

THE NATURAL HISTORY MUSEUM, LONDON

Dates of visit: 13 – 15 December 2007

Foundation, Location and Public Significance

The Natural History Museum was founded through the efforts of Sir Hans Sloane (1660 – 1753) who, while serving as physician to the Governor of Jamaica for 15 months, carefully recorded the island's natural history, and returned to London with hundreds of plant and animal specimens. By the time he died, in 1753, Sloane had amassed a collection of 80,000 specimens and books in his London home, which was consulted by other scientists, including Carl Linnaeus (1707 – 1778). Sloane left all his property to the nation in his will. The Museum occupies a magnificent large building specially designed for its purpose, in South Kensington. The building was completed in 1881. Situated close by are the Science Museum and the Victoria and Albert Museum. The Natural History Museum houses 70 million specimens, collected from all over of the world, representing all groups of living things, fossils, rocks and minerals. The Museum houses nearly 850,000 type specimens. It attracts over 3 m visitors a year (registered electronically by sensors at the public entrances). International visitors account for 30% of visitors and local visitors from within two hours driving distance account for 40 – 45% (percentages obtained by sampling exercises). Entrance is free except to Special Exhibi-



The iconic main building

tions, of which two or three are staged each year. The Museum is closed only on Christmas Day.

Governance and Management

The Museum was established by Act of Parliament as a non-profit organization. It is funded mainly by the Government and is governed by a Board of Trustees. There are 12 trustees of whom eight are appointed by the Prime Minister, one by the Government upon the recommendation of the Royal Society and three are co-opted by the Board itself. The present



Chairman is Mr Oliver Stocken. The Board of Trustees appoints the Director, currently Dr Michael Dixon, who was previously Director-General of the Zoological Society of London. The Board conducts an annual review of the performance of the Museum. New members of the Board attend a one-day induction and training course. Five sub-committees report to the Board of Trustees. These committees cover (i) audit, (ii) finance, (iii) remuneration, (iv) Darwin Centre Phase Two and (v) Nominations to the Board and its sub-committees. Staff salaries are determined by the Board. For scientists the salaries are generally equivalent with salaries for academic staff of universities.

The great hall

A dinosaur greeting visitors at the great hall

Under the Director of the Museum, there are six Directors, in charge of (i) Public Engagement, (ii) Science, (iii) Finance, (iv) Human Resources, (v) Estates, and (vi) the Walter Rothschild Museum at Tring. The Museum employs 850 staff.



Public Engagement

Role

Of the Museum's total staff, about half are employed under Public Engagement, which is responsible for exhibitions, learning activities, design, events, fund-raising, public communications and maintenance. The aim of public engagement is to increase scientific literacy in society by making knowledge available in visually and intellectually stimulating and friendly formats.

Each exhibition project team has a 'champion' to deliver the project and a team to prepare the content and design, develop learning activities, design a marketing campaign, produce related website activities and

generally manage the project. An exhibition takes up to three years to prepare. The design is done in collaboration with outsourced design companies and the first result is a 'Concept' with text and graphics that can be used in bids for raising financial support. A Concept may take eight months to prepare. If support is secured, the Concept is moved to Scheme Design and then Detailed Design followed by implementation-production. Implementation of exhibitions is by outsourced contractors, but multimedia is done in-house. One advantage of outsourcing is that each contractor brings its own style and the result is a diversity of styles across exhibitions whereas in-house work may result in a single in-house style.

Permanent exhibitions are no longer as permanent as before. Current thinking is to upgrade them in 10 to 12 year cycles. The Museum is currently preparing a gallery re-development programme for the Museum's permanent galleries. This involves master-planning the public spaces and developing a suite of concepts for new galleries. Each existing gallery will require preparing a Concept and raising funds for its implementation.

Two or three Special Exhibitions are staged each year, each for a period of 6 to 12 months, after which they can be rented to other organizations and countries. Summer blockbuster exhibitions are most often aimed at the Museum's largest target audience—families. The current *Ice Station Antarctica* exhibition (to be on for one year) is already booked to travel overseas for the next five years. The Museum's Art/Science programme delivers one exhibition per year that is often a collaboration between artists and scientists. *Wildlife Photographer of the Year*, an annual competition that aims to find the most stunning and original wildlife pictures taken by photographers worldwide of all ages, becomes a touring exhibition after its debut in the Museum.

Public engagement is not confined to staff of the Public Engagement Department. The scientists are expected to do their part by publishing books and papers for scientific and general audiences and to give talks and presentations, including impromptu ones to visiting groups. They are featured in the *Nature Live* programme, a daily programme giving visitors an opportunity to talk to scientists. Scientists may also be assigned to exhibition development teams.

Left: Mammal Gallery in traditional style



Right: Mammal Gallery in modern style
Opp page, top: Herbivores
Opp page, bottom: Reptile Gallery

Investigate Centre

This is a special centre for children of ages 6–14 years. Created and managed by Dan Wormald, this centre exposes young people to the processes of science rather than to packaged information. A large assortment of specimens (rocks, bone fragments, skins, dried plant parts, shells, fossils, etc.) are placed in drawers, and visitors can pull out any drawer, touch the specimens, and examine them closely under a lens or microscope, or call up an SEM image on computer. There are four work stations provided with such equipment. Visitors are encouraged to formulate and test their own hypotheses. The staff are trained as facilitators to help the visitors ask probing questions and to look for evidence in the specimens, as



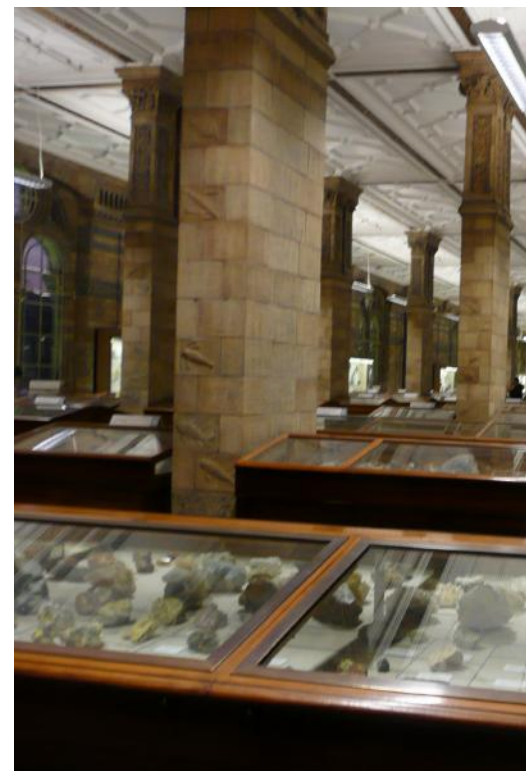
real scientists would do. The Centre includes an enclosed garden with a pond. Here visitors can examine aquatic life, soil organisms, plants and insects. The Centre caters for 80,000 visitors a year. According to Dan, the centre is, in principle, suitable for people of any age since the specimens are real natural objects, and visitors learn about them through their own exploration.

Science

Research

The Natural History Museum is a major research organization, employing 350 scientists as researchers, collections managers and technologists, headed by Richard Lane, Director of Science. The Museum hosts visiting scientists from all over the world, at the rate of over 9000 a year. It processes over 50,000 scientific enquires a year from the public.

Holding the oldest and most comprehensive collections of biological and mineral specimens in the world, the Natural History Museum is a



unique resource that continues to grow at an average rate of 150,000 new specimens a year. About five years ago the Museum went through a re-branding exercise to determine how best to use its unique resources, in particular what scientific questions it should concentrate on. Since a museum collection is a sample from the real world, it can be used to produce conceptual models of the world. The value of a model is that it can itself be analysed and experimented upon to see how well it explains the real world. A model is an instrument, and a public museum collection is a public domain instrument that can be used to investigate questions that cannot be investigated in other ways, e.g. to find out which are the biodiversity hotspots in a country, to identify gaps in knowledge, and to highlight and predict areas of concern. The scientific agenda of the Natural History Museum is now focused on six fundamental questions about the processes that generate biodiversity, and their implications—broad questions about the universe that require groups of researchers to work in collaboration.

Left: Display of gold minerals
Centre: Mineral Gallery and collection
Right: Wet Collection in Darwin Centre One



These questions are

- What determines biological diversity in a changing world?
- How do large-scale physical and biological processes and their interactions influence the evolution of the earth and other planets?
- What are the relationships between biodiversity and ecosystem functioning?
- How do interactions between hosts and their parasites impact on disease epidemiology and control?
- How is the diversity of phenotypes, genes and genomes related to environment and evolution?
- What form does the Tree of Life take?

The scientists at the Museum develop their own areas of research but new scientists are increasingly being recruited for their potential contribution to teams that can work on these six questions. The Museum differentiates between 'strategic' appointments of versatile scientists who have a proven record of scientific leadership, and 'tactical' appointments of junior scientists

Ichthyologist
Oliver Crimmen
demonstrating a
preserved fish



whose work will complement those of the senior scientists. For example, a person who works on the evolution of arthropods could be complemented by a person who works on plants that co-evolve with arthropods. Research appointments no longer fall within the traditional compartments of Botany, Zoology, etc.

The Museum looks for the best candidates in the world. The British

scientists who get appointed usually have had overseas experience, but 85% of appointments are made from international applicants. The Museum does not hire unless it has found the right candidate, because a poor candidate is recognized as a long-term liability until he or she is retired or separated. Many of the 350 research scientists are on contracts funded by research grants.

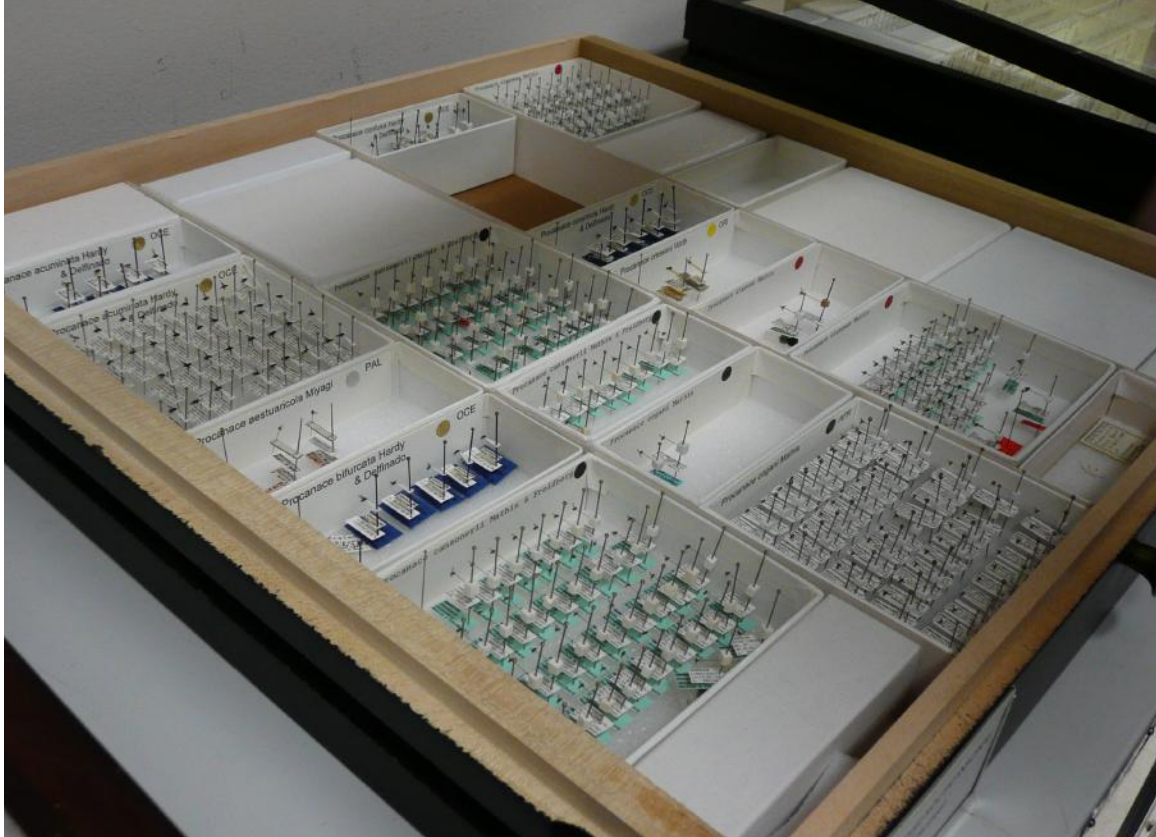
There over 150 post-graduate students doing research at the Museum. The post-graduate students are registered in universities in the UK and abroad, but spend 30% or more of their time at the NHM, with an NHM staff member acting as principle supervisor or advisor. There are 60 scientific associates who are unpaid, often retired staff, who do research in the Museum. There are also many volunteers who donate time to the Museum, working under the direction of researchers and collections managers.

The Museum runs two Masters Programmes organized in conjunction with the Imperial College nearby: in Advanced Methods, and Biosystematics.

Collections management

Collections management has become more demanding because of rising standards of care for specimens—no more use of poisons, greater dependence on strict hygiene, more emphasis on quarantine and deep freezing—and the growing need to conform to legal requirements for record keeping of gifts, loans, and other acquisitions.

Since no museum has enough resident experts, museums welcome and provide facilities for visiting experts. Specimens are also sent out on loan and such loans require recording and tracking. In 2005/2006, the museum loaned over 70,000 specimens to over 3,000 venues across the world.



Insect Collection

Laboratory for fossils

Collections managers often have a Masters in museum studies. They are not expected to do research but must be able to dialogue with researchers. The Museum employs about 70 professional staff for collections management.

At the new museum extension Darwin Centre One, which was designed to provide modern facilities for storing specimens, there are glass windows through which visitors can see how specimens are stored and how scientists work. Darwin Centre One houses the wet collection of 22 million specimens preserved in alcohol, ranging from microscopic plankton to a giant squid, and facilities for the scientists who work on them. Darwin Centre Two, under construction now, will house the entomology collection of 28 million specimens, the botany collection of 3 million specimens, and the scientists who work on them.

Fund-raising and marketing activities

Government grants covers 60% of operating expenses. The remaining 40% is raised by the Museum through various fund-raising and marketing activities. The scientists compete for research grants, some of which are national and some from the European Union. The exhibitions group develops concepts that are used to interest donors. There is also income from training courses run by the Museum in collaboration with Imperial College.

The Museum rents out space for the operation of restaurants and halls for private functions after hours. It operates the souvenir shops within the Museum. It markets travelling exhibitions, and museum consultancy services. The NHM has been involved in the planning and design of exhibitions in Dubai (The Restless Planet), Japan (UK Pavilion in the Aiki Expo), the UK (Jurassic Coast World Heritage Site), Qatar (Lost Worlds exhibition) and Kenya (National Museums of Kenya redevelopment plan).

Membership

The public are encouraged to become Members of the Natural History Museum. The membership fee for adults is £50 per annum. Members are invited to special events—lectures, behind-the-scenes visits, guided tours, children's workshops, previews of Special Exhibitions—and are provided with the quarterly magazine *Nature First*. The fee is treated as a gift to help finance the NHM.

Miscellaneous

Care of fossils

Fossil specimens are often brittle and easily damaged. Small specimens are stored individually in close-fitting boxes made of acid-free cardboard,

resting on bases of inert polypropylene 'corex'. Larger specimens are supported on cushions or fitted into cradles of corex, the bases of which are hollowed to conform to the specimen. This is to prevent specimens moving and rubbing against each other or on other surfaces when drawers are opened and closed or when specimens are being moved. Crumbly specimens are strengthened by impregnating with an acrylic adhesive Paraloid B72 which can be removed totally if necessary. Paraloid B72 can also be mixed with glass beads to act as a filler-cum-adhesive.

Display and care of mineral specimens

Most of the older natural history museums include minerals in their collections. NHM London houses probably the best mineral collection in the world. There are 177,000 mineral samples, of which 12,000 are on

Fossil mollusk collection



display in glass-topped cases in the minerals gallery. Below the display cases are locked drawers in which the research specimens are kept. Hence the same gallery serves two purposes: exhibition and specimen-storage. Valuable exhibits are displayed in a special high security room known as *The Vault*. Of the 4200 species of known minerals, 2,500 are represented in the Museum. The geology team of 35 scientists in NHM London is one of the largest teams of geologists in the UK.

Fossilized plant parts



Tissue collections

The Museum is building up collections of tissues for DNA and protein analysis. Samples are stored in special refrigerators. Under the Frozen Ark project, tissues are taken from endangered species and stored at -80°C as a strategic conservation measure should the species become extinct. Other specimens are stored at -20°C .

European Union initiatives

The European Union encourages the exchange of scientists between European countries by funding travel and other expenses through the SYNTHESYS initiative, designed to promote cooperation between museums in Europe. SYNTHESYS also funds the development of museum databases that will eventually be linked into a pan-European information domain.

The Union also supports a project to raise the standards for museums on a rating of A to D. The assessment is done on-site by visiting teams of assessors. In the beginning, museums were reluctant to join the scheme but more and more are now joining because the museums now realize that they benefit from being assessed and being advised on how to upgrade themselves.

The Biodiversity Heritage Library (BHL)

The Natural History Museum is one of ten leading US and UK museums that have come together in a project to get all the world's biodiversity literature digitized and made freely available on the Internet. The BHL project involves very high quality scanning of publications using special scanners developed by Internet Archive, an American non-profit organization. There are 20 machines in Washington and Boston operated in two shifts a day. Four million pages have already been scanned. The



Souvenir shop in the Museum

target is 25 million pages. The emphasis is currently on old literature not under copyright. Literature under copyright is subject to negotiation with copyright holders.

Two scanned copies are produced, one of which is displayed as a scanned page and the other is subjected to Optical Character Recognition (OCR). Taxonomic Intelligence software is being developed which will identify species names in the texts. All names referring to the same species will be eventually identified and linked so that name searches can be made using any name, in whatever be form it may have appeared in the literature (including spelling variants, mis-spellings and synonyms).

More and more countries have expressed interest in joining in the programme, which will eventually include scientific literature in German, French, Chinese and other languages. The whole project will require such large memory resources (10 – 20 petabytes) that eventually it may have to be run by a consortium of portals linked to a central portal.



Restaurant in the Museum



Portrait of Alfred Russel Wallace, author of *The Malay Archipelago*, the great classic of natural history



Library

Of the 1.8 million known species in the world, over 50% are from the tropics, so in a sense, information about them is being 'repatriated' to the tropics via this project. Interestingly, 25% of species names have occurred only once in the literature, indicating that after their first publication, no further information on them has been added.

More information on BHL is provided under the National Museum of Natural History of the Smithsonian Institution.

NATURALIS: THE NATIONAL MUSEUM OF NATIONAL HISTORY, NETHERLANDS

Date of visit: 19 December 2007

Foundation, Location and Public Significance

Naturalis is the name specially coined for the National Natural History Museum of the Netherlands, established in 1820. It is located close to the historic University of Leiden, the ultra-modern Science Park and the Central Railway Station. The foundation collections were donated by members of the Netherlands Royal Family, who were avid collectors of natural curiosities in the 1600s and 1700s. The museum holdings now total 15 million specimens, many of them important historic collections made by employees of the Dutch trading companies operating overseas and especially Indonesia. The collections are housed in a 20-storey building that towers over its surroundings. The museum's missions are to

- increase understanding of nature through research
- make knowledge available to the public

Contrast between the windowless Collections Tower Block and the amply transparent Exhibitions Building



Exhibitions
Building and
Collections Tower
Block



- care for the national natural history collections

The exhibition galleries attract 250,000 to 300,000 visitors a year and are closed on Mondays. Visitors pay an entrance fee.

Governance and Management

Naturalis is a Foundation established under an Act of Parliament for the purpose of managing the scientific collections of the country. It is funded almost entirely by the Government through the Ministry of Culture and

Higher Education. The budget is planned in four-year cycles. The annual allocation is treated as a management fee paid by the Government to the Foundation. Government auditors check on how well the collections are managed. One indicator is that a specimen should be produced on demand within five minutes.

Clockwise: Big mammals greeting visitors
Herbivores
Carnivores

The museum is headed by a General Director. It employs about 20 professional staff in administration and finance and is organized into three divisions: Public Programmes, Collections, and Research, with 50, 35, and 20 professional staff respectively.

Naturalis is managed by a Board of seven members. The Board meets



quarterly and approves the budget. It has the power to appoint and terminate the General Director and to appoint new Board members to replace retiring ones.

Public Programmes

Public Programmes cover the design, implementation and management of the public display galleries and the delivery of other public information and education services.

The Museum's galleries occupy a five-storey building adjacent to the 20-storey collections tower. The first and second floors are merged to accommodate tall exhibits such as a huge dinosaur. Display shelves are usually made of transparent glass or acrylic. There are sections for gems, various groups of vertebrates, and paleobiology. There are special (temporary) exhibitions lasting about 10 months, and permanent exhibitions which last longer but no longer as permanently as before. Guided tours are available for school groups. Each guide takes up to 20 students. About 18,000 primary schoolchildren visit a year, of which 80% come on guided tours. Secondary school students come in larger numbers, about 25,000, of which 70% come on guided tours.

Animal models for exhibition are made by external service providers, often in the countries of collection, e.g. in Vietnam and Philippines. The trend is for exhibitions to be implemented by external service providers, with the Museum staff acting as content developers and coordinators.

The Museum's websites attract 3.5 million visitors a year. The success of the websites is due to good concepts (good identification of needs and gaps), reliability (current science), good partnerships (using experts from everywhere) and good illustrations. One product is a catalogue of species in the Netherlands. Another is the linkage of species locations to Google

maps. Another is the mapping of the Netherlands through geological time, with locations of fossils. Another engages people in recording whale beachings on the coast of the Netherlands.

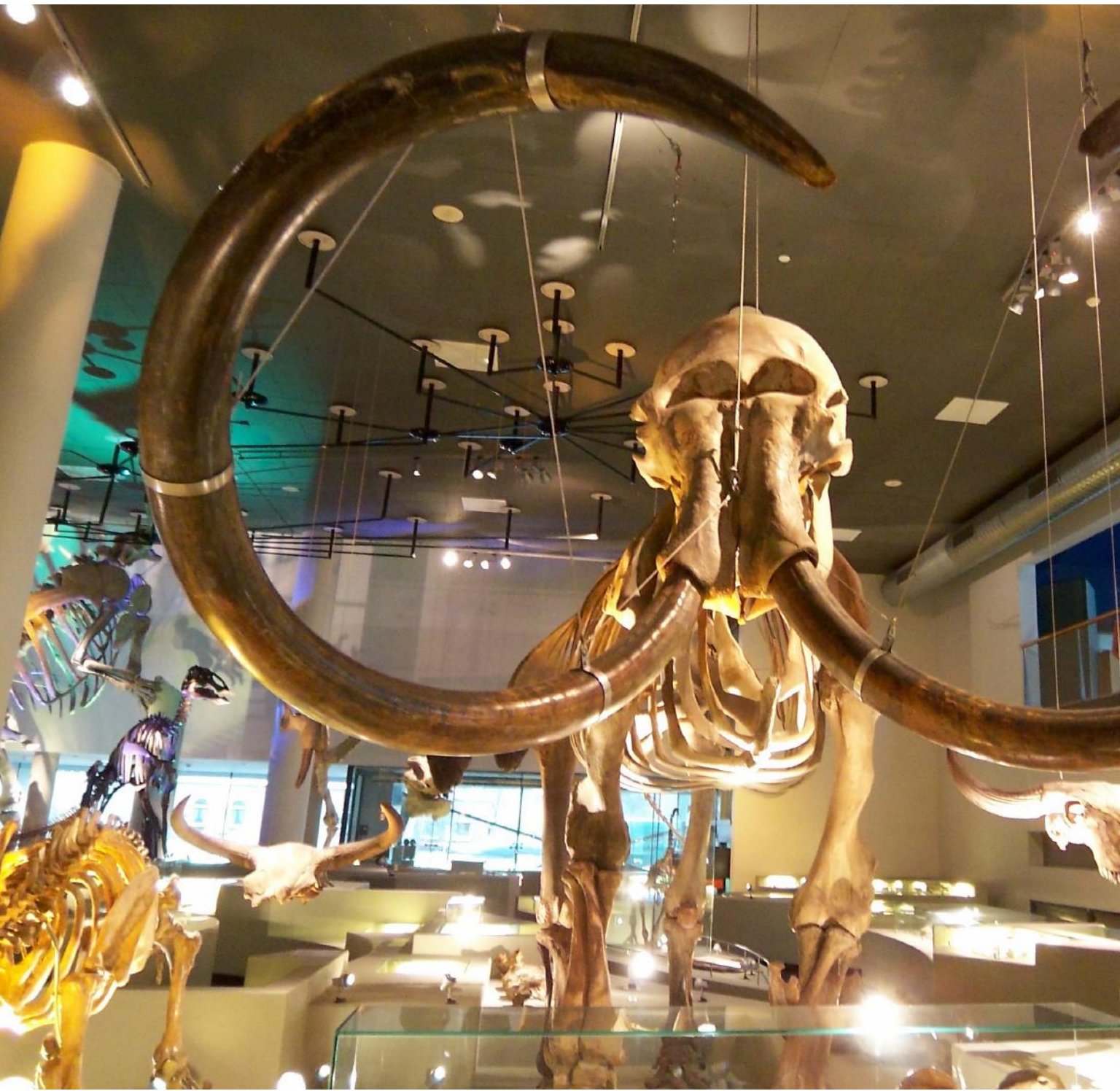
Naturalis also organizes each week a web conference in which a school group interacts with a scientist while the scientist does a dissection, stuffs a bird, or digs up a fossil; this is for schools located in the more distant areas of the country. Education programmes are all developed in-house.

The museum shop, selling books and souvenirs, is at the single public exit/entrance, which visitors have to pass through twice, as they enter and as they exit. The museum bookshop offers the most comprehensive collection of natural history books in the country. The cafeteria is outsourced, but the museum shop is managed entirely by Naturalis. These businesses are regarded as services, not profit centres, and do not make much money for the Museum.

Collections

Collections come under a Director of Collections, who with 35 professional staff, are responsible for 12 – 15 million specimens. The collections are housed in a 20-storey 'Tower' building measuring 20 m x 20 m that has no windows. The tower building has double walls, to keep the internal climate stable at 17°C and 50% RH. The internal air is kept fresh by ventilators. Insects can only enter by creeping in under the tight-fitting doors; to keep them out, the floors are treated with residual poison three times a year. Specimens taken out of the collection have to be placed in deep freeze for one week before being returned to the collection rooms. The collection is outstanding for birds, of which there are 10,000 species worldwide, 8,000 species of which are represented in this collection.

Wet collections are in special rooms with extra safety features, e.g. with





A mammoth

Display of comparative anatomy

Mineral Gallery



Bird collection in the Tower Block

light switches located outside the rooms so that there is no danger of electric sparking inside the rooms, and the floors are designed so that any spilled alcohol will drain out quickly through openings in the floor (this is also the case at the MSC and Darwin Centre One)

Contrary to the practice in many other new and refurbished museums, the storage cabinets are nearly all fixed units with shelves open on all sides rather than movable closed compactor-cabinets. This was the deliberate decision of the former (late) General Director who preferred specimens to be kept visible, free from vibration (from movement of cabinets), and open to air circulation. It was explained that closed cabinets create pockets of still air and high humidity. An open system provides better air circulation around the specimens and allows the collections managers to keep all specimens in full view. The absence of movement and vibration is better for the preservation of delicate specimens. Specimens are in complete darkness unless people are working in the rooms. People are advised not to stay longer than two hours at a stretch in these rooms, because the absence of natural light is thought to have negative health effects. The internal atmosphere is impressively dust-free and free of odours, and the colours of the specimens are impressively preserved.

Formerly the collections were managed as 20 – 25 separate collections, each managed by a scientist with one or two assistants. As a result, the policy for each collection was different depending on the scientist in charge. Now all the collections are unified under one policy and managed by one Director. The scientists are now either collections managers or researchers but not both simultaneously.

Some collections managers specialize in the care and management of

specimens, others in recording of specimens as digital images and in the compilation of databases using the software program RECORDER, which is suitable for plants, animals and minerals. RECORDER is an open-source program. Naturalis is very happy with this database program.

Collections staff and visiting scientists have their work spaces located within the Tower.

Research

Research comes under a Scientific Director and is organized into three departments: Zoology, Entomology and Geology. There are 20 full-time researchers of whom four hold concurrent university positions as professors, which allow them to supervise PhD candidates. There are also a number of retired scientists, who continue to work voluntarily, as well as visiting scientists and other volunteers.



Primate collection
in the Tower Block

Common-user facilities for research include a microscopy lab, SEM lab, molecular lab, and library. The research activities include taxonomy, molecular phylogenetics, and DNA barcoding. Researchers determine their own research programmes, but with emphasis on the natural history of the Netherlands and Southeast Asia. The Division organizes one large expedition a year, mostly in Southeast Asia. In 2007 the expedition was to a forest in Vietnam. In 2009, the expedition will be to a marine park in Sabah. The annual expeditions are the main sources of new materials for the collections. The research emphasis is moving from inventory of biodiversity to studying processes of change: including the effect of climate change on biodiversity and the effect of invasive species.

Naturalis publishes three journals and its own series of books, e.g. Fauna Malesiana. Researchers are evaluated by production of research papers,

citation criteria and journal impact factor. Researchers are also challenged to compete for research funds from the National Science Foundation and the European Union.

Discussion with the Acting Director, Dr Dirk Houtgraaf

The Acting Director, Dr Houtgraaf has produced a book, *Mastering a Museum Plan*, which provides information on the establishment of Naturalis and the development of museum exhibitions. The museum began basically as a place for research. Its current public programme is only 10 years old, but the new emphasis on exhibitions and other public-oriented activities has changed the work culture.

Naturalis is not responsible for managing plant specimens at present. Plant specimens are mainly in the Herbarium of Leiden University and other universities. Universities also have their own zoological museums. However, Dr Houtgraaf says there is a plan to merge all university museums with Naturalis to form a large entity to be called the National Centre for Biodiversity, which will hold a total of 57 million specimens.

The income of Naturalis consists of 85% from government allocation and 15% from entrance tickets, with a small profit from the shop and cafeteria businesses and the organization of conferences. Conferences make some money, but their main value is in scientific networking. To Dr Houtgraaf's regret, Naturalis does not have enough rooms for conferences and meetings of various sizes.



Birds of Southeast Asia

Field Museum

2006 Annual Report of the Field Museum.

The Field Museum Exhibition Process. Version Jan 12, 2007.

Collective Knowledge: The Value of Natural Science Collections.

National Museum of Natural History of the Smithsonian Institution

GoSmithsonian June 25, 2007.

Understanding Our World 2004 – 2009: Strategic Plan for the National Museum of Natural History.

Creating Exhibits: Policies and Practices of the Department of Public Programs. June 1998, modified 2/04.

NHM London

Annual Review 05/06: A global agenda.

Natural History Museum Souvenir Guide.

Naturalis

Naturalis Museum Guide 2003.

Mastering a Museum Plan. Strategies for exhibit development. Dirk Houtgraaf & Vanda Vitali. 2008. Naturalis, Leiden.

Appendix 3

STUDY OF THE BOTANIC GARDENS AND THE RAFFLES MUSEUM OF BIODIVERSITY RESEARCH, SINGAPORE

INTRODUCTION AND OVERVIEW

Singapore has two natural history museums—the Botanic Gardens and the Raffles Museum of Biodiversity Research. These two museums began as the regional museums for natural history of the British-administered territories in Southeast Asia before independence. With independence, Singapore inherited the two regional museums, while Malaysia was left without any natural history museum of comparable stature.

The Government of newly-independent Singapore initially had no interest in natural history, so both museums went through a steep period of decline. The Raffles Museum, originally a museum combining natural

history with anthropology, became the National Museum of Singapore, but the new National Museum of Singapore had no place for natural history. The natural history collections were packed up in crates. The iconic whale skeleton that used to hang from the ceiling of the Raffles Museum was sent to Muzium Negara, Kuala Lumpur. The other crates were moved from place to place by concerned scientists in Singapore who took it upon themselves to save as much as they could of Singapore's scientific heritage for the day when, perhaps, the Museum would be restored. The collections suffered from 14 years of neglect. Some specimens were lost.

The Botanic Gardens survived because it served as a public park, and had a new role to play in the development of Singapore as a garden city. However, its scientific role was greatly diminished compared with its earlier role as the leading centre of tropical botany in the world. During the colonial period, Directors and Assistant Directors of the Botanic Gardens Singapore had included H.N. Ridley, pioneer of the rubber industry; I.H. Burkill, whose monumental two-volume *Economic Products of the Malay Peninsula* remains the primary reference source on the natural resources of Malaysia and Southeast Asia; E.J.H. Corner, who pioneered research on tropical trees and fungi; R.E. Holttum, who pioneered research on orchids, ferns and ornamental plants; and J.W. Purseglove, whose four volumes on tropical crops remain key references for tropical agriculture today.

At one stage, institutions in other parts of the world began to consider buying up the museum collections from Singapore.

The Raffles Museum came back to life after it was incorporated into the Faculty of Science of the National University of Singapore as the Raffles Museum of Biodiversity Research. Plans are now being made to relocate the Museum to a new museum complex to be specially designed and built.

The Botanic Gardens is once again becoming a major tropical research centre with the appointment of international scientists, and the establishment of a new herbarium building and new research facilities.

Main Building



THE BOTANIC GARDENS SINGAPORE

Children's Fantastic Forest

Public reading room and reference centre

-Date of visit: 26 February 2008



The Botanic Gardens Singapore was founded in 1859. In 1990 it became part of a much larger organization, the National Parks Board (NParks). The National Parks Board manages 55 parks and nature reserves in Singapore, totalling almost 2,500 ha. The Botanic Gardens occupies 52 ha, within easy walking distance from Orchard Road, the commercial centre of Singapore. It is open daily from 5 am to midnight and does not charge an entrance fee. However, within the garden is the National Orchid Garden, which charges an entrance fee of SING\$5 per adult, with concessions for students and senior citizens. The Botanic Gardens services a Public Reference Centre that is open daily (10 am - 4 pm on Mondays to Fridays; 9 am - 1 pm on Saturdays and Sundays). It also organizes public lectures and other public activities throughout the year. Other major attractions are a specially designed Ginger Garden, an air-conditioned Cool House for tropical montane plants, and a Children's Garden. The Botanic Gardens attracts 3.2 million visitors a year (counted by infrared sensors) and is one of the major tourist attractions of Singapore,



as well as a major recreational centre for residents. The National Orchid Garden attracts 500,000 visitors a year.

Governance and Management

The National Parks Board is a statutory board of the Ministry of National Development. It is overseen by a Board of 10 members currently headed by Mrs Christina Loh, who comes from the corporate world. She succeeds Prof. Leo Tan, an academic scientist. The CEO of the NParks is a member of the Board. The other members are drawn from the corporate world and from the Government. The Board endorses broad directions, policies and strategies, oversees operating and financial performance, provides guidance on development, and approves tenders.

The Botanic Gardens is headed by a Director, assisted by a Deputy Director,



Tree House



Giant Mushrooms

and six Assistant Directors assigned to the following six areas of responsibility: Research, Living Collections, Visitors, Singapore Garden Festival (held at two-yearly intervals), Physical Facilities, and Education.

Collections and Research

The Herbarium was founded in 1875. Administratively, the Herbarium comes under the Gardens' Assistant Director for Research. The head of the Herbarium is titled 'Keeper of the Herbarium'. The Herbarium houses 650,000 specimens, including over 7,000 type specimens. The average rate of growth is 200 – 300 specimens per month. The collections are kept under

24-hour air conditioning (with alternate air conditioners operating) and 55% RH (maintained by three dehumidifiers), and the specimens are protected from insect pests (especially beetles) by treatment with mercuric chloride. The Herbarium is fumigated annually with methyl bromide and there is a continuous programme of monitoring and trapping of herbarium beetles. The collections are managed by a Collections Manager.

The Herbarium building is part of a new building complex completed in 2007. The Herbarium section has a floor area of about 1,000 sq m. The number of visiting scientists using the Herbarium in 2007 was 37. Local visitors using the Herbarium for reference work accounted for 164 visits.

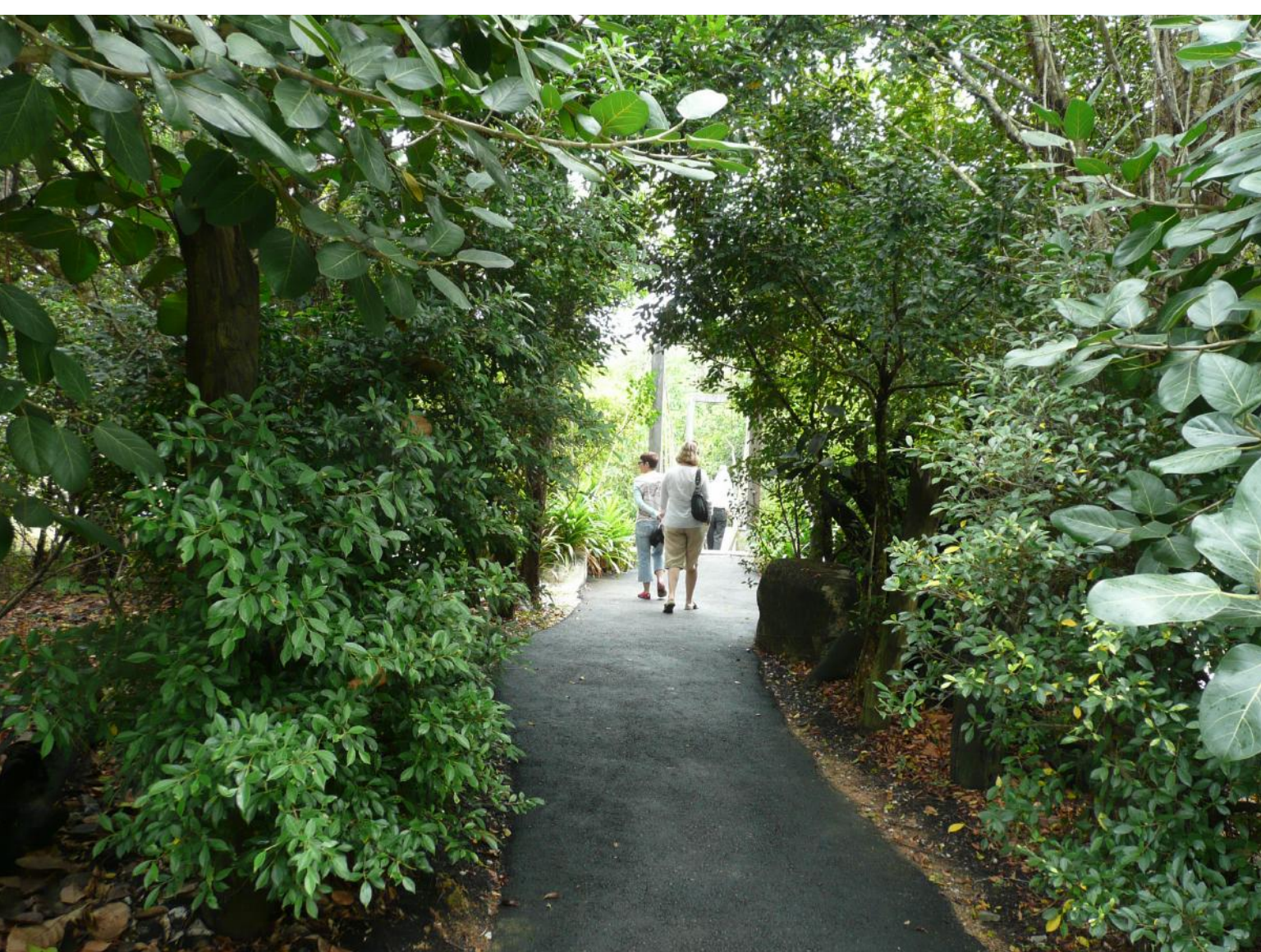
There are seven scientists employed in botanical research, covering bryophytes, Convolvulaceae, Orchidaceae, Begoniaceae, Memycylaceae, Zingiberaceae, orchid breeding and tissue culture. Five of the scientists are taxonomists who built their reputations elsewhere before they were recruited by the Botanic Gardens Singapore; their current research covers Southeast Asia.

Library and Publication

The Library has 26,500 volumes of books and 300 periodicals. The Gardens publishes the Gardens' Bulletin Singapore. First published in 1912, the Gardens' Bulletin is probably the oldest extant scientific journal in the region.

Exhibitions, Outreach and Education

The exhibitions of the Botanic Gardens are in the form of living plant collections, which are arranged in various ways, e.g. by taxonomy, ecology or usage. There are orchid, ginger, palm and bromeliad gardens, which are examples of grouping by taxonomy. The cool house and aquatic Mysterious Forest





Secret Cave

gardens group plants that require similar ecological conditions. Spice and fruit gardens represent grouping by usage.

Of particular interest is the Jacob Ballas Childrens' Garden, designed to introduce children to nature in a safe and controlled play environment. This garden was built with a SING\$7 m donation from Singapore philanthropist Jacob Ballas. It has turned out to be a very popular garden for families with young children.

There are several other gardens in the Botanic Gardens which are identified by the names of their sponsors.

Costs and benefits

The annual budget for salaries and maintenance of the Botanic Gardens is about SING\$8 million. The funds are provided by the Government, but the Botanic Gardens is permitted to retain part of its earned income. The earned income is now approaching SING\$4 million per annum. The main sources of income are

- leases for the Food Court, restaurant and café
- entrance fees to the National Orchid Garden
- rental and commission from souvenir and book shops
- commission from the car park operator

The National Orchid Centre attracts 500,000 visitors a years with tickets at SING\$5 per adult entry. A visit to the Botanic Gardens requires a half-day stay in Singapore, which contributes to the economy in terms of money spent on accommodation, travel, food and other expenditures.

In addition, the Gardens provides society with a beautiful recreational resource and a competent educational and reference facility.

THE RAFFLES MUSEUM OF BIODIVERSITY

RESEARCH

Date of visit: 27 February 2008

Foundation, Location and Public Significance

The Raffles Museum is named for Sir Stamford Raffles, founder of modern Singapore, who had first mooted the idea. The original museum was founded in 1849 and located in what was at that time a large building in Stamford Road. It had galleries for anthropology and natural history, but it was the whale hanging from the ceiling that all visitors remember. In 1969 the Raffles Museum became the National Museum of Singapore and its natural history division was abolished. The collection of 126,000 zoological specimens, the most comprehensive in Southeast Asia at that time, was put into crates and moved to the newly established Singapore Science Centre. The Science Centre had no room for it, so after one year, the collection was moved to the then University of Singapore. Over the next 14 years, the crates were moved from place to place, at one time to the library of Nanyang University at Jurong. Each move took several months and required at least 40 lorries. The specimens suffered from neglect during this period. In 1989, the collection, known as

Model of the dodo,
icon of extinction



the 'Zoological Reference Collection' was finally given a proper home, in a three-storey building in the new campus of the National University of Singapore at Kent Ridge. In 1998, the University decided to establish a research centre for biodiversity, with a mandate for research, publication and public education. The 'Zoological Reference Collection' was united with the herbarium of the former Department of Botany of the University to constitute the Raffles Museum of Biodiversity Research.

Governance and Management

The Museum is now part of the Faculty of Science of the National University of Singapore and gets its funding from the University. Its scientists are appointed as university teaching staff. The museum is managed by a Director, Dr Peter Ng, and an Assistant Director. Among the staff are two Research Officers, one Education Officer, one Outreach officer and three Curators (for fish and reptiles, corals and insects, and crustaceans) and one Administrator.

Gallery of
Singapore wildlife



Collection and Research

The collections occupy three floors. The rooms are maintained at a temperature of 20°C and 60-70% RH round the clock.

The old Raffles Museum carried out many expeditions, notably to Christmas Island, Pulau Tioman and Taman Negara. After its re-establishment, new expeditions have been organized, at the rate of one or two per annum to various parts of Southeast Asia, and as far away as Yunnan in

China. The collections now total 500,000 specimens, growing at the rate of 10,000 specimens per annum. With collections spanning 150 years and including 6,000 types specimens, the Raffles Museum has again become attractive to visiting scientists. In 2007, about 100 scientists came to refer to its collections. The Museum also sponsors selected scientists by paying air fares and a daily stipend for 3 – 4 weeks per scientist. In 2007 it sponsored 14 scientists at a cost of SING\$30,000. In 2007, the Museum also sent out loans of specimens for study to 388

scientists overseas. All this activity results in scientific papers, published mostly in the Museum's own journal, which raises the University's profile as a centre of excellence for Southeast Asian biodiversity.

One of the interesting design features of the Museum is a laboratory for visiting scientists, with an internal door to the Collections and an external door to the outside. The internal door is locked at closing time, but visiting scientists are provided with a key to the external door. They can have specimens moved to the visitors' laboratory, to be worked on after closing time and during weekends. Since visitors have only a short stay of 3 – 4 weeks, most of them would want to maximise their time by working longer hours than resident scientists. Visiting scientists have been extremely good value for money!



Director Dr Peter Ng
with theme for 2008

Library and Publication

The natural history library of the old Raffles Museum is housed in the new Museum. The Bulletin of the Raffles Museum, first published in 1934, was revived in 1987 as the Raffles Bulletin of Zoology. It is a peer-reviewed, citation-indexed journal now considered the premier journal for Southeast Asian biodiversity research.

Exhibition, Outreach and Education

The museum maintains a gallery for exhibitions, small by international standards but with permanent as well as seasonal displays. The current seasonal display is on rats, to mark the Year of the Rat. Entrance is free.

Specimen
preparation room





Laboratory for
visiting scientists

Every museum needs an iconic exhibit. For its icon, the Museum commissioned a special model of a dodo (the most famous extinct bird) for USD20,000 two years ago. This spectacular bird now stands in a glass case and is the first specimen one sees as one enters the Exhibition Gallery.

The Museum joined with the Singapore Science Centre to hire a travelling exhibition, *A T. rex named Sue* from the Field Museum of Chicago. This exhibition ran for three months and not only paid for itself but also made a good profit for its co-sponsors.

Future development

There is no room for expansion of the Museum in its present location and the present facilities also do not conform to modern fire-safety regulations. Also, its location within a university campus conveys the wrong message—that it is a university facility rather than a general public facility. A new modern museum is being planned, to be located in a more central part of Singapore.

Appendix 4

ROSTER OF NATURAL HISTORY SCIENTISTS IN MALAYSIA 2008

('T' symbolises taxonomy; 'E' ecology; 'B' both taxonomy and ecology)

No	Title	Name	Postal & E-mail Address	Peninsular Malaysia	Sabah	Sarawak	Southeast Asia	World	Vascular Plants	Bryophytes	Fungi	Lichens	Algae	Mammals	Reptiles	Amphibians	Birds	Insects	Crustaceans	Spiders	Freshwater fishes	Marine fishes	Molluscs	Others	
1	Mr.	Affendi, Y.A.	Institute of Biological Sciences, Faculty of Science, Universiti Malaya, 50603 Kuala Lumpur. affendi@um.edu.my	•										E										Scleractinian hard corals, coral reef	
2	Dr.	Andrew, A.T.	Institute of Biodiversity and Environmental Conservation, Universiti Malaysia Sarawak, Kota Samarahan, 94300 Sarawak. aatuen@ibec.unimas.my			•								B		B									
3	Dr.	Ani, S.	Forest Research Institute Malaysia, 52109 Kepong, Selangor. anis@frim.gov.my	•					B																
4	Ms	Asmah, A.	Quarantine Section, Department of Agriculture, Jalan Gallagher, 50480 Kuala Lumpur. asmah8419@yahoo.com	•							E							E							
5	Ms	Avelinah, J.	Forest Research Institute Malaysia, 52109 Kepong, Selangor. avelinah@frim.gov.my	•	•				T																
6	Mr.	Aziz, I.	Entomology Unit, Infectious Diseases Research Centre (IDRC), Institute for Medical Research, Jalan Pahang, 50588 Kuala Lumpur. aziz@imr.gov.my	•														B							
7	Ms	Azlina, Z.	Forest Research Institute Malaysia, 52109 Kepong, Selangor. azlinaz@frim.gov.my	•														B							

No	Title	Name	Postal & E-mail Address	Peninsular Malaysia	Sabah	Sarawak	Southeast Asia	World	Vascular Plants	Bryophytes	Fungi	Lichens	Algae	Mammals	Reptiles	Amphibians	Birds	Insects	Crustaceans	Spiders	Freshwater fishes	Marine fishes	Molluscs	Others
8	Haji	Azmi, C.A.	Lembaga Koko Malaysia, PO Box 36307, Sungai Sumun, Perak. haca@koko.gov.my	•	•	•					B													
9	Dr.	Badrul, M.M.Z.	School of Environmental and Natural Resource Sciences, Faculty of Science & Technology, 43600 Bangi, Selangor. abgbadd@ukm.my	•	•	•								T										
10	Dr.	Bakhtiar, E.Y.	Institute for Tropical Biology & Conservation (BTCP), Universiti Malaysia Sabah, 88999 Kota Kinabalu, Sabah. bakhtiareffendi@yahoo.co.uk	•	•	•												T						
11	Dato'	Barlow, H.S.	Southdene Sdn. Bhd., PO Box 10139, 50704 Kuala Lumpur. hsbar@pc.jaring.my	•	•													E						
12	Dr.	Chang, Y.S.	Forest Research Institute Malaysia, 52109 Kepong, Selangor. changys@frim.gov.my	•				•			T													
13	Ms	Chew, M. Y.	Forest Research Institute Malaysia, 52109 Kepong, Selangor. chew@frim.gov.my	•	•	•			B															
14	Ms	Chew, P.C.	Freshwater Fisheries Research Centre, Department of Fisheries Malaysia, Glami Lemi, Titi, Jelebu, 71650, Negeri Sembilan. chew@pppat.gov.my	•	•	•															B			
15	Dr.	Chey, V.K.	Forest Research Centre, Sabah Forestry Department, PO Box 1407, 90715 Sandakan, Sabah. VunKhen.Chey@sabah.gov.my		•													B						
16	Dr.	Chong, J.L.	Dept of Biological Sciences, Faculty of Science & Technology, Universiti Malaysia Terengganu, 21030 Kuala Terengganu, Terengganu. julian@umt.edu.my	•	•	•	•	•	E					E										Population genetics

No	Title	Name	Postal & E-mail Address	Peninsular Malaysia	Sabah	Sarawak	Southeast Asia	World	Vascular Plants	Bryophytes	Fungi	Lichens	Algae	Mammals	Reptiles	Amphibians	Birds	Insects	Crustaceans	Spiders	Freshwater fishes	Marine fishes	Molluscs	Others	
17	Ms	Chong, L.	Forest Research Centre, Sarawak Forestry Corporation, Km 10, Jalan Datuk Amar Kalong Ningkan, 93250 Kuching, Sarawak. chongl@tm.net.my			•					T														
18	Mr.	Chong, M.H.N.	Asian Raptor Research & Conservation Network, 208, Jalan H-8, Taman Melawati, 53100 Kuala Lumpur. mikechn@pcjaring.my	•	•	•	•	•									B								
19	Prof.	Chong, V.C.	Institute of Biological Sciences, Faculty of Science, Universiti Malaya, 50603 Kuala Lumpur. chong@um.edu.my	•	•														B			E			
20	Dr.	Chung, A.Y.C.	Forest Research Centre, Sabah Forestry Department, PO Box 1407, 90715 Sandakan, Sabah. Arthur.Chung@sabah.gov.my		•													B							
21	Dr.	Chung, R.C.K.	Forest Research Institute Malaysia, 52109 Kepong, Selangor. richard@frim.gov.my	•	•	•			T																
22	Mr.	Daud, A.	Fisheries Research Institute, Sarawak Branch, Department of Fisheries Malaysia, Jalan Perbadanan, Bintawa, PS 2243, 93744 Kuching, Sarawak. daudawang@dof.gov.my		•	•													B			B		Jelly fish	
23	Ms	Endela, T.	Forest Research Centre, Sarawak Forestry Corporation, Km 10, Jalan Datuk Amar Kalong Ningkan, 93250 Kuching, Sarawak. endela@sarawakforestry.com			•			B																
24	Mr.	Faisal, A.A.K.	Faculty of Resource Science and Technology, Universiti Malaysia Sarawak, Kota Samarahan, 94300 Sarawak. faisal69@hotmail.com	•	•	•	•							B										Bats and rodents	

No	Title	Name	Postal & E-mail Address	Peninsular Malaysia	Sabah	Sarawak	Southeast Asia	World	Vascular Plants	Bryophytes	Fungi	Lichens	Algae	Mammals	Reptiles	Amphibians	Birds	Insects	Crustaceans	Spiders	Freshwater fishes	Marine fishes	Molluscs	Others
25	Prof.	Fatimah, A.	Faculty of Resource Science and Technology, Universiti Malaysia Sarawak, Kota Samarahan, 94300 Sarawak. fatim@frst.unimas.my		•	•												B						
26	Dr.	Fauziah, A.	Institute of Biological Sciences, Faculty of Science, Universiti Malaya, 50603 Kuala Lumpur. fauziah@um.edu.my	•	•	•	•											B						
27	Mr.	Gary, K.Z.A.	EDUTREE, 2, Jalan Anggerik Aranda 31/12, Kota Kemuning, 40460 Shah Alam, Selangor. edu3_services@yahoo.co.uk	•												B		B						
28	Mr.	Gonzaga, A.D.	Forest Research Institute Malaysia, 52109 Kepong, Selangor. adgonzaga@hotmail.com	•	•	•	•	•										B						
29	Dr.	Han, K.H.	Faculty of Science and Engineering, Universiti Tunku Abdul Rahman, Jalan Universiti, Bandar Banat, 31900 Kampar, Perak. hankwai@hotmail.com	•	•	•								B	E									Molecular taxonomy
30	Mr.	Het, K.	Forest Research Centre, Sarawak Forestry Corporation, Km 10, Jalan Datuk Amar Kalong Ningkan, 93250 Kuching, Sarawak. hetk@sarawakforestry.com			•												B						
31	Prof.	Idris, A.G.	School of Environmental and Natural Resource Sciences, Faculty of Science & Technology, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor. idrisgh@ukm.my	•	•	•	•	•										B						
32	Dr.	Japar, S.B.	Faculty of Agriculture and Food Sciences, Universiti Putra Malaysia Bintulu Campus, 97008 Bintulu, Sarawak. japar@science.upm.edu.my	•	•	•	•		B				B											

No	Title	Name	Postal & E-mail Address	Peninsular Malaysia	Sabah	Sarawak	Southeast Asia	World	Vascular Plants	Bryophytes	Fungi	Lichens	Algae	Mammals	Reptiles	Amphibians	Birds	Insects	Crustaceans	Spiders	Freshwater fishes	Marine fishes	Molluscs	Others
33	Mr.	John, B.S.	Sandakan Herbarium, Forest Research Centre, Sabah Forestry Department, PO Box 1407, 90715 Sandakan, Sabah. John.Sugau@sabah.gov.my		•	•			T															
34	Ms	Julia, A.S.	Forest Research Centre, Sarawak Forestry Corporation, Km 10, Jalan Datuk Amar Kalong Ningkan, 93250 Kuching, Sarawak. juliasang@sarawakforestry.com	•	•	•			T															
35	Mr.	Kennedy, A.A.	Borneo Marine Research Institute, Locked Bag No 2073, Universiti Malaysia Sabah, 88999 Kota Kinabalu, Sabah. kennedy1@ums.edu.my		•								B											
36	Mr.	Khairul, N.K.	Biodiversity Institute, Department of Wildlife and National Parks, Bukit Rengit, 28500 Lanchang, Pahang. knizam@wildlife.gov.my	•														B						
37	Ms	Khoo, V.S.I.	Forest Research Institute Malaysia, 52109 Kepong, Selangor. veronica@frim.gov.my	•														T						
38	Dr.	Kirton, L.G.	Forest Research Institute Malaysia, 52109 Kepong, Selangor. laurence@frim.gov.my	•	•	•	•											B						
39	Mr.	Lau, K.H.	Forest Research Institute Malaysia, 52109 Kepong, Selangor. laukh@frim.gov.my	•	•	•	•		B															
40	Dr.	Lee, S.S.	Forest Research Institute Malaysia, 52109 Kepong, Selangor. leess@frim.gov.my	•		•				T														
41	Dr.	Leh, M.U.	Sarawak Museum, Jalan Tun Abang Haji Openg, 93566 Kuching, Sarawak. charllmu@sarawaknet.gov.my			•								B	T	T	T	T	T	T	T	T	T	

No	Title	Name	Postal & E-mail Address	Peninsular Malaysia	Sabah	Sarawak	Southeast Asia	World	Vascular Plants	Bryophytes	Fungi	Lichens	Algae	Mammals	Reptiles	Amphibians	Birds	Insects	Crustaceans	Spiders	Freshwater fishes	Marine fishes	Molluscs	Others
42	Dr.	Lim, C.K.	Sarawak Forestry Corporation, Level 11, Office Tower, Hock Lee Centre, Jalan Datuk Abang Abdul Rahim, 93450 Kuching, Sarawak. lck@sarawakforestry.com			•												F						
43	Mr.	Lim, C.L.	Forest Research Institute Malaysia, 52109 Kepong, Selangor. limchunglu@frim.gov.my	•				T																
44	Dr.	Lim, G.T.	Forest Research Institute Malaysia, 52109 Kepong, Selangor. grace@frim.gov.my	•														B						
45	Dr.	Lim, P.E.	Algae Research Laboratory, Universiti Malaya, 50603 phaikem@yahoo.com	•	•	•	•	•					T											
46	Mr.	Lim, T.T.	Resource Stewardship Consultants Sdn. Bhd., 94, Jalan Maarof, 59000 Kuala Lumpur. limtztshen@rescu.com.my	•	•	•								T				T						
47	Prof.	Mahani, M.C.	Faculty of Science & Technology, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor. mahani@ukm.my	•	•	•			B															
48	Mr.	Maklarin, L.	Sabah Parks, PO Box 10626, 88806 Kota Kinabalu, Sabah. maklarin@yahoo.com		•									E	E	E	E							
49	Mr.	Marfaisal, M.	Forest Research Centre, Sarawak Forestry Corporation, Km 10, Jalan Datuk Amar Kalong Ningkan, 93250 Kuching, Sarawak. marfaisal@sarawakforestry.com			•																		
50	Dr.	Mariana, H.A.	Acarology Unit, Infectious Diseases Research Centre (IDRC), Institute for Medical Research, Jalan Pahang, 50588 Kuala Lumpur. mariana@imr.gov.my	•																				Acarine (ticks & mites)

No	Title	Name	Postal & E-mail Address	Peninsular Malaysia	Sabah	Sarawak	Southeast Asia	World	Vascular Plants	Bryophytes	Fungi	Lichens	Algae	Mammals	Reptiles	Amphibians	Birds	Insects	Crustaceans	Spiders	Freshwater fishes	Marine fishes	Molluscs	Others	
51	Ms	Meriam, M.Y.	Pusat Penyelidikan dan Pembangunan Koko, Lembaga Koko Malaysia, Batu 10, Jalan Apas, Peti Surat 60237, 91012 Tawau, Sabah. meriam@koko.gov.my	•	•	•												B						Weeds	
52	Prof.	Mohamed, A.M.	Biology Department, Universiti Brunei Darussalam, Gadong BE1410, Brunei. binabdulmajid@gmail.com	•	•	•	•			B															
53	Mr.	Mohammad, S.A.	Forest Research Institute Malaysia, 52109 Kepong, Selangor. shahfiz@frim.gov.my	•	•	•	•	•						E											
54	Tunku	Mohammad, N.Y.	82, Jalan Ampang Hilir, 55000 Kuala Lumpur. tnazim@tm.net.my	•	•	•	•	•						B	B	B	B				B	B			
55	Dr.	Mohd, T.A.	Faculty of Resource Science and Technology, Universiti Malaysia Sarawak, Kota Samarahan, 94300 Sarawak. tabdullahmt@gmail.com	•	•	•								B											
56	Dr.	Mustafa, A.R.	Faculty of Resource Science and Technology, Universiti Malaysia Sarawak, Kota Samarahan, 94300 Sarawak. rmustafa@frst.unimas.my	•	•	•	•										B								
57	Dr.	Muta, H.Z.	Faculty of Agriculture and Food Sciences, Universiti Putra Malaysia Bintulu Campus, 97008 Bintulu, Sarawak. drmuta@btu.upm.edu.my	•	•	•	•		B				B												Sea-grasses, aquatic plants, macroalgae
58	Ms	Nada, B.	Forest Research Institute Malaysia, 52109 Kepong, Selangor. nada@frim.gov.my	•														E							
59	Ms	Nadiah, I.	Forest Research Institute Malaysia, 52109 Kepong, Selangor. nadiahidris@frim.gov.my		•	•			T																
60	Dr	Ng, F.S.P.	A-9-5 Menara Menjalara, Bandar Menjalara, 52200 Kuala Lumpur. fng@pc.jaring.my	•	•	•	•	•	B																

No	Title	Name	Postal & E-mail Address	Peninsular Malaysia	Sabah	Sarawak	Southeast Asia	World	Vascular Plants	Bryophytes	Fungi	Lichens	Algae	Mammals	Reptiles	Amphibians	Birds	Insects	Crustaceans	Spiders	Freshwater fishes	Marine fishes	Molluscs	Others
61	Dr.	Ng, Y.F.	Centre for Insect Systematics, School of Environmental and Natural Resource Sciences, Faculty of Science & Technology, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor. ng_yf@ukm.my	•	•	•												B						Parasitic wasps, thrips, dragonflies
62	Ms	Noorainie, A.A.	TRAFFIC Southeast Asia, Unit 9-3A, 3rd Floor, Jalan SS23/11, Taman SEA, 47400 PJ Selangor. naatsea@pojaring.my	•	•	•	•	•	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	Trade monitoring
63	Dr.	Noorma, W.H.	Institute of Biological Sciences, Faculty of Science, Universiti Malaya, 50603 Kuala Lumpur. noorma@um.edu.my	•	•	•			T															
64	Ms	Noraswati, M.N.R.	Forest Research Institute Malaysia, 52109 Kepong, Selangor. noraswati@frim.gov.my	•							B													Polyporaceae
65	Dr.	Norela, S.	School of Environmental and Natural Resource Sciences, Faculty of Science & Technology, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor. vozela@pkriscc.ukm.my	•	•													T						Acari
66	Mr.	Norhanizan, S.	Freshwater Fisheries Research Centre, Department of Fisheries Malaysia, Glami Lemi, Titi, Jekebu, 71650 Negeri Sembilan. norhanizans@yahoo.com					•																Aquatic plants
67	Ms	Norhayati, A.S.	Forest Research Centre, Sarawak Forestry Corporation, Km 10, Jalan Datuk Amar Kalong Ningkan, 93250 Kuching, Sarawak. norhayatias@sarawakforestry.com			•					T													
68	Ms.	Nur, Z.A.M.	Forest Research Institute Malaysia, 52109 Kepong, Selangor. nurzatiakma@frim.gov.my	•														E						

No	Title	Name	Postal & E-mail Address	Peninsular Malaysia	Sabah	Sarawak	Southeast Asia	World	Vascular Plants	Bryophytes	Fungi	Lichens	Algae	Mammals	Reptiles	Amphibians	Birds	Insects	Crustaceans	Spiders	Freshwater fishes	Marine fishes	Molluscs	Others
69	Mr.	Ong, P.T.	Forest Research Institute Malaysia, 52109 Kepong, Selangor. ongpohsteck@frim.gov.my	•					T															
70	Ms	Ong, S.P.	Forest Research Institute Malaysia, 52109 Kepong, Selangor. ongsuping@frim.gov.my	•														T						
71	Ms	Ooi, L.S.	Department of Geography, Faculty of Arts & Social Sciences, Universiti Malaya, 50603 Kuala Lumpur. gongdive@yahoo.com	•	•								E											
72	Mr.	Oswald, B.T.	Protected Areas & Biodiversity Conservation Unit (PABC), Sarawak Forestry Corporation, Level 11, Office Tower, Hock Lee Centre, Jalan Datuk Abang Abdul Rahim, 93450 Kuching, Sarawak. oswaltdisen@sarawakforestry.com			•								E	E									
73	Ms	Patahayah, M.	Forest Research Institute Malaysia, 52109 Kepong, Selangor. patahayah@frim.gov.my	•							B													
74	Ms	Pereira, J.T.	Sandakan Herbarium, Forest Research Centre, Sabah Forestry Department, PO Box 1407, 90715 Sandakan, Sabah. Joan.Pereira@sabah.gov.my		•	•			T															
75	Ms	Petherine, J.	Institute for Tropical Biology & Conservation (IBTP), Universiti Malaysia Sabah, 88999 Kota Kinabalu, Sabah. ethrine@ums.edu.my		•													E						
76	Prof.	Phang,	Institute of Biological Sciences, Faculty of Science, Universiti Malaya, 50603 Kuala Lumpur. phang@um.edu.my	•	•	•	•						B											Sea-grasses
77	Ms	Phon, C.K.	Forest Research Institute Malaysia, 52109 Kepong, Selangor. phonchoikhim@frim.gov.my	•														E						

No	Title	Name	Postal & E-mail Address	Peninsular Malaysia	Sabah	Sarawak	Southeast Asia	World	Vascular Plants	Bryophytes	Fungi	Lichens	Algae	Mammals	Reptiles	Amphibians	Birds	Insects	Crustaceans	Spiders	Freshwater fishes	Marine fishes	Molluscs	Others
78	Ms	Phoon,	Forest Research Institute Malaysia, 52109 Kepong, Selangor. phoon@frim.gov.my	•					T															
79	Ms	Rafidah, A.R.	Forest Research Institute Malaysia, 52109 Kepong, Selangor. rafidahar@frim.gov.my	•					T															
80	Mr.	Rahmat, M.S.	Institute for Medical Research, Jalan Pahang, 50588 Kuala Lumpur. rahmat@imr.gov.my	•	•	•								E										
81	Dr.	Rhett, H.	Forest Research Institute Malaysia, 52109 Kepong, Selangor. rhett@bio.miami.edu	•	•	•	•		E					E			E	E						
82	Ms	Roziah, A.	Division of Genetics & Molecular Biology, Institute of Biological Sciences, Faculty of Science, Universiti Malaya, 50603 Kuala Lumpur. salmiah@frim.gov.my	•																				
83	Dr.	Ruhana, H.	Faculty of Resource Science and Technology, Universiti Malaysia Sarawak, Kota Samarahan, 94300 Sarawak. hruhana@frst.unimas.my			•							B										B	
84	Dr.	Salmiah, U.	Forest Research Institute Malaysia, 52109 Kepong, Selangor. salmiah@frim.gov.my	•							B													Wood deterioration
85	Ms	Sam, Y.Y.	Forest Research Institute Malaysia, 52109 Kepong, Selangor. samyen@frim.gov.my	•		•			T															
86	Dr.	Saw, L.G.	Forest Research Institute Malaysia, 52109 Kepong, Selangor. sawlg@frim.gov.my	•	•	•	•		B															
87	Dr.	Sepiah, M.	Faculty of Resource Science and Technology, Universiti Malaysia Sarawak, Kota Samarahan, 94300 Sarawak. msepiah@frst.unimas.my	•	•	•					B													

No	Title	Name	Postal & E-mail Address	Peninsular Malaysia	Sabah	Sarawak	Southeast Asia	World	Vascular Plants	Bryophytes	Fungi	Lichens	Algae	Mammals	Reptiles	Amphibians	Birds	Insects	Crustaceans	Spiders	Freshwater fishes	Marine fishes	Molluscs	Others
88	Ms	Shahlinney, L.	Forest Research Institute Malaysia, 52109 Kepong, Selangor. shahlinney@frim.gov.my	•														B						
89	Mr.	Shawn, C.	Forest Research Institute Malaysia, 52109 Kepong, Selangor. shawn@frim.gov.my	•	•	•	•	•										B						
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No	Title	Name	Postal & E-mail Address	Peninsular Malaysia	Sabah	Sarawak	Southeast Asia	World	Vascular Plants	Bryophytes	Fungi	Lichens	Algae	Mammals	Reptiles	Amphibians	Birds	Insects	Crustaceans	Spiders	Freshwater fishes	Marine fishes	Molluscs	Others	
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99	Ms	Syahida Emiza, S.	Forest Research Institute Malaysia, 52109 Kepong, Selangor. syahida@frim.gov.my	•	•	•		B																	
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No	Title	Name	Postal & E-mail Address	Peninsular Malaysia	Sabah	Sarawak	Southeast Asia	World	Vascular Plants	Bryophytes	Fungi	Lichens	Algae	Mammals	Reptiles	Amphibians	Birds	Insects	Crustaceans	Spiders	Freshwater fishes	Marine fishes	Molluscs	Others
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106	Ms	Wan Norjuliana, W.M.	Institute for Medical Research, Jalan Pahang, 50588 Kuala Lumpur. wnjuliana23@yahoo.com.my	•														B						
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109	Mr.	Yusri, Y.	Institute of Oceanography, Universiti Malaysia Terengganu, 21030 Kuala Terengganu, Terengganu. yusriyusuf@umt.edu.my	•	•	•															B	B		Corals, echinoderms, sponges
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Ministry of Science, Technology and Environment Malaysia: Director of Science & Technology.

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Natural History Museum, London: Interpretation Manager in development of exhibitions and public engagement programmes; Senior Developer for the Natural History Museum's Planning and Design Consultancy.

Photos: Left to right from top row.

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