The Influence of Tree Phenology on Neotropical Migrant Birds in Southwestern North America: Implications for SRER and WGEW

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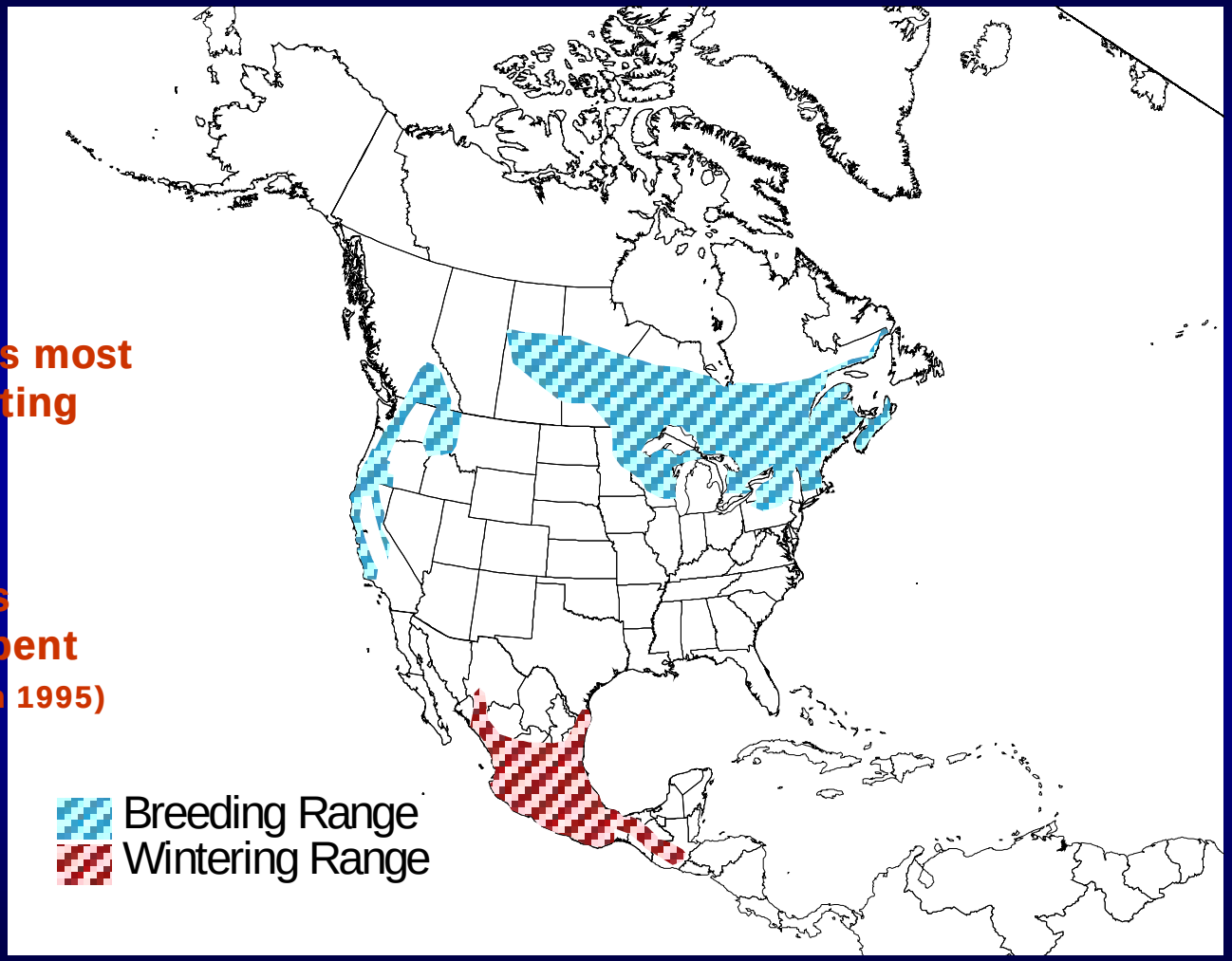
Nashville warbler

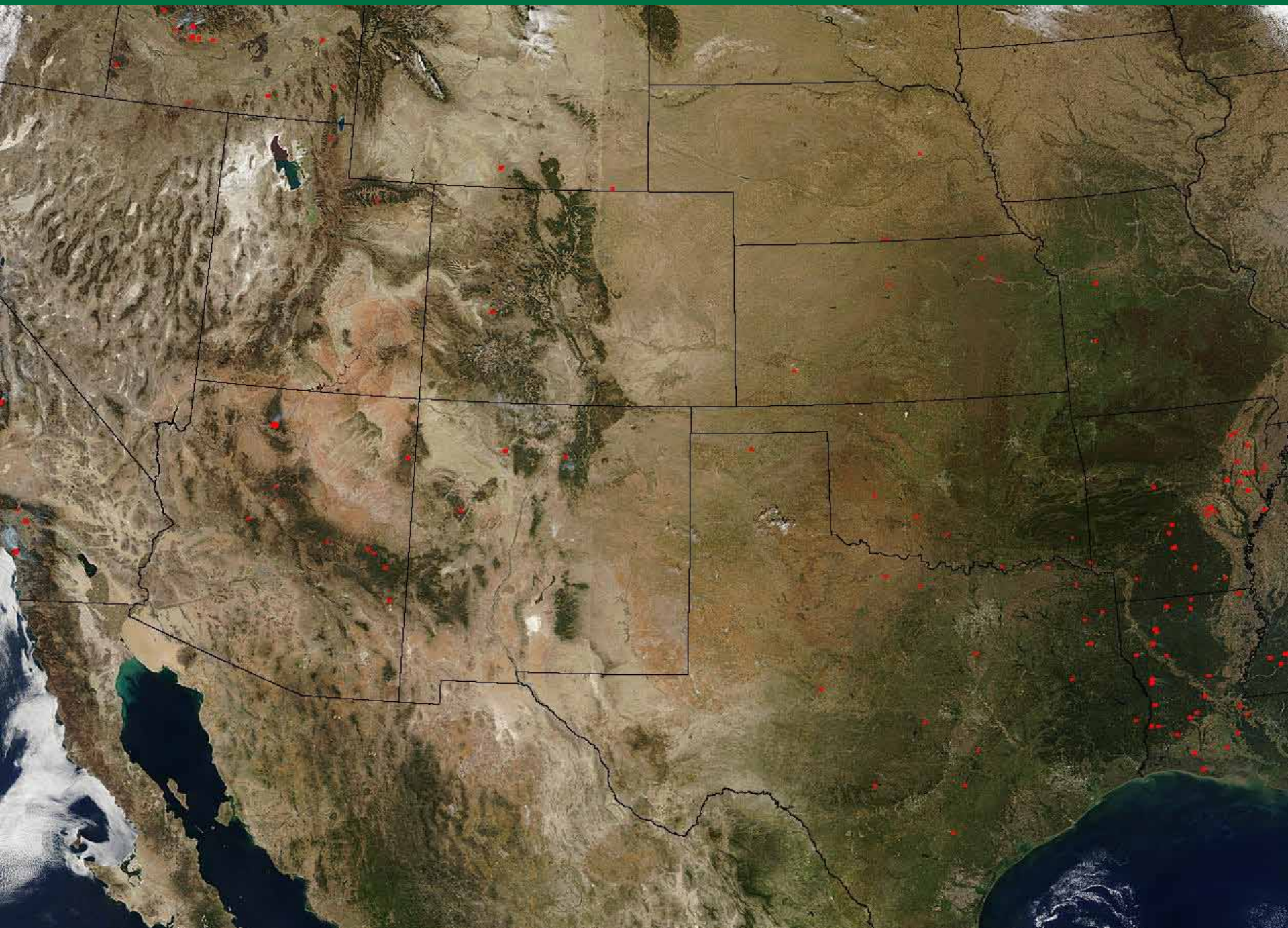
Nashville Warbler

- **Foraging constrains most severe while migrating (Moore and Aborn 2000)**

- **Selective pressures to minimize time spent on route (Linderstrom 1995)**



Graphic design: Kristina Ecton Data: Dunn and Garrett (1997)



Lower Colorado River Today

40,000 hectares left of 180,000 ha of riparian vegetation

-75% reduction in one century

- Climate change will further influence this total

Urbanization

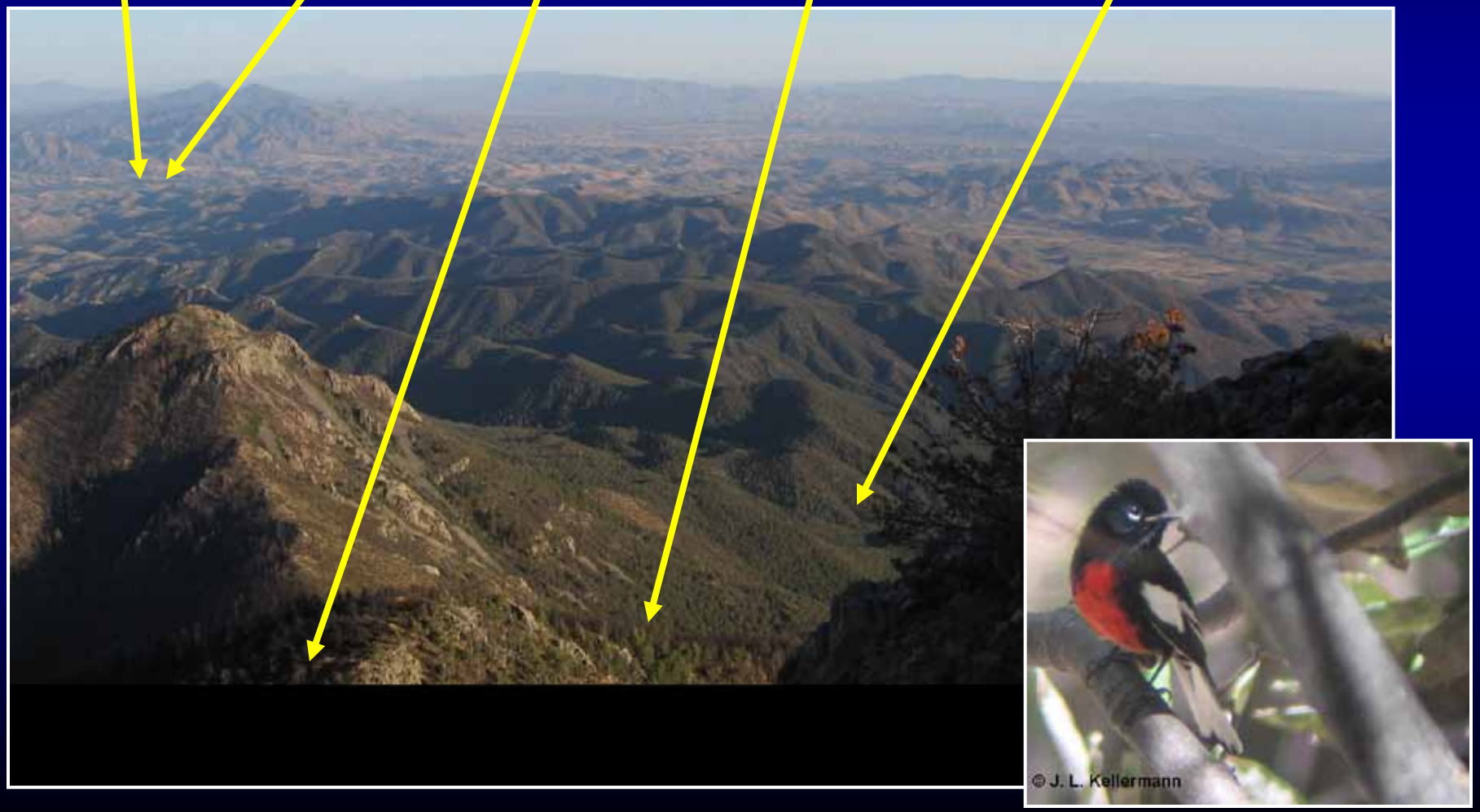
Agriculture Conversion & River Regulation

Anderson and Ohmart 1984 & Younker and Anderson 1986

What landscape feature is selected?

Que caracteristica del paisaje selecionan ?

Elevational Gradient – Vegetation Zones



Methods

Point counts

Mist netting

Foraging Observations

Invertebrate Sampling

Vegetation sampling

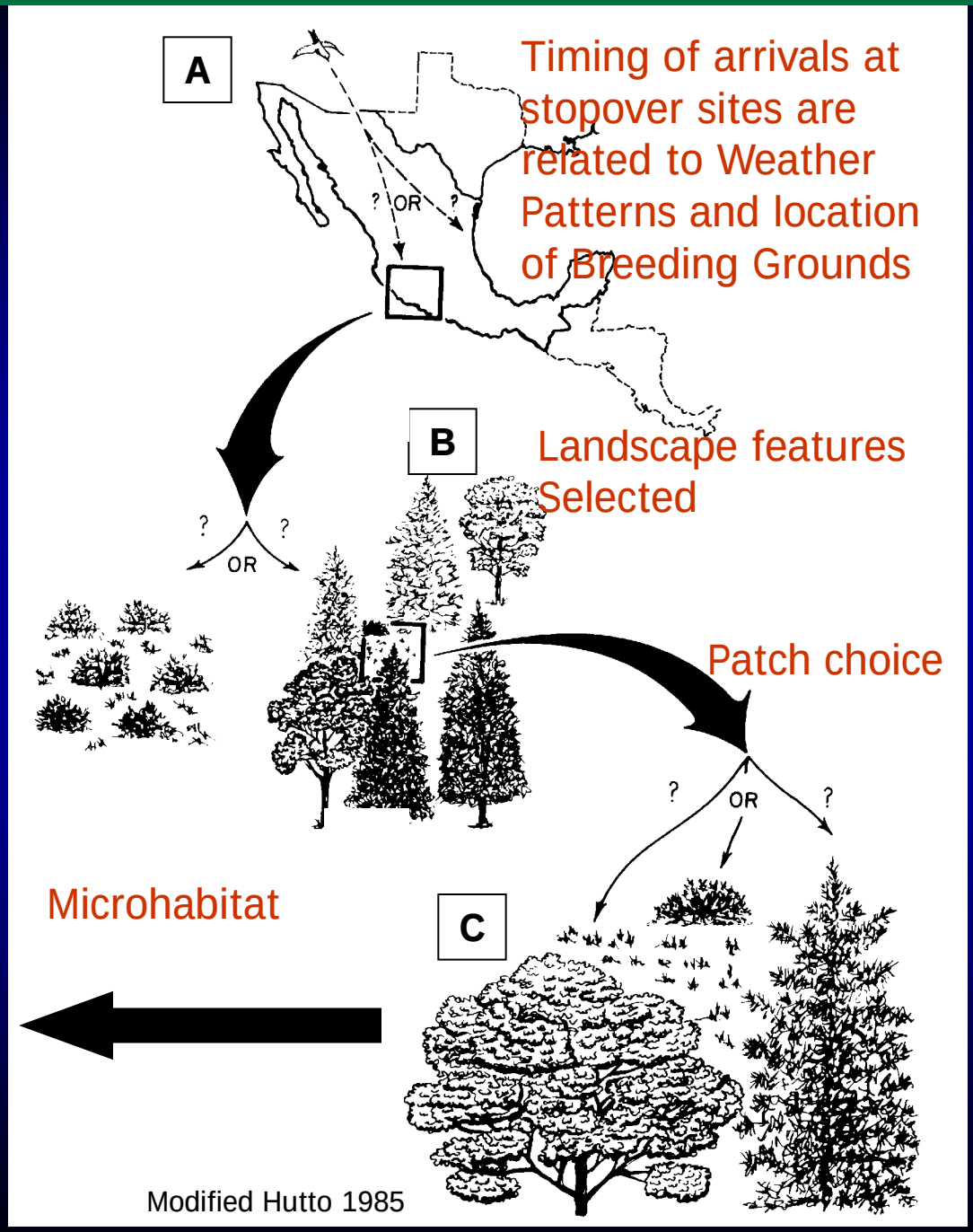
Tree Phenology

Radio and Isotopes

AUWA

Habitat Selection is Hierarchical

(Johnson 1980, Hutto 1985, Carslile et al 2009)

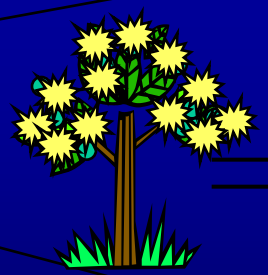


D

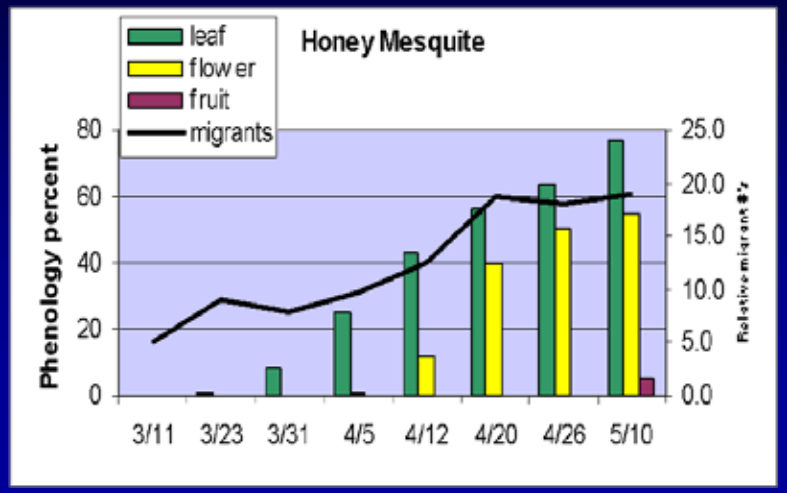
Food availability is the most important factor in habitat selection for migrating birds (Hutto 1985)

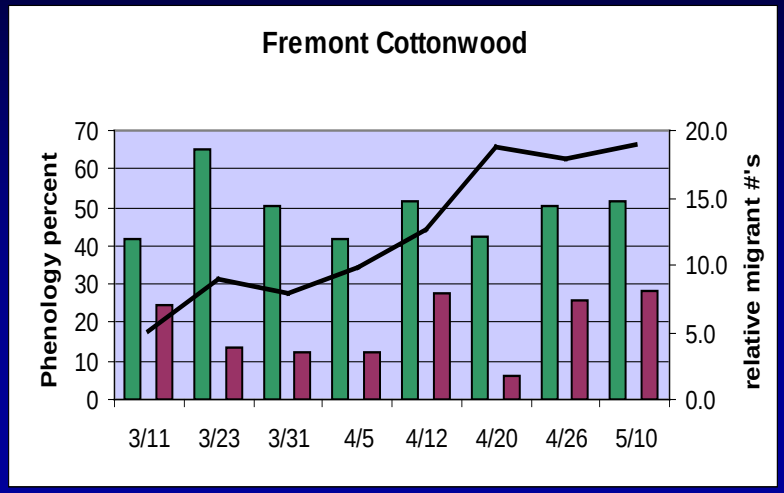
Hypothesis:

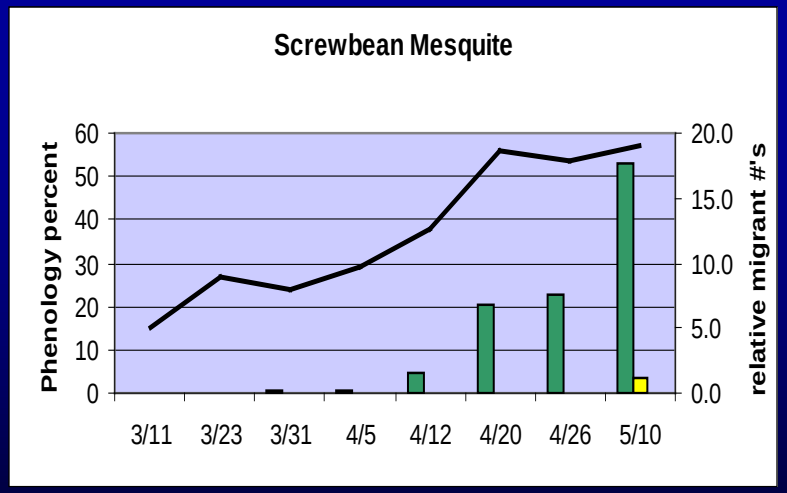
Phenology of Specific Tree Species
serve as food targets for migrant birds

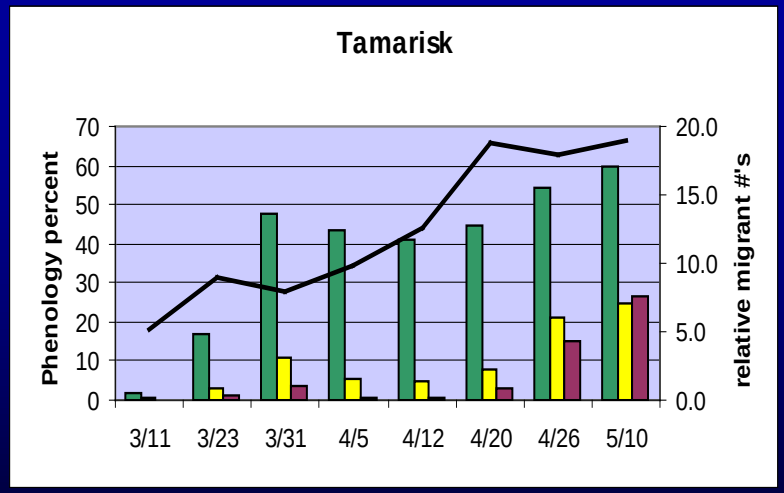


Tree Phenology as Related to Bird Numbers



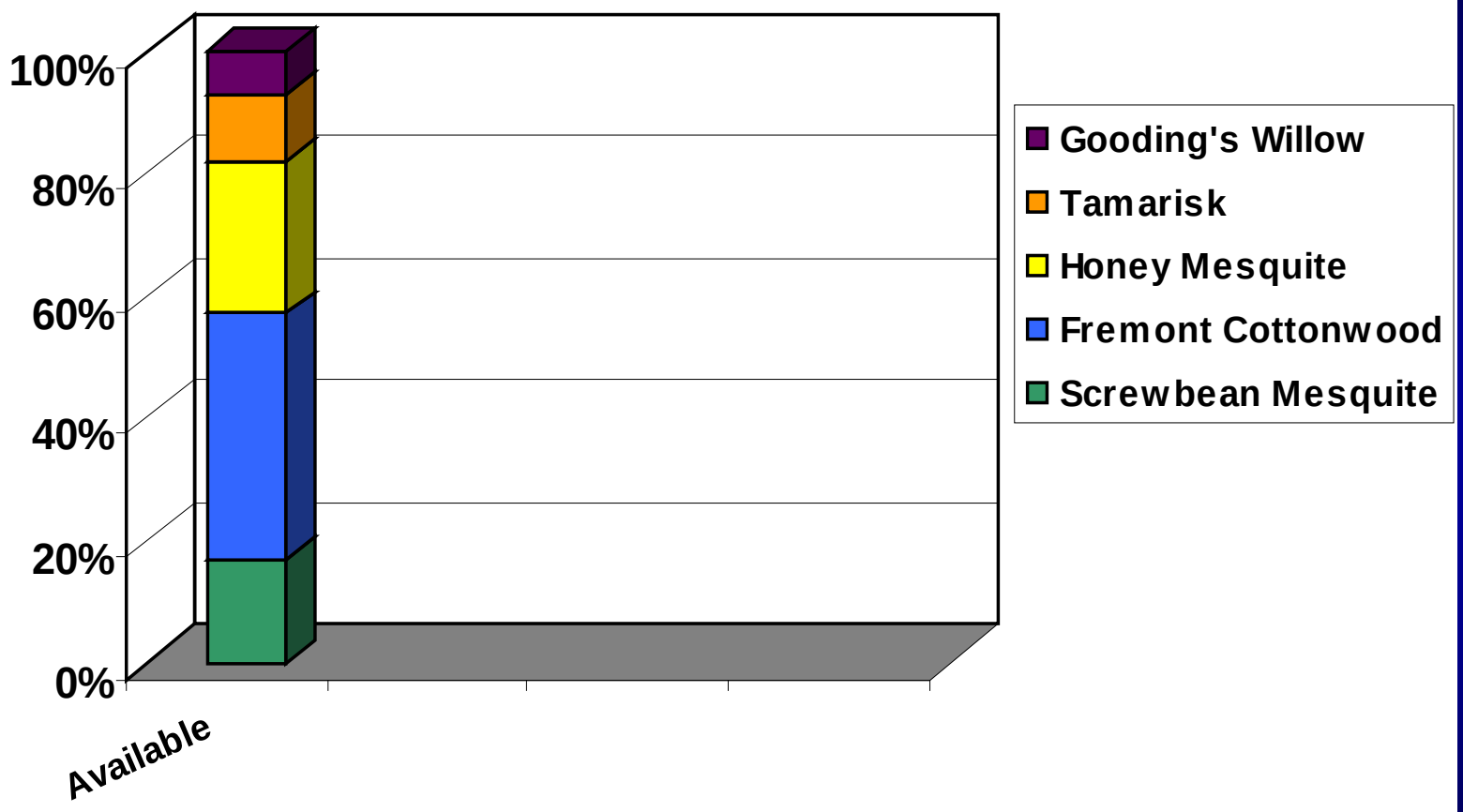




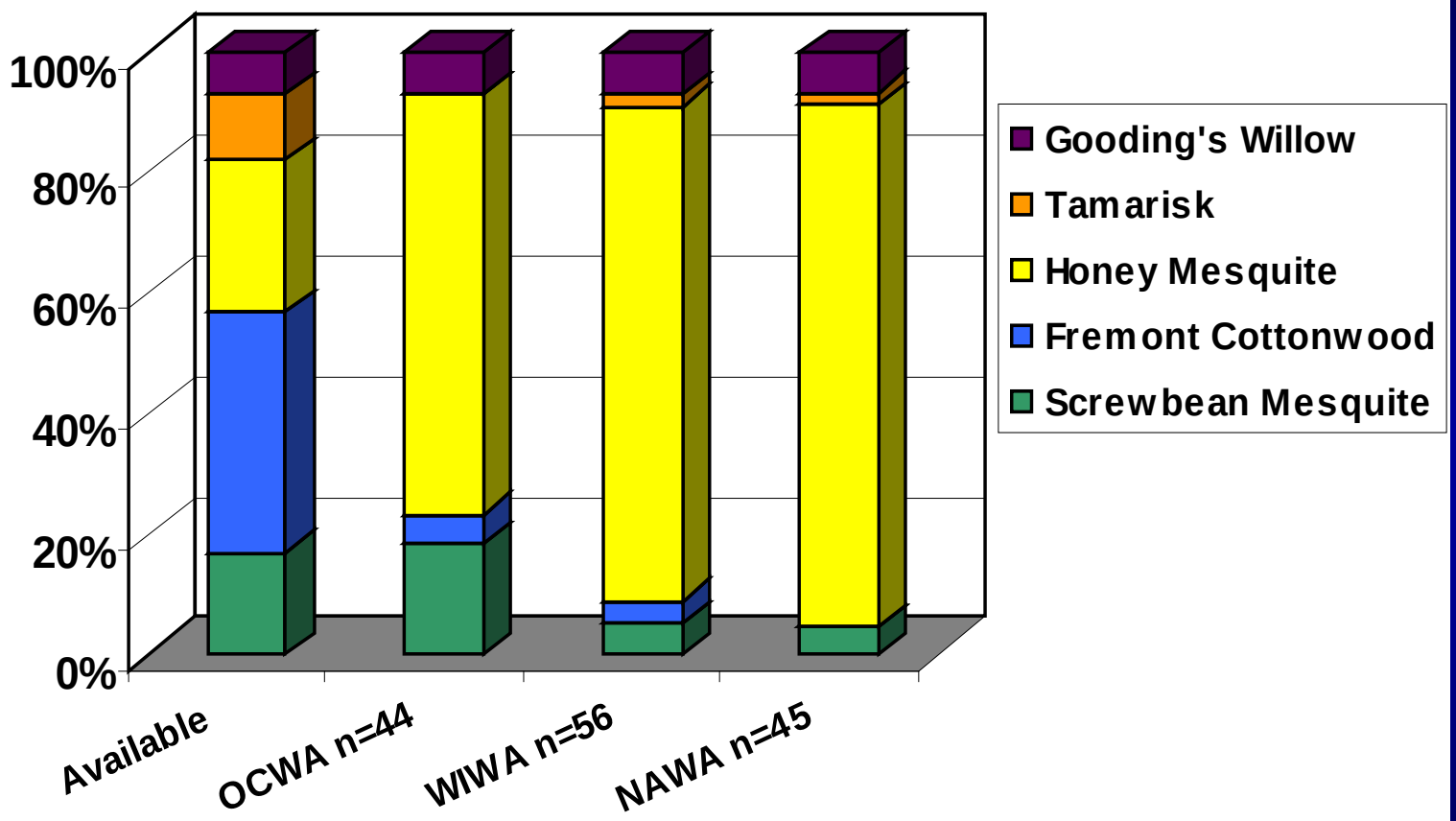


Timing: Migrant Arrivals Correlates with Honey Mesquite Peak Flowering (2002-5)

Patch level: Relative abundance of Available Trees

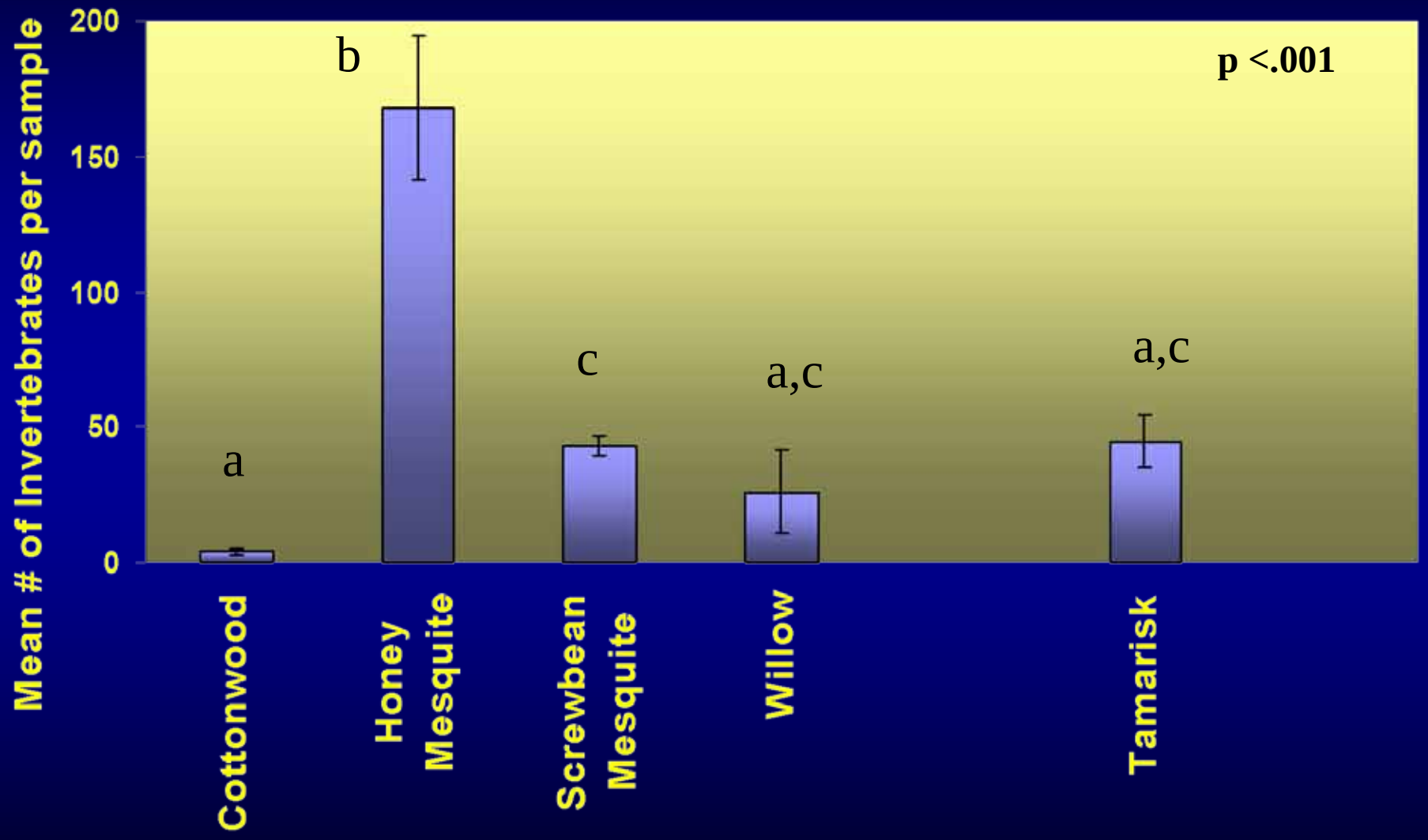


Patch level: Migrant Birds Select Honey Mesquite



NAWA (x^2_3 = 38.542, p <0.0001)
OCWA (x^2_3 = 26.194, p <0.0001)
WIWA (x^2_3 = 48.524, p <0.0001)

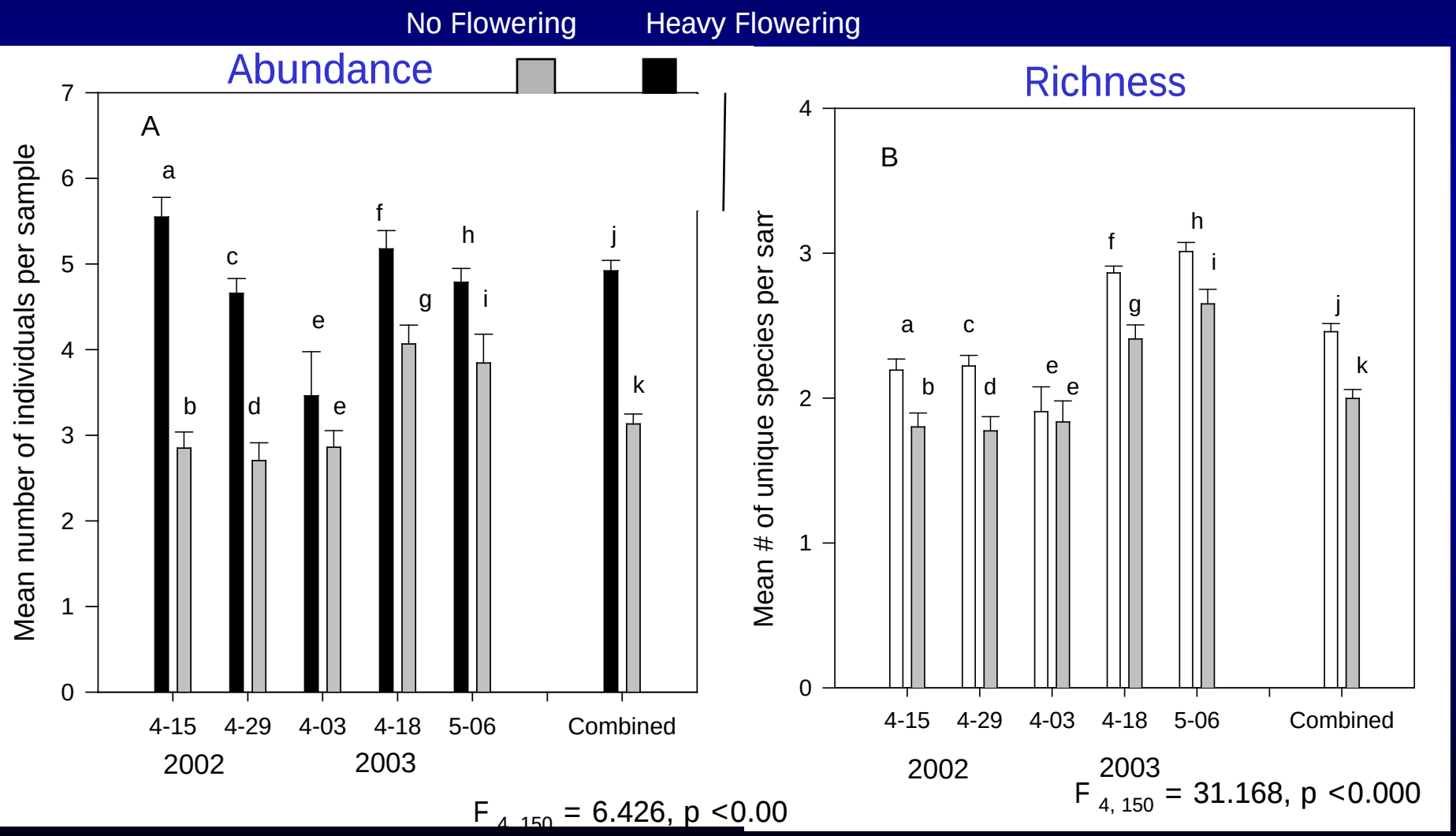
Foliage Invertebrates on Riparian Tree Species



Native Habitat

Non-Native Habitat

Microhabitat level: Arthropod Abundance and Richness Greatest on Heavy Flowering Trees



Microhabitat Choices: Paired Tree Treatments

Naturally Occurring Pairs

Heavy Flowering vs. Light

N= 49

Flower Removal Pairs

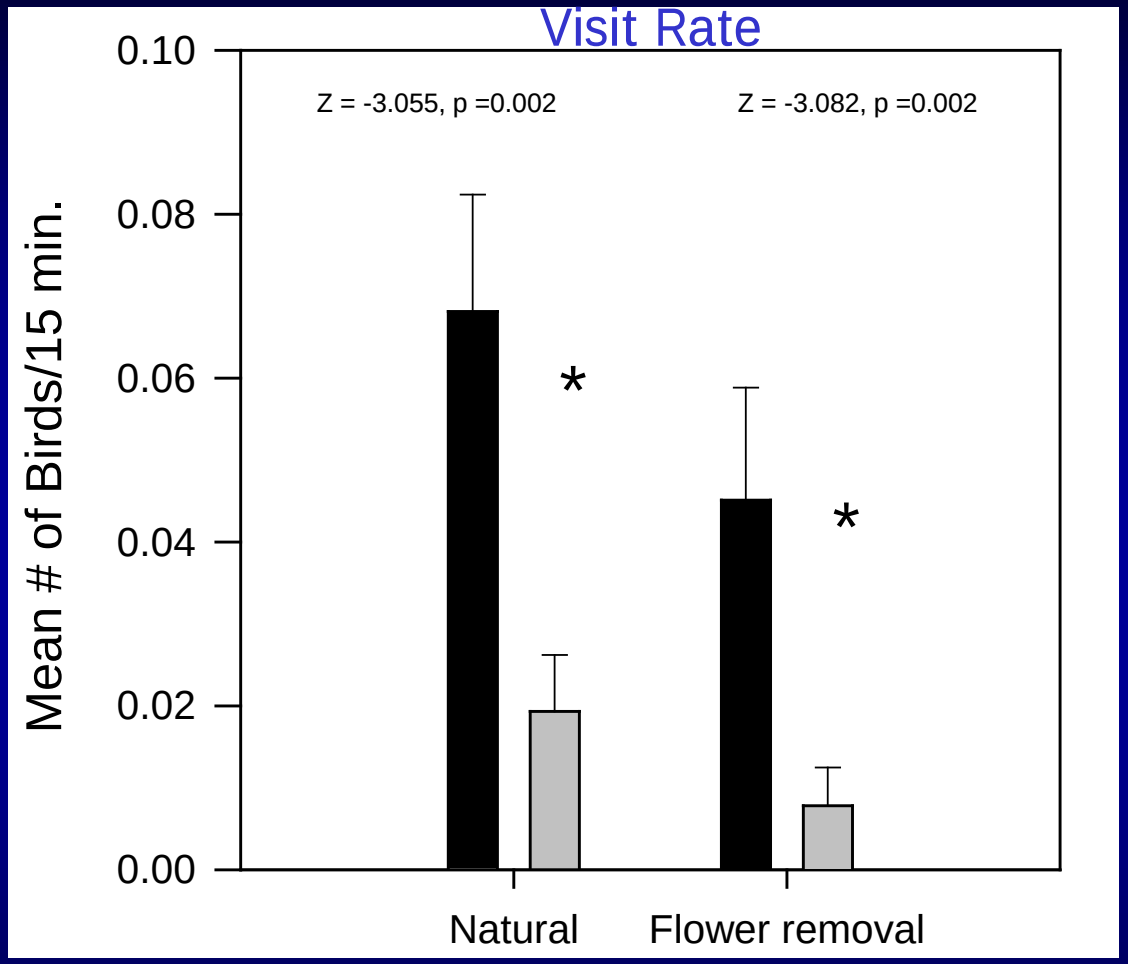
Heavy Flowering vs. Flowers Removed

N = 34

1) **VISITATION RATE**

Microhabitat level:

Foraging Behavior at Paired Trees Shows Flower Selection



Heavy Flowering

Light/No Flowering

Natural Pairs
n =49 pairs

Experimental Pairs
n= 34 pairs

Does plant phenology drive avian migratory routes and timing?

-Similar latitude

Similar tree communities

-Differ in elevation

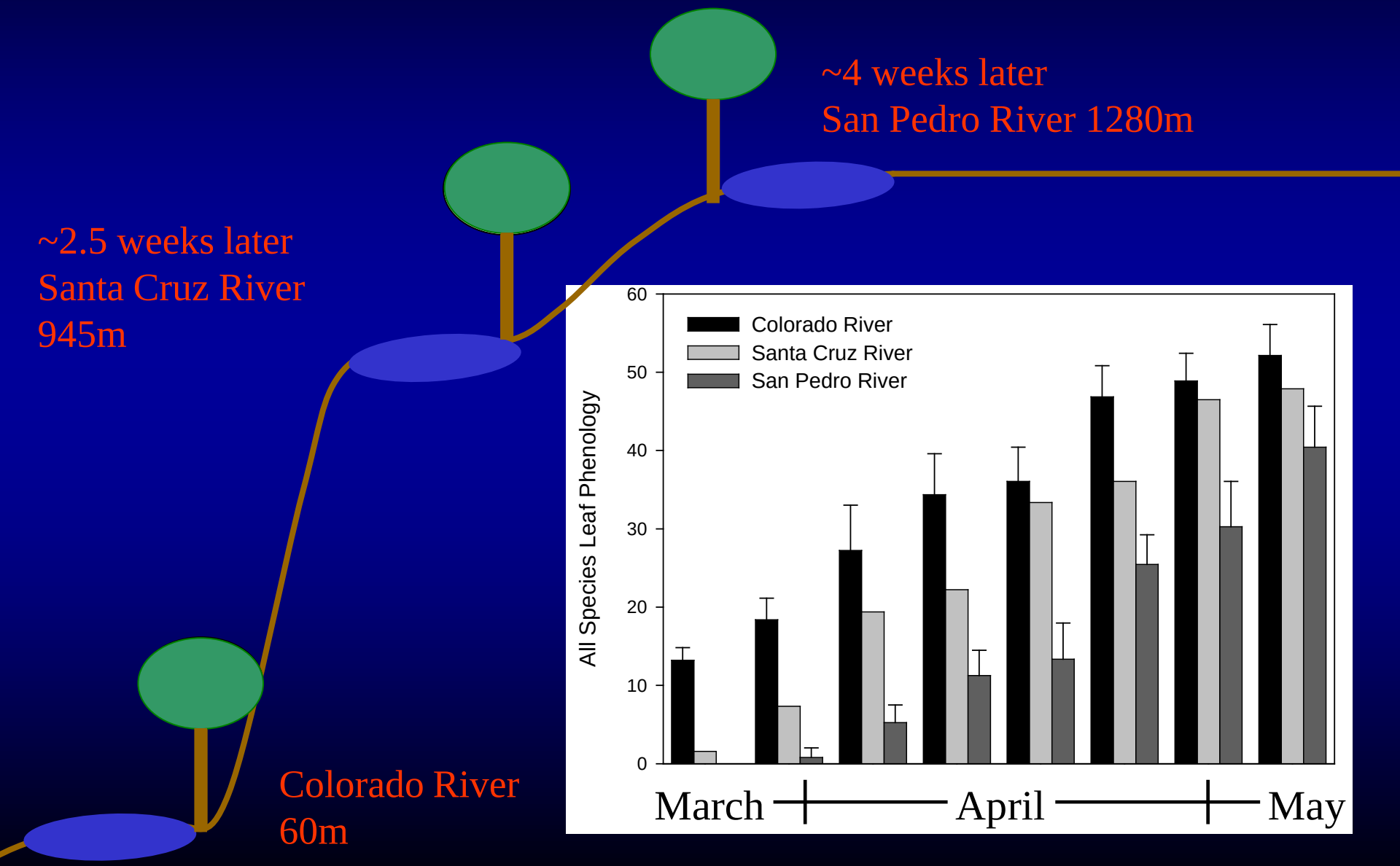
Mesquite
Cottonwo
Tamarisk

Colorado River
33.4N
60m

Santa Cruz River
31.5N
945m

San Pedro River
31.5N
1280m

Elevation delays tree phenology

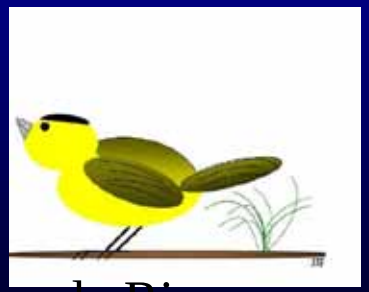


Elevation delays timing of migration

~1 week later
Santa Cruz River
945m

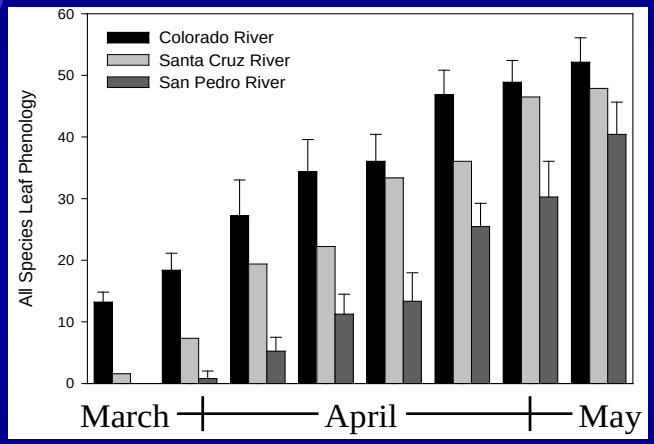
~1 week later
San Pedro River 1280m

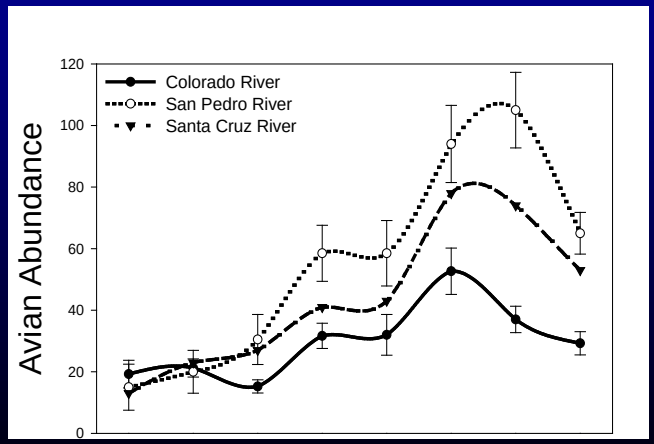
Birds arrive 1-2 weeks earlier than phenology would predict on Colorado River 85 m elevation



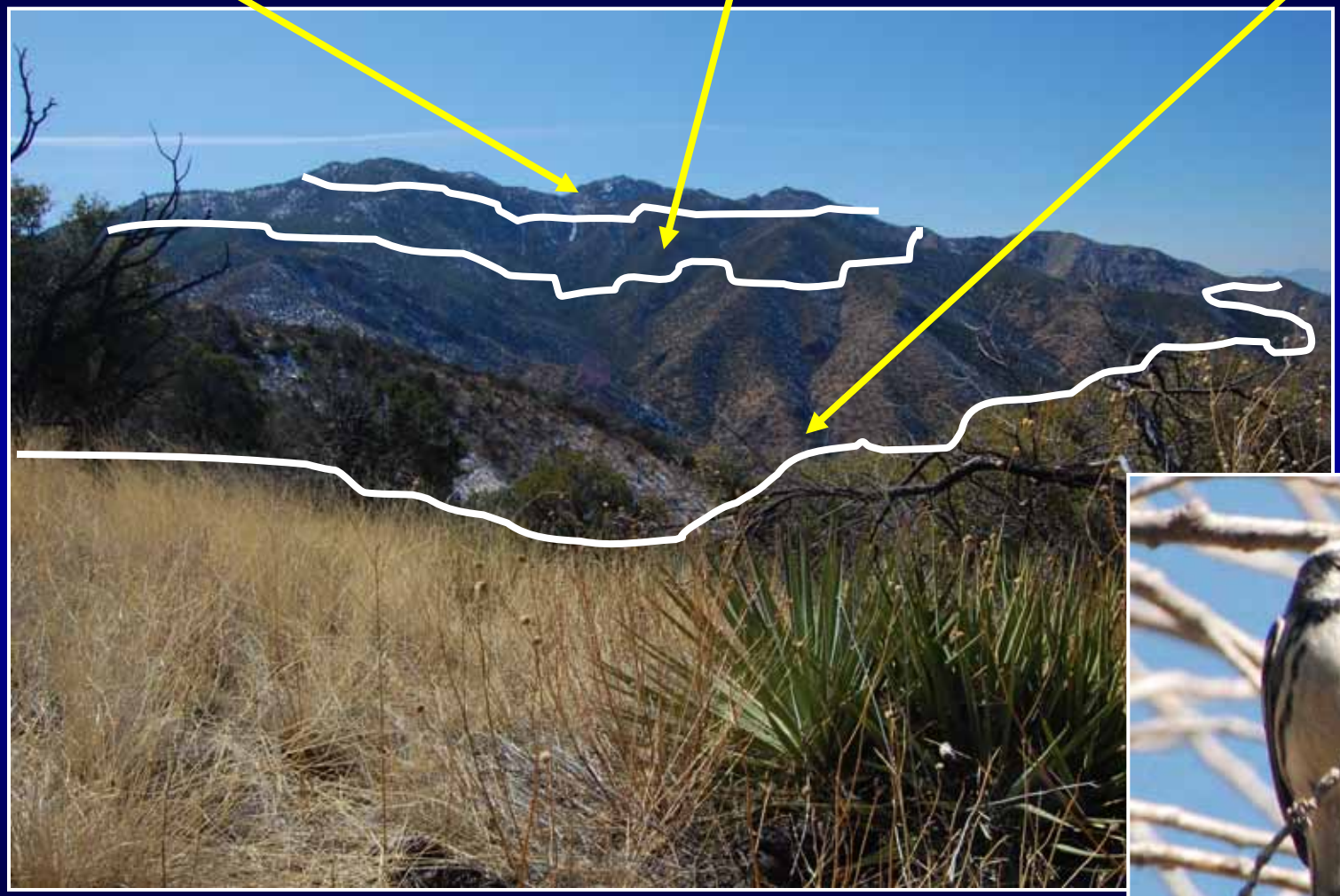
Colorado River
60m

Leaf Phenology

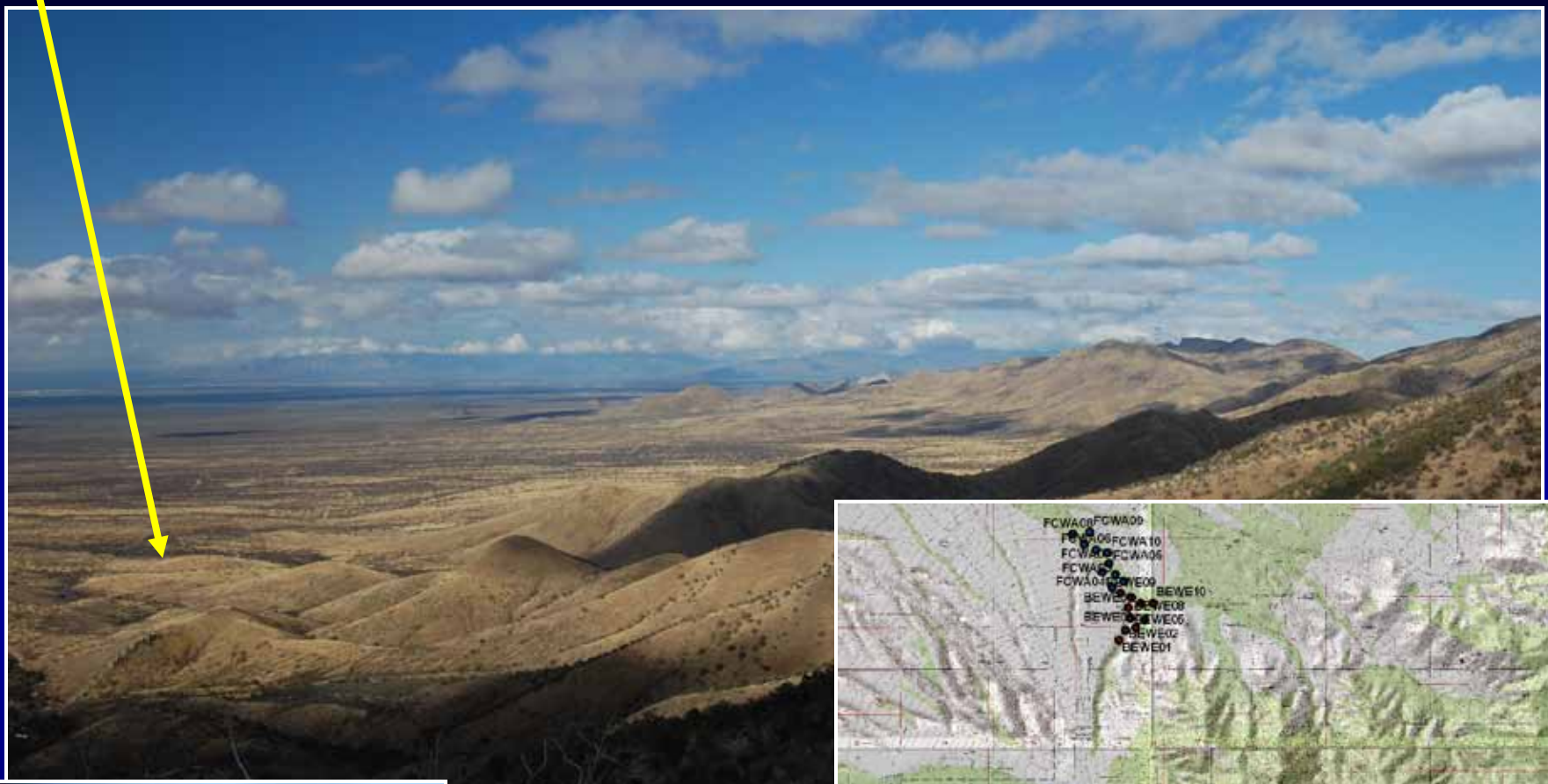


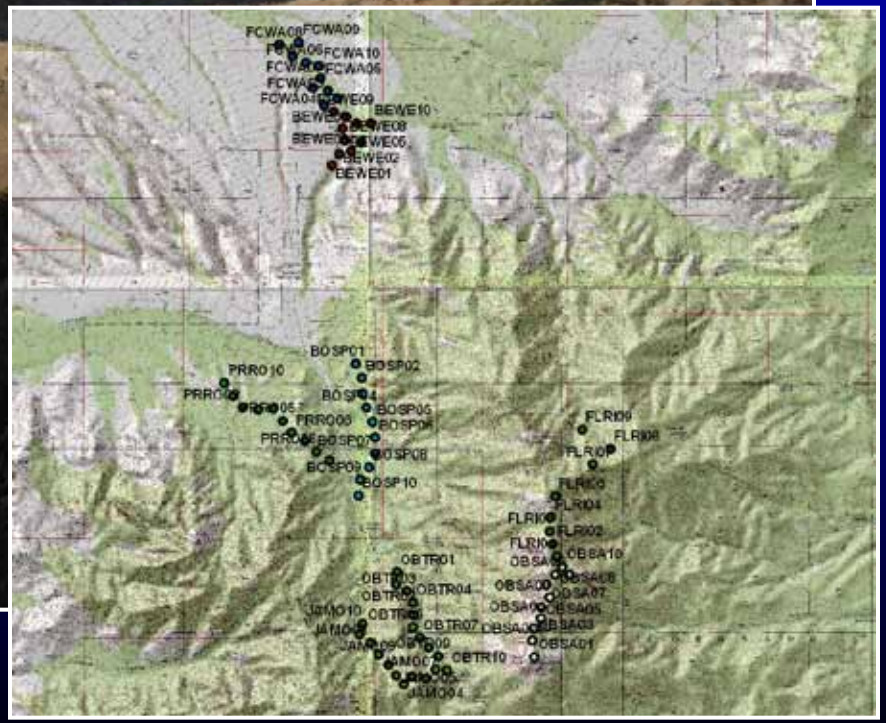


Elevational Gradient – Vegetation Zones



Santa Rita Experimental Range





CONCLUSIONS

- Neotropical migrant warbler species arrive from Mexico to Southwestern stopover sites (like WGEW and SRER) at different times, but all within the time when flowering trees (e.g., honey mesquite)are at peak bloom. Climate change will disrupt this.

- Birds initially key on large-scale habitat features to select stop-over sites, then refine their choices to patch and individual trees within that patch, all influenced by tree phenology.

- While at a stop-over site, neotropical migrant warblers forage primarily on tree species that are in flower and host significantly more insects than other riparian tree species. Climate change will influence this.

CONCLUSIONS (cont'd)

- If the temporal aspects of plant phenology will be altered with climate change, spring neotropical migrant warblers will be greatly influenced by changing tree phenology as plants in the southwest along the migration corridor, and on the breeding grounds, are differentially influenced by changes in climate and weather patterns.

- Areas like the USDA-ARS Walnut Gulch Experimental Watershed (WGEW) and the University of Arizona Santa Rita Experimental Range (SRER), will become even more important as stop-over locations for neotropical migrant birds.

IN SUMMARY:

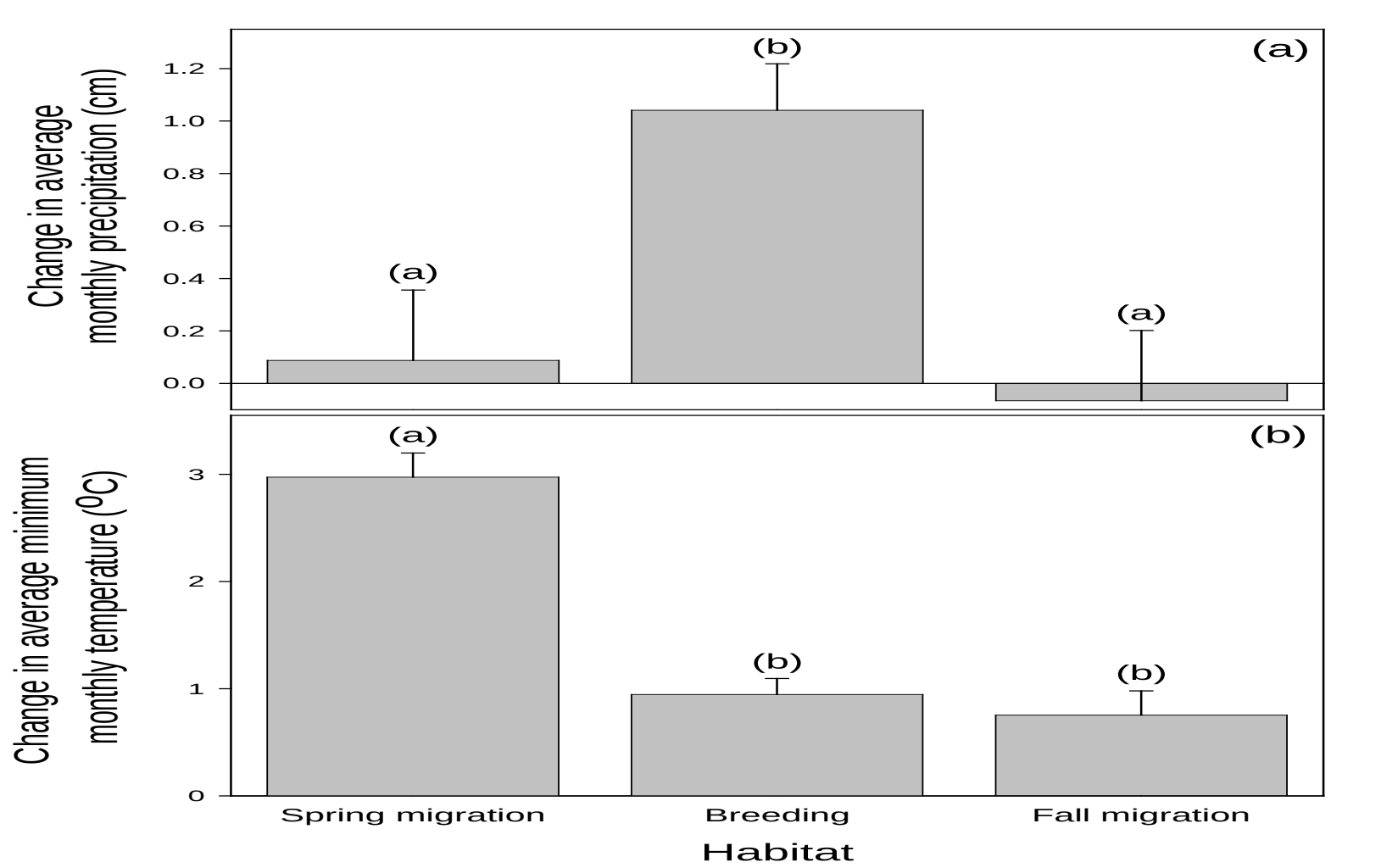
Plant Phenology has a Major Influence on Migrating Southwestern Birds: WGEW and SRER will Play an important role as stop-over habitats

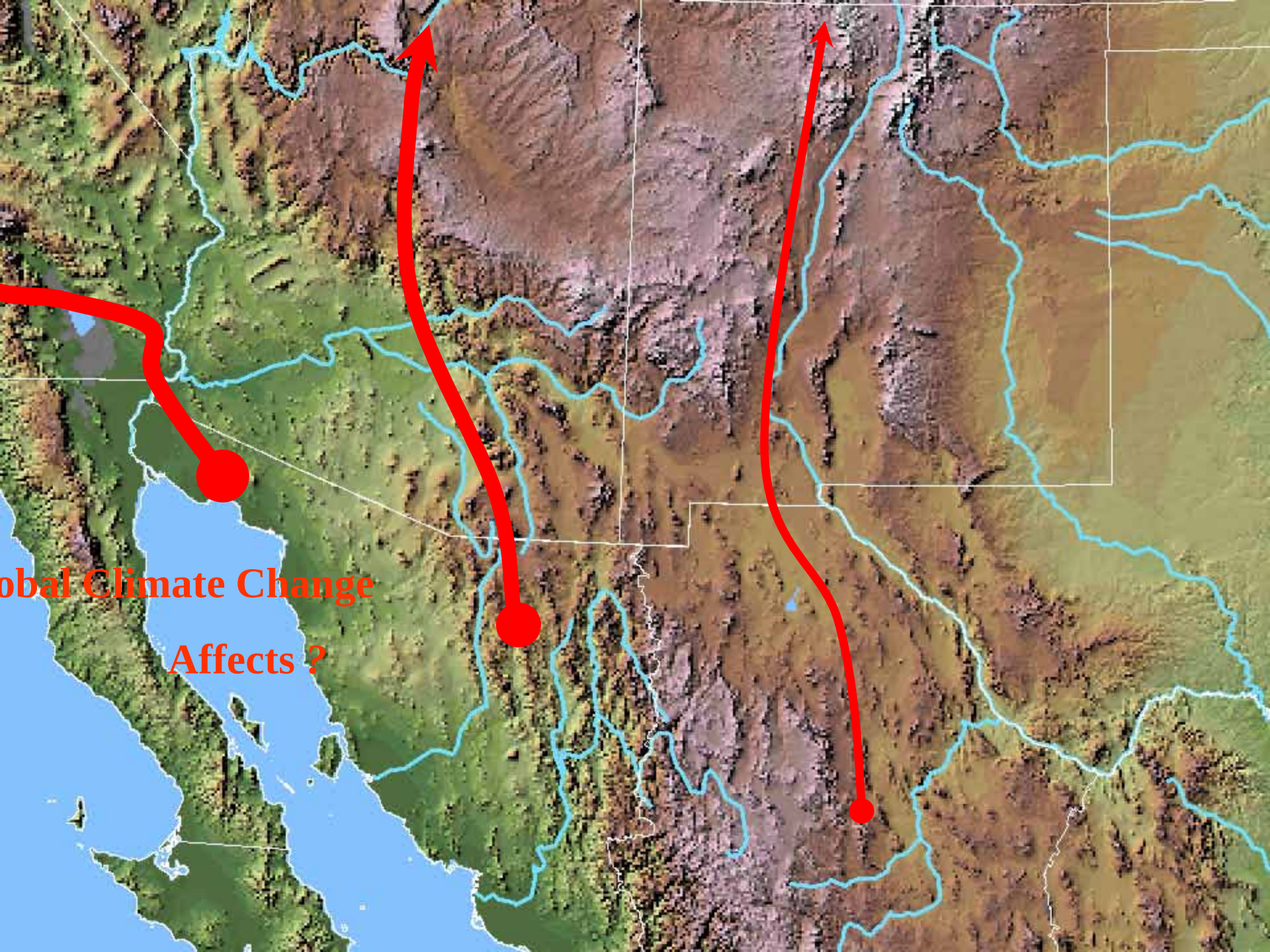
USGS

THANK YOU
Yellow Warbler

Migratory birds experience differences in climate change among spring migration, breeding, and fall migration locations.

After accounting for when birds are present at breeding versus migratory locations, climate change differed significantly between habitat categories, with birds experiencing relatively wetter breeding locations (a) and warmer spring migration locations (b). Columns denoted by different letters are significantly different at the 0.05 level according to an LSD post-hoc test.



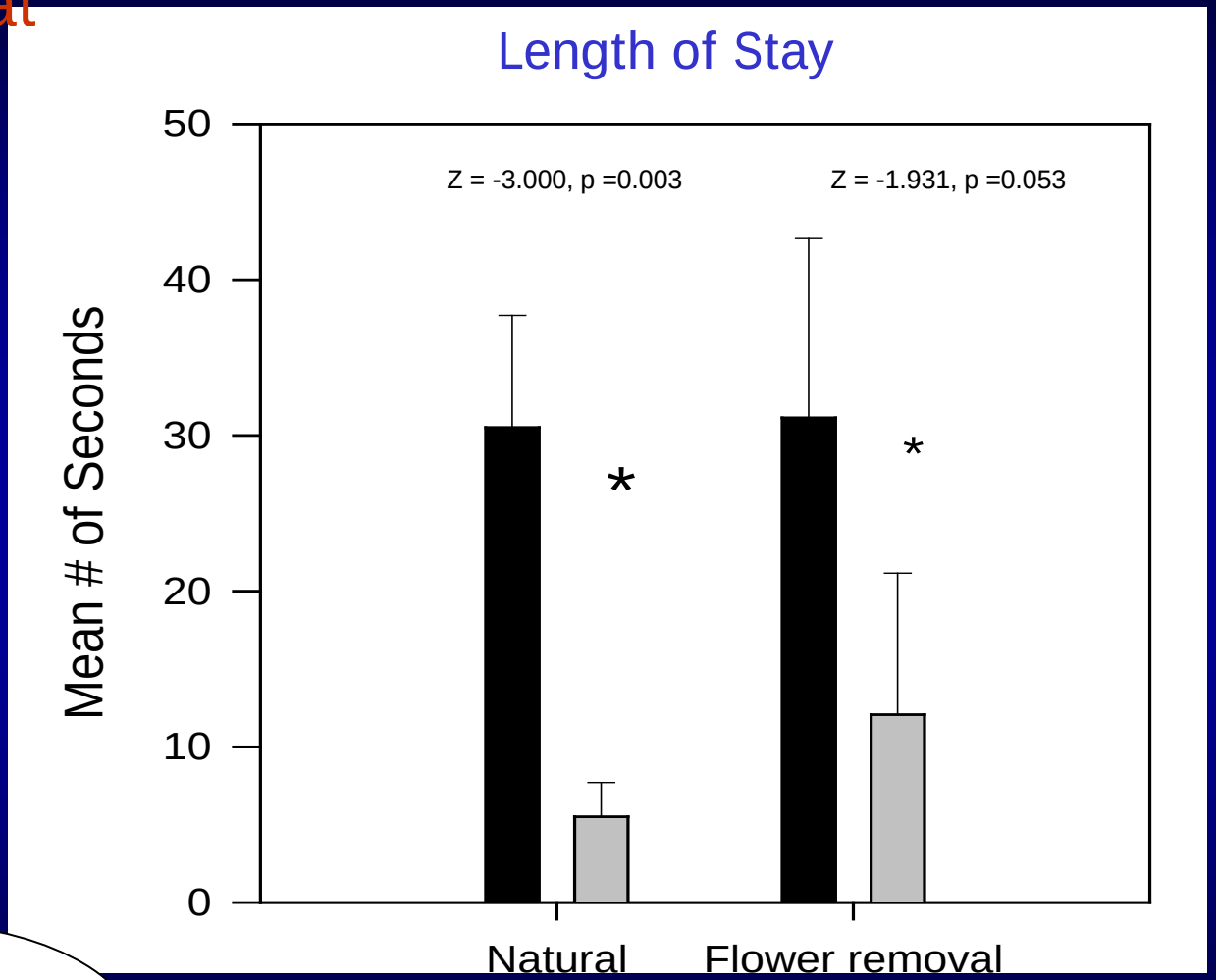

obal Climate Change
Affects ?

Microhabitat level:

Foraging Behavior at Paired Trees Shows Flower Selection

Heavy Flowering

Light/No Flowering



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n =49 pairs

Experimental Pairs
n= 34 pairs

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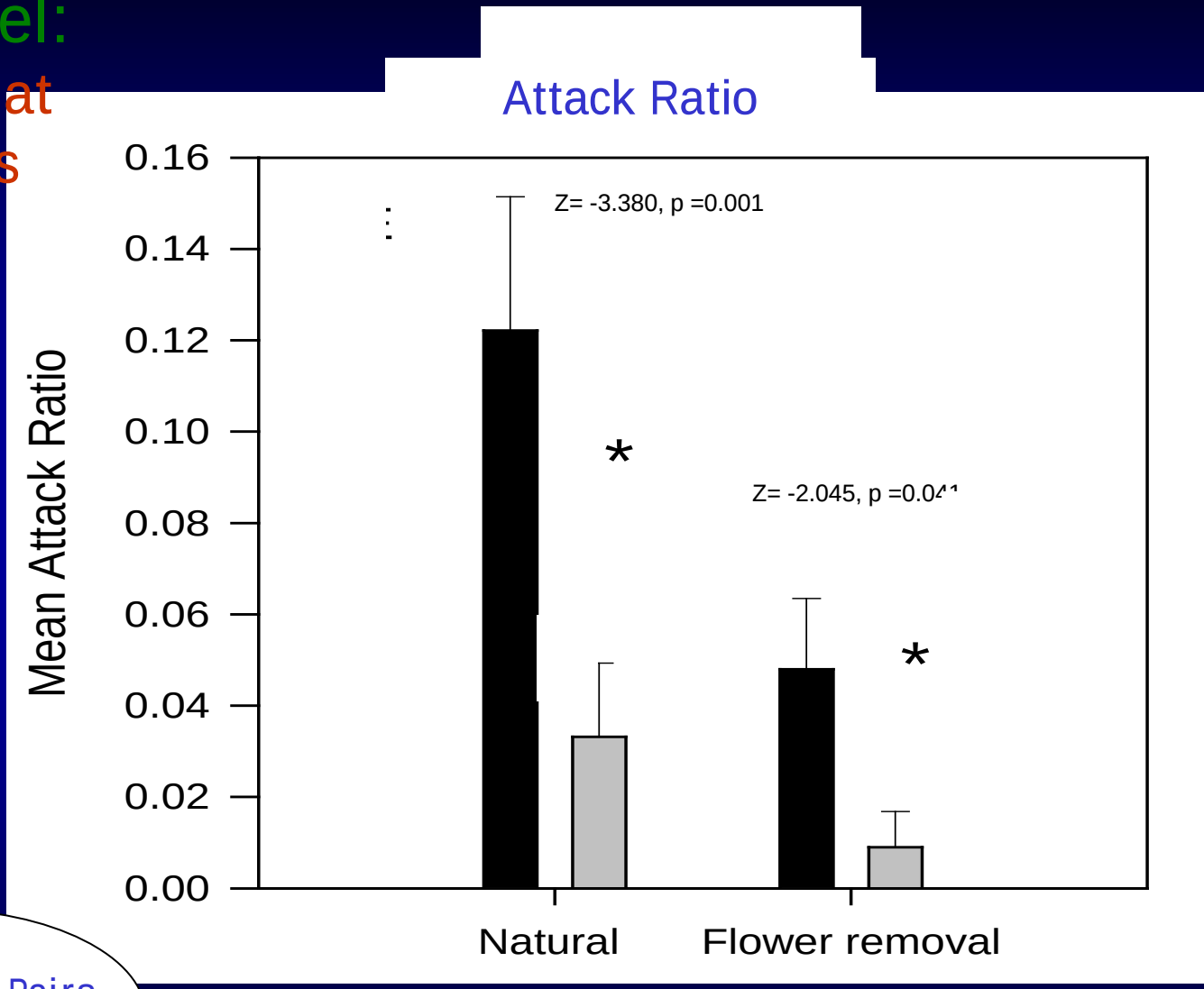


Natural Pairs
n =49 pairs

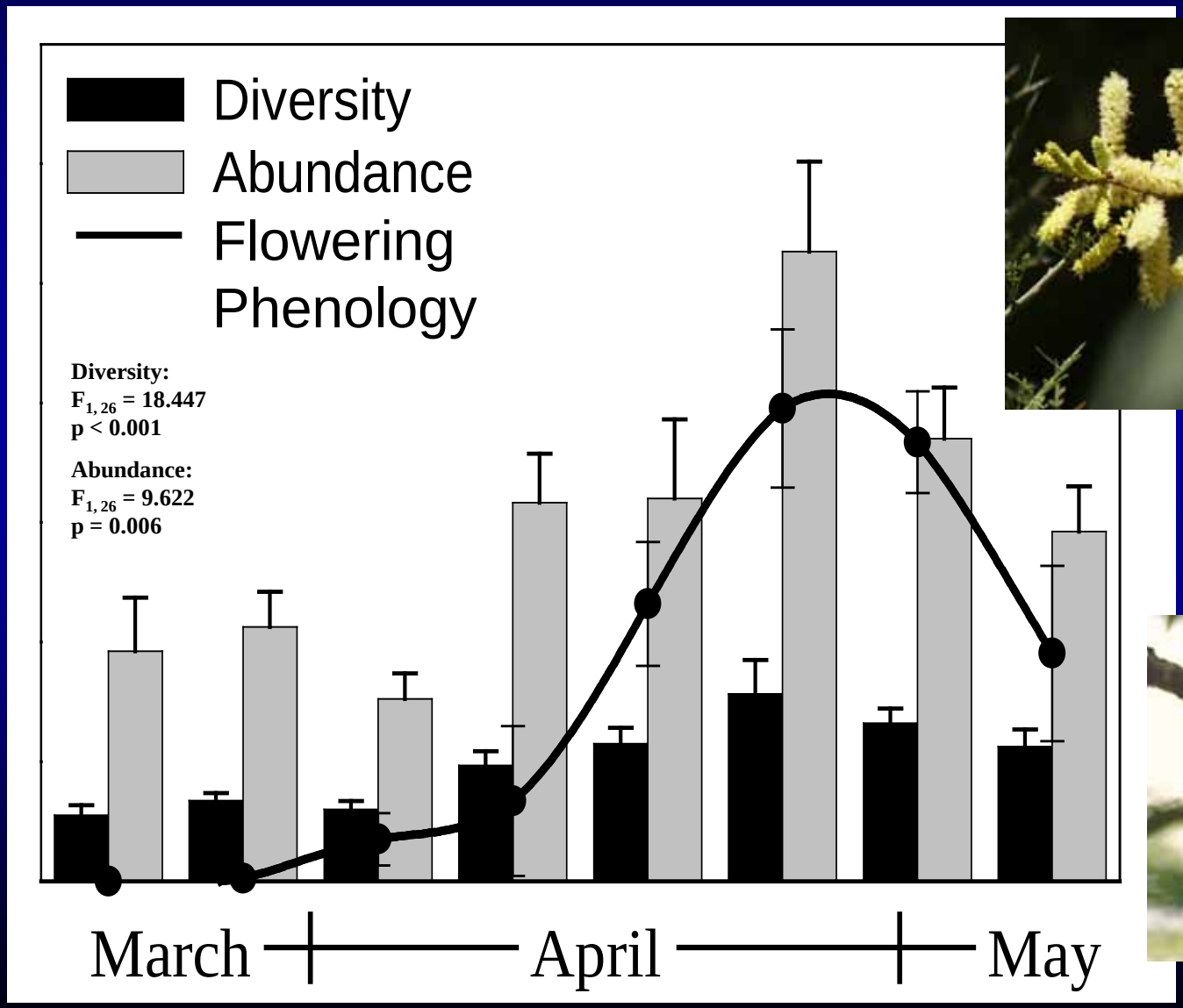
Experimental Pairs
n= 34 pairs

- Tree phenology influences patterns of avian migration throughout the Southwest

AND,

- Differences in migration patterns among sites are not as extreme as we would predict based on tree phenology alone (e.g., temporal constraints on reaching the breeding grounds)

On the Colorado River, avian diversity and abundance mirrors Honey Mesquite flowering



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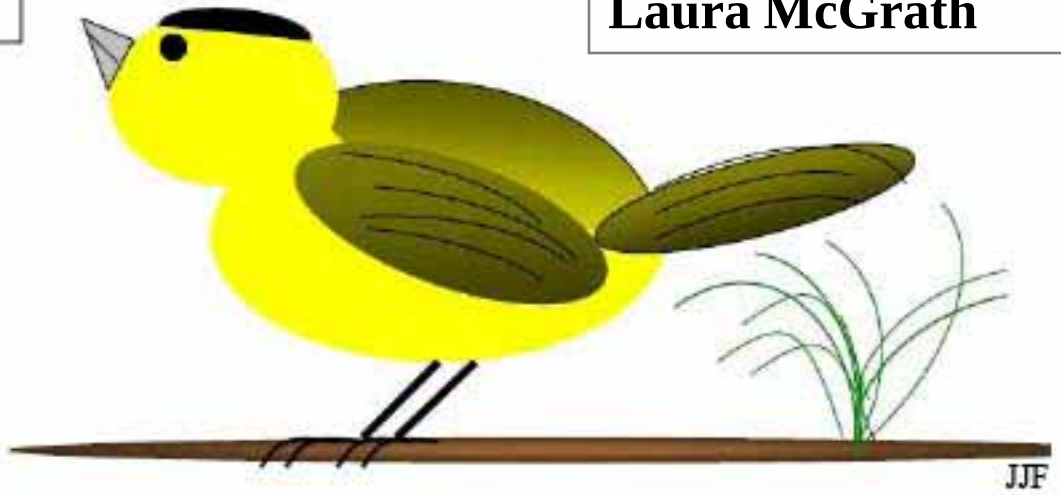


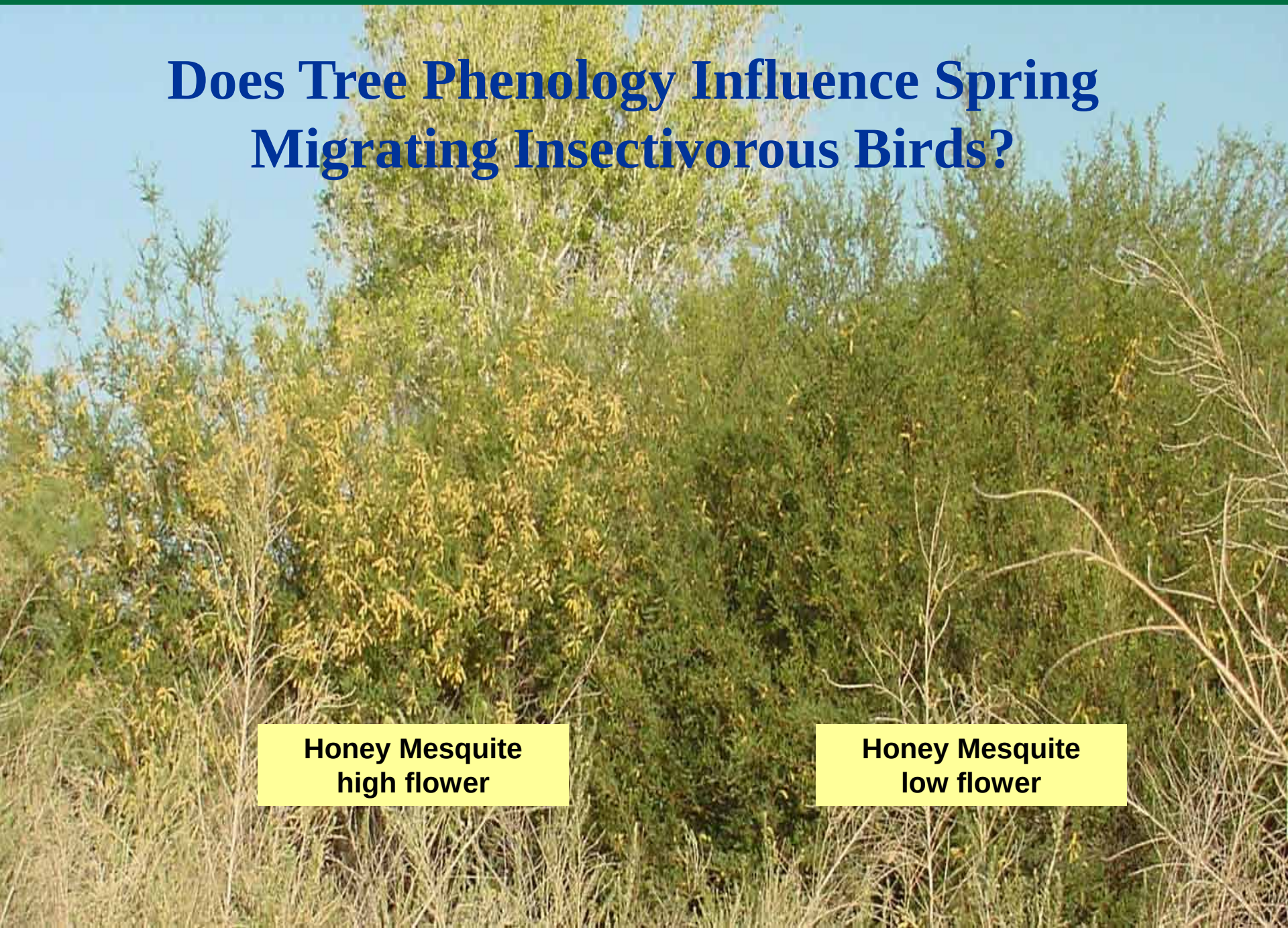
But how general are these patterns?

Colorado River

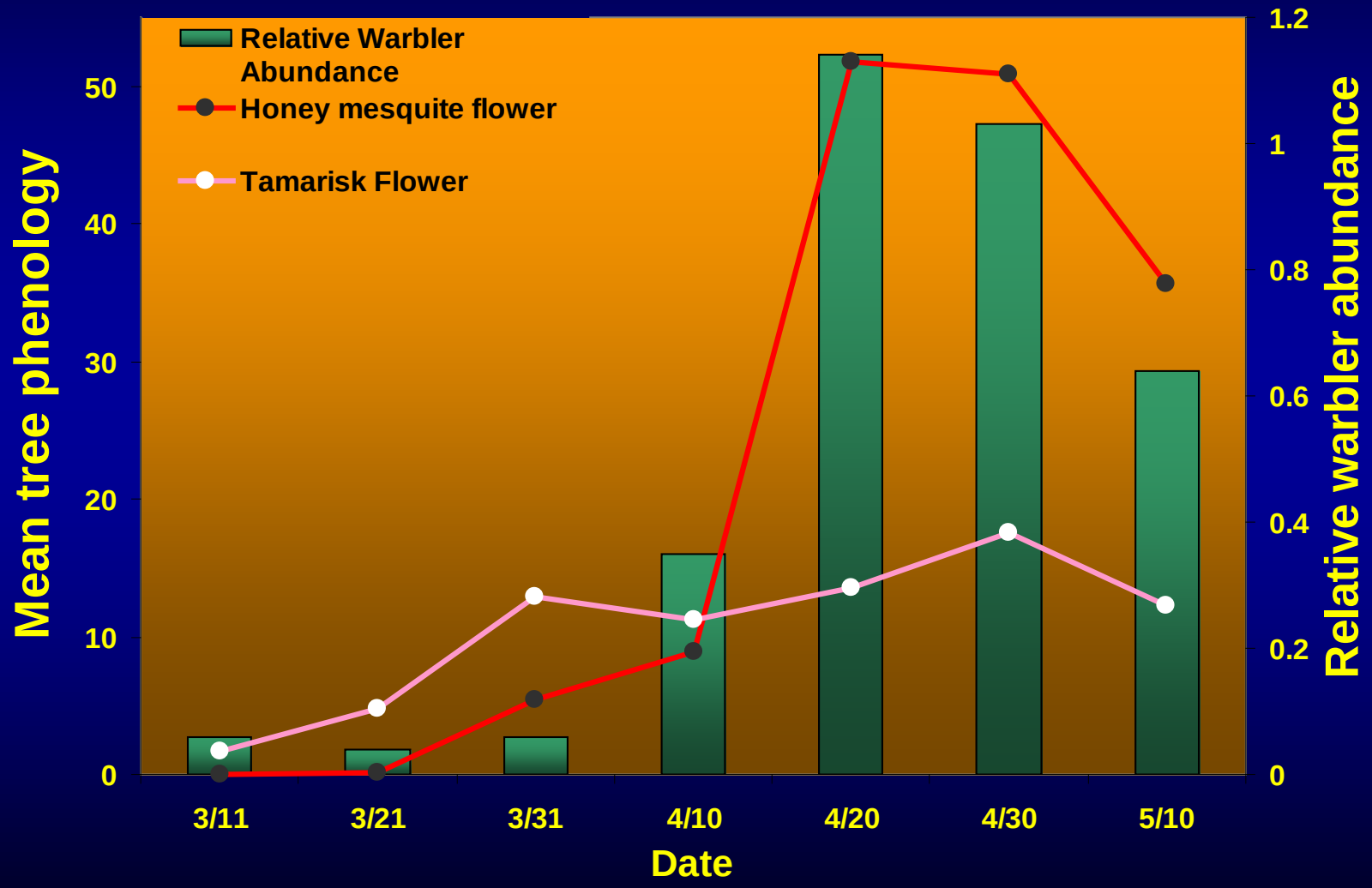
San Pedro River

Santa Cruz River

Does Tree Phenology Influence Spring Migrating Insectivorous Birds?

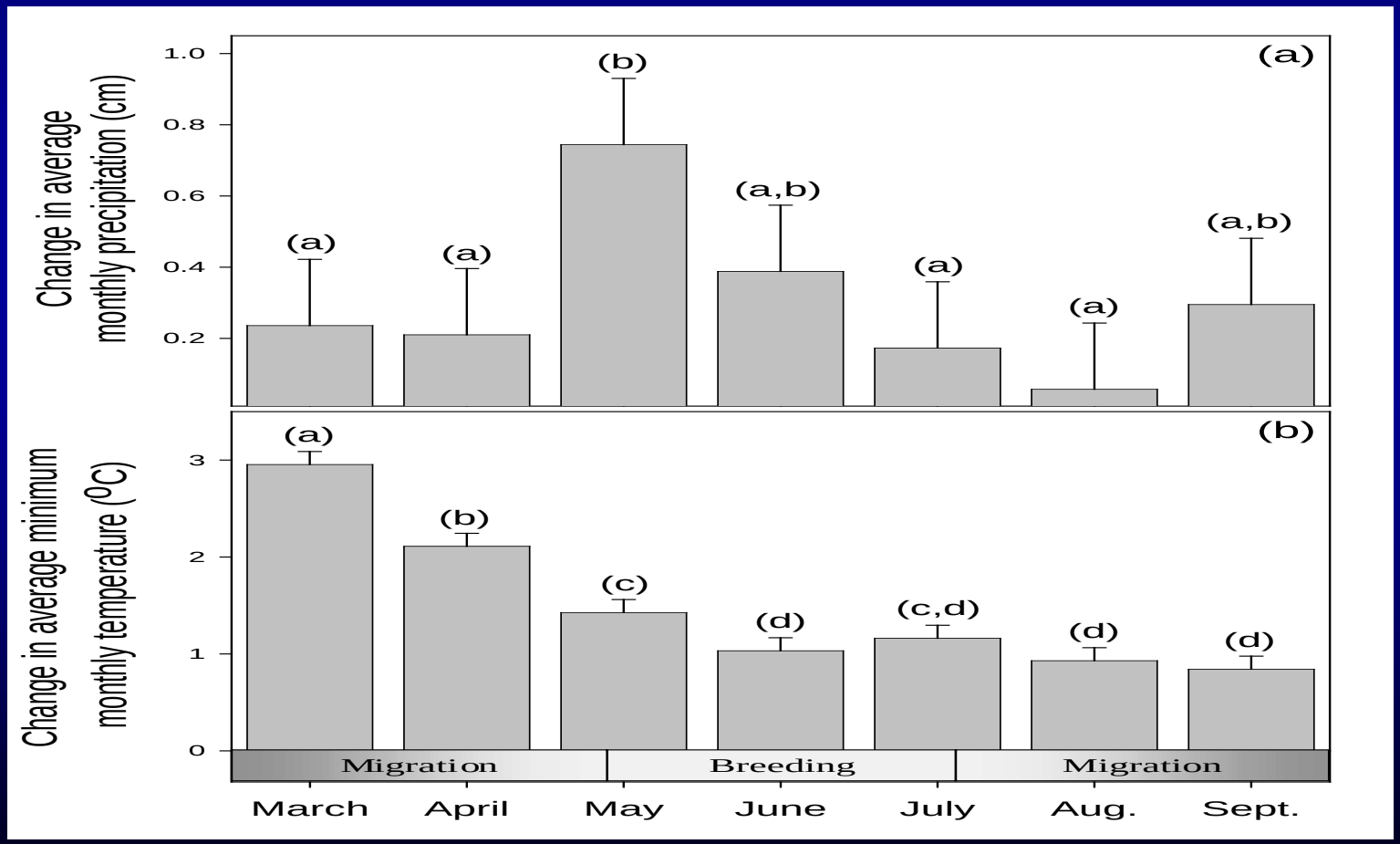


Warbler abundance and flower phenology on Tamarisk and Honey Mesquite

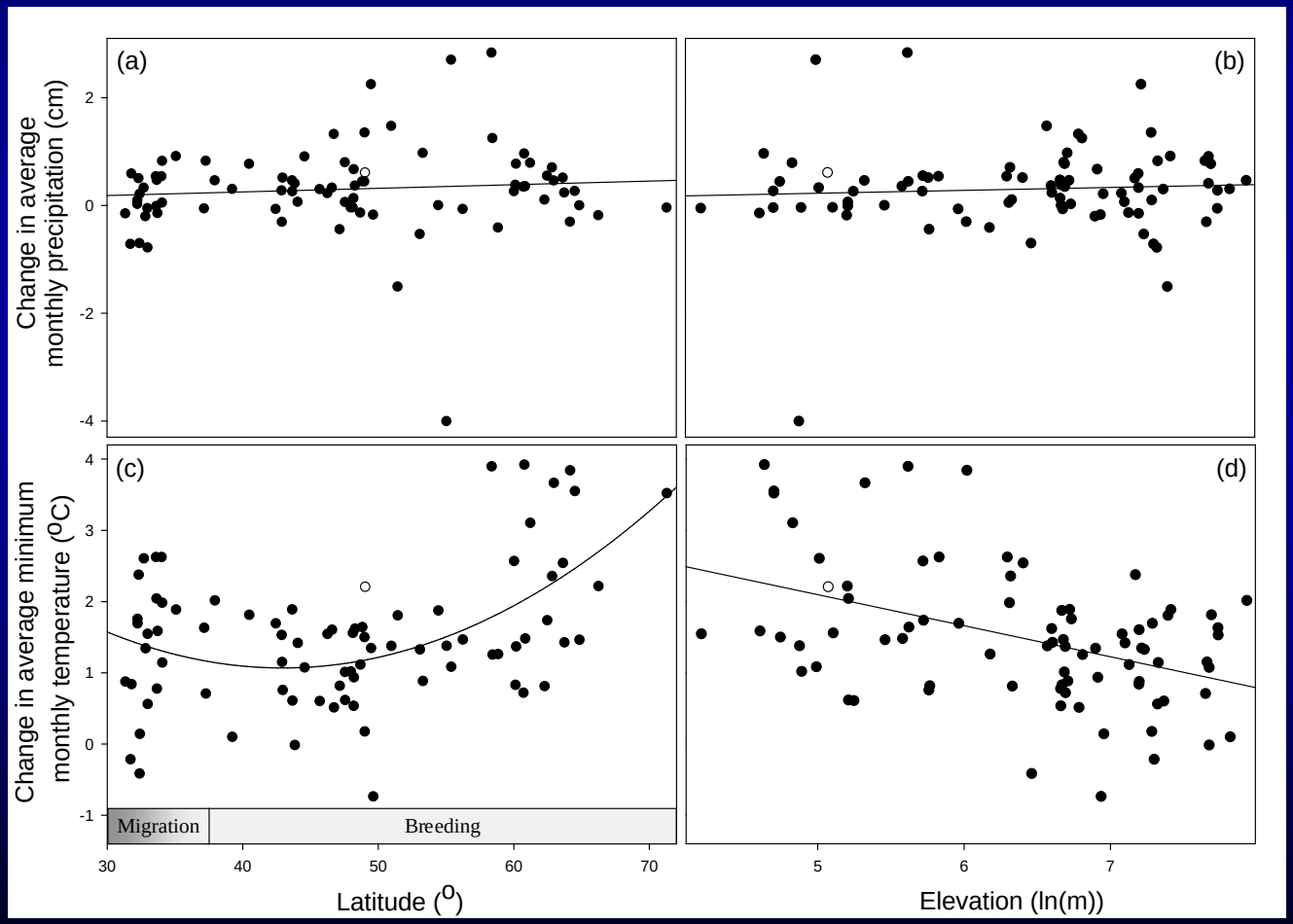


Changes in temperature but not precipitation show a clear seasonal trend.

Western North America experienced increasing precipitation (a), but with the exception of May the change did not differ across months or show any predictable seasonal pattern (r2 = 0.001). Minimum temperature also increased (b), but in contrast to precipitation, temperature changes showed a clear seasonal decline (r2 = 0.196). Columns denoted by different letters are significantly different at the 0.05 level according to an LSD post-hoc test.



Changes in temperature but not precipitation vary with latitude and elevation.

Changes in precipitation for Western North America are consistent across (a) latitudes (r2 = 0.002) and (b) elevations (r2 = 0.001); but changes in minimum temperature are more extreme at (c) higher latitudes (r2 = 0.111) and (d) lower elevations (r2 = 0.085). Elevations were natural-log transformed to correct for higher variance at lower elevations. For visual simplicity data presented here represent mean changes for the months of March-September

for the years 1954-2006.