



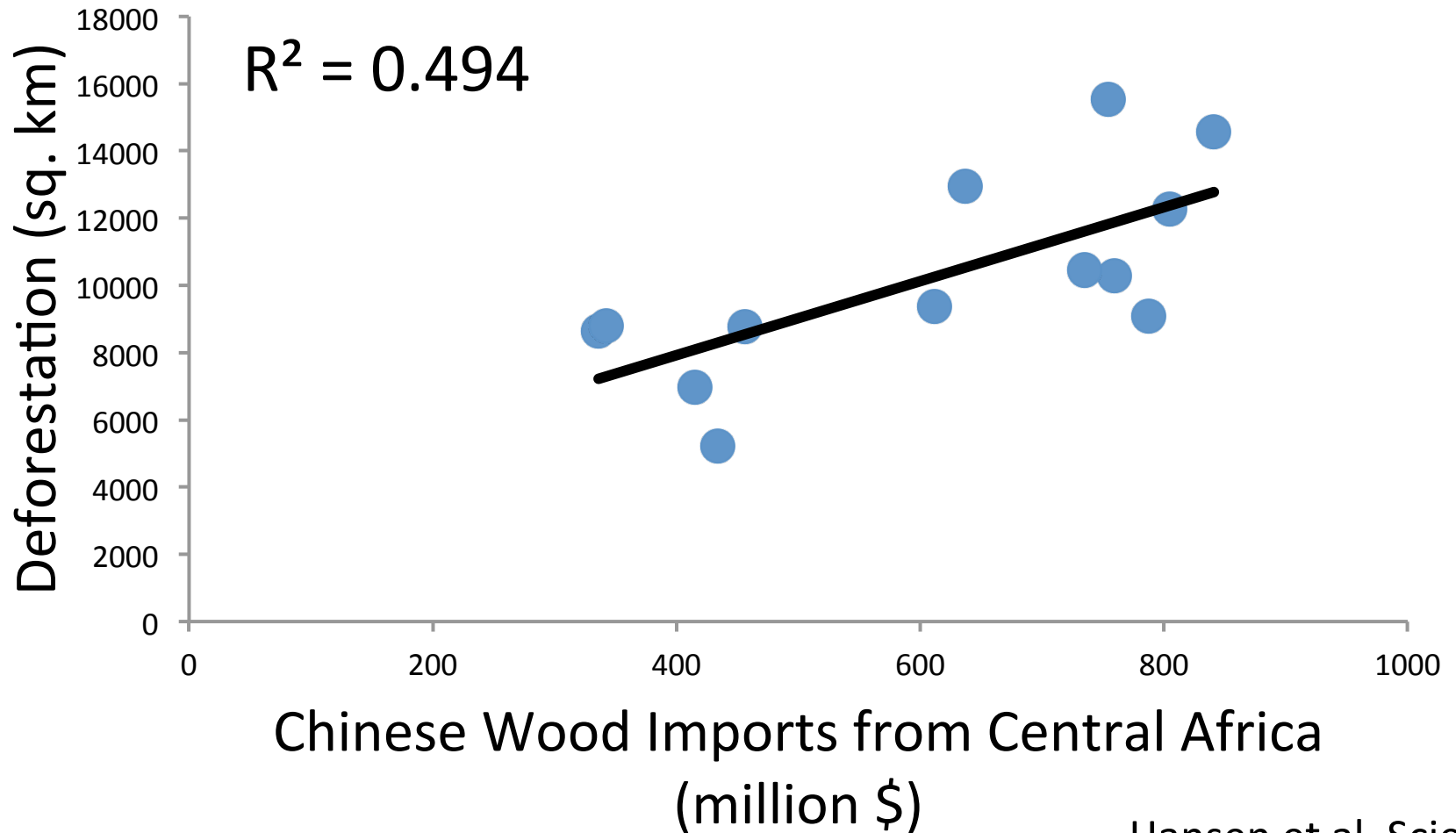
Valuing Evolutionary Services: Preserving Adaptive Variation under Climate Change

Trevon Fuller
Thomas B. Smith

Center for Tropical Research
University of California, Los Angeles

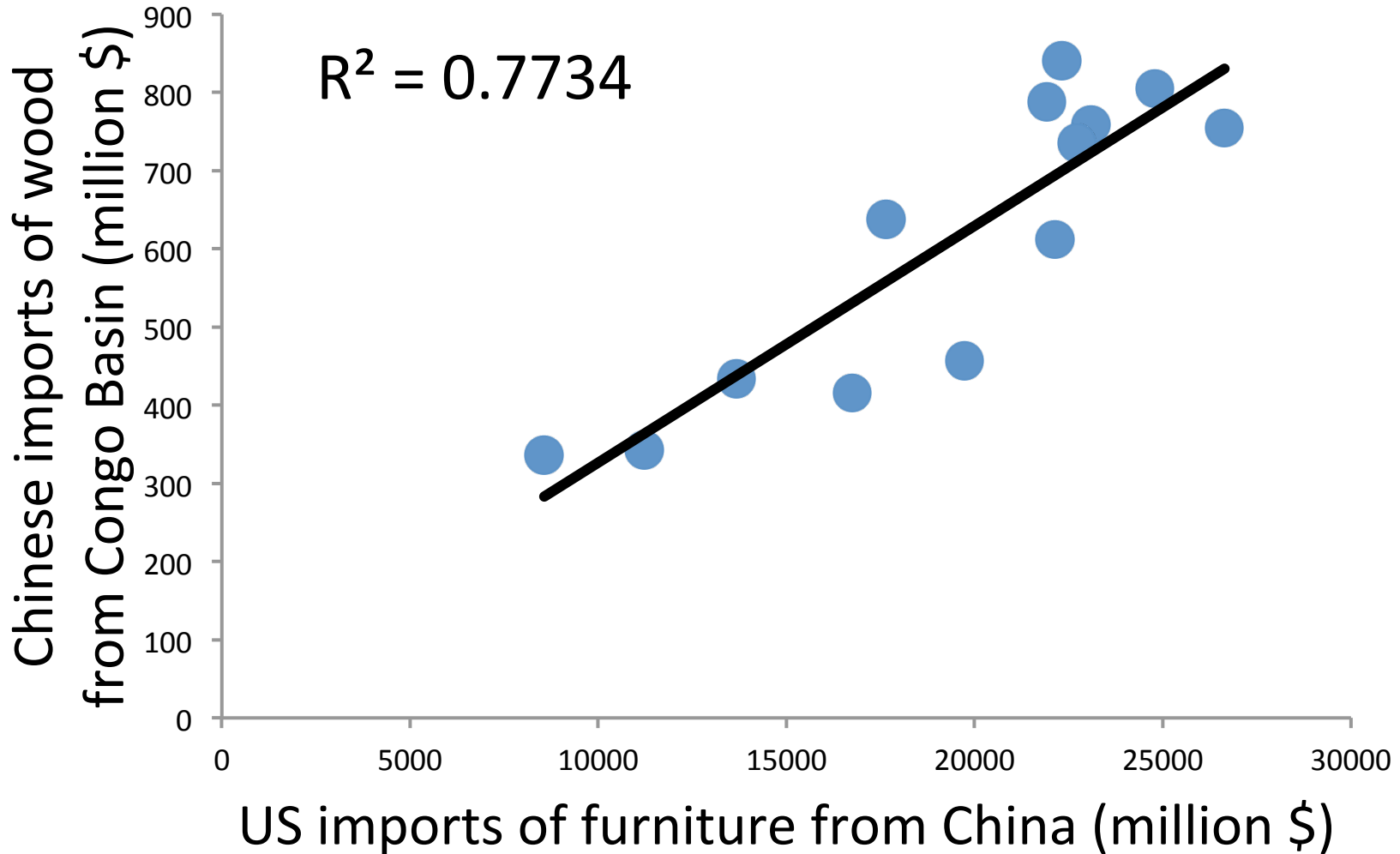


Effect of Chinese Wood Imports on Deforestation in Congo Basin



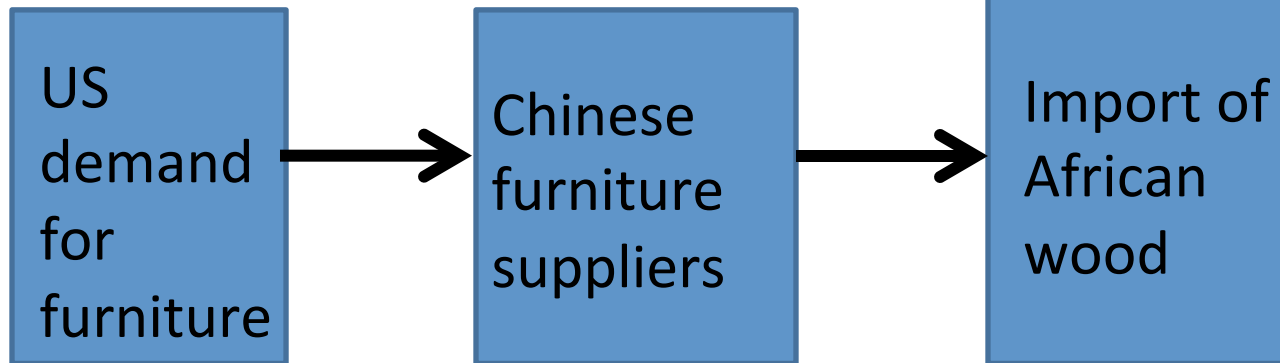
Hansen et al. Science
UN Comtrade

US Imports from China Drive Chinese Imports from Congo Basin



Effect of international trade on deforestation in Central Africa

US-China
furniture trade



Overview

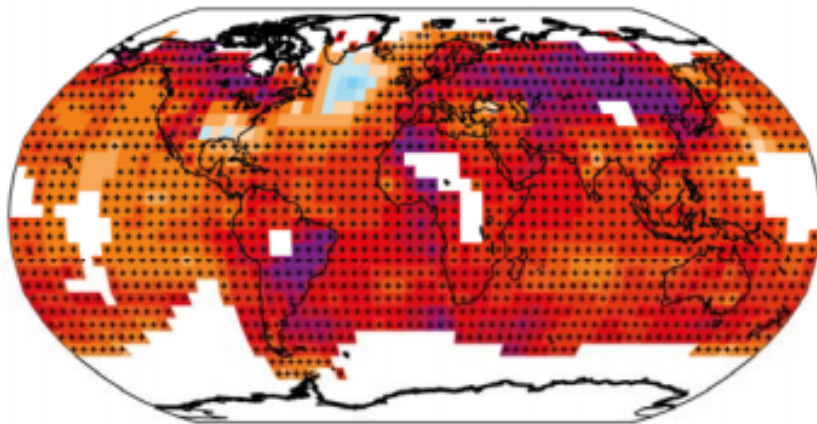
- Climate change in the Congo Basin
- Approaches to conserving adaptive variation
- Case study using a rainforest songbird

Overview

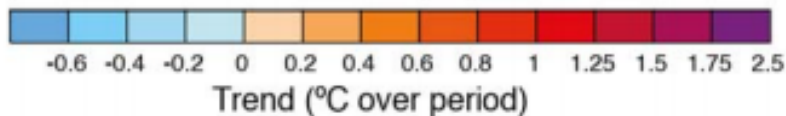
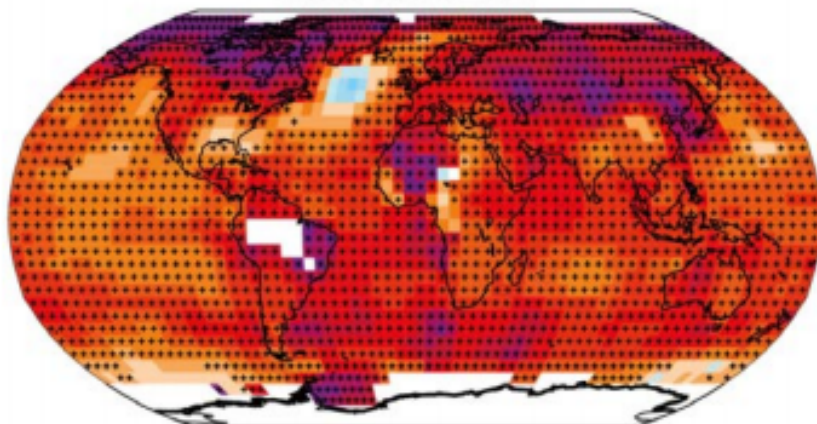
- **Climate change in the Congo Basin**
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20th Century Climate Change in Africa

MLOST 1901-2012

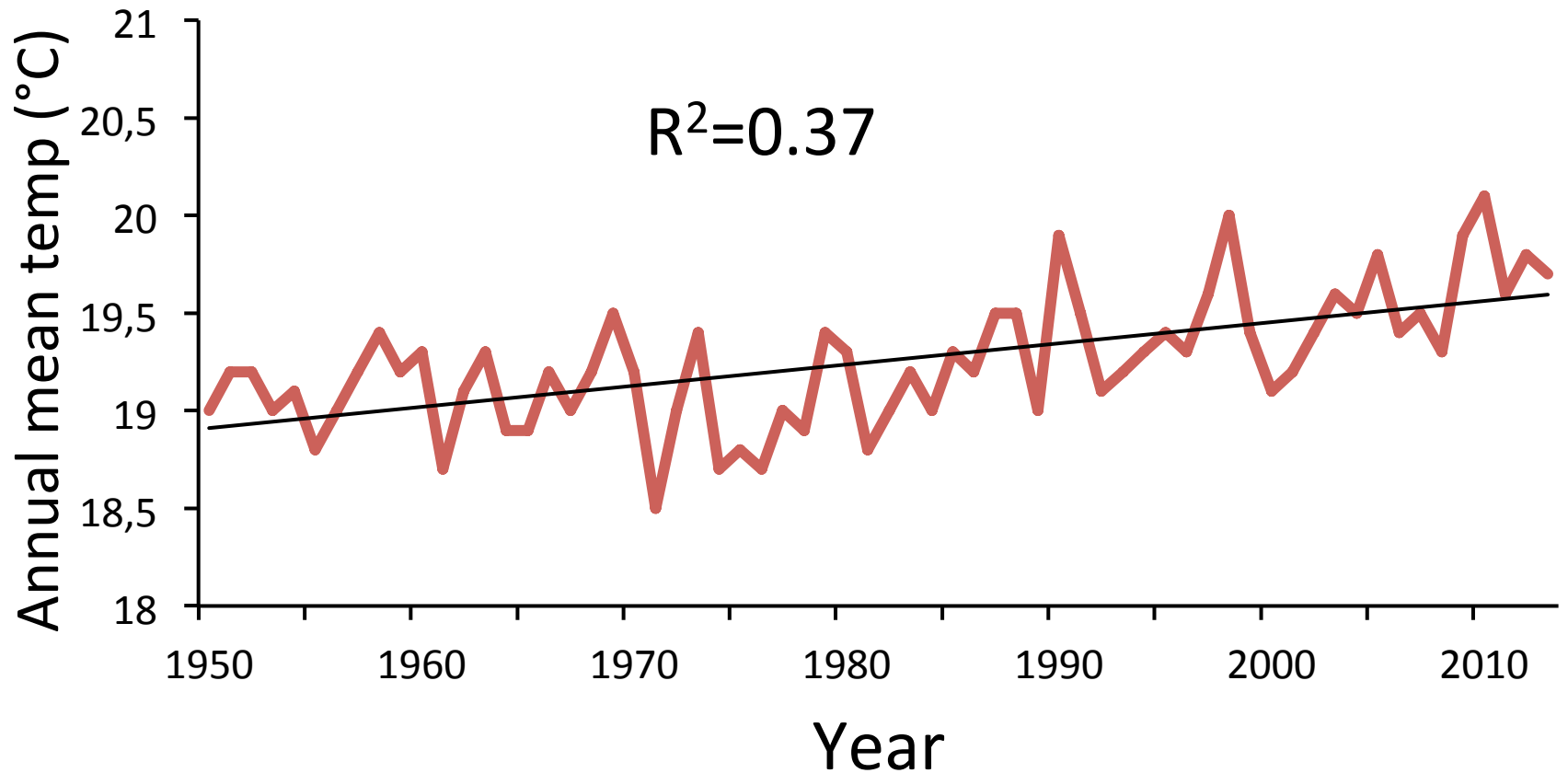


GISS 1901-2012



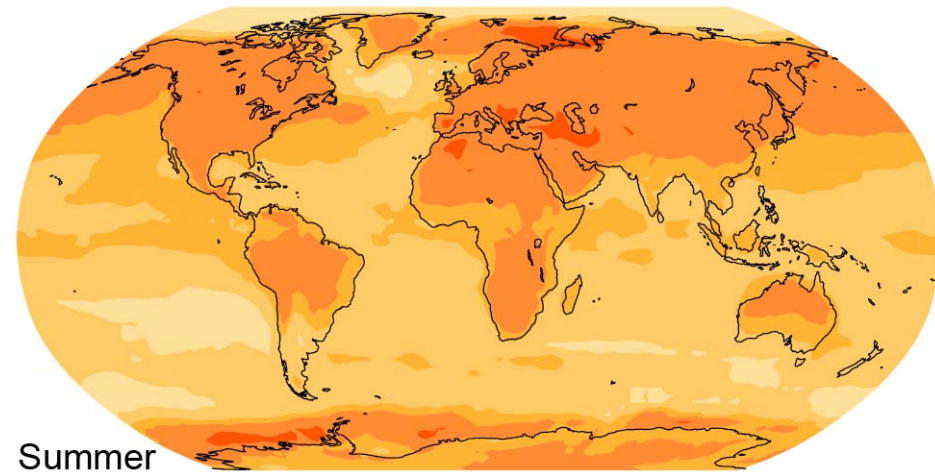
- Increased frequency and intensity of droughts
- Increased surface relative humidity
- Within Central Africa, increased large-scale precipitation due to a southward shift of ITCZ

20th Century Climate Change in Cameroon

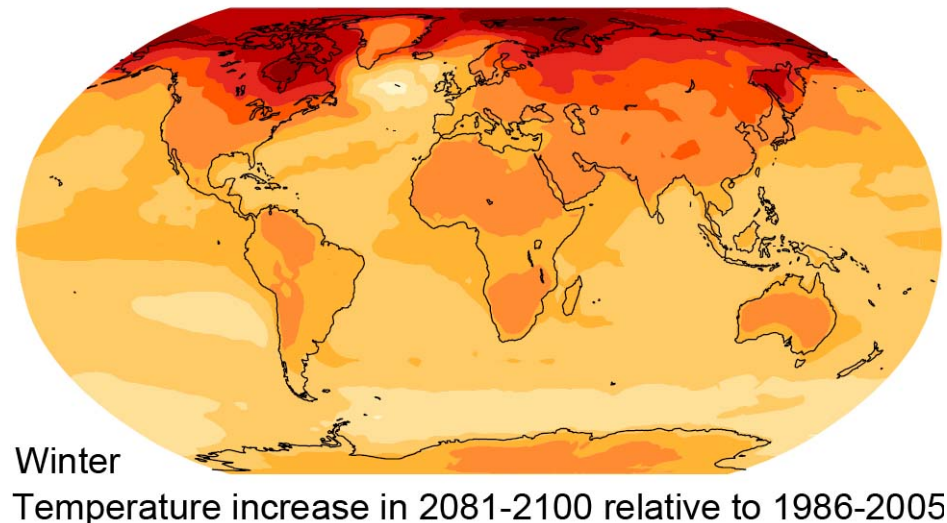


Climate Research Unit CY data set

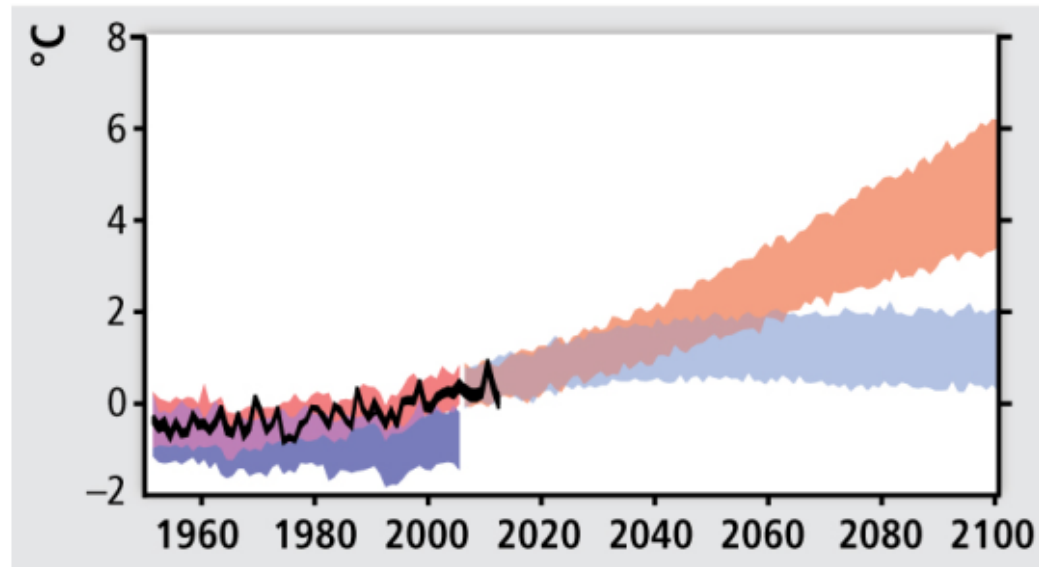
Late 21st Century Predictions for Africa



- Increase of 3-4°C in mean annual temperature
- Increased summer precipitation in West Africa
- Increased landfall of cyclones in East Africa due to warming of Indian Ocean



Late 21st Century Predictions, Central Africa

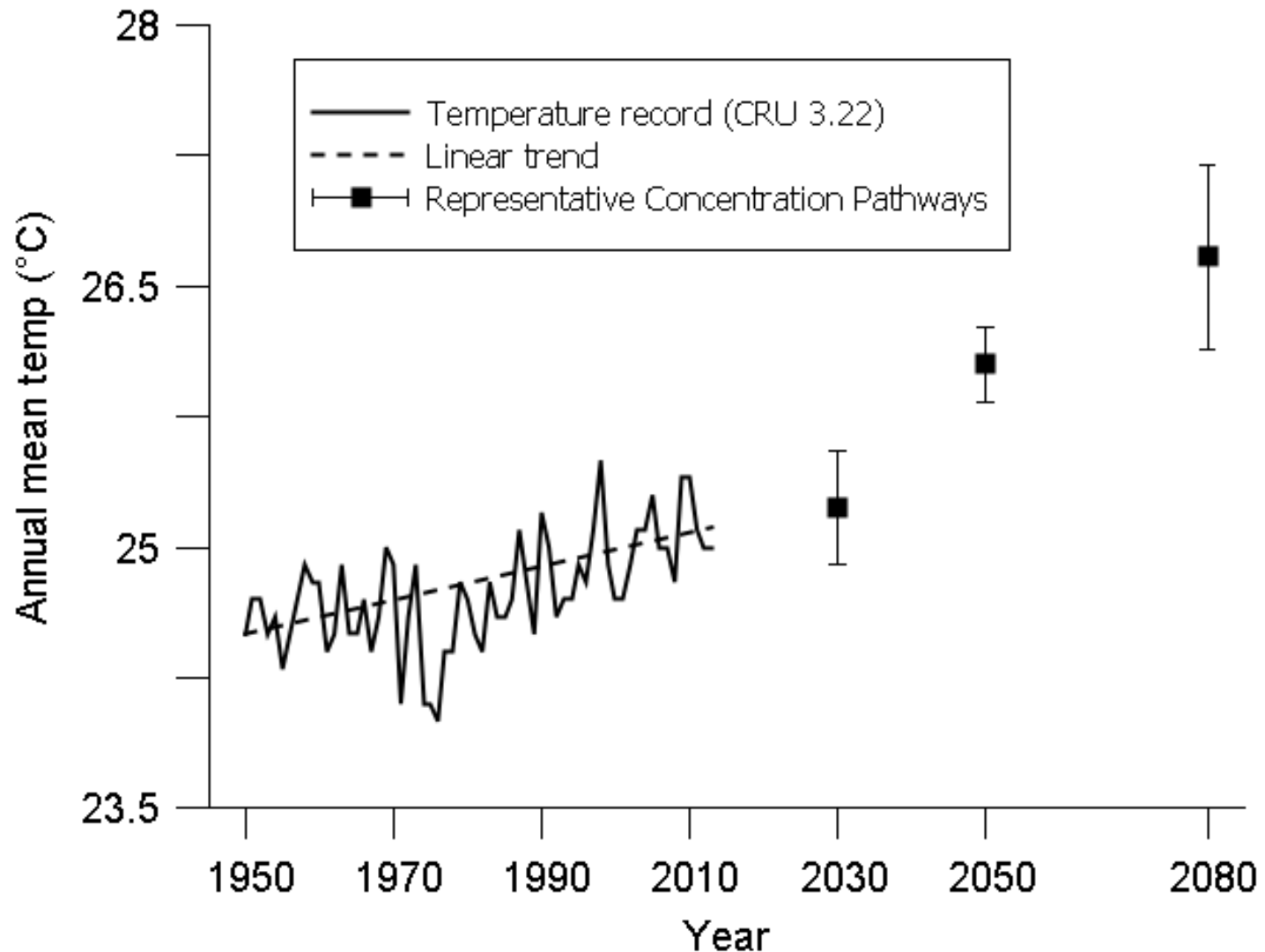


— Observed

Historical
Overlap
Natural

RCP8.5
Overlap
RCP2.6

21st Century Predictions, Cameroon



Overview

- Climate change in the Congo Basin
- **Approaches to conserving adaptive variation**
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Hotspots

Typical approach
for prioritizing areas for conservation focuses
on areas of high richness and endemism



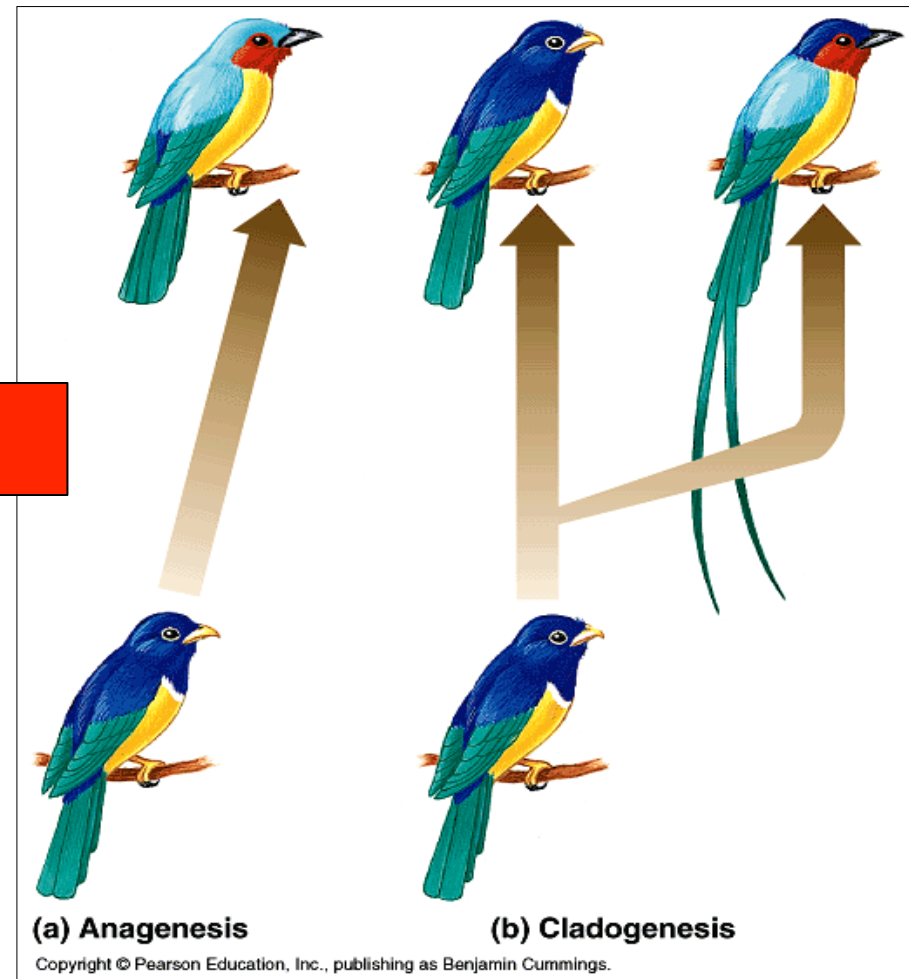
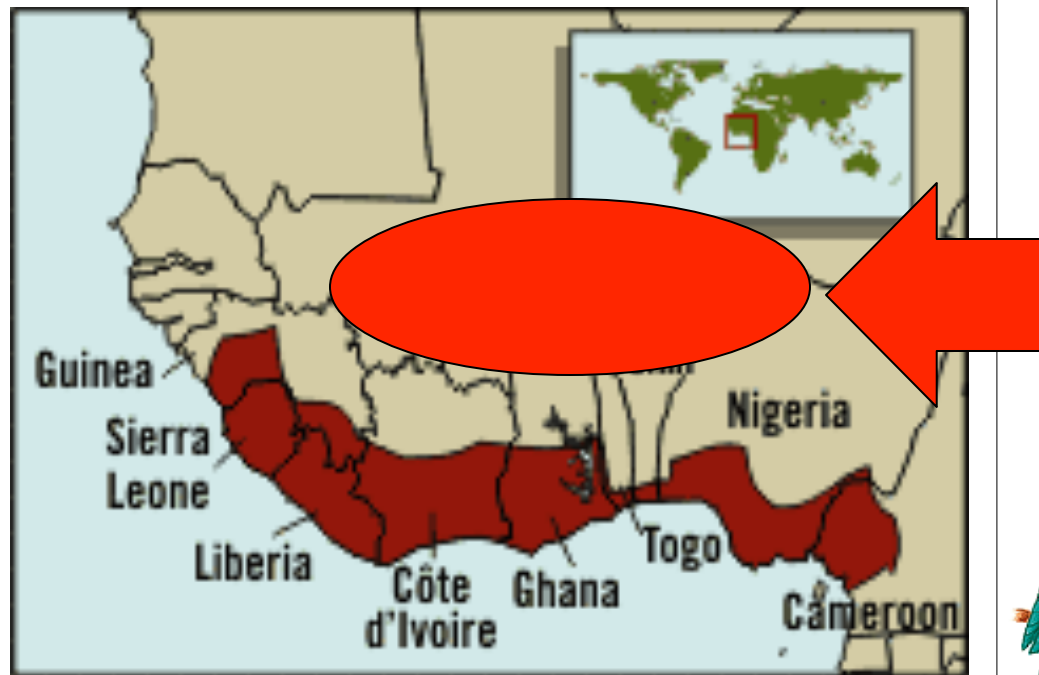
Problem with Hotspots

Under climate change,
today's hotspots may not be tomorrow's hotspots



Processes that Give Rise to Biodiversity May Not Coincide with Hotspots

Speciation

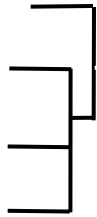


Balanced Stock Portfolio Approach

Preserve regions with as much
Adaptive Variation as possible!



Where is Adaptive Variation Concentrated?



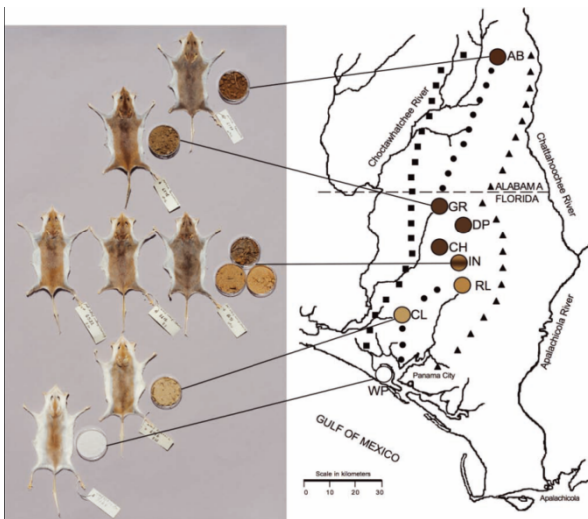
- Vegetation
- Climate
- Elevation
- Biotic factors



Smith 1993, 1997



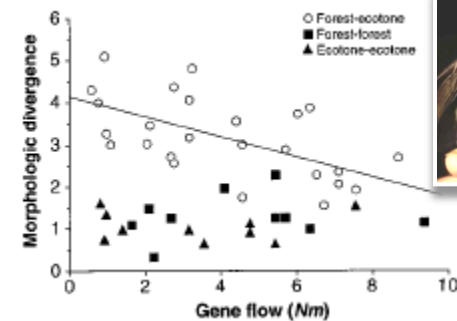
Seehausen et al. 2008



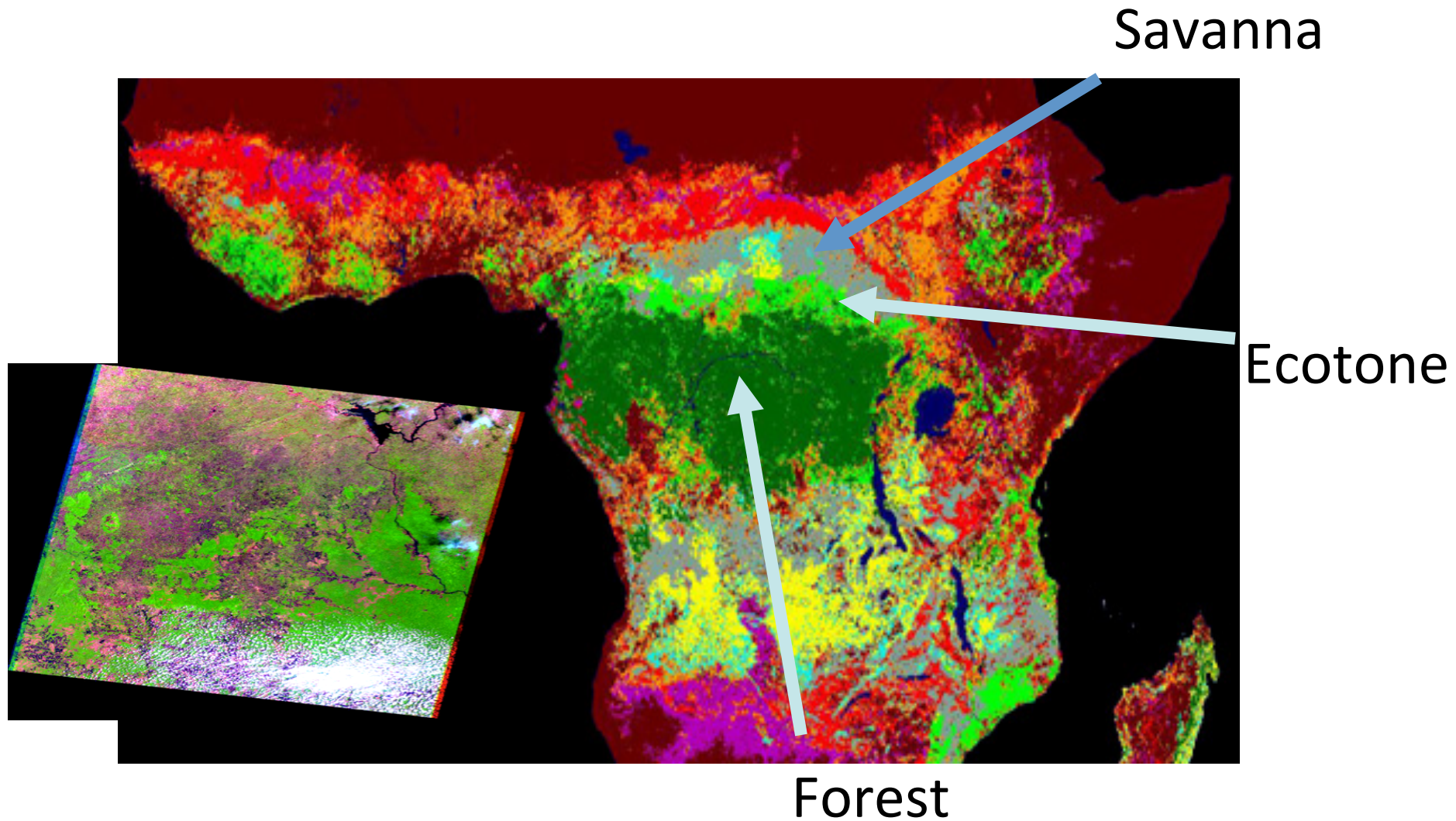
Mullen and Hoekstra 2008



Niemiller et al. 2008



Smith et al. 1997



Forest/savanna gradient is important in diversification

Rainforest

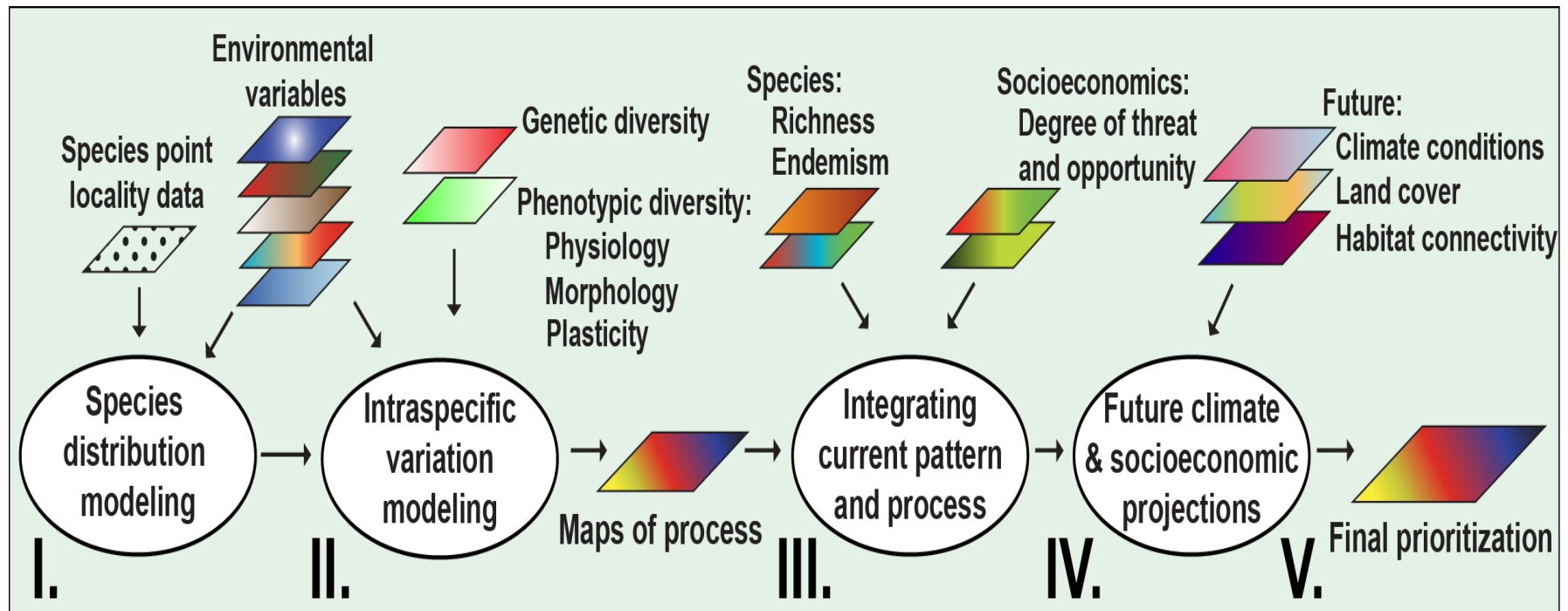


Savanna/Forest Mosaic - Ecotone

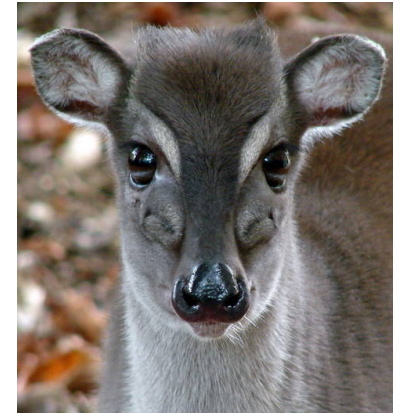


Overarching Goal

To develop a framework for
conserving Central African biodiversity under
climate change, which is both
evolutionary-informed and grounded in the
socioeconomic constraints of the region



Target Taxa

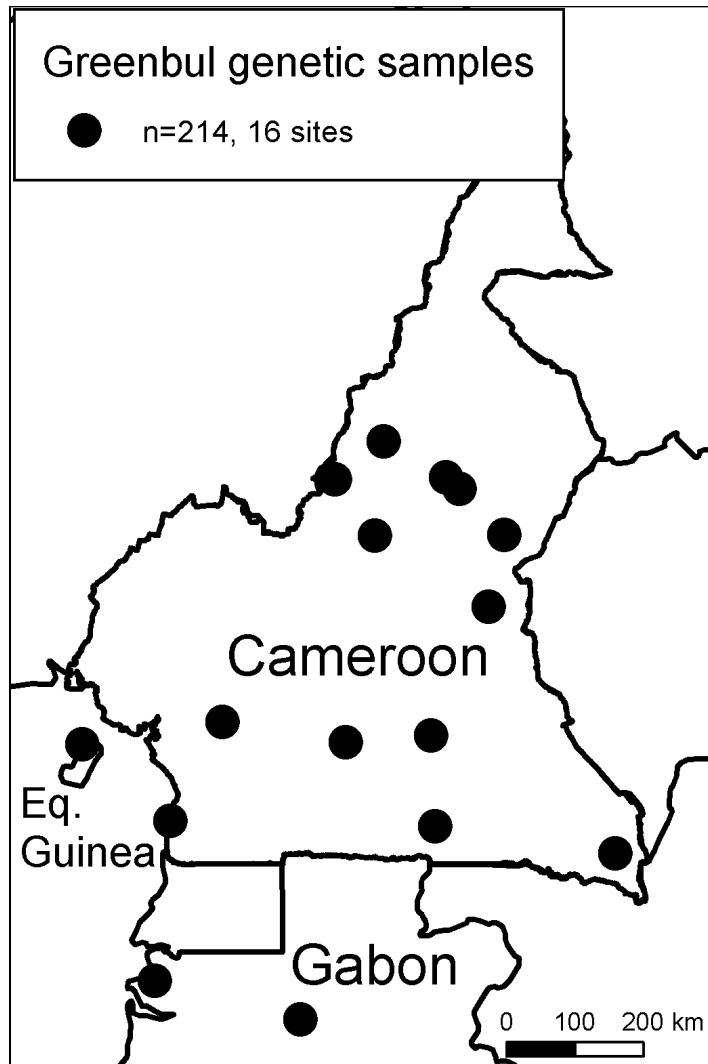


Overview

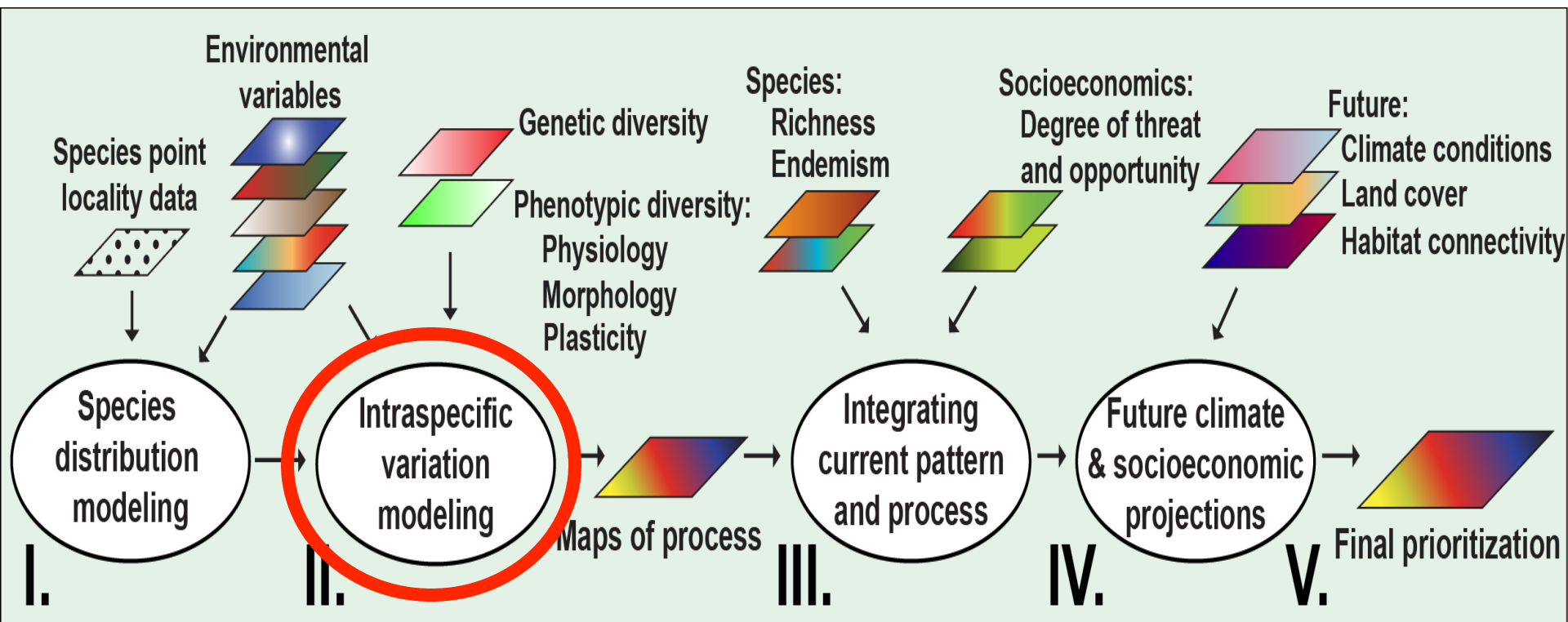
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Case Study - Little Greenbul

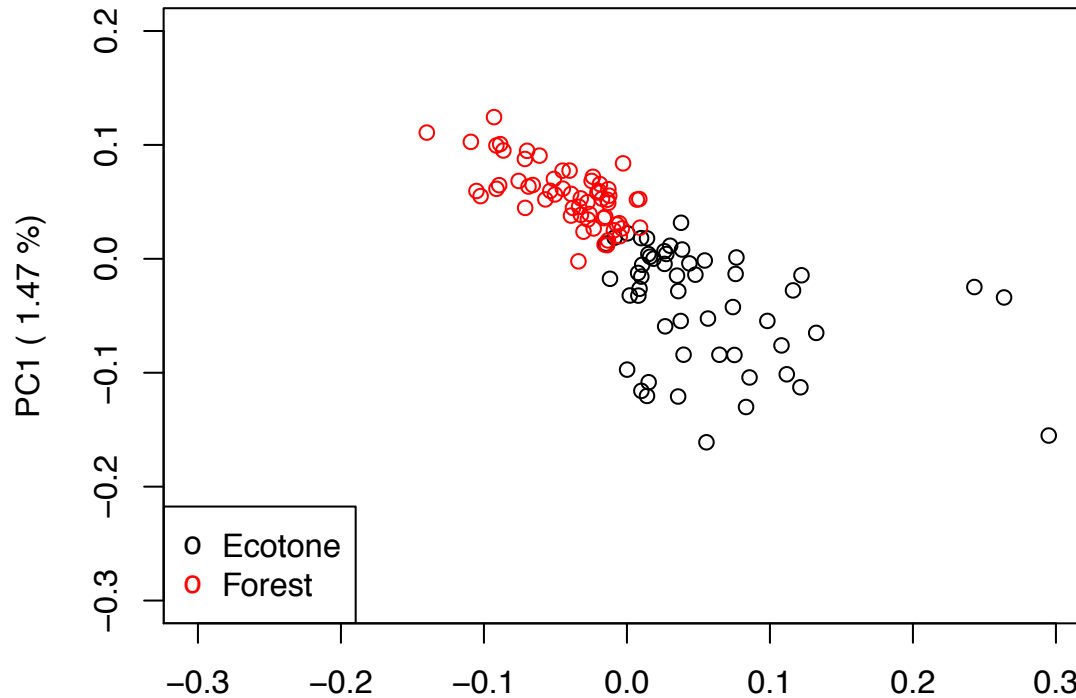
(*Andropadus virens*)



Smith et al. 1997, 2005, 2008,
2013;
Slabbekoorn and Smith 2002;
Kirschel et al. 2011

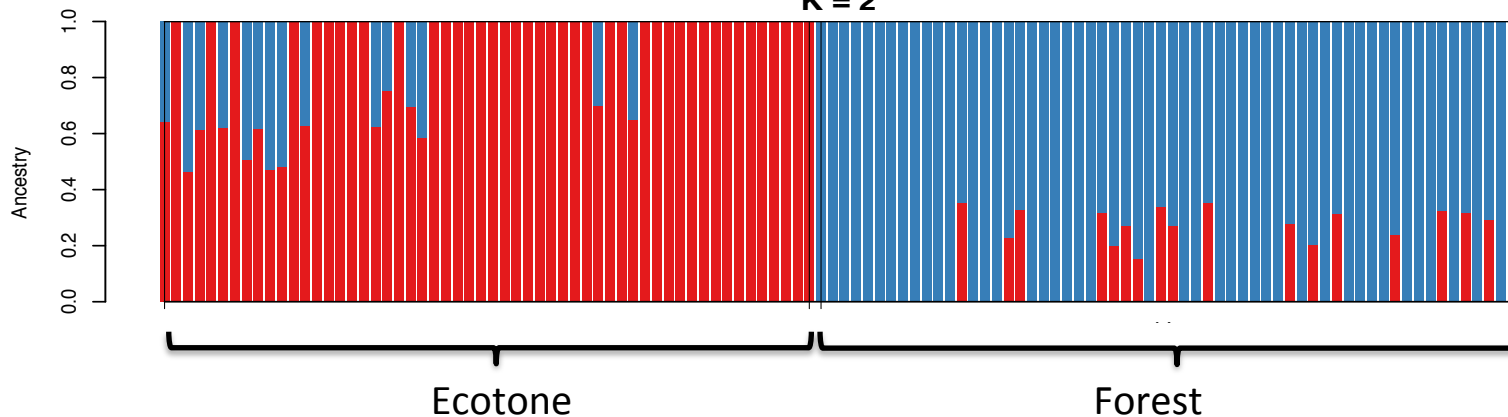


Characterization of Intraspecific Genetic Variation

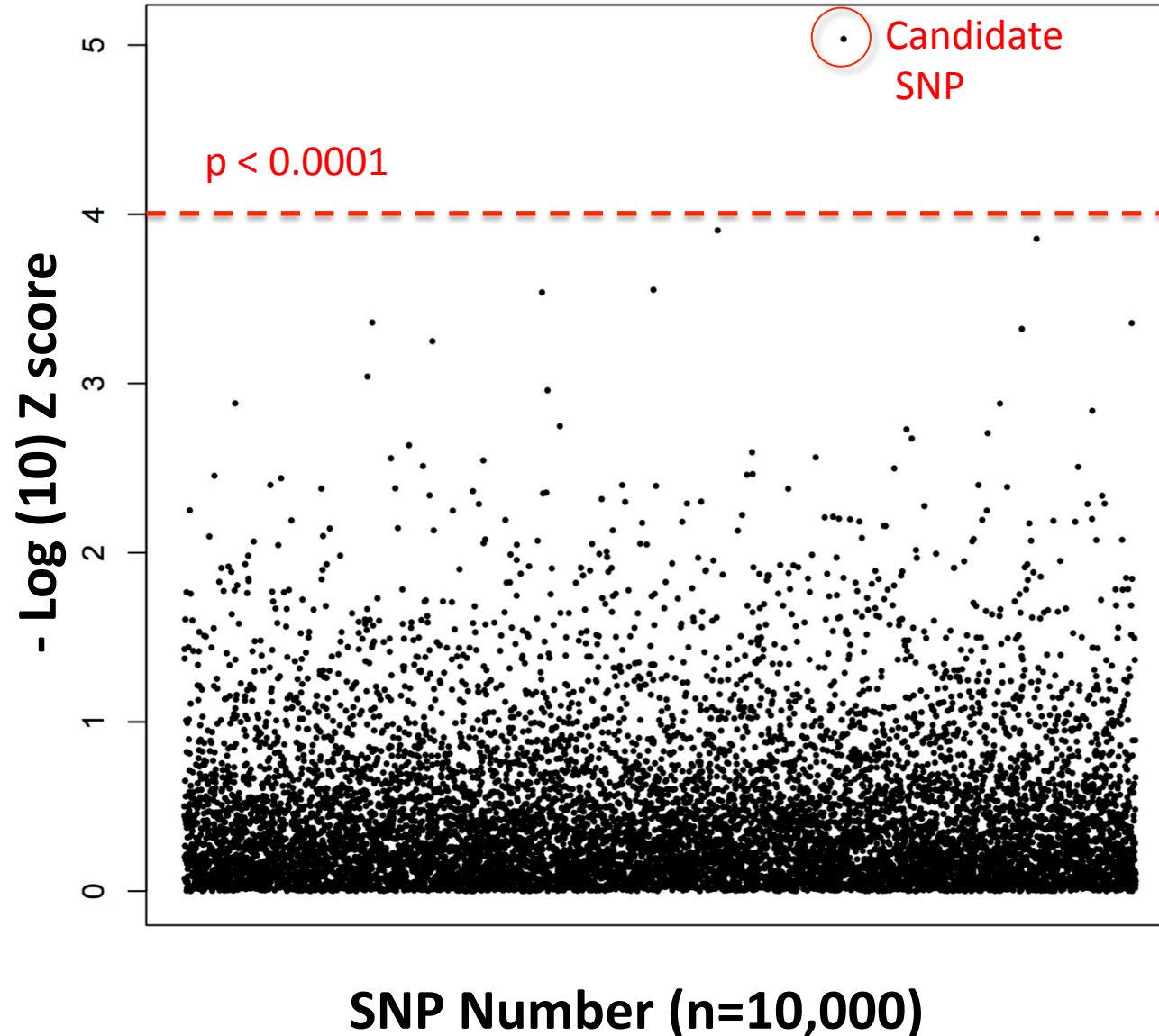


N=116
10,005 SNPs

PC2 (1.34 %)
K = 2

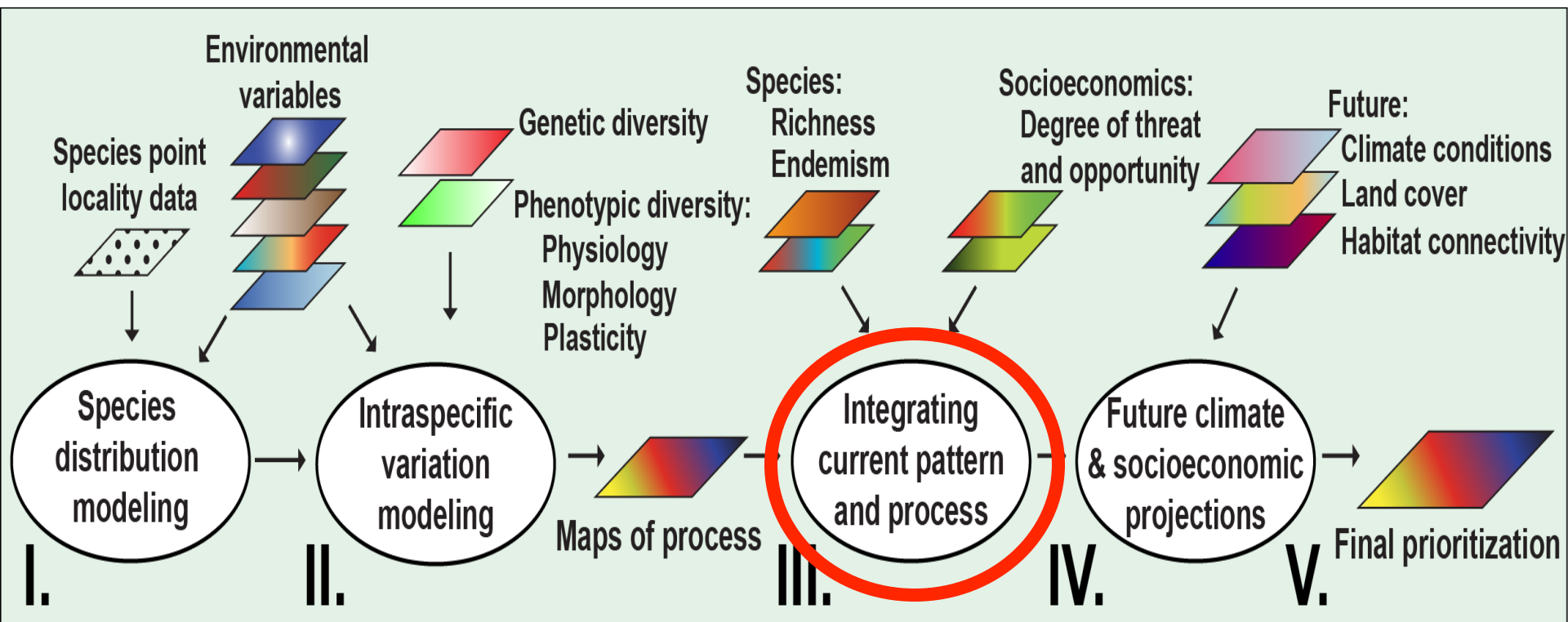


Linking SNPs to Environment



Latent Factor Mixed Model (LFMM, Frichot et al. 2013)

1. Background structure from neutral markers
2. Uses Bayesian mixed model to link SNPs to predictors
3. Identify SNPs under environmental selection

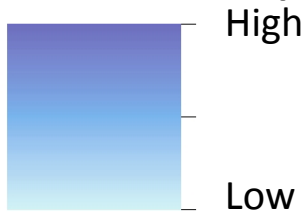


Greenbul SNP Variation

Allele Frequency



Mean Annual Precipitation



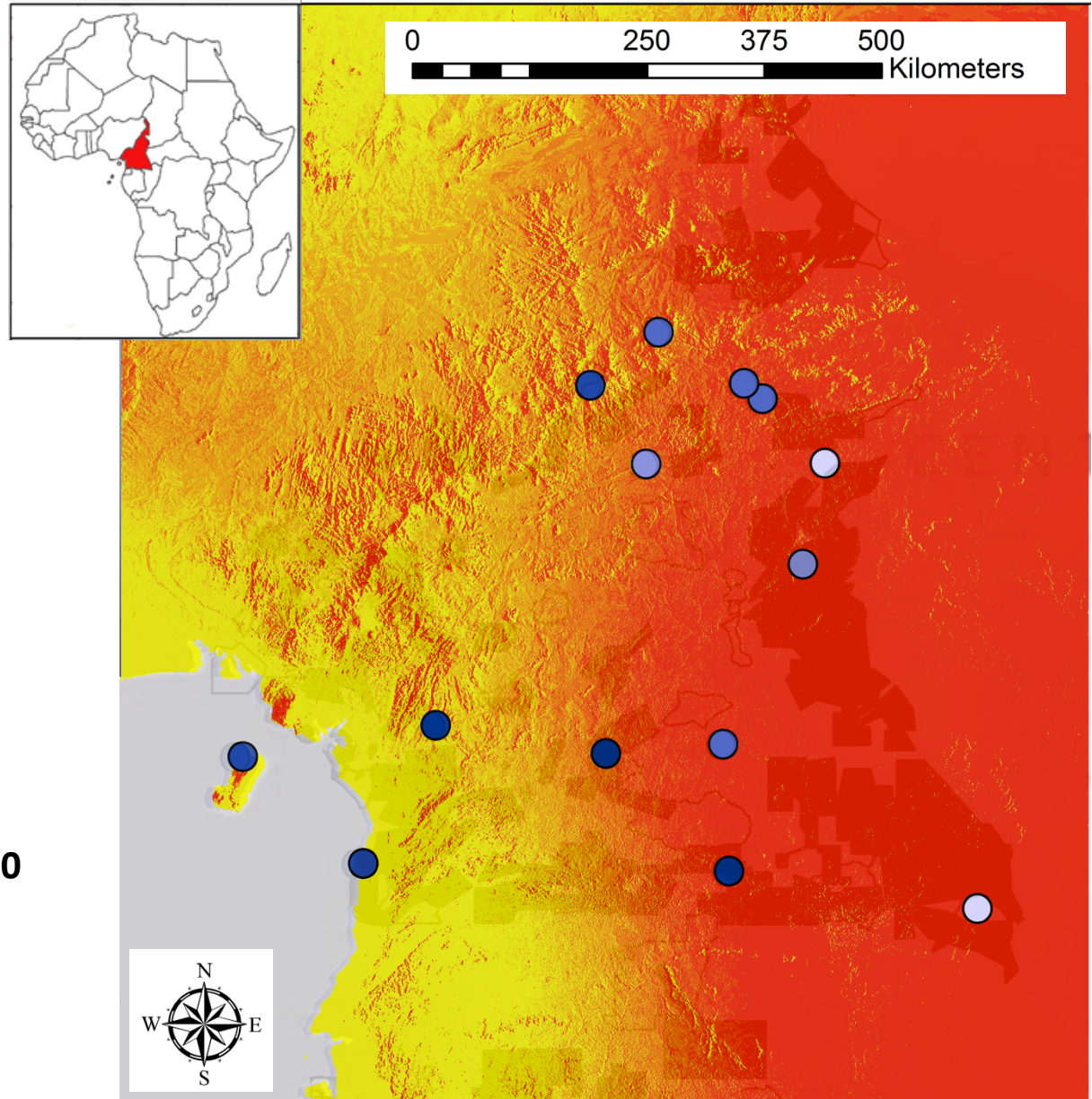
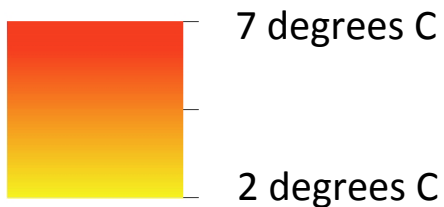
Parks



Mines



Temperature Change by 2050



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Central African Biodiversity Alliance

Conservation under climate change

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