# Understanding range shift deviance: The influence of generation time and rate of adaptation on species distribution models.

**Working group proposal**
Short title: Range shifts and rates of adaptation
*Submitted to NCEAS on August 31, 2012*

**Principle Investigator**
Edmund M. Hart
Beaty Biodiversity Center
Dept. of zoology
University of British Columbia
4200-6270 University Blvd
Vancouver, B.C. V6T 1Z4
*ehart@zoology.ubc.ca*

**Project Summary:** Species range shifts is one of the most well documented responses of species to climate change and have been modeled using correlative niche models (species distribution models, SDMs) for more than a decade. Because these models are based on stastical correlations between a species realized niche and abiotic variables, there is often a deviance between predictions and a species' actual distribution. Our group will seek to understand the source of this deviance using meta-analysis. The first goal will be to test how rates of adaptation may constrain or enhance species' ability to match climate predictions. Further exploration of patterns in model deviance can be explored once data on range predictions and extant ranges has been assembled such as model artifacts and mutualistic networks. Currently much of the data from these models is locked in the form of published figures and maps though. Therefore a second product of our working group will be the development of a web-based data extraction tool. This will allow anyone to upload a figure and extract data from it and store that data in the NCEAS Knoweledge Network for Biocomplexity and other open source data sites. This will result in a data product with a usefulness that will outlast our working group, and enable future meta-analysis.

## Introduction

Species' range shifts was one of the earliest documented ecological responses to climate change (Parmesan, 1996; Parmesan *et al.*, 1999; Parmesan & Yohe, 2003). Since the late 1990's ecologist's have been using species' distribution models (SDM's) to try and predict how those ranges will shift over the next century (Davis *et al.*, 1998; Iverson & Prasad, 1998; Guisan & Zimmermann, 2000; Peterson, 2001). These models assume that the realized niche of a species is primarily determined by climate variables (Austin, 2002; Dormann, 2007). Ignoring physiology, biotic interactions and rapid local adaptation has long been a source of criticisms for these approaches (Davis *et al.*, 1998; Pearson & Dawson, 2003; Guisan & Thuiller, 2005; Helmuth *et al.*, 2005)

## References


Austin, M. (2002). Spatial prediction of species distribution: an interface between ecological theory and statistical modelling. *Ecological Modelling*, 157, 101–118.

Davis, A.J., Jenkinson, L.S. & Lawton, J.H. (1998). Making mistakes when predicting shifts in species range in response to global warming. *Nature*, 391, 783–786.

Dormann, C.F. (2007). Promising the future? Global change projections of species distributions. *Basic and Applied Ecology*, 8, 387–397.

Guisan, A. & Thuiller, W. (2005). Predicting species distribution: offering more than simple habitat models. *Ecology Letters*, 8, 993–1009.

Guisan, A. & Zimmermann, N.E. (2000). Predictive habitat distribution models in ecology. *Ecological Modelling*, 135, 147–186.

Helmuth, B., Kingsolver, J.G. & Carrington, E. (2005). Biophysics, physiological ecology, and climate change: does mechanism matter? *Annual review of physiology*, 67, 177–201.

Iverson, L. & Prasad, A. (1998). Predicting abundance of 80 tree species following climate change in the eastern United States. *Ecological Monographs*.

Parmesan, C. (1996). Climate and species' range. *Nature*, 382, 765–766.

Parmesan, C., Ryrholm, N., Stefanescu, C., Hill, J.K., Thomas, C.D., Descimon, H., Huntley, B., Kaila, L., Kullberg, J., Tammaru, T. & Others (1999). Poleward shifts in geographical ranges of butterfly species associated with regional warming. *Nature*, 399, 579–583.

Parmesan, C. & Yohe, G. (2003). A globally coherent fingerprint of climate change impacts across natural systems. *Nature*, 421, 37–42.

Pearson, R.G. & Dawson, T.P. (2003). Predicting the impacts of climate change on the distribution of species: are bioclimate envelope models useful? *Global Ecology and Biogeography*, 12, 361–371 ST – Predicting the impacts of climate ch.

Peterson, A.T. (2001). Predicting species' geographic distributions based on ecological niche modeling. *The Condor*, 103, 599–605.