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Title

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Journal

Frontiers of Biogeography, 5(2)

Author

Erkens, Roy

Publication Date

2013

DOI

10.21425/F5FBG18580

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On why we should teach biogeography and the need for a *biogeography compendium*

Before I started working as a PhD student I never realized that there was a field called biogeography. I had never travelled very far, at least not with a keen eye for my biological surroundings. Also, I never really asked myself whether or not all species that occurred around my city of birth had always been there. My view of the world in terms of biodiversity, as with so many other people, was rather stable. I was furthermore used to the species-poor environment that The Netherlands are, in comparison to many other parts of the world.

When I started my work at the plant systematics group where I did my PhD research in 2000, this world view radically changed. I started working on *Guatteria* (Annonaceae) a species-rich genus of Neotropical understory trees. The distributions of these trees range from narrow endemics (or even only known from a single collection; see for instance Erkens et al. 2008) to a species that occurs from south-eastern Brazil up to Honduras. The latter species looks extremely similar across its wide distributional range, while other species exhibit tremendous morphological diversity in, for instance, leaf size (with mature leaves ranging from 40x15 cm on one side of the distributional range to 13x4 cm at the other end). I must admit that these differences were very scary for me as a staring PhD student (and frankly, sometimes still are). On the other hand, these differences also fascinated me. I began asking questions like: “why are these species distributed in the way they are?”, “have these species always been distributed in the same way?”, and “where have all these species originated?” It was only then that I realized I was asking biogeographical questions.

So how could I have missed out on such an apparently important topic as biogeography during my studies? Biogeography was completely lacking as a discipline from my university curriculum, as was probably the case at that time in many universities. Reading back, I see that biogeography as a discipline was not perceived as a mature and independent scientific field in those

days (Nelson 1978, Crisci et al. 2003). In my own experience, biogeography was hidden as a sub-discipline in, for instance, evolutionary biology or systematic biology courses and students were only brought into contact with the “patterns of biodiversity” as though they were static and unchangeable. Fortunately, today biogeography is blooming more than ever, with an increase in publications over the last decade (e.g., Posadas et al. 2013).

The task of answering the sorts of biogeographic questions posed above is quite daunting, especially for the Neotropical system I am working on. For example, an estimated 4.3×10^{11} trees (with diameter at breast height >10 cm) occur solely in the Amazon Basin, predicting c. 12,500 woody tree species in the Amazon alone (Hubbell et al. 2008). These trees are part of the enormous diversity of the Neotropics as a whole, where c. 30% of all world-wide plant diversity occurs (Thomas 1999), more than on any other continental land mass. The Neotropical rainforest contains three species-rich blocks: the Amazon, the Brazilian Atlantic Coastal forest and the area comprising Central America and the Pacific coast of Colombia and Ecuador. Of these, the latter two were labelled as biodiversity hotspots because of the exceptional concentrations of species restricted to those areas combined with the exceptional loss of habitat these areas are undergoing (Myers et al. 2000). Needless to say, these species-rich blocks are focal points for conservation and hundreds of millions of Euros have been spent on their protection (Halpern et al. 2006). Unfortunately, mechanisms behind this extraordinary diversity remain a controversial issue in biogeography and ecology. Yet, it is essential to understand these mechanisms if we are to safeguard the future of this biodiversity through conservation (Purvis et al. 2005). We need to generate more basic data on the distributions and ecologies of tens of thousands of plant species, in combination with more directed studies and large-scale experimental manipulations, in order to address these

questions (Feeley et al. 2012).

Generating all these data is daunting, but obtaining proper insight using the knowledge already available is also daunting for many young scientists, non-specialists or conservationists (among others). That is why *Frontiers of Biogeography* now has the *biogeography compendium* section. When working in a field like biogeography, we all frequently need easily accessible papers. Biogeography is a very multidisciplinary science, with connections with geography, geology, palaeontology and many areas of biology, such as ecology. However, next to these more traditional areas of biogeographic knowledge, new disciplines are entering the arena. These need to be understood at a basic level in order to understand their impact on biogeography. For example, the recent perspective paper in this journal by Rocha et al. (2013) is a very useful introduction to how to use massive parallel sequencing opportunities. Since the current spatial species-richness and distribution patterns have ultimately resulted from the interplay of ecological, biogeographic, climatic and evolutionary processes throughout geological time (Ricklefs 2004, Wiens and Donoghue 2004, Stevens 2006), we need some basic knowledge of all these fields. Understanding the relative contribution of these processes to the composition of contemporary biotas is one of the most challenging goals for the near future (Cox and Moore 2005, Lomolino et al. 2006, Wiens 2012) and is probably also one of the most challenging problems for us, as researchers, to conceptually grasp.

The *biogeography compendium* series starts with a paper by Malhado et al. (2013). This paper explains in clear terms the current state of knowledge of the ecological biogeography of Amazonia. For anybody interested in the origin of the enormous diversity of the Neotropics, the paper can serve as a starting point. It shows the importance of botanical plot studies and the importance of collaborator networks for collating the data that individual research teams have painstakingly compiled. It also gives directions for future research by identifying gaps in current knowledge.

Given the current biodiversity crisis, understanding the processes that generate and main-

tain biodiversity takes on added importance and urgency (Smith et al. 2005). Knowing the mechanisms underlying the origin and distribution of biodiversity is important for at least three reasons (Purvis et al. 2005). First, it provides a baseline against which the present and future states of biodiversity can be judged. Second, it promotes the safeguarding of the future of biodiversity through facilitating conservation of evolutionary processes, as well as of the patterns they have produced—that is, the protection of existing groups while maintaining their potential to evolve. Third, it shows how particular lineages have responded to challenges in the past, which may help us to understand how they are responding today to anthropogenic changes. These reasons are good enough for me, since I am interested in biogeographic questions from a scientific point of view: I just want to know why. However, there is also direct societal importance. The large amount of money involved in conservation makes it necessary to test the validity of theories underlying conservation efforts (e.g., the criticized but popular beliefs concerning refugial isolation, which have driven conservation prioritization in many regions; Myers et al. 2000). Biogeographic approaches to these questions can yield important additional insights (Blair et al. 2012).

Biodiversity conservation has become a broadly acknowledged societal goal. Conservation efforts have led to the generation of many (international, and local policies on biodiversity, and to a cornucopia of policy documents, educational material and media campaigns (Santamaría and Méndez 2012). This means that many non-specialists need some knowledge about what biodiversity is and how it is regulated. So we, as scientists, have an obligation to make our knowledge more accessible (for example explaining basic biological nomenclature to chemists; Erkens 2011). Papers such as that of Malhado et al. (2013) are therefore strongly welcomed by *Frontiers in Biogeography*. In the long run the *biogeography compendium* should become a comprehensive compilation of articles providing short updates on key biogeographic topics. *Biogeography compendium* articles should be highly appropriate

for teaching biogeography at the graduate/postgraduate level, but can also provide technicians, non-specialists or researchers from other areas with an overview of the current state of the topic. The papers can be on biotic patterns (such as the ecological biogeography of the Amazon), abiotic patterns (e.g., quaternary climate change), organismal topics (for instance biogeographic patterns in ladybirds), or methodologically focused (such as an explanation of species distribution modelling). The journal will actively invite authors to submit to this section, but proposals for *biogeography compendium* articles are also very much welcomed.

The *biogeography compendium* is strongly in line with the mission of the International Biogeography Society¹; two of the mission's goals directly link to communicating biogeography. The statement that the IBS wants to "increase both the awareness and interests of the scientific community and the lay public in the contributions of biogeographers" means that non-biogeographers should be aware of what is happening in the field. The second statement, that the IBS wants to "promote the training and education of biogeographers so that they may develop sound strategies for studying and conserving the world's biota", is even more directly linked to teaching and communicating our subject.

So why should we teach biogeography? Personally, I want to show my students the beautiful biogeographical complexities that I missed out on during my early life. However, I also like to teach biogeography to others because it has become an indispensable tool for many non-biological areas in society, and people need to understand the basics of it.

Roy H. J. Erkens

Maastricht Science Programme, Maastricht, The Netherlands.

roy.erkens@maastrichtuniversity.nl

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¹ http://www.biogeography.org/html/About%20IBS/about_ibs.html, last accessed 14/06/2013.

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