BIODIVERSITY AND NATIONAL DEVELOPMENT: ACHIEVEMENTS, OPPORTUNITIES AND CHALLENGES

Proceedings of the Conference
held in Kuala Lumpur, Malaysia from 28–30 May 2008

Editor

Yong Hoi Sen

Organised by:

Academy of Sciences Malaysia
World Wide Fund for Nature – Malaysia
Malaysian Agricultural Research and Development Institute
Forest Research Institute Malaysia
Department of Wildlife and National Parks
Department of Marine Park Malaysia

Supported by:

Ministry of Science, Technology and Innovation
Ministry of Natural Resources and Environment
Ministry of Agriculture and Agro-based Industries

Perpustakaan Negara Malaysia Cataloguing-in-Publication Data

Conference on Biodiversity and National Development (2008 : Kuala Lumpur).
Achievements, opportunities and challenges : Conference on Biodiversity and National Development, 28 May, 2008, The Legend Hotel, Kuala Lumpur.
ISBN 978-983-9445-34-3
1. Biodiversity–Malaysia–Congresses. 2. Biodiversity conservation–Malaysia–Congresses. I. Title.
333.9509595

Printed by Percetakan J. R.
No. 4, Jalan 15/48A, Sentul Raya Boulevard,
51000 Sentul, Kuala Lumpur.
2009

Contents

Abstract of Poster Presentation

Foreword

I would like to extend a warm welcome to all participants of the three day Conference on Biodiversity and National Development organized jointly by Academy of Sciences Malaysia and WWF-Malaysia with full support of MARDI, FRIM, PERHILITAN and Department of Marine Park Malaysia.

The convening of this forum is in fulfillment of the Academy's many functions, among which are to offer a forum for interchange of ideas among scientists, engineers and technologist and identify where science, engineering and technology can provide solutions to particular national problems.

This Conference is an important initiative of the Academy of Sciences Malaysia and we are confident the Conference findings will have a significant bearing on the nation's biodiversity.

I hope that the participants will be able to translate recommendations of the Conference into practical programmes of action. I am optimistic we can achieve this.

Tan Sri Dr Yusof Basiron, FASc
President
Academy of Sciences Malaysia

Foreword

The Conference on *Biodiversity and National Development: Achievements, Opportunities and Challenges*, is a well timed gathering as it coincides with the current global food crisis. We have to note that the crisis is being compounded globally by the growing world population, extreme weather, and ecological stress.

In efforts to increase agricultural production to meet the demands of the growing population, planners had traditionally promoted unsustainable agriculture such as short-term planning and land conversion, and somehow failed to pay attention to the contribution of biological diversity. The food crisis can be overcome by adopting a biodiversity-based paradigm for sustainable agriculture development. The paradigm demands increased collaboration in the conservation, and sustainable and fair use of biodiversity — in particular agricultural biodiversity. For example, genetic diversity is the foundation of improvements to agriculture. It helps to improve productivity by raising yield stability, contributing to pest and disease control, and improving the environment.

The Malaysian government has positively supported the research and development (R&D) programmes in MARDI to unravel the potential contributions of biodiversity for sustainable development of the agriculture sector. The main challenges are to understand the combined ecological and social functions of agricultural biodiversity, determine its contribution to ecosystem goods and services and value for society at large, and evaluate options for the sustainable use and conservation of biodiversity across the agricultural landscape.

Datuk Dr Abd. Shukor Abd. Rahman
Director General
Malaysian Agricultural Research and Development Institute

Foreword

I welcome the efforts undertaken by the Academy of Sciences in organizing the conference entitled Biodiversity and National Development, which will provide a platform to reevaluate the country's achievements in promoting sustainable use and conservation of our biodiversity resources. This would also provide an opportunity to review some of the challenges that we had faced and develop new strategies in enhancing the future stewardship of our biodiversity resources.

The Department of Wildlife and National Parks (DWNP), is proud to be associated in the country's efforts to manage the biodiversity resources, at the ecosystem, species and genetic levels. Although the designation of protected areas started in 1903, on-site management of many of these sites actually took place over last one decade, following the ratification by Malaysia of the Convention on Biological Diversity. Earlier efforts to do so were hindered due other development priorities and the security status of many of the forested areas classified as 'Black Areas' in Peninsular Malaysia.

One of the past successes came about in the early 1970s, when the federal government became interested to be actively involved in the conservation of our biodiversity resources. This interest resulted in the passing of a comprehensive *Protection of Wildlife Act* in 1972 and followed by the strengthening of the state DWNPs under the federal government. The dedication of a specific environment related ministry, starting with Ministry of Science, Technology and the Environment and in 1975 and followed by Ministry of Natural Resources and Environment (NRE) in 2004, enabled the DWNP to strengthen its capacity from a mere 200 personnel in 1972 to about 1500 at present. As a result, the DWNP has been able to curb many of the wildlife crime, prosecute such crimes in the courts, maintain the integrity of Taman Negara National Park, manage our wildlife within and outside the protected areas, monitor through licensing the sustainable utilization of some of the wildlife resources and undertake ecotourism activities within protected areas.

One of the challenges that the DWNP faced was to enhance the protected areas system as envisaged by the federal government under the Third Malaysia Plan and the facilitating federal National Parks Act that was passed in 1980. Although only Penang National Park was gazette under this law, the future seems optimistic with more state governments undertaking their own initiatives in protecting their habitats and contributing to the sustainable use of our biodiversity resources.

Abd. Rasid Samsudin
Director General
Department of Wildlife and National Parks
Peninsular Malaysia

Introduction

Biodiversity or biological diversity is the foundation for environmental/ecosystem health and for sustainable resource production/development. It provides raw materials for biotechnologies, agriculture and natural resource development.

Malaysia's National Policy on Biological Diversity (1998) states that "Biological diversity is a national heritage and it must be sustainably managed and wisely utilized today and conserved for future generations. The benefits from sustainable management of biological diversity will accrue, directly or indirectly, to every sector of society".

The Vision of Malaysia's National Policy on Biological Diversity is "to transform Malaysia into a world centre of excellence in conservation, research and utilization of tropical biological diversity by the year 2020".

Many aspects of biodiversity have been discussed and debated at local, regional and international meetings and conferences. This conference on Biodiversity and National Development will focus on achievements, opportunities and challenges. With 2020 around the corner, it is opportune to take stock of the current status of our biodiversity utilization and formulate an action plan for the way forward.

Plenary Paper 1

Government Perspective — National and State Policies on Biodiversity

S. ELAGUPILLAY
Director, Law and Enforcement Division, Deparment of Wildlife and National Parks Peninsular Malaysia
Km 10 Jalan Cheras, 56100 Kuala Lumpur, Malaysia

Abstract

In 1972, new biodiversity related legislation, the Protection of Wildlife Act, 1972 was passed and was seen as a landmark policy initiative because the federal government took direct responsibility in managing species and habitats. Part of the initiatives included an undertaking to enlarge the Protected Areas System under federal laws. This initiative apparently could be seen as part of the ongoing standardization and Malaysianization policies in administrating the country upon independence that eventually encompassed various biodiversity fields. However, Malaysia being administered under a federal system of government these federal driven initiatives has to be undertaken with well defined strategies in implementing them on the ground at state level depending on the sectors. In the forestry sector, the federal government succeeded in bringing about coordination of forestry issues, through standardized legislation and a forestry council, while the jurisdiction remained under the states. With the signing of CBD in 1992, the federal government increasingly saw the management of species and habitats as biodiversity issues and as a result a national biodiversity policy and a coordinating council were created in late 1990s. With specific strategies and actions recommended in the National Policy on Biodiversity the state governments were encouraged to undertake biodiversity conservation and management. Such strategies had encouraged the designation of state parks under state conservation legislation and providing direct assistance. The future challenge would be to learn from the past and enhance long-term collaborative mechanisms by bringing together state governments that owns the natural resources and the federal government that has the management capabilities to ensure the biodiversity resources are sustainably managed.

The Malaysian Constitution ensures that state governments have considerable autonomy over many natural resource matters, including land and forests. The main reason for this, according to the former Lord President, Tan Sri Abbas, is that these matters were traditionally administered prior to and during colonial era by the state governments. On the other hand, a number of non-traditional matters such foreign policy, international conventions, education, defense and internal security were entrusted under the jurisdiction of the federal government.

There are a number of other issues, including the management of wildlife and national parks, which were placed under the concurrent jurisdiction of the constitution. This concurrent status enables both the federal government and the state governments could pass legislation through their respective legislative bodies to administer and manage wildlife and national parks. The constitution also ensures Sabah and Sarawak have additional jurisdiction and thereby limiting federal intervention, including over biodiversity matters, in these two Borneon states.

At the time of independence, biodiversity as a subject matter did not arise and therefore biodiversity policy development has been sectoral primarily based on what the constitution has empowered the federal and state governments. This paper explores development of biodiversity policies over the last five decade by focusing on the wildlife and national parks (a subset of protected areas) sectors. These sectors could be also used as proxies to represent the components of biodiversity; species and ecosystem. In addition, the constitution empowers both the federal and state governments to develop policies over these sectors to enable this paper to examine the biodiversity policy development and evolution phenomenon at the federal and state levels.

The Malayanization Initiative

Upon independence of Malaya in 1957, the policy making powers of the new federal government was handed over to Malaysians. However, many of the senior administration positions of the federal government were still in the hands of expatriate and experienced British senior officers. Under such a scenario the remaining British expatriate officers were replaced by Malaysians. The sudden departure of expatriate British officers left a huge vacuum within the Federal and State Department of Wildlife and National Parks (DWNP), many of whom were experienced wildlife and protected areas managers. As a result, the government had to hire Malaysians on a contract basis from other sectors to administer the DWNP at federal and state levels. In addition, experienced field rangers who had worked under these British expatriates were deployed to the Home Guard units to combat the communist insurgents. This led to a serious institutional memory loss within the DWNP which then led to the neglect of designated wildlife reserves under the management of the state governments.

Standardization Policy

Although, the Malayanization policy was successfully completed by the mid 1960s, the federal government faced numerous obstacles in administrating the country in a coherent manner with clear sectoral policies. This was because many of the sectors, including forestry and wildlife came under the direct jurisdiction of the respective state governments and the policies varied from state to state. Many of the state governments were not willing invest terms of resource allocation to manage the wildlife and the designated wildlife reserves The only exception was that the management of Taman Negara National Park, the largest protected area in the country, which was

under the management of the federal government through the direct supervision of the Director General of the Federal DWNP (see *Figure 1* below).

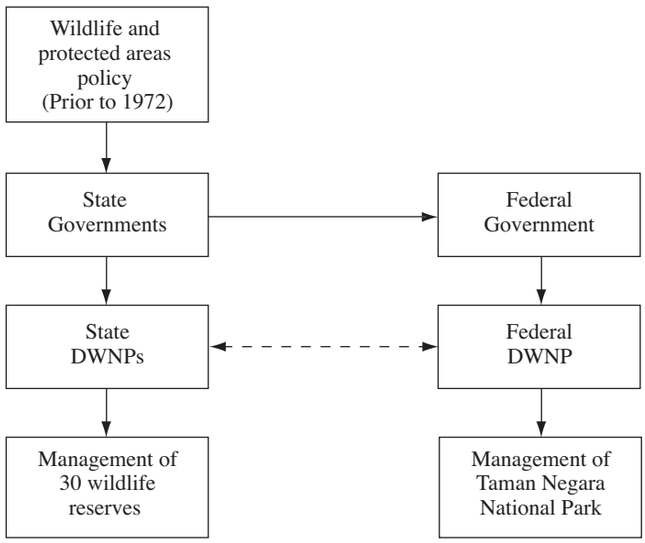


Figure 1. Wildlife and Protected Areas Policy Development in Peninsular Malaysia Prior to 1972. (Adapted from Elagupillay 2005)

To streamline the administration of the different sectors across the 11 states, the Federal Government embarked on a standardization policy, another cross cutting administrative strategy, that commenced in the 1960s. One of the early outcomes of this policy was the proclamation of the standardized *National Land Code in 1960*, which was subsequently adopted by all states as the standard law in governing land matters in Peninsular Malaysia. This standardization policy also affected the biodiversity sectors differently depending to the extent to which the federal government had powers under the federal constitution. For the wildlife and national parks sectors, two new federal laws were passed for Peninsular Malaysia. The *Protection of Wildlife Act (PWA)* was passed in 1972 followed by the *National Parks Act (NPA)* in 1980 with the DWNP enforcing both laws on behalf of the federal government. The aim of these initiatives by the federal government then was to have standard federal policies for the protection and management of wildlife and protected areas in Peninsular Malaysia.

Successful Federalization of Wildlife in Peninsular Malaysia

The enactment of the PWA in 1972 was a turning point since it empowered the federal government to be directly involved in biodiversity related policy development in Malaysia. The PWA led to the

enforcement throughout Peninsular of one standard legislation for the protection and management of wildlife. The major impact of this policy was that the PWA enabled the federal government to federalize the administration of all eleven State DWNPs from the respective state governments and placing them under the Federal DWNP as a unified DWNP. In addition, the federal government also took over the management of some 1000 odd wildlife species and 30 protected areas in the form of wildlife reserves (see *Figure 2* below).

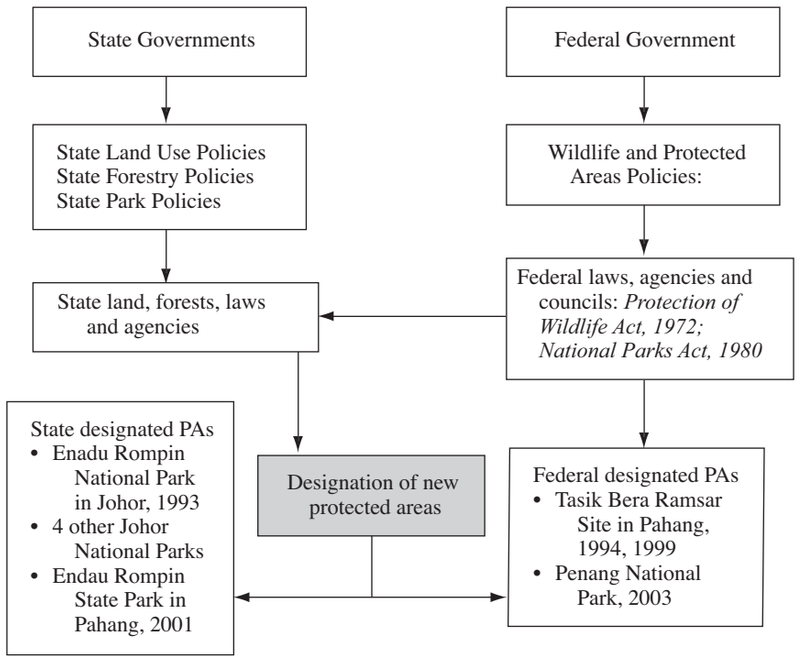


Figure 2. Wildlife and Protected Areas Policy Development in Peninsular Malaysia Post 1972 (Adapted from Elagupillay *2005)*.

FEDERAL POLICY INITIATIVE TO PROTECT ECOSYSTEM

Following the successful consolidation of the administration of wildlife in Peninsular Malaysia at the species level, the federal government's policy development attention turned towards protecting the ecosystem through the enactment of a standardized NPA in 1980 to designate new protected areas. Though the federal policy to protect wildlife under the federal PWA law was eventually accepted by the state governments, the federal policy to designate new protected areas under the federal NPA was not well received by the state governments. To pursue this at higher levels of the state governments, a number of federal agencies played key policy making roles.

Between 1957 and 1975, there was no dedicated ministry to develop biodiversity and environmental related policies. In the case of wildlife and protected areas, the Federal Economic Planning Unit (EPU) under the Prime Minister's Department and the Federal DWNP were the major decision-making bodies. The policy to designate new protected areas came about following Federal EPU's decision to include it under the Third Malaysia Plan (1976–1980). A total of 22 new protected areas comprising over 500 000 ha were earmarked for designation. This included the creation of the second national park at the Endau Rompin region located at the Pahang-Johor borders. Federal EPU pursued this with the establishment in 1980 of an interagency committee to assist in this matter.

As the federal government gained sufficient ground in the administration and management of environmental and biodiversity issues, the Department of Environment and Ministry of Science, Technology and the Environment (MOSTE), were created in 1975 to strengthen federal government's policy making and decision making capacity in these sectors. It was only after the creation of MOSTE, the federal government took a proactive role in speeding up the designation of Endau Rompin as a protected area. In order to do that, MOSTE took great interest in drafting the NPA that was eventually passed though the Parliament in 1980.

However, Johor State Government had several reservations over the extent of federal powers under the NPA and MOSTE rather quickly amended the NPA through the Parliament in 1983 to increase the state representation under the NPA. Even this was not well received by Johor and other state governments. This ambitious federal policy to designate new protected areas under federal mechanisms that included the PWA and NPA came to a halt as Johor decided not to hand over the management of Endau Rompin to the federal government in early 1990s.

To convince the state governments to protect the identified ecosystems as protected areas, the federal government had to develop alternative policies. This task was given to the Ministry of Culture Arts and Tourism (MOCAT) which emerged as a major player in the designation of new protected areas in the 1990s. MOCAT developed the National Ecotourism Plan in 1998, which provided the policy to promote the sustainable development of biologically rich ecosystems for the ecotourism industry. The plan identified 27 natural sites to be protected and developed as ecotourism sites and many of these identified sites included sites that were earlier proposed for protection by the Federal EPU, DWNP and MOSTE. Among the sites identified in the National Ecotourism Plan were Endau Rompin in Johor, Tasik Bera in Pahang, Belum in Perak and Pantai Acheh in Penang.

Emergence of State Biodiversity Policies

The decision by Johor State Government on the early 1990s, not to designate Endau Rompin as a federal national park, was another turning point in the field of biodiversity policy development in

Malaysia. Using the provisions under the constitution, Johor state government enacted its own protected area legislation, the National Parks Corporation Enactment (Johor) in 1989. This was followed by the creation of a state agency, Johor National Parks Corporation. These state mechanisms were used in designating and managing Endau Rompin National Park as a state protected area in 1991. Since then, Johor has developed its own protected areas system to protect its biodiversity resources following the designation of 5 more protected areas under the state mechanism.

In addition to the DWNP and the Ministry of Natural Resources (the successor of MOSTE), the Johor State Government has become a major policy-making body in identifying and designating new protected areas for the conservation and management of biodiversity resources in Malaysia. This state level policy initiative is viewed by Johor as complying with overall federal policy initiative in protecting the nation's biodiversity heritage while at the same time maintaining the state government desire to retain control and management over its natural resources. The successful adaption of the federal protected area designation policy by Johor was subsequently adopted by other states in Peninsular Malaysia. In 2003, the Perak State Government passed a similar state legislation to designate the Royal Belum State Park, while the Selangor State Government has also passed a similar legislation.

Flexible Federal Policy to Protect Ecosystem

Unlike the approach undertaken by DWNP and MOSTE, MOCAT's ecotourism policy approach provided flexibility with the states governments having a choice to designate ecotourism sites as protected areas under federal or state law to receive federal assistance. This alternative policy introduced by MOCAT enabled the Johor State Government and other states to create their own mechanisms, including the enactment state parks legislation and state parks agency to designate and protect their ecosystem.

While the ecotourism policy initiative through MOCAT was well received by the state governments, the federal government continued to find solutions to convince the state governments to use the federal mechanisms to protect the ecosystem. In the early 1990s, the federal Cabinet appointed MOSTE as the focal agency responsible for two major environmental conventions; the Convention on Biological Diversity and the Ramsar Convention. With the agreement of the Pahang State Government, MOSTE nominated Tasik Bera as the first Ramsar site in 1994. However, the legal designation and management of the site under the federal mechanism was not well received by Pahang.

To resolve this issue, the Federal EPU decided to use the international assistance from the Danish government, to develop a management plan for Tasik Bera. Based on the recommendations of the management plan, the Pahang State Government decided in 1999 to hand over the management of Tasik Bera Ramsar Site to the federal government through DWNP. However, the

Pahang State Government retained the legal designation of Tasik Bera under the state law. Nevertheless, Task Bera became the first new protected area under federal management after 27 years of federal government's policy initiative to protect the ecosystem in 1972.

The protection of ecosystem as protected areas received new impetus from MOSTE following the adoption of the National Policy on Biological Diversity in 1998. To implement this policy MOSTE created a federal-state consultative mechanism, the National Biodiversity and Biotechnology Council (NBBC). Using this new policy instrument, MOSTE managed to convince the Penang State Government to designate Pantai Acheh Forest Reserve as Penang National Park under the NPA. In 2003, the Deputy Prime Minister officially declared the designation of Penang National Park, the first new protected area to be designated under a federal law since 1972.

CONCLUSION

Malaysia being a federation of 13 states, the state governments have major jurisdiction over biodiversity resources as enshrined under the constitution. However, the federal government has shown great interest in formulating various policies and mechanisms to protect biodiversity resources but needed the cooperation of the state governments to protect the ecosystem. At the same time the state governments in Malaysia have also shown varying interest in the conservation of its biodiversity resources with few states willing to use the federal mechanisms. As shown by Johor, many of the states are more comfortable in developing their own policy in protecting their biodiversity resources under their state mechanisms. With the active involvement of the federal and state governments since 1972 in the field of biodiversity policy development the management and protection of biodiversity resources in Malaysia has become increasingly complex and challenging.

To avoid the federal-state tensions, a flexible approach as undertaken by MOCAT under the National Ecotourism Plan, would be needed for an acceptable and workable biodiversity policy to be implemented in Peninsular Malaysia. Such an empowering policy should acknowledge the interest and capacity of the federal government in protecting the biodiversity resources of the country while recognizing the state governments and community rights over the biodiversity resources. Using such an approach, the protection and management of biodiversity resources including the ecosystems could be enhanced in the near future.

REFERENCES

Abas, M S 1986, 'Traditional elements of the Malaysian Constitution', in *The Constitution of Malaysia: further perspective and developments*, eds FA Trindade & HP Lee, Oxford University Press, Singapore.

Ahmad, ZA 2002,'Four more national parks for Johor', *Star* 22 August.

Aiken, SR & Leigh, CH 1992, *Vanishing rain forest: the ecological transition in Malaysia*, Clarendon Press, Oxford.

Chung, DNFN 1986, *The constitutional position of Sabah*, in *The Constitution of Malaysia: Further perspective and developments*, eds FA Trindade & HP Lee, Oxford University Press, Singapore.

DARA 1977, 'Proposal to gazette Tasik Bera Wildlife Reserve', in *Temerloh: SE Pahang Development Authority* (DARA).

DWNP 1980, DWNP 1975 Annual Report, DWNP, Kuala Lumpur.

DWNP 1982, DWNP 1980 Annual Report, DWNP, Kuala Lumpur.

DWNP 1983a, DWNP 1980/81 Annual Report, DWNP, Kuala Lumpur.

DWNP 1983b, *Master Plan for Wildlife Conservation in Peninsular Malaysia*, unpublished report, DWNP, Kuala Lumpur.

DWNP-DANCED 1996, *Master Plan on capacity building and strengthening of the protected areas system in Peninsular Malaysia*, DWNP, Kuala Lumpur.

Elagupillay, S 1998, 'The gazettement of protected areas in Peninsular Malaysia', *Journal of Wildlife and Parks (Malaysia),* vol. 14.

F-EPU 1976, The Third Malaysia Plan 1976–1980, Federal Economic Planning Unit, Kuala Lumpur.

F-EPU 1999, 'Integrated management of Tasek Bera Project: support for implementing obligations under the Ramsar Convention', unpublished memo to DWNP, F-EPU, Kuala Lumpur.

Hubback, TR 1932, *The Wildlife Commission of Malaya Report*, Wildlife Commission of Malaya, Singapore.

Lowry, WR 1998, *Preserving public lands for the future: the politics of intergenerational good,* Georgetown University Press, Washington, DC.

Malaysia, G 1972, *The Protection of Wildlife Act of 1972*, Government of Malaysia, Kuala Lumpur.

MNS-Penang, 2003, 'Gazette Pantai Acheh Forest Reserve as a national park', in *MNS-Penang Newsletter*, MNS-Penang, Georgetown.

MOCAT 1996, *National Ecotourism Plan: executive summary*, MOCAT, Kuala Lumpur.

MOCAT 1999, *The National Tourism Development and Promotion Committee Meeting*, DWNP, Kuala Lumpur (unpublished).

MOSTE 1998*, The National Policy on Biological Diversity*, MOSTE, Kuala Lumpur.

Singh, G 1977, 'Proposed co-ordination of Endau Rompin', (unpublished memo to DWNP).

Star, 14 December 1995, 'More Danish funds for green projects'.

Stevens, WE 1968, *The Conservation of wildlife in West [Peninsular] Malaysia*, Federal DWNP, Seremban.

Suffian M 1976, *An introduction to the Constitution of Malaysia*, Government Press, Kuala Lumpur.

Vincent, JR & Ali, RM 1997, *Environment and development in a resource-rich economy: Malaysia under the new economy policy*, Havard University Press, Havard College.

Vinesh, D 2003, 'Pantai Acheh declared as a national park', *Star 5 April*.

Plenary Paper 2

National Policy on Biodiversity: An NGO Perspective

D. SHARMA
WWF Malaysia,
49, Jalan SS 23/15, Taman SEA Petaling Jaya,
Selangor 47300

Recognition of the crucial role played by biodiversity towards the continued survival of mankind led to the adoption of the Convention on Biological Diversity in Rio de Janeiro in June of 1992[1]. The main objectives of the Convention were clear; biological diversity must be conserved, it's components must be used sustainably and there is to be fair and equitable sharing of benefits arising from genetic resources.

In view of the fact that the Convention calls for the adoption of national strategies to conserve biodiversity, Malaysia proceeded to develop the National Policy on Biological Diversity which was offcially adopted in 1998 under the erstwhile Ministry of Science Technology and the Enviroenment (MoSTE) . The policy statement of the document is ambitious, for it aims:

"To conserve malaysia's biological diversity and to ensure that its components are utilised in a sustainable manner for the continued progress and socio-economic development of the nation".

The overall framework of the Policy contains 14 strategies and 86 action plans ranging from improving scientific knowledge and research to integrating biodiversity considerations into planning, as well as institutional and legislative development.

The existence of a National Policy on Biodiversity is of course not a panacea but could be perceived a first step in the right direction. Every policy ultimately must see effective implementation. and to facilitate this, we intend that this paper outlines certain principles and strategies that will assist in effectively implementing the National Policy on Biodiversity. Suggesting practical measures that will meet the objectives and aspirations of the policy is by no means an easy task; thus, the incorporation of certain principles and the use of a number of strategies (which will be further elaborated in later paragraphs) will go substantially a long way in ensuring coherent and effective implementation of the policy.

[1] Malaysia ratified the Convention on Biological Diversity on the 24th of June 1994.

By way of summary, this paper will elaborate three main strategies that are likely to play a significant and contributory role towards effective biodiversity policy implementation i.e.

- The participatory approach
- The use of biodiversity principles such as the precautionary principle; and
- The use of new approaches to policy implementation.

The Participatory Approach

Whether in the design of strategies, the formulation of action plans, the drafting and review of legislations, or the revision of programmes containing elements of awareness and education, the meaningful involvement i.e. participation of stakeholders and civil society is paramount and should be treated as the main axis of government led initiatives and decision making.[2]

Though there have been attempts to decentralize environmental decision making in Malaysia over the last five years or so, it can hardly be considered satisfactory. The fundamental approach that must be adopted is the institutionalization of participation. Necessary reforms that incorporate and entrench civil society participation both legislatively and institutionally must be urgently carried out.

The benefits of a participatory approach to policy implementation and decision-making involving multi stakeholders and civil society are numerous. These include:

- Enabling the forming and fostering of effective partnerships between the various levels of government, civil society and the private sector.
  [*It must be said that efficient, working and thriving partnerships between the government and civil society can be only be formed by the establishment of proper systems that encourage building of such partnerships]*.
- Enables reconciliation of Government objectives and plans with society's needs and priorities, which will in turn facilitate a two-way flow of experiences and perspectives; and
- Facilitates information sharing and exchange that can lead to the discovery of root problems that might not otherwise be discovered in isolation.

No government can nor should go alone in the implementation of national policies. Of crucial importance is the need to ensure all stakeholders are motivated and adequately empowered to deliver objectives regarding biodiversity and ultimately sustainable development. It is the government's responsibility to ensure that all stakeholders feel some form of ownership and

[2] The National Policy on Biodiversity at Strategy XII does elaborate the role of NGO's in the conservation and sustainable utilization of biological diversity. Policy assurances alone however will not suffice; civil society participation must be realized by formal processes.

commitment towards delivering these biodiversity objectives. Roles for various stakeholders must be coherently defined whereas mechanisms, procedures and structures must be put in place to ensure their effective participation. *As stated earlier, these structures must be developed either through legislation or administratively*.

As a matter of priority the government must undertake a comprehensive review of existing consultative mechanisms in the country that seek to facilitate civil society participation. This will indicate the existing efficacy and **potential** of civil society contributions to policy planning and implementation. Participation must not be treated as a one off exercise but seen as a continuing process in policy planning, implementation and monitoring. In addition to traditional approaches, new innovative approaches to civil society participation must be tried and tested.

Capacity building on participatory approaches and methodology is an important component that must be addressed if participation is to be successful. At the national level, capacity building must be centered around issues concerning participatory approaches to consensus building, improved networking with stakeholders, information sharing, enquiry handling, and the appropriate utilization of various tools that facilitate and promote participation.

The Adoption on Environmental Principles in Biodiversity Management

From the building of dams, resorts and roads to the harvest of flora and fauna, decisions that have a profound effect on biodiversity, the environment and natural resources of the nation and concurrent decisions concerning the management and conservation of biodiversity are made everyday. Not all decisions can be made with scientific certainty with clear indications of the cause and effect. There are bound to be potential risks and hazards to human health and the environment. The Precautionary Principle was developed as a strategy in the assessment and management of risks and that potentially can aid decision-making.

At the UN General Assembly in 1982, The World Charter for Nature was adopted. The Charter contained the first international endorsement of the precautionary principle. At the Rio Earth Summit in 1992, the precautionary principle was enshrined as Principle 15 in the Rio Declaration on Environment and Development:[3]

> *"In order to protect the environment, the precautionary approach shall be widely applied by states according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."*

[3] The Convention of Biological Diversity (CBD), the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and Agenda 21 have all incorporated the precautionary principle.

The widespread application of the precautionary principle in environmental decision-making in Malaysia is not evident. There are of course many critics of the principle that would (rather quickly) dismiss the precautionary principle on the grounds that it is not well defined, thus making application difficult and ambiguous. However, the principle does have a number of merits and values, and Malaysia must actively pursue positive steps that seek to define and **'flesh'** out the principle into a practical strategy that aids decision-making. Malaysia must identify and explore with urgency the following:

- **The range of issues to which the principle should apply**.
  This entails the determination of the application of the principle to issues related to forestry, species harvesting and protection, development planning, fisheries management and various other sectors. Once the range of issues are identified it is necessary to establish supportive **legal**, **policy, institutional** and **administrative frameworks** that would assist in the effective incorporation and application of the principle. Where possible and applicable the principle must be entrenched into domestic legislation pertaining to the environment and natural resources.[4]

- **The level of risk which would activate the application of the precautionary principle.**
  This is somewhat a more technical matter but one that nevertheless requires careful deliberation. The fundamental question that requires clarification and determination is related to the question of '**the level of risk**' that will trigger the application of the principle. The Rio Declaration states that there must be "threats of serious or irreversible damage" but there are numerous other interpretations that can be considered for application. These must be translated into the biodiversity context nationally.[5]

- **The type of action that is required by the decision maker.**
  There are some quarters that hold the view that the application of the precautionary principle dictates inaction (though it may be warranted in some cases) thereby by having an effect of curtailing development and advancement. The competing view is that it dictates caution and the application of the principles provides choices about the variety of precautionary/ mitigatory measures that can be taken as well as the adoption of less risky alternatives where they are available. The application of the principle is very context specific and does not in all circumstance require a demonstration of 'zero risk'.[6]

Practical frameworks for the application of the principle ought to be developed, after the careful deliberation and resolution of the more complex and contentious issues surrounding the principle. Needless to say, deliberations on the application of the precautionary principle must be carried

[4] Some countries, such as France have chosen to enshrine the principle in the constitution.

[5] By way of legislation, risk assessment requirements can be built into legislation to overcome the issue of lack of evidence to support decision-making.

[6] See Greenpeace Australia V Redbank Power Company (1994) where the Courts decided that acceptance of the principle does not necessarily result in a particular activity being curtailed.

out with the participation of a wide spectrum of stakeholders. In a nutshell, some of key questions that must be answered are:

- How to incorporate the principle into practical procedures?
- How to resolve potential conflicts in decision-making?
- How can the costs and obligations in the application of the principle be distributed?
- How to incorporate scientific knowledge into decision-making processes?

Exploring New Approaches to Policy Implementation

Effective implementation of government policy is bound to be complex. The complexity is more evident in biodiversity related policies. In Malaysia, the lack of political will, the federal state dichotomy, the deficit in capacity and human resources and the inadequacy of funding are often cited for the lackluster implementation of the National Policy on Biodiversity.

As much as the factors above strongly influence the success of policy implementation, so do the **approaches** utilized to implement the policy.

There are many approaches for policy implementation. According to Thomas (2007) referring to Bridgman and Davis (1998), these can be categorized as follows:

- Policy through advocacy (which involve methods using education or persuasion)
- Policy through money (utilizing spending or taxing mechanisms)
- Policy through direct government action (involving delivery of services through government agencies); and
- Policy through law (by using legislations, regulation and authority).

Malaysia of course uses a combination of approaches in policy implementation and in many cases a mixed approach is perhaps most desired. The use of legislation or regulatory approaches as it were, are in some cases, the only effective way a policy can be implemented in specific cases. Regulatory usage has it's limitations and may only be effective in certain situations. Whilst regulatory approaches have and must play a strong role in meeting biodiversity objectives, there is a need for policy makers and implementers to explore the wider use of economic instruments and market-based approaches to meet these objectives.[7]

Thomas again (in 2007) referring to Dovers (2005) captures the proposition accurately with the following statement:

[7] "Instruments that affect estimates of costs and benefits of alternative actions open to economic agents. Economic instruments, in contrast to direct regulations, thus allow agents the freedom to respond to certain stimuli in a way they themselves think most beneficial." (OECD, 1994, p.17.)

"It is foolish to imagine that one kind of policy instrument will always or even usually be superior to others, given the diversity of problems and contexts in environment and sustainability"

Over the last decade, there has been tremendous interest generated and inroads made in the development of economic instruments and market based approaches to biodiversity conservation. Since the overall goal of the biodiversity management is to achieve long term and sustainable use of biodiversity resources, conjunctive use of economic instruments such as environmental funds, market creation, liability and incentive based tools such as environmental taxes, fees and charges, payments for environmental services will become necessary.[8] These approaches can in the long-term assist the promotion of behavioral change, efficiency, spark innovation and enable the setting of higher environmental standards.

Furthermore, the use of the right economic instrument can prove to be effective in ensuring there are financial resources for the long term comprehensive natural resource management and conservation related initiatives at the national level.

There are numerous instruments to choose from, and the choice of a particular economic instrument very much depends upon careful analysis of specific institutional, economic and social needs of the nation and must be evaluated for use on a case by case basis. **The government must begin the exploration of the use of economic instruments seriously and identify possible areas for application.**

An Example

One such instrument that is increasingly being used worldwide is the concept of payment of environmental services (PES). The objective is to create incentive measures for managing natural resources, addressing livelihood issues for the rural poor as well as providing sustainable financing for protected areas.[9] The basic underlying principle for PES is those who "provide" a particular environmental service[10] should be rewarded or paid for doing so.

PES schemes can take numerous forms and can involve different instruments, for example tradable quota systems in carbon offsetting. Payment schemes are by and large a market arrangement between two willing parties (i.e. the buyer and the seller) Payments by tourist

[8] **The Convention on Biological Diversity,** as one of the principal international agreements for the conservation of biological diversity, requires Parties to "adopt economically and socially sound measures that act as incentives for the conservation and sustainable use of components of biological diversity" (Article 11).

[9] Payment for Environmental Services can be said to be an incentive driven measure. The use of such schemes helps internalize the cost of conservation. It's added advantage is that it can be use to promote socio economic development of the poor.

[10] Ecosystem services include provisions such as food, fuel, flood control, freshwater, climate regulation and a range of other services.

companies to African communities for the protection of their wildlife is one such example. It can also be a scheme intermediated by a large private or public entity, for example, a portion of household water bills in New York is used by the water company to buy watershed protection services from farmers in the vicinity of the water company intake. Large PES schemes can even be government-driven, where public revenues are used to 'pay' the providers of ecosystem services.

A functioning PES scheme would very much depend on the existence of certain enabling conditions. There must of course be a willingness to pay for the services provided and a willingness to sell those services. The necessary legal frameworks, a good understanding of the environmental linkages and characteristics are all important prerequisites.[11]

The need for funds to adequately conserve biodiversity along with the ecosystem services that it provides will only escalate. The use of PES has the potential to overcome funding challenges and may succeed where other approaches have failed.

SOME CASE STUDIES

The United States

The United Sates currently has the largest PES program which takes numerous forms such as the Conservation Reserve Programme, the Nature Conservancy Programme, and the Local Land Trusts Programmes. These programmes include the purchase of lands that are critical for habitat protection, biodiversity conservation and ecological functions. Tax relief is provided to landowners that are willing to protect the land for a particular purpose.

Costa Rica

In Costa Rica, a National Programme on PES was launched in 1996, which targeted private landowners. An amendment to the Forestry Law of the country legitimized the implementation of a PES system there. The Forestry Law has identified a number of environmental services derived from natural forests, tree plantations, and agro-forestry systems, such as carbon fixation, hydrological services, biodiversity protection, and landscape beauty. Private landowners are paid (by way of fees) to undertake conservation activities (such as tree planting) and are paid according to land area that is reforested by them.

There is no 'one size fits all' approach to PES as well as other economic approaches, but a necessary action plan by the nation with regard to economic instruments is to begin vigorous

[11] The Convention of Biological Diversity at COP Decision VI/15 has recognized the importance of valuation as a tool for designing appropriate incentives. Malaysia must therefore proceed to explore methodologies for valuation of biodiversity and the services it provides.

exploration of the various approaches with stakeholders and the private sector. We cannot afford not to.

REFERENCES

Carew-Reid J, Presscott-Allen, R, Bass,S and Dalal-Clayton,DB 1994, Strategies for national sustainable development: a handbook for their planning and implementation. IIED and IUCN

Cooney, R 2004, *The precautionary principle in biodiversity conservation and natural resources management*; An issues paper for policy makers, researchers, and practitioners, IUCN, Gland, Switzerland and Cambridge, UK.

Guidelines for Applying the Precautionary Principle to Biodiversity Conservation and Natural Resource Management 2005, The Precautionary Principle Project; see <www.principle.net>.

Mount Cameroon Policy Briefing Note No. 4 February 2002, *A participatory biodiversity conservation strategy* — an approach for achieving national poverty and biodiversity conservation policy objectives.

National Policy on Biological Diversity 1998, Ministry of Science Technology and the Environment, Malaysia.

OECD 2004, *Recommendation of the Council on the use of economic instruments in promoting the conservation and sustainable use of biodiversity*, as Adopted by the OECD Council.

Tickner, J, Raffensperger, C & Myres, N, 'The precautionary principle in action, in *A handbook written for the science and environmental* health network, 1st edn.

The Precautionary Principle in Biodiversity Conservation and Natural Resource Management 2005, Workshop Summary Report, Convened by The Precautionary Principle Project and TRAFFIC, South America.

Thomas, I 2007, *Environmental policy: Australian practice in the context of theory.*

UNEP 2004, *Economic instruments in biodiversity – related multilateral environmental agreements.*

Waters-Bayer, A *et al*. 2005, ETC Foundation, ETC EcoCulture, Netherlands *(2005). Multi-stakeholder partnerships to integrate participatory approaches into institutions of agricultural research and development (ARD).*

Wilkinson, D 2002, *Environment and law, routledge introduction to environment series.*

World Wide Fund for Nature 2006, *Payments for environmental services: an equitable approach for reducing poverty and conserving nature.*

World Commission on the Ethics of Scientific Knowledge and Technology, (COMEST) 2005, *The precautionary principle.*

The Precautionary Principle in Biodiversity Conservation and Natural Resource Management 2005, in *Workshop Summary Report*, Convened by The Precautionary Principle Project and TRAFFIC, South America.

Contribution of Biodiversity Towards Sustainable Agriculture Development

A.R.A. SHUKOR, A.M. MOHD YUSOFF, H.M. NOROWI
AND N.M. SHUKOR
Malaysian Agricultural Research and Development Institute
P.O. Box 12301, 50774 Kuala Lumpur

Abstract

Agriculture is an important sector in the Malaysian economy. It is proclaimed as the third engine of growth. It is a source of foods, fibers and fuel. The major challenge for agriculture developer today and in the future is the management of agricultural biodiversity in a sustainable manner so that agriculture can continuously undertake the demand of current and future generations. The tasks are daunting. The demand for global foods is expected to be increased by fifty percent in order to feed of increase in population and change of consumption pattern. On top of that agriculture resources are reduced. To complicate the matter, majority of current agriculture practices are against the conservation of biodiversity.

Biodiversity is essential for sustainable agricultural development. It provides various food products suitable for human consumption, sources of commodity for economic growth and various functions for social benefit. Malaysia is blessed with an extremely rich biodiversity. There are abundant untapped potential biological resources that are important for increasing the range of food and food products. Biodiversity is also sources of biotechnology development.

Realising the importance of proper management of biological resource for sustainable development, MARDI establish a research thrust area to seriously develop technology that promote conservation and sustainable utilization of biodiversity relate to food and agriculture. At the same time, alternative technologies are formulated to eliminate unsustainable agricultural practices such as over dependence on chemical inputs and overuse of water.

Sustainable agricultural development depends on agroecosystem that has the capacity to continuously produce agricultural products, supply adequate and safe foods, provide employment opportunities, as well as contribute the export earnings and economic growth for current and future generations. This requires an efficient use of technology that is conducive to sustainability. Furthermore, due to the fact that agriculture is affected by changes in market and resource decisions in other sectors and regions, it is important to ensure that changes do not provide a rationale for depleting the environment locally (Wilson Tyrchniewicz 1995).

Promotion of sustainable agricultural development is one of the national agenda. The elements of sustainability such as environmental considerations are being increasingly integrated into our development planning. For example, the government is emphasizing the need to ensure a balance between development and environmental sustainability in the ninth Malaysia Plan (JPM 2006).

Agriculture is an important sector in the Malaysian economy. After almost two decades of reduced emphasis, interest in agriculture is returning in a big way. It is proclaimed as the third engine of growth. It is a source of foods, fibers and, increasingly, fuel. The major task for agriculture developer today and in the future is the management of agricultural biodiversity in a sustainable manner.

Biological Resources of Malaysia

Malaysia is blessed with an extremely rich biodiversity. It is one of the world's twelve mega diversity developing countries in world. The number of species in Malaysia is not known with certainty especially the smaller organisms such as insect and worms. The best estimate puts the number at more than 170 000 species. It has about 16 per cent of the world's classified species (MNRE 2006). Therefore, there are abundant untapped potential biological resources that are important for increasing the range of food and food products suitable for human consumption.

This paper will focus on the contribution of the biodiversity of crop species on which agricultural biodiversity components research has been conducted by MARDI. The species include food and industrial crops such as rice, coconut, herbs, casava and sweet potato; horticultural crops such as fruits and vegetables; floriculture such as orchids (cut flowers and potted plants), potted ornamentals, foliage (cut) and landscape plants. Of late, MARDI research program considers potential crops such as jatropa and nipah palm for biofuels, and stevia for sugar. MARDI is firmly committed to sustainably develop these crops/commodities in order to achieve our vision of being a world-renowned R&D organization in food, agriculture and bio-based industries by 2015.

ISSUES AND CHALLENGES OF SUSTAINABLE AGRICULTURE DEVELOPMENT

Increase in Global Food Demand

Global food production is under tremendous pressure. By 2030, human population is expected to reach 8 billion people (Scherr & McNeely 2007). Population growth alone is not solely responsible for driving demand for food and non-food crops. As populations become wealthier, consumption patterns change and demand for protein such as meat and milk products goes up. For example,

the production of 1 kg of chicken meat requires about 3 kg of grain which further amplifies the demand for grain.

Reduction of Resources for Agriculture

Rural-urban migration effects agriculture system. This migration pattern is reducing the availability of agricultural labor. Thus, it is putting greater pressure on farmers to increase production to feed urban populations. Furthermore, as population continues to grow, more land is required for building and other uses. Again the end result is agriculture has to produce more, and it has to produce through modern agriculture.

Modern Non-sustainable Production Practices

Modern agriculture to a large extent involves managing land in ways that conflict with the conservation of biodiversity and the healthy functioning of ecosystems. For example, modern agriculture often requires fields to be leveled and hedgerows removed, thus reducing wild-life habitat. Similarly, single crops are planted over large areas which lead to reduce species and genetic diversity. All these factors, in addition to the heavy use of pesticides and chemical fertilizers, tend to lead to major losses of biodiversity, particularly where land is managed in a way that is aimed primarily at maximizing agricultural productivity. These practices often harm beneficial wild species like pollinators, predators that prey on agricultural land, etc. Moreover, some of the introduced crops have become invasive species, spreading beyond their introduction range and displacing native species. All these factors put further pressure on ecosystems and biodiversity.

Conservation of Biodiversity for Agriculture

Conservation of biodiversity that relate to agriculture is also a major challenge of securing and keeping of biological resource for future generations. The conservation effort should not be emphasized only on the conservation of genetic diversity but also the other components related to it. The ecosystem approach provides a platform to effectively conserve and sustainably use biodiversity. The approach requires us to view and understand agricultural system which will effectively provide us the basic answer to what, why, where and how to conserve the source of genetic diversity. In other words, ecosystem approach will help us formulate conservation strategies effectively in holistic manner.

Ecosystem function and traditional knowledge diversity are two important components related to genetic diversity and need to be considered simultaneously in conservation of biodiversity for agriculture. Although ecosystem functions are less understood and not well documented, they are essential for geneflow, reproduction, etc. (Sajise 2006). Likewise, traditional knowledge is also important part of biodiversity. It is embedded with genetic diversity and passed from one to the next of farming generations. This process ensures agricultural system continue to flourish. The knowledge of planting, managing, selecting, harvesting processing and utilizing agricultural genetic diversity are deteriorating. The migration of the young generation to urban areas because of better opportunities has affected the transmission of this knowledge from one generation to another. Thus, it is imperative to properly document any traditional knowledge associated with agricultural system.

CONTRIBUTION OF BIODIVERSITY TO NATIONAL AGRICULTURAL DEVELOPMENT

Biodiversity refers to the variety of life and its processes; and it includes the variety of living organisms, the genetic differences among them, and the communities and ecosystems in which they occur. Agriculture depends on biodiversity for pollination, the existence of genetically diverse plant and crop varieties, development of robust, insect or disease-resistant strains, crop protection management and watershed control.

In Malaysia, biodiversity contributes significantly to the development of agricultural sector. The sector in turns provides various food products suitable for human consumption, source of commodity for economic growth and various jobs for social benefit. Rice is staple food to Malaysia and vegetable and tropical fruit are source of export income. In addition, agricultural sector provide employment opportunities.

Table 1 indicates the growth rate of agriculture sector from 1960–2005. Immediately after independent the sector was growing convincely at 7%. This was mainly contributed by development of large and extensive land scheme. For the period of 1970 to 1990, the growth declined. In 1980, the growth was about 4%. During this period, income from agriculture fell behind those of a rapidly growing non-agricultural economy. At the same time the First National Agriculture Policies was formulated with the aim to ensure a balance and sustainable growth rate of the sector. The sector further declined in the nineties, sliding to nearly 1%.

TABLE 1. GROWTH IN AGRICULTURAL SECTOR IN MALAYSIA, 1960–2005

Period	Growth rate (%)
1961–1970	7.0
1971–1980	5.0
1981–1990	4.1
1991–1995	1.8
1006–2000	1.2
2001–2006	4.5

The sector is resurging is the last few years. It has been transformed to become the nation third engine of growth. This is largely fuelled by a new understanding that growth in the agricultural sector plays a major role in overall national growth. In 2005, the growth of agriculture sector increases to more than 4%. Today, the Ministry of Agriculture and Agro-base industry stress that 'Agriculture is business'. This new approach is aimed to reduce the balance of trade of food bill, which is about six billions presently (Wong 2007). Based on the current scenario, biodiversity will play a greater role in national development agenda.

Biodiversity and Sustainable Agriculture Development

Sustainable agriculture development depends on three pillars — economy, environment and social balance. Biodiversity provides the ingredients to satisfy this demand. Biodiversity fulfill economic demand by offering genetic and species diversity to increase productivity. Biodiversity is also important to maintain healthy environment and provide various ecosystem functions that are necessary for agricultural development. Last but not least, biodiversity is also valuable in satisfying the social needs of the local community.

Biodiversity for food security and economic growth. Biodiversity is one of the main resources to increase agriculture productivity. For innovation in seeds, biodiversity is the crucial 'raw material' – genes. Conservation and management of broad-based genetic diversity within domesticated species have been improving agricultural production for thousand of years. Crop breeding program in MARDI has resulted in the increase in yield of many agricultural commodities. Currently, some of our rice varieties are capable to produce more than 10 tons/ha. The rice breeding program utilized both local and foreign gene materials. Increase in rice productivity is important to our nation food security.

Genetic diversity is also a source of new varieties of fruits and vegetables commodities. *Table 2* indicates traded values of fruit and vegetable from 2000–2005. Such increases in value have been supported by new varieties such as Maspine and Josapine of pineapple; eksotika of papaya. These were developed with specialty characteristic that increase competitiveness at the world market.

TABLE 2. CONTRIBUTION OF FRUITS AND VEGETABLES TO THE MALAYSIAN ECONOMY

	Traded value (RM Bil)	
Year	Fruits	Vegetables
2000	1.20	0.53
2001	1.29	0.57
2002	1.42	0.62
2003	1.56	0.68
2004	1.62	0.73
2005	1.72	0.79

Likewise, species diversity is also a source of new commodity with economic value. Floriculture industry depends on biodiversity. *Table 3* indicates the economic gain from floriculture commodities in 2006 that nearly reach RM200 millions.

TABLE 3. EXPORT VALUE OF FLORICULTURE COMMODITIES IN 2006

Commodities	Value (RM)
Orchid, fresh	13 373 736
Other cut flowers and flower buds, fresh	73 533 653
Other cut flowers and flower buds, other than fresh	30 750 857
Other foliage, branches, etc. without flowers or flower buds, fresh	13 570 574
Other foliage, branches, etc. without flowers or flower buds, other than fresh	249 482
Total	191 478 302

(Source: Ministry of Agriculture and Agro-based industries)

Biodiversity, especially microbes are important for food processing. These beneficial microorganisms have been used in the production of fermented foods such as tapai, yoghurt, tempeh, pickles, wines, vinegar and soy sauce for a long time in Asian countries without the producers really understanding the science behind their role. Newly discovered micro-organisms can be employed to increase the availability of food and the production of new types of products and supplements such as single cell proteins and probiotic yoghurt.

Microbes are also providing enzymes for food processing. Enzymes speed up a number of specific reactions which produce changes in food constituents, leading to enhancement of texture, safety, appearance, nutritional value and flavors in foods. Enzyme-catalyzed processes are scaleable with requirements for a simple manufacturing base, low capital investment and low energy consumption, and may be utilized in upgrading a number of food processing applications.

Based on these examples, it is obvious that biodiversity is a major contribution to economic growth. Through the trade liberalization process, mega diverse countries like Malaysia can seize the opportunities to take advantage of the biodiversity to develop their agro-industry to create employment and to generate income.

Biodiversity for the healthy agroecosystem. Biodiversity is essential for maintenance of ecosystem functions. These ecosystem functions such as nutrient cycling, decomposition of organic matter, crusted or degraded soil rehabilitation, pest and disease regulation, water quality, and pollination are maintained by a wide range of biologically diverse populations in natural ecosystems and in and near agricultural ecosystems. Maintaining this diversity of species and building on and enhancing ecosystem functions reduces external input requirements by increased nutrient availability, improved water use and soil structure, and natural control of pests.

A diverse range of organisms contributes to the resilience of agricultural and natural ecosystems, their capacity to recover from environmental stress and their ability to evolve. Presently, these services and functions are taken for granted. More works to understand and quantify them are necessary.

Biodiversity for social need. Biodiversity is also linked to socially value. Although Malaysia is endowed with diverse ethnicity, religions, beliefs and cultures, we are sharing many common uses of biodiversity such as the use of plants, animals as food sources, drinks, clothings, dwelling constructions, and in rituals. The diversity of ethnicity itself guarantees diversity of ethnobiology. For example, the dependence of Melanau on sago (*Metroxylon sagu*) for carbohydrate source has been documented for ages. The Penans are hunters and they depend of various wild animals for protein source. In Sabah, the Orang Sungai of Bukit Garam, are known to use many varieties of plants for medicine (Latiff 2006)

FUTURE CONTRIBUTION OF BIODIVERSITY

Biodiversity will continue to offer its services for national development. Besides ensuring food security, biodiversity will continue to provide new source of growth for agricultural sector. With the new technologies available today, such as biotechnology and alike, there are more opportunities to be offered by biodiversity.

Biodiversity and Biotechnology

Biotechnology serves as a comprehensive tool in helping to create wealth from our biological resource. This is in line with the current tout that the 21st Century is the 'Biology Century'. Biotechnology can contribute greatly to innovations, cost reductions, productivity, etc.

Biotechnology development in genetic analysis, coupled with information and communication technology, and nanotechnology have revolutionalized and pushed up agriculture productivity and profit frontiers. Biotechnology is a vital tool for improvements, new processes, and new products, and will no doubt opens greater opportunities for maximizing and sustaining biodiversity utilization. Biotechnology can play a significant role in:

- the discovery new genes, hence opening the opportunities for breeders;
- the conservation of known and unknown genes of plant/organism, and
- the manipulation of genomes that results in new high value products or processes.

Molecular biological techniques have enhanced our knowledge in genomics and bioinformatics. High throughout screening of genes and characterization of genes and gene functions through techniques such as microarray, expressed sequence tags (EST) and serial analysis gene expression (SAGE) have contributed to our understanding in functional genomics. The advent of metabolomics, too, has enabled us to view genes and products in a more holistic way. These are valuable tools that could enhance discovery of new genes.

Bioprospecting

Our biological resources, particularly the rare and wild species of food crops have not been fully studied and very little is known on their actual distribution and potential use. Some species are near to extinction even before they are documented. Systematic effort to inventorize and document the range of biodiversity related to agriculture, including old land races, traditional varieties and specific ecotypes needs to be expended.

AGRICULTURAL BIODIVERSITY RESEARCH AND DEVELOPMENT IN MARDI

The responsibility given to MARDI to help the country benefits from biodiversity is a heavy one. The challenge is to meet the government's agenda to have positive food trade by 2010. The challenge has to be met without jeopardizing the health of agroecosystem. For that matter, MARDI is looking seriously in the management of biological resource relate to food and agriculture (Sharif 2006). This is to ensure food security for current and future generation. One of MARDI thrust research area is the Management and Utilization of Biological Resources. The main objective of the thrust is to conserve and sustainably use biodiversity for agricultural development.

Genetic and Species Diversity Conservation

One of the activities related to the thrust is the conservation of genetic diversity. Some of the activities that relate to conservation are inventorization, ethnobotanical studies, and conservation of genetic resource. Inventorying the plant biodiversity at species level is vital in deciding the proper collection and conservation strategy. Inventory of the insects and microbial strains found on crops include not only the identification of right species but also their relationship with the crop. MARDI currently has relatively good coverage on the inventories of underutilized fruit crops such as pulasan (*Nephelium ramboutan-ake,* kuini (*Mangifera odorata*) and binjai (*Mangifera caesia*).

Ethnobotanical studies involve the collection of indigenous knowledge with respect to the usefulness of the particular plant species in the daily life of the local community and the indigenous people. This area of work is very relevant in as far as identifying the commercial value of the particular species. The current work relates to various medicinal plants surveyed in eastern part of Peninsular Malaysia; in the state of Kelantan, Terengganu and Pahang.

Collections and conservations of genetic resources in MARDI encompass plants, insects, microbes and farm animals. Plant genetic resources are being maintained as living collections either in field genebanks or seed genebanks at selected MARDI stations throughout the country. These *ex-situ* collections of plant genetic resources are made up of germplasm materials representing indigenous and non-indigenous crops and their wild relatives. These crops include rice, fruits, vegetables, medicinal and aromatic plants, ornamentals, spices and beverages, coconut, tobacco, roots and tubers as well as pastures.

With regards to collections of insect specimens relevant to agriculture, MARDI has established an insect museum at Serdang. Currently the museum holds over 30 000 specimens of insects. The

museum acts as the national referral centre for insects relevant to agriculture. In addition, over 500 specimens of active microbes are also being maintained in microbe genebanks in MARDI Serdang.

Sustainable Utilization

Some of the activities related to utilization of plant genetic resource are, characterization, identification of under utilized species and genetic enhancement. Characterization is important as the information generated would allow potential users such as geneticists, breeders, biotechnologists and scientists at large to identify accessions or lines of specific interests.

Arthropod provides three major services in agriculture development – biological control, pollinators and arthropod-based protein source particularly for animal feed. Several biological control agents have been identified and utilized for managing insect pests on vegetables (e.g. cabbage) and medicinal plants (eg. mengkudu). Likewise, a few microbial strains are found to be promising as bioherbicide and biopesticide in agriculture. A fungal pathogen (*Exserohilum monoceras*) have been shown effective to control rumput sambau in rice fields. The virus-based biopesticides such as the use of Nuclear Polyhydrosis Virus (NPV) have been effective against *Spodoptera* pests of vegetables. A strain of bacteria (*Stretomyces* sp.) to be a potential agent for controlling bacterial wilt disease. Microbe is important in food processing industry. The screening of microbial diversity has been emphasized in research on bioprocessing of food which could involve baking, brewing and fermentation for processing and preservation of raw food.

Currently MARDI is embarking on several research activities to look for new commodity that can generate income to the nation. Kenaf (*Hibiscus cannabinus*) is found to be potential crop for animal feed and fibers. Jatropha (*Jatropha curcas*) and Nipah palm (*Nypa fruticans*) are two potential agro-fuels crops. Although our research on these commodities is still in infant stage, preliminary finding indicates they are potential to become economic crop to Malaysia.

Ecosystem Research

Another area of research under this thrust is the ecosystem research. Ecosystem research involves conducting basic and applied researches, and integrating ecoagriculture technologies to establish workable models of ecological agriculture according to the eco-environmental issues in the development of highly intensive and complex agriculture (McNeely & Scherr 2001). It stresses on the maximizing ecological, economic and social synergies among them, and minimizing the conflicts. The challenge is daunting. However, the fact that the agricultural sector was now more open to environmental advice and pressure provided opportunities for synergy between the environmental and agricultural agendas.

Some of the works to be covered include quantification of cost conservation techniques, quantification of ecosystem services provided by biodiversity component and formulation of technologies that promote sustainable agriculture development.

Lack of Ecosystem Approach in Agricultural Biodiversity Conservation

The major challenge is to secure and increase agricultural yield while at the same time conserving biodiversity, ecosystems, and resources as well as maintaining a healthy base for those who rely on agriculture for their livelihoods. In other words, agriculture has to be made more effective and sustainable on the land already cropped. This challenge may be answered by a fully integrated approach to agriculture, conservation and rural livelihoods, within agriculture landscape or ecosystem. The approach is coined as ecoagriculture. Ecoagriculture explicitly recognizes the economic and ecological relationships and mutual interdependence among agriculture, biodiversity, and ecosystem services. Effective ecoagriculture systems rely on.

CONCLUSION

Taken together, the opportunities for action at local, national and global level is to support the wider use of agricultural biodiversity to reduce poverty, promote development and improve food security. This implies that a new approach to agricultural research and development is needed, to meet the needs of the majority of the rural poor who live in areas that have fewer natural resources. They are prone to natural disasters, and who far less able to purchase inputs such as fertilizers and pesticides.

The old approach has provided many successes. It aims to increase production to meet demands but involved increased dependence on pesticides and fertilizers and overuse of water. A paradigm shift is required to move from chemical-based intensification to biological intensification that draws on the richness of genetic resources. This approach is more complex, based on strategies aimed at farming systems rather than particular crops, and less reliance on external inputs. It requires greater use of agricultural biodiversity in the field of plant breeding that now makes use of specific adaptation.

This new approach also requires greater involvement of farmers, local communities, and indeed the whole array of civil society at local and national levels. Farmers in particular should be perceived as managers of biodiversity rather than as managers of food production factories. At the same time, effective action should be taken against forces promoting unsustainable agriculture such as short-term planning, unscrupulous land conversion, and failure to pay attention to ecosystem services.

REFERENCES

JPM 2006, Speech by the Prime Minister in the Dewan Rakyat.

Latiff, A 2006, Biological diversity and traditional knowledge, iinovations and practices in Malaysia — Issues and Challenge, *in National Conference on Agrobiodiversity Conservation and Sustainable Utilization*, MARDI, Kucing, Sarawak.

McNeely, JA & Scherr, SJ. 2001, *Common ground common future: how ecoagriculture can help feed the world and save biodiversity, IUCN*, pp. 28.

MNRE, 2006, Biodiversity in Malaysia. Ministry Natural Resources and Environment, Kuala Lumpur.

Sajise, PE 2006, 'Ecosystem perspective and its implications in agrobiodiversity conservation and sustainable use', *in National Conference on Agrobiodiversity Conservation and Sustainable Utilization*, MARDI, Kucing, Sarawak.

Scherr, SJ & McNeely, JA 2007, *Farming with nature: the science and practice of ecoagriculture*, Islander Press, London.

Sharif, H 2006, 'Agrobiodiversity research in MARDI – current status and future plans, *in National Conference on Agrobiodiversity Conservation and Sustainable Utilization*, MARDI, Kucing, Sarawak.

Wilson, A & Tyrchniewicz A 1995, 'Agriculture and sustainable development: Policy analysis on the Great Plains', International Institute for Sustainable Development. Winnipeg.

Wong, LC-Y 2009, 'Food Security and Growth: Malaysia's strategic approach and future adjustments 1', *Food Security Malaysia*, eds Academy Science Malaysia, Kuala Lumpur.

Contribution of Farm Animal Genetic Resources to National Development

A.K. RAYMOND AND A.J. AZIZ
Department of Veterinary Services, Wisma Tani, Podium Block, Lot 4G1, Precinct 4
Federal Government Administration Centre, 62630 Putrajaya, Malaysia

Abstract

Farm Animal Genetic Resources (FAnGR) in Malaysia are quite diverse and consist of a total of 101 breeds and major breed crosses. They have and continue to have a positive impact on the economic, social and cultural development of the country. In 2007, the value of the livestock sector was RM8.834 billion, representing a contribution of 40.1 percent to the food sector. Other than for food, animal products have found a plethora of uses as well as for social, religious and cultural purposes. FAnGR have also been used to positively contribute to the environment by providing organic fertilizer, for environmental management in oil palm-cattle integration projects, as providers of mechanical energy and for harvesting biogas. Present challenges in the utilization of FAnGR include their perceived negative impact to the environment, especially when intensively farmed, and the increasing cost of production due to the high cost of feed. Other threats are the use of a narrow genetic base in modern production systems, lack of awareness, lack of sufficient technical expertise, funding issues, land competition, biodiversity loss, and decreased utility of some breeds. Opportunities for sustainable utilization can be realized in Malaysia's large number of institutions with a conservation focus, and our collaboration with the global focal point and regional networks. Proper management of our animal genetic resources and mainstreaming biodiversity considerations into livestock development will ensure the conservation and sustainable utilization of these resources for present and future generations.

Farm Animal Genetic Resources (FAnGR) have evolved over the millennia and become adapted to various production environments. They play a major role in the economies and social development of countries, provide employment for 1.3 billion people and have created livelihoods for over one billion of the world's poor (Steinfeld *et al*. 2006). In Malaysia, FAnGR are quite diverse and include cattle, buffalo, goat, sheep, horses, poultry, pig and deer. These animal species consist of a known total of 101 breeds and major breed crosses. Over time they have had a positive impact on the economic, social and cultural development of Malaysia. In what is now termed the Livestock Revolution, livestock production is expected to rise significantly in developing countries due to rising incomes and increasing demand for livestock products. This trend is also evident in Malaysia and will bring new challenges upon its FAnGR. In addition to this are the challenges of globalization and liberalization of trade, which compel our livestock industry to become more competitive and

to surmount both trade and non-trade barriers. How well we conserve and utilize these breeds will determine how well we will be able to sustain our animal industry for future generations.

Figure 1. Kedah-Kelantan cattle managed under integration.

CONTRIBUTION OF FARM ANIMAL GENETIC RESOURCES

In Malaysia, FAnGR have and continue to contribute to national development in the areas of agricultural production, socio-economic advancement and through environmental impact.

Agricultural Production

As far as food production is concerned, the value of the livestock sub-sector was RM8.834 billion in year 2007. This represents a contribution of 40.1 percent to the food sector (Azizah 2008). In 2006, there were a total of 774 400 head of cattle; 132 300 head of buffalo; 334 000 head of goats; 116 700 head of sheep; 2.02 million head of swine; 185.10 million head of poultry and 8.14 million head of ducks (DVS Statistics). These animals produce meat, milk, eggs, skins and a variety of other products. From 1997 to 2006, the production of beef (cattle/buffalo), mutton (including goat meat), poultry meat, eggs (chicken and duck), milk and raw hides/skins increased by 100%, 188%, 45%, 10%, 34% and 79%, respectively. The production of pork however was reduced by 25.4 percent during the same period due mainly to the stigma of the Nipah virus disease outbreak, reduced demand for pork and concerns on environmental pollution. The output and consumption of major livestock products in year 2006 is shown in *Table 1*.

TABLE 1. OUTPUT AND CONSUMPTION OF MAJOR LIVESTOCK PRODUCTS, 2006

Commodity	Output	Consumption	Per capita consumption	Self-sufficiency (%)	Ex-farm value (RM mil)
Beef (Cattle and buffalo)	31 885 mt	146 373 mt	5.49 kg	21.78	580.74
Goat Meat and mutton	1600 mt	17 800 mt	0.67 kg	8.99	40.61
Pork	210 510 mt	197 513 mt	7.41 kg	106.58	1368.00
Poultry Meat	1 035 400 mt	828 730 mt	31.11 kg	124.94	4616.15
Chicken/Duck eggs	7 751 ml	7 107 ml	267	109.06	1621.36
Milk	45.45 ml	975.81ml	36.63	4.66	61.62
Raw Hides and skin	9131 mt	–	–	–	7.76
Total					8296.24

Source: DVS Livestock Statistics 2005/2006

The value of major livestock products in 2006 was RM8.30 billion, with the poultry sector having the highest ex-farm value followed by the swine sector. The output of poultry meat, chicken-duck eggs and pork is beyond local consumption needs. However the production of beef, mutton-goat meat, and milk are currently at very low levels and unable to meet local consumption needs. Much needs to be done to utilize local ruminant genetic resources to better meet demand for ruminant products within the country.

Other than meat, milk, eggs and skin-hide, animals and their products can be used to produce velvet (from deer and thought to be an aphrodisiac), elastin for use in cosmetics, emulsifiers to facilitate mixing of liquids, felt (e.g. from rabbit skins), pigskin (used for manufacture of wallets, bags and shoe linings), tallow, whey, gelatine, glycerine, lard and blood meal (from blood or feathers). Not all these products are utilized in Malaysia, as the manufacturing volume may be limited or there may be particular religious sentiments against their use.

Socio-economic Contribution

In Malaysia, meat which is an important source of dietary protein and energy, is mainly from chicken (75%), followed by pig (18%), although pig meat is not consumed by the majority (60%) Muslim population. Ninety three percent of the eggs consumed are from chickens. Milk used by

the various communities, is mainly from cattle and is consumed in the form of fresh or packaged milk, yogurt, butter, cheese and ice cream. Goat milk and horse milk are mainly utilized as health drinks or supplements. Buffalo milk is mainly used by the Indian community, for making clarified butter. Hindus in particular use milk for performing their religious obligations. Skin is mostly from cattle (90%) and is cured and used as hides. Animal dung has been processed using modern technology (especially using Effective Microbes or vermicomposting) to produce high-grade fertilizer, which some farmers have dubbed as 'black gold' because of its high value. Similarly, the blood and bone of livestock has been processed into fertilizer.

Culturally, animals are very important for religious activities. In Muslim culture, cattle, sheep and goats are important as religious sacrifices. The Hindu population views cattle with reverence, while goats and chickens are used as sacrificial offerings. To the Chinese community, poultry and pigs are used in various religious rituals. Cattle, buffalo and pigs are also used by various communities as dowries for marriages. The horse is used for recreational purposes such as riding and horseracing. In the state of Sabah, buffaloes are used for buffalo races. Animals like cattle and goats have also been used for risk management, in the sense that they are maintained as a 'bank account' and can be easily converted to hard cash in difficult times. In times past, cattle and buffalo have been used by man as beasts of burden. With modernization and mechanization animals have lost their importance as providers of draught power. However in countries now facing economic crisis due to the high cost of fossil-based fuels, buffaloes are again being used for this purpose. It is evident therefore that animals have enriched lives economically, culturally and socially over the ages.

Environmental Impact

Cattle manure and poultry waste continue to be considered as excellent organic fertilizers in Malaysia and provide nutrients such as nitrogen, phosphorus and potassium to the soil. Application of these kinds of manure should be well managed however, to avoid hazards to the environment through leaching of nitrate-nitrogen into groundwater and the runoff of nitrogen and phosphorus into streams (Mitchell 1992).

The grazing of livestock is a way to control weeds and undergrowth. In this respect, animals have been used for environmental management in crop-livestock integration schemes. In oil palm estates for example, cattle have contributed not only to increasing incomes of these estates through the added production of 'eco-friendly beef', but also in reducing the use of inorganic fertilizers and herbicides.

To reduce the use of fossil fuels and directly reduce the emission of greenhouse gasses, the use of animal draught power as described in the previous section is again being given some focus. In

some oil palm estates, buffalos are being used to pull carts carrying oil palm bunches. Horses and donkeys also have the possibility of being used again for mechanical energy.

Some projects are being initiated to harvest biogas from livestock farms and in the process gain carbon credits, a main component of international emission trading schemes employed to mitigate global warming. Properly managed, animals can be used to mitigate the negative impact to the environment and the effects of climate change.

CHALLENGES IN UTILIZATION OF FAnGR

In a recent report by the Food and Agriculture Organization of the United Nations (FAO) entitled 'Livestock's Long Shadow' (Steinfeld *et al*. 2006), the fast expanding global livestock sector has emerged as one of the most significant contributors to environmental problems. Globally, livestock are responsible for 18% of greenhouse gas emissions as measured in CO_2 equivalents. Other than affecting climate change, livestock are also implicated in causing land and water degradation, and the loss of biodiversity. In order to mitigate the environmental effects of livestock production, the report highlighted the need for an improvement in the way resources are utilized. In the Malaysian context however, the population of livestock is too limited to have significant negative global ramifications. We can however help reduce the negative impact our livestock have on the environment by breeding and producing more efficient livestock (e.g. those with fast growth rate and higher meat production). Another way is to use technology such as supplementing the animals' diet with an amino acid called cysteine, which can reduce the amount of methane gas produced by the animal without compromising on the animals' productivity or the quality of its meat (Takahashi 2002). The use of biogas reactors on farms will prove to be beneficial investments in harnessing methane for energy production and at the same time reducing emissions to the atmosphere.

Another recent challenge to livestock utilization is the increasing cost of grain feed. High feed costs are thought to be mainly caused by lowered production of grain brought about by poorer harvests due to climate change, and competition for available land between feed grain producers and producers of biofuel. In fact animals are competing with humans for grain. This situation is unlikely to change for the better in the near future and will likely worsen. Livestock farmers are in a quandary as high feed costs will translate into higher production costs and the public having been used to relatively low prices of livestock products are unlikely to pay high prices for beef, chicken and other livestock products. Perhaps better awareness programs to inform the public of these concerns will help livestock farmers to continue their businesses and at the same time fully utilize the animal genetic resources of our country. As for ruminants, perhaps it would be better to farm these animals in production systems which are more sustainable, based on fiber consumption and less reliant on grain feedstuffs.

Another challenge to farm animal genetic resources is the commercial production system itself, which uses one or a very few number of breeds. Breeds, which are thought to be less productive, are marginalized and that poses a threat to their conservation and use. In an earlier study done to assess the state of Malaysia's animal genetic resources (DVS 2003), it was found that out of 36 locally adapted breeds only 25 percent are widely used. The other 75 percent are actually under threat as utility is usually a prerequisite for conservation. Much needs to be done to promote the use of breeds that are currently not widely used.

Other threats faced by farm animal genetic resources are a lack of sufficient technical expertise within the country, lack of a funding mechanism to undertake FAnGR conservation projects, competition for land used for agriculture, loss of genetic diversity and increase in inbreeding, sanitary and phytosanitary challenges, decreased utility of farm animals (e.g. decreased use of cattle and buffalo as beasts of burden) and lack of awareness concerning conservation and sustainable use of FAnGR (Raymond *et al*. 2006).

OPPORTUNITIES FOR SUSTAINABLE UTILIZATION OF FAnGR

Part 5 of Malaysia's *Animals Act 1953* (Revised 2006) is entitled 'Conservation of Livestock'. This goes to show the long heritage that Malaysia has had in the conservation of livestock. As a result of that commitment to conservation, there exist today a large number of farms for the breeding and conservation of animal genetic resources (refer to *Appendix 1*). These farms are the tools that will be used for enhancing work on conservation and sustainable use of Malaysia's animal genetic resources.

Figure 2. Bali cow being conserved at the Institute Haiwan in Kluang, Johore.

In 1989, the Department of Veterinary Services established the National Institute of Animal Biotechnology (NIAB) in Jerantut, Pahang. This institute is the FAO recognized Malaysian focal point for Animal Genetic Resources. It has a Semen Bank where frozen semen of various breeds of livestock are stored. It is also involved in several *in situ* and *ex situ* conservation projects. The future focus at NIAB will be to further develop technical expertise, have regional and international collaborative projects, as well as developing it into a regional reference center for AnGR conservation. The recent establishment of the National Embryo Center at MARDI (Malaysian Agricultural Research and Development Institute) will further expand the options available for *ex situ* conservation of animal genetic resources.

Figure 3. The National Institute of Animal Biotechnology in Jerantut, Pahang.

Since 1994, when Malaysia was involved in the Japanese funded-FAO Conservation and Use of Animal Genetic Resources in Asia and the Pacific Project (FAO Project No. GCP/RAS/144/JPN), there has been the creation of local expertise in animal genetic resources, greater awareness of issues related to conservation and sustainable utilization and the initiating of several *in situ* and *ex situ* conservation projects (Raymond & Krishnalingam 1997; Raymond 1998). There was even a regional focal point for Animal Genetic Resources, which operated from Bangkok between 1994 and 1999, but had to be closed due to financial constraints. With the finalization of the recently negotiated FAO Global Plan of Action for Animal Genetic Resources (FAO 2007), the countries in general and Malaysia in particular will be in a better position to undertake *in situ* and *ex situ* conservation projects, strengthen the legal framework for conservation and utilization issues, have access to a global financial mechanism to undertake local and regional conservation projects, have assess to conservation technology and become integrally involved in regional and international networks.

CONCLUSION

Since time immemorial farm animal genetic resources have been interacting with mankind and contributing to various human needs. They are a wonderful gift to man. How they are conserved and utilized will determine their future and will have implications on the future quality of human life. Adjustments will have to be made to the way they are farmed and how they affect the environment. Their mismanagement or neglect will only lead to biodiversity loss. Many breeds of farm animal genetic resources are already extinct and some have been classified as endangered or under some level of threat. The Watch List for Domestic Animal Diversity (Third Edition) (FAO 2002) lists 740 breeds as extinct. This is 12 percent of the 6379 reported breed populations in the FAO database. Certainly we in Malaysia do not want any of our own animal genetic resources to be highlighted in these watch lists. By proper management, and by mainstreaming biodiversity considerations into livestock development, we are confident of ensuring the conservation and sustainable utilization of our farm animal genetic resources for the present and future generations.

REFERENCES

Azizah Y 2008, personal communication.

DVS 2003, *Animal genetic resources in Malaysia. country report – state of the world's animal genetic resources,* ISBN 983-99673-5-5.

FAO 2002, *World watch list for domestic animal diversity*, 3rd edn, FAO/UNEP, ISBN 92-5-104511-9.

FAO 2007, *Global Plan of Action for Animal Genetic Resources and the Interlaken Declaration*' FAO Commission on Genetic Resources for Food and Agriculture, ISBN 978-92-5-105848-0.

Mitchell C 1992, *Environmental quality – agriculture and natural resources*, Extension Environmental Education, Auburn University, AL 36849-5647.

Raymond AK & Krishnalingam, *V*, 1997, 'Malaysia country report', in *Proceedings of the FAO Third Regional Training Workshop on the Conservation of Domestic Animal Diversity and the Fourth National Coordinators' Meeting*, Bangkok, Thailand, FAO/GCP/RAS/144/JPN Document No. 4.

Raymond AK 1998, 'Malaysia country report', in *Proceedings of the FAO Workshop on the Development of Animal Genetic Resources in Asia with Special Regard to the Evaluation of Production Environment Descriptors and the Fifth Regional Meeting of National Coordinators'*, Katmandu, Nepal. FAO/GCP/RAS/144/JPN Document No. 5.

Raymond AK, Ibrahim CE & Ernie-Muneerah 2006, 'Challenges and opportunities in the conservation and utilization of farm animal genetic resources in Malaysia', in *Proc. National Conf. on Agrobiodiversity Conservation and Sustainable Utilization*, Kuching, Sarawak.

Steinfeld H 2006, *Livestock's long shadow – environmental issues and options*, Lead Digital Library.

Takahashi, J 2002, 'Nutritional manipulation of methane emission from ruminants', in *Greenhouse gases and animal agriculture*, Elsevier Science, London.

Appendix I
INSTITUTIONS DIRECTLY INVOLVED IN CONSERVATION OF FARM ANIMAL GENETIC RESOURCES†

Institution	Location	Breeds Conserved	Activities
National Institute of Animal Biotechnology (NIAB)*	Jerantut, Pahang	*Ex situ*: Cattle, goat, sheep, buffalo & banteng breeds *In situ*: Kuda Padi (Paddy Horse)	Activities focused on improving the genetic quality of livestock, conserving AnGR and improving livestock performance through the use of modern biotechnology. Operates Semen Bank for various breeds of farm animals.
University of Malaya (UM)	Kuala Lumpur	Jermasia (synthetic goat breed)	R&D activities to develop Jermasia goats. Genetic selection. Cryogenic storage of semen.
Malaysian Agricultural Research & Development Institute (MARDI)	Bukit Ridan, Pahang & Kluang, Johore	Brakmas and Charoke (synthetic beef breeds)	R&D activities to develop Brakmas and Charoke beef breeds. Genetic selection. Cryogenic storage of semen.
Jenderak Seladang Breeding Center, Wildlife Department	Jenderak, Pahang	Seladang (wild ox)	Breeding of Seladang in captivity. Associated R&D activities.
Veterinary Institute (IH)*	Kluang, Johore	Bali cattle, Mafriwal cattle (synthetic dairy breed), Sambar deer.	Conservation herds for Bali cattle and Sambar deer. Development of Mafriwal cattle. Semen bank (reserve semen bank to NIAB).
Poultry Development Institute (IKTA)*	Johore Bahru, Johore	IKTA Quail	Development of IKTA quail for meat and eggs. Genetic selection.
Air Hitam Livestock Breeding Center*	Air Hitam, Johore	Mafriwal cattle, a few horse breeds	Genetic improvement of Mafriwal cattle.
Tersat Livestock Breeding Center*	Kuala Berang, Terengganu	Kedah-Kelantan cattle	Conservation herd for Kedah-Kelantan cattle.
Pantai Timor Livestock Breeding Center*	Tanah Merah, Kelantan	Kedah-Kelantan cattle	Conservation herd for Kedah-Kelantan cattle.
Gemas Livestock Breeding Center*	Gemas, Johore	Various breeds	Strategic sourcing of breeds.
Ulu Lepar Livestock Breeding Center*	Gambang, Pahang	Nelore cattle	Development of Nelore cattle.
Pondok Tanjung Livestock Breeding Center*	Taiping, Perak	Future development of Boer Goats (National Boer Breeding Centre)	Being developed for R&D and breeding function.

Appendix I (cont.)
INSTITUTIONS DIRECTLY INVOLVED IN CONSERVATION
OF FARM ANIMAL GENETIC RESOURCES[†]

Institution	Location	Breeds Conserved	Activities
Lenggong Livestock Breeding Center*	Lenggong, Perak	Breeds ConservedDeer – Axis, Timorensis, Sambar. Eland.	R&D.
Batu Arang Livestock Breeding Center	Batu Arang, Selangor	Breeding bulls from various cattle breeds.	Functions as a bull park.
Chaluk Livestock Breeding Center*	Chaluk, Terengganu	Barbados Blackbelly & other hair sheep	Nucleus breeding farm for hair sheep breeds.
Gajah Mati Sheep Breeding Center*	Gajah Mati, Kedah	Boer goats	Breeding and R&D.
Jeram Pasu Goat & Sheep Breeding Center*	Jeram Pasu	Malin sheep	Breeding and R&D.
Kampong Kuala Pah Goat & Sheep Breeding Center*	Kampong Pah, Negeri Sembilan	Jermasia & Boer goats	Breeding and R&D.
Ijok Goat & Sheep Breeding Center	Batang Berjuntai, Selangor	Rams from various sheep breeds	Functions as ram park.
Tebing Tinggi State Genetic Resources Center*	Jerantut, Pahang	Brahman cattle	Genetic development of Brahman cattle.
Ulu Lepar State Genetic Resources Center*	Ulu Lepar, Pahang	Nelore cattle	Genetic development of Nelore cattle.
Bukit Kajang State Genetic Resources Center*	Bukit Kajang, Pahang	Kedah-Kelantan cattle	Genetic development of Kedah-Kelantan cattle.
Infoternak Farm*	Sungei Siput, Perak	Ostrich, deer, goat (Saanen)	Breeding, multiplication & research.
Paya Jeras Duck Breeding Center*	Paya Jeras, Selangor	Muscovy ducks	Breeding of Muscovy ducks.

[†] Adapted from State of the World's Animal Genetic Resources — Malaysia's Country Report
* Institutions under the Department of Veterinary Services, MOA

Contribution of Biodiversity in Aquaculture and Fisheries Development

C.A. JUNAIDI
Department of Fisheries Malaysia

Malaysia is one of seventeen 'megadiverse' countries in the World. This group of countries has less than 10% of the global surface, but support more than 70% of the biological diversity on earth. The World Conservation Monitoring Centre recognised 17 megadiverse countries in July 2000 including Australia, Brazil, China, Colombia, Democratic Republic of the Congo (DRC) (formerly Zaire), Ecuador, India, Indonesia, Madagascar, Malaysia, Mexico, Papua New Guinea, Peru, the Philippines, South Africa, the United States of America (USA) and Venezuela. Together, these 17 countries harbour more than 70% of the earth's species.

The Malaysian Aquatic ecosystems housed many species including phytoplankton, zooplankton, aquatic plants, insects, fish, birds, mammals, and others. They are being organized at many levels, from the smallest building blocks of life to complete ecosystems, encompassing communities, populations, species, and genetic levels. The aquatic biodiversity includes all unique species and habitats, and the interaction between them. It boosts ecosystem productivity where each species, no matter how small, all have an important role to play and that, it is this combination that enables the ecosystem to possess the ability to prevent and recover from a variety of disasters. This is useful for mankind as a larger number of species of plants and animals will ensure that the ecosystem is naturally sustained.

Biodiversity has enormous economic and aesthetic value and is largely responsible for maintaining and supporting overall environmental health. We depended on aquatic resources for food, medicines, and materials as well as for recreational and commercial purposes such as fishing and tourism. Aquatic organisms also rely upon the great diversity of aquatic habitats and resources for food, materials, and breeding grounds. For example, mangrove ecosystem provides coastal defences while generating local livelihoods.

The variety, quantity, quality, dynamics and distribution of biodiversity are the attributes required to enable ecosystems to function. The roles of biodiversity can be categorized as provisioning (food, fuel or fibre), regulating (pollination), supporting (such as microorganisms as cycling nutrients and soil formation) and potentially cultural (spiritual or aesthetic benefits or cultural identity). Genetic diversity provides the basis for adaptation, allowing living organisms to respond to natural selection, and adapt to their environment. They play a strong role in the resilience of biodiversity to global changes, such as climate change or novel diseases and provide direct benefits to people, such as the genetic material needed for improving yield and disease resistance.

MALAYSIAN FISHERY

The fisheries sector has for decades been playing an important role as a major supplier of animal protein to the Malaysian population. The sector is being divided into three sub-sectors: capture fisheries (coastal fisheries, offshore fisheries and tuna fishery), aquaculture (fresh and brackish waters) and industry-based fishery product.

The focus of fisheries development trends and activities is mainly directed towards improving the well-being of the people engaged in the fisheries sector which, in addition to fishers, includes processors, traders, and others directly working in and dependent on the sector.

As the full potential of wild fisheries resources has been achieved — and often 'lost' through overfishing — the main objective and emphasis in capture fisheries development strategies has changed from increasing harvest (an objective during the first three quarters of the last century) to establishing a more sustainable and optimal use of the available fisheries resources (particularly since UNCED in 1992). The same path has been followed by aquaculture where development from the 1950s to the 1990s emphasized technology development, intensification, and larger harvest.

In 2006, the fisheries landings of the country amounted to 1 595 961 tonnes, with an estimated value of RM6.234 billion. Its contribution to GDP amounted to 1.3% (*Table 1*). The fisheries consist of two major components, namely the marine capture fisheries and aquaculture. The greater bulk of the fish landings have always been coming from the capture fisheries, constituting 86% of the total fish production for the year 2006, with the rest coming from aquaculture. Production from the inland fisheries is negligible, standing at around 0.3% which is usually not taken into consideration in total production. The production pattern remains unchanged over the last couple of years.

TABLE 1. TOTAL FISH PRODUCTION IN 2006

Item	Quantity (Tonnes)/Value (RM)
Quantity of Production (Tonnes)	1 595 961
Capture Fisheries	1 379 770
Inland Fisheries	4 165
Aquaculture*	212 026
Value of Production (RM Million)	6 234.00
Capture Fisheries	4 939.32
Inland Fisheries	2.94
Aquaculture*	1 291.75
Contribution to GDP (%)	1.3

* Include seaweed

The marine capture fishery is further sub-divided into the coastal fisheries and offshore sub-sectors. The coastal fisheries have contributed about 82% (1 128 400 tonnes) to the total marine landings while offshore fisheries only about 251 370 tonnes. The contribution from the coastal fisheries has remained fairly static lately at around 1.0 million tonnes (*Table 2*). It is generally well accepted that the coastal fisheries has been fully exploited with possibly some extent of over-fishing. The Department of Fisheries (DOF) has over the years tried various measures in an attempt to reduce the fishing effort in the areas.

TABLE 2. CONTRIBUTION OF COASTAL FISHERIES IN FISHING INDUSTRY FROM 2001-2006

Activity	Quantity ('000 tonnes)					
	2001	2002	2003	2004	2005	2006
Coastal fisheries	1063.4	1083.3	1084.8	1060.2	988.3	1128.4
Offshore fisheries	167.9	190.7	198.4	271.5	221.3	251.3
Sub-total	1232.3	1272.1	1283.3	1331.6	1209.6	1379.7
Value (RM '000)	4169	4207	4014	4 272	4 018	4939.3

Further expansion of the capture fisheries would need to come from offshore sub-sector, namely the South China Sea. It has been estimated that the potential yield from the offshore areas is slightly over 400 000 tonnes. With the present landings of 251 300 tonnes, the scope for increased yield is quite limited.

In 2006, there were a total of 38 276 licensed fishing vessels in the country, out of which about 7854 are commercial fishing vessels (trawlers and purse seiners) and more than 70% are traditional vessels operating traditional fishing gears such as drift/gill nets, hooks and lines, stationary traps, portable traps, bag nets, barrier nets and other minor fishing gears.

Among the various fishing gears used, trawlers are the most efficient fishing gear, amounting to about 56% of the total marine catches and followed by purse seiners, with a share of 22%. Despite greater number of traditional fishing vessels, only 18% of the landings were taken up by these vessels operating mostly drift/gill nets (10%) and the remaining catches taken by vessels operating hooks and lines, bag nets and other miscellaneous fishing gears. The inland fisheries contributed an insignificant production of 4 100 tonnes in 2004. There is probably not much scope for further expansion.

In 2006, total number of people involved fishing industry is about 118 047 of which 82% involved in capture fisheries (97 947) and the remaining in aquaculture (20 100).

Recreational fishing has been practised for decades or possibly century in the country, both in the inland water bodies and out in the open sea. Lately a significant number of aquaculture ponds, both brackish and freshwater, have also been converted into angling ponds. The European Tackle Traders Association estimated that the value of angling and related expenditure in Malaysia in 2000 at around USD54 million. Arguably, this figure must have increased significantly with the growth in the number of local anglers over the past few years and the increase in foreign anglers visiting our shores.

AQUACULTURE INDUSTRIES IN MALAYSIA

Following the impact after 1997 world financial crisis, Malaysia fast made a revised on its agricultural food production to ensure the sector's contribution to the national economy. Its global competitiveness continuously remains strong. As a testimony of the Malaysian government's commitment, the Third National agricultural policy (NAP3) and its action plans was formulated and endorsed in the year 1998. Within, the potential and importance of fisheries as food security commodity and potential foreign exchange earning was highlighted and given a significant task to balance out food import bill (BOT) which was long time indicated a deficit. The increase in production and contribution was set to be from aquaculture sector which is currently is not fully utilized. Government will capitalize the vast production area which is still available and not the least to employ improves biotechnology which enables high productivity yet with environmentally friendly approach. The target was set at 662 000 tonnes to be achieved by and beyond 2010. The main commodity singled out from aquaculture food production are marine shrimp (180 000 tonnes), marine fish (122 000 tonnes), freshwater fish (230 000 tonnes), cockle (130 000 tonnes) and sea weed (125 000 tonnes). In a move to get closer to the production target and to boost the image as a producer of quality aquaculture products the government introduced best aquaculture practices management and food safety programs.

Similar to other nations in the regions fish and fish based products are importance daily diet of people in Malaysia. Majority still depend on fish as the main source of animal protein. Malaysian has put more preference on marine fish rather than freshwater fish for the reason of taste despite a much lower market price of the later fish. This particular demand may be justified by the fact that Malaysia is surrounded by sea. Apparently, there is very little natural productive area for freshwater fish production in the country. It is notable to note that being a cheap source of animal protein and has access to the commodity, an average Malaysian takes more fish than other animal protein. Though there was no statistical data to indicate passed consumption rate but record for 2000 indicated that an average per capita consumption was 49 kg/capital. This was further recorded an increased to 53 kg/capital in 2005 and expected to rise to 56 kg/capital in 2010. For such consumption rate definitely will put Malaysia as among the country with highest fish consumption in the world.

The important of fish as food is further reflected in expenditure of the household. On average this was about 20% of their food budget (8th Malaysia plan). With the increase in number of population of the country and increase in health consciousness among the people, apparently current local production will not be able to meet the goal of self sufficiency within these coming years. Basically, the self sufficiency was only 89% in 2000 and slightly increased to 90% in 2005 and expected to increase slightly to 94% in 2010.

Malaysian aquaculture production in 2006 was 212 026 tonnes including seaweed and the sector has long been identified as having the most potential for further development.

Among various culture systems, culture of cockle on coastal mudflats of west coast Peninsular Malaysia has traditionally been the most dominant, with cockle landings amounting to 32% of total aquaculture production. This is followed by freshwater pond culture, 20%; brackish water pond culture, 16%; long-line culture of seaweed, 15% and several other minor culture systems including marine cage culture of fish, raft culture of mussel and oyster, mining pool culture of freshwater fishes, freshwater cage culture, and tank culture of freshwater fishes, in that order.

Eventhough, the production of brackish water pond comes out third in terms of volume but it has always been a way ahead of other culture systems in terms of economic value as a result of higher prices of marine shrimp produced. A significant portion of the shrimp is being exported. The long-line culture of seaweed, practised only in Sabah, has been rapidly gaining importance lately. Its production used to be negligible in the past several decades.

BIODIVERSITY IN AQUACULTURE AND FISHERIES DEVELOPMENT

In term of productivity, genetic diversity within domesticated species have been improving aquaculture production and provide food and other products to the diverse natural populations. High production levels are sustained through maximizing the beneficial impact of biodiversity for aquaculture. A diverse range of organisms contributes to the resilience of aquaculture, fishery and natural biodiversity, their capacity to recover from environmental stress and their ability to evolve. Informed adaptive management of agricultural and natural biodiversity, above and below ground and under water secures sustained production.

Sustainable aquaculture and fishery have effects on biodiversity. Small-scale aquaculture projects and traditional fisheries can acknowledge and identify promising new species or help quantify the value of native biodiversity. This can be achieved by:

(a) Closed culture ensures better containment of cultured organisms to prevent escape of the organism

(b) Sterilization can easily induced way of avoiding direct genetic effects

(c) Localization i.e. by locating farms away from wild populations and choosing locations for sea ranching that minimize straying so as to reduce gene flow to wild populations

(d) Coastal parks and marine protected areas by providing totally protected areas for valuable wild populations

(e) Reduced or selective fishing: protecting native populations by reducing fishing pressure or by directing that pressure toward cultured fish

(f) Restrictions on transport: reducing the spread of exotic genes and diseases by restricting transport or live fish and eggs

(g) Gene banks: counteracting extinction of local populations by the establishment of gene banks

(h) Minimal genetic differences from native populations: reducing effects of gene flow by minimizing the genetic differences between escaping or released fish and recipient wild populations; and

(i) Capacity building: basic training of aqua-culture workers (including non-specialists) to minimize the risk of accidental releases of organisms into aquatic ecosystems.

ISSUES AND CHALLENGES

Biodiversity is affected by changes in ecosystems, populations of species and genetic changes and comprises much of the renewable natural capital on which livelihoods and development are grounded. However, ongoing, and in many cases, accelerating declines and losses in biodiversity over the past years have decreased the capacity of many ecosystems to provide services, and have had profound negative impacts on opportunities for sustainable development around the planet. These impacts are particularly pronounced in developing countries, in large part due to the patterns of consumption and trade in industrial world, which themselves are not sustainable.

Aquaculture should be managed to avoid impacts upon biodiversity. Chief amongst these are habitat loss due to conversion of wetlands into aquaculture operations, and the widespread introduction of exotic species and native strains/varieties that result in direct loss of genetic diversity. Effective remedies for the latter include the application of codes of practice for use in pre-introduction assessments.

Most aquaculture produces comes from about 200 species. Aquatic biodiversity is being lost at alarming rates in natural systems, especially inland waters. The vast majority of this decline has been caused by pollution, human-induced structural changes in aquatic habitats, and the release of introduced species. These losses will constrain efforts to evaluate the aquaculture potential of aquatic organisms. It is already becoming difficult for fish breeders to locate and collect genetic materials from healthy or relatively undisturbed wild populations.

Geography is the main reason why marine and freshwater organisms look and act different. Marine environments are 'open,' with few barriers, while freshwater systems are 'captive,' so animals cannot escape habitat disturbances. Thus, freshwater populations are smaller and more vulnerable than marine ones. While freshwater and marine ecosystems face similar threats, there are some differences regarding the severity of each threat. Runoff from agricultural and urban areas, the invasion of exotic species, and the creation of dams and water diversion have been identified as the greatest challenges to freshwater environments (Allan & Flecker 1993; *Scientific American* 1997). Overfishing is the greatest threat to marine environments, thus the need for sustainable fisheries has been identified by the Environmental Defence Fund as the key priority in preserving marine biodiversity.

Other threats to aquatic biodiversity include urban development and resource-based industries, such as mining and forestry that destroy or reduce natural habitats. In addition, air and water pollution, sedimentation and erosion, and climate change also pose threats to aquatic biodiversity.

Aquaculture relies on biodiversity, affects biodiversity and causes considerable controversy by its environmental effects. Aquaculture productivity depends on a wide diversity of other aquatic organisms for food and for maintenance of water quality. In turn, it can have adverse impacts on the diversity of natural populations of aquatic organisms and the structure of ecosystems through the release of farmed organisms or conversion of one habitat to something else.

While it can be a beneficial process, certain types of aquaculture can also contribute to the degradation of natural environments. For example, it can contribute to the accidental release of non-native species, habitat conversion, pollution, as well as actually eliminate more fish than is being produced. In addition, the food supplies of other aquatic organisms including seabirds can be depleted through the amount of schooling fish used to make fishmeal for aquaculture production. For example, in the aquaculture industry, fish faeces and uneaten fish feed can also contribute to pollution.

Human activities are causing species to disappear at an alarming rate. Aquatic species are at a higher risk of extinction than mammals and birds. Losses of this magnitude impact the entire ecosystem, depriving valuable resources used to provide food, medicines, and industrial materials to human beings.

In order to control fish disease during the process of aquaculture, the use of antibiotics in fish feeds has increased. Antibiotics may leave residual traces in uneaten feed and fish faeces, which can become trapped in sediments in the marine environment, potentially leading to toxic conditions for some species. Antibiotic used in aquaculture also lead to the development of bacteria, which is antibiotic-resistant.

As well as conserving diversity at the level of species, we also need to cherish the genetic diversity that occurs within them. Modern agricultural techniques, including aquaculture, have led to an excessive dependence on a few miracle strains of even fewer plants and animals. Meanwhile the wild relatives of these strains are often lost when natural habitat is converted for other uses. Without a large natural genetic reservoir, we make our food supplies vulnerable to disease.

Introduced species may have environmental as well as social and economic impacts. Aquatic ecosystems may be affected by the introduced species through predation, competition, mixing of exotic genes, habitat modification and the introduction of pathogens. Human communities may also be impacted through change in fishing patterns due to a newly-established fishery or through changes in land use and resource access when high valued species are introduced into an area.

The practice of using species outside their natural range to increase production or profitability can be expected to continue. The issue is not to ban alien species — or to abandon regulation of their movement — but rather to assess associated risks and benefits and then, if appropriate, develop and implement a plan for their responsible use. One mechanism to assist in the responsible use of introduced species is the development of codes of practice has been developed by the International Council for the Exploration of the Sea and the European Inland Fishery Advisory Commission.

DISCUSSION

Being a sector that traditionally supplies food and continuously contribute to the national economic, aquaculture potential was lately given a special attention by government of Malaysia. The strategy and action plan to develop the sector was clearly spelled out in the Third National Agricultural Policy (NAP3 1998-2010), a long term plan for agricultural development. A volume of 600 000 metric tons was set for aquaculture sector to deliver by year 2010.

Being at pioneer stage the marine finfish industry can learn a lot from story of success and failure in shrimp industry. Foremost, seed should be of high quality and if possible an SPF standard. To pursue, domestication and selective breeding programme should be in the list. Come along with the set is a biosecurity system. On the development aspect, specific species should be focused to develop into a food industry. Indirectly, it means one cannot rely much on live fish market. Frozen fish market should be the main agenda and diversify the market through value added and varieties to increase intake by local consumer. On set to that land based production system be it in pond or tank should be a mean of production in future as environmental may no longer permit waterway to use for cage operation.

A report from *Nature* magazine also explains that genetic diversity helps to prevent the chances of extinction in the wild (and claims to have shown proof of this). To prevent the well known and well documented problems of genetic defects caused by in-breeding, species need a variety of genes to ensure successful survival. Without this, the chances of extinction increases. And as we start destroying, reducing and isolating habitats, the chances for interaction from species with a large gene pool decreases.

Biodiversity factors including overexploitation of species, the introduction of exotic species, pollution from urban, industrial, and agricultural areas, as well as habitat loss and alteration through damming and water diversion all contribute to the declining levels of aquatic biodiversity in both freshwater and marine environments. As a result, valuable aquatic resources are becoming increasingly susceptible to both natural and artificial environmental changes. Thus, conservation strategies to protect and conserve aquatic biodiversity are necessary to maintain the balance of nature and support the availability of resources for future generations.

CONCLUSION

A healthy biodiversity can definitely contribute to aquaculture and fisheries development through the provision of:

1. Natural services such as protection of water resources, nutrient storage and recycling, pollution breakdown and absorption, contribution to climate stability, maintenance of ecosystems and recovery from unpredictable events.
2. Biological resources, such as food, medicinal resources and pharmaceutical drug, breeding stocks, population reservoirs, future resources and diversity in genes, species and ecosystems

As we erode ecosystems and reduce biodiversity, based on the above list of things we start to lose, the cost of replacing these (if possible) would be extremely expensive. It is therefore very necessary for any development to proceed towards sustainability of resources.

REFERENCES

Coates, D *et al*. 2003 'Biodiversity and fisheries in the Mekong River Basin', *Mekong Development Series No. 2*, Mekong River Commission, Phnom Penh.

Harvey, B & Baer, A 2003, *Conservation and sustainable use of agricultural biodiversity: a sourcebook*.

World Fisheries Trust 2002, *Sustainable Use of Aquatic Biodiversity: Key Issues and Opportunities for IDRC*

Biodiversity Conservation in Oil Palm Industry — A Case Study in Carey Island

Y. N. SITI, H. KHAIRUDIN AND S. S. WAN MOHD
Sime Darby Plantation Sdn Bhd

Abstract

Carey Island intrigues the present generation by its unusual name which requires unravelling. Carey Island itself comprises several types of ecosystems which made it so unique until the time when it was known as Golden Heritage for its valuable ecosystem especially mangroves. Mostly the land is already converted to plantation since the early 1920's. Since then, major conversion had taken place and bigger estates were being open up and managed by Sime Darby Plantation. Significant studies show that actually it has direct major impact to the quantum of biodiversity in the whole area. Recently, biodiversity conservation in oil palm has frequently being debated and argued in order to maintain the sustainability on how it should be managed. The issue of conservation is now the first priority, significantly versus the economical growth in the other hand. Thus, this paper is to discuss several elements that had been implemented so far by the management of Sime Darby by taking example upon the establishment of a few management plans in Carey Island for the case study.

Carey Island is named after the late Edward Valentine Carey (1865 – 1914) who was believed to be the founder of the island. Carey Island is situated on the south of Port Klang, separated from the mainland by Klang River, connected by a bridge from Chodoi near Banting. It is a very huge island, with total area of 16 000 ha and 11 700 ha of the area are belongs to the Sime Darby Plantation. It is an initial settlement area for the Mah Meri who is one of the aborigine tribes of Malaysia and the island is now largely planted with oil palm.

The island is most obviously a plantation island but there are still other uses that form very significant components of the overall land use of the island.

TABLE 1. CURRENT LAND USED COMPONENTS

Current land use of the Island	Ha
Area planted with oil palm	10 521.84
Forest Reserves (mainly mangroves)	1876.85
Land parcel granted to the company	82.35
Concession held by Yayasan Selangor	1583.61
State land	1340.72
Prawn breeding concession	103.52
Area under *Orang Asli* Settlement	532.11
Area under other settlements (Malay and Indian villages)	146.45
Total	16 187.45

Source: *Carey Island A Golden Heritage (Reviving History, Preserving Legacy)-Published by Golden Hope Plantations Berhad 2006.*

Carey Island itself is very unique comprises a variety of ecosystem that is essential to the sustainability and conservation of its diversity. The island is mostly rounded by a large area of mangroves which is the most important elements of biodiversity. Mangroves generally are valuable ecosystems to Carey Island — they act as nurseries and feeding grounds for many fish and crustaceans and non-resident fish enter the mangroves to feed at high tide. Besides that, there are many flora and fauna to be found in this island. The existing of several groups of ecosystems had actually established naturally several number of species population.

BIODIVERSITY AND CONSERVATION

Conservation Biology

Conservation biology is a mission-oriented science that focuses on how to protect and restore biodiversity, or the diversity of life on Earth. Like medical research, conservation biology deals with issues where quick action is critical and the consequences of failure are great. To preserve biodiversity, scientists must answer three general questions. First, how is the diversity of life distributed around the planet? Second, what threats does this diversity face? Third, what can people do to reduce or eliminate these threats and, when possible, restore biological diversity and ecosystem health? When these questions answered, then the practices of conserving biodiversity would be able to be done.

Why is Biodiversity Valuable?

Most conservation biologists recognize that biodiversity is valuable in two ways:

- Biodiversity has **utilitarian value** because it benefits people directly and maintains interactions between the living and non-living parts of the environment. For example, biodiversity has provided plants for crops that feed billions of people, as well as decomposing organisms (such as bacteria and fungi) that release nutrients from organic material into soil and water.
- Biodiversity also has **inherent value** to many people. In other words, it has worth beyond the goods and services it provides humans and ecosystems.

Biodiversity Concerns in Oil Palm

Salleh and Ng (1983) are concerned about the biodiversity in Malaysian plantations due to its simplistic form which create environments very different from natural forests. In this case Carey Island is one of them. They indicated that plantation crops lack a multi-layered structure and low in biodiversity. The dominant crop is usually uniform in size, distribution and of narrow genetic base. Plantation management practices are also said to discourage biodiversity because of deliberate eradication of so-called weeds and pests, which are actually nature's attempt to add variety. Henson (1994) said that the mixed Dipterocarp forests of Sarawak contained at least 225 different tree species while Platterborze (1970) stated that there are only 6 species of plants growing under cultivated pine forest.

Biodiversity study in Carey Island. In September 2004, both the Universiti Malaya and Sime Darby Plantation formed a collaborative relationship for specially addressing research and development that could be undertaken with reference to conservation and development of biodiversity and natural resources on Carey Island. The collaboration had begun naturally, with an interest in what features on Carey Island may be pertinent to address in conservation terms, or which could become the basis for significant, even innovative, conservation approaches.

There are five areas of studies that were conducted and to be conducted for future development. The studies are:

- Floristic survey of Carey Island — this includes all the plants and trees found in the designated areas along the coastal line, surrounding the oil palm and fresh water sources, in some identified forested areas and in swampy areas
- Biodiversity survey and conservation management of fauna of Carey Island – this includes all the general inventory of birds, small mammals, fruitflies, butterflies, dragonflies and mudskippers, which are components most visibly dependent on the presence of vegetation incorporating sufficient diversity and structural variables (niches), and in themselves a barometer for ecosystem complexity and health

- Ecological and physiological studies on the Mud Lobster – this project provide an understanding of the influence of bund characteristics on the Mud Lobster population
- Regeneration and mass propagation of the *Nyireh Batu* (*Xylocarpus*); and
- The effects of POME on germination and early growth of selected plants; to sustain and enhance the growth of any plants by testing it to existing crop mainly oil palm.

The initial results of the study were presented in the seminar on 'Biodiversity Conservation through Sustainable Plantation Practices on Carey Island' held in November 2006 as follows:

- Avifauna – 65 species, 44 are residence and others are migratory
- Butterflies – 41 species
- Dragonflies – 26 species
- Flora – 52 species
- Phytoplankton – 195 species
- Mushroom – 51 species.

As to date, more findings had been recorded such as:

- Phytoplankton — 2 new species of diatom and 2 species of algae are added to the present list. Another study had indicated that the two algae, *Spirogyra* sp. and Oedogonium sp. can be used as raw material in biodiesel production.
- Bird — another eleven species had been added into the checklist (in addition to 65 species namely:
  - Common Snipe (*Gallinago gallinago*)
  - Common Moorhen (*Gallinula chloropus*)
  - Common Kingfisher (*Alcedo atthis*)
  - Rusty Breasted Cuckoo (*Cacomantis sepulcralis*)
  - Mangrove Blue Flycatcher (*Cyornis rufigastra*)
  - Yellow Bittern (*Ixobrychus sinensis*)
  - Asian Brown Flycatcher (*Muscicapa dauurica*)
  - Dark Necked Tailorbird (*Orthotomus atrogularis*)
  - Great Tit (*Parus major*)
  - Streak-breasted Woodpecker (*Picus viridanus*)
  - Olive-winged Bulbul (*Pycnonotus plumosus*)

- Mud Lobster — the study shown that mud lobster derived their nutrition mainly from the mangrove sources (as well as phytoplankton); and
- Nyireh Bunga — the data on reproductive biology of Nyireh Bunga is now available to facilitate the reforestation programme.

From the above account, it is evident that biodiversity does exist in an oil palm plantations contrary to the conventional preconceived notions of mono-crop planting. It can be a significant harbour of wildlife and plants that are rare, endangered or of scientific, heritage or ethno botanical interest.

CONSERVATION AND ENHANCEMENT OF BIODIVERSITY

Notwithstanding the inherent biodiversity of the oil palm environment, Sime Darby strives to encourage biodiversity in its plantations through the following conservation and enhancement activities;

Conservation

Zero burning — replanting technique. Zero burning replanting is a practical and environmentally sound technique that has been adopted and implemented by Sime Darby since 1989. This is the best option to the previous burning practices and is suitable for converting other crops such as cocoa, rubber and coconut into oil palm cultivation. The zero burning replanting technique is a practice in which the old and uneconomical stands of oil palm and other tree crops are felled and shredded and left to decompose *in situ*. This technique also allows all plant tissues to be recycled, enhancing soil organic matter. This will invariably help to restore and improve soil fertility. The biomass of the palm residue through the decomposition recycles nutrients into the soil and reduces the input of inorganic fertilizers. The return of organic matter also improves the physical and chemical properties of the soil. In contrast with the clean-clearing method where the old stands are burned, the zero burning technique allows replanting to be done without violating the *Environmental Quality (Clean Air) Regulations 1978*. Besides non-polluting, it also contributes positively towards efforts in minimizing global warming. In the case of replanting, Carey Island has shown out that all the works has been conducted with zero burning technique.

Maintenance of green belt area. The areas of wetland and swamps which are considered marginal for oil palm planting are kept untouched. The maintenance of natural vegetation riparian border along rivers helped to reduced siltation of rivers and also acts as wildlife refuge and corridors.

Agricultural practices — soil enhancement. Good agricultural practices are been adopted within each of the aforementioned methods to enhance agro-biodiversity in Carey Island. The planting of

leguminoceae cover crops with improved nitrogen fixation through rhizobium associations is a simple yet effective method of biodiversity enhancement. Besides this, mycorrhizal associations are known to play a very important role in the ecology and nutrition of forest trees (Appanah and Weinland, 1993). Hence, the wider use of mycorrhizal fungi, in particular the cosmopolitan and non-host specific Endogonaceous fungi species (Mosse 1973), in Malaysian plantation agriculture should be encouraged.

Integrated pest management. Integrated pest management (IPM) is essentially the utilisation of all suitable techniques and methods of pest control in a compatible manner as possible to suppress past levels to below those causing economic injury. Components of IPM encompass cultural, physical, chemical and biocontrol methods. By this method, over-dependence on any one method, e.g., the use of pesticides is avoided, leading to control being more sustainable and this also added to the biodiversity in the plantation.

Control of Oryctes rhinoceros

Oryctes rhinoceros, is indicated in the section on zero burning, as a severe pest in such replants. A combination of fore described cultural, chemical and biological control is now being used in an integrated manner to successfully manage outbreaks of the pest in Carey Island and were applied throughout the country.

Bagworms and Nettle caterpillars

Bagworms and Nettle caterpillars are opportunistic pests that can devastate large areas of oil palm if not detected and treated early. Thus, the entomopathogenic fungi like Cordyceps, non-occluded spherical and granulosis viruses and predatory pentatomid bugs have been used to successfully control outbreaks of nettle caterpillars (Ho & Teh, 1997).

Rat control

Notwithstanding initial disagreements by the oil palm industry over the usefulness of the barn owl Tyto alba for natural control of rats, Ho and Teh (1997) have shown that the raptor is able to provide long-term suppression of rat damage to oil palm below consequential levels without the need for chemical intervention.

Ganoderma *basal stem rot*

The basal stem rot of oil palm caused by *Ganoderma boninense* is the most serious disease of oil palm in Malaysia. Arbuscular mycorrhizal fungi have been indicated to increase productivity of palms infected by the basal stem rot caused by it (Ho 1998).

Enhancement

Four methods of biodiversity conservation in oil palm plantation in Carey Island have been identified. Enhancement of biodiversity conservation in oil palm could begin with a simple act of crop diversification and further to stimulate a climax conditions through the concept of agro-forestry; combining the two elements flora and fauna which includes together in the greeneries aesthetic man-made landscape and the establishing of the bird sanctuary on the island.

Crop diversification. Simple crop diversification, e.g. the planting of more than a monoculture, is often overlooked as the initial step towards increasing biodiversity in agriculture. When viewed from the perspective of agro-biodiversity, crop diversification is expected to increase genetic, species and ecosystem biodiversity, albeit falling far short of that of the climax rainforest.

Agro-forestry. Agro-forestry is a sustainable land management system which combines the production of crops and forest plants and or animals simultaneously or sequentially on the same unit of land and applies management practices that are compatible with the cultural practices of the local population (King & Chandler 1978). For instance, the combining of two elements; crop and forest plants and cows in the same land would be known as agro-silvi-pastural or it would be only silvi-pastural if the crop is absence or only agro-pastural with the absence of forest plants. Mahmud (1997) had provided a comprehensive review of agro-forestry and techniques for its implementation in Malaysian plantation. Agro-forestry especially multi-layered ones are expected to have greater biodiversity than that of monoculture agriculture.

Landscaping. The only venue for the re-establishment of biological species is within the 'open space' areas (i.e. *kawasan lapang)*. Although the diversity of the flora and fauna could never be similar to those previously in the existing environment (i.e. before plantation implementation), nonetheless effort to ensure a masterfully landscaped environment should be placed under priority status. Apart from introducing the landscape plants, the existing suitable vegetation such as the regenerating timber species should be retained at areas not subjected to any plantation materials.

In terms of fauna population, the number of species that are attracted to these modified habitats would be nominal; any greenery that is being planted within the plantation area definitely lends an attractive outlook and provides a comfortable living ambience. The common landscape plants for open areas are: *Allamanda cathartica* (Alamanda), *Bougainvillea* (*Bunga Kertas*), *Caesalpinia pulcherrima* (Peacock Flower), *Calliandra* spp. (Red/Pink Powder Puff), *Coleus* spp. (Hati-hati), *Cordyline* spp. (Jejuang), *Cycas* spp. (Paku gajah), *Ixora javanica* (Ixora), *Hibiscus rosa-sinensis* (*Bunga raya*), *Langerstroemia indica* (Crape Myrtle) *and Licuala grandis* (Fan Palm). There are number of forest tree species which are commonly used as wayside trees. This should be encouraged due to shrinking of natural forest areas especially in Carey Island. Examples of such forest species are: *Hopea odorata* (Merawan Siput Jantan), *Gardenia carinata* (Cempaka Hutan),

Eugenia grandis (Kelat), *Ochanostachys amentacea* (Petaling), *Sterculia rubiginosa* (Kelumpang), *Dyera costulata* (Jelutong) and *Alstonia* spp. (Pulai).

Bird sanctuary. The establishment of Carey Island Bird Sanctuary is to ensure that the mission to preserve the earth's biological diversity and to secure the future of threatened bird species in their natural environments would be achieved. We work to fulfill that mission through education, captive breeding, field studies and rehabilitation. It might as well act as one of the genetic stocks for other animals rather than only birds. The ecosystem of which mixed plantation, crops, forest plants, landscaping trees and wetland that comes together in a useful package is essential to sustain and to conserve the biodiversity in oil palm plantation in Carey Island.

CONCLUSION

Carey Island is viewed as one of the island which had been transformed into fully agricultural land in recent decades. However, being a plantation area is actually has created a new ecosystem which still owns biodiversity in its own way. The process of conservation would take decades to achieve but the achievements are precious and valuable. Carey Island itself is unique because it is surrounded by mangroves.

Under the definition of species diversity, a ten square mile area of Carey Island contains different species than does a similar sized area in Perhentian Island. In ecosystem diversity, a familiar example is the variety of habitats and environmental parameters that constitute the Carey Island ecosystem: grasslands, mangroves, wetlands, plantation, and horticultures, rivers, and estuaries, fresh and salt water. To date, Carey Island has successfully sustained the existing ecosystem and maintaining it with a sustainable plantation management system in order to conserve the biodiversity which has been discussed above.

REFERENCES

Golden Hope Plantations 2006, Carey Island a golden heritage (reviving history, preserving legacy), Golden Hope Plantations Berhad, Kuala Lumpur.

Vellve, CDR *et al*. 1992, Growing diversity: *genetic resources and local food security*, Intermediate Technology Publications, London.

Jensen, DB, Torn, M & Harte, J 1990, *In our own hands: a strategy for conserving biological diversity in California*.

Gaston, KJ 1996, *Biodiversity. A biology of numbers and difference*, Blackwell Science Ltd, Oxford.

Hension, IE 1994, 'Environmental impacts of oil palm plantations in Malaysia', PORIM Occasional Paper 33: 27.

Ho, CT 1996, *The integrated management of* Oryctes Rhinoceros (L) *populations in the zero burning environment*, in *PORIM International Palm Oil Congress: "Competitiveness for the 21st Century"*, Kuala Lumpur.

Ho, CT 1998, '*Safe and efficient management systems for plantation pests and diseases*', *The Planter*, vol. 74, pp. 369–385.

Khairudin, H *et al*. 2006, '*Biodiversity and oil palm plantations: economic-environment gridlock or peaceful co-existence*', in *International Planters Conference 2006*, Putrajaya (26–28 June 2006).

King, KFS & Chandler MT 1978, *The Wasted lands*. International Council for Research in Agroforestry, Nairobi, Kenya.

Mahmud, AW 1997, 'Agroforestry: *an option for future timber industry',* in *International Planters Conference* '*Plantation Management for the 21st Century*', Incorporated Society of Planters, Kuala Lumpur.

Noss 1990, 'Indicators for monitoring biodiversity: a hierarchial approach', *Conservation Biology,* vol. 4, no. 4, pp. 355–364.

Platterborze, A 1970, 'A soil and vegetation study under a *Pinus carabea* plantation in West Malaysia', *Malaysian Forester*, vol. 23, no. 3, pp. 243–258.

Rosli R *et. al*. 2006, *Birds of Carey Island*, Sime Darby and Universiti Malaya publication, Kuala Lumpur.

Salleh, MN & Ng, FSP 1983, '*Conservation in Malaysia*', *The Planter*, vol. 59, pp. 483–490.

Sime Darby 2004*, Sime Darby sustainable palm oil practices*, Sime Darby, Kuala Lumpur.

Wilson, EO 1992, *The diversity of life*, Allen lane/Penguin Press, London.

World Resources Institute, World Conservation Union, and United Nations Environment Programme 1992, *Global biodiversity strategy*.

Insect Diversity: Their Impact on Enhancing Plant Health and Crop Production

A.S. SAJAP
Faculty of Forestry, University Putra Malaysia,
43400 UPM, Serdang, Malaysia
AND
M.N. HAMID
Strategic Resource Research Centre, MARDI,
P.O. Box 12301, 50774 Kuala Lumpur Malaysia

Abstract

Insects are the most diverse group of animals in the world. Even though they inhabit almost all ecosystems on earth but great majority of these insects can be found in the tropic particularly in the tropical rainforests. These forests provide habitats for thousands species insects and reservoirs for many beneficial species of pollinators, decomposers, parasitoids and predators. Pollination service s are essential for maintenance of flowering plant communities. These services are provided by bees, flies, wasps, butterflies, moths, midges, thrips and beetles. The soils are continuously replenished with nutrients partly by soil inhabiting insects such as Collembola, ants, termites and beetles. These insects decompose plant and animal debris and consequently increase organic content of the soils. Parasitoids and predators provide biological control services to regulate many insect pests. They maintain the diversity of insect species by regulating the population of insects in the forest and agro-ecosystems. The high level diversity of biological control agents which is conserved in the protected forest reserves is available as a potential resource to biological control projects in the pest management systems. The diversity of these agents and beneficial insects, however, is currently under threat as thousands hectares of refuges and forests have fallen in the name of progress and modernization. The loss of these natural resources might hamper our efforts in enhancing plant health and crop production in a manner that is economically and environmentally sound. Thus insect diversity in must be conserved through maintaining protected areas such as forest reserves. These areas serve as reservoirs and refuges for natural enemies and their hosts that are adversely affected by losses of habitats.

Insects are the most diverse group of animals in the world. Even though they inhabit almost all ecosystems on earth but great majority of these insects can be found in the tropic particularly in the tropical rainforests. Tropical rainforests are by far the richest reservoirs of biodiversity. These forests cover just seven percent of the world's land area or represent only one- third of the world forests, but contain at least half of all plant and animal species including insects. Apart from the herbivores, majority of these are beneficial insects as they provide various ecosystem services, such as pollination, nutrient cycling, population regulation etc.

Insect Pollinator Diversity

One of the most significant ecosystem services provided by insects is pollination. Pollination is essential in the survival and maintenance diversity of flowering plants. About two third of these flowering plants are pollinated by insects with cross-pollination activities that broaden genetic bases and prevent the loss of gene pools. Even though many species of insects direct or indirectly involve in pollination, great majority of pollinators are represented by the bees, flies, beetles, butterflies and moths. In the lowland tropical forests pollination is dominated by highly social bees, *Trigona* and *Apis* species and beetles, followed by other bees and flies (Corlett 2004). In the Malaysian lowland forest of Pasoh, the stingless bee, *Trigona* is represented particularly by *T. peninsularis* (Osawa and Tsubaki, 2003) while scarabaeid beetle, *Dasyvalgus* sp. is the most common flower visiting beetle (Fukuyama *et. al.* 2004). However, in some *Shorea* species, thrips evidently are the most abundant pollinators comprising over 95% of the floral visitors (Appanah & Chan 1981). Despite of their weakness in flying, their movements between tree crowns and cross pollination are aided by drifting effects of evening air currents.

Contributions of insect pollinators in crop production are immense. The United State Agriculture Department Authority estimated that the value of increased crop yield and quality achieved by pollination by honey bees alone was USD93 billion and USD14.6 billion in 1989 and 2000, respectively (Morse and Calderone, 2000). Additional annual value of more than USD3 billions was attributed by native bees (Losey & Vaughan, 2006). In Malaysia, the weevil, *Elaeidobius kamerunicus*, introduced into oil palm plantation in Malaysia in 1981, has been proven not only to successfully improve pollination and increase fruit set of the palm oil but eliminated the costly and inefficient process of assisted pollination (Syed *et al*. 1982). The pollination service provided by this beetle saved the oil palm industry US$ 100 million per year.

A study conducted in Indonesia shows that coffee yields depend on forests inhabited by pollinating bees (Olschewski *et al.* 2006). The yield yields, fruit sets and berry weight, decreased with the increased in the distance from the forest where the bees were nesting. An estimated reduction of total net revenue in the adjacent coffee plantation from USD 16 347 to USD 15 214 would be incurred if deforestation to occur in the 32 ha forest, 100 m from the coffee area. The average value of pollination service provide by 32 ha of forest margin was USD35/ha.

Even though, species of insect pollinators and their contributions to crop productions other than oil palm have yet to be recorded and quantified, but the insect pollinators are there performing their natural functions. Their functions must neither be neglected nor taken for granted because there are evidences showing the declining pollinator abundances occur in human-dominated landscapes. In USA, beekeepers are losing their bee colonies, while in Europe it was found that significant decline in pollinator diversity since 1980s (Beismeijer *et al.* 2006).

The use of pesticides has had one of the greatest negative effects on pollinator populations. These chemicals can lead to unintentional poisonings and to destruction of pollinator food sources. There is evidence that other factors also contribute to the disappearance of some pollinators, among them habitat destruction or fragmentation, parasitic mites and pathogens. As exemplified by solitary and stingless bees, these bees require dead wood or in tree holes in forest habitat for their nesting. Thus indiscriminate destruction of forests can hamper their population dynamics.

Parasitoid and Predator Diversity

Parasitoids and predator are key factors in insect population regulation. They regulate many insect herbivore populations. In stable communities, such as the primary forests, action of all of with combination of all environmental factors maintains oscillation of population of any particular insect species within certain so-called naturally established tolerable limits. This equilibrium oscillation, however, can be disrupted with extreme ecological changes occurring in the forests. They were unable to adapt to the altered environment due to habitat destruction.

Parasitoids are primarily represented by parasitic Hymenoptera. They are common and abundant in all terrestrial ecosystems especially in the forest ecosystems. Their abundance and diversity, however, may vary with the type habitats they inhabit. For example, the abundance and diversity of ichneumonid wasps are significantly different among the chosen habitats (Idris 2000; Idris & Hanidah 2003). The number of species was significantly higher in the primary forest reserve than in other habitat types. A total of 617 individuals from 32 species were recorded from this primary forest. In another study, Idris *et al*. (2003) recorded a total of 953 braconid individuals comprising 19 subfamilies and 91 species (morphospecies) from three logged over forest reserves with varying level of recovery.

Large number of predator species combined with their ability to regulate the population size of their hosts, enable them to maintain ecological balance and diversity of other organisms. Parasitic hymenopterans, for example, play an important role in regulating populations of herbivores or seed feeding insects. Seed of dipterocarps are often attacked by weevils, *Alcidoses* spp.and *Nanophyses* spp. Parasitoids, like *Glypta* sp. (Ichneumonidae) and *Ascogaster* spp. (Braconidae) were recorded to be parasitizing these weevils. Natural stands of *Palaquium*, for example, are often defoliated by semi-looper caterpillar, *Achea janata* (Noctuidae) and two parasitoids, *Microplitis maculipennis* (Braconidae) and *Tachina sorbens* (Tachinidae) were found be associated with the caterpillar. This is an example where key mortality factors prevent resurgence or outbreaks of herbivore species that would out-compete other species and consequently maintain high species diversity of herbivores (La Salle & Gauld, 1992).

Some species like *Xanthopimpla*, an ichneunomid wasp, however, thrive better in a new regenerating forest. Idris *et al*. (2003) recorded that the abundance and diversity of this genus was relatively higher in the forests logged five years ago than in the forests that had been logged 26

years ago. One of the reasons suggested was that regenerating forests support more vegetation like herbs, shrubs and saplings than the old forest stands. The vegetation supposedly provides an abundant food source for both the parasitoids and their host species. A relatively diverse species of *Xanthopimpla* recorded from UKM Forest Reserve, a small isolated forest reserve, indicates that this forest serves as a refuge for many *Xanthopimpla* species, as this forest is surrounded by developing urban areas. In addition to this, *Xanthopimpla gampsura* is the only species found in disturbed forest while *X. minuta minuta* is found undisturbed forest habitats. Thus these species could be also used as a biological indicator of habitat disturbance.

Predator is another group of beneficial insect associates with forest and agriculture ecosystem. Predators are free living individuals comprising of insects such as lacewings, preying mantis, beetles, ants and syrphid files. They are generalist in their feeding habit and they tolerate a broad habitat. Ants, for example, are the most diverse and abundant predatory insects in the floor of tropical forests (Sajap *et al*. 1999; Haneda, *et al*. 2006). They forage particularly on small arthropods in the forest floor and canopies. Ant species such as *Crematogaster* spp. *Camponotus* spp. *Myrmecaria* spp. and *Oecophylla* sp. are capable of colonizing plants. They can survive on alternate sources of food and are also aggressive predators of many insects.

Apart from ants, there are other predacious insects that play an important role in the complex forest ecosystems. One of which is the lacewing, *Glenochrysa* sp. (Neuroptera: Chrysopidae). This relatively unknown lacewing primarily lives in natural forests and predominantly forages within 5 to 10 m above ground under the forest canopy (Sajap *et al*. 1997). Its abundance varies with the stages of forest recovery after logging (Henada, *et al*. 2007). Many more predators in the forests with potential benefits have yet to be recorded. Efforts are therefore needed to evaluate the roles of these predators in different ecosystems so that they can be effectively utilized in the management of insect pests.

Insect pests of industrial plantation crops and timber species are regulated by a number of natural enemies. The bagworms in oil palm plantations are preyed and parasitized by many predators and parasitoids. *Metisa plana*, for example, is parasitized by at least three hymenopteran parasitoids (Basri *et al*. 1995). A complex species of predators and parasitoids have also been associated with slug and nettle caterpillars. Despite of their association with the pests their activity was unable to suppress the pest population to below their economic threshold levels. This led to frequent bagworms and nettle caterpillars outbreaks in oil palm plantations. *Acacia mangium,* an exotic timber species selected for forest plantation, was defoliated by two species of noctuids, *Spirama retorta* and *Ericeia subcinerea*.. These noctuid pests attacked an area of 800 ha of young *A. mangium* plantation in Perak. These pests were not even recorded to exist in the country before their outbreaks. Fortunately, the population of the noctuid was kept under controlled by the action of tachinids, *Blepharella*, *Carcelia* and *Exorista* (Sajap *et al*. 1997).

A complex insect pests and natural enemies association occurs in agro-ecosystems. Different types of crops planted in a particularly area allow the existence of multiple species of insects. Many of these insects could increase to destructive levels and become pests. In many cases, unknowingly, natural enemies prevent insects in this ecosystem becoming pests because they keep them check most of the time. The diamondback moth*, Plutella xylostella,* a serious pest of crucifers, is not lacking of its parasitoids. However, its indigenous parasitoids, *Diadegma insulare* and *Cotesia plutellae* fail to keep the pest below its economic threshold because of anthropogenic disturbances (Rowell et. al 2005). Excessive and continuous applications of conventional insecticides had not only build resistance but disrupted the regulatory impact of the parasitoids on the pest population. Effectiveness of these parasitoids could be restored through an integrated pest management (IPM) approach. Through IPM, natural control should be maximized, enhanced and relied upon whenever possible.

In-situ Conservation of Natural Enemies

Conservation and habitat manipulation. The effectiveness of natural enemies in maintaining the pest population can be enhanced through conservation and habitat manipulation. Natural enemies can be conserved through reducing the effects of pesticides of them. Their numbers and activity can be improved through the provision of food, often nectar and pollen sources, permanent habitats or refuges, and alternate prey or hosts. One of the practices in providing these resources is through manipulating vegetation diversity of the ecosystem. This practice has been adopted in oil palm plantation where nectariferous plants like *Euphorbia heterophylla*, *Cassia cobanensis*, *Antigonon leptopus* and *Turnera subulata*, are being planted to attract beneficial insects, particularly parasitoids. These parasitoids feed on nectar and extrafloral secretions and parasitize phytophagous insect pests such as bagworms and nettle caterpillars.

In the absence of effective natural enemies, ant species have been selected and their populations manipulated for controlling certain pests. As an example the black cocoa ant, *Dolichoderus thoracicus* has been used effectively for controlling cocoa pod borer, *Conopomorpha cramerella,* and cocoa mirid, *Helopeltis theivora*. These aggressive ants deter the mirid and the pod borer from visiting developing pods. The ants forage on mealy bugs, *Cataenococcus hispidus* that are common on the peduncle of the cocoa pod and the pod itself, as well as on the stems. The mealybugs, provide honey dew to the ants and in return the ants offer protection on the mealy bug from its natural enemies (See & Khoo 1996). Lim (2007) has shown that weaver ant, *Oecophylla smaragdina* , is capable of reducing damage by mahogany shoot borer, *Hypsipyla robusta* on *Khaya ivorensi* mahogany. She recommends that inter-planting *Morinda citrifolia* (L.) with mahogany and providing food supplements could enhance the introduction and establishment of weaver ant colonies for control of the mahogany shoot borer.

Forest reserve conservation: The role of natural forest reserves as reservoirs for many species of beneficial arthropod may not be replaced by other forest or agricultural establishments. Even though, establishment of agricultural or plantation forests to a certain extent relieves some economic pressure on the society, but the process of converting the natural forests to plantations could lead to the desolation of many flora and fauna. During the conversion, forest vegetation is slashed and burnt. The barren land is than planted with crops or fast-growing exotic trees. These operations drastically reduced not only the plant also the animal compositions and communities. The diversity of insects, indicated by Shannon indices, dropped from 5.11 in a natural forest to 2.97 in an *Acacia mangium* plantation (Sajap & Kotulai 2000). They also saw a reduction in the hymenopteran diversity when a natural forest was converted to an *A. mangium* plantation.

The presence of a high level of diversity and abundance of beneficial insects in the Malaysian tropical rainforest can be regarded as having potential value of various ecosystem services in various agroecosystems. These bioresources, according to LaSalle (1993) must be conserved even though their identity, taxonomy and biology of those biological control agents have yet to be studied or known for the reason that the future pest species can not be predicted. Earlier records have shown that many new pests could emerge through changes in agriculture and forestry operations. LaSalle (1993) noted that naturally occurring parasitoids of any known pest are important not only to that pest because parasitoids can switch over from a native pest to a related exotic pest, sometimes with better performance. Thus maintaining ability to control future pests in a manner that is both economically and environmentally sound is one of the strongest reasons for conserving biodiversity (LaSalle 1993). In order to conserve biodiversity, it is essential to adopt several conservation strategies for managing the forests and their life forms, including insects.

CONCLUSION

Although crop pests are sometime seen as threats to crop production and plant health, the beneficial contributions of insects to mankind and their ecosystem services to be overshadowed. Future development initiatives, processes and functions performed by insects, such as pollination, nutrient recycling, population regulation and component of food chain should be taken into consideration. By harnessing these so-called 'naturally free services' crop production and plant health can be enhanced without jeopardizing the environment.

REFERENCES

Appanah, S & Chan, HT 1981, 'Thrips: the pollinators of some dipterocarps', *Malaysian Forester*, vol. 44, pp. 234–252.

Basri, MW, Norman K & Hamdan AB 1995, 'Natural enemies of the bagworm, *Metisa plana* Walker (Lepidoptera: Psychidae) and their impact on host population regulation', *Crop Protection*, 14, pp. 637–645

Biesmeijer, JC *et al*. 2006, 'Parallel declines in pollinators and insect-pollinated plants in Britain and the Netherlands', *Science*, vol. 313, pp. 351–354.

Corlett, RT 2004, 'Flowers visitors and pollination in the Oriental (Indomalayan) region', *Biological Reviews*, vol. 79, pp. 497–532.

Fukuyama, KK, Maeto & Sajap, AS 2003, 'Spatial distribution of flower visiting beetles in Pasoh Forest Reserve and its study technique', in *Pasoh: Ecology of Lowland Rain Forest of Southeast Asia*, eds T Okuda, K Niiyama, SC Thomas & PS Ashton, Spinger-Verlag, Tokyo.

Haneda, NF, Sajap AS & Hussin, MZ 2006, Ant community in logged and primary forests', *Journal of Biological Science*, vol. 6, pp. 45–48

Haneda, NF, Sajap, AS & Idris, AB 2007, 'Abundance of lacewing (*Glynochrysa* sp. Chrysopidae) in forest of various of recovery after logging at Sungai Lalang Forest Reserve, Selangor, Malaysia', *Journal of Entomology*, vol. 4 pp. 346–349.

Idris, AB, 2000, 'A comparative study on the abundance and diversity of ichneumonid wasps (Hymenoptera: Inchneumonidae) in selected forest and non-forest habitats of Peninsular', *Malaysian Journal of Bioscience*, vol. 11, pp. 45–51.

Idris, AB & Hanidah, J 2003, 'Diversity of Ichneumonid wasps in the logged over forests in Langat Basin', *Pakistan Journal of Biological Science*, vol. 3, pp. 259–270.

Idris AB, Hanidah, J, & Gonzaga, AD, & Nur Azura, A 2003, 'Diversity, abundance, species composition of Genus *Xanthopimpla* (Ichneumonidae:Pimplinae) in logged and fragmented forests of Langat Basin in Selangor, Malaysia', *Journal Asia-Pacific Entolomology*, vol. 6, pp. 55–62.

LaSalle, J and Gauld, ID 1992, 'Parasitic Hymenoptera and the biodiversity crisis', *Redia,* vol. 74, pp. 315–334.

LaSalle, J 1993, 'Parasitic Hymenoptera, biological control and biodiversity', in *Hymenoptera and biodiversity*, eds LaSalle & ID Gauld, C.A.B. International, UK.

Lim, GT 2007, 'Enhancing the potential of the weaver ant, *Oecophylla smaragdina* (Hymenoptera: Formicidae) as a biological control agent of the mahogany shoot borer, *Hypsipyla robusta* (Lepidoptera: Pyralidae)', PhD. thesis, Virginia Tech.

Losey, JE & Vaughan, M 2006, 'The Economic value of ecological services provided by insects, *BioScience*, vol. 56, pp. 311–323

Morse, RA & Calderone, NW 2000, 'The value of honey bees as pollinators of U.S. crops in 2000', *Bee Culture*, vol. 128, pp. 1–15

Olschewski, R, Tscharntke, T, Benítez PC, Schwarze S & Klein A 2006, 'Economic evaluation of pollination services comparing coffee landscapes in Ecuador and Indonesia', *Ecology and Society,* vol. 11, pp. 7. <http://www.ecologyandsociety.org/vol11/iss1/art7/>.

Osawa, N & Tsubaki, Y 2003, 'Seasonal variation and community structure of tropical bees in a lowland tropical forest of Peninsular Malaysia: the impact of general flowering, in *Pasoh: Ecology of a Rainforest in South East Asia*, eds T Okuda *et al*., Springer, Tokyo.

Rowell, B, Bunsong, N, Satthaporn, K, Phithamma, S & Doungsa-ard, C 2005, 'Hymenopteran parasitoids of Diamondback moth (Lepidoptera: Ypeunomutidae) in Northern Thailand', *Journal of Economic Entomology*, vol. 98, pp 449–456.

Sajap, AS Maeto, K, Fukuyama, K, Faujan, ABH & Yaacob, AW, '1997. Chrysopidae attraction to floral fragrance chemicals and its vertical distribution in Malaysian lowland tropical forest', *Malaysian Applied Biology*, vol. 26, pp. 75–80.

Sajap, AS, Yaacob, AW & Aidah, M 1997, 'Biology of *Spirama retorta* (Lepidoptera: Noctuidae). A new pest of *Acacia mangium* in Peninsular Malaysia', *Journal Tropical Forest Science,* vol. 10, pp. 167–175.

Sajap, AS, Yaacob, AW & Aidah, M 1997, 'An outbreak of *Ericeia subcinerea* Snellen (Lepidoptera: Noctuidae), new pest of *Acacia mangium*', *MAPPS Newsletter*, vol. 20, pp. 5.

Sajap, AS & Kotulai, JR 2000, 'Diversity of insects in canopies of natural forest and selected forest plantations', *Malaysian Forester*, vol. 63, pp. 32–36.

See, YA & Khoo, KC 1996, 'Influence of *Dolichoderus thoracicus* on cocoa pod damage by *Conopomorpha cramerella* in Malaysia', *Bulletin of Entomological Research*, vol. 86, pp. 467–474.

Syed, RA, Law, IH & Corley, RHV 1982, 'Insect pollination of oil palm: introduction, establishment and pollinating efficiency of *Elaeidobius kamerunicus* in Malaysia', *Planter*, vol. 58, pp. 547–561.

Information System for Agrobiodiversity Collections and Conservation

T. SADI, M.M. RADZALI, N.M. SHUKOR AND, I. SALMA
Strategic Resource Research Centre, MARDI Head Office,
P.O. Box 12301, G.P.O. 57704, Kuala Lumpur
AND
J.M. NAZARI, R.A.R.K. AZAHAM AND K.M.K.T.K. AZAIRY
Spatialworks Sdn. Bhd. 385, Jalan 5/59, Section 5, 46000 Petaling Jaya, Selangor

MARDI Agrobiodiversity Information System, AgrobIS is a database system for the collection and conservation of genetic resources related to agrobiodiversity component; plants arthropods and microbe. Difficulty in tracing accession information, no standardization in data collection, characterization and evaluation and limited access to the data have been identified as major constraints to developing or enhancing genetic materials in crop improvement programme.

AgrobIS was develop as an easy to use application for development of biological resource database. It is a web based application which capable to handle specific characters of each agrobiodiversity resources component to be conserved in our germplasm.

The database offers open-ended features which capable to expend and evolve with progress of ICT and needs in agriculture. The current version of AgrobIS supports multiple collection of different dataset by using object-hierarchical design to enable inter-relational between each of agrobiodiversity component even with different data format (database, pictures and geographical data). AgrobIS data can be view using any standard web browser that support javascript base scripting that complied with ECMA-262 Edition 3 (e.g. Internet Explorer 5.7 and above, Mozilla Firefox 1.7 and above). AgrobIS application have the capabilities to customize the extent of the data such hierarchy and the relation of the data, content definition of each of the dataset, details of the item in the data, security and accessibility of the data for each user.

THE MARDI AGROBIOVERSITY INFORMATION SYSTEM (AGROBIS)

Several meeting and extensive communication among researches involve in conservation of genetic resources in MARDI since the year 2000; agreed to the importance of sharing information of the collection in order to enhance our genetic resource especially those related to agriculture.

During the year, the work mainly focused on evaluation of various soft wares that were suitable for the system. At the initial stage the objective was to, transfer data from catalogs and log books to digital format. Six individual stand alone database systems were developed using Microsoft

Access mainly for rice, indigenous fruits, medicinal plants, indigenous vegetables, arthropods and microbes. The reason for developing the database as individuals was to protect unique characters of each agrobiodiversity group, especially for the plant group. However the system has limited access, besides it is not efficient for multisearch function.

The main constraint in the development of the databased was related to plants accession collected. Each crop plants that we collected and conserved a such, mangifera, durio, bacaurea, solanum, cucurbits, rice, labisia, and zingers have different characters and there is difficulties in putting them together in one database since our collection was considered specialized. Based on IPGRI and AVRDC descriptors, the data and information we collected for each plant accession can be divided into 5 catagories: (1) Passport data — contains basic information of the collection, such as, accession number, collectors name, collection date, cultivar name, donor name and extra; (2) Environment and site — consist of data or information on site where the accession are collected; (3) Management — consist of information on how the collection being manage, duplicated area, preservation techniques and other related information; (4) Characterization — data and information on characters of, vegetative growth, leaf, inflorescence, fruits, and seeds; and (5) Evaluation — data and information of pest status, fruiting times, biochemical contents, cytology characters, molecular makers were included.

Information on passport data, management, environmental and site can be standardized for all crop plants , how ever data in the characterization and evaluation was developed uniquely to each plant genera. AgrobIS was developed to handle this problem, so the database can cater all plant species with multiple accessions. With the development of AgrobIS, we just maintain one data base and it was cost effective.

HOW AgrobIS WORKS?

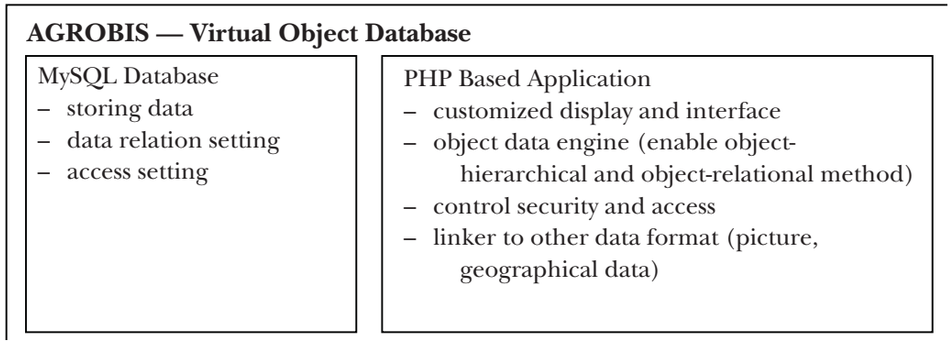
AgrobIS is an innovative technology of handling agrobiodiversity information. It was based on licences free software; MySQL (multithreaded, multi-user SQL database management system) for database development and PHP (computer scripting language, originally designed for producing dynamic web pages.) for the web interface. The AgrobIS applications consist of 2 interface; owner interface and public interface. There are 3 steps involve in owner interface before they can key in their data: (1) Development of the descriptors; (2) Customizing information that they want to share with public; and (3) Keying data.

SYSTEM ARCHITECTURE

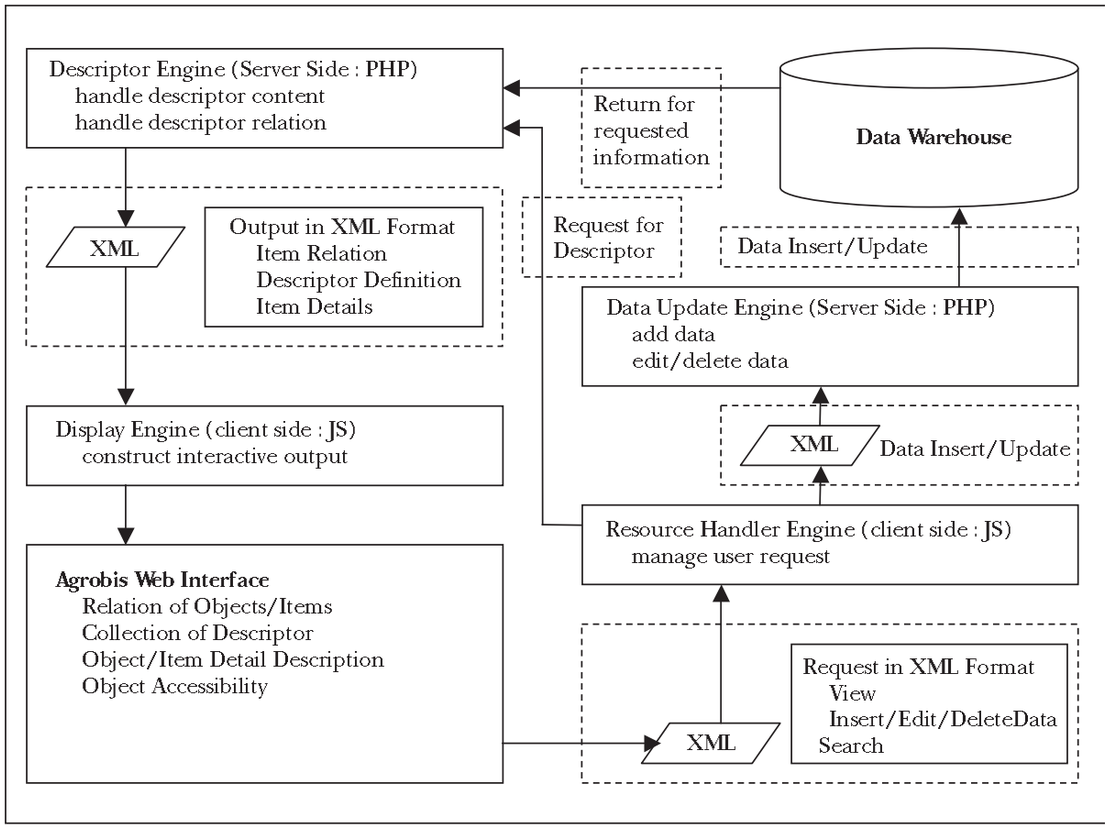
AgrobIS as a Virtual Object Database

AgrobIS is a Web-Based Information System that operates as an open-ended data management for agrobiodiversity information management. It is a customized "virtual **Object Database"** and was

develop using **Object-Relational Mapping** technique by converting data between incompatible type systems in relational databases (MySQL) and object-oriented programming languages.



General System and Data Flow Architecture

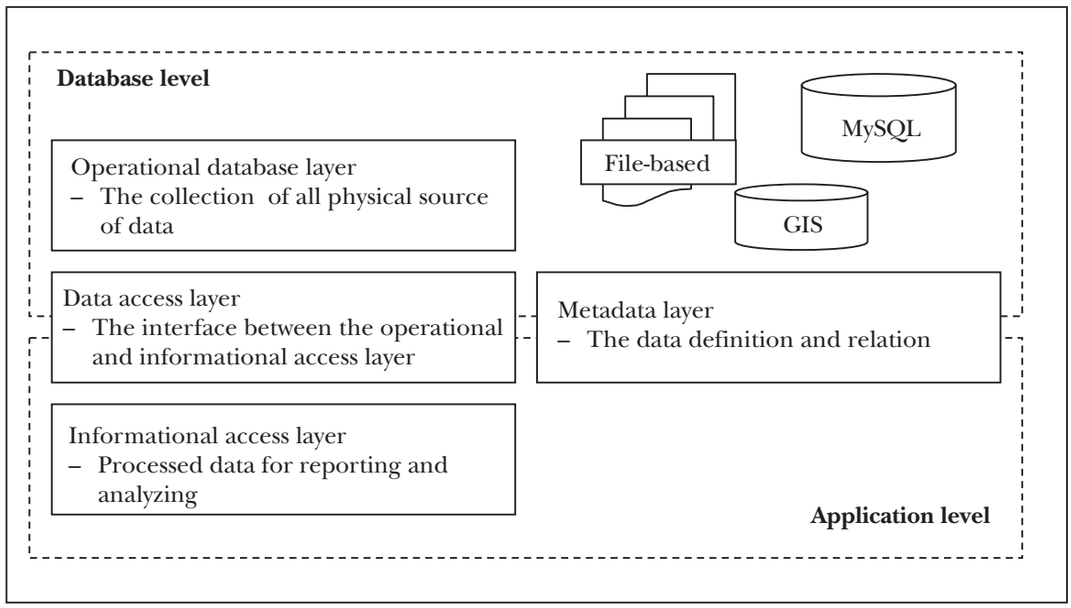


AgrobIS as Data Warehouse

AgrobIS provides a common data model for data, regardless of the data's source. Data warehousing makes it easier to generate report and information analysis as AgrobIS's data type is a combination

of collection of different data structure that relate with file-based information like digital images or document and geographical information system dataset.

Conceptualization of a AgrobIS's data warehouse architecture consists of the following interconnected layers.



Functionality

The AgrobIS system is a web base system which is real time based, fast and user friendly. It contains:

- Data management system for passport, characterization (phenotypic), environment and site were accession were collected, evaluation and management of the accession collected
- Link to geographical information system that can manipulate all data associated with latitude and longitude
- Application for maintaining updates and correct or editing records and tracking changes and updates
- Tools to add other genetic resource groups, descriptors (data field) and new accession; and
- Tools to clone and drag and drop function of cloned descriptors.

Link to National or International Biodiversity Information System

Upon completed AgrobIS were expected to become one of MARDI contributions to the nation, towards information sharing of agrobiodiversity data, via internet to various users, such as students,

government agencies, farmers, taxonomist, conservation biologist, tourist and others. It is also possible to link the database to other national or international database related to biodiversity and become a tool for sharing the treasure of unique data collected from Malaysia.

CONCLUSION

AgrobIS was a comprehensive database for agrobiodiversity information management developed in the nation. Its encourage information sharing of genetic resources, by providing specific information of crop accession that can be potentially used in crop improvement or as a new source of income.

The next challenge of the database is to maintain and improved it paralleled to the advancement of the ICT in the world and in return it will become the source nation of treasure, as it contains valuable information of agrobiodiversity and proved of Malaysia commitment in the Convention of Biodiversity.

The Role of Local Communities in Sustainable Utilization of Protected Wildlife in Sabah

L.N. AMBU, A. TUUGA, AND T.P. MALIM
Sabah Wildlife Department, 5th Floor, Block B, Wisma MUIS,
88100 Sembulan, Kota Kinabalu

Abstract

Local communities everywhere play a very important role in sustainable utilization of variety of wildlife species. Generally, in Sabah local communities have been utilizing wildlife in relation with their traditional way of life. Evidence since the prehistoric time shows that local communities were depended on wildlife resources in order to sustain their living. The fact that tropical forests in Sabah are rich in biodiversity, and therefore the use of wildlife in human culture is widespread. The inter-relationship of wildlife and local communities are so intricate that their social and economic well-being often depends on good management of wildlife and other natural resources. Therefore, issue of local communities in developing good wildlife management practices have always been given due consideration and deliberation. This is essentially true because a sense of ownership of wildlife found within their territories is probably the best incentive for them to invest in the development and protection of biological resources. It must be mentioned that local communities understand that one of the responsibilities bestowed to them by their ancestors is to respect and care for the environment. The Sabah Wildlife Department realized in progressing wildlife management and conservation efforts that local communities are, and will always, part of the ecosystem and therefore they are part of the solution. It is well accepted in many endeavour in managing protected wildlife species that the local communities have demonstrated the value of ecological and technical control, as well as, socio-cultural control of resources. The key to sustainable wildlife utilization by local communities lies within the means of better communication and trust between the government agencies involve in biodiversity conservation and the local communities whereby the traditional adversarial relationship is replaced by a partnership and a shared vision that encompasses both conservation and development.

The concept of collaborative approach to ensure sustainable wildlife utilization is widely used within the debate of natural resource management in general and the conservation debate in particular. However, this concept is sometime difficult to be translated into actions on the absence of relevant field experience. In order to translate this concept into practice, the Sabah Wildlife Departmnent initiated in incorporating the perceived development needs of the local communities living in and around protected area, which are dependent on the land and natural resources for their livelihood. Furthermore, local community participation in some of wildlife management and conservation efforts is a vital issue in the development of policies and strategies.

Concerning sustainability, the World Conservation Strategy in 1980 defined natural resources use as sustainable when it did not significantly affect the wild population. And so when is wildlife utilization sustainable? A simple answer is when harvest does not exceed production (Bennett & Robinson 2000). Under the National Policy on Biological Diversity 1998, the role of local communities in conservation, management and utilization of biological diversity has been recognized and their rightful share of benefits should be ensured. Consecutively, under the Sabah Conservation Strategy 2000 a policy on local community participation in wildlife management and conservation stated that local communities play a major role in the sustainable utilization of natural resources for the socio-economic development of the people of Sabah. Consequently, the Sabah Wildlife Department recognized the underlying assumption on community participation whereby community institutions existed for management of wildlife and habitats, and that they would continue to be effective (Tuuga 2005).

Concerning local communities, Borrini-Feyerabend *et al*. (2004) defined a community is a human group sharing a territory and involved in different but related aspects of livelihoods — such as managing natural resources, producing knowledge and culture, and developing productive technologies and practices. The fact that local communities are advocating collective rather than individual rights is of great importance for conservation. It was further elaborated that management practices that engage local communities are seen to enhance the long-term effectiveness of conservation. In this context, Sabah's ethnic diversity among its indigenous people is perhaps, its most remarkable feature in a population that is relatively small in proportion to its land area and when compared to other states of Malaysia (Regis 1989). Such diversity invariably has considerable ramifications in the conservation of natural resources and socio-economic development of the state.

This paper shares some of the significance role of the local communities in sustainable utilization of protected wildlife in Sabah. The specific objectives of this paper are threefold:

- To share a brief description of wildlife utilization within the context of the Sabah Wildlife Conservation Enactment 1997;
- To share a brief description of diverse faunal species which are protected by the law and allow uses by local communities; and
- The role local communities can play in meeting the sustainable utilization of wildlife in Sabah.

BASIC UNDERSTANDING CONCERNING WILDLIFE UTILISATION BY LOCAL COMMUNITIES IN THE CONTEXT OF THE *SABAH WILDLIFE CONSERVATION ENACTMENT 1997*

Under the *Sabah Wildlife Conservation Enactment 1997* 'wildlife' mean plants and animals. Under this law 'animal' mean any vertebrate or invertebrate and the egg thereof but does not include any domestic animals or the eggs thereof. Consequently, there are two forms of utilization have been

introduced. Firstly, part IV of the law concerning protection of animals and legalization of hunting activities whereby local people is allowed to carry out hunting activities on specific type of species, numbers and their location to hunt. For management purposes these species are listed under the Schedule II and III of the law. Several provisions under this part have contributed enormously to the formation of management and conservation policies and strategies in relation to sustainable hunting in Sabah.

Secondly, part VII of this law is specifically concerning wildlife utilization whereby provisions of the law allowing the government to establish a wildlife hunting area in a specified area. The Sabah Wildlife Department has implemented this provision at the Kampung Monsok, Tambunan in 2003. Through this, local communities have benefited whereby they continued to do hunting within the designated hunting area. Furthermore, their sense of pride and ownership has enhanced towards conserving some of precious wildlife in their territories. To date, however, this proviso has not been operational in other parts of Sabah because most of natural forests have been given protection status such as forests reserves and parks, which are governed by the Sabah Forestry Department and Sabah Parks respectively. Moreover, local communities still can practice hunting activities in many places in Sabah.

However, the introduction of sustainable utilization of wildlife to local communities in Sabah under operation of the law is confronted with several issues some of which have serious implications on their roles and values. Lately, an emerging issue confronting the management of sustainable utilization of wildlife is the threat of massive areas of rich natural forests have been sacrificed for other land uses particularly for agricultural development. Incidentally, a major of most precious habitat of wild flora and fauna have been destroyed while others are fragmented at varying degrees of damage.

Consequential to that effect, the introduction of sustainable utilization of wildlife is clouded by illegal wildlife hunting activities which are stimulated by easy access due to opening up of roads to remote areas and thus huge opportunities in obtaining wild meat. In addition, rampant use of fire arms by illegal hunters has also contributed to the massive declining of game animals.

PROTECTED WILDLIFE SPECIES LISTED UNDER THE SABAH WILDLIFE CONSERVATION ENACTMENT 1997

Out of 222 species of mammals recorded for Borneo excluding domesticated animals, seven species of mammals and three species of reptiles as listed in the following are categorized as totally protected animals under Schedule I of the law (*Table 1*). Section 25 of the law stipulated that no form of utilization is allowed for these animals, thus in respect to an offence relating them, to a fine of fifty thousand ringgit or to imprisonment for five years or to both.

TABLE 1. PROTECTED MAMMALS AND REPTILES

No.	Protected species
1.	Sumatran Rhinoceros (*Dicerorhinus sumatrensis*) Badak Sumatra
2.	Orang Utan (*Pongo pygmateus*) Orang Utan
3.	Sun Bear (*Helarctos malayanus*) Beruang Madu
4.	Dugong (*Dugong dugon*) Duyung
5.	Proboscis Monkey (*Nasalis larvatus*) Monyet Bangkatan
6.	Clouded Leopard (*Neofelis nebulosa*) Harimau Dahan
7.	Gharial (*Tomistoma schlegeli*) Buaya Julung-julung
8.	Green Turtle (*Chelonia mydas*) Penyu Hijau
9.	Hawksbill Turtle (*Eretmochelys imbricata*) Penyu Sisik
10.	Tembadau (*Bos javanicus*)

Nine most common species of mammals as listed in the following are allowed to hunt with license (*Table 2*). These species are inter-related with needs of local communities in order to get additional source of protein. Furthermore, some of them are still common elsewhere in many parts of natural forests in Sabah. In addition, some of local communities hunt them as food product in order to get cash. In other word, local communities are allowed to sell wild meats provided they obtained a license to do so.

TABLE 2. MAMMALS THAT COULD BE HUNTED WITH LICENCE

No.	Species of mammals
1.	Sambar Deer (*Cervus unicolor*) Rusa
2.	Bornean Yellow Muntjac (*Muntiacus atherodes*) Kijang
3.	Common Barking Deer (*Muntiacus muntjac*) Kijang
4.	Greater Mousedeer (*Tragulus napu*) Pelanduk Napoh
5.	Lesser Mousedeer (*Tragulus javanicus*) Pelanduk
6.	Bearded Pig or Wildboar (*Sus barbatus*) Babi Hutan
7.	Common Porcupine (*Hystrix brachycura*) Landak Raya
8.	Island Flying Fox (*Pteropus hypomelanus*) Keluang Pulau
9.	Large Flying Fox (*Pteropus vampyrus*) Keluang Bakau

Other type of animals comprises mammals, birds and butterflies as listed in *Table 3* are also allowed for hunting with license, but of limited numbers.

TABLE 3. OTHER MAMMALS THAT COULD BE HUNTED WITH LICENCE

No.	Mammals
	Mammals
1.	Kinabalu Shrew (*Crocidura baluensis*) Cencurut Kinabalu
2.	Dayak Roundleaf Bat (*Hipposideros dyacorum*) Kelawar Ladam-bulat Dayak
3.	Coppery Pipistrelle (*Pipistrellus cuprosus*) Kelawar Hidung Pendek Tembaga
4.	Gilded Tube-nosed Bat (*Murina rozendaali*) Kelawar Hidung Laras Emas
5.	Flying Lemur (*Cynocephalus variegatus*) Kubung
6.	Slow Loris (*Nycticebus coucang*) Kongkang
7.	Tarsier (*Tarsius bancanus*) Kera Hantu
8.	Maroon Leaf Monkey (*Presbytis rubicunda*) Monyet Merah
9.	Grey Leaf Monkey (*Presbytis hosei*) Monyet Kikok
10.	Silver Leaf Monkey (*Presbytis cristata*) Monyet Kelabu
11.	Long-tailed Macaque (*Macaca fascicularis*) Kera
12.	Pig-tailed Macaque (*Macaca nemestrina*) Beruk
13.	Gibbon (*Hylobates muelleri*) Kelawat
14.	Pangolin (*Manis javanica*) Tenggiling
15.	Giant Squirrel (*Ratufa affinis*) Tupai Kerawak Putih-kuning
16.	Kinabalu Squirre (*Callosciurus baluensis*) Tupai Kinabalu
17.	Giant Tufted Ground Squirrel (*Rheithrosciurus macrotis*) Babut
18.	Hose's Pygmy Flying Squirrel (*Petaurillus hosei*) Tupai Terbang Kecil
19.	Temminck's Flying Squirrel (*Petinomys setosus*) Tupai Terbang Dada Putih
20.	Horsfield's Flying Squirrel (*Iomys horsfieldi*) Tupai Terbang Ekor Merah
21.	Grey-cheeked Flying Squirrel (*Hylopetes lepidus*) Tupai Terbang Pipi Kelabu
22.	Black Flying Squirrel (*Aeromys tephromelas*) Tupai Terbang Hitam
23.	Smoky Flying Squirrel (*Pteromyscus pulverulentus*) Tupai Terbang Kotor
24.	Whiskered Flying Squirrel (*Petinomys genibarbis*) Tupai Terbang Berjambang
25.	Spotted Giant Flying Squirrel (*Petaurista elegans*) Tupai Terbang Bintang
26.	Red Giant Flying Squirrel (*Petaurista petaurista*) Tupai Terbang Merah

No.	Mammals
27.	Thomas's Flying Squirrel (*Aeromys thomasi*) Tupai Terbang Merah
28.	Long-tailed Porcupine (*Trichys fasciculata*) Lambat Padi
29.	Thick-spined Porcupine (*Thecurus crassispinis*) Landak Borneo
30.	Yellow-throated Marten (*Martes flavigula*) Mengkira
31.	Malay Weasel (*Mustela nudipes*) Pulasan Tanah
32.	Ferret-Badger (*Melogale personata*) Pulasan Lamri
33.	Malay Badger (*Mydaus javanensis*) Teledu
34.	Hairy-nosed Otter (*Lutra sumatrana*) Memerang Kumis
35.	Smooth Otter (*Lutra perspicillata*) Memerang Licin
36.	Oriental Small-clawed Otter (*Aonyx cinerea*) Memerang Kecil
37.	Malay Civet (*Viverra tangalunga*) Musang Tanggalong
38.	Otter-Civet (*Cynogale bennettii*) Musang Memerang
39.	Binturong (*Arctictis binturong*) Musang Binturong
40.	Small-toothed Palm Civet (*Arctogalidia trivirgata*) Musang Akar
41.	Masked Palm Civet (*Paguma larvata*) Musang Lamri
42.	Common Palm Civet (*Paradoxurus hermaphroditus*) Musang Pulut
43.	Hose's Civet (*Hemigalus hosei*) Musang Hitam Pudar
44.	Banded Palm Civet (*Hemigalus derbyanus*) Musang Belang
45.	Banded Linsang (*Prionodon linsang*) Munsang Linsang
46.	Collared Mongoose (*Herpestes semitorquatus*) Bambun Ekor Panjang
47.	Short-tailed Mongoose (*Herpestes brachyurus*) Bambun Ekor Pendek
48.	Leopard Cat (*Felis bengalensis*) Kucing Batu
49.	Marbled Cat (*Felis marmorata*) Kucing Dahan
50.	Flat Headed Cat (*Felis planiceps*) Kucing Hutan
51.	Bay Cat (*Felis badia*) Kucing Merah
52.	Asian Elephant (*Elephas maximus*) Gajah
53.	Sei Whale (*Balanoptera borealis*) Ikan Paus Sei
54.	Bryde's Whale (*Balanoptera edent*) Ikan Paus Bryde
55.	Killer Whale (*Orcinus orca*) Ikan Paus Buding
56.	Short-finned Pilot Whale (*Globicephala macrorhynchus*) Ikan Paus Pendek Sirip
57.	Pygmy Sperm Whale (*Kogia breviceps*) Ikan Paus Nayan

No.	Mammals
58.	Grey Dolphin (*Grampus griseus*) Dolfin Kelabu
59.	Bottlenose Dolphin (*Tursiops truncatus*) Dolfin Hidung Botol
60.	Indo-Pacific Hump-backed Dolphin (*Sousa chinensis*) Dolfin Bongkok Bernie
61.	Irrawaddy Dolphin (*Orcaella brevirostris*) Dolfin Empesut
62.	Finless Porpoise (*Neophocaena phocaenides*) Ikan Lumba-lumba Ambu
63.	Fraser's Dolphin (*Lagenodelhis hosei*) Dolfin Fraser
64.	Long Snouted Spinner Dolphin (*Stenella longirostra*) Dolfin Hidung Mancung
	Reptiles
65.	Estuarine Crocodile (*Crocodylus porosus*) Buaya
66.	Monitor Lizard (*All Varanus species*) Biawak
67.	Reticulated Python (*Python reticulatus*) Ular Sawa Panjang
68.	Blood Python (*Python curtus*) Ular Sawa Darah
69.	King Cobra (*Ophiophagus hannah*) Ular Tedung Selar
70.	Forest Tortoise (*Tetsudo emys*) Kura-kura Bukit
71.	Asian Giant Turtle (*Orlitia borneonsis*) Juku-juku Besar
	Frigate Birds
72.	Christmas Island Frigatebird (*Fregata andrewsi*) Simbang Pulau Christmas
73.	Lesser Frigatebird (*Fregata ariel*) Simbang Kecil
	Cormorants and Darters
74.	Great Cormorant (*Phalacrocorax carbo*) Dendang Air
75.	Oriental Darter (*Anhinga melanogaster*) Kosa
	Herons and Bitterns
76.	Great-billed Heron (*Ardea sumatrana*) Bangau Bakau
77.	Purple Heron (*Ardea purpurea*) Bangau Paya
78.	Grey Heron (*Ardea cinerea*) Seriap
79.	Reef Egret (*Egretta sacra*) Bangau Laut
80.	Little Egret (*Egretta garzetta*) Bangau Kecil
81.	Chinese Egret (*Egretta eulophotes*) Bangau Cina
82.	Intermediate Egret (*Egretta intermedia*) Bangau Kerbau
83.	Little Heron (*Butorides striatus*) Pucong Keladi

No.	Mammals
84.	Black-crowned Night-Heron (*Nycticorax nycticorax*) Pucong Kuak
85.	Rufous Night Heron (*Nycticorax caledonicus*) Pucong Malam
86.	Malayan Night Heron (*Gorsachius melanolophus*) Pucong Rimau
87.	Yellow Bittern (*Ixobrychus sinensis*) Pucong Merah
88.	Schrenck's Bittern (*Ixobrychus eurhythmus*) Pucong Gelam
89.	Black Bittern (*Ixobrychus flavicollis*) Pucong Hitam
90.	Cinnamon Bittern (*Ixobrychus cinnamomeus*) Pucong Bendang
	Storks
91.	Storm's Stork (*Cicona stormi*) Botak Storm
92.	Lessers Adjutant Stork (*Leptoptilos javanicus*) Botak Kecil
	Ibises
93.	Black-headed Ibis (*Threskiornis melanocephalus*) Sekendi Kepala Hitam
	Hawks and Eagles
94.	Bat Hawk (*Machaeramphus alcinus*) Helang Malam
95.	Jerdon Baza (*Avicedo jerdoni*) Helang Baza
96.	Crested Honey-Buzzard (*Pernis ptilorhynchus*) Helang Lebah
97.	Brahminy Kite (*Haliastur indus*) Helang Merah
98.	Black Kite (*Milvus migrans*) Helang Kembara Hitam
99.	Black Eagle (*Ictinaetus malayensis*) Helang Hitam
100.	Lesser Fish-Eagle (*Ichthyophaga humilis*) Helang Kangok
101.	Grey-headed Fish-Eagle (*Ichthyophaga ichtyaetus*) Helang Kepala Kelabu
102.	Kinabalu Serpent-Eagle (*Spilornis kinabaluensis*) Helang Kinabalu
103.	Kinabalu Serpent-Eagle (*Spilornis kinabaluensis*) Helang Kinabalu
104.	Crested Serpent-Eagle (*Spilornis cheela*) Helang Berjambul
105.	Besra (*Accipiter virgatus*) Helang Pipit
106.	Crested Goshawk (*Accipiter trivirgatus*) Helang Putih
107.	Wallace's Hawk-Eagle (*Spizaetus nanus*) Helang Selat
	Ospreys
108.	Osprey (*Pandion haliacetus*) Helang Tiram

No.	Mammals
	Falcons
109.	White-fronted Falconet (*Microhierax latifros*) Falko Dahi Putih
110.	Peregrine Falcon (*Falcon peregrinus*) Falko Belalang
111.	Common Falconet (*Microhierax caerulescens*) Falko Biasa
112.	Oriental Hobby (*Falco severus*) Falko Timor
113.	Eurasian Kestrel (*Falco tinnunculus*) Falko Serani
	Megapodes
114.	Tabon Scrubfowl (*Megapodius cumingii*) Tambun
	Partridges and Phesant
116.	Blue-breasted Quail (*Coturnix chinensis*) Pikau
117.	Long-billed Partridge (*Rhizothera longirostris*) Siul Selanting
118.	Ferruginous Partridge (*Caloperdix oculea*) Sang Beruk Rimba
119.	Red-breasted Partridge (*Arborophila hyperythra*) Siul Dada Merah
120.	Chestnut-necklaced Partridge (*Arborophila charltonii*) Sang Serok
121.	Black Wood-Partridge (*Melanoperdix nigra*) Siul Bertam
122.	Crested Partridge (*Rollulus rouloul*) Siul Berjambul
123.	Crimson-headed Partridge (*Haematortyx sanguiniceps*) Siul Kepala Merah
124.	Crested Fireback (*Lophura ignita*) Ayam Pegar
125.	Crestless Fireback (*Lophura erythopthalma*) Merah Mata
126.	Bulwer's Pheasant (*Lophura bulweri*) Pakiak
127.	Bornean Peacock-Pheasant (*Polyplectron schleiermacheri*) Merak Pongsu
128.	Great Argus (*Argusianus argus*) Kuang Raya
	Plovers
129.	Malaysian Plover (*Charadrius peronii*) Rapang Pasir
	Sandpipers and Snipes
130.	Far Eastern Curlew (*Numenius madagascariensis*) Kedidi Timor
131.	Nordmann's Greenshank (*Tringa guttifer*) Kedidi Kaki Hijau Berbintik
132.	Asian Dowitcher (*Limnodromus semipalmatus*) Kedidi Dada Merah
	Thick-Knees
133.	Beach Thick-knee (*Esacus magnirostris*) Burung Lutut Tebal

No.	Mammals
	Skuas, Gulls and Terns
134.	Black-naped Tern (*Sterna sumatrana*) Camar Tengkuk Hitam
135.	Bridled Tern (*Sterna anaethetus*) Camar Batu
136.	Chinese-crested Tern (*Sterna bernsteini*) Camar Cina Berjambul
	Pigeons and Doves
137.	Large-Green Pigeon (*Treron capellei*) Lengguak
138.	Cinnamon-headed Green-Pigeon (*Treron fulvicollis*) Punai Bakau
139.	Black-napped Fruit-Dove (*Ptilinopus melanospila*) Punai Tengkuk Hitam
140.	Grey Imperial Pigeon (*Ducula pickering*) Merpati Raja Kelabu
141.	Metalic Wood-Pigeon (*Columbia vitiensis*) Merpati Kayu
142.	Emerald Dove (*Chalcophaps indica*) Punai Tanah
143.	Nicobar Pigeon (*Caloenas nicobarica*) Punai Emas
	Parrots
144.	Blue-napped Parrot (*Tanygnathus lucionensis*) Bayan Tengkuk Biru
145.	Blue-rumped Parrot (*Psittinus cyanurus*) Bayan Puling
146.	Long-tailed Parakeet (*Psittacula longicauda*) Bayan Nuri
147.	Blue-crowned Hanging-Parrot (*Loriculus galgulus*) Bayan Kecil / Serindit
	Cuckoos, Malkohas and Coucals
148.	Violet Cuckoo (*Chrysococcyx xanthorhynchus*) Sewah Rembah
149.	Short-toed Coucal (*Centropus rectunguis*) But-but Jari Pendek
150.	Sunda Ground-Cuckoo (*Carpococcyx radiceus*) Sewah Tanah
	Owls
151.	Bay Owl (*Phodilus badius*) Jampuk Pantai
152.	Reddish Scops-Owl (*Otus rufescens*) Hantu Merah
153.	Mountain Scops-Owl (*Otus spilocephalus*) Hantu Gunung
154.	Collared Scops-Owl (*Otus lempiji*) Hantu Reban
155.	Mantanani Scops-Owl (*Otus mantananensis*) Hantu Mantanani
156.	Barred Eagle-Owl (*Bubo sumatrana*) Hantu Bubu
157.	Buffy Fish-Owl (*Ketupa ketupu*) Hantu Kuning
158.	Collared Owlet (*Glaucidium brodiei*) Hantu Kecil

No.	Mammals
159.	Brown Boobook (*Ninox scutulata*) Hantu Betemak
160.	Brown Wood-Owl (*Strix leptogrammica*) Hantu Punggor
	Frogmouths
161.	Large Frogmouth (*Batrachostomus auritus*) Segan Besar
	Nightjars
162.	Bonaparte's Nightjar (*Caprimulgus concretus*) Tukang Bonaparte
	Swifts
163.	Waterfall Swifts (*Hydrochous gigas*) Layang-layang Hantu
164.	Edible-nest Swiftlet (*Aerodramus fuciphagus*) Layang-layang Gua
165.	Black-nest Swiftlet (*Aerodramus maximus*) Layang-layang Padi
166.	Brown-backed Needletail (*Hirundapus giganteus*) Layang-layang Besar
	Hornbills
167.	Wrinkled Hornbill (*Rhyticeros corrugatus*) Enggang Berkedut
168.	Wreathed Hornbill (*Rhyticeros undulatus*) Enggang Gunung
169.	White-crowned Hornbill (*Berenicornis comatus*) Enggang Jambul Putih
170.	Bushy-crested Hornbill (*Annorrhinus galeritus*) Enggang Belukar
171.	Black Hornbill (*Anthracoceros malayanus*) Enggang Gatal Birah
172.	Pied Hornbill (*Anthracoceros coronatus*) Enggang Tangling
173.	Rhinoceros Hornbill (*Buceros rhinoceros*) Enggang Badak
174.	Helmeted Hornbill (*Rhinoplax vigil*) Enggang Terbang Mentua
	Honeyguides
175.	Malaysian Honeyguide (*Indicator archipelagicus*) Gembala Lebah
	Woodpeckers
176.	Speckled Piculet (*Picumnus innominatus*) Belatok Belang
177.	Rufous Woodpecker (*Celeus brachyurus*) Belatok Kecil
178.	White-bellied Woodpecker (*Dryocopus javensis*) Belatok Gajah
	Pittas
179.	Giant Pitta (*Pitta caerulea*) Pacat Besar
180.	Fairy Pitta (*Pitta nympha*) Pacat

No.	Mammals
181.	Blue-headed Pitta (*Pitta baudi*) Pacat Kepala Merah
182.	Blue-banded Pitta (*Pitta arquata*) Pacat
183.	Banded Pitta (*Pitta guajana*) Pacat Bukit
184.	Blue-winged Pitta (*Pitta moluccensis*) Pacat Sayap Biru
185.	Hooded Pitta (*Pitta sordida*) Pacat Gembala Pelandok
	Bulbuls
186.	Straw-headed Bulbul (*Pycnonotus zeylanicus*) Barau-barau
187.	Hook-billed Bulbul (*Setornis criniger*) Merbah
	Thrushes
188.	Everett's Thrush (*Zoothera everetti*) Murai Everett
189.	White-crowned Forktail (*Enicurus leschenaulti*) Murai Cegar Belukar
190.	White-rumped Shama (*Copsychus malabaricus*) Murai Rimba
191.	Magpie Robin (*Copsychus saulari*) Murai Kampung
	Babblers
192.	White-chested Babbler (*Trichastoma rostratum*) Burung Telanjuk
193.	Ferruginous Babbler (*Trichastoma bicolor*) Rimba Sampah
194.	Grey-breasted Babbler (*Malacopteron albogulare*) Rimba Dahan
195.	Bornean Wren-Babbler (*Ptilocichla leucogrammica*) Rimba Borneo
	Flycatchers
196.	Sunda Blue Flycatcher (*Cyornis caerulata*) Sambar Biru Sunda
197.	Malaysian Blue Flycatcher (*Cyornis turcosa*) Sambar Biru Malaysia
198.	Asian Paradise Flycatcher (*Terpsiphone paradisi*) Sambar Ekor Panjang
	Whistlers
199.	Mangrove Whistler (*Pachycephala cinerea*) Sambar Siul Belukar
	Flowerpeckers
200.	Mangrove Whistler (*Pachycephala cinerea*) Sambar Siul Belukar
	Starlings and Mynas
201.	Hill Myna (*Gracula religiosa*) Tiong Mas

No.	Mammals
	Bristleheads
202.	Bornean Bristlehead (*Pityriasis gymnocephala*) Burung Jambul
	Jays and Crows
203.	Black Magpie (*Platysmurus leucopterus*) Murai Hitam
204.	Short-tailed Green Magpie (*Cissa thalassina*) Murai Hijau
	Insects
205.	Rajah Brooke's Birdwing (*Trogonoptera brookiana*) Kupu-kupu Rajah
206.	Common Birdwing (*All Troides Species*) Kupu-kupu (Semua Species Troides)

RELATIONSHIP BETWEEN HUNTING BY LOCAL COMMUNITIES AND WILDLIFE AND HABITATS

Apart from the agriculture activities of local communities mainly, paddy cultivation they also conducted hunting activities in and around their territories. As shown in *Figure 1* hunting activities most often occurred at night and these are related to certain type of animals and their daily activities. This knowledge has been acquired by local communities from their ancestors thus ground animals particularly mammals which are active day and night normally are the most hunted.

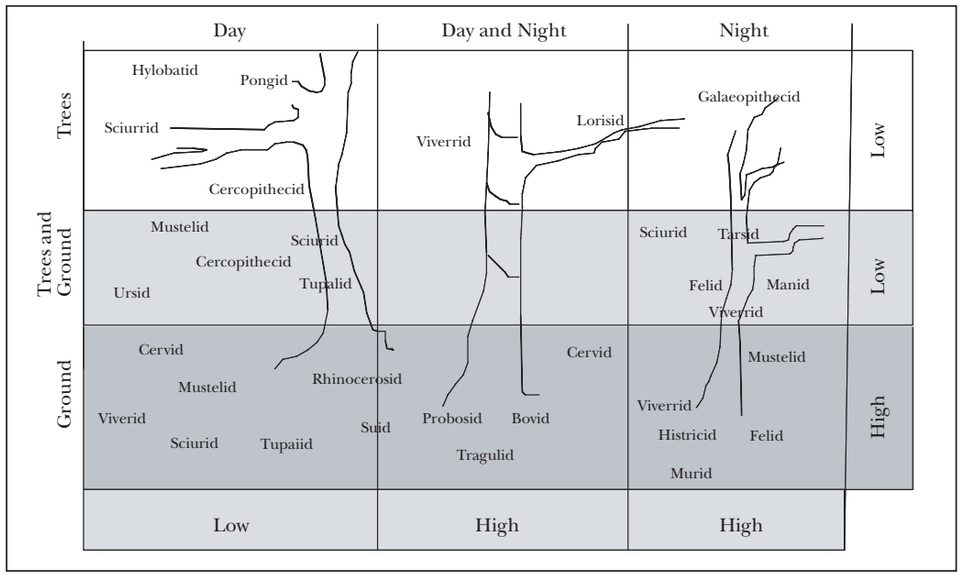


Figure 1. Space-and time-partitioning of non-flying mammals effected by local communities hunting activities.

(Source: Adapted from MacKinnon *et al.* 1996)

In relation to forests of Sabah, hunting activities by local communities is shown in *Figure 2*. Forests of Sabah cover approximately 44 487.5 sq.km or 60.3% of the state's total land area (source from the Sabah Forestry Department 1989, 1999 by Yasuma and Andau, 1999). Translating this information of local communities hunting activities is of primary importance in convincing that wildlife and its natural forest habitats as life-supporting system. Most often local communities spend more time and energy hunting in lowland mixed dipterocarp forests.

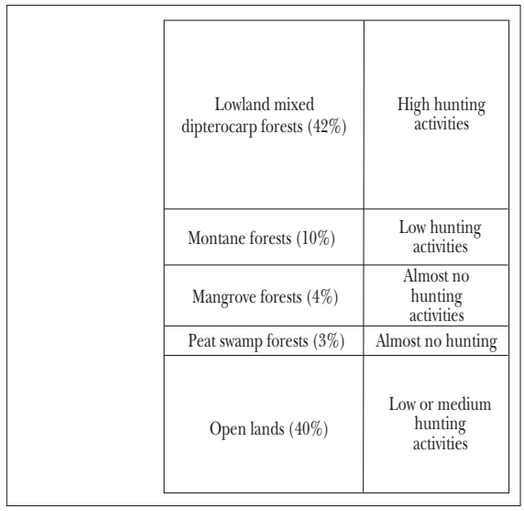


Figure 2. Relationship between forests of Sabah and hunting activities by local communities.

(Source: Adapted from Yasuma & Andau 1999)

At the same time, wildlife populations dwindle to such level at open lands that they may become locally extinct, and so hunting activities is almost none. Montane forests are non-favourable hunting area because of steep terrains which demanding more energy and low hunting success. Similarly, mangrove and peat swamp forests are even more difficult to conduct hunting activities and so the level of hunting is almost insignificant.

ROLE OF LOCAL COMMUNITY IN SUSTAINABLE WILDLIFE UTILIZATION

Elsewhere in Malaysia, the general approach has been to prohibit utilization of wildlife in specific areas or for selected species as far as law is concerned. Focusing on management solutions that conserve wildlife yet allow continued local communities access to an important resource, therefore essentially local communities can play a very important role through:

- Active participation in the establishment of protected areas. A very good example in this context was the establishment of the Lower Kinabatangan Wildlife Sanctuary. It was a good model whereby it becomes absolutely necessary preserving the Santuary with its associated local communities, fauna and flora. In creating the Sanctuary with assures reasonable

permanence that cooperation and collaboration of local communities as a major stakeholder in ensuring utilization of wildlife sustainably (Malim *et al*. 1999).

- Controlling hunting access to key wildlife areas by excluding outsiders from traditional hunting areas. A good example in this context was the establishment of kampong hunting area at Kg. Monsok, Tambunan in 2003.
- Leaders of local community establishing and enforcing rules in accordance with their *adat* against ownership and rights to collect bird's nests of swiftlet. An example to this was the establishment of cave ownership by the Idahan ethnic group in Lahad Datu. The ownership and inheritance concerning their rights to collect bird's nests at Madai Caves was determined by their family relationship. Further, this tradition was incorporated in their *adat*. The Government of Sabah recognized this cave and the Idahan people is the sole custodian of their caves.
- Since they are in control of their activities, therefore, they can abstain or minimize from carrying out wildlife hunting when the risk of specific wildlife species becoming locally extinct is evident.
- Through the concept of *gotong-royong*, local communities can perform early detection and in the case of illegal hunting happened in their territories, they can perform initial prevention by providing immediate information to the Sabah Wildlife Department. In Sabah and elsewhere in Malaysia, this practice was recognized as a vital point in enhancing local community cooperation and collaboration in managing protected areas, including wise use of natural resources therein.
- Through the introduction of Honorary Wildlife Warden provided under the *Sabah Wildlife Conservation Enactment 1997*, local communities are empowered to enforce the law. The Sabah Wildlife Department has appointed over 100 local communities, as well as non-governmental organizations, statewide.

Local communities are one of the most important stakeholders that can play a vital role in the sustainability of wildlife untilisation. This is due to the fact that they are located strategically at the site where they can perform their traditional way of life. Indeed, the success in this context is attributed to a commitment to communication, a focus on shared values, willingness to negotiate over differences, and joint responsibility for decision-making.

CONCLUSION

Sustainable utilization is an important issue as it has brought about a holistic effect in management and conservation of wildlife in Sabah. Certainly this requires the system of command and control to be continuously enhanced and supported by effective local community participation. It is very important that the Sabah Wildlife Department continues working closely with the local communities on an equal level, though this is not an easy one.

Several of the SWD's conservation projects revealed that the local communities will only participate in wildlife conservation if they benefits from it. The local communities shared the view that their rights be assured to them. Therefore, collective and collaborative approaches, which gradually gained the confidence and cooperation of the local community, seems to be effective in managing utilization of wildlife sustainably as they are part of the ecosystem and therefore was made as part of the solution.

REFERENCES

Bennett, EL & Robinson, JG 2000, *Hunting of wildlife in tropical forests. implications for biodiversity and Forest Peoples,* The World Bank and The Wildlife Conservation Society, USA, Paper No. 76.

Borrini-Feyerabend, G, Kothari A & Oviedo, G 2004, *Indigenous and local communities and protected areas. Towards equity and enhanced conservation,* IUCN, Gland, Switzerland and Cambridge, UK.

MacKinnon, K, Hatta, G, Halim H & Mangalik, A 1996, *The ecology of kalimantan*, Periplus Editions, Singapore.

Malim, P, Andau M & Ambu, L 1999, 'Towards the establishment of the Kinabatangan Wildlife Sanctuary: Threats, conflicts and possible alternatives', in *Seminar 'Oil Palm Effluents and Pollution Management'* April 1999, Sandakan, Sabah.

MOSTE 1998, *National Policy on Biological Diversity*, Ministry of Science, Technology and the Environment, Malaysia, Kuala Lumpur.

Regis, P 1989, *Demography*, In *Sabah 25 Years Later 1963 – 1988*, eds JG Kitingan & MJ Ongkili, Institute for Development Studies (Sabah), Kota Kinabalu, Sabah, Malaysia, pp. 405–450.

Sabah Wildlife Conservation Enactment 1997, Government Printing, Kota Kinabalu.

MCET 2000, *Sabah Conservation Strategy*, Ministry of Culture, Environment and Tourism, Kota Kinabalu.

Tuuga, A 2005, 'Policy and legislation on local community participation in wildlife management in Sabah', in *Proceedings of the Tenth Sabah Inter-Agency Tropical Ecosystem (SITE) Research Seminar: Towards Converging Community Involvement in Protected Areas Management in Sabah*, Sabah Wildlife Department, Kota Kinabalu, Sabah, pp. 123–134.

Yasuma, S & Andau, M 1999, *Mammals of Sabah. Field guide and Identifcation,* Japan International Agency (JICA) and Sabah Wildlife Department, Kota Kinabalu.

Natural Product Discovery at MerLion Pharmaceuticals

K. YOGANATHAN
MerLion Pharmaceuticals Pte Ltd, 1 Science Park Road,
#05-01 The Capricorn, Singapore Science Park II
Singapore 117528

Abstract

Ever since Fleming's paper in 1929 on the discovery of penicillin, we have enjoyed the benefits of microbial natural products. These compounds include antibiotics, antitumor agents, cholesterol-lowering agents, immunosuppressants for organ transplantation, bioherbicides, enzyme inhibitors, bio-insecticides and many others. However, the rate of discovery has dropped to dangerous proportions whereas the resistance of pathogenic microbes and tumor cells has increased, and the rate of nosocomial infections has risen. Also, new diseases have evolved and will continue to evolve. In the 1990s the pharmaceutical industry greatly de-emphasized the exploration of natural products owing to major advances in high throughput screening, structure-based design and parallel synthesis applied to medicinal chemistry.

Recently, there has been a renewed interest in natural product research due to the failure of alternative drug discovery methods to deliver many leads compounds in key therapeutic areas such as immunosuppression, anti-infectives, and other metabolic diseases. To continue to be competitive with other drug discovery methods, natural product research needs to continually improve the speed of the screening, isolation, and structure elucidation processes, as well increasing the chemical screening space, finding novelty or new pharmacophores or new modes of action and addressing the suitability of screens for natural product extracts. Advances in new ways for natural product drug discovery at MerLion Pharmaceuticals have been made.

From a Library of Indigenous Plants to Natural Product Discovery and Development: On-going Sarawak's Experience

Y.T. CHIA
Sarawak Biodiversity Centre, KM 20 Jalan Borneo Heights, Semengoh, Sarawak

HISTORICAL PERSPECTIVE

The Sarawak Biodiversity Centre (SBC) was set up in 1998 after the enactment of the *Sarawak Biodiversity Ordinance 1997* which provided for the establishment of the Centre and the establishment of the Sarawak Biodiversity Council. Together with the *Sarawak Biodiversity (Access, Collection and Research) Regulations 1998*, it provided for the administrative and regulatory mechanisms to facilitate and authorize access to the biological resources of Sarawak.

In 2003, after several years of implementation, the Sarawak Biodiversity Ordinance was amended [Sarawak Biodiversity Centre (Amendment) Ordinance, 2003] (SBC 2003) to focus the role of SBC in undertaking studies, research and documentation of the traditional uses of biological resources by the indigenous communities in the State. The Centre was also given the mandate to set up facilities for bioactive compound research to characterize bioactive compounds, genes and proteins of interests from the biodiversity. As a first step, the SBC embarked on a programme to set up a natural products library to provide the chemical compounds based the indigenous plants that were used by the communities in the Sarawak for medicines, food and other applications for screening activities. The research goal was to isolate and identify bioactive compounds that could be developed commercially for pharmaceuticals, medicinal products and industrial applications.

In line with amendments made to the Ordinance, *Sarawak Biodiversity Regulations, 2004 (SBC 2004)*, was enacted to replace the *Sarawak Biodiversity (Access, Collection and Research) Regulations 1998*. This new regulation was meant to facilitate general research work such as fauna and flora taxonomic studies and collection of biological materials for educational purposes which was placed under the jurisdiction of the Sarawak Forest Department. There were also special procedures and exemption for state agencies and for certain type of collections. However, research into ethnobotanical uses, bioactive chemical properties and commercialization of the biodiversity requires approval from the Sarawak Biodiversity Council and an agreement with the State government. This is in accordance with the guidelines of the Convention of Biological Diversity which protects the rights to the biological resources, sustainable utilization of the biological resources and sharing of benefits that arise out of the utilization of the biological resources.

BIODIVERSITY: A SOURCE FOR DISCOVERY

Sarawak is one of richest states within Malaysia in terms biodiversity. It also has a substantial indigenous population that still utilize the biodiversity as traditional medicines, food, nutrition and other applications. This knowledge on the use of the biodiversity is traditionally passed on from one generation to the next and is referred to traditional knowledge (TK). The study of TK in ethnomedicinal practices is a modern approach to discover drug leads for pharmaceuticals and bioactives for medicinal therapy. From past experiences, this method has been successful in yielding a number of blockbuster drugs and medicines.

Natural products from plants have long since played an important role in drug discovery. It is estimated that 25% of all prescribed drugs today come from plants (Farnsworth & Morris 1976). In cancer therapy, it is plants that continue to make the most impact with 47% of developed cancer drugs being either a plant-derived natural product or a direct derivation of the natural molecule (Raskin & Ripoll 2004).

There are scientific evidences that suggested ethnobotanical employing indigenous knowledge yielded a higher number of 'hits' and therefore, is one of the approach that is popular in natural product discovery (Cox & Balick 1994). Furthermore, the 'cultural pre-screen' evolving from usage of the indigenous plants by the communities as medicines constitutes a trial and error process over time that is highly suggestive of the presence of useful bioactivity content i.e. efficacy and safety in the plants that are selected.

SBC TRADITIONAL KNOWLEDGE (TK) DOCUMENTATION PROGRAMME

One of SBC's main organizational roles is to facilitate the documentation of TK in the usage of indigenous plants by the communities in Sarawak as medicines, food, nutrition and other applications. Traditional knowledge on medicinal uses of the plants is commonly recognized as leads that could be scientifically validated to confirm the medicinal claims for potential commercial development.

So far, SBC has implemented this project in 12 ethnic communities at 28 locations throughout Sarawak. The communities participating in the projects are Bidayuh, Selako, Iban, Malay, Melanau, Penan, Berawan, Lun Bawang, Kayan, Kelabit, Bisaya and Kenyah. Some of the locations of the villages are quite remote, rendering the collection and follow-up collection of plant materials difficult. However it is at these remote places where the indigenous communities tend to use biodiversity the most and hence the traditional knowledge available is abundant.

The current number of plants contributed by the communities is 2543. There is possible redundancy in the plants collected i.e. similar plants contributed on different occasions or by different communities. The lack of taxonomic identifications made it difficult to sort out potential duplication of plants collected.

LIBRARY OF INDIGENOUS PLANTS FOR DRUG DISCOVERY & DEVELOPMENT

The plants collected from the communities are recorded, sorted, dried and grounded to be extractions using a solvent mixture of dichloromethane/methanol (50:50). This extraction method was adopted from the protocol established by Developmental Therapeutics Program (DTP) at National Cancer Institute, USA, for their drug discovery programmes.

Using the method above, the indigenous plants collected from the TK programme are systematically extracted, bar-coded and deposited in a library. The library not only contains the physical plant extracts but a database of information related to a plant including biological assay results and bioactive compounds isolated all prudently managed by a database system being developed at SBC called BioDNatPro Database System.

SARAWAK'S EXPERIENCE IN NATURAL PRODUCT DISCOVERY

Calanolides

In 1986, a programme to collect plant samples was carried out by the National Institute of Health (NIH) through National Cancer Institute (NCI) in different parts of the world including Sarawak. The collection in Sarawak was led by Prof. Doel Soejarto of the University of Illinois in Chicago. In 1988, research on the plants samples collected for anti-HIV and anti-cancer activities yielded a novel coumarin compound called calanolide A from *Calophyllum lanigerum*. Calanolide A was shown to be active against HIV. However, a recollection of *C. lanigerum* failed to produce sufficient amount of calanolide A required for preclinical development. A synthesis approach for calanolide A was undertaken and the product was successfully shown to be biologically identical to the natural form (Jenta & Flavin 2001). Sarawak MediScience Pharmaceuticals, Inc. (USA) owns the patents on the manufacturing process of calanolide A.

Biological Activity and Properties

Calanolide A is a non-nucleoside reverse transcriptase inhibitor (NNRTI) of HIV-1. NNRTIs suppress HIV-1 replication by binding to a region away from the active site resulting in conformational changes at the active site of the reverse transcriptase, thereby inhibiting its activity (Pomerantz & Horn 2003). NNRTIs are highly specific and are used in conjunction with other anti-HIV drugs. Some of the current NNRTIs in the market are etavirine, efavirenz, nevirapine and delavirdine.

Calanolide A is expected to undergo Phase II clinical trials in 2009. Phase IA and IB clinical trials indicated that the compound has favorable properties. It is active against a wide range of HIV-isolates and sub-types including HIV-strains that are resistant to current marketed drugs. It works in synergy with other classes of anti-HIV agents (protease inhibitors and nucleoside reverse

transcriptase). Other properties of calanolide A include a relatively long half life, mild and transient side effects (information from CRAUN Research Sdn. Bhd.). Interestingly, calanolide A is also active in inhibiting *Mycobacterium tuberculosis* (TB). This finding shed light on the potential application of natural products as therapeutic agents for acquired immunodeficiency disease syndrome (AIDS) and TB.

Silvestrol

The circumstantial events leading to the discovery of silvestrol can be an interesting subject for discussion among natural product discovery chemists. In 1996, the State Government of Sarawak signed a flora collection and research agreement with AMRAD Natural Products Pty. Ltd, Australia, to undertake the collection of plant material for screening on various types of bioassays including anti-cancer. In 2000, Cerylid Biosciences, a spin-off biotech company of AMRAD, filed a patent application for a compound called CBL316 isolated from *Algaia leptantha* (later revised to *Aglaia stellatopilosa*) which was shown to exhibit potent cytotoxic and cytostatic effects on cancer cell growth and viability. Therefore, by nature of its effects on cancer cells, this compound and its derivatives may be useful as therapeutic agents in the treatment of cancer and diseases associated with cellular proliferation (Meurer – Grimers *et al*. 2004). The patent filed by Cerylid was registered in the US in 2004. The patent was assigned to the Sarawak State Government to take over the development of the compound for anti-cancer therapy.

In the same year that the patent was registered, a multidisciplinary natural products discovery team in US headed by Dr Douglas Kinghorn from the Department of Medicinal Chemistry and Pharmacognosy, University of Illinois in Chicago, published a paper in Journal of Organic Chemistry (Hwang *et al*. 2004), to report the discovery of two cytotoxic rocaglate derivatives, named silvestrol and its enantiomer, episilvestrol, from *Aglaia silvestris* (revised to *Aglaia foveolata*). The plant was collected in Indonesia. The chemical structure of the compounds was unique and they showed potent *in-vitro* cytotoxic activity against several human cancer cell lines. Further anti-cancer analysis using *in vivo* hollow fiber test and in murine P-388 leukemia model supported the potential investigation of silvestrol as a new cancer chemotherapeutic agent.

It was a coincidence that CBL316 and silvestrol turned out to be the same compound but isolated from two different plant species collected by two different teams; one from Sarawak and one in Indonesia. In general, the compound is low in abundance and is detectable in leaves, bark, twigs and fruits.

Uses of *Aglaia* Species

Crude extracts of *Aglaia* species have been reported to be used in traditional medicine as anti-inflammatory remedies in several countries in South East Asia. It was also used for fever, fractures,

parturition, inflammation and as bactericides, insecticides, in perfumery, as an astringent, tonic, a refrigerant and for the treatment of abdominal tumors (Meurer – Grimes *et al*. 2004)

Chemical and Biological Properties of Silvestrol

Silvestrol and episilvestrol are rocaglate derivatives with an unusual dioxanyloxy unit. It is potent *in vitro* against a panel of human cancer cell lines derived from breast, prostrate and lung. The potency of silvestrol is in the range of ED_{50} 1.2 to 1.5 nM comparable to that seen for paclitaxel (ED_{50} 0.7 nM to 4.7nM) and camptothecin (ED_{50} ~ 30 nM). Epi-silvestrol on the other hand was reported to be 3 times less potent that silvestrol.

Current Status

In view of the potent activity of silvestrol towards cancer cells, Ohio State University Medical Center's Chronic Lymphocytic Leukemia (CLL) Group headed by Dr Michael Grever has been working towards the development of silvestrol in pre-clinical trials. Their work includes testing the efficacy of silvestrol in mouse cancer model that mimics the human disease of CLL.

The total synthesis of silvestrol had been achieved by two groups; Dr. John Porco's group at Boston University (El *et al*. 2007) and Dr. Mark Rizzacasa's group at University of Melbourne (Gerard et al. 2007). Both group established that synthesized silvestrol maintained their biological activity. However, the number of reaction steps and the low yield of final product from the synthesis mean that scale-up production of silvestrol at the moment is not feasible and isolation of the compound from the source may still be required.

ACKNOWLEDGEMENTS

State Government of Sarawak, Sarawak Biodiversity Centre, Sarawak Forestry Department, CRAUN Research Sdn. Bhd., Ohio State University Medical Center, National Cancer Institute.

REFERENCES

Cox, PA & Balick, MJ 1994, *Sci. Am,* vol. 270, no. 6, pp. 82–87.

El, SM, *et al*. 2007, *Angew Chem. Int. Ed. Engl.* vol. 46, no. 41, pp. 7835–7838.

Farnsworth, NR & Morris, RW 1976, *Am. J. Pharm. Sci. Support, Public Health,* vol. 148, pp. 46–52.

Gerard, B *et al*. 2007, *Angew Chem. Int. Ed. Engl.* vol. 46, no. 41, pp. 7831–7834.

Hwang, BY *et al*. 2004, *J. Org. Chem*, vol. 69, no.10, pp. 3350–3358.

Jenta, T & Flavin, M 2001, in *Biodiversity 2000 Kuching*, pp. 78–82.

Meurer-Grimes, B, Yu, J & Viaro, GL 2004, U.S. Patent 6,710,175B2, March 23.

Mi, Q *et al*. 2006, *Anticancer Res,* vol. 26, no. 5A, pp. 3349–3356.

Newman, DJ & Cragg, GM 2007, *J. Nat. Prod*, vol. 70, pp. 461–477.

Pomerantz, RJ & Horn, DL 2003, *Nature Medicine,* vol. 9, no. 7, pp. 867–873.

Raskin, I & Ripoll, C 2004, *Curr. Pharm. Des,* vol. 10, pp. 3419–3429.

Sarawak Biodiversity Centre (Amendment) Ordinance 2003.

Sarawak Biodiversity Regulations 2004.

Nutraceutical and Cosmetic Products Developed from Malaysian Biodiversity Resources

M.A. RASADAH AND A.R. LI
Medicinal Plants Programme, Forest Research Institutes Malaysia (FRIM)
52109 Selangor Darul Ehsan

Abstract

In Malaysia, medicinal plants are known to form an important component of the rain- forest biodiversity. There are over 15 000 species of higher plant found in Malaysia and about 1200 of these plant species have been reported to have potential pharmaceutical value of which some are being used as herbal medicine. In 1993, the World Health Organization (WHO) estimated that more than 3.5 billion people in the developing countries rely on plants as components of their primary healthcare. The practice of traditional medicines in Malaysia is still common among various ethnic groups, i.e. Malay, Chinese and Indian, and this knowledge has been passed down through many generations.

Herbs have many uses. Their use can be channeled into four product groups, i.e. herbal remedies, pharmaceuticals, flavor and fragrance and bio pesticides. Herbal medicinal products have taken on increasing significance as regards medical and economic importance over the last two decades, and have registered a strong comeback in developed countries in the USA, the European Union (EU), Australia and Canada. The global expansion of the herbal industry has a significant impact on the Malaysian market. In Malaysia, the herbal market, which was worth RM3.8 billion (USD1.03 billion) in 2006, is anticipated to grow with an annual growth rate of between 15 and 20 percent. The Natural Resources and Environment Deputy Minister said that the local herbal market in Malaysia is expected to exceed 8 billion ringgit (USD2.16 billion) by 2010.

There is a focus on herbs based on traditional systems of medicine and remedies based on folk knowledge due to their access, low cost and faith of the people. Natural products from medicinal and aromatic plants can be applied to a wide range of items such as herbal and traditional medicine, food and beverages, bio-pharmaceuticals, flavours and fragrances, cosmetics and toiletries, dyes, detergents, bio-pesticides and special chemicals. Considering their importance, quality is essence and guidelines for quality control at each step of production are critical to the sustainability of the product and its wider acceptance. WHO has emphasized and provided guidelines to ensure quality control of medicinal plant products using modern method. Several pharmacopoeias have provided parameters that can be used to maintain quality and standardize procedures in identification/authentication of medicinal plants and their products.

It is inevitable that in order to gain a foothold in the global herbal market, we must compete in terms of quality, safety, efficacy, pricing and even on packaging besides meeting standards of the various markets. With the development of science and technology and with the accessibility to new technologies, local herbal manufacturers must keep pace with national, regional and global demand for safe and high quality herbal products. Genuine raw materials, consistency in activity, presence of marker compounds, standardised extracts, acceptable levels of heavy metal and microbial counts are some of the parameters that producers must provide guarantee for.

This paper will highlight on some of the examples of nutraceutical and cosmetic products developed from the Malaysian bio-resources.

Medicinal plants are the major component of traditional and herbal medicines and are more recently known as medicinal products. Herbal medicinal products have taken on increasing significance as regards medical and economic importance over the last two decades, and have registered a strong comeback in developed countries in the USA, the European Union (EU), Australia and Canada. The global expansion of the herbal industry has a significant impact on the Malaysian market. In Malaysia, the herbal market, which was worth RM3.8 billion (USD1.03 billion) in 2006, is anticipated to grow with an annual growth rate of between 15 and 20 percent. The Natural Resources and Environment Deputy Minister said that the local herbal market in Malaysia is expected to exceed 8 billion ringgit (USD2.16 billion) by 2010. The government has identified medicinal plants as huge potential assets which will generate economic growth for the country. The government urged researchers, academicians and industry operators to grab the opportunity by stepping up their research and development activities to produce new medicines and market them worldwide. According to a World Bank report, the international herbal medicine market is expected to exceed USD5 trillion in 2050 with an annual growth rate of between 10 and 20 percent. Consumer interest in natural products, which are considered safe and cost effective, is responsible for their increased demand in the world market.

Despite being one of the world's 12 mega biodiversity centers, 80-90% of the country's herbal products are imported. The present supply of raw material in Malaysia comes mainly from the wild or imported from neighboring countries (i.e. mainly from China India and Indonesia; neither of these practices is good for Malaysia economically and environmentally). It is clear that, although Malaysia is endowed with a rich variety of plant species that have medicinal value, we are yet to fully utilize these bioresources to meet the local demand. The local industry is increasingly dependent on imported material, which has caused the outflow of large amounts of the nation's cash to other countries. Besides, the local industry is also exposed to the risk of price instability, low quality material and adulteration with low quality products.

In view of the increasing demand for quality medicinal and aromatic plants and in line with the recent Malaysian's policy on herbal medicine, agencies and local herbal industries have embarked upon cultivating medicinal and aromatic plants as new commodities in integrated cropping.

Medicinal Plants Demand

Medicinal and aromatic plants are used by many groups, mainly pharmaceutical and food industries, traditional or alternatives practitioners, folk or household users, and cosmetic and flavour industries. The data on demand from these sectors are sparsely available, making it difficult to estimate the exact figure from all the sectors. However the trends can be deduced from the data available from major user groups as listed below:

(a) Phytopharmaceutical

(b) Herbal medicines

(c) Natural health products (e.g. nutraceutical) and

(d) Phyto-cosmetic & personal care products.

Nutraceutical. Nutraceutical are food products supplemented with herbal ingredients, vitamins, minerals and nutrients or ingredients isolated/ purifies from conventional foods. These are the latest products in a succession of health food revolution, constituting dietary supplement, fortified foods, foods and beverages with added bioactive ingredients, and entire food regimes.

The nutraceutical industry is a promising sector with enormous growth potential. The USA leads the markets, followed by countries of Western Europe and Japan. In 1999, the global nutraceutical market was USD6.8 billion, almost thrice the value in 1987 (*Table 1*) (Theodore 1997; Freedonia Group Inc. 2001). The three main constituents of nutraceutical are herbal extracts, vitamins and mineral nutrients. The global demand fro herbal extracts in nutraceutical grew to USD2.9 billion in 1999 from USD0.5 billion in 1987, an almost four-fold rise in demand. Freedonia Group Inc. in its report in 2001 has further predicted that herbal extracts will generate the fastest growth in worldwide demand among all nutraceutical, reflecting their widely perceived health advantages.

TABLE 1. GLOBAL NUTRACEUTICAL DEMAND FROM 1987 TO 2002

Item	Demand value (Billion USD)				% annual growth	
	1987	1997	1999	2002	1987/97	1997/02
Herbal extracts	0.5	1.7	2.9	3.0	12.9	11.3
Vitamin	0.7	1.4	2.3	1.9	7.2	7.0
Minerals and nutrients	1.1	2.4	1.6	3.3	7.7	6.7
Total	2.3	5.5	6.8	8.2	8.9	8.3

Source: Theodore 1997; Freedonia Group Inc. 2001

In Malaysia, there are a few multi-national companies such as Nestle, Livita, Dutch baby Industries and others being involved in the production of health/ functional food such as low fat yoghurts, low fat milk, yoghurt and yoghurt drink, isotonic drink, fortified bread and fruit juices.

Phyto-cosmetics and personal care products (cosmeceutical). Beginning in the early 1990s, cosmetic manufacturers began to use the term Cosmeceutical to describe OTC skin care products that claim therapeutic benefits through the addition of active ingredients such as alpha-hydroxy acid and vitamins. Thus, the cosmeceutical are products that lie on the boundary between drugs and cosmetics, and possess desirable physiological activities such as skin healing, anti-oxidant, smoothing or conditioning properties.

The cosmeceutical market has grown with the addition of new active ingredients, discovery of enhanced technologies, and the spread of cosmeceutical ingredients to make–up and hair care products. Manufacturers are naw frequently replacing vitamins with herbal ingredients such as saw palmetto (*Serenoa repens* Bart.), ginseng (*Panax* spp) and gingko (*Gingko biloba* L). The Aloe vera (L.) Burm. is the most demanded plant species in the cosmeceutical industry owing to its soothing, calming and sun-protection properties. Major cosmeceutical categories include skin-care (age-defying and sun protection) products; hair-care products (hair-growth retardants and hair-growth stimulants); professional products used for appearance-enhancing facial implants, injections, chemical peels and related procedures, and other products

In the USA, the market for cosmeceutical was estimated at USD2.5 billion where the market for botanical ingredients for use in cosmetics and toiletries stood at USD345 millions in 1998 to increase 7.9% annually to reach USD505 million by 2003 and 720 million by 2008 (Table 2) (Brown 1998; Harvilicz 2000)

RESEARCH ACTIVITIES IN FRIM ON NUTRACEUTICAL AND COSMETIC

The Medicinal Plants Research in FRIM started in the late eighties as a small unit under the Forest Chemistry Division. Only then in 1995 was it established as a formal Medicinal Plant Research Programme under the Cabinet's Directive. It was given the mandate by the Government of Malaysia to lead national research activities in medicinal plants. The research units under the Medicinal Plants Program currently consist of the Bioresources, Chemistry, Therapeutic Evaluations and the Product Formulation Units and the Herbal Technology Center (HTC). This programme has a total staff strength of fifty three (53) personnel of which about 32 of them are professionals and specialized in the various fields of phytochemistry, formulation chemistry, molecular chemistry, process plant engineering and taxonomy, to name a few.

The Herbal Program at FRIM aims to promote medicinal plants research and provide technical assistance to the local herbal industry in Malaysia. Our major research activities include exploration and documentation of ethno-botanical information and local knowledge, chemical and biological profiling of medicinal plants, establishment of modern processing technology, product formulation and in the long term, identification of lead compounds for drug development. FRIM collaborates formally and informally in medicinal plants research with research institutes, universities and industry within the country as well as with international organizations. Through seminars, workshops, dialogues and training courses, FRIM brings the latest research findings, relevant issues and updated technology to researchers, industry, relevant agencies and individuals. In addition to the above, the Program also looks into sustainable harvesting of local resources; quality control of medicinal and aromatic plants and their products; development of quality standards for medicinal plants; emergence of traditional medicines in health care systems of developing countries; present trends in plant drugs, development of drugs and pertinent issues related to this challenging industry in the South East Asian and Asian regions.

Research activities initiated at FRIM have yielded encouraging results. The multi-disciplinary approach that involves chemists, biologists, pharmacologist and medical specialists as well as industries and traditional practitioners should be strengthened and further encourages. To date species such as *Eurycoma longifolia, Labisia pumila, Centella asiatica, Piper sarmentosum, Cinnamomum* sp; Garcinia atroviridis and Cymbopogon nardus has been studied scientifically and processed using modern techniques in order to produce good quality and safe products for the consumers.

New Neutraceutical and Cosmeceutical Products Development

FRIM over the last couple of years have developed a range of herbal teas, beverages, neutraceutical and cosmeceutical products and a range of standardized extracts. Many of these products have been passed on to the industry for commercialization through technology licensing agreements. The range of products is outlined in *Table 2*.

TABLE 2. PRODUCTS FOR COMMERCIALIZATION

Herbal Teas
Daun misai kuching tea
Daun mas cotek tea
Asam gulugor tea
Legundi tea

Bevarages

Beverages from Kadok leaves labeled as 'Cartilac' and 'Avonys'

Assam glugor based drink labeled as 'Trimmeal'

Ice-cream and mangosteen juice (JoyStyn)

Cosmeticeutical Products

Serai wangi body shampoo

Serai wangi hair shampoo

Serai wang insect repellent cream

Guava based day and night face cream for skin whitening

Guava based mask, toner and cleanser

Mangosteen based day and night face cream for skin whitening

Mangosteen based mask, toner and cleanser

Citrus based hand wash lotions

Natural anti-0xidants and Standardized Extracts

Kadok leave extracts

Beluntas leave extract

Pegaga leave extract

Selom leave extract

Ulam raja leave extract

Cemumar leave extract

Natural Antioxidant Skin Whitening Standardized Extracts

Pink guava leave extract

Mangosteen peel extract

Beluntas leave extract

Gajus shoot extract

Manjakani gall extract

Nutraceutical Products

Assam glugor tablets labeled as 'Betrimm'

Kacip fatimah capsules labeled as 'Biolabasia'

Tongkat Ali capsules

The industrial partners are namely, Syarikat Minyak Afiat Sdn Bhd, Furley Marketing Sdn Bhd, Herbal care Sdn Bhd and Nova Laboratories Sdn Bhd to name a few of the main players in our programme.

Problems and Constraints to Development of Nutraceutical and Cosmetics

There are several issues facing the herbal industry in Malaysia:

(a) Insufficient supply of raw material to cater the a growing industry

(b) Inconsistent quality of imported raw materials

(c) Lack of large scale cultivation/plantation of potential species of medicinal plants

(d) Lack of technologies in pest control, harvesting technologies, handling and transportations

(e) Shortage of skilled labour in the plantation as well as in the processing line

(f) Lack of standardization and quality control measures within SMI resulting in poor product quality; and

(g) Absence of scientific evidence (R&D) for health related claim.

CONCLUSION

Medicinal plants and their products have taken on increasing medicinal and economic importance. With product categories like health foods, cosmetics and personal –care products containing natural ingredients, the demand fro medicinal plants is growing exponentially. The use of herbal medicines is becoming ever more popular with rising green consumerism. Although many of the herbal resources are locally available, the major supply of raw materials or plant ingredients however is still coming from China, India and Indonesia with small amounts being harvested from the Malaysian forest. Malaysia should pursue the path of strengthening the domestic demand for Malaysian health food and medicine in order to increase domestic consumption and at the same time reduce reliance on imported herbal medicine. For the Malaysian herbal medicine to be competitive both in the domestic and global market, the product must possess the highest standard of manufacture (GMP), safety, quality and efficacy and at the same time be affordable to the ordinary people.

REFERENCES

Brown, R 1998, 'The natural way in cosmetics and skin care', *Chemical Market Reporter*, vol. 254, no. 2, pp. 8–9.

Freedonia Group Inc. 2001, *Nutraceutical, study no. 1359*, Freedonia Group Inc., Cleveland, USA.

Harvilics, H 2000, 'New activities for botanicals in personal care', *Chemical market Reporter*, vol. 257, p. 16

Theodore, S 1997, 'Nutraceuticals spur new product growth', *Beverage Industry*, vol. 88, p. 45.

Plant Diversity in Traditional *Dusun* from Different Communities in Sarawak

I.B. IPOR, C.S. TAWAN, A.N. LIEW AND M. A. CHAGAT
Faculty of Resource Science and Technology, University Malaysia of Sarawak, 94300 Kota Samarahan, Sarawak

Abstract

The study on the diversity of tree and herbaceous plants grown in traditional dusun by different communities in Sarawak were conducted at Kampung Landeh, Kuching (representing Malay community), Kampung Grogo at Bau (representing Bidayuh community) and Kampung Remun at Gedong, Samarahan (representing Iban community). Plots of 20 m × 20 m were established to obtain the floristic composition and estimated above ground biomass in the selected traditional dusuns. The most dominant tree species was Durio zibethinus for Kampung Landeh, Baccaurea bracteata for Kampung Grogo, Bau and Lansium domesticum for Kampung Remun. Gedong. The result revealed that the degree of stratification and tree size varied between dusun from different ethnic groups. The biomass of all surveyed fields ranged between 98.2 t/ha to 287.7 t/ha. The total estimated above ground biomass from Kampong Grogo, Bau was comparatively higher than those from Kampong Remun, Gedong and Kampong Landeh. Mature Koompasssia excelsa trees contributed mainly to the high value of biomass at this particular location.

Traditional *dusun* is an ecosystem (agroecosystem) with large number of interacting and interdependent physical and biological components. It is commonly comprised of mixture of several species of fruit trees and other species of different ethnobotanical importance to the local people. These traditional *dusuns* are usually able to sustain for more than 100 years that significantly displayed their complexity in plant diversity. Beside fruit trees, the complex community comprised of all kinds of other plants such as climbers, epiphytes, strangling plants, parasitic and saprophytes. However, herbaceous plants are typically non- woody and low height. They formed an important component of the ground vegetation in tropical forest (Polunin 1992). Various herbaceous crops were grown, even when the land was planted up with a tree crop (Polunin 1992). The mature *dusun* considered stable with balance in environmental factors. Continous stability wil allow its to withstand posibble perturbations in the *dusun* conditions commonly caused by moisture stress, pests and diseases occurrence, nutrient decline as a result of soil erosion and socio-cultural factors.

This paper reports on the diversity, structure and floristic composition of traditional *dusun* established by different communities in Sarawak (viz. Iban, Malay and Bidayuh).

MATERIALS AND METHODS

Field surveys were conducted in three different places in Kuching Division, Sarawak; Kg Grogo at Bau to represent Bidayuh community, Kg Remun at Gedong, Samarahan to represent Iban community and Kg. Landeh at Batu Sepuluh, Kuching to represent Malay community. These areas were chosen because of the abundant existence of mature traditional *dusuns*.

For inventory of tree species, 25 plots of 20 m × 20 m (every plot was divided into 4 subplots of 10 × 10 m) were randomly established for each Kampong. All plants of ≥2.5 cm-diameter breast height (dbh) were enumerated. All specimens were collected for identification. The above ground biomass, total leaf area (one side only), basal area, relative frequency, relative density, relative dominance and important values of tree species were determined for every species by following method described by Brower *et al*. (1990) and Yamakura *et al*. (1986).

RESULTS AND DISCUSSIONS

At Kampung Landeh, Durian, *Durio zibethinus* was identified as the most dominant species with the highest Importance Value (Iv = 40.45). The ranking was followed by Getah, *Hevea brasiliensis* (Iv = 28.27), Cempedak, *Artocarpus integer* (Iv = 24.41), Terap, *Artocarpus rigidus* (Iv = 19.45) and Koko, *Theobroma cacao* (Iv = 16.94). The estimated total above ground biomass was 98.2 t/ha with the leaf area index of 1.72 ha/ha. Pelaik, *Alstonia sp.* has the highest estimated total above ground biomass of 2.17 t/ha followed by *Artocarpus rigidus* (1.95 t/ha) and *Artocarpus odoratissimus* (0.55 t/ha) (*Table 1*).

A total of 33 species from 316 trees had been enumerated in the plots at Kampung Grogo. Of these, *Baccaurea bracteata* was the most dominant with the highest Important value (Iv = 41.89); followed by *Koompassia excelsa* (Iv = 28.60), *Nauclea spp*. (Iv = 27.29*), Lansium domesticum* (Iv = 26.82) and Adicea (Iv = 22.17) as shown in *Table 2*. The least dominant species was *Xanthophyllum amoenum* (Iv = 1.30). *Durio zibethinus* was the most abundant with the average DBH and height of 46.51 cm and 28.22m respectively. The estimated total above ground biomass of *Durio zibethinus* from Grogo was 28.77 t/ha. *Koompassia excelsa* has the highest estimated total above ground biomass (7.29 t/ha) followed by *Artocarpus odoratissimus* (5.97 t/ha), *Pangium edule* (5.21 t/ha), *Mangifera grafithii* (1.92 t/ha), *Mangifera quadrifida* (1.80 t/ha) and *Litsea garciae* (1.69 t/ha) (*Table 2*).

TABLE 1. IMPORTANCE VALUES AND ESTIMATED ABOVE GROUND BIOMASS OF TREES WITH A DBH OF >2.5 CM FOUND AT KAMPUNG LANDEH, KUCHING. (WS = WEIGHT OF STEMS, WB = WEIGHT OF BRANCHES, WL = WEIGHT OF LEAVES)

Species	Iv	Total Tree (d)	Average dbh (cm)	Average height (m)	ws (kg)	wb (kg)	wl (kg)	Biomass (kg)
Durio zibethinus	40.45	112	28.49	20.40	288.62	48.06	7.66	344.34
Hevea brasiliensis	28.27	77	19.78	15.41	107.10	16.82	3.69	127.61
Artocarpus integer	24.41	54	21.14	16.10	127.38	20.21	4.22	151.81
Artocarpus rigidus	19.45	5	55.54	24.80	1295.83	235.76	29.10	1560.69
Theobroma cacao	16.94	47	8.10	5.15	6.33	0.84	0.62	7.80
Estonia sp.	14.28	1	51.30	32.50	1445.76	264.74	24.83	1735.33
Artocarpus odoratissimus	13.38	17	31.62	21.18	367.42	62.06	9.43	438.91
Areca catechu	12.54	40	12.38	12.54	34.88	5.13	1.45	41.45
Mangifera indica	11.43	14	27.21	16.25	210.97	34.48	6.99	252.44
Baccaurea motleyana	10.84	9	36.88	13.17	311.78	52.15	12.83	376.76
Lansium domesticum	10.29	17	16.1	12.00	55.94	8.46	2.45	66.84
Nephelium lappaceum	8.86	16	16.88	9.00	46.29	6.92	2.69	55.89
Shorea macrophylla	8.64	6	30.33	16.67	267.68	44.37	8.68	320.73
Cocos nucifera	7.29	7	27.30	17.79	232.07	38.15	7.03	277.25
Garcinia mangostana	6.63	4	24.63	10.88	117.04	18.48	5.72	141.24
Artocarpus dadah	5.53	1	30.20	20.00	317.37	53.14	8.61	379.12
Maducha borneensis	5.02	1	28.50	18.20	258.22	42.71	7.66	308.60
Pithecolobium lobatum	4.91	6	13.67	9.83	33.36	4.89	1.76	40.02
Dracontomerlon doa	4.60	1	27.00	17.00	217.19	35.56	6.88	259.63
Canarium odontophyllum	3.98	6	16.43	13.83	66.91	10.22	2.55	79.68
Garcinia parvifolia	3.98	3	19.83	11.50	80.76	12.47	3.71	96.94
Eugenia aquea	3.78	6	15.17	11.33	47.05	7.04	2.17	56.26
Artocarpus sericicarpus	3.35	3	16.40	14.00	67.48	10.31	2.54	80.33
Baccaurea bracteata	3.35	1	22.00	17.00	145.31	23.23	4.57	173.11
Evodia lunur-ankenda	3.35	1	22.00	19.50	166.25	26.80	4.57	197.61
Litsea garciae	2.90	3	6.90	8.00	7.12	0.95	0.45	8.53
Mangifera odorata	2.86	4	11.50	6.38	15.55	2.18	1.25	18.98
Garcinia atroviridis	2.36	1	17.00	14.00	72.41	11.11	2.73	86.25
Ficus sp.	2.32	2	10.40	10.00	19.84	2.82	1.02	23.68
Eugenia jambos	2.16	2	8.75	7.50	10.66	1.46	0.72	12.84
Fragraea fragrans	1.62	1	12.00	14.00	36.55	5.39	1.36	43.30
Neolarmarkia cadamba	1.48	1	10.80	6.00	12.94	1.79	1.10	15.84
Mangifera pajang	1.47	1	10.70	6.00	12.71	1.76	1.08	15.55
Garcinia nitida	1.39	1	10.00	7.50	13.85	1.93	0.94	16.72
Macaranga sp.	1.34	1	9.40	9.00	14.67	2.05	0.83	17.55
Parkia javanica	1.33	2	6.85	8.00	7.02	0.94	0.44	8.41
Flacourtia rukam	1.25	1	8.50	8.50	11.38	1.57	0.68	13.63
Averrhoa carambola	0.99	1	4.50	3.00	1.18	0.14	0.19	1.51
Vernonia arborea	0.99	1	4.50	2.50	0.98	0.12	0.19	1.29
Total	–	477	–	–	–	–	–	78541.46 @ 785.4 t/ha

TABLE 2. IMPORTANCE VALUES AND ESTIMATED ABOVE GROUND BIOMASS OF TREES WITH A DBH >3.0 CM FOUND AT KAMPUNG GROGO IN BAU DISTRICT. (IV = IMPORTANCE VALUE, WS = WEIGHT OF STEMS, WB = WEIGHT OF BRANCHES, WL = WEIGHT OF LEAVES)

Species	Iv	Total Tree (d)	Average dbh (cm)	Average height (m)	ws (kg)	wb (kg)	wl (kg)	Biomass (kg)
Adicea sp.	22.17	1	12.50	13.00	36.82	5.43	1.39	43.64
Garcinia mangostana	11.06	4	13.68	12.25	41.46	6.16	1.51	49.14
Artocarpus odoratissimus	9.04	1	74.10	43.50	3960.62	769.68	42.80	4773.09
Canarium odonthophyllum	5.40	1	7.70	11.00	12.08	1.67	0.61	14.36
Santiria tomentosa	5.29	1	9.20	9.00	14.06	1.96	0.69	16.71
Durio oxleyanus	5.01	2	18.45	15.75	95.44	14.89	2.79	113.12
Artocarpus integer	2.12	27	29.22	18.89	281.27	46.76	6.16	334.19
Artocarpus dadah	1.48	1	13.00	12.00	36.76	5.42	1.39	43.57
Nephelium lappaceum	1.48	13	24.01	17.00	172.51	27.86	4.30	204.67
Baccaurea motleyana	1.47	3	24.93	14.33	157.05	25.23	4.02	186.30
Baccaurea angulata	1.39	5	15.80	11.80	53.03	7.99	1.81	62.83
Mangifera grafithii	1.38	1	48.70	32.00	1285.75	233.82	18.75	1538.32
Theobroma cacao	1.34	6	7.65	6.30	6.90	0.92	0.41	8.23
Ficus sp.	1.32	3	10.63	11.83	24.42	3.52	1.03	28.97
Mangifera pajang	1.32	3	25.53	21.00	239.43	39.43	5.47	284.33
Xanthophyllum amoenum	1.30	1	8.10	9.00	10.95	1.50	0.57	13.03
Pangium edule	4.96	1	75.00	37.00	3460.03	667.06	38.76	4165.85
Hevea brasiliensis	9.94	62	20.71	16.62	126.23	20.02	3.42	149.67
Saurauia sp.	7.92	1	9.00	11.00	16.40	2.31	0.77	19.48
Knema kunstleri	2.92	1	8.10	11.00	13.34	1.85	0.66	15.85
Tristania sp.	9.90	1	23.70	28.00	274.40	45.55	6.05	326.00
Shorea macrophylla	1.86	27	19.55	17.46	118.31	18.69	3.26	140.27
Mangifera quadrifida	2.80	4	48.58	30.00	1201.02	217.53	17.84	1436.39
Stemonurus sp.	2.80	1	10.40	16.00	31.47	4.60	1.24	37.30
Pleiocarpidia sp.	4.71	2	10.70	10.50	22.01	3.15	0.95	26.11
Baccaurea bracteata	41.89	4	13.73	14.75	50.11	7.53	1.74	59.38
Durio zibethinus	19.82	72	46.51	28.22	1038.40	186.47	16.03	1240.91
Koompassia excelsa	28.60	3	85.17	40.33	4832.73	950.25	49.52	5832.49
Lansium domesticum	26.82	47	28.99	19.49	285.57	47.52	6.22	339.31
Litsea garciae	17.84	8	46.36	31.06	1133.65	204.63	17.10	1355.38
Macaranga sp.	16.81	8	7.34	9.19	9.22	1.25	0.50	10.97
Nauclea sp.	27.29	1	22.10	14.00	121.17	19.17	3.32	143.66
Total	–	316	–	–	–	–	–	23013.51 @ 230.1 t/ha

Floristically, traditional *dusun* at Kampung Remun in Gedong was moderately rich and possessed the second highest number of species in relation to other kampungs. A total of 607 trees belonging to 38 species were enumerated. Their diameter breast height (dbh) and height ranged from 2.5 cm to 101.0 cm and 2.0m to 46.5m, respectively (*Table 3*). *Lansium domesticum* or locally called *'Langsat'* was the most dominant species with an important value of 43.49. These trees occurred conspicuously in every plot surveyed. Other dominance species that followed in order of ranking included *Ficus* sp., *Durio zibethinus*, *Theobroma cacao*, *Artocarpus odoratissimus* and *Baccaurea motleyana*. *Artocarpus altilis* was observed to be the least dominant species. The estimated total above ground biomass of this locality was 205.2 t/ha. *Ficus* spp. contributed 44.76% or 9.18 t/ha of the total biomass. The ranking was then followed by *Artocarpus odoratissimus, Xanthophyllum amoenum, Lansium domesticum, Artocarpus sericicarpus, Baccaurea bracteata, Croton argyratus* and *Durio zibethinus*. The leaf area index of this forest was 2.50 ha/ha.

Large woody climbers reaching the upper canopy were of frequent occurrence especially in traditional orchards at Kampung Grogo (*Table 4*) and this also included several species of rattans. Epiphytes were also numerous including bryophyte covered most of tree crowns. The traditional orchards involved during the survey had luxuriant growth of bamboo, *Tetratophyllum* and *Nephrolepis* ferns.

The tree heights and girths contribute to the various stratification of *dusun*. The variations between individual trees and species composition are major factors to differentiate different characteristic of *dusun* raised by different communities *Table 5* and *6*. The traditional *dusun* communities are made up of different overlapping sub-populations consisting of individuals of different species and ages. The individual trees in the *dusun* are also different in their dimensions and geometrical shapes as similarly observed by Richard (1952) and Whitmore (1984) in tropical rainforest. The complexity of each individual tree can also be severely affected by the presence of its neighbours in a specific area (Hozumi *et al*. 1955; Mithen *et al*. 1984). The shading of small trees by the canopy of big trees can also primarily influence forest stratification in the traditional *dusun*.

In term of fruit trees, *Durio zibethinus, Langsium domesticum, Artocarpus rigidus, Artorcarpus integers, Bacccaurea motleyana, Pangium edule, Mangifera indica* and *Garcinia mangostana* are the most popular which occurred most of the plots. These species are highly prefferred by the local people for both their own consumption and sale in the local market. Good fruit season normally provide them satisfactory financial return from sale of these fruits.

One of the main characteristics distinguishing agricultural ecosystem from natural ecosystems is the primary role that human activities in manipulating the vegetational structure and functions of the agroecosystem. The traditional *dusun* provides products not only for human consumption but also for the numerous other species of living organisms that can affect functions of the agroecosystem. Some of these organisms are pests which compete with crops or feed upon crops.

TABLE 3. IMPORTANCE VALUES AND ESTIMATED ABOVE GROUND BIOMASS OF TREES WITH A DBH OF >3.0 CM FOUND AT KAMPUNG REMUN, GEDONG. (IV = IMPORTANCE VALUE, WS = WEIGHT OF STEMS, WB = WEIGHT OF BRANCHES, WL= WEIGHT OF LEAVES)

Species	Iv	Total Tree (d)	Average dbh (cm)	Average height (m)	ws (kg)	wb (kg)	wl (kg)	Biomass (kg)
Adicea sp.	22.17	1	12.50	13.00	36.82	5.43	1.39	43.64
Lansium domesticum	43.49	149	31.5	46.5	788.98	139.40	9.36	937.74
Ficus sp.	35.95	2	101.0	36.0	6040.73	1203.51	96.25	7340.49
Durio zibethinus	34.01	105	36.5	21.1	484.33	83.15	12.54	580.02
Theobroma cacao	33.49	164	10.7	6.7	14.18	1.98	1.09	17.25
Artocarpus odoratissimus	12.63	4	52.0	28.3	1293.96	235.40	25.51	1554.87
Baccaurea motleyana	12.43	29	21.4	13.9	113.01	17.80	4.33	135.14
Artocarpus sericicarpus	10.69	6	43.0	19.2	607.61	105.71	17.40	730.73
Xanthophyllum amoenum	10.65	5	45.6	25.8	914.78	163.05	19.62	1097.44
Garcinia mangostana	10.52	17	9.1	7.4	11.33	1.56	0.78	13.67
Nephelium mutabile	8.56	5	15.3	11.4	48.13	7.21	2.21	57.55
Areca catechu	7.91	16	12.6	12.4	35.99	5.30	1.51	42.79
Shorea macrophylla	7.73	20	22.5	17.7	158.13	25.41	4.78	188.32
Litsea garciae	5.64	9	15.0	15.4	62.64	9.53	2.13	74.30
Mangifera pajang	5.59	7	17.6	13.3	73.74	11.33	2.93	88.00
Croton argyratus	5.12	4	33.3	25.5	486.54	83.55	10.43	580.51
Baccaurea bracteata	5.04	1	35.0	26.0	548.42	94.84	11.56	654.81
Pangium edule	4.86	6	23.2	21.7	204.32	33.34	5.07	242.73
Artocarpus integer	4.45	5	16.5	14.3	69.39	10.62	2.56	82.57
Nephelium lappaceum	4.33	23	14.4	13.1	49.21	7.38	1.96	58.56
Nephelium sp.	4.05	3	29.0	26.7	388.70	65.87	7.93	462.50
Garcinia nitida	3.92	1	30.0	23.0	359.31	60.61	8.49	428.41
Baccaurea angulata	3.82	5	9.2	11.6	18.04	2.55	0.80	21.39
Durio oxleyanus	2.90	2	23.5	19.5	189.22	30.73	5.21	225.17
Cocos nucifera	2.81	1	24.0	26.0	261.53	43.29	5.43	310.26
Mangifera torquenda	2.81	1	24.0	18.5	187.28	30.40	5.43	223.11
Mangifera indica	2.62	1	22.8	15.0	137.84	21.97	4.90	164.72
Mangifera odorata	2.11	3	8.8	8.2	11.72	1.62	0.73	14.06
Mangifera quadrifida	1.78	2	5.3	7.0	3.66	0.47	0.26	4.39
Macaranga sp.	1.18	1	10.0	12.0	21.97	3.14	0.94	26.05
Dillenia suffructicosa	1.17	2	7.0	9.0	8.23	1.11	0.46	9.80
Artocarpus anisophyllus	1.12	1	9.0	11.0	16.40	2.31	0.76	19.47
Annona squamosa	1.03	1	7.5	6.0	6.33	0.84	0.53	7.70
Dacryodes cuspidata	1.01	1	7.0	8.0	7.33	0.98	0.46	8.77
Hevea brasiliensis	0.99	1	6.5	7.0	5.56	0.73	0.40	6.69
Eugenia jambos	0.93	1	5.0	2.0	0.97	0.12	0.24	1.32
Lepisanthes alata	0.92	1	4.8	4.0	1.77	0.22	0.22	2.21
Citrus sp.	0.88	1	3.5	4.0	0.95	0.11	0.12	1.18
Artocarpus altilis	0.86	1	2.5	6.0	0.73	0.09	0.06	0.88
Total	–	607	–	–	–	–	–	16415.59 or 164.15 t/ha

TABLE 4. THE QUANTITATIVE ESTIMATES OF THE 52 HERBACEOUS SPECIES PRESENT TRADITIONAL *DUSUN* AT KAMPONG GROGO, BAU

Taxon	Rd* (%)	Rf** (%)	SDR*** (%)
Axonopus compressus	22.779	5.464	14.122
Ageratum conyzoides	9.782	4.372	7.077
Eleusine indica	8.924	4.918	6.921
Phyllanthus niruri	6.489	5.464	5.977
Cyperus kyllingia	5.339	4.918	5.129
Hedyotis corymbosa	6.391	3.825	5.108
Lindernia crustacea	5.027	3.825	4.426
Borreria repens	3.780	4.918	4.349
Digitaria cilliaris	4.930	2.732	3.831
Cleome rutidosperma	2.553	4.372	3.462
Paspallum conjugatum	2.553	4.372	3.462
Peperomia pellucida	3.624	2.732	3.178
Sida acuta	1.130	4.372	2.751
Cyperus cephalotes	2.280	2.186	2.233
Emilia sanchifolia	2.825	1.639	2.232
Panicum repens	1.559	2.732	2.146
Mikania micrantha	0.624	3.279	1.951
Euphorbia hirta	1.637	2.186	1.911
Sacciolepis myosuroides	1.247	1.639	1.443
Amaranthus spinousus	0.565	2.186	1.375
Cyperus compressus	0.487	2.186	1.336
Erigeron sumatrensis	0.409	2.186	1.297
Crytococcum acrescens	0.292	2.186	1.239
Asystasia intrusa	0.370	1.639	1.005
Paspallum commersonii	0.818	1.093	0.956
Ludwigia hyssopifolia	0.253	1.639	0.946
Cyperus rotundus	0.156	1.639	0.898
Fimbristylis miliacae	0.351	1.093	0.722
Digitaria longifolia	0.682	0.546	0.614
Melastoma malabathricum	0.058	1.093	0.576
Blechnum orientale	0.039	1.093	0.566
Syngonium podophyllum	0.429	0.546	0.488
Cyperus flavidus	0.390	0.546	0.468
Hypetis brevipes	0.195	0.546	0.371
Ipomea ni	0.136	0.546	0.341
Borreria latifolia	0.097	0.546	0.322
Brachiaria reptans	0.097	0.546	0.322
Cyperus brevifolius	0.097	0.546	0.322
Cyperus distan	0.097	0.546	0.322
Echinocloa colonum	0.097	0.546	0.322
Fimbristylis tomentosa	0.078	0.546	0.312
Ficus aurata	0.058	0.546	0.302
Spinifex literous	0.058	0.546	0.302
Ficus acuta	0.039	0.546	0.293
Paspallum vaginatum	0.039	0.546	0.293
Ficus orata	0.019	0.546	0.283
Fimbristylis globulosa	0.019	0.546	0.283
Hyptis capitata	0.019	0.546	0.283
Impatiens balsamina	0.019	0.546	0.283
Laurentia longifolia	0.019	0.546	0.283
Neolamarckia kedamba	0.019	0.546	0.283
Nephrolepis biserrata	0.019	0.546	0.283

TABLE 5. THE QUANTITATIVE ESTIMATES OF THE 50 HERBACEOUS SPECIES PRESENT IN TRADITIONAL *DUSUN* AT KAMPONG LANDEH, KUCHING

Taxon	Rd* (%)	Rf** (%)	SDR*** (%)
Axonopus compressus	14.071	7.143	10.607
Ageratum conyzoides	12.144	4.286	8.215
Lindernia crustacea	7.788	7.143	7.465
Paspalum conjugatum	8.580	5.714	7.147
Phyllanthus niruri	6.415	5.000	5.707
Eleusine indica	5.808	5.000	5.404
Sacciolepis myosuroides	2.270	5.000	3.635
Cyperus pygmaeus	5.121	2.143	3.632
Euphorbia hirta	4.356	2.857	3.607
Cyperus compressus	2.640	3.571	3.106
Cyperus kyllingia	3.300	2.857	3.079
Cyperus brevifolius	2.165	2.857	2.511
Mimosa pudica	1.795	2.857	2.326
Borreria repens	2.112	2.143	2.127
Mikania micrantha	1.030	2.857	1.943
Spinefex literous	1.637	2.143	1.890
Peperomia pellucida	1.742	1.429	1.585
Fimbristylis miliacea	0.950	2.143	1.547
Sida acuta	0.924	2.143	1.533
Borreria latifolia	1.584	1.429	1.506
Hedyotis corymbosa	0.713	2.143	1.428
Imperata cylindrica	0.449	2.143	1.296
Hyptis capitata	0.290	2.143	1.217
Crytococcum acrescen	0.950	1.429	1.189
Digitaria ciliaris	0.871	1.429	1.150
Hydrocotyle asiatica	1.584	0.714	1.149
Cynodon dactylon	1.320	0.714	1.017
Clidermia hirta	0.396	1.429	0.912
Cyperus elatus	1.056	0.714	0.885
Ipomea aquatica	0.317	1.429	0.873
Syngonium podophyllum	0.290	1.429	0.859
Panicum paludosum	0.792	0.714	0.753
Labisia pothoina	0.792	0.714	0.753
Paspalum scabilium	0.686	0.714	0.700
Fimbristylis dichotoma	0.528	0.714	0.621
Laurentia longifolia	0.422	0.714	0.568
Cyperus malaccensis	0.396	0.714	0.555
Physalis minima	0.396	0.714	0.555
Alternanthera sessilis	0.264	0.714	0.489
Nephrolepis biserrata	0.264	0.714	0.489
Asystasia intrusa	0.132	0.714	0.423
Cyperus flavidus	0.132	0.714	0.423
Ischaemum magnum	0.132	0.714	0.423
Cyperus sphacelanthus	0.106	0.714	0.410
Manihot esculenta	0.079	0.714	0.397
Athrium asculentum	0.053	0.714	0.384
Cleome rutidosperma	0.053	0.714	0.384
Premna cordifolia	0.053	0.714	0.384
Ipomea reptans	0.026	0.714	0.370
Ludwigia hyssopifolia	0.026	0.714	0.370

TABLE 6. THE QUANTITATIVE ESTIMATES OF THE 39 HERBACEOUS SPECIES PRESENT IN TRADITIONAL *DUSUN* AT KAMPONG REMUN, GEDONG

Taxon	Rd* (%)	Rf** (%)	SDR*** (%)
Axonopus compressus	14.071	7.143	10.607
Borreria repens	13.790	5.921	9.856
Hedyotis corymbosa	10.312	6.579	8.445
Eleusine indica	8.349	6.579	7.464
Phyllanthus niruri	8.349	5.921	7.135
Cyperus cephalotes	8.210	4.605	6.408
Paspalum conjugatum	5.751	6.579	6.165
Cyperus kyllingia	4.146	5.263	4.705
Cyperus pygmaeus	6.109	2.632	4.370
Ageratum conyzoides	2.761	4.605	3.683
Torenia violacea	2.892	3.947	3.419
Eragrostis unioloides	2.696	3.289	2.993
Ludwigia hyssopifolia	0.961	4.605	2.783
Cyperus flavidus	2.826	2.632	2.729
Rorripa indica	2.688	2.632	2.660
Emilia sonchifolia	1.727	3.289	2.508
Echinochloa colonum	2.973	1.974	2.473
Euphorbia hirta	1.548	3.289	2.419
Artanema longifolium	2.444	1.974	2.209
Cyperus sphacelatus	1.401	2.632	2.016
Axonopus compressus	0.692	3.289	1.991
Fimbristylis globulosa	1.914	1.316	1.615
Leersia hexandra	0.611	1.974	1.292
Digitaria longiflora	1.629	0.658	1.143
Cyperus rotundus	1.385	0.658	1.021
Lindernia crustacea	0.652	1.316	0.984
Cleome rutidosperma	0.456	1.316	0.886
Bergia ammannioides	0.407	1.316	0.862
Peperomia pellucida	0.114	1.316	0.715
Impatiens balsamina	0.057	1.316	0.686
Fimbristylis tomentosa	0.652	0.658	0.655
Grangea maderaspatana	0.652	0.658	0.655
Sacciolepis myosuroides	0.367	0.658	0.512
Eriochloa polystachya	0.163	0.658	0.410
Erigeron sumatrensis	0.138	0.658	0.398
Bergia capensis	0.081	0.658	0.370
Hyptis capitata	0.041	0.658	0.349
Nephrolepis biserrata	0.033	0.658	0.345
Nicotiana tabacum	0.016	0.658	0.337
Blumea lacera	0.008	0.658	0.333

* : Relative density
** : Relative frequency
*** : Summed Dominance Ratio

Other organisms are beneficial and essential in sustaining crop production on a long term basis. Traditional *dusun* or agroecosystem of Malaysia are notable for the complexity of their structure (Hussein 1984). Multiple cropping or the use of more than one kind of crops in the same field is a common practice (Gomez & Gomez 1983).

REFERENCES

Brown, S, Gillespie, AJR & Lugo AE 1989, 'Biomass estimation methods for tropical forests with applications to forestry inventory data', *Forest Science vol.* 35, no. 4, pp. 881 – 902

Gomez, AA & Gomez KA 1983, 'Multiple cropping in humid tropics of Asia,' Inter. Dev. Research Centre (IRDC) Report No. IRDC – 176 e, Ottawa, Canada.

Hussein, MY 1984, 'Perception and management of pests and pesticides by Malaysia traditional small farmers', in *Management of pest and pesticides*, eds J Tait & B Napompeth, Westriew Press, Boulder.

Kim, SC & Moody, K 1983, 'Minimum sampling size and minimum quadrat number for weed data collection in transplanted rice', *Korean Journal of Crop Science, vol.* 8, no. 3, pp. 319 – 22.

Kueh, TK, Lim, LL & Fatimah, O 1993, *Weeds and weed management in pepper cultivation*. Department of Agriculture Sarawak, Malaysia.

Polunin, I 1992, *Plants and flowers of Malaya*. Times Edition, New Industrial Road, Singapore.

Richards, PW, 1952 *The tropical rain forest: an ecological study*, Cambridge University Press, Cambridge.

Voon, BH, Chin, TH, Sim, P & Sabariah, P 1990, *Wild fruit and vegetable in Sarawak,* 2 edn, Department of Agriculture, Sarawak, Malaysia.

Yamakura, T, Hagihara, A, Sukardjo, S & Ogawa, H, 1986, aboveground biomass of tropical rain forest stands in Indonesian Borneo', *Vegetatio,* vol. 68, pp. 71–82.

Strategy for Marine Biodiversity Conservation under the Sulu-Sulawesi Marine Ecoregion Conservation Plan: From Reefs to Ecoregion to Reefs

A.S. CABANBAN
Sulu-Sulawesi Marine Ecoregion Programme,
WWF-Malaysia

Abstract

Conservation of marine ecosystems in the whole world lags behind terrestrial conservation as reflected in the percentage of areas under protection. Less than 1% of the surface of the oceans area and about 1.4% of the coastal areas are protected compared to 10 % terrestrial forests in various biomes that are currently protected in different categories. The need to protect more marine ecosystems for its biodiversity and this assessment of progress prompted the Conference of Parties of the Convention on Biological Diversity (CBD 2002) to set bold and time-bound targets in its Plan of Action for Protected Areas to:

2002–2006 — Advance implementation of the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities and the Montreal Declaration on the Protection of the Marine Environment from Land-based Activities … on municipal wastewater, the physical alteration and destruction of habitats, and nutrients ….; par. 33.

2004 — Urgently develop and implement national, and where appropriate, regional plans of action, to put into effect the international plans of action of the Food and Agriculture Organization of the United Nations, in particular the International Plan of Action to Prevent, Deter, and Eliminate Illegal, Unreported and Unregulated Fishing; par. 31d.

2004 — Establish a regular process under the United Nations for global reporting and assessment of the state of the marine environment, including socio-economic aspects, both current and foreseeable, building on regional assessments; par. 36b.

2005 — Urgently develop and implement national, and where appropriate, regional plans of action, to put into effect the international plans of action of the Food and Agriculture Organization of the United Nations, in particular the International Plan of Action for the Management of Fishing Capacity by 2005; par. 31d.

2012 — Encourage the application of the Ecosystem Approach, Reykjavik Declaration of Responsible Fisheries in the Marine Ecosystem, and decision V/6 of Conference of Parties (CoP, CBD); par. 30d.

2012 — Develop and facilitate the use of diverse approaches and tools, including the Ecosystem Approach, the elimination of destructive fishing practices, the establishment of marine protected areas consistent with international law and based on scientific information, including representative networks.

2015 — Maintain or restore stocks to levels that can produce maximum sustainable yields …; par. 31a.

In the countries of the Association of Southeast Asian Nations (ASEAN), regional marine conservation has its beginnings under the East Asian Seas Programme of the United Nations Environment Programme and the ASEAN-Australia Living Coastal Resources Project (mid-1980s to mid-1990s). The East Asian Seas Programme includes a vast area of marine ecosystems that includes the South China Sea, Indonesian Seas, Sulu Sea, Sulawesi Sea, and part of the northern, tropical waters of Australia. These seas form Large Marine Ecoregions that are considered geographic units for marine conservation.

The World Wide Fund for Nature (WWF) facilitated ecoregional conservation of Large Marine Ecosystems in the world in the mid-1990s. The Sulu-Sulawesi Marine Ecoregion, in the territories of Indonesia, Malaysia, and the Philippines, was one the ecoregions that was high in the list for conservation because of the high diversity and the need to address growing threats to the survival of this diversity. The national offices of WWF in Indonesia, Malaysia, and the Philippines facilitated planning consultations in the respective countries towards the Sulu-Sulawesi Marine Conservation Plan. The governments of the three countries signed a Memorandum of Understanding at the Conference of Parties of the CBD in Kuala Lumpur in 2004 that was ratified by the legislature of these countries by 2006. The SSME Conservation Plan since then became a government-led marine conservation programme that has the potential in meeting their respective governmental commitments to the Convention on Biological Diversity.

The Sulu-Sulawesi Marine Ecoregion Conservation Plan has a Vision to ensure that the unique marine biodiversity in this ecoregion remains the same in the future, that this marine ecoregion continues to provide for the economic and cultural needs of the peoples living in the coastal waters, and that the management of these ecoregion is participatory across cultural and political boundaries. Priority Conservation Areas were selected by representatives of the three countries at the Biodiversity Visioning Workshop in Manila in 2001. Ten objectives on ecological, socio-economic, and management goals for biodiversity conservation were outlined. Activities towards achieving these objectives were prepared for Marine Protected Areas, Sustainable Fisheries, and Charismatic and Endangered Species. The governments have formed SSME National Committees

to implement these Actions in their respective countries and a Tri-national Steering Committee whose chairmanship is rotated among the countries. Malaysia holds the chairmanship of the Tri-national Steering Committee and the implementing agency is the Department of Fisheries, Sabah. The governmental agencies with the environmental mandates in the respective countries and the stakeholders, including WWF and Conservation International Foundation, implement projects in the SSME. The Sulu-Sulawesi Marine Ecoregion Programme of WWF-Malaysia implements projects, with the support of the coastal district offices of Kudat, Pitas, Marudu, and Semporna and with the collaboration of Sabah Parks and the Department of Fisheries and TRAFFIC-Southeast Asia in the Kudat, Sandakan, and Semporna Priority Conservation Areas.

The SSME Conservation Plan is further supported by the governments in having this as one of the two flagship environmental programmes of the Brunei-Indonesia-Malaysia-Philippines East Asia Growth Programme (BIMP-EAGA). The adoption provides another regional, inter-governmental channel for implementing marine biodiversity conservation for sustainable development. The ratification by the governments and the adoption by the BIMP-EAGA are steps towards meeting commitments as signatories to the CBD and achieving Targets under the Plan of Action for marine conservation. The stewardship of the Sulu-Sulawesi Marine Ecoregion and its resources under this administrative structure requires financing that the tri-national Committee is now addressing. With sustainable financing, either from governmental allocations and grants, this conservation strategy to 'scale-up from reefs to ecoregion to implement down to reefs' will enable the realization of the ecoregional vision for marine biodiversity conservation.

Biodiversity Conservation in Taman Negara Malaysia: Allignment of International Treaties and National Policies

S.S. SULAIMAN AND R.M. KHALID
Faculty of Law, Universiti Teknologi MARA, Shah Alam, Selangor

Abstracts

Conservation of biodiversity includes the conservation of flora and fauna, variety among living organisms and the ecological communities which they inhabit. Three kinds of biodiversity which are essential to preserve the global ecosystem are: (1) genetic diversity which describes the variation of genes within a species; (2) species diversity describing the number of different kinds of organisms within individual communities or ecosystems and (3) ecological diversity which assesses the richness and complexity of a biological community including the number of niches, trophic levels and ecological processes that capture energy, sustain food webs and recycle materials within this. Through the introduction of National Physical Plan in 2006, the government of Malaysia had already gazzetted national and state parks, wildlife reserve or sanctuaries, marine parks, protected forests and other areas designated for statutory protection as a protected areas. A protected area is defined by the International Union for the Conservation of Nature as "an area of land or sea especially dedicated to the protection and maintenance of biological diversity and of natural and associated cultural resources and managed through legal or other effective means". As one of the protected areas, Taman Negara has been seen as a place suitable for the conservation of biological diversity. Taman Negara or the national park of Malaysia is the largest protected area in Malaysia covering an area of 434 350 ha of pristine tropical rain forest. It is one of the oldest rainforest in the world, estimated about 130 million years old. It is the home to 14 500 flowering plants and trees, 600 species of birds, 200 species of mammals, 350 species of reptiles and numerous species of insects and other life forms. In line with the National Physical Plan of 2006 and Malaysia's National Policy on Biological Diversity of 1998, Taman Negara should be managed effectively and in a sustainable manner in order to ensure a proper and systematic usage of natural resources. The effectiveness of the management of the National Park can be measured through policy and law enforcement. This article highlights several national and international legal frameworks governing conservation of biological diversity in the national park of Malaysia. A reference to the International treaties will shed a light on the improvement of the management of the National Park in order to conserve its biological diversity.

LEGAL FRAMEWORK ON NATIONAL PARK IN MALAYSIA

Malaysia plays an active role in conserving biological diversity, as the country is rich with natural resources that need to be used in a sustainable manner. With this regard, Malaysia's National Policy on Biological Diversity was officially declared on 16 April 1998 by the Ministry of Science, Environment and Technology (Ministry of Natural Resources and Environment). This policy aim to conserve Malaysia's biological diversity and to ensure that its components are utilized in a sustainable manner for the continued progress and socio-economic development of the nation.

According to the Malaysia's National Policy on Biological Diversity, there is no single comprehensive legislation in Malaysia which relates to biological diversity conservation. Much of the legislation is sector-based, for instance, the *Fisheries Act 1985* deals mainly with the conservation and management of fisheries resources, the *Protection of Wild Life Act 1972* deals with the protection of wildlife, and the *National Forestry Act 1984* deals with the management and utilization of forests alone. Not to be mentioned, these Acts have it own flaws and are toothless. Taken for example the *Protection of Wild Life Act 1972* which has been criticized recently as this Act is unable to protect the wild life in Malaysia (Startwo 2008).

However, with regards to National Park itself, the respective National Park Enactment for each state governs the management of the Park. *National Park Act 1980* shall not apply to Sabah and Sarawak and the State Parks of Kelantan, Pahang and Trengganu which together constitute the Taman Negara as described in the Schedule to the *Taman Negara (Kelantan) Enactment [En. 14 of 1938]* and in the First Schedules to the *Taman Negara (Pahang) Enactment 1939 [En. 2 of 1939]* and the *Taman Negara (Trengganu) Enactment [En. 6 of 1939]*.

The National Park in Malaysia was created as a National Park in 1939 as a result of recommendations made by the *Wildlife Commission of Malaya Report of 1932*. The principle legislation governing National Park consists of three separate legislations. This is due to a reason that the Park boundary transverse through the states of Pahang, Kelantan and Trengganu and therefore 3 different state legislations were enacted. These legislations are *Taman Negara (Pahang) Enactment (No. 2 of 1939)*, *Taman Negara (Kelantan) Enactment (No. 14 of 1938)* and *Taman Negara (Trengganu) Enactment (No. 6 of 1939)*. In integrating the conservation and sustainable use of biological diversity into the policy and programmmes of the National Physical Plan mentioned above, the administration of the National Park is divided into three main units. The administration units will cover National Park of Pahang, National Park of Kelantan and National Park of Terengganu respectively. The Superintendent of National Park of Pahang is responsible for the National Park of Pahang, while the National Park of Kelantan and Terengganu are under the administration of the Directors of each of the State Department of Wildlife and National Park.

Based on the three enactments, the State Park is dedicated to hold the trust for the purposes of the propagation, protection and preservation of the indigenous flora and fauna, objects and places

of aesthetic, historical or scientific interest. Trustees means the persons referred to in sub-section (ii) of section 3 in whom the state park is from time to time jointly vested. Such persons fulfilling the duties and exercising the powers of the Sultan of Kelantan, Sultan of Terengganu, Sultan of Pahang and Yang di-Pertuan Agung respectively in the three national park.

As such, the three Enactments had listed out several acts which are strictly prohibited within the State Park in effort to preserve its biodiversity. It is stated in the three Enactments (section 8) that no person other than a Park official acting in the performance of this duty shall:

(a) Convey into the State Park or within the confines of the State Park be in possession of any weapon, explosive, trap, net, birdlime, poison or other thing intended or calculated to cause injury to any animal within the State Park;

(b) Convey into the State Park or within the confines of the State Park be in possession of any implement or tool intended or calculated for the provisions of this Enactment or of any Rule made thereunder;

(c) Introduce any animal into the State Park or permit any domestic animal to stray into the State Park;

(d) Within the State Park disturb or take the nest of any animal or kill, injure, capture, or molest any animal: Provided that any dangerous animal may be killed in defence of human life or prevent the infliction of personal injury;

(e) Remove from the State Park any live animal or any part of any dead animal other than an animal lawfully introduced into the State Park;

(f) Within the State Park cut destroy or damage any tree or plant or clear break up dig or cultivate any land; and

(g) Remove from the State Park any tree or plant or any part of any tree or plant.

It is also an offence if a person (i) willfully or negligently destroys, damage or defaces any object of zoological, botanical, geological, ethnological or other scientific or aesthetic interest or value, (ii) destroy damage deface or remove any notice, boundary mark or other thing whatsoever the property of the Trustees and (iii) no person shall use or occupy any building, vehicle, boat or other thing the property of the Trustees except in accordance with any permission granted by a Park official competent to grant such permission or otherwise in accordance with the provisions of this Enactments (section 9 of the Enactments).

In order for the Park Official to carry out their duty under the Enactment, it is further provided in section 10 that the trustees may make Rules in particular and without prejudice to the generality of their power. To that effect, such Rules may:

(a) Delegate to any Park official any of the powers and duties of the Trustees (including the power of further delegation);

(b) Prescribe the condition under which the State Park may be used;

(c) Prohibit the doing of any particular act within the State Park;

(d) Prescribe the fees payable in respect of any particular use of the State Park or of anything done under this Enactment;

(e) Prescribe in respect of any contravention of any Rule, penalties not exceeding imprisonment for six month or fine of five hundred dollars or in the case of a continuing offence a fine of fifty dollars for every day on which the offence has been committed;

(f) Provide for the seizure and for the forfeiture after conviction of any animal or other thing by means of which or in respect of which any offence has been committed.

By virtue of section 11 of the Enactments, any person contravening, offending against or not complying with any provision of this Enactment or any Rule in respect of which no specific penalty has been prescribed shall be liable to a fine of five hundred dollars or to imprisonment for six months.

Nonetheless, there are activities that still can be conducted within the National Park. As mentioned in section 5(i) of the Enactments, the Trustees may lease or permit the leasing, use or occupation of any land within the State Park subject to such conditions and restrictions as they think fit to impose and for the following purposes only:

(a) The construction and maintenance of roads;

(b) The construction and maintenance of railways and railway building;

(c) The construction and maintenance of aerodromes;

(d) The construction and maintenance of dams and reservoirs;

(e) The construction and maintenance of hotels, rest houses, dwelling houses, buildings and works of public utility where the Trustees consider these to be necessary and in the interests of the development of the State Park in accordance with the purposes referred to in sub-section (i) of section 3; and

(f) Mining in accordance with the provisions of section 7.

In line with the above-mentioned activities prescribed by the Trustees, it shows that there development that can be conducted within the national park area. Moreover, since National Park has now been transformed to become a centre of tourism attraction, several tourist and recreational facilities should be developed. However, in order to ensure that this development will not endanger the environment or the ecosystem within the National Park, the management should adhere to the guidelines specified under the Environmental Impact Assessment Guidelines for Development of Tourist and Recreational Facilities in National Park. Referring to these guidelines, there are several activities which are subjected to the Environmental Impact Assessment (EIA). This is a legal requirement for activities prescribed under the Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 1987.The said Order is made under provisions of section 34A of the *Environmental Quality Act 1974* which requires any person undertaking a prescribed activity has to prepare and submit a report to the Director General of Environmental

Quality for his approval. In the context of the above discussion, activities that are subject to an EIA report are as follows:

a. Development of tourist and recreational facilities in national parks designated under the *National Parks Act 1980* and various state enactments or ordinances;

b. Tourist facilities may be taken to include 'tourist accommodation premises' and 'tourist restaurants' as defined under the *Tourism Industry Act 1992*. Tourist accommodation premises include any building, including hostels, hotels, inns, boarding-houses; campsite; and any caravan or motor home. Tourist restaurant means any premises or part of that has been licensed to provide or sell food or drinks; and

c. Recreational facilities may be taken to include those facilities for sports, relaxation, entertainment or amusement. These include for example golf courses, boating facilities, water skiing facilities and others.

It should be noted that EIA report is needed as it will assess the environmental consequences of each development project conducted in the area of National Park. Only activities which do not give adverse impact to the environmental quality of the area will be given an approval from the Director General of Environmental Quality. Ideally, every National Park should have been thoroughly studied and a management plan set out which includes the identification of areas within the parks that may be developed for tourism and recreational purposes.

In the light of the above statement, the management of National Parks will also be governed by its Master Plan (Taman Negara Master Plan, 1987). This Master Plan is a general policy document which is meant to form the basis of more detailed studies, plans and development proposals. However, this document itself is not to be considered as a final statement but is intended to be updated and modified. This plan covers the following:

- The basic policy concerning all possible aspects of Taman Negara, its resources and uses;
- A description of the Park, its characteristics and resources;
- A general policy for Park development and use together with sample guidelines for the development and implementation of some areas; and
- A general policy for the development of specific disciplines e.g. Wildlife management.

INTERNATIONAL LEGAL FRAMEWORK ON NATIONAL PARK

The Langkawi Declaration on the Environment and Development of 1989 by the Heads of Government of Commonwealth countries marked a significant step in the evolution of Malaysia's prominent role in environmental issues in international arena. This role was further strengthened in the negotiations leading to the United Nations Conference on Environment and Development (UNCED) in June 1992 in Rio de Janeiro, Brazil.

Having ratified the Convention on Biological Diversity on 24 June 1994, Malaysia must incorporate into the national policy the set of commitments under the treaty. This effort should be taken in line with Article VI of the Convention on Biological Diversity 1992 which said that each contracting parties shall in accordance with its particular conditions and capabilities develop national strategies, plans or programme for the conservation and sustainable use of biological diversity which shall reflect the measures set out in this Convention. The Contracting Party shall also integrate, as far as possible the conservation and sustainable use of biological diversity into relevant sectoral or cross-sectoral plans, prgrammes and policies.

The conservation mentioned in the Convention includes an *ex-situ* and *in-situ* conservation. *Ex-situ* conservation means the conservation of components of biological diversity outside their natural habitats (Article IX). *Ex-situ* Conservation includes:

(a) Adopt measures for the *ex-situ* conservation of components of biological diversity, preferably in the country of origin of such components;

(b) Establish and maintain facilities for *ex-situ* conservation of and research on plants, animals and micro- organisms, preferably in the country of origin of genetic resources;

(c) Adopt measures for the recovery and rehabilitation of threatened species and for their re-introduction into their natural habitats under appropriate conditions;

(d) Regulate and manage collection of biological resources from natural habitats for *ex-situ* conservation purposes so as not to threaten ecosystems and *in-situ* populations of species, except where special temporary *ex-situ* measures are required under subparagraph (c) above; and

(e) Co-operate in providing financial and other support for *ex-situ* conservation outlined in subparagraphs (a) to (d) above and in the establishment and maintenance of *ex-situ* conservation facilities in developing countries.

On the other hand, *in-situ* conservation means the conservation of eco-systems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings (Article VIII). *In-situ* conservation includes:

(a) Establish a system of protected areas or areas where special measures need to be taken to conserve biological diversity;

(b) Develop, where necessary, guidelines for the selection, establishment and management of protected areas or areas where special measures need to be taken to conserve biological diversity;

(c) Regulate or manage biological resources important for the conservation of biological diversity whether within or outside protected areas, with a view to ensuring their conservation and sustainable use;

(d) Promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings;

(e) Promote environmentally sound and sustainable development in areas adjacent to protected areas with a view to furthering protection of these areas;

(f) Rehabilitate and restore degraded ecosystems and promote the recovery of threatened species, inter alia, through the development and implementation of plans or other management strategies;

(g) Establish or maintain means to regulate, manage or control the risks associated with the use and release of living modified organisms resulting from biotechnology which are likely to have adverse environmental impacts that could affect the conservation and sustainable use of biological diversity, taking also into account the risks to human health;

(h) Prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species;

(i) Endeavour to provide the conditions needed for compatibility between present uses and the conservation of biological diversity and the sustainable use of its components;

(j) Subject to its national legislation, respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity and promote their wider application with the approval and involvement of the holders of such knowledge, innovations and practices and encourage the equitable sharing of the benefits arising from the utilization of such knowledge, innovations and practices;

(k) Develop or maintain necessary legislation and/or other regulatory provisions for the protection of threatened species and populations;

(l) Where a significant adverse effect on biological diversity has been determined pursuant to Article 7, regulate or manage the relevant processes and categories of activities; and

(m) Cooperate in providing financial and other support for *in-situ* conservation outlined in sub-paragraphs (a) to (l) above, particularly to developing countries.

Apart from being a signatory to the Convention on Biological Diversity, Malaysia is also a party to Agenda 21. Agenda 21 is a programme run by the United Nations (UN) related to sustainable development. It is a comprehensive blueprint of action to be taken globally, nationally and locally by organisations of the UN, governments, and major groups in every area in which humans impact on the environment. Chapter 15 of the Agenda listed out programmes to improve the conservation of biological diversity and the sustainable use of biological resources. as well as to support the Convention on Biological Diversity.

According to Chapter 15.4 governments at the appropriate level, with the co-operation of the relevant United Nations bodies and regional, intergovernmental and non-governmental organizations, the private sector and financial institutions, and taking into consideration indigenous people and their communities, as well as social and economic factors, should:

(a) Press for the early entry into force of the Convention on Biological Diversity, with the widest possible participation;

(b) Develop national strategies for the conservation of biological diversity and the sustainable use of biological resources;

(c) Integrate strategies for the conservation of biological diversity and the sustainable use of biological resources into national development strategies and/or plans;

(d) Take appropriate measures for the fair and equitable sharing of benefits derived from research and development and use of biological and genetic resources, including biotechnology, between the sources of those resources and those who use them;

(e) Carry out country studies, as appropriate, on the conservation of biological diversity and the sustainable use of biological resources, including analyses of relevant costs and benefits, with particular reference to socio-economic aspects;

(f) Produce regularly updated world reports on biodiversity based upon national assessments;

(g) Recognize and foster the traditional methods and the knowledge of indigenous people and their communities, emphasizing the particular role of women, relevant to the conservation of biological diversity and the sustainable use of biological resources, and ensure the opportunity for the participation of those groups in the economic and commercial benefits derived from the use of such traditional methods and knowledge;

(h) Implement mechanisms for the improvement, generation, development and sustainable use of biotechnology and its safe transfer, particularly to developing countries, taking account the potential contribution of biotechnology to the conservation of biological diversity and the sustainable use of biological resources;

(i) Promote broader international and regional cooperation in furthering scientific and economic understanding of the importance of biodiversity and its functions in ecosystems;

(j) Develop measures and arrangements to implement the rights of countries of origin of genetic resources or countries providing genetic resources, as defined in the Convention on Biological Diversity, particularly developing countries, to benefit from the biotechnological development and the commercial utilization of products derived from such resources.

Malaysia also is a member of the World Conservation Union (IUCN). The World Conservation Union is the world's largest and most important conservation network. The Union brings together 83 States, 110 government agencies, more than 800 non-governmental organizations (NGOs), and some 10,000 scientists and experts from 181 countries in a unique worldwide partnership. The Union's mission is to influence, encourage and assist societies throughout the world to conserve the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable.

Last but not least, Malaysia is also a Party to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) since 1978. CITES carries with it certain obligations with regard to control of trade of flora and fauna between countries. This Convention was signed at Washington, D.C. on 3 March 1973 and was amended on 22 June 1979.

By virtue of this Convention, it is agreed that the contracting States shall:

- Recognize that wild fauna and flora in their many beautiful and varied forms are an irreplaceable part of the natural systems of the earth which must be protected for this and the generations to come;
- Conscious of the ever-growing value of wild fauna and flora from aesthetic, scientific, cultural, recreational and economic points of view;
- Recognizing that people and States are and should be the best protectors of their own wild fauna and flora; and
- Recognizing in addition that international co-operation is essential for the protection of certain species of wild fauna and flora against over-exploitation through international trade.

For that matter, CITES had agreed to the following fundamental principles:

1. Appendix I shall include all species threatened with extinction which are or may be affected by trade. Trade in specimens of these species must be subject to particularly strict regulation in order not to endanger further their survival and must only be authorized in exceptional circumstances.
2. Appendix II shall include:
   a) All species which although not necessarily now threatened with extinction may become so unless trade in specimens of such species is subject to strict regulation in order to avoid utilization incompatible with their survival and
   b) Other species which must be subject to regulation in order that trade in specimens of certain species referred to in sub-paragraph (a) of this paragraph may be brought under effective control.
3. Appendix III shall include all species which any Party identifies as being subject to regulation within its jurisdiction for the purpose of preventing or restricting exploitation and as needing the co-operation of other Parties in the control of trade.
4. The Parties shall not allow trade in specimens of species included in Appendices I,II and III except in accordance with the provisions of the present Convention.

CONCLUSION

The introduction of several international legal frameworks with regard to the conservation of biological diversity can be seen as a guideline or yardstick to the legislation of law in the national level. Since Malaysia has become a signatory to these important International Conventions, the responsible authority should prepare a good and specific law on conservation of biological diversity. In line with the strong understanding and co-operation with other contracting parties, Malaysia has taken the challenge in protecting the biodiversity with the establishment of National Park in Malaysia and other protected areas. The national park has helped to conserve the biological diversity from extinction. Through this conservation it will promote the education, health, aesthetic

values and the recreation of the people. Despite the fact that National Park in Malaysia has been in existence since 1939, it can be noted that there are still rooms for improvement with regard to its management of the park. For that matter a reference to the international legal frameworks on the conservation of biological diversity should be strictly applied to the National Park in Malaysia. Not only that, the enforcement of National Park Enactments should be looked into seriously and scattered Acts governing conservation of biological diversity should be integrated wisely.

REFERENCES

Environmental Impact Assessment Guidelines for Development of tourist and Recreational Facilities in National Park.

Environmental Quality Act 1974.

Fisheries Act 1985.

National Forestry Act 1984.

National Park Act 1980.

Protection of Wild Life Act 1972.

Taman Negara (Pahang) Enactment (No. 2 of 1939).

Taman Negara (Kelantan) Enactment (No. 4 of 1938).

Taman Negara (Trengganu) Enactment (No. 6 of 1939).

Taman Negara Master Plan.

Convention on Biological Diversity 1992.

Convention on International Trade in Endangered Species of Wild Fauna and Flora 1973.

International Union for the Conservation of Nature.

Langkawi Declaration on the Environment and Development of 1989.

Malaysia's National Policy on Biological Diversity 1998.

Hassan Kassim & Mohd Zulkifli Arshad 2004, 'Taman Negara, Peninsular Malaysia: Management and Operation', in *Concept of Park Development in Malaysia Seminar, Jabatan Perhutanan Negeri Perlis*.

M. Sabri Yusof 2000, *International environmental law*, ILBS, Selangor.

Wildlife Trade Management in Malaysia: Challenges in Implementing Wildlife Legislation

N.A. ANAK
TRAFFIC Southeast Asia, Unit 9-3A, Jalan SS23/11, Taman SEA, 47400 Petaling Jaya, Selangor

Abstract

Wildlife resources are important to everyone, providing us with food, medicine, clothing and other products. However, increasing demand and consumption are depleting the Earth's living natural resources at an alarming rate. Although habitat destruction due to logging, agriculture and land conversion may be the greatest threat to most species, overexploitation through illegal trade plays an important part in driving species to extinction.

Wildlife trade can be divided into a few categories such as trophies, ornaments and luxury items, traditional medicines, pets, food, timber and non-timber forest products (NTFPs).

Trade in animals and plants are partly driven by domestic (national) and regional demand that exists in all the sectors listed above, whether for subsistence or commercial use. At the national level, Malaysia has a number of wildlife legislations and other legislation that relevant in combating wildlife crime.

Although these laws are in place, there are a number of challenges faced by enforcement authorities when it comes to controlling and monitoring the wildlife trade. In order to address these challenges, improved domestic laws and management of wildlife trade will therefore have to be implemented effectively all levels, i.e. public, government agencies, media. These should also include increased co-operation through, scientific monitoring, effective enforcement and compliance, capacity building, and awareness.

At the regional level, Malaysia has a number of commitments which can complement its efforts to further strengthen the management of wildlife trade, for example ASEAN Wildlife Enforcement Network or ASEAN-WEN. The main objective of ASEAN-WEN is to reduce the illegal wildlife trade by 2010 by establishing a co-operative and cohesive wildlife law enforcement framework within and between countries in ASEAN.

Wildlife resources are important to everyone, providing us with food, medicine, clothing and other products and the trade of it offers opportunities to generate income and maintain cultural values.

However, for many species in the tropical realm, the change from subsistence to commercial levels of extraction is the most significant concern for conservation. These resources are traded commercially, domestically and internationally and support human livelihoods across many sectors of society.

Like any other regions, over harvesting, unsustainable use and illegal trade of many species, their parts and derivatives, are threatening not only their survival but also that of ecosystems and livelihoods of communities and local economies that depend on these species. Although habitat destruction due to logging, agriculture and land conversion may be the greatest threat to most species, overexploitation plays an important part in driving species to extinction.

Wildlife trade or the sale and exchange of wild animals and plant resources, is an issue at the very heart of the relationship between biodiversity conservation and sustainable development. Increasing demand and consumption are depleting the Earth's living natural resources at an alarming rate. The trade can be conducted legally and sustainably, but it is dependent on an efficient management system. The wildlife trade generates billions of dollars worldwide, but illegal and unsustainable activity poses a major threat to many species. Many laws and conventions are in place to control the trade but the lack of co-ordinat enforcement undermines the effectiveness of these legal instruments.

CATEGORIES OF WILDLIFE TRADE

Southeast Asia is a major hub for trade in wildlife, functioning as supplier, consumer and a transit point for plants, animals and their derivatives. Wildlife trade can be divided into a five main categories; trophies, ornaments and luxury items, traditional medicines, pets, food, timber and non-timber forest products (NTFPs).

Trophies, Ornaments and Luxury Items

A wide range of animal products are found in the ornamental trade, including marine turtle shell and eggs, seashells, reptile skins, ungulate horns, elephant ivory, cat skins, hornbill casques and feathers, mounted insects such as butterflies and beetles. The great majority of ornamental plants in trade, including most orchids and pitcher plants, have been artificially cultivated in nurseries, but large numbers are still taken directly from the wild with specialist collectors actively seeking out rare, exotic and often endangered species to add to their collection.

International travelers frequently purchase goods made from endangered species as souvenirs and curios while abroad. Often this illegal trade is unintentional, resulting from ignorance of the laws and the species which require permits for export and or import. In many cases, these products can be legally offered for sale in popular tourist locations, but transporting them across international

borders requires a special permits. In other cases, wildlife products are sold in open violation of national or local laws — and concerted investigations and law enforcement is needed to police any continuing availability. Greater awareness of the legality of these products is needed, so travelers can buy wisely.

Traditional Medicines

Many traditional medicines use wildlife as ingredients, for example traditional East Asian medicines use parts and derivatives from more than 1000 plant and animal species including seahorses, bear gall bladder, pangolin scales, rhinoceros horn, and orchids (eg *Dendrobium* spp.). Schippmann *et al*. (2006), estimated about 50 000 – 70 000 plant species are used in traditional and modern medical systems throughout the world. Maintaining medicinal plant harvest and trade within sustainable levels also presents a major challenge in the region. TRAFFIC's work has shown continued availability of rare species as ingredients without any systems in place to ensure their legality and sustainability —and medicinal vendors rarely have any knowledge on the status of the species in the wild.

Pets

While humans have always kept animals as companions, recent decades have seen a substantial increase in the number of wild species sold as pets. Much of the pet trade is dominated by reptiles and birds, and an increasing trend exists to meet the demand of specialist collectors for some of the world's rarest species. These 'hobbyists' often specialise in particular groups of species such as types of parrots and songbirds, sometimes Orang-Utan, gibbons and other primates, elephants, and Arowana.

Food

For many people, wildlife is an important source of protein. In some countries, food harvested from nature, whether wild meat, fisheries products or edible plants, contributes to national economies and the livelihoods of local communities. However, in recent decades, growing human populations, unsustainable harvesting and illegal activities have put additional pressure on these resources.

For example, studies by TRAFFIC have shown that trade in live reef fish for food is a serious threat to the survival of wild populations of groupers and wrasses in South-east Asia, with the declining aggregations of Humphead Wrasse *Cheilinus undulatus* illustrative of broader trends (Bentley 1999).

In many parts of the region, wild meat from species such as deer, pangolin and snakes is consumed as delicacies or 'tonic' food items, rather than for subsistence needs. In East Asia, meat

from freshwater turtles (such as the South-east Asian Box Turtle *Cuora amboinensis*) is consumed in huge volumes despite the fact that three-quarters of the 90 species found in Asia are considered threatened, and 18 are considered critically endangered, such as the River Terrapin *Batagur baska* (TRAFFIC Southeast Asia's leaflet). As turtles are long-lived animals, consumers hope to attain similar longevity, and many believe that the 'wildness' of the meat will benefit their health.

Skins, Furs and Wools

Skins, furs, wools and hairs from many species of mammal, reptile, bird and fish species are traded in the international market to make products ranging from clothing and accessories such as footwear, shawls and wallets to ornaments and furnishings such as charms, rugs and trophies.

As an example, shahtoosh shawl … In order to get the wool which was woven from the down hair of the Chiru or Tibetan Antelope *Pantholops hodgsonii*, the animals must be hunted and killed. Around five or six Chiru killed to gain the materials necessary for a single Shahtoosh shawl. An average size shawl of shahtoosh is so fine that it can pass through a wedding ring. http://en.wikipedia.org/wiki/Shahtoosh>.

Timber and NTFPs

Home to millions of plants and animals species, the world's forests house diverse resources that are used to generate income for hundreds of millions of people, as well as foreign currency and tax revenue when those resources are exported. Local forest communities depend on a variety of forest products for their, medicines and livelihoods.

Unfortunately, in many cases the need to conserve forest ecosystems is being overlooked in the rush to supply global markets with timber and other forest products. Illegal logging and timber smuggling is a growing problem, due to an inexhaustible demand, particularly for high-value species. The trade in Ramin *Gonystylus* spp. is a pertinent example of such a species from Southeast Asia that illustrates the full spectrum of challenges to regulate and enforce harvest, export and re-export controls. (Lim, Soehartono & Chen 2004).

Agarwood or gaharu, the highly prized fragrant heartwood produced by several species in the Thymeleaceae family, is used primarily for medicinal, religious and aromatic purposes in Asian cultures ranging from the Middle East through to China (including Hong Kong and Taiwan) and Japan. Indonesia and Malaysia are the main producer countries and despite threats of over-harvesting and illegal trade, the prospects for long-term sustainable management of this high-value product are clear (Barden *et al. 2000*).

A great deal of wildlife trade is legal, but some of the trade is illegal, driven by a variety of factors including ignorance of relevant laws, subsistence needs, consumption for attributed medicinal benefits, obsessive collecting or organized crime. Many laws and conventions in place to control the wildlife trade but lack of coordinated enforcement undermine the effectiveness of these legal instruments.

CHALLENGES

There are number of challenges faces by the authorities when it comes to controlling and monitoring the wildlife trade, for examples the trade routes where wildlife travels illegally from country to country throughout Malaysia is relatively easy and accessible. Virtually all roads crossing international borders are utilized by smugglers, as borders checkpoints are often weak.

Major airports and sea ports in the region are heavily utilized by illegal wildlife dealers, often using false declarations for their cargoes, or other means, to pass through customs. Collaboration between some authorities and illegal wildlife dealers also is to blame in some cases for the lack of enforcement in the airports. Many airport or port authorities are unaware of their responsibilities in enforcing wildlife trade regulations, and traders take full advantage of these weaknesses. (*source: Wildlife Trade Regulation TMP 2008)*

Beside that our penalties is very low, our judicial system not aware about the value of our wildlife and the most importantly is to increase the public awareness.

In some places enforcement is lax enough that selling wildlife openly is commonplace and elaborate smuggling techniques are hardly needed however in places where enforcement is more rigid, more imaginative techniques are used. Example of the smuggling techniques are:

- Hidden compartments in shipping containers
- Concealing items on the person
- Concealing items in luggage
- Mixing with 'look-alike' species
- 'Double packaging'
- Hidden among other cargo
- False declaration (see Box 1)
- Inaccurate documents; and
- Internet purchasing/trading.

Box I: **Example of false declaration in Bangkok, Thailand**

Thai authorities confiscated an illegal shipment of 245 pangolins and 64 freshwater turtles on June 25, 2006 at Don Muang Airport, Bangkok. The cargo had arrived on board a Thai Airways flight originating from Penang in Malaysia. After receiving a tip-off, Thai authorities discovered the concealed animals hidden in 60 crates falsely declared as Red-eared Sliders (*Trichemys scripta elegans*) — an unprotected North American freshwater turtle. (*source: Wildlife Trade Regulation TMP 2008*.

Improved domestic regulation and management of wildlife trade will therefore have to act at a variety of levels – and should include increased co-operation for implementation of multi-lateral agreements like the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), scientific monitoring, enforcement and compliance, education and awareness, and correct permitting.

In Malaysia, regulation, protection, conservation and management of wildlife and its habitat is enshrined in the Federal Constitution that empowers the Federal and the States to make laws regarding wildlife resources. Eleven states in Peninsular are managed under an Act while Sabah enacted an Enactment and Sarawak an Ordinance. <http://en.wikipedia.org/wiki/Malaysian_Wildlife_Law>.

The freshwater turtles are managed by various state legislations while the marine mammals and turtles are protected under the *Fisheries Act 1986, Sabah Wildlife Enactment 1997 and Wildlife Protection Ordinance 1997*).

Below are list of Malaysian legislations that can be used for the protection of wildlife :

Peninsular Malaysia:

1. *Protection of Wildlife Act 1972*
2. *Fisheries Act 1985*
3. *National Forestry Act 1984 (Amend. 1993)*
4. *Malaysian Timber Industry Board Act 105 (1973)*
5. *Plant Quarantine Regulation 1981*
6. *Customs Act 1967*
7. *Customs (Prohibition of Import and Export) Order 1998*
8. *Malaysian Maritime Enforcement Agency Act 2004*
9. *International Trade in Endangered Species 2007 (not gazetted yet*)

Sarawak:

1. *Sarawak Wildlife Protection Ordinance 1998*
2. *STIDC Ordinance (Amendment) 1999*
3. *Forest Ordinance 1958 (rev. 1997)*
4. *Plant Quarantine Regulation 1981*
5. *The Sarawak Biodiversity Centre (Amendment) Ordinance 2003*
6. *The Sarawak Biodiversity Regulations 2004*
7. *Customs Act 1967*
8. *Customs (Prohibition of Import and Export) Order 1998*
9. *Malaysian Maritime Enforcement Agency Act 2004*
10. *International Trade in Endangered Species 2007 (not gazetted yet)*
12. *Fisheries Act 1985*

Sabah:

1. *Sabah Wildlife Conservation Enactment 1997*
2. *Sabah Biodiversity Enactment 2000*
3. *Forest Enactment 1968*
4. *Parks Enactment 1984*
5. *Fisheries Act 1985*
6. *Plant Quarantine Regulation 1981*
7. *Malaysian Timber Industry Board Act 105 (1973)*
8. *Customs Act 1967*
9. *Customs (Prohibition of Import and Export) Order 1998*
10. *Malaysian Maritime Enforcement Agency Act 2004*
11. *International Trade in Endangered Species 2007 (not gazetted yet)*

Malaysia become a party to CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) on 20th November 1977, and came into force on 18th January 1978. Ministry of Natural Resources and Environment is the lead Scientific and Management Authorities. Their duties are to ensure that the export does not endangered the species and the import of species fulfills its objective and does not endanger the survival of the species before the import permits are issued.

<http://www.cites.org/common/ directy/ e_directy.html)>.

For the CITES Management Authority (*Table 1*), they has two basic roles which is communicating with the CITES Secretariat and other Parties and granting permits and certificates under the terms of the Convention.

Specific task for Management Authority imposed by the text of the Convention:

- Articles III, IV and V – permit issuance and acceptance provisions
- Article VI - retaining and cancelling the export permit or re-export certificate and any corresponding import permit presented with imports; marking specimens
- Article VII – determining the applicability of exemptions
- Article VIII – responsibility for confiscated live specimens
- Article IX – communication with the Secretariat and other Parties.

TABLE 1. CITES MANAGEMENT AUTHORITIES IN MALAYSIA

Products	Peninsular Malaysia	Sabah	Sarawak
Fauna	Dept of Wildlife and National Parks	Sabah Wildlife Dept	Sarawak Forestry Dept / Corporation
Fisheries	Fisheries Dept	Fisheries Dept	Sarawak Forestry Dept / Corporation
Plants	Agriculture Dept	Sabah Wildlife Dept	Sarawak Forestry Dept / Corporation
Timber	Malaysian Timber Industrial Board	Malaysian Timber Industrial Board	Sarawak Forestry Dept / Corporation

(Source: Chen & Perumal 2002)

Training and capacity building also important in order to increase the ability of the enforcement in the field. A few training have been conducted in Malaysia such as species identification, smuggling techniques, investigation and also other related training for the enforcement. On the other hand, judicial awareness should be highlighted as well, whereby the seriousness of illegal wildlife trade should be addressed, imposing deterrent penalties and imposing maximum extent of the law including imprisonment.

At the regional level, Malaysia has a number of commitments which can complement its efforts to further strengthen the management of wildlife trade for example ASEAN Wildlife Enforcement Network or ASEAN-WEN whereby the main objective of ASEAN-WEN is to reduce the illegal wildlife trade by 2010 by establishing a cooperative and cohesive wildlife law enforcement

framework within and between countries in Asia. This objective is in line with the Objective 2 of the *ASEAN Regional Action Plan on Trade in Wild Fauna and Flora 2005-2010*. To meet this goal, ASEAN-WEN will:

(a) Determine how national law enforcement agencies can support the development of ASEAN-WEN at the national and regional levels;

(b) Develop national wildlife crime task forces in each ASEAN member country that bring national agencies together to combat illegal wildlife trade; and

(c) Promoting collaborative capacity-building efforts for improved law enforcement.

The *ASEAN Regional Action Plan on Trade in Wild Fauna and Flora 2005-2010* provides a solid framework agreement for collaboration between the 10 member countries. Specifically, it addresses common issues of enhanced law enforcement networking, inter-agency co-operation, strengthened national legislation and increasing the availability of scientific information to guide wildlife trade management by CITES authorities. The Regional Action Plan also prioritizes engagement with civil society to raise awareness of issues of legality and sustainability with industry groups, traders and local communities involved in wildlife trade. These ranges from scientific research and trade monitoring, which provides baseline data necessary for informed decision-making, to information sharing which is a key component of ASEAN-wide law enforcement co-operation. Under the Action Plan, Malaysia is taking the lead in Objective Three that is to promote research, monitoring and information exchange on CITES-related issues by:

(a) Exchanging information on permit issuance, regional market dynamics and trade flows to improve understanding of producer-consumer relationships, including re-exports, in the region;

(b) Encouraging research activities to ensure that sufficient biological and population dynamics information is available on species in trade in order to undertake non-detriment findings (NDFs) and to establish export quotas; and

(c) Establishing a mechanism by which information about CITES-listed species may be shared, with a particular focus on illegally traded species found in more than one country.

CONCLUSION

In order to address these challenges, improved domestic laws and management of wildlife trade will therefore have to be implemented effectively all levels, i.e. public, government agencies, media. These should also include increased co-operation through, scientific monitoring, effective enforcement and compliance, capacity building, and awareness. Enforcement of trade control requires improved anti-poaching capacity, specialized units for undercover investigations and necessary deterrents and incentives to combat unsustainable harvest and trade of wildlife.

REFERENCES

Barden, A, Awang, N, Mulliken, T, & Song, M 2000, *Heart of the matter: agarwood use and trade, and CITES implementation for* Aquilaria malaccensis*,* TRAFFIC International.

Bentley, N 1999, *Fishing for solution: can te live trade in wild groupers and wrasses from Southeast Asia be managed? TRAFFIC Southeast Asia*.

Chen HK & Perumal B, 2002, *In harmony with CITES?: an analysis of the compatibility between current forestry management provisions and the effective implementation of CITES listing for timber species in Malaysia,* TRAFFIC Southeast Asia.

Viewed on 25 May 2008, <http://www.asean-wen.org/aboutus.php>.

Viewed on 14 May 2008, <http://www.cites.org/common/directy/e_directy.html>.

Viewed on 2 June 2008, <http://en.wikipedia.org/wiki/Malaysian_Wildlife_Law>.

Viewed on 21 April 2008, <http://www.traffic.org/trade/>.

Viewed on the 2 June 2008, <http://en.wikipedia.org/wiki/Shahtoosh>.

Lim, TW, Soehartono, T & Chen, HK 2004, *Framing the picture: An assessment of ramin trade in Indonesia, Malaysia and Singapore,* TRAFFIC Southeast Asia.

Schippmann, U, Leaman, D & Cunningham, AB 2006, 'A comparison of cultivation and wild collection of medical and aromatic plants under sustainability aspects', in *Proceedings, Frontis Workshop on Medicinal and Aromatic Plants,* eds R Bogers, L Craker & D Lounge, *Wageningen, The Netherlands*.

Wildlife Trade Regulation TMP 2008, a series of powerpoint presentation prepared by ASEAN-WEN Support Programme.

Evolution of Policies and Legislation in Conserving Biodiversity Resources in Sarawak: The Wild Life Protection Ordinance and the National Parks and Nature Reserve Ordinance

W. LANDONG
Sarawak Forestry Corporation, Protected Areas and Biodiversity Conservation
Level 11, Office Tower, Hock Lee Centre,
Jalan Datuk Abang Abdul Rahim, 93450 Kuching, Sarawak

Abstract

Sarawak's natural biodiversity particularly wildlife is an integral part of the people's culture and animal parts are used in traditional ceremonies and dances. Sarawak recognised the need to conserve its natural resources in the 1950s. Two pieces of legislation were enacted: the Wild Life Protection Ordinance in 1957 and the National Parks Ordinance in 1958 (National Parks and Nature Reserves Ordinance, 1998). *These provided for the protection and conservation of Sarawak's natural biodiversity. It also provides for the establishment of protected areas either as Wildlife Sanctuaries, National Parks or Nature Reserves. Areas of fragile wildlife habitats that are crucial for protection of wildlife are gazetted as wildlife sanctuaries.*

Sarawak also recognised that local communities were living or using the resources within areas needed as protected areas. Thus, the Ordinances required that their rights to the resources be respected. This resulted in the granting of rights and privileges for the local people to continue using resources within protected areas and in some cases to reside there.

There have been a number of amendments to Wild Life Protection Ordinance, 1957 and the National Parks Ordinance 1958 to strengthen its provision to reflect new discoveries, additional knowledge, internationals commitments and changing demands on natural resources.

Conservation of biodiversity includes the conservation of flora and fauna, variety among living organisms and the ecological communities which they inhabit. Three kinds of biodiversity which are essential to preserve the global ecosystem are: (1) genetic diversity which describes the variation of genes within a species; (2) species diversity describes the number of different kinds of

organisms within individual communities or ecosystems and 3) ecological diversity which assesses the richness and complexity of a biological community including the number of niches, trophic levels and ecological processes that capture energy, sustain food webs and recycle materials within this system (William P. Cunningham & Mary Ann Cunningham, 2007).Through the introduction of National Physical Plan in 2006, the government of Malaysia had already gazzetted national and state parks, wildlife reserve or sanctuaries, marine parks, protected forests and other areas designated for statutory protection as a protected areas. A protected area is defined by the IUCN (International Union for the Conservation of Nature) as "an area of land or sea especially dedicated to the protection and maintenance of biological diversity and of natural and associated cultural resources and managed through legal or other effective means". As one of the protected areas, Taman Negara has been seen as a place suitable for the conservation of biological diversity. Taman Negara or the national park of Malaysia is the largest protected area in Malaysia covering an area of 434,350 hectares of pristine tropical rain forest. It is one of the oldest rainforest in the world, estimated about 130 million years old. It is home to 14500 flowering plants and trees, 600 species of birds, 200 species of mammals, 350 species of reptiles and numerous species of insects and other life forms. In line with the National Physical Plan of 2006 and Malaysia's National Policy on Biological Diversity of 1998, Taman Negara should be managed effectively and in a sustainable manner in order to ensure a proper and systematic usage of natural resources. The effectiveness of the management of the National Park can be measured through policy and law enforcement. It is therefore, the intention of the writers to highlight on several national and international legal frameworks governing conservation of biological diversity in the national park of Malaysia. A reference to the International treaties will shed a light on the improvement of the management of the National Park in order to conserve its biological diversity.

Biodiversity in Recreation: Sarawak's National Parks and Nature Reserves

O.B. TISEN
Sarawak Forestry Corporation, Protected Areas and
Biodiversity Conservation, Level 11, Office Tower, Hock Lee Centre
Jalan Datuk Abang Abdul Rahim
93450 Kuching

Abstract

Sarawak being close to the Equator is blessed with an ideal climate for life to flourish making it among the highest biodiversity per unit area in the world. So far, Sarawak has recorded 185 species of mammals, 530 species of birds, 166 species of snakes, 104 species of lizards and 133 species of amphibians.

A large proportion of Sarawak's fauna are unique to Borneo, with approximately 19% of the mammals, 6% of the birds, 20% of the snakes and 32% of the lizards being endemic to the island.

Although Sarawak's national parks and nature reserves are established to protect these unique biodiversity, they also become the main attractions for tourists to Sarawak. Some of the examples are the in Batang Ai National Park, Semenggoh Wildlife Centre and Matang Wildlife Centre; the proboscis monkey in Bako National Park; the marine turtles nesting in Talang — Satang National Park; the hornbill including Sarawak's state bird the rhinoceros hornbill in Tanjong Datu National Park; the swiftlets nesting in Niah Cave; the bats in Gunung Mulu National Park; the rafflesia in Gunung Gading National Park; the dolphins and crocodiles in Kuching Wetland National Park; the diversity of palms in Kubah National Park; the red-banded monkey in Maludam National Park and the diversity of plants in Lambir Hills National Parks.

Sarawak is no different from the rest of the developing world in that tourism plays an important role in its economy, but for Sarawak to be competitive, she has to focus on the products that are unique to the state. Sarawak's strength lies in the development of 'Culture, Adventure and Nature' products (State government of Sarawak 1993). Each of these aspects is in some ways integrated within Sarawak's protected natural area systems, which are established mainly for the protection of Sarawak's native flora and fauna.

Visitors to Sarawak are motivated by her rich and unique biodiversity, cultural and historical values. The nature experience of the state's unique biodiversity occurs almost entirely in national parks and nature reserves, thus national parks and nature reserves are central to its tourism and

recreation. For example, visitors to Niah National Park want to view the collection of the edible bird's nests, the prehistoric cave paintings and Asia's oldest archaeological site. Visitors to Batang Ai National Park want to experience the long house culture of the Iban and a chance to observe the natural habitat of the orangutan, or to Gunong Mulu National Park for the unique experience of walking through the worlds' largest cave passage, the Deer Cave or observing millions of bats exiting Deer Cave at dusk.

As tourism and recreation in Sarawak are motivated mainly by nature, in particular the unique biodiversity which occurs almost entirely in national parks and nature reserves, I will discuss issues of conservation and tourism and also the importance of institutional framework, management practices and human resource development aspects of Sarawak Forestry, the management authority for protected areas and biodiversity in the state. Based on the concept of sustainable development and sustainable tourism, I will evaluate the current practices in Sarawak and make recommendations towards sustainability.

SARAWAK'S BIODIVERSITY

Sarawak being close to the Equator is blessed with an ideal climate for life to flourish making it among the highest biodiversity per unit area in the world (WCS & FD 1996). Hazebroek and Abang Morshidi (2001) suggest that a conservative estimate of flowering plants in Borneo is in the range of 10 000 to 12 000 species which is about five to six per cent of the world total. They also suggest that 40% to 50% of these are restricted only to Borneo. Whitmore (1984) reported that Borneo has the most abundant and diverse species of big trees from a single family, the dipterocarps. Among the dipterocarp family, Sarawak records 247 species out of the 291 species in Borneo (Soepadmo & Wong 1995). For example, the mixed dipterocarp forest of Lambir Hills National Park appears to be the richest of all forest types in Malaysia (Asthon 1995).

Sarawak recorded a huge number of trees, exceeding 2500 (Anderson 1980), 185 species of mammals (Payne *et al*. 1985), 530 species of birds (MacKinnon and Phillips 1993), 166 species of snakes, 104 species of lizards and 133 species of amphibians (Anon. 1985). A large proportion of Sarawak's fauna and flora are unique to Borneo, with approximately 19% of the mammals, 6% of the birds, 20% of the snakes and 32% of the lizards are endemic to Borneo (WCS & FD 1996). However, in the past 20 years the rapid development in Sarawak has impacts on its native biodiversity with some facing severe problems or has gone extinct (Bennett & Tisen 2001). Some of the examples are:

- The *tembadau* become extinct in Sarawak in the first half of the twentieth century (Midway 1977).
- The last definite record of Sumatran rhinoceros in Sarawak was in 1987 (WCS & FD 1996).
- The marine turtles nesting in Sarawak's Turtle Islands has declined by 95 % (WCS & FD 1996).

- Proboscis monkey once were abundant in Sarawak, now the population has declined to less than a thousand individual (Bennett & Gombek 1993).
- The hornbill including Sarawak's state bird the rhinoceros hornbill have become rare through out Sarawak (Bennett *et al*. 1997).
- The number of swiftlets nesting in Niah Cave has declined by 91% between 1935 and 1995 (Leh *et al*. 1995).
- Flying foxes has become a rare sight or never seen in much of Sarawak compared to thirty years ago when it was often seen in large numbers (Bennett 1992); and
- The range of orangutan has shrunk greatly with population found only in Lanjak-Entimau and Ulu Batang Ai (WCS & FD, 1996).

The main causes of the decline and losses of Sarawak's native biodiversity are due to habitat losses and hunting (WCS & FD 1996). Conversion of forest areas to make way for towns, industries, agriculture and aquaculture has reduced habitats for wildlife, and hunting has been responsible for decline of many species of native fauna (Bennett *et al*. 2000). Thus, to conserve all species and habitats in perpetuity, Sarawak has adopted the International Union for the Conservation of Nature (IUCN) recommended action that at least 10% of its land area should be put aside as totally protected areas. In 1996, the Wildlife Conservation Society and Sarawak Forest Department was tasked to come up with a master plan for wildlife and in 1997 all its recommendations through its endorsement by the State Cabinet, were adopted as policy. In 2002, the State Government established Sarawak Forestry which is responsible to manage its forests, including conserving and protecting Sarawak's biodiversity.

TOTALLY PROTECTED AREAS IN SARAWAK

Sarawak national parks and nature reserves are accorded total protection status by law. National parks, nature reserves together with wildlife sanctuaries form the totally protected areas system (TPAs), and are established with the primary aims of protecting representative of all of Sarawak's native species of flora and faun and their habitats. TPAs are established according to a planned strategy, taking into consideration ecological, biological, topographical, climatic and social factors. Thus, TPAs are home of world-class wonders of nature (Hazebroek & Abang Morshidi, 2001).

TPAs also include very fragile environments such as small islands where turtles lay their eggs, mangroves forests, and mountain summits. They are home to many unique plants and animals which occur only in Borneo, some only in Sarawak and others only in a small area in Sarawak. For example, proboscis monkeys only occur in Borneo and the red-banded langurs probably occur only in Maludam National Park (Bennett 1987). Botanical examples include two pitcher plants which are unique only to Sarawak's highest mountains. It is for these kinds of reasons that national

parks of Sarawak are of such high conservation value and also of great commercial importance in providing economic opportunities for tourism.

A National Park is defined as any area constituted for, …"conservation and protection of wild life and their habitat; preservation of geological or physiological features; facilitating study and research on the biodiversity; protection of the natural scenic beauty, and the historical sites and monuments; and affording opportunities for public appreciation, enjoyment and education of the natural scenic beauty, wild life habitat, flora and fauna, geological and physiographical features, historical sites and historical monuments of the State"(Sarawak Government Gazette, Part 1, 1998a; p. 4)

Nature reserves serve similar functions as national parks except for differences in physical size. A nature reserve consists of an area of one thousand hectares or less. Area larger than one thousand hectares may be considered for gazettement as national park or wildlife sanctuary.

Wildlife sanctuaries are areas established strictly for the protection of wildlife and its habitat and are not open to the general public. Very limited access is allowed for research purposes only. Hence they are not used for nature tourism and recreation (Sarawak Government Gazette, Part 1, 1998b).

The present and the proposed protected areas together will form a sustainable 'Protected Area System' which covers broadly all the ecological and habitat types, through out the State, and will protect most of Sarawak's biodiversity.

Each of the parks were established primarily for its conservation values such as Lambir Hills for its flora diversity, Niah for its cultural and geological formations, Batang Ai for the protection of the orangutan, Meludam for the protection of the endemic red banded langur, to name some. Tourism and recreation is secondary; however it provides economic return and is thus an additional justification for the protection of the area.

Institutional Frameworks and Organizational Structure

Management of TPAs is provided for under the National Parks and Nature Reserves Ordinance and the Wild Life Protection Ordinance. The Protected Areas and Biodiversity Conservation (PABC) Unit of Sarawak Forestry are entrusted with the responsibility of carrying out the functions as provided for in these Ordinances.

At the headquarters level, PABC Unit is divided into four departments, namely the Biodiversity Conservation Department, the Planning Department, the Operation Management Department and

the Business Development Department. A General Manager heads the Unit, and he is responsible directly to the Chief Executive Officer/Managing Director of Sarawak Forestry. A Senior Manager heads each of the four departments below him.

The Operations Management Department is responsible for all matters pertaining to the day-to-day operations and management of all parks, reserves and wildlife sanctuaries. They are also responsible to provide facilities for tourism and recreation, and to conduct park interpretation programmes.

The Biodiversity Conservation Department is responsible for wildlife management, the management of habitats in TPAs, planning for general wildlife conservation and rehabilitation; promote public awareness for nature conservation and protection of wildlife.

The Planning Department focuses on the overall planning, both physical and management in TPAs. The Business Development Department is tasked with identifying, developing and market products including tourism products in TPAs.

At the park level, a Park Warden heads the respective stations. To strike a balance between conservation and use, the park officers are assigned duties in areas of Conservation and Protection, Visitors Management and Facilities Maintenance. However, issues relating to visitor management often occupies most of staff time with little time for conservation and protection. It is crucial to commit staff to specifically deal with conservation issues and to take appropriate steps to mitigate any effect of tourism before it becomes apparent.

National Parks and Nature Reserves

Currently, there are nineteen National Parks and five Nature Reserves in the state covering an area of approximately 500 000 ha. A number of the parks are situated in remote locations accessible only by water and / or air transport. This influences use in many ways.

Not all the national parks and nature reserves are open to the general public due to their remoteness and lack of facilities. However, entry permits may be granted to specialist groups or individuals. In addition, two wildlife centres were constructed in protected areas near to Kuching for rehabilitation of wildlife, to provide venue for conservation education and appreciation of wildlife (*Table 1*).

TABLE 1. KEY REASONS FOR ESTABLISHMENT OF TPAS

No.	TPAs	Reasons for establishment
1	Bako NP	Diverse vegetation types in a small area (mangrove, beach and coastal, hills, kerangas, padang, lowland)
2	Gunong Mulu NP	Diversity of vegetation types (limestone, lowland, hills, mountains)
3	Niah NP	World famous archaeological treasures (30,000 years old human remains)
4	Lambir Hills NP	Plant diversity and water catchment (the most species rich rainforest in the world)
5	Similajau NP	Coastal vegetation (Beach forest, Clift vegetation, mangrove, lowland forest)
6	Gunung Gading NP	Home of Rafflesia — world's biggest flower (Rafflesia tuan mudae),
7	Kubah NP	Protection and conservation of Palms (Highest diversity of palms in the world)
8	Batang Ai NP	Protection of Orangutan (Pongo pygmaeus)
9	Talang Satang NP	Protection of Turtle
10	Loagan Bunut NP	Protection of unique, biodiversity rich natural freshwater lake (oriental darters)
11	Tanjong Datu NP	Protection of coastal beaches, hill forest, natural geological formations — wildlife and its habitats (hornbills and turtles).
12	Maludam NP	The only viable population of the red banded langur (Presbytis melalophos cruciger), one of world's most beautiful monkey
13	Kuching Wetland NP	Protection of mangrove, crocodile and dolphins
14	Pulong Tau NP	Mountain vegetation (Rhododendron) and wildlife particularly the large mammals — rhinoceros and clouded leopards.
15	Bukit Tiban NP	Protection of natural forest (Native forest seed trees)
16	Rajang Mangrove NP	Protection of mangrove habitat
17	Usun Apau NP	Protection of high altitude (plateau) forest habitat
18	Miri-Sibuti Coral Reef NP	Protection of coral reef and marine habitat
19	Santubong NP	Protection of coastal hills forest habitat
20	Sama Jaya NR	Natural forest in the heart of the city — the urban park for Kuching

No.	TPAs	Reasons for establishment
21	Bukit Hitam / Bukit Sembiling NR	Natural forest in the heart of the city — the urban park for Limbang
22	Wind Cave NR	Conservation of limestone habitat and cave
23	Fairy Cave	Conservation of limestone and caves
24	Matang WC	Rehabilitation of endangered species of wildlife
25	Semengoh NR (WC)	Rehabilitation of Orangutan
26	Samumsam WS	Protection of Proboscis monkey
27	Pulau Tukong Ara –banun WS	Sea birds breeding colony
28	Lanjak-Entimau WS	Protection of Orangutan
29	Sibuti WS	Protection of migratory birds resting site and mangrove/peat swamp habitat

Development in National Parks and Nature Reserves

As protected areas play very important role in the promotion of tourism, physical development of these areas place heavy emphasis on the provision of infrastructure[1] to meet tourism needs. In the 1990, approximately 70% of development budgets[2] have been spent on infrastructure (Cotter 1999). The increase in budget allocation from 1985 onwards reflected the recognition of the critical role that protected areas played in the development of tourism in the state.

To ensure that conservation values are maintained, an '*Environmental Impact Assessment*' report is required for major development such as road, railway, dam, power transmission line, cable car or airfield. Before any permission is given for its construction, the Controller[3] in consultation with the Minister, is satisfied that all conditions and measures to mitigate against any adverse environmental impact have been complied with. The Controller must be satisfied that construction of such infrastructure is essential in the public interest and that there is no alternative route or site outside the protected areas (Sarawak Government Gazette, Part 1, 1998a; Sarawak Government Gazette, Part 1, 1998b).

[1] Infrastructure: Include hostels, chalets, plank walks, cave lighting, interpretation centres, bridges, nature trails, jetties, helipads in remote areas, water and electricity supply systems.

[2] Development budget for protected areas: Ringgit Malaysian (RM) 2.2 million during the 1981 to 1985 Plan, RM13.2 million during the 1986 to 1990 Plan, RM24.8 million for 1991 to 1995 Plan and RM49.5 million for 1995 to 2000 Plan (Cotter 1997).

[3] Controller: A member of the public service of the State appointed by the Minister for the purpose of performing the functions and duties assigned to him under the *National Parks and Nature Reserves Ordinance, 1998*. At the moment he is also the Director of Forests.

To ensure sustainability, it is crucial that this provision is strictly followed and that development of infrastructure in protected areas is permitted only if there is no other alternative outside the protected areas.

Involving Local Communities

The vast expanse, remoteness and rugged terrain of protected areas, makes it impossible for the government to protect them without the support and collaboration of the local people. Thus, participation of the local communities in their management is vital (Ahmad, Tisen & Bennett 1999). This is where the local communities work as partners with the government in a co-management concept to protect the areas and share the benefits from protecting the areas (Tisen & Meredith 2000).

To gain the support of the people for conservation, it is vital for the people to understand the problems of unsustainably high levels of hunting, and the multiple benefits of protected areas (Ahmad, Tisen & Bennett 1999). This is done through the Conservation Education Program which reaches out to the communities, especially in the rural areas.

Management of Services and Visitors

The National Parks and Nature Reserves Ordinance 1998 includes a provision for the appointment of any person or company, referred to as 'managing agent' to build, manage, or maintain any building and facilities, any historical site or monument; or undertake the provision of services within a national park or nature reserve. This particular provision allows for the privatisation of services in protected areas.

Currently, the government undertakes the management of operations in all protected areas, sometimes resulting in poor services, which leads to visitor dissatisfaction. In some parks, certain services such as transportation, catering, and laundry are undertaken by the private sector. Recently, the private sector has shown great interest in taking over the management of some high profile parks. Currently, the tourism management zone of Gunong Mulu National Park is managed by Borsar Mulu Sdn. Bhd., a private organisation. However the government must recognise the dangers. "Large scale or total transfer of the national park into private hand is undesirable as the profit maximisation objectives might supersede the long term management objectives of conservation" (Ahmad, Bujang & Buding 1998; p. 255) To ensure the balance between use and conservation, it is vital that only certain services are privatised and that the management of the natural resources remain with the government.

Sarawak Forestry has put in place Customer Service Assistants in all TPAs that are open to the public. Their tasks are to render assistance to the visitors, to provide correct information and to

conduct briefing on the attractions and well as the "do's and don'ts" of the parks. In addition to the customers' services, each TPAs that are open to the public operate the Park Shop, where visitors can purchase necessary items including souvenirs.

Park Maintenance

All parks are now *ISO 9001* and *OHSAS* accredited. Maintenance of facilities follows standards as laid down by management. Every park uses a standard Park Maintenance Manual, which sets out procedures and guidelines for the maintenance personnel to follow in their preventive maintenance program. An Internal Auditing Team monitors all maintenance work undertaken on the ground.

Park facilities maintained at the highest level at all times will ensure visitor satisfaction and reduce conflict between visitors and management. Well-maintained facilities also reduce impacts on the natural resources. For example, a well maintained trail would help reduce erosion and trail widening at the same time adding to visitor comfort.

Human Resource Development

Central to managing for sustainability of nature-based tourism are the knowledge and skills relevant to protected areas. Thus, to meet the challenge of working towards nature conservation and managing natural areas for tourism and recreation, NPWD[4] needed to have a professionally qualified and highly motivated team of protected area staff (Johari & Adee 1999). For this reason, the State Government put in place a special training program, which was run jointly with Lincoln University of New Zealand from 1999 to 2002. This training program enabled staff to study towards attaining the University's Certificate in Conservation and Eco-tourism Management. Seventy-five staff of Sarawak Forest Department went through the program which was run in Kuching, and graduates were awarded with the certificates. Most have now joined Sarawak Forestry with a number assigned as park wardens.

Sarawak Forestry has also recruited individuals with the desired skills to enhance both biodiversity conservation and tourism needs. Sarawak Forestry is currently embarking on an internship program where fresh graduates go through an in-house training to expose them and for them to explore 'best-fit' position in the organisation. On the tourism front, Sarawak Forestry with Universiti Tecknologi Malaysia (UiTM) is conducting park guide training for people who aspire to guide in Sarawak's national parks and nature reserves. It is a requirement by law under the National Parks and Nature Reserves Regulations that all guides in national parks and nature reserves must

[4] National Parks and Wildlife Division of Sarawak Forest Department was responsible for the management of TPAs and biodiversity conservation prior to the establishment of Sarawak Forestry. The functions were taken over by the Protected Areas and Biodiversity Conservation Unit of Sarawak Forestry in 2003.

possess park guide license and must have gone through the necessary training and courses approved by the Controller of National Parks and Nature Reserves. The park guide license will only be issued to those who have undergone the training and passed all the relevant examinations.

NATURE (BIODIVERSITY) BASED TOURISM:

Nature based tourism should combine the goals of development and conservation, have a negligible effect on the environment, and foster the sustainable management of resources (WCS & FD 1996).

Nature based tourism and recreation can provide economic benefits, which in turn promote conservation of resources. In Costa Rica, nature based tourism is the country's largest earner of foreign exchange and takes place on the 30% of the country protected in conservation areas (WCS & FD 1996). Nature based tourism and recreation provides stimulation of economic development in isolated rural areas thus reducing the pressure of communities on natural resources. In Sarawak, tourists visit Batang Ai National Park for its forests, wildlife, and the Iban Culture at the periphery of the park. A survey on a longhouse community in 1995, showed that there is marked reduction in shifting cultivation activities as tourism related businesses occupy most of the local people's time and provides substitute income (WCS & FD 1996).

An indirect benefit of nature-based tourism is the knowledge gained by both the local communities and the general public on conservation, thus enhancing their support for protection of nature and its environment.

In Sarawak, providing for tourism opportunities is often used to justify conservation and protection of natural areas as policy makers realise that such initiative can bring in revenue to the government coffers.

Problems of Nature Based Tourism and Recreation

Nature based tourism and recreation can have long-term negative effects on the resources and the local communities. If it is badly managed, nature based tourism and recreation may impact the environment through degradation of soil, vegetation, wildlife and water resources (Hammit & Cole 1998). Direct impacts may occur through clearing for buildings or other infrastructure, through erosion of paths in sensitive areas and through pollution by sewage and rubbish. Impact on wildlife may be direct such as outright killing or unintentional disturbance. In Bako National Park, the

unintentional feeding[5] of monkeys by visitors resulted in habituation and becoming so aggressive that they have to be culled (WCS & FD 1996).

Negative effects can be in the form of increasing antagonism towards protected areas by local communities who see their traditional land and rights being removed in favour of tourists, particularly if they are excluded from tourism planning and receive few benefits from it (WCS and FD 1996). In the early 1990s' in Gunung Mulu National Park, the local people destroyed park facilities in protest at the construction of an international hotel just outside the park, which they saw as a major competitor to their small-scale accommodation businesses.

Sarawak addresses community issues through the establishment of the Special Park Committee or the Special Wildlife Committee. Through this forum, representatives of the local communities as well as other stakeholders work together with the park / wildlife sanctuary management to formulate ideas and proposed / recommend to the Controller to address management issues. Members of the SPC / SWC are paid sitting and other allowances when they attend meetings or are requested to assist in the park.

Sustainable Tourism

The Burndtland Report states that sustainability "… meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development [WCED], 1987, p.8). Currently the World Tourism Organisation (WTO 2002) defines sustainable tourism development as:

> *Meet[ing] the needs of the present tourists and host regions while protecting and enhancing the opportunities for the future. It is envisaged as leading to management of all resources in such a way that economic, social, and aesthetic needs can be fulfilled while maintaining cultural integrity, essential ecological processes, biological diversity and life support systems.*

A widely accepted meaning for sustainable tourism is …"tourism that is developed and operated in such a manner as to follow the principles of being appropriate and morally correct as well as being environmentally suitable" (Butler 1980; p. 27). Thus for tourism to be sustainable, the environmental, cultural, political, economic, social, managerial and governmental dimensions must all be considered.

[5] Feeding of monkey is not permitted in Bako NP. The long-tailed macaque might have acquired the knowledge that certain items brought in by the visitors are eatable through observation and trial and error of testing discarded pieces. Some has waited on diners for opportunity to grabs the food and dashed off up the tree.

"If tourism is to contribute to the broader social, political and economic goals of sustainable development, institutional mechanisms need to be put in place that will facilitate the participation of local residents in tourism planning" (Milne 1998; p 46). Thus, government institutions play the main role to ensure sustainable tourism through planning, managing, regulating and promoting tourism. If interpreted purely in economic terms rather than the viability of the physical and social environment, tourism activities may lead to the *'tragedy of the common'* a condition which suggests that environmental decline is inevitable in the absence of assigned responsibility for resources protection (Hardin 1968).

To ensure sustainability, Sarawak Forestry had adopted the '5S' management framework developed by The Nature Conservancy (TNC). Most of the TPAs have developed the management framework based on the 5S concept.

TOURISM IN SARAWAK

Sarawak is a small developing tourism destination in South East Asia. While it is a constituent state of Malaysia, because of its geographical isolation on the island of Borneo, Sarawak is in many ways developmentally distinct from the remaining states of Peninsular Malaysia (Simmons 1996). In 2006, of the total 17.55 million arrivals to Malaysia, Sarawak account for only 16.6% (2.93 million), however Sarawak has recorded an increasing number of foreign visitors arrivals in the past years (Tourism Malaysia 2008; STB 2008).

Sarawak is expected to play a central role in the development of Malaysian tourism. In contrast to the urban and coastal attractions of the peninsula, Sarawak has much to offer in its natural and cultural attractions. In line with the efforts by the Federal Government, Sarawak's State government also put high priority on tourism development in the mid-1980s. Sarawak, with its multiracial society, wide range of wildlife and forest habitats particularly in protected natural areas, and wide range of natural features such as caves, rivers and mountains is promoted as an opportunity for 'culture, adventure and nature', usually referred to as 'CAN'. Slogans such as 'Land of the Hornbill', Land of Headhunters', Land of Many Rivers' and 'Land of the White Rajah' used in promotion and brochures are indicative of culture, wildlife, natural beauty and history of Sarawak (Hon 1990).

In 1992, the State together with the then Federal Ministry of Culture, Arts and Tourism commissioned the Second Sarawak Master plan to guide the orderly development of tourism. The conceptual framework for the preparation of the master plan stressed a multi-dimensional approach which sets Sarawak explicitly in the national context and that of the wider ASEAN region (Pearce 1995). The plan recommended that Sarawak offer a myriad of tourism products ranging from cultural attractions (Kuching City, Sarawak Cultural Village, Longhouses, Niah Caves and the Penan

Community), nature based attractions (National Parks, Nature Reserves and Wildlife Centres), adventure activities, beach products, food and shopping and special events and festivals (Government of Sarawak [GOS] 1993a; 1993b).

The exotic images of Borneo such as longhouses, Dayak cultures, and wild tropical landscapes have become major attractions to entice tourists to Sarawak. Zeppel (1994) pointed out that tourist brochures mainly depict Iban longhouses, Dayak people wearing traditional costume, Borneo wildlife and spectacular scenery like Mulu caves or Niah caves, tropical rainforest, British colonial buildings, Chinese temples, handicrafts, river scenery and also the Sarawak Cultural Village.

In Sarawak, all matters related to tourism fall under the purview of the Ministry of Urban Development and Tourism (MoUDT) which is responsible for the implementation of the State Tourism Policy, including market development, tourism related infrastructure developments, human resource development and market promotion. The Sarawak Tourism Board (STB) established under the Ministry handles both local and international market promotions. The MoUDT and the STB work closely with the Sarawak Tourism Association, which represents the interest of the private tourism businesses in areas of market development, market promotion and human resource development. In market development and infrastructure development, the Ministry works very closely with the Sarawak Forestry which is responsible for the management of protected areas.

Tourism Attractions in TPAs (National Parks and Nature Reserves)

Sarawak's TPAs are established for the protection of unique biodiversity or natural features which often are also the main attractions to the parks. The recognition that protected areas play a major role in tourism and recreation in the State is seen in the Sarawak National Parks Tourism policy. The policy seeks to (i) promote conservation by establishing additional protected areas as national parks, wildlife sanctuaries and nature reserves, (ii) promote nature and conservation education; promote forest recreation particularly among Sarawakians, (iii) promote tourism through the creation and development of protected areas and to carry out scientific research.

The main thrust of the policy is to see that the creation and management of protected areas is associated with the benefits derived from tourism such as generation of foreign exchange, assisting the economy in areas where protected area development occurs and the development of basic physical and other infrastructure in rural areas (State Government of Sarawak 1993). *Table 2* shows the parks unique qualities that has also become the tourism attractions to the parks.

TABLE 2. ATTRACTIONS IN SELECTED NATIONAL PARKS (NP), NATURE RESERVES (NR) AND WILDLIFE CENTRES (WC) OPEN TO THE PUBLIC

No.	TPAs	Tourism Attractions (Biodiversity)
1	Bako NP	Proboscis monkey (Nasalis larvatus)
2	Gunong Mulu NP	Bats exiting Deer Cave at dusk
3	Niah NP	Harvesting of Swiftlets (Collocalia maxima)
4	Lambir Hills NP	Species rich rainforest
5	Similajau NP	Beach forest
6	Gunung Gading NP	Rafflesia –world's biggest flower (Rafflesia arnoldii),
7	Kubah NP	Diversity of Palms and frogs
8	Batang Ai NP	Orangutan (Pongo pygmaeus)
9	Talang Satang NP	Turtle and coral reefs
10	Loagan Bunut NP	Biodiversity rich natural lake
11	Tanjong Datu NP	Hornbills
12	Maludam NP	Red banded langur
13	Kuching Wetland NP	Crocodile and dolphins
14	Pulong Tau NP	Mountain vegetation (Rhododendron) and wildlife
15	Sama Jaya NR	Nature walk (flora)
16	Bukit Lima NR	Nature walk (flora)
17	Wind Cave NR	Caving (Bats)
18	Fairy Cave	Caving (Cave fauna)
19	Matang WC	Endangered species learn to live wild again
20	Semmengoh WC	Orangutan rehabilitation

Visitors to National Parks and Nature Reserves

To date, sixteen TPAs have been open to the public. They are Bako NP, Gunong Mulu NP, Niah NP, Lambir Hills NP, Similajau NP, Kubah NP, Gunung Gading NP, Batang Ai NP, Loagan Bunut NP, Tanjung Datu NP, Talang Satang NP, Maludam NP, Sama Jaya Nature Reserves, Wind Cave Nature Reserves, Matang Wildlife Centre and Semenggoh Wildlife Centre. Sarawak's' TPAs receive an average of more than 300 000 visitors per year since 2004, with local visitors accounting for

about 70% (*Figure 1*). There has also been a gradual increase in the percentages of the total number of foreign visitors to TPAs from 14.75% in 2001, 17.22% in 2002, 18.16% in 2003, 23.13% in 2004, 23.32% in 2005, 25.12% in 2006 and 25.31% in 2007.

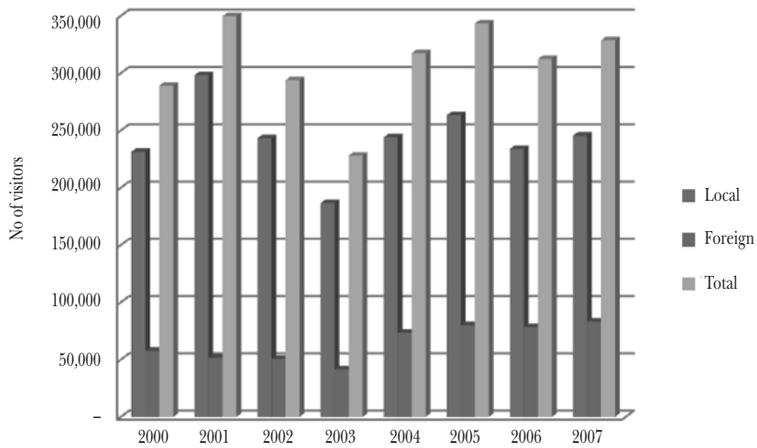


Figure 1. Visitors to national parks and nature reserves by year

Sarawak registered a total of 2 261 696 foreign visitors in 2005 and 2 030 162 in 2006 (STB 2008). The total foreign visitors to Sarawak TPAs for the same year were 78 464 and 80 070, which is 3.9% and 3.54% of the total foreign visitors to the state respectively. This indicated that only a small fraction of foreign visitors to the state did actually visited Sarawak's National Parks. With improved facilities, good packaging of products and promotions, Sarawak should be able to entice more foreign visitors to the state to visit the parks.

Revenue Generated from Park Facilities and Services

Sarawak TPAs has seen a steady increase in revenue collected over the year from RM2.03 in 2004, RM2.18 in 2005, RM2.20 in 2006 and RM2.41 in 2007 (*Figure 2*). By April 2008, Sarawak TPAs has generated RM640,299. These are revenue derived from direct use of facilities and services such as payment of entrance fees and accommodations in Sarawak National Parks. It does not take into account the indirect benefits such as spinoff and multiplier effect of tourism to the state.

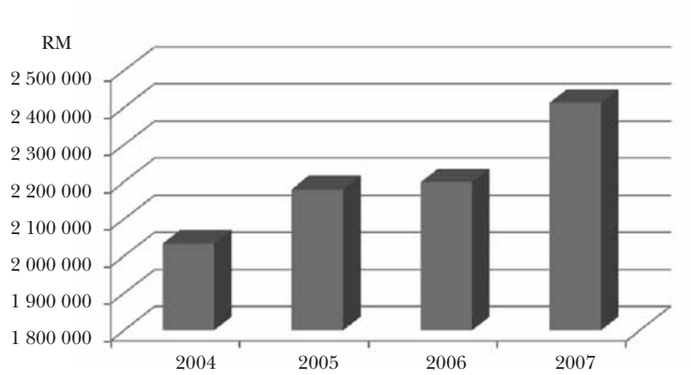


Figure 2. Revenue derived from entrance fees and accommodation in TPAs.

Tourism Malaysia recorded 15.7 million visitor's arrival to Malaysia in 2004, 16.43 million in 2005 and 17.55 million in 2006. This brought in RM29 291.1 million in 2004, RM31 954.1 million in 2005 and RM36 271.7 million in 2006 with a average receipt per head amounting to RM1865.70, RM1944.90 and RM2066.80 for the respective year (*Table 4*). Sarawak TPAs received a total of 73 442 foreign visitors in 2004, 80 070 in 2005 and 78 464 in 2006, thus contributing RM137.02 million in 2004, RM155.73 million in 2005 and RM162.20 million in 2006 in tourism receipts to Malaysia. This is a substantial amount of revenue generated from the existence of Sarawak's TPAs. The key challenge is to be able to channel back some of these money for the protection or management of these TPAs.

TABLE 4. TOURIST ARRIVAL AND RECEIPT TO MALAYSIA

Year	Arrivals* (Million)	Receipts* (RM) (Million)	Receipt / head (RM) SNPs	Foreign Visitors to	Estimated Tourism Receipt from SNPs (RM) (Million)
2004	15.7	29 291.1	1865.70	73 442	137.02
2005	16.43	31 954.1	1944.90	80 070	155.73
2006	17.55	36 271.7	2066.80	78 464	162.20

(*Source: Tourism Malaysia 2008)

NATURE DILEMMA

Tourism flourishes in quality environments. The environment, however, is a perishable commodity, i.e. hard to restore and in short supply while the tourism consumer, is dynamic and fast growing (Butler 1980; OECD 1980). Maintenance of good environments is essential to sustain or foster further growth of tourism. Tourism is like a double-edged sword; it can provide economic benefits and diversification of the economy and promote the conservation of nature. It also exerts a lot of pressures on the resources of destinations and, if badly managed, will affect the very resources on which it thrives (Ioannides 1995).

Rapid growth in tourism may result in a degree of environmental degradation. Often, highly sensitive areas such as breeding areas for wildlife, fragile environments such as small islands where turtles lay their eggs, mangrove forests, lake sides, and mountain summits are all premium attractions for tourists, making their degradation seem inevitable (Backer 1995; Booth & Cullen 1995; Barton *et al*. 1998; Terborgh 1999; Crawford, *et al*. 2001). In certain areas, degradation of the environment has already brought about a decline in the growth of tourism (OECD 1980). Recreational use of natural areas results in habitat degradation, soil erosion and compaction, animal disturbance, water and air pollution, contaminated soil and damage to vegetation (PCE 1997; Hammitt & Cole 1998). For example, in Bako National Park, Sarawak, the more common adverse environmental impacts observed include litter, erosion, damage to vegetation and disturbance to wildlife (Chin *et al*. 2000).

Tourism can weaken mutual help and cooperation based on traditional norms, increase intergenerational conflicts, and destroy intimate, personal and friendly relations. It "… brings certain informal traditional human relations into the area of economic activity, turning acts of once spontaneous hospitality, for example, into commercial transactions" (de Kadt 1979; p. 14). The disruption of intimate and personal relations is associated with commercialisation and materialism in human relationships which is perhaps one of the most common consequences of tourism. Commercialisation signifies demanding money for services which used to be provided free. Thus, a value system based on moral values is replaced by one based on money. Tourism transforms human relationships into a source of economic gain and the proportion of non-economic relationships diminishes. Previously warm and intimate relationships are transformed into commercial forms. In traditional rural society in Sarawak, families would share resources and produce with the neighbour. For example, wild meat from hunting trip is also shared with the others who do not partake in the hunting. However, with tourism comes commercialization, wild meat has become a commodity and sold for profit. This ultimately has a negative effect on the wildlife as more people would hunt for commercial gain.

Relevant to management is that visitors are an accepted component of the environment and the aim is to achieve an appropriate compatible balance between use and protection (DOC 1997). However, impact on resources does not occur in isolation, it is dynamic and changes in space and

time. The concentration or dispersal of use has a lot of implications for management in that dispersal reduces the amount of use on a site, thus reducing the impacts. On the other hand, dispersal spreads impacts over a wide area which makes management more difficult. Thus, the level of management intervention should be based on a case-to-case basis depending on the particular conservation values and objectives for specific areas.

As distribution of use is related to the distribution of impacts, use distribution is a major management concern for recreation resource managers. To be able to manage impacts on tourist areas, particularly in natural areas, it is crucial to identify and assess impact problems related to the key conservation values of the area (DOC 1997). The New Zealand Department of Conservation (1997) defines conservation values as "… the specific elements of natural and historic resources which establish their significance for being assigned conservation priority by management agencies" (p.7). Crucial to management is the point that any use of the area will have effects on the conditions and values associated with the area that not all effects result in negative impacts, and that impacts do not occur in isolation (DOC 1997; Hammitt & Cole, 1998; Ioannides 1995).

The end result of the above factors for a destination is that tourists may now avoid the place, locals are unhappy and the cultural or natural environments demeaned or destroyed. The aim of management must be to avoid this situation by thoroughly understanding its origins and putting in place systems for monitoring and control.

WAY FORWARD AND CHALLENGES

Sarawak Forestry has taken stock of the present situations evaluating strength, weaknesses, opportunities, threats and key challenges, and taking a hard look at our hope and fears in moving toward out vision to be globally recognized as a leader in management of totally protected areas and biodiversity conservation. We are confident that we are moving in the right direction taking the motto of moving *'Steadily and Surely'* and *'Surely and Steadily'* in our every move forward (Landong & Tisen 2006).

Sarawak Forestry through its Protected Areas and Biodiversity Conservation Unit has identified five key strategic thrusts, they are information management, human capital development, strengthening legislation, one million hectares of TPAs and resources protection (PABC 2003). Sarawak Forestry has developed the Proprietary Information Management System (PIMS) for managing information to enhance management. PIMS would fit nicely into the organisation's vision and mission and will definitely speed-up the dissemination of information not only within Sarawak but all over the world (Lim 2006). When fully operational, it will be accessible via the internet.

In moving forward Sarawak Forestry identifies five focus areas toward achieving an ideal state of biodiversity conservation and management. They are the stakeholders' engagement, IUCN framework, conservation education, centres of excellence and global partnership.

Sarawak Forestry is now a member of the IUCN and has adopted the IUCN guidelines in its strategy to conserve biodiversity. The special committee for each TPAs has enabled stakeholders to contribute to the management of TPAs. Our biodiversity and our environment is just one world, it cannot be managed in isolation and definitely not the duty of a few. Any changes to the environment ultimately affect everyone, thus the ideal state, the management of our biodiversity is the responsibility of all people on this planet. Promoting conservation education and awareness is crucial towards transferring the responsibility from the few to the wider public.

As the saying goes, it is not necessary to 'reinvent the wheels', thus Sarawak Forestry will work with global partners to share information and ride on the strength and achievement of others who have managed to gain global recognition and finally be recognised as global centre of excellence too.

CONCLUSION

Nature based tourism and recreation can provide economic benefits which in turn promote conservation if properly managed. On the opposite end of the scale, nature based tourism and recreation can have long-term negative effects on the resources and the local communities. In pursuing economic gain from nature based tourism and recreation, there is a tendency for businesses to over-develop and over-promote use of the resources which can lead to serious environmental impacts and dissatisfaction of users. This can be counter productive in the long run.

Sarawak Forestry, backed by legislative and legal mandate, initiates and installs various management policies and practices to balance between conservation and use of protected areas. As protected areas do not exist in isolation, Sarawak looks at them as a system to strengthen conservation values and to provide for wider recreation opportunities. Beyond the boundaries of the protected areas, Sarawak Forestry works as a partner in a concept of co-management with the local communities and to other stakeholders to protect the resources. To meet all these challenges, Sarawak Forestry has established a training program to upgrade the capabilities and knowledge of its personnel.

With all these in place, it is hoped that Sarawak will be able to continue to gain from nature based recreation as well as achieving its conservation goals. Sustainable tourism will thus be the outcome. Only time will tell.

REFERENCES

Ahmad, SH, Bujang, AW, & Budeng, B 1998, 'Privatization of national parks concession management, scope and approaches', *Hornbill,* vol. 2, pp. 250–264.

Ahmad, S, Tisen, OB, and Bennett, EL 1999, 'Wildlife conservation and local communities in Sarawak', *Hornbill,* vol. 3, pp. 223–229.

Anderson, JAR 1980, *A checklist of trees of Sarawak*, Sarawak Forest department, Kuching.

Anon 1985,' Status of snakes, lizards and amphibians in Sarawak,' in *Report and Recommendations to Dewan undangan Negeri Select Committee on Flora and Fauna in Sarawak,* Appendix B. *Ad-hoc* Sub-committee on Fisheries, Reptiles and Amphibians. Dewan Undangan Negeri, Kuching. Pp. 105–112.

Barton, K, Booth, K, Ward, J, Simmons, DG & Fairwater, JR, 1998, *Visitors and New Zealand Fur Seal Interactions along the Kaikoria Coast*. Tourism Research and Education Centre (TREC) Report No: 9. Lincoln University, New Zealand.

Backer, C 1995, 'Tourism and the environment', in *European tourism: regions, space and restructuring,* eds AW Montanari & AM Williams, John Wiley & Sons Ltd, England, pp. 207–220.

Bennett, EL 1987, *A survey of the peatswamp forests of Maludam: wildlife, human use and recommendations to protect the area*, National Parks and Wildlife Office, Sarawak Forest Department, Kuching.

Bennett, EL, 1992, *A Wildlife Survey of Sarawak*, Wildlife Conservation Society International, New York and WWF Malaysia, Kuala Lumpur.

Bennett, EL & Gombek, F 1993, *Proboscis monkeys of Borneo*, Natural History Publications (Borneo) and KOKTAS, Kota Kinabalu, Sabah, Malaysia.

Bennett, EL, Nyaoi, AJ & Sompud, J 1997, 'Hornbills Buceros spp. And culture in Northern Borneo: can they continue to co-exist?', *Biol. Cons*., vol. 82 pp. 41–46.

Bennett, EL, Nyaoi, A & Sompud, J 2000, 'Saving Borneo's bacon: the sustainability of hunting in Sarawak and Sabah', in *Hunting for sustainability in tropical forests,* eds JG Robinson & EL Bennett, Columbia University Press, New York, pp. 305–324.

Bennett, EL & Robinson, JG 2000, 'Hunting for the snake', in *Hunting for Sustainability in Tropical Forests,* eds JG Robinson & EL Bennett, Columbia University Press, New York, pp.1–9.

Bennett, E L & Tisen, OB 2001, 'A master plan for wildlife conservation', *Sarawak Gazett*, vol. 128 no. 1543, pp. 4–10.

Booth, K & Cullen, R 1995, 'Recreation impacts', in *Outdoor recreation in New Zealand: a review and synthesis of the research literature 1,* eds PJ Devlin, RA Corbett & CJ Peebles, Department of Conservation.

Butler, RW 1980, 'The concept of a tourist area cycle of evolution: Implications for management of resources', *Canadian Geographer*, vol. 24, pp. 5–12.

Chin, LMC, Moore, SA, Wallington, TJ & Dowling, RK 2000, 'Ecotourism in Bako National Park, Borneo: visitors' perspectives on environmental impacts and their management', *Journal of Sustainable Tourism,* vol. 8, no. 1, pp. 20 –35.

Cotter, DD 1999, National parks of Sarawak, *in The concept of park development: framework, management and operation', 13 June 1999,* Kangar, Perlis, Malaysia.

Crawford, K, Phillips, J, Ward, J & Hughey, K 2001, *Biophysical impacts of tourism: an annotated Bibliography,* Tourism Recreation Research and Education Centre (TREC), Lincoln University, New Zealand.

De Kadt, E 1979, *Tourism: passport to development? Perspectives on the social and cultural effects of tourism in developing countries, Oxford University Press,* New York.

Department of Conservation (DOC) 1997, *Impacts of visitors on natural and historic resources of conservation significance*, Science & Research Internal Report No. 157, Department of Conservation, Wellington.

Government of Sarawak (GOS) 1993a, *The Second Tourism Masterplan Study, Sarawak: vol 1. Executive Summary*, State Government of Sarawak, Malaysia.

Government of Sarawak (GOS) 1993b, *The Second Tourism Masterplan Study Sarawak: vol. 3, Implementation Plans*, State Government of Sarawak, Malaysia.

Hammitt, W & Cole, D 1998, *Wildland recreation: ecology and management,* 2nd edn, John Wiley, New York.

Hardin, G 1968, 'The tragedy of the commons', *Science,* vol. 162, pp. 1243–1248.

Hazebroek, HP & Morshidi, AKA 2001, *National Parks of Sarawak*, Natural History Publications (Borneo) Kota Kinabalu, Sabah, Malaysia.

Hon, D 1990, 'Sarawak tourism potential', *Sarawak Gazette*, Oct., 12–16.

Ioannides, D 1995, 'Planning for international tourism in less developed countries: toward sustainability', *Journal of Planning Literature*, vol. 9, no. 3, pp. 235–253.

Johari, S, and Adee, S 1999,' The Sarawak-Lincoln university programme (S-LUTP): an update', *Hornbill,* vol. 3, pp. 112 –115.

Landong, WS & Tisen, OB 2006, 'Biodiversity conservation: the way forward', *Hornbill,* vol. 8.

Leh, C *et al.* 1995, *A status report on the swiftlet population of Niah Caves, November 1995*, Forest Department and Sarawak Museum, Kuching.

Lim, CK, 2006, 'PABC proprietary information management system', *Hornbill,* no. 8. Sarawak Forestry, Kuching, Sarawak.

MacKinnon, J & Phillips, K 1993, *A field guide to the birds of Borneo, Sumatra, Java and Bali*, Oxford University Press, Oxford and New York.

Medway, L 1977, *Mammals of Borneo. Monographs of the Malaysian branch of the Royal Asiatic Soceity, no. 7,* MBRAS, Kuala Lumpur.

Milne, S 1998, 'Tourism and sustainable development: exploring the global-local nexus,' in *Sustainable tourism*, eds M Hall & A Lew, Addison Wesley Longman Limited. USA pp. 35–48.

Organisation for Economic Cooperation and Development (OECD) 1980, *The impact of tourism on the environment,* General Report, OECD, Paris.

Protected Areas and Biodiversity Conservation Unit (PABC) 2003, *Business Plan 2004–2006*, PABC, Sarawak Forestry Corporation (unpublished business plan).

Parliamentary Commissioner for the Environment [PCE] 1997, *Management of the environmental effects associated with the tourism sector* PCE, Wellington.

Payne, J, Francis, CM, & Phillipps, K 1985, *A field Guide to the mammals of Borneo*, The Sabah Society with WWF Malaysia, Kota Kinabalu.

Pearce, DG 1995, 'Planning for tourism in the nineties: an integrated, dynamic, multi scale approach', in *Change in tourism: people, places, processes,* eds RW Butler & DG Pearce, London, Routledge, pp. 229–244.

Sarawak Tourism Board [STB] 2008, *Visitor arrival into Sarawak*, viewed on the 23 May 2008, <http://www.sarawaktourism.com/content.cfm/ID/794F1666-B478-6EBC-D5A5A012CD172463>.

Sarawak Government Gazette, Part 1, 1988a, *National Parks and Nature Reserves Ordinance, 1998*. Percetakan National.

Sarawak Government Gazette 1998b, *Wild Life Protection Ordinance 1998 Sarawak Government Gazette, Part 1, Percetakan National*.

Sarawak Forestry 2007, *Visitors statistics and Revenue to Sarawak National Parks,* Sarawak Forestry, Sarawak, Malaysia.

Simmons, DG 1996, 'Assessing tourism's and cultural impacts: methods and practice for national level planning,' in *Proceedings of the Annual Conference of the International Association of Impact Assessment,* Estroil, Portugal. (II), pp. 795–800.

Soepadmo, E & Wong, KM 1995, '*Tree Flora of Sabah and Sarawak*, vol. 1, Forestry Research Institute, Sabah Forest department and Sarawak Forest department, Kuala Lumpur.

State Government of Sarawak 1993, *The Second Tourism Masterplan Study, Sarawak,* Tourism Resource Consultants/Lincoln International Limited). Kuching, Sarawak.

Terborgh, J 1999, *Requiem for nature*, Island Press, Washington, D.C.

Tisen, OB, & Meredith, M 2000, 'Participation of local communities in management of totally protected areas, *Hornbill*, vol. 4, pp. 42–49.

Tourism Malaysia 2008, *Welcome to tourism Malaysia corporate site,* viewed 23 May 2008, <http://www.tourism.gov.my/tourismbiz/media_centre/statistic.asp>.

Whitmore, TC 1984, *Tropical rain forest of the Far East,* 2nd edn, Oxford University Press, Oxford.

Wildlife Conservation Society and Sarawak Forest Department (WCS & FD)1996 *A Master Plan for Wildlife in Sarawak,* Wildlife Conservation Society and Sarawak Forest Department, Kuching Sarawak.

World Commission on Environment and Development (WCED) 1987, *Our common future*, Oxford University Press, London.

World Tourism Organisation (WTO), 2002. *Sustainable tourism development: concepts and definitions*, viewed 25 November 2002, <http://www.world-tourism.org/sustainable/concepts.html>.

Zeppel, H 1994, 'Authenticity and Iban cultural tourism in Sarawak', in *Proc. Tourism Conference of Student Research*, Townsville: Department of Tourism, James Cook University pp. 20–26.

The Role of a Natural History Museum in Education and Recreation

F.S.P. NG
Academy of Sciences Malaysia, Kuala Lumpur
902-4, Jalan Ismail, 50480 Kuala Lumpur

Abstract

Malaysia's location in South East Asia makes it one of the major biodiversity countries of the world. With this advantage, Malaysia can be a leader in research and management of biodiversity. Indeed, Malaysia's National Policy on Biological Diversity carries the Vision statement: "To transform Malaysia into a world centre of excellence in conservation, research and utilization of tropical biological diversity by the year 2020." To realize this vision, Malaysia needs to establish a natural history museum with a nation-wide mandate.

The national vision does not mention education, but natural history museums are the most effective institutions for providing multiple-level education in society: pre-school, school, university, and throughout life.

- *Preschool: Young children have a natural curiosity about nature, and museums of natural history have found that young children can be taught how to examine natural objects and make discoveries; this is a useful skill for them to carry into adulthood.*
- *School: Museums can support the school curriculum by providing learning experiences of high scientific quality to complement the teaching curriculum.*
- *University: For the training of undergraduate and young professionals in the life sciences, the scientific collections of a museum provide an invaluable resource that all universities can use.*
- *Life-long education: Museums uplift the general level of scientific literacy in society* through dynamic and changing thematic exhibitions.

Museums that are good in presenting knowledge in entertaining packages attract millions of local and international visitors every year and become centres for 'edu-tainment', which is the combination of education with entertainment.

The word 'history' in 'natural history' is derived from the ancient Greek ἱστορία (pronounced 'historia') meaning 'knowledge acquired by investigation'. Natural history is knowledge of nature acquired by investigation. In conjunction with the investigation of nature, people collect specimens

for various purposes: for further study, to serve as reference materials, to use in demonstration and teaching, and to display and keep as mementos. Natural history museums began as buildings to house such collections.

The need to house natural history collections in a secure and permanent manner was first felt in medicine, which until recent times was based mainly on plants. Since descriptions are liable to misinterpretation, it became the practice to keep authenticated specimens in a safe place for people to refer to. This was how the first plant museums or 'herbaria' came to be established. Each plant was pressed, dried and glued to a sheet of paper, and important notes, including the name of the plant and the name of the person authenticating it, were written on the sheet. Sometimes such sheets were bound into books. Books of authenticated specimens were, of course, extremely valuable.

From herbal medicine, the practice of preserving specimens for reference spread to all other kinds of plants, to animals and to minerals. A preserved specimen is different from a description or picture. If we put a description or picture under a microscope, all we will see are magnified particles of ink and paper. If we put a real specimen under a microscope we will see microscropic details of the specimen. We can analyze a piece of specimen for its chemical content. We can dissect a specimen to determine its internal structure. With advances in molecular biology, we may even extract its DNA and learn about its genetic make up. Museum specimens are real records of species from places and times where they may no longer exist. Hence scientifically alert countries treat museum collections as irreplaceable national heritage collections, with a 'front' dedicated to exhibitions and a 'back' dedicated to scientific research and care of scientific collections.

Malaysia's location in South East Asia, the region of highest biodiversity in the world (*Table 1*), gives it a big advantage in natural history. This is the region in which many new discoveries can be made. This is where round-the-year field observation and experimentation is possible. Recognizing Malaysia's advantage, a National Policy on Biological Diversity (MOSTE 1998) was adopted in 1998 with the ambitious Vision:

To transform Malaysia into a world centre of excellence in conservation, research and utilization of tropical biological diversity by the year 2020.

At the Fifth National Biodiversity and Biotechnology Council (NBBC5) meeting on 29 September 2006, chaired by the Prime Minister of Malaysia, a decision was made to establish a Natural History Museum in Malaysia. Following this decision, the Ministry of Natural Resources and Environment formulated a consultancy project to develop a framework for the establishment of the Natural History Museum.

TABLE 1. WORLD BIODIVERSITY RANKINGS ACCORDING TO THE NATIONAL BIODIVERSITY INDEX (NBI), BASED ON VERTEBRATES AND VASCULAR PLANTS

Ranking	Country	NBI
1	Indonesia	1.000
2	Colombia	0.935
3	Mexico	0.928
4	Brazil	0.877
5	Ecuador	0.873
6	Australia	0.853
7	Venezuela	0.850
8	Peru	0.843
9	China	0.839
10	Costa Rica	0.820
11	Madagascar	0.813
12	Malaysia	0.809
13	Panama	0.793
14	Philippines	0.786
15	Brunei	0.777
16	Papua New Guinea	0.775
17	Guatemala	0.744
18	India	0.732
19	Bolivia	0.724
20	Equatorial Guinea	0.714
21	South Africa	0.714
22	Cuba	0.703

Source: Secretariat of the Convention on Biological Diversity, Montreal 2001

A team of consultants was appointed to develop the framework. The Consultancy Team made a study of selected natural history collections/museums/institutions in Malaysia, Singapore, the USA, England and the Netherlands. I was the Lead Consultant for the study. In this paper I will briefly outline our findings and recommendations with particular reference to the role of natural history museums in education and recreation. Education and recreation are not mentioned in the Vision Statement, but they are important functions of natural history museums, and natural history museums perform these functions better than most other institutions.

Natural History Museums in Malaysia

There is no comprehensive natural history museum in Malaysia comparable with museums overseas such as the Natural History Museum in London, the Field Museum in Chicago or the National Museum of Natural History of the Smithsonian Institution in Washington DC. Instead, we have about 22 natural history collections in various parts of the country. These collections may be grouped into three classes:

A. Collections in Government departments and institutes, (e.g. Institute for Medical Research, institutes for forestry, agriculture, fisheries, and wildlife), established to:

   1. To provide identification services for organisms important to health, forestry, agriculture, fisheries, wildlife, etc;
   2. To document and inventorize the plants and animal of the country or state;
   3. To train parataxonomists in identification (of pests, weeds, timbers, protected species, etc.);

B. Collections in Universities, established to support teaching and research activities in the life sciences, both basic (biology) and applied (e.g. forestry, environment / natural resources management); and

C. Collections in museums of culture and history, in which natural history is a subsidiary component.

The Role of Natural History Museums in Lifelong Learning

Historically, the educational role of museums began with the display of specimens that people found unusual, spectacular, exotic, or intriguing. The main hall of a natural history museum usually displays it most spectacular specimens. From the main lobby, a visitor would go into a series of rooms or galleries each dedicated to a particular theme, e.g birds, mammals, dinosaurs, Africa, economic plants, etc.

Now, in addition to permanent displays of things in systematic order, the leading museums of natural history also run dynamic programmes of exhibitions with special themes, each exhibition running for no more than a few months and providing a succession of educational experiences. Since people think and learn in many different ways, natural history museums have learnt to use specimens, models, dioramas, hands-on activities, videos, animations, artists' renderings, and audio components to communicate complex messages in informative, entertaining, and intellectually stimulating ways. In the leading museums, exhibitions are managed by full-time by professional staff with expertise in events-management, designing, writing, graphic arts, model-making, education, science communication, public relations, information technology, and related subjects. After a temporary exhibition is over, it can become a traveling exhibition to be loaned or rented to other museums. In this way, museums have come to play a very prominent role in providing life-long learning and in raising the level of scientific literacy in society.

Museums are particularly effective in educating people about:

- Their own country,
- Their region,
- The world,
- The present and past, and
- Changes in the environment.

More and more, museums have taken on the role of educating the public about environmental change and its consequences such as the extinction of species, destruction of fragile environments and global warming. A well-informed public is better prepared to take responsibility for the health of the environment.

It is pertinent to note that in a survey commissioned by the American Association of Museums in 2001, it was found that 87% of Americans view museums as the most trustworthy sources of objective information—followed by books (61%), television (49%), newspapers (34%) and the Internet (23%). This is a very powerful public endorsement of museums.

Natural History Museums in Research and Advanced Training of Scientists

The public credibility of a natural history museum, and hence its value as an educational resource, is based on its commitment to science. All world-class museums of natural history are world-class scientific institutions.

The most important physical resources of a museum are not the specimens on display in the exhibition galleries in 'front', but the scientific reference collections of specimens kept at the 'back'. The Natural History Museum of London holds 70 million specimens representing all forms of life, accumulated by 250 years of global exploration, including fossils that go back hundreds of millions of years (Natural History Museum London 2005/2006). It continues to add to the collection at the rate of 150 000 specimens a year. The National Museum of Natural History of the Smithsonian Institution in Washington DC holds 126 million specimens (National Museum of Natural History of the Smithsonian Institution 2007).

The level of comprehensiveness of a museum collection and the quality of its maintenance or *curation* defines the level of research that the museum can support. In a museum with comprehensive collections, species that never occur side by side in nature, species that no longer exist, and specimens collected recently, can all be laid out side by side for comparative study. Scientists with new questions are often able to find the answers in museum collections. Hence, the leading museums attract visiting scientists from all over the world. The Natural History Museum

in London attracts over 9000 visiting scientists a year. The National Museum of Natural History in Washington attracts about 8000.

Universities benefit greatly from proximity to such museums, and collaboration is strengthened by the appointment of museum staff as adjunct professors at the universities and the appointment of university professors to honorary positions in the museums. Young scientists training in such museums, being exposed to global collections and global experts, quickly develop global competence and ambitions themselves, and are positioned to become the scientific leaders of the future. Working together, the leading natural history museums and their associated universities have produced most of the leading biologists of the world.

In contrast, the natural history collections in Malaysia are small by world standards. They are also very narrow in geographical and thematic coverage. For example, the collections in the Forest Research Institute Malaysia consist mainly of collections made in Peninsular Malaysia that are of interest to forestry. The collections in the Forest Research Centres in Sabah and Sarawak consist mainly of collections made in Sabah and Sarawak respectively. The scientists working on such limited collections tend to have a limited view of science, not a national, regional or global view. A scientist for example, in Sabah would have little idea of what goes on across the border in Sarawak, Brunei, Kalimantan or Philippines.

Parochialism also affects our universities. University students in the western universities have access to great museums and develop a world view quite naturally while university students in Malaysia have a typically parochial view. The establishment of more universities will not address this issue. We need one comprehensive museum of natural history to provide a comprehensive resource that all the universities can share.

As an example of the degree of parochialism in Malaysia, I can cite our experience in organizing a symposium on mosquitoes and mosquito-borne diseases for the Academy of Sciences Malaysia in year 2000 (Ng & Yong 2000). We found that mosquito scientists in Malaysian could only speak about mosquitos in Malaysia. For regional overviews, we had to invite experts from Japan. Japanese scientists are encouraged to develop a global view, which puts them on par with scientists in the West, while Malaysians rarely make this effort.

Natural History Museums Complement the School Curriculum

The school curriculum in science is an ambitious one, but it is not possible to provide a uniform high standard of teaching everywhere. Museums support the teaching curriculum by staging educational experiences to which all schools can have access to. Museums also run preparatory

courses for teachers so that teachers know how to organize a museum visit. Museums also loan authenticated specimens to schools for teachers to use.

Museums in the US and Europe have found that primary schools benefit most from museums because in primary schools there is usually one teacher identified with each class and this one teacher can be motivated to bring the class out on a museum excursion. In a secondary school it is more difficult to organize class expeditions, but secondary schools students are old enough to organize their own visits in small groups. Most museums do not charge students for entry or charge a greatly reduced rate.

Natural History Museums Complement Parental Teaching Efforts

Most parents would like to give their children the best educational experiences possible, but do not know how, or cannot afford it. A good natural history museum is the best public solution. For families living close to a good natural history museum, museums have become a regular focus for family outings because they offer much to see and experience. Children have a natural curiosity about nature and such curiosity, if properly nurtured, becomes part of the intellectual equipment that they carry into adulthood. In the Natural History Museum in London there is a children's gallery known as the Investigate Centre. Here natural specimens such as minerals, fossils, bones, seeds and other natural objects are made available for children to handle and examine. Lenses and microscopes provided for closer examination of specimens. The children are assisted by facilitators who help the children to satisfy their curiosity by encouraging them to ask questions and suggesting how they could find answers, using the tools of investigation made available to them. The aim is to teach children how to learn about the world through observation and reasoning. For young children, natural history objects provide the best introduction not only to natural history but also to science in general and to the practical skills of thinking.

Natural History Museums in Recreation

Natural history museums are major visitor attractions. Local people interested in their own country and international visitors wanting to know more about the country they are visiting, would normally think of a museum as the best place to visit. Children are particularly attracted to dinosaurs, mammals, birds and reptiles, while adults may head for the minerals and gems, the wildlife photo gallery, and so on.

TABLE 2. COMPARISON OF SELECTED NATURAL HISTORY MUSEUMS/INSTITUTIONS

Museum	Natural History Museum London	National Museum of Natural History of the Smithsonian Institution, Washington DC	Field Museum, Chicago	Naturalis, Leiden	Raffles Museum of Biodiversity Research, Singapore	Botanic Gardens Singapore
No of general visitors a year	3 200 000	7 200 000	2 000 000	300 000	Not applicable	3 200 000
No of visiting scientists a year	9 200 (2005/06)	7 748 (2007)	607	250	100	37
Number of reference specimens	Total 70 m specimens. Animals 28 m Plants 5.2 m Minerals 350,000 Fossils 9 m Insects 28 m	Total 126 m specimens. Insects 30 m Plants 4.5 m Fish 7 m	Total 23 m specimens.	Total 12 – 15 m specimens. Insects 5.3 m Other invertebrates 2.3 m Vertebrates 1 m Fossils 1 m Rocks and minerals 440,000	Total 500 000 specimens. Animals over 400 000	Total 650 000 plant specimens
Geographical coverage	global	global	Global	Netherlands and South East Asia	South East Asia	South East Asia

Table 2 shows the number of visitor annually to major natural history museums, divided into two categories: general visitors to see the exhibitions and scientists to use the reference collections. The National Museum of Natural History in Washington DC tops the list of general visitors, with 7.2 million. The Natural History Museum in London attracts 3.2 million and this is equaled by the Botanic Gardens Singapore.

The number of scientific visitors is related to the size of the reference collections and their geographical coverage. Not surprisingly, the global museums attract more scientists than the regional museums.

A botanic garden with a herbarium is a natural history museum for plants, with a herbarium as its scientific 'back' and garden displays as its educational and recreational 'front'. By this definition, the botanic garden in Penang does not qualify as a botanic garden because it has no scientific support behind its recreational façade. It is nevertheless an important recreational resource with a long history, and it could easily become a true botanic garden by appointing the right people and providing them with a scientific mandate.

Natural History Museums as a Key Element in the Knowledge Economy

Natural history museums serve as centres of information to support modern knowledge-based economies. The range of knowledge services that a comprehensive natural history museum can provide is indicated by the following client list of the Natural History Museum, London (viewable on the NHM website 'Science enquiries and NHM consulting'):

- The food industry and retailers;
- Customs officers, importers and shipping agents;
- Health authorities, public analysts, laboratories, veterinary practices, including officers requiring identifications of venomous or noxious species;
- Farmers, agriculturists, horticulturists and gardeners;
- Scientists, environmentalists and agencies undertaking terrestrial, marine and freshwater surveys;
- The legal profession requiring expert witnesses;
- Forensic scientists and the police, including officers investigating evidence relating to fly larvae or the movement of contraband;
- Publishers requiring validation of technical content (both images and text);
- Mining, petroleum, water and waste disposal industries;
- Material technologists, architects and other users of building stones;
- Auctioneers requiring information on amber, carved materials, and natural history artifacts.

This client list tells us that in a modern economy, many industries and professions need quick and easy access to expertise on plants, animals and minerals. If Malaysia is to benefit fully from its biodiversity, it must make expertise readily available to members of the public whose business is not science or biodiversity, but food and agriculture, pest control, health and beauty, waste disposal, manufacturing, industry, tourism, law enforcement, publishing, horticulture, and so on. These people all contribute to economic development and need occasional scientific backup. If backup is not available, they will manage without, but their ignorance may affect their ability to compete globally. Some go overseas for help. However, although the museums overseas may be globally comprehensive, they will lack local familiarity. They will also charge for their expertise. The charge for identification of specimens, levied by the Natural History Museum of London on commercial enquiries, is _89 per specimen. However, scientists do not normally charge each other for information; instead they collaborate by exchanging information. A Malaysian Natural History museum, through scientific exchange, is the best vehicle for tapping into the information resources of the world and making it available locally.

A Natural History Museum in Malaysia

So far, there has been little progress in implementing the national vision in biodiversity, and this, we think, is due to the lack of an institution with a national mandate to implement it. We need a natural history museum with such a mandate.

Natural history museums are now being renovated and expanded in many parts of the world, and new ones are being built or planned, particularly in China, Japan, Korea, and the emerging economies of eastern Europe. These museums are usually built as symbols of their countries' rising scientific and technological capabilities. Beneath their grand façade is a purpose of great significance—the elevation of scientific literacy in the nation.

Science is a black box to many people—they cannot see what goes on inside the box, and the school curriculum, with its emphasis on exam-passing and rote-learning does little to make the box transparent. Natural history museums are committed to transparency in the development of scientific knowledge and its dissemination in a friendly and un-pressurized manner. Every year of delay in the establishment of a natural history museum is a year of opportunities lost in terms of benefits in scientific advancement, economic development, sustainable resource management and public education.

We estimate that the cost of establishing a natural history with global impact by 2020 will not be less than RM400 million. This is less than the cost of establishing a new public university and it should be viewed as a necessary investment in national development.

REFERENCES

MOSTE 1998, *National policy on biological diversity*, Ministry of Science, Technology and the Environment, Malaysia.

National Museum of Natural History of the Smithsonian Institution 2007, 'GoSmithsonian', National Museum of Natural History of the Smithsonian Institution 25 June.

Natural History Museum London (NHML) 2005/2006, 'A global agenda', Annual Review 05/06:

Ng FSP & Yong HS (eds) 2007, *Mosquitoes and mosquito-borne diseases*, Academy of Sciences Malaysia, Kuala Lumpur.

Global Diversity Outlook, Secretariat of the Convention on Biological Diversity (SCBD) 2001, SCBD, Montreal.

A Structured Approach Towards Environmental Education by Non-governmental Organizations in Biodiversity Conservation

H. R. SINGH
Department of Biology, Faculty of Applied Sciences, UiTM, 40450 Shah Alam
AND
S. RAHMAN
Malayan Nature Society (MNS), JKR 641 Jalan Kelantan, Bukit Persekutuan, 50480 Kuala Lumpur

Abstract

The manner in which environmental education and communication is carried out and its ability to engage and motivate target audiences determine the success of an NGO's campaign. A well structured environmental education programme should include social marketing and communication channels. The objectives of such a programme must include awareness creation, knowledge accumulation, acquiring positive attitudes, acquisition of skills for problem solving, citizen participation and opinion generation. Environmental education works at two levels, namely school based and public awareness and participation. The former includes passive education, interaction education, experiential education and empowerment while the latter emphasizes behaviour modification via specific approaches and communication channels. Without the education of youth in schools or the general public, there will be insufficient knowledge of a cause. Without knowledge, there can be no action, and without action there can be no change. In replacing the standard marketing practices of the four P's (product, price, place, promotion), social marketing and communication for environmental NGO's replaces benefits of behaviour modification as the product value; overcoming behaviour barriers as the price value; easy access or how fast a change can take place as the place value; and the message outreach and the channel used as the promotion value. The approach and the channel as to how a 'non-doer' evolves into a 'doer' or advocate of environmental principles are discussed. The challenges of implementing environmental education programmes include financial constraints, effectiveness of the education plan, understanding the use of the behavioural model, human resource needs, economic and political will, integrated approach between education and other implementing agencies. Several factors can make or break an environmental education program, whether it is school-based or a general public awareness campaign. The environmental message must be accessible and tailored to the existing knowledge and interests of the target market (schools and public) and it must also be clear and uncomplicated. The participation of community stakeholders in an environmental awareness campaign is crucial for its success. Empowering students as well as the public results in their ability to organize and execute courses of action required to attain designated types of performances. Small incremental steps lead to large movements when the collective movement of several

individuals becomes a force to be reckoned with and its enthusiasm motivates others to do the same which then becomes contagious.

Biodiversity is defined as the variety of living organisms including their genes, all species and the ecosystems that they live in (Cunningham & Cunningham 2008; Enger & Smith, 2008). The concept has more relevance with regard to the sustainable use of natural resources and is often linked with conservation approaches, often wielding from conservation biology to social, economic and political issues (Perlman & Adelson 1997). One aspect of biodiversity that has been neglected and is becoming increasingly important is cultural diversity which encompasses anthropogenic cultures that live in and are dependent on natural habitats. For these cultures nature carries spiritual or moral connotations where a particular species or landscape may be linked to a sense of identity or meaning either in the spiritual or moral context.

There are approximately 1.54 million known species on earth and more are still being documented especially microorganisms and the organisms that live in the deep oceans. We understand the importance of biodiversity in terms of the services these organisms provide: food, medicines, aesthetic, recreation and cultural benefits (Chavas 2008). At the same time we are aware of and are part of the forces that threaten biodiversity: habitat destruction and disturbance, invasive species, pollution, human population growth, over-harvesting, commercial collections, and predator and pest control (Cunningham & Cunningham 2008).

Modern man with his thirst and hunger for development, and blinded by science and technology has strayed from a life of coexistence with nature towards an anthropocentric lifestyle. Much of the destruction of nature that we see today is a result of such a philosophy, and to sustain biodiversity on earth, it is thus imperative to realign the human paradigm towards the concept of coexistence with other species. Human domination of the Earth has resulted in dramatic changes to global and local patterns of biodiversity. Biodiversity is critical to human sustainability because it drives the ecosystem services that provide the core of our life-support system.

Education and awareness of the importance of biodiversity in sustaining life on earth is now even more important with the current levels of species extinction. This can be achieved through sound formal environmental education (schools, colleges and universities), education of environmental managers at local councils, state and federal levels, and the public at large. In Malaysia, the role in public environmental education and awareness by non-governmental organizations (NGO's) is becoming increasingly important as social mobility and affluent lifestyles becomes more prominent among her citizens.

Environmental Conservation and Education

Environmental conservation and education groups have long adopted various missions to further their cause in conservation. The first has been to lobby those in power (government decision makers and environmental managers) and financiers of projects (banks, corporations, industries, government) to implement sound environment policies and conduct responsible environmental management respectively. Next is to educate the public (the layman, the student and the up-and-coming activist) about their cause and the need to further it.

Indeed, it is often recognized that without the educational component of their work, NGO's will not be successful in lobbying for change in public policy and public perception. Without adequate knowledge of the facts or threats to an environment (or to themselves), a person in power would loathe to challenge the *status quo*. Without reaching out to others in the community, the activists fight a lonely battle; the weight, voice and energy of others in that society go a long way in instigating the change that is desired and needed.

Environmental education is not just restricted to working with children in schools. The key to an NGO's success is its ability to communicate with the general public, decision-makers and local stakeholders as well as dissenters to their cause. Through an astute combination of social marketing, traditional environmental education (formal) and behaviour modification processes, an NGO will have the tools to equip itself convert the apathetic, persuade the opposition and change attitudes for the good of the planet.

What Exactly is Environmental Education?

In many countries, including Malaysia, the concepts of environmental awareness and education are assimilated into the existing school curriculum. Unfortunately, the implementation of Environmental Education (EE) tends to occur in a 'piece-meal, diffuse and uncoordinated manner' (Holsman & Dark 2001). There is often little framework, guidance or explicit direction given towards the implementation of EE within a syllabus, and much of the work is left to the teacher to improvise and implement. Because of this, environmental literacy remains low (Volk & McBeth 1998) and teachers do not feel competent enough to provide environmental education due to a lack of training and exposure (Plevyak 1997; Smith-Sebasto & Smith 1997). This is especially so when it comes to experiential learning programs outdoors (hands on) (Ferry 1995; Simmons 1998).

In addition, environmental education activities are easier to start in the non-formal education system, through youth group activities and field visits that engage learners in the hands on approach (Monroe *et al.* 2002). As a result, many teachers welcome the presence of NGO's to

supplement their teaching content or to carry out specific EE activities for their students. To that end, EE would refer to any structured program run by an NGO or school club linked to NGO's that has specific environmental objectives for behaviour modification of students (of any age group).

UNESCO (1978) defines environmental education as:

A process of developing a world population that is aware of and concerned about the total environment and its associated problems, and which has the knowledge, skills, attitudes, motivations and commitment to work individually and collectively toward solutions of current problems and the prevention of new ones.

An NGO's use of EE spreads far beyond its implementation within the school system, however. Environmental education is employed in the dissemination of information to the public about a cause or concern and in instigating, reinforcing and entrenching attitudinal and behavioural changes to meet the NGO's environmental objectives related to conservation.

The objectives of this sort of EE, better known as social marketing and communication, would be:

1. To create **awareness** and sensitivity to the environment and its problems and to remove any existing apathy towards a specific cause or concern
2. To help the public to gain positive experiences in the environment, and to garner **knowledge** and a basic understanding of it and its problems
3. To generate a genuine interest in the environment and acquire a set of values and positive **attitudes** towards it to the point of actively participating in its improvement and protection
4. To facilitate the acquisition of **skills** for identifying and solving environmental problems
5. To encourage citizens to **participate** and be actively involved in working towards the resolution of environmental problems (adapted from UNESCO, 1978)
6. To encourage the public to actively lend their **opinion** on issues that affect natural ecosystems

HOW DOES ENVIRONMENTAL EDUCATION WORK?

School-based Environmental Education

Passive education. There are several levels to an NGO's involvement with schools with respect to environmental education. At the most passive level, NGO's can create awareness by giving talks during school assembly or lectures to individual year groups or mixed groups. Exhibition panels,

poster displays and the distribution of other relevant reading material to the student population would supplement these talks and lectures, and facilitate increased awareness among the student population.

At this first level, there is minimal two-way interaction. Increased knowledge does not necessarily lead to appropriate (desired) behaviour or attitudinal change (Hines, Hungerford & Tomera 1987). The passive level is therefore rarely sufficient to make a big difference.

Interaction education. Workshop, discussions or other in-class sessions would allow for more interaction between the students and NGO representatives. This enables the initiation of detached problem-solving thought processes; the students are not taught '*what to think*' but '**how to think**', giving them skills to analyze information, make 'sound' judgments and respond with their solutions, ideas or further questions (Monroe, Day & Grieser 2002). The interactive method (discussions and experiments) was used by USAID in Jordan in 1997 to implement a water conservation curriculum with school eco-clubs. An evaluation of the program indicated that students not only demonstrated higher levels of knowledge of water conservation facts, but were also performing recommended water-saving behaviours and discussing them with their parents (Day & Smith 1996). The interaction mode internalises the behaviour.

While this second level of involvement with students is more effective, it is still confined to in-class sessions and the quality of the responses from the students largely depends on:

- their own life experiences,
- prior exposure to the topic by their teachers or
- the amount of information that they picked up from an earlier talk or lecture by an NGO.

Hands-on education (Experience) First-hand experience in the actual ecosystem that an NGO is attempting to preserve is always an effective way to encourage others to empathise with the cause. Students can become environmental stewards by conducting research to better understand their local environment (Adkins & Rowland 2001), or work with local scientists to monitor and collect data on specific species in their vicinity (LaBranche 2001).

Programs with established protocols such as SandWatch, FeederWatch and SeagrassWatch have allowed students, teachers and scientists to work together to critically evaluate problems and conflicts affecting their environment. Teaching students to develop critical-thinking and problem solving skills as well as nurture more empathy for the ecosystems that they have worked in creates a lasting impression and impact on the students (Cambers & Ghina 2005).

Substantial evidence exists to indicate that properly implemented fieldwork and outdoor classroom experiences have the following effects:

- Add value to their classroom experiences
- Have positive impact on students long-term memory; and
- Improve attitudes towards the environment (Rickinson *et al.* 2004).

The outdoor classroom/laboratory can provide a place for long-term observation, allowing students to learn first-hand how their activities affect the environment; teaching them how to make decisions that affect the use and management of natural resources. On top of that, learning becomes fun (Kimbro 2006). Learning while having fun is not only restricted to children but is also very much applicable to adult learners.

Empowerment. The next step in an NGO's involvement with school-based EE is empowerment. With adequate awareness, facilitation and positive experiences in the environment, students can be encouraged to design and implement their own research projects (LaBranche, 2001). When people commit to a course of action that is their own idea (bottom-up), the results are more likely to succeed and continue than when ideas are imposed from the outside in a top-down approach (Grieser 2002).

To this end, NGO's such as the Malaysian Nature Society (MNS) and Malaysian Society of Marine Sciences (MSMS) have trained students as facilitators and leaders for their environmental workshops and camps, empowering them with the knowledge and confidence required to teach their peers about their natural heritage and what they can do to protect and conserve it. This technique has proven to be more effective than when students are taught by external 'experts'. Children respond better to those closer to their age group, they are better able to relate to student facilitators and these young leaders serve as models that can be emulated and mimicked.

An example of such student facilitator programmes develops young environmental leaders is the *Yayasan Anak Warisan Alam* (YAWA – Children's Environmental Heritage Foundation) environmental camps and programs for youth of all ages. These programmes are coordinated and facilitated by former members who have reached the age of 18. These older youth act as mentors to others taking part in YAWA's programs both in Malaysia and overseas. The foundation also has a Junior Board comprised of youths elected by their peers to represent them.

It has been shown that stakeholders who design their own communication strategy, message and campaign improve the environmental education program, add credibility and strengthen their own skills to do similar work in the future (Monroe, Day & Grieser 2002). Once this level of initiative, self-motivation and environmental leadership is achieved, an NGO has come full circle in its contribution to the nurturing of highly aware and concerned citizens of the future.

Public Awareness and Environmental Education

NGO Business — Behaviour Modification. Environmental education for the public must move away from institutionalized pedantic protocols to social marketing and behaviour modification practices. Underlying these practices is the concept that people will change their behaviour in exchange for benefits, and not necessarily as a function of increased knowledge or awareness. Therefore, for a public awareness campaign to succeed an NGO must identify the specific behaviours that need to be changed and the benefits available to the target audience for them to commit to the behavioural change (Day & Smith, 1996). Instead of telling the audience what the NGO feels they should know, they need to be shown how the information is relevant to them and to their daily needs (Holsman & Dark 2001).

Social marketing principles applied to a successful NGO environmental communication campaign include (Lefebvre & Flora 1998; Maibach 1993):

- The adoption of consumer orientation,
- Audience segmentation and research,
- Development of clear and realistic objectives,
- Pre-testing of messages,
- Use of multiple channels; and
- Outcome evaluation

In line with standard marketing practices, social marketing and communication for environmental NGO's should consider the four P's:

1. *Product* — this is the **benefit** that the consumer will gain from behaving in a certain way. This product could be the alleviation of guilt, a sense of self-esteem, control, belonging or doing the right thing.
2. *Price* — this goes beyond the monetary cost to include the **barriers** that the consumer will need to overcome in order to adopt the new behaviour or practice. This could include opportunity cost, inconvenience, status loss and time loss.
3. *Place* — this refers to the system through which the 'products' or benefits are made available. **Easy access** or the ease with which a change can be made or an action can be taken is often the key to the effectiveness of a system.
4. *Promotion* — this is dependent on the **message** and the **channel**. This would include the functions of outreach advertising, public relations, consumer promotions, user education, community organization and interpersonal support. (adapted from Smith, 1999)

The Approach. Crucial to the success of an NGO's awareness campaign is the organisation's ability to understand its target market and the reasons why their audience behaves the way it does.

Initial assessments comprising carefully posed open-ended questions to gain knowledge about an issue and people's everyday attitudes, beliefs and behaviours are essential (Day 2002). Formative research is also important in order to identify the behaviour to be promoted or modified, the barriers to the desired behaviour and the central themes and messages that should comprise the promotional mix (Hernandez 2002). Identifying the reasons behind daily behaviour (whether desired or undesired) provides the NGO with an idea of the benefits that can be 'sold' to the audience in return for behavioural change. Finding out why people do not behave in an appropriate way will enable an assessment of how to remove the obstacles that stand in the way of their adopting positive attitudes.

The concept of 'place' or easy access can be dealt with by ensuring that it is easier for the target market to adopt the desired behaviours. This might entail offering training so that appropriate skills are learnt (e.g. how to recycle, how to access), ensuring proper infrastructure is available to support the use of those skills (e.g. making recycling bins available or providing information about the location of recycling centres) or offering some other form of incentive (e.g. a 10¢ discount if a shopper carries his own bag, or if he/she brings a friend into recycling).

In composing a message, it is vital to keep in mind that effective messages are those that minimize energy expenditure, psychological dissonance and threat (Petty & Cacioppo 1986). Exaggerating the dire consequences of an action will not help a cause. The message source and placement also affect behavioural change. Expert sources, rational or logical appeals and appeals that offer counter-arguments (yet successfully rebut them) are more effective for intelligent, sophisticated audiences (Holsman & Dark 2001). The message is to be kept clear and simple. The goal of message design is to gain and hold the target audience's attention, which is mainly determined by how well they understand the message and whether it offers just entertainment or clear instrumental utility (Holsman & Dark 2001). Leiss (1994) has also found that people are more likely to carry out the desired actions if they are perceived to be achievable or if they have been empowered to carry them out.

The ultimate key to a successful message, however, is how well the NGO knows and understands its audience and their inherent values. With a portrait of the intended audience in mind, a message that is relevant to its target market, meets their needs, appeals to their desires and offers them benefits or incentives that they want can be created (Smith 1999).

The channel. The channels through which a message is delivered to its target audience can be pivotal to an awareness campaign. The choice of the channels to use would depend on the behavioural characteristics of the target audience; which again reemphasizes the importance of initial assessments and formative research in order to accurately understand the target market.

The volume of communication and its effectiveness are positively related, though with diminishing returns (Atkins 1981). Studies show that multiple channels are more effective in conveying a message, comprising tools such as (Pomeroy & Rivera-Guieb 2005):

- Advertising and public relations,
- Publicity through the mass media,
- Special events,
- Celebrity endorsements,
- Testimonials; and
- Advocacy campaigns.

Prochaska & DiClemente (1986) cite five stages through which a 'non-doer' evolves into a 'doer' or advocate:

Unwaware ⇨ contemplative ⇨ preparing/making decisions ⇨ trying ⇨ maintaining behaviour

The promotional mix for an environmental awareness campaign should meet the above stages, offering the same basic message through a variety of channels in order to prevent cognitive dissonance, a discomfort with a new behaviour that could lead to an abandonment of desired habits before they become entrenched (Day 2002).

Thus, reinforcement should be provided in order to keep positive attitudes and behaviours on track. These reinforcements could come in the form of positive peer pressure by informing potential doers how many other people are behaving positively, such as through petitions (Katzev 1986), public recognition for action taken (via prizes, certificates, and gifts) (Monroe & DeYoung 1994), incentives and keeping the doers informed of the positive consequences of their actions (eg. increase in fish catch, increase in tourism arrivals, increase in environmental quality) (Day 2002).

To ensure that limited financial resources are not wasted, it is important to test a message with focus groups or individuals who are representative of the target market before it is delivered through the marketing channels (Day 2002).

In order to complete the social marketing process, the awareness campaign should be constantly evaluated after its implementation and the results compared to attitudes and behaviours that existed before the implementation of the campaign. The campaign should also be flexible enough to accommodate changes or innovations if they are deemed necessary as a result of the periodic

evaluation of behavioural change. Sharing evaluation and research results with stakeholders is also an important component of the marketing mix and allows all parties to benefit from capacity building knowledge and experience (Day 2002).

Challenges and Considerations in Implementation

Financial constraints. The availability (or lack) of funds is always an issue for NGO's. The scarcity of funds leads to a dilemma in its use for furthering a cause. However, it is possible to run a 'minimalist social marketing campaign' according to the following principles:

- Keep the desired behaviour and the target audience in mind at all times
- Make the behaviour required fun, easy and/or popular for the audience
- Ensure that decisions are made on hard facts; be innovative in verifying assumptions made
- Build partnerships with the media, local corporations, schools local religious and cultural groups and politicians
- Realise that every meeting is a marketing opportunity – tailor the presentation to the audience's wants and interests; and
- Remain realistic but positive, offer praise before criticism (adapted from Smith, 1999)

Funds related to environmental education and awareness, and community development projects should be made available via the Corporate Social Responsibility (CSR) component of major corporations and industries, local councils, state and federal agencies. This way the related NGO's need not spend unnecessary effort and time to solicit funds since most NGO's (at least in Malaysia) are volunteer based organizations.

Effectiveness of the education plan. There are several considerations to keep in mind when planning for environmental education. Sometimes these factors are forgotten or not adequately emphasized, leaving the NGO struggling to meet its objectives and effectively carry out its plans.

- *Understanding and using the behavioural model.*
  - — It is imperative that an NGO accurately understands its target market and their behaviour. It is vital to precisely assess why consumers do not behave in a desired way so that the campaign can offer features that overcome the obstacles revealed in the formative research (Day 2002).
  - — It is also important to evaluate whether the chosen behaviours to be promoted make sense technically. Behaviours that have immediate positive consequences or tangible benefits will be easier to adopt than those that have distant, intangible benefits.
  - — Behaviours chosen should also be financially sensible in that they do not cost the target audience more time, money and effort (Hernandez & Monroe 2002).

- *A lack of manpower or staff.*
  - — Most NGO's are staffed by a minimal number of paid workers and supported by a pool of volunteers. Unfortunately, while volunteers are often committed, passionate individuals, they have to deal with their own full time jobs and families and may not always be available when they are needed.
  - — NGO staff members tend to be overworked and underpaid. In planning an education programmes, the availability of manpower, their skill sets and the commitment required needs to be ascertained before deciding on a program. To offset this difficulty, it is imperative to capacity-build and train local stakeholders involved in the program so that they can continue to run and implement the awareness program into the future (Day 2002).
- *Environmental education must reach those in power (economic and political).*
  - — While a grassroots movement and community activism makes a difference on the ground, it is as important, if not more important, that government officials (state and federal) and local authority figures are educated in environmental issues, problems and ideal behaviours as they have direct control and influence over policy issues and laws (Pomeroy & Rivera-Guieb 2005).
  - — The concept of Corporate Social responsibility (CSR) by corporations can be emulated in a new form that can be termed as Corporate Environmental Responsibility (CER). Large corporations and industries, and banks must be accountable to the environment and should put aside a certain amount of profits for environmental education and community development programmes. The education component should not only include their staff but also be part of communities that may directly or indirectly be affected by their projects or fundings.
- *Environmental education cannot stand alone.*
  - — An environmental awareness campaign must be integrated with other strategic tools such as effective policy implementation, technology transfer and capacity building in order to be effective and sustainable in the long-run (Day 2002).

Keys to Success

There are several factors that can make or break an environmental education program, whether it is school-based or a general public awareness campaign.

Accessibility. It is important to be able to relate to the target audience. Beyond ensuring that the message is tailored to the existing knowledge and interests of the target market, it must also be clear and uncomplicated.

The language used in the message is crucial. The use of technical terms will not engage an uninterested layman but will more likely turn him away from the cause. Students will not respond to vocabulary that they do not understand or content that too closely resembles their daily curriculum. The NGO must be able to think like the audience, and reach out to them in a way that makes sense to them, rather than persuade the audience to think like the NGO (Smith, 1999). This might require simplifying the message so that it makes more sense to the target audience and breaking down the desired behaviours into smaller elements or steps so that they can learn and practice those components one at a time (Hernandez & Monroe 2002).

The amount of information given to the target audiences is also important. Too much information at the beginning of a relationship with a student or a member of the public will inevitably confuse and confound him/her and result in a refusal to listen or react in the desired manner. Messages that invoke a litany of technical terms will likely reduce most peoples' willingness to attend to and process the information (Petty & Cacioppo 1986). Information provided to a new audience should be selected to provide the most impact and 'hook' them to a topic. All environmental education and communication products, messages and materials must be capable of commanding the attention of the intended audience so that they will want to stay on or keep coming back for more (Day 2002).

Stakeholder participation. The participation of community stakeholders in an environmental awareness campaign is crucial for its success. Assessments of a target audience's needs and wants allow an NGO to determine how to adapt their conservation goals to the desires of local stakeholders, but allowing the stakeholders a say in the development of the message, the choice of marketing mix channels and then involving them in the implementation of the awareness program allows for interactive learning and sharing. This interactive communication enhances common knowledge and awareness and promotes dialogue and open discussion of different points of view (Borrini-Feyerabend *et al*. 2000).

The NGO must be fully committed to participation, even to the extent of literally stepping into the shoes of the local stakeholder faced with an environmental problem; spending time with them, living amongst them and working with them. Committing to stakeholder participation to this extent levels the playing field, shows all concerned parties that everyone's knowledge and opinion is valuable, and ensures that the campaigning NGO truly understands the mindset and life challenges of the local stakeholder (Grieser 2002).

Grieser (2002) writes that 'No matter how skilled the experts, they cannot presume to stand in the shoes of the client'. It must be noted that Western-trained experts look at environmental issues and concerns through a particular mental model that may not necessarily apply or be relevant to a local community's training, knowledge or life experiences. This is precisely why formative research questions and campaign messages are better designed, framed or influenced by those in the local community (Grieser 2002).

Grieser reiterates that 'useful participation is less a matter of applying techniques, methods and approaches, than of an attitude that values the views of all who are directly affected by a project.'

Empowerment. Self-efficacy is the perception a person has of his own ability to 'organize and execute courses of action required to attain designated types of performances' (Bandura, 1977). In other words, it is the self-confidence to affect a new behaviour or develop a new attitude. According to this behavioural theory, perceptions of self-efficacy and the positive or negative outcome expectancies of that behaviour are the keys to behaviour change (Hernandez & Monroe, 2002). Attitudes are a function of a person's salient beliefs about the consequences of a behaviour (Ajzen & Fishbein 1980). The more a person believes that there are positive consequences to a behaviour, the more positive the attitude and the higher the likelihood that (positive) behaviour change will be effected and ingrained into habit.

Increased self-efficacy and thereafter empowerment can be brought about by reinforcing positive behaviour, offering timely and targeted information on the positive consequences of this behaviour (Day 2002) and encouraging repetition of simple processes and practices to build the skills required to perform the behaviour (Hernandez & Monroe 2002).

Small incremental steps lead to large movements. The concept of 'heating up' addresses both the varying rates of change amongst those in a target audience and the complexity of change. While change (especially to a cash-strapped NGO) can seem unbearably slow, it is a positive step to begin with groups of receptive people who are already prepared to make a change. This first group of converts can gain competence and confidence in their ability to try more complex actions or behavioural changes in future. They can then influence the other segments of society to follow in their footsteps either as models to emulate and mimic or through positive peer pressure.

'Heating up' takes place when the collective movement of several individuals becomes a force to be reckoned with and its enthusiasm motivates others to do the same; adopting new positive attitudes and behaviours then becomes contagious. The nature of environmental social marketing is such that change always has to begin to take place on an individual level but it has the potential to move beyond the singular towards a community activism that can make a real difference (Day 2002).

This potential for success needs to be pointed out by the NGO to its target audience to encourage and empower them to move beyond a sense of helplessness; and to allow them to believe that they can and know how to make a difference as individuals.

CONCLUSION

Environmental education is the crux of NGO work. Without it, there is no way to convince others to come onboard with the cause that an NGO is trying to promote. The manner in which environmental education and communication is carried out and its ability to engage and motivate target audiences will determine the success of an NGO's campaign. Without the education of youth in schools or the general public, there will be insufficient knowledge of a cause. Without knowledge, there can be no action, and without action there can be no change.

It is vital that NGO's realize that effective, well planned environmental education programs will stand them in good stead and is the first step in achieving their other lofty goals. While there are numerous obstacles and considerations to keep in mind, the rewards garnered from a successful educational campaign are unlimited and could benefit society for many generations.

REFERENCES

Adkins, C & Rowland, P 2001, 'Using research to build stewardship', in *2001: An EE Odyssey NAAEE Conference Proceedings*, ed NJ Smith-Sebasto, Rock Spring, Georgia, USA, pp. 3–5.

Ajzen, I & Fishbein, M 1980, *Understanding attitudes and predicting social behaviour*, Englewood Cliffs, Prentice Hall, Inc. NJ.

Atkins, CK 1981, 'Mass media information campaign effectiveness', in *Public communication campaigns*, eds RE Rice & WJ Paisley, Sage, pp. 265–279.

Bandura, A 1977, *Social learning theory*, Englewood Cliffs, NJ: Prentice Hall, Inc.

Borrini-Feyerabend, G, Farvar MT, Nguinguiri JC & Ndangang V 2000, *Co-management of Natural Resources: Organizing, Negotiating and Learning-by-doing,* GTZ and IUCN, Kasparek Verlag, Heidelberg, Germany.

Chambers, G & Ghina F 2005, *Introduction to Sandwatch — an educational tool for sustainable development,* UNESCO, Paris, France.

Chavas, JP 2008, *On the productive value of biodiversity*, Environ Resource Econ.

Cunningham, WP & Cunningham MA 2008, *Principles of environmental science — enquirt and applications*, McGraw Hill, New York.

Day, BA 2002, *Heating up society to take environmental action,* Academy for Educational Development, Washington DC.

Day, BA 2001, 'Media campaigns', in *Environmental education and Communication for a sustainable world — Handbook for international practitioners, eds BA Day & MC Monroe,* Academy for Educational Development, Washington DC pp. 79–84.

Day, BA & Smith, WA 1996, The applied behaviour change (ABC) framework: environmental implications, Academy for Educational Development, Washington DC.

Enger, ED & Smith, BF 2008, *Environmental science – a study of interrelationships*, McGraw Hill, New York.

Ferry, B 1995, 'Enhancing environmental experiences through effective partnerships among teacher educators, field study centers, and schools', *Journal of Experiential Education*, vol. 18, pp.133–137.

Grieser, M 2001, 'Participation', in *Environmental Education and Communication for a sustainable world – handbook for international practitioners,* eds BA Day & MC Monroe, Academy for Educational Development, Washington DC pp. 17–22.

Hernandez, O 2001, 'Formative Research', in *Environmental Education and Communication for a sustainable world – handbook for international practitioners,* eds BA Day & MC Monroe, Academy for Educational Development, Washington DC pp. 47–56.

Hernandez, O & Monroe, MC 2001, 'Thinking about Behaviour', in *Environmental Education and Communication for a sustainable world – handbook for international practitioners,* eds BA Day & MC Monroe, Academy for Educational Development, Washington DC pp. 7–15.

Hines, JM, Hungerford, HR & Tomera, AN 1986–1987, 'Analysis and synthesis of research on responsible environmental behaviour: a meta analysis', *The Journal of Environmental Education,* vol. 18, no. 2, pp. 1–8.

Holsmann, RH & Dark, MJ 2001, 'Comunicating about environmental education: preaching beyond the choir, In Smith-Sebasto, NJ (ed) *2001 in An EE Odyssey NAAEE Conference Proceedings, ed NJ Smith-Sebasto,* Rock Spring, Georgia, USA, (pp.19–23).

Katzev, RD 1986, 'The impact of commitment in promoting consumer energy conservation', in *Consumer behaviour and energy policy: an international perspective*, Praeger, New York.

Kimbro, CC 2006, *Developing an outdoor classroom to provide education naturally*, The University of Tennessee.

LaBranche, MS 2001, 'Bird Odyssey: citizen science for rural to urban communities', in *2001: An EE Odyssey NAAEE Conference Proceedings, ed NJ Smith–Sebasto,* Rock Spring, Georgia, USA, pp. 85–87.

Lefebrve, C & Flora, J 1988, 'Marketing and public health intervention', *Health Education Quarterly,* vol. 15, no. 3, pp. 299–310.

Leiss, W 1994, 'Risk communication and public knowledge', in *Communication theory today*, eds Crowley D & Mitchell D, Stanford, CA: Stanford Press.

Maibach, E 1993, *Social marketing for the environment: using information campaigns to promote environmental education,* Academy of Educational Development, Washington, DC.

Monroe, MC, Day, BA & Grieser, M 2002, 'GreenCOM weaves four strands', in *Heating up society to take environmental action,* Academy for Educational Development. Washington DC.

Monroe, MC & DeYoung, R 1994, 'The role of interest in environmental Information: a new agenda', *Children's Environments*, vol. 11, no. 3, pp. 243–250.

Petty, RE & Cacioppo, JT 1986,' The elaboration likelihood model of persuasion', in *Advances in experimental psychology,* ed Berkowitz L, Academic Press, New York, pp. 123–205.

Perlman DL & Adelson, G 1997, *Biodiversity: exploring values and priorities in conservation*, Blackwell Science, Oxford.

Plevyak, LH 1997, 'Level of teacher preparation in environmental education and level of implementation of environmental education in the elementary classroom with a mandated environmental education teacher preparation state', PhD thesis, Ohio State University.

Pomeroy, RS & Rivera-Guieb, R 2006, *Fishery co-management—a practical handbook*, CABI/IDRC. Cambridge, MA, USA.

Prochaska, JO & DiClemente CC 1986, 'Towards a comprehensive model of change', in *Treating addictive behaviors, eds Miller U & Dillmente CC,* New York: Plenum Press, pp. 3–27.

Rickinson, M *et al*. 2004*, A review of research on outdoor learning*, National Foundation for Educational Research and King's College London, Shrewsbury, UK.

Simmons, D 1998, 'Using natural settings for environmental education: perceived benefits and barriers,' *Journal of Environmental Education*, vol. 29, pp. 23–31.

Smith, WA (ed) 1999, *Social marketing lite*, Academy for Educational Development, Washington DC.

Smith-Sebasto, NJ & Smith, TL 1997, 'Environmental education in Illinois and Wisconsin: a tale of two states', *Journal of Environmental Education*,vol. 28, pp. 26–36.

UNESCO 1978, *Final report, intergovernmental conference on environmental Education*, UNESCO in cooperation with UNEP, Tbilisi, USSR.

Volk, T & McBeth, W 1998, 'Environmental literacy in the United States', in *Essential readings in environmental education,* eds H Hungerford *et al*., Stipes Publishing Company, Champaign, IL, pp. 75–88.

Abstract of Poster Presentation

Study of Rove Beetle (Coleoptera: Staphylinidae) at Kenyir Water Catchment, Terengganu, Malaysia

F. ABDULLAH AND I. SINA
Institute of Biological Sciences, Faculty of science, University of Malaya
50603 Kuala Lumpur, Malaysia

A study was conducted on staphylinid beetles at the largest man made lake in South east Asia namely Tasik Kenyir, Terengganu, Malaysia from 30 July to 1 August 2007. The staphylinids were collected from two study sites, Teluk Bewah a bay with limestone vegetation and Sungai Cicir of dipterocarp forest vegetation. Assemblage was done using 60 pitfall traps and six Malaise traps for 24 hours. Ten light traps was set for 4 hours from 1900 hours to 22:00 hours at each study sites whereas net sweeping was conducted in the day time after the traps day traps were set up. As a result, 73 specimens from 21 species were assembled from Teluk Bewah whereas 28 specimens from 10 species were sampled from Sungai Cicir. Pitfall was most efficient collecting 87% (N=89) of species from both sites. The staphylinid is very diversed at Kenyir (Simpson index diversity; 0.921). Staphylinid beetle was more abundant and diversed at Teluk Bewah. 18 species were identified are new records for Tasek Kenyir. Nine genera *Astenus, Bledius, Charichirus, Eleusis, Hesperus, Orphnebius, Oxytelus, Paederus, Stenomastax* were found at Tasek Kenyir. High diversity of staphylinids at Kenyir was due to high moisture content of the surrounding habitat being a water cachment area most suitable for staphylinid beetles.

Abundance and Diversity of Rove Beetles (Coleoptera, Staphylinidae) at Man-made Kenyir Lake, Terengganu, Malaysia

F. ABDULLAH AND I. SINA
Institute of Biological Sciences, Faculty of science, University of Malaya
50603 Kuala Lumpur, Malaysia

A study was conducted on staphylinid beetles at Kenyir Lake, Terengganu, Malaysia from 30 July to 1August 2007. The staphylinids were collected from two study sites, Bewah Bay and Cicir River using ten light traps, six Malaise traps, 60 pitfall traps and net sweeping. 73 individuals from 21 species were assembled from Bewah Bay whereas 28 individuals from 10 species were sampled from Cicir River. Pitfall was most efficient collecting 87% (N=89) of species from both sites. The staphylinids are very diversed at Kenyir Lake (Simpson index diversity; 0.921) whereby the staphylinid beetles were more abundant and diversed at Bewah Bay than at Cicir river. 18 species identified are new records for Kenyir lake. High diversity of staphylinids at Kenyir Lake was discussed are due to low land use, few human activity and rich vegetation type.

Microdistribution and Biodiversity of Aquatic Insects and Their Drift in Kenaboi Forest Reserve, Jelebu, Negeri Sembilan

C.K.N. AZMA AND M. SOFIAN-AZIRUN
Institute of Biological Science, University of Malaya,
50603 Kuala Lumpur, Malaysia

Kenaboi Forest Reserve (03° 174′ 92″ N, 101° 988′ 52″ E) were situated at Jelebu, Negeri Sembilan, Peninsular Malaysia, belongs to an official protected area. Partly of this forest were affected by anthropogenic activities such as logging, agriculture and urban settlements. Aquatic insects communities and their drift in 3 rivers of Kenaboi Forest Reserve were sampled to provide a first description of lotic communities in this forest. Sg. Kering (03° 11′ 468″ N, 101° 59′ 062″ E), Sg. Kemalai (03° 10′ 308″ N, 101° 59′ 22.3″ E) and Sg. Kenaboi (03° 174′ 92″ N, 101° 988′ 52″ E) are characterized as small width, shallow and with riffles and pools area. Totally, 5 Ephemeroptera, 4 Plecoptera, 2 Trichoptera, 2 Odonata, 3 Diptera and 3 Coleoptera taxa were found. Ephemeroptera were represented mainly taxa that spread out in 3 rivers. Net-spinning hydropsychids and psychomyiids dominated the Trichoptera then heptageniid and baetid mayflies were relatively abundant. *Kamimuria* sp., *Etrocorema* sp. and *Neoperla* sp. dominated the Plecoptera but poorly represented. Overall, predatory insects and shredders were scarce. Drift by using Surber sampler, showed clear patterns, with more morphospecies and individuals drifting at night. Members of the Order Ephemeroptera dominated the drift accounting for 64% of the total drift. Drift and benthos samples yielded the same total number of order but differed in composition number of species for each taxa. Sampling drift and benthos provided more comprehensive information in community composition than drift and benthos samples alone.

Beetles (Insecta: Coleoptera) as Indicator of High Biodiversity in Forest Reserves in Peninsular Malaysia

F. ABDULLAH
Institute of Biological Sciences, Faculty of science, University of Malaya
50603 Kuala Lumpur, Malaysia

A study has been carried out from 2002 to 2007 at several selected forest reserves and islands in Malaysia in the aim of investigating the status of biodiversity and species richness of fauna in Malaysia by using beetle as an indicator of change. The study was also done in order to compare between biodiversity in forest reserves to that of islands. Assemblage of beetle fauna at forest reserves was carried out at southwestern side of Endau Rompin National park, Panti Forest Reserve, Gunung Angsi and Gunung Berembun Forest Reserves, , Malacca Forest reserves. Samplings on islands were conducted at Langgun island, Dendang island, mainland Langkawi and islands in the Straits of Malacca, namely Jarak island, Lalang island and Rumbia island. Sampling was also conducted at the man made lake of Kenyir. Assemblage of beetel fauna was done by light trapping, Malaise traps, pitfall traps and net sweeping. Using Simpson index of Diversity biodiversity of beetle fauna was highest at Endau Rompin National park (0.989) followed Kenyir lake National park (0.979), Gunung Angsi and Berembun Forest reserves (0.973), Panti Forest reserves (0.966), Jarak island (0.9718), Rumbia island (0.9334) , Langgun island (0.926), Dendang island (0.790 and Lalang island (0.7857), respectively. Abundance was high in the forest reserves with Endau rompin (87.738) followed by Gunung angsi and Gunung Berembun (39.973), Kenyir lake (35.889) and Panti FR (19.998). Abundance was very low in the islands with Langgun island (9.753), Dendang (9.716), Jarak (6.057), Lalang (2.854) and Rumbia (2.232). This study shows that biodiversity is still high in the forests reserves of peninsular Malaysia and islands in Malaysia. However there is more abundance and species richness of beetel fauna in forest reserves compared to isolated islands. Lists of identified beetles located in each study sites are given including a number of new species found. The implications of the findings are discussed.

Upland Rice Varieties: Potential Gene Pool for Future Rice Breeding in Malaysia

A.R.S. NOORZURAINI AND M. A. B. BOERHANNOEDDIN
Rice Genebank, Stesen MARDI Seberang Perai, Beg Berkunci No. 203, Pejabat Pos Kepala Batas
13200 Seberang perai, Pulau Pinang
AND
M. ZAIN
Faculty of Agrotechnology and Food Sciences, University Malaysia Terengganu
21030 Kuala Terengganu, Terengganu, Malaysia

Upland rice varieties or dry rice refers to rice grown on sloping areas, that were prepared and seeded under dry conditions, and that depend on rainfall for moisture. In Malaysia, upland culture is an important, although not the major, system of growing rice. In Rice Genebank, MARDI Seberang Perai a total of 1777 accessions of upland rice varieties were conserved and evaluated. Most of upland rice varieties are of the traditionally tall type, lodging-susceptible, bold grained and low tillering type. But, a few of these evaluated varieties showed desirable traits such as *Putih*, *Rambut* (high percent of fertility); *Jarom Mas*, *Kunyit*, *Langsat* (slender grained); *Putih*, *Bongkok*, *Langsat* (erect leaf type); and *Bawang*, *Huma Wangi*, *Rotan*, *Kunyit* (resistant to blast).

Biodiversity of Forensically Important Flies in Malaysia

C. C. DHANG, L. H. LIM AND N. W. AHMAD
Medical Entomology Unit, Infectious Diseases Research Centre, Institute for Medical Research
Jalan Pahang, 50588 Kuala Lumpur, Malaysia
AND
K. RAJAGOPAL, H. C. CHIN, AND M. SOFIAN-AZIRUN
Institute of Biological Sciences, Faculty of Science, University of Malaya
50603 Kuala Lumpur, Malaysia
AND
J. JEFFERY
Department of Parasitology and Medical Entomology, Faculty of Medicine
University Kebangsaan Malaysia, 50300 Kuala Lumpur, Malaysia

Blow flies play an important ecological role in decomposition of animal remains. Most commonly, the blow flies larvae are used to estimate the minimum post-mortem interval (PMI) time since death, using growth parameter and larval length as a 'biological clock'. Precise development data for blow flies to be used as a forensic indicator are essential for accuracy in the estimation of PMI.

The application of blow flies evidence to criminal investigations is not a new idea. The first documented forensic entomology case is reported by the Chinese lawyer and death investigator Sung Tz'u in the 13th century. It was not until the mid-1800s that medico criminal entomology saw recorded use in the West. The first observations on insects and other arthropods as forensic indicators were documented in Germany and France during mass exhumations in the late 1880s by Reinhard and Hofmann. Nevertheless, these works were mostly conducted in Europe and North America where conditions are vastly different from the tropics such as countries like Malaysia.

In Malaysia, the first report on the use of fly maggot in forensic entomology cases was by Reid in 1953. However, there was no report on forensic entomology cases in the following 30 years. Only in 1982, a study emerged about the recovery of *Hermetia sp*. larva from a dead female. Studies undertaken by researchers between 1984–2004 reviewed and reported forensic cases associated with fly maggots recovered from human cadavers from 1973 to 2002. Detail studies of PMI in monkey carrions was also conducted in Malaysia. The first report on insect succession on pig carcasses was also reported in 2007. The studies of PMI on monkey carrion under indoor condition in Malaysia was first reported 2008. In 1994 and 2008, the first recovery of *Synthesiomyia nudiseta* and *Piophila casei* from human cardaves was reported. Owing to the rapid development in these works, a forensic entomology kit for determination of PMI was developed in 2005.

The objective of this paper is to review the various types of forensic flies found in human cadavers and carcasses of various animals under study.

Preliminary Investigation of *Pandanus Pygmaeus* (Pandanaceae)

H.F. MOHSIN, N. S. TAIB, I. A. WAHAB, H. NAZ AND J. F. F. WEBER
Faculty of Pharmacy, Universiti Teknologi MARA, 40450 Shah Alam, Selangor, Malaysia

This paper is about the pharmacy students' research project on the preliminary investigation of a Pandanaceae species. The students' achievement includes the isolation of pure compounds, having the opportunity to conduct a field trip and also grasping the challenges in elucidating the chemical structures. Much work has to be done on the spectroscopic analysis. The determination of partial structures of a compound with α-methyl α, β-unsaturated γ-lactone moiety and a triterpenoid was regarded as part of the pharmaceutical chemistry module. In large, pharmacy education plan is also integrated with the knowledge and awareness of the biodiversity of non-timber species, having important medicinal values.

Fragmented BRIS Ecosystem in Terengganu—*Drosera burmanni* as a Conservation Tool?

M.S. JAMILAH, S.M. RAZALI, I.N.K. HUSNA AND S.N. EFFADAH
Department of Biological Sciences, Faculty Science and Technology, Universiti Malaysia Terengganu, 21030 Kuala Terengganu, Malaysia

Fragmentation is critically important issue for the protection of the biodiversity in the rapidly developed part of the world. Ecosystem on Beach Ridges Interspersed with Swales (BRIS) soil of Terengganu is less given attention in conservation effort. It is noted that only specialized vegetations can thrive well on oligotrophic site of BRIS ecosystem. *Drosera burmanni* (Droseraceae), a type of pigmy Drosera which is the rarely reported carnivorous plant in Malaysia has shown a fluctuation in its abundance across natural habitat of BRIS ecosystem in Terengganu. The understanding of *D. burmanni* ecology and biology may assist us in providing a basis for *in situ* conservation of neglected heath ecosystem on BRIS soil of Terengganu. We discussed the value of having this species as a tool for conservation strategies on this particular ecosystem.

Biodiversity of Soil Actinomycetes Isolated from Crocker Range, Sabah

L.S. H. JEFFREY AND A. R. AZRIZAL
Strategic Resource Research Centre, Malaysian Agriculture Research and Development Institute, 43400 Serdang, Selangor, Malaysia

A total of 74 isolates of actinomycetes were isolated from the soil of Crocker Range, Sabah. It was observed that 30, 13, 9, 11, 4, 6 and 1 isolates of actinomycetes showing a diversed colour group that is dark grey, grey, dark brown, brown, yellowish white, white and green respectively. 74 isolates that were tested for their emzymatic activities shows a wide distribution of enzymatic activity from these actinomycetes. It was observed that 55.4%, 37.8%, 39.2% and 54.0% of the actinomycetes produces proteolytic, lipolytic, cellulolytic and xylanase activity, respectively.

Potential for Josapine Improvement in Somaclonal Variation

R. KOGEETHAVANI, A.G.M. BAHAGIA, P.F. LAM
AND A. HASLI
Malaysian Agricultural Research and Development Institute,
Serdang, 43400 Selangor, Malaysia

Josapine pineapple has proven its niche in fresh fruit market and export, but their high susceptibility to bacteria heart rots disease and inclination to bear multiple crowns has certainly become a major shortcoming to this variety. Both affect the commercial value of fruit, the prior reduces production and the latter limits their space in packing for exportation. This situation demands for cultivation of improved Josapine cultivars. Therefore, an attempt has been made to generate somaclonal variation on Josapine through tissue culture method and to screen for improved Josapine. Somaclonal variation offers an opportunity to change one or two characters without altering the remaining part of the genotype and has remarkable potential for producing a useful variety. The exploitation of heritable somaclonal variants has been used in various plant improvement strategies. This paper will report on the field performances of Josapine somaclones.

Acceleration of Wound Healing Potential by *Solanum Torvum* Fruit Extract in Rats

A. MAHMOOD, M.N. SUZITA, H.M. FOUAD, U.R. KUPPUSAMY, I. SALMAH,
N. ANWAR AND M.A. HAPIPAH
Faculty of Medicine, Faculty of Science and Faculty of Dentistry,
University of Malaya, 50603 Kuala Lumpur, Malaysia

The effects of topical application of *Solanum torvum* fruit extract were evaluated on wound-healing activity in rats. Four groups of adult male *Sprague Dawley* rats, all animals were experimentally wounded in the posterior neck area. Wounds were dressed with thin layer of blank Vaseline, Vaseline containing 5%, 10% *S. torvum* fruit extract and Intrasite gel, respectively. To asses wound healing activity, rate of complete wound healing and histology of healed wounds were determined. Macroscopically, wound dressed with *S. torvum* extracts significantly accelerate wound healing activity compared to the control Histological analysis of healed wounds in experimental rats showed markedly less scar width at wound enclosure, and wound contained more collagen, fibroblast and blood capillaries, and absence of inflammatory cells compared to control. In conclusion, the present study demonstrates that the *S. torvum* extracts promotes and hastens wound healing by acceleration of the rate of wound healing grossly and microscopically.

Mycoflora of Mangroves in East Coast of Peninsular Malaysia

T. MARIAM, A. HAZARINNA, AND M.S. JAMILAH
Department of Biological Sciences,
Faculty of Science and Technology, Universiti Malaysia Terengganu,
21030 Kuala Terengganu, Malaysia

The importance of fungi relies on its nutritional needs despite its very diverse taxonomic groups and overlapping ecological roles. Some functions as decomposers in forest ecosystems like leaf and wood-decaying fungi, while others may function either as mutualists (e.g. ectomycorrhizal and arbuscular mycorrhizal fungi) or as pathogens. However, the role of individual fungi is still unknown. Several authors describe wood decaying fungi as the engineers of ecosystems, as they directly modulate the availability of resources for few other functional. Inhabiting various stages of decay, fungi inhabiting wood and litter are the key of nutrient cycling and biomass turnover in order to ensure that energy flows from detritus to higher tropic level, particularly in nutrient-poor habitats.

Mangrove mycoflora consist of mainly ascomycetes and deuteromycetes, follows by few basidiomycetes. Based on its ability to withstand low oxygen-tension environment in the sediments compared to bacteria and other invertebrates, mangrove fungi particularly marine fungi has been regarded as primary decomposer in this unique ecosystem. This project aims to document the diversity of mangrove mycoflora in East Coast of Peninsular Malaysia and to investigate potential mycoflora that can be exploited for pharmaceutical industry.

Langkawi Geopark: Contribution and Achievements in Research and Education on Biodiversity

A. NORHAYATI, M.N. SHUKOR, W.A.W. JULIANA AND A. LATIFF
School of Environment and Natural Resource Sciences/ Institute for Environment and Development, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor

Ever since Langkawi was declared a duty-free port in 1987, all eyes are fixed on this island, especially on the development of the tourism industry. Local residents started to depend on tourism as their main subsistence, thus, requiring the steady flow of investments from hotel developers and tourists. Development of infrastructure was put into place right away, and this created economic opportunities for many. Langkawi has its own international airport, ports and marinas, cable car system, exclusive and back-packers hotels, highways, and many other facilities. After much deliberation by the Federal and State Governments, Langkawi has now become one of the most visitied places in Malaysia. The development of Langkawi based on its status as a free-duty port, however, has not fully benefited the local communities, and has not given due consideration to the environment. In this regard, the Geopark concept was introduced to Langkawi so that the local community could reap benefits from the natural resources in a sustainable approach to development. The Langkawi Geopark was proposed based on the concept introduced by the UNESCO in 1999, as a conservation area with specified boundary, having various geological features that are special, important, interesting, rare, and with scientific and conservation values. The area is not only designated for research area, but also for education, recreation, and for economical development of the local people. This initiative has grabbed the attention of the management and the academia, as reflected in the various plans to develop Langkawi.

Research-wise, the sentiment was the start of an intergrated research initiative among researchers in universities and research institutes and other governmental agencies. In 1996, a MoU between LADA and UKM was signed when the Langkawi Research Centre was established to foster integrated research on the natural resources in Langkawi and the potential to use the resources for developing a more sustainable ecotourism. Although, the Centre was only established in 2002, research activities have been actively conducted since mid 1990s. In fact, the potential of Langkawi as a geopark, has been realized and identified at the UNESCO since 2000. The Department of Forestry has provided 16 forest reserves for various functions of protection and conservation, seven recreational forests, and three Geoforest parks. The three Geoforest parks in Langkawi are the Machinchang Cambrian Geoforest Park, Kilim Karst Geoforest Park, and Dayang Bunting Marble Geoforest Park. The big move forward was marked by the endorsement of Langkawi by the Kedah State as a national geopark on the 31st May 2006, and subsequently declared as the 52nd member of the Global Geopark Network which is a UNESCO initiative, on the 30th June 2007. Thus, Langkawi became the first global geopark in Southeast Asia. This paper elaborates on some of the current status in biodiversity of Langkawi, with some mention on endemicity and rarity, and the plans and programmes on research and education in Langkawi.

Agriculture System and Biodiversity Conservation Among Indigenous People of Sabah

N. OTHMAN, S.R. ISMAIL, A. A. HALIM, J.A. JAWAN
AND N.N. IBRAHIM
Department of Government and Civilization Studies, Faculty of Human Ecology,
University Putra Malaysia, 43400 UPM Serdang,
Selangor, Malaysia

Sabah's indigenous people have over the centuries developed unique indigenous systems that have safeguarded and established for their communities, a peaceful existence, a sustainable livelihood and use of the resources within their surroundings. The key principle in the agriculture system are also equivalent which they have harmonious relationship with nature, dignity of all things, subsistence and sustainability. Although rural communities continue to maintain and practice their own customs or traditional set of values, these are being threatened by the arrival of a new value system. This traditional knowledge has been lost or denigrated due to lack of the importance of indigenous system and their potentials. Moreover, there does not seem to be enough efforts in recording and applying indigenous systems.

Citrus Indexing to Detect Greening and Tristeza Diseases

M.R.R. HAIREEN AND H. NURADNI
Strategic Resource Research Centre,
Malaysian Agricultural Research and Development Institute,
Serdang, 43400 Selangor, Malaysia

The most important diseases affecting citrus worldwide is called citrus greening (CG) caused by a proteobacteria, *Candidatus* Liberibacter asiaticus or *Candidatus* Liberibacter africanus (GO). The disease is widely distributed. It is easily spread through infected planting materials or transmitted by a psyllid vector, *Diaphorina citri*. Citrus tristeza virus (CTV) is generally the second most important disease problem. It is transmitted by several aphid species with most effective being the brown aphid (*Toxoptera citricida*) CTV causes different symptoms on citrus plants depending on the virus strain, the variety of citrus, and the scion-rootstock combination. Plants having infection with CTV and then co-infected with CG are believed to show severe symptom of expression and suffer greater yield loss. CG and CTV are difficult to diagnose on the basis of physical symptoms. Thus, in this study plant indexing was conducted by symptomatology and by using serological and molecular approach to determine the presence of GO as well as CTV on these citrus species which later will be used for breeding and conservation purposes.

Exclusion Study of Insect Pollinator in Indonesian Salak (*Salacca edulis* Reinw)

J. ROSLIZA AND A.Z.A. LATIF
Strategic Resource Research Centre,
Malaysian Agricultural Research and Development Institute,
Serdang, 43400 Selangor, Malaysia

Curculionid beetles from Acalyptini tribe have been noted in previous survey to be the major insect pollinator for salak. The exclusion study conducted was to confirm the importance of this insect in salak fruit setting. The following treatments had been assigned to a series of inflorescence: (1) natural pollination, (2) insect exclusion and (3) hand pollination. From the result gathered we confirmed that fruits fail to set if pollinator insects are excluded by physical barriers. On the other hand there was no significant difference in the number of fruits formed after being pollinated through natural pollination (by insect pollination) or by hand pollination.

Diversity of Mangrove Plants of Carey Island

M.Z. ROZAINAH, I.M. IRFAN AND N.W. HARON
Institute of Biological Sciences, University of Malaya,
50603 Kuala Lumpur, Malaysia

An extensive study on mangrove floral species composition of Carey Island was carried out from October 2007 to March 2008. The sample has been collected throughout the island, mainly by the riverines and small streams opening to the Straits of Malacca and Langat River. A total of 20 sites have been visited to record the mangrove plants diversity, especially at the west coast of the island. Vegetation were studied with reference to species composition, distribution and importance of each species. The total number of mangrove species recorded and identified up to species level was 31, including non-exclusive and associate mangrove plants from 16 different families. The families present were from Acanthaceae to Sterculiaceae. The samples collected were identified in the field and were brought back to be made into voucher herbarium specimen and deposited in the University of Malaya Herbarium and Mangrove Research Centre, Carey Island.

Organising Committee

Academician Prof Emeritus Yong Hoi Sen, F.A.Sc. (Chairman)
Dr Goh Swee Hock, F.A.Sc.
Dr Lim Boo Liat, F.A.Sc.
Dr Francis S.P. Ng, F.A.Sc.
Prof Soh Aik Chin, F.A.Sc.
Dr Tan Swee Lian, F.A.Sc.
Dato' Dr Dionysius Sharma (WWF-Malaysia)
Dr Sivananthan Elagupillay (PERHILITAN)
Mr Ahmad Shamsuddin Shaari (PERHILITAN)
Dr Mohd Norowi Hamid (MARDI)
Dr Gary Theseira (FRIM)
Ms Lim Ai Gaik (Department of Marine Park Malaysia)

List of Participants

Abd. Aziz Othman	Rimba Ilmu, Institut Sains Biologi Universiti Malaya 50603 Kuala Lumpur
Abdul Fatah Amir	Sabah Biodiversity Centre Aras Bawah (Podium) Wisma Innoprise 88817 Kota Kinabalu Sabah
Abdul Rahman Milan	MARDI 43400 Serdang Selangor
Abdullah Md. Zain	Fakulti Agroteknologi & Sains Makanan Universiti Malaysia Terengganu 21030 Kuala Terengganu Terengganu
Adrien K. Raymond	Department of Veterinary Services Wisma Tani Podium Block 4G1 Presint 4 Pusat Pentadbiran Kerajaan Persekutuan 62630 Putrajaya
Ahmad Bin Ngalim	MARDI Hilir Perak P.O.Box 25 36307 Sungai Sumun Perak
Andi Maryani A. Mustapeng	Forest Research Centre Sabah Forestry Department P.O.Box 1407, 90715 Sandakan Sabah
Arthur C. Y. Chung	Forest Research Centre P.O. Box 1407 90715 Sandakan Sabah
Azhar Bin Ishak	Jabatan Meteorologi Malaysia Jalan Sultan 46667 Petaling Jaya Selangor
Azrizal Ahmad Rashdi	Strategic Resource Research Centre MARDI 43400 Serdang Selangor
Azuan B Amron	Strategic Resource Research Centre MARDI 43400 Serdang Selangor

Badrulhadza bin Amzah
MARDI Seberang Perai
Beg Berkunci 203
Pejabat Pos Kepala Batas
13000 Pulau Pinang

Chen Chee Dang
Medical Entomology Unit
Institute for Medical Research
Jalan Pahang
50588 Kuala Lumpur

Daicus Belabut
LESTARI
Universiti Kebangsaan Malaysia
43600 Bangi
Selangor Darul Ehsan

Ernie Muneerah Bt. Mohd Adhan
Department of Veterinary Services
Wisma Tani Podium Block 4G1
Presint 4
Pusat Pentadbiran Kerajaan Persekutuan
62630 Putrajaya

Fairuz Khalid
Faculty of Applied Science
UiTM
40450 Shah Alam
Selangor Darul Ehsan

Farahzety Abdul Mutalib
Horticulture Research Centre
MARDI Kluang Station
Locked Bag 525
86009 Kluang
Johor

Faridah Qamaruzzaman
Unit Biodiversiti
Institut Biosains
Universiti Putra Malaysia
43400 Serdang
Selangor Darul Ehsan

Fatimah Abdullah
Institute of Biological Sciences
Faculty of Science
Universiti Malaya
50603 Kuala Lumpur

Fatmajihan Bt. Fauzee
Institute of Biological Sciences
Faculty of Science
Universiti Malaya
50603 Kuala Lumpur

Fauziah Bt. Abdullah
Institute of Biological Sciences
Faculty of Science
Universiti Malaya
50603 Kuala Lumpur

Ghizan Bin Saleh
Fakulti Pertanian
Universiti Putra Malaysia
43400 Serdang
Selangor Darul Ehsan

Hairunnisa Bt. Osman	Pusat Hubungan Universiti Industri Universiti Malaysia Pahang Karung Berkunci 12 25000 Kuantan Pahang
Hajjah Ramlah Bt Lani	Unit Perancang Ekonomi Negeri Tingkat 4, Wisma Sri Pahang 25646 Kuantan Pahang
Halimi B Mohd Saud	Jabatan Fakulti Pertanian Fakulti Pertanian Universiti Putra Malaysia 43400 Serdang Selangor Darul Ehsan
Hannis Fadzillah Bt. Mohsin	Fakulti Farmasi Aras 10, Blok 5 Kompleks Sains & Teknologi Universiti Teknologi Mara 40450 Shah Alam Selangor
Hasmahzaiti Omar	Institute of Biological Sciences Faculty of Science Universiti Malaya 50603Kuala Lumpur
Hasniza Bt. Ramli	Perbadanan Bioteknologi & Biodiversiti Negeri Johor Block 2, Innovation Centre UTM-MTDC Technovation Park 81300 Skudai Johor
Hazarinna Ali	Department of Biological Sciences Faculty of Science and Technology Universiti Malaysia Terengganu 21030 Kuala Terengganu Terengganu
Hazmi Awang Damit	Faculty of Applied Science UiTM 40450 Shah Alam Selangor Darul Ehsan
Hj. Mohd Noor B. Nawi	Pusat Hubungan Universiti Industri Universiti Malaysia Pahang Karung Berkunci 12 25000 Kuantan Pahang
Hjh Ramlah bt. Abdul Majid	PERHILITAN Negeri Johor Tingkat 9, Blok B Wisma Persekutuan Jalan Ayer Molek 80000 johor Bahru

Ho Tze Ming
Institute for Medical Research
IMR, Jalan Pahang
50588 Kuala Lumpur

Huda Farhana Muslim
Techno-economics & Research Management Division
Block D7
FRIM
52109 Kepong
Selangor Darul Ehsan

Ibnu Sina
Institute of Biological Sciences
Faculty of Science
Universiti Malaya
50603 Kuala Lumpur

Ibtisam Abdul Wahab
Fakulti Farmasi
Aras 10, Blok 5
Kompleks Sains & Teknologi
Universiti Teknologi Mara
40450 Shah Alam
Selangor

Irmazatussyehdany Buniyamin
Fakulti Farmasi
Aras 10, Blok 5
Kompleks Sains & Teknologi
Universiti Teknologi Mara
40450 Shah Alam
Selangor

Isa Bin Ipor
Faculty Resource Science & Technology
University Malaysia Sarawak
94300 Kota Samarahan
Sarawak

Ismail bin Mohamad Nor
MARDI Seberang Perai
Beg Berkunci 203
Pejabat Pos Kepala Batas
13000 Pulau Pinang

Jamadon Bahari
Strategic Resource Research Centre
MARDI HQ
43400 Serdang
Selangor

Jamilah Bt. Mohd Salim @ Halim
Department of Biological Science
Universiti Malaysia Terengganu
21030 Kuala Terengganu
Terengganu

Jeffrey Lim Seng Heng
Strategic Resource Research Centre
MARDI
43400 Serdang
Selangor

Jiro Iguchi
JLCA
14th Floor, Menara Tun Mustapha
88052, Kota Kinabalu
Sabah

Julia Abdul Aziz	Unit Biodiversiti Institut Biosains Universiti Putra Malaysia 43400 Serdang Selangor Darul Ehsan
Kamarulnizam Shamsulaman	Institute of Biological Sciences Faculty of Science Universiti Malaya 50603Kuala Lumpur
Khadijah Awang	Strategic Resource Research Centre MARDI 43400 Serdang Selangor
Khadijah bt. Awang	Strategic Resource Research Centre MARDI 43400 Serdang Selangor
Khaironizam Md. Zain	Institute of Biological Sciences Faculty of Science Universiti Malaya 50603 Kuala Lumpur
Khairuddin Bin Itam	Institute of Biological Sciences Faculty of Science Universiti Malaya 50603 Kuala Lumpur
Kogeethavani	MARDI Stesen MARDI Kluang Beg Berkunci 525 86009 Kluang Johor
Mariam Taib	Department of Biological Sciences Faculty of Science and Technology Universiti Malaysia Terengganu 21030 Kuala Terengganu Terengganu
Mariana Ahamad	Institute for Medical Research IMR, Jalan Pahang 50588 Kuala Lumpur
Mayaizar Khaidizar	Strategic Resource Research Centre MARDI 43400 Serdang Selangor
Mazlani Bt. Muhammad	Agensi Remote Sensing Malaysia No 13, Jalan Tun Ismail 50480 Kuala Lumpur

Mirfat Ahmad Hasan Salahudin
Strategic Resource Research Centre
MARDI HQ
43400 Serdang
Selangor

Mohamed Rani Mat Yusoh
Strategic Resource Research Centre
MARDI HQ
43400 Serdang
Selangor

Mohd Azman Hj. Shahidin
Technology Park Malaysia Corp. S/B
Level 5, Enterprise 4
Lebuhraya Puchong – Sg. Besi
Bukit Jalil
57000 Kuala Lumpur

Mohd Azmin B. Yusoff
Planning and Research Department
Ministry of Higher Education
Level 3, Block E3, Parcel E,
62505 Putrajaya

Mohd Hafiz Abdul Rahman
National Institute of Animal Biotechnology
Department of Veterinary Services,
Bukit Dinding
27000 Jerantut
Pahang

Mohd Nor Faizal Ghazali
Strategic Resource Research Centre
SR 01, Room L15
MARDI
43400 Serdang
Selangor

Mohd Rasdi Zaini
Faculty of Applied Science
UiTM
40450 Shah Alam
Selangor Darul Ehsan

Mohd Saifuddin Ismail
Strategic Resource Research Centre
MARDI
43400 Serdang
Selangor

Mohd Saiful Bin Mohd Zin
Jabatan PERHILITAN
Bahagian Konservasi Biodiversiti
KM 10, Jalan Cheras
56100 Kuala Lumpur

Mohd Shahir Shamsir
Biological Science Department
Faculty Bioscience and Bioengineering
Universiti Teknologi Malaysia
Skudai
Johor Darul Takzim

Mohd Shukri bin Mat Ali @ Ibrahim
Strategic Resource Research Centre
MARDI HQ
43400 Serdang
Selangor

Mona Lisa bt. Md Rasip	Institute for Medical Research Bacteriology Unit IMR, Jalan Pahang 50588 Kuala Lumpur
Motohiro Hasegawa	JLCA 14th Floor, Menara Tun Mustapha 88052, Kota Kinabalu Sabah
Muhammad Bin Yaacob	Unit Biodiversiti Institut Biosains Universiti Putra Malaysia 43400 Serdang Selangor Darul Ehsan
Muhammad Shafie Md. Sah	Strategic Resource Research Centre MARDI 43400 Serdang Selangor
Naila Azma Kamaruzaman	Institute of Biological Sciences Faculty of Science Universiti Malaya 50603 Kuala Lumpur
Neelam Shahab	SIRIM Berhad Block 19 1, Persiaran Dato' Menteri Section 2, P.O. Box 7035 40911 Shah Alam Selangor
Noor Fadzillah Abdul Rashad	Perbadanan Bioteknologi & Biodiversiti Negeri Johor Block 2, Innovation Centre UTM-MTDC Technovation Park 81300 Skudai Johor
Noor Hisham bin Mohd Zainal Abidin	MARDI Seberang Perai Beg Berkunci 203 Pejabat Pos Kepala Batas 13000 Pulau Pinang
Nor Asiah Ismail	MARDI Stesen MARDI Terengganu 21230 Ajil Terengganu
Nor Ayshah Alia	Strategic Resource Research Centre MARDI 43400 Serdang Selangor
Nor Rasidah Hashim	Department of Environmental science Faculty of Env. Studies Universiti Putra Malaysia 43400 Serdang Selangor

Nor Zuhaili Binti Zaidan
Jabatan Meteorologi Malaysia
Jalan Sultan
46667 Petaling Jaya
Selangor

Noraisyahalia Bt. Ali Hassan
MARDI
Peti Surat 12301
Pejabat Pos Besar
50774 Kuala Lumpur

Norhayati Ahmad
School of Environment and Natural Resource Science
Universiti Kebangsaan Malaysia
43600 Bangi
Selangor

Norida Mazlan
Jabatan Teknologi Pertanian
Fakulti Pertanian
Universiti Putra Malaysia
43400 UPM
Selangor

Norlia Bt. Yunus
MARDI Research Station
Kubang Keranji P.O. Box 154
15710 Kota Bharu
Kelantan

Norzaimawati Aman Nejis
Strategic Resource Research Centre
MARDI
43400 Serdang
Selangor

Nuradni bt. Hashim
MARDI
Blok G, Strategic Research Centre
MARDI Headquarters
43300 Serdang
Selangor

Nurul Asihikin Abdullah
Institute of Biological Sciences
Faculty of Science
Universiti Malaya
50603Kuala Lumpur

Ramlah Bt. Kadir
Institute of Biological Sciences
Faculty of Science
Universiti Malaya
50603Kuala Lumpur

Razali Abd. Rahman
Strategic Resource Research Centre
MARDI
43400 Serdang
Selangor

Razean Haireen Mohd Razali
MARDI
Ibu Pejabat MARDI
Peti Surat 12301
Pejabat Pos Besar
50774 Kuala Lumpur

Razfan Haireen Mohd Razali
MARDI
Peti Surat 12301
Pejabat Pos Besar
50774 Kuala Lumpur

Rohana bt. Che Nordin
Institute of Biological Sciences
Faculty of Science
Universiti Malaya
50603 Kuala Lumpur

Rosalie Clara Corpuz
Forest Research Centre
Sabah Forestry Department
P.O.Box 1407,
90715 Sandakan
Sabah

Rosliza bt. Jajuli
Strategic Resource Research Centre
MARDI
43400 Serdang
Selangor

Rosnah Hassan
Strategic Resource Research Centre
MARDI
43400 Serdang
Selangor

Rozainah M. Zakaria
Institute of Biological Sciences
Faculty of Science
Universiti Malaya
50603 Kuala Lumpur

S. Vikineswary
Institute of BioScience
Faculty of Science
University Malaya
50603 Kuala Lumpur

Saiful Arif Abdullah
LESTARI
Universiti Kebangsaan Malaysia
43600 Bangi
Selangor Darul Ehsan

Salma Idris
Strategic Resource Research Centre
MARDI HQ
43400 Serdang
Selangor

Salman Johari
Faculty of Computer Science & information System
Universiti Teknologi Malaysia
81310 Skudai
Johor

Samsudin Abd Rahim
Fakulti Pertanian
Universiti Putra Malaysia
43400 UPM Serdang
Selangor

Sharmillah Salleh
Ecotourism & Urban Forestry Programme,
FRIM
52109 Kepong
Selangor Darul Ehsan

Sheryn Sum Pei San
MSC Headquarters
2360, Persiaran APEC
63000 Putrajaya

Site Noorzuraini Abd Rahman
MARDI Seberang Perai
Beg Berkunci 203
Pejabat Pos Kepala Batas
13000 Pulau Pinang

Siti Rafeqah Bt. Samsunanwar
Institute of Biological Sciences
Faculty of Science
Universiti Malaya
50603Kuala Lumpur

Suhaida Aini
Agensi Remote Sensing Malaysia
No 13, Jalan Tun Ismail
50480 Kuala Lumpur

Surin Suksuwan
WWF-Malaysia
49, Jalan SS 23/15
Taman SEA
47400 Petaling Jaya
Selangor

Syahar Amir B. A. Gani
Jabatan Sains Praklinikal Veterinar
Fakulti Perubatan Veterinar
Universiti Putra Malaysia
43400 Serdang
Selangor Darul Ehsan

Tajuddin Abdul Manap
Unit Biodiversiti
Institut Biosains
Universiti Putra Malaysia
43400 Serdang
Selangor Darul Ehsan

Tan Geok Hun
Bioresource Management and Utilization Program
Strategic Resource Research Centre
MARDI
43400 Serdang
Selangor

Tan Geok Hun
Strategic Resource Research Centre
MARDI
43400 Serdang
Selangor

Tong Pei Sin
TRAFFIC South East Asia
Unit 9-3A, 3rd Floor
Jalan SS 23/11 Taman SEA
47400 Petaling Jaya
Selangor

Tosiah Sadi	MARDI Ibu Pejabat MARDI Persiaran MARDI-UPM 43400 Serdang Selangor
Umi Kalsom Md. Shah	Strategic Resource Research Centre MARDI HQ 43400 Serdang Selangor
Zulhairi Ariffin	Strategic Resource Research Centre MARDI 43400 Serdang Selangor

Acknowledgements

Ministry of Science, Technology and Innovation
The Ministry of Natural Resources and Environment
The Ministry of Agriculture and Agro-based Industries
WWF-Malaysia
Malaysian Agriculture Research and Developments Institute (MARDI)
Forest Research Institute Malaysia (FRIM)
Department of Wildlife and National Park (PERHILITAN)
Department of Marine Park Malaysia
Department of Veterinary Services (DVS)
Department of Fisheries
Department of Sabah Park
TRAFFIC
LESTARI, Universiti Kebangsaan Malaysia
Universiti Putra Malaysia
Universiti Teknologi MARA
Universiti Malaysia Sarawak
Malay Tea House
Golden Hope Plantation
Merlion Pharmaceutical (Singapore)
Sabah Wildlife Department
Sarawak Biodiversity Centre
Sarawak Forestry Corporation