Council of Australian Biological Collections
Productivity Commission "Barriers to Climate Change Adaptation" Issues Paper
December 2011

The Council of Australian Biological Collections (CABC) welcomes the opportunity to provide input to the Productivity Commission's "Barriers to Climate Change Adaptation" issues paper.

CABC is the peak body in Australia for biological collections.
Its membership comprises the following organisations:
Australian Biological Resources Study (ABRS),
Council of Heads of Australasian Herbaria Inc. (CHAH),
Council of Heads of Australian Faunal Collections Inc (CHAFC)
Council of Heads of Australian Entomological Collections (CHAEC)
Council of Heads of Australian Collections of Microorganisms (CHACM).

CABC notes that one of the greatest barriers to effective adaptation of natural resource management to climate change is the paucity of knowledge on likely impacts.

Ecosystems are associations of species that coexist, and are controlled by extrinsic drivers including climate. Changes in those drivers can result in ecosystem disassembly and the creation of novel ecosystems as individual species respond to particular climatic drivers. The ability of species and ecosystems to respond to climate change is largely dependent on ecological space being available, and their ability to migrate against the pace of those changes. In Australia the fragmentation of ecosystems and populations is one of the greatest risks to adapation, and our ability to predict change must be predicated on knowledge of past drivers of change.

Biological collections play an important role in understanding species responses to these climate change impacts. In Australia, vouchered specimens of flora and fauna and their associated data have been collected in a systematic way for over 100 years. Indeed within some jurisdictions these collections have been made in a geographically comprehensive way as part of regional biodiversity assessments, e.g. the South Australian Biological Survey carried out by the S.A. Dept. of Environment and Natural Resources, S.A. Herbarium and S.A. Museum from the late 1970's that vouchered plants and animals state wide along with tissues suitable for DNA analysis.

These are critical historical records of unique events and processes, and provide an invaluable resource for the study of morphological, phenological and geographic changes in response to shifts in climate over the last century. A few brief examples on the Australian biota are:

Gallagher *et al.* (2009)[1] used herbarium records to determine trends in flowering times of several Australian alpine plant species. They found a trend towards earlier flowering corresponding with long-term shifts in average spring temperatures for several species. Herbarium collection records provide verifiable location and environmental data of past distributions. Such data can be used to predict where these species might grow in the future and to identify populations within current distributions that would be best to preserve as a stock for revegetation under future climate conditions. While these predictive tools will not only enable better prioritisation, and can be applied to monitoring and predicting the spread of environmental weeds, they are underpinned by collection records.

[1] Gallagher R V, Hughes L, Leishman M R. (2009) A phenological trend among Australian alpine species: using herbarium records to identify climate-change indicators. *Australian Journal of Botany* 57: 1–9.

Mac Nally et al. (2009)[2] compared frogs collected from northern Victoria in the 1970s with more recent populations from the same sites, and noted serious declines in abundance and geographic coverage of several species which they attributed to protracted drought. The common and widespread clicking froglet (*Crinia signifera*), which occupied all sites in the 1970s, was recorded from only 35% of sites by current surveys.

Biological collections with accurate collection location data show that the relict stag beetle, *Sphaenognathus munchowae*, is now confined to the Consuelo and Blackdown Tablelands less than 150 km apart in the Brigalow Belt of Queensland, with intermediate populations having disappeared. Moore and Monteith (2004)[3] interpreted this disjunct distribution as a consequence of erosion isolating the two plateaus, potentially through direct climate change or indirectly by the impact of inappropriate land management practices.

Dunlop and Brown (2008)[4] listed the arrival of new (native and exotic) species in response to climate change as a significant threat with impacts on conservation of native genetic resources. Invasive species have been well documented as a major cause of extinction and species decline in Australia, and their potential to benefit from climate change is well recognised (Low 2008)[5]. The ability to detect and manage invasions depends on firstly knowing what is native and local. This is unequivocally only possible through maintaining and developing quicker access to biodiversity collections and the development of rapid identification tools (such as high resolution micro-photography or DNA barcoding) from the biological collections as testable evidence for the future.

Despite the growing evidence of how the biota responds to climate change impacts (adaptation, extinction), there are still many more questions than answers, as amply illustrated by the very poor statistic of how little we still know about the invertebrate fauna in Australia, particularly arthropods. As an example, it is estimated that Australia has approximately 210,000 insects yet only *c*. 62,000 (30%) have been described (Chapman 2010)[6]. In the marine realm, a recent comprehensive survey of the seabed of the Great Barrier Reef (i.e. from which the emergent reefs grow), found that two of the five most prevalent species of sponges (Porifera) were new to science (and not even found previously in existing museum collections) — telling us how much we still don't know of even the shallow waters of our allegedly well-known World Heritage Area (Sutcliffe et al. 2009)[7].

Such studies can help inform natural resource management by providing information on which species are at greatest risk from climate change. We note the considerable investment of the Federal Government and partner organisations (in particular the membership of CABC) in the Atlas of Living Australia, which provides the means to disseminate the critical information in the biological collections. However, the continued realisation of the ALA investment relies on a continued flow of new interpreted and scientifically verifiable information from the biological collections via an infrastructure maintained at a world class standard. It is clear to us that there is a critical gap in knowledge about Australian biodiversity that will hamper our ability to adapt to a changing world. This knowledge gap can in part be addressed through digitisation efforts of existing collection information, and investment in documentation and description of Australia's unique biodiversity.

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[2] Mac Nally R, Horrocks G, Lada H, Lake PS, Thomson JR, Taylor AC (2009). Distribution of anuran amphibians in massively altered landscapes in south-eastern Australia: Effects of climate change in an aridifying region. *Global Ecology and Biogeography* 18: 575- 585.

[3] Moore BP, Monteith GB (2004). A second Australian species of the Gondwanan stag beetle *Sphaenognathus buquet* (Coleoptera: Lucanidae), *Memoirs of the Queensland Museum* 49: 693-99.

[4] Dunlop M, Brown PR (2008). Implications of climate change for Australia's national reserve system: A preliminary assessment. Canberra, CSIRO Sustainable Ecosystems.

[5] Low T (2008). Climate change and invasive species: A review of interactions. Canberra, Biological Diversity Advisory Committee.

[6] Arthur D. Chapman (2009). Number of Living Species in Australia and the World (2nd Edition). Report for the Australian Biological Resources Study, Canberra, Australia. September 2009. Page 24.

[7] Sutcliffe PR, Hooper JNA, Pitcher CR (2010). The most common sponges on the Great Barrier Reef seabed, Australia, include species new to science (Phylum Porifera). *Zootaxa* 2616: 1-30.

CABC looks forward to continued communication with the Productivity Commission on its review of barriers to climate change adaptation. The Council is happy to provide further information on the collections infrastructure and opportunities for using this resource to help inform adaptation to climate change as appropriate.

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