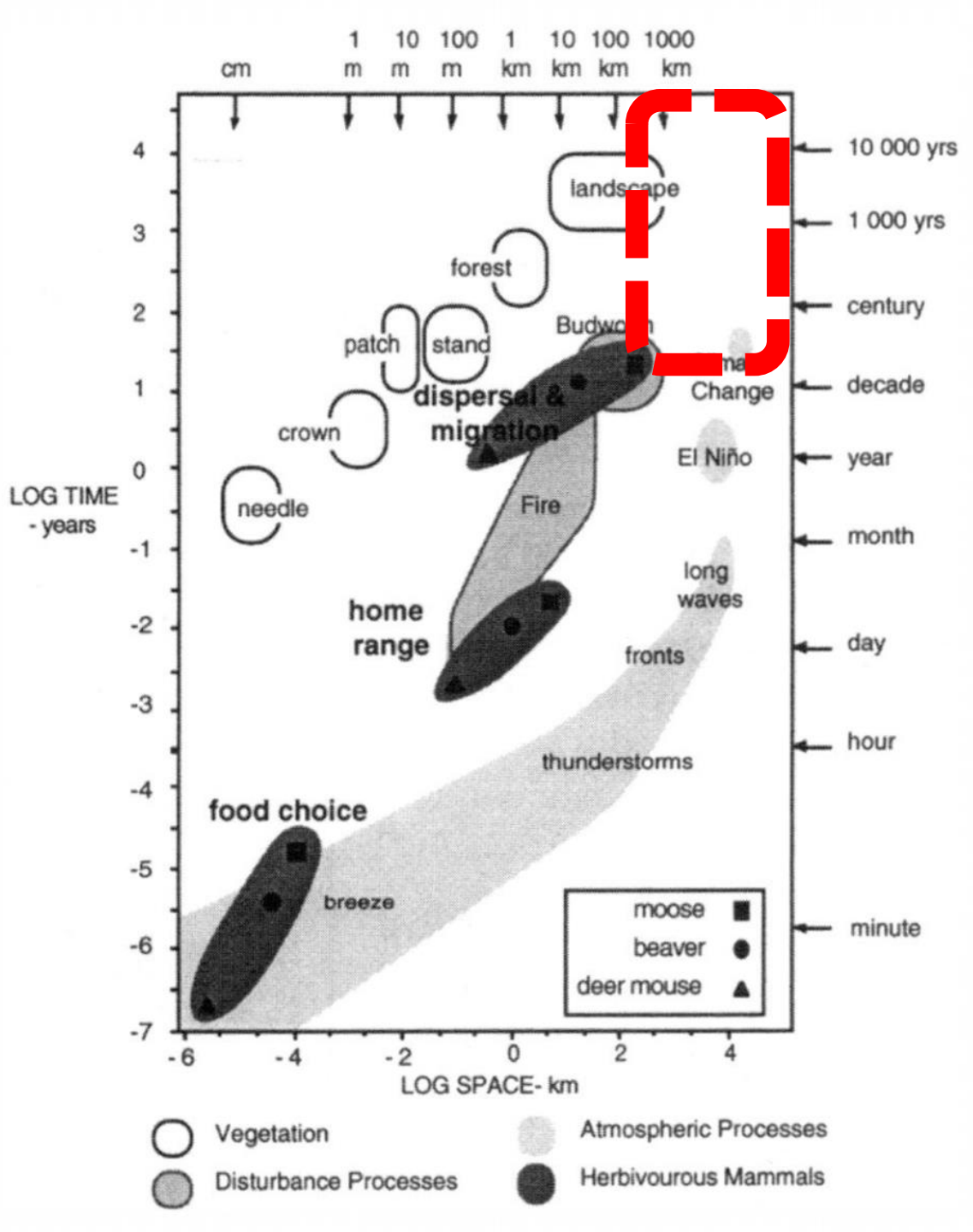
Avifaunal Change Over Three Decades in North America Detected Via Integration of Specimen and Observational Data

Town Peterson and numerous colleagues

University of Kansas Biodiversity Institute


cm
1 m
10 m
100 m
1 km
10 km
100 km
1000 km
10 000 yrs
1 000 yrs
century
decade
year
month
day
hour
minute
LOG TIME - years
LOG SPACE- km
landscape
forest
patch
stand
Budworm
dispersal & migration
Change
crown
El Niño
needle
Fire
long waves
home range
fronts
thunderstorms
food choice
breeze
moose
beaver
deer mouse
Vegetation
Disturbance Processes
Atmospheric Processes
Herbivourous Mammals

RESEARCH ARTICLE

ECOLOGY

Twentieth century turnover of Mexican endemic avifaunas: Landscape change versus climate drivers

10.1126/sciadv.1400071

A. Townsend Peterson,[1]* Adolfo G. Navarro-Sigüenza,[2] Enrique Martínez-Meyer,[3] Angela P. Cuervo-Robayo,[3,4] Humberto Berlanga,[4] Jorge Soberón[1]

Numerous climate change effects on biodiversity have been anticipated and documented, inc range shifts, phenological shifts, and breakdown of interactions in ecological communities, yet t of different climate drivers and their relationships to other agents of global change (for example, use change) remains relatively poorly understood. This study integrated historical and current b distributions of 115 Mexican endemic bird species to document areas of concentrated gains and local communities, and then related those changes to climate and land-use drivers. Of all driver relatively coarse spatial resolution, only temperature change had significant impacts on avifaun precipitation change nor human impact on landscapes had detectable effects. This study, condu geographic distributions, and covering all of Mexico, thanks to two large-scale biodiversity data relative importance of specific climatic drivers of biodiversity change.

PeerJ

Digital Accessible Knowledge and well-inventoried sites for birds in Mexico: baseline sites for measuring faunistic change

A. Townsend Peterson[1], Adolfo G. Navarro-Sigüenza[2] and Enrique Martínez-Meyer[3]

[1] Biodiversity Institute, University of Kansas, Lawrence, KS, United States
[2] Museo de Zoología, Facultad de Ciencias, Universidad Nacional Autónoma de México, México, Distrito Federal, México
[3] Instituto de Biología, Universidad Nacional Autónoma de México, México, Distrito Federal, México

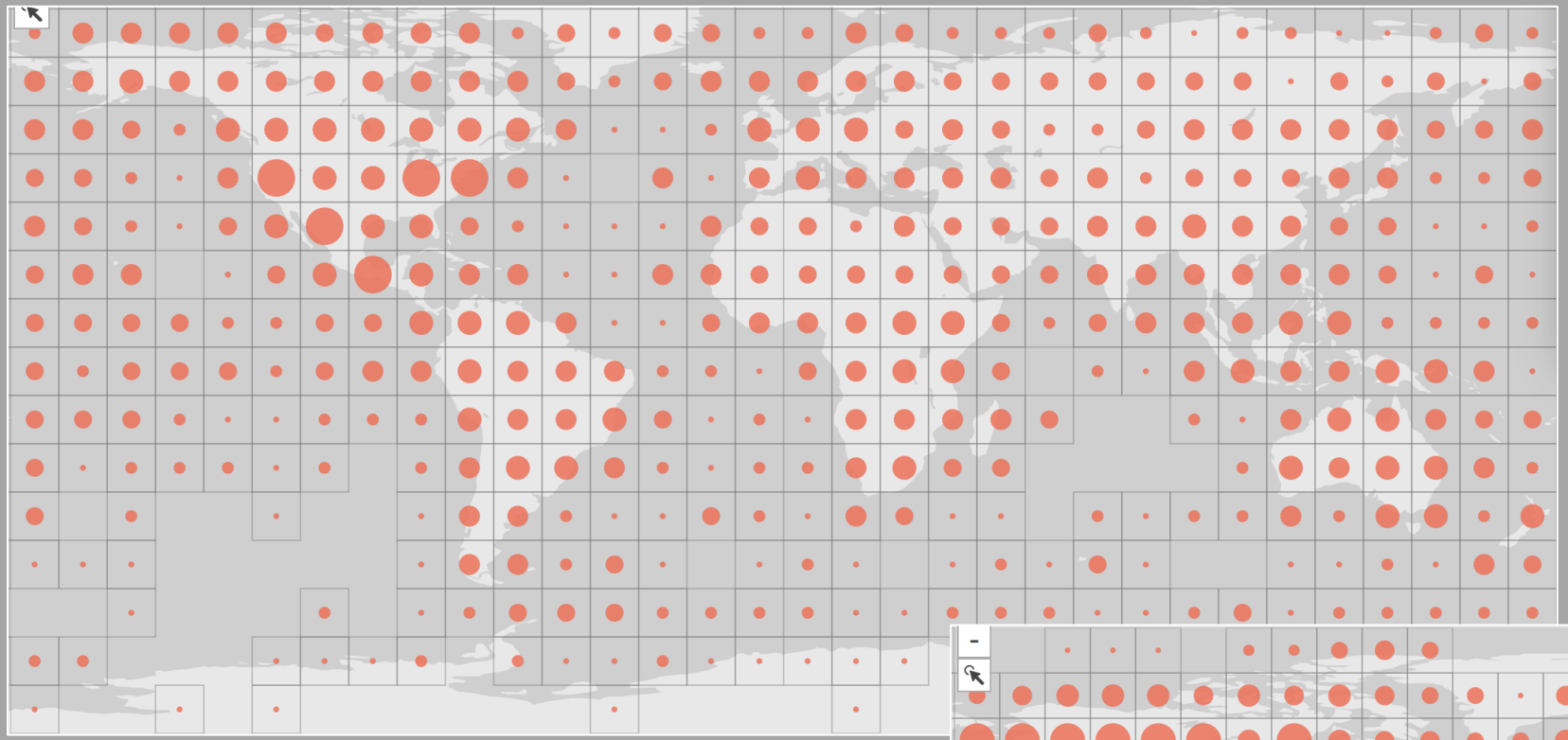
ABSTRACT

Background. Faunal change is a basic and fundamental element in ecology, biogeography, and conservation biology, yet vanishingly few detailed studies have documented such changes rigorously over decadal time scales. This study responds to that gap in knowledge, providing a detailed analysis of Digital Accessible Knowledge of the birds of Mexico, designed to marshal DAK to identify sites that were sampled and inventoried rigorously prior to the beginning of major global climate change (1980).

Methods. We accumulated DAK records for Mexican birds from all relevant online biodiversity data portals. After extensive cleaning steps, we calculated completeness indices for each 0.05° pixel across the country; we also detected 'hotspots' of sampling, and calculated completeness indices for these broader areas as well. Sites were designated as well-sampled if they had completeness indices above 80% and >200 associated DAK records.

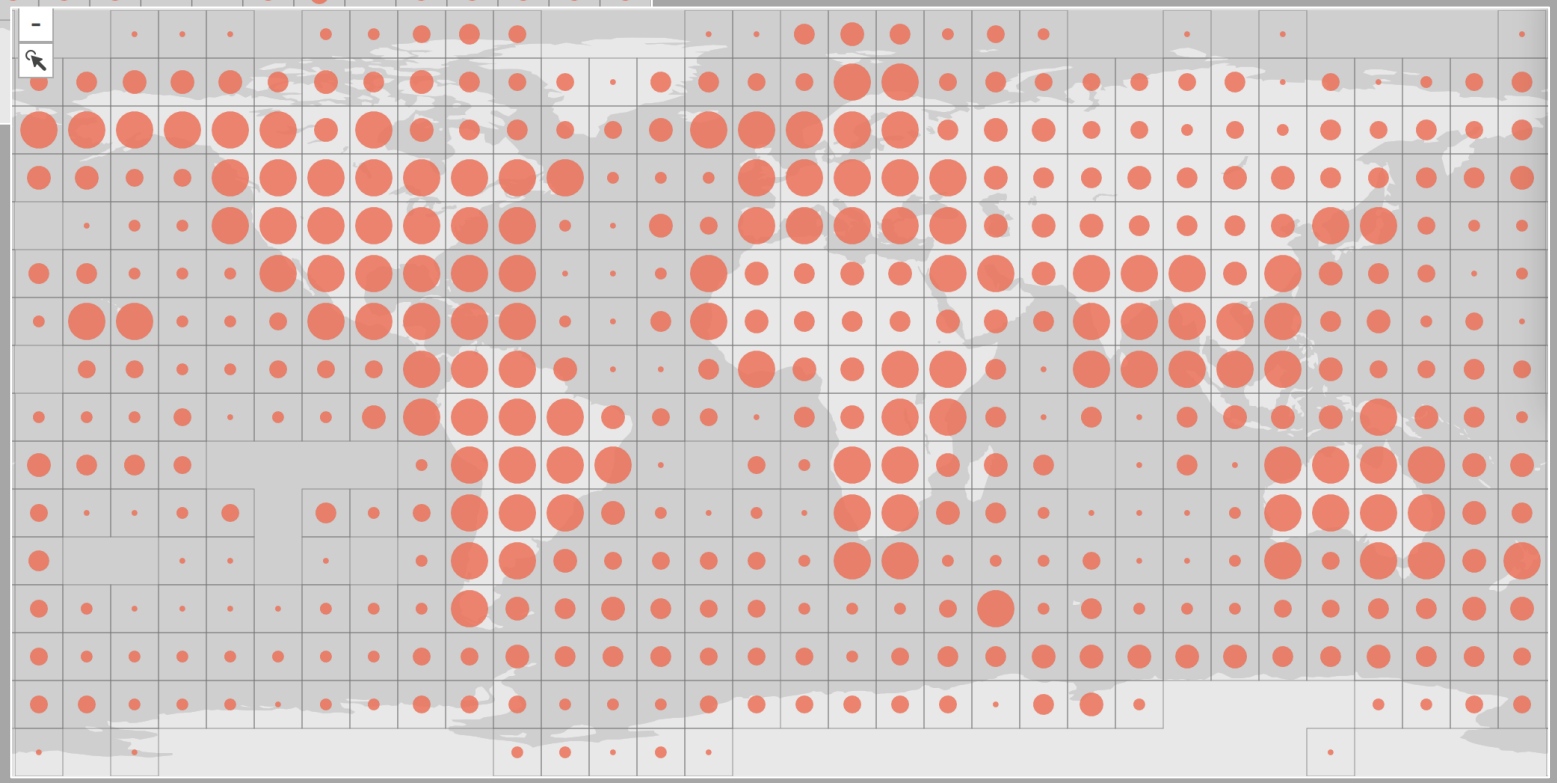
Steps in the Analysis

- Scope the question
- Find before-and-after data
- Aggregate the data (as little as possible, but cognizant of underlying precision of georeferencing)
- Assess completeness before and after
- Compare where inventories are complete before and after
- Test for spatial autocorrelation (i.e., are there macro-scale patterns?)
- Explore and interpret species- and site-level changes



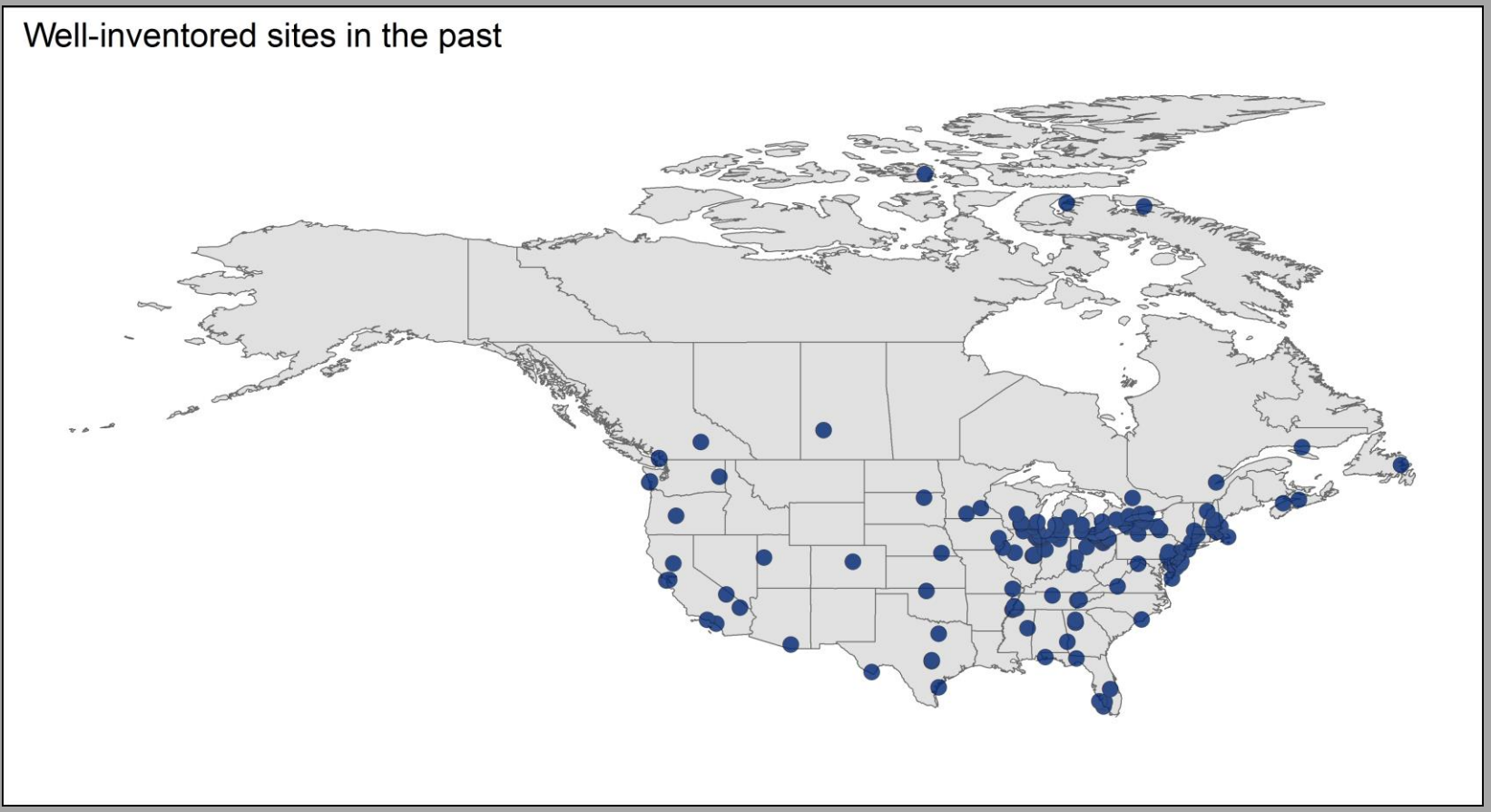
2,869,313 specimen records in Feb 2018

549,509,614 observational records in Feb 2018



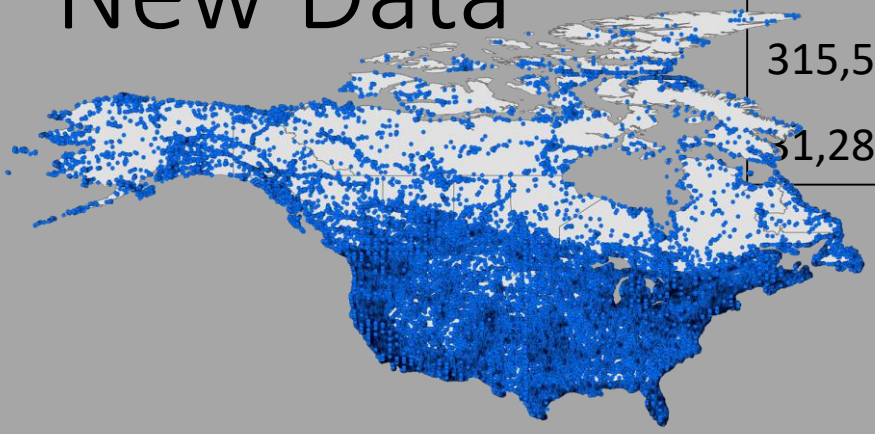
Old Data

4,843,222 old records → 3,073,785 usable unique records



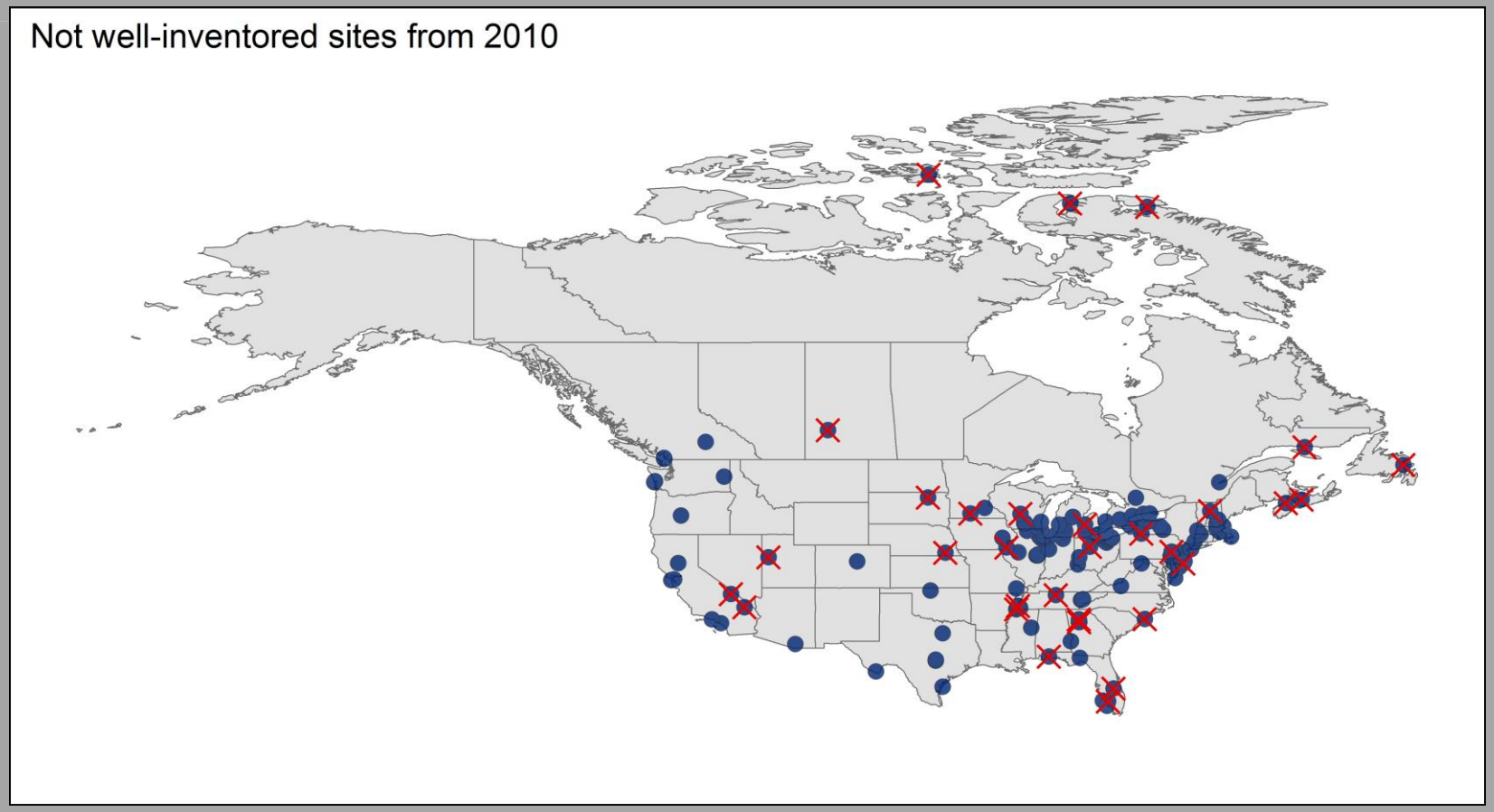
- Check all year/month/day formats for consistency
- Create time marker “Y-M-D”
- Check place for consistency/accuracy
- coordinateUncertaintyInMeters < 5 km; if blank, retain
- Is lat-lon in the US and/or Canada?
- Does lat-lon match the county/state/country?
- Remove records with species names unclear or lacking
- Match taxonomy against an authority
- Shift taxonomy to (older) Sibley-Monroe arrangement
- Remove any duplicate records

New Data

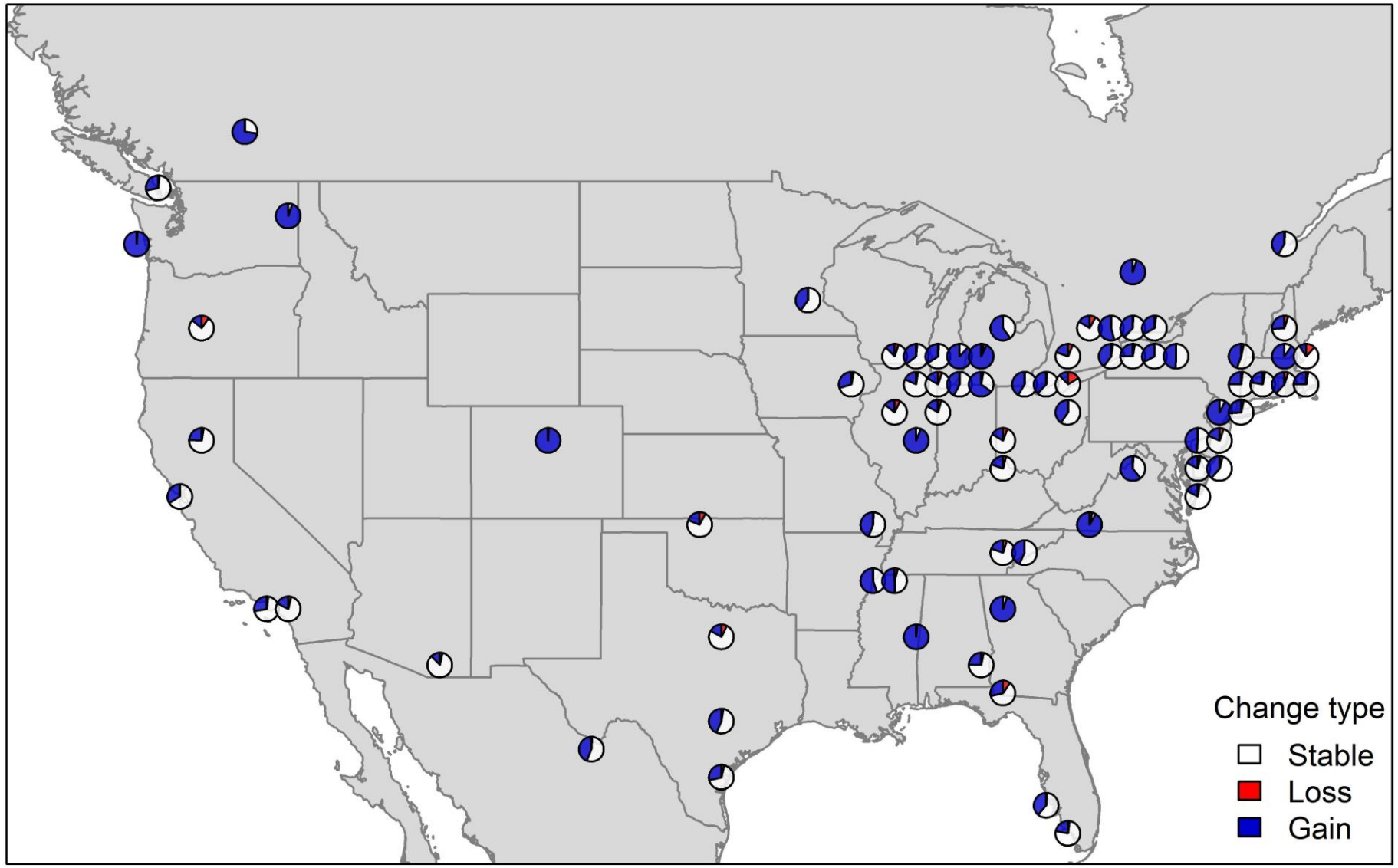


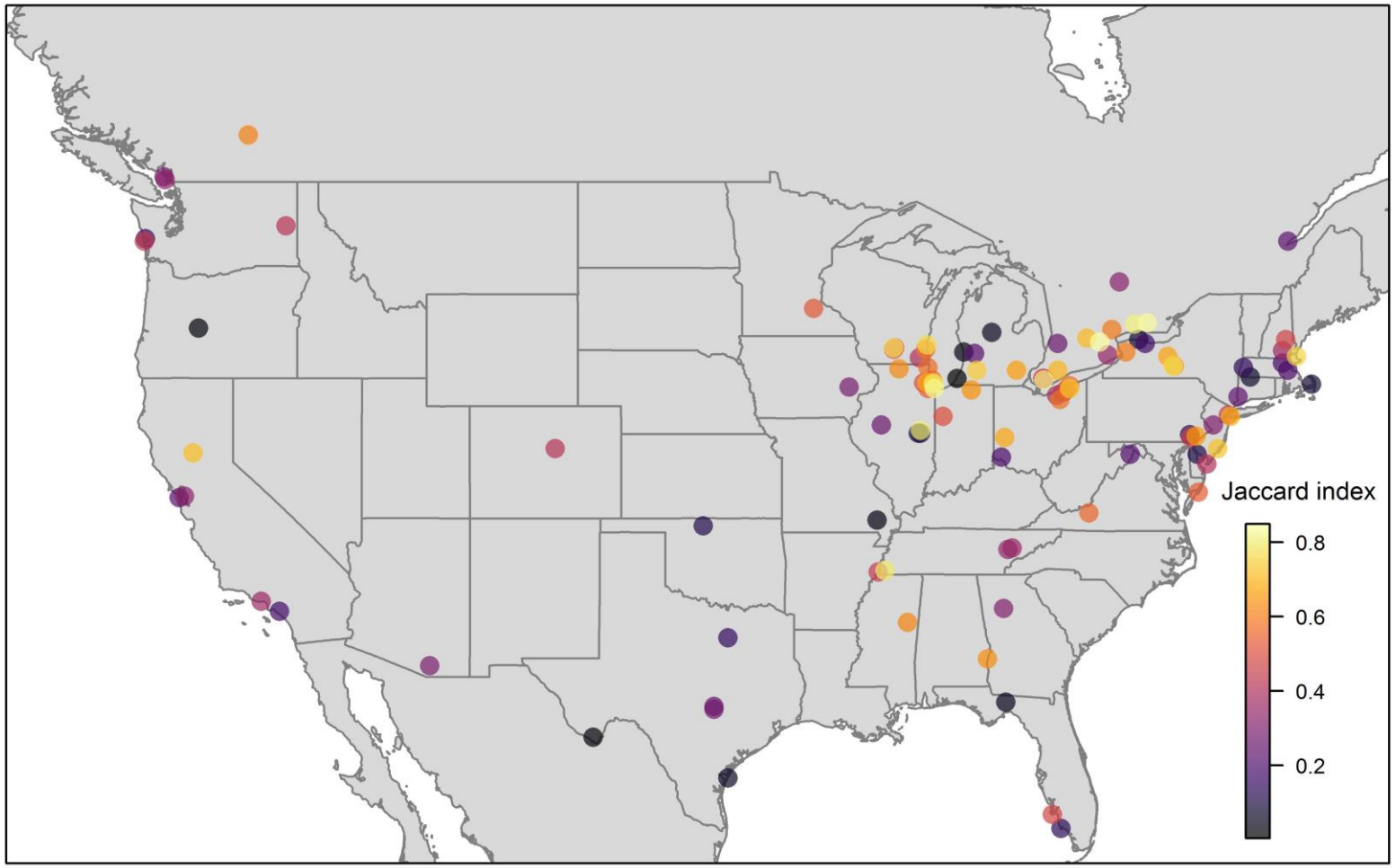
315,532,312 records initially …

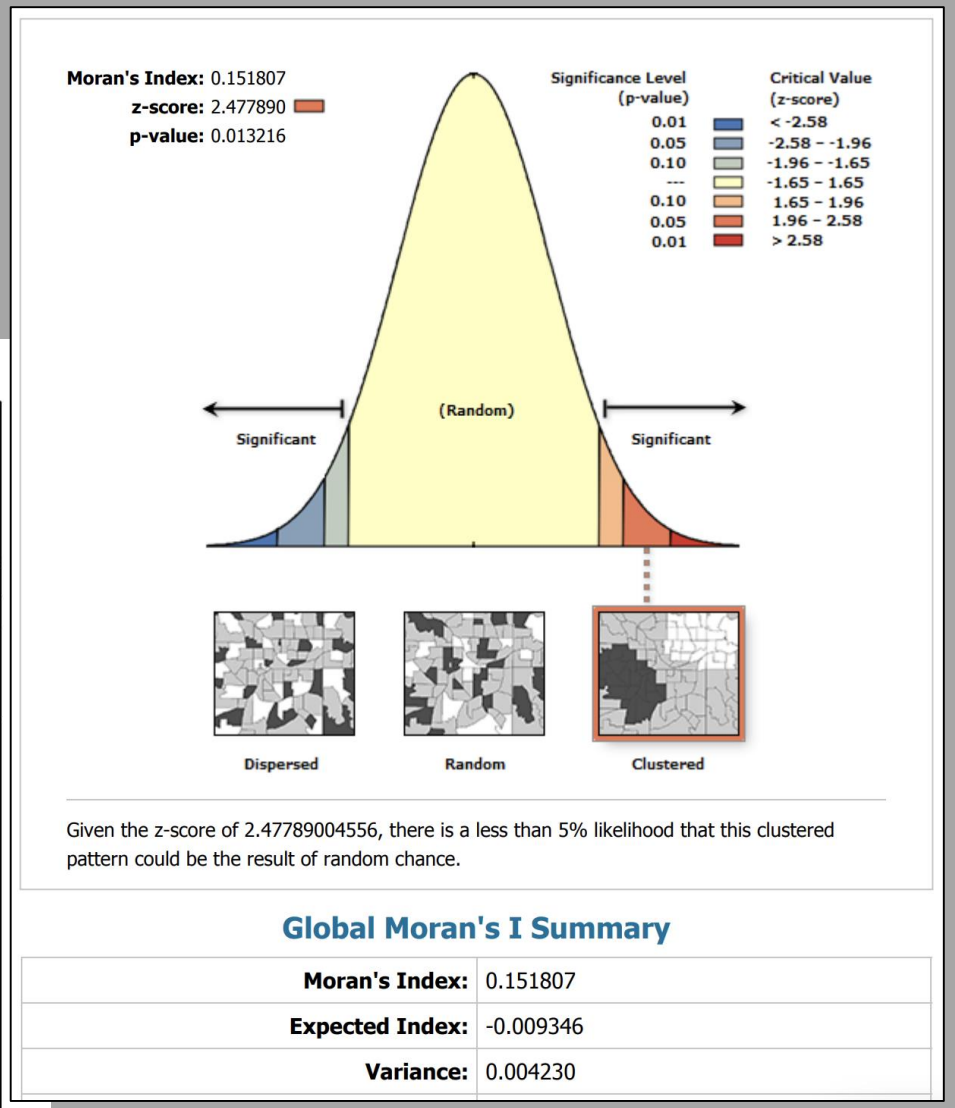
31,280,623 records analyzed …



- Extracted all new data (2010 and after) <10 km from a key site
- Check taxonomy against SM list
- Remove domestics and uncertain names
- Remove ID errors and vagrants via filtering to species records <50 km from IUCN range outlines
- Analyze completeness in EstimateS, but down-sample sites with >2400 days of sampling


Change type
Stable
Loss
Gain





Given the z-score of 2.47789004556, there is a less than 5% likelihood that this clustered pattern could be the result of random chance.

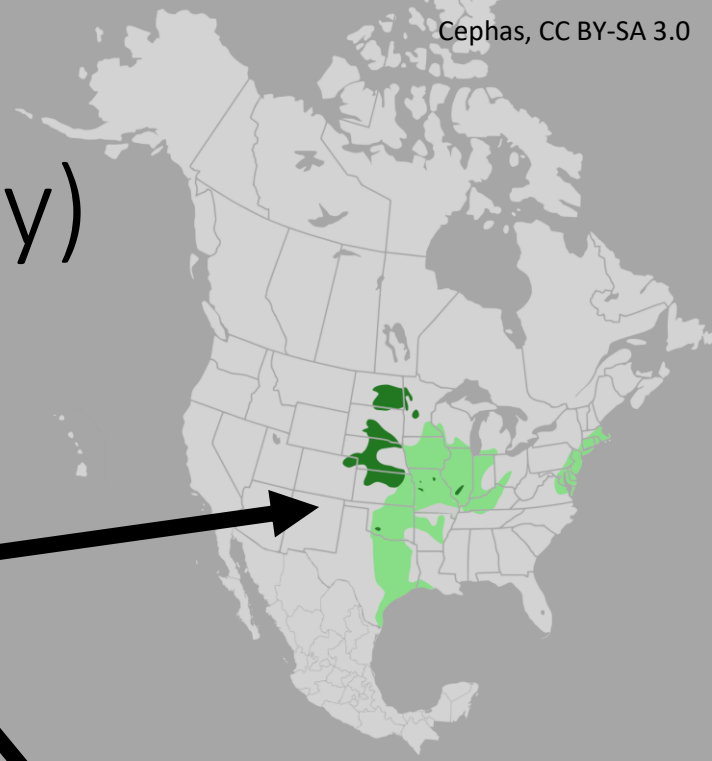
Global Moran's I Summary

Moran's Index:	0.151807
Expected Index:	-0.009346
Variance:	0.004230

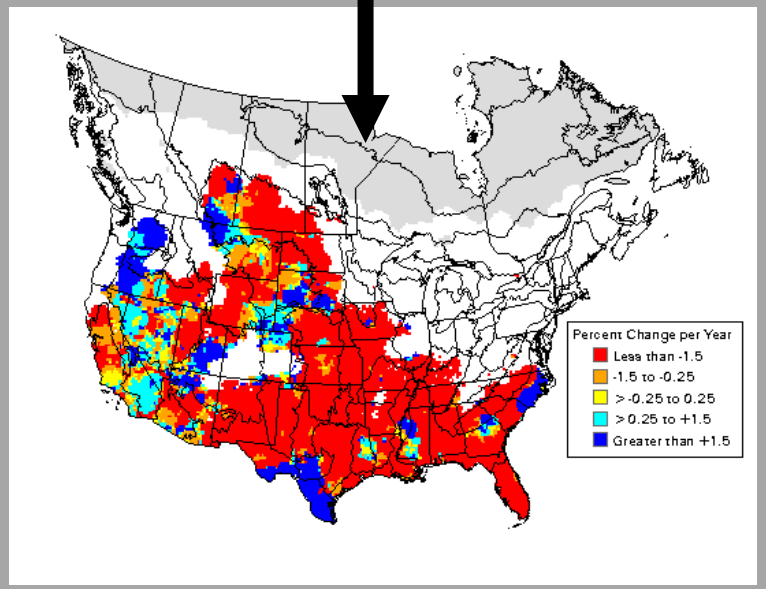
Species by Species Changes (sig only)

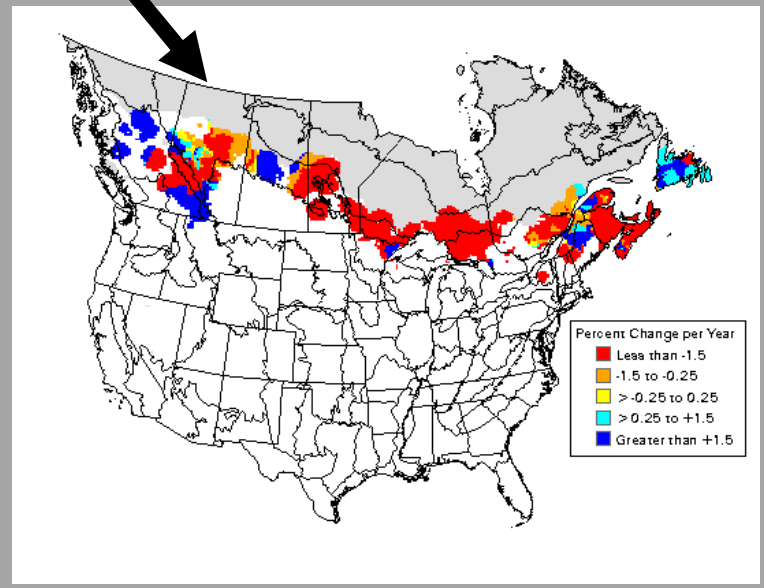
- *Tympanuchus cupido* 4 of 4 populations disappear
- *Parus hudsonicus* 10 of 13 populations disappear, one gain
- *Lanius ludovicianus* 27 of 54 populations lost, 13 gains

Species by Species Changes (sig only)



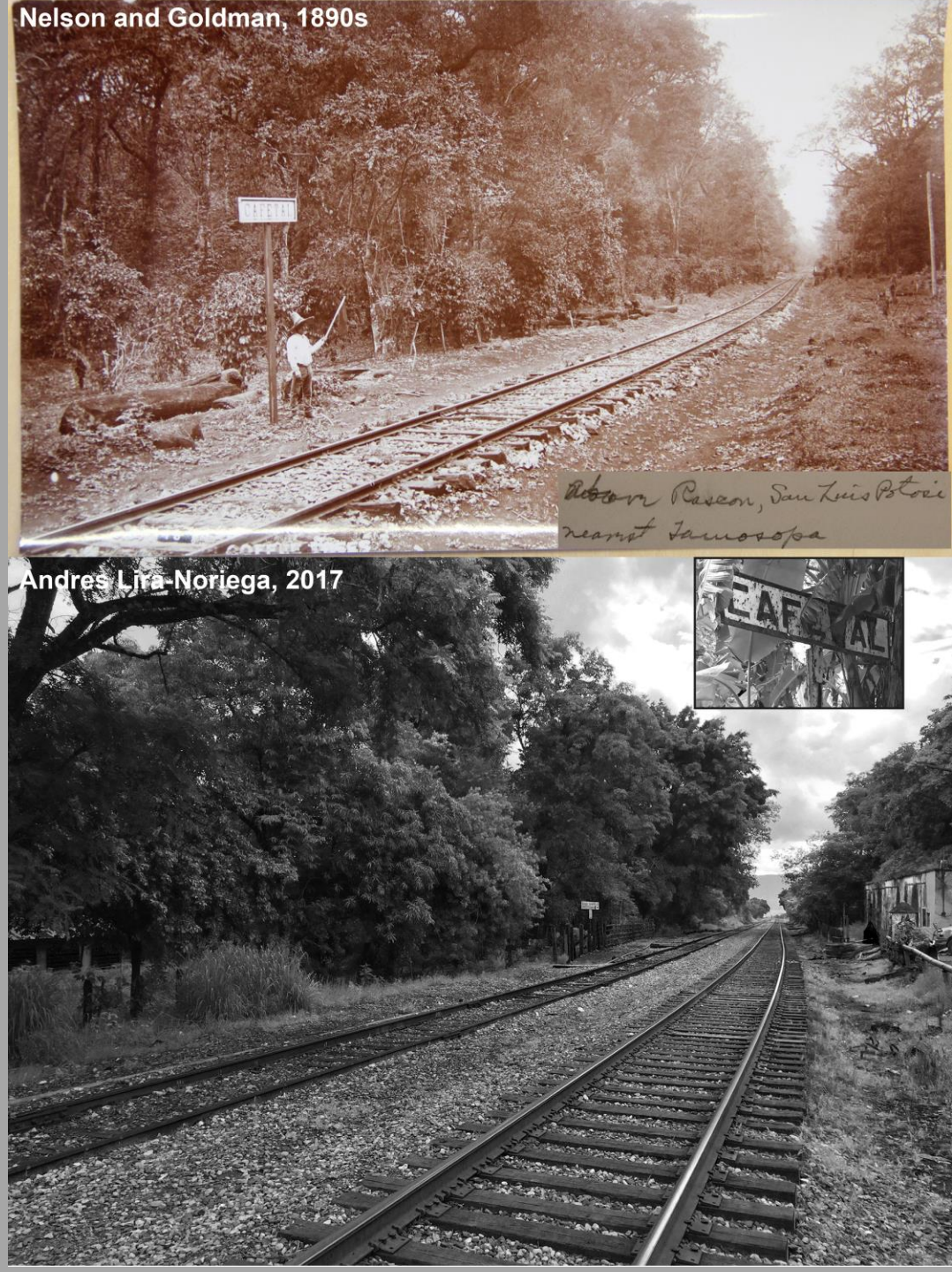
- *Tympanuchus cupido* 4 of 4 populations disappear
- *Parus hudsonicus* 10 of 13 populations disappear, one gain
- *Lanius ludovicianus* 27 of 54 populations lost, 13 gains





Summary and Future View…

- Biodiversity information are reaching critical mass for interesting analyses that can illuminate biodiversity change on meso-time scales
- Requires careful integration of data from diverse sources and with diverse characteristics
- Will ideally combine with landscape-scale views of change



town@ku.edu