

Submission

2016 National Research Infrastructure Roadmap Capability Issues Paper

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Declaration of Interests.

Royal Botanic Gardens Victoria is a partner in the Atlas of Living Australia through the Council of Heads of Australasian Herbaria Inc. our data is made accessible through the Australia's Virtual Herbarium portal and within the ALA itself.

Preparation of the Submission.

The views in this submission have been reached through discussions with colleagues within the RBGV and through several forums with the wider collections community including CHAH, members of Council of Heads of Australian Faunal Collections Inc. (CHAFC) and University Colleagues. The opinions expressed here are those of the institution.

Background

The ALA NCRIS Capability has created infrastructure that has fundamentally improved data accessibility to the Nationally Distributed Biological Research Collections (NDBRC) records. The RBGV provides 873,000+ records to the ALA and the usage statistics show that 27.7 million records have been downloaded in the last 12 months (data accessed 8/9/2016) from the RBGV or that each record is downloaded 31.8 times per year. This data has been used for a range of uses or has been examined using the research tools that the ALA has built.

The NDBRC represent a vast piece of infrastructure that has been assembled over nearly 200 years. The breadth of time it has been built over means that long time series data can be developed from it an important aspect for evaluating and predicting the effects of climate change. The NDBRC represent the only verifiable record of what species occurred where and when and as such is critical infrastructure for many aspects of biodiversity research. It is difficult to estimate the true value of the NDBRC but the replacement costs alone would run into billions of dollars. The replacement value on the RBGV collections alone is \$242 million.

The ALA infrastructure only allows access to limited data about the specimens being what they are, when they were collected, and where they were collected from. Yet the physical objects contain a vast store of information that is not accessible. Furthermore the distributed nature of the NDBRC infrastructure means accessibility by the research community is expensive and limited. Given the value that has been released to date through the ALA vast potential exists if the NDBRC was available as a digital infrastructure for research. Imagine being able to create and examine plant trait data to understand environmental drivers of vegetation change. Overseas digitisation initiatives of specimens are fundamentally altering research output and increasing efficiency. One project in our sector is Global Plants. This initiative has accelerated species discovery and documentation as critical specimens (type specimens) are now available through digital infrastructure. No longer do botanists working on vascular plants need to save up all their questions and go on a tour through European Herbaria. They can answer questions through this online infrastructure and determine the correct names and whether recently collected material is new.

A digitised NDBRC would open doors for a whole range of research communities especially where other data layers such as genomic information is tied to the specimens in the digital infrastructure. This would enable a whole range of new ways to discover access and interpret data sets. It is well known that interfaces between disciplines is where the greatest strategic benefit lies and a digitised

NDBRC collections that interfaces with genomic and other data through a bridging Capability would maximise benefit to the research community.

In summary the managers of the NDBRC have already demonstrated a strong collaborative approach to the development and delivery of research infrastructure that makes data widely accessible for a range of research purposes. Both CHAH and CHAFC have long recognised the benefit of having our data out there and available and that this approach inevitably value adds to the collections themselves. The resourcing challenge of collections management has resulted in a continual mindset of improvements to reduce duplication and inefficiencies in the system. Digitised NDBRC would create a unique global infrastructure for biological (including the “onomic” capability areas), environmental, conservation management and climate change research.

Response to the questions posed

Question 1: Are there other capability areas that should be considered?

The issue paper appears to miss a key capability area of Agriculture and Food Security which naturally fits into the *Environment and natural resource management* capability.

Question 2: Are these governance characteristics appropriate and are there other factors that should be considered for optimal governance for national research infrastructure.

The governance criteria are well-defined but it should be kept in mind that a one size fits all model is unlikely to be appropriate across all capability areas. Stakeholder engagement, independence and National Benefit are other areas that could be explored for inclusion. In the current capabilities the lack of presence of key stakeholders at the table has limited oversight on collaboration or indeed missed opportunities for greater interaction. One consideration might be cross fertilisation between the governance boards where appropriate to foster greater collaboration between capabilities

Question 3: Should national research infrastructure investment assist with access to international facilities?

Yes definitely this should be considered as part of any investment as a number of significant international initiatives would leverage additional benefit to NCRIS capabilities. An issue in this space appears to be the lack of allocated funding within the NCRIS capabilities to allow this as currently the costs of access (country membership, steering committee meetings etc) is not funded and largely cobbled together from institutions that want to be involved. This results in a less than strategic approach. Additionally, access to many international resources may be available through the University sector having combined their efforts to gain reasonable subscription rates (Universities Australia consortia agreements for library access is an example). However, other sectors, in particular the State Based science and research groups have limited ‘buying’ power and leverage options could be significant to both access and contribute to global initiatives.

Question 4: What are the conditions or scenarios where access to international facilities should be prioritised over developing national facilities?

There are three main areas where access should be facilitated. These include where the facility or the cost to invest in a facility in Australia exceeds Australian Government capacity but that such a facility would serve national benefit. Where involvement in an international research community provides a critical benefit to the capability area or where expertise is not available in Australia and access would provide a level of training to build that capacity. Consideration should be given to targeted funding for participation and access where this meets the requirements and need of the national capabilities.

Question 5: Should research workforce skills be considered a research infrastructure issue?

Human capital is often overlooked in infrastructure projects to the long term detriment of the investment. Often capabilities areas require a high degree of technical expertise to maintain, develop and operate the facilities and without these the facilities would not function efficiently or effectively. Being able to maintain these skills has been a major issue in relation to the short term funding of the current facilities. This has often meant that key skills have walked out the door due to the funding uncertainty and the critical relationships that they have developed with the user community are lost and has to be rebuilt when the next tranche of funding (often for only 12 months) comes through. It is important to recognise that the research infrastructures only really value add benefit when the workforce skills are considered part of the equation. Currently Australia has a declining capacity in taxonomy and this is an area that needs to be addressed.

Question 6: How can national research infrastructure assist in training and skills development?

A strong link needs to be developed between the facilities and education. Community engagement in science and STEM education is critical for the future of Australia yet our position in this continues to decline. Consideration should be given to how facilities support training and development not only in the Tertiary education sector but right through the School system to community engagement. There should be a strong requirement for the infrastructure to engage in this area and identify training needs to maximise the infrastructure investment. The NCRIS facilities should be integral to training the next generation of scientists.

Question 7: What responsibility should research institutions have in supporting the development of infrastructure ready researchers and technical specialists?

No comment see above

Question 8: What principles should be applied for access to national research infrastructure, and are there situations when these should not apply?

Equal and open access to the whole research community should be a key principle but recognising that this may not be possible where demand exceeds capacity. In these cases access based on a merit process would be best but caution needs to be exercised in this space particularly where researchers may be applying for access to a range of separate facilities. One current issue is the complexities and different "merit" requirements for applications for access that results in inefficiency and wasted time. A harmonised approach would be preferred but this requires a level of coordination between facilities that is currently lacking.

However, it does need to be recognised that each facility is different and a range of models can be implemented. Consideration of cost reduced access ramping up to cost recovery might also be considered for some capabilities where the service provided has a clear market.

Question 9: What should the criteria and funding arrangements for defunding or decommissioning look like?

As technology changes what are major infrastructure investments today will be standard benchtop capabilities of the future. Decommissioning and defunding are therefore reasonable expectations but need to be managed on a timescale that allows adaptation and acceptance in the research community. Consideration should be given to such as process to create some certainty, clear investment cycle and horizons so that strategies for management can be put in place. In particular clear communication for change management of widely used resources into new infrastructure needs to be explicit.

Question 10: What financing models should the Government consider to support investment in national research infrastructure?

This will vary considerable from facility to facility depending of a range of factors such as market forces where a fee for service would be acceptable to users as opposed to facilities where open access would be expected. A key consideration needs to be whether the facility is a critical underpinning for the wider community.

Question 11: When should capabilities be expected to address standard and accreditation requirements?

All facilities should be expected to meet national and international standards and accreditation requirements as a condition of funding.

Question 12: Are there international or global models that represent best practice for national research infrastructure that could be considered?

EU, UK and German models may provide Australia with additional insights into best practice. However, it should be kept in mind that the Australian model has been examined closely by international organisations and is considered exemplary in creating national solutions that provide shared access and set priorities. Within specific capability areas the models may vary due to the diversity of facilities offered.

Question 13: In considering whole of life investment including decommissioning or defunding for national research infrastructure are there examples domestic or international that should be examined?

Again consideration of the models in the EU, UK and Germany could be looked at.

Question 14: Are there alternative financing options, including international models that the Government could consider to support investment in national research infrastructure?

No comment

Health and Medical Sciences

Question 15: Are the identified emerging directions and research infrastructure capabilities for Health and Medical Sciences right? Are there any missing or additional needed?

Nil comment

Question 16: Are there any international research infrastructure collaborations or emerging projects that Australia should engage in over the next ten years and beyond?

Global Genome Biodiversity Network (GGBN) is an emerging collaboration to speed discovery and expose data related to Genomic collections. While largely focused on biodiversity tissue banks these have identical attributes to those described in 5.2.4 some synergies may exist in a collaborative approach to biobanking between the medical/health sciences and environmental and natural resources management capability areas.

Question 17: Is there anything else that needs to be included or considered in the 2016 Roadmap for the Health and Medical Sciences capability area?

Biobanking and tissue banking are increasingly part of the NDBRC focus and several institutions are becoming involved in the GGBN. GGBN also has human tissue banks as part of the network. Consideration should be given to potential synergies between biobanks in the Health and Medical capabilities and those in the Environmental and Natural Resource Management capabilities.

Environment and Natural Resource Management

Question 18: Are the identified emerging directions and research infrastructure capabilities for Environment and Natural Resource Management right? Are there any missing or additional needed?

The NDBRC consisting of over 73.8 million specimens representing investment of over \$2billion are a key piece of research infrastructure yet they are absent from the issues paper. It is estimated that over 9,000 national researchers and at least 4,000 international researchers access these collections annually spending 11.2 person years of research effort. Importantly this researcher effort value adds to the NDBRC. In fact the NDBRC are one of the few pieces of infrastructure that gets sharper through time as more data layers are added to it. The NDBRC provide basic research tools that underpin biosecurity, genomics, fisheries, mining, forestry, agriculture, conservation and environmental management. Although the ALA has made accessible information about the specimens held and that this information has been used for significant and impactful research this data represents a small part of the potential of this infrastructure. These collections are managed by a diversity of institutions including museums, universities, botanic gardens, CSIRO, etc. The collections themselves are represented by the Council of Heads of Australasian Herbaria, Council of Heads of Australian Faunal Collections, Australian Seed Bank Partnership, Council of Heads of Australian Botanic Gardens and Council of Museum Directors.

Over the last ten years the value and relevance of the collections has increased enormously as they represent verifiable records that other data layers are increasingly added (e.g. genomic

data, native digital images, etc). the ALA provides access to a small proportion of the collections that have digital data available about them and an even smaller proportion of digital specimens. Massive digitisation and deployment of these through a data aggregator would significantly enhance research infrastructure for the Environmental and Natural resource management capability area. Consideration should also be given to whether the NDBRC are part of a national underpinning research infrastructure.

Question 19: Are there any international research infrastructure collaborations or emerging projects that Australia should engage in over the next ten years and beyond?

NDBRC increasingly form the basis of research done with emerging technologies and that generates end-user products. A good example of the mutual benefits for eDNA. While eDNA provides the raw information about biodiversity it is only through comparison to referenced and verifiable sequences held in the NBRC that we can identify what is present. Other examples included DNA finger-printing to track illegal harvesting of tropical timbers or CITES species; rapid identification for biosecurity using imaging or DNA; using advanced imaging and chemical trace analysis to develop sustainable fisheries or analysing climate change responses. This mirrors trends in medical and health science research. Such new research trends require better, direct access to biological collections.

Question 20: Is there anything else that needs to be included or considered in the 2016 Roadmap for the Environment and Natural Resource Management capability area?

See above statements

Advanced Physics, Chemistry, Mathematics and Materials

Question 21: Are the identified emerging directions and research infrastructure capabilities for Advanced Physics, Chemistry, Mathematics and Materials right? Are there any missing or additional needed?

Question 22: Are there any international research infrastructure collaborations or emerging projects that Australia should engage in over the next ten years and beyond?

Question 23: Is there anything else that needs to be included or considered in the 2016 Roadmap for the Advanced Physics, Chemistry, Mathematics and Materials capability area?

Understanding Cultures and Communities

Question 24: Are the identified emerging directions and research infrastructure capabilities for Understanding Cultures and Communities right? Are there any missing or additional needed?

Question 25: Are there any international research infrastructure collaborations or emerging projects that Australia should engage in over the next ten years and beyond?

Question 26: Is there anything else that needs to be included or considered in the 2016 Roadmap for the Understanding Cultures and Communities capability area?

Note: some nexus exists between the NDBRC and this capability area. The NDBRC are also rich in cultural information such as indigenous usage, early European exploration, etc

National Security

Question 27: Are the identified emerging directions and research infrastructure capabilities for National Security right? Are there any missing or additional needed?

Question 28: Are there any international research infrastructure collaborations or emerging projects that Australia should engage in over the next ten years and beyond?

Question 29: Is there anything else that needs to be included or considered in the 2016 Roadmap for the National Security capability area?

Nil response

Underpinning Research Infrastructure

Question 30: Are the identified emerging directions and research infrastructure capabilities for Underpinning Research Infrastructure right? Are there any missing or additional needed?

The National Distributed Biological Research Collections should be seen as an underpinning infrastructure that support critical areas e.g. biosecurity, environmental research, health research, etc. They are one of the few repositories of long time series data about environmental and climate change and so need continual development to maintain this potential. Digital access through the ALA provides a window to the specimens but the lack of digital objects limits new and innovative research that could be undertaken. Mass digitisation of these collections would place Australia in a unique position globally. Digitisation technologies have rapidly advanced in recent years and are becoming achievable at scale for a modest outlay. A good example is the Paris herbarium that digitised the collection as part of a relocation program. The digitised collection not only provide a limited insurance policy against loss but has accelerated a range of research programs that previously would have been unachievable or expensive to implement.

Question 31: Are there any international research infrastructure collaborations or emerging projects that Australia should engage in over the next ten years and beyond?

Major global collections in Europe (e.g. The Natural History Museum London, Kew Gardens, and Natural History Museum Paris) are holders of extensive Australian collections while those in Asia are increasingly relevant as species expand southwards. Digitisation initiatives should look at how these collections could be incorporated into a national digital infrastructure. Examples of projects or programs that are relevant in this space include Global Plants a project that has accelerated biodiversity discovery and documentation.

Question 32: Is there anything else that needs to be included or considered in the 2016 Roadmap for the Underpinning Research Infrastructure capability area?

No further comment.

Data for Research and Discoverability

Question 33 Are the identified emerging directions and research infrastructure capabilities for Data for Research and Discoverability right? Are there any missing or additional needed?

No further comment.

Question 34: Are there any international research infrastructure collaborations or emerging projects that Australia should engage in over the next ten years and beyond?

No further comment.

Question 35: Is there anything else that needs to be included or considered in the 2016 Roadmap for the Data for Research and Discoverability capability area?

No further comment.

Other comments

If you believe that there are issues not addressed in this Issues Paper or the associated questions, please provide your comments under this heading noting the overall 20 page limit of submissions.

No further comment.