

Australian Museum

Science Research Strategy

2007 – 2012

(UPDATED JULY 2007)

nature culture **discover**



Table of Contents

| | |
|--|----|
| > INTRODUCTION | 3 |
| > DRIVERS | 3 |
| > EXTERNAL DRIVERS | 3 |
| 1. Significant Issues in New South Wales | 3 |
| 2. International Issues | 3 |
| 3. National Research Priorities | 3 |
| 4. Resourcing and Collaboration | 4 |
| > INTERNAL DRIVERS | 4 |
| 1. Research and Collections Review 2005 | 4 |
| 2. Research Fields | 4 |
| 3. Collection Focus | 4 |
| 4. Other key research infrastructure | 4 |
| 5. Recognised Experts | 4 |
| 6. Exhibition, publication and public programs | 4 |
| > RESEARCH PROGRAMS | 5 |
| Program 1 | |
| Addressing knowledge gaps and problems in understanding the biota in Australasian marine environments. | 5 |
| Program 2 | |
| Addressing knowledge gaps and problems in understanding the biota in Australian terrestrial and freshwater environments. | 6 |
| Program 3 | |
| Increasing our understanding of the genetic variation in key taxa (species) of the Australasian and Indo-Pacific biota. | 6 |
| Program 4 | |
| Origin, evolution and biogeography of the biota of the Indo-Pacific and Australasian region. | 7 |
| Program 5 | |
| Understanding human impacts on the Australian biota. | 7 |
| Program 6 | |
| Investigating the history of human cultures and communities in Australia and the Pacific Region. | 8 |
| Program 7 | |
| Linking intangible and tangible heritage. | 9 |
| Program 8 | |
| Investigating extant and extinct faunas and environmental systems in the context of recent geological history to better forecast future changes. | 10 |
| > COLLABORATION AND CROSS-PROGRAM INITIATIVES | 11 |
| > MOVING FORWARD | 11 |
| > RESEARCH & COLLECTIONS ADVISORY COMMITTEE | 11 |

Introduction

The Australian Museum's purpose is to inspire the exploration of nature and cultures, in part through undertaking an active and innovative program of research into the environments and indigenous cultures of the Australasian region. Under legislation (the Australian Museum Trust Act, 1975) the Museum has specific objectives to propagate knowledge about the natural environment of Australia and to increase that knowledge, particularly in the natural sciences of biology, anthropology and geology. The Museum's Corporate Strategic Plan includes the specific goals to:

- Find new connections across nature, culture and our lives
- Build a time series of objects defining our natural and cultural world
- Unlock and share the knowledge in our natural and cultural collections

The purpose of this Research Strategy is to set out the Australian Museum's science research priorities for the next five years, including strategies and broad activities to address those priorities. In developing the Strategy, the Museum's vision, purpose, context, research strengths and capabilities have been taken into account, as have both state and national priorities. In particular, the Strategy has been informed by the work of the Museum's Research and Collection Advisory Committee and its Research and Collections Review Stage 1 2005.

The Research Strategy balances the Museum's existing research and collections strengths with emerging issues and priorities. While the Strategy provides a framework for research at the Museum, it allows individual researchers to have some freedom in the development of their research directions to make best use of their expertise and knowledge.

The five-year time frame reflects the need to balance long-term projects requiring detailed cumulative analysis with short-term projects developed in response to urgent issues or changing needs.

Drivers

EXTERNAL DRIVERS

1. Significant Issues in New South Wales

The Museum's research and collections are well placed to make significant contributions to addressing major environmental issues in NSW. Identified priority areas include the loss of biodiversity (NSW Biodiversity Strategy 1999), climate change (NSW Biodiversity and Climate Change Adaptation Framework 2006-2008), invasive species (NSW State of the Environment Report) and better environmental outcomes for native vegetation, biodiversity, land, rivers and coastal waterways (NSW State Plan: A New Direction for NSW, November 2006). Museum research is directly relevant to several of the NSW Government's state-wide targets for natural resource management under the State Plan, in particular, those relating to biodiversity and water.

As a NSW government agency the Museum has responsibilities under the Two Ways Together Policy. The Museum contributes to two key areas, in particular 'enhancing the skills and capacity of Aboriginal communities and individuals' and 'supporting and affirming Aboriginal people's culture and heritage'. The Museum's anthropological and archaeological research

contributes to a stronger multi-cultural society in NSW by being directly relevant to the following government policies: Green Paper, 'Cultural Harmony: the Next Decade 2002-2012', and the White Paper 'Building on our Cultural Diversity: Ethnic Affairs Action Plan 2000'.

In addressing these issues, the Australian Museum seeks to work collaboratively with other relevant state agencies.

2. International Issues

As a leader in research into the biodiversity and Indigenous cultures of the Australasian-Pacific region, the Australian Museum is well placed to continue to work independently and in collaboration with Australian communities and Pacific nations on answering fundamental questions about the natural history and cultures of the region.

3. National Research Priorities

The Commonwealth Government has committed substantial funding to research infrastructure and the development of strategic research priorities across Australia in line with its National Research Priorities. Much of the research undertaken at the Australian Museum is aligned with one or more of these priorities, primarily:

- An environmentally sustainable Australia;
- Frontier Technologies for Building and Transforming Australian Industries; and
- Safeguarding Australia.

The National Collaborative Research Infrastructure Strategy has identified biological collections as key research infrastructure and provided funding through this program to develop an Atlas of Living Australia. The availability of Commonwealth Government funding offers the opportunity for the Australian Museum to leverage funding for the purposes of contributing to development of infrastructure and research in NSW.

4. Resourcing and Collaboration

A significant proportion of Australian Museum research funding (other than salaries of permanent staff) is sourced externally – around \$1.5m annually. Funding sources include International bodies, National and State Government agencies and the private sector. Grants reflect priorities of the funding organizations and, in many cases because of the scale and nature of the projects involved, necessitate collaborative efforts.

Researchers at the Australian Museum collaborate with a large number of Australian and international research institutions, resource management agencies and private sector organizations in projects relevant to the Museum's vision and objectives.

INTERNAL DRIVERS

1. Research and Collections Review 2005

The Research and Collections Review 2005 made a number of recommendations pertinent to the conduct, promotion and application of Australian Museum research. Recommendations particularly relevant to the content and nature of research included:

- The need to identify, prioritise and address strategic gaps in zoological collections;
- The need to regularly review emerging issues for which the AM collection may contribute better understanding and/or solutions; and
- Bringing together interdisciplinary teams to address key issues.

2. Research Fields

Current research and/or collection strengths are in the areas of zoology, palaeontology, geology, materials conservation, archaeology, anthropology, taxonomy, systematics, molecular genetics, biodiversity mapping and measurement, and ecology. Some areas of the Museum's research are world-leading.

3. Collection Focus

The Museum collection comprises more than 14 million specimens and objects with particular strengths in Indigenous archaeology, Australian and Pacific ethnographic artefacts, rocks, minerals, fossils, birds, fish, reptiles, mammals, molluscs, insects, spiders, crustaceans, echinoderms and annelids.

The Museum's collections are a valuable source of material and information for research, display, education, managing the biodiversity and geodiversity of Australia, and understanding indigenous cultural diversity and heritage in the Australasian Region. In addition, the collections serve as a reference base and historical archive of the diversity of animal species (both past and present), plant species from the past, geological diversity in Australia and other parts of the world, as well as representing the significant cultural heritage of contemporary Indigenous people of greater Australia and the Pacific Region.

The relationship between the Museum's collections and research is an important one, with each part serving to shape the direction and development of the other. The relationship is explored in more detail in the Research and Collections Review Stage 1 2005. The research priorities detailed in this Strategy have been developed in consideration of how the Museum's research can gain the most value from its collections and equally, how the Museum's research can add the most value to its collections.

4. Other key research infrastructure

The Museum's major facilities include a Bioinformatics and Geographic Information Systems unit, a Scanning Electron Microscope, a Microanalysis and Imaging unit and a DNA laboratory. The Museum also owns and operates the Lizard Island Research Station – a world-leading coral reef field station situated on the northern Great Barrier Reef, 270km north of Cairns, Queensland. The Museum is also affiliated with the Sydney Harbour Institute of Marine Sciences, which supports marine research in Sydney Harbour

5. Recognised Experts

Much of the Museum's research strength lies in its specialist research scientists and collection management staff, many of whom are world authorities in their fields. Their expertise and research networks are key drivers of existing emerging research questions and projects. The Research Strategy recognises the need to build on the abilities and achievements of its leading researchers.

6. Exhibition, publication and public programs

The Museum's objective – to inspire the exploration of nature and culture – recognises the need for the Museum's primary functions of research, collections and public programs to be integrated. Research resources are used to support a wide range of public program initiatives, with support ranging from the coordination and provision of existing knowledge in response to public enquiries through to generating new knowledge for new exhibitions. For significant exhibitions research staff may be employed specifically to work on exhibition development in their field. Discoveries made by the Australian Museum's researchers are also actively integrated into its public programs.

RESEARCH PROGRAMS

This Research Strategy outlines eight broad Programs (problems, issues, knowledge gaps or challenges) that define the research span of the Australian Museum. These Research Programs have been identified through consideration of the internal and external drivers as well as the Australian Museum's Corporate Strategic Plan and the Research and Collections Review Stage 1 2005.

The Museum's research effort can also be described as a series of specialist activities, techniques or approaches, and these activities can and do often address more than one Program. Rather than repeating these through the individual Programs, the following research activities are assumed to be fundamental to Museum research:

- Descriptions of fauna
- Development of Phylogenies / taxonomies
- Genetic and DNA studies
- Descriptions of rock types, minerals, fossils etc
- Building of collections through space and time
- Mapping species and artefact distributions
- Documenting intangible heritage and oral histories
- Excavation and recording of archaeological sites.

The Programs outlined in this Strategy essentially represent the application of these fundamental research activities to addressing significant questions. These range from filling key knowledge gaps in basic research, to directly addressing questions of significant community interest, such as understanding the impact of rapid climate change or how water usage and shortages impacts on river dependent biodiversity.

Key research and goals have been outlined within each of the broader Programs. While the basic research activities will remain relatively fixed over time due to the fundamental role of museum research, it is important for the Australian Museum to maintain a degree of flexibility so it can respond to changing demands, contemporary challenges and new opportunities.

Program 1

Addressing knowledge gaps and problems in understanding the biota in Australasian marine environments.

Our marine domain covers an area of over 8 million square kilometres – more than the Nation's land area. Human impacts continue to create threats to the sustainability of our marine ecosystems and the maintenance of marine biodiversity. A key requirement for conserving and managing marine environments is better understanding of marine biological communities.

The Australian Museum is undertaking several projects relating to Australia's marine environments. In selecting projects, consideration is given to a variety of factors including the status of taxonomic knowledge of the group;

whether species are of particular ecological significance; whether the Museum's collections are strong in an area and would support the exploration of evolutionary questions; and whether the Museum has particular expertise in the field.

Key research goals

a) Understanding Australia's marine biodiversity, emphasising species with key ecological roles and high sensitivity to human impact.

Within Australia's extensive marine domain, there are some geographic areas and some taxonomic groups that are particularly important. Over 80% of Australians live on the coast. The resultant anthropogenic (human) impacts seriously affect the diverse and productive marine ecosystems that occur along the coast and out onto the shelf. By virtue of these pressures, there is a particular need to undertake research and collection development in coastal and intertidal areas, especially on the east coast.

Knowledge of the offshore biota is also particularly important at this time. Biological characterisation of offshore areas is required to inform the development of a national representative system of Marine Protected Areas in Commonwealth waters by the Australian Government. A similar course of action is underway in state waters.

Given their fundamental ecological roles and sensitivities to impact, benthic (sea floor) fauna should be a particular focus for research and collections.

b) Understanding the connectivity of marine populations.

Defining the scale of connectivity among marine populations and determining the factors driving this exchange are necessary to understanding the population dynamics, genetic structure, and biogeography of many coastal species. This knowledge can be used to identify centres of endemism, 'sources' and 'sinks' and be applied in planning individual species and biodiversity management options.

c) Understanding the biodiversity of coral reefs.

Coral reefs around the world are under threat from both global influences and local pressures. Basic taxonomic and ecological knowledge is fundamental to understanding coral reef systems and helping to understand responses to anthropogenic impacts. The Australian Museum's research station at Lizard Island is a world-leading facility for this type of basic research. The Station provides an outstanding on-reef platform for research at the northern end of the Great Barrier Reef for both site-specific and comparative studies.

Areas for potential further development

Given current initiatives in regional marine planning and the establishment of marine protected areas within both state and offshore waters, the Museum will give greater focus to research that can support decision-making in these areas.

Program 2

Addressing knowledge gaps and problems in understanding the biota in Australian terrestrial and freshwater environments.

A key requirement for conserving and managing Australia's terrestrial environments is better understanding of the composition and interactions of their fauna (vertebrates and invertebrates), particularly in areas of high human impact/threat, and in areas of high species diversity. The stocktake of Australia's biota is only about 30% complete. Because we are currently in a phase of significant biodiversity loss, we must accelerate the process of identifying, documenting and describing Australia's fauna particularly in areas and for groups that are most vulnerable.

The Australian Museum is extremely well placed to contribute to this because of its extensive collection of terrestrial fauna, taxonomic expertise within its research and collections staff; long standing international reputation in taxonomic research, and extensive network of external expert collaborators and institutional partnerships.

Key research goals

a) Understanding the species and places of high biodiversity significance in Australia.

There is a critical need to prioritise geographic areas for implementation of conservation measures within Australia to protect biodiversity and ensure financial resources are allocated cost-effectively. Eastern Australia is the most densely populated region and has suffered the greatest loss of natural habitat. Research is required to obtain the basic taxonomic and distribution data and to develop robust methodologies for data analysis and information presentation in conservation planning. By focusing on regions of high species diversity, and/or high endemism, coupled with the high threat of species loss, the Australian Museum will contribute not only to the documentation of species, but also to the identification of areas of high conservation value. Priorities will be driven by both the taxonomic expertise available at the time and the relevant state/national priorities.

b) Understanding the distribution, interaction and evolution of key species in arid Australia.

The arid zones of Australia have been heavily impacted by clearing and are particularly fragile. By focusing on this region the Australian Museum will contribute not only to the documentation of species, but also to the identification

of places of biodiversity significance and where these places intersect with human activity. The Museum's research in this area has focused on those taxonomic groups with significant evolutionary radiations within the dryer regions of Australia. The groups have been studied in an effort to understand whether they have colonised those areas from wetter regions or whether they have successfully radiated in situ. Those projects may develop our understanding of how climate change and other anthropogenic forces could impact on future generations of diversity.

Areas for potential further development

Given the increasing focus on water resource issues in NSW and indeed across Australia, the Museum will look at ways to enhance its capabilities in the taxonomy, biology and ecology of freshwater fauna.

Program 3

Increasing our understanding of the genetic variation in key taxa (species) of the Australasian and Indo-Pacific biota.

Genetic information is now a powerful tool in evolutionary and systematic studies. Genetic data provide objective assessments of species identity, including the ability to differentiate physically similar species as well as robust information on species relationships. Understanding the genetic diversity within species and populations is a key component of modern conservation planning because maintaining genetic diversity in taxa is recognised as a key component in their long-term ability to survive and adapt. The distribution of genetic variation within species complements behavioural studies to provide insights into the patterns of dispersal and movement.

Key research goals

a) DNA Barcoding of taxonomic groups that are of economic, social or environmental concern.

Compiling a library of DNA barcodes linked to voucher specimens can provide a significant reference tool for identifying species. Potential applications of barcoding include identification of animal parts or products (for instance in relation to wildlife trade) and identification of animals at various life history stages (such as early detection of larvae of introduced marine pests or commercial fish species).

b) Genetic approaches to monitoring biodiversity and assisting resource-use planning for biodiversity conservation.

A suite of molecular biological approaches are developing to support conservation management policy and planning. One such innovative approach is Landscape Genetics. This approach combines leading edge biotechnologies with geographic information systems to develop new tools for monitoring biodiversity and assessing the impact of threatening processes (e.g. climate and habitat change) on populations, species and ecosystems. The Australian

Museum is well placed to be a leader in this area given its developing expertise, collections and facilities. A further strengthening of this capability is to link it with geological research focused on key current biogeographical and environmental regions.

Areas for potential further development

Given the significant international efforts in the use of genetic approaches to species identification and conservation, the Museum will engage more with the Consortium for the Barcode of Life and work with natural resource management agencies to identify key environmental issues that genetic approaches may resolve.

Program 4

Origin, evolution and biogeography of the biota of the Indo-Pacific and Australasian region.

One of the world's most significant biogeographical barriers is "Wallace's Line" which defines the break between the faunas of the Oriental Region and the Indo-Pacific and Australasian Region. Recent studies have identified the Indo-Pacific and Australasian Region as the centre of origin for many taxonomic groups now centred in the northern hemisphere. These studies have generated renewed international interest in the Region.

The Australian Museum is uniquely placed to play a key role in leading major research initiatives in the Region. The main advantages are the expertise and infrastructure currently available and being developed, and the fact that Australia is centred within this biologically significant Region.

Key research goals

a) Understanding the origins of the Australian fauna.

The fauna of Australia consists of a huge variety of unique animals. More than 85% of major animal groups that inhabit the continent are endemic to Australia. This high level of endemism can be attributed to the continent's long geological isolation.

Elucidating which components of Australia's biota have evolved in situ as opposed to those which have recently colonised Australia from surrounding regions, is important from several perspectives. It identifies those species groups that have a long term adaptation to the environment and are able to respond effectively to environmental changes, and those groups which colonise and recolonise regions as conditions change. Such information adds to our knowledge on the biogeographical history of Australia as well as allowing us to better model the potential evolutionary consequences of climate change.

b) Understanding the biogeography and evolution of the Indo-Pacific fauna.

To understand the complexity of the Australian biota it is essential to place it into a regional context. Issues that need to be addressed include: determining which components of the Australian biota have developed in situ and which have been derived from the Indo-Pacific region; what role has the break-up of Gondwana had on shaping the present day southern biota; and what are the patterns of differentiation and speciation on continental versus island biotas.

Areas for potential further development

Given the complexity of questions in this area, this research needs to be implemented through multidisciplinary approaches involving molecular, morphological, palaeontological and biogeographical studies. Some of the areas that need to be addressed include: testing competing hypotheses on the biogeography of Australian and Indo-Pacific biota; understanding the nature of the Australian biota in the context of its relationship to other geographical areas of the Southern Hemisphere; investigating processes such as co-evolution, adaptive radiation, dispersal and modes of speciation to explain biodiversity patterns in Australasia and Indo Pacific; and synthesising morphological, molecular and palaeontological information so that general theories can be proposed on the origin of Australia's biota and its global significance.

Program 5

Understanding human impacts on the Australian biota.

Over at least the last 50,000 years human habitation in Greater Australia has had major impacts on the fauna and flora. Some of these have been direct (through harvesting animal and plant species as well as landscape/habitat modification including Aboriginal firing practices), some indirect (introduction of invasive species), while others operate through more circuitous and longer term routes (climate change). Not all activities are deleterious to all species, and some species have benefited from human-induced changes. These, in turn, have themselves had negative effects on other facets of the environment. As anthropogenic (human) influences will continue, especially in high density areas, it is necessary to incorporate information about the long-term history of anthropogenic impacts into planning for the future.

It is important for the Australian Museum to identify those areas that can be addressed through its current collections and expertise and what is necessary to address identified gaps. This will often require the development of close working associations with key organisations and stakeholders associated with environmental and conservation planning and management. Such networks will allow the Australian Museum to identify priority taxonomic groups most likely to inform current conservation planning and management and to develop multidisciplinary approaches to assessment of overall biodiversity patterns.

The Australian Museum can also establish palaeontological, archaeological, and historical baselines against which recent and future changes to Australia's biodiversity can be compared.

Key research goals

a) Assessment of the vulnerability of Australia's freshwater and estuarine ecosystems to human impacts.

Many river systems, particularly in the south, have been extensively degraded by water extraction and habitat destruction. Some major river systems are in a state of ecological crisis. Estuaries, where these rivers meet the sea, are the recipients of accumulated impacts and this is of particular concern given their nursery role for marine fishes and invertebrates. Given the potentially enormous social and economic impacts of changes to water use patterns, information based decision making on conservation alternatives is critical. Australian Museum research into the fauna of these sensitive ecosystems and comparisons with historical records will support assessment of the health of the systems.

b) Investigating the effects of climate change on the Australian fauna.

The distribution of most species, populations and communities is determined, at least at some spatial scale, by climate. Climate change may involve both changes in average conditions and changes to the frequency of occurrence of extreme events.

Response of organisms to future climate change (however caused) is likely to differ from that in the past because it will occur in a highly modified landscape in which the distribution of natural communities is highly modified. This may limit the ability of organisms to survive climate change through dispersal. Terrestrial and marine species at risk include those with long generations, poor mobility, narrow ranges, specific host relationships, isolated and specialised species and those with large home ranges. Pest species may also be advantaged by climate change. With reference to historical collection records and knowledge of the biology and distribution of individual species as well as their taxonomic relationships Museum research can contribute to an understanding of both historical changes and potential future scenarios of climate change impacts.

c) Understanding Human Impacts in the Sydney environs.

Growth and expansion of the Sydney population has had, and continues to have, significant impacts on the ecology of the environment. Archaeological research has shown that human impacts, particularly through the use of fire have a long history in this region but more needs to be known about the antiquity of this practice and the nature of impacts on local fauna and flora. As well as informing policy and planning decision-making (for example through faunal surveys to support informed assessment of potential environmental impacts of development),

research into the impacts of urbanisation on fauna offers prime opportunities for community education through involvement in research activities.

Areas for potential further development

Given the historical depth of its collections the AM should make greater use of this unique resource to assess human impacts and to forecast possible future scenarios. The Museum's capacity for freshwater faunal research should be strengthened.

Program 6

Investigating the history of human cultures and communities in Australia and the Pacific Region.

A core goal of anthropological research is to understand the origins and processes of the changes in Indigenous communities which led to cultural diversity. Assessing the influences of the physical and biotic environment, including climate change and natural disasters, and demographic factors, on social, economic, technological and ideological aspects of life as reflected in artefacts and ecofacts (natural items such as plant seeds found at archeological sites) is critical to this research.

Research focused on cultural landscapes considers the interplay between environmental context and cultural meaning. It therefore plays a major role in promoting and preserving Indigenous cultural heritage – movable (objects) and immovable (places) and their associated intangible heritage.

Key research goals

a) Understanding the history and diversity of Indigenous material culture.

Throughout the history of Greater Australia and the Pacific indigenous people have devised new tool forms and technologies. Investigating the origins of these, the reasons for their appearance and changing abundance, and their relationships to shifts in subsistence, mobility and social links provides evidence for the way in which societies diversified over time. Current projects include the analysis of stone tools and their functions from current excavations as well as material held in the Museum's Archaeological and Ethnographic Collections. An important new focus is research on the Ethnographic collections to understand the nature of interactions between indigenous communities and European explorers, traders, colonisers and tourists during the past 200 years.

b) Tracking the history of human interaction with the natural environment.

One of the most important questions of the contemporary world is whether and in what ways human societies can adjust to climate change.

Archaeological research provides useful information about how past societies have both managed and controlled their local environment and how they have reacted and coped with climatic changes and natural disasters.

c) Understanding the origin and functions of social exchange.

Systems for exchange are integral to all human societies, but they are very diverse in terms of the material and nonmaterial components that circulate, the methods by which these are passed between individuals and/or groups, and their role within economic, social and ideological spheres of life. Research on exchange demonstrates the complexity of Indigenous cultures and the extent of their interconnectedness. The very early occurrence of exchange systems in the Australasian region and their large spatial extent means they stand out on a global scale and highlight them as of particular importance for understanding the history of human culture.

Areas for potential further development

In 2006 the Museum initiated a two-year project to identify supplementary strategic directions for cultural/ anthropological research, collection development, access and outreach at the Australian Museum. The outcomes of the project will guide the nature and future direction of the cultural and anthropological research of the Museum, and include a set of clearly articulated priorities and a plan for their implementation, as well as a strategic plan for the development of the cultural collections. The project will also highlight opportunities for further engagement with key community stakeholders through innovative outreach and collection access programs.

Program 7

Linking intangible and tangible heritage.

Understanding cultural diversity requires research on Indigenous knowledge systems because these shape all aspects of daily and ritual life in these communities. UNESCO has recognized the urgency of promoting and preserving traditional intangible heritage because it is under constant threat of survival due to development and globalization. Intangible heritage includes genealogies and kinship systems, oral history, legends, myths, and knowledge about domestic, ritual craft and artistic practices, and practical technologies relating to, for example, subsistence and navigation.

The Australian Museum has an extensive collection of cultural material from Australia, New Guinea and the Pacific. Building our collection of intangible heritage will increase our understanding of the role and meaning of these artefacts both within the past and contemporary communities from which they derived. These items are more than just research objects; rather they represent aspects of the living culture of the creator communities. It is important for museums to link the collections back

to source communities to foster and celebrate the living collections of the region. Moreover, some intangible heritage is not linked to artefact.

Key research goals

The nature of research in this area is being considered in the above-mentioned two year review. Current research in this area is focused on the following:

a) Understanding the roles of material culture and traditional knowledge in Indigenous cultures.

Understanding the diverse roles that artefacts play in the lives of social communities is a key research focus in contemporary Anthropology. The extensive cultural collections at the Australian Museum hold a potential fund of knowledge about how artefacts were used and valued within societies, how these have changed during the past 100 years and the role of artefacts in negotiations with outsiders through trade and exchange (e.g. Western explorers, collectors, missionaries, etc.). Incorporating traditional knowledge provided by community members is a standard practice in fieldwork, but represents a significant innovation for museum anthropology.

b) Understanding the collecting process.

Research into the process of collecting is essential for understanding the history and composition of the cultural collections, for putting them into their social context in the past and in the contemporary world and for designing relevant collection strategies for the future.

Such research also represents an essential component to best practice collection management.

c) Engaging with creator communities to better understand the significance of our collections.

Increasing the ongoing research projects of collecting intangible heritage related to museum objects will significantly enhance the scientific value and contemporary relevance of the anthropological collections at the Museum. Apart from providing a resource for the creator communities, they can also add their own intangible heritage to the database and thereby further support current aspects of their culture and assist with cultural revitalisation.

The Museum will actively continue to engage with creator communities from a variety of regions, with a focus on communities from NSW, Australia and from areas of the Pacific Region from which the Museum holds significant collections.

Areas for potential further development

Current research towards these goals outlined above is well supported by extensive multi-institutional collaborations. Areas for potential further development will be guided by the outcomes of the two year review mentioned previously.

Program 8

Investigating extant and extinct faunas and environmental systems in the context of recent geological history to better forecast future changes.

While traditional earth science research has focused on describing and documenting faunas, geological features, and processes, there is a rapidly growing emphasis on using knowledge of past environments, events and processes to contribute to our understanding of current and future change. This shift away from the traditional descriptive approaches in both palaeontology and geology is appropriate, and indeed urgently required in view of the widely documented threats of human activity to the support systems of life on Earth.

Given the diversity of Australia's environments, and the scale and complexity of current issues requiring multi-disciplinary approaches, research in this area will need to rely heavily on collaborative endeavours.

Earth scientists, especially palaeontologists, can contribute significantly to 'reading the library' of past environmental change and, with this as a backdrop, they are in a pivotal position for carrying the exercise forwards, contributing to modelling the future. Increasingly frequent extinction events and increasing concern over global environmental change call for immediate attention.

The Australian Museum has an excellent record in 'deep time' palaeontology. Particular examples include the remarkable Devonian fossil fish faunas of central-western NSW, as well as mounting stunning exhibitions of the great dinosaur faunas of China and Mongolia. The educational value of the latter has been enormous. In the context of increasing focus on contemporary global change, this area of research is regarded as being of lower priority than the key goals outlined below.

Key research goals

The nature of research in this area is being considered in the above-mentioned two year review. Current research in this area is focused on the following:

a) Studying animal groups that leave good fossil records to help forecast future change.

Research into particular animal groups that leave good fossil records can offer significant contributions to predicting future change on the basis of past change. Palaeoclimatic modelling, in concert with this knowledge of past impacts on Australia's biodiversity, provides a powerful collaborative synergy. Of particular relevance to Australian biota and environments today are the changes that occurred during the mid- to late Cainozoic. Molluscs are by far the most important group for analysis of Mesozoic and Cainozoic patterns of community ecology and biogeographic change. It would be useful for an invertebrate palaeontologist at the AM to have

broad expertise in molluscs, specifically through the end-Cretaceous to Recent time-slice rather than for events in the very deep past. Other groups of potentially great ecologic value are the bryozoans, ostracods and foraminifers for the same time-slice. Australia, considered in conjunction with New Zealand, has superbly exposed stratigraphic sequences for undertaking this sort of research.

b) Analysing dynamics of contemporary and recent reef systems.

Reef systems are pivotal in man's survival as carbon sinks and as contributors to regulating the sort of air we breathe and, indirectly, to food supplies. The Australian Museum has had a long and significant involvement in contemporary reef studies. Excellent, essentially untouched, target areas for parallel/integrated analyses of our contemporary reefs and the dynamics of Late Cenozoic reefs are available in the South West Pacific. There has been remarkably little research on these elegantly exposed reef systems (reflecting reef dynamics through the last 30-40 million years). There is thus potential for a palaeontologist-neontologist with expertise in hard corals, calcareous algae, bryozoans, foraminifers or molluscs to contribute significantly to elucidating reef dynamics through this long period of time and to modelling the future of our threatened reef systems. There is great potential for team-involvement with biologists in the AM and other organisations with coral reef expertise.

c) Sedimentary mineralogy.

The Australian Museum is a globally important repository of mineral elegance, and has a long history of significant contributors to traditional mineralogy and igneous petrology, including identifying economic minerals. A slight shift in focus towards sedimentary mineralogy would enable the Museum to contribute in a wider way to projects involving sediments. The Museum's long involvement with reef research, for instance, has lacked research on associated sediments and wresting environmental information from them. Partnering and forging collaborations (with experts in sedimentary mineralogy) would allow the Museum to contribute significantly to documenting the changing patterns of habitat and climate in the present and recent past in NSW, including the patterns reflected in our coastal sediments and their biota, living and fossil.

Areas for potential further development

Given the increasing focus on the collective impact of human activity, Australian Museum earth science research should be oriented more strongly towards understanding dynamics in the recent past with a view to informing predictions of future change. Faunas that leave good fossil records, reef systems and sediments offer exciting research opportunities in this context.

COLLABORATION AND CROSS-PROGRAM INITIATIVES

Researchers at the Australian Museum collaborate with a large number of Australian and international research institutions, resource management agencies and private sector organizations in projects relevant to the Museum's vision and objectives.

Collaborations take many forms:

- Working with peers on substantial projects and where multiple skills and disciplines are required;
- Joint funding, at times with the Museum as industry partner;
- Student supervision (at both secondary and tertiary levels);
- Involvement in the planning and delivery of tertiary courses; and
- Visiting Research and Collections Fellowships (provided by the Australian Museum).

Reflecting the strength of collaborative arrangements, many of the Museum's research scientists hold adjunct appointments at Australian universities, and several at overseas institutions.

Since around 2000, research emphasis at the Museum has moved increasingly towards multidisciplinary programs that have outcomes of high social or scientific relevance. An evolution of organisational structures has both encouraged and reflected this change. The current three Branch arrangement (Research, Collections and Collections & Research Resources Branches) provides a relatively seamless platform for integrative research.

MOVING FORWARD

Whether the Museum decides to undertake a particular research activity or program will be based on a synthesis of all of the factors outlined above. Research projects will be pursued if they meet a substantial number of the following summarised criteria:

- The research falls into one of the 8 Program areas identified in this strategy
- The research builds on existing expertise and collection strengths
- The research opens opportunities for collaboration with other partners
- The project or activity is primarily public good research
- The research is primarily to do with our region of the world (Australia, south east Asia and the Indo-Pacific)
- The research addresses an area of community interest or concern

- The research is consistent with NSW, national or (relevant) international priorities
- The research addresses a group of organisms where there is (national) consensus that the group is a priority for research
- Funding for the research can be identified from core Museum resources and/or grants or other external funding.

Implementation of this Strategy will be progressive as opportunities for change arise. Specifically, recruitment of new research staff will be guided by this strategy, as will the pursuit of major grants. A separate implementation and evaluation plan will guide and monitor the uptake of the Science Research Strategy.

RESEARCH & COLLECTIONS ADVISORY COMMITTEE (RACAC) MEMBERS

Dr Ronnie Harding

Chair, Visiting Associate Professor, Institute of Environmental Studies, University of New South Wales

Professor Maria Byrne

Department of Anatomy and Histology, School of Biological Sciences, University of Sydney

Dr Leslie Christidis

Assistant Director (Science & Collections), Australian Museum

Dr Hal Cogger

John Evans Memorial Fellow, Australian Museum

Professor Lesley Head

School of Earth and Environmental Sciences, University of Wollongong

Mr Frank Howarth

Director, Australian Museum

Dr Klaus Koop

Director, Environmental and Conservation Sciences, Department of Environment and Conservation (NSW)

Professor Margaret Rose

Director, Research Management, South East & Illawarra Area Health Service, Professor, University of NSW

Associate Professor Stephan Schnierer

Director, College of Indigenous Australian Peoples, Southern Cross University, Lismore

Mr Brian Sherman AM

President, Australian Museum Trust

Dr Brett Summerell

Director, Science and Public Programs, Royal Botanic Gardens

Professor John Talent

Professor, Department of Earth and Planetary Sciences, Macquarie University