
BIOPLATFORMS
AUSTRALIA
CATALYST
2019
ANNUAL
REPORT

## LEADERSHIP

Bioplatforms Australia is committed to maintaining a high standard of governance and leadership. Strategic direction and operational oversight is provided by an independent Board of Directors and supported by an Executive Management Committee who advise on platform technologies and organisational initiatives.

**Board Members and Responsibilities**

Bioplatforms Australia's Directors offer a wealth of experience across scientific, business and government domains. Each Director has responsibility for particular aspects of organisational strategy in addition to their fiduciary duties.

**Dr Leslie Trudzik – Chairman**
Les is a founding Board Member of Bioplatforms Australia and became Chairman in 2013. He is responsible for developing the organisation's performance and impact framework.

**Dr Sue Meek – Director**
Sue joined the Board in 2012 and is responsible for organisational communications and liaison with the Commonwealth government.

**Dr Katherine Woodthorpe – Director**
Katherine joined the Board in 2014 and is responsible for industry engagement, advising on the innovation pipeline, and providing experience to support challenging decision-making processes.

**Professor Peter Gray - Director**
Peter was appointed to the Board to provide scientific insight and expertise to all platforms. He supports academic and industry engagement, and integration with aligned NCRIS capabilities.

**Executive Management Committee**

The Executive Management Committee manages and advises on platform issues and operations. It is also responsible for implementing strategic initiatives, including Commonwealth funding agreements established with network partners.

Committee members are:

**Chair**
Andrew Gilbert, Chief Executive, Bioplatforms Australia

**Genomics Convenor**
Professor Marc Wilkins

**Proteomics Convenor**
Professor Ian Smith

**Metabolomics Convenor**
Professor Malcolm McConville

**Bioinformatics Convenor**
Associate Professor Andrew Lonie

# Contents

# Chairman's Review

## Bioplatforms – an empowering and catalytic year

The 2019 year saw Bioplatforms Australia build on the May 2018 Commonwealth Government NCRIS funding announcements to commit to longer term arrangements with a national network of Genomics, Proteomics, Metabolomics and Bioinformatics research infrastructures. The support provided by the Commonwealth Government positions Bioplatforms to empower researchers and research infrastructure providers for the next decade, delivering cutting edge technology and knowhow to the breadth of the Australian research and innovation system.

### Refreshed funding commitments

To assist with developing the forward commitments, Emeritus Professor Michael Berndt was engaged by the Board to provide independent advice on the appropriateness of the existing Bioplatforms facility portfolio and emerging trends in biomolecular sciences. This was used to inform recommendations for a revised network of providers for the next five years of NCRIS funding.

Professor Berndt led a national consultation process across 14 open fora, meeting over 270 attendees, and a series of one-on-one meetings with key institutional research leaders. The initiative provided diverse input, gathered intelligence on changing and emerging research infrastructure needs, and has been instrumental in making future funding decisions.

The Board acted to reinforce network areas of high demand and performance, re-setting others to meet changing research profiles and trajectories, and allowing agility in taking advantage of emerging technologies.

In overview, Bioplatforms allocated in excess of $55 million to the provision of new capital and ongoing operational support across the Genomics, Proteomics and Metabolomics capability – ensuring Australia has an 'omics asset that meets the growing demand in biomedical science, agricultural research, biodiversity and ecological investigation and that is broadly accessible to industry.

We are deeply grateful to a growing national network of co-investors who are matching the Commonwealth investment. This includes commitments totalling $13 million from the ACT, Queensland, South Australian and Western Australian Governments. A further $20 million has been allocated for a revised Bioinformatics strategy – the Australian BioCommons – in the first instance with generous support from AaRNET and the Australian Research Data Commons. This investment aims to provide a suite of storage, computational, software and skills resources to the 30 thousand strong Australian Life Science research community.

We have also recognised the direct and indirect benefit of the National Framework Initiatives that Bioplatforms has developed over the past 9 years, and allocated ongoing resources to continue existing initiatives and develop new ones in response to national research needs. We look forward to communicating further with the research community in building these initiatives over the coming years.

Finally, the Board used the opportunity of the refresh to grow the strength of the network by hosting an inaugural Bioplatforms "All Hands" meeting in May 2019, bringing together Bioplatforms facility staff from around the country. It is planned to continue these annually.

### Bioplatforms facility achievements

The Bioplatforms network undertakes substantial volumes of work on behalf of the national life science research effort. In 2018/19 the network contributed to over 450 peer reviewed publications, These included reaching the cover of Nature Genetics in May 2019, where collaborators from our ANU and Biomolecular Resource Facility genomics investment used a single-cell high-resolution chromosome conformation capture (Hi-C) method to observe a level of four-dimensional genome conformation that reinforces the silencing of repressed developmental genes.

The total workload of the facilities increased by 14%, with Bioplatforms facilities contributing to over 15,000 research contracts, demonstrating the ever growing and pervasive nature of 'omics within the broad array of life science research. Universities continue to be the major clientele, with 60% of users identifying as university based researchers. The next substantial category is from medical research institutes at 20% of the user base. Industry access remained steady at approximately 10%. Bioplatforms continues to strengthen its focus on industry and aims to provide both increased service and enhanced value to industry partners via several new strategies.

### Strategic research partnerships

Bioplatforms maintained its long-held strategy of engaging closely in major collaborative national grant schemes, with partnerships on several Australian Research Council Centre of Excellence proposals that reached the interview stage:

- Synthetic biology
- Mathematical modelling of cellular systems
- Cell design
- Plant success in nature and agriculture
- Innovations in peptide and protein science.

The intent here was to deploy the national 'omics asset as a scientific contributor to these grants.

### Planning for the future

Bioplatforms was engaged by the Department of Education and Training to support a scoping study and an implementation plan for a national Synthetic Biology research infrastructure. The study was led by an Expert Working Group comprising Professor Sakkie Pretorius, Associate Professor Claudia Vickers, Professor Joseph Trapani, Dr Phil Wright, Dr Mark Jacobs and Professor Emily Parker.

The implementation plan was provided to the Department of Education and Training after twelve months of significant national consultation. It includes investment concepts across the "Design-Build-Test-Learn" continuum for Australian plant, biomedical and environmental research sectors.

### A highly effective team

The Board of Directors takes this opportunity to thank Professor Michael Berndt for his significant contribution in undertaking the important national investment consultations. We are confident that the resultant network support will serve Australia's life science research community well over the coming years.

The achievements of the year were also made possible only through the efforts and commitment of the large number people in the Bioplatforms network. On behalf of the Board, I would like to thank all involved, and particularly acknowledge the contributions of the platform Convenors – Professor Marc Wilkins (Genomics), Professor Ian Smith (Proteomics), Professor Malcolm McConville (Metabolomics) and Associate Professor Andrew Lonie (Bioinformatics). Collectively, and individually, our Convenors have played a significant role in engaging broad research communities, providing advice to the Board, supporting our Executive, and acting as the face of Bioplatforms in the wider research community.

I am also extremely privileged to have the support and guidance of my fellow Directors – Dr Sue Meek, Dr Katherine Woodthorpe and Professor Peter Gray – especially throughout such an important transitional time.

Last, but certainly not least, has been the insight, energy and relationship building of our Chief Executive, Andrew Gilbert, and his small yet high achieving team. They have been instrumental in our past accomplishments, and to the future opportunities that these now permit.

**Dr Les Trudzik**
**Chair**

# Highlights 2018/2019

## Capability

**16** world-class facilities

**$13.4** million invested

**197** funded staff
(175 full time employees)

## Framework collaborations

**12** active framework initiatives

**2** new initiatives in development stage

**300** science and industry collaborators

**266** new registered users to the data portal

## Access

**3,040** users

**15,224** research contracts

**283** clients (9%) from industry and commercial organisations

**61%** of research contracts were performed for the biomedical sector

Agriculture and environmental research accounts for 30% of activity

## Scientific outcomes of technology platform nodes

**450+** research papers published in peer-reviewed journals

**94** papers published in top 10% journals including Nature, Science and Proceedings of the National Academy of Sciences (PNAS)

**111** ARC and NHMRC grants supported

**44** IP/commercialisation activities



# Bioplatforms Australia

**Bioplatforms Australia is a national asset that supports Life Science innovation by connecting investment and researchers with leading 'omics research capabilities and bioinformatics.**

Our mission is to enhance Australian genomics, proteomics, metabolomics and bioinformatics research capabilities, to support innovation and help transform scientific outcomes into tangible benefits for Australians. We do this by:

- Supporting strategic national investments in scientific research infrastructure and personnel
- Enhancing **Accessibility** of the national infrastructure to enable Australian research,
- Maximising **Quality** of research via international best practice;
- Identifying and supporting **Impact** to ensure socio-economic return;
- Maximising **Collaboration** in delivery and usage of the national infrastructure; and
- Acting as a **Catalyst for research collaborations**.

**NATIONAL CHALLENGES**

| Biomedical Science | Environmental Science | Innovation | Agriculture, food and energy |
|---|---|---|---|

| TECHNOLOGY EXPERTISE | BIOINFORMATICS | FRAMEWORK INITIATIVES |
|---|---|---|
| Genomics | Platform Support | Agriculture, Food, Biosecurity, Energy |
| Proteomics | Australian Bioinformatics Commons | Environment |
| Metabolomics | Integrated Science | Biomedical |

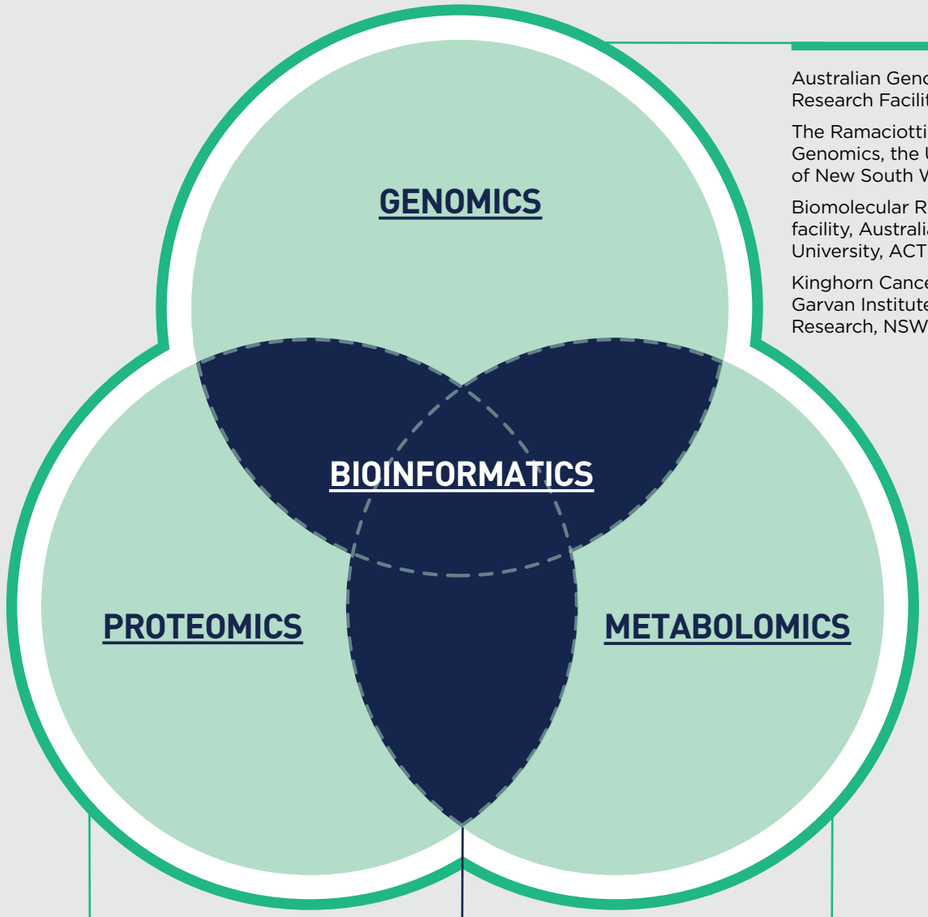
**LANDMARK PROGRAMS**

| Academic | | | Publicly funded | | | Commercial | |
|---|---|---|---|---|---|---|---|
| ARC | NHMRC | Universities | MRI | CSIRO | CRC | RDC | Private |

PARTNERSHIP

ACCESS

# Infrastructure platforms and nodes




Australian Genome Research Facility

The Ramaciotti Centre for Genomics, the University of New South Wales, NSW

Biomolecular Resource facility, Australian National University, ACT

Kinghorn Cancer Centre, Garvan Institute of Medical Research, NSW

Australian Proteome Analysis Facility, NSW

Monash Biomedical Proteomics Facility, VIC

University of South Australia, SA

Proteomics International, Harry Perkins Institute of Medical Research, WA

Monash Antibody Technology Facility, VIC

European Molecular Biology Laboratory (EMBL) Australia, Bioinformatics Resource, VIC

Centre for Comparative Genomics, Murdoch University, WA

Systems Biology Initiative, the University of New South Wales, NSW

Separation Science and Metabolomics Laboratory, Murdoch University, WA

Bio21 Institute, University of Melbourne, VIC

Australian Wine Research Institute, SA

Centre of Metabolomics, University of Western Australia, WA

Australian Institute of Bioengineering and Nanotechnology, University of Queensland, QLD



# Bioplatforms activities

**Bioplatforms expansion**

2018/19 was a period of expansion and renewed focus for the Bioplatforms team. Last year Michael Berndt undertook a national consultation and review of Bioplatforms Capabilities Network. This resulted in a recommendation for further investment and planning to strengthen the Network for the future. This, along with receiving the next phase of NCRIS funding, has facilitated stability and allowed for long-term strategic outlook.

Chief Executive, Andrew Gilbert and Scientific Program Managers Drs Mabel Lum and Anna MacDonald have been joined by new staff members:

**Dr Sophie Mazard, Manager** – Scientific Programs and Communications

**Dr Natalie Curach**, Manager - Partnerships

**Sarah Nisbet, Manager** – Platforms and Engagement

**Dr Johan Gustafsson**, Bioinformatics Engagement officer – Framework Initiatives

The injection of new skills and expertise brought by additional team members has allowed for a renewed focus on Framework Initiatives and expansion towards greater engagement and structure within our Capabilities Network and collaborations, as well as augmenting Industry relationships.

Anna Fitzgerald who had a central role at Bioplatforms for the last nine years left to undertake new challenges. Anna oversaw the creation of the Framework Initiative Strategy and established these as a core feature of Bioplatforms activities now and for the future. We thank Anna for her significant contribution and wish her well.

**Bioplatforms enabling Omics Capabilities Network**

Our commitment to strengthen our Capabilities Network and broaden our engagement to improve research capacity was spearheaded by our inaugural Capabilities Network 'All-Hands' meeting. The two-day event saw over 80 representatives from each partnering research facility attend and provide valuable input and ideas.

The agenda covered past, present and future activities and helped to identify potential opportunities and strategic priorities as we move forward. A rich list of actions and activities was developed which now forms a significant part our 'To Do' list. This includes:

- Development of a stronger engagement strategy
- Increase in intra- and cross-communication of platforms
- Greater support for clients, and
- Improved services for the varied research sectors

A commitment was made for an annual 'All Hands' event to keep building and strengthening our Network.

# Cracking the code in the war on toxic cane toads

MAPPING THE CANE TOAD GENOME IS PROVIDING NEW INSIGHT INTO THE EVOLUTIONARY AND GENETIC MAKEUP OF THIS INTRODUCED INVASIVE SPECIES AND HELPING TO DEVELOP IMPROVED METHODS FOR MANAGING ITS IMPACT ON AUSTRALIA'S FAUNA AND ENVIRONMENT.

Using the cutting-edge technology provided through Bioplatforms' network, a collaborative research team led by UNSW senior lecturer Dr Rich Edwards worked at the Ramaciotti Centre for Genomics to deliver a world first high draft genome sequence of the cane toad. This milestone achievement is the first step in understanding how the cane toad quickly adapts to new environments and map the production pathway of its toxic poison, potentially paving the way for new control and/or eradication measures.

Since its introduction to Queensland in 1935 the cane toad has rapidly invaded Australia. Several hundred million toads now occupy over 1.2 million square kilometres and are spreading at a rate of 40-60 kms per year. The cane toad's powerful poison are toxic to many native species such as the northern quoll, freshwater crocodiles, lizards and snakes. This toxic arsenal, coupled with the toad's predatory nature and ability to quickly adapt and evolve to new environments has, until now, made it difficult to control the rapid advancement of this invasive species.

**With no broadscale way to control this pest, an Australian-led group of international researchers have been working to understand cane toad genetics by mapping its genome.**

With no broadscale way to control this pest, an Australian-led group of international researchers (University of Sydney, UNSW, Deakin University and researchers from Portugal and Brazil) have been working to understand cane toad genetics by mapping its genome. Not an easy task, given the amphibian's genome is nearing 3 billion DNA 'letters', similar in size to that of humans.

The sequencing of the cane toad genome, one of the few amphibian high draft genomes available, is great news for the field of amphibian biology. The published sequence is freely accessible for further research and is already providing value as a reference genome in a number of new studies investigating biocontrol measures and characterising potential pathogenic viruses.



# ASPREE-SNP: Powerful resource for biomedical research

BIOPLATFORMS' GENOMICS CAPABILITY IS SUPPORTING PIONEERING GENETIC RESEARCH INTO THE FACTORS THAT CONTRIBUTE TO HEALTHY AGING. THE ASPREE-SNP PROJECT IS CREATING A POWERFUL RESOURCE FOR AUSTRALIAN BIOMEDICAL RESEARCH.

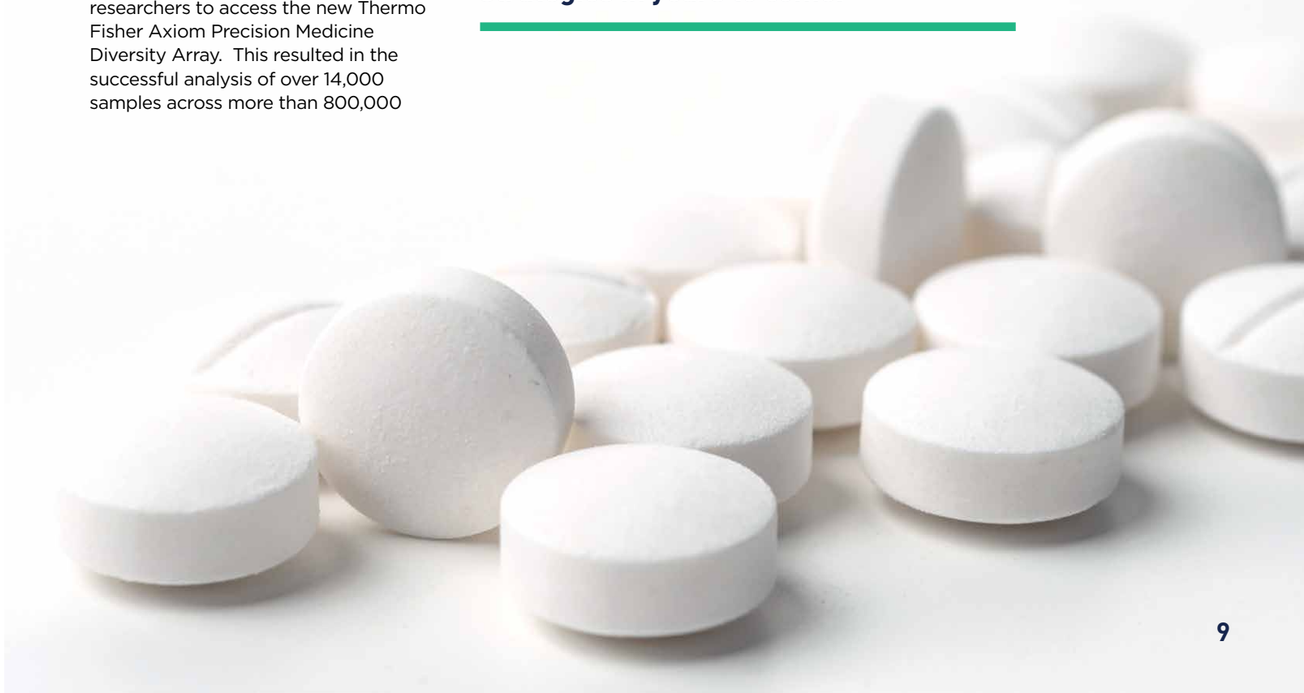
The ASPREE-SNP project is one of the largest genetic screening studies in Australia. The project is pioneering research that focusses on the genetic factors contributing to good health or disease in the elderly. In partnership with Monash University, Bioplatforms is funding the $1million data resource, which provides a platform for the genetic analysis of 15,000 participants aged 65 and over, with ongoing analysis expected to continue for years to come.

The Australian led project builds on the ASPirin in Reducing Events in the Elderly (ASPREE) collaborative clinical trial and longitudinal study of healthy ageing between the USA and Australia. ASPREE collected biosamples (blood, saliva and urine), along with extensive phenotyping and clinical outcome data from the trial participants. ASPREE-SNP will provide complementing detailed genetic analysis of the DNA samples from participants whose health was comprehensively tracked for up to seven years.

Our facility at the UNSW Ramaciotti Centre for Genomics, enabled researchers to access the new Thermo Fisher Axiom Precision Medicine Diversity Array. This resulted in the successful analysis of over 14,000 samples across more than 800,000 markers. Using this state-of-the-art technology researchers were able to measure genome-wide Single Nucleotide Polymorphism (SNP) and analyse common SNP variation, thereby enabling studies of complex traits and multifactorial polygenic diseases. Further analysis of this comprehensive data resource will allow researchers to pioneer new genetic research into a range of health problems associated with aging, such as cancer, diabetes, dementia and age-related macular degeneration.

Dr Paul Lacaze, Head of Public Health Genomics, Monash University, said:

**The project is generating much-needed evidence to help inform whether genetic factors may play a role in guiding more effective therapeutic and prevention strategies in years to come.**



# Network access

**Effective results driven research requires a critical mass of expertise and state-of-the-art infrastructure for the Australian life sciences sector. Through Bioplatforms' infrastructure and personnel investment we ensure highly skilled researchers have access to world-class technology platforms in Genomics, Proteomics and Metabolomics with integrated Bioinformatics capabilities.**

The life sciences sector is transforming with increased focus on data-enabled approaches to modern day complex biological challenges. To ensure an ongoing state-of-the-art capability across the research sector, Bioplatforms has consolidated our diverse platforms and technology capabilities into 'critical mass' Centres, each with specialised functions.

Our 'omics capabilities are in high demand, 2018/19 has seen over 15,200 research contracts completed, a growth of 14.3% from last year. These contracts have led to impacts across all four capabilities (Genomics, Proteomics, Metabolomic, Bioinformatics) which are highlighted across this report.

### Client access

In the past year 3,040 clients accessed the platforms capabilities nationally. This represents nearly a 3% increase in domestic clients, with 3.5% of our client base being international clients.


**Figure 1: Clients across Australia for 2018-19**


**Figure 2: Our research partnerships**

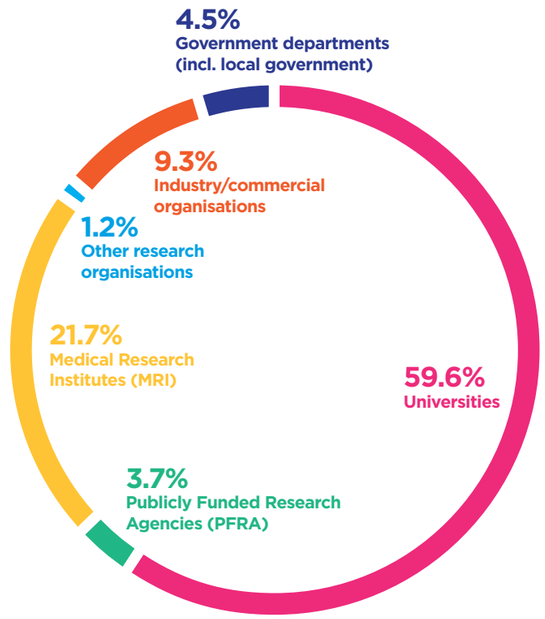



**Figure 3: Client access by sector**

### Contribution to Australian research system

Bioplatforms is focused on engaging and contributing to the Australian research system through strategic partnership. Our facilities collaborate with with key research institutions and programs (e.g. Australian Research Centres of Excellence (CoEs) and Cooperative Research Centres (CRCs) to provide broad based reach and impact across the whole Australian research system.

### User profile and broad access

We support the breadth of the Australian research community through our diverse client base. Universities remain a key client of Bioplatforms facilities, making up 60% of research contracts followed by independent research organisations (25%), with commercial and government clients accounting for 13.8 percent of users.

Research contracts completed were distributed proportionally across clients and sectors, with an average of five submissions per client, indicative of the value of Bioplatforms facilities to researchers.

The majority of clients accessing our national infrastructure network were external to the Bioplatforms network, highlighting the strong inclusive value of this national infrastructure available to all researchers wishing to access 'omics capabilities.

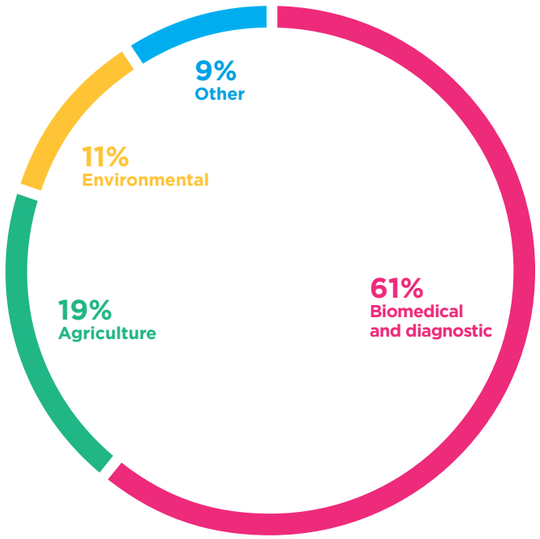



Figure 4: Client numbers by discipline

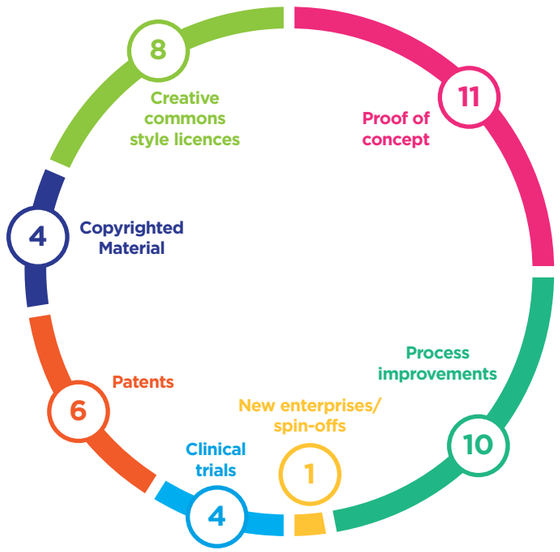



Figure 5: A snapshot of intellectual property (IP) and commercialisation activities

### Research focus

Research disciplines accessing our infrastructure continued to be heavily focused on biomedical research and diagnostics, interestingly, there was a 9% increase in research related to agriculture.

### Commercial focus

Highlighting our link to commercial outcomes, we were involved in more than 44 commercially linked activities. This period saw a high focus on proof-of-concept and process improvements, with a strong increase in creative-commons style licences. Similar to previous years, 72% of key IP and commercialisation activities occurred through proteomics facilities.

### Bioinformatics training

Over the last 12 months we have supported multiple education initiatives. In collaboration with the NSW Office of Health and Medical Research (OHMR), the Queensland Facility for Advanced Bioinformatics (QFAB), EMBL Australia Bioinformatics Resource (EMBL-ABR), CSIRO and others, we sponsored workshops on genomics data analysis and bioinformatics skills for life sciences researchers.

Through the Winter School in mathematical and computational biology, hosted by the Institute for Molecular Bioscience, over 290 participants from a broad range of under- and post- graduate students, postdoctoral researchers and others working across relevant fields were introduced to bioinformatics, mathematical and computational biology. The event captured attendees from 54 Australian and 11 overseas institutions, spanning 8 countries.



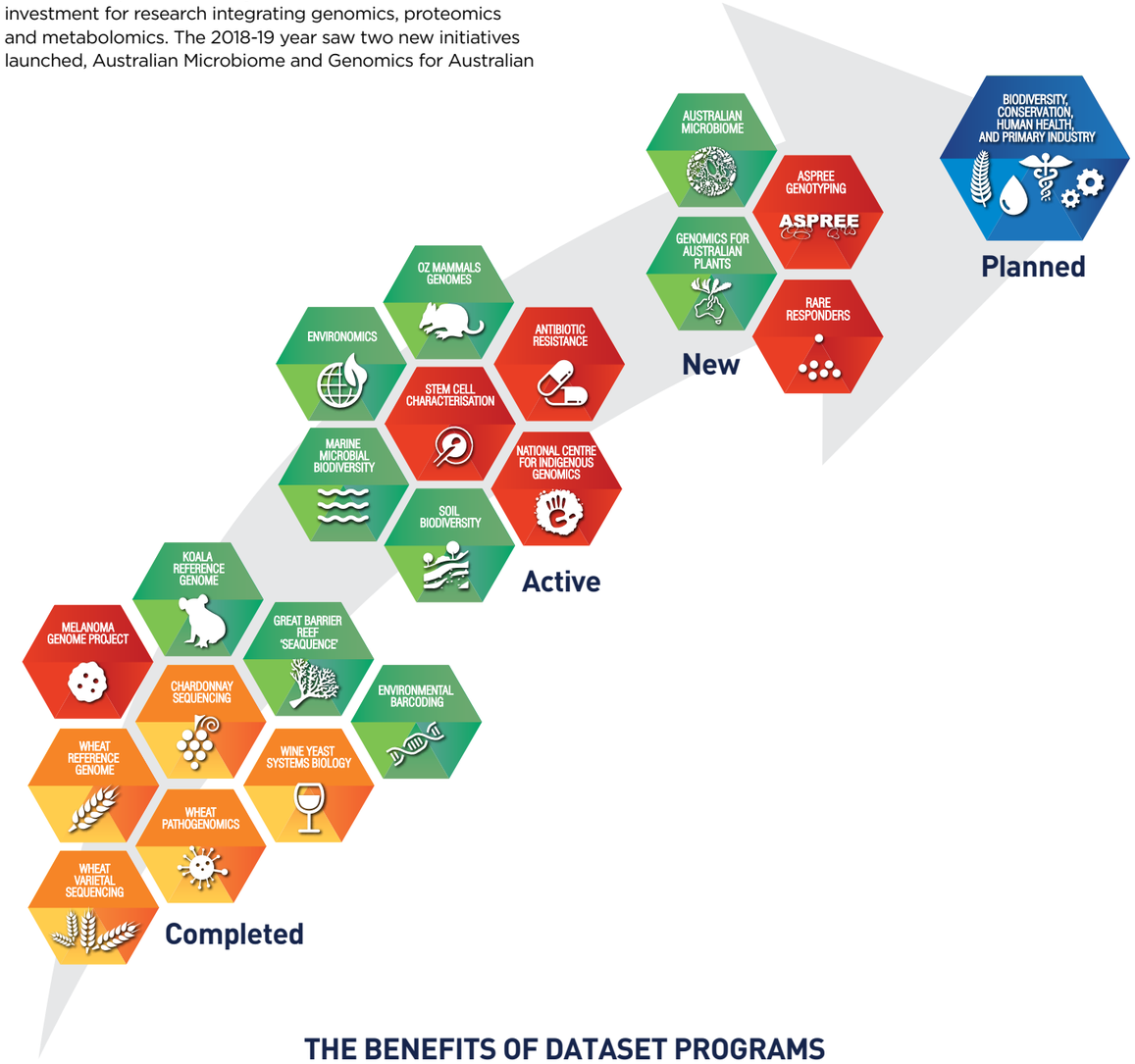
# National Framework Initiative

Bioplatforms catalyses research collaborations to build new capabilities and critical data resources to support some of Australia's biggest scientific challenges. These challenges span agriculture, biomedicine and the environment, as well as extending to relevant international endeavours.

Bioplatforms' Framework Initiatives are national collaborative projects that use integrated 'omics infrastructure to support research themes of national significance. The interdisciplinary and collaborative nature of these projects ensures the datasets are relevant to current scientific questions and immediately employed for high impact research.

Over the lifespan of the Program, 20 initiatives have received investment for research integrating genomics, proteomics and metabolomics. The 2018-19 year saw two new initiatives launched, Australian Microbiome and Genomics for Australian Plants. Both projects have made substantial progress in establishing governance protocols and commencing project activities.

Five additional programs are being scoped for future Framework Initiative investment, centered on Australian biodiversity, conservation, human health and primary industry.




## THE BENEFITS OF DATASET PROGRAMS

Build large-scale data resources → Maximise impact of national research infrastructure → Build scientific capabilities → Catalyse scientific collaboration and international linkages → Attract co-investment



# GAP FEATURED FRAMEWORK INITIATIVE

### Protecting Australia's unique flora through Genomics

Plants sustain life on Earth. They provide oxygen, food, medicine, shelter, and habitat. Plants also regulate water, carbon and nitrogen cycles, capturing and storing carbon released from the burning of fossil fuels.

Australia's unique native plant life is under threat, with over 75% impacted by disturbance or neglect since European settlement. Changes in temperature, rainfall, atmosphere and environmental disturbance affects diversity and greatly impacts plants that are unable to rapidly adapt to new conditions.

Using genomic approaches, we can unlock the genetic basis of our flora to help improve management and conservation decisions, and support sustainable use of Australia's unique biodiversity.

Genomics for Australian Plants (GAP) is one of Bioplatforms' key initiatives. The program was launched in December 2018, in partnership with researchers from the Australian State and National Herbaria and Botanic Gardens. The program aims to develop genomics resources to enhance our understanding of the evolution and diversity of Australia's unique flora.

**Key aims of the project** (achieved through three areas of activities: reference genomes, Phylogenetics, conservation genomics):

1. **Better understand Australia's unique plant diversity** – Sequence and assemble representative Australian plant genomes across the plant tree of life.
2. **Enhance the use of genomic data for Australian plants** – Build capacity and create networks to enable the collection, management, dissemination and effective application of genomic data.
3. **Improve conservation management approaches** – Provide tools to enable genetic data to be used to identify and classify biodiversity at a range of scales.

In November 2018, the Steering Committee launched the first activity through a pilot project to test national capability for creating reference genomes of non-model native plant species. The plant community was invited to propose projects to create the first reference genomes through an expression of interest process. Three species were chosen and announced at the project launch: Australia's floral emblem, the Golden Wattle (*Acacia pycnantha*), Waratah (*Telopea speciosissima*) and Spider Flower (*Areocleome oxalidea*). The current activities include testing extraction protocols for short and long read sequencing, and investigating sequencing approaches and bioinformatics pipelines for genome annotation and assembly.

In February 2019, the Phylogenomics Working Group established the second activity which will collaborate with existing global initiatives to generate a dataset of at least three species from 95% of Australian plant genera. A pilot study to determine the phylogenomic approach to most efficiently deliver this activity has commenced. This GAP activity will provide a step change in genomics resources for understanding the Australian flora, and is the technological platform required for future research. It will also place Australian research within a global initiative aiming to build a phylogeny of all plants.

In the next activity, the Conservation Genomics working group will be established to explore the aims and approaches for the conservation component of the GAP initiative.

**www.genomicsforaustralianplants.com**
**@PlantsAus**

Genomics for Australian Plants

# Collaboration and partnerships

**Impact through collaboration**

Bioplatforms' state of the art biomolecular ('omics) platforms capabilities facilitate greater multi-disciplinary integration in basic and translational bioscience and fosters research collaborations that address scientific challenges of national significance, supporting international expansion of research networks.

Bioplatforms has ongoing partnerships with Cooperative Research Centres (CRC), Australian Research Council (ARC) Centres of Excellence (CoE), and ARC Industry Transformation Research Hubs. We also collaborate closely on national programs and have strong links with international partners.

These national and international partnerships are central to delivering on our core values and beliefs – building impact, quality, collaboration and trust.

**Our collaborations and partnerships for 2018/19**

BIOPLATFORMS AUSTRALIA

## INTERNATIONAL ENGAGEMENTS

Elixir (Europe)

Join Genome Institute (US)

National Microbiome Data Collective (US)

Kew Gardens (UK)

National History Museum (UK)

Earth BioGenome Project (Multinational)

## ARC INDUSTRY TRANSFORMATION RESEARCH HUBS

ARC Centre for Medicinal Agriculture

ARC research hub for Sustainable Crop Protection

## COOPERATIVE RESEARCH CENTRES

CRC for alertness, safety and productivity

CRC for mine restoration (pending)

## PROGRAMS

Synthetic biology

Reef monitoring

Bioinformatics training

## CENTRES OF EXCELLENCE

ARC CoE in Nanoscale BioPhotonics

ARC CoE in Plant Cell Walls

ARC CoE for Australian Biodiversity and Heritage

ARC CoE in Synthetic Biology

ARC CoE in Plant success in nature and agriculture

ARC CoE in Innovations in peptide and protein science

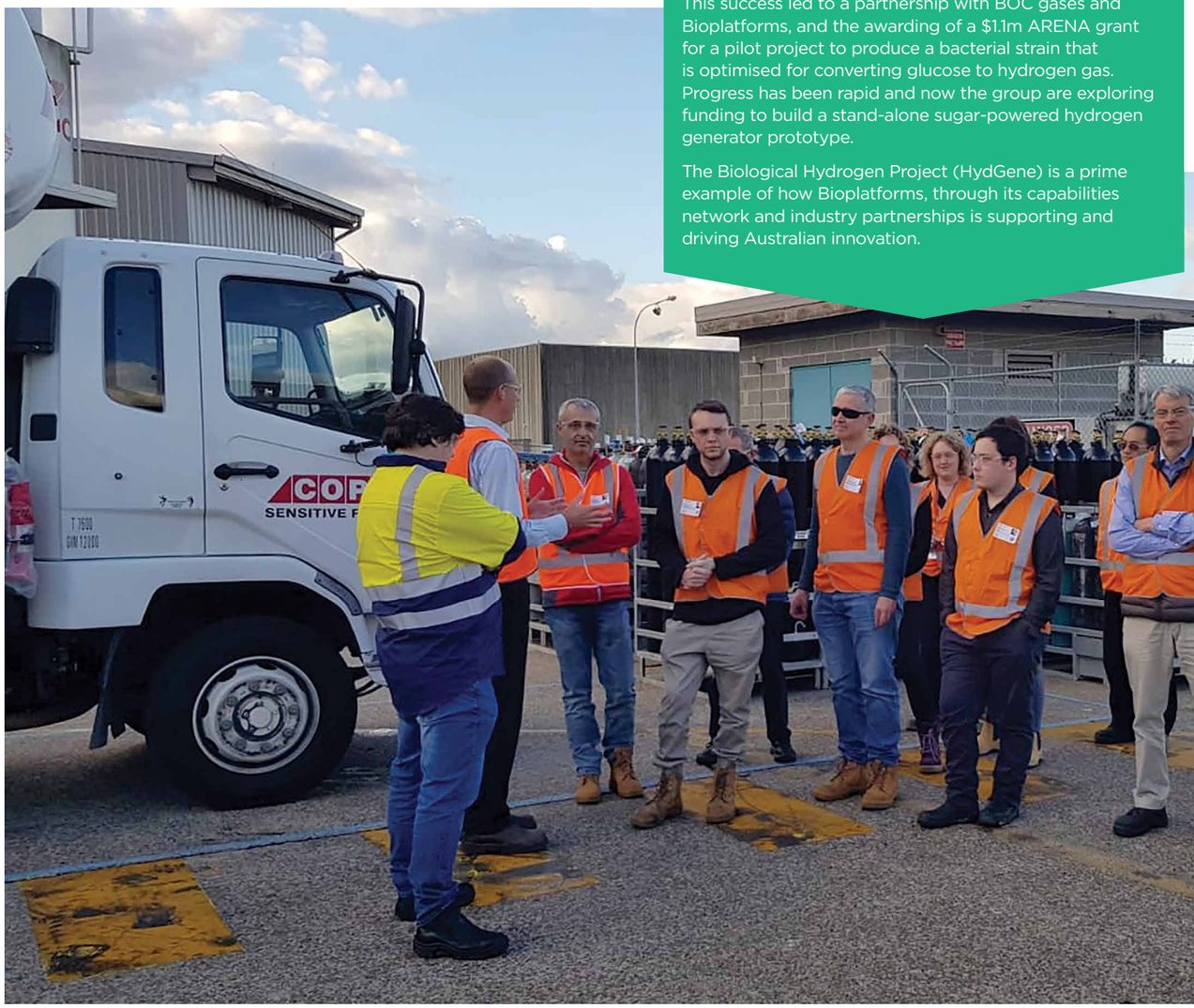
# Industry engagement

**Industry engagement is a key component of the programs and initiatives that Bioplatforms supports. We support engagement through engagement through our facilities on industry led projects, partnering with industry on grant opportunities and brokering relationships for constructive collaborations with the research community. This approach ensures we are able to maximise commercial outcomes, deliver research that is targeted to industry and end user needs, and that links with current national scientific priorities.**

Now is an exciting time for life sciences and biological innovations. Worldwide, research capabilities are evolving at a rapid pace and Bioplatforms is strategically positioned to provide the infrastructure, and network connections to support Australia's research sector now and into the future.

Through our targeted partnership approach, we drive opportunities for constructive research collaborations with industry and the global innovation ecosystem. We provide connections through our extensive capabilities network and help to facilitate data sharing, research collaboration and knowledge translation. As well as links to services and financing for furthering technology. These activities continue to build our influence as key contributors to the National Innovation and Science Agenda.

The development of our Industry Engagement Strategy will streamline our communications and knowledge sharing channels to thoughtfully harness the collective expertise within our Capabilities Network. Our can-do culture helps us to focus on providing exceptional customer service, high value and positive outcomes that translate to great impact.



HYDGENE TEAM MEMBERS VISIT THE BOC SYDNEY OPERATIONS CENTRE

INDUSTRY ENGAGEMENT CASE STUDY 1: HYDROGEN

## Taking an idea to market – Industry partners the Biological Hydrogen Project

Often the simplest ideas produce the greatest impact and this is potentially the case for the Biological Hydrogen Project.

Hydrogen has long been known as an excellent 'zero emission' fuel to generate electricity, power vehicles, produce heat, steel and bio oil. It is clean, high energy and versatile. However, currently 96% of all hydrogen production is derived from burning fossil fuels, thereby, negating any environmental benefit.

A team at Macquarie University has found a way to produce bacteria that can efficiently and rapidly convert sugars from various renewable sources into hydrogen gas. Thereby producing a 100% clean and renewable energy source. The project stemmed from the 2017 student team's winning entry in the international iGEM competition. This success led to a partnership with BOC gases and Bioplatforms, and the awarding of a $1.1m ARENA grant for a pilot project to produce a bacterial strain that is optimised for converting glucose to hydrogen gas. Progress has been rapid and now the group are exploring funding to build a stand-alone sugar-powered hydrogen generator prototype.

The Biological Hydrogen Project (HydGene) is a prime example of how Bioplatforms, through its capabilities network and industry partnerships is supporting and driving Australian innovation.

INDUSTRY ENGAGEMENT CASE STUDY 2: BIOLOGY

## Synthetic Biology – History in the making

Synthetic Biology is an emerging field that is widely believed to have the potential to make the most profound impact on the way we solve many of the greatest challenges facing humanity of the next 50 years.

Bioplatforms recognised the potential of Synthetic Biology early in Australia and supported the Yeast 2.0 project in 2014. On the back of this project and the increasing opportunities for Australian researchers to be at the forefront of the Synthetic Biology field, the 2016 National Research Infrastructure Roadmap recommended a scoping study to be undertaken for Synthetic Biology to identify the technical requirements for enabling Australian researchers to conduct world-leading Synthetic Biology research.

In 2018/19 Bioplatforms provided secretariat to the research infrastructure scoping study commissioned by the Department of Education and Training. A national consultation was conducted by a working group chaired by Prof Sakkie Pretorius. The learnings from the community were considered and a set of guiding principles formulated to provide a framework for the implementation plan. This work will continue into FY2019-20 with the resulting recommendations considered in the NCRIS 2020 Investment plan.

# Capabilities network

**Scientific research changes lives through innovation.**

Bioplatforms encourages innovation by investing in scientific infrastructure and biomolecular research capabilities through our Capabilities Network. This Network spans 16 leading universities and research facilities across Australia, employs nearly 200 staff annually and has resulted in over $100 million invested in high-end instrumentation since Bioplatforms was founded in 2007.

Our capabilities network is organised into four technology platforms – genomics, proteomics, metabolomics and bioinformatics.



# Genomics

**The genomics platform is important to every field of life science research and provides cutting-edge genome research services via our state-of-the-art infrastructure and world class specialists with expertise in high throughput genomics, transcriptomics, epigenomics and bioinformatics**

- Australian Genome Research Facility (AGRF)
- Ramaciotti Centre for Genomics
- Biomolecular Resource Facility
- The Kinghorn Centre for Clinical Genomics

CASE STUDY 1: BLACK TIGER SHRIMP

## Securing more prawns for the BBQ

Black tiger shrimp (prawns) are the second most widely farmed prawn species globally. However, over the last 20 years there have been significant problems with disease and domestication resulting in stagnated production levels.

As part of the ARC research Hub for advanced prawn breeding, Australian researchers and the Seafarms group collaborated with AGRF to use Next Generation Sequencing platforms to create an extensive molecular resource for the black tiger shrimp. This resource will assist researchers in understanding the black tiger shrimp's genome structure and identifying significant commercially relevant traits, thereby transforming future breeding programs.

The project has produced the world's most comprehensive black tiger shrimp (*Penaeus monodon*) genome sequence and transcriptome covering various life stages and target tissues. This has laid the groundwork for expansion of further genetic resources available for this species and others, that will underpin future transformational advances in how prawns are farmed globally.

**BIOPLATFORMS FACILITIES:** AGRF

**PARTNERS:** The Australian Research Council Industrial Transformation Research Hub for Advanced Prawn Breeding, consortium involving researchers and industry from James Cook University, CSIRO, University of Sydney and Seafarms Group

**OUTCOME:** A comprehensive black tiger shrimp (*Penaeus monodon*) molecular resource (genome and transcriptome) enabling the most advanced and industry transformative improvement program for any aquaculture species globally.

**EXPECTED IMPACT:** Selective breeding programs leading to the farming of prawn strains that will yield maximum productivity, will be economically and sustainably farmed, and that will place Australia as a major global leader in the production of seafood using advanced animal breeding approaches.

CASE STUDY 2: FAECAL TRANSFER

## The 'good' poo for colitis treatment

Ulcerative colitis is a chronic disease of the colon. With Crohn's disease, these conditions are known as inflammatory bowel disease (IBD). IBD affects nearly 85,000 Australians per year with an estimated financial cost and economic burden of $2.7 billion to Australia. There is no known cure and many patients continue to suffer poor disease control from the limited effective treatment options.

Researchers collaborated with the Ramaciotti Centre for Genomics and the Systems Biology Initiative, to help identify which bacteria are 'good' and which are 'bad' when it comes to successful faecal transplants for ulcerative colitis. This study is part of an international collaboration between Australia and the USA.

Faecal transplants are known to be successful in helping to establish a healthy colony of gut bacteria. However, what was not known is which bacteria are best at easing symptoms and which do not assist. This breakthrough in 'good' and 'bad' bacteria identification is helping inform the selection of suitable donors for faecal matter transplants (FMT) and paving the way for personalised medicine approaches such as tailored microbial mixtures that are effective at inducing remission.

**BIOPLATFORMS FACILITIES:** Ramaciotti Centre for Genomics; Systems Biology Initiative

**PARTNERS:** UNSW, Icahn School of Medicine Mount Sinai, St Vincent's Hospital, Nambour General Hospital, Bankstown-Lidcombe Hospital, Liverpool Hospital, Centre for Digestive Diseases.

**OUTCOME:** Identification of bacteria that are beneficial in faecal matter transplants, potentially used to design microbe-targeting therapies.

**IMPACT:** Bacterial-induced remission in patients with ulcerative colitis.

# Proteomics

Proteomics is concerned with protein structure and function. Bioplatforms' supported facilities offer a broad range of services including high throughput proteomics, protein biochemistry, monoclonal antibody production, along with drug discovery and screening.

- Proteomics International
- University of South Australia - Future Industries Institute
- Monash University Biomedical Proteomics Facility, Antibody Technology Facility
- Australian Proteome Analysis Facility

CASE STUDY 1 – TASSIE DEVIL

## Saving the Tasmanian devil

The Tasmanian Devil population is inflicted with two forms of transmissible cancer – creatively named devil facial tumour 1 and 2 (DFT1 and DFT2) – each characterised by large visible tumours which appear on the devil's face. Transmission occurs through biting and has resulted in a decline in the devils' population to the extent that they are now considered endangered.

Research funded by the Australian Research Council, the Save the Tasmanian Devil Appeal, and Bioplatforms Australia, has helped a team of collaborators from the University of Tasmania's Menzies Institute for Medical Research, School of Medicine and Central Science Laboratory University of Cambridge, the Australian Proteome Analysis Facility, and the Walter and Eliza Hall Institute of Medical Research to establish that both forms of cancer are associated with cells covering the nerves, called Schwann cells, indicating for the first time that there is a common cellular origin for the two cancers.

The discovery in a single mammalian species presents an unprecedented opportunity to gain new insight into cancer development, transmission, and immune evasion in mammals.

**BIOPLATFORMS FACILITIES:** Australian Proteome Analysis Facility (APAF) at Macquarie University.

**PARTNERS:** University of Tasmania's Menzies Institute for Medical Research, School of Medicine and Central Science Laboratory University of Cambridge, Walter and Eliza Hall Institute of Medical Research, Save the Tasmanian Devil Appeal

**OUTCOME:** Potential treatment for the Tassie devil tumour.

**IMPACT:** A better understanding of cancer pathogenesis.

CASE STUDY 2 – ENDOMETRIOSIS

## Innovative diagnosis for women's health

Endometriosis is a common gynaecological disorder affecting 5-10% of women of reproductive age who often experience chronic pelvic pain and infertility. Laparoscopy is the gold standard diagnostic test for endometriosis, but it is invasive, expensive and carries surgical risks. Currently, there are no non-invasive tests available that accurately diagnose this disorder. Reliable and valid non-invasive biomarkers that can be used in routine clinical diagnosis are urgently required to improve care.

Researchers and clinicians in partnership with the Mass Spectrometry and Proteomics facility at the Future Industries Institute are using detailed clinical and epidemiological data and biospecimens collected from over 850 women as part of an endometriosis study to develop non-invasive diagnostics that can differentiate women with pelvic pain who have endometriosis from those that do not.

Preliminary results have supported an extended application for further funding from the National Health and Medical Research Council (pending) for this vital work.

**BIOPLATFORMS FACILITIES:** University of South Australia – Mass Spectrometry and Proteomics facility at the Future Industries Institute; Metabolomics Australia

**PARTNERS:** University of Melbourne and The Royal Women's Hospital Melbourne

**OUTCOME:** A method for non-invasive testing for endometriosis.

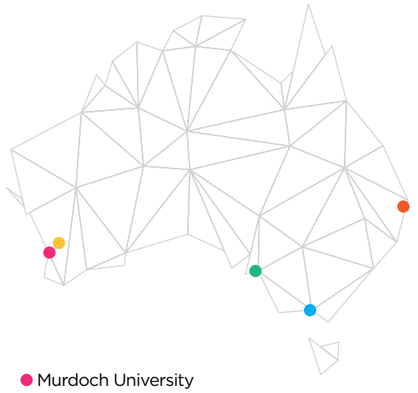
**IMPACT:** Clinical efficiency and better detection options.



# Metabolomics

Metabolomics involves large-scale analysis of cell metabolites. Metabolomics is integral to the suite of 'omics technologies required for systems analysis and is often described as the 'glue' that brings multiple 'omics efforts together.

Though our network of metabolomics partner facilities we provide state-of-the-art metabolomics capabilities and customised services, from specific detection and quantification services, through to complex investigations and systems wide analyses in biological systems.



- Murdoch University
- University of Western Australia
- Australian Wine Research Institute (AWRI)
- The University of Melbourne
- University of Queensland

CASE STUDY 1 – WINE

## Lower alcohol and a boost in flavour

Winemakers and consumers want high-quality, great tasting low alcohol wine; however, the yeasts currently used to make reduced-alcohol wine sometimes produce off-flavours and undesirable by-products, which might be hindering the growth of the low-alcohol wine market.

Bioplatforms Australia's supported metabolomics capabilities have helped to facilitate the first comprehensive systems-based approach study aimed at improving the flavour and aroma of low alcohol wine.

This collaborative study used a combination of transcriptomics, proteomics and metabolomics with complex integration of these 'omics' data to investigate changes that occur in low-alcohol yeast strains during alcoholic fermentation. This enabled researchers to identify the main volatile metabolites responsible for unwanted aromas and the genes involved in their production.

The data produced is informing wine yeast strain development programs, which use non-genetically modified breeding techniques to generate new strains, thereby assisting winemakers to produce low-alcohol wines with improved flavour and aroma.

**BIOPLATFORMS FACILITIES:** AWRI, APAF, Metabolomics Australia (Queensland, University of Melbourne and AWRI Facilities

**PARTNERS:** UNSW; Australian Institute for Bioengineering and Nanotechnology; University of Queensland; The University of Adelaide

**OUTCOME:** Comprehensive dataset to inform wine yeast strain development.

**IMPACT:** Improved quality of low-alcohol wine provides healthier wine options for the consumer and promotes growth of the wine industry.

CASE STUDY 2 – SLEEP LOSS

## Keeping Australia awake

Insufficient sleep can cause fatigue, slower reaction times, and impaired attention, concentration, memory and reasoning. However, there is currently no reliable way to diagnose it. Identifying biomarkers of sleep loss is the first step in developing a test for sleepiness. Such a test could benefit many industries that depend on people staying alert over extended periods or during times when sleep is disrupted, such as transportation, logistics, mining, and other types of shift work. It could also be used to predict driving impairment at the roadside, or even before someone gets behind the wheel. As many as one-fifth of road accidents in Australia are thought to be related to fatigue, with an estimated economic cost of around A$3 million a year.

Researchers at the Alertness CRC collaborated with Metabolomics Australia to identify biomarkers of sleep loss. The project saw 23 participants kept awake for 40 hours, with samples of their blood taken every two hours. More than 400 blood samples were analysed and researchers found around 1000 metabolites, further narrowed to a smaller group that predict sleep loss with high accuracy. They also developed an algorithm to weight each metabolite according to its importance in predicting the sleep state. The Alertness CRC filed a provisional patent application covering the number and weighted combination of metabolites and is now working with Metabolomics Australia to identify the individual molecules.

**BIOPLATFORMS FACILITIES:** Metabolomics Australia (University of Melbourne)

**PARTNERS:** Cooperative Research Centre for Alertness, Safety and Productivity (Alertness CRC)

**OUTCOME:** Biological molecules associated with sleep loss have been identified, the molecules could be used to develop a roadside test for sleepiness.

**IMPACT:** Increased safety in industries and day to day activities that rely on people staying alert, through an objective test for sleepiness.

# Australian BioCommons

**Partnering for the future of Life Sciences**

Ensuring Australia's life science research sector remains globally competitive through the application of cutting-edge bioinformatics is of key importance as the sector transforms with new digital technology advances.

To help address this significant challenge, Bioplatforms is investing in the Australian BioCommons - an ambitious project that will provide access to the tools, methods and training required for researchers to respond to national challenges such as food security, environmental conservation and disease treatments. The BioCommons will enhance Australian research in its ability to better understand the molecular basis of life across environmental, agricultural and biomedical science.

Life sciences research is currently faced with extensive challenges as it addresses critical data-related infrastructure requirements in relation to developing, managing and exploiting the vast array of data assets that exist. These assets occur at multiple scales, locations, formats, and purposes. Additionally, the interpretative power of 'omics data is best achieved by connecting molecular level data with behavioural and observation based data sets, which necessitates compatibility across all formats.

These data integration challenges are real, persistent and important, and their scale and complexity are set to shape future e-infrastructure investments.

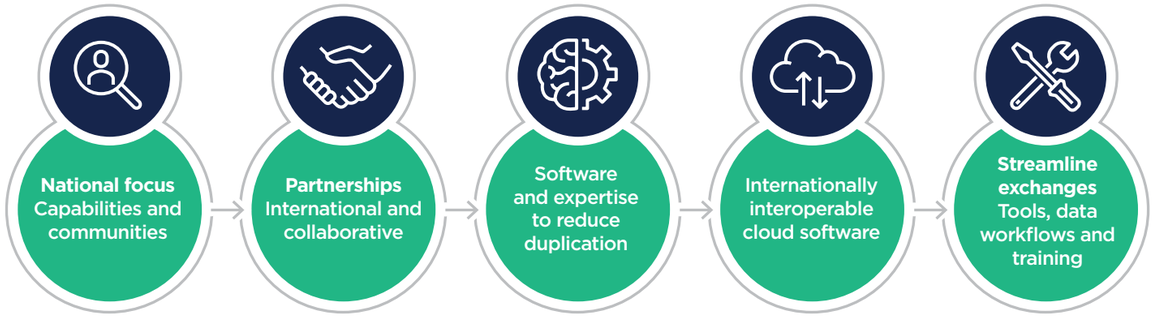
The first phase of the BioCommons is to be conducted over 12 months (2019) as a 'Pathfinder' exercise, in which Bioplatforms is partnering with the Australian Research Data Commons (ARDC) and Australia's Academic and Research Network (AARNet). It is designed to inform the development of new technology capabilities, and will investigate and provide recommendations for the services and tools that are needed to make sense of data on subjects such as DNA sequencing, protein chemistry and metabolic analysis at scale.

The initial Pathfinder exercise will strongly engage with the research community, international infrastructure initiatives, and national digital resource providers to deliver:

- An operating infrastructure providing a core set of bioinformatics services
- A set of research activities and associated communities providing exemplars for others to follow
- A consortium of participants providing guidance and implementation support
- A strategic plan for the BioCommons
- A five year operational plan for the delivery of the Commons (through to 2023)



## PRINCIPALS OF THE BIOCOMMONS




There are four implementation studies that form part of the current Pathfinder. These are pilot projects that will serve to inform the broader BioCommons outcomes.

**They are:**

1. **Establishment of a 'BioCloud': cyberinfrastructure that is appropriate for data-driven biology research** – This activity will focus on developing highly dependable and sustainable cloud infrastructure for both compute and storage, with associated expertise. This will be developed and maintained in concert with international peer infrastructures.

2. **Developing systems for non-model organism de novo genome assembly and annotation** - This activity will design (with extensive and representative community engagement) a service (or a number of highly related services) that support communities of researchers wishing to undertake de novo genome assembly and genome annotation across a variety of taxa, with Oz Mammals and GAP as exemplar case studies.

3. **Improvements to a 'Bring Your Own Data' Analysis** - This activity will focus on ensuring that the national Galaxy Australia 'BYO Data' service is extended such that it is fit-for-purpose for an ever-increasing range of analyses and communities.

4. **Delivering impact to Australian Researchers by participating in a Global Data Commons** – This activity will focus on understanding how we can connect the compute, analysis and data requirements of Australian-based research programs with the US-based (and NIH Data Commons supported) programs, with Kids First as an exemplar case study.

BIOPLATFORMS AUSTRALIA

NCRIS
National Research Infrastructure for Australia
An Australian Government Initiative

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Bioplatforms Australia is a non-profit organisation that supports Australian Life science research by investing in state-of-the-art infrastructure and expertise in genomics, proteomics, metabolomics and bioinformatics. Investment funding is provided by the Commonwealth Government National Collaborative Research Infrastructure Strategy.