AUSTRALIAN MUSEUM RESEARCH INSTITUTE

SEMINAR & DISCUSSION

FRIDAY 8 NOVEMBER 2013
10am to 12noon

AUSTRALIAN MUSEUM THEATRE

WHAT DO MUSEUM COLLECTIONS REVEAL ABOUT CLIMATE CHANGE?

Welcome and Introduction: Brian Lassig (Head, Australian Museum Research Institute)

Leveraging museum collections to understand species response to environmental change: Professor Craig Moritz **(**ANU Research School of Biology)

Museum collections, specimens originally gathered for different reasons and subsequently protected, continue to provide a key resource to answer emerging questions. Among these is the impact of rapid environmental (including climate) change on species. In this talk I will illustrate how the early 20th Century collections of Californian birds and mammals amassed by Joseph Grinnell at the UC Berkeley Museum of Vertebrate Zoology have enabled insights into species response to 100 years of change. Resurveys of distributions, recollecting of specimens and subsequent analyses of phenotypic and genetic diversity has revealed both common patterns and idiosyncratic responses of species. More importantly this "Grinnell Resurvey Project" amply illustrates that carefully curated museum collections provide a unique, physical record of species' and population histories that be interrogated in increasingly diverse ways and to address new questions.

Collections as a key part of new integrative approaches for assessing climate change impacts on biodiversity: Dr Dan Faith (Principal Research Scientist, Australian Museum)

This meeting is to explore the extent to which museum collections “are useful in understanding past or future impacts of climate change”. It should not be surprising that collections are a key source of information about climate change impacts, particularly when we want to assess the impacts on biodiversity (the wide variety of living things, rather than, say, a single species). Collections broadly inform about biodiversity at the species, phylogenetic and (increasingly) genetic levels. However, collections typically are not fully informative on their own – we integrate environmental data, expert opinion, and so on, in order to assess impacts. Two of my current climate change research activities highlight such integrative approaches, and the broad utility of Museum work linked to collections.

1. Climate change scenarios point to changes in the environment, including the changing climate of localities. We can talk about the change in (or even loss of) different kinds of localities or ecosystems. Models that integrate available environmental data with multi-species collections information convert such climate change scenarios into corresponding predictions about biodiversity loss. The

development of a "report card" for NSW, based on these analyses, will fill a major gap in current reporting of climate change impacts on biodiversity.

2. Museum collections support the development of phylogenies, and so link to biodiversity conservation focussed on preserving the tree of life, and our evolutionary heritage (we refer to "phylogenetic diversity" or "PD"). As our recent work on corals illustrates, assessments of potential climate change impacts on PD reveal information not found in the existing assessments of the impacts at the species level. A new "phylogenetic risk analysis" must cope with potential tipping points that would imply high loss of phylogenetic diversity.

These examples highlight priorities for research, and these priorities then flow through to priorities for collections, including priority taxa/localities for improved models, and priority species for more complete phylogenies.

Natural science collections support climate change research: Dr Dave Britton (Acting Head, Natural Sciences, Australian Museum)

There is no question that natural science collections are vital resources for climate change researchers. There are no other places where researchers can access curated historical collections of expertly identified specimens to address questions about changes in the biota over time in response to environmental change. However, museum collections were not collected with climate change research in mind, and the specimens and data associated with them are not always ideal for answering questions about climate change. There are often big gaps in time series, collections from single localities are not repeated over time, the absence of species at a given location and time is not recorded, and the taxa targeted by collectors may not be useful to researchers.

Can we improve the development of collections to better support climate change research? What resources are needed to do this, and what might be the benefits and costs of this approach to collection development? This presentation aims to generate objective discussions about the future development of museum collections.

Use of museum collections to identify changes in species distributions which can be attributed to climate change: Dr Pat Hutchings (Senior Principal Research Scientist, Australian Museum)

A recent study looked at distributions of several marine invertebrate groups along the east coast of Australia (Przeslawski et al. 2012) based on Australian Museum collections. After reviewing the data we selected molluscs and divided records into those prior to and after 1970. However it is critical that the appropriate experts are consulted to assess which species may be useful and whose taxonomy is relatively stable. It is also important to know the history of collecting during the relevant periods and relate this to the available expertise. Without such specialised expertise and knowledge the wrong conclusions can easily be drawn. So the take home message is that museum collections are useful but need to be carefully analysed by the relevant experts.

We also proposed a strategy to use the resultant data to undertake long term future studies using selected species at reference sites along the East Australian coast.

Rachel Przeslawski, Inke Falkner, Michael B. Ashcroft, Pat Hutchings. 2012.

Using rigorous selection criteria to investigate marine range shifts. *Estuarine, Coastal and Shelf Science* 113 (2012) 205e212

Museum records demonstrate range reductions in *Brachidontes rostratus:* Dr Don Colgan (Principal Research Scientist, Australian Museum)

The marine intertidal can be first-order modelled as a one dimensional system. In practice, this significantly enhances the application of Museum records to questions about species' ranges. In particular, the records can demonstrate range reductions given reasonable provenance accuracy, and adequate contemporary surveys. This approach has been used to reveal a range reduction In the mussel *Brachidontes rostratus* whose distribution characterises the Peronian-Maugean boundary. This reduction is a warning that many other species whose northern range ends at this boundary are at risk of being lost from NSW as a result of climate change.

Climate Change and Montane Biotas: Dr Dan Bickel (Principal Research Scientist, Australian Museum)

Global warming associated with climate change is predicted to drive many montane habitats/ biotas to progressively higher elevations as they track similar climatic zones.

I have been participating on an IBISCA- sponsored survey of Mt Wilhelm in Papua New Guinea, with intensive sampling at eight sites at 500 m intervals, from 200 m - 3700 m, partially to provide a baseline to study how montane biodiversity will be affected by climate change. I will briefly review this program and argue for establishing a similar but on-going baseline survey in New South Wales. The Museum collections provide a vital component of such work.

Size Matters: Malacology Collections and Climate Change: Dr Mandy Reid (Collection Manager of Malacology, Australian Museum)

Our collections hold a wealth of information that can be used to examine the effects of climate change. For example, increasing global temperatures will affect mollusc distributions, with ranges for colder-adapted species shifting southwards, or for terrestrial molluscs, attitudinally. Range shifts can be determined based on historical known distributional ranges as determined from our collections.

In this talk, however, I am going to focus on another trend that is already being observed as a result of climate change: shrinkage. One of the most serious threats to marine molluscs is ocean acidification. Increasing quantities of acid in the world's oceans is already being observed and likely to continue. Ocean acidification makes it harder for marine creatures such as molluscs to form their calcium carbonate skeletons, resulting in reduced growth rates. Shelled molluscs are likely to become smaller at a given age or completely lose the ability to form exoskeletons.

It is not just marine molluscs that are affected, however. Shrinkage in body size is already occurring in many organisms because development and growth and thus organism size is

affected by temperature and water availability. It is likely that the rate and degree of shrinkage will vary widely. Many organisms may not respond quickly enough, leading to extinctions.

The consequences of shrinkage could be far reaching for biodiversity and humans alike. For example, smaller bodies will support fewer or smaller consumers. The study of museum specimens can be used to quantify changes in size across a broad array of taxa, thus providing an excellent opportunity to examine the observed heterogeneity of size changes across both taxonomic and ecological groups. Being able to predict change is critical in creating strategies that reduce negative effects and the historical data held within our collections can play an important role in formulating these predictions.

Geoscience Collections and Climate Change Studies: Dr Ross Pogson (Group Manager of Geosciences, Australian Museum)

In the late 1970s the Australian Museum gained the rock collection and field notes from James Lambeth's 1947- 48 expedition to the sub-Antarctic Heard Island Volcano. A new study on this collection by a PhD student from the University of Tasmania is using isotope and other analysis methods on these rocks to find clues to former ice and sea-levels to reconstruct recent climate changes.

Limestone caves are 'time vaults' which preserve climate data within their calcite speleothems. Measurements of Uranium/Thorium/Lead isotopes, luminescence and palaeomagnetism can give ages, while oxygen & carbon isotopes can correlate to rainfall, warmer/colder periods, and surface vegetation data, over a several 1000 to about 500,000 year time period, to reconstruct recent climate history. There has been limited application of these methods by ourselves and others (e.g. CSIRO, ANSTO, Sydney University) to Jenolan Caves, and there is scope for further collaborative studies.

Panel Discussion (All presenters)