A GLANCE INTO THE HISTORY OF FOREST RESEARCH IN SARAWAK

ALFRED RUSSEL WALLACE
- British naturalist, biologist, anthropologist, ethnographer, epidemiologist
- Conceived theory of evolution through natural selection, despite Charles Darwin being more well-known for the theory
- Did his studies at Mt. Santubong, Damai Peninsular and Mt. Serabuk, Simawan, Bau (the latter was where James Brooke’s summer cottage at Baliki Peninsular was located)
- Wrote the ‘Malay Archipelago’ and put Sarawak on the map

1854
1856

1865
1868

ODOARDO BECCARI
- One of the great botanical explorers/naturalists of the 19th century
- Spent 13 years in the region (2 years in Sarawak) to yield remarkable discoveries and published a book
- Magnificent collections laid foundations for all future botanical work in Sarawak

DR. GEORGE DARBY HAVILAND
- British surgeon and naturalist, who served as Director of the Raffles Museum in Singapore (1893-1898) as well as being a medical officer in Sarawak and Curator of the Sarawak Museum in Kuching from 1893 to 1895 (possibly already acting in 1893)
- Special interest in termites and published observations and descriptions in Journal of Linnens Society 1898
- Returned to Kuching in 1895
- Several plants were named after him
- The oldest specimen in Sarawak herbarium, Cyamandrium rufum Stapf, ex Hk. was collected by Haviland in May 1890

1893
1895

1914

JAPANESE OCCUPATION
- Only two wooden boxes of herbarium specimens survived the Japanese occupation and were kept in the top floor of the Kuching General Post Office Building

1941
1945

1955
1960

- In 1955, Sarawak Herbarium was established, combining Sarawak Museum Herbarium and Forest Department collection, and kept in Sarawak Museum cabinets but they remain the property of Forest Department and were considered on loan to the Museum.
- Consisted of a few thousand specimens from herbariums in Brunei, North Borneo (Sabah) and Singapore, together with two boxes which survived the Japanese occupation.
- Notable researchers from this period:
  - Prof. Peter Shaw Ashby, Prof. Eberhard Brunig, J. A. R. Andersen, Bertram Evelyn

1961

- New herbarium at Jalan Baduddin completed

1996

- Forest Research Center at KM 10, Jalan Penrissen Kuching was established
- It houses the Sarawak Herbarium, one of the biggest herbaria in Malaysia, alongside FRIM in Kepong and Sandakan Herbarium in Sabah

Present

- Research, Development and Innovation Division of Forest Department Sarawak

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CONTENTS

A Glance Into The History Of Forest Research In Sarawak

Research, Development and Innovation Division

Indigenous species for landscaping

Orchids of Gunung Pueh

Agarics: Mushrooms and toadstools of Kubah

Water quality: An Introduction

Soil Laboratory Insights

A Picture Guide for Xylocarpus granatum and Xylocarpus moluccensis: a true mangrove species

Plants of Ulu Mentawai

Scientific Collaboration Visit To Lambir Hills National Park

Kumpulan Inovatif dan Kreatif (KTK)

Office activities

Runi ak Sylvester Punggah
Senior Assistant Director
Research, Development & Innovation Division

Praise to God the Almighty for the blessings and Salam sejahtera.

The first “SARAWAKENSIS: Sarawak Forest Research Bulletin” highlights issues and findings on three major topics such as the forests, biological resources and conservation. The focus area of research encompasses inventory of forest biodiversity (flora & fauna), taxonomy, ecology, propagation, environmental chemistry and soils science.

As we all know, forests are central to all biological resources including human beings. It provides both tangible and intangible benefits. Therefore, we need comprehensive conservation efforts and strategies to ensure that the forests and the resources are sustainably managed.

The information and data gathered from our research activities will be documented and disseminated to the relevant authorities, agencies, stakeholders and public. It is our hope and aim that the research findings, which emphasise on conservation aspects, would be integrated into development planning while striving to achieve socio-economic development goals.

I wish to acknowledge and appreciate the contribution of researchers from the Research, Development and Innovation Division. It is my sincere hope that the researchers will continue to excel and be dedicated in their work to achieve a world class civil service.
The Research, Development and Innovation Division (RDID) of Forest Department Sarawak is responsible for the state’s forestry research as well as documentation of biodiversity of flora, fauna and forest environment. The division comprises three main sections, namely the Biodiversity (Flora) Section, Biodiversity (Fauna) Section and the Development and Innovation Section. Various research programmes are carried out under these sections, such as botany, ecology, mycology, entomology, zoology, pest management, conservation, biotechnology, soil and environmental chemistry. Some of the facilities available are the herbarium, mycological reference collection, entomology reference collection, zoological reference collection, soil laboratory, wood anatomy collection, laboratories, nurseries and research resource center.

The main functions of the Research, Development and Innovation Division include:

- To generate knowledge and develop appropriate technology for the conservation, sustainable management, development and utilisation of forest resources;
- To document, inventories and investigate the biodiversity of flora, fauna and forest environment of Sarawak;
- To acquire skill and knowledge as well as to disseminate information on related research activities;
- To manage and maintain reference collections of plants, fungi, insects, wood samples, wildlife specimens and more;
- To provide technical advice on forest research and conservation.

A. Biodiversity (Flora) Section

The Biodiversity (Flora) Section focuses on various fundamental research on plants and fungi, including ecology, phenology, taxonomy, anatomy and morphology.

Among the oldest and most outstanding specimen is Cyanandrium rufum from family Melastomataceae, collected 127 years ago by Haviland in May 1890.

Besides that, there are also a large number of wet and carpological collections, with a total of 1,550 and 3,040 respectively. All data are kept systematically in the Botanical Research and Herbarium Management System (BRAHMS) database.

Currently, there are also more than 5,000 wet and dry fungi specimens in the mycological reference collection. Among one of the interesting specimens kept in there is a type specimen of Spongeforma squamata from the family Boletaceae collected in Lambir Hills National Park in 2011.

B. Biodiversity (Fauna) Section

Sarawak has one of the most diverse and unique fauna biodiversity in the world with more waiting to be discovered. Currently, the biodiversity fauna section is focused on insects, pest management and wildlife.

As of now, the entomology reference collection has more than 500,000 wet and dry specimens including the Rajah Brooke’s Birdwing, which is endemic to Borneo and protected in Sarawak.

The Entomology programme is currently engaged in a long-term ongoing collaborative study with the Japan Research Consortium for Tropical Forests in Sarawak (JRCTS), which is focused on flora and fauna of Lambir Hills National Park.
The Development and Innovation section is focused on conservation, environmental chemistry and biotechnology. Conservation efforts are both in-situ and ex-situ, targeting protected and selected species such as wild orchids through propagation and replanting. To complement conservation efforts, the forest environment research focuses on soil nutrient-plant relationship and water quality studies. Besides that, the research also aims to promote wild plant species for landscaping purposes and plantation purposes.

C. Development and Innovation

OTHER ACTIVITIES:
- To provide technical advice on forest research and conservation for schools, community and other agencies
- Public awareness activities through exhibitions, educational talks by in-house or invited researchers as well as visits from schools and agencies
- Collaboration visits to other research agencies or institutions

SCIENTIFIC EXPEDITIONS:
Scientific expeditions are carried out annually at a variety of areas throughout Sarawak including national parks, totally protected areas as well as unexplored and undocumented areas deep in the lush tropical jungles of the state. Some of the expeditions organized or participated by RDID in recent years:

<table>
<thead>
<tr>
<th>RDID Expeditions</th>
<th>Heart of Borneo Expeditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Others : 1. Pulong Tau (2012)</td>
<td>Others :</td>
</tr>
</tbody>
</table>

INDIGENOUS SPECIES FOR LANDSCAPING

Asplenium nidus
Category: Fern
Family: Aspleniaceae
Local name: Rajang
Notes: Epiphyte, rosette of linear leaves/fronds, sword-shaped, spore cases are arranged in lines along the vein of the frond, black midrib.

Nepenthes ampullaria
Category: Climber/Creeper
Family: Nepenthaceae
Local name: Entuyut, Peruk Kera
Notes: Young shoot and leaves hairy, leaves oblong-obovate, pitchers in clusters, rounded, green or reddish-brown

Melastoma malabatricum
Category: Shrub
Family: Melastomataceae
Local name: Kemunting
Notes: Can grow up to 1 m tall, stem reddish, leaves simple, narrow with three prominent longitudinal veins, flower 5 petals, dark purple to pinkish, on rare occasion, white. Fruit is oval with purple pulp and edible.

Spathoglottis plicata
Category: Terrestrial Orchid
Family: Orchidaceae
Common name: Ground orchid
Notes: Leaves variable in size, narrowly lanceolate, inflorescence about 1 m tall, color of the flower often deep pink, lip with yellow midlobe.

Eurycoma longifolia
Category: Treelet Orchid
Family: Simaroubaceae
Local name: Sengkayap, Tongkat Ali
Notes: Bark cream or pale yellow, leaves spirally arranged and clustered at terminal ends, inflorescence long with reddish stalks and flowers, fruits oblong, red in color.
Borneo, the third largest island in the world, is well-known as a habitat for orchids, where 2,000 species out of 20,000 orchid species estimated worldwide can be found here. For Sarawak, 1,019 species of 120 genera have been recorded.

During the Gunung Pueh Scientific Expedition in 2015, 77 orchid specimens were collected and 25 genera were identified.

**Bulbophyllum refractilingue J.J. Sm.**

This epiphytic species is endemic to Borneo and can be found at elevation of 100 to 400 meters along the riverine forest of Gunung Pueh.

**Cleisostoma Subulatum Blume**

This is an epiphytic orchid species growing at the elevation range of 100 to 300 m. Found in Borneo, India, Burma, Thailand, Peninsular Malaysia, Cambodia, Riau Archipelago up to Philippines. This species is native to Southeast Asia mainly Thailand, Malaysia, Philippines, Borneo, Java and Sumatra.

**Dendrobium sanguinolentum Lindl.**

Dendrobium sanguinolentum is identified by its deep cream flower with crimson-purple tips, which gave it the name “Blood-stained Dendrobium”. However, varieties without purple tips appear to be more commonly found in habitats such as limestone and hill forests. This species is native to Southeast Asia mainly Thailand, Malaysia, Philippines, Borneo, Java and Sumatra.

**Aphyllorchis pallida / Aphyllorchis montana**

This is one of the 30 species classified under the genus Aphyllorchis Blume or also known as pauper orchid. It is a terrestrial mycoheterotrophic orchid and lacks chlorophyll. It gains nutrients from fungi. During flowering, the bract emerges from the ground up to 1 meter above ground.

**Pomatochalpa sp.**

The genus is widely distributed in Malesia, Australia and Taiwan with its centre of diversity in Thailand and Peninsular Malaysia. There are about thirteen species recorded under this genus.

**The boletes have a close resemblance with the agarics. The most distinct characteristic between these two fungi is the presence of tubes or pores at the under cap ( hymenia) of boletes.**

Troops of *Pulveroboletus* sp. were found growing in a massive number in some trails. The bright colour of these fungi makes them easier to spot and identify.
POLYPORES: WOODY AND BRACKET FUNGI

Microporus xanthopus
Thelephora sp.
Lentinus sp.
Amauroderma sp.
Stereum sp.

Polypores have a very noticeable feature; the multiple pores formed under its hard fruiting body. These pores have various kinds of shapes and formations depend on the genera and species which are crucial for identification process. Polypores' fruiting bodies texture is mostly woody or leathery.

Genus of Microporus has the highest number and were vastly scattered on forest floor that grow on the dead logs or dead twigs. Microporus xanthopus is the most likely species found on every trail.

OTHER MACROFUNGI

Other than those three common types of macrofungi, several number of other macrofungi forms were found and observed.

These fungi appeared to have various shapes and special characteristics compared to the common macrofungi. The genera that have been recorded are Cookeina sp. (Cup Fungi), Dacrymyces sp. (Jelly fungi), Scleroderma sp. (Earth Star), Xylaria sp. (Club fungi), Ramaria sp. (Coral fungi), Cantharellus sp. (Cantharelle), Hydnum sp. (Tooth fungi), Calostoma sp. (Stalked Puffball), Tremella sp. (Jelly fungi) and Hypoxylon sp.

WATER QUALITY: AN INTRODUCTION

by Nur Bazilah Ismail

INTRODUCTION

Water is an essential element in the maintenance of all forms of life, and most living organisms can survive only for short periods without water. In other words, water is an essential resource that sustains life on earth. Changes in the natural quality and distribution of water have ecological impacts that can be devastating. About 97% of our raw water supply for agricultural, domestic, and industrial needs are derived from surface water sources primarily river.

WHAT IS WATER QUALITY?

Water quality can be defined as the chemical, physical, and biological characteristics of water, usually in respect to its suitability for a designated use.

WHAT IS WATER QUALITY ANALYSIS?

Water quality analysis is to measure the required parameters of water, following standard method to check whether they are in accordance with the standard. Most common and basic water quality parameters are pH, temperature, dissolved oxygen, biochemical oxygen demand, chemical oxygen demand, turbidity, total suspended solids, and ammoniacal nitrogen.

Certain water quality parameter can be measured in-situ, where the parameter is measured directly in the field using portable or handheld multiparameter meters.

On the other hand, other parameters that need to be further analyzed will be sampled and brought to the laboratory. In Malaysia, the Interim National Water Quality Standards (INWQS) is used to classify rivers into classes which ranged from Class I to V (I, IIIA, IIB, II, IV, V).
FOREST AND WATER QUALITY

Rivers, lakes, and its catchment areas are the main component of natural heritage that has to be preserved. Forest in the catchment area should not be disturbed by any means and need to be preserved as they are the repository of our natural heritage besides their association with rivers which are important water resources. Forests’ most significant contribution to water for all living things is in maintaining high water quality. They achieve this through minimizing soil erosion on site, thus reducing sediment in water bodies (wetlands, ponds and lakes, streams and rivers), and through trapping or filtering other water pollutants.

IMPORATANCE OF WATER QUALITY TESTING

Water quality is an important part of environmental monitoring. When water quality is poor, it affects not only aquatic life but the surrounding ecosystem as well. Water quality testing provides baseline data of forest environmental characteristic (river physiochemical properties) which contribute to forest biodiversity. Besides, it can determine the water quality of the river which might affect forest ecosystem and at the same time ensure that the river is in a preserved condition. Apart from that, water quality monitoring can help researchers predict and learn from natural processes in the environment and determine human impacts on ecosystem; forest specifically.

REFERENCES

SOIL LABORATORY INSIGHTS

RDID has several laboratories and one of it is the Soil Lab. It has the basic facilities to conduct several determinations or chemical analyses such as bulk density testing, pH, loss of ignition, total nitrogen, calorimetric testing, nutrients analysis and etc.

The most complex and advanced instrument in this lab is Atomic Absorption Spectrometer (AAS) model CE3000 series from Thermo Scientific. It was acquired in year 2016 and training was carried out in early 2017. Currently, this powerful tool is planned to be used to run nutrients checking for certain element such as Ca, Mg, Mn, K, Zn and Fe. However, it has limited lamps availability and will be improved from time to time subject to budget and future research requirement.

AAS can be operated manually or automated. A total of 240 samples could be tested at a time.

A TRUE MANGROVE SPECIES: XYLOCARPUS GRANATUM & XYLOCARPUS MOLUCCENSIS

by Noorhana binti Mohd Sapawi

The genus Xylocarpus (Meliaceae) comprised of three species, including two mangrove species namely X. granatum and X. moluccensis. Xylocarpus occurs in coastal localities and its distribution is from East Africa and India to China, through Asia and Indonesia to New Guinea and northern Australia. Both species occur in mixed stands within middle to upper tidal limits or middle to upper estuarine reaches and can be differentiated by distinctive morphological characters. The X. granatum or commonly known as ‘Nyireh Bunga’ is evergreen while X. moluccensis or known as ‘Nyireh Batu’ is notably deciduous with leaves turning red and orange before falling.

The other characteristics used to identify the two species are illustrated in the table below. The pictures were taken during field studies in Kuching Wetland National Park (KWNP).

<table>
<thead>
<tr>
<th>Buttresses and pneumatophores</th>
<th>Bark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buttresses are ribbon-like undulations extending away from the trunk</td>
<td>Bark smooth</td>
</tr>
<tr>
<td>Pneumatophores absent</td>
<td>Pale orange</td>
</tr>
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<td></td>
<td>Flaking off in patches</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Leaf</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leaflets spoon-shaped with rounded tips</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fruit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leaflets eye-shaped with pointed tips</td>
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<td></td>
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</tbody>
</table>
PLANTS OF ULU MENTAWAI, MULU NATIONAL PARK by Nur Safinas Binti Jelani

Photos: Yazid Bin Kalbi & Mohamad Zainuddin Bin Mohamad Kameri

Ulu Mentawai could be accessed by boat from Ulu Mendarat, Limbang or by walking from Head Hunter Trail to Kuala Tenkai at Gunung Mulu National Park. Ulu Mentawai has a wide diversity of plant species from herbs and shrubs to big trees.

Fruits of Garcinia sp. (Clusiaceae) or known as Kantis

Fruits of Lithocarpus sp. (Fagaceae) or known as Empil or Empenit.

Beautiful bright orange brown colour bark of Selunsor or Tristaniopsis sp. (Myrtaceae) trees at Ulu Mentawai, Mulu National Park

Climbers on tree: Aeschynanthus sp. (Gesneriaceae) or known as Gincu monyet or Gincu kera

Flowers with attractive colours from family Loranthaceae

Fruits of Tabernamontana sp (Apocynaceae) or commonly known as Pelir kambing or Tarak manang

Orange-coloured pods with black seeds from fruits of family Sterculiaceae

Flowers of Rhododendron sp. (Ericaceae)

Attractive bright orange reddish colour of Bauhinia sp. (Fabaceae) flowers along the river of Ulu Mentawai, Mulu National Park

SCIENTIFIC COLLABORATION VISIT TO LAMBIR HILLS NATIONAL PARK

Lambir Hills National Park, an area consisting of mixed dipterocarp forest, is known for its extremely high species richness of trees. Currently, it is estimated to contain more than 1,200 species of trees in an area of nearly 70 sq. km., making it one of the richest forests in terms of tree species of all forest types in Malaysia. Japanese and JRCTS in November 2012.

To better understand the long-term research conducted by the Japanese researchers, research officers and staff from the Research, Development and Innovation Division (RDID) of Forest Department Sarawak, led by Senior Assistant Director Mdm. Runi Sylvester Pungga, made a visit to Lambir from 21st to 22nd February 2017, where the department's researchers were briefed on the projects by several of their Japanese counterparts, namely Prof. Dr. Takao Ittsuka and Dr. Tomonori Kume.

The research conducted by JRCTS in Lambir since 1990s include research fields such as botany, entomology, plant and insect ecology, evolutionary biology, mycology, hydrology, meteorology and more. Some of the research facilities available at
Lambir are rearing room for insects, laboratories, shade house, collection room, mini library and so on.

At least 150 researchers from Japan have taken part in this joint project in Lambir over the past 20 over years. As of now, 120 researchers from JRCTS are currently conducting research in Lambir and they are from 14 universities and 3 research institutions from Japan. More than 200 research papers about Lambir have since been published.

Lambir Hills National Park is such a hotspot for researchers because of the extremely high species richness. It is also discovered to have very high tree canopies. An interesting phenomenon noted by Prof. Dr. Itoko and his colleagues is that the trees undergo mass flowering, where a majority of emergent and large trees bear flowers at the same time, sometimes after years of not flowering.

Most of the trees’ reproductive organs are in the tall canopies and since insects play an important role in the reproduction of plants, it is crucial that we study and understand the insect-plant interaction in the canopies.

For such canopy-related research, JRCTS has constructed a canopy access system, which consists of two tree towers, 60m and 55m respectively, as well as a canopy crane with 80m tall mast, complete with a gondola to transport researchers over the canopies of trees to do their periodical surveys.

The eddy covariance system was also installed on the canopy crane to analyse key atmospheric gases such as H2O and CO2. The canopy crane also housed a detector to study other meteorological parameters such as temperature, radiation, wind strength and rain fall.

Researchers from FDS were also briefed about various fields and subjects that they were encouraged to collaborate and have joint projects with their Japanese counterparts.

The trip also saw FDS researchers and staff making a visit to the tree towers and canopy crane to experience the walkways built between trees as well as getting to know the operations of the crane.

Prof. Dr. Itoko also expected to find more than 2,000 species of trees if the research area were expanded beyond the existing 70 sq. km. of Lambir Hills National Park.

Overall, it has been a fruitful trip to Lambir Hills National Park, where knowledge was shared and potential collaboration opportunities were made through networking with the experienced researchers from JRCTS.
RDID ACTIVITIES

Chinese New Year Celebration (9th February 2017)

Pre-Gawai Celebration (25th May 2017)

Hari Raya Celebration (6th July 2017)

RDID ACTIVITIES

A visit to RDID by YBhg. Dr. Wan Lizozman bin Wan Omar, Permanent Secretary of the Ministry of Urban Development and Natural Resources 22th August 2017

RDID Sports Week (6th to 12th January 2018)