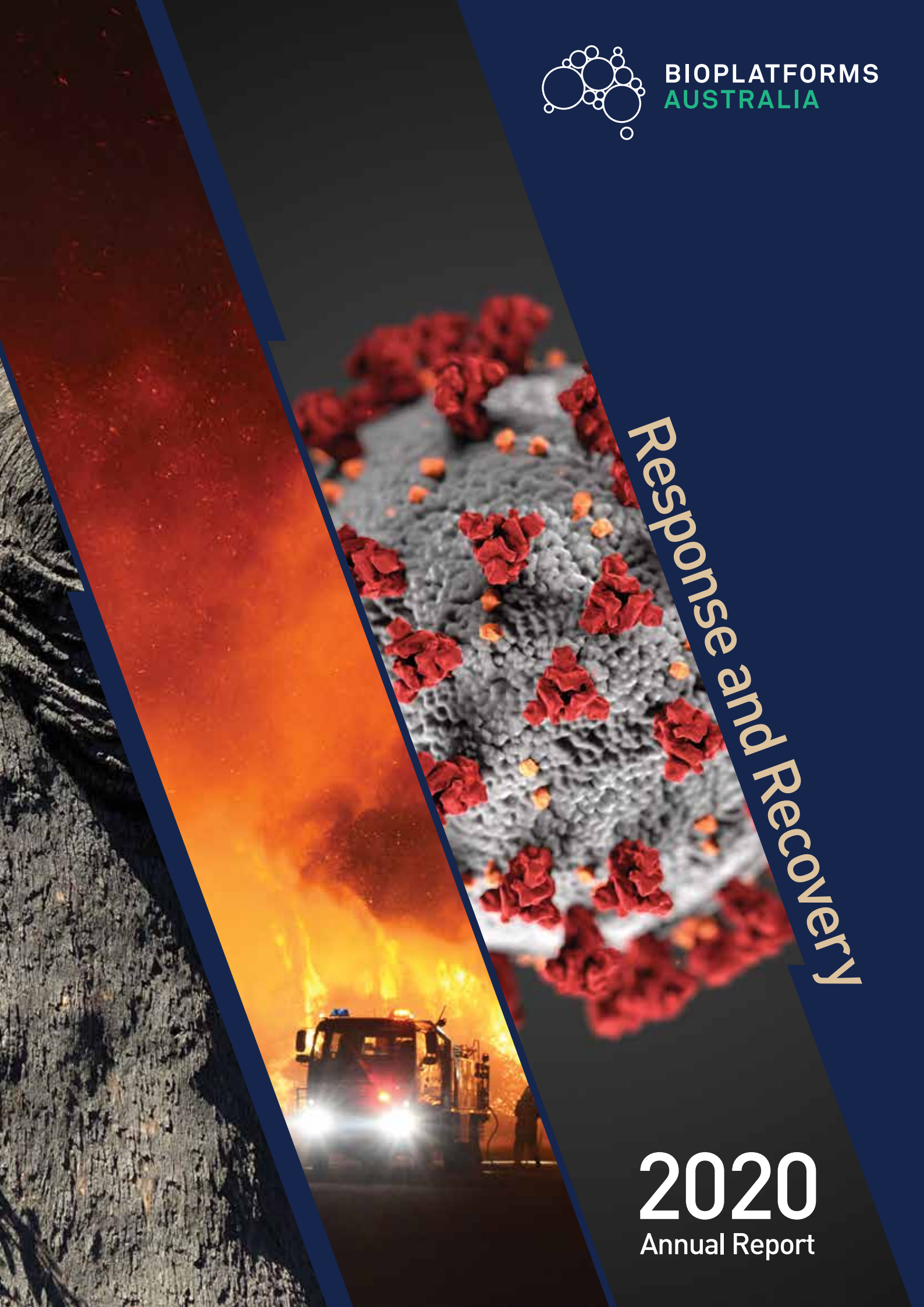




**BIOPATFORMS
AUSTRALIA**

Response and Recovery

2020
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

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Chairman's Review

The last year has been like no other, with Australia in particular facing a succession of challenges related to drought, bushfire and the global pandemic. These have caused intense strain on individuals, families, communities and the nation at large. Our thoughts remain with those affected, and we are pleased to have had the opportunity to play some small part in focussing our actions on responses to, and mitigation of, the challenges.

Scientific disciplines and our nation's scientists have come to the fore, providing objective analysis and advice on pressing issues. Moreover, there appears to be growing acknowledgement of the important role of science and scientific advice, and that investment in science is a critical national resource in leading the mitigation and recovery from devastating drought, bushfires and COVID-19.

One critical way the scientific community has responded is through the deployment of national capability to support the current acute circumstances. Also important will be the role that will be needed in consolidating hard gained lessons and knowledge into planning for future events, and to support the rebuilding of the economy with new services, products, businesses and jobs. There is much that can be done to position Australia for greater self-reliance in light of the needs revealed during the current pandemic.

Research Infrastructures as collective national assets have been ready and well positioned to respond to emergency needs over the year. The ongoing investment in and operation of NCRIS has ensured that leading-edge instrumentation, staffed with expert scientists and operating with a culture of collaboration and service, has been available when, where and as needed.

We thank our network of NCRIS facilities who have persisted, and in some cases re-oriented, through difficult circumstances to deliver access to critical services in genomics, proteomics, metabolomics and bioinformatics. They have supported vital research agendas such as:

- investigation of traits in native plants that will provide solutions to drought tolerance in agriculture and food security. Australia's native flora has an amazing tolerance and adaptability to a range of stresses and we are aiming to harness this plasticity in future agricultural development.
- development of genetic analyses to support breeding programs for Australia's most threatened species, acutely brought to the nation's attention with the devastation caused to our wildlife through the Bushfire crisis.
- support for the development of a crucial vaccine for COVID-19 by the CEPI team at The University of Queensland Australian Institute for Bioengineering and Nanotechnology. This work was not only in response to the current pandemic but builds critical capacity to contribute to future concerns. Pleasingly, this work has been driven together with our NCRIS peer - Therapeutic Innovation Australia.

Notwithstanding that it has been an extraordinarily difficult year that has demanded significant attention over and above normal operations, the national Bioplatforms team has made great progress on all fronts of our strategy. We have now implemented all new funding arrangements in response to the 2018 budget contribution to our NCRIS program, including the establishment of two new facilities in South Australia and Western Australia.

The South Australian Genomics Consortium (SAGC) is a newly formed cooperative of genomics facilities and users in South Australia, forming a consolidated capacity and staff aimed at providing South Australian researchers with a broader and deeper genomic resource. Connected into national capacities through the Australian Genome Research Facility (AGRF), the SAGC will focus on local needs for biomedical research and plant science with sites at the South Australian Health and Medical Research Institute (SAHMRI) and the Waite Campus respectively.

Genomics Western Australia has also been formed, combining key participants in Perth and consolidating access to significant state-based capacities, including recently acquired Illumina NovaSeq and PacBio Sequel II instrumentation. This consolidated consortium will enhance the ability of WA researchers to collaborate readily with research teams from elsewhere in the country.



We thank our network of NCRIS facilities who have persisted, and in some cases re-oriented, through difficult circumstances.

The Bioplatforms Australia Melanoma Genome Project, which was initiated in 2012 and whose findings were published in Nature in 2017, was again analysed in the context of an international "Pan-cancer analysis of whole genomes" investigating molecular dysfunction across cancer families. This second study was also published in Nature in February 2020 and is indicative of the strategic approach that has been established for developing critical data resources for use and re-use.

In reporting the above achievements, I would like to acknowledge my fellow Directors, Professor Sue Meek, Dr Katherine Woodthorpe and Professor Peter Gray, all of whom have provided flexible and adaptive leadership of Bioplatforms over the past year.

The Bioplatforms team, led by our Chief Executive Andrew Gilbert, also continue to deliver high quality ideas and outcomes and have performed beyond expectations in this difficult year of isolation, adjusting rapidly and seamlessly to new ways of working themselves, as well as with those of the broader Bioplatforms network.

In relation to these facilities, it is important to recognise the critical role provided by Bioplatforms' scientific leadership - Professor Marc Wilkins (Genomics),

Professor Ian Smith (Proteomics), Professor Malcolm McConville (Metabolomics) and Associate Professor Andrew Lonie (Bioinformatics). All have led the growth and development of our national networks with great energy, spirit and direction.

I look forward to ongoing interaction with the Bioplatforms Australia network in the coming year, and to ensure that NCRIS investment in research infrastructure continues to best meet both the immediate and longer-term needs of the life sciences.

**Dr Les Trudzik
Chair**

Response and Recovery

Capability

-  **15** world-class facilities
-  **\$18.7** million invested in best of breed technology and leading expertise
-  **269** funded staff (226.7 full time employees)

Access

-  **2,886** users
-  **14,194** research contracts
-  **549** clients (19%) from government, industry and commercial organisations
-  **62%** of research contracts were performed for the biomedical sector
-  Agriculture and environmental research accounts for **26%** of activity

Initiatives and collaborations

-  **12** active National initiatives
-  Partner Organisation to **5** ARC Centres of Excellence
-  **266** new registered users to the data portal
-  **8,806** registered users to Galaxy Australia (online Bioinformatics infrastructure)

Scientific outcomes of technology platform nodes

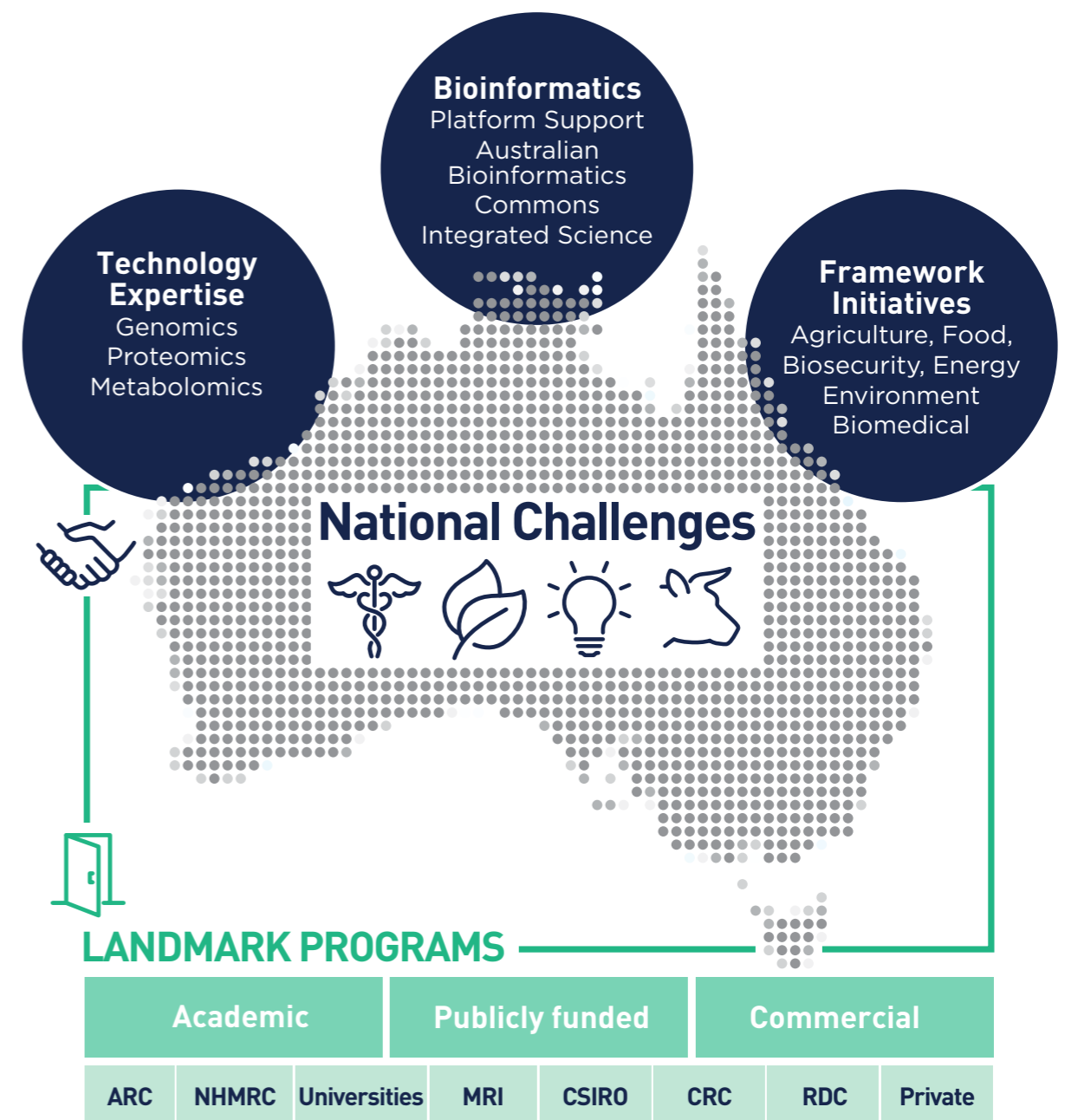
-  **874** research papers published in peer-reviewed journals
-  **109** papers published in top 10% journals including Nature, Science and Proceedings of the National Academy of Sciences (PNAS)
-  **150** ARC and NHMRC grants Chief Investigator, partner investigator/organisation
-  **17** Bioinformatics training (BioCommons, face-to-face and webinar)
-  **5,464** training attendees (18% live, 82% YouTube channel)

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.



Bioplatforms network



GENOMICS

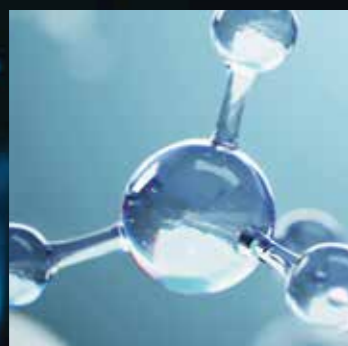
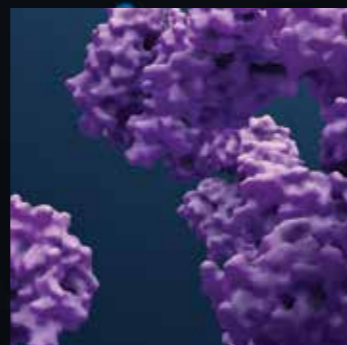
Gene Discovery and Genome Function

- Australian Genome Research Facility
- The Ramaciotti Centre for Genomics, UNSW, NSW
- Biomolecular Resource facility, ANU, ACT
- Garvan-Weizmann Centre for Cellular Genomics, NSW
- Genomics Western Australia, WA
- South Australian Genomics consortium, SA

PROTEOMICS

Protein Structure and Function

- Australian Proteome Analysis Facility, NSW
- Monash Proteomics & Metabolomics Facility and Monash Antibody Technologies Facility, VIC
- University of South Australia, SA
- Proteomics International and UWA, WA



METABOLOMICS

Small Molecule Analysis

- Bio21 Institute, University of Melbourne, VIC
- Australian Wine Research Institute, SA
- Centre of Metabolomics, UWA, WA
- Australian Institute of Bioengineering and Nanotechnology, UQ, QLD

BIOINFORMATICS

Data acquisition, integration, analysis and modelling

- Australian BioCommons



Bioplatforms activities

Bioplatforms team update

Bioplatforms has welcomed Sarah Richmond to the team. Sarah was previously a program manager experienced in the coordination and delivery of innovative national-scale research infrastructure programs such as the EcoCommons, the Biodiversity and Climate Change Virtual Laboratory (BCCVL), and the ecocloud Platform.

With a research background in ecology, she has both a professional and personal passion for tackling complex technical challenges to better allow researchers and decision-makers to efficiently discover practical solutions to significant research challenges. Sarah joins Bioplatforms as our General Manager for Science Programs and is responsible for overseeing the framework initiatives and building communities of practice around 'omics.



The Bioplatforms network is strengthened by its global connectivity, leveraging international best practice, workflows, tools and expertise.

Bioplatforms Australia, national capability with international scope

The Bioplatforms network is strengthened by its global connectivity, leveraging international best practice, workflows, tools and expertise. Our international engagement has allowed us to optimise the benefits of international memberships and partnerships including access to global facilities and participation in strategic collaborations, including:

- Collaborative agreement with ELIXIR: the Australian BioCommons recently signed a collaboration strategy with ELIXIR. This three-year collaboration will actively involve Australian BioCommons in many of the activities related to the European life science infrastructures. The mutually-beneficial relationship will enhance the complementary areas of both infrastructures; while ELIXIR will offer extensive pan-European experience, Australian BioCommons will provide an international perspective.
- Corbel participation: Bioplatforms recently led an Australian NCRIS delegation to the final all-hands meeting of Corbel, an EU funded project, with the aim of connecting life science research projects to multiple research infrastructures. The valuable insights gained from the delegation will inform the strategic plan for the transition of our infrastructure towards a more coordinated and collaborative model.
- New Zealand: the Bioplatforms Australia Chief Executive is a member of Genomics Aotearoa international advisory panel and routinely reviews New Zealand based research proposals. Genomics Aotearoa is our peer in NZ, building local genomics and bioinformatics capability.
- Bioplatforms Australia is an institutional partner of the international Earth BioGenome Project (EBP) which aims to establish a genomics resource for all of Earth's eukaryotic biodiversity. We will contribute the output of our Biodiversity efforts when it aligns to the goals of the EBP particularly for initiatives currently focussed on Australian vertebrates and plants. This provides a valuable pathway for sharing workflows and standards with the international life science community.

FEATURE STORIES

Bushfire response

Bioplatforms Australia was able to apply our extensive network of capability to biodiversity conservation and industrial needs arising from the summer's bushfire crisis.

Conservation assessments based on traditional taxonomy can fail to consider major components of within-species variation. This was deemed true for many vertebrate species prioritised by the Wildlife and Threatened Species Bushfire Recovery Expert Panel for actions following the 2019-20 fires. Bioplatforms collaborators, led by Prof Craig Moritz, Director of the Centre for Biodiversity Analysis at ANU, are summarising available genetic information on Australian species to enable the Expert Panel and state and territory agencies to make better informed assessments of fire impacts. It will also generate new data on genetic risk (diversity and connectivity) for heavily impacted species where samples and genomic resources permit and are prioritised by agency partners.

In response to the 2019/20 summer bushfires across Australia, the Metabolomics Australia group at the Australian Wine Research Institute (AWRI), a South Australian NCRIS facility supported by Bioplatforms Australia, the State Government and the AWRI, mobilised staff and resources quickly to collaborate with industry in conducting smoke taint testing of bushfire-affected samples and in supporting trials to help wine-grape growers better predict future smoke taint impact.

The support by Metabolomics Australia included provision of:

- technical staff to assist with sample preparation, operation of HPLC-MS systems and data analysis for testing of smoke exposure markers in grape samples
- access to a new HPLC-QQQ (purchased in late 2019 through NCRIS) for smoke marker analysis, as a back-up instrument for routine testing and extra capacity for research trials
- access to a GC-MS for method improvement and validation, seeking to cut analysis time and improve throughput of existing methods for analysis of volatile phenols from smoke
- services for the benchmarking of commercial products such as enzymes which might be suitable to the amelioration of smoke taint in wine
- support to ongoing research trials in the Adelaide Hills (e.g. the PIRSA-funded project 'Evaluation of the impact of early-season smoke exposure on grape and wine composition and wine sensory properties') and Hunter Valley.

COVID-19 response

Bioplatforms Australia is proud that our network of research facilities remained open and responsive to COVID-19 demands and research.

Specific contributions included:

- support for the Coalition for Epidemic Preparedness Innovations (CEPI) vaccine development (UQ, metabolomics and proteomics, AGRF genomics)
- sewerage and other sentinel surveillance (AGRF)
- global tracking of COVID-19 and mutational profiles (Australian BioCommons, bioinformatics)
- investigation of rationale for absence of symptoms and acute illness in Children (APAF proteomics)
- new screening assay based upon biomarkers (Proteomics International)

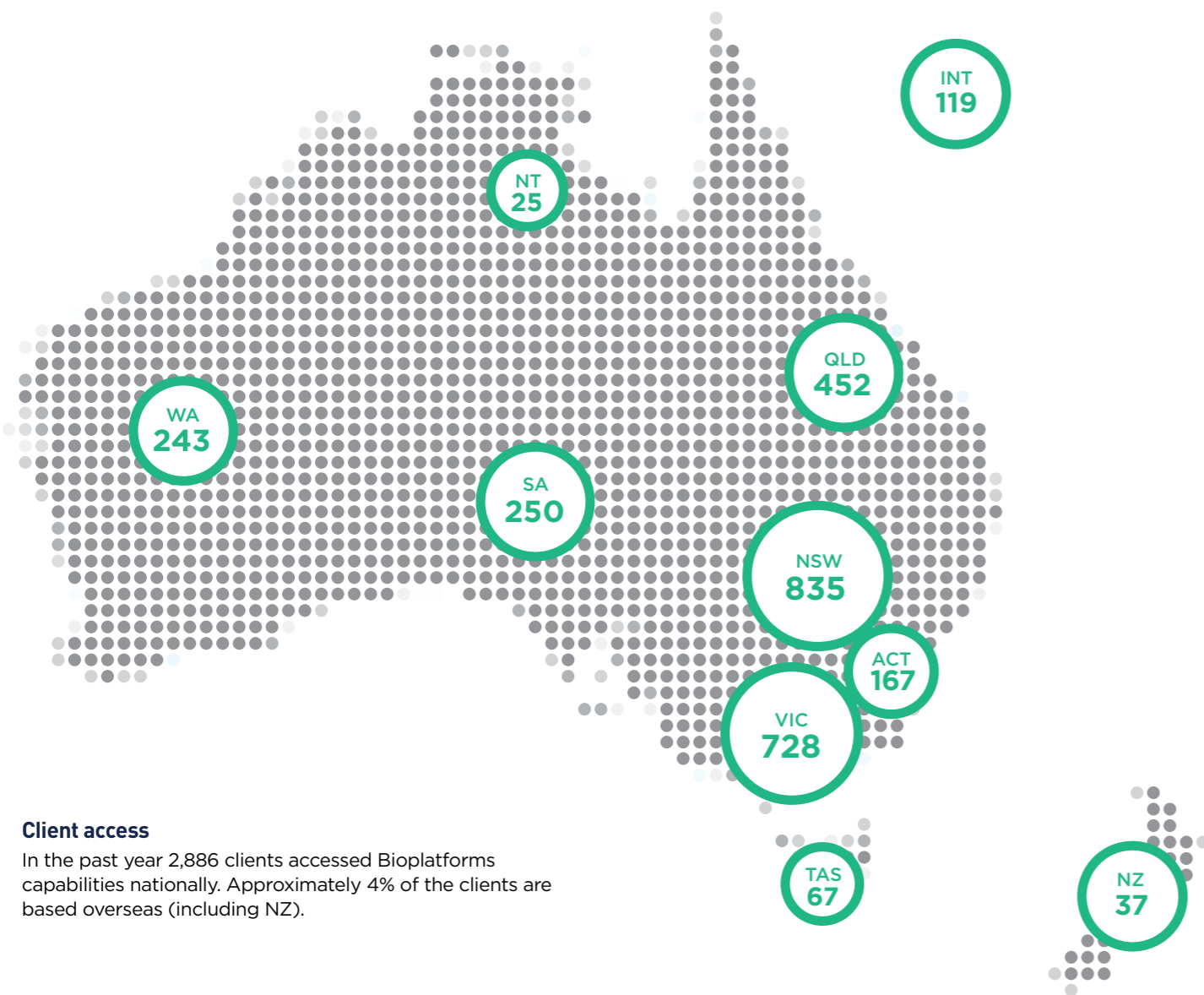
Bioplatforms Australia has been very active in coordinating COVID-19 related activities both within our own network and across the NCRIS portfolio. We developed a COVID-19 "offering" and distributed this broadly to Commonwealth and State Chief Scientists, leading officials from the NHMRC, MRFF, ARC and CSIRO together with operational agencies within State Governments and private pathology providers.



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.

Figure 1: Client across Australia for 2019/2020



Client access

In the past year 2,886 clients accessed Bioplatforms capabilities nationally. Approximately 4% of the clients are based overseas (including NZ).

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, despite the impact both the dramatic bushfires from the turn of the year and COVID19 had on research, 2019/20 has seen over 14,100 research contracts completed. These contracts have led to impacts across all four capabilities (Genomics, Proteomics, Metabolomic, Bioinformatics) which are highlighted across this report.

Contribution to the Australian research system

Bioplatforms Australia strategically partners with, and provides broad based access to, the breadth of the Australian research system. We actively engage peak programs such as the Australian Research Centres of Excellence (CoEs) and Cooperative Research Centres (CRCs), to meet the needs of our very best researchers and ensuring our network is engaged in significant collaborative research.

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 59% of research contracts followed by independent research organisations (22%), with commercial and government clients accounting for 19% 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 2: Client access by sector

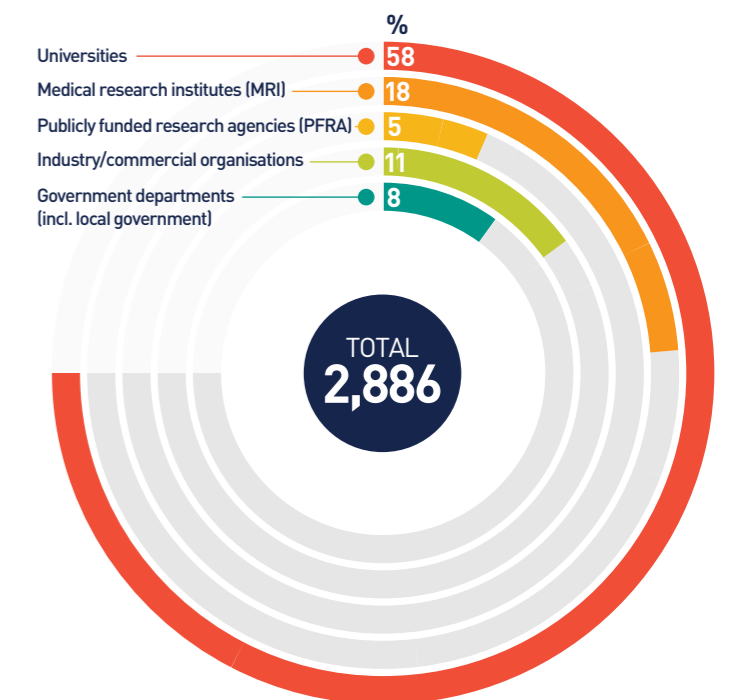
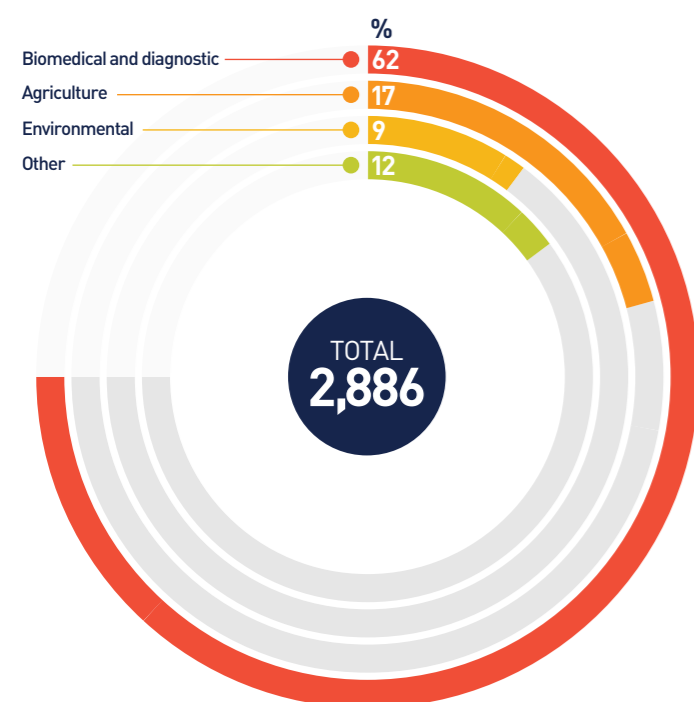


Figure 3: Client numbers by discipline



Research focus

Research disciplines accessing our infrastructure continued to be heavily focused on biomedical research and diagnostics, followed by agriculture research (17%) and environmental research (9%).

Bioinformatics training

Over the last 12 months, the Australian Bioinformatics Commons have supported 17 training events consisting of 3 hybrid trainings and 14 webinars. Hybrid training is a newly developed mechanism by which global leaders facilitate education and training from their location, but are supported with hands-on tutors within Australian training facilities. It has been highly effective in ensuring we remain connected to best of breed bioinformatics training from around the globe.

A total of 996 attendees attended the live hybrid training and webinars. Notably a further 4,468 researchers accessed the recorded training via the associated YouTube channel.

Figure 4: A snapshot of intellectual property (IP) and commercialisation activities



Commercial focus

Highlighting our link to commercial outcomes, we were involved in 32 commercially linked activities. This period saw a high focus on process improvements, proof-of-concept, clinical trials and patents. Over half of key IP and commercialisation activities occurred through the proteomics facilities.

StemCore

StemCore is a state-of-the-art facility offering comprehensive pluripotent stem cells and transgenic cell line generation and supply. StemCore provides services include the provision of human pluripotent stem cell lines (including NIH-listed and extensively-studied MEL family of human embryonic stem cell lines), off-the-shelf and custom-generated induced pluripotent stem cells engineered using CRISPR/Cas9 and similar approaches.

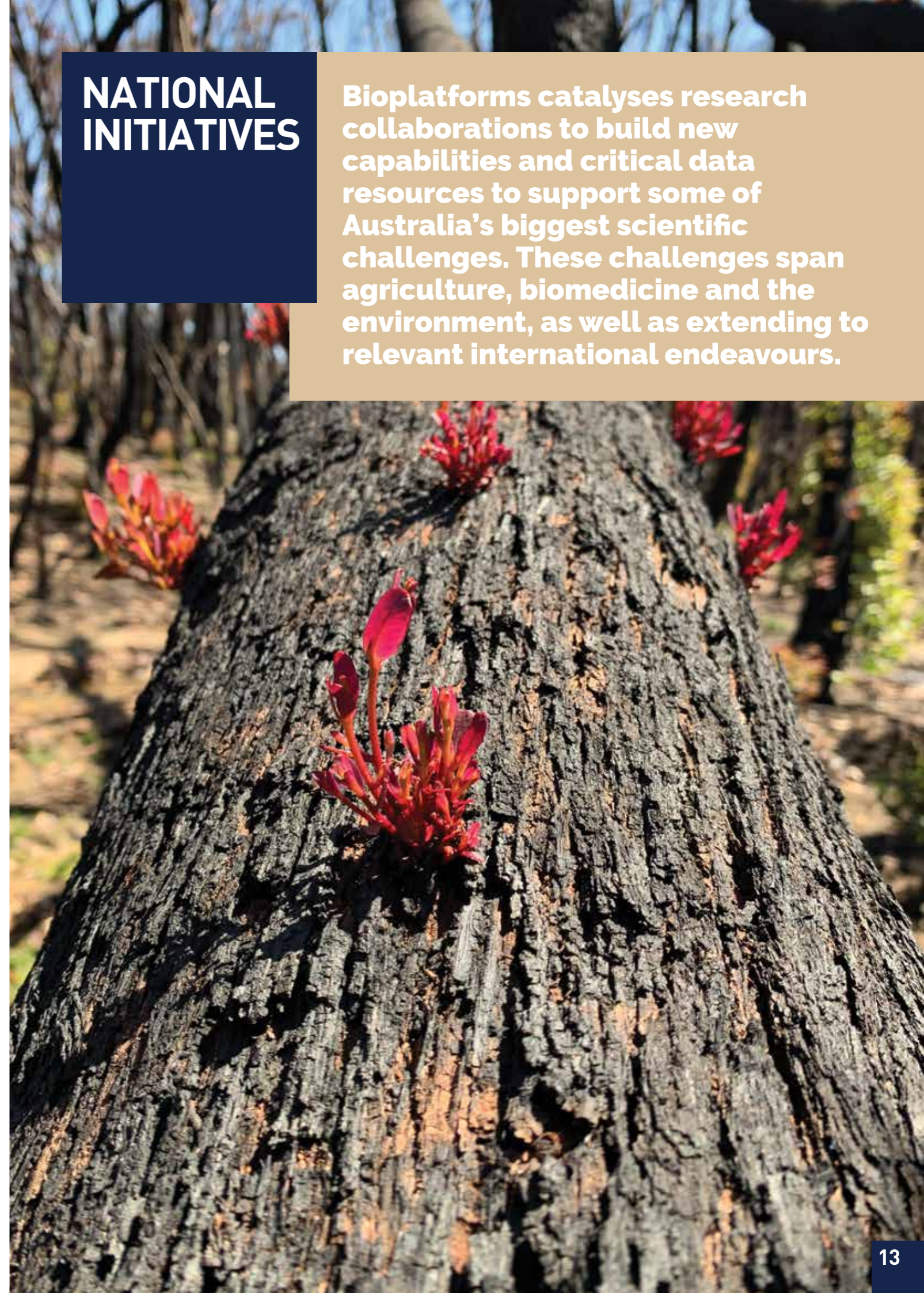
The facility serves a variety of University of Queensland, interstate and international clients with both off the shelf cell lines and tailored products. A particular highlight has been a collaboration with an Australian SME developing iPS cells for clinical applications,

StemCore is a Bioplatforms facility and forms an important part of our Queensland network together with AGRF, AIBN and QCIF, all of whom are generously supported via the Queensland State Government RICF program.

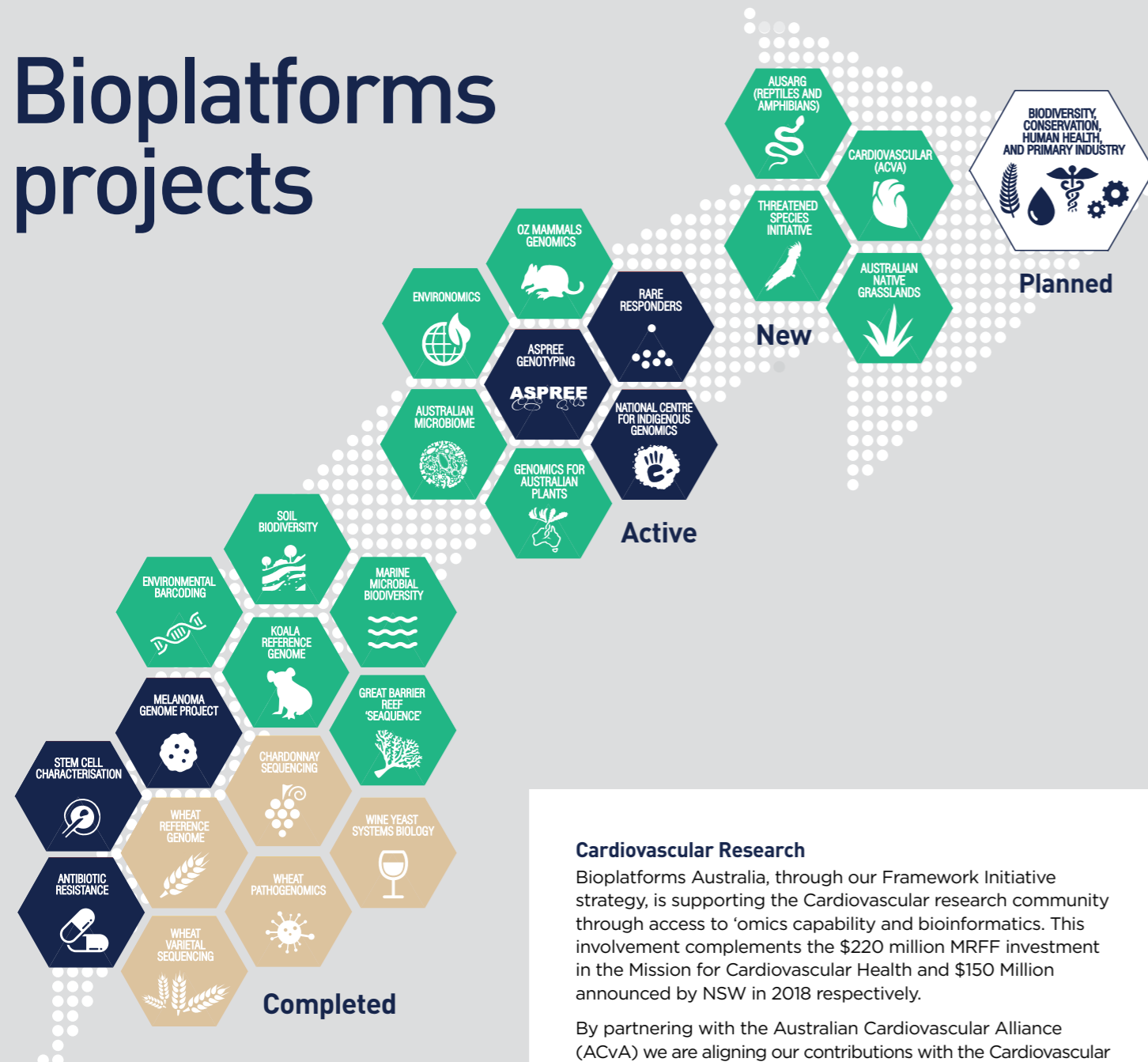


NATIONAL INITIATIVES

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 projects



Cardiovascular Research

Bioplatforms Australia, through our Framework Initiative strategy, is supporting the Cardiovascular research community through access to 'omics capability and bioinformatics. This involvement complements the \$220 million MRFF investment in the Mission for Cardiovascular Health and \$150 Million announced by NSW in 2018 respectively.

By partnering with the Australian Cardiovascular Alliance (ACVA) we are aligning our contributions with the Cardiovascular Health Mission Flagships established to promote collaboration, translation and health impact, including:

Implementation and Policy Research Flagship
Clinical Trials Flagship
Big Data Flagship
Precision Medicine Flagship: embedding multi-omics platforms (from genomics to metabolomics) and computational bioinformatics with well-phenotyped clinical cohorts to discover new markers and mechanisms
Bioengineering Flagship
Drug Discovery and Translation Flagship

We aim to maximise the value of our national network through deployment to MRFF mission priorities. We thank Professor Gemma Figtree, President of the ACVA, and Kerry Doyle the newly appointed Executive Director for their collaborative leadership and ongoing support of the ACVA - Bioplatforms Australia collaboration.

Bioplatforms' 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, 24 initiatives have received investment for research integrating genomics, proteomics and metabolomics. The 2019-20 year saw four new initiatives approved, Australian Amphibian and Reptile Genomics, Threatened Species, Cardiovascular mission and Australian Native Grasslands.

Three of the new initiatives have been launched and have made substantial progress in establishing governance protocols and commencing project activities.

Additional programs are being scoped for future Framework Initiative investment, with particular focus on primary industry.

Australian Native Biodiversity

Bioplatforms Australia is supporting a national effort to build an understanding of the diversity and evolution of life through a foundational genetic assessment of Australia's unique and diverse flora and fauna.

This assessment began with a resource for mammals through the Koala and Oz Mammals Genomics (OMG) initiatives. These interdisciplinary and collaborative programs established a blueprint for successfully delivering large-scale initiatives to create reference genomes, phylogenomics and taxonomy/conservation resources. Building on the lessons learned, we established the Genomics for Australian Plants (GAP) and the Australian Amphibian and Reptile Genomics (AusARG) initiatives with the aim of supporting more of the Australian Tree of Life. Together, these programs lay the foundations for the recently established Threatened Species Initiative (TSI), which has been developed in direct consultation with government threatened species managers and conservation organisations to develop a systematic approach to integrating genomics into species recovery plans.

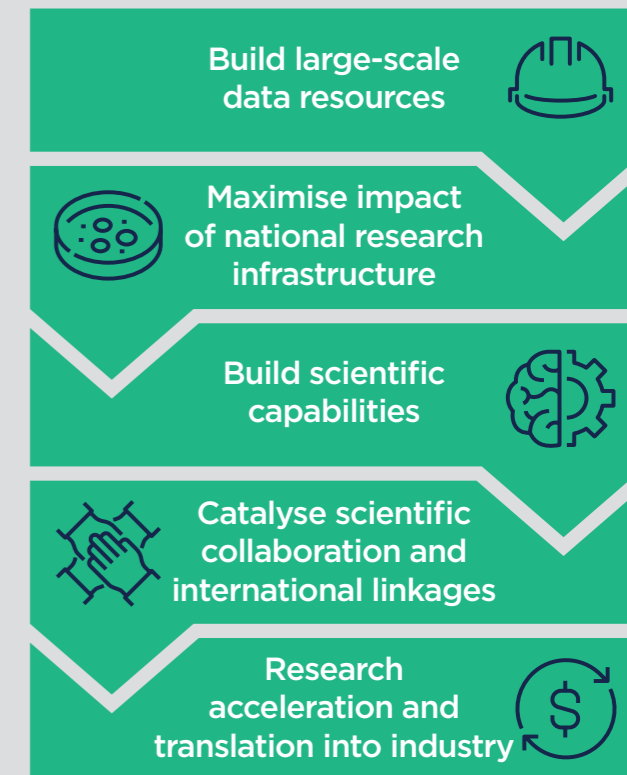
41 reference genomes generated or underway

Increased phylogenomic framework across mammals, plants and reptiles

9 conservation actions supported

Collectively, these initiatives are providing an understanding of the diversity and evolution of life of Australia's flora and fauna and are pioneering the use of genomic information to support species recovery management, ultimately improving efforts in preserving our unique biodiversity now and into the future.

THE BENEFITS OF DATASET PROGRAMS



Exceptional Responders

Exceptional responders to trial therapies, that is people presenting exceptionally positive or adverse responses, have the potential to help us better understand human biology and to uncover new pathways to treat diseases through analysis of their genomes. Such studies could also reveal biomarkers that could be used to predict responses to the same or similar treatments in other patients.

Bioplatforms Australia, with generous support from the Kinghorn Foundation supported an initiative to investigate exceptional responders at the Garvan. In 2019/20:

99 exceptional response patients were referred, by

33 clinicians, from

18 clinical trial centres, across

5 jurisdictions, with

Melanoma, Sarcoma, Prostate and Urothelial cancers.

Whilst initially focused on cancer patients and response the program of work intends to extend to all relevant clinical trials in the years to come, including immunology and haematology, and potentially rheumatology, renal, gastroenterology and endocrinology.

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.

INTERNATIONAL ENGAGEMENTS

ELIXIR (Europe)	Kew Gardens (UK)
Joint Genome Institute (USA)	National History Museum (UK)
National Microbiome Data Collective (USA)	Earth BioGenome Project (Multinational)



ARC INDUSTRY TRANSFORMATION RESEARCH HUBS (ITRH)

ARC Centre for Medicinal Agriculture	ARC Research hub for Sustainable Crop Protection
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COOPERATIVE RESEARCH CENTRES

CRC for Alertness, Safety and Productivity (Alertness CRC)	CRC for Transformations in Mining Economies (CRC-TIME)
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CENTRES OF EXCELLENCE

ARC CoE in Nanoscale BioPhotonics	ARC CoE in Synthetic Biology
ARC CoE in Plant Cell Walls	ARC CoE in Plant Success in Nature and Agriculture
ARC CoE for Australian Biodiversity and Heritage	ARC CoE in Innovations in Peptide and Protein Science



PROGRAMS

Biological Hydrogen production - HydGene	Reef monitoring
Synthetic biology	Bioinformatics training



Industry Engagement

The Bioplatforms infrastructure network is a resource for Australian business and industry. Expertise in life science research and development is relevant across the sectors of health and medicine, agriculture and food, biotechnology and waste.



Our facilities are available for outsourced product development and for more collaborative research and development. We commonly perform industry led projects, partnerships on grant opportunities and broker relationships for constructive collaborations with the research community.

Bioplatforms Australia also provides project management for solutions to industry-identified problems. This approach ensures we are able to maximise commercial outcomes, deliver targeted research to end user needs, and ensure links with current national scientific and innovation priorities. Industry engagement is a key component of the programs and initiatives that Bioplatforms supports.

Outlook

Bioplatforms Australia is exposed to the intersection between academic and applied scientific discovery and believe this is the foundation for emerging knowledge-based economy. Our Federally funded network is crucial for enabling technologically-heavy start-ups and Small to Medium Enterprises (SME) to become the Australian bio-industries of the future. We offer various levels of assistance and support to enable innovative ideas to attract further investment.

CASE STUDY



1

ZOETIS

Zoetis produces a large number of vaccines locally and globally, and holds the largest market share of the US\$4.6bn animal vaccine market.

Bioplatforms Australia Proteomics node at AIBN Queensland developed a rapid assay to quantitate toxoid production, determine batch performance and for screening raw materials, resulting in consistent fermentations. The improved vaccine production process has created an improved product and reduced production costs whilst maintaining quality and standardised production of vaccines for livestock, without the need for animal trials, thus eliminating animal welfare issues.

Zoetis is the only global animal vaccine company with an active vaccine R&D program in Australia, and projects such as this provide global reach and reputation for the expertise within the Bioplatforms Australia network.

CASE STUDY



2

LANZATECH

Lanzatech is a world leader in gas fermentation as an economically attractive option for the sustainable production of fuels and chemicals from otherwise polluting, gaseous waste feedstocks.

Lanzatech was interested in understanding the underlying molecular aspects of acetogens energetics. In particular, Bioplatforms Australia Queensland node for metabolomics and proteomics engineered and characterised at a systems-level, recombinant poly-3-hydroxybutyrate (PHB)-producing strain of *C. autoethanogenum*. Integration of the data into the genome-scale metabolic model showed energy limitations for PHB production.

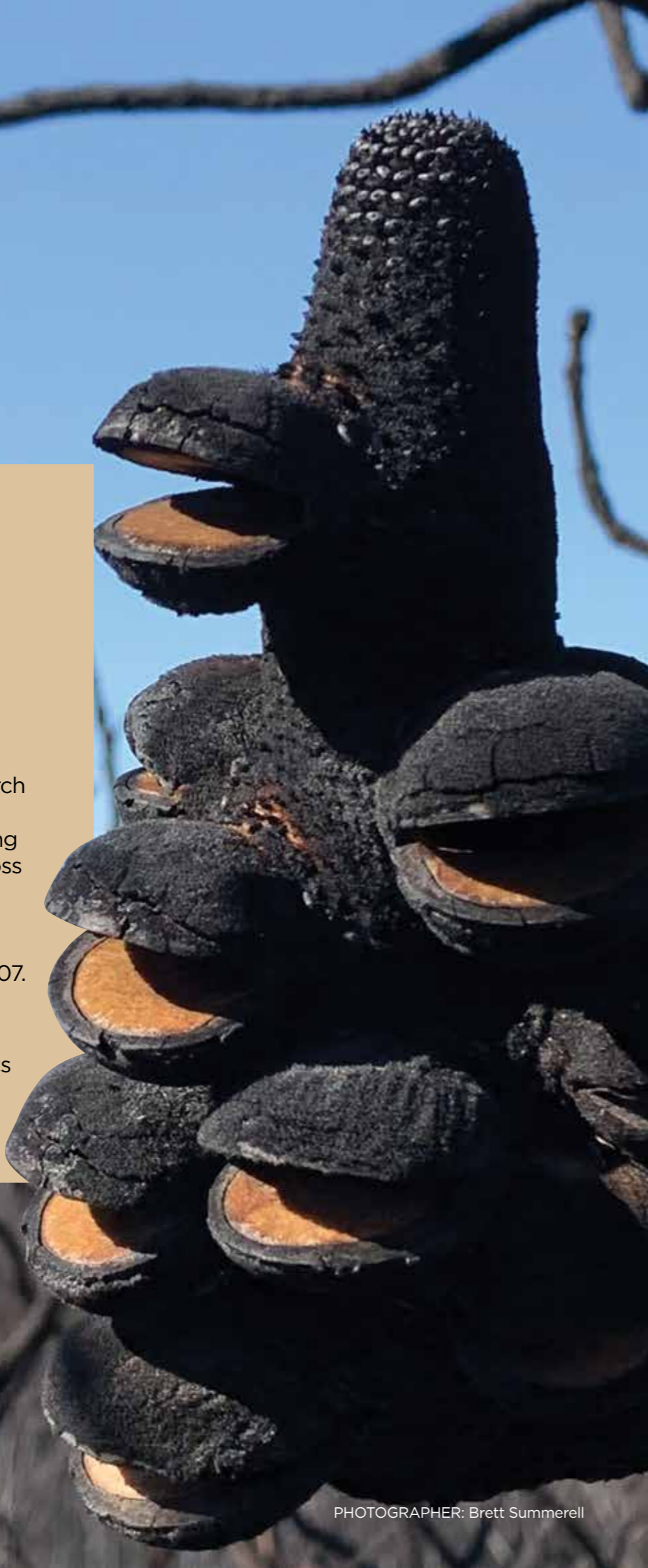
Altogether, the data presented advanced the fundamental understanding of heterologous product synthesis in gas-fermenting acetogens and is being utilised by Lanzatech to expand its product lines and enhance the economics of gas fermentation. This work was also supported by an ARC Linkage grant.

CAPABILITIES NETWORK

Scientific research changes lives through innovation

Bioplatforms Australia encourages innovation by investing in scientific infrastructure and biomolecular research capabilities through our Capabilities Network. This Network spans 15 leading universities and research facilities across Australia, employs 269 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.



PHOTOGRAPHER: Brett Summerell

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
- Ramaciotti Centre for Genomics
- Biomolecular Resource Facility
- Garvan-Weizmann Centre for Cellular Genomics
- Genomics Western Australia
- South Australian Genomics consortium

CASE STUDY



1

A NEW TOOL IN THE FIGHT AGAINST LEAF RUST IN WHEAT

Monitoring and understanding wheat leaf rust

Wheat is one of Australia's major crops and one of the most important grain crops in world commerce. In Australia, wheat is grown throughout the southern and eastern regions in the crescent known as the Australian grain belt. Annually Australia produces 25 million tonnes of wheat, with the majority destined for export.

Leaf rust, caused by the fungus *Puccinia triticina*, is one of the most devastating diseases of wheat, affecting production in nearly all wheat-growing regions worldwide. Despite its economic importance, genomic resources for *P. triticina* are very limited. In this project researchers used long-read next generation sequencing to produce a reference genome for *P. triticina*. The resulting genome represents the best quality leaf rust genome available to date.

BIOPLATFORMS FACILITIES: AGRF

PARTNERS: The University of Sydney

OUTCOME: Improved leaf rust fungus (*Puccinia triticina*) molecular resource (genome and transcriptome) to help researchers understand how the fungus causes wheat diseases and identification of new leaf rust genes, which will be useful in the development of new diagnostic tools for leaf rust monitoring.

IMPACT: The ability to monitor and manage the spread of leaf rust fungus will minimise the spread and impact of the disease and improve wheat crop productivity.

CASE STUDY



2

BRINGING COLOUR BACK TO THE REEFS

Developing heat resistant coral to fight bleaching

Coral reefs worldwide are suffering mass bleaching events and mortalities from marine heat waves, with increased frequency due to global warming.

Scientists from the University of Melbourne, CSIRO and the Australian Institute of Marine Science (AIMS) have successfully produced in a laboratory setting a coral that is more resistant to increased seawater temperatures. This was made possible by making the coral more tolerant to temperature-induced bleaching by bolstering the heat tolerance of its microalgal symbionts – tiny photosynthetic eukaryote cells that live inside the coral tissue.

Further testing of the algal strains in adult colonies across a range of coral species will be carried out to see if the same results can be observed.

BIOPLATFORMS FACILITIES: Ramaciotti Centre for Genomics, funded by a NovaSeq mini grant run in conjunction with Illumina.

PARTNERS: CSIRO Synthetic Biology Future Science Platform, University of Melbourne, Australian Institute of Marine Science (AIMS)

OUTCOME: Coral stock with enhanced climate resilience can be developed through genetic manipulation of the coral's microalgal endosymbionts.

IMPACT: Increasing the heat tolerance of corals will allow the regeneration and conservation of coral reefs that are under threats for oceanic warming, allowing these rich and magnificent areas to be maintained for future generations.

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.



- Australian Proteome Analysis Facility
- Monash Proteomics & Metabolomics Facility and Monash Antibody Technologies Facility
- University of South Australia
- Proteomics International and UWA

CASE STUDY

1



TARGETING PLASMODIUM'S ACHILLES HEEL

Malaria vaccine development

Malaria is a serious and sometimes fatal disease caused by the Plasmodium parasite. Plasmodium commonly infects the female Anopheles mosquitoes and the parasite can be transferred to humans they feed on. Patients with malaria are typically very sick with high fevers, shaking chills, and flu-like illness. In 2018, 228 million cases of malaria were reported globally, with a death toll of over 400,000.

Plasmodium parasite changes through several life stages while in the human host, presenting a challenge for vaccine development as different immune response activating molecules are presented to the human host, thus making it hard to know which Plasmodium molecule should be targeted.

Researchers from Australia and Germany, in collaboration with MPMF identified a portion of a Plasmodium protein molecule that can be developed as a vaccine target to generate human immune cells which can effectively monitor and fight the parasitic infection.

BIOPLATFORMS FACILITIES: Monash Proteomics and Metabolomics Facility (MPMF)

PARTNERS: Institute of Clinical Chemistry and Clinical Pharmacology, University Hospital of Bonn (GER), ARC Centre of Excellence in Advanced Molecular Imaging, Bio21 Molecular Science and Biotechnology Institute, Burnet Institute, Centenary Institute, Deakin University, John Curtin School of Medical Research, Monash Biomedicine Discovery Institute, Peter Doherty Institute for Infection and Immunity, University of Melbourne, Walter and Eliza Hall Institute.

OUTCOME: The portion of the Plasmodium protein molecule which was identified through this collaboration, is present throughout the parasitic life cycle and across different Plasmodium species. This is a strong target for malaria vaccine development.

IMPACT: The development of a strong malaria vaccine which would be effective across parasitic life cycles of the different Plasmodium species would greatly decrease the worldwide health burden from malaria and save thousands of deaths yearly.

CASE STUDY

2



DECIPHERING SARS-COV-2 INFECTION

Understanding how COVID-19 affects children and adults differently

Coronaviruses are a large family of viruses, which can infect humans or animals. In December 2019, the SARS-CoV-2 virus causing the COVID-19 disease was first detected in Wuhan, China. This new coronavirus is closely related to a bat coronavirus but not previously identified in humans.

SARS-CoV-2 has since spread rapidly globally and has been declared a pandemic. Large ongoing outbreaks continue in many countries, impacting businesses, economies and disrupting daily life. Human coronaviruses generally cause mild illness, and in the case of COVID-19, 80% of people recover from the disease without needing hospital treatment. However, the remaining 20% of these patients become seriously ill and develop difficulty breathing. The virus also affects children differently from aged patients.

In an effort to understand the mode of infection and altered effect of the virus across age groups, researchers collaborating with the Australian Proteome Analysis Facility are investigating the shared protein molecules present (> 100 identified) and undertaking comparative studies of these proteins between healthy and COVID-19 adults and children.

BIOPLATFORMS FACILITIES: Australian Proteome Analysis Facility (APAF)

PARTNERS: Murdoch Childrens Research Institute

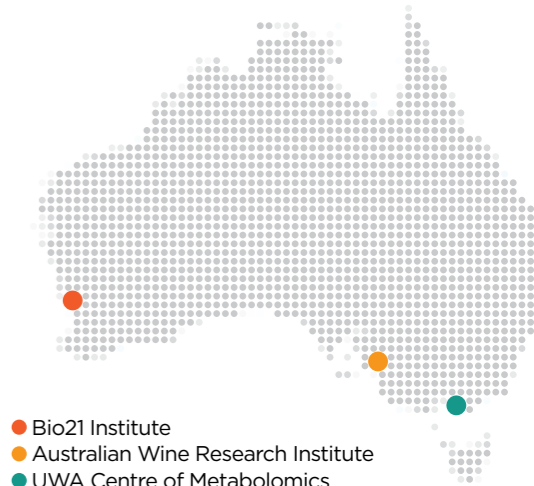
OUTCOME: More than 100 protein targets with potential role in the differential effect of the COVID-19 disease across age groups were identified and are now being the subject of in-depth comparative studies.

IMPACT: Understanding how the SARS-CoV-2 viral infection progresses differently between children and adults would provide significant support for clinical organisations and assist the disease management.

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.

Through 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.



- Bio21 Institute
- Australian Wine Research Institute
- UWA Centre of Metabolomics
- Australian Institute of Bioengineering and Nanotechnology

CASE STUDY

1



HARNESSING THE POWER OF STEM CELLS

Identification of human pluripotent stem cells with self-renewal capacity

Human pluripotent stem cells have the potential to differentiate into distinct cell types, sparking enormous interest in their use in cell therapies for many diseases.

Deciphering the cell processes that allow these stem cells to self-replicate or differentiate to other cell types is critical for understanding human development. It also has significant potential in the development of new therapies.

A large international collaboration identified a subpopulation of human pluripotent stem cells that has a unique capacity for self-renewal. Researchers have refined the methods necessary for obtaining and maintaining these highly valuable cells which represent a minority of stem cell populations.

This is a vital step for the development of stem cell therapies which relies on a tightly controlled and efficient ability to maintain, expand, and differentiate these cells in vitro.

BIOPLATFORMS FACILITIES: Metabolomics Australia - University of Melbourne

PARTNERS: The Jackson Laboratory (USA), the University of Melbourne, The Walter and Eliza Hall Institute, The University of Queensland, the Florey Institute of Neuroscience and Mental Health. This project is part of Bioplatforms Australia's Stem Cells Collaborative Framework Data Initiative.

OUTCOME: Increase the fundamental understanding of human development and improve methods to generate human pluripotent stem cells important for stem cell therapies.

IMPACT: Capacity to develop efficient and targeted stem cell therapies

CASE STUDY

2



PREVENTING SMOKE TAIN IN WINE

Diagnostics for smoke exposure of grapes (bushfire response program)

Many Australian vineyards have their grapes exposed to bushfire smoke which not only affects the fruit crop but can result with undesirable characteristics in the wines produced, such as ashy, smoky burnt or medicinal, usually described as 'smoke tainted'. Unsurprisingly, consumers have been shown to respond negatively to smoke tainted wines.

In response to the 2019/20 summer bushfires across Australia, the Metabolomics Australia group at the Australian Wine Research Institute (AWRI) with the support of the South Australian State Government, mobilised staff and resources quickly to collaborate with the wine industry to conduct and optimise smoke taint testing of grapes from bushfire-affected areas and to lead trials to help wine growers better predict future smoke taint impact.

Research is also conducted in benchmarking commercial products which may be suitable to ameliorate smoke taint in wine.

BIOPLATFORMS FACILITIES: Metabolomics Australia - Australian Wine Research Institute (AWRI)

PARTNERS: South Australia State Government, Australian Wine Research Institute (AWRI), Wine industry partners

OUTCOME: The wine industry is dramatically impacted by bushfire and their emitted smoke potentially losing entire yearly crops. The collaborative project will help the wine industry in responding and coping with the impact of future bushfires, which is likely to happen at increasing frequencies due to climate change and human impact.

IMPACT: Providing the wine industry with mechanisms to respond and cope with the impact of bushfire. Avoiding millions of dollars in losses each year through wasted crops and wines.

Australian BioCommons

The Australian BioCommons is an ambitious digital infrastructure capability that is enhancing Australian research in its ability to understand the molecular basis of life across environmental, agricultural and biomedical science. This large-scale investment in digital infrastructure is ensuring Australian life science research remains globally competitive, providing access to the tools, methods and training researchers require to respond to national challenges such as food security, environmental conservation and disease treatments.

Progress

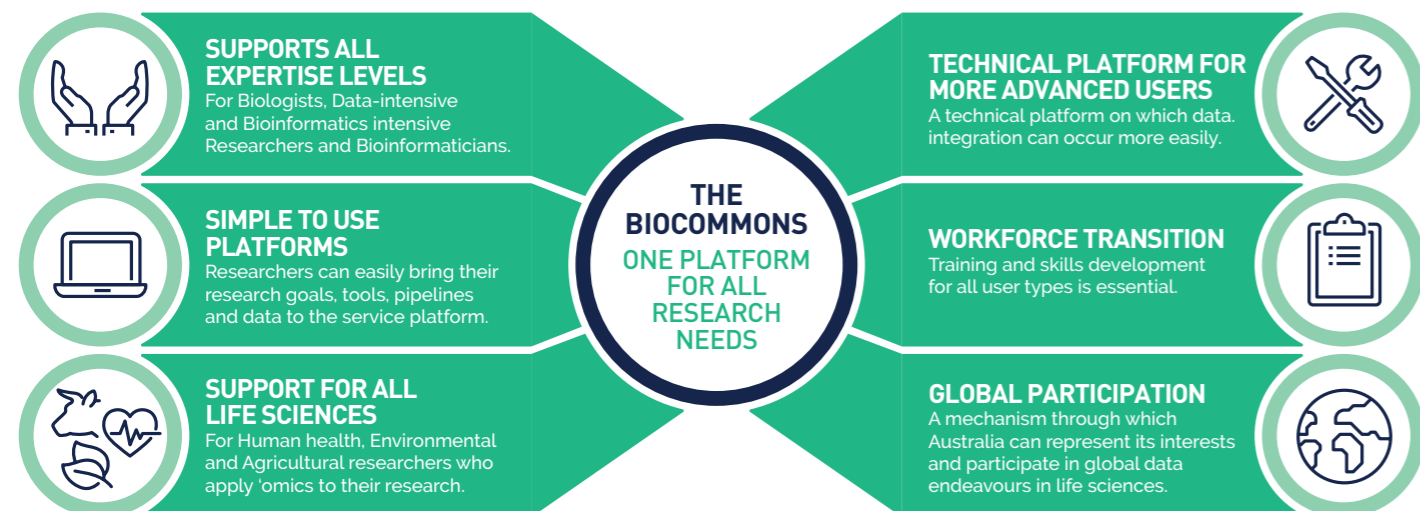
- Established communities of practice to define their digital infrastructure needs: Genome assembly and Genome annotation; Metabolomics, Metagenomics, Phylogenomics, Proteomics
- Engaged with national High Performance Computing (HPC) providers to address these current challenges and deploy tools that are being made accessible to the community: Facilitated and coordinated access to computational resources; Genome annotation and assembly tools (Agreement with Softberry for a licensed copy of Fgenesh++; Hosted Apollo Portal)
- Improved Galaxy Australia's platforms, a free hosted web-accessible platform that allows researchers to conduct accessible, reproducible, and transparent computational biological research, with greater accessibility and offering. The platform provides a free 600GB of working data storage for Australian based users. It contains over 1,100 bioinformatics tools which can be chained together into workflows and 220 reference datasets, and also has extensive online training material.

International links for best practice

BioCommons has entered in a 3-year strategic collaboration with ELIXIR, which will seek to create a cooperative plan to exploit international synergies between the two research infrastructures. This collaboration will actively involve Australian BioCommons in many of the activities related to the European life science infrastructures. The mutually-beneficial relationship will enhance the complementary areas of both infrastructures; while ELIXIR will offer extensive pan-European experience, Australian BioCommons will provide an international perspective.

This strategy will allow ELIXIR and Australian BioCommons to better support research challenges of international scope, with activities including:

- international adoption of standards in software platforms, workflows, tools and data
- international collaboration on methodological platform and tools (e.g. Galaxy), training and training materials in bioinformatics
- supporting global research communities (such as in metagenomics methods, biodiversity, de-novo genome assembly, phylogenomics, plant phenotyping-genotyping)
- delivery of federated solutions to human data preservation and research access
- delivery of global identity and access management



United in fighting the war against childhood cancer

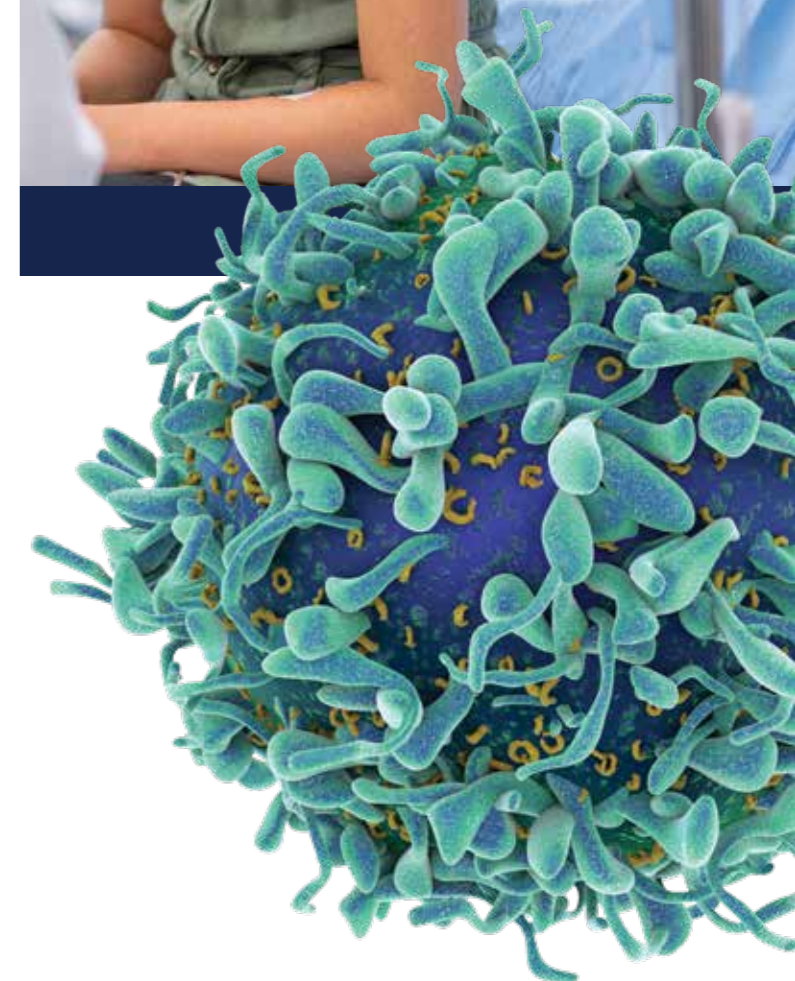
The Australian BioCommons has entered in a collaborative partnership with ZERO Childhood Cancer (ZERO), the Australian Research Data Commons (ARDC), The Gabriella Miller Kids First Data Resource Center (Kids First DRC) and the Children's Brain Tumor Tissue Consortium (CBTTC). Cancer kills more children than any other disease in Australia.

Every week three children and adolescents in Australia die because of it. Every child is different, every cancer is unique, so treatment has to be tailored for each individual. Through an international data collaboration on paediatric cancer subtypes, researchers and clinicians hope to better understand how to treat the cancers that are found in Australia, based on information that was previously inaccessible.

Research will be done on the CAVATICA Platform, a cloud-based system for collaboratively accessing, sharing and analysing childhood cancer data. The CAVATICA Platform allows clinicians and scientists worldwide to rapidly access large amounts of genomic data and workflows within a computation and storage environment where they can share, process, integrate and analyse data.

The platform has enabled researchers and clinicians to harmonise and process over 15,000 whole genomes, whole exomes and RNA-seq, including alignment, somatic variant calling, copy number calls, structural variants, RNA expression and fusions. Additionally, integrations with the Kids First Data Resource Center portal allows users to create cohorts and manage their analysis in secure, cloud-based projects in CAVATICA.

This collaboration massively increases the capacity of researchers driving improved outcomes and novel research. This will change the way sick children can access treatment, and will enable more children to access personalised cancer treatments.





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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.

