agrf

# Annual Report

Financial Year 2021–22

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# Chairman’s message

It is my pleasure to share with you AGRF’s Annual Report for the year ended 30 June 2022.

During 2021–22, we adapted to living with an ongoing global pandemic. We reconnected with colleagues and clients, and we worked collaboratively to support the research community, while expanding our services in health and primary industries. We continued to operate throughout the entire pandemic, proudly supporting Australian and international scientific communities.

AGRF had a successful year, providing genomic services through our national network of laboratories. We also supported innovative research by providing access to our advanced platforms and technical experts, enabling our clients to achieve valuable scientific outcomes.

Our partnership with the Zero Childhood Cancer Program (ZERO) was announced in September 2021 and has been pivotal for AGRF. We’ve sequenced more than 890 patient tumour and germline samples and more than 1,500 samples across our whole genome sequencing, RNA sequencing and DNA methylation services. We are proud to contribute to this project, working together with the talented team at the Children’s Cancer Institute and ZERO partners to make a meaningful impact on the lives of children living with cancer. This is a wonderful example of the profound impact genomics can have on the health outcome of patients.

We continue to expand our partnerships in agriculture, aquaculture and primary industries, collaborating on critical projects such as working closely with CSIRO and the University of Adelaide to support conservation efforts via sequencing of the critically endangered night parrot. This highlights the importance of genomics in safeguarding population diversity.

I would like to acknowledge the commitment and contributions from the AGRF Board, along with the Executive Team. Their input to the changing needs of the genomics market is invaluable.

Finally, I would like to thank the Australian Government’s National Collaborative Research Infrastructure Strategy (NCRIS) for its valuable funding and support via Bioplatforms Australia.

2023 promises to be an exciting year of growth for AGRF as we expand our services further in health and primary industries and continue to support genomic research. The AGRF Board looks forward to working with management, staff and our clients to build sustainable and impactful outcomes for everyone through the use of genomics.

**Professor Simon Foote**
Chairman AGRF

# A message from our Chief Executive Officer

This year represented a period of transformation for AGRF. Having established an excellent reputation as a genomics service provider over our first 25 years, our Board and management team have worked to embed AGRF as the national leader in genomic analysis.

The world of genomics has entered an era of rapid change and acceleration of technologies. AGRF continues to respond swiftly to evaluate and adopt new genomic technologies, while still providing Australian researchers, commercial scientists and clinicians with the latest and most comprehensive services. We have continued to expand our portfolio with bespoke workflows and accreditations that build on our past successes.

We proudly support more than 2,000 clients from more than 200 universities, hospitals, research institutes, commercial partners, contract research organisations, biotechnology companies and government departments. This year, AGRF processed more than 450,000 samples, including sequencing of more than 4,500 whole genomes. We also sequenced multiple new types of genomes using our long-read technologies.

We continued our strong history of partnering with our clients, collaborating on exciting new projects such as the development of new genomic-based tools relevant to aquaculture breeding programs in conjunction with James Cook University to improve the sustainable farming of aquatic species.

Using our long-read sequencing technologies, we helped Queensland researchers determine the composition and key components in jellyfish venom to enable better treatment methods for people who have been stung. We were also privileged to sequence a 117-year-old preserved lizard, in partnership with CSIRO, continuing our history of aiding conservation efforts.

We are very proud of our partnership with the Zero Childhood Cancer Program, undertaking sequencing for Australia's first and most comprehensive personalised medicine program for children and young people with cancer.

The strength of AGRF reflects the leadership of our Board, the management team and our dedicated staff. We are excited about a future where genomics continues to make the world a better and more sustainable place and we will continue to invest in new technologies to ensure our team continue to be at the forefront of genomic science.

**Joe Baini**
Chief Executive Officer

# A message from our Chief Scientific Officer

At AGRF we take pride in our level of engagement with the research community. We are committed to ensuring the services we provide meet researchers' needs, and we actively seek to assist in translating Australian research to health and industry settings.

This year, AGRF has co-authored 13 peer-reviewed publications and has been cited in a further 437. We have invested in our Science and Technology team and our research and industry partnerships. Our Innovation and Development group has expanded to three post-doctoral scientists across our Melbourne and Sydney laboratories. This has enabled us to deliver increased capacity in both Melbourne and Brisbane through the implementation of automation, and to increase our collaborations in single cell and spatial biology.

AGRF have invested in 14 newly awarded grants, including an ARC Industrial Transformation Research Hub (ITRH) Supercharging Tropical Aquaculture and a Cooperative Research Centre (CRC) Transformations in Mining Economies grant. These two partnerships are pivotal for our exploration into how genomics can advance sustainable food supply through aquaculture and agriculture, and for delivering solutions to the environmental challenges Australia and the world are facing.

We are founding members of Melbourne Genomics and this year renewed our membership for a further three years. We are working within the alliance to implement clinical genomics in Australia, including expanding our clinically accredited workflows and having a key role in the development of clinical data analysis tools.

In Sydney, our involvement in a Medical Research Future Fund (MRFF) exploring the use of bacteriophage to treat antimicrobial resistant infections has seen us become more deeply embedded with the Westmead research and clinical communities. Our newly appointed innovation and development scientist supports our research collaborations and works on the MRFF to deliver genomic data to the project.

In Brisbane, we invested in a second long-read sequencing system to support our rapidly growing services. With this increased capacity we are now well positioned to expand the services we offer through this platform.

This year AGRF has strengthened our capabilities and capacity and formed critical strategic partnerships around the country. It is an exciting time in genomics, with AGRF leading the way for new application development.

**Dr Cath Moore**
Chief Scientific Officer

# Our governance

## Our Board

**Dr Simon Foote**
Chairman

- *BMedSci, MBBS, PhD, DSc, FFSc (RCPA), FAA, FAHMS, FTSE*
- *Member of the Finance, Audit & HR Committee*

Professor Foote is an Emeritus Professor at The John Curtin School of Medical Research at The Australian National University. He has been Director of the John Curtin School, Dean of the School of Medicine at Macquarie University, Director of the Menzies Research Institute at the University of Tasmania and Divisional Head at the Walter and Eliza Hall Institute, Melbourne. Professor Foote was elected to the Australian Academy of Science in 2016 and was a founding member of the Australian Academy of Health and Medical Sciences (AAHMS) after being elected to the Academy in 2014 and is also a Council Member of the AAHMS. He was elected as a Fellow of the Australian Academy of Technological Sciences and Engineering (ATSE) in 2009, and he was a postdoctoral fellow at the Whitehead Institute at the Massachusetts Institute of Technology.

**Prof. Nick Samaras**
Deputy Chairman

- *BSc (Hons), PhD, MBA, FAIM, FAICD, FWCLP*
- *Member of the Finance, Audit & HR Committee*

Professor Samaras has worked in senior positions of several global life sciences companies for over 30 years. Professor Samaras has served on the boards of several Australian-based technology companies and is currently the Chairman of Genetic Signatures Ltd. He is also an Enterprise Professor at the University of Melbourne and Professor (Practice) at Monash University. He has extensive experience in the global life sciences and advises the AGRF Board on current technological advances, market trends and industry engagement.



AGRF would like to thank and acknowledge the contributions of Mr. Andrew McDonald who retired from our Board prior to this publication

**Prof. Gabrielle Belz**
*BVBiol, BVSc, PhD, DVSc, FAHMS, MAICD*

**Prof. Benjamin Kile**
*BSc (Hons), LLB (Mon), PhD, FAHMS*

**Prof. Ingrid Winship AO**
*MBChB, MD (Human Genetics), FRACP, FACD, FAICD*

**Prof. Brandon Wainwright AM**
*BSc (Hons), PhD*

**Dr John Bell**
*BSc, MSc, PhD, FTSE, FRACI, Comp I.E. Aust, MAICD*

AGRF would like to thank and acknowledge the contributions of Mr. Andrew MacDonald who retired from the Board prior to this publication.

## Our Executive Team

**Joe Baini**
*Chief Executive Officer*

**Dr Cath Moore PhD**
*Chief Scientific Officer*

**Matthew Tinning**
*Head of Laboratory Operations*

**Jessica Poy**
*Chief Commercial Officer*

**Karen Jenkins**
*Head of People & Culture*

**Jim Nanos**
*Chief Operating Officer*

# Our vision, mission and values

## Our *Vision*

To help make the world a better and more sustainable place through the use of genomics.

## Our *Mission*

AGRF's purpose is to partner with the genomics community to make profound improvements to people's lives by delivering a world-class, innovative, and integrated capability.

## Our *Values*

**Integrity**

We strive to do the right thing by engaging with our community using respectful, ethical and honest actions and communication.

**Collaboration**

We build inclusive teams and valued relationships in pursuit of shared goals creating a meaningful impact for the community.

**Knowledge**

We embrace challenges with curiosity and initiative to provide our clients with access to cutting-edge genomic and analytical technologies.

**Accountability**

We take ownership and can be trusted for our role in delivering quality outcomes with reliability and consistency.



# Highlights 2021–22

We continued to work across a wide range of biological fields including environmental research, agriculture research, aquaculture, human health, and plant research.

We successfully secured high calibre joint applications, including:

- ARC Industrial Transformation Programs
- ARC Linkage and Discovery Grants
- MRFFs and NHMRC Ideas Grants
- Cooperative Research Centre (CRC)
- QLD Government Research Infrastructure and Co-investment fund

## Key *Stats*

### Publications

AGRF has co-authored **13 peer reviewed publications** and been cited in a further **437**

### Genotyping

We processed over **450,000** samples

**14,535** SNP and Methylation Array samples processed

### Long-read Sequencing

We've sequenced **50 new genomes**

**15 strains/ cultivars** of existing genomes

### Next-Generation Sequencing

Over **4,600 whole genomes** sequenced from different species, including over **1,000 human genomes**

# Impacting children's lives with precision medicine

**AGRF's data insights have proved invaluable for tailoring treatments and improving the outcomes of children with high-risk, rare or relapsed cancer.**

**"ZERO is all about data-driven medicine, and AGRF plays a critical role in providing that data."**

Zero Childhood Cancer (ZERO) is Australia's national precision medicine program for children with cancer. This world-leading program provides in-depth molecular analyses and testing of samples from each participating child. It is led by the Children's Cancer Institute and Kids Cancer Centre at Sydney Children's Hospital and involves all nine of Australia's children's hospitals.

Thanks to AGRF's extensive multi-omics sequencing data, including both whole genome sequencing (WGS) and RNA sequencing (RNA-seq), the ZERO team gain valuable insights into the genetics of each child's cancer and can identify clinically relevant information for their treating oncologist.

Once a child's tumour has been sequenced, scientists can look for any genetic mutations or alterations that may be driving its growth and then search for drugs capable of targeting those alterations. This genomic analysis can also lead to a whole new depth of understanding about each child's cancer, which can inform other aspects of clinical care, including diagnosis, prognosis, risk stratification and treatment.

ZERO Program Leader, Adjunct Associate Professor Vanessa (Ness) Tyrrell, says the team was thrilled to have AGRF come on board as genomics partner.

"ZERO is all about data-driven medicine, and AGRF plays a critical role in providing that data," she says.

Since September 2017, ZERO has been available for children with high risk, relapsed, rare or undiagnosable cancers with less than a 30% chance of survival. Since its launch, we have exceeded 900 patients enrolled. Some children alive today would almost certainly have died had they not taken part in ZERO, while other children have been able to spend more precious time with their families.

The program is being expanded, with an increasing number of patients now eligible to join ZERO's national clinical trial, beginning with all those up to 18 years of age who are diagnosed with brain cancer. By the end of 2023, all children and young adults diagnosed with cancer in Australia will have access to precision medicine through ZERO, regardless of their cancer type or risk profile – up to 1,000 children a year.

"Key to our ability to cater to this increased number and range of patients will be the ability to analyse their cancers quickly and reliably, and this is where the AGRF partnership really comes to the fore," says Associate Professor Tyrrell. "The expansion of ZERO is projected to result in a five-fold increase in patient recruitment over the next 18 months. We've been working closely with AGRF to transition our existing workflows and analytics, so we are well prepared for the massive increase in both the number and range of cancers to be analysed."

"We're now reaching a very exciting point where we're going to learn the true potential of precision medicine to improve outcomes for young Australians with cancer. But the benefits of ZERO are sure to extend far beyond our national borders. Through online data sharing platforms, we are working to make data from ZERO available to scientists and clinicians all over the world, and expand collaborations to drive research that stands to benefit all children with cancer, wherever they may live."

> *"This collaboration will drive research that stands to benefit all children with cancer, wherever they may live."*

# Bioinformatics – making data meaningful

**AGRF's leading Bioinformatics team is translating data to help researchers identify genetically inherited diseases, paving the way for personalised treatment and better health outcomes.**

Our Bioinformatics team uses state-of-the-art genomic platforms to produce incredible amounts of data every day. In general, these instruments produce either a single or series of letters representing nucleotides, encoded as 'A', 'C', 'G', 'T'.

The team converts data into meaningful information for clients across research, industry and pathology fields.

One of the team's key projects includes undertaking a nucleotide assessment whereby a person can be genetically identified as having an inherited disease or not.

"By assessing which nucleotides are different, or out-of-order, across the 3,117,292,070 nucleotides[1] comprising the human genome, we can identify if a person has a genetically inherited disease," says Steven Bentley, one of AGRF's leading Bioinformaticians.

One method the team uses is finding where each of >600,000,000 fragments, 150 nucleotide-long snippets of information (known as 'reads') have come from in the human genome. These 'mapped reads' are then assessed against a 'reference genome' for quality and likelihood of being correctly mapped and informative. Each position that does not match the 'reference' genome is then assessed if the differences are likely real or not.

> *"I'm extremely excited to see the flow-on effect of the rising interest in genomics in the wider population."*

"We expect millions of differences for each person – after all, we are unique, in personality and on the molecular genetic scale[2]," says Steven.

These identified differences are then assessed in large databases to provide further insight into the variation, for instance, if it is frequently seen in any population or if it might negatively affect a protein's function. This is only one of many applications requiring bioinformatics.

The AGRF Bioinformatics team is led by Kenneth Chan and comprises eight members: Matthew Andrews, Nathan Bachmann, John Fitzpatrick, Lesley Gray, Naga Kasinadhuni, Martha Zakrzewski and Steven Bentley. Collectively, the team has expertise in analysing data across many sample sources: bacteria, fungi, plant, animal and human, as well as many applications, including clinical genomics, microbial and animal diversity profiling, gene expression and genome reference development.

Steven joined AGRF in 2020 and primarily works in variant detection applications for human genetics, detecting both inherited (germline) and acquired (somatic) genomic variations, using data from the Illumina NovaSeq sequencing instrument. These analyses aid in patient diagnostics and improve the understanding of disease by identifying novel molecular causes and possible tailored treatments for disease. Steven's position at the AGRF allows him to be at the forefront of ever-evolving applications of the technology.

"I'm extremely excited to see the flow-on effect of the rising interest in genomics in the wider population. Increasing understanding and interest can reduce the fear of the unknown, allowing more informed decisions regarding personal healthcare and policymaking in general," he says. "Sparking the interest of cross-discipline professionals can also lead to novel solutions for unsolved issues. Watch this space."


1. While the 'human genome project' completed in 2003, it has been updating ever since as DNA sequencing technology improves. This nucleotide count was from January 2022
2. This statement is also partially true for monozygotic twins. On top of early developmental DNA changes, acquired DNA changes, known as somatic, can arise in individual cells that were not inherited and are not passed down. Making each person unique when taking all the cells as a whole
3. https://training.galaxyproject.org/archive/2019-07-01/topics/proteomics/images/variant_calling.png

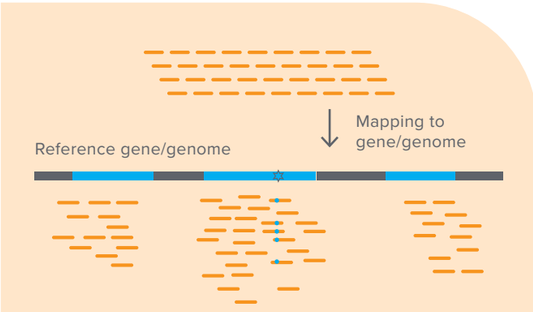



Fig.1 Variant Calling[3]

# Transforming toxins into treatments

**AGRF's genomic data is helping researchers uncover the secrets in the venom of some of the world's most dangerous creatures.**

**"AGRF is a reliable facility with amazing applicational and analytical knowledge for both gDNA and RNA sequencing."**

Professor Glenn King and his team at The University of Queensland's Institute for Molecular Bioscience (IMB) are studying the mechanisms and composition of of two box jellyfish species, the Irukandji jellyfish Carukia barnesi and the infamous box jellyfish Chironix fleckeri, whose tentacles can reach 3 metres in length.[1]

Molecular genetics is helping the team understand the evolution and composition of jellyfish venoms through the sequencing and assembling of each animal's genome using long-read sequencing performed on the Sequel IIe at AGRF and The University of Queensland.

"Having the genetic information of both animals will help identify the composition and key components in each animal's venom," says Cebrina Nolan, PhD student and team member. "The long term goal is to to develop better treatment methods for people who have been stung by a box jellyfish."

Venoms are a complex mixture of peptides and proteins and affect various vital systems in the human body. So far, the genomic research performed at The University of Queensland has uncovered useful information about the venom of *Chironex*.

"It is very potent, very cardiotoxic and very necrotic. Its cardiotoxicity is most likely due to the activity of pore-forming toxins but may also involve other factors," says Cebrina.

The team have almost finished the genome assembly for the Irukandji species also being studied, which will be the world's first *Carukia barnesi* genome.

Genomics is an essential tool in understanding the biology and evolution of life. As Cebrina says, it is changing not only with the rise of more efficient and accurate technologies, but also its importance in conducting any molecular-based biological study.

Professor Glenn's team is combing cellular and *in vivo* assays with proteomic, transcriptomics and genetic studies to characterise the composition and function of the venom and indiviual venom components. Technologies involved include FLIPR, confocal imaging, Illumina sequencing, Omni-C sequencing and, of course, PacBio HiFi long-read sequencing.

"AGRF is a reliable facility with amazing applicational and analytical knowledge for both gDNA and RNA sequencing. They also have a close relationship with the IMB, allowing us to have easy access and high-quality reads right next door," says Cebrina.

"The partnership with AGRF provides me with advice and encouragement on how to figure out the best methods to extract high quality gDNA from difficult jellyfish tissues as well as support on identifying the best sequencing techniques and quality of the gDNA and RNA in question," she adds.

Genomics provides information and future opportunities for Professor King's team for the development of better treatment methods for people stung by a box jellyfish. While the average beachgoer should still admire these potentially lethal animals from a safe distance, the research being done now is at an exciting stage and offers hope for safer beaches in the future.

> *"Having the genetic information ... will help identify the composition and key components in each animal's venom"*

1. Australian Museum (2022) Box jellyfish. Available at: https://australian.museum/learn/animals/jellyfish/boxjellyfish (Accessed 16 December 2022)

# Spotlight on Abdi – pursuing a passion for science

**Abdifatah Abdi**

Laboratory Technician
Genotyping team
*Joined AGRF in 2021*

While Abdi's work involves studying some of the smallest units of life, he always keeps his mind on the bigger picture.

"Genomics is helping the world in many ways. It is especially beneficial in human health, starting from understanding the genetic basis of inherited genetic diseases to being able to gene edit somatic cells to protect against certain conditions," he says.

A science enthusiast from a very young age, Abdi pursued his passion to learn and evolve as a science specialist by completing his Bachelor of Science Degree at the University of Waikato in his hometown of Hamilton, New Zealand. He spent some of his early career understanding the metagenome of cattle milk with a view to identifying animal health issues and finding genetic solutions to improve animal welfare and outcomes for the dairy industry.

After moving to Melbourne, he joined AGRF in October 2021 as a Laboratory Technician in the Genotyping team, and now works with the chain termination sequence process, an area considered to be a powerhouse of DNA sequencing for scientific innovation and genomics.

"My work at AGRF makes a difference. It influences people's lives, whether it's improving their health outcomes or contributing towards sustainability," he says.

> *"It has given me a sanctuary to incubate and develop my skills further."*

As part of the Sanger Sequencing team, Abdi plays a key role in providing clients with the data they need to further their research projects.

"The primary applications addressed by the Sanger service at AGRF are vital for different types of research, such as paediatric research. My work helps provide the genetic information clinicians and researchers need to understand whether there are genetic causes for things such as intellectual disability, developmental delay, and behavioural conditions in children."

AGRF has enabled Abdi to develop expertise in this scientific field and foster his scientific interests.

"AGRF provided me with the chance to do something impactful with my life," he says. "I took this role because it presented a great working environment – conducive, collaborative and inspiring. It has given me a sanctuary to incubate and develop my skills further."

Abdi is proud to be part of an organisation that has proven time and again to be a market leader as a genomic service provider.

"AGRF strives for the betterment of human beings and that aligns with my own values and my commitment to be an innovator who can assist in developing new services and solutions for humanity. I have found AGRF to be the best in a collaborative environment. I always look forward to coming to work and collaborating with several departments to achieve common goals," he says.

Abdi's aspirations to have a successful career in the field of science are well supported at AGRF. He plans to continue his journey of practical learning without limiting himself to any one specific field of science. From his laboratory in Melbourne, Abdi knows his work has the potential to make an impact across the world, including the countries with which he retains strong ties.


"I want to actively give back and contribute towards making New Zealand and Somalia strengthened nations fortified by the power of advanced sciences and technology. All you need is to find a place and dedicate your time and see what is needed of you."

# Meet Lazarus – the night parrot

**AGRF and Bioplatforms Australia (BPA) are helping researchers in their quest to protect the critically endangered night parrot, one of only three grounddwelling parrots in the world.**

**“We’re so grateful for the support of BPA and AGRF. The service has been very efficient and really collegial. It’s been exemplary.”**

Photo by Nick Leseberg, supplied by Bush Heritage Australia

The night parrot (*Pezoporus occidentalis*) is a Lazarus species. Presumed by some to be extinct, this nocturnal, ground-dwelling bird was eventually rediscovered after 78 years and is now the focus of genomic research by CSIRO and The University of Adelaide.

The research, led by Dr Joseph, Director of the Australian National Wildlife Collection at CSIRO, and Dr Austin, Associate Professor at the University of Adelaide, aims to inform and improve conservation practices of this unique creature. Thanks to AGRF and the power of genomics, the team has been able to look at thousands of loci from the Western Australian and extinct South Australian populations to help answer evolutionary questions and to develop approaches to species recovery plans.

Dr Joseph says the birds are incredibly difficult to pinpoint.

“Someone once said to me, they were at that time the only bird in the world for which you can say: no one has ever shown someone else a night parrot,” he says.

“These parrots were discovered in the 1840s and seen a fair bit until the 1870s. And then, for much of the 20th century, they just disappeared, and no one could find them. Then, in 1990, a dead one was found on the side of a road in Western Queensland – and that was pretty exciting.”

Dr Joseph says the gaps in knowledge about these elusive birds are slowly being filled in.

“A key part of rediscovering them was learning what they sounded like. Most bird watching is done with your ears, and nobody knew what the night parrot sounded like,” he says. “Now, armed with the knowledge of what they sound like and what their habitat really is, people have been able to find them in other places.”

After the discovery in Western Queensland, Pullen Pullen Reserve was formed – a sanctuary to protect and conserve these birds and keep them safe while researchers learn more about them.

Dr Joseph says there are still many questions about the genetic structure of the parrots, so the research team is using genomics to learn more about night parrots.

“We’ve advocated recognising two species in the ground parrot, so what if there are two species of night parrot?”

Evidence of the birds found in Western Australia, north-western Victoria and Queensland is helping researchers to understand the night parrot’s history and explore its genetic structure. Using toe pad data collected from the birds, scientists have performed genomic sequencing to uncover information about their genetic make-up.

“Being able to ask and answer questions about genetic structure, should there actually be any, we hope will shed light on the genetic diversity that we’ve lost,” says Dr Joseph.

As well as helping a threatened species survive, this project may unlock answers about genetic diversity in general – and help to prevent parts of our flora and fauna from disappearing forever.

“It’s important to know how genetic diversity is distributed across the landscape because it’s another level of conservation and management. We want to preserve that genetic biodiversity. If these parrots become extinct, it’s a little part of our nation that’s gone.”

Dr Joseph credits BPA and AGRF for helping the project get off the ground.

“We’re so grateful for the support of BPA and AGRF. You effectively waved a magic wand and said, we’ll do it for you. It’s been very efficient and really collegial. It’s been exemplary.”

> *“If these parrots become extinct, it’s a little part of our nation that’s gone.”*

# Spotlight on Adjunct Associate Professor John Stephen – a rewarding career

**John Stephens**

Partnerships Manager, South Australia

*Joined AGRF in 2003*

John Stephen's career began as a researcher at a time before the pre-genomics explosion of molecular biology in the 1980s and 90s. He worked in the UK, Netherlands and USA at various government and research laboratories, and travelled to meetings and conferences in Brazil, Canada, Germany and France.

John's globetrotting career provided him with an incredible depth of knowledge and experience, which benefits the AGRF clients he works with today. Drawing on his background and expertise in microbial ecology and his experience working on the US Department of Energy's National Accelerated Bioremediation (NABiR) Program, John advises clients in the areas of agriculture and the environment.

"Not all our clients are genomics experts," says John. "Clients might use genomics as an assessment tool for ecological health or to answer some of their fundamental questions. We help them understand how genomics can provide the data they need to make more informed decisions."

> *"It's a very rewarding spread of responsibilities, with plenty of satisfaction in seeing client projects achieve their potential."*

During his early years at AGRF, John managed lab teams while also working directly with local, interstate and international clients on longer-term contracts and collaborations. One of his key achievements has been establishing AGRF's third national site on the Waite Campus of the University of Adelaide.

"It always seemed important to me that the efforts to 'give back' to our client base should be visible and formal," says John.

John's expertise and experience have meant he has been able to involve AGRF in many research grant proposals with partners who are enthusiastic about seeing AGRF as a key contributor to cutting-edge research.

He has represented AGRF as a Partner Investigator on several ARC and other grants and co-authorships. Recently, he was awarded the title Adjunct Associate Professor with the University of Adelaide, thanks to successful collaborations, including elucidating aspects of the First Nations migration into Australia and how the regions of the Barossa Valley interact with the genomes of grapevines and soil microflora.

Currently, John manages AGRF client accounts in South Australia and New Zealand and is directly involved in developing and supporting our collaborations in South Australia with the South Australian Genomics Centre, the University of Adelaide and Flinders University.

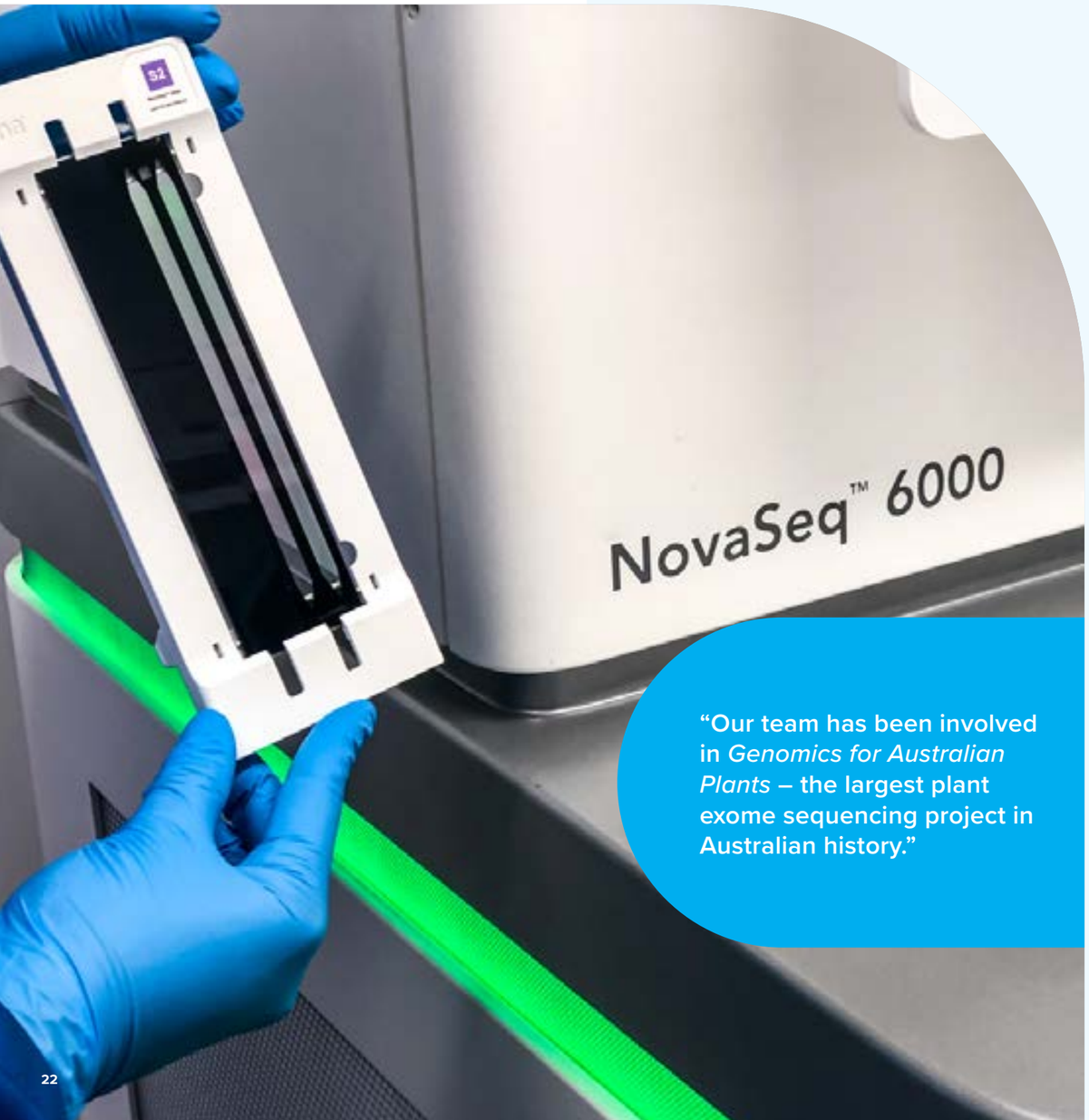
"It's a very rewarding spread of responsibilities, with plenty of satisfaction in seeing client projects achieve their potential," he says.

One of the most gratifying parts of John's role is helping AGRF clients meet their research needs through discussion, planning and collaboration.

"It will soon be 20 years since I joined AGRF, and it has been quite the adventure so far."


# Next Generation Sequencing – harnessing our expertise to make a difference

**AGRF are driven to succeed by delivering genomic information to our clients for researchers and clinicians to use to make amazing discoveries and profound improvements to people's lives.**




**"Our team has been involved in *Genomics for Australian Plants* – the largest plant exome sequencing project in Australian history."**

Next Generation Sequencing (NGS) has revolutionised the genomic world by meeting the growing need for accessible and affordable data. A powerful and reliable technology at AGRF, NGS produces masses of sequencing data every year, revealing the journey from DNA to data. Our expert multi-disciplinary team of scientists, bioinformaticians, project managers and leading NGS technology platforms interpret this data to provide actionable insight and research outcomes for our clients.

With the capability to look at genomes or subsets of genes of interest in depth, NGS produces masses of reliable data much faster than traditional technologies. As the national leader in genomic services, AGRF paves the way in making this technology accessible and more affordable to the wider Australian scientific and medical communities through personalised project management, access to emerging technologies, new innovative methodologies and bioinformatic pipelines. We continuously engage with our clients and work across a wide range of scientific fields, from environmental and agricultural research through to human health.

Recent times have seen an extraordinary shift in knowledge of the human genome and its role in medical research and disease treatment strategies.[1] With incredible work and dedication, our NGS team have partnered with the medical community to provide NGS expertise on programs such as the ZERO Childhood Cancer Program. The COVID-19 pandemic also illustrated the importance of NGS in global pathogen and monitoring surveillance. We were privileged to be involved with the development of multiple COVID-19 vaccine projects and will continue to apply our technologies to minimise the risks of future pandemics and zoonotic outbreaks and to strengthen Australia's biosecurity.

Across the environmental space, our team has been involved in *Genomics for Australian Plants* – the largest plant exome sequencing project in Australian history, initiated by BPA and in partnership with researchers for the Australian State and National Herbaria and Botanic Gardens.[2] The team's work with night parrots has also provided insights that will aid conservation efforts of this critically endangered species.

We expect to see NGS continue its upwards trajectory as a tool to improve lives. The genomic community is just starting to seize the opportunities NGS offers and AGRF's expertise in this service will continue to be an invaluable resource for the future of Australian genomic research.

> *"As the national leader in genomic services, AGRF paves the way in making this technology accessible and more affordable to the wider Australian scientific and medical communities."*

1. John S Mattick, Marie A Dziadek, Bronwyn N Terrill, Warren Kaplan, Allan D Spigelman, Frank G Bowling and Marcel E Dinger. (2014) 'The impact of genomics on the future of medicine and health'. *Medical Journal of Australia*, 201 (1): 17–20, viewed 16 December 2022, <https://www.mja.com.au/journal/2014/201/1/impact-genomics-future-medicine-and-health>
2. *Genomics for Australian Plants*. Available at: https://www.genomicsforaustralianplants.com/ (Accessed 20 December 2022)

# Old lizards – an old lizard can teach you new tricks

**AGRF are using cutting-edge technology to help researchers analyse the genomic makeup of archival specimens, previously considered to be devoid of DNA.**

CSIRO Research Fellow Dr Erin Hahn has been sequencing the genomes of lizards lately – using samples dating back as far as 1905. AGRF optimised the IDT xGen cfDNA and FFPE workflow for these samples to assist with Dr Hahn's project. The incredible age of the sample isn't an anomaly to Dr Hahn, who enjoys the challenge of extracting information from historic samples.

"It's my job to get DNA out of super tricky specimens," she says.

Dr Hahn works with museum samples of animals kept frozen in time with the help of formaldehyde. While this preservation practice protects specimens for future study, she points out it often comes at a loss.

"For geneticists, it's an absolute nightmare, because formaldehyde does dirty work to the DNA. When you try to extract DNA from these formalin-preserved specimens, anything you manage to get is really fragmented," she says.

Dr Hahn is seated in the Australian National Wildlife Collection (CSIRO), which has advantages when it comes to the samples themselves.

"I came into the Wildlife Collection to break that stigma of formalin-preserved specimens being absolutely devoid of DNA. We strategically chose to test DNA extraction and sequencing methods on specimens that represented the broad range of preventation conditions we see in our collection. In doing so we now have provided guidelines to other researchers to help them vet specimens for sequencing success."

Extracting DNA from a lizard that is over 100 years old involved a lot of trial and error.

"With museum specimens you don't have a lot of material to work with. Every single specimen is precious. We had to be prepared to have low success rates," says Dr Hahn.

She has been working with her team to develop new and better methods of extracting data from these historic samples.

"After about six years of work, we've devised methods that can now reliably get better DNA out of the specimens."

The team has worked out how to use the formaldehyde concentrate of the specimen jar itself as a marker of how much usable DNA the sample will yield, so the delicate sample itself can remain intact. They've also discovered how – shown in the lizard sample from 1905 – it seems a specimen's age doesn't matter as much as the condition it was in when first preserved.

"The DNA we sequenced from that older specimen didn't appear to be any more degraded than ones from the 1970s or 1990s," she says.

Dr Hahn describes these samples as an "informative little window to the past".

A recent collaboration study on the eastern water dragon, using formalin-preserved samples, demonstrates exactly what her research is attempting to achieve.

"We can look back in time and look at how [the dragons] have changed and adapted over time, in response to things like urbanisation and the introduction of novel pathogens. So, we've been applying our methods of extracting DNA from these museum specimens to provide genomic resources for this study. We've also been developing methods of not just getting genomic information out of these specimens, but to get gene expression information from historical specimens."

With her research, Dr Hahn is hoping to inspire a big boom in the sequencing of archival specimens – and to teach and make public all the new systems and information she is learning about the processes.

"So many museums are sitting on a wealth of information they don't even know they have," she says. "Since publishing our methods of genome sequencing, we've had researchers asking us to collaborate with them to find and vet specimens. I am more than happy to help and enable other researchers to achieve their goals."

It was AGRF's commitment to innovation that helped Dr Hahn achieve her own research goals.

**"What brought us to AGRF was your willingness to trial new methods on samples."**

"What brought us to AGRF was your willingness to trial new methods on samples that other companies were going to turn away from. You didn't shy away when I presented a tube of DNA that you couldn't even detect DNA in," she says. "You also gave recommendations on library prep methods suitable for the kind of input DNA we had. It's really fantastic I can focus on the things I'm good at, which is doing the DNA extraction and then analysing the gross data AGRF is able to provide."

> *"Since publishing our methods of genome sequencing, we've had researchers asking us to collaborate with them to find and vet specimens."*

# Revolutionising aquaculture breeding programs

**AGRF are helping researchers use genomic data to improve the quality and sustainability of commercial aquaculture in Australia.**

**“We chose AGRF as our partner because of their interest in working with the agri-aquaculture sector.”**

Townsville-based Professor Dean Jerry is a world-renowned aquaculture researcher, whose primary area of research focuses on the application of genetic technologies to improve the farming of aquatic species.

Professor Jerry and his team at James Cook University have worked closely with AGRF for seven years on numerous aquaculture species. The partnership has resulted in the development of new genomic-based tools relevant to aquaculture breeding programs. These include the assembly of the complex genome and transcriptome of the black tiger prawn, high-resolution genotyping panels for barramundi and grouper, as well genotype by sequencing applications.

“Genomics allows an unprecedented ability to understand the underlying genetic basis of production performance in aquaculture species,” he says. “Advances in genomic technology improve the understanding of how organisms can adapt and respond, allowing me to identify genes significantly influencing traits of commercial importance in species like pearl oysters, grouper and black tiger prawns, mechanisms driving natural sex change in barramundi, and how bacterial communities (or the microbiome) link to fish health and disease.”

Genomic technologies are rapidly changing our traditional approaches in aquaculture practices. By allowing genomics to be routinely integrated into industry we can increase the precision with which we identify and select superior animals to breed from.

Unlike livestock and crop species, many commercially important aquaculture species do not have the extensive genomic resources (such as an assembled genome) needed to conduct advanced selection programs and to understand gene function.

“Having a genome for the tropical aquaculture species I work on allows better design of high-density SNP arrays,” says Professor Jerry. “These tools can be useful for genomic selection practices, as well as forming a basis for understanding the role of the epigenome in control of traits such as sex change, maturation, and nutritional-derived health.”

It is hard to retain information on the pedigree of aquaculture species due to their small size at stocking, uncertain parentage due to mass spawning of brood-stock or, in the case of crustaceans, molting of physical tags as they grow and shed their exoskeleton.

“By integrating genotyping into our workflows we’re able to prevent inbreeding through defining pedigree of animals as well as training genomic markers to predict the genetic merit of the individual,” says Professor Jerry.

This improves selection choices leading to higher rates of genetic progress for traits under selection like growth.

“The partnership with AGRF has allowed us to develop critical genomic assets and knowledge, such as genotyping tools, genome assemblies, and microbiome profiles, that we use with our aquaculture industry partners to improve their animal population genetic base and to use as tools to better predict disease occurrence,” he says. “We chose AGRF as our partner because of their interest in working with the agri-aquaculture sector to drive production gains through the use of cutting-edge genomic technologies.”

This collaboration paves the way for healthier crops, livestock and fisheries.

“Our partnership with AGRF has created a shared vision with James Cook University’s own vision for the use and power of genetics to transform productivity when applied to aquaculture species in northern Australia.”

> *“This collaboration paves the way for healthier crops, livestock and fisheries.”*

# Spotlight on Bhawana – a curious mind reflects

**Bhawana Nain**

Sydney Site Manager
National Sanger Manager
Sanger Sequencing Team

*Joined AGRF in 2009*

Bhawana has always had a curious mind. Fascinated by the world around her, she grew up constantly asking “why is it like this?” and “how does that work?” A presentation at her local high school in India by a renowned scientist catalysed her interest. From then on, she was determined to pursue a career in biotechnology and molecular biology.

“Science was the one field that allowed me to continually ask questions. From researching animal viruses and plant genetics right through to the human genome. ‘A’, ‘T’, ‘G’, ‘C’ were more than just letters for me, they were my life’s calling,” says Bhawana.

Bhawana now manages the Sanger Sequencing team. During her time at AGRF, she has seen tremendous growth in each site around Australia and witnessed the release of many new services at the intersection of cutting-edge genomic technologies. She describes her role as extremely fulfilling, enjoying her interactions with the talented AGRF team across Australia.

“Everyone works together and strives to advance AGRF’s service and quality. We work closely with clients to ensure they have first access to breakthrough technologies,” she says.

By enhancing AGRFs service delivery and fostering positive client experience, Bhawana plays her part in upholding AGRF as a partner of choice.

“Being part of a researcher’s or clinician’s journey in finding pieces of their puzzle excites me,” says Bhawana. “Every genetic discovery has proven to advance our understanding of all living beings on Earth and unlocks further research, innovation, and applications to increase quality of life.”

> *“Hearing about our impact – from finding life-saving cures to supporting time-critical decisions for clinicians – inspires me every day.”*

Sanger sequencing continues to be a staple service at AGRF. First developed in 1977 by Fredrick Sanger, it was one of the technologies used in the Human Genome Project.[1] Still used widely today, Sanger sequencing is essential for a wide range of applications, from solving research and forensic conundrums to understanding insect outbreaks or disease profiles in human samples.

Bhawana has witnessed the explosion of genomic technology. A huge area of change has been the acceleration of genomic workflows due to advances in instrumentation, technology and software.

“People can access so much information now through publications. With the introduction of Next Generation Sequencing (NGS) the time to results has dramatically improved and more clients are delighted by the volume, quality and speed of data we provide,” she says.

Working with clinicians, Bhawana’s team works around the clock for high-priority samples such as ensuring a time-sensitive transplant and donor organ is compatible with a patient.

Bhawana sees AGRF work as the connection between patients, clinicians, researchers and discoveries.

“We have the utmost focus to process samples with care and velocity. We particularly spend time understanding each client’s requirements and work closely with them to design workflows using a scalable action plan and troubleshoot data for routine services.”

Bhawana knows only too well what a difference speedy analysis can make, such as preventing significant biosecurity threats.

“AGRF’s accelerated analysis of the invasive fall armyworm – a highly invasive and destructive caterpillar[2] – provided data that supported subsequent decisions made by the NSW Government.”


It’s fulfilling work that Bhawana finds even more rewarding as a team effort.

“The team are infinitely curious and impact-driven. Hearing about our impact – from finding life-saving cures to supporting time-critical decisions for clinicians – inspires me every day. AGRF have always been a place where new ideas are welcome. Together, we are dedicated to helping the Australian genomics community.”

1. DNA Sequencing Technologies, Jill U. Adams, Ph.D. 2008, *Nature Education*, Available at https://www.nature.com/scitable/topicpage/dna-sequencing-technologies (Accessed 18 October 2022)
2. Fall armyworm, Agriculture Victoria (2020) Available at: https://agriculture.vic.gov.au/biosecurity/pest-insects-and-mites/priority-pest-insects-and-mites/fall-armyworm (Accessed 18 October 2022)

# Funding partners

"A job worth doing is worth doing together."

Bioplatforms Australia (BPA) provides access to 'omics technologies for a wide range of academic and commercial users. BPA is enabled by the Australian Government's National Collaborative Research Infrastructure Strategy (NCRIS) and is AGRF's largest funding partner.

We work closely with BPA on their Framework Initiative projects, which are large national projects comprising researchers from many different institutes, universities, museums, and conservation and wildlife organisations. These projects are of great cultural and economic importance as they provide a genomics resource on many native species, some of which are on threatened species lists.

AGRF is an integral partner to BPA's Framework Initiatives by providing a wide range of innovative genomics platforms to ensure these projects are successfully completed. In addition, our National Next Generation Sequencing Manager, Dr Chris Noune, and Brisbane site and Platform Manager, Dr David Hawkes, serve on BPA's Framework Initiative Steering Committees, which further strengthens our partnership.

AGRF has collaborated with BPA on four major Framework Initiatives in recent years:

- Genomics for Australian Plants
- Oz Mammals Genomics
- Threatened Species Initiative
- Australian Microbiomes.

Other notable BPA projects AGRF has worked on include the:

- Stem Cells
- Australian Research Data Commons Cross-NCRIS OzBarley
- Commonwealth Scientific and Industrial Research Organisation's (CSIRO) Future Science Platforms.

# Better together

As a leader in the Australian genomic community, AGRF collaborate with a wide variety of organisations across Australia. This includes partnerships with our funding bodies, host institutes and the greater research community. These partnerships and connections allow us to uphold our mission and be a key enabler of genomic research in Australia.

As such, we are constantly engaging with our partners on innovative projects that explore and evaluate new-to-market technologies. For these projects we use novel techniques and platforms, distinct from our regular services, and evaluate the feasibility of offering these services to the wider research community. This ensures Australian researchers have access to the best genomics technologies to keep them at the forefront of scientific research.

Our expert Innovation and Development team work on exploratory DNA and RNA extraction methods, novel short and long-read sequencing applications, and various innovative genotyping platforms and approaches. These projects encompass a wide range of biological fields, including environmental research, agriculture and aquaculture research, human health and plant research.

Some notable examples of our Innovation and Development projects include:

- Metagenomic sequencing of complex soil samples using the PacBio Sequel IIe
- Single-cell multi-omic analyses of patient derived xenografts
- Long-read direct RNA sequencing in mice
- Allegro high-throughput low cost genotyping solutions for primary industries
- HiChIP analyses to understand chromatin conformation.

With over 20 years of combined experience, our Innovation and Development team are experts who provide researchers with state-of-the-art genomic platforms to support high-impact scientific publications and preliminary data for research grant applications.

We are proud to work together with some of the most brilliant scientists who help answer fundamental biological questions, and of our role in enabling them and Australia to remain world leaders in their fields of research.

**Acknowledgment of Country**
AGRF acknowledge the Aboriginal and Torres Strait Islander people as the Traditional Owners of the land on which we work and live, and we pay our respects to Elders past and present.

We respect and recognise their continuing connection to Country and land, water and community.

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**AGRF is a not-for-profit organisation, committed to quality and innovation.**
We actively seek to partner and share our knowledge and expertise in genomics. Through our national network, AGRF provides access to innovative and leading technologies, enabling genomics in the biomedical, agricultural and environmental sectors. From single gene analysis to whole genome sequencing, AGRF provides a full range of genomic capabilities and services with complementary bioinformatics across the entire biological spectrum, to academia, healthcare and commercial industries.

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