UNSW AUSTRALIA

Ramaciotti Centre for Genomics

Annual Report 2014

Never Stand Still | Science | Ramaciotti Centre for Genomics

Ramaciotti Centre for Genomics

Ramaciotti Centre for Genomics
Biological Sciences Building (D26)
UNSW
NSW 2052 Australia

www.ramaciotti.unsw.edu.au

Tel: +61 2 9385 1241

Email: ramaciotti@unsw.edu.au

Editor: Dr Helen Speirs
Designer: Sarah Drury
Slingshot Design

The **Ramaciotti Centre for Genomics** supports research at UNSW and Australia-wide by offering genomic services to academic and industry based research groups.

Mission

To deliver internationally competitive genomic services to the Australian Research Community.

Objectives

The Ramaciotti Centre for Genomics aims to:

- Provide our users with enabling technology and services, to facilitate internationally competitive research
- Provide genomics and related services to the highest possible quality
- Provide support for bespoke and niche projects
- Provide services at competitive rates
- Build the genomics community in the state of NSW and beyond

Partners

The Ramaciotti Centre exists as a collaboration between major universities and research institutes in New South Wales.

Supported by

Member of

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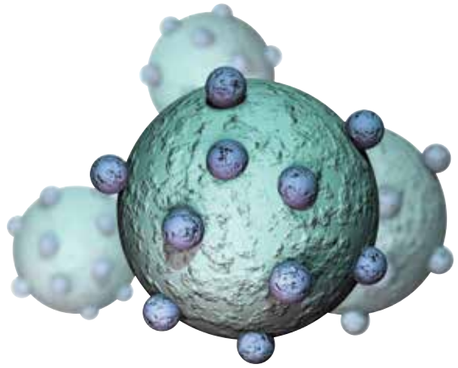


“ ... these technologies help keep the Centre at the forefront of genomics and one of the best equipped facilities in Australia.”

Professor Marc Wilkins, Director

DIRECTOR’S REPORT

The Centre continues to go from strength to strength. With ARC LIEF grant funding this year, we acquired further new sequencing technology. The NextSeq 500 platform – one of the new platforms from Illumina – is ideal for mammalian transcriptomics and other medium-scale projects. We were also pleased to announce a strategic alliance with the Kinghorn Centre for Clinical Genomics. Through this, Centre users can now access the Kinghorn’s Illumina XTen platform for low-cost human genome sequencing. Together with other recent acquisitions, these technologies help keep the Centre at the forefront of genomics and one of the best equipped facilities in Australia.

The use of the Centre by the research community continued to grow. We saw an even greater increase in next-generation sequencing, where the number of samples analysed grew from 2,974 in 2013 to 9,144 in 2014. Also notable was the large volume of samples analysed by microarray – a total of 2,845. Perhaps surprisingly, this is the second largest number ever processed by the Centre in its operational history. The Fluidigm, a new service in 2013, was also used extensively in 2014, with a total of 3,565 samples analysed. It is encouraging to see such strong uptake of this new platform in the Centre.

The staff of the Centre continue to show remarkable skill in all aspects of their work. What is particularly admirable is the fact that, despite the dramatic year-on-year increase in sample throughput, we have had only a small increase in the number of staff in the team. We welcomed Dr Caitriona Murray, Carolina Correa Ospina and Kylie Cairns to the Centre in 2014, to our total team of 10. I warmly congratulate the staff for their ongoing dedication, the pride they take in their work, and their consistent patience with the research community that the Centre serves.

The financial position of the Centre is very sound. Now recognised as national infrastructure, the Centre has received Federal Government NCRIS funding – which follows on from last year’s CRIS funding. This has been matched, in part, with funding from the NSW State Government and UNSW. We have also continued our success with ARC LIEF grants in that the Ramaciotii Consortium grant, which was led from UNSW, was almost fully funded. We look forward to the challenge of securing another LIEF grant next year.

The Centre continues to participate in a very large number of projects. Whilst too numerous to mention, we enjoyed the diversity of these in 2014. The projects included understanding social-induced developmental plasticity in the Australian black cricket, along with major projects on the Australian soil biome, corals from the great barrier reef, fungal pathogens of wheat and the sequencing of grape varieties used in wine making. Many other biomedical projects were also undertaken in the Centre.

Last but by no means least; I’d like to thank Dr. Helen Speirs and the Steering Committee. Dr. Speirs, the Centre Manager, plays a central role in all aspects of the Centre. Its ongoing successes are a reflection of her dedication, enthusiasm and talent. Institutional representation is essential to the functioning of the Centre and its associated consortium and I thank the Steering Committee, and its chair Prof. Ian Dawes, for their time, enthusiasm and support in 2014.

We look forward further successes in 2015.

Professor Marc Wilkins
Director

“ The Ramaciotti Centre has consistently provided a world-class service and demonstrated a level of professionalism that exceeds that of other core facilities I have worked with. The genomic data generated by the facility is very high quality and the projects are always completed within a rapid time frame.”

Dr Anthony Bosco, Research Fellow,
Telethon Institute for Child Health Research

STEERING COMMITTEE

Independent Chair
Professor Ian Dawes

Director
Professor Marc Wilkins
University of New South Wales

Deputy Director
A/Professor Kevin Morris
University of New South Wales

Professor Ian Charles
University of Technology, Sydney

Professor Merlin Crossley
University of New South Wales

Professor Edward Holmes
University of Sydney

Professor John Mattick
Garvan Institute for Medical Research

A/Professor Debbie Marsh
Kolling Institute of Medical Research

Professor Ian Paulsen
Macquarie University

Professor Rodney Scott
University of Newcastle

Dr Catherine Suter
Victor Chang Cardiac Research Institute

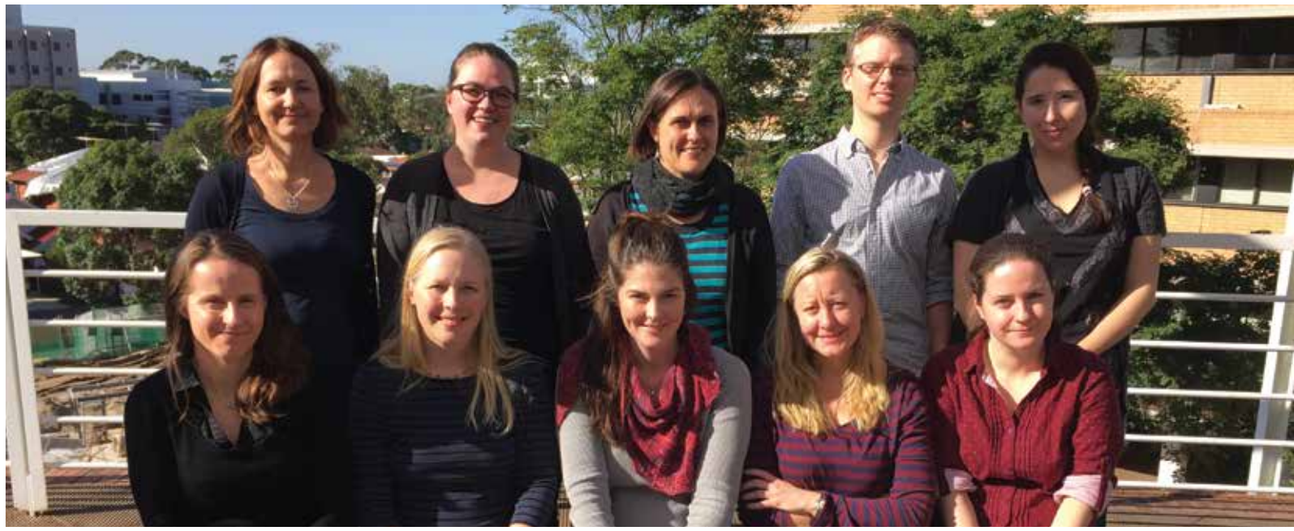
Alternates

Professor Steven Djordjevic
for Professor Ian Charles

Professor Nicki Packer
for Professor Ian Paulsen

Professor Claire Wade
for Professor Edward Holmes

CENTRE STAFF



Back row (L-R): Helen Speirs, Kylie Cairns, Bronwyn Robertson, Jason Koval, Carolina Correa Ospina
Front row (L-R): Tonia Russell, Helena Mangs, Hannah Ginn, Erika Becker, Caitriona Murray

The Ramaciotti Centre Team

Our professional team of scientists has many years of experience, delivering personalised service from design through to downstream analysis. This year we welcomed Dr Caitriona Murray, Carolina Correa Ospina and Kylie Cairns to the team.

Centre Manager
Dr Helen Speirs

Next Generation Sequencing Specialists
Dr Helena Mangs
(Illumina Next Generation Sequencing Manager)
Jason Koval
Tonia Russell
Dr Hannah Ginn
Dr Caitriona Murray
Kylie Cairns

Microarray Specialists
Dr Bronwyn Robertson
Dr Erika Becker

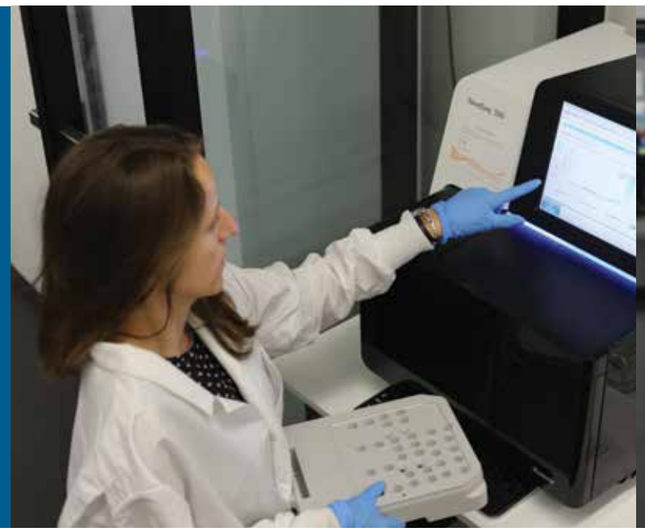
Sanger Sequencing Specialists
Jackie Chan
Carolina Correa Ospina

qPCR & Single Cell Specialist
Dr Kristin North

IT Support
Robin Heron

CENTRE SERVICES

> “ As an informatics group working with data from disparate sources we have always found the quality of data generated by the Ramaciotti Centre to be of the highest standard. This has contributed greatly to the success of our research and that of our collaborators.”
>
> Dr Warren Kaplan, Chief of Informatics, Centre for Clinical Genomics, Garvan Institute of Medical Research



The Ramaciotti Centre is committed to building world-class genomic research capability and capacity. As a National Collaborative Research Infrastructure (NCRIS) facility we enable access to state-of-the-art, cutting edge technologies and deliver data of the highest quality to the research community. Our technology suite includes next-generation sequencing, Sanger sequencing, single-cell genomic analysis, microarrays, and high-throughput qPCR. Our commitment to delivering high quality data is demonstrated in our ongoing Illumina Certified Service Provider (CSPro) and Authorised Affymetrix Service Provider status. Our services include:

next generation sequencing
microarray genotpying and qPCR
single cell analysis Sanger sequencing
quality control service bioinformatics

Next Generation Sequencing

The Ramaciotti Centre delivers next-generation sequencing services using a range of technologies, allowing us to support a broad range of sequencing projects.

Sequencing Services

- Genome
- Whole human genome
- Exome
- RNA seq
- Small RNA
- Single cell sequencing
- ChIP seq
- Mate-pair
- Targeted & amplicon

Sequencing Technology

- Illumina HiSeq 2500
- Illumina HiSeq 2000
- Illumina NextSeq 500
- Illumina MiSeq
- Illumina X^{TM}Ten (Kinghorn Centre for Clinical Genomics)

Microarray

We provide a comprehensive range of services on three different microarray technology platforms. We have access to an extensive portfolio of arrays for RNA and DNA analysis for a diverse range of species.

Services

- Gene expression
- Transcriptome
- miRNA analysis
- SNP, CGH and CNV
- FFPE copy number
- Custom arrays

Microarray Technology

- Affymetrix
- Agilent
- Illumina

CENTRE SERVICES

SNP Genotpying and qPCR Services

The Ramaciotti Centre is equipped with a Fluidigm BioMark HD system for high-throughput real time PCR. The system utilises multiple chemistries and offers unparalleled throughput for real-time PCR and SNP genotyping.

Services

- Gene expression
- SNP genotyping
- Sample identity tracking (SNPTrace™)

Single Cell Services

Using the Fluidigm C1™ Single Cell Auto Prep System the Centre can provide a range of single cell services.

Services

- Gene expression profiling (qPCR)
- mRNA sequencing
- Whole genome sequencing
- Exonic sequencing
- Targeted sequencing

Sanger Sequencing

We provide Sanger sequencing and genotyping services using an Applied Biosystems 3730 DNA Analyzer.

Services

- DNA sequencing
- Genotyping

Quality Control Services

The Centre offers a nucleic quality control (QC) service using the Agilent 2100 bioanalyzer and Agilent TapeStation.

Services

- RNA integrity analysis (RIN)
- DNA integrity analysis (DIN)

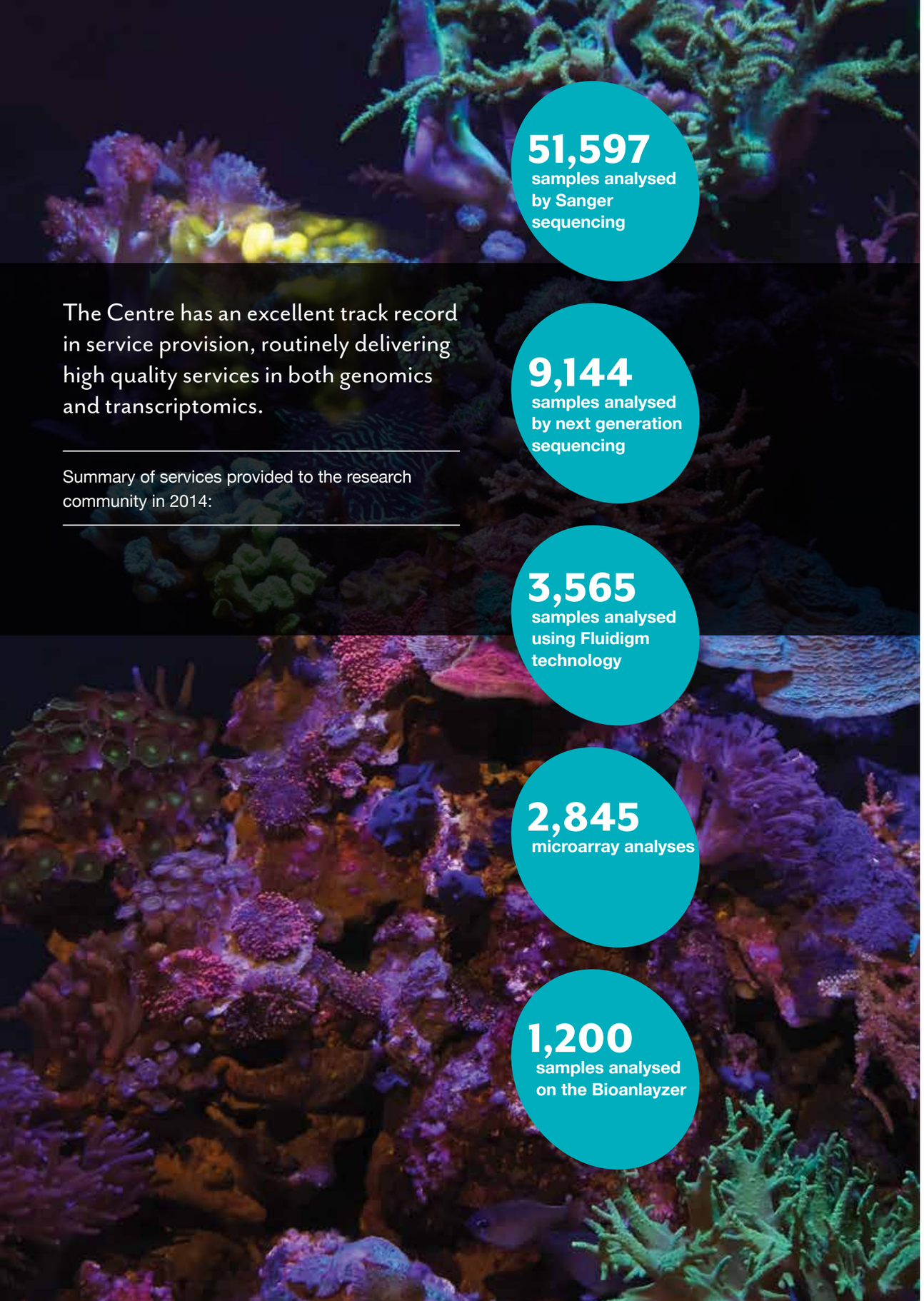
Bioinformatics

The Centre has continued its longstanding collaboration with the NSW Systems Biology Initiative (the SBI) for the analysis of data. The SBI has expertise in:

- genome assembly and annotation
- comparative genomics
- transcriptomics data analysis from next-gen and microarray platforms
- pathway, network and systems-level analysis of transcriptomic data
- network visualization
- integrative analysis of transcriptomic and proteomic data.

The SBI works with users of the Ramaciotti Centre collaboratively and also encourages researchers to work inside the SBI on a ‘research hotel’ basis.

The Centre continues to collaborate with the Queensland Facility for Advanced Bioinformatics (QFAB). QFAB provide bioinformatic services for genomic, proteomic and clinical datasets. They also provide bioinformatic and biostatistics courses and workshops.



The Centre has an excellent track record in service provision, routinely delivering high quality services in both genomics and transcriptomics.

Summary of services provided to the research community in 2014:

OPERATIONAL REPORT

The Centre delivers high quality, state-of-the-art genomic and transcriptomic services to the research community. During 2014 the Centre:

- Was the first facility in Australia to provide single cell genomic and transcriptomic services to the research community.
- Increased the number of analyses performed by next-generation sequencing by over 200% on the previous year and increased the range of sequencing services that we provide.
- Added a new next generation sequencer to our portfolio of Illumina instruments.
- Introduced a high-throughput genotyping service providing a fast, inexpensive method for identity checking of bio-banked or clinical DNA samples.
- Introduced a new copy number analysis service suitable for FFPE samples.

Single Cell Genomic Analysis

With the acquisition of single cell technology and an increase in our next-generation sequencing capacity, the Ramaciotti Centre remains at the forefront of genomic research in Australia. Using state-of-the-art technology we are able to rapidly isolate the genetic material from up to 96 single cells in a few hours. Understanding cell-to-cell variation is key to advances in many research areas including cancer cell biology, stem cell research and immunology. We have a number of medical research institutes using this technology in order to develop better disease monitoring and targeted treatments.

Next Generation Sequencing Service

The next generation sequencing service continues to develop, and the number of samples sequenced using this technology increase. This year we expanded our amplicon sequencing service and optimised primer sets for 16S, 18S and ITS amplicons. These new services saw demand for the MiSeq service increase dramatically, with a 78% increase in the number of runs performed and a 520% increase in the number of samples submitted for sequencing on the MiSeq.

In November the Centre acquired an Illumina NextSeq 500 sequencer using funds from our previous successful ARC LIEF grant. This has expanded our capacity for generating short read sequencing data and substantially reduced sequencing costs and turnaround times for transcriptomic services.

New Sample Identity Tracking Service

The Centre purchased a panel of primers for its Fluidigm BioMark system that facilitates quality control and identification of DNA samples. The panel consists of 96 single nucleotide polymorphism (SNP) assays selected by Rutgers University to provide critical information regarding sample identity, integrity and quality. It generates unique SNP profiles for individuals, enables tumour to normal sample pairing, verifies gender and assess contamination. The low cost per sample makes it accessible to Australian bio banks and human genomic sequencing facilities who are required to track and sample identity.

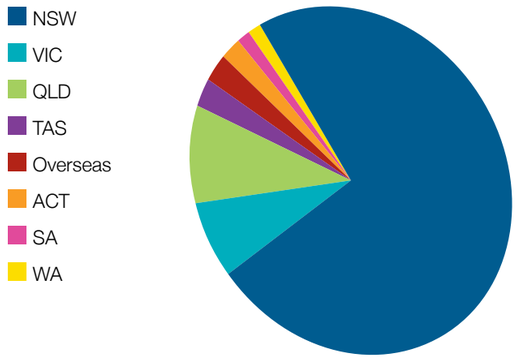
Copy Number Analysis on FFPE Samples

A new Affymetrix array service that facilitates whole-genome copy number analysis on degraded FFPE-derived tumour DNA was brought online this year. The OncoScan array provides high-resolution copy number detection for around 900 cancer genes, loss of heterozygosity and somatic mutation analysis in one assay. Until recently this assay was only accessible through the Affymetrix in house laboratory with a minimum sample number of 48. The Centre offers this service with a minimum sample number of 11, making the assay more accessible to researchers.

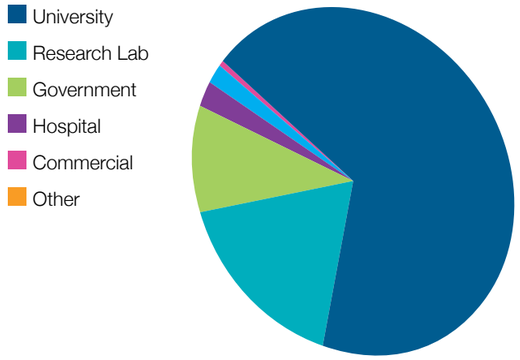
CUSTOMER PROFILE

The Centre has a customer base of around 350 research groups from both academia and industry. We serve all the leading universities and research institutes in Australia and support a wide range of research covering many disciplines.

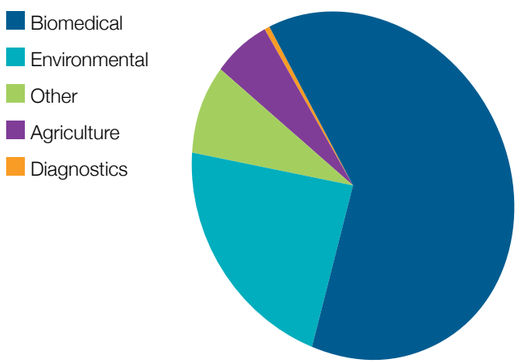
Customers by State or Country



Customers by Type



Customers by Discipline



A
Asbestos Diseases Research Institute
Australian Institute of Marine Sciences
Australian Museum
Australian National University
Australian Wine Research Institute
ANZAC Research Institute
ARC Centre of Excellence in Plant Energy Biology
Australian Antarctic Division

B
Baker IDI Heart and Diabetes Institute
Brain & Mind Research Institute

C
Centenary Institute
Cephalon Australia
Charles Darwin University
Charles Sturt Univeristy
Children's Cancer Institute Australia
Children's Hospital at Westmead
Children's Medical Research Institute
CSIRO Agriculture Flagship
CSIRO Animal, Food and Health Sciences
CSIRO Australian Animal Health Laboratory
CSIRO Biosecurity Flagship
CSIRO Black Mountain
CSIRO Food & Nutrition Flagship
CSIRO Land & Water
CSIRO Livestock Industries
CSIRO Molecular & Health Technologies
CSIRO Oceans & Atmosphere Flagship
CSIRO Plant Industry
Curtin University

D
Department of Economic Development, Jobs, Transport and Resources

F
Flinders University
Florey Institute

G
Garvan Institute of Medical Research
Genea
Griffith University

I
Ingham Institute

J
James Cook University

H
Huon Aqua

K
Kinghorn Cancer Centre
Kirby Institute
Kolling Research Institute

L
La Trobe University

M
Macquarie University
Melbourne University
Microbiogen
Monash University
Murdoch Children's Research Institute

N
Nepean Hospital
Neuroscience Research Australia
NSW Department of Primary Industries

P
Peter MacCallum Cancer Centre
Princess Alexandra Hospital
Prince of Wales Hospital
Prince of Wales Medical Research Institute

Q
Queensland Institute of Medical Research
Queensland University of Technology

R
Reproductive Health Sciences
Royal Botanic Gardens
Royal Children's Hospital
Royal North Shore Hospital
Royal Prince Alfred Hospital

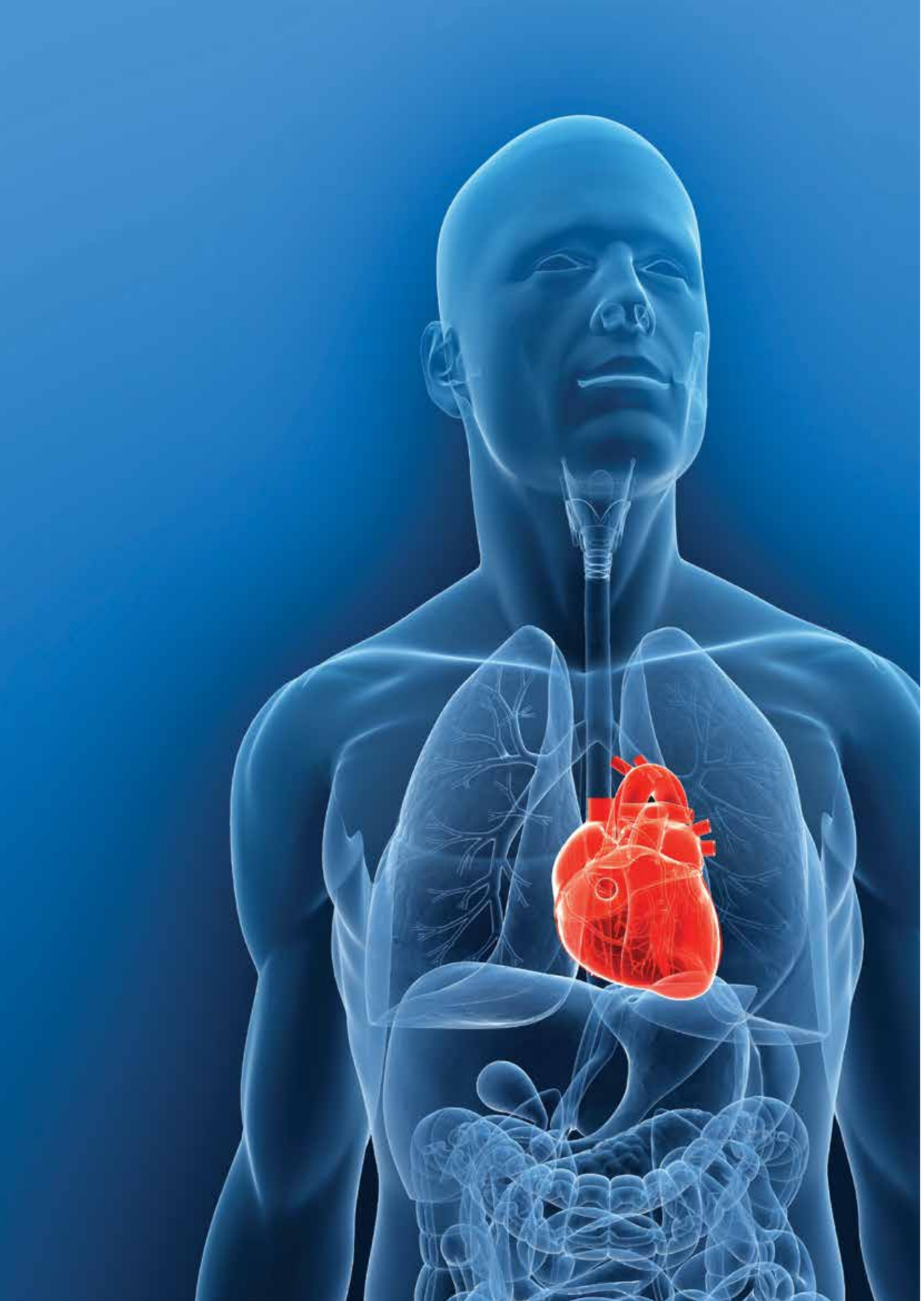
S
Schizophrenia Research Institute
South Australian Museum
Southern Cross University
St George Clinical School
St George Hospital
St Vincent's Centre for Applied Medical Research
St Vincent's Hospital
St Vincent's Institute
Sugar Research Australia

T
Telethon Institute for Child Research
Terragen Biotech
Teva Australia

U
University of Adelaide
University of Aukland
University of Ballarat
University of Canberra
University of Newcastle
University of New South Wales
University of Queensland
University of Melbourne
University of Padova
University of Sydney
University of Tasmania
University of Technology, Sydney
University of Western Sydney
University of Western Australia

V
Victor Chang Cardiac Research Institute

W
Walter and Eliza Hall Institute
Westmead Millennium Institute



HIGHLIGHTS FROM 2014

ARC LIEF Grant Success

The Ramaciotti Centre Consortium was successful in their bid to the ARC Linkage Infrastructure, Equipment and Facilities (LIEF) grant for a PacBio RSII single molecule sequencer. This was the Centre's fifteenth successful LIEF grant, bringing the total ARC LIEF funds awarded to the Ramaciotti Centre Consortium to over $9 million. The PacBio RSII sequencer is unique as it is the only commercially available sequencer capable of sequencing single molecules of DNA and RNA, with very long reads of up to 40,000 bases. Long read lengths are of great value to researchers as they make the assembly of genomes easier and also allow new insights into the populations of mRNA splice variants. The sequencer is scheduled for installation in early 2015.

National Framework Dataset Programs

The Centre continues to work on a number of Bioplatforms Australia funded strategic dataset projects. These projects seek to build biomolecular datasets that have impact on problems of importance to Australia. They include:

- Biome of Australian Soil Environments – metagenomic and amplicon sequencing to map soil biodiversity
- DNA barcoding – sequencing genetic markers to enable rapid species identification and aid conservation
- Great Barrier Reef – sequencing coral and symbionts to protect and preserve the coral reef
- Melanoma – genome sequencing to identify genetic mutations that lead to cancer
- Wheat – sequencing pathogens to increase yields and help defend against disease
- Wine – sequencing chardonnay varieties and yeast to enhance wine characteristics

The Australian Black Cricket

A team of researchers, led by Dr. Michael Kasumovic (Evolution & Ecology Research Centre, UNSW), have been investigating how social environment affects resource allocation during development. When exposed to cricket calls during juvenile stages, crickets show changes in phenotype and also in their own behaviour. The team has used RNA-seq to generate a *de novo* transcriptome. Subsequently, it has investigated the gene expression changes that occur in brains as a consequence of exposure to different social environments. This study should help understand the molecular basis of development plasticity, an issue that is of importance for all higher organisms.

HIGHLIGHTS FROM 2014

A New Alliance with the Garvan Institute's Kinghorn Centre for Clinical Genomics

On the 9th of September the Centre announced an alliance with the Garvan Institute's Kinghorn Centre for Clinical Genomics (KCCG) that will allow the research community access to the most powerful sequencing platform currently available, the Illumina HiSeq X Ten. The X Ten system provides unparalleled sequencing capacity and is capable of sequencing around 350 human genomes a week, or 18,000 a year. The KCCG was one of the first in the world to acquire the X Ten platform, and the first in Australia to operate a purpose built facility for sequencing clinical grade human genomes. By forming this alliance the Ramaciotti Centre will allow the broader research community access to this world-class genomics sequencing facility.

Stephen Damiani formally launched the alliance on the 8th of October with a presentation on a very personal genomics story. His talk titled "Cracking the Code" took us on a four year journey, from when Stephen and Sally Damiani's baby son Massimo succumbed to a mystery disease, which saw Massimo lose the ability to eat and crawl, to his teaming up with a young geneticist to map the family's genomes in an attempt to discover the cause of his son's illness. Stephen's determination to make a difference lead him to establish the Mission Massimo Foundation, a non-profit organisation that promotes the prevention, diagnosis and treatment of childhood leukodystrophies. Its aim is to increase awareness and support local medical research into these debilitating conditions.

Professional Women in Leadership

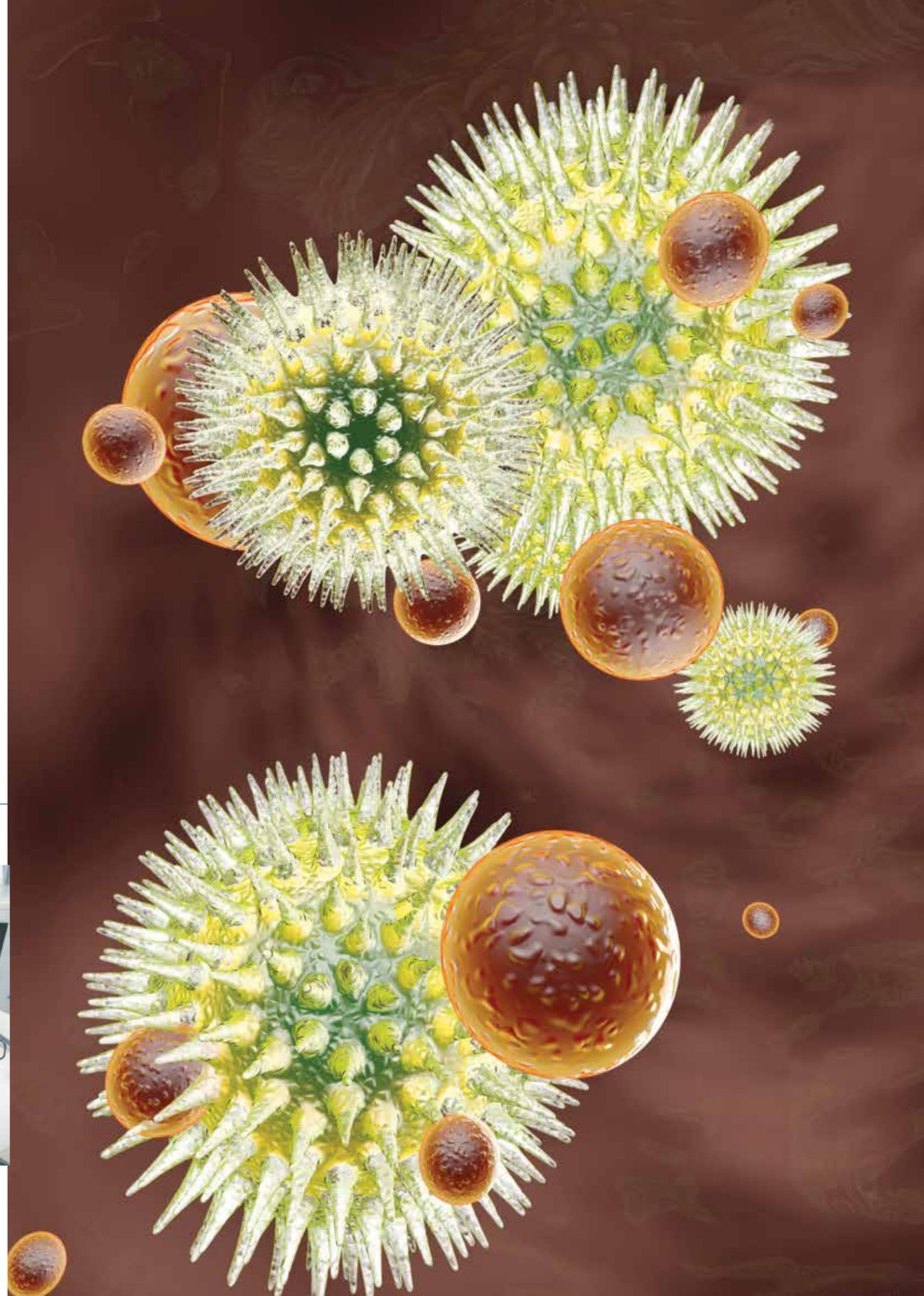
The Centre Manger Dr Helen Speirs was accepted into the inaugural UNSW Professional Women in Leadership Program (PWIL). The program aims to identify, grow and retain a pool of high potential talented women to take up leadership roles within UNSW. It supports the University's strategic objective of improving leadership and operational capabilities and seeks to develop strong female role models. With over 300 eligible candidates for nomination, Helen was one of 21 Professional staff selected to be part of the 12- month program.

Beta Testing the Oxford NanoPore MinION

The Ramaciotti Centre was selected to be part of the Oxford NanoPore Technologies (ONT) MinION access early programme. The MinION is a new long read sequencing technology that utilises nanopore technology. It has the potential to revolutionise sequencing due to its small footprint, portability and low cost per unit. The MinION sequences by passing an ionic current through nanopores in a membrane and measuring the changes in current as molecules pass through the nanopore. The information on the changes in current can be used to identify the molecule. As part of the early access program The Centre has been beta testing the MinION system on lambda and *E. coli* DNA.

Launch of the New Centre Website

Our new website was launched in May. The new website is easy to update with news, promotions and information on new services that we have brought online. Google Analytics reports in an average month that we have 1,150 visitors to the site, 60% are returning and 40% are new visitors.



As part of our commitment to the Australian genomics community we organise educational workshops, special interest group meetings, seminars, and support scientific meetings and conferences

Activities in 2014 included:

PROMOTIONAL ACTIVITIES

Workshops

qPCR Workshop – 12th June
The Centre organised a one-day qPCR workshop covering sample QC, experimental design, primer design and data analysis. The workshop was sponsored by BioRad, Fluidigm, Life Technologies and Qiagen. The workshop was oversubscribed with attendance limited to the room capacity of 90.

Next Generation Sequencing Workshop – 13th June
The Centre held a one-day NGS transcriptomics workshop cpvering topics such as: library preparation options, read length and depth, pushing the limits of NGS, experimental design and analysis. The workshop was sponsored by Illumina, Life Technologies and Qiagen. It was well attended with 71 attendees from the Sydney area.

UCSC Genome Browser Workshop – 11th September
On Wednesday 10th September the Associate Director of the UCSC Genome Browser, Dr Bob Kuhn, ran two training sessions on use of the browser and associated tools; an introductory 1 hour tutorial and an advanced 3 hour workshop. Both were well received with the workshop being heavily oversubscribed and limited to 35 attendees. The event was organized by QFAB in association with the Centre and sponsored by the Australian Bioinformatics Network.

Partek Data Analysis Workshop – 11th March and 17th September
Partek held microarray and NGS data analysis workshops at UNSW.

Next-Generation Sequencing Special Interest Group Meetings

The Ramaciotti Centre, in association with the Australian Genome Research Facility, organises the 'NSW Next-Generation Sequencing Special Interest Group meeting'. This special interest group was established to encourage discussion and interactions around next generation sequencing. Seminars are held at different locations across Sydney.

25th March at Westmead Millennium Institute
Speakers:
A/Prof Vitali Sintchenko
Centre for Infectious Diseases and Microbiology, Westmead Clinical School
"The importance of NGS in the public health sector"
Joey Lai
Westmead Millennium Institute
"NGS library prep – what's involved and the different options available"

19th of June at UNSW:
Speakers:
Dr Ruby Lin
Senior Research Fellow, Asbestos Diseases Research Institute
"NGS, microarray or good old fashioned qPCR? How genomic technologies have shaped research questions."

Dr Ashwin Unnikrishnan
Research Fellow, Adult Cancer Research Program, Lowy Cancer Research Centre, UNSW
"From the bedside to the bench, and back again: Illuminating the molecular basis of epigenetic therapy in Myelodysplastic Syndrome."

9th October at the University of Technology, Sydney:
Speakers:
A/Prof Aaron Darling
ithree Institute, UTS
"MinIONs & Hi-C: short vignettes on the state of nanopore sequencing and application of Hi-C to metagenomic sequencing"

Dr Fabian Buske
Garvan Institute of Medical Research
"Epigenomics: The many garments of the genome sequence"

4th December at the The Kinghorn Cancer Centre:
Speakers:
David Miller, Dr Warren Kaplan, Dr Mark Cowley and A/Prof Marcel Dinger
Garvan Institute for Medical Research/ Kinghorn Centre for Clinical Genomics
"X-Ten: Days of Future Past (and Present)."

PROMOTIONAL ACTIVITIES

Education and Training

Microarray and sequencing data generated by the Centre features in the work of many Honours and PhD students. Students from UNSW and other educational organisations benefit from its resources. In a typical year approximately 60 PhD students and 30 Honours/Diploma/MPhil students will benefit from the Centre's resources and expertise.

The Ramaciotti Centre provides tours of the facility to groups of university and school students. This year we provided tours of the Centre for three different groups of third year students studying cell biology, pathology and genomics. We provide students with an overview of high throughput genomics and its application in their area of interest. The Illumina app MyGenome and the Oxford NanoPore MinION was a great focal point for discussion on the future of genomics.

As part of our commitment to educating the broader community on genomics we provided a tour of the facility to a group of 10 home schooled students and their parents and a work experience student from Beverly Hills High School for 1 week work experience.

Marketing

The Centre continues to promote its services in various ways. Helen Speirs gave presentations on the Centre's services to the Kirby Institute, the Joint Academic Microbiology Meeting (JAMS) and the Kinghorn Cancer Centre. The Centre also had a trade display at the Lowy Cancer Research Centre, UNSW in June and trade booths at the following conferences:

- Lorne Cancer – Lorne 13–15th February
- Lorne Genome – Lorne 16–18th February
- Genetics Society Australia – Sydney 6th–9th July
- Australian Genomics Technologies Association - Melbourne 12th–15th October

Publications

The Ramaciotti Centre does not conduct its own research; nonetheless, in 2014 Centre staff were authors on two publications and the Centre was acknowledged as the service provider in 59 peer reviewed publications, some examples are listed below. These publications demonstrate the diversity of projects supported by the Ramaciotti Centre.

Staff Publications

Changing interpretation of chromosomal microarray over time in a community cohort with intellectual disability. E Palmer, **H Speirs**, PJ Taylor, G Mullan, G Turner, S Einfeld, B Tonge, D Mowat. *American Journal of Genetics* (2014).

Methylation-capture and next-generation sequencing of free circulating DNA from human plasma. Warton, L Kristina, V Lin, T Navin, NJ Armstrong, W Kaplan, K Ying, B Gloss, **H Mangs**, SS Nair, NF Hacker. *BMC Genomics* (2014)

Selected Publications

Gene profiling reveals association between altered Wnt signaling and loss of T-cell potential with age in human hematopoietic stem cells. MLM Khoo, SM Carlin, MA Lutherborrow, V Jayaswal, DF Ma, JJ Moore. *Aging Cell* (2014)

Metastatic progression of breast cancer: insights from 50 years of autopsies. MC Cummings, PT Simpson, LE Reid, J Jayanthan, J Skerman, S Song, AE McCart Reed, JR Kutasovic, AL Morey, L Marquart. *The Journal of Pathology* (2014)

Variability in Microbial Community Composition and Function Between Different Niches Within a Coral Reef. J Tout, TC Jeffries, NS Webster, R Stocker, PJ Ralph, JR Seymour. *Microbial Ecology* (2014)

Isolation and characterisation of microsatellite loci in the bush stone-curlew (Burhinus grallarius), a declining Australian bird. RAB Mason, C Price, WE Boles, KA Gray, E Rickard, MDB Eldridge, RN Johnson. *Australian Journal of Zoology* (2014)

Plasma microRNA are disease response biomarkers in classical Hodgkin lymphoma. K Jones, JP Nourse, C Keane, A Bhatnagar, MK Gandhi. *Clinical Cancer Research* (2014)

The necrotrophic effector protein SnTox3 re-programs metabolism and elicits a strong defence response in susceptible wheat leaves. B Winterberg, LA Du Fall, X Song, D Pascovici, M Molloy, S Ohms, Stephen; PS Solomon. *BMC Plant Biology* (2014)

FUNDING

The Australian Commonwealth Government supports the Centre's operations through National Infrastructure Scheme (NCRIS) and Collaborative Research Infrastructure Scheme (CRIS) funding. The Ramaciotti Centre gratefully acknowledges the support it receives from this funding body and the co-contributions made by the University of New South Wales.

Funding Awarded in 2014

Australian Research Council
Linkage Infrastructure, Equipment and Facilities
Expanding the Genomic Frontier - from Species to Strains and Individuals to Populations.

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