species. The Coppersmith barbet, *Megalaima haemacephala*, is another magnificent bird. Although considered common in the campus where it is fond of visiting the fig fruiting trees, its numbers suffered a few years ago from deforestation in Penang Island. As it is very noisy, its presence is known as soon as it arrives anywhere and is easily spotted. Its monotonous "toonk, toonk, toonk" calls are like a hammer beating on metal and hence its name.



The male coel.



The female coel.

The pink-necked green pigeon, *Treron vernans*, the thick-billed green pigeon, *Treron curvirostra*, and the little green pigeon, *Treron olax*, usually come in flocks of anything between 50 to 100 birds during the fig fruiting season. In the campus, they seem very quiet in the morning but become more active usually around 4.30-7.30 p.m. They are frugivorous and feed on fruits and berries of all kinds. Their habits of congregating in large flocks always attract people. A few individuals come in initially, later followed by batches and then suddenly a whole flock covers the trees. Any distraction or disturbance will make the whole flock take off at once. The pigeons roost communally outside the campus but during the fig fruiting season, they seem to roost in the campus. They can be observed resting on tall trees especially during the early mornings in the Durian Valley and Desa Harapan lakes. In late afternoons, they can be spotted on fig fruiting trees all around the campus.

Another interesting bird of prey, spotted especially in the Durian Valley, is the Japanese sparrowhawk, *Accipiter gularis*, which feeds on small birds. Like many birds of prey, the sparrowhawk will always cause a sudden panic amongst smaller birds, long before they are visible to human beings - a clue for birdwatchers and photographers to be on guard for its sudden appearance. Interestingly, the same phenomenon can be observed or watched in the campus during the fig fruiting season - hundreds of frugivorous birds which gather on a fig tree will suddenly panic and take off at once because of the appearance of the sparrowhawk. Once the sparrowhawk leaves, all the birds will return, first a few, then ten and hundreds.

Besides the colourful day time or diurnal birds, a few nocturnal birds are present in the USM campus. The nightjars are insectivorous, catching their prey on the wing and often favouring a perch on electric wires or cables alongside street lights. Some nightjars are forest birds which do come to the forest edges and into more open country. The large-tailed nightjar, *Caprimulgus macrurus*, is frequently seen during the day in the Durian Valley, resting on the ground or sitting on low branches. It produces a peculiar unbird-like call, a monotonous, metallic "tchunck-tchunck-tchunck" or "tok-tok-tok" which is repeated continuously for half an hour or more during the night to mark its territory. This bird is also known as "burung tukang" (carpenter birds). The other familiar nocturnal birds found in the campus are the owl and the owl family. Most are dark brown forest birds. The barn owl, *Tyto alba*, has undergone an amazing increase in population in recent years because it is closely associated with oil-palm estates which provide a rich food supply of pest rodents. The owl hunts from a low perch, attacking insects, small reptiles and mice on the ground. In Malaysia, the barn owl, *T. alba*, is considered an effective biological control for pest rats compared to the cold-blooded snake, the cobra (*Naja* sp.).



The common lora.



The peaceful dove.



The greater coucal.



The brown-throated sunbird.

Conclusion

To bird watchers (and photographers), the campus is a haven for opportunities. The author, for example, has seen the bee-eater, *M. philippinus*, hammering bees on dead branches from side to side (probably to break the bee sting spikes) before swallowing them and the Japanese sparrowhawk, *A. gularis*, grabbing smaller birds in the Durian Valley, causing a panic. Watching the latter return in droves after the sparrowhawk's departure is spectacular. He has also photographed a scavenger Brahminy kite, *H. indus*, tearing apart a young long-tailed macaque, *Macaca fascicularis*.

It is evident that the campus is a natural habitat for various species of birds, common as well as rare. Their presence is both refreshing and encouraging and as such, the grounds and greenery of the entire university should be maintained to encourage their continued presence.



Subterranean Termites of Universiti Sains Malaysia

Professor Lee Chow Yang

Introduction: termites and their basic biology

In essence, termites are pests but they are also beneficial insects. They help to break down fallen leaves and play a role in the decomposition of organic matter. Besides their role in the ecosystem, termites are also important as food to animals, eco-tourism attractions and are reputed to be a good source of aphrodisiac for men. In Southeast Asia, the culture of worshipping termite mounds is common especially among the local communities (Figure 1). Those who worship termite mounds believe that they can obtain wealth, luck or even the realisation of a wish.



Figure 1: *Worship of a termite mound by the local communities in Malaysia.*



Figure 2: *The Western drywood termite (Incisitermes minor).*

Termites are social insects and they live in colonies. Most termite species can be found in tropical and subtropical regions and an estimated 2,700 species have been identified. In Malaysia, there are approximately 175 species from 42 genera.

Termites can be classified either as drywood (Figure 2), dampwood or subterranean termites (Figure 3). The subterranean termites form the most important group as these termites normally cause greater damage to buildings and structures (Figure 4) than those from the other two groups. Drywood termite damage is usually limited to the wood piece that the colony resides (Figure 5). Subterranean termites build their nests in the soil and are highly dependent on soil for moisture. They construct mud tubes to overcome desiccation during the process of searching for cellulose sources above the ground level.



Figure 3: *The Asian subterranean termite, Coptotermes gestroi.*



Figure 4: *Damage by drywood termites.*



Figure 5: *Damage by subterranean termites.*

Being eusocial, termites live in colonies. A colony consists of several different castes, namely, the royal pair (the king and queen) (Figure 6), soldiers, workers and immature stages. The soldiers and the workers (which is the caste with the highest number of individuals) are blind and sterile females (non-reproductive). The soldiers defend the nest, while workers forage for food and tend to the nest. When a colony becomes mature, winged termites or swarmers will emerge (Figure 7). The swarmers consist of both male and female counterparts. These insects are frequently sighted by home owners, especially in warm and humid evenings. Upon finding their mates, the swarmers will copulate, nest and start a new colony.

Termites locate their food source by foraging in an upward manner when they reach thermal shadow(s) in the soil. In other words, when termite workers forage and reach a portion of soil that is cooler than the others, they will move upwards. These are usually on pieces of wood or large structures such as buildings from which the soil beneath them has been protected from the sun. This explains why when a piece of wood is placed on the surface of the soil, it will have termites chewing on it within several weeks.



Figure 6: A pair of royals of *Macrotermes carbonarius* (left: King; right: Queen).



Figure 7: A swarmer (winged termite) of *Macrotermes gilvus*.

The termites found at Universiti Sains Malaysia

Species

Destructive termites are found throughout Universiti Sains Malaysia. They belong to the following main species:

- *Coptotermes gestroi* (88.2 %) (Figure 8).
- *Macrotermes gilvus* (5.9 %) (Figure 9).
- *Globitermes sulphureus* (5.9 %) (Figure 10).



Figure 8: *Coptotermes gestroi* (Asian subterranean termite).



Figure 9: *Macrotermes gilvus*.



Figure 10: *Globitermes sulphureus*.

Apart from these destructive termites, other less destructive species are also found within the campus as well. These include the following:

- Genus *Schedorhinotermes* (Figure 11).
- Genus *Macrotermes* (Figure 12).
- Genus *Microcerotermes* (Figure 13).
- Genus *Microtermes* (Figure 14).
- Genus *Odontotermes* (Figure 15).
- Genus *Nasutitermes* (Figure 16).



Figure 11: *Schedorhinotermes* sp.



Figure 12: *Macrotermes carbonarius*.

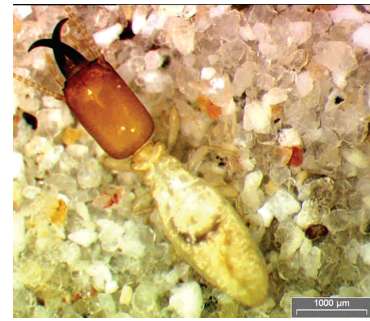


Figure 13: *Microcerotermes crassus*.



Figure 14: *Microtermes pakistanicus*.



Figure 15: *Odontotermes* sp.



Figure 16: *Nasutitermes* sp.

Termite mounds

Termite mounds are found throughout the Minden campus (Figure 17). In fact, there are close to a thousand termite mounds in the campus. Some of these mounds are "gorgeous" and should not be indiscriminately destroyed because not all mound-building termites are destructive to buildings, structures or trees. In fact, we can learn a great deal from these mounds to help with the design of ventilation and heat/cooling systems.



Figure 17: Termite mounds in Universiti Sains Malaysia campus (left: mound of *Globitermes sulphureus*; middle: mound of *Microcerotermes* sp.; right: mound of *Macrotermes gilvus*).

The locations of termite mounds in the campus are as follows:

- *Macrotermes gilvus* mounds (Figure 18).
- *Macrotermes carbonarius* mounds (Figure 19).
- *Microcerotermes* mounds (Figure 20).
- *Globitermes sulphureus* mounds (Figure 21).

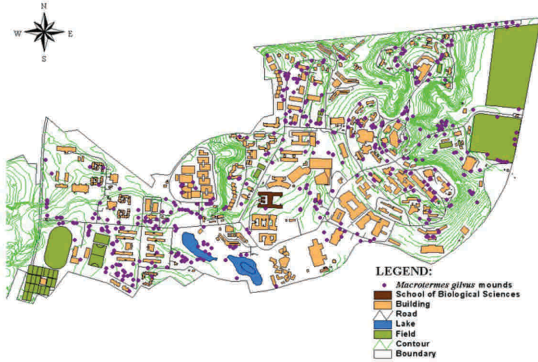


Figure 18: Distribution of *Macrotermes gilvus* mounds in Minden campus.

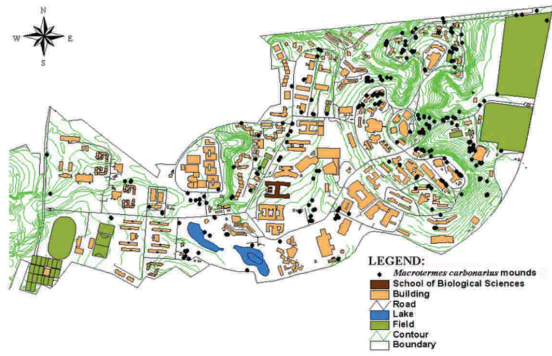


Figure 19: Distribution of *Macrotermes carbonarius* mounds in Minden campus.



Figure 20: Distribution of *Microcerotermes* sp. mounds in Minden campus.

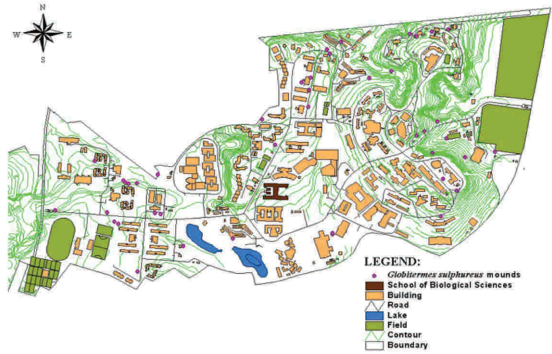


Figure 21: Distribution of *Globitermes sulphureus* mounds in Minden campus.

Termite problems confronting Universiti Sains Malaysia

In the campus, termite infestations are prevalent in buildings as well as in trees. Many of the termite problems in trees in the campus are associated with diseased trees and trees that are not healthy. In addition, there are also many buildings in the campus that have favourable conditions for termite infestations.

Where the infestation of trees is concerned, there are various susceptible species and these include the following:

- *Acacia mangium* (Figure 22).
- *Araucaria cunninghamii* (Figure 23).
- *Araucaria excelsa* (Figure 24).
- *Casuarina equisetifolia* (Figure 25).
- *Delonix regia* (Figure 26).
- *Enterobium saman* (Figure 27).
- *Frangraea frangans* (Figure 28).
- *Pongamia pinnata* (Figure 29).
- *Pterocarpus indicus* (Figure 30).
- *Swietenia* sp. (Figure 31).
- *Tabebuia* sp. (Figure 32).

The tree species, however, that is more tolerant to termite infestation is the imperial palm (*Roystonea oleracea*).



Figure 22: *Acacia mangium*.



Figure 23: *Araucaria cunninghamii*.



Figure 24: *Araucaria excelsa*.



Figure 25: *Casuarina equisetifolia*.



Figure 26: *Delonix regia* (left: a normal tree; right: a termite-infested tree).



Figure 27: *Enterobium saman*.



Figure 28: *Fagraea fragrans*.



Figure 29: *Pongamia pinnata*.



Figure 30: *Pterocarpus indicus*.



Figure 31: *Swietenia macrophylla*.



Figure 32: *Tabebuia* sp.

Work has been done to check the prevalence of termite infestations among the trees in the campus. To date, the following has been observed:

Table 1: Prevalence of termite infestations among different tree species in USM Minden campus.

Species	No. trees checked	% infested
<i>Acacia mangium</i>	16	87.5
<i>Casuarina equisetifolia</i>	13	84.6
<i>Fagraea fragrans</i>	13	84.6
<i>Araucaria excelsa</i>	12	75.0
<i>Tabebuia</i> sp.	13	69.2
<i>Enterobium saman</i>	76	61.8
<i>Pterocarpus indicus</i>	47	61.7
<i>Swietenia</i> sp.	32	60.0
<i>Delonix regia</i>	35	57.1
<i>Araucaria cunninghamii</i>	11	54.5
<i>Pongamia pinnata</i>	30	50.0

Issues associated with the termite infestation in Universiti Sains Malaysia

Various factors have been associated with the termite infestation in the university. Among them are the following:

- Poor pest control measures
- Poor pre-construction anti-termite measures
- Poor pre-construction sanitary measures
- Poor moisture management in buildings
- Lack of management of sick trees
- Lack of understanding about termite management

It has been noted that there is poor sanitation as well as poor moisture management in buildings within the campus (Figure 33). Many new buildings have also been constructed on what used to be plantation estates. During the clearing of the land, trees have been felled; however, while the tree trunks are cut, their roots are often left inside the soil. In many instances, the trunks have also been left at the building sites until the completion of relevant buildings. Such trunks serve as food for termites.

In addition, termite infestation was also found to increase with building age (Figure 34). Older buildings have higher chances to be infested by termites, when compared to the newer ones.



Figure 33: *Poor moisture management is one of the most important factors contributing to termite infestation in buildings and structures in USM Minden campus.*

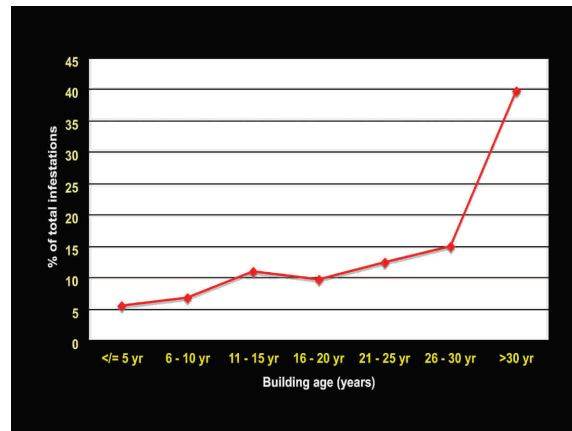


Figure 34: *Relationship between building age and prevalence of termite infestation in USM Minden campus.*

Termite management

During these past few decades, buildings and structures have been protected from termite infestation by administering a chemical barrier between the building and the soil. This is done before any building or structure is constructed. Therefore, it is important that the developers, contractors and workers are trained on the proper handling of chemicals and correct treatment techniques although they should not be the ones carrying out the treatment. Treatment should be done by trained pest management professionals. One major problem that contributes to persistent termite infestation is the lack of trained developers and construction personnel on pre-construction anti-termite treatments. To make matters worse, most workers are not familiar with preparing dilutions of termiticide formulations and end up treating the soil with an extremely diluted termiticide. This will definitely not provide any adequate protection against the subterranean termites.

Gone are the days when chlordane can be used for soil treatment. If properly applied, it can last for as long as 20 years in the soil. After chlordane was banned in Malaysia in 1998 due to environmental issues, several chemicals have replaced it. Chemicals which are now commonly used for soil treatment include chlorpyrifos, imidacloprid, fipronil, cypermethrin, etc. A paradigm shift is necessary in treating the soil because these chemicals are not as "forgiving" as chlordane; so treatment with these chemicals must be

done properly to ensure their performance and longevity in the soil. The barrier treatment will protect against the penetration of foraging termites through the soil into the building by repelling the termites away (e.g., using cypermethrin).

More recently, there has been an increasing popularity in the use of non-repellent termiticides. This characteristic is unique because termites will not be able to detect the presence of the treated termiticide, and thus will continue to forage through the soil until the demise or suppression of the whole colony. These compounds also show a delayed mode of action that continues to allow termites to forage freely in and out of the treated zone, thus promising a greater impact to the whole colony.

It is important to note that the effect of these newer and post-chlordane chemicals cannot be sustained as long as chlordane in the soil. Many research results have shown that soil treatments using these chemicals can last only for an average of three to five years. It is important to note that to achieve a longer lasting protection via soil termiticides, the application must be carried out by a trained pest management personnel and treatment must be done in accordance to industry standards.

Termite management activity can be divided into treatment made prior to the construction of buildings and structures, and those that are made after the buildings have been constructed. Pre-construction treatment involves treatment of soil with termiticides before a house is built. This is to create a chemical barrier that will prevent subterranean termites from penetrating or crossing the barrier and moving into the house. Other methods which are not available in Malaysia as yet but are currently being used in other parts of the world include laying a fine stainless steel mesh to prevent termites from penetrating and entering a building, and is required to be installed before a house is built. In addition, a basaltic barrier (finely crushed granite that is applied underneath the concrete slab) utilising a similar concept of protection, is also available. For indoor renovations/constructions, home owners can also choose from a variety of local wood species available (e.g. merbau, cengal, meranti, etc.) that are resistant to termite infestation.

For post-construction treatment, there are several methods that can be engaged through a pest management company such as spot treatment, corrective soil treatment and baiting. Spot treatment, the least expensive one, is done by puffing an insecticidal dust (often red in colour) into the mud tubes. However, this is a symptomatic treatment and often provides management for only several months. Corrective soil treatment is conducted by pumping termiticides into drilled holes along the inner/outer perimeters of the house. The distance between two holes is an extremely crucial factor to ensure a continuous chemical barrier beneath the house upon application. If the distance between the holes is too wide apart, a gap will be present and this will allow subterranean termites to move up into the house.

Baiting is a passive management method which requires the termites to feed on baits containing insecticides (or insect growth regulators). The bait normally consists of cellulosic material (e.g., paper or cellulose powder) that has been impregnated with a toxicant. Upon feeding by the termites, the bait will subsequently be shared with other colony members through trophallaxis (a feeding behaviour found among all social insects). This method is known to be able to either suppress or eliminate the entire termite colony, but it is generally more costly than the two previous methods. Though it may take between one and three months before a termite colony is suppressed or eliminated, this method has been gaining popularity in Malaysia in recent years, due to the minimal usage of insecticides. It is also less intrusive when compared to corrective soil treatments that require the drilling of floors in order to apply a relatively larger amount of termiticides into the ground. In addition, termite baits are also available in above-ground bait formulations which can be applied directly onto active termite mud tubes.

Although baits have been found to be highly effective, it is important to note that they are only effective against lower termites from the genus of *Coptotermes* and *Schedorhinotermes* (family Rhinotermitidae). Higher termites from the family Termitidae are normally not responsive to paper-based baits. This situation is not unique to Malaysia, but is also similarly observed in Thailand, Singapore, Indonesia and Australia.

As there is a wider range of pest termite genera consisting of both lower and higher termites in Southeast Asia and Australasia, such a situation may pose a challenge to pest management professionals since baiting only works against certain species. The situation is further complicated when a structure can be attacked simultaneously by more than one species or in succession by different species. In addition, when

baiting reduces or eliminates populations of lower termites such as *Coptotermes*, other species that are normally considered as secondary pest species or non-pest species could also become important and enter buildings.

A major challenge in managing multi-genera termite faunas in Malaysia and Singapore, especially with the use of termite baits, is re-infestation by a higher termite species after the suppression or elimination of the lower termites. To date, it is not possible to manage higher termites effectively with baits. It has been reported earlier of the difficulty of managing *M. gilvus* that infested residential premises which had been previously baited for *Coptotermes* infestation. *M. gilvus* was later found in the house as early as two months after the elimination of *Coptotermes*. Although re-infestation by *Coptotermes* is relatively high (~85%), pest management professionals find it difficult to explain to home owners that the baits were only effective against *Coptotermes* and *Schedorhinotermes*. In many incidents, they had to resort to spraying insecticides to repel the higher termites. This, however, was only a temporary measure as re-occurrence of higher termites in other locations of the premises could be observed after a short period of time.

Integrated Pest Management (IPM) against subterranean termites in the USM campus

The USM campus has a high diversity of flora and fauna and it is important to practise the use of chemicals judiciously. Thus, termite management in the campus should emphasise the IPM approach and pesticides should only be used as and when they are required. It is important that pest monitoring and surveillance be carried out on a regular basis. When termites are detected, it is best to choose the least toxic and most effective approach to manage the problem.

Where the campus is concerned, a complete paradigm shift is needed in order to manage the ecosystem, landscape and heritage of the university. All termite management decisions made should be geared towards sustainable pest management practice.