

Symposium summary — organizer's perspective

## Biogeography and ecology: two lenses in one telescope

A symposium at 5th International Biogeography Society Conference – Heraklion, Greece, 7–11 January 2011

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Biogeography and ecology had common roots in natural history but have been largely separate disciplines for decades, as evidenced by their distinct journals and professional societies. A dichotomous key to the disciplines might separate biogeography and modern ecology as explicitly historical and ahistorical, respectively (McIntosh 1985, Lomolino et al. 2010). In addition, experimental ecology has necessarily focused on local-scale processes and patterns that operate over relatively short time intervals, whereas biogeography has typically focused on processes and patterns that operate over long time intervals and larger spatial scales. Thus, biogeography and ecology may be considered at first glance to be very different views of nature.

In spite of their divergent histories, biogeography and ecology are increasingly converging on intermediate spatial and temporal scales, as evidenced by theoretical and empirical research on metapopulations, metacommunities, regional communities, and evolutionary ecology (e.g., Ricklefs & Schluter 1993, Hanski & Gaggioti 2004, Holyoak et al. 2005, Emerson & Gillespie 2008, Ricklefs 2007, 2008, Cavender-Bares et al. 2009). This convergence has resulted from the maturation and extension of each discipline and from increasing attention to global climate change and its effects at regional scales. As the temporal and spatial scales of biogeographical and ecological concepts increasingly overlap, the two disciplines risk developing separate conceptual imagery, jargon, and expectations for the same natural phenomena. If biogeography and ecology are to inform the conservation and management of nature amidst the simultaneous pressures of 7-plus billion people and global climate change, these disciplines must speak the same language to talk about common concepts. To extend the visual metaphor of the symposium title, the two lenses of biogeography and ecology need to be aligned to form one telescope through which we receive

clear and accurate conceptual images of the natural world and human impacts.

As part of the 5<sup>th</sup> International Biogeography Society meeting in Crete (7–11 January 2011), a symposium was convened entitled “Biogeography and Ecology: Two Lenses in One Telescope”. Speakers were organized in pairs: one ecologist and one biogeographer were each assigned to a topic and asked to converse with each other in advance of the symposium. After an introduction by David Jenkins outlining the background of the symposium, four topics relevant to both disciplines were addressed by the eight speakers; niche, comparative ecology/macroecology, community assembly, and diversity.

Jonathan Chase addressed core issues with a summary of ecological niche concepts and suggested that divergent ecological and biogeographic views of niche might be regarded as “MacArthur's Paradox” (Robert MacArthur contributed mightily to both ecological niche and island biogeography). Dr. Chase also explained more recent extensions of ecological niche research, including neutral theory and the use of null models to distinguish niche-based and stochastic processes driving community structure. John Wiens then considered the niche concept at biogeographic scales (e.g., species ranges), and noted that abiotic tolerances have been prominent in biogeography while biotic interactions remain relatively unstudied as drivers of large-scale distribution. Dr. Wiens also argued that biogeography should incorporate species' ecology and niche into explanations for species distributions.

Phylogeny is explicit in much of biogeography, but not often in ecology. However, Robert Poulin emphasized the benefit of a phylogenetic context and consideration of ecological traits (e.g., niche breadth) to modern comparative ecology. Dr. Poulin's research on parasites highlighted the intersection between ecology and biogeography when he described the interaction of host speci-

ficity, life cycle, and host mobility as factors affecting parasite communities across spatial scales. In contrast to that detail-oriented approach, Felisa Smith championed macroecology as a broad, phenomenological approach to general patterns at large temporal and spatial scales. Dr. Smith highlighted the prominent role that mammal body size has played in macroecology to reveal common patterns across continents and through evolutionary time.

Community assembly has a long and sometimes acrimonious history in ecology, including recent disagreements over neutral and niche-based processes. Evan Weiher summarized community assembly from an ecological view, and emphasized that a mechanistic understanding of species traits, particularly in combination with phylogenetic analyses of communities, will better advance community assembly theory. Brent Emerson discussed the value of a phylogenetic approach to community assembly, focusing on the application of high-throughput sequencing to understanding diversity in communities of cryptic organisms, such as Collembola.

Diversity is a fundamental measure of ecological and biogeographic pattern. Alessandro Chiarucci summarized the diverse methods used by ecologists to quantify diversity, and the ongoing challenges in measuring diversity for conservation applications and at biogeographic spatial scales. He emphasized the need for spatially explicit, large-scale programs using standardized methods, efforts that require multinational collaborations. Jonathan Davies discussed phylogenetic diversity (PD), which goes beyond ecological diversity measures (e.g., species richness) to include phylogenetic relationships among species in a clade. Dr. Davies used analyses of terrestrial mammals to show that PD adds an evolutionary dimension to diversity-based conservation approaches, producing better-informed regional conservation strategies.

Robert Ricklefs wrapped up the symposium with an overview that tied together the four themes discussed by the speakers, and related similarities and differences among biogeography and ecology to their separate terminologies and

traditions, focal scales for data collection and analyses, and different applications of history (recorded in phylogenies and biogeographic patterns). Recent research at the interface between biogeography and ecology, often conducted at regional scales, suggests that the two disciplines can be connected through evolution and other large-scale processes, which filter down to the local scale. Dr. Ricklefs suggested that these processes might include coevolutionary interactions between species and their pathogens, which might influence regional distributions of species on spatial scales that lie between ecology and biogeography.

Naturalists followed different traditions as biogeography and ecology were separated, deconstructed, and then re-built from the component parts. The processes of re-assembly have progressed far enough that the two disciplines once again interact. The symposium “Biogeography and Ecology: Two Lenses in One Telescope” highlighted points at which biogeography and ecology are already exchanging ideas (e.g., modern comparative ecology and macroecology are each phylogenetically based), as well as subjects where ecology and biogeography are just beginning to converge (e.g., niche concepts, measures of diversity). Much recent progress has also been made in phylogenetic community assembly (e.g., Emerson & Gillespie 2008, Cavender-Bares et al. 2009) which also serves to join the otherwise divergent disciplines. Evolutionary history (as represented in phylogeny) and ecological traits will continue to be important for research on questions of niche, community assembly, regional diversity, and macroecological comparisons, which span the intersection of biogeography and ecology. The symposium will be published in a forthcoming issue of the *Philosophical Transactions of the Royal Society, B* and hopefully will contribute to aligning the biogeography and ecology lenses. We look forward to watching and participating in this potential alignment —it is an exciting time to be a biogeographer and/or ecologist.

## References

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## Symposium summary — a perspective from two delegates

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The heterogeneous distribution of life on Earth is a ubiquitous pattern, but knowledge about causal factors remains elusive. Questions regarding this pattern have been traditionally addressed with different approaches, namely historic (biogeographical) vs. contemporary (ecological). Often, these perspectives were considered separate since each recognized different processes responsible for biological diversity, geography and history on one side and ecological interactions and climate on the other. This created a chasm between ecology and biogeography that remained from the maturation of ecology during the 1960's and until recent years (Wiens & Donoghue 2004). Recognition of scale as an object of study instead of a nuisance in ecological studies (Wiens 1989) and the broadening perspective of ecological systems being influenced by both biogeographical and ecological contexts (Ricklefs and Schluter 1993) paved the way to acknowledge the interaction of regional effects on local patterns and vice versa. Consequently, the development of new concepts and disciplines (e.g. neutral theory, macroecology), along with analytical techniques and data availability (e.g. phylogenetic reconstruction), have helped bridge the gap towards a com-

prehensive understanding of biodiversity patterns. As an example of such bridging, Dave Jenkins and Bob Ricklefs convened a symposium during the 5<sup>th</sup> IBS meeting, in Crete, Greece, that showed progress in this direction. Here, we give a brief overview of this symposium through the lenses of two biogeographers in-training.

A major constraint to the evaluation of the effect of biogeographic factors in local communities is the lack of manipulative ways to address their influence. Null modelling approaches have provided a framework to distinguish potential processes involved in community assembly when experiments are not possible. Jon Chase presented an example of combining these approaches with actual experiments. He showed that integration of null models and controlled experiments under a regional perspective aids in disentangling the relative effects of niche and stochastic processes in biogeography. His results of experiments in freshwater ponds reveal the effect of niche-based processes in lower productivity systems and stochastic processes (i.e. drift) at higher productivities. In the same vein, Evan Weiher presented results of a unique large-scale experiment evaluating the relative influence of dif-

Author Queries:

1. The citations of McIntosh 1985 and Lomolino et al. 2010 are missing from the list of references
2. Sentence rephrased, (added "and ecology"); check meaning