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symposium summary

Biogeography: multidisciplinary approaches in space and time

International Biogeography Society Early-Career Conference 2014 – Canberra, Australia, 7–11th January 2014

In January 2014, the second Early-Career Conference of the IBS was held in Canberra, Australia, organized by The Australian National University (ANU) and CSIRO. The conference was attended by 130 biogeographers: approximately half were students and the rest mainly early-career researchers. The attendees came from 18 countries, representing Australia and New Zealand, Asia, Africa, Europe and the Americas. Three days of oral and poster presentations in three symposia—covering species' distributions, phylogenetic methods and biodiversity turnover—were preceded by a day of four workshops on the same topics. These cross-cutting themes describe a great bulk of recent biogeographic research, and we report the highlights from each symposium.

Species' distributions across time and space

The first day's symposium, *Species' distributions across space and time*, focused primarily on understanding factors influencing species' spatial distributions, and transferring those insights to other times and places. The organisers chose this topic in response to the continued growth in the development and application of methods that infer species' ecology from geographic data. This symposium offered an opportunity to survey cutting-edge research and recent technological advances in the field, and to highlight some of the standing challenges of research taking an ecological approach to biogeography.

Presentations in this symposium ranged from studies of microclimate to global-scale studies of the distribution of biodiversity and the use of models to predict species' distributions in the past, present and future. The two keynotes admirably demonstrated this breadth of scales: Michael Kearney (University of Melbourne) discussed how models integrating species' physiology and microclimate occupancy with environmental data can be scaled up to make predictions of the suitability of habitat, while Catherine Graham (Stony

Brook University) presented new methods for studying the mechanisms underlying global distributions of beta diversity, and how that diversity might respond to climate change.

Many of the talks focused on methodological studies and applications of species' distribution modelling (SDM). These studies use species' occurrence data in conjunction with environmental variables in order to construct mathematical models of the species' tolerances, which are used to predict the relative suitability of habitat over space. These methods have faced some fairly severe criticisms in recent years (Bahn and McGill 2007, Rodríguez-Rey et al. 2013), but there is also empirical evidence demonstrating that they can produce useful estimates of habitat suitability (Guisan et al. 2013). Talks in this symposium discussed choice of predictor variables, the inclusion of new data sources such as biotic interactions, natural history, evolutionary history and spatial sampling bias. One clear message from the symposium was the huge momentum for application of spatial modelling techniques outside terrestrial ecosystems, and for the incorporation of data sources beyond the traditional environmental layers. For example, talks provided examples of the development and application of modelling tools for a diverse array of marine systems, clearly a growth area for biogeography. Other talks focused on improving model performance through the incorporation of archaeological, palynological, and fossil data, providing promising ways forward for better calibration of species' distribution models. While the use of SDMs in biogeography is still growing, the talks presented here made it clear that many users are working towards incorporating more biological insight into the modelling process.

Advances in phylogenetic methods for biogeography

The integration of geography with phylogenetics

and phylogenomics has heralded a new era for biogeography, providing an increasingly in-depth understanding of processes and patterns of biodiversity at regional and global scales (Wen et al. 2013). The symposium *Advances in phylogenetic methods for biogeography* captured much of the current excitement of this field. Presentations reflected the rapid uptake of sophisticated new analytical methods and their application to a wide range of taxonomic groups (birds, fish, plants, insects, mammals, reptiles, bacteria), geographic regions (Australia, Pacific, India, Madagascar, Brazil, North America), and ecological settings.

The two keynotes offered a showcase of recently developed phylogenetic methods for biogeography. Craig Moritz (ANU) presented his group's current work on the poorly known reptile biodiversity of Australia's monsoonal tropics, an excellent example of the power of integrating geography with phenotypic and phylogenomic datasets to delineate evolutionary lineages and infer their evolutionary history and dynamics. H el ene Morlon ( cole Polytechnique) proposed a synthesis of phylogenies with models of cladogenesis, species' distribution data, and palaeoenvironmental data to understand how geography and ecology shape spatial patterns of diversity. Morlon illustrated how this can work with her group's recent work on latitudinal diversity gradients and patterns of diversification through time.

Presentations by early-career researchers also demonstrated a range of novel approaches that integrate data and techniques from diverse sources, such as palaeoenvironmental data, ecological niche modelling, GIS, morphology and genetic diversity measures, all placed within a comparative evolutionary framework. These talks reflected the very recent explosion in the use of next-generation sequencing (Ronquist and Sanmart ın 2011, Rocha et al. 2013), which is extending the use of molecular data in biogeography far beyond the 'simple' interpretations of species' phylogenies that prevailed until a few years ago. The atmosphere of the symposium was very much one of being on the cusp of a revolution in both the quality and volume of data, and the computational methods used to analyze the data. For all of

the rapid increase in methodological sophistication, however, we should all remember that the basics of good scientific enquiry—honest observations and accurate logic, according to Robert MacArthur—have not changed. In this respect, it was gratifying to see that the presenters in this symposium had not forgotten the important questions about speciation, extinction, demography, population structure, migration, dispersal, vicariance, diversification rates, adaptations and geographic barriers that make biogeography such a diverse and exciting field.

Biodiversity turnover across spatial scales

Analysis of compositional turnover is an approach increasingly used for basic questions in biogeography, such as the relationships between space, environment and community composition (Kraft et al. 2011), and as a modelling technique to address questions of biodiversity change and conservation (Mokany et al. 2014). Presentations in the final symposium, *Biodiversity turnover across spatial scales*, ranged broadly across traditional biogeography, macroecology and conservation, all considered in terms of assemblage composition and turnover.

Simon Ferrier (CSIRO) opened the symposium with a keynote address exploring the many ways in which compositional turnover modelling across space and time contributes to conservation assessment activities at various scales, including assessments of the representativeness of protected areas and the location of potential climate-change refugia. In the final keynote of the conference, Matt Fitzpatrick (University of Maryland) showed how techniques developed for community-level modelling can be applied to the analysis of intraspecific genomic variation, to identify non-linear gene–environment relationships, and generate maps of how adaptive genomic diversity is predicted to vary across the landscape.

Presentations by early-career researchers included many methodological innovations. For example, several presented techniques to better represent processes driving compositional turnover, including dispersal limitation, ecosystem function or directionally specific turnover. Others

investigated the relationship between composition and current or past environmental conditions, for example the influence on composition of river biotas, of connections between river systems at times of lower sea levels, or the relationship between historical climate stability and current functional diversity. Models of compositional turnover were used to assess gaps and priorities for conservation of species or phylogenetic diversity. Another theme was the use of compositional similarity to empirically delineate biogeographic regions and breaks. Several presentations focused on making the best use of relatively sparse marine species' occurrence data to identify marine biogeographic regions and compositional breaks. In this symposium we saw the increasing range of approaches that move beyond correlative models of composition, aiming to better represent dynamic processes such as isolation, dispersal and diversification which structure biodiversity.

Conclusions

Since its inception, biogeography has been a multidisciplinary field. Conferences focused on early-career researchers provide insights into the future foci and trends of a field. The 2014 IBS Early-Career Conference demonstrated that biogeography is a field that not only maintains, but is also increasing its multidisciplinary, and continues to draw in excellent students and researchers that shape its future. For many, this makes biogeography one of the most exciting fields within ecology, evolution and biodiversity research. We look forward to the next peek into the future of biogeography at the upcoming meetings of the IBS.

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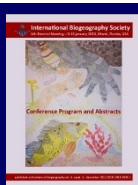
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<http://www.biogeography.org/html/Meetings/2013/program.html>.