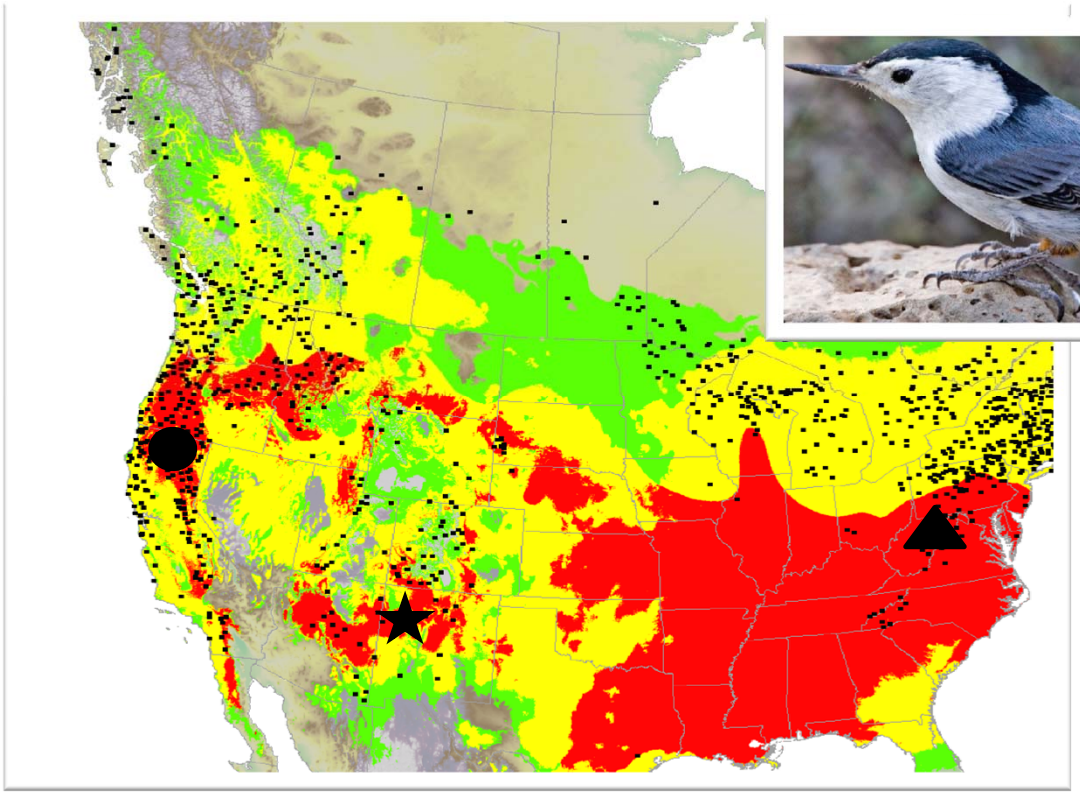
Predictive modeling of climate-induced range shifts



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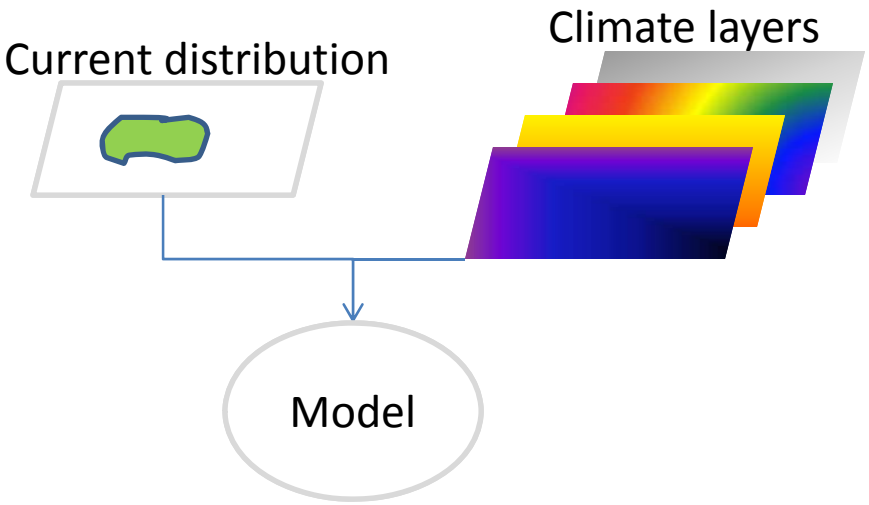
Florida Climate Institute

3 February 2011

Research Objectives

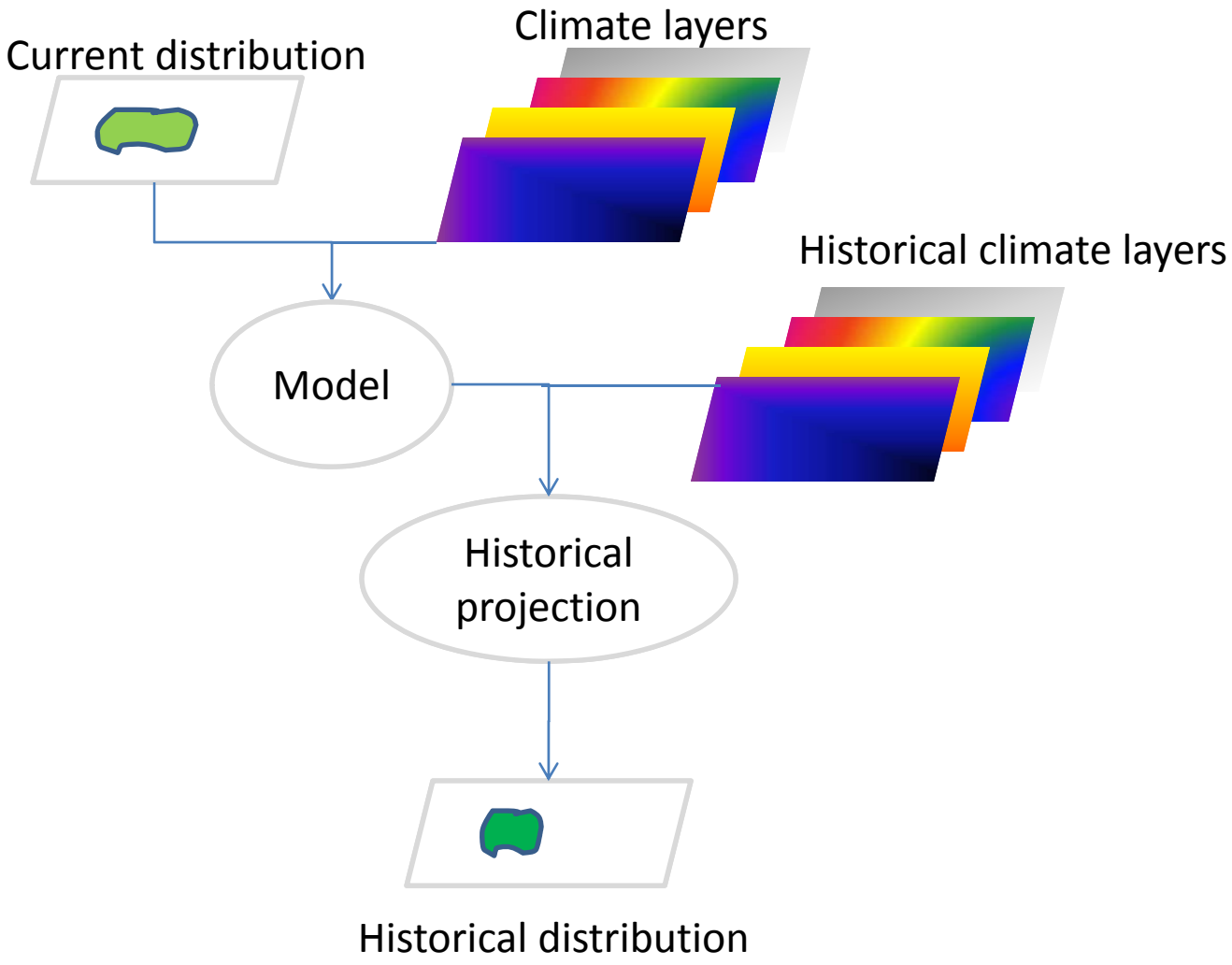
- Create spatially-explicit predictive models of biodiversity patterns
- Quantify impacts of past climate change to improve prediction of future threats
- Inform conservation management to maintain biodiversity pattern and process

Predictive modeling of range shifts

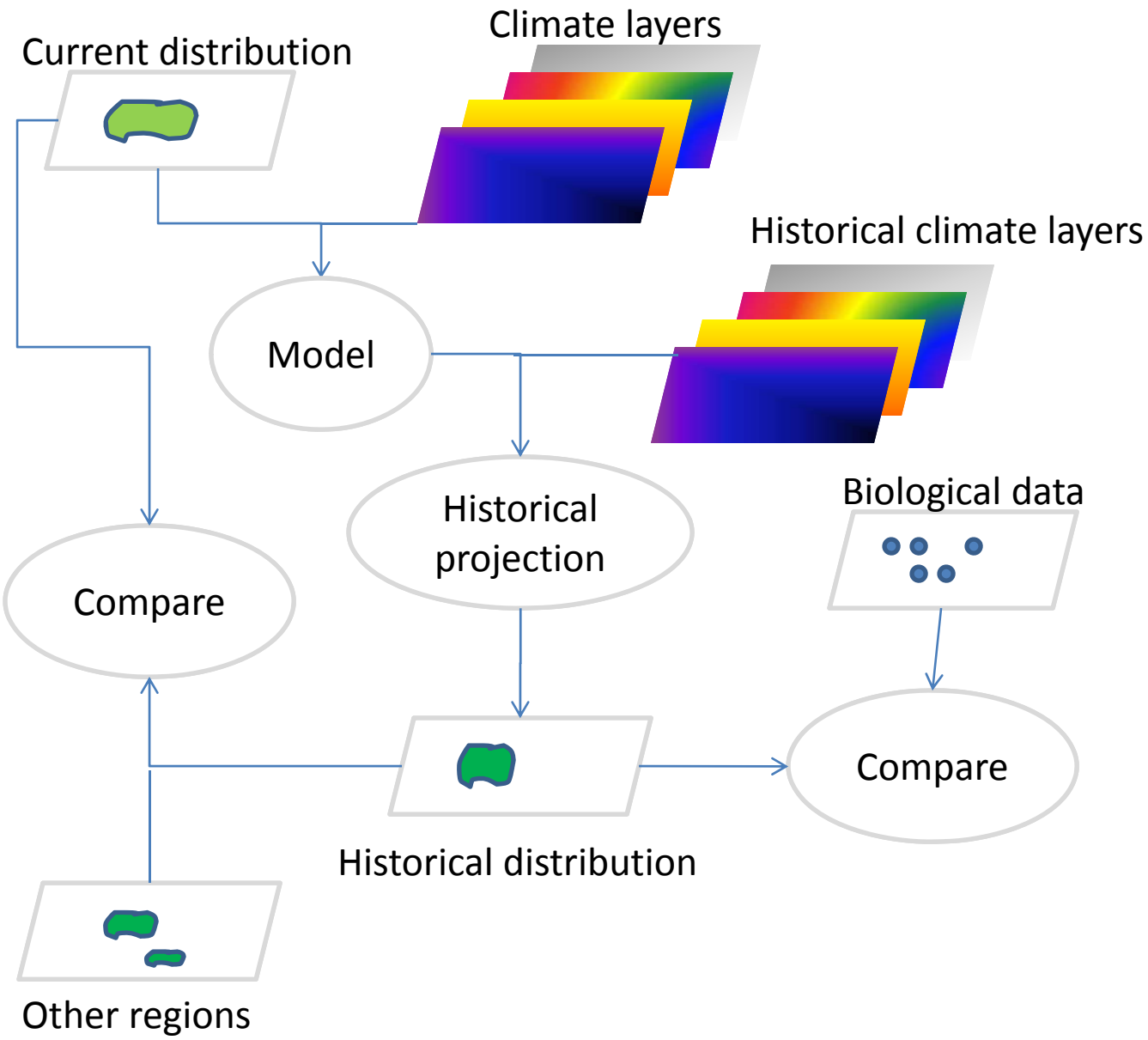


Hijmans, Cameron et al. 2005 *Int. J. Climatology*

Predictive modeling of range shifts



Predictive modeling of range shifts



What can past climate change tell us about the future?

- Are areas that were stable in the past (refugia) also predicted to have high stability in the future?

What can past climate change tell us about the future?

- Are areas that were stable in the past (refuges) also predicted to have high stability in the future?
- Where are predicted refuges for Pine-oak woodland birds?
- Is present day diversity explained by Pleistocene refuges?

Methods

- Create model of current species distribution
  - Presence/Absence (Maxent, Phillips et al. 2006)
  - Abundance (Generalized linear model, neural net)
- Project model to historical time periods
  - Last Glacial Maximum (LGM, 21 kya)
  - Last Interglacial (LIG, 120 kya)
- Compare predicted refuges across species
- Compare with multi-locus nuclear data (in progress)

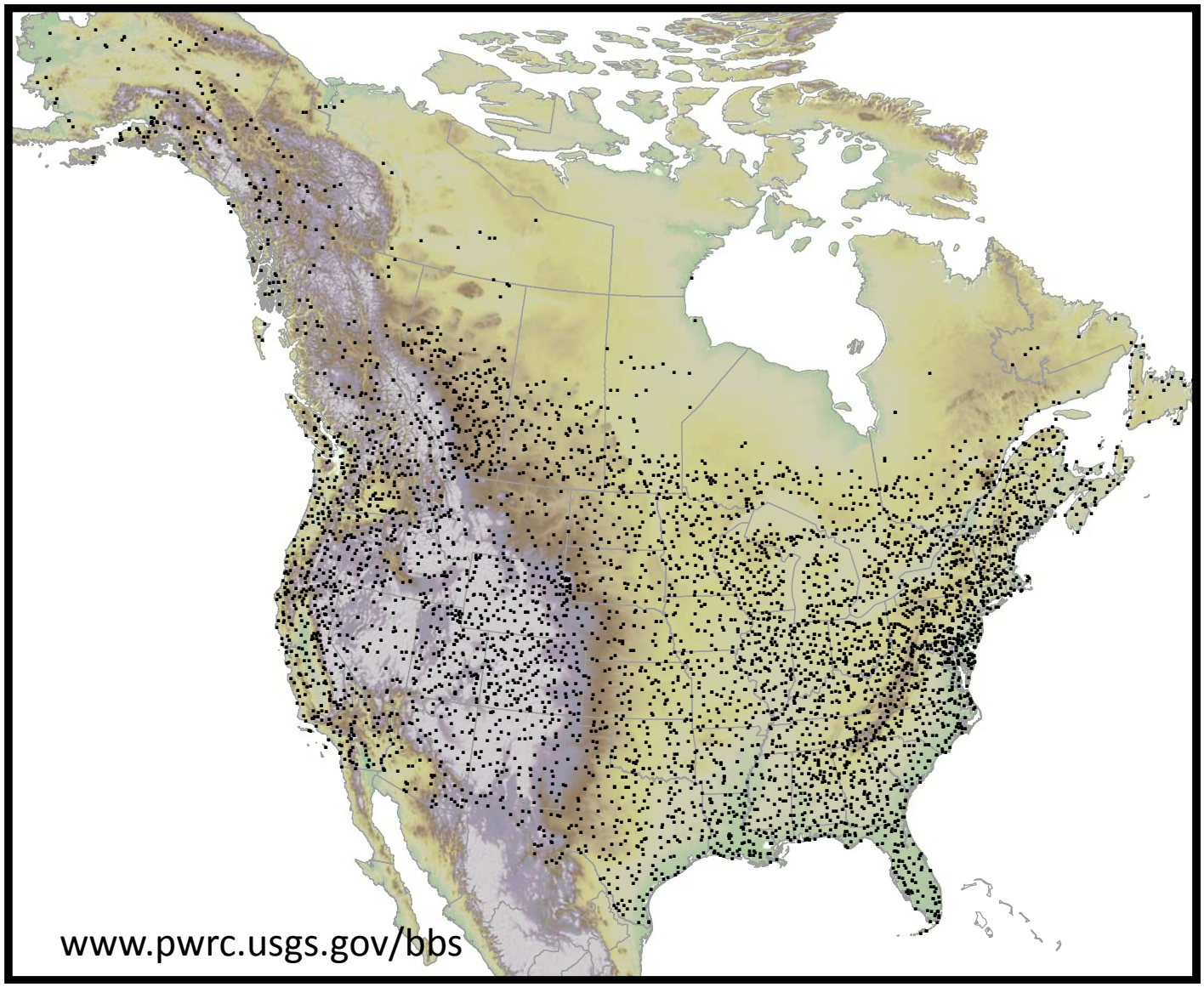
Study species

- Black-headed Grosbeak *Pheucticus melanocephalus*
- Brown Creeper *Certhia americana*
- Bushtit *Psaltriparus minimus*
- Cassin and Purple Finch species complex *Carpodacus purpureus; cassini*
- Western Flycatcher species complex *Empidonax difficilis; occidentali*
- Hairy woodpecker *Picoides villosus*
- Mountain Chickadee *Poecile gambeli*
- Solitary Vireo species complex *Vireo solitarius; plumbeus; cassinii*
- Pygmy Nuthatch *Sitta pygmaea*
- Spotted Towhee *Pipilo maculatus*
- Steller's Jay *Cyanocitta stelleri*
- Warbling Vireo *Vireo gilvus*
- Western Tanager *Piranga ludovicianus*
- Western Wood-pewee *Contopus sordidulus*
- White-breasted Nuthatch *Sitta carolinensis*

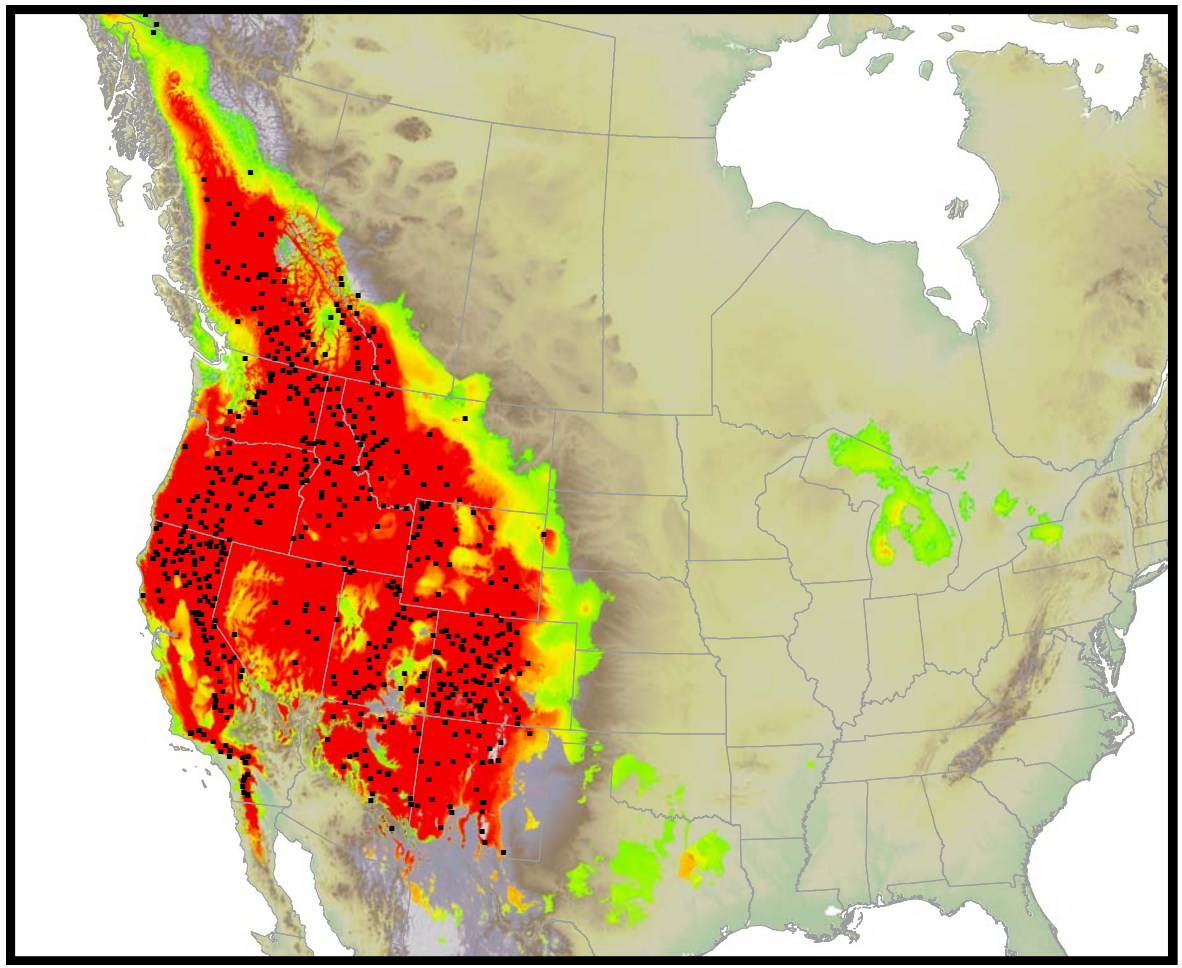
Data

- Species data
  - Breeding Bird Survey data
    - 5159 unique sites
    - 1113 ± 202 records per species
    - Systematic survey, includes absence and abundance
- Climate data
  - Worldclim.org (Hijmans et al. 2005)
    - Current, LIG, LGM
    - 9 Bioclim climate layers– 1, 2, 5, 8, 9, 11, 14, 15, 19

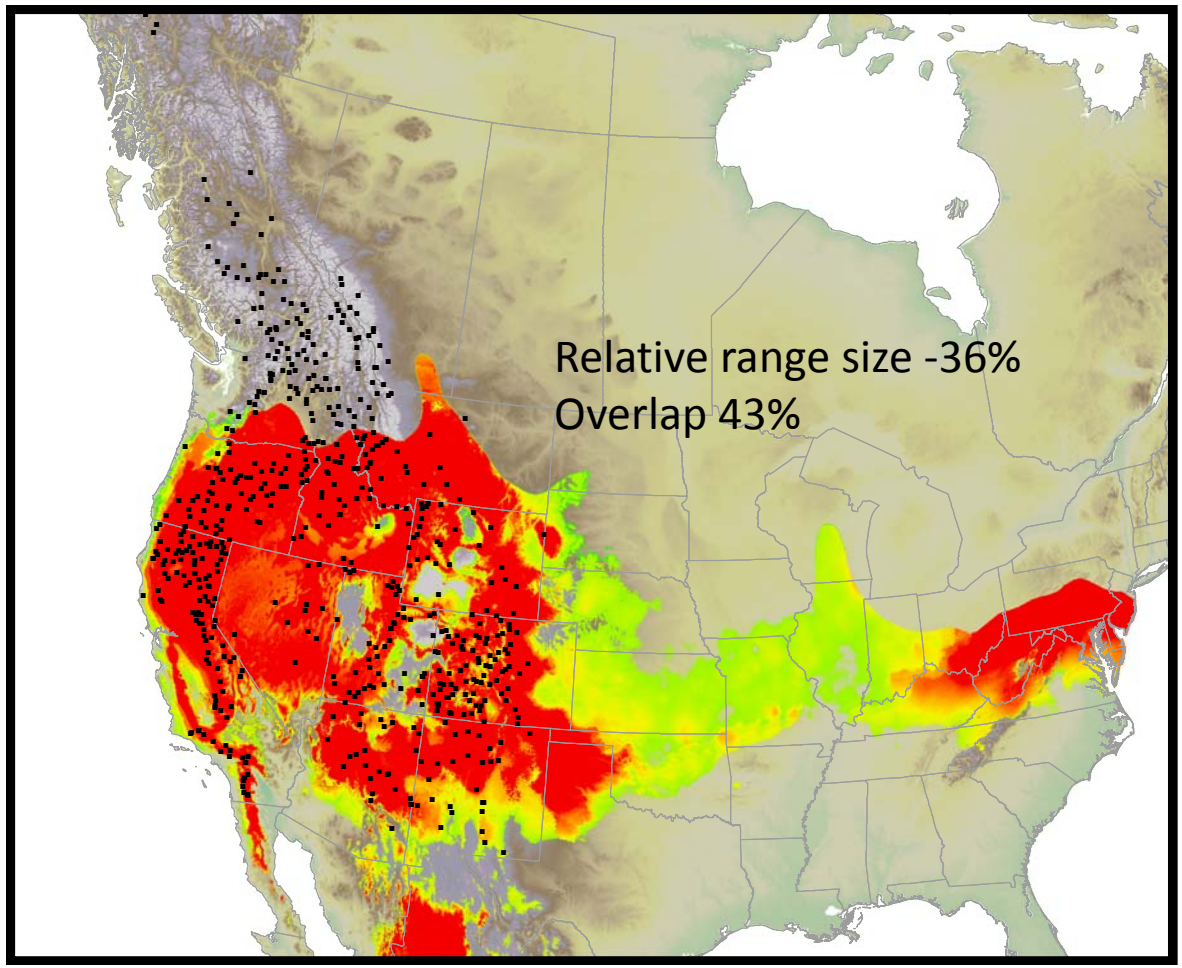
Breeding bird survey locations



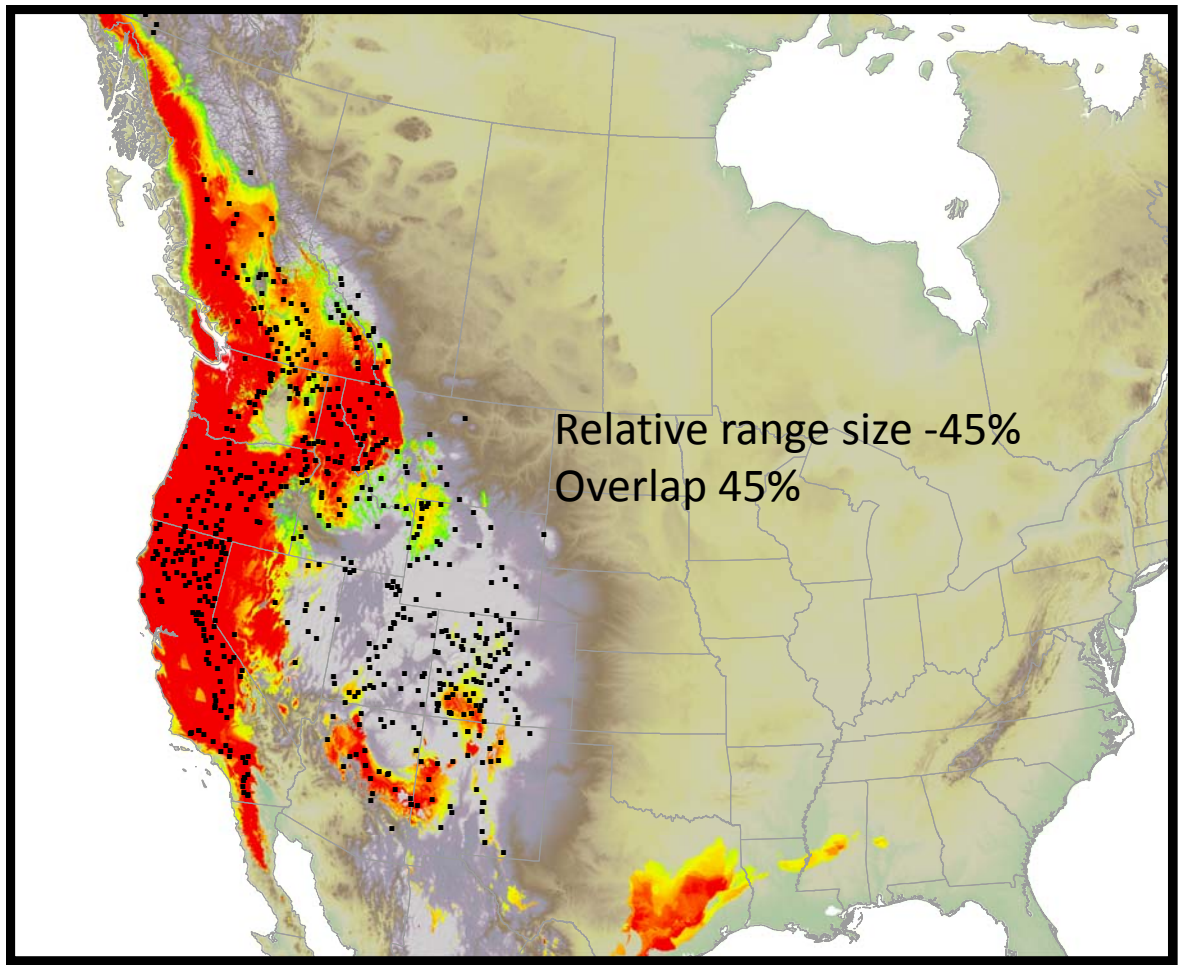
Present - *Mountain chickadee*



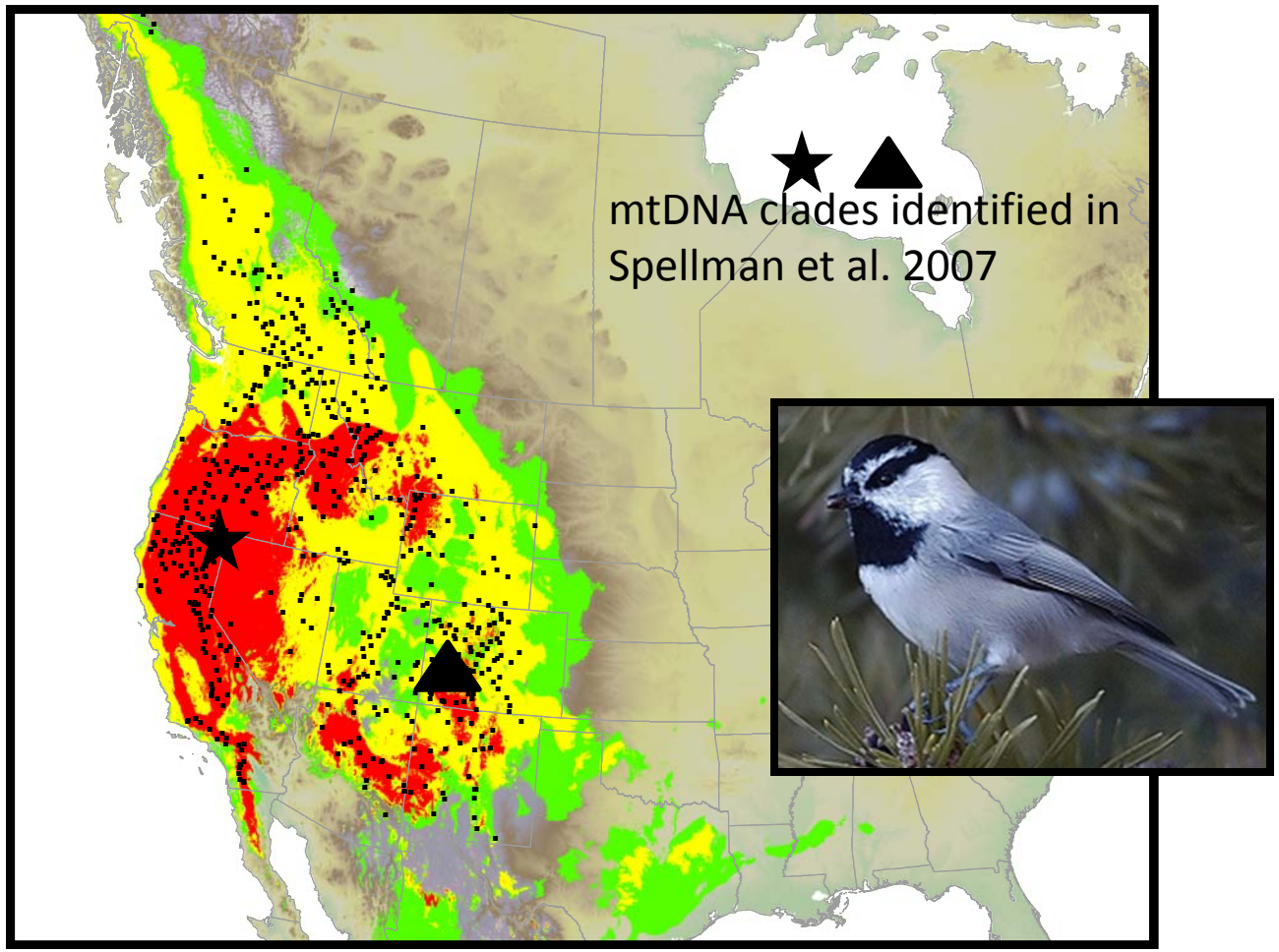
LGM (21 kya) - *Mountain chickadee*



LIG (140 kya) – *Mountain chickadee*



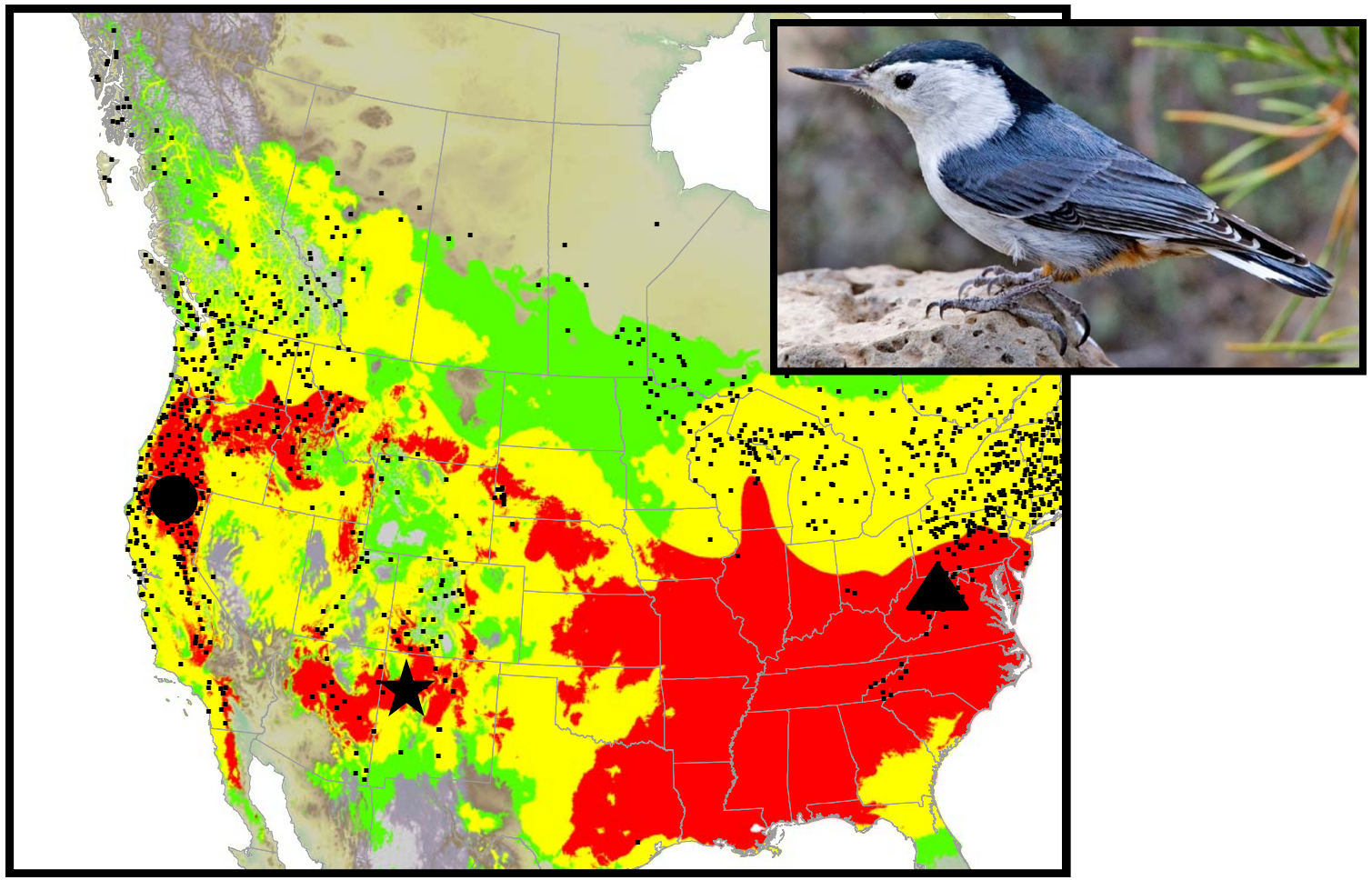
Summed stability (LIG,LGM, current)
Mountain chickadee



Cameron, In Prep. *Global Ecology & Biogeography*

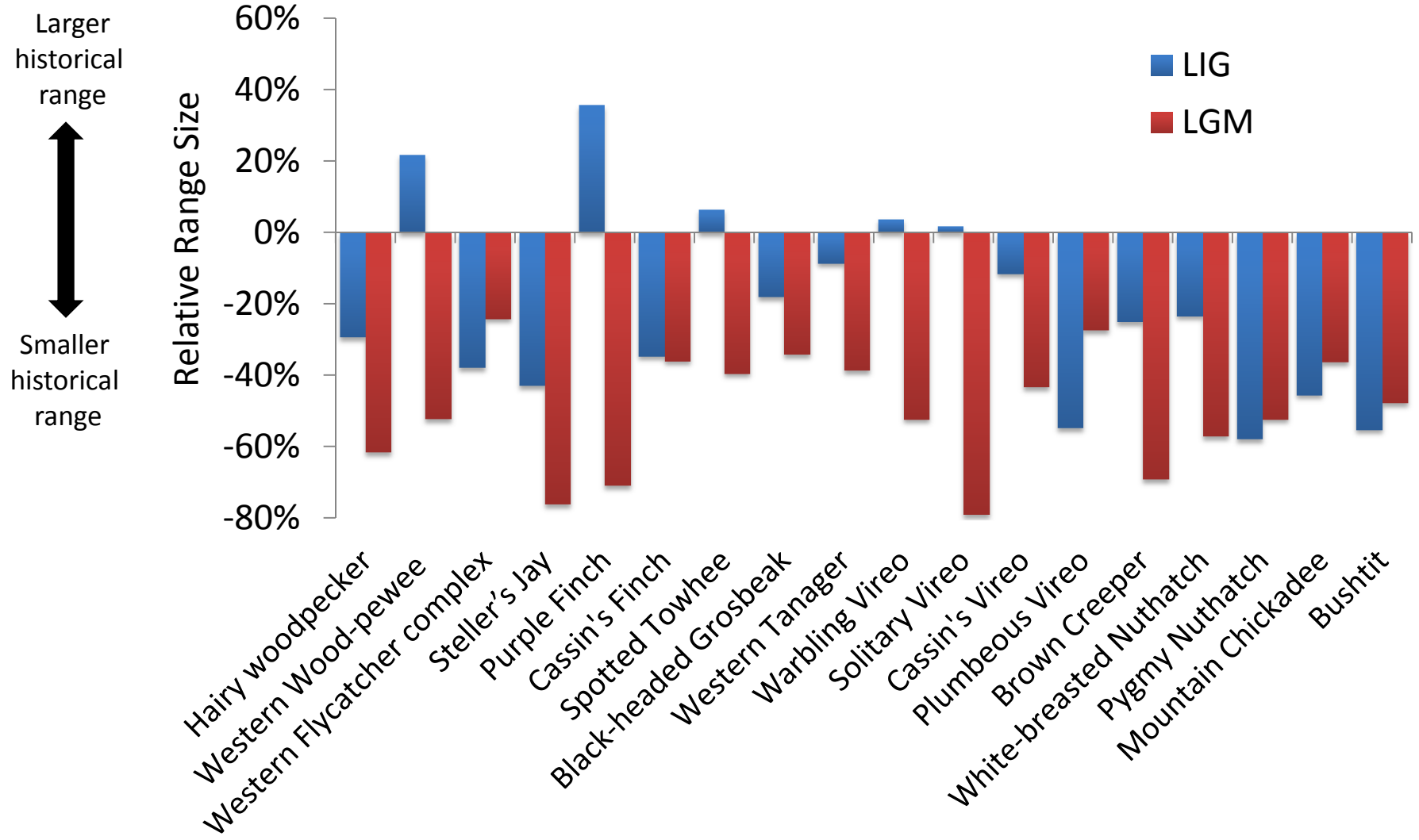
Summed stability (LIG, LGM, current)

White-breasted nuthatch



● ★ ▲ mtDNA clades identified in Spellman & Klicka 2007

Relative range size



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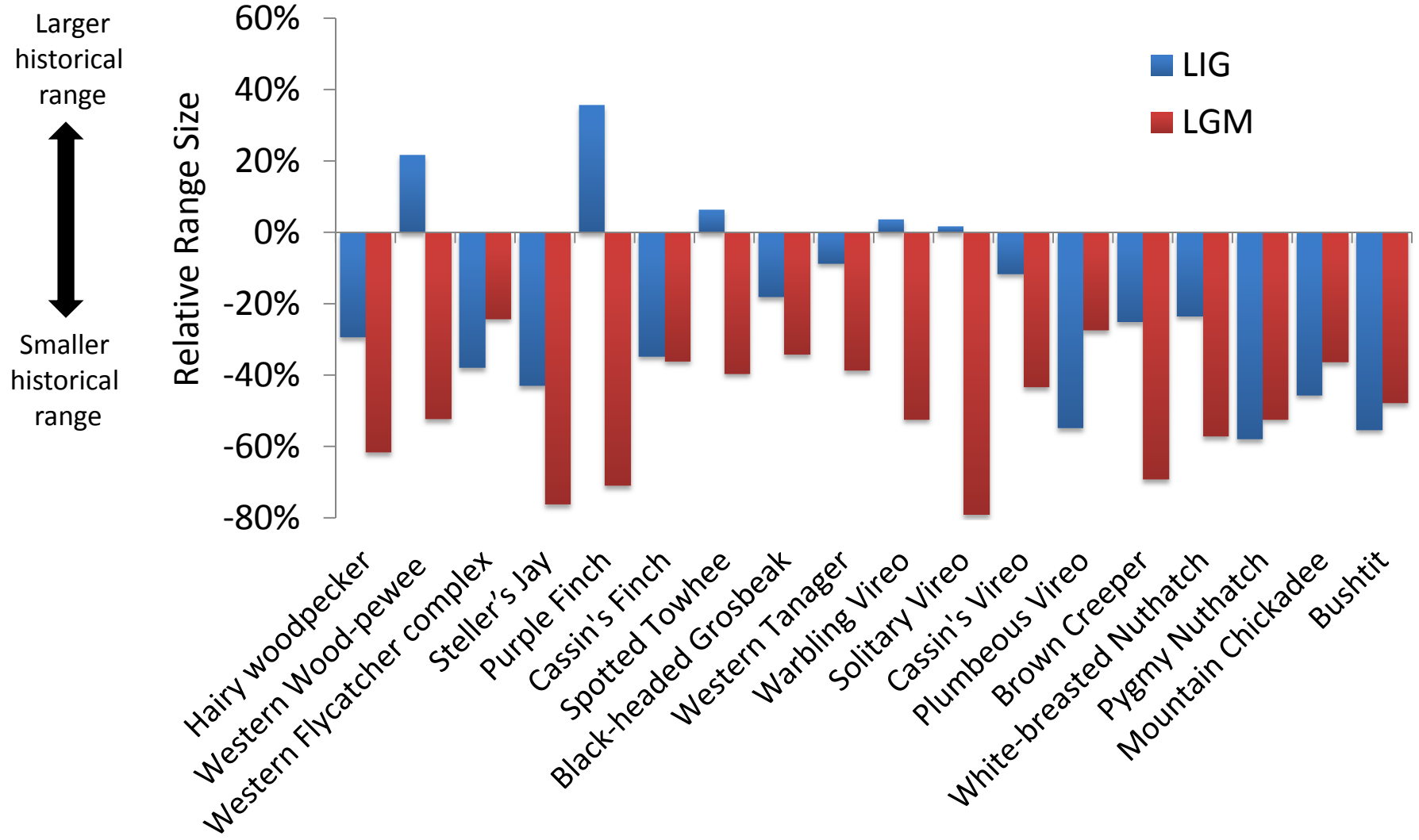
Relative range size



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Refuges for Pine-oak woodland birds

- Considering both glacial and interglacial periods gives a better estimate of phylogeographic patterns than either alone

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- Major refuges predicted in Pacific NW, Colorado Plateau, Appalachia

Refuges for Pine-oak woodland birds

- Considering both glacial and interglacial periods gives a better estimate of phylogeographic patterns than either alone

- Major refuges predicted in Pacific NW, Colorado Plateau, Appalachia

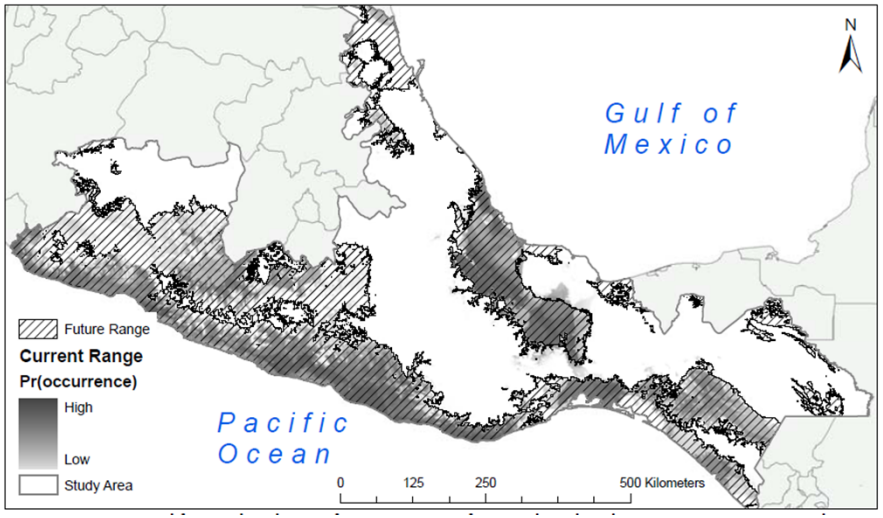
- Ongoing work to compare refuges with multi-locus phylogeography

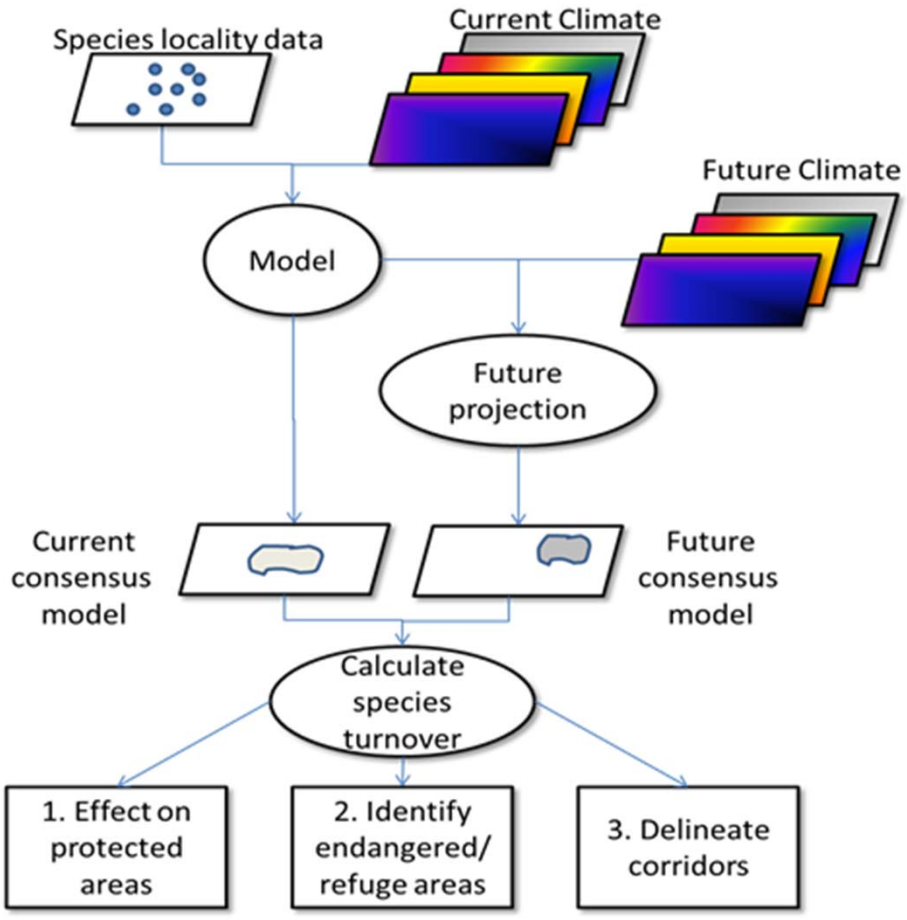
Predicting climate change impacts on Mexican reptiles and amphibians

Susan E. Cameron Devitt – *Wildlife Ecology and Conservation, UF*
& Oscar Flores Villela – *Museo de Zoología, UNAM Mexico*

Objective:

Assess vulnerability of 582 species focusing on on 188 protected areas





Linking sea-level rise models with conservation prioritization in Florida's Big Bend

Jennifer Seavey, Robert Fletcher, William Pine, Susan Cameron Devitt – *Wildlife Ecology and Conservation, UF*
& Gregory Kiker – *Agricultural and Biological Engineering, UF*

Objective:

Apply SLAMM to identify specific locations and habitats vulnerable to SLR; prioritize areas for conservation action