Effects of Surface Water and Groundwater Depletion on Arizona's Riparian Bird Communities

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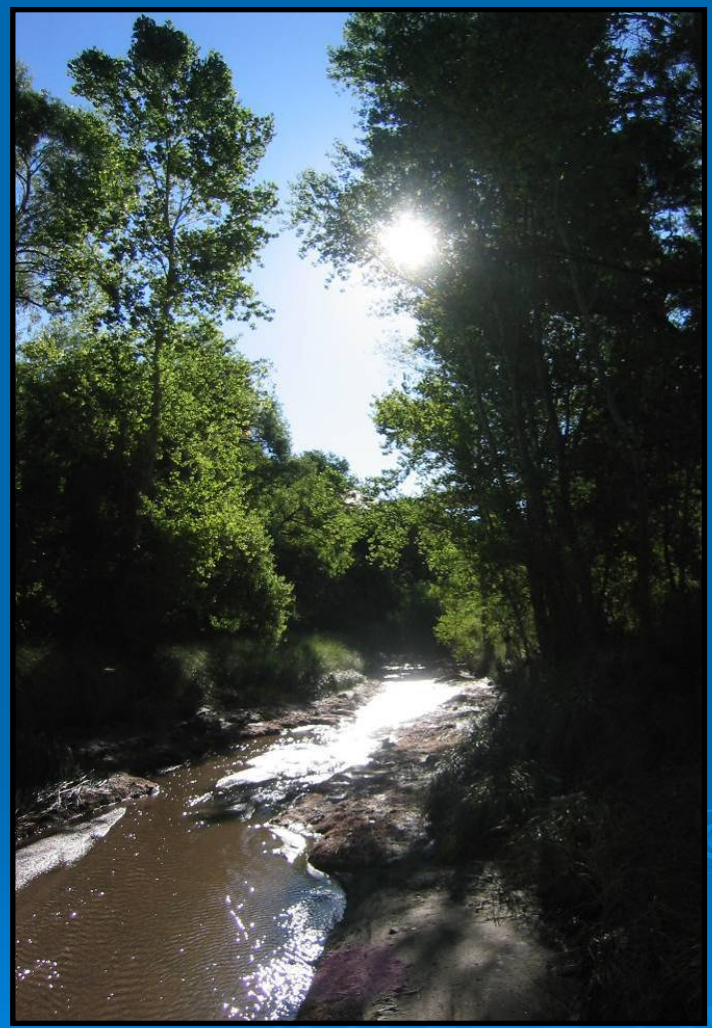

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Arizona's Riparian Woodlands

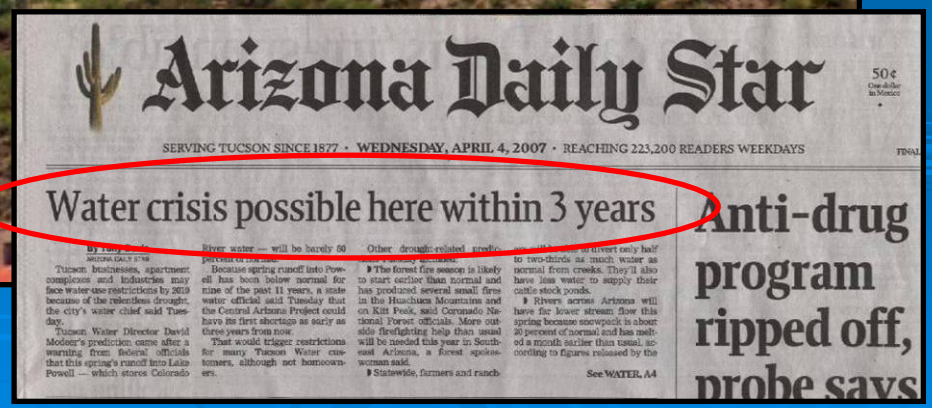
- Cover <1% of the State's landmass
- Support >50% of breeding bird species, including birds of conservation concern
- Provide critical stopover habitat for numerous species of Neotropical migratory birds

Riparian Obligate Birds

Riparian Obligate Birds

Increasing demand for limited water resources in Arizona

Population growth
Continued drought
Climate change



Arizona Daily Star

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Water crisis possible here within 3 years

By [illegible]
ARIZONA DAILY STAR

Tucson businesses, apartment complexes and industries may face water-use restrictions by 2010 because of the relentless drought, the city's water chief said Tuesday.

Tucson Water Director David Modeer's prediction came after a warning from federal officials that this spring's runoff into Lake Powell — which stores Colorado River water — will be barely 50 percent of the state.

Because spring runoff into Powell has been below normal for nine of the past 11 years, a state water official said Tuesday that the Central Arizona Project could have its first shortage as early as three years from now.

That would trigger restrictions for many Tucson Water customers, although not homeowners.

Other drought-related predic[illegible]

▶ The forest fire season is likely to start earlier than normal and has produced several small fires in the Huachuca Mountains and on Kitt Peak, said Coronado National Forest officials. More outside firefighting help than usual will be needed this year in Southeast Arizona, a forest spokeswoman said.

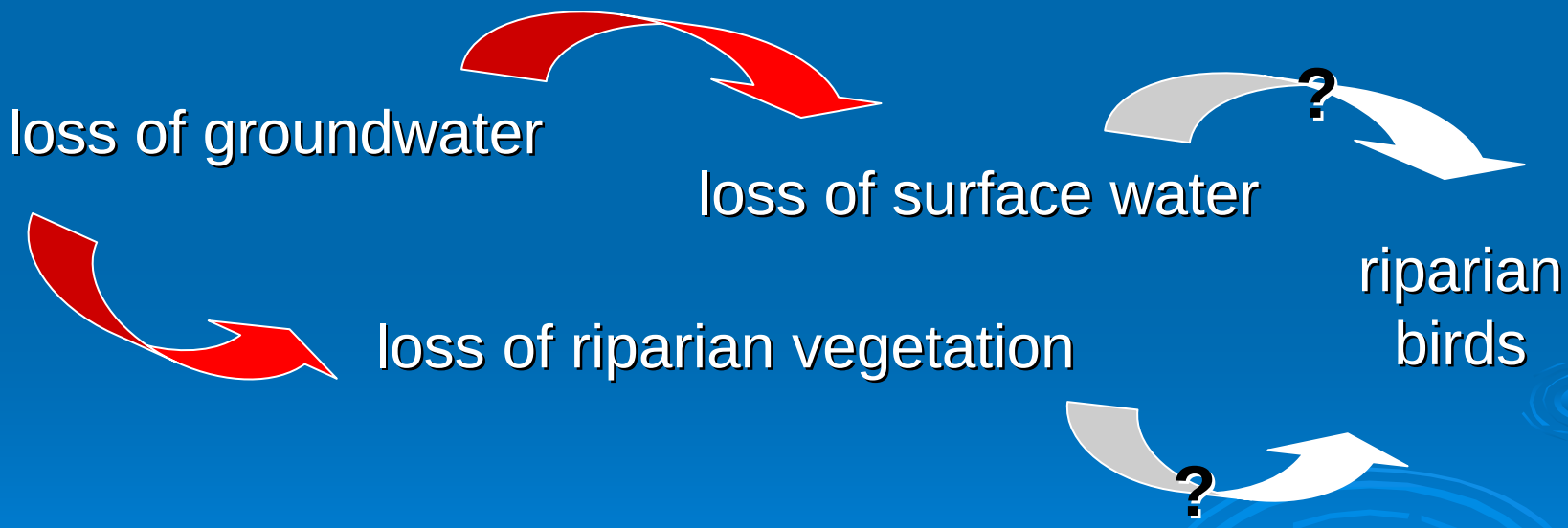
▶ Statewide, farmers and ranch[illegible] to divert only half to two-thirds as much water as normal from creeks. They'll also have less water to supply their cattle stock ponds.

▶ Rivers across Arizona will have far lower stream flow this spring because snowpack is about 20 percent of normal and has melted a month earlier than usual, according to figures released by the

See WATER, A4

Anti-drug program ripped off, probe says

"…losses in riparian vegetation are strongly associated with extensive groundwater use…" (Webb and Leake 2006)



Study Objectives

- Understand connections between groundwater, surface water, and the health of riparian bird communities in Arizona
- Examine underlying ecological processes (e.g., availability of food resources) that may influence these connections

Study Objectives

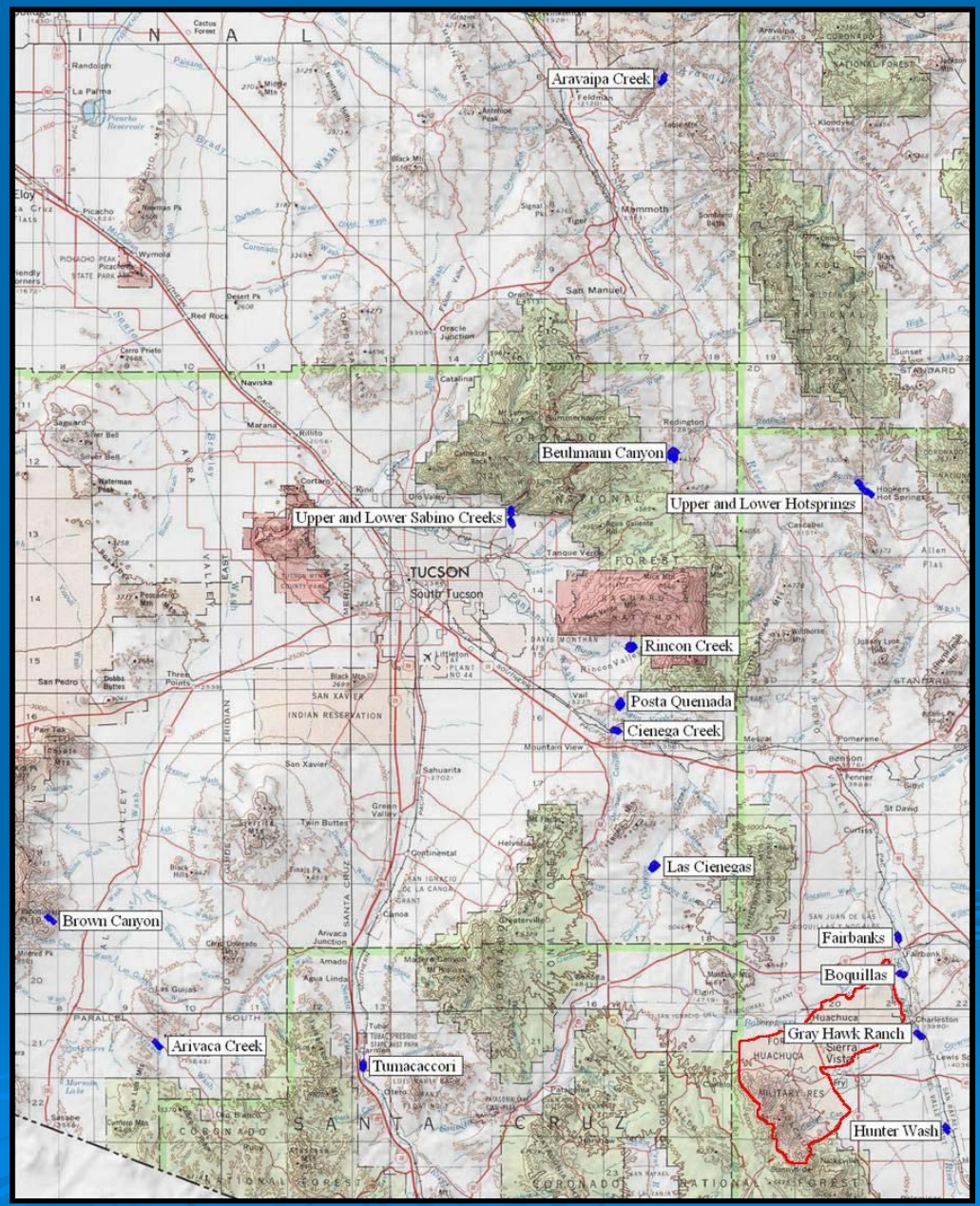
- Develop models to predict how future changes in surface water and groundwater levels will affect riparian bird abundance, diversity, and reproductive success
- Provide information to help secure instream flow rights to protect water resources for the benefit of wildlife

Hypotheses to be Tested

- Sites with more surface water and healthier riparian vegetation will have:

  1) Greater abundance and diversity of birds
  2) Increased food resources (e.g., arthropods)
  3) Increased growth rates of nestlings
  4) Increased clutch sizes

Study Area in Southeastern Arizona (with 17 Replicate Study Sites)



Range of Conditions Among Sites

Cienega Creek

Perennial Surface Water

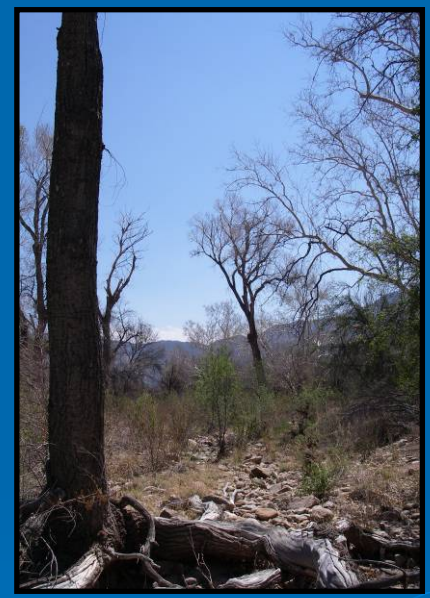
Healthy Vegetation

Arivaca Creek

Intermittent Surface Water

Healthy Vegetation

Rincon Creek

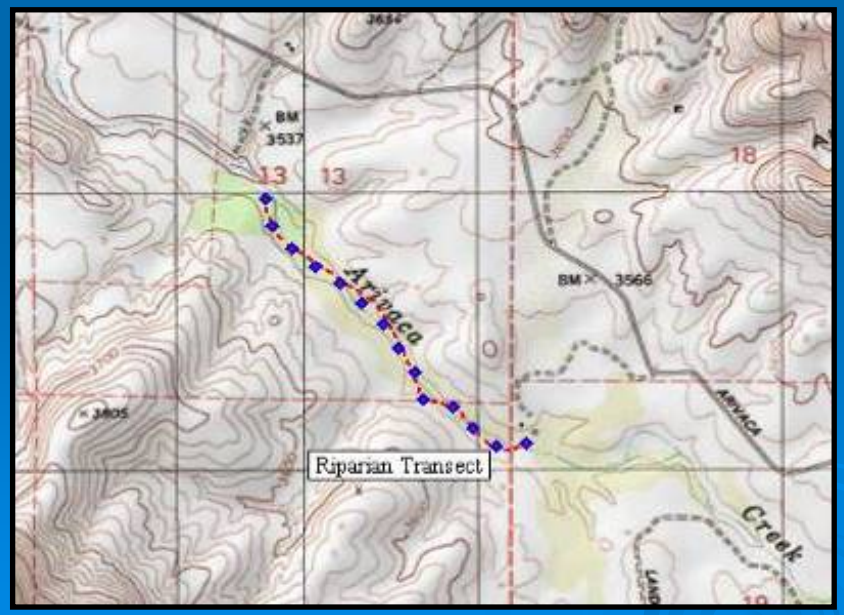


No Surface Water

Stressed Vegetation

Bird Surveys

- Estimate bird relative abundance and spp. richness (4-5 replicate surveys; April-June)

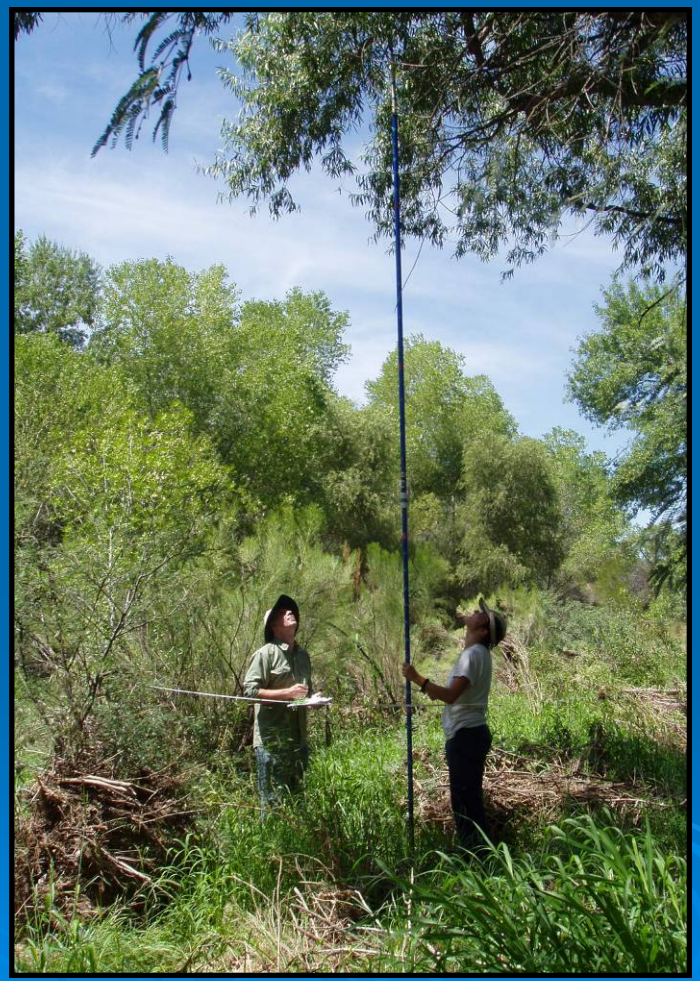


Surface Water Sampling

- Estimate surface area and vol. of water <50 m from bird survey pts

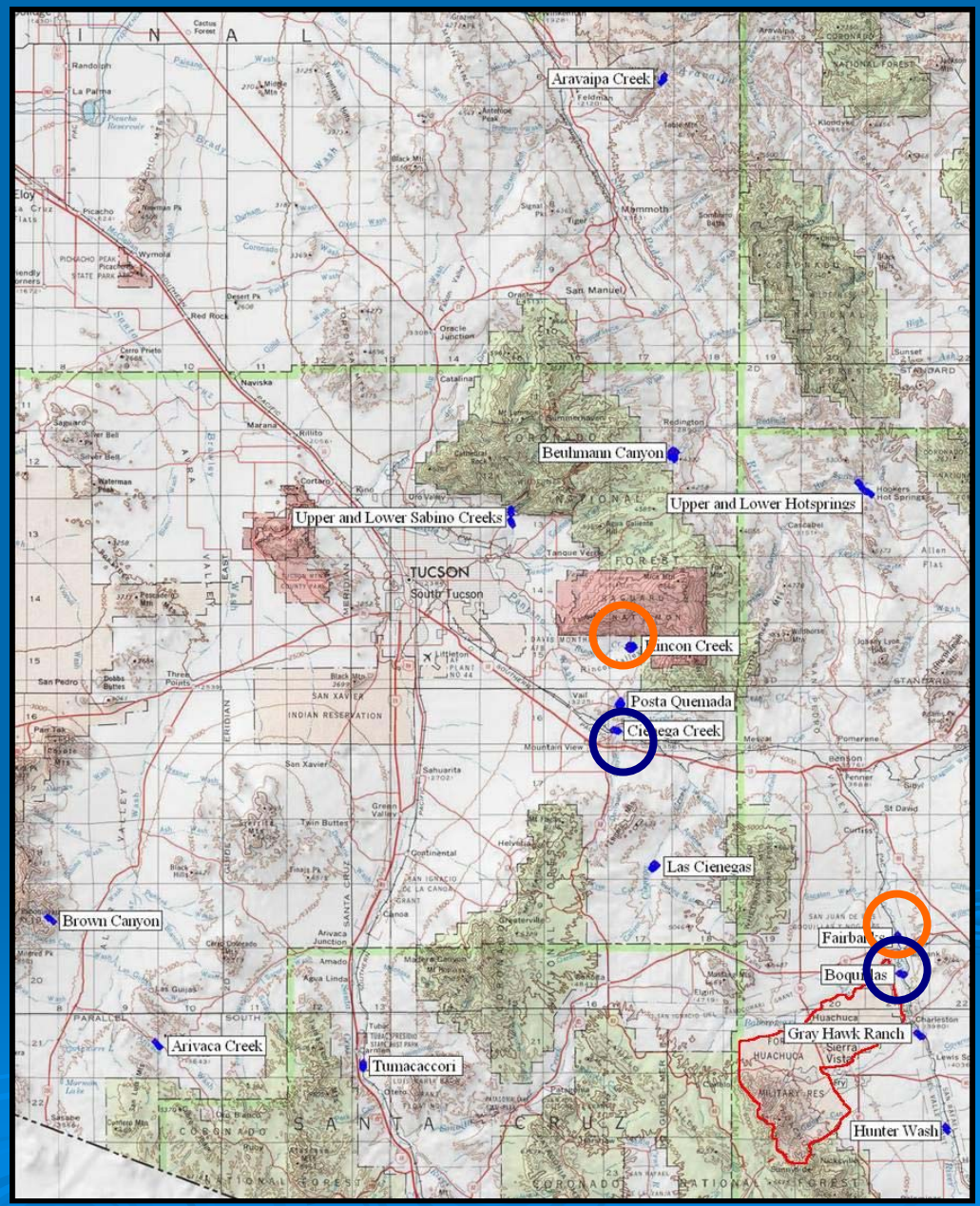
Vegetation

- Estimate volume of riparian vegetation (live and dead/dormant) using point-line-intercept method (Mills et al. 1991)
- Estimate top canopy height and width of riparian vegetation



Nest Monitoring

- “dry” site
- “wet” site

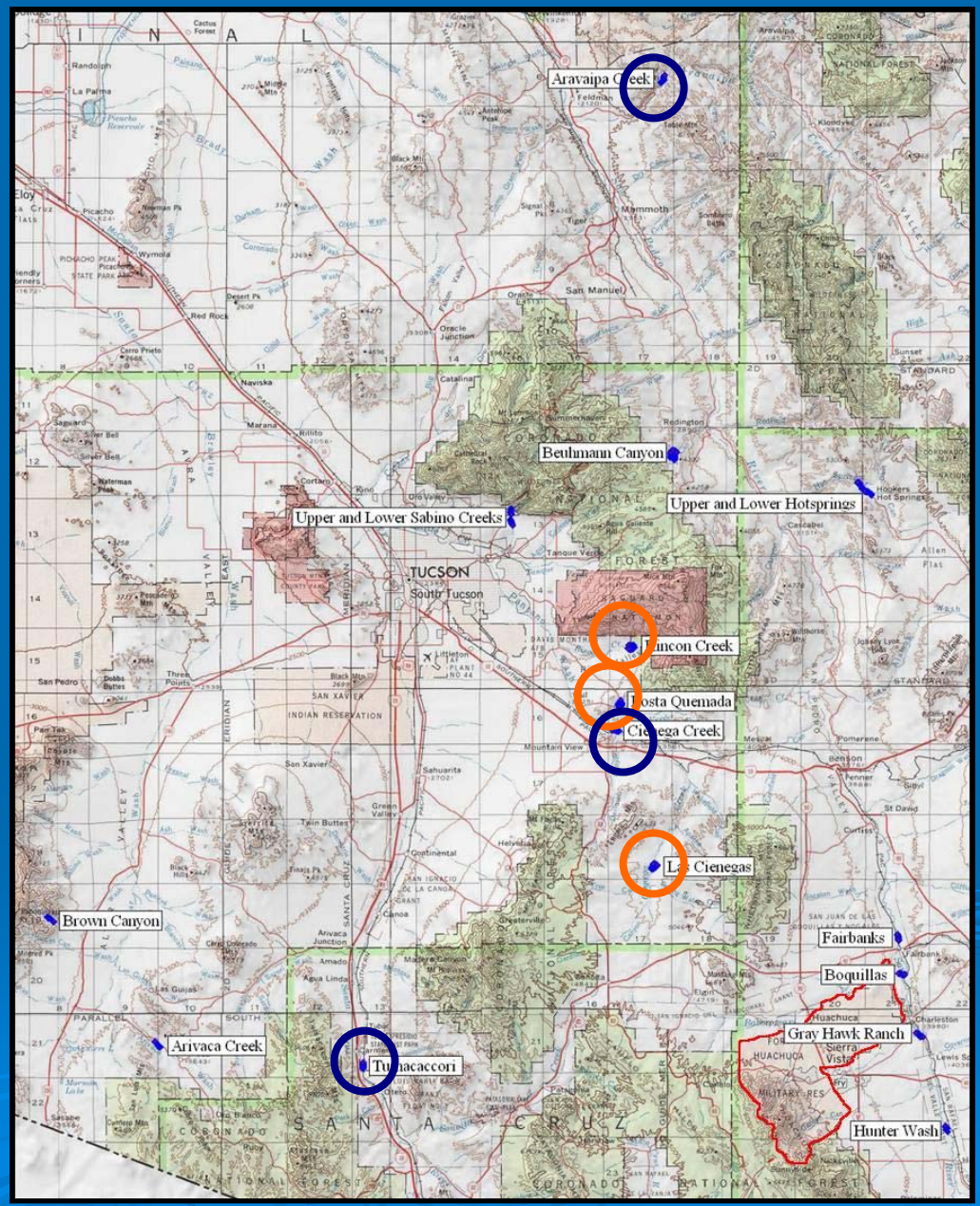


Nest Monitoring

- Estimate nestling growth rates and average clutch sizes

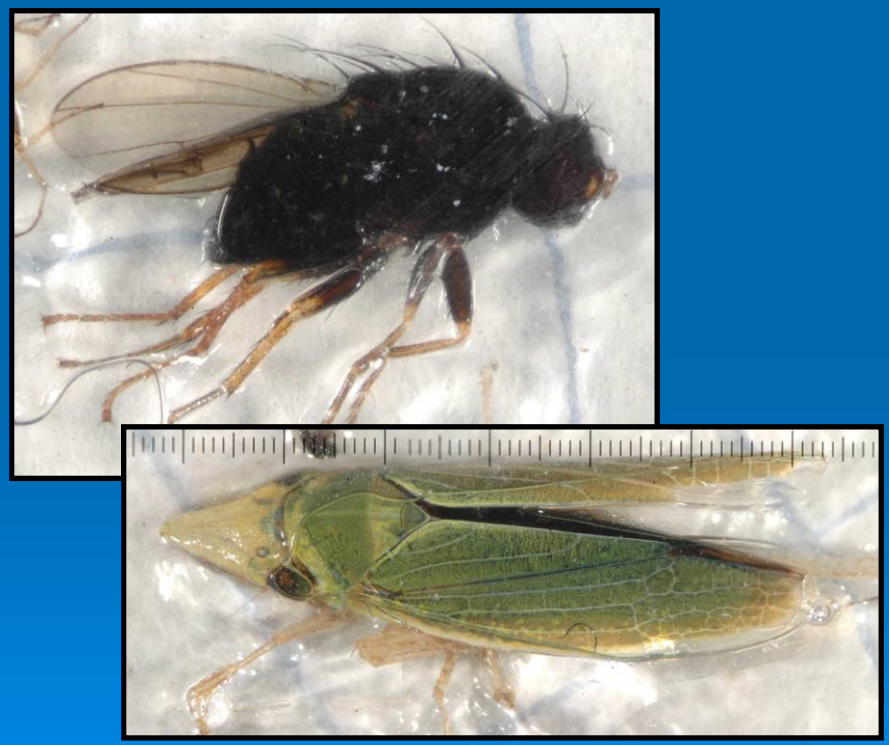
Arthropod Sampling

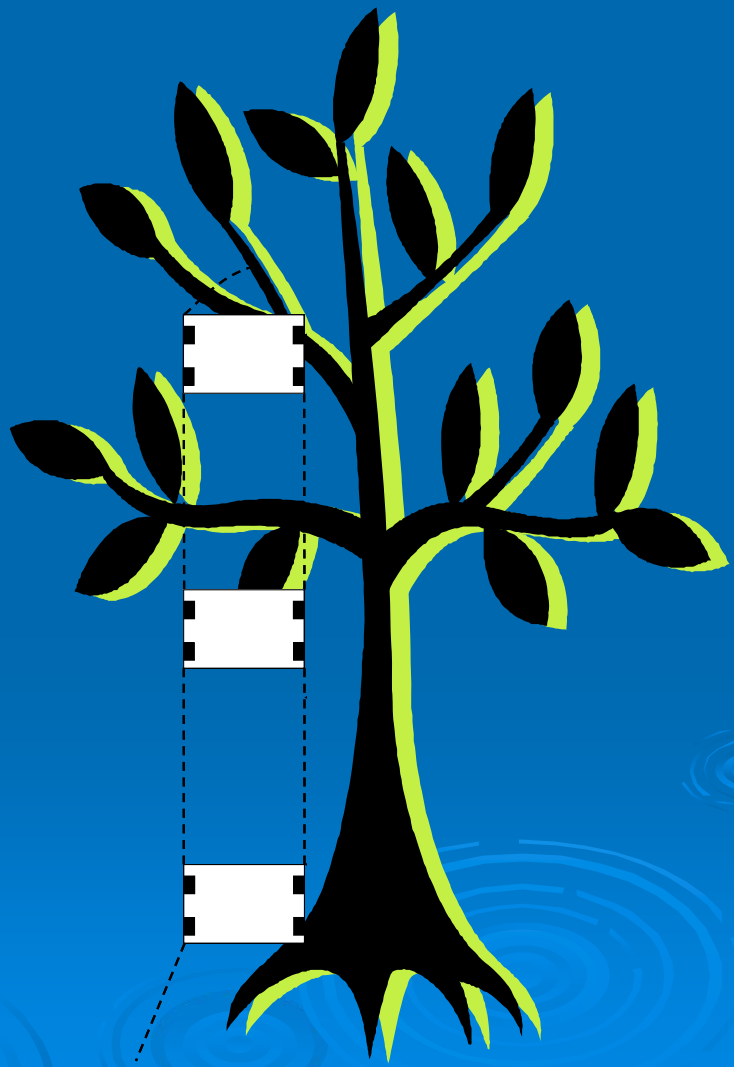
- “dry” site
- “wet” site



Arthropod Sampling

- Estimate aerial arthropod biomass using sticky traps

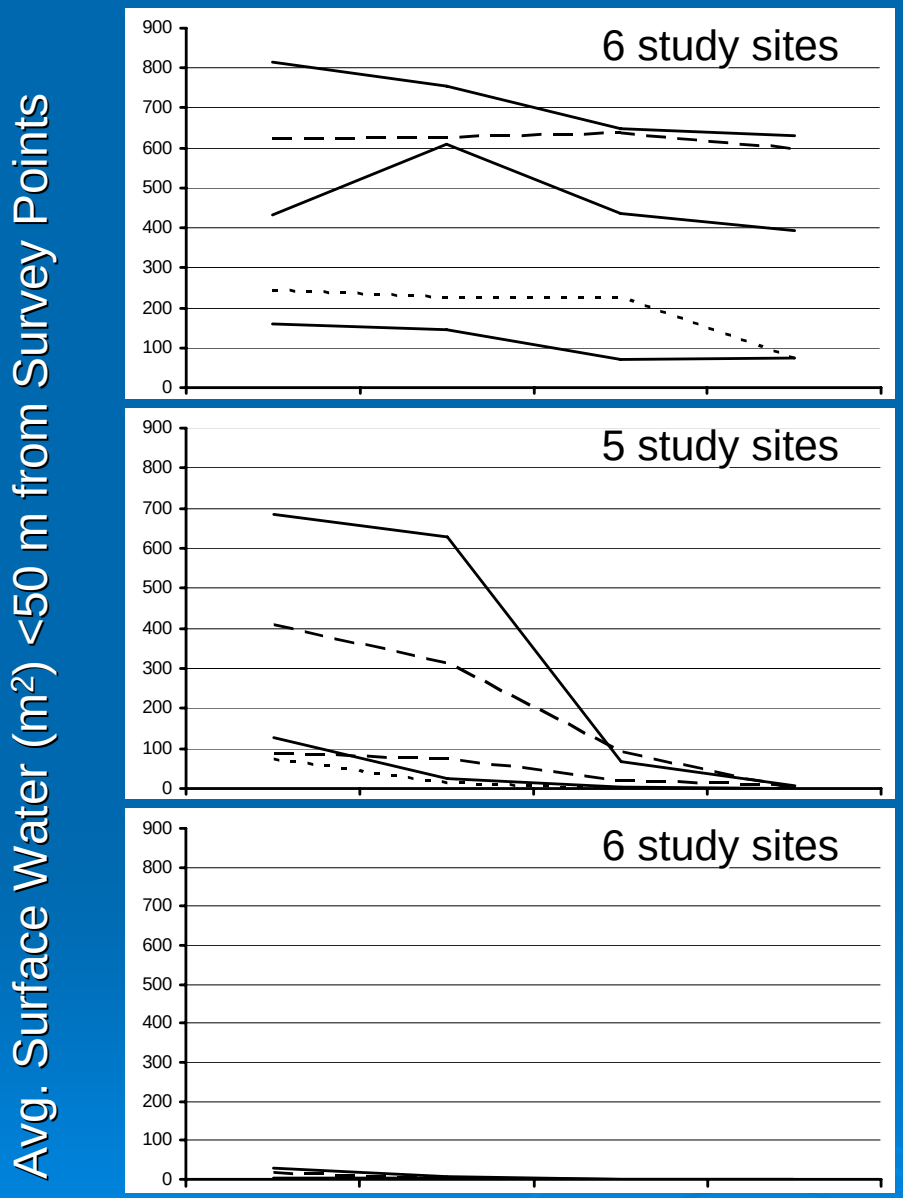


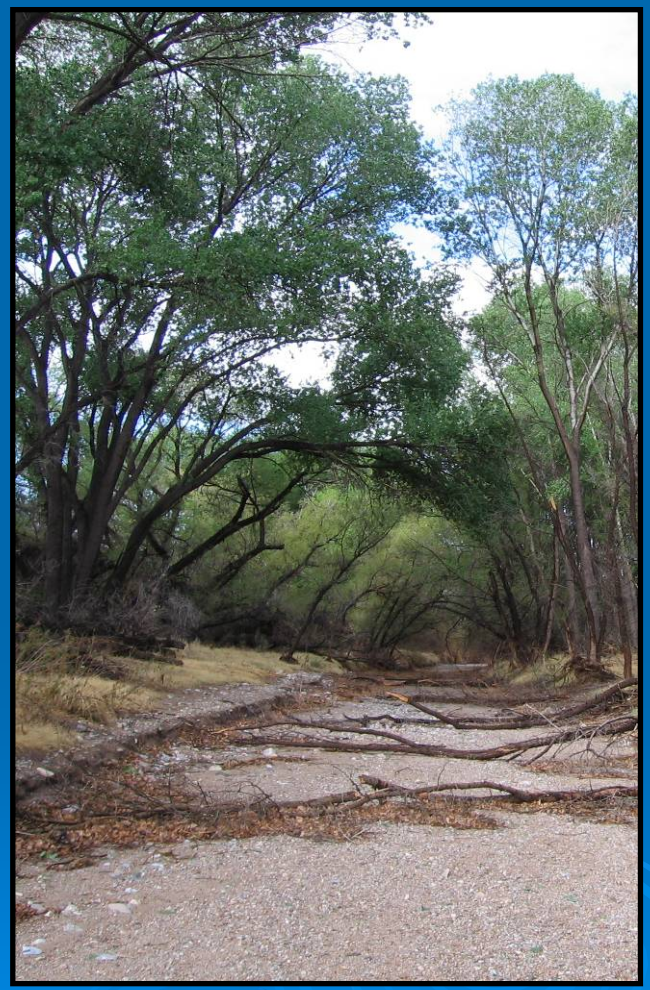


Multiple linear regression

- Response Variables:
  - Species richness
  - Relative abundance (total, by species)
- Explanatory Variables (27):
  - Surface water
  - Vegetation volume (total live & dead, by species, overstory & understory)
  - Interactions (surface water * veg. volume)
  - Width riparian woodland
  - Top canopy height
  - Elevation
  - Stream order

2006 Surface Water Conditions





Effect of Surface H_2O

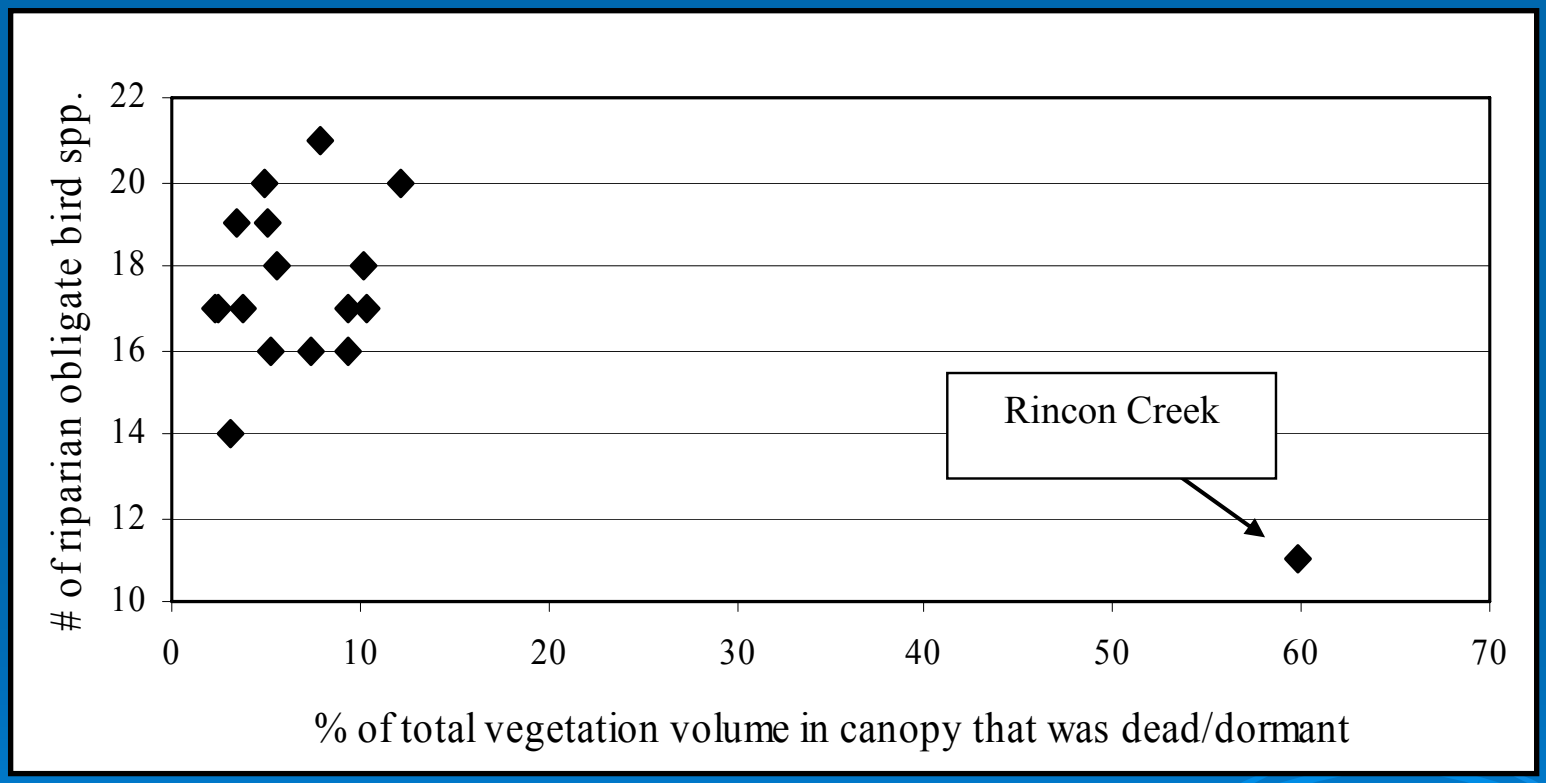
Positive interactions between surface water and live vegetation volume for Black Phoebe, Wilson's Warbler, and Yellow-rumped Warbler

Arthropod Biomass > in “Wet” Areas

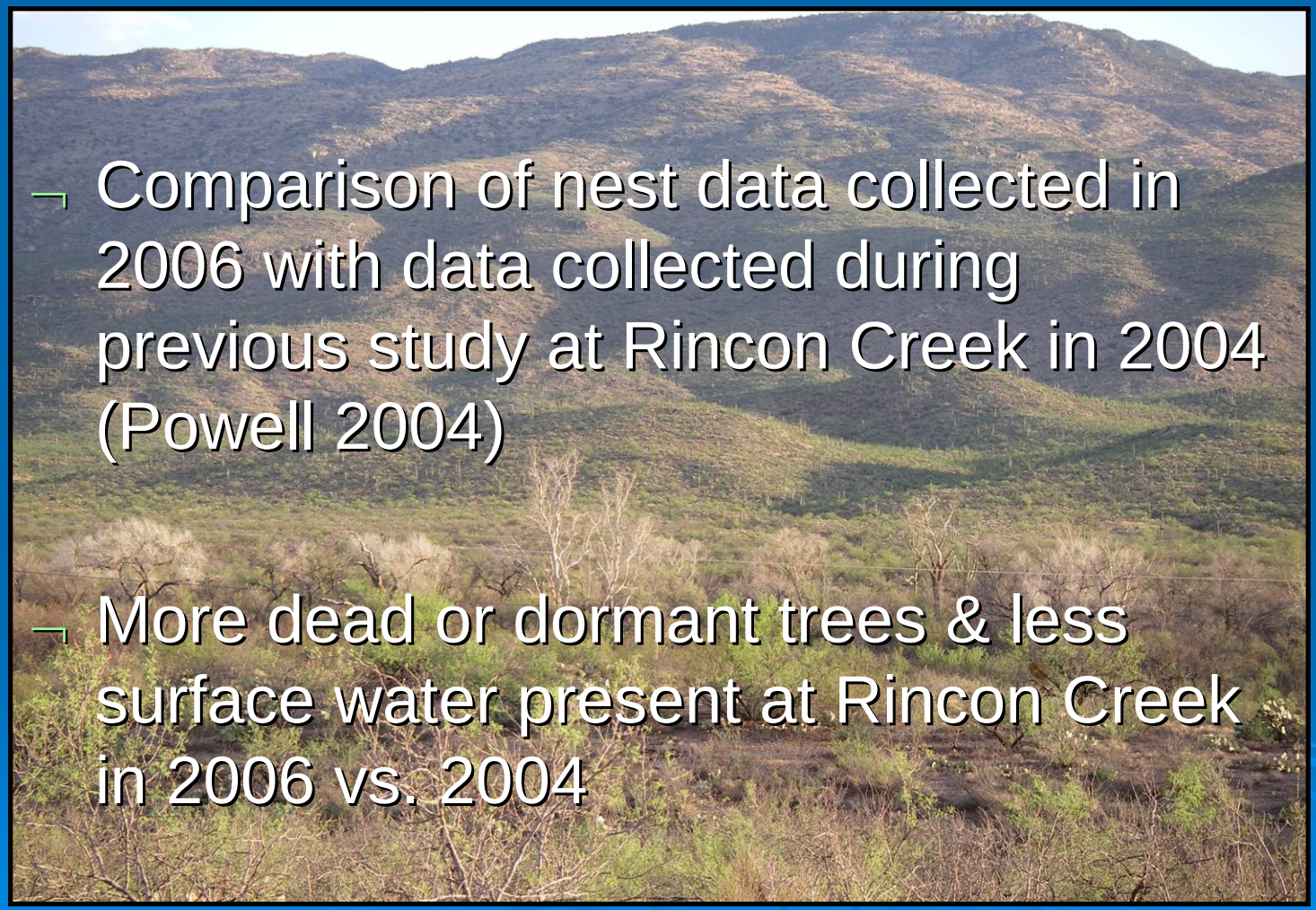
	Dry Biomass (mg) of Aerial Arthropods					
	“Wet" sites (n = 3)		**“Dry" Sites (n = 3)**			
Order	**Mean**	SE	**Mean**	SE	$F^*_{1,4}$	***P****
Diptera	**15.5**	3.5	**5.0**	1.6	11.9	**0.03**
Mecoptera	**0.5**	0.1	**0.1**	0.0	13.0	**0.02**
Trichoptera	**0.4**	0.3	**0.1**	0.0	3.9	**0.12**
Total (all orders)	**73.4**	10.0	**57.5**	10.0	0.3	**0.62**

* One-way ANOVA

Effect of Vegetation Health



Nest Monitoring (Rincon Creek)



- Comparison of nest data collected in 2006 with data collected during previous study at Rincon Creek in 2004 (Powell 2004)
- More dead or dormant trees & less surface water present at Rincon Creek in 2006 vs. 2004

Yellow Warbler

- 2004: Yellow Warblers common (at least 5-6 pairs present throughout breeding season; Powell 2004)
- 2006: Yellow Warblers rare (only 1 bird detected during a single bird survey)

Bell's Vireos

- < 2004: 9 Bell's Vireos nests found along Rincon Creek (B. Powell, unpublished data)
- 2004: Breeding of Bell's Vireos confirmed at Rincon Creek (Powell 2004)
- 2006: Single, failed nest attempt by Bell's Vireos

Summary (Year One of Study)

- Positive associations with surface water for several species, including breeding and migrant birds
- Positive associations with surface water for several arthropod orders
- Breeding of some riparian-obligate species curtailed in areas with tree stress and die-off (e.g., Rincon Creek)

Future Work

- Increase sample size of replicate sites (especially sites with tree stress/die-back)
- Incorporate groundwater monitoring data into analyses