

Centre for
Biodiversity
Analysis
c b a . a n u . e d u . a u



Australian
National
University



2012-13 Annual report

October 2013

1. Director's summary

At the end of its first year of operation, the Centre for Biodiversity Analysis is now well established and on the way to increasing collaboration across ANU and CSIRO and increasing the visibility of our collective strengths in relevant aspects of genomics, evolutionary biology and spatial ecology. In no small part, our achievements are due to sustained engagement by CSIRO and ANU members of the CBA Liason Committee (Young, Sheppard, Keogh and Borevitz) and, especially, the excellent work by the newly appointed CBA coordinator, Claire Stephens. My thanks to you all.

Key achievements have been to develop a flexible and informative web site, to initiate several "ignition grants" to promote collaborative research and workshops across ANU and CSIRO, and to hold a national conference on "Biodiversity Genomics".

All of these activities have been targeted at early career researchers. Our web site reports on their research and how it relates to policy and management and attendees at the conference were clearly dominated by ECRs – the people who actually do this ground breaking research!

In our second year of operation (2013-14) we are putting more emphasis on engaging and supporting ECRs across member labs from ANU and CSIRO. The continuing challenge is to find out who they all are and what we can do to support them. One initiative, now underway, is a process wherein CBA ECRs (postdocs, PhD students etc.) have nominated topics for skills-based workshops that CBA can support. Planning for three of these during 2014 is now underway.

Another area of emphasis in the coming year(s) is to support integration of spatial- and paleo-ecology with spatial analyses of phylogenetic and genomic diversity. To this end the CBA is supporting a workshop on paleoecology in November 2013 and, in partnership with CSIRO-OCE, a larger workshop conference on biodiversity informatics is planned for April 2014. Proposals for ignition grants in this area would be especially welcome.

In relation to biodiversity genomics, our 2013 conference on biodiversity genomics helped to expose ecologists and evolutionary biologists, including many from museums and herbaria across the country, to emerging methods for genome-scale analyses using next-gen sequencing and new methods for analyses. To support uptake locally, the CBA is supporting development of a large-RAM computing cluster (at ANU - BRF) and an experimental genomics facility, initially housed in the Linneaus building on the ANU campus. Discussions are underway about how these might be expanded as part of the developing ANU-CSIRO precinct. To continue to support the national capacity in biodiversity

genomics, we hope to collaborate with museums and herbaria to support ongoing annual workshops in emerging methods and capabilities in this area.

Finally, an additional emphasis for our second year is to increase engagement with policy-makers and managers. Understanding of the emerging capabilities, genomics in particular, and how these can be applied to support decision-making in conservation and resource management remains sparse, and we hope that CBA can contribute to building the needed bridges between the science and its applications.



Craig Moritz
CBA Director



Figure 1.1 L to R: Scott Keogh (ANU), Craig Moritz (ANU), and Mark Lonsdale (CSIRO) at the launch of the CBA and the opening of the Biodiversity Genomics Conference, April 2013.

2. Executive summary

2.1 CBA Director

- Craig Moritz (craig.moritz@anu.edu.au) arrived at ANU, July 2012
- Jointly funded by ANU and CSIRO (as a Visiting Fellow).

2.2 Umbrella agreement finalised

- Agreement on scope and operating principles from ANU and CSIRO - August 2012.
- Transferred Year 1 funds to operating account.

2.3 50% Centre Coordinator appointed

- CBA Coordinator, Claire Stephens (claire.stephens@anu.edu.au), commenced employment July 2012.
- Primary roles include providing administrative coordination and support services to the Director and the CBA, developing and maintaining information products (web site, newsletters, agendas, minutes, reports, etc.), and the coordination and organisation of CBA activities, including meetings, conferences, symposia and workshops.

2.4 Liaison Committee meetings – quarterly

- Liaison Committee: Justin Borevitz, Scott Keogh (ANU), Andy Sheppard and Andrew Young (CSIRO).
- CBA Coordinator maintains and distributes Liaison Committee meeting agendas and minutes.
- The first meeting (August 2012) established the goals, rational, focus and operation (including budget) of the CBA.
- The core CBA research focus was established as integrating genomics, biogeography and spatial ecology into biodiversity analysis, including species discovery, analysis of the distribution of diversity from genes to ecosystems, and inference of processes that sustain diversity.

2.5 CBA membership recruited

- Lab leaders and research scientists from ANU and CSIRO were invited to participate in the CBA (August-November 2012) from a range of relevant Divisions and Schools:
 - **CSIRO:** Ecosystem Sciences, Plant Industry, Computational Informatics.
 - **ANU:** Research School of Biology (Evolution, Ecology & Genetics and Plant Science), School of Culture, History & Language (Archaeology & Natural History) and Centre for Aboriginal Economic Policy Research.
- Currently around 60 lab leaders and research scientists are CBA members cba.anu.edu.au/about-us/people
- Post doctoral fellows and post graduate students are considered CBA members by affiliation of their lab / research group.
- First social gathering of invited members (September 2012). Introduced the CBA, Ignition projects, Visiting scientist support and the Biodiversity Genomics conference.
- First social gathering of post docs and graduate students (July 2013). Introduced the CBA and early career training support funding and asked for proposals/suggestions.

2.6 CBA website and logo

- Website went live December 2012 cba.anu.edu.au
- Key role is to connect information relevant to the CBA mission and focus across CSIRO and ANU and is used to publicise CBA and other relevant events, and advertise funding opportunities and student projects.

- Hosted by ANU, the site is based on a content management system that can be largely updated by the CBA Coordinator.
- Website includes:
 - Information on the CBA (Background, Aims, etc.);
 - List of Members and links to their own institutional pages;
 - Research highlights (ECRs) and CBA-funded Projects;
 - Public policy areas (linked to relevant CBA Highlights, Projects and News and external Department of the Environment biodiversity policy pages); and
 - News and events.
- A logo (Fig. 2.1) was designed for the CBA in 2012 to represent the Centre and its core research areas of biodiversity genomics and spatial ecology.

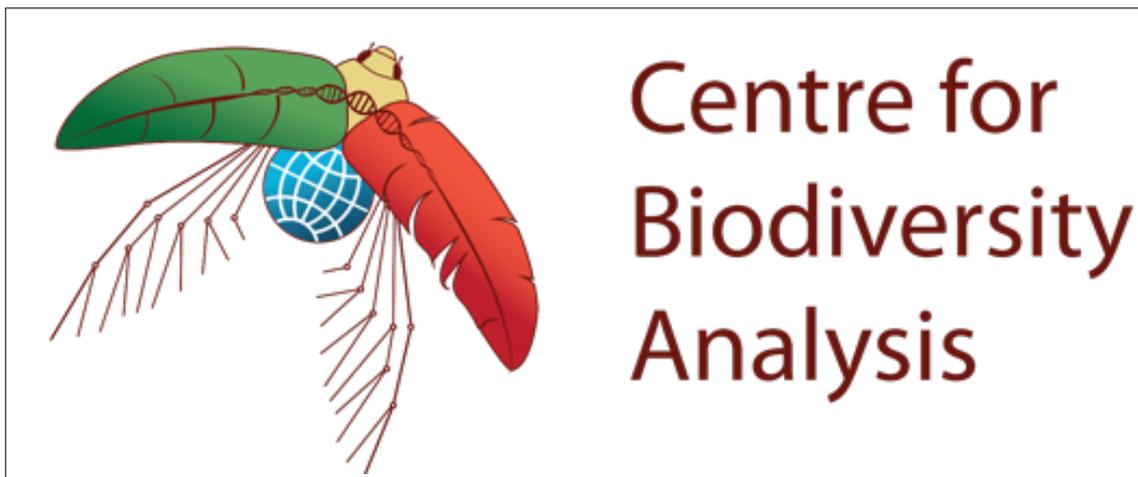


Figure 2.1 CBA logo A DNA strand spans the plant (eucalypt leaf) and animal (feather) components that form the elytra of a beetle, a symbol of biodiversity, comprising an estimated one fifth of all known living organisms on earth. The membranous hind-wings are phylogenetic trees that, together with the DNA, represent biodiversity analysis. A globe, representing ecosystems and spatial ecology, forms the beetle's abdomen. Designed by Sharyn Wragg (sharyn.wragg@anu.edu.au).

2.7 Computing infrastructure

- Recognising the need for a flexible development platform for genomics and spatial analysis, the CBA purchased a large 256 GB RAM node computing cluster (\$30K).
- Located in, and operated by, the Genome Discovery Unit at ANU.
- Contact Jason Bragg (jason.bragg@anu.edu.au) for details on capabilities and access.

2.8 CBA activities (details below)

- Ignition projects
- Biodiversity Genomics conference
- Visiting scientists, training workshops and seminars
- ECR training support

3. CBA activities

3.1 Ignition projects

Each year CBA funds a number of small pilot projects, called **Ignition projects**. These aim to 'kick-start' new ANU-CSIRO collaborative research, with the intention that results will subsequently form the basis of more substantial research proposals and collaborations.

Initially, the focus was on assisting ANU-CSIRO researchers get new projects started in biodiversity genomics by providing a fixed quantity of next-generation sequencing, as well as support in project design, sample preparation, and analysis. The aim was to 'lower the barriers to entry' for genomic research for ecologists and evolutionary biologists who might otherwise have difficulty accessing these technologies.

In June 2013, the Liaison Committee agreed to broaden scope of CBA Ignition projects to also include field-work, travel, workshops/meetings and technical salaries in addition to next-generation sequencing, maintaining the same aim of initiating new, and future, ANU-CSIRO collaborations.

cba.anu.edu.au/opportunities/grants-funding/ignition-projects

Table 3.1 2012-13 Projects

Year	Project title	Funding
2012	How local is local? Landscape genomics in Yellow box cba.anu.edu.au/research/projects/how-local-local-landscape-genomics-yellow-box	\$5000 (sequencing)
2012	Hybrid history: deep sequencing of the Tasmanian blue gum cba.anu.edu.au/research/projects/hybrid-history-deep-sequencing-tasmanian-blue-gum-0	\$5000 (sequencing)
2013	Evolutionary processes in Billy buttons cba.anu.edu.au/research/projects/evolutionary-processes-billy-buttons	\$5000 (sequencing)
2013	Species discovery and refugia in the monsoonal tropics cba.anu.edu.au/research/projects/species-discovery-and-refugia-monsoonal-tropics	\$2000 (fieldwork)
2013	Species boundaries in Australian orchids cba.anu.edu.au/research/projects/species-boundaries-australian-orchids	\$5000 (sequencing)
2013	A curation community for coral environmental genomics cba.anu.edu.au/research/projects/curation-community-coral-environmental-genomics	\$5000 (technical salary)
2013	Climate change and ecosystem structure, function and composition cba.anu.edu.au/research/projects/climate-change-and-ecosystem-structure-function-and-composition	\$5000 (workshop)
2013	Palaeoecological indicators of biodiversity change through time cba.anu.edu.au/research/projects/palaeoecological-indicators-biodiversity-change-through-time	\$5000 (workshop)

Completed Projects:

- ***How local is local? Landscape genomics in Yellow box*** - Justin Borevitz (ANU) and Linda Broadhurst (CSIRO).
Outcomes:
 - ARC Linkage Grant “Landscape restoration genomics for climate adaptation in eucalyptus foundation species”.
 - Paper outline completed.
 - A new yellow box (*Eucalyptus melliodora*) subspecies identified.
- ***Species discovery and refugia in the monsoonal tropics*** - Craig Moritz (ANU), Scott Keogh (ANU), Justin Perry (CSIRO), Eric Vanderduys (CSIRO) and Simon Ferrier (CSIRO).
Outcomes:
 - Two new gecko species identified: *Gehyra* sp. and *Heteronotia* sp.
 - Honours project, co-supervised by Moritz and Ferrier, has been initiated.

Other Ignition projects are currently ongoing.



Figure 3.1 A range of study species from some of the current CBA Ignition projects, L to R: Yellow Box *Eucalyptus melliodora*; Billy Buttons *Craspedia aurantia*; Gecko *Gehyra* sp.; Blue gum *Eucalyptus globulus* forest; pollen grain of *Polygonum orientale*.

3.2 CBA Biodiversity Genomics conference 2-5 April 2013 (\$25K)

In April 2013, the CBA hosted its inaugural conference on **Biodiversity Genomics**. The aim of the meeting was to expose ecologists and evolutionary biologists to current advances and capabilities in DNA sequencing and bioinformatics that has allowed for the expansion of detailed genomic analysis from a few ‘model species’ to a wide diversity of species, communities and ecosystems.

Over 180 delegates attended the well-received two-day conference and five half-day workshops. CBA invited 18 world-class local and international researchers who highlighted the contribution of biodiversity genomics to:

- Micro-and macroevolution
- Ecosystems and metagenomics
- Biodiversity policy, conservation and management

In addition to the invited speakers, delegates also presented over 30 contributed “Lightning talks” and posters.

The conference opened with the official launch of the CBA by Professor Ian Young, AO (Vice-Chancellor of the ANU) and Dr Mark Lonsdale (Chief CSIRO Ecosystem Sciences).

cba.anu.edu.au/news-events/cba-biodiversity-genomics-conference

Table 3.2 2013 Conference Budget

Costs	\$	Income (sponsorship, registration)	\$
Airfares (12 invited speakers)	17275.03	CBA	25000
Invited speaker accommodation	6031	Bioplatforms Australia	5000
Venue hire	600	Illumina	2500
Catering	18200	Full registration	19350
Conference Dinner	15135.5	Student registration	1900
Program, stationary, etc.	1511.2	Full workshop	7000
TOTAL	58752.73	Student workshop	1360
		TOTAL	62110

3.3 OCE-CBA Biodiversity Informatics conference 2014 (\$30K)

In November 2012, Craig Moritz and Owain Edwards (CSIRO) were successful in an OCE Cutting Edge Science symposium proposal for a 2014 OCE-CBA conference on biodiversity informatics. The

conference and series of workshops, **Understanding biodiversity dynamics using diverse data sources**, will be held in Canberra from 22-24 April, 2014.

3.4 Visiting scientists, training workshops and seminars

A major objective of CBA is to enhance collaboration and training opportunities via external visitors who will conduct a workshop, tutorial or master class during their visit to ANU and CSIRO. In our first year we supported four visiting scientists (in addition to the Biodiversity Genomics conference invited speakers) who presented a range of well-attended workshops that all received positive feedback. Workshops were open to ANU and CSIRO staff and students, and were also attended by several students and researchers from the University of Canberra.

cba.anu.edu.au/opportunities/grants-funding/visiting-scientist-support

Table 3.3 2012-13 Visitors, workshops and seminars

Date	Visitor	Funding
April 2013	Dr Joseph Heled (University of Auckland, NZ) - presented a day-long BEAST2 training workshop cba.anu.edu.au/news-events/cba-workshop-beast2	\$1610 (flights, accomm)
April 2013	Dr Steve Stones-Havas (Biomatters, NZ) - presented a day-long Geneious training workshop cba.anu.edu.au/news-events/cba-workshop-geneious	\$1068 (flights, accomm)
July 2013	Professor Peter Smouse (Rutgers University, USA.) – presented a week-long a workshop on genetic analysis for population studies cba.anu.edu.au/news-events/genetic-analysis-population-studies	\$4000 (flights, accomm)
July 2013	Professor Alexei Drummond (University of Auckland, NZ) - presented a day-long phylogenomics BEAST2 workshop cba.anu.edu.au/news-events/phylogenomics-workshop and a RSB Director's / CBA seminar cba.anu.edu.au/news-events/rsb-directors-seminar	\$1333 (flights, accomm)

3.5 ECR training support

For our second year of operation, a primary goal is to increase interaction among early career researchers (ECRs - post graduate students and postdoctoral fellows) across ANU and CSIRO.

In August 2013 we asked for direct input from CBA-affiliated ECRs regarding the types of training activities that would address their specific interests and requirements. Several ideas were proposed, and subsequently three workshops will be organised, with CBA support, by post docs and graduate students in 2014:

1. Population and landscape genomics (March)
2. Testing diversification (June/July)
3. Comparative phylogenetic analysis (September/October)

cba.anu.edu.au/opportunities/grants-funding/training-support

4. Summary of discoveries made, or other achievements, including Project IPR, other IPR and Confidential information.

4.1 Biodiversity Genomics conference

The Biodiversity Genomics conference in April 2013 exposed a strong need for ongoing engagement across Australian museums and herbaria as they establish the capacity to exploit next-gen sequencing as a core tool for exploiting their collections. We are considering how the CBA, in conjunction with other partners, can continue to contribute to strategic capacity building in this area.

cba.anu.edu.au/news-events/biodiversity-genomics-conference

4.2 How local is local? Landscape genomics in Yellow box

Results from the Yellow-box landscape genomics Ignition project, together with the CSIRO-ANU collaboration developed, were critical to the success of a new ARC Linkage grant “Landscape restoration genomics for climate adaptation in eucalyptus foundation species” awarded in 2013 to Justin Borevitz (ANU), Margaret Byrne (WA Dept Environment & Conservation), Adrienne Nicotra (ANU), Linda Broadhurst (CSIRO), Jason Bragg (ANU) and Matthew Daws (Alcoa of Australia). A new yellow box (*Eucalyptus melliodora*) subspecies was also identified.

cba.anu.edu.au/news-events/arc-linkage-success

4.3 Species discovery and refugia in the monsoonal tropics

Field surveys of targeted lizard species across the Einasleigh Uplands of north Queensland by Moritz and Eric Vanderduys (CSIRO) were completed in mid April 2013. Initial genetic analysis of specimens from two gecko genera (*Gehyra* and *Heteronotia*) has revealed two new taxa. These are currently being further evaluated through next-gen sequencing of nuclear loci. Discussions have been held regarding an extended collaboration to focus on refugial dynamics across this region to the Mt Isa Inlier. An Honours project, co-supervised by Moritz and Simon Ferrier (CSIRO) has also been initiated.

cba.anu.edu.au/research/projects/species-discovery-and-refugia-monsoonal-tropics

5. Interactions and developing interactions with third parties.

5.1 Conference workshop: “The contribution of biodiversity genomics to policy and management”

One of the major objectives of the CBA is to connect and translate new biodiversity knowledge with policy and management across government, non-government organisations and community. During the 2013 Biodiversity Genomics conference CBA held a workshop that discussed how genomics might inform decisions about policy, management and conservation, and how biodiversity scientists might interpret and communicate the outcomes and policy relevance of new data with policy makers and managers. Panel members were from the Department of the Environment (SEWPaC), DECWA, CSIRO, ANU, University of Melbourne and Monash University.

The workshop was well received by both the panelists and audience, and will now serve as a starting point for continued interaction of the CBA with the Department of the Environment.

cba.anu.edu.au/news-events/cba-biodiversity-genomics-conference/workshop-3-contribution-biodiversity-genomics

5.2 Science and Industry Endowment Fund (SIEF)

CSIRO is working with ANU to establish a precinct in “bio-systems” via the SIEF Research Infrastructure (SIEF RI) program. Moritz has been involved in these discussions and will continue to contribute to the planning and application process. One identified need is to establish joint innovation and training facilities to promote development and uptake of new capabilities in genomics and biodiversity informatics. As a precursor, Moritz led a successful bid to the Research School of Biology (RSB, ANU) to establish an experimental genomics facility, located (in the interim) in the Linnaeus Building (ANU), and accessible to CBA members.

6. Financial statement

- The core CBA budget is \$200K/year, shared equally by CSIRO and ANU.
- In the Centre's first year, funds were allocated to a large-RAM computing cluster, projects, including our inaugural conference, and external visitors and workshops.
- In our second year, projects, a conference (OCE Science Symposium) and visitors will continue to be funded.
- Second-year spending will also focus on public policy engagement, the experimental genomics facility, and ECR-led training initiatives.

Table 6.1 Budget summary for Years 1 & 2 of operation

Item	YR 1	YR 2	Notes for YR 2
Coordinator: C Stephens (50%)	39	40	
Bioinformatics support: J Bragg (24%)	27	27	
Outreach & promotion	4	30	Increase for public policy engagement & communication (genomics perspective)
Projects (now including field work, travel, meetings & technical salaries)	30	60	Up to six at \$10K each or 12 at \$5K each
Hardware & equipment	30	15	Contribution to experimental genomics facility
Annual symposium & training workshops	50	50	\$30K for OCE Symposium; \$20K for ECR workshops
Short term visiting fellowships	10	30	
Carryforward	0	-57	\$57K cfwd from 2012-2013
Total	200	195	