AUTHOR COMMENTARIES - From Special Topics

Climate Change - November 2009
Interview Date: November 2009

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Dr. Miguel Araújo in the museum.

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Miguel Araújo

From the Special Topic of Climate Change

In our Special Topics analysis on Climate Change, Dr. Miguel Araújo has 10 papers in our Research Front Map on Climate Change and Species Distributions. One of these papers is also among the 20 most-cited over the past two years. In Essential Science Indicators℠ from Thomson Reuters, Dr. Araújo's record includes 72 papers, the majority of which are classified under Environment & Ecology, cited a total of 2,395 times between January 1, 1999 and June 30, 2009.

Dr. Araújo is the Leader of the Biodiversity and Global Change (BIOCHANGE) Lab, which shares its headquarters between the Department of Biodiversity and Evolutionary Biology at the Museo Nacional de Ciencias Naturales in Madrid (which itself is part of Spain's CSIC), and the University of Évora in Portugal, as part of the Rui Nabeiro Biodiversity Chair. He is also the Deputy Editor of Ecography *and the Associate Editor of the* Journal of Biogeography, Conservation Letters, *and* Geography Compass.

In this interview,* ScienceWatch.com *talks with Dr. Araújo about his highly cited research as it relates to climate change.

SW: What first interested you in climate change research?

I was working on the development of reserve-selection methods for biodiversity. The idea was to develop approaches that would lead to reserve systems that are more robust to local extinctions of species. I then realized that despite evidence for climate change already having an effect on the distributions and phenology of species, nobody was trying to integrate climate change into conservation planning methodologies.

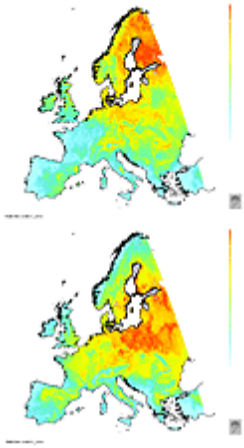
This is why I became involved in climate change research: to improve understanding of climate change effects on species and develop new approaches to minimize such effects.

SW: On what particular aspect of climate change research do you concentrate?

My research is driven by three unifying questions: 1) how did past climate changes affect biodiversity? 2) how might current and future environmental changes affect biodiversity? 3) how can biodiversity be conserved given current and future challenges?

To address these questions I use large climate and species distributions

databases, descriptions of behavioral and physiological traits of species, phylogenies, and the fossil record. Most of my research involves statistical analyses of ecological data, including data mining and bioclimate modeling, but it is in the development of new approaches for modeling species distributions under climate change scenarios that I have focused most of my research in the last 10 years.



Maps of modelled richness of birds in Europe in the present (above) and in 2080 (below).
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SW: Would you talk a bit about your September 2005 *Global Change Biology* paper, "Validation of species-climate impact models under climate change" (Araújo MB, et al., 11[9]: 1504-13), and why it is so well cited?

There are now hundreds of studies that use models to project species distributional changes under climate change scenarios, but our paper was the first that provided an independent test of such projections. This is a difficult test to perform because models are typically used to make projections for times that have yet not passed, so it impossible to independently test them.

A possibility is to "hind-cast," that is, to project distributions of species into the past and evaluate the models with the fossil record. The problem is that the quality of the fossil record is uneven, so it becomes difficult to know if differences between model projections and reconstructed species distributions are a signal of model failure or data incompleteness.

Our paper—and the companion paper, "Reducing uncertainty in projections of extinction risk from climate change" (Araújo MB, *et al*., *Global Ecology and Biogeography* 14[6]: 529-38, November 2005)—overcomes these difficulties by using high-quality 20th century data for bird distributions in two different time periods in the United Kingdom.

Miguel Araújowith colleagues Carsten Rahbek and Alejandro Rozenfeld (left to right)
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Unfortunately, there are not many data sets of comparable quality, so independent testing of species-climate-change models is likely to remain scarce.

SW: Your November 2005 *Science* paper, "Ecosystem service supply and vulnerability to global change in Europe" (Schroter D, *et al*., 310 [5752]: 1333-7, 25 November 2005), is also highly cited. Would you tell our readers about this paper?

This paper provides the first attempt to quantify how services provided by European ecosystems could change under a range of environmental change scenarios. It is an important paper because there is now a wide recognition that if efforts to conserve biodiversity are to succeed we need to complement the traditional focus on extinctions with that of the services provided by ecosystems to society.

The main reason why a focus on extinctions is insufficient is because concern for the loss of biodiversity is not shared by everyone. So when decisions involve complex tradeoffs, like cutting down a forest for fuel, or protecting it because of its biodiversity, one is forced to weigh intangible values (biodiversity) with tangible ones (the livelihoods of local communities). To address the problem of weighting units of value that are not fully comparable, one can quantify the full costs and benefits of cutting the down the forest versus managing it sustainably. This can be done by quantification of the services provided by the forest, such as water provision, CO2 sequestration, protection against natural hazards, etc.

SW: More recently, you published a paper in *Global Ecology and Biogeography*, "The importance of biotic interactions for modelling species distributions under climate change" (Araújo MB, Luoto M, 16[6]: 743-53, November 2007). Did your methods change from the 2005 *Global Change Biology* paper to this one?

Our field is moving fast, and one of the trends is towards making models more realistic. This includes consideration of interactions among species and simulations of how species might disperse under environmental change. The paper you mention is one attempt to add realism to the models, but we are still very far from having a general understanding on how biotic interactions affect the ability of species to adapt to environmental changes.

"...there is now a wide recognition that if efforts to conserve biodiversity are to succeed we need to complement the traditional focus on extinctions with that of the services provided by ecosystems to society."

SW: Have the models you developed been applied in a practical setting, i.e., used to select a reserve site, etc.?

There is a lag between scientific innovation and its utilization in real-world practical implementation. This lag is partly due to the existence of the gap between scientists and the broader community of users of scientific results, but it is also a consequence of the need for scientific results to reach a certain level of maturity before they can be widely used. The field of bioclimatic modeling has witnessed an almost vertiginous development in the past 10 years with new methods and approaches for combining them being proposed ad evaluated regularly.

We are now reaching a stage where progress is likely to slow down and this is the moment when models might become more widely used for guiding conservation action. For example, last year the Spanish and the Portuguese governments contacted me to provide an assessment of the potential impacts of 21st century climate changes on Iberian biodiversity. The idea is to use the ensembles of forecasts developed in my lab to support conservation planning by the State agencies of the two countries.

SW: Do you think climate change is getting the attention it deserves in the scientific community and from governments, and even ordinary citizens?

There is a broad interest in climate change, but focus on biodiversity is lagging behind. In particular, our understanding of the effects of climate change on biodiversity is limited and progress can only be achieved by greater integration among disciplines and by promoting a much more ambitious research program. It is staggering that we spend so much money trying to discover life outside our planet and are spending such modest sums to understand the future of life on Earth and how best to conserve it.

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Miguel Araújo's current most-cited paper in *Essential Science Indicators*, with 178 cites:

Thuiller W, *et al.*, "Climate change threats to plant diversity in Europe," *Proc. Nat. Acad. Sci. USA* 102 (23): 8245-50, 7 June 2005. Source: *Essential Science Indicators* from Thomson Reuters.

Additional Information:

Dr. Miguel Araújo has 10 papers in our Research Front Map on Climate Change and Species Distributions.

KEYWORDS: CLIMATE CHANGE, BIODIVERSITY, RESERVE-SELECTION METHODS, SPECIES DISTRIBUTION, PHENOLOGY, CONSERVATION PLANNING METHODOLOGIES, SPECIES-CLIMATE IMPACT MODELS, ECOSYSTEM SERVICE SUPPLY, EXTINCTIONS, TRADEOFFS.

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