

Effects of Drought on a Desert Riparian Woodland

Dominic D. LaRoche¹, Courtney J. Conway^{1,2}, Don Swann³, and Chris Kirpatrick¹

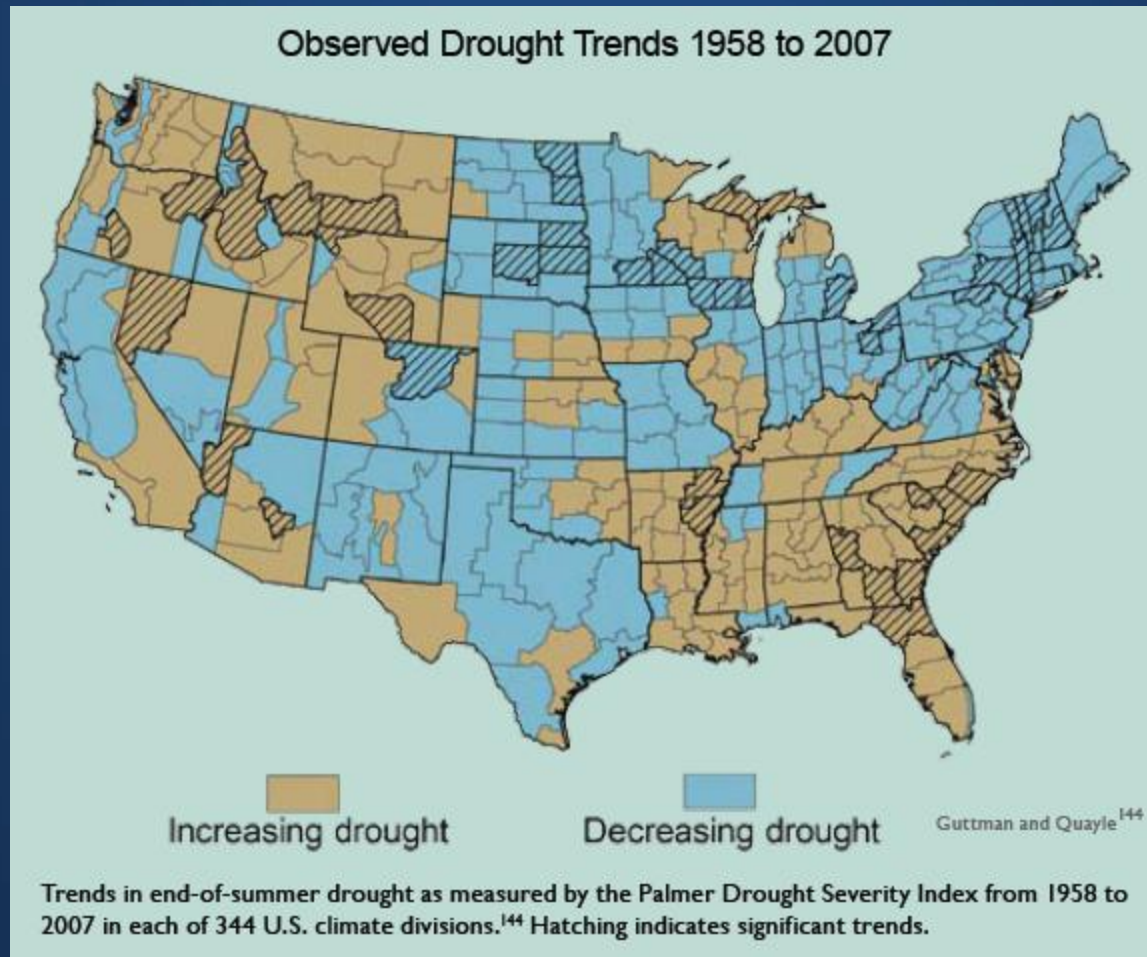
¹School of Natural Resources & the Environment, Univ. of AZ

²USGS Arizona Cooperative Fish and Wildlife Research Unit

³Saguaro National Park

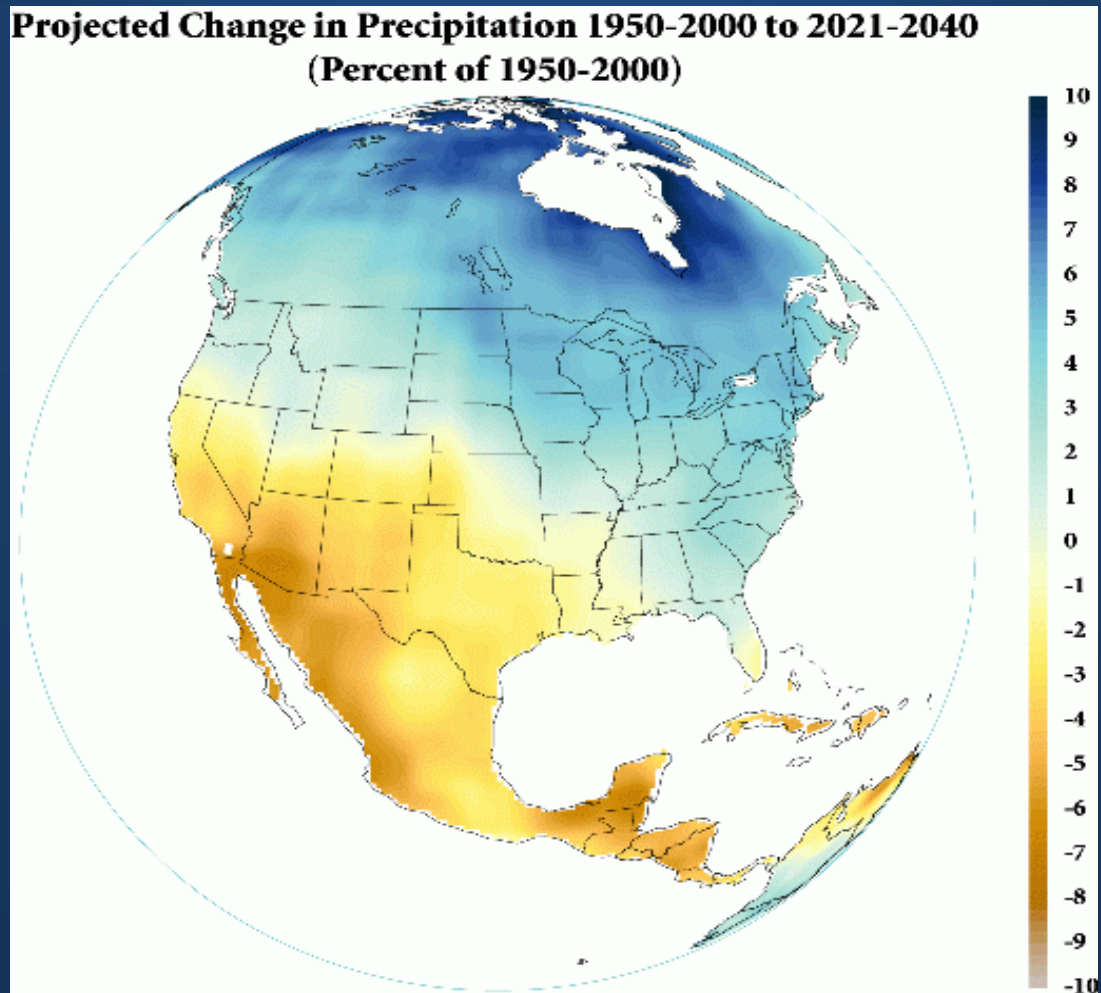


Water Resources in the Southwest are already under pressure



From *Global Climate Change Impacts in the United States*, Thomas R. Karl, Jerry M. Melillo, and Thomas C. Peterson, (eds.). Cambridge University Press, 2009.

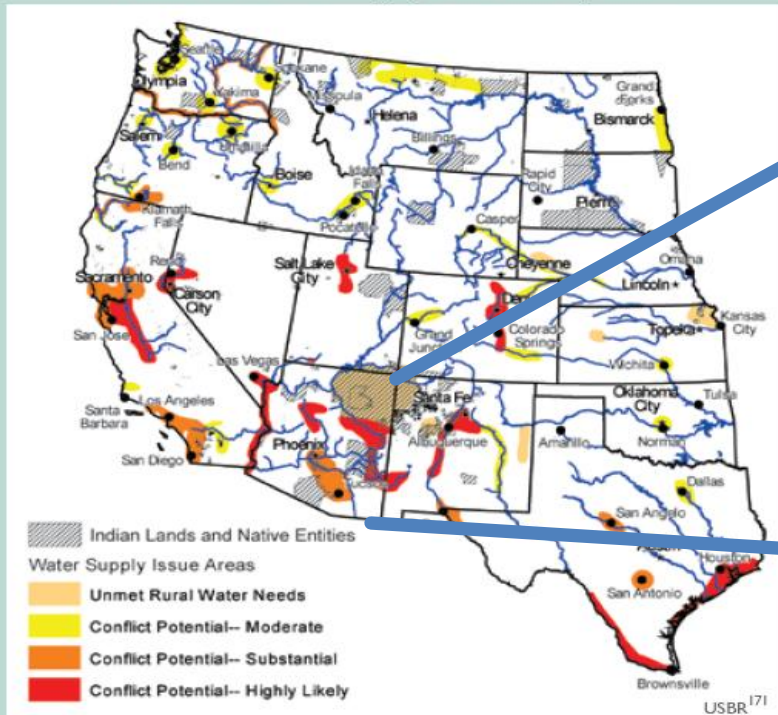
Climate Change likely to lead to a more arid environment in the southwest



From *Global Climate Change Impacts in the United States*, Thomas R. Karl, Jerry M. Melillo, and Thomas C. Peterson, (eds.). Cambridge University Press, 2009.

We will see increasing conflict between the human population and the environment for water resources

Potential Water Supply Conflicts by 2025

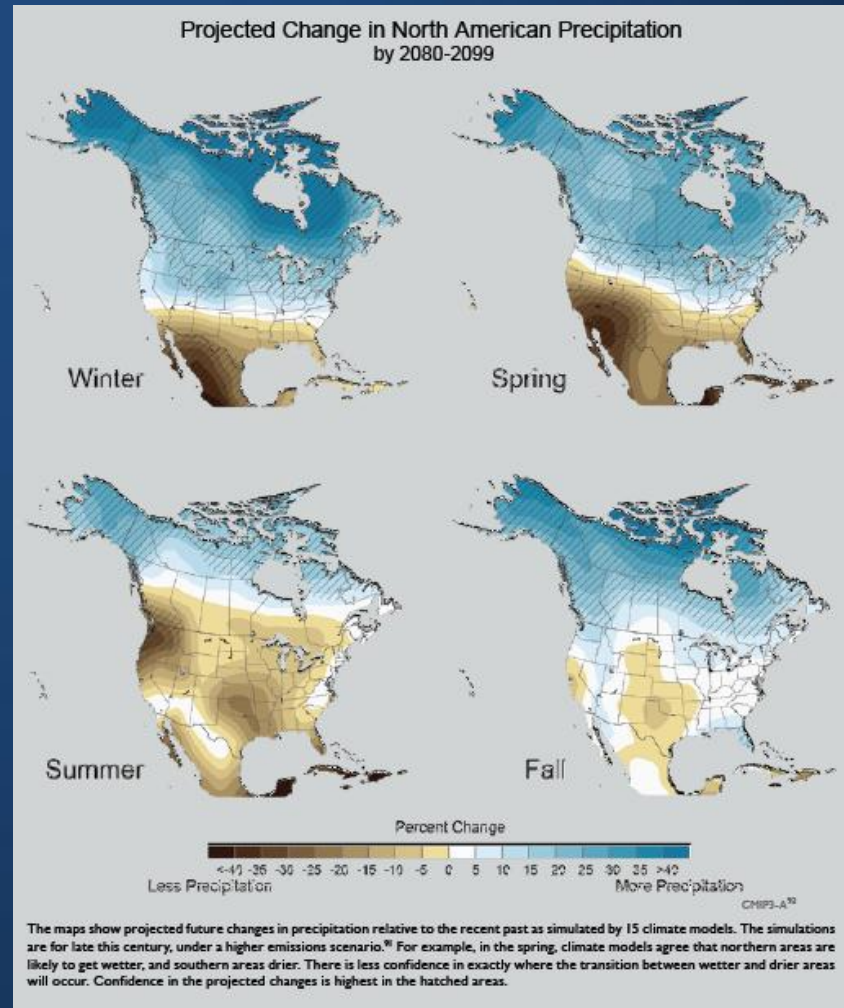


The map shows regions in the West where water supply conflicts are likely to occur by 2025 based on a combination of factors including population trends and potential endangered species' needs for water. The red zones are where the conflicts are most likely to occur. This analysis does not factor in the effects of climate change, which is expected to exacerbate many of these already-identified issues.¹⁷¹

From *Global Climate Change Impacts in the United States*, Thomas R. Karl, Jerry M. Melillo, and Thomas C. Peterson, (eds.). Cambridge University Press, 2009.

Likely mechanisms for decreased water availability

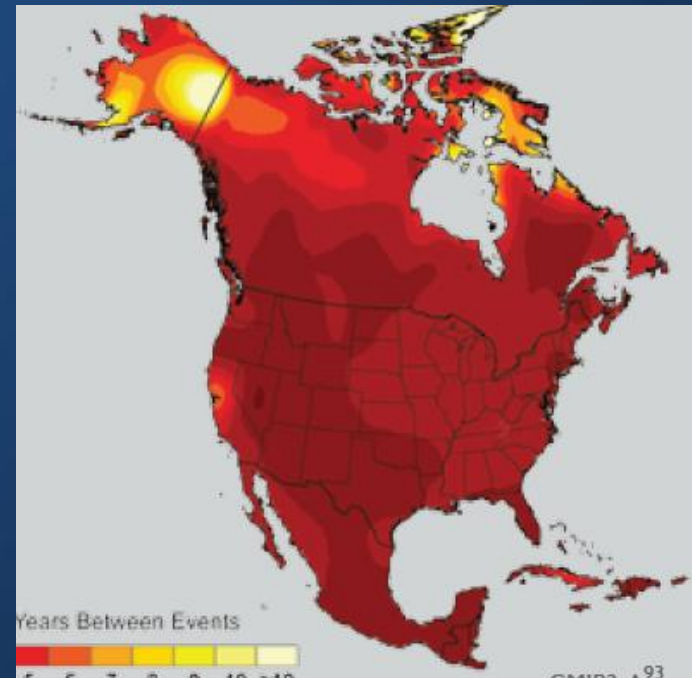
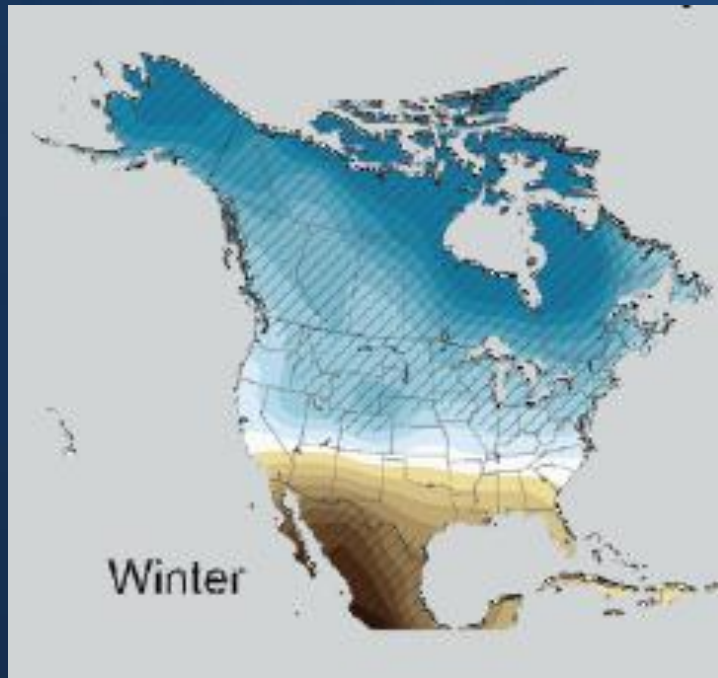
- Decreased winter and spring precipitation



From Global Climate Change Impacts in the United States , Thomas R. Karl, Jerry M. Melillo, and Thomas C. Peterson, (eds.). Cambridge University Press, 2009.

Likely mechanisms for decreased water availability

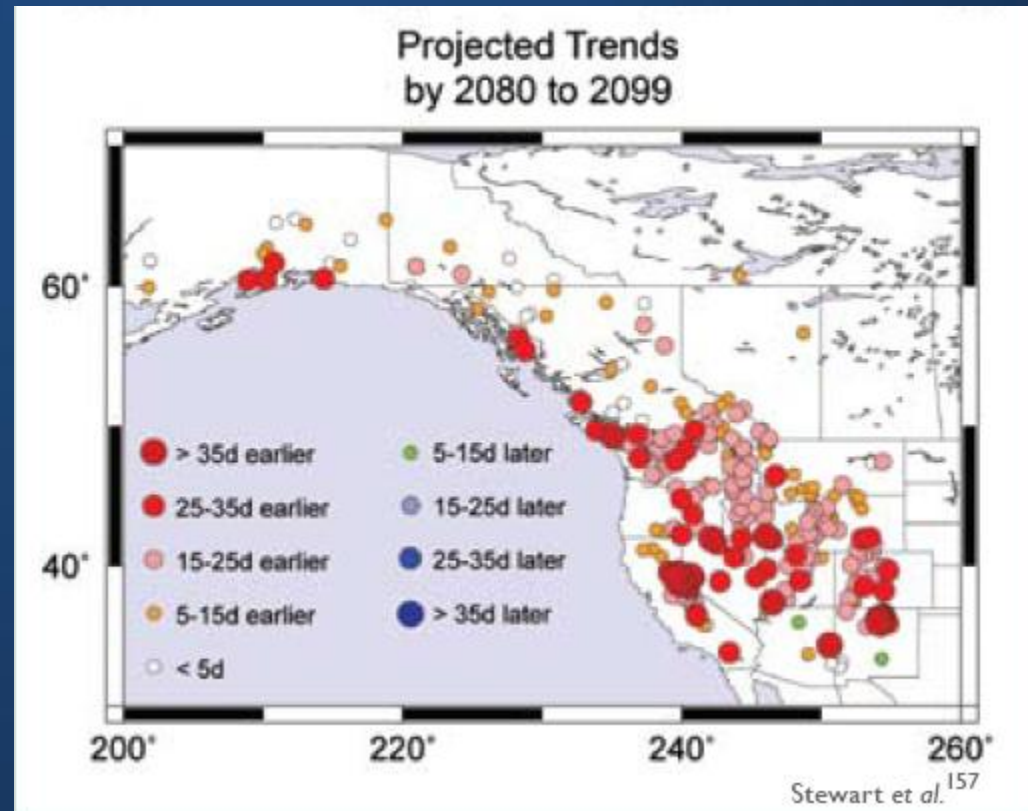
- Decreased Winter Snowpack



From Global Climate Change Impacts in the United States , Thomas R. Karl, Jerry M. Melillo, and Thomas C. Peterson, (eds.). Cambridge University Press, 2009.

Likely mechanisms for decreased water availability

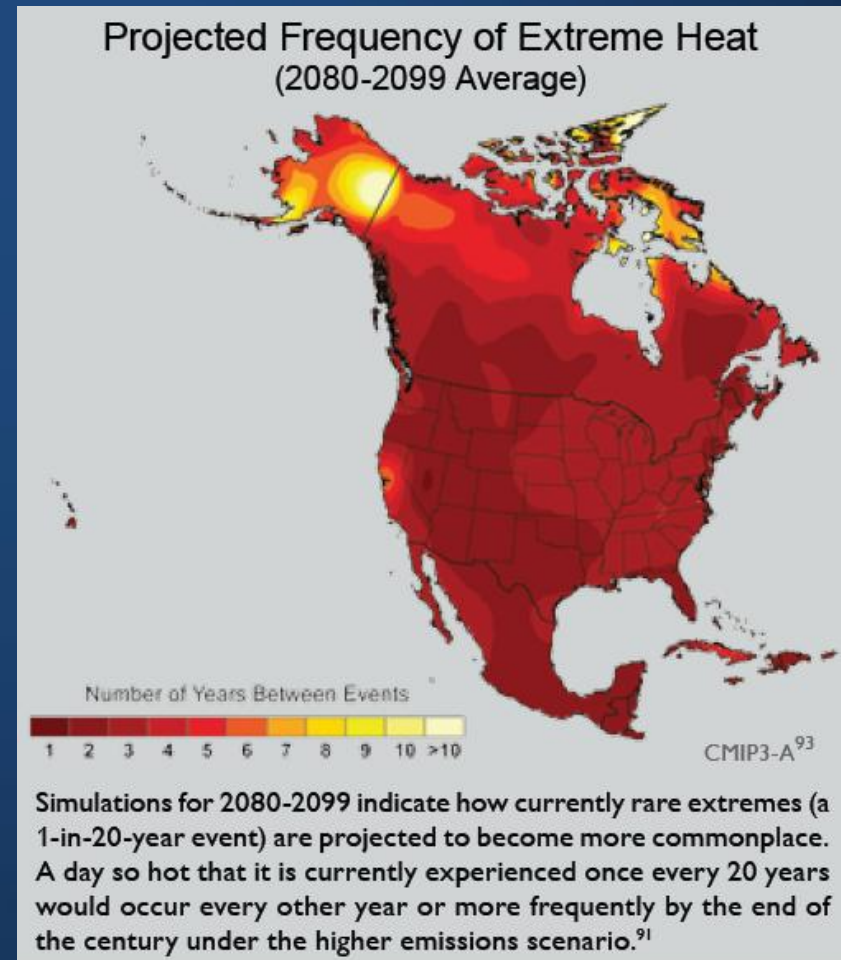
- Earlier snowmelt



From Global Climate Change Impacts in the United States , Thomas R. Karl, Jerry M. Melillo, and Thomas C. Peterson, (eds.). Cambridge University Press, 2009.

Likely mechanisms for decreased water availability

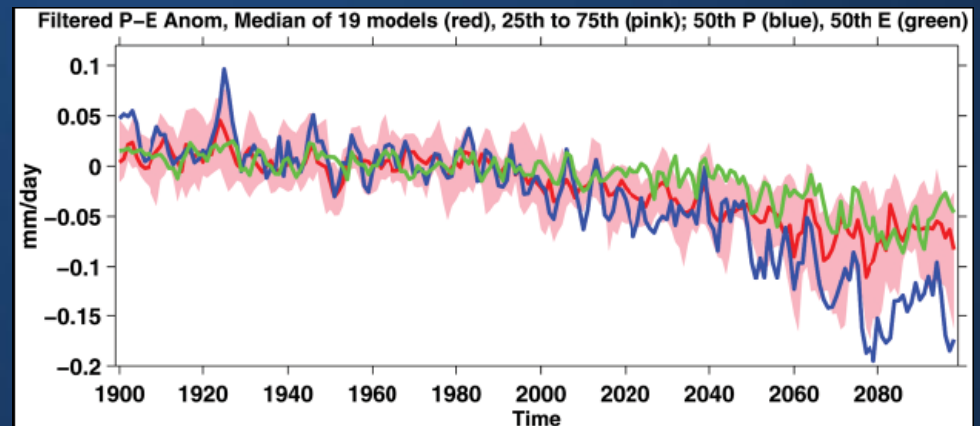
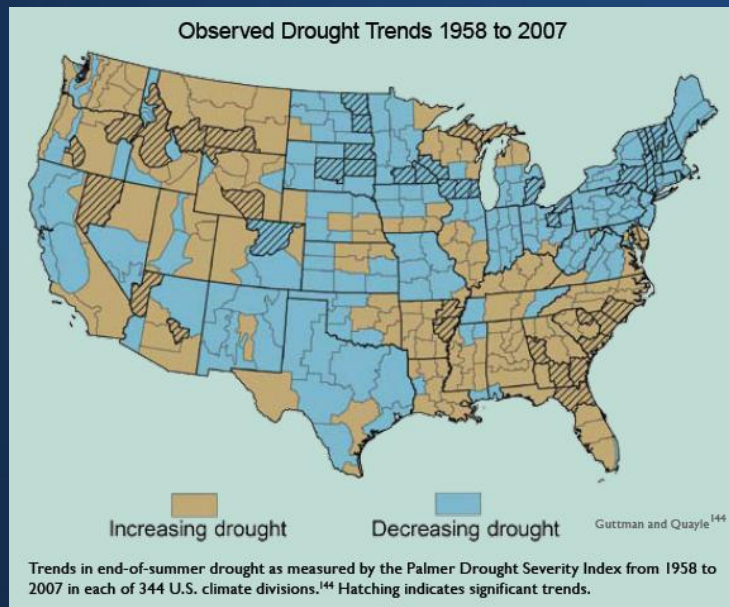
- Higher temperatures



From Global Climate Change Impacts in the United States , Thomas R. Karl, Jerry M. Melillo, and Thomas C. Peterson, (eds.). Cambridge University Press, 2009.

Likely mechanisms for decreased water availability

- Increasing frequency of droughts
- Increasing severity of droughts



From: Seager, R., M. Ting, I. Held, Y. Kushnir, J. Lu, G. Vecchi, H. P. Huang, N. Harnik, A. Leetmaa, N. C. Lau, C. Li, J. Velez, and N. Naik. 2007. Model projections of an imminent transition to a more arid climate in southwest North America. *Science* 316

What does this mean for riparian woodlands in the southwest?

- Cover only 0.5% of the State's landmass
- Thought to support >50% of breeding bird species (Johnson et al. 1977), including many spp of conservation concern
- Thought to provide critical stopover habitat for numerous species of migratory birds
- Surprisingly few long-term studies

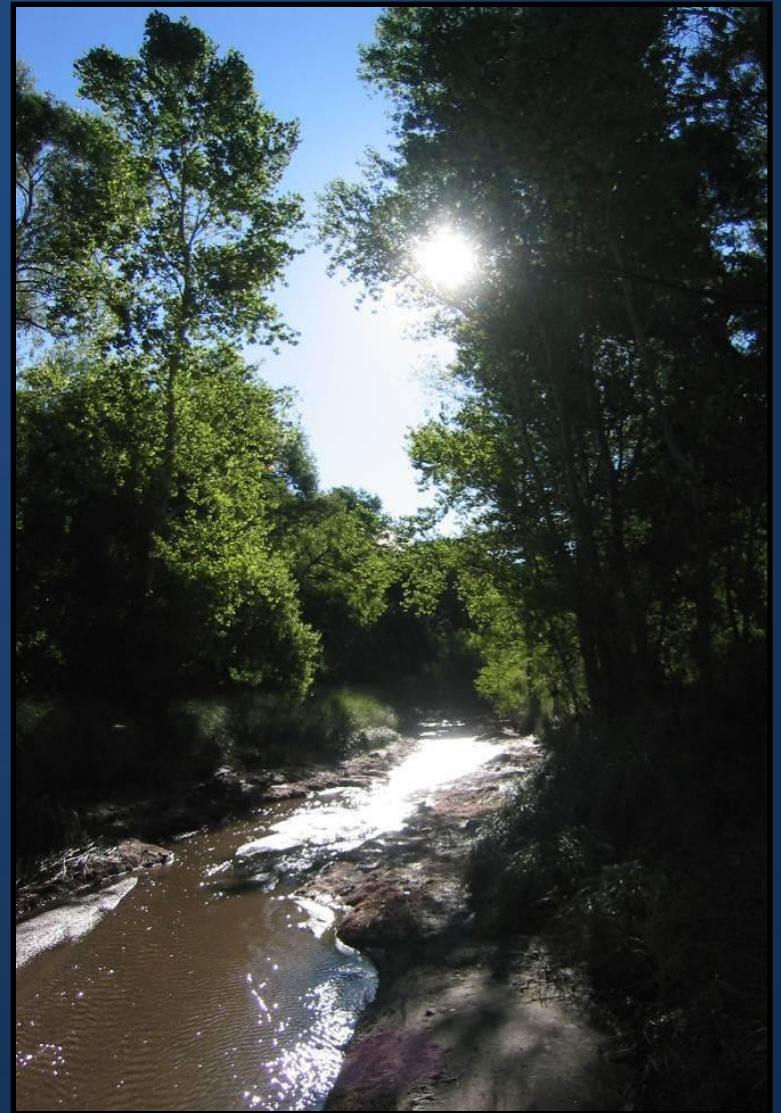
Methods

Study Site:

Rincon Creek, Saguaro National Park,
Tucson, Arizona

Low elevation (965m) riparian
woodland

Suffered severe drought in 2006



Methods

Bird Surveys:

10 Survey stations 100m apart

Conducted 8 minute passive surveys
for all birds seen or heard within 50m
of survey stations

Conducted 4 surveys per year at each
point during the breeding season

Surveyed for 4 years



©Audrey Nelson

Methods

Nest Monitoring:

Located and monitored nests of all species

Focused efforts on 4 species:

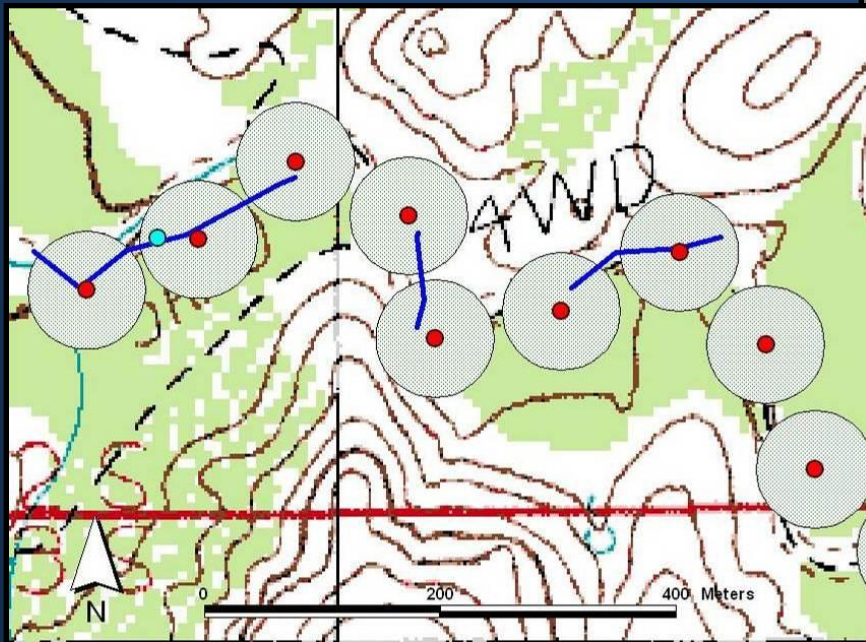
- Abert's Towhee
- Northern Cardinal
- Bell's Vireo
- Lucy's Warbler

Checked nests every other day and measured clutch size, egg volume, and nestling growth rates



Methods

We estimated the surface area of standing pools and flowing water within 50m of all survey points after each survey



We collected data from 3 groundwater monitoring wells located 5, 47, and 89m from the stream channel at the upstream end of the study site

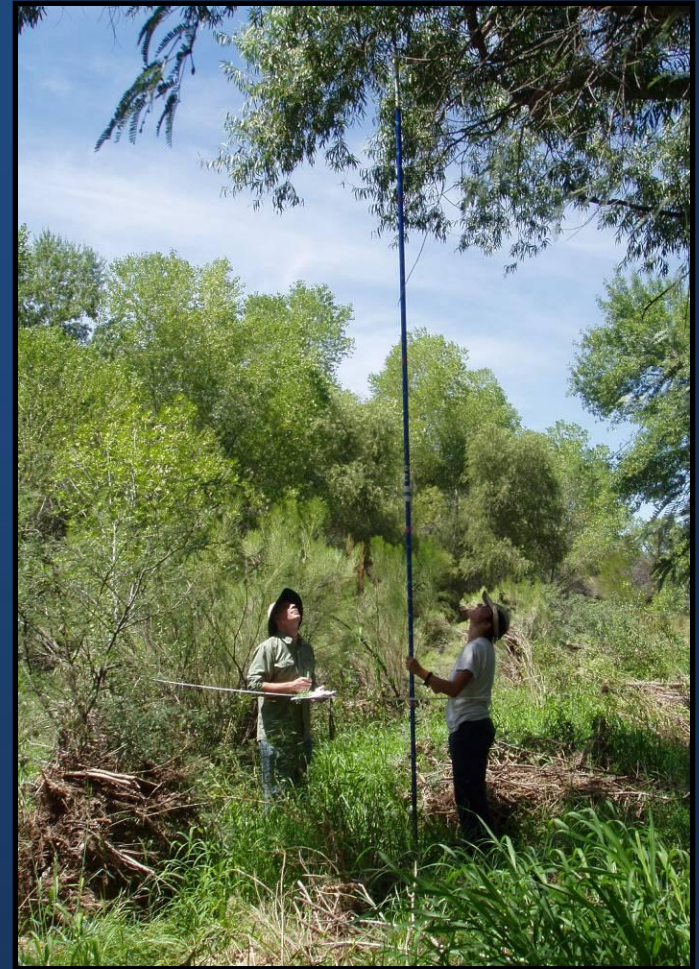
Methods

Vegetation Measurements:

Estimated volume of both live and dead vegetation at the end of the breeding season in each year

Used point-line-intercept method

Estimated vegetation volume within 50m of survey stations



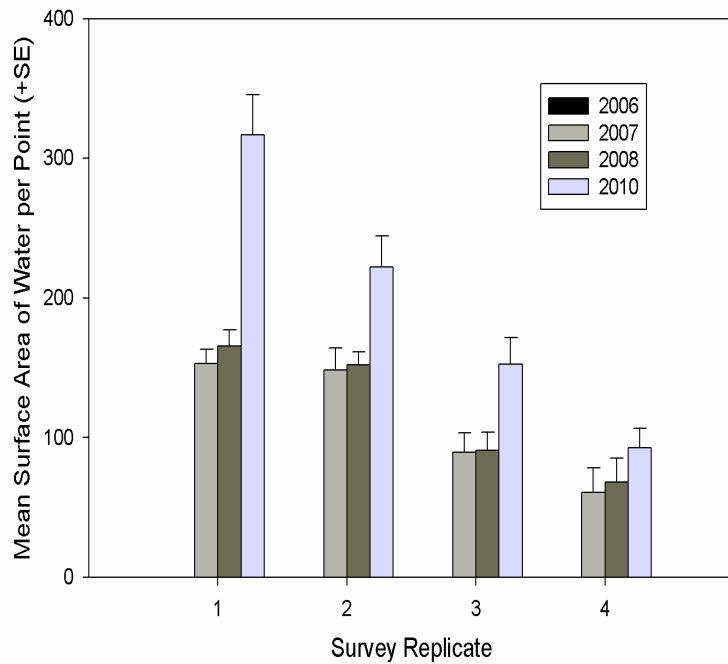
Modeling

- We derived 3 vegetation variables which represent the proportion of live to dead vegetation within 50 m of a survey station at three height categories: 0-2.5m, 2.6-5m, and 5.1-20m
- We used GIS to calculate the total amount of surface water within each survey station
- We used a linear mixed model and Akaike's Information Criteria (AIC) to determine the relative importance of surface water, and vegetation variables for predicting the relative abundance of each bird species
- We also tracked the relative abundance of each bird species throughout the 4 year period and modeled trends in abundance

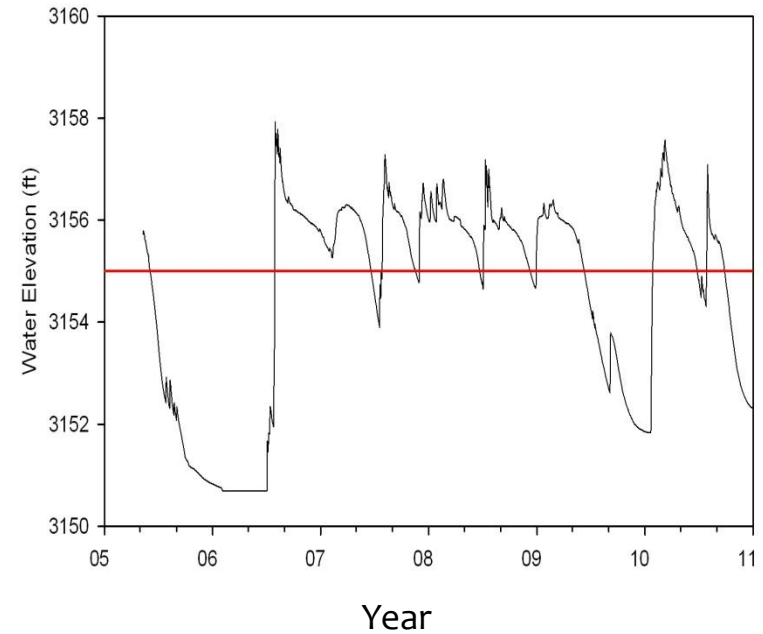
Results

Trends in both surface and ground water at Rincon Creek

Surface Water

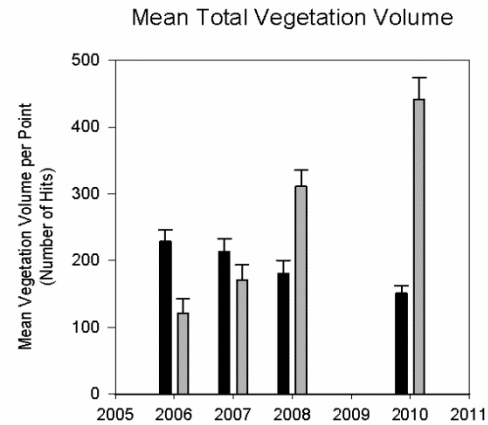
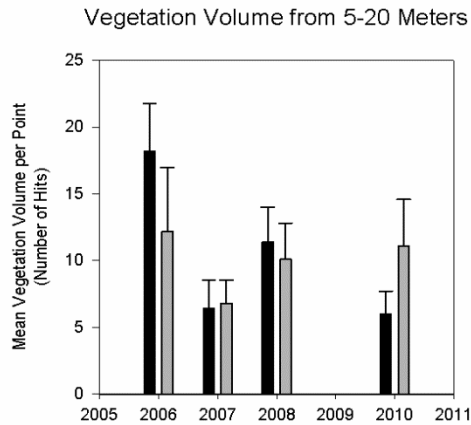
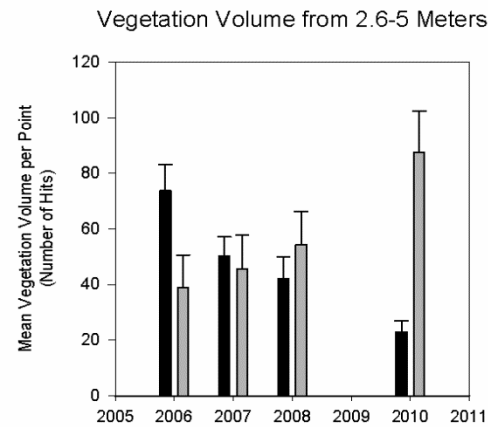
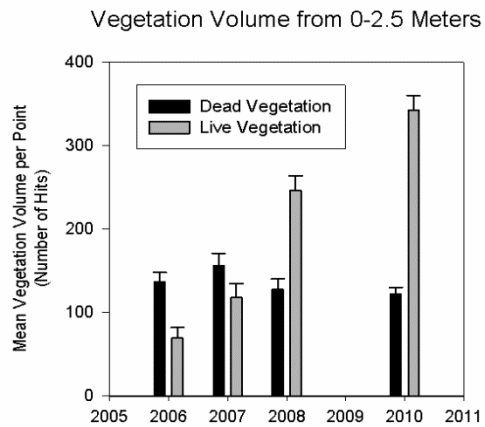


Ground Water



Results

Trends in both live and dead vegetation at Rincon Creek





Aug 2006



Aug 2006



Jul 2007

2007 7 14





Aug 2006



Jul 2007

2007 7 14



2009 6 17

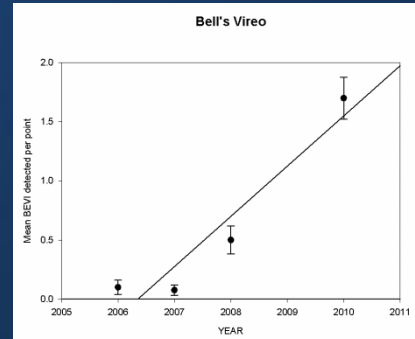
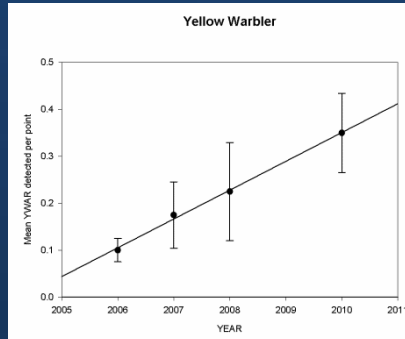
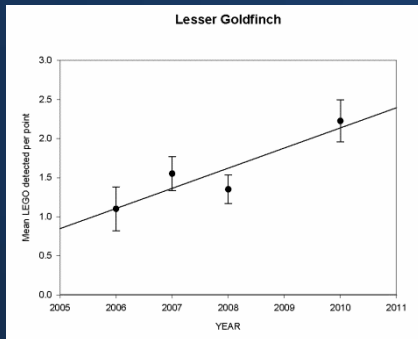
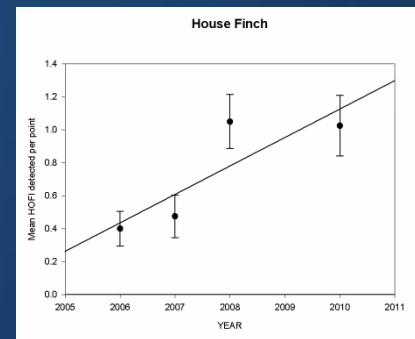
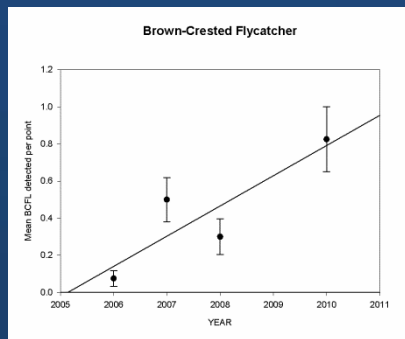
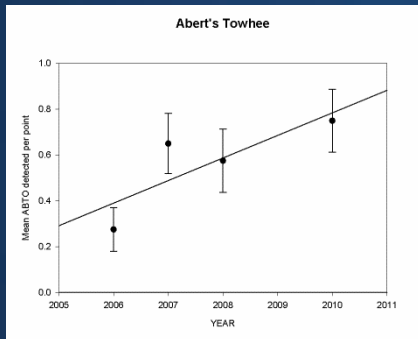


Results

Trends in Bird Abundance

We examined 20 bird species for trends in abundance from 2006 to 2010

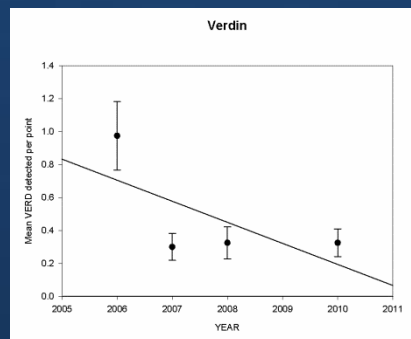
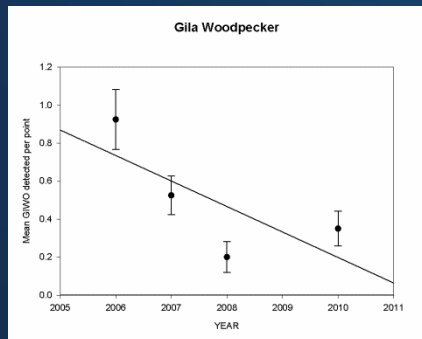
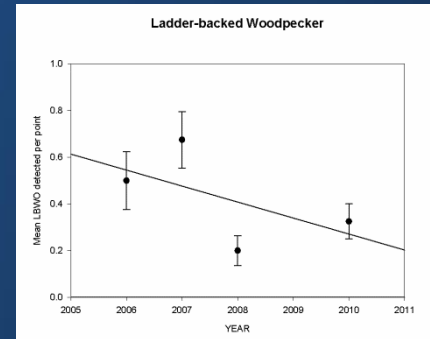
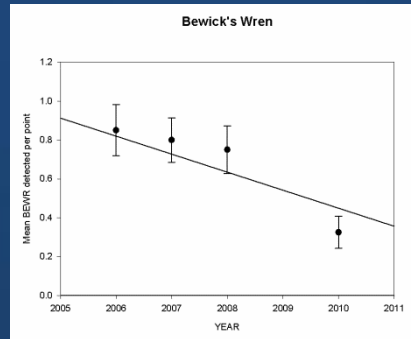
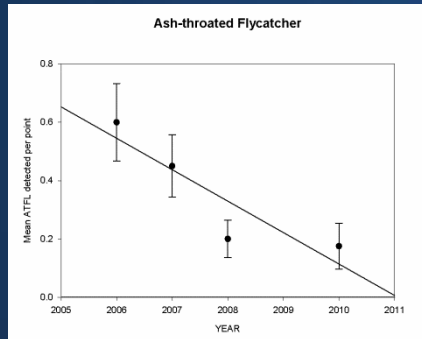
- 6 exhibited an increasing trend



Results

Trends in Bird Abundance

- 5 exhibited a decreasing trend



Results

Trends in Bird Abundance

Species which increased as the riparian woodland recovered were mostly riparian obligate breeders, e.g.

- Abert's Towhee
- Brown-crested Flycatcher
- Black-chinned Humming bird
- Bell's Vireo
- Yellow Warbler



Species which declined as the riparian woodland recovered were either desert generalist species, e.g.

- Verdin
- Ash-throated Flycatcher

Or, were cavity nesters and therefore linked to dead vegetation, e.g.

- Gila Woodpecker
- Ladder-backed Woodpecker
- Bewick's Wren

Results

Importance of water and vegetation



Surface water was the most important predictor for 9 bird species and overall species richness



The proportion of live vegetation from was the most important predictor for 9 species

- 0-2.5 m for 6 species
- 2.6-5 m for 3 species

Results

Nest Monitoring

We were unable to compare nesting parameters because of the complete lack of nests of our focal species during the drought!

Year	Bell's Vireo	Northern Cardinal	Yellow Warbler	Yellow-billed Cuckoo	Varied Bunting
2006	~1	1	0	0	0
2007	0	0	0	0	0
2008	8	4	1	0	0
2010	22	10	1	1	1

Conclusions

What does this mean for the birds of riparian woodlands in the southwest?

Conclusions

The Good News

A return of available water to Rincon Creek led to:

- A return of many sensitive riparian bird species
- Increases in abundance for numerous bird species
- Increases in avian species richness
- Recovering riparian vegetation

Conclusions

The Bad News!

Decreased water availability in riparian woodlands will likely lead to:

- Local extirpation of a number of sensitive riparian birds
- Reductions in abundance for numerous bird species
- Reductions in avian species richness, and
- Decreased riparian vegetation and altered vegetation composition

Conclusions

What we don't know:

- How will this affect long distance migrant bird species?
- What will be the effect of longer lasting or more widespread drought?
- How do riparian obligate birds cope with disturbance caused by drought?

Conclusions

Other species will also be affected



Conclusions

It will be increasingly difficult to ensure an adequate water supply to riparian woodlands in future years.

- Need to include wildlife as a potential water user when planning for future water needs
- Need to identify particularly sensitive watersheds for protection
- Understanding the mechanisms of how riparian birds cope with drought may help mitigate the effects of climate change

Thank You

Field Assistants: Moez Ali, James Barr, Gavin Bieber, Kylan Frye, Zach Holderby, Patrick Rainbolt, Eli Rose, Nicholle Stephens, Sarah Taos, Caroline Pott, Scott Carey, Mary Ann Hollenbeck, Ann Johnson, Jake Mohlmann, Robert “Bob” Beatson, Gabrielle Robinson, Benton Leitner, Vanessa Boocher, Hilary Ahern, Aaron Miller, and Brit Oleson.

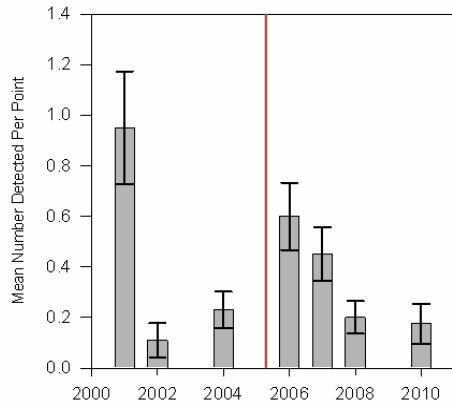
Project Support: Ann Rasor, Natasha Kline, Matt Daniels (NPS), Sheridan Stone (DOD), Sally Gall, Mary Hunnicutt, Kathie Senter, Kyle Todd (USFWS), Bill Childress, Patrick O’Neil, Keith Hughes, Jeff Simms, Mark Fredlake (BLM), Mickey Reed, Brian Powell (UA), Bob Rogers, Susan Crask, Rob Marshall, Cascabel Community, Barbara Clark, Susan Newman, Mark Haverstitch (TNC), Kerry Baldwin, Martie Meirhauser, Don Carter, Staffan Shorr, Julia Fonseca (Pima Co.), Josh Taiz, Jim Sutton (USFS), Sandy Anderson (Gray Hawk Nature Center), Douglas Kooi (HVHOA).



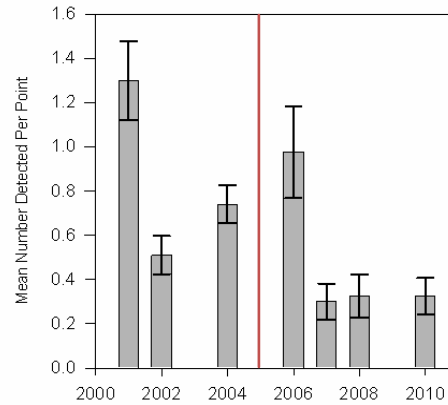
Results

Trends in Bird Abundance

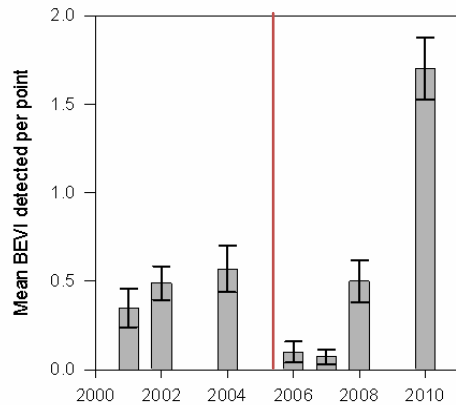
Ash-throated Flycatcher



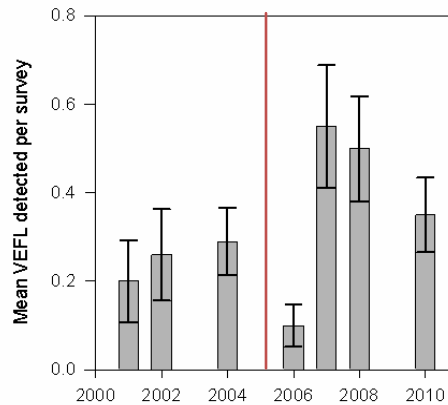
Verdin



BEVI



VEFL



YWAR

