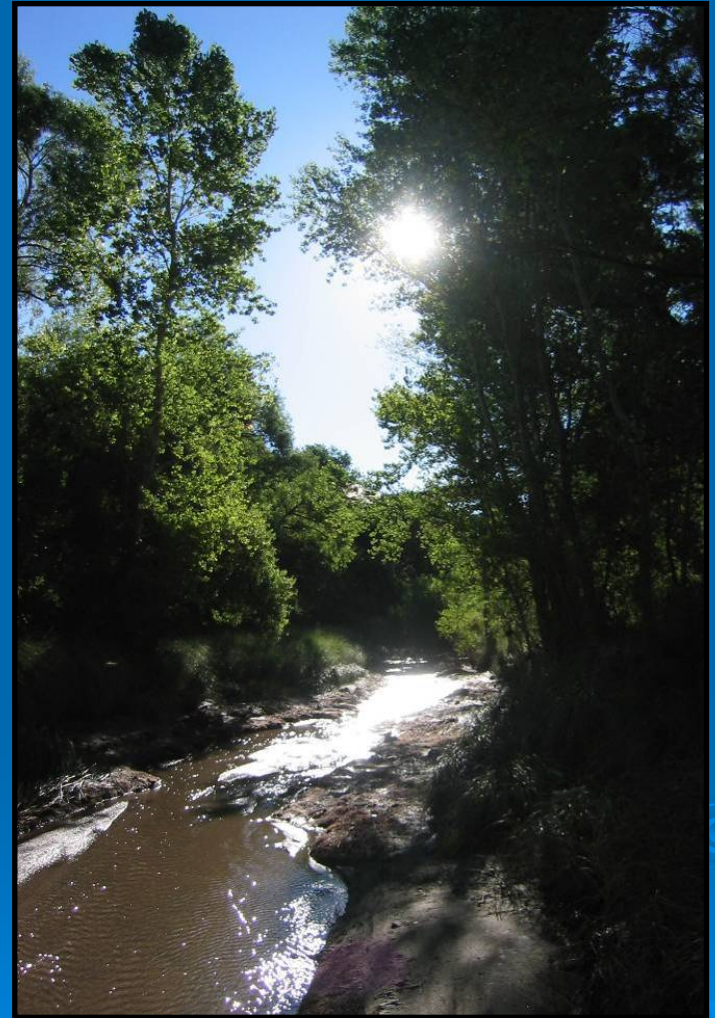


Effects of Surface Water and Groundwater Depletion on Arizona's Riparian Bird Communities

Chris Kirkpatrick & Courtney J. Conway

*USGS AZ Cooperative Fish and
Wildlife Research Unit,
School of Natural Resources,
University of Arizona*





Field Assistants: Moez Ali, James Barr, Gavin Bieber, Kylan Frye, Zach Holderby, Dominic LaRoche, Patrick Rainbolt, Eli Rose, Nicholle Stephens, and Sarah Taos.

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

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

© A. Morris/VIREO



© B. Henry/VIREO



© T. Beck/VIREO



Riparian Obligate Birds

© Brian E. Small/VIREO



© A. Whittaker/VIREO



© S. & S. Rucker/VIREO



Increasing demand for
limited water resources
in Arizona

Population growth
Continued drought
Climate change



Arizona Daily Star
SERVING TUCSON SINCE 1877 • WEDNESDAY, APRIL 4, 2007 • REACHING 223,200 READERS WEEKDAYS

Water crisis possible here within 3 years

Other drought-related predic-
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 melt-
ed a month earlier than usual, ac-
cording 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

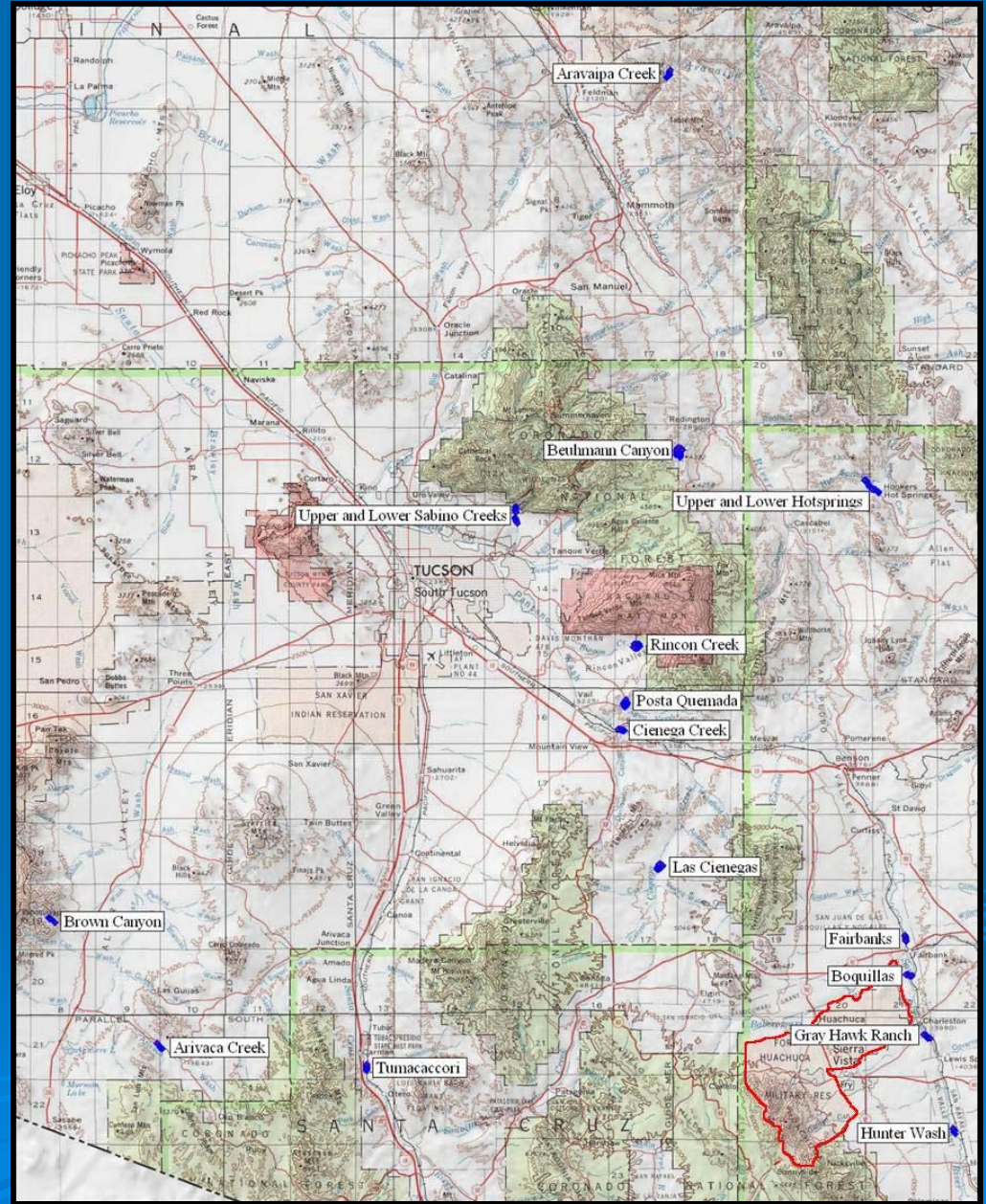
Study Objectives

- 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



Arivaca Creek



Rincon Creek



Perennial Surface Water

Healthy Vegetation

Intermittent Surface Water

Healthy Vegetation

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

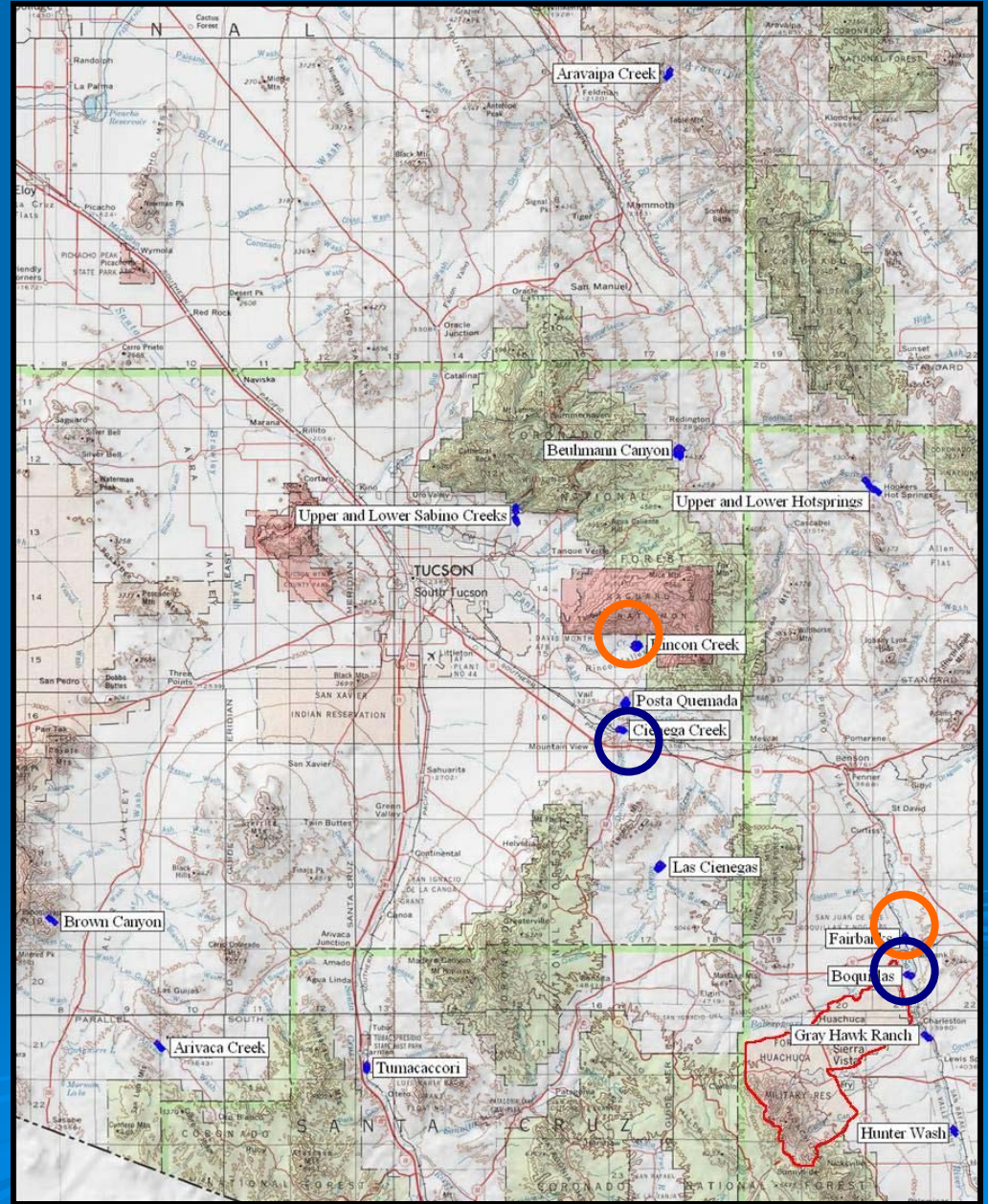
Vegetation

- 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



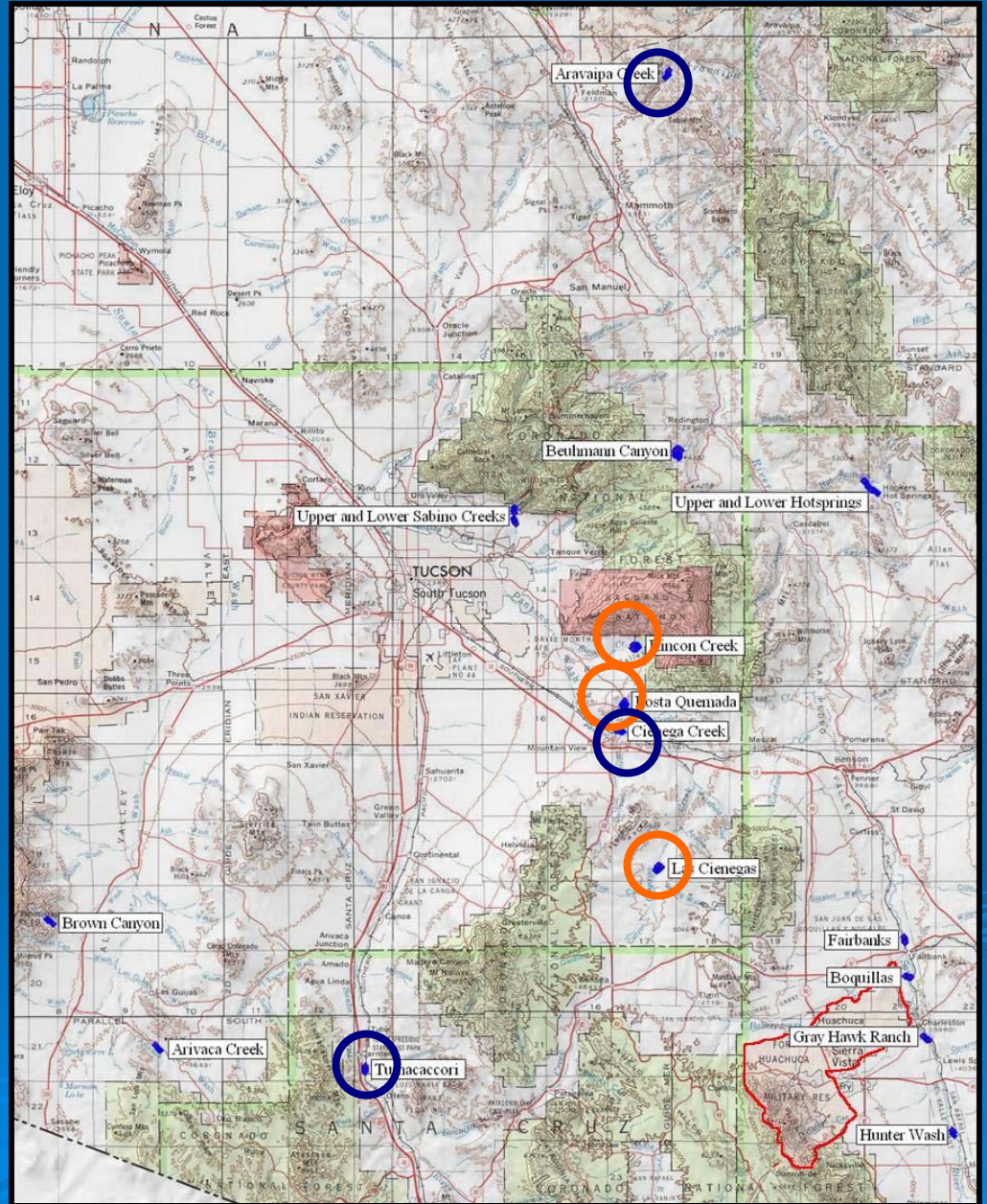
Nest Monitoring

- Estimate nestling growth rates and average clutch sizes



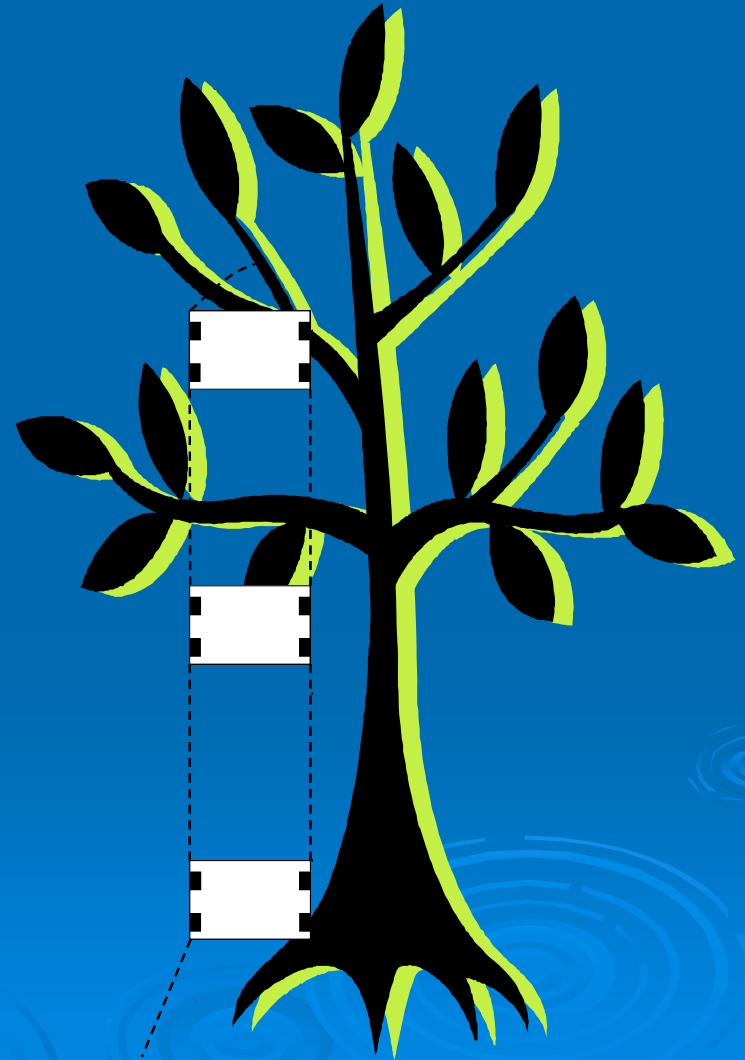
Arthropod Sampling

- “dry” site
- “wet” site



Arthropod Sampling

- Estimate aerial arthropod biomass using sticky traps



Multiple linear regression

→ Response Variables:

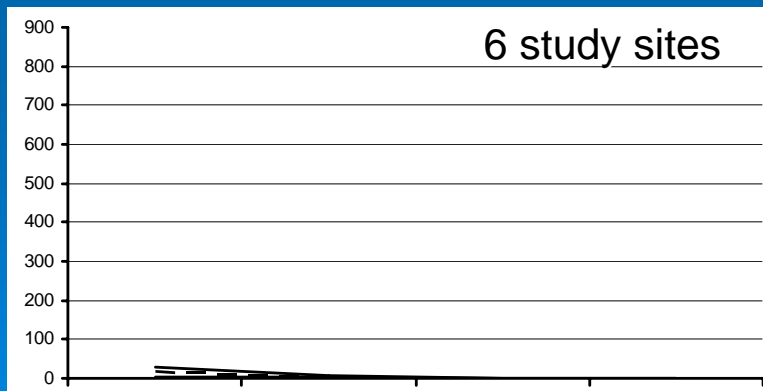
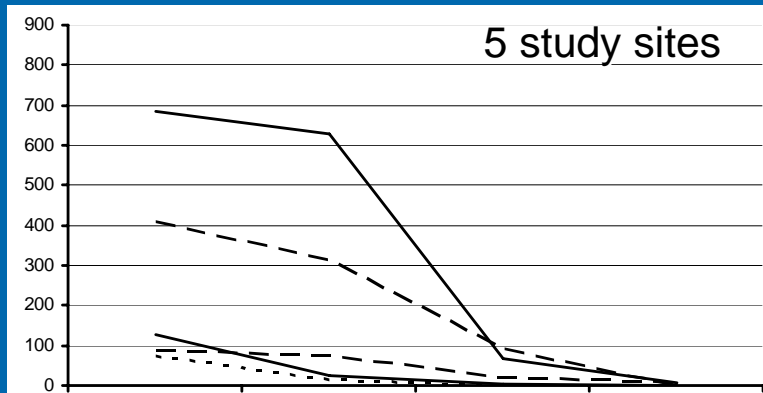
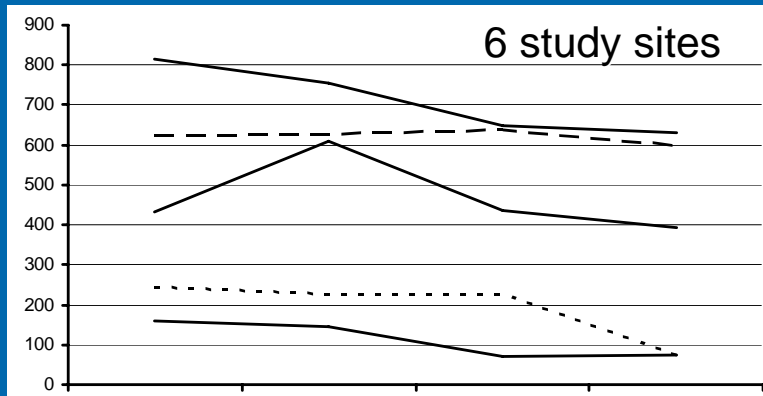
- λ Species richness
- λ Relative abundance (total, by species)

→ Explanatory Variables (27):

- λ Surface water
- λ Vegetation volume (total live & dead, by species, overstory & understory)
- λ Interactions (surface water * veg. volume)
- λ Width riparian woodland
- λ Top canopy height
- λ Elevation
- λ Stream order

2006 Surface Water Conditions

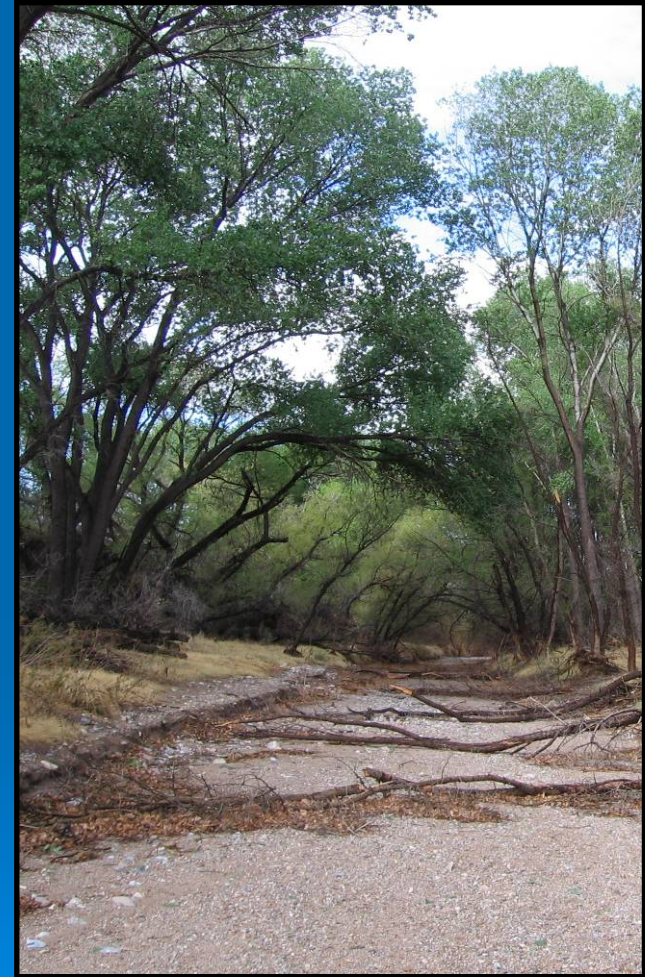
Avg. Surface Water (m^2) <50 m from Survey Points



April



June



Effect of Surface H₂O

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



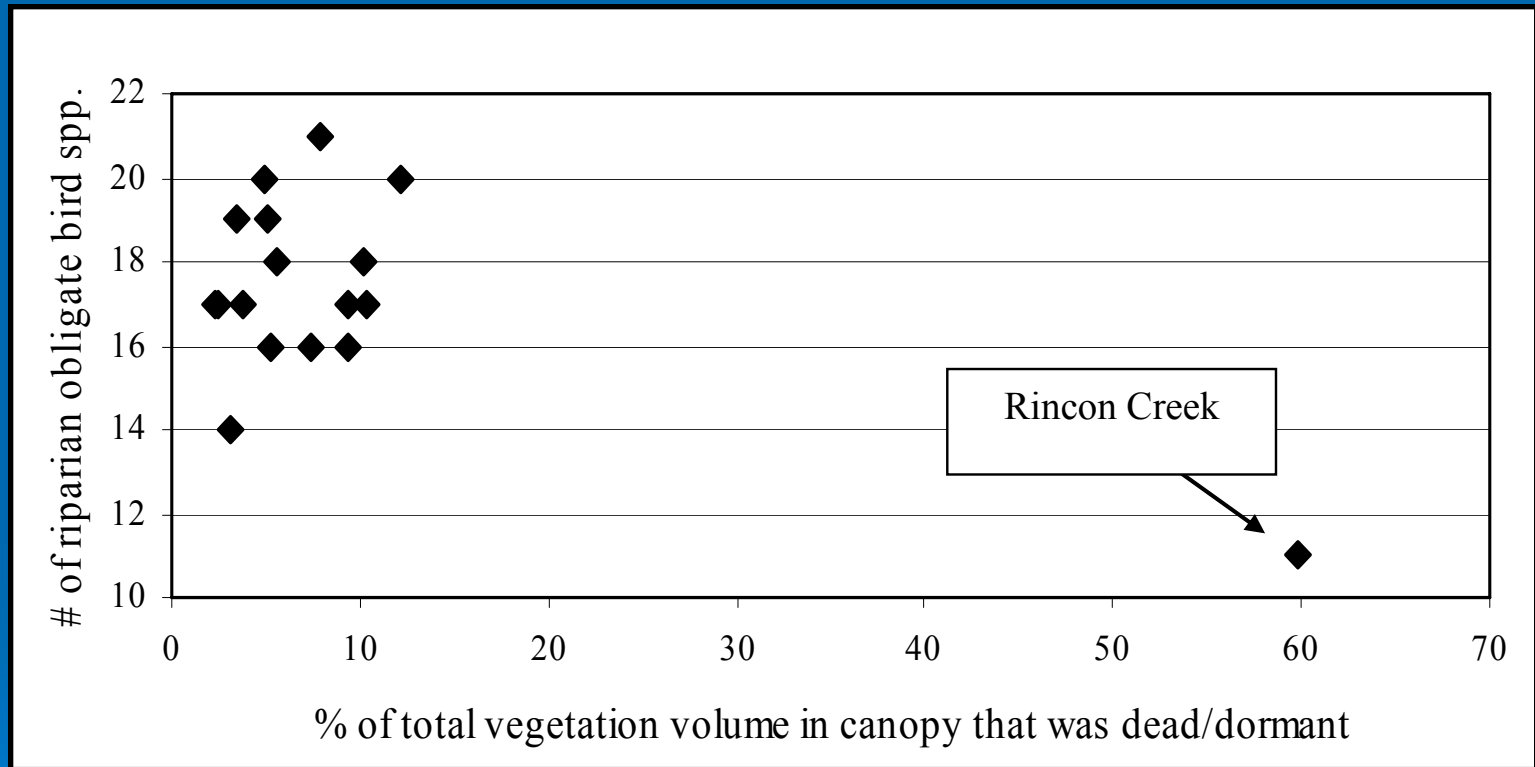
Arthropod Biomass > in “Wet” Areas

Dry Biomass (mg) of Aerial Arthropods

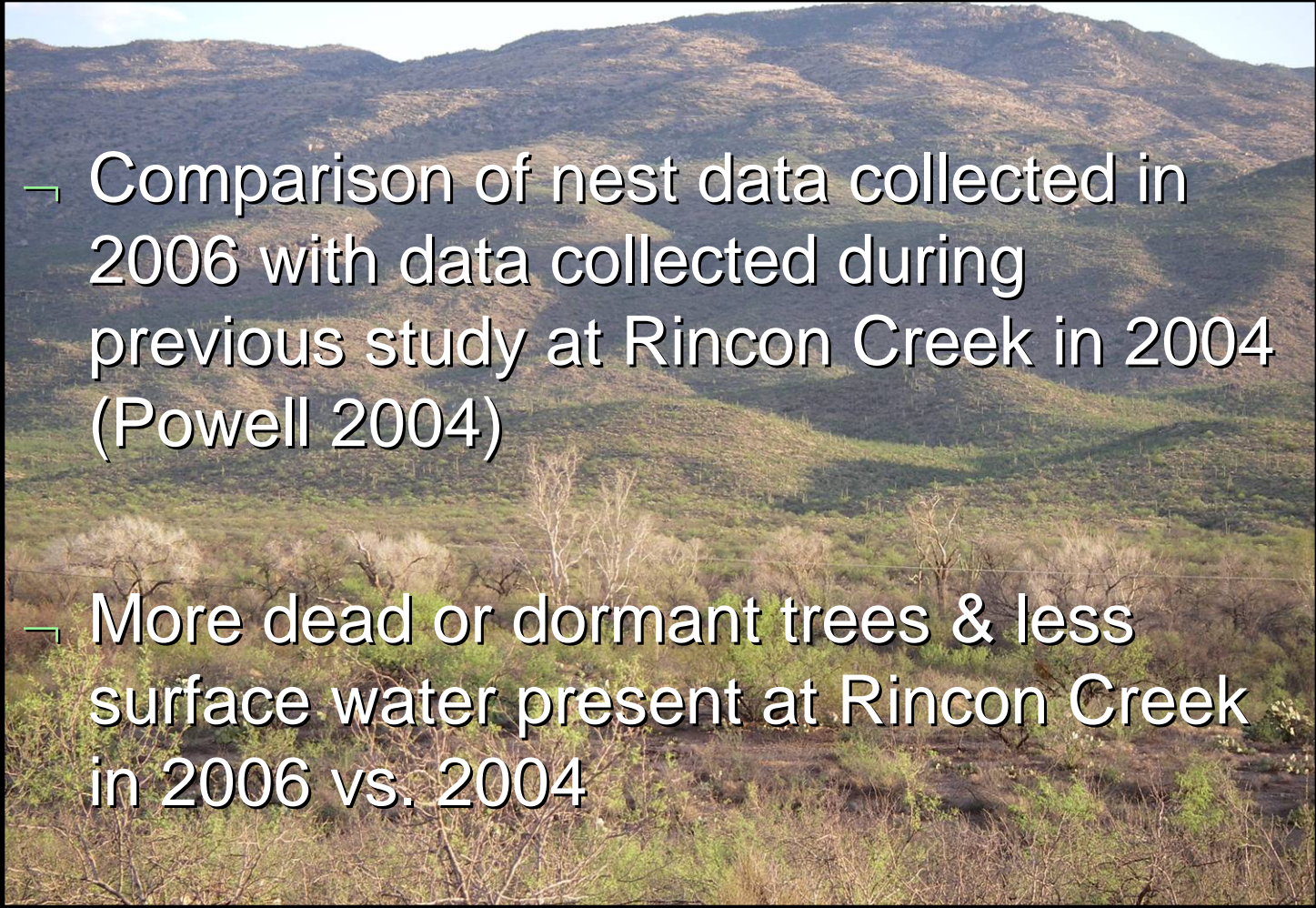
Order	“Wet” sites (n = 3)		“Dry” Sites (n = 3)		$F^*_{1,4}$	P^*
	Mean	SE	Mean	SE		
Diptera	15.5	3.5	5.0	1.6	11.9	0.03
Mecoptera	0.5	0.1	0.1	0.0	13.0	0.02
Trichoptera	0.4	0.3	0.1	0.0	3.9	0.12
Total (all orders)	73.4	10.0	57.5	10.0	0.3	0.62

* 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)



B. Henry/VIREO

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



S & S Rucker/VIREO

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

