



Centre for Biodiversity Analysis 2023-24 Annual Report

October 2024

cba.anu.edu.au/research/our-impact/reports

The Centre for Biodiversity Analysis (CBA) continues its mission to enhance the understanding, protection, and resilience of Australia's unique biodiversity in the face of environmental change. Through collaborations with ANU, CSIRO, and the University of Canberra, CBA integrates advanced applications of genomics and environmental analysis to drive biodiversity science and policy innovation.

Key achievements and activities over the last 12 months

- 1. Leadership Transition: The CBA welcomed Professor Justin Borevitz as its new Director, succeeding founding Director Professor Craig Moritz. Under Moritz's leadership, the CBA grew into a globally recognized hub for biodiversity science, leveraging advancements in genomics, ecology, and evolutionary biology. Professor Borevitz aims to build on this strong foundation with a focus on policy impact and expanding partnerships.
- 2. **Engagement and Collaboration:** The CBA sustained its mission of fostering biodiversity science through a diverse range of workshops, symposia, and visiting scientists. Highlights included:
 - **Biosystematics Conference 2023:** Collaboration with national and regional societies to celebrate 50 years of taxonomic achievements in Australia.
 - **Population Genomics Workshop:** Advanced training in genomic data analysis to equip researchers and managers with the skills needed for conservation efforts.
 - **Airborne eDNA Workshop:** Focused on emerging technologies to detect species through genetic remnants in the air, enhancing biodiversity monitoring capabilities.
 - **DiversityScanner Collaboration:** Continued development of a high-throughput genomic sequencing technology for biodiversity discovery in partnership with German institutions.
- 3. **Knowledge Exchange:** Transition in the Knowledge Broker role, with Jessica Ward-Jones taking over from Paula Doyle to continue building networks between scientists, policy makers, and conservation organizations.

As the CBA concludes its 12th year and looks towards its future beyond 2025, it is actively engaging with stakeholders, including government partners, to shape the Centre's next phase of evolution. The CBA remains committed to driving innovative research and cross-disciplinary collaborations to ensure Australia's biodiversity is resilient against environmental challenges.

Further details and specific outcomes from the year's activities are outlined below. A "CBA outcomes summary (2012-23)" prepared for the Liaison Committee is also included at the end of this report.

Summary of the activities coordinated, facilitated and funded by the Centre for Biodiversity Analysis (Year 12, 2023-24).

Interactions and collaborations are indicated by **bold** font. Further detailed information on each activity is available on the CBA webpage via links.

Collaborative projects 2023-24

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

Australian Biodiversity Discovery Facility

https://cba.anu.edu.au/news-events/events/abdf-open-day

In 2023 the Centre for Biodiversity Analysis hosted Rudolf Meier from the Center for Integrative Biodiversity Discovery at Berlin's **Museum fur Naturkunde** for discussions on "DiversityScanner". The novel technology developed by Meier's and Christian Pylatiuk's (**Karlsruher Institut für Technologie**) labs combines robotics, machine learning and high-throughput genomic sequencing to scan, classify and quantify invertebrate taxa from bulk environmental samples.

Over the past 12 months we have continued to work with Meier and his collaborators to bring this technology and associated workflows to Australia to establish the **Australian Biodiversity Discovery Facility**. The CBA Liaison Committee agreed to allocate \$500K of the CBA Mk3 budget to the ABDF initiative as all CBA partners will benefit from establishing and testing the DiversityScanner infrastructure in the EBL and we expect it to be a key capability for CBA V4. This includes seed funds for use/development of the facility and technical salary support.

Lead by Megan Head and supported by Rachel Mapperson (RSB, ANU), we have initiated the establishment of the ABDF in 2024 using the DiversityScanner technology. Our goal is to develop a facility where researchers and managers will be able to bring samples for processing and training and to experiment and co-develop projects for the monitoring and discovery of Australia's biodiversity. In November 2024 we will host interested researchers, students, conservation managers and other stakeholders at an open day to hear about and observe the DiversityScanner and discuss potential projects to assist with testing and development of the technology for discovering, identifying and monitoring biodiversity.

Ignition Grants and Synthesis Groups

An important measurable outcome of the CBA is the number of collaborative projects between the ANU, CSIRO and University of Canberra's scientists and students. Some of our key tools for engagement and collaboration across ANU, CSIRO and University of Canberra are our Ignition Grant and Synthesis Group funding schemes. Below are the collaborative Synthesis Groups funded by the CBA over 2022-23:

Ignition grants (2023-24)				
Dec 2024	As we establish the CBA's new <u>DiversityScanner project</u> , calls for <u>pilot projects</u> (including student projects) to test, develop and innovate with the DiversityScanner technology were made in Oct/Nov 2024 as part of our Ignition Grant Program.			
	Successful applicants of both the Diversity Scanner test projects and 2024 Ignition Grants will be notified in December.			
Synthe	esis Groups (2022-23)			

Apr 2024	Bogong Moth Summit: Uniting people, place, and purpose for conservation	Kate Umbers (WSU / Invertebrates Australia), Saul Cunningham (ANU - FSES), Josh Coates (ANU - FSES), Adrienne Nicotra (ANU - RSB), Jasper Montana (ANU - CPAS), Fabien Medvecky (ANU - CPAS), Jesse Wallace (CSIRO), Peter Caley (CSIRO), Eleanor Drinkwater (WSU), Connor Marsland (WSU), Rose Lownds (WSU)	\$15,000
Apr 2024	AirDNA Workshop	Linda Neaves, ANU; Erin Hahn, CSIRO; Francesco Martoni, Ag Victoria; Dianne Gleeson, UC; Foyez Shams, UC; Alejandro Trujillo Gonzalez, UC; Anna MacDonald, Australian Antarctic Division; Travis Ashcroft, Biosecurity New Zealand; Rachel Tulloch, CSIRO; David Thuo, CSIRO; Harry Eyck, CSIRO Kye Robinson, CSIRO; Todd McLay, CSIRO; Vivek Shrestha, CSIRO; Tracey Steinrucken, CSIRO; Anna Kearns, CSIRO; Tracey Steinrucken, CSIRO; Anna Kearns, CSIRO; Francisco Encinas-Viso, CSIRO; John Roberts, CSIRO; Olly Berry, CSIRO; Jenny Giles, CSIRO; Josh Newton, Curtin University; Paul Nevil, Curtin University; Kristen Fernandes, DBCA; Laurence Dugal, DBCA; Rebekah Hortin, DBCA; Fabian Roger, DNAir, Switzerland; Kat Dawkins, eDNA Frontiers; Shane Herbert, eDNA Frontiers; Kazushi Masuda, Hiroshima University; Cecilia Villacorta- Rath, JCU; Karen Bell, NSW DPI; Kelly Hill, SARDI; Daniele Giblot-ducray, SARDI; Hyensoo Kim, Seoul National University; Matt Barnes, Texas Tech University; Kristine Bohmann, University of Copenhagen; Gracie Kroos, University of Otago; Ang Mcgaughran, University of Waikato; Jenny Vivian, USC; Ryohei Nakao, Yamaguchi University; Beth Clare, York University.	\$19,800
Apr 2024	Integrating mechanistic models and individual-based data to predict population dynamics in a changing world	Daniel Noble, RSB , ANU ; Ben Sheele, Fenner, ANU ; Simon Clulow, UC ; Richard Duncan, UC ; Isabel Smallegange, Newcastle University , UK; Robert Salguero-Gomez, Oxford University , UK; Jean Francoise Le Gilliard, CNRS , France; Michael Kearney, Melbourne Uni ; Megan Head, RSB , ANU ; Dalton Leibold, RSB , ANU ; Naomi Laven, RSB , ANU ; Jordann Crawford-Ash, Fenner, ANU ; Matt Hollanders, UC ; Grant Webster, UC ; Kris Wild, Melbourne/ANU ; Joanne Bennett, Fenner, ANU	\$20,310

Workshops, symposia, conferences and seminars 2023-24

cba.anu.edu.au/news-events/event-series/cba-workshops cba.anu.edu.au/news-events/event-series/cba-conferences-symposia cba.anu.edu.au/news-events/event-series/cba-seminars

A key aim of the CBA is to build capacity through training of graduate and postdoctoral scholars. Our technical workshops typically focus on advanced analytical and technical methods, with the primary developers of the methods presenting, across population- and phylo-genomics, macro evolution and ecology, and biodiversity informatics. We strongly encourage direct input from post docs and PhD students regarding the types of dry and wet lab training they need for their specific research requirements and interests and support national and international visiting scientists who present a workshop and/or seminar during their time in Canberra.

The CBA also facilitates and supports other activities such as working groups, round table discussions and symposiums that support research development and collaboration across our partner institutions and knowledge exchange amongst scientists, managers and policy makers.

Below are the workshops, symposia, conferences and seminars facilitated by the CBA over 2023-24:

	1		
Nov 2024	<u>Multispecies Coalescent</u> <u>Analysis</u>	Training Workshop & seminar	In this workshop Adam Leaché, from the University of Washington , will give an introduction and run through practical activities on coalescent theory and analysis.
Nov 2024	Land and Climate mini- symposium	Seminars & discussion	A special mini-symposium on land use and climate that will discuss soil metagenomics, carbon mapping and the role of natural forests and agriculture in carbon sequestration. Speakers: CSIRO, DCCEEW, University of South Wales, ANU
Oct 2024	BPA fungal bioinformatics workshop	Training Workshop	Bioplatforms Australia fungal bioinformatic workshop at ANU
Oct 2024	Working with schools to document insect biodiversity using DNA barcoding: impact and possibilities	Seminar	Erinn Fagan-Jefferies from the University of Adelaide gave an overview of 'Insect Investigators', a citizen science project that brings together expert taxonomists, educators and communicators to help school students collect and identify new species of insects.
Sept 2024	Gen3sis: Simulating the evolution of biodiversity	Technical training workshop	Visiting scientist Oskar Hagen (iDiv , Germany) and ANU ECR Alexander Skeels presented a workshop that aimed to develop skills required to simulate biodiversity patterns using MEEMs, and specifically the Gen3sis engine, enabling participants to design experiments and test multiple interconnected hypotheses for the evolution of biodiversity.
Sept 2024	From German Romanticism to Modern Computational Biodiversity Models	Seminar	Visiting scientist Oskar Hagen from the German Centre for Integrative Biodiversity Research (iDiv) will talk on the history of modelling biodiversity and its change across space and time.
June 2024	AirDNA workshop	Synthesis Group workshop	A two-day CBA Synthesis Group workshop explored the uptake and effectiveness of Airborne eDNA technologies.
Apr 2024	Introduction to molecular lab fundamentals 2024	Technical training workshop	The EBL's annual 3-day introductory course to molecular lab fundamentals for Honours and PhD students and other researchers new to molecular lab work.
Mar 2024	R-evolutionary Insights: Deep dive into SNP-based population genomics	Technical training workshop	A 5-day training workshop at ANU's Kioloa coastal campus and online run by developers of popular R packages and experienced practitioners helped students and ECRs get the most out their population genomics research using R.
Feb 2024	Individual variation in mitochondrial metabolism	Seminar & Workshop	Visiting ecophysiologist Karine Salin from the Institut Français de Recherche pour l'Exploitation de la Mer (French Research Institute for Exploitation of the Sea) presented a talk and workshop on mitochondrial metabolism.
Nov 2023	BEAST 2 workshop	Technical training workshop	In conjunction with Biosystematics 2023, the CBA hosted a post-conference workshop on phylogenetic analysis software BEAST 2 presented by Remco Bouckaert and Jordan Douglas, Centre for Computational Evolution, University of Auckland .
Nov 2023	Biosystematics 2023	Conference	In collaboration with the Australian Biological Research Study, Australasian Systematic Botany Society, Society of Australian Systematic Biologists and Australasian Mycological Society, the CBA supported this combined conference that celebrated the achievements and identified future directions in the discovery, documentation and protection of Australasia's biodiversity.
Nov 2023	Stakeholder engagement: Turning lectures into conversations	Workshop	This hands-on workshop showed participants how to speak about their research to invite conversation, whether it be amongst other scientists, stakeholders, or the general public. Presented by Robyn Shaw, Kyle Hemming (University of Canberra), Andrea Wild (CSIRO), Michael He, Joel Keen (National Centre for Indigenous Genomics), Paula Doyle (Knowledge Broker, CBA)
Nov 2023	Macroecology meets hi-tech	Working group	A working group to discuss the development of a new CBA initiative investigating the potential of new data sources to unify the three elements of biodiversity - ecosystems, species and genes. Participants from ANU , UCanberra , CSIRO , DCCEEW .
Nov 2023	Detecting selection	Workshop	A one-day workshop presented by Bruce Walsh from the University of Arizona to provide an overview of the wide

			array of approaches that have been proposed to detect selection.
Nov 2023	Leveraging museum specimens to ask ecological questions in the era of genomics	Seminar	Bruce Walsh from the University of Arizona discussed how the ability to whole-genome sequence from museum specimens has fundamentally changed the way we view the value of collections.

Publications from CBA funding 2023-24

cba.anu.edu.au/research/our-impact/publications

A significant outcome of CBA Project, Synthesis and Workshop funding are peer-reviewed publications. Below are those published in 2023-24:

Shaw, R.E., Brockett, B., Pierson, J.C. <i>et al.</i> Building meaningful collaboration in conservation genetics and genomics. <i>Conserv Genet</i> (2024). <u>https://doi.org/10.1007/s10592-024-01636-4</u>	Synthesis Group: Conservation Genetics in ACTion: a case study for the incorporation of genetic theory into management processes
Potter S, Moritz C, Piggott MP, McDonald-Spicer C et al. 2024. Museum skins enable identification of introgression associated with cytonuclear discordance, Systematic Biology. <u>https://doi.org/10.1093/sysbio/syae016</u>	Ignition Project: Bringing next generation approaches to conservation genomics using museum collections – Rock wallaby museum skinomics
N. E. Langmore et al. Coevolution with hosts underpins speciation in brood- parasitic cuckoos. Science 384,1030-1036 (2024). DOI: <u>10.1126/science.adj3210</u>	Ignition Project: Barcoding and capture-based approaches for eggshell genomics to improve biodiversity assessment in Australian birds
Patrice Pottier, Daniel W.A. Noble, Frank Seebacher, Nicholas C. Wu, Samantha Burke, Malgorzata Lagisz, Lisa E. Schwanz, Szymon M. Drobniak, Shinichi Nakagawa, New horizons for comparative studies and meta-analyses, Trends in Ecology & Evolution,2024, ISSN 0169-5347, <u>https://doi.org/10.1016/j.tree.2023.12.004</u>	Synthesis Group: Reconciling comparative and meta-analytic practices in an era of big data
Matheson P, Parvizi E, Fabrick JA, Siddiqui HA, Tabashnik BE, Walsh T, McGaughran A. (2023). Genome-wide analysis reveals distinct global populations of pink bollworm (<i>Pectinophora gossypiella</i>). Sci Rep. 2023 Jul 20;13(1):11762. doi: 10.1038/s41598-023-38504-z. PMID: 37474628; PMCID: PMC10359307	Ignition Project: Understanding biological invasions: assessing the biosecurity threat of the pink bollworm to Northern Australia
Notarnicola, Rocco & Arnold, Pieter & Feng, Zhi-Ping & Hamilton, Jemimah & Jones, Ashley & Loke, Stella & Nicotra, Adrienn & Schwessinger, Benjamin & Ganguly, Diep. (2023). Transcriptional acclimation to warming temperatures of the Australian alpine herb <i>Wahlenbergia ceracea</i> . 10.1101/2023.09.27.559694.	Ignition Project: Building a reference genome for a non-model species: <i>Wahlenbergia ceracea</i>
Courtney Jones, S. K., Geange, S. R., Hanea, A., Camac, J., Hemming, V., Doobov, B., Leigh, A., & Nicotra, A. B. (2023). IDEAcology: An interface to streamline and facilitate efficient, rigorous expert elicitation in ecology. Methods in Ecology and Evolution, 14, 2019–2028. <u>https://doi.org/10.1111/2041-210X.14017</u>	Synthesis Group: Using expert elicitation to identify impacts of climate change on Australian species
Donelson, J.M., Gaitan-Espitia, J.D., Hobday, A.J. et al. 2023. Putting plasticity into practice for effective conservation actions under climate change. Nat. Clim. Chang. 13, 632–647. https://doi.org/10.1038/s41558-023-01706-4	Synthesis Group: Planning with plasticity: Shifting management and conservation paradigms by integrating biological and organizational plasticity
Shukhrat Shokirov, Tommaso Jucker, Shaun R. Levick, Adrian D. Manning, Timothee Bonnet, Marta Yebra, Kara N. Youngentob. 2023. Habitat highs and lows: Using terrestrial and UAV LiDAR for modelling avian species richness	Ignition Project: Laser scanning ecosystem structure to map habitat quality and measure landscape change

and abundance in a restored woodland, Remote Sensing of Environment, 285, 113326, https://doi.org/10.1016/j.rse.2022.113326.	
Wild KH, Roe JH, Schwanz L, Rodgers E, Dissanayake DSB, Georges A, Sarre SD, Noble DWA. Metabolic consequences of sex-reversal in two lizard species: a test of the like genotype and like phenotype hypotheses. J Exp Biol. 2023 Jun 13: jeb.245657. doi: 10.1242/jeb.245657.	Ignition Project: Energetic costs of sex reversal in lizards: implications for understanding evolutionary transitions between environmental and genotypic sex determination
Paul M Oliver, Andrew F Hugall, Audrey Prasteya, Alex Slavenko, Sabin Zahirovic, Oligo-Miocene radiation within South-west Pacific arc terranes underpinned repeated upstream continental dispersals in pigeons (Columbiformes), Biological Journal of the Linnean Society, 2023;, blad003, <u>https://doi.org/10.1093/biolinnean/blad003</u>	Synthesis Group: Crossing Lines: a new synthesis on Asian, Melanesian and Australian biotic exchange

Knowledge exchange and outreach 2023-24

cba.anu.edu.au/research/our-impact/knowledge-exchange-outreach

A major objective of the CBA is to exchange knowledge, perspectives and challenges amongst scientists, policy makers, and find ways to effectively engage, now and into the future. In June 2024 the CBA farewelled its inaugural Knowledge Broker of five years Paula Doyle. Bringing enthusiasm and resourcefulness from a science education background, Paula joined the CBA in 2019. Over five years her wide-ranging communication, relationship-building and event management skills forged valuable networks among scientists and students from across the Centre's partners, and with policy makers and managers from state and federal environmental departments and other conservation organisations.

To build on Paula's connections and projects the CBA is now excited to welcome Jessica Ward-Jones to the team. Jess brings a wealth of experience in ecology, project management, research, and science communication. Previous roles at the Invasive Species Council saw Jess develop and manage a highly successful national citizen science project focused on invasive species. Jess also has experience with the CBA, having been the coordinator for the CBA-funded High-Country Dieback Network where she managed connections between researchers and land managers invested in ongoing understanding of several dieback affected Eucalyptus species in the Australian high country. With a background in managing complex environmental projects and fostering collaborations across sectors, Jess is looking forward to working with CBA scientists and students, learning about their research and perspectives to create impactful partnerships with environmental management and policy.



Centre for Biodiversity Analysis

Linking biodiversity scientists, students and their research across ANU, CSIRO and UC







The Centre for Biodiversity Analysis operates as a highly collaborative, crossinstitutional partnership jointly funded by the ANU, CSIRO and University of Canberra.

Mission statement: Through collaborative science and training, with a focus on cuttingedge applications of genomics and environmental analysis, to improve the understanding, protection and resilience of Australia's unique biodiversity and ecosystems in the face of accelerating environmental change.

Promote collaborative biodiversity science across partner institutions to develop and demonstrate novel approaches and tools for biodiversity discovery, understanding and analysis.

Connect



- Collaborative research
 » Ignition Grants
 » Synthesis Groups
- Seminars, symposia & conferences
- Visiting scientists
- Working groups

Build capacity through training of graduate and postdoctoral scholars.

Build



- ECR advanced training workshops
 Joint ECR research & student
 - projects
- Co-supervision across institutions
- Industry/Gov internships

Incorporate new knowledge and tools into the conservation policy and management of Australia's biodiversity.

Apply



- Knowledge exchange between science, policy & management
 - » Synthesis Groups
 - » Workshops & symposia
 - » Knowledge Broker

The CBA was established in 2012 on the arrival of Director Craig Moritz at ANU and is administered from ANU's Research School of Biology via an Umbrella Agreement.

Supported by a Coordinator, Knowledge Broker and Ecogenomics & Bioinformatics Lab Manager, the CBA is governed via a Liaison Committee composed of representatives from all funding partner institutions.

Centre for Biodiversity Analysis (2012-2025)	Budget	Co
CBA V1 (2012-17) ANU + CSIRO	\$1,000,000	
CBA V2 (2017-20) + University of Canberra	\$1,200,000	Bio
CBA V3 (2020-25) + Ecogenomics & Bioinformatics Lab	\$2,700,000	Pr
Tota	\$4,900,000	



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Collaborations enabled by CBA seed funding and network creation across ANU, CSIRO and University of Canberra have leveraged over \$28M in external funding opportunities (2013-23).



The strong support and engagement of the CBA community across the three partner institutions has ensured continuous funding of the Centre for 13 years (2012-25).



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ANU

28%

CSIRO 17%



"Our synthesis funds were very successful in establishing a large number of collaborations and interactions with researchers outside the ANU. In addition, the synthesis funds have been instrumental in training students both in comparative and meta-analysis about each other's fields and the challenges and approaches in each." EMCR, ANU, 2019 "CBA is a great venture, and it is important to keep the collaborations with the other institutes in Canberra." Assoc Prof, ANU, 2023

"The Ignition Grants are a very effective scheme to kick-start novel ANU-CSIRO collaborative research. The seed funding provided was crucial in developing a more substantial research proposal." Research Scientist, CSIRO, 2016

"I've always found CBA to be useful and interesting, a great way of meeting fellow researchers." HDR Student, ANU, 2023

"The Ignition Grant I received allowed me to see my honours year as much more than a university assessment. It gave me an incredible opportunity and working with CSIRO encouraged me to think about the potential consequences and applications of my research. It also helped fund conference attendance and I feel attributed to the beginning of an exciting science career for me." Hons student, ANU, 2016

> "This (Ignition Grant) is the best grant scheme of its type I have come across in my life so far. Keep it up! Little chunks of money for pilot experiments is exactly what ECRs need. Expand the scheme if you can!" Postdoc, ANU, 2016

"This funding was integral to my PhD project, and development as an early-career scientist, facilitating networks with CSIRO." PhD student, ANU, 2019



collaborations and to generate

baseline from which to attract

larger research funds." EMCR,

CSIRO, 2019

important initial data that serves as

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The CBA has demonstrated that new methods developed for fundamental research can be rapidly deployed to solve urgent real-world problems.

Ignition Project team takes on rapid COVID-19 sequencing



This collaboration, kicked off by a 2017 Ignition Project, connected CSIRO's viral expertise via Robyn Hall (Health & Biosecurity) with ANU's advanced genomic sequencing know-how through Benjamin Schwessinger's lab (Research School of Biology). In mid 2021, as the country was plunged into lockdown, Robyn and Benjamin, along with Ashley Jones and Emma Crean (ANU), stepped up as the primary team sequencing ACT COVID-19 samples and comparing genomes from the Australian database to assist with contact tracing across Canberra, sequencing 15-30 genomes a day for ACT Health.

cba.anu.edu.au/news-events/news/ignition-project-team-takes-rapid-covid-19-sequencing

Genetic assessment of bushfire-impacted vertebrate species

The 2019-2020 Australian bushfires had devastating effects on many animal species, significantly impacting their populations and habitats. In response, the Department of Agriculture, Water and the Environment devised a draft framework to urgently assess and prioritise conservation efforts for these species. However, genetic evaluations revealed inaccuracies in the existing taxonomic classifications, leading to mis-prioritisation and potential loss of cryptic species diversity. Recognising the limitations of traditional morphological taxonomy, the Centre of Biodiversity Analysis conducted an expert assessment which confirmed this. Consequently, a project supported by the NESP Threatened Species Hub and the CBA was launched to gather and analyse genetic data, which would refine the understanding of species diversity and aid in the accurate reassessment of conservation priorities. The project's final report provides crucial landscape genetic information for about 50 priority species helping to inform State conservation strategies. It underscores the importance of integrating genetic insights into conservation planning and maintaining continuous collaboration between geneticists, policy makers, and conservation managers.



cba.anu.edu.au/news-events/news/genetic-assessment-bushfire-impacted-vertebrate-species