BIOLOGICAL RESOURCE CENTRES

Enabling Australian Innovation in Biotechnology and Nanotechnology

Submission to the National Enabling Technologies Strategy

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1. SUMMARY OF KEY ISSUES

(1) A vibrant and competitive biotechnology and nanotechnology sector in Australia requires world class OECD compliant Biological Resource Centres (BRCs) to ensure access to a full range of the necessary microbial cultures and cell lines, Australian microbial genetic diversity, genomes and metagenomes, DNA libraries, nucleic acid sequences, metabolites, diagnostics and associated expertise. Important biological material from Australian research and research publications is not easily accessible and has been, and will continue to be, lost to future scientists and bioindustries unless the concept of Biological Resource Centres is embraced as an Enabling Technology and included in national scientific funding strategies. This will require a whole of government approach to optimise efficiency.

(2) The Australian Microbial Resources Research Network (AMRRN) [http://www.amrin.org] has taken the lead role in coordinating and fostering Australian collections of microorganisms. Submissions have been made previously to the National Research Infrastructure Taskforce (Sly 2003) and the Review of the National Innovation System (Sly 2008) on the need for OECD compliant BRCs in Australia. NCRIS has recognised the value of the data in Australia's animal, plant and microbial collections and has been funding the development of the Atlas of Living Australia (ALA) which will electronically integrate collection databases for research and problem solving applications. Now that the integration of the microbial culture collection databases is underway through the ALA project, this submission addresses the complementary need to provide more curatorial, scientific, and technical support within the collections, to assist the facilities to meet the standards of OECD Global BRCs, and to meet the requirements for accreditation as NATA Reference Material providers. An innovative biotechnology and nanotechnology sector will demand this level of quality in order to be internationally competitive.

(3) Recently, AMRRN established the Council of Heads of Australian Collections of Microorganisms (CHACM) [http://www.chacm.org] as the peak body to foster and oversee the development of microbial culture collections and development of BRCs.

CHACM is a collaborator in the NCRIS Atlas of Living Australia [http://www.ala.org.au] project to electronically integrate the data and access to materials in Australia's animal, plant and microbial collections. CHACM has responsibility for the development of the AMRiN Integrated Data Set for the Australian collections of microorganisms.

(4) CHACM recommends that a scoping study be undertaken to determine the most efficient model for an appropriately resourced network of Biological Resource Centres in Australia. An important element of the network would be a central BRC and/or coordination unit for the management of the AMRiN integrated database being developed for the NCRIS Atlas of Living Australia project and to maintain and develop this resource into the future. The unit would also be needed to provide support to BRCs with regard to material and data standards, regulatory requirements, access to microbial genetic resources, material transfer regulations, quality systems management, and a register of quality control cultures used in Australian and international standard methods for regulatory compliance, and, for example, in GMP/GLP/GCP.

(5) CHACM would be pleased to work with the Enabling Technologies and Public Awareness Sections to address these issues and work towards the development of Biological Resource Centres to enable the progress of biotechnology and nanotechnology research and emerging bioindustries. CHACM members have expertise in a broad range of biological material in various sectors including health, agriculture, government, CSIRO, industry, and universities to assist with developing BRCs to meet the needs of biotechnology and nanotechnology and to participate in the OECD Global Biological Resource Centres Network (GBRCN).

2. BIOLOGICAL RESOURCE CENTRE CONCEPT

The OECD has recognised the essential role of Biological Resource Centres for the life sciences and biotechnology (OECD 2001) and has developed best practice guidelines for biological resource centres (OECD 2007).

To progress the development of standards to implement the best practice guidelines, Demonstration Project for a Global Biological Resource Centre Network [http://www.gbrcn.org/index.php] commenced in 2008 involving BRCs in 15 countries. Figure 1 shows the global distribution of these BRCs.

Figure 1. BRCs in Canada, UK, Netherlands, France, Belgium, Germany, Finland, Portugal, Spain, Italy, China, Japan, Brazil, Uganda and Kenya collaborating in the Global Biological Resource Centres demonstration project [http://www.gbrcn.org/index.php].

In order to maximise Australia's competitiveness and global collaboration in the life sciences and biotechnology, and to provide world class higher education in the biological sciences, there is an urgent need to develop a network of OECD-compliant Biological Resource Centres by establishment of purpose built facilities and/or up-grading of suitable microbial culture collections to provide access to a comprehensive range of quality assured microbial and cell cultures and associated

molecular biology resources. This infrastructure will enhance current and future progress in many areas of the life sciences, biotechnology, industry, and education. It will allow Australia to join the emerging OECD Global Biological Resource Centre Network (GBRCN) with other OECD member countries that have developed either centralised, or decentralised but coordinated, facilities to support research and innovative bioindustries. These facilities underpin research and development in a wide range of disciplines and are needed in Australia to provide essential biological resources and services such as:

1. Quality assured microbial and cell cultures for applications in industry; biotechnology; human, animal and plant health; research; molecular biology; education; and quality assurance testing for regulatory compliance.
2. Molecular vectors, genomic DNA, DNA clone libraries, and genetic strains for applications in molecular biology research and biotechnology.
3. Internet accessible information on Australian microbial diversity, cultures, and genetic resources via the AMRiN Integrated Data Set in the developing NCRIS capacity 5.2.3 *Atlas of Living Australia*.
4. *Ex-situ* conservation of Australian microbial diversity for current and future applications, as well as conservation of important biological resources resulting from publically-funded research.
5. Expertise and services for isolation of cultures for specific applications; screening of strains for specific traits; identification of cultures for research, industry, testing laboratories, biosecurity; and taxonomic characterization and nomenclature for patents and other purposes.
6. Sources of microorganisms for discovery of new natural product opportunities for bioindustries including novel enzymes, metabolites, biopolymers, pharmaceuticals, and genes.
7. Sources of microorganisms for use in bioremediation, industrial processes and biotransformations, pollution control, microbial inocula for soil and plant health.
8. Centres of taxonomic excellence for research and research training.

Biological Resources Centres are essential for research and development in the life sciences for advances in the quality of the environment; agriculture; and human, animal and plant health; and for the commercial development of biotechnology.

Government has recognised the value of microbial collections as part of the NCRIS initiative 5.2.3 *Atlas of Living Australia* (ALA) which is developing the IT resources to integrate the databases in Australia's biological collections. However, Australia's microbial collections are under resourced to provide the curatorial support to maximise data input into the ALA and to meet the quality system requirements necessary to join the OECD GBRCN as NATA accredited providers of biological reference materials for science and biotechnology. Australian microbial collections need to partner with government to realise this objective.

As part of an Australian BRC network, a central BRC or unit to coordinate the management of the AMRiN integrated database being developed for the NCRIS Atlas of Living Australia project [http://www.ala.org.au] and to maintain and develop this

resource into the future would be required. The unit would also be needed to provide support to BRCs with regard to material and data standards, regulatory requirements, access to microbial genetic resources, material transfer regulations, quality systems management, and a register of quality control cultures used in Australian and international standard methods for regulatory compliance, and, for example, in GMP/GLP/GCP.

A number of institutional microbial collections in Universities, CSIRO, government and research institutions has the potential to form a core national infrastructure of Biological Resource Centres in Australia (Sly, 1998). Details of the major Australian Collections of Microorganisms are available from the AMRiN website [http://www.amrin.org], and members of the Council of Heads of Australian Collections of Microorganisms [http://www.chacm.org] developing the AMRiN integrated Data Set are shown in Table 1.

Currently there is no mechanism available to support the role that these collections have at a national strategic level across all disciplines to underpin and enable technologies such as biotechnology and nanotechnology, and emerging bioindustries. Existing institutional facilities are diverse and fall under the responsibilities of a wide range of government departments including science, industry, health, agriculture, environment, and education. A whole of government approach would assist the development of a national infrastructure for Biological Resource Centres as in other countries with developed or developing biotechnology and nanotechnology sectors.

Several government reviews have recognized the value of collections and Biological Resource centres and the importance of biological resources including microorganisms as a source of few frontier opportunities for bioindustries in Australia. The need to strengthen and support culture collections of microorganisms has been recommended to provide the necessary resources to underpin the life sciences and the development of strong and competitive biotechnology. These include:

- *The National Strategy on the Conservation of Australia's Biological Diversity, 1992*
- From *Bioprospecting: Discoveries changing the future* (House of Representatives Standing Committee on Primary Industries and Regional Services, August 2001)
- Report on the Review of the Innovation System. Department of Innovation, Industry, Science and Research, 2008.

Culture Collection	**Head**
Australian Wine Research Institute, Adelaide	Eveline Bartowsky
IMVS Culture Collection, Institute of Medical and Veterinary Science, Adelaide	Dean Beasley
QPI&F Plant Pathology Herbarium, Queensland Primary Industries and Fisheries, Brisbane	Dianne Davos
Mycology Culture Collection, Womens and	David Ellis

Childrens Hospital, Adelaide	
Department of Agriculture and Food Western Australia Plant Pathogen Collection	Nuccia Eyres
IFM Quality Services Pty. Ltd., Ingleburn	Ingrid Flemming
Phytoplasma DNA Collection, Charles Darwin University, Darwin	Karen Gibb
Australian Legume Inoculants Research Unit, NSW Department of Primary Industries, Gosford	Elizabeth Hartley
CSIRO Division of Food Research, Sydney	TBA
Microbiological Diagnostic Unit Public Health Laboratory, University of Melbourne, Melbourne	Geoff Hogg
CSIRO Culture Collection of Micro-algae, CSIRO Marine and Atmospheric Research, Hobart	Ian Jameson
University of the Sunshine Coast Microbial Library, Maroochydore	Ipek Kurtböke
Medical Mycology Collection, Westmead Hospital, Sydney	Wieland Meyer
Microbial Gene Research and Resources Facility, Griffith University, Brisbane	Bharat Patel
Microbiology Culture Collection, University of New South Wales, Sydney	Jani O'Rourke
Australian Collection of Plant Pathogenic Bacteria, and Plant Pathology Herbarium, Orange Agricultural Institute, Orange	Michael Priest
University of Western Australia Microbiology Culture Collection, Perth	Harry Sakellaris
Plant Pathology Culture Collection, Queensland Primary Industries & Fisheries, Brisbane	Roger Shivas
Australian Collection of Microorganisms, University of Queensland, Brisbane	Lindsay Sly (CHAIR)
Centre for Reference and Research on Leptospirosis, Queensland Health, Brisbane	Lee Smythe
Western Australian Collection, Western Australian Centre for Pathology and Medical Research, Perth	Cheryl Worsley

Table 1. Members of the Council of Heads of Australian Collections of Microorganisms.

Research

Research Fields Dependent and Enabled by Biological Resource Centres

Implementation of the recommendations made in this proposal and in recommendations to government will have a direct beneficial effect on the following disciplines:

Microbial Diversity

- Australian Biodiversity research
- Taxonomy
- Evolution and genomics
- Ecology

Microbial Resources

- Australian collections of microorganisms
- *Ex-situ* conservation
- Supply of microbial cultures
- Supply of molecular vectors
- Supply of DNA
- Identification of microorganisms

Microbial Bioinformatics

- NCRIS Atlas of Living Australia (ALA)
- Australian Microbial Resources Information Network (AMRiN)
- Integrated electronic catalogue access
- Research network support

Microbial Biodiscovery and Biotechnology

- Environmental microbial genomics
- Gene discovery and expression
- Novel metabolites
- Natural products discovery
- Enzymes
- Pharmaceuticals
- Biopolymers
- Molecular diagnostics

National Benefits and Outcomes from Biological Resources Centres

Implementation of the recommendations made in this proposal leading to the support of Australian Biological Resource Centres would deliver the following benefits and outcomes:

1. Access to microbial cultures for applications in industry; biotechnology; human, animal and plant health; research; molecular biology; education; and quality assurance testing including:

- Cultures for biotechnology applications
- Cultures for research and discovery
- Taxonomic type and reference cultures
- Cultures for Australian Standard methods
- Control cultures for standard methods of analysis for regulatory compliance
- Cultures from Australian research publications

2. Access to information on Australian microbial diversity, cultures, and genetic resources including:

- Cultures maintained in Australian culture collections
- Location of cultures with specific characteristics
- Links to gene sequences
- Links to literature

3. *Ex-situ* conservation of Australian microbial diversity including:

- Microbial species diversityEvolutionary and genetic diversity
- Metabolic diversity
- Ecological and biogeographic diversity
- Strain diversity of human, animal, and plant pathogens
- Environmental gene clone libraries
- Biological cultures arising from research

4. Systematic study of Australian microorganisms

- Description of novel endemic species
- Clarification of taxonomic relationships
- Evolution of Australian microbial diversity
- Co-evolutionary relationships with native flora and fauna

5. Access to expertise and services for:

- Isolation of cultures for specific biotechnology applications
- Screening of strains for specific traits
- Identification of cultures for research, industry, testing laboratories, biosecurity
- Taxonomic characterization and nomenclature
- Microbial preservation methods for *ex-situ* conservation

6. Discovery of new natural product opportunities for bioindustries:

- Novel enzymes
- Biopolymers
- Pharmaceuticals
- Genes

7. Discovery of natural microorganisms for:

- Bioremediation
- Industrial processes and biotransformations
- Pollution control
- Microbial inocula for soil and plant health

3. INTERNATIONAL PERSPECTIVE

A review of practices in other countries with well developed Biological Resource Centres indicates that governments recognise that these facilities underpin and enable many areas of research and industry and are essential national infrastructure for the life sciences and biotechnology. There is a recognition that these facilities require government support for core activities beyond host institutional needs, and that it is not possible to rely on full cost recovery without compromising quality and long term objectives for science and industry.

International Examples of Biological Resource Centres

Examples of facilities available to scientists and biotechnology in other countries which provide the biological resources, expertise and information which is the subject of this proposal can be observed at the following websites:

Stand-alone BRCs

- American Type Culture Collection (ATCC) [www.atcc.org]
- Centraalbureau voor Schimmelcultures (CBS) [www.cbs.knaw.nl]
- German Collection of Microorganisms and Cell Cultures (DSMZ) [www.dsmz.de]
- National Institute of Technology and Evaluation (NITE) [http://www.nbrc.nite.go.jp/e/index.html]

BRC Networks

- Belgium Coordinated Collections of Microorganisms (BCCM) [www.belspo.be/bccm]
- Common Access to Biological Resource and Information (CABRI) [http://www.cabri.org/]
- United Kingdom National Culture Collection (UKNCC) [www.ukncc.co.uk]

7. REFERENCES

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