

# 'Niche modeling': that uncomfortable sensation means it's working. A reply to McNerny and Etienne

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I thank McNerny and Etienne for their comments [1] on my article in *TREE* [2]. First, two points of clarification. I stated that '...models estimate some subset of the conditions within which a species can survive and reproduce (i.e., the niche)' [2]. McNerny and Etienne interpreted the parenthetical statement as referring to the subset of conditions rather than the entire set. That was not my intent and I apologize for not making my meaning clear. They also suggest that I had said that Elith and Leathwick favored the term Species Distribution Modeling (SDM) 'in order to retreat from ecology'. I was in fact discussing a more general retreat from the terms Ecological or Environmental Niche Modeling (ENM) based on 'skepticism and uncertainty about these models...', of which Elith and Leathwick were one example. Elith and Leathwick's stated motivation for SDM terminology is '...a healthy skepticism about which components of the niche are represented by predictions from an SDM' [3], clearly indicating that they advocate SDM terminology out of uncertainty about the interpretation of the models. I admire that paper and its authors and I do not want to be perceived as misrepresenting them.

Now to more substantial comments. McNerny and Etienne appear to believe that terminology should be driven by the data going into the model rather than the structure, interpretation, and application of the model. In my opinion, this is misguided in a literature where the latter three are fraught with conceptual problems that are widely ignored and where the construction and interpretation of models clearly demonstrates that the intent is to model a biological phenomenon rather than simply generalize patterns in the data [2,4,5(pp. 41–47)].

They argue that distributional data are a product of abiotic tolerances, history, dispersal, and biotic interactions, among other things, and that 'SDM' acknowledges this. However, models are not intended to represent all of those processes, and this is obvious in their construction and application. McNerny and Etienne acknowledge that we typically do not incorporate dispersal, biotic interactions, and history into the models adequately, but that stops short of the reality: much research has gone into determining appropriate modeling choices specifically to minimize the effects of these processes [5(pp. 141–149),6]. As a result, even a very good ENM using the best modern methods will often poorly predict the actual distribution (or change in distribution) of the species unless we apply estimates of historical factors, dispersal limitations,

and biotic interactions to the habitat suitability scores estimated by the ENM. This is not a failure of the methods; it is an inevitable result of the fact that our goal is typically to model the suitability of habitat due to the abiotic environment, not the species distribution. If our procedures are such that an ideal model cannot be expected to predict a distribution on its own, but only the portion of that distribution determined by the abiotic niche, how can one argue that it is better thought of as a model of the distribution rather than the niche? If the goal of SDM is to include all of these factors, as McNerny and Etienne suggest, should we perhaps reserve the name SDM for models that attempt to include, rather than actively exclude, these other phenomena [6]?

Finally, McNerny and Etienne suggest that 'SDM' challenges users to think carefully about the pitfalls of modeling. In my personal experience, it has the opposite effect: using 'distribution' typically does not promote clarity, it merely disguises a lack of clarity. It is generally understood that a 'niche' is controversial and difficult to estimate, whereas 'distribution' seems somehow less problematic, despite the fact that modeling the phenomena generating distributions requires that we estimate the niche (with all its problems) in addition to those other processes [6]. McNerny and Etienne themselves demonstrate this phenomenon by devoting a great deal of their letter to what aspects of the niche might be relevant to ENMs, but devote very little to defining what they mean by 'distribution', nor what aspects of the distribution an SDM is intended to estimate, nor why we would estimate species distributions using only environmental variables that we think are ecologically relevant.

The fact that neither they nor I can answer all of the questions raised by the niche assumption is not a justification for removing it from the terminology; the very fact that 'distribution' fails to make them as uncomfortable as 'niche' is precisely why the latter is preferable. If anything, I would change terminology to 'Extremely Problematic Niche Model'; the more discomfort users have with that assumption, the more likely they are to construct and interpret the models with appropriate caution. However, given the potential for these approaches across ecology, evolution, and conservation biology, 'Extremely Promising Niche Model' might be equally accurate.

## References

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