Influence of Beaver Activity, Vegetation Structure, and Surface Water on Riparian Bird Communities along the Upper San Pedro River, Arizona

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Riparian Areas

- **Less than 1% of western U.S.**
  - **> 95% of original southwestern U.S. destroyed**

- **Critically important for bird populations**
  - **High density, diversity**
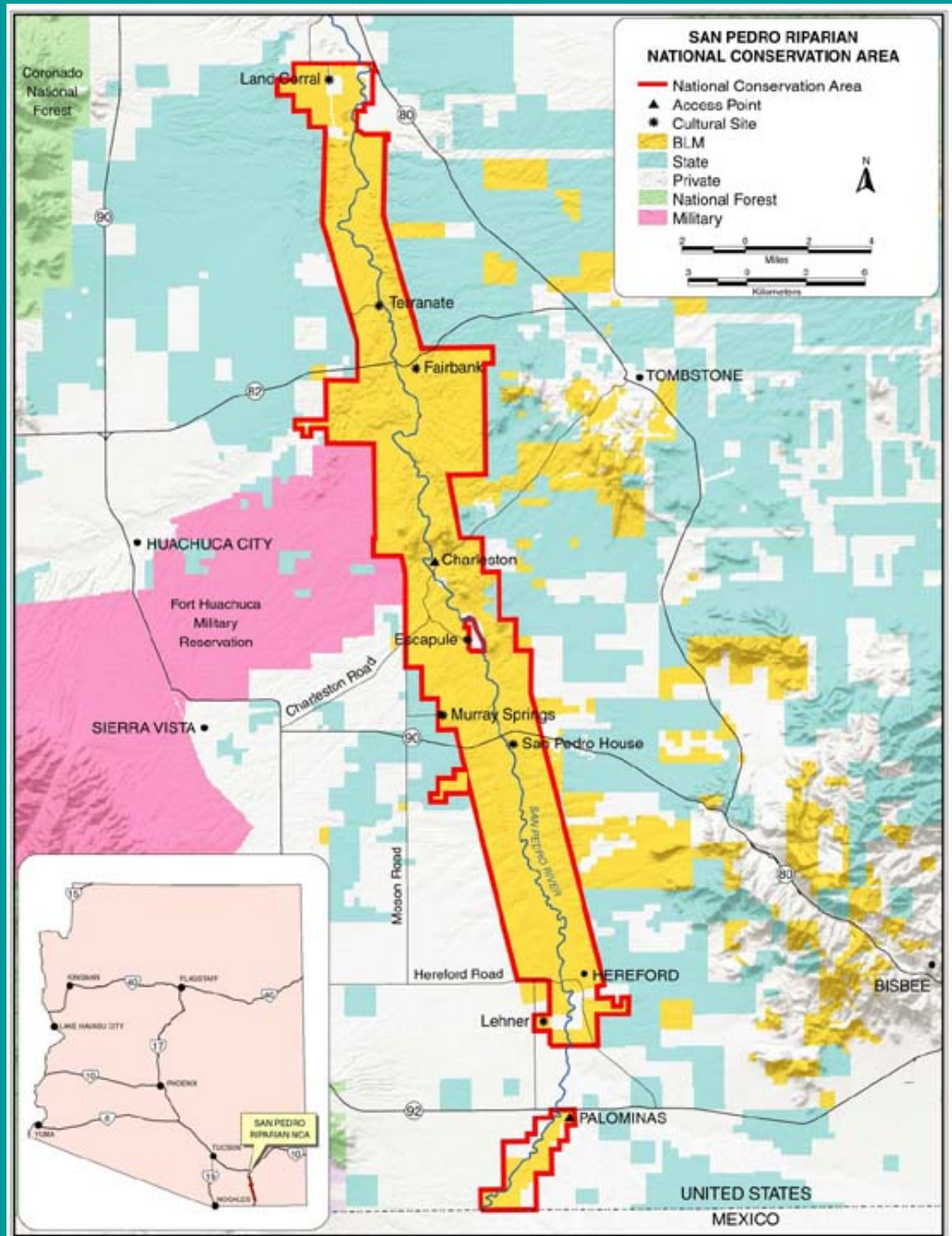 - **Majority of breeding bird species**
  - **Migrants**

Knopf and Samson 1994, Ohmart 1994
Anderson Ohmart 1984, Askins 2000
Johnson et al. 1977, Skagen et al. 1998
Krueper et al. 2003

San Pedro Riparian National Conservation Area

Est. 1986

↖ **Tucson**

↓ **Mexico**

San Pedro R.N.C.A.

- **Historic beaver influence—wide riparian, marshy**

- **Live stock grazing 100 + years**

- **Increased runoff, erosion, flood events**

- **Surface flows and riparian vegetation threatened groundwater pumping**

Stromberg and Tiller 1996

Beaver Re-introduction

- **BLM objectives**
  - **Retain water later in dry season**
  - **Slow flood flows**
  - **Increase historic heterogeneity of habitat**

- **Nineteen animals released 1999-2001**

- **BLM conducted yearly census of all beaver activity**

- **Presently at least 60—12 different family groups, up to 1.5 river km per group**

Beaver as Ecosystem Engineer

- **Hydrology**
- **Vegetation structure**
- **Vegetation productivity**
- **Landscape**

"Cause physical state changes in biotic and abiotic materials that, directly or indirectly, modulate the availability of resources to other species" (Jones et al. 1994, 1997).
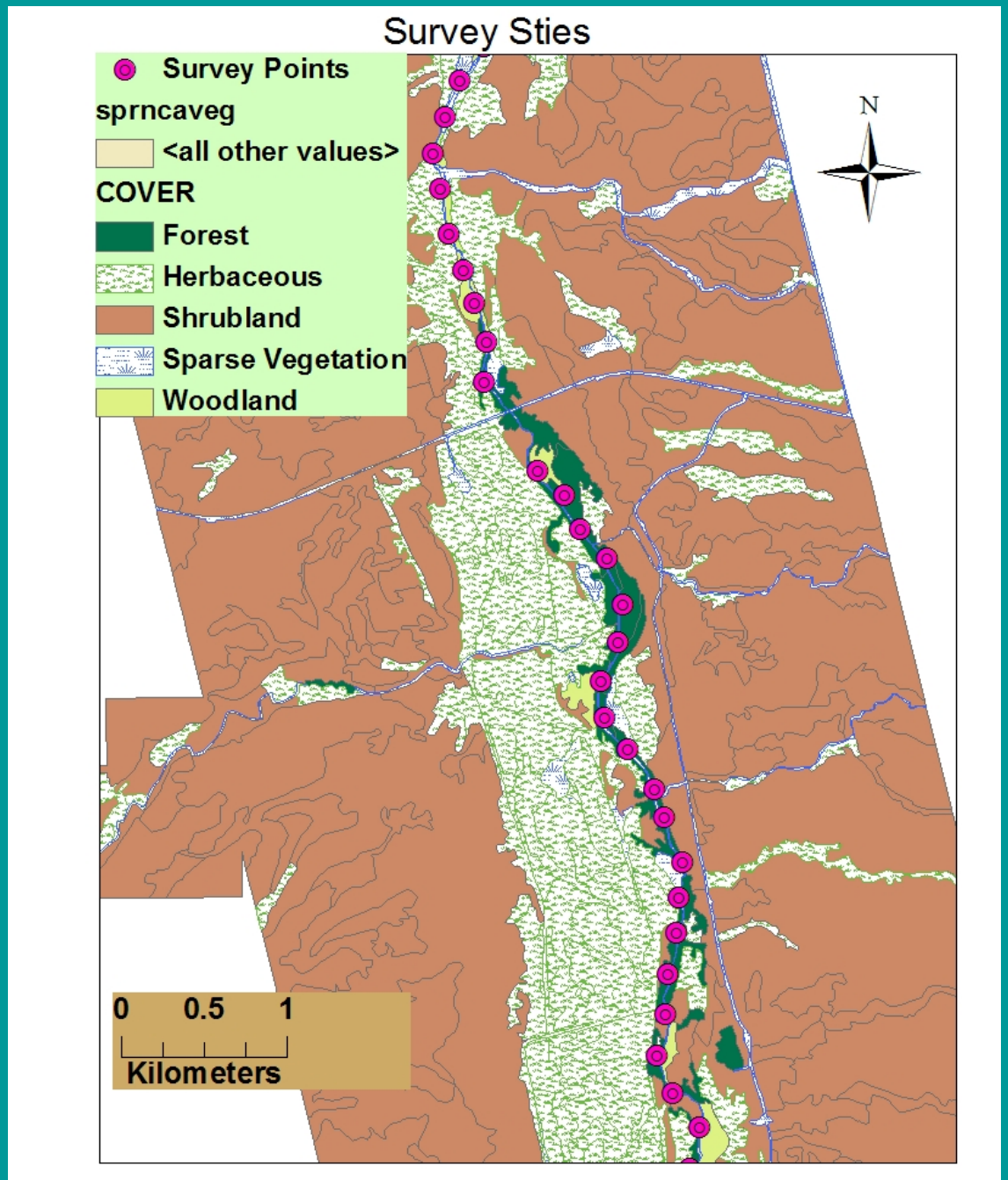
Study Design

- **Systematic Bird Survey of SPRNCA**

- **Sample Across Gradient of Conditions**

- **Stepwise Variable Selection**

- **Multiple Linear Regression, AIC**

- **Determine Relative Influence of Beaver Activity After Covariates Accounted For**
  - **Hydrology (Surface Water, Depth To Ground W.)**
  - **Vegetation structure, Floristic Composition**

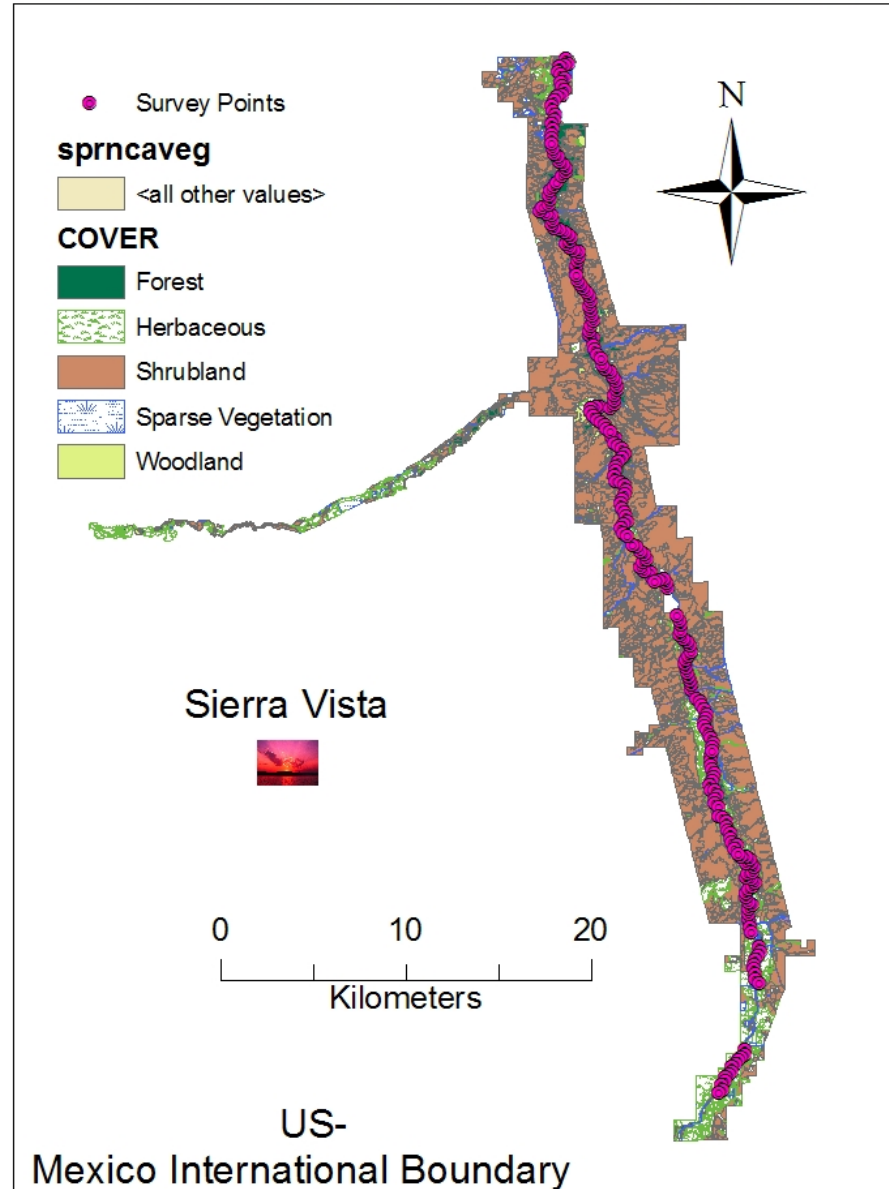# Survey Sites San Pedro Riparian National Conservation Area

Tucson

Mexico

Survey Sties

- **Survey Points**
- sprncaveg
  - <all other values>
- COVER
  - Forest
  - Herbaceous
  - Shrubland
  - Sparse Vegetation
  - Woodland

N

0   0.5   1
Kilometers

Survey Sites San Pedro Riparian National Conservation Area

Tucson

Mexico

San Pedro Riparian National Conservation Area

Methods

Avian Surveys

- Survey station placed every 275m, random start
- VCP Point Counts, distances recorded to each bird
- Only detections in riparian w/in 50 m analyzed

Environmental Measurements

- Canopy coverage in several height strata (30m)
- Stem counts w/ d.b.h of all trees (Basal Area @ 30m)
- Width of riparian vegetation, closure above river
- Beaver sign, dams, etc (BLM Census 2000-2005)
- Presence of surface water

Analyses

Explanatory Variables

- Presence/absence of any beaver sign

- Severity of beaver sign (0-4) w/in 50

- Number of years dam w/in 100, 250 meters

- Distance to dam location (any year)

Analyses

Response Variables

- **Species richness (all visits)**
- **Relative abundance (detections/effort):**

    Song Sparrow

    Yellow Warbler

Covariates

- **Riparian vegetation width (m)**
- **Canopy coverage (%), Basal Area (dbh)**
- **Surface water (dry, isolated puddles/drying, flowing/backwater)**

Results - Species Richness

Covariate Model	Direction	P-value
% Willow Cover (3-5m)	+	< 0.001
% Cotton W. (15-25m)	+	0.003
Surface water (late May)	+	0.03
% Tamarisk (> 3m)	-	0.02
Cotton W. Basal Area	-	0.02
Riparian vegetation width	-	0.06

Results - Species Richness

Each Potential Explanatory Beaver Variable Included (individually) w/ covariate model

Explanatory	Direction	*P*-value
Presence/absence	+	0.0023
No. yrs w/ dam (250)	+	0.005
Sign (0 light- 4 heavy)	+	0.01
No. yrs w/ dam (100)	+	0.05
Dam w/in 100m ever	+	0.07
Dist to Dam	(spatially auto-correlated)	

Results - Species Richness

Final Model	Direction	*P*-value
% Willow Cover (3-5m)	+	0.001
% Cotton W. (15-25m)	+	0.01
% Tamarisk (> 3m)	-	0.08
Riparian vegetation width	-	0.08 / 0.05
Beaver Variables (individually)		
No. yrs w/ dam (250)	+	0.0007
Sign (0 light- 4 heavy)	+	0.01

Results - Species Richness

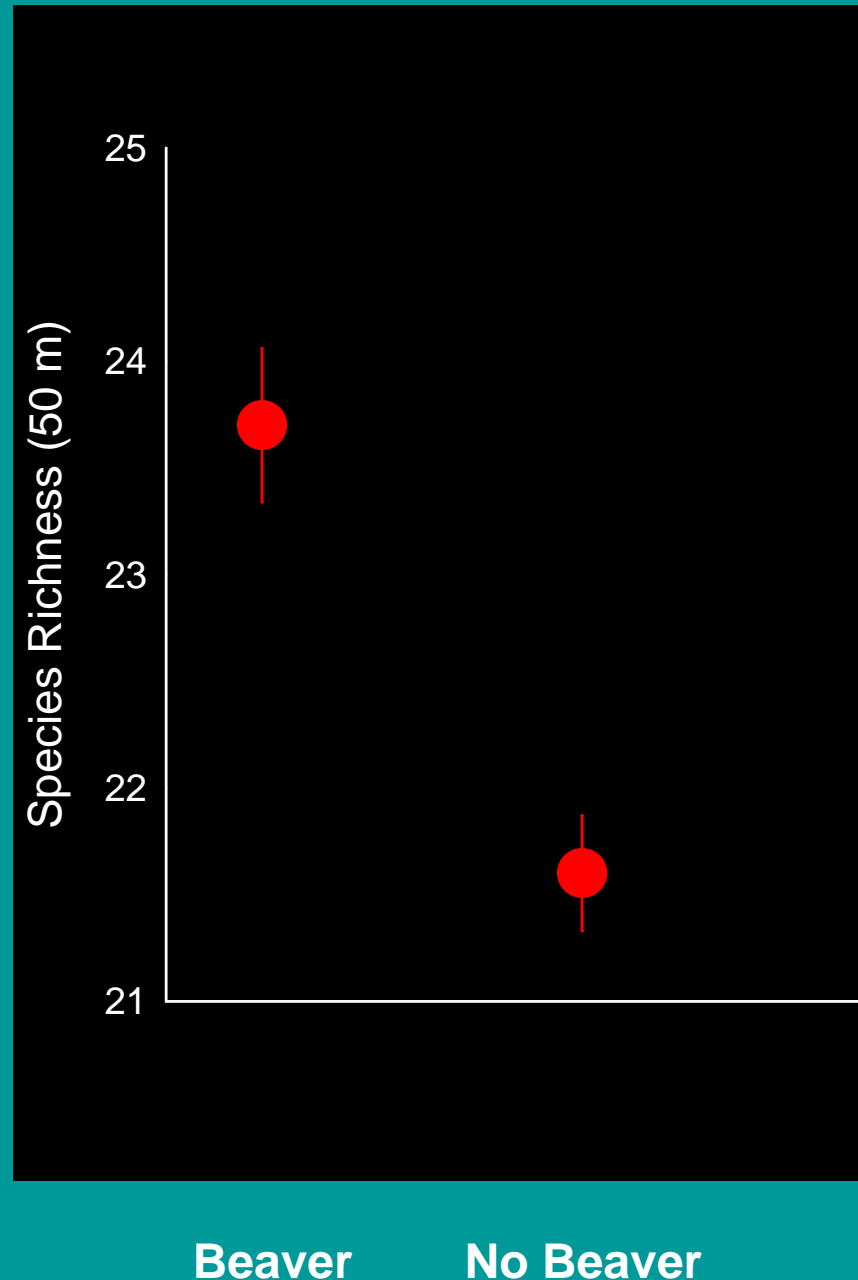| Final Model	Direction	P-value
Dropped:		
Surface water (late May)	+	0.2
Cotton W. Basal Area	-	0.3

Unadjusted Species Richness

All levels of beaver Influence vs. no Beaver sign

Effect : + 2.2

P-value: < 0.001

Results - Species Richness
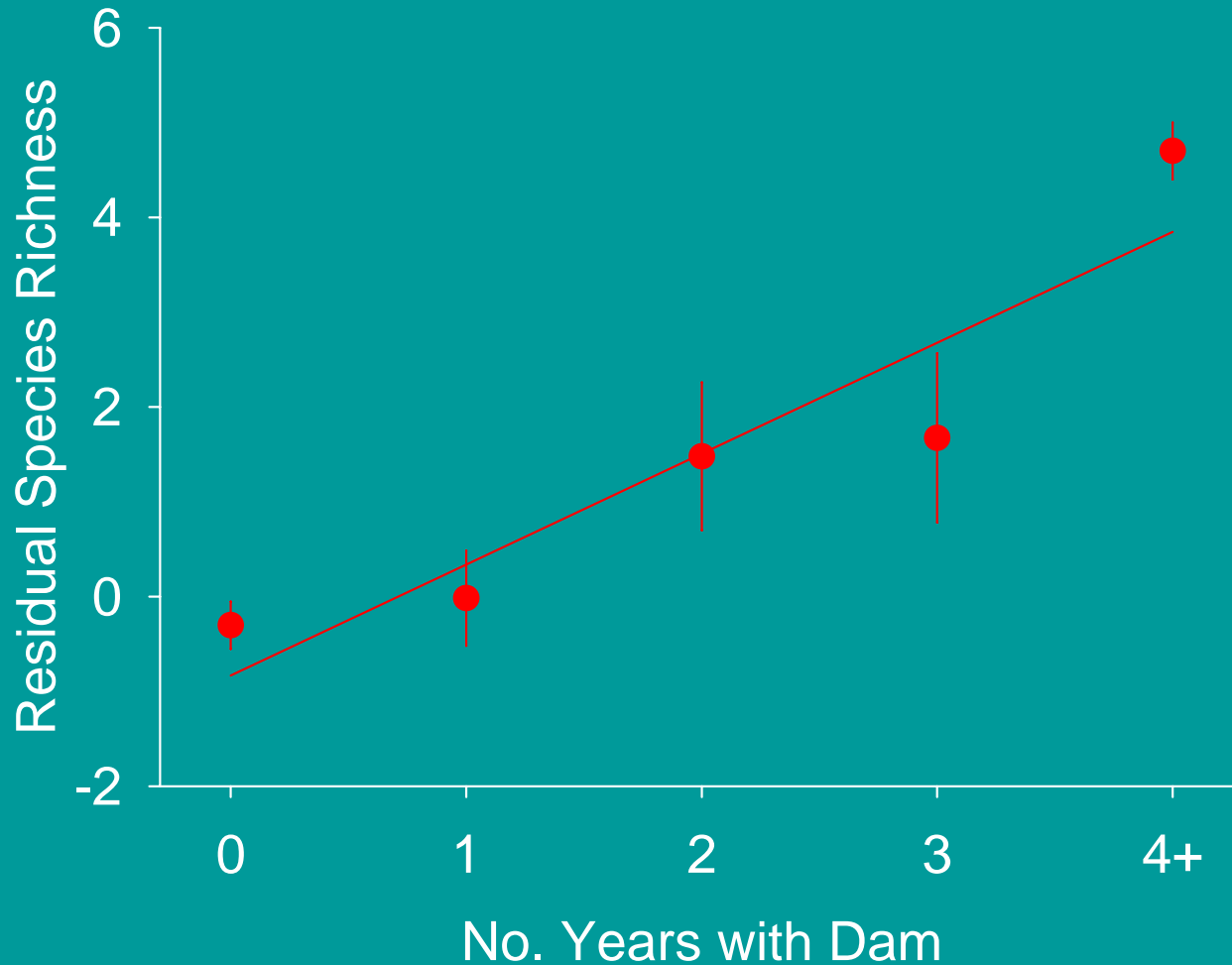
Results – Song Sparrow

Final Model	Direction	*P*-value
% Willow Cover (3-5m)	+	0.0032%
Tamarisk (> 3m)	-	0.02
Surface Water (May)	+	<0.001
Beaver Variables (individually)		
No. yrs w/ dam (250)	+	0.0032
Sign (0 light- 4 heavy)	+	0.01

Results – Yellow Warbler

Final Model	Direction	*P*-value
% Cotton W. (15-25m)	+	0.002
% Willow Cover (7-10m)	+	0.03
Surface Water (May)	+	<0.0001
Riparian vegetation width	+	0.005
% Tamarisk (> 3m)	-	< 0.001
Beaver Variables (individually)		
No. yrs w/ dam (250)	+	0. 3
Sign (0 light- 4 heavy)	+	0.5

Conclusions

- Beaver Activity Associated w/ Increased Species Richness

- Song Sparrow Assoc. w/ Beaver Activity

- Yellow Warbler not Assoc. w/ Beaver

- Adjusting for covariates important

Conclusions

- Stronger Effects w/ Time?

- Incorporate density, AIC to chose model

- Surface Water Important, yet effect overshadowed by Beaver

  (Habitat Selection?)

Conclusions

- Riparian restoration alternatives increasingly employing beavers

- No published experimental / replicated studies

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