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Monophyllea hosfieldii,
an endemic species
bearing one leaf per
plant



Appendix 1

REVIEW OF NATURAL HISTORY COLLECTIONS IN MALAYSIA



Bukit Takun, a limestone hill in Selangor

Introduction and overview

There is no institution in Malaysia dedicated fully to natural history, but there are 22 institutions that maintain natural history collections (Table 1). Collectively, these 22 institutions hold about three million specimens. Each institution is defined by region as Peninsular Malaysia, Sabah or Sarawak, and by sector such as health, forestry, fisheries, agriculture, wildlife and culture. No institution has overview of the biological diversity of Malaysia as a whole.

Natural history collections in Malaysia were established primarily to provide identification services. When a specimen has been identified by an expert who has been able to match it against a type or other authenti-

cated specimen, such a specimen itself serves as an authenticated specimen for the identification of other specimens. It takes a lot of time and effort to get a collection identified. An identified collection is an invaluable reference tool, not only for the identification of new specimens, but also as a record of what existed where and when. For example, a collection of fishes from the waters of Sabah made 50 years ago would contain information about the fishes and waters of Sabah 50 years ago that would not be available from any other source. Even if a book has been written on the fishes of Sabah, the book cannot substitute wholly for the specimens, because specimens are real whereas a book is an interpretation.

In our review, we found the state of collections management in Malaysian institutions to range from fairly good in some places to deplorable in others. The upgrading of standards in collections management requires urgent national attention, otherwise some priceless reference collections will be lost forever. The international standard is for museum collections to be kept at constant low temperature and humidity, totally protected from sunlight, and free of fungal and insect pests, at all times.

The role of exhibition and public education is being undertaken with energy and enthusiasm at various institutions. The Forest Interpretation Centre of the Forest Research Centre in Sabah and the Rainforest and Environment Exhibition Gallery at the University of Malaya are outstanding examples. Both facilities are relatively new and spacious. Older exhibition galleries such as those at the Institute for Medical Research and the Zoological Museum at the University of Malaya suffer from lack of space. The major museums in the world have placed exhibitions in the hands of full-time specialists, but exhibitions in Malaysia are still amateur efforts.



INSTITUTE FOR MEDICAL RESEARCH, KUALA LUMPUR

Date of visit: 17 October 2007

The Institute for Medical Research (IMR), funded by the Federal Government, was established as the Kuala Lumpur Pathological Institute in 1900 by order of Sir Frank Swettenham, then head of the British Administration, to carry out research on tropical diseases—causes, prevention and cure. The natural history collections in the IMR consist of animals that have actual or potential impact on human health as pests, disease carriers, or hosts of potential diseases.

The IMR established a Biomedical Museum in 1954. This has two small galleries for displaying small vertebrates: mammals, birds, snakes and frogs. Entrance is free.

The insect collection, consisting of mosquitoes, flies, cockroaches, fleas, bedbugs and other insect pests and vectors, is kept in the Entomology Unit. This



Mosquito specimens



IMR Heritage building

collection dates back to the beginning of the IMR in 1900. The collection was important enough that during the World War II, it was packed up and sent, first to Singapore, and then to Australia, ahead of the Japanese Invasion. After the War, the collection was returned to the IMR.

The natural history collections are housed in old buildings which have

been gazetted as heritage buildings. The rooms are small and already crammed from floor to ceiling. There is no space for expansion. Because of their heritage status, the buildings cannot be renovated to meet the requirements of a modern museum. There is also little or no funding for collection of new specimens.

The natural history collections are used mainly for identification and teaching. The identification function provides critical identifications of pests and vectors. The teaching function is associated with the SEAMEO-TROPED programmes in applied parasitology, entomology and acarology. These six-month courses are held annually and students come from all over the tropics, especially from tropical Asia.

New species are confirmed at the National Museum of Natural History of the Smithsonian Institution in the US, by taxonomists who have established a relationship with IMR. An older working relationship with NHM London has lapsed.



Top: Storage room for insects
Below: Exhibit of birds



Natural History Gallery

SABAH MUSEUM, KOTA KINABALU

Date of visit: 29 October 2007

The Sabah Museum is funded by the State Government of Sabah. The museum concentrates on the cultures of Sabah, and on the interaction of culture with the natural environment. The grounds, in Kota Kinabalu, cover 43 acres. Within the grounds are the main Museum building, a separate building housing the preparation rooms, another building for the Museum of Islamic Civilization, an ethnobotanic garden, and a heritage village (Kampung Warisan).



Preparations room

In the main building, the entrance foyer displays the skeleton of a Bryde's whale recently beached in Sabah. Upstairs are cultural galleries displaying handicrafts, ceramics, musical instruments, woven materials, tools and other cultural artefacts, complemented by natural history galleries displaying mammals, birds and insects. There is a display of plants that have played or continue to play significant roles in the lives of the people.

The annual operational budget of about 11m, increasing at the rate of



about 10% per annum, is provided mainly by the state government. The museum employs a taxidermist. Identification work is done by parataxonomists. The museum earns about RM0.75 m per annum from entrance tickets. There is a shop for books and souvenirs, operated privately by a concessionaire. The museum promotes local handicrafts by holding a Craft Exotica exhibition annually at the Kampung Warisan.

Bryde's whale in the great hall



The Wet Collection

THE NATURAL HISTORY MUSEUM OF UNIVERSITI MALAYSIA SABAH (UMS), KOTA KINABALU

Date of visit: 29 October 2007

The natural history collections of the Universiti Malaysia Sabah are used to support research and teaching. There are four large collections rooms: for insects, vertebrates, herbarium, and wet collections. The rooms are modern and spacious, with state-of-the-art compactor shelves, 24-hour air conditioning, dehumidifiers, dust filters, automatic fire extinguisher system, automatic sliding doors, etc. Much of the equipment was donated by Japan through the Japan International Cooperation Agency (JICA). The specimens are databased using a data management software system MUSEBASE developed in Japan by Fujitsu, based on MUSETHEQUE, a system used by many museums in Japan.

Students using the
Herbarium



FISHERIES RESEARCH INSTITUTE, KG LIKAS, KOTA KINABALU

Date of visit: 30 October 2007

The Fisheries Research
Institute

Below: The fish collection

This Institute is funded by the State Government of Sabah. It houses a large collection of fish, in hundreds of museum glass jars. The collection, representing the physical evidence of the condition of fisheries in Sabah going back 50 years or more, together with the records left by the collectors, are irreplaceable scientific data for interpreting the fisheries environment in Sabah. We found the collection in an open-sided shed at the back of the Institute, without air conditioning and exposed to strong side light. All the specimens have been irreparably bleached by sunlight.



The fish collections





In the Herbarium

FOREST RESEARCH CENTRE, SEPILOK, SANDAKAN

Date of visit: 30 October 2007

The Forest Research Centre is part of the Forestry Department of Sabah, funded by the state government. It holds three natural history collections: herbarium (plant collection), xylarium (wood collection) and insect collection. In 2007 it opened an attractive exhibition centre, known as the Forest Interpretation Centre, within a landscaped garden of rare and interesting plants.

The Wood Collection

The herbarium has had a history of disasters. It was originally located within Sandakan town. This was destroyed in 1945, by wartime bombing. The second time, in 1961, it was destroyed by a fire spreading from a nearby factory. The first 10,000 collecting numbers were lost in these disasters, but their duplicates survive in other parts of the world. The herbarium







has now grown to over 250,000 specimens and is housed in a new modern building equipped with locally-made compactor shelves. There are over 400 type specimens, which are kept separately in a cabinet for types. The herbarium and its two research officers are active participants in research under the Tree Flora of Sabah and Sarawak project.

Entomology display

Opp page: The Herbarium Building

The wood collection was started in the 1940s and contains over 4,000 specimens of wood representing 1,000 species, 400 genera and 96 families.

The entomological collection, started in the 1940s is managed by two research officers. New species are described with help from the Natural History Museum London.

SARAWAK BIODIVERSITY CENTRE (SBC), SEMENGOH, KUCHING

Chemicals Extraction
Laboratory



Date of visit: 31 October 2007

The SBC is a corporation set up and funded by the State Government of Sarawak. It has 27 research officers, mostly working in the chemistry laboratory. Its natural history collections are obtained from two sources: inventory projects and documentation of traditional knowledge. The SBC carried out an inventory of the Bau Limestones which resulted in a collection of 3,910 plant and 11,062 animal specimens. The traditional knowledge documentation has yielded thousands of plants

for chemical analysis and 230 species for growing in the Laila Taib Ethno Garden. Many of the plants in the Laila Taib Ethno Garden have never been seen in cultivation before and some are new species.

In the Chemistry Lab, chemicals are extracted from plants and stored dry in vials. Each extract is cross-referenced to a plant specimen in the herbarium. Correct identification of the plant is vital for identifying the source of the extract, but identification is hampered by shortage of botanical expertise in Sarawak.

Laila Taib *Ethno
Garden*



The work room



SARAWAK MUSEUM, KUCHING

Date of visit: 1 November 2007



Bird specimens

The Sarawak Museum, established by Charles Rajah Brooke in 1891, is the oldest museum in Malaysia. It is funded by the state government. It covers culture, history and natural history, but the natural history part has been gradually diminished. The plant collection was transferred to the herbarium of the Forestry Department in 1970. The animal collection has remained at the museum but this collection may be split up, with the research collections transferred elsewhere, leaving only the exhibition specimens in the galleries.

The dry research collection of animals is housed in a building dedicated to this purpose—the Natural History Building. This has a large working room and many wooden cupboards. Small specimens fill the drawers. Large specimens like crocodiles are stored on top of cupboards and under the tables. This collection has been worked on by many generations of visiting scientists, making the Sarawak Museum an important reference centre for scientific work in the tropics. The building is air conditioned during the

day but not at night. There is one post each for curator of natural history, assistant curator, and taxidermist.

The wet collection, consisting of thousands of bottled specimens, is kept in an old house where it is protected from rain, but the house itself is a wooden building in dilapidated condition. There are plans to move the collection to the Forest Research Centre for safe-keeping. Considering that this collection has a history of more than 100 years, its safety and management should be a matter of great concern.

The public galleries are in the main building. The natural history section displays mammals, birds, reptiles, fish, mollusks and other animals. The museum attracts up to 500,000 visitors per annum, of whom about 150,000 are tourists from overseas. There is no entrance fee but there is a collection box for donations. There is a small shop in the museum operated by a concessionaire.

Left: The Wet Collection
Right: Display of birds





Top: Insect
Collection
Mid: The
Herbarium
Bottom:
Databasing
specimens

FOREST RESEARCH CENTRE, KUCHING

Date of visit: 1 November 2007

The Forest Research Centre, formerly the research arm of the Forestry Department, is now administered by the Sarawak Forestry Corporation. It houses a large herbarium, a large collection of insects, and a collection of fungi including specimens of wood fungi. There is a separate wood reference collection kept at the Timber Technology Laboratory in another location in Kuching.

The herbarium collection, managed by one research officer, is the oldest plant collection in Malaysia, with specimens as old as 120 years, transferred to it from the Sarawak Museum. The herbarium holdings include 200,000 mounted sheets and a wet collection of 2,000 specimens. The type collection, of 1,500 plant specimens, is the largest and oldest in Malaysia. The herbarium and its staff are active participants in the Tree Flora of Sabah and Sarawak project.

The entomology collection is managed by two research officers. It includes the canopy insects collected by a Japanese project at Lambir.

There is a small collection of fungi and bryophytes.

FACULTY OF RESOURCE SCIENCE AND TECHNOLOGY, UNIVERSITI MALAYSIA SARAWAK (UNIMAS), KUCHING

The newly equipped
herbarium

Date of visit: 2 November 2007

The Faculty of Resource Science and Technology has a herbarium managed by two botanists, and an insect collection managed by one entomologist who specializes in microlepidoptera. A start has also been made to establish a vertebrate collection. The campus is new and the laboratories and collections rooms are spacious and well-equipped. The collections are used for courses in biodiversity assessment, biogeography, phylogenetics, systematics, water management and wildlife ecology.



Right: A collection of micro-lepidoptera
Overleaf: A collection of bats



Akrolopius
FSL 09
Mick
Mick

TK 05020
TK 05020

TK 05020
TK 05020

Akrolopius = creaghi
80-11-22 = 12.7
Mick National Park
Malaysia
FSL III
FA = 50
(S. Mei 2007)

56810

95
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FSL 100
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(FA = 44.0)
- 18(0) = 68

FOREST RESEARCH INSTITUTE MALAYSIA, KEPONG

Date of visit: 12 November 2007

The Forest Research Institute Malaysia is funded by the Federal Government. Its herbarium dates back to about 1918 and now houses about 300,000 specimens, mostly of forest plants of Peninsular Malaysia. This herbarium has been a centre of taxonomic research ever since its establishment. Its first significant taxonomic publication was C.F. Symington's *Foresters' Wood Collection*

Manual of Dipterocarps, published in 1941 during the Japanese Occupation of Malaya. From the 1960s to 1980s it was the centre for the *Tree Flora of Malaya*, published in four volumes under the leadership of Dr T.C. Whitmore and Dr Francis Ng. It is now the centre for the production of the *Tree Flora of Sabah and Sarawak*, headed by Dr E. Soepadmo, now in its sixth volume, and the new *Flora of Peninsular Malaysia*, headed by



Dr Ruth Kiew, that will replace the outdated Flora of the Malay Peninsula produced by H.N. Ridley in the 1920s. The herbarium has just recruited 10 new botanists and will soon be moving a new herbarium building with twice the capacity of the present herbarium.



The Entomology Laboratory specializes in studies on termites, butterflies and fireflies. It has a collection of dry and wet insect specimens. Termites are major pests of timber, while fireflies have made their habitat in Kuala Selangor a world-famous ecotourism attraction.

The Mycology Laboratory was set up for research on fungal pathogens of trees and timber and on forest mycorrhizae. It houses a growing collection of macrofungi but the storage facilities are improvised and cramped. There are no fungal taxonomists in Malaysia to deal with the wealth of fungal diversity.



The Wood Anatomy Laboratory houses about 10,000 timber and bark samples cross-referenced to voucher specimens kept in the herbarium. The collection is managed by two research officers and supports the identification and training services of the laboratory. About 20 persons are trained each year in this laboratory in timber identification for the timber industry.

Top: The Herbarium Collection
Bottom: Dr Lee Su See explaining the Fungus Collection
Opp: The Botanic Garden

The Institute is located in a spacious forested campus, part of which is being developed into a Botanic Garden. In the forested area there is a stand of trees of kapur, *Drybalanops aromatica*, that has become world famous as the icon of *crown shyness* in the forest canopy. The campus is open to the public as a recreational park. An entrance fee is charged.



INSTITUTE FOR BIODIVERSITY, DEPARTMENT FOR WILDLIFE AND NATIONAL PARKS (PERHILITAN), BT RINGGIT, KRAU GAME RESERVE, PAHANG

The Insect
Collection



Date of visit: 13 November 2007

This museum is new and attractively laid out. It is funded by the Federal Government as the research arm of the Department for Wildlife and National Parks. It houses a research collection of vertebrate specimens including mammals, amphibians and reptiles, birds and fish and an insect collection. The museum collection was started in 1989. A bigger facility is being planned for which RM25 m has been allocated. The museum has five posts for



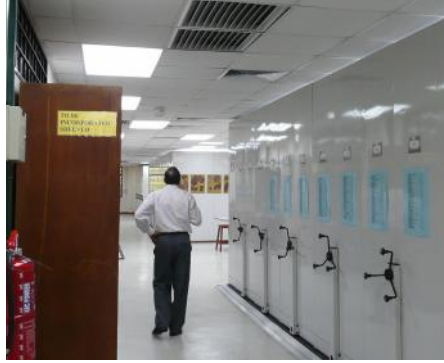
research officers. Nearby is the Elephant Centre which houses elephants captured in areas where they have come into conflict with people. The capture, translocation and upkeep of such elephants are major activities of the Department. The elephant centre attracts about 10,000 visitors a year.

Skin of a python



The Bone Collection

Left: Herbarium
Right: Bryophyte
Collection



THE SCHOOL OF BIOLOGICAL SCIENCES, UNIVERSITY OF MALAYA, KUALA LUMPUR

Date of visit: 14 November 2007



A bryophyte
specimen

The museum facilities in the University of Malaya are basically for teaching and research purposes, but there is a Rainforest and Environment Exhibition Gallery which was opened in year 2000. The exhibition is bright and spacious and attracts 10,000 visitors a year. Entrance is free.

The herbarium is modern and holds about 100 type specimens. The voucher specimens of the KL series supporting the Phytochemical Survey of Malaya are preserved here. There is also a large bryophyte collection, probably the largest in the country.

There is a herbarium of seaweeds and seagrasses in another part of the building. This is the largest collection of seaweeds and seagrasses in the country.

Nearby is a conservatory with an impressive living collection of slipper orchids and other rare plants.

The Zoology Museum is in a small four-storey building. The ground floor houses the wet collections of invertebrates, fishes, frogs and reptiles; the first floor is for exhibition; the second floor for entomology, parasites (as wet collections) and hard corals; the third floor is for birds and mammals. Compared with the botanical collections at the University, the zoological collections are poorly funded, and the space is totally inadequate for proper storage, display, exhibition and interpretation.



Rainforest and Environment Exhibition Gallery
Bottom: The Faunal Collection





NATIONAL REPOSITORY FOR AGRICULTURAL PESTS, DEPARTMENT OF AGRICULTURE, KUALA LUMPUR

Date of visit: 28 January 2008

The Department of Agriculture manages the National Pest Repository for pests of agriculture, including insect pests, weeds, plant pathogens and nematodes. The collection was started in about 1939. Its oldest specimen is a weed collected by H.N. Ridley in 1892 from 'the Cottage' at Taiping. The data on the insect collection are being entered into a database using the program ACCESS. The Repository will be moved to Serdang in 2009 to the new Department of Agriculture Complex now under construction.



Above: Collection of paintings of insect pests of agriculture
Right: Painting of a pest life cycle

The Department has a small one-room exhibition gallery on agricultural pests, which is open upon request.



The Repository is responsible, under Malaysia's WTO commitments, for surveillance of pests in agricultural products for export. To fulfil its commitments, it has to be able to identify pests, but with the retirement of experienced staff, there has been a loss of taxonomic expertise for the identification of pests and weeds.

SCHOOL OF ENVIRONMENTAL AND NATURAL RESOURCE SCIENCES, UNIVERSITI KEBANGSAAN MALAYSIA, BANGI

Date of visit: 29 January 2008

The School of Environmental and Natural Resource Sciences maintains botanical and zoological collections. The botanical collections cover higher plants, ferns, mosses and algae, and include 27 type specimens. The animal collections cover vertebrates and invertebrates and there has been particular interest in entomology. A journal of entomology *Serangga* is published here with financial support from the Muzium Negara.

There is a small zoological museum which, due to lack of space, spills over into the corridors and passages.

The university is situated beside the



Bangi Forest Reserve and 100 ha of this forest has been designated as the University Forest. There is a fern garden of 7 ha established within this forest.

The staff are concerned about the poor state of the facilities under which they have to work. During our visit, there was a power failure and this has been a recurrent event for years. The walls of the building are mouldy, and the animal specimens are in poor shape, with hair dropping off from the preserved skins.

Loss of experienced staff is a serious problem. As the staff retire, their positions have been left vacant. In the corridor are many boxes of plant specimens from Sabah that used to be housed in the herbarium of the University's branch campus in Sabah. These were moved to Bangi when the branch campus was closed over ten years ago. Owing to shortage of staff, the specimens are still in their boxes, unavailable to scientists who want to work on them.

Left: Herbarium
Right: Vertebrate
Gallery



MUZIUM NEGARA, KUALA LUMPUR

Date of visit: 3 March 2008

The natural history gallery of Muzium Negara has been dismantled and the exhibits are now kept in storage pending the development of a new building for natural history. However, because of insufficient financial allocation, the building has not been constructed and there has been no progress in the past few years. The museum has five curators for natural history: three for fauna, one for flora and one for minerals. Its collections include gifts from by private collectors, e.g. a collection of butterflies by H.R.M. Storey and a collection of bird's nests and eggs, various mounted vertebrates and a wet collection of fish. The museum also holds natural history specimens confiscated by the authorities, which have to be kept as evidence in court.



Left: A tapir in storage
The Wet Collection





Mounted small mammals

The number of visitors to the museum has varied greatly between years. In recent years, the highest figure was 737,600 in 2002, and the lowest was 161,200 in 2004. There is an entrance charge of RM2 per person, but school children are exempted. The museum is closed one day a year, on Hari Raya Puasa. On other days, it is open from 9 am to 6 pm.



Appendix 2

STUDY OF MAJOR NATURAL HISTORY MUSEUMS

INTRODUCTION AND OVERVIEW

The Consultancy Team made a study tour of four major museums of natural history in December 2007. The museums were the Field Museum in Chicago, the National Museum of Natural History of the Smithsonian Institution in Washington DC, the Natural History Museum in London and 'Naturalis' in Leiden. These four museums are situated in prime locations in their respective cities, close to commercial, cultural or educational centres.

Museum funding

The Field Museum is a non-government organization financed by funds raised by the Museum itself. The other three are financed by their

respective national governments, though all are engaged to some extent in fund-raising activities.

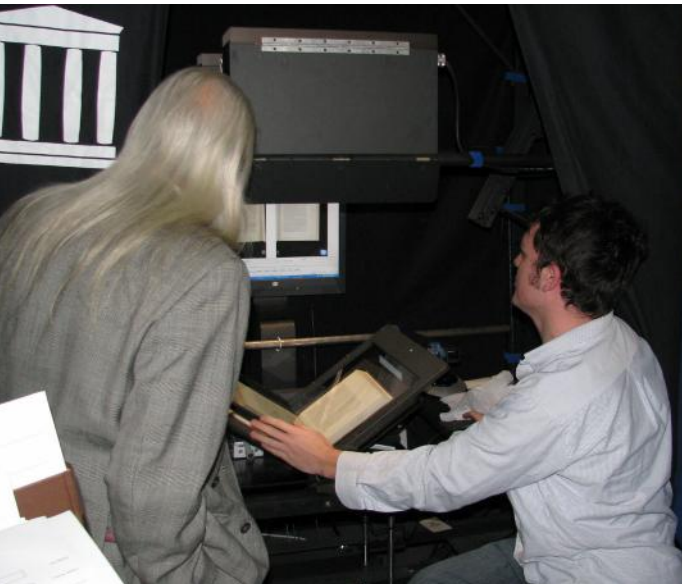
Museum core activities

All these museums are engaged in three core activities: scientific research, collections management, and exhibition. Exhibition is their most visible activity, but it is scientific research that gives a museum authority and credibility. The scientific collections in a museum enable scientists to work on materials from all over the world and from different periods in time. All the museums are involved, in association with universities, in advanced training of scientists.

Biodiversity literature being scanned for global free access on the Web under the Biodiversity Heritage Library (BHL) Project, at the Natural History Museum, London

Exhibition

In all the four museums, exhibition and associated public outreach and educational activities are managed by full-time professional staff with expertise in events-management, designing, writing, graphic arts, model-making, education, public relations and information technology. The research scientists act as content advisors to ensure the scientific accuracy of all museum productions. Museums have found that people think and learn in many different ways. Museum exhibitions have to use “specimens, models, dioramas, hands-on activities, videos, animations, artists’ renderings, and audio components geared to communicate complex messages succinctly and



clearly while accommodating a wide variety of learning styles” (quote from the 2006 Annual Report of the Field Museum). To encourage repeat visits by the public, special temporary exhibitions are staged throughout the year to complement the permanent exhibition galleries, but permanent exhibitions are also reviewed and renewed regularly. The

busiest museums arrange lectures and other special events every week. In addition, all the museums maintain active websites. The major museums take pride in the variety and excellence of the experiences they offer, and in their ability to engage people of all ages, from preschool children to senior citizens. Judging from the crowds of visitors, museum exhibitions are holding their own successfully against shopping malls, amusement parks and other facilities competing for public attention. In a study on credibility in the US, museums have been rated the most trusted of public institutions. This is testimony to the ability of US museums to combine show-business professionalism with scientific excellence.

A laboratory at the Field Museum, Chicago



Collections management

At Naturalis, research and collections management are separate departments of the museum. In the other museums, research and collections management are combined. However, the new buildings specially designed to house the natural history collections at the Natural History Museum in London (Darwin Centres One and Two) and at the National Museum of Natural History in Washington (Museum Support Center) are indications of increased emphasis given to collections management. There are many reasons for the increased emphasis. Type specimens are irreplaceable. Many species no longer exist where they used to exist. Some are extinct. The preserved specimens are records of the prevailing conditions at the times and places where they lived. A time-series of specimens provides a record of how changes in the environment have affected a species or community of organisms. For example, scientists have discovered, from preserved museum specimens, that the eggshells of predatory birds have become thinner since the widespread introduction of pesticides in agriculture. The effects of climate change are also captured in museum collections in various ways. Classic examples are trees with growth rings reflecting the environmental conditions prevailing for every year of their growth. Hence museum collections enable scientists to decipher environmental and other trends that may have regional and global security implications.

Since museum specimens are real specimens, the information they contain are forever fixed, to be extracted as and when new tools are developed. Until the mid-20th Century, scientists could only study specimens with magnifying glasses and microscopes. Then scanning electron microscopes were invented, and more information could be extracted from the specimens. With the development of refined chemical techniques, even very small samples could be chemically analysed. Now, with new molecular techniques, molecular and genetic information can be extracted.

Public engagement: the President of the Field Museum addressing supporters (members) of the museum at the book launch of Birds of Peru



Playlab at the Field Museum—a gallery for children

The collections continue to yield information and become more valuable with time. However, the scale of complexity of biodiversity is such that no major museum has enough scientists to work on all its collections. There are large collections that have not yet been sorted, because each new expedition results in collections that take many years to work through, and there are not enough scientists for the task. All museums depend on visit-

ing scientists to complement the museum's own scientists in deciphering and interpreting their collections. Collections management involves not only maintaining collections in pristine condition so that no information is lost, but also in getting specimens to the scientists who can interpret them, and making it possible for visiting scientists to work comfortably and efficiently on the collections.



Scientific research

In the core area of scientific research, the pressures on museum scientists have increased greatly in recent years. The scientists employed for research are required to be world leaders in their respective fields of research, to win competitive research grants, and to attract circles of research associates, students and volunteers around themselves. This is the principle of

leverage as applied to science. In the past, the bulk of museum science was in the documentation of biodiversity but now, museum scientists are expected to enquire into the origin and significance of biodiversity and to improve our understanding of the forces of change. Scientists are evaluated on the impact of the papers they publish, and this has had a major effect on the questions that scientists choose to work on. The major museums now recruit scientists very selectively, for qualities of scientific originality and leadership. At the same time, the research scientists are held responsible for the scientific content of the museum's exhibitions and public outreach activities.

Museums in the information revolution

Modern science is based on the premise that knowledge is most reliable and beneficial to society when it is open, transparent, and publicly accessible. However, there was a limitation to accessibility due to the cost of storing, multiplying and distributing paper documents. This limitation has now been removed by advances in digitization of information and by the global reach and power of the Internet. (See box 4)

The most exciting prospect is that all of the world's scientific literature, beginning with the old classics that used to be carefully guarded in the great libraries, are being digitized and made available freely to the public on the Internet.

In May 2007 a web-based initiative, called the Encyclopedia of Life, was launched by a consortium consisting of the Smithsonian Institution, the Field Museum, Harvard University and others. It is a global effort to document all 1.8 million species of living things on the Web. There will be



Fossils for children to handle



An ancient 'herbal' of medicinal plants, pressed, dried and preserved for reference

a web entry for each species, consisting of text, video, photographs, sound, location maps and other information as available. The encyclopaedia will be built on the expertise and integrity of thousands of experts around the world in a wiki-style environment. The MacArthur Foundation and Sloan Foundation have provided USD12.5 million to support the enterprise.

Museums in public engagement

Where museums are funded by government, the public tends to be passive beneficiaries. The Field Museum is exceptional in that it is not funded by the national government. The local government in Chicago provides about 30% of its funding but the museum has to raise the rest by a very active public engagement programme. The degree to which

the people of Chicago identify with their museum and take pride in supporting it is quite remarkable. Other museums are not as driven in their public engagement programmes but all depend on volunteers and 'members' to support the museum and help run the museum's activities.

Museums in the 21st century

Far from being 'museum pieces' themselves, the major museums have become thriving scientific, cultural, and educational establishments. A visit to the national museum of a country reveals more about the state of science, culture, and education in the country than almost anything else. It is clearly apparent that the strength of the major natural history museums rests on their reputations as scientific institutions. A museum's scientific reputation gives it public credibility and attracts financial support.

The tradition in all the major museums is for the research scientists to determine their own research programmes and to take personal responsibility for them. The organization influences the direction of research only in broad terms, e.g. by defining the geographical context (Netherlands and Southeast Asia in the case of Naturalis), by defining the fundamental research questions (in the case of the Natural History Museum London) and by differential allocation of resources (more for zoology than botany in the case of the Field Museum). Increasingly, research positions are being internationalized in order to obtain the best candidates. Self-driven scientists with a passion for scientific discovery and the ability to inspire others, are in great demand.

There is a global revolution in data management, which will result in the world being flooded with scientific data that used to be inaccessible. This will benefit countries with the institutional capacity to put

globally-available data to good use. All countries aspire to be part of the Knowledge Economy, but countries without institutional capacity will miss out completely. Natural history museums are key institutions in the Knowledge Economy. They generate knowledge and raise the level of scientific literacy in a country. No other institutions set themselves the target of educating all levels of society from young children to senior citizens. No other institutions enjoy as much public credibility as natural history museums. Such credibility has been earned by the great museums through hard work, good management, and world-class science.

THE FIELD MUSEUM, CHICAGO

Dates of visit: 3 - 7 December 2007

Foundation, Location and Public Significance

The Field Museum was established in 1893 with an endowment of USD1 million from a businessman, Marshall Field. The Museum is housed in a massive square building with seven floors, two of which are underground, at the edge of Lake Michigan, close to the commercial centre of Chicago and next to the Shedd Aquarium and the Adler Planetarium. The local government provides an annual contribution to the museum, but about 70% of the Museum's annual budget is raised by the Museum itself through fundraising and business activities. The building houses 23 million reference specimens. It attracts 1.5–2.5 million visitors a year and is open every day of the year except on Christmas Day. Visitors buy an entrance ticket, with discounts for members and Chicago citizens. Entry is free for school parties of young children.

Marshall Field, US business leader who funded the establishment of the Columbian Museum of Chicago in 1893, renamed in 1910 as the Field Museum of Natural History



Governance and Management

The Board of Trustees has over 80 members, including many CEOs of corporations and other civic leaders. All board members are expected to bring money to the museum. The Board meets three times a year, receives the Annual Report, approves the budget, and appoints the President and new board members. Board members also serve on the Museum committees for governance, budget, investment, finance, facilities, science, and public relations.

The Museum is headed by a President, John McCarter, who has had working experience in Federal Government, corporate consultancy, and academia. The President appoints 10 Vice Presidents, viz. an Executive Vice President for Finance and Facilities, Vice President for Institutional Advancement (Operations Development, Sponsorships, Corporate and Foundation Giving), Vice President for External Affairs and General Council, Vice President for Auxiliary Boards and Board Relations; Senior Vice President for Strategic Initiatives, Senior Vice President for Environment Culture and Conservation, Senior Vice President for Museum Enterprises (Exhibitions, Marketing, Public Relations, Web Communications, Membership, Museum Stores, Special Events and Group Sales), Senior Vice President for Collections and Research (Anthropology, Botany, Geology, Zoology, the molecular laboratory, and the journal *Fieldiana*), Vice President for Administration (Human Resources, Information Technology, Education, Library), and Vice President for Operations (Guest Relations, Houskeeping, Protection Services). The Museum employs over 500 staff members.

Exhibition and Education

Exhibition

The exhibitions of the Museum occupy galleries of various sizes, located on the ground, first and second floors. Some of the permanent exhibitions



Grand entrance

showcase priceless examples of museum art that can no longer be reproduced, e.g. beautiful 3-D models of plants, and dioramas of animals resting, playing or hunting in family groups. The Museum stages about five special exhibitions a year, each taking up to four years to plan and implement. At any time, the exhibitions staff are engaged in 12 or more exhibition projects in different stages of planning and design. Special exhibitions are on show for three to six months each.

Each exhibition is planned around a theme or story line. As visitors proceed from the entrance to the exit of each gallery, they experience a story told through specimens and pictures accompanied by short, engaging narratives. The story ends at the exit. A small shop is located at the exit to display and sell merchandise related to the theme of the particular exhibition.



View of Chicago
from the Museum

Exhibitions are of various sizes, requiring between 800 and 8,000 sq ft each. Exhibitions are almost entirely developed and produced in-house, by staff totalling about 100 persons, with a wide range of qualifications such as in history, literature, anthropology, science, linguistics, architecture, industrial design, and art. The Museum has well-equipped facilities for printing and artwork, and workshops for wood-working, metal-working and plastics moulding. However, most of its animal models are made by commercial service providers. An exhibition requires an adequate 'staging area' of up to 20,000 sq ft for developing and assembling the exhibits. Without such a staging area it would be impossible for a museum to develop its exhibitions in-house.

An exhibition starts with an idea, which may originate from anywhere. If accepted, this idea is taken up by a team which carries out initial research, writes the story line and lists the kinds of exhibits required, in consultation with museum curators, educators, fund-raisers and marketers. Research is also carried out to assess public perceptions, and costs are estimated. The project goes through the stages of design and visualization, including the building of three-dimensional scale models, before final production. An outline is prepared for marketing purposes, to solicit funding. The

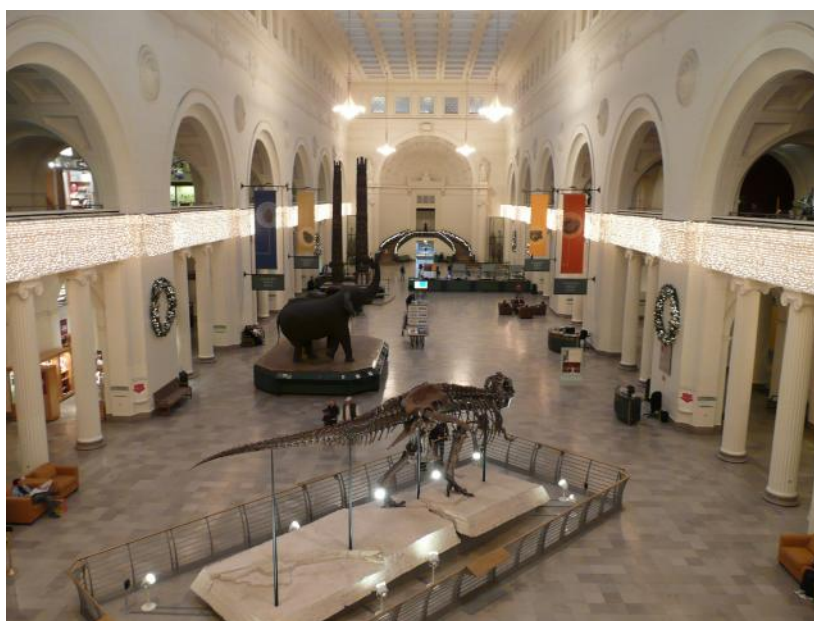
development of exhibitions generates continuous excitement, brings repeat visitors and enables the Museum to maintain the interest and support of donors, members, volunteers and the media.

The exhibition galleries are serviced by volunteers trained to explain and discuss exhibits with visitors. We spoke to one such volunteer, a retired engineer, who used to bring his children regularly to the Museum. The Museum inspired his children to take up science and engineering. The children have grown up and become successful in their professions. In retirement, the father volunteers to help other people enjoy the Museum. There are 400 – 500 such volunteers, who take turns to provide services at the Museum.

After their period of display at the Museum, the Museum's special exhibitions are marketed as 'travelling' exhibitions. There are currently 11 such travelling exhibitions, including the dinosaur exhibition *A T. rex named Sue* that has been in Japan, Thailand and Singapore.

The great hall

In partnership with National Geographic, the Museum organizes a lecture programme of nine popular lectures a year.



Education

The education activities of the Field Museum are run by 23 staff members and 200 volunteers. The staff members have a variety of skills and interests including teaching, project design and management, performing arts, biology, archeology and paleontology. For school children there are special galleries that engage children in activities that will keep their attention, including a very innovative and popular 'playlab' for preschool children where young children are introduced to nature study. This has lots of play activities that encourage observation and simple experimentation, assisted by volunteers who love working with children. The Museum hosted 250,000 student visits in 2006. Its outside events (e.g. fossil hunting expeditions) engaged another 35,000 students.

The Field Museum is involved in developing the curriculum for schools in Chicago. It supports local schools by loaning them specimens for teaching. It has 170,000 specimens out on loan to schools. It organizes special programmes for school teachers to prepare them for bringing students to the museum in group visits. The programmes for teachers cater mainly to primary school teachers, because it is in primary schools that each class is closely managed by one teacher, who can be motivated to organize a museum visit.

Collections and Research

The Collections

The Museum holds a global collection of 24 million specimens in four departments: Anthropology, Botany, Geology, and Zoology, of which Zoology is the largest. Each department occupies its own part of the building, with its own offices, collection rooms, labs, and library, but all the departments share a molecular lab, a scanning electron microscope lab, and an elemental and isotope lab. Collections and Research employs about 165 staff members and have the services of 400 volunteers.



Tyrannosaurus rex,
the most feared
dinosaur, in the
great hall



Deer in Mammals Gallery

The collections are shielded from sun and UV light and the collections rooms are kept under conditions of low humidity and low temperature round the clock. Wet collections are kept in bottles of 70% ethanol, the levels and concentrations of which are regularly monitored and maintained.

Curators

The senior scientific staff members are called 'curators'. There are about 35 curators. A full Curator is equivalent to a university professor, and many Curators hold adjunct professorial appointments at the University of Chicago and other universities. Associate Curators are equivalent to Associate Professors and Assistant Curators are equivalent to Assistant Professors. Positions are advertised and appointments are made after broad consultation among the curators. About 25% of curators are of overseas origin. Curators establish research programmes in areas of their own choice, which need not be the areas defined in the advertisement for the position. It is considered more important to recruit an outstanding scientist than someone less outstanding who fits the position advertised. Curators are expected to lead the way in research, publish regularly, project a good public image of themselves and the Museum, attract curatorial endowments (endowments that help pay the salaries of curators), obtain research grants from the National Science Foundation (such grants are awarded to fewer than 20% of applicants), and attract a circle of graduate students, research associates and volunteers to work around themselves. Curatorial staff begin as Assistant Curators without tenure. Assistant Curators get promoted to Associate Curators after five years, during which time they are expected to have obtained one National Science Foundation grant, and published several research papers. Those who fall below expectations are given one year to look for another job.

The fish Gallery



Curators Emeritus are retired curators who continue to work in the Museum and are treated as full staff members but without salaries. Adjunct curators and Research Associates are non-staff scientists given staff facilities to do research at the museum.

There are about 100 graduate students in the Museum who work on the collections for their own thesis research projects and 12 'post-docs' with doctoral degrees, who are employed on fixed contracts.

Collections staff report to curators and are responsible for managing the collections. They are not required to do research.

Interns are high school and college students who work for short periods and receive a small stipend to cover transport and lunch expenses.

Volunteers work at the Museum without pay but have to be serious and professional. They are terminated if they do not keep to their agreed hours and duties.

There are one or two administrative staff in each department who provide office support.

Botany

The herbarium holds 2.7 million specimens, of which 2.2 million are vascular plants. There are two curators for flowering plants, two for mycology and one for lichnology. The majority of collections are from Central and South America. Types are in the process of being scanned and will be made available for viewing on the Web. The Field Museum is also in the process of digitizing type specimens held in European herbaria and has already covered over 70,000 specimens. Specimens are filed in motorized compactor units operated by push button. Bulky collections (e.g. cacti, large fruited specimens) are filed in boxes, one box per number, designed to fit into the herbarium shelves.

Zoology

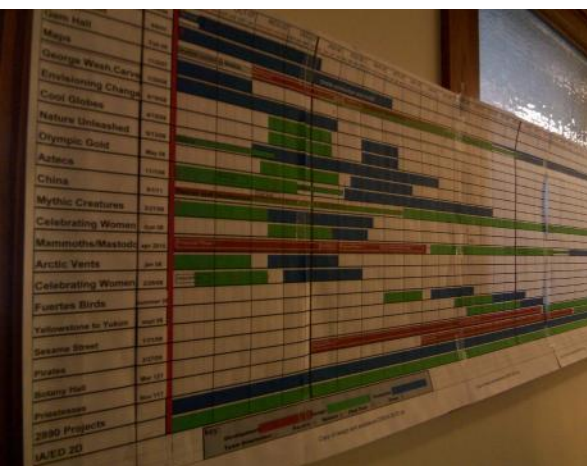
In Zoology, the emphasis is on mammals, birds, amphibians, reptiles, fish, molluscs and insects. In general, there are two curators for each of the above areas. There are 18 million reference specimens, of which 12 million are insects. Each collection ranks globally among the top five in their class, in terms of size and coverage.

Scientific data management

The value of a scientific specimen or collection lies in the data associated with it. A specimen without data such as place and date of collection

and associated information is of little scientific value. Most of the requests that the Museum has to deal with are actually for data rather than specimens, and the data are in notebooks, labels, registers and catalogues kept with the specimens. Now, the data are being transferred to digital format for better security and accessibility.

Flowcharts tracking the progress of exhibitions under development





After years of trial and error, such electronic databases have become stable, and efforts are being made to standardize database formats across museums so that data can be shared. The final aim is to make databases available as a free global public resource. Already, the information on the Internet has cut down greatly the volume of requests that used to consume a lot of museum curatorial time.

Tissue collections

One of the new developments in museum management is the collection and storage of tissue samples. Some species are easier to identify by their DNA than by morphological characters. For identification of fragmentary material, DNA often offers the only solution. In principle every species can be identified by its DNA, and DNA barcoding of all species has become technically possible. To pave the way for this development, museums are beginning to take tissue samples from all new collections, to be stored for future DNA analysis and other kinds of analysis that may be developed in the future. For plants, young leaves are dried in silica gel and stored dry. For animal tissues a small sample of about 1 cm cube can be cut out from the liver or some other tissue and stored in 95% ethanol in small tubes. The tubes are sealed and stored in freezers at -15°C or in liquid nitrogen.

Library

The library employs 12 staff and has a volunteer support group of 'Friends of the Library'. It is organized into a main library housing interdepartmental books and journals, and smaller departmental libraries located within each department. The departmental libraries contain the books and journals that are most used by the scientists of that department. This is a great time-saving arrangement. However, the main library and the departmental libraries are all managed centrally. The library also maintains archives of films and photos, and a display of rare books.

Peacocks in the Bird
Galiery

Institutional Advancement

This arm of the Museum is responsible for raising donations from individuals, foundations and corporations. This is a staff activity because it is considered important for the Museum to interact directly with its supporters. The Museum estimates that it spends about 15 cents in raising each dollar of donations. It produces an Annual Report, the most important readers of which are the donors who support the Museum. Practically all the lecture halls, classrooms and galleries are named after donors who pay for the naming privilege.

Museum Enterprises

Revenue-earning activities

Museum Enterprises is a unit that employs 200 staff and earns income for the Museum through sales, rentals and commissions. It raises 28% of the Museum's operating funds.

Most visibly, there is a cafeteria (the Corner Bakery) and a MacDonaldis outlet in the Museum that pay rental to the Museum for their space, and a percentage from sales. Also very visible is a large store selling books, rocks, toys and souvenir items. Every special exhibition includes a small store at its exit selling items related to the special exhibition. *Museum Enterprises* is responsible for all operations from sourcing of merchandise to inventory and sales.

After closing time, the grand hall, as well as the lecture halls, meeting rooms, outdoor terrace, and other spaces, are available for rent. The main galleries are spacious and the largest can hold 10,000 people. The grand hall, with its dinosaur and elephant exhibits, is a popular venue for wedding receptions and children's birthday parties. *Museum Enterprises* holds a liquor license and maintains a short list of approved caterers and



Top: Studio for design

Mid pic: A museum workshop

Bottom: Studio for concept development

service providers for food, décor, lighting, movable furniture etc. The caterers and other service providers pay the Museum a commission on the fees they charge their clients.

Museum Enterprises markets group tours, especially to foreign and special groups. It also markets the travelling exhibitions, publishes books (usually with a co-publisher that has a distribution network), and sells consultancy services. It does its own marketing research to keep its fees and charges competitive.

Public relations

The public relations office defines its mission as “getting the word out on what the museum is doing”. It produces the quarterly illustrated magazine *In the Field*, which is the main organ of communication with the 45,000 ‘members’ of the Field Museum. Members pay an annual donation to support the museum. The magazine carries news about the Museum and descriptions of forthcoming events.

The PR office cultivates close contact with the media. It produces a press kit for every museum event. Press kits contain stories as well as CDs with images that reporters can use. These are sent to TV and radio stations, newspapers and other media in the city, state and beyond, but mainly covering an area within a day’s drive from the Museum. It arranges previews of events for the media and invited guests before such events are open to the public.

PR does not pay for publicity and cannot control what the media produces. It works by building trust with the media as a trustworthy provider of information.

Human resources development

Curators are considered equivalent to professors in universities and associate curators to associate professors. It is very costly to recruit and train new staff, but a certain level of turnover is considered healthy because each time a vacancy arises, it gives an opportunity to review job descriptions and to make organizational changes to keep the Museum in line with changing opportunities and needs.

New employees are reviewed after six months. Otherwise, reviews are held annually. Staff members are reviewed by their supervisors on a one-to-one basis. They are provided with job descriptions, and are informed of what is expected of them individually. There is a system in place for appeal and counselling.

Bird Collection



Fund-raising

Fund-raising is a pervasive feature of museum management. It is undertaken with enthusiasm by everybody, from the Board and President to all staff members and volunteers.

We saw the President in action one evening, at a ceremony launching a book, *Birds of Peru*, held in the main auditorium. Before an audience of several hundred supporters of the Museum, the President lavished praise on the book and its authors and supporters. He was obviously No

1 cheerleader. After him other speakers and the authors gave speeches, all in praise and support for those who had contributed to the book, which had taken 50 years to produce. During the cocktail party before the launching we talked to some members of the Chicago public that had turned up for the event. They were 'members' of the Museum, who had become members by making annual donations. Members get invited to museum functions and receive its quarterly magazine *In the Field*. People went home from this event feeling they had done something worthwhile for science and conservation, and for Peru.

During our tour of the Museum and its many departments, we met many people and were impressed by the way all were willing to talk enthusiastically about their work. The Museum hosts many visitors and every visitor is treated as an actual or potential supporter. Every staff member is expected to 'sell' the Museum to members of the public. In



Frog Collection

this way, fund-raising efforts are not confined to the fund-raising and marketing departments, but spread out across the entire organization. For example, the Vice President for Collections and Research, Lance Grande, estimates that he spends 25% of his time in fund-raising activities.

After its establishment with seed money from Marshall Field, the Field Museum has maintained its momentum by cultivating public support, and the public has responded magnificently. Members and supporters of the Museum, and the citizens of Chicago in general, evidently take great pride in their museum, which has become a world-class scientific, cultural and educational institution through their support.

Plant Collection



THE NATIONAL MUSEUM OF NATURAL HISTORY OF THE SMITHSONIAN INSTITUTION, WASHINGTON, D.C.

Dates of visit: 10 – 11 December 2007

Foundation, Location and Public Significance

The National Museum of Natural History is one of a complex of 19 great museums under the Smithsonian Institution. The Smithsonian Institution was founded by the US Government in 1846 with an endowment from an Englishman, James Smithson, who willed his entire fortune to the US Government to found an establishment “for the increase and diffusion of knowledge”. The Smithsonian Institution is financed by the US Government but raises 30% of its budget through fund-raising activities. Every American wants to visit Washington, D.C. at least once in a lifetime, and this ‘pilgrimage’ almost always involves visits to the museums of the Smithsonian Institution.

The National Museum of Natural History occupies a huge building occupying two city blocks (the size of 18 football fields), located centrally on the National Mall, close to the Capitol and other national monuments and museums. With a floor space of 1.5 million sq ft overall, of which



Grand entrance



Dome of the Museum

the exhibition and public space occupies 325,000 sq ft, this is the largest museum of natural history in the world. The number of visitors to the National Museum of Natural History is about 7.2 m a year. In peak seasons, there may be 30,000 visitors a day. The Museum is open every day except on Christmas day. Entrance is free.

Governance and Management

As a component of the Smithsonian Institution, the natural history museum comes under the overall administration of the Smithsonian Headquarters Organization, known as the 'Castle'. The Castle manages the security, custodial (cleaning and maintenance) and business activities across the Institution. The business activities include the letting of space for private functions, the letting of space for restaurants, and the management of shops within the Museum. The Museum operates on a budget of USD120 m a year, with a workforce of over 1,000 persons and 600 volunteers.

The head of the National Museum of Natural History is Acting Director Dr Paul Risser whose background is in research (plant ecology) and academia. Under the Director are three Associate Directors, for Operations (including Budget and Finance, Information Technology, Personnel, Facilities Operations, and Museum Support Centre), Public Programs and External Affairs (Exhibitions, Education and Outreach, Administration, Public Affairs, Development, and Special Event), and Research and Collections (Anthropology, Botany, Entomology, Mineral Sciences, Paleobiology, Vertebrate Zoology, Invertebrate Zoology, and Laboratory for Analytical Biology).



View of the Capitol (the U.S Senate and House of Representatives), from the Museum

The Museum has an Advisory Board which reviews the state of research and collections and helps in fund-raising. The Smithsonian Institution itself has a Board headed by the Chief Justice of the United States and includes three members of the House of Representatives and three members of the Senate.

Strategic Goals

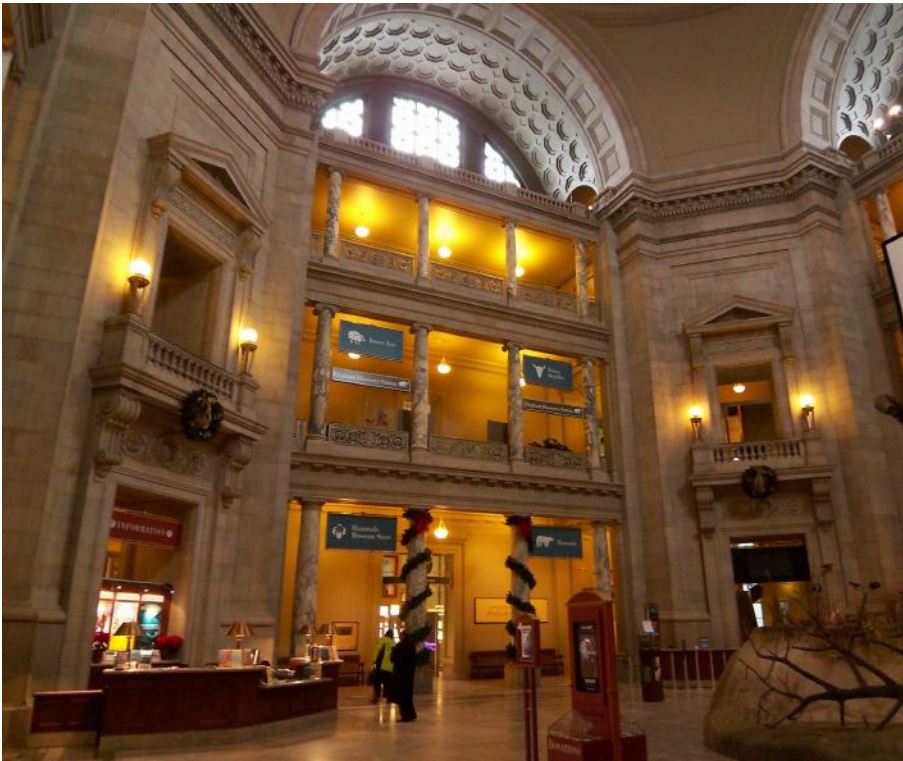
The strategic goals of the Museum, stated in its strategic plan for 2004-2008, are

- to strengthen the visibility, value, and impact of its science by integrating research, collections, exhibits, and education
- to lead the global community of natural history museums in programmes of science, collections management, exhibits, and education
- to transform the Museum's staffing, management, culture and infrastructure to support the Museum's mission, vision and strategic plan
- to increase and diversify the Museum's funding to address strategic priorities

MISSION

To inspire curiosity, discovery, and learning about nature and culture through outstanding research, collection, exhibitions, and education.

“Understanding the natural world and our place in it”



The great hall

Exhibitions, Education and National Outreach

The museum organizes permanent and special (temporary) exhibitions. An exhibition may take up to three years to stage. Most of the cost of exhibition development is raised from donors. Currently three exhibitions are being prepared. The most ambitious exhibition under development is *Oceans*, which will cost USD60 m to set up and a USD10 m endowment to support its annual maintenance. A model of a whale to hang from the



African elephant
in the great hall

ceiling will cost USD250,000; a huge aquarium tank for corals and fish will cost USD700,000 per annum to maintain; a giant squid will be displayed in large tank containing an expensive non-inflammable preservative; there will be huge images projected on the walls, and a theatre to simulate an experience in deep ocean exploration. Another exhibition, *Human Origins* will cost USD30 m and be funded by two donors, each contributing USD15 m. The third one, on butterflies, will include an indoor butterfly house for 500 living butterflies of 24 species, which will be supplied by butterfly farms in South America and replenished continuously—the life-span of a butterfly being about two weeks.

An exhibition starts with an idea which goes through an exhaustive process of approval, consultation and development involving the preparation of scripts and illustrations, the identification and refinement of the message or purpose in relation to the target audiences, and the development of previews by computer, such previews being used to allow more participants to be involved in the review and refinement

of visuals and texts. The design and implementation of exhibitions are contracted to outside service providers. For an exhibition occupying an area of 10,000 sq ft, the staging area has to be about 15,000 sq ft of which 5,000 sq ft will become a storage area for the crates and other materials in which the exhibits came in, and which will be needed when the exhibition is dismantled and moved out. The packing, unpacking and checking of items, followed by repacking, are major logistical exercises best reduced to the minimal number of moves. The design and location of elevators and passages close to galleries are very important so that the development of one exhibition does not affect the operation of other exhibitions.

Exhibitions are family oriented, with the texts pitched at the level of 10 – 14 year olds, written like newspaper stories with punchy headlines and story lines.

Research and Collections Management

Research

The Museum employs 100 PhD scientists and provides facilities for another 30 from other agencies in government, including the US Geological Survey's Biological Resources Division, the Department of Agriculture's Systematic Entomology Laboratory, the Department of Commerce's National Marine Fisheries Service Systematics Laboratory and the Department of Defence's Walter Reed Biosystematics Unit.

The collections total 126 million specimens. In 2007, the scientific collections were referred to by over 7,748 visiting scientists.

The Museum's scientists exercise traditional freedom to pursue long-term scientific studies, and are encouraged to apply for external research grants to support their research programmes.



Holding room for incoming crates



Open shelves waiting for large specimens



Wet Collection

Collections Management

The Museum is developing a Collections Management Policy. This is required by the Government and by the Museum's Board. The policy requires that the collections be defined and ranked by 14 criteria so that the Museum can evaluate the relevance of each collection to the Museum's mission, formalize legal ownership, identify weaknesses and strengths, keep track of the physical condition and usage of each collection and decide on manner of disposal if necessary. The policy will enable the Museum to decline gifts of specimens that do not meet legal and scientific criteria, such as specimens with ambiguous or undetermined ownership and specimens with inadequate collection data. Specimens and collections that are to be disposed of may be given to colleges for use in teaching. The policy is dynamic and is reviewed from time to time. In special cases, exceptions to the rule may be written in. Registrars document gifts and loans. Every year there are about 800 gift accessions and an average of 2,000 loans signed in and out.

Museum Support Center MSC

The Museum has run out of space and is now in the process of moving most of its collections to a new facility outside the city, called the Museum Support Center or MSC. It is also renovating its central building in stages according to a master plan that is implemented in annual stages at a budget of USD22 million per annum. As each part of the building is renovated, its equipment is upgraded.

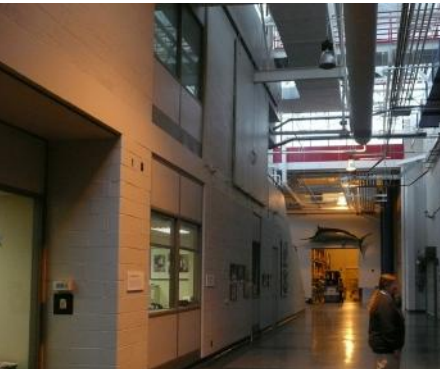
The Museum Support Center, costing USD42 m has been established to house 25 m specimens, especially wet collections in ethanol, which constitute a fire risk. MSC has a footprint of 100,000 sq ft and is equipped with state-of-the-art equipment and safety features. Most scientists are expected to remain in the Museum and commute to the MSC to work on specimens. Visiting scientists are provided with working space at the MSC. The facilities at the MSC are so good that more and more staff scientists are considering moving there.

Membership

The Museum actively recruits members, who are called 'Museum Associates'. There is a programme of talks almost every evening that people buy tickets to attend, but 'Museum Associates' get a discount. There are 45,000 associates.



A museum laboratory



Wide corridor between the two parts of a MSC duplex: laboratories on one side, collections vaults on the other side

Biodiversity Heritage Library (BHL)

The National Museum of Natural History is a member of a consortium of ten major museums in US and UK driving the development of a virtual library—the Biodiversity Heritage Library (BHL)—with technology provided by a non-profit partner, Internet Archive. The aim is to digitize all the biodiversity literature of the world on an open access Internet platform. This means that researchers anywhere in the world will, for the first time in history, have access to all published information. Files can also be made available for those who want to develop linkages to other files (repurposing).

Scanning is done on special machines at very high resolutions (up to 1 mb per page). The books are placed on special cradles that allow for two facing pages to be flattened and scanned at the same time. Further correction of page curvature is done with software. OCR is carried out on the texts, and the software identifies species names (including probable species names) for checking and confirmation by eye. 'Taxonomic intelligence' software is being developed to link up synonyms, spelling variants, and misspellings for each species so that the library can be searched under any species name that has appeared in the literature.

Internet Archive was founded by Brewster Kala with support from the Sloan and other foundations to promote open access to published information via digitization. Additional information on BHL is provided in this report under the Natural History Museum, London.