



Interactions between urban water policy, residential irrigation, and plant & bird diversity in the Fresno-Clovis Metro Area

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Urban Long-Term Research Area
Fresno And Clovis Ecosocial Study





Water: a key resource & ecosystem service in any urban Socio-Ecological System



What drives water consumption?

- ❖ Socioeconomic status is positively correlated with levels of resource consumption
 - ❖ at individual/household scale as well as larger social units
- ❖ As both a good and a service, water is usually priced at a low rate in industrialized and post-industrial countries
 - ❖ as it is deemed essential to human survival;
 - ❖ and therefore, often priced for delivery of service rather than for the resource itself



What drives water consumption?

- ❖ Household consumption of water is shaped & constrained by
 - ❖ home design (*age of house, irrigation technology*)
 - ❖ residential landscape design (*type of plants, yard layout*)
 - ❖ status honor gained by conspicuous consumption of resources
 - ❖ *or*, by decreased consumption through newer technology and design that may be linked to greater environmental awareness



Water pricing as a regulatory tool?

- ❖ Water pricing may reduce water consumption under certain conditions
 - ❖ but most municipal water departments avoid water pricing policies that could encourage conservation
- ❖ The cost of water is negligible for budgetary decision making in most households - particularly true in the US

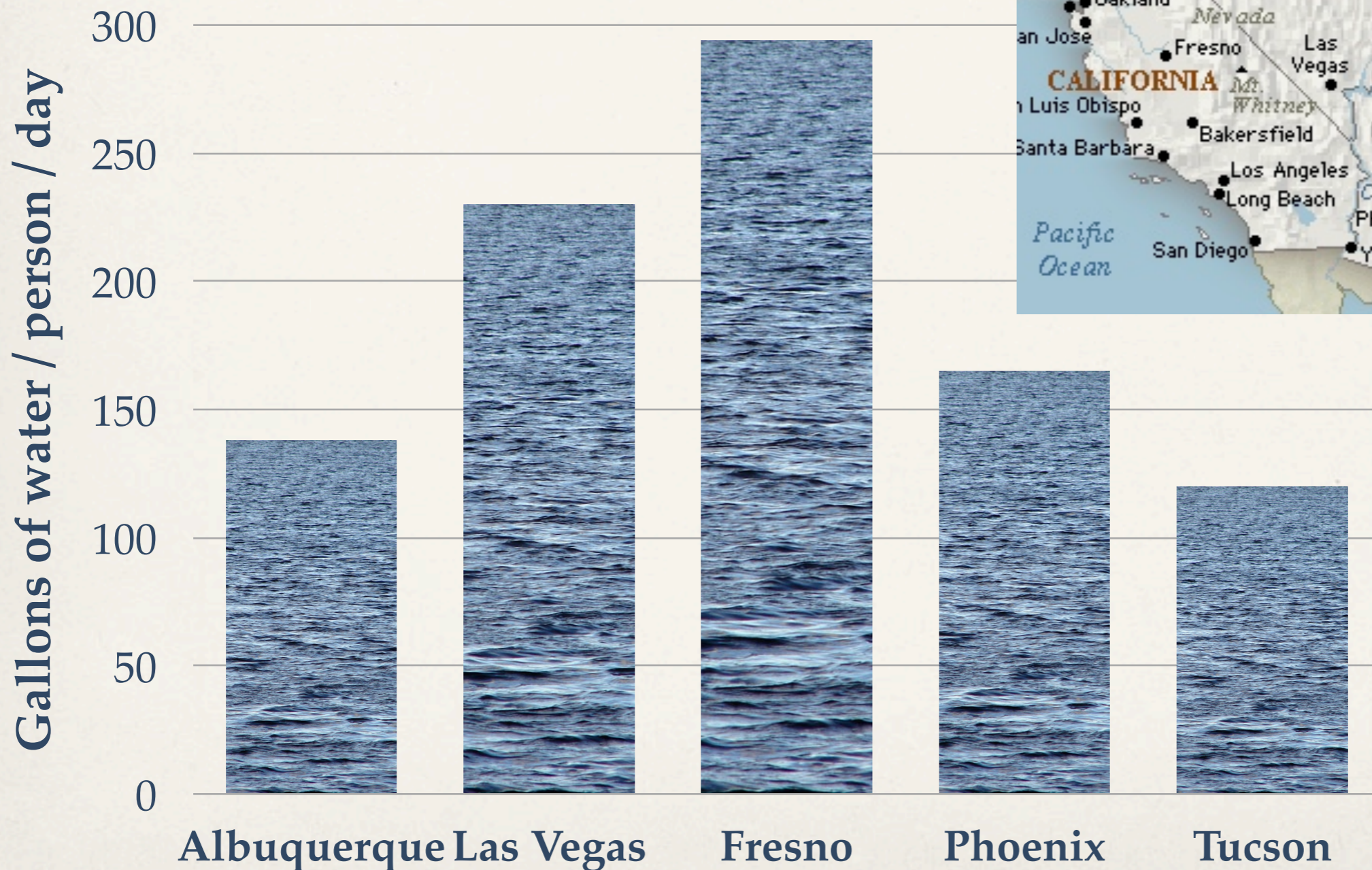


Consequences of human water consumption for urban biodiversity

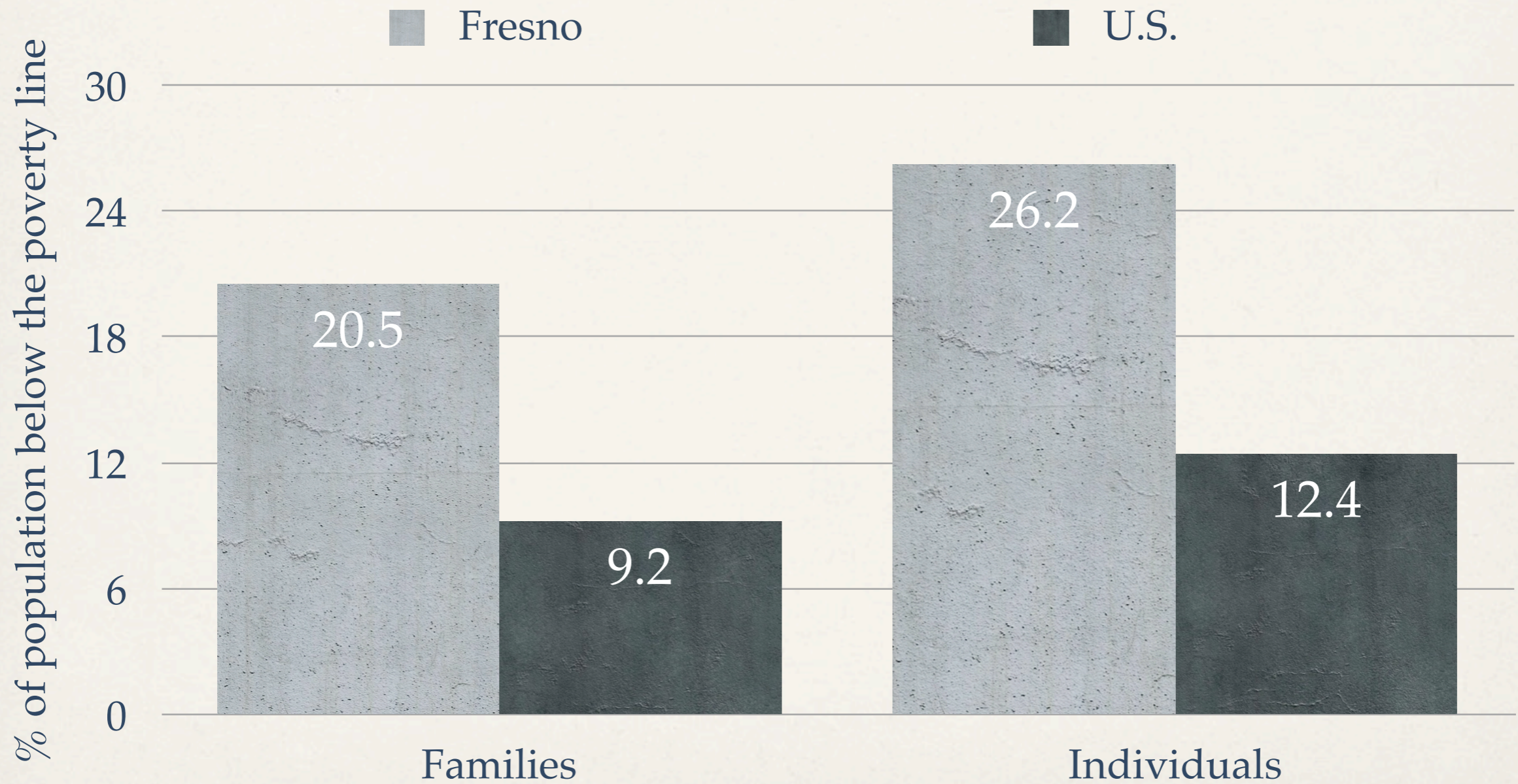
- ❖ Patterns of water use by humans shape the urban landscape
- ❖ Water availability, irrigation technologies, and human preferences determine urban plant diversity
 - ❖ plant diversity is more directly driven by human actions
- ❖ Water availability, plant diversity & cover, landscape structure and heterogeneity drive animal diversity
 - ❖ birds freely choose to inhabit/ abandon urban habitats,
 - ❖ therefore they are good indicators of biodiversity outcomes



How much water do we use in the Cadillac Desert?



Poverty in Fresno



Household Water Use in Fresno

- ❖ Currently, 51% of city water supply is used residentially
 - ❖ 70% of residential water use is for landscape irrigation
- ❖ No meters: water bill is at a flat monthly rate
 - ❖ Neighboring Clovis has metered water since 1910
 - ❖ Fresno rejected metering in early 1990s referendum
- ❖ Meters now being installed; target date for full implementation of metering: 2013 *(we hope...)*



Experimental opportunity

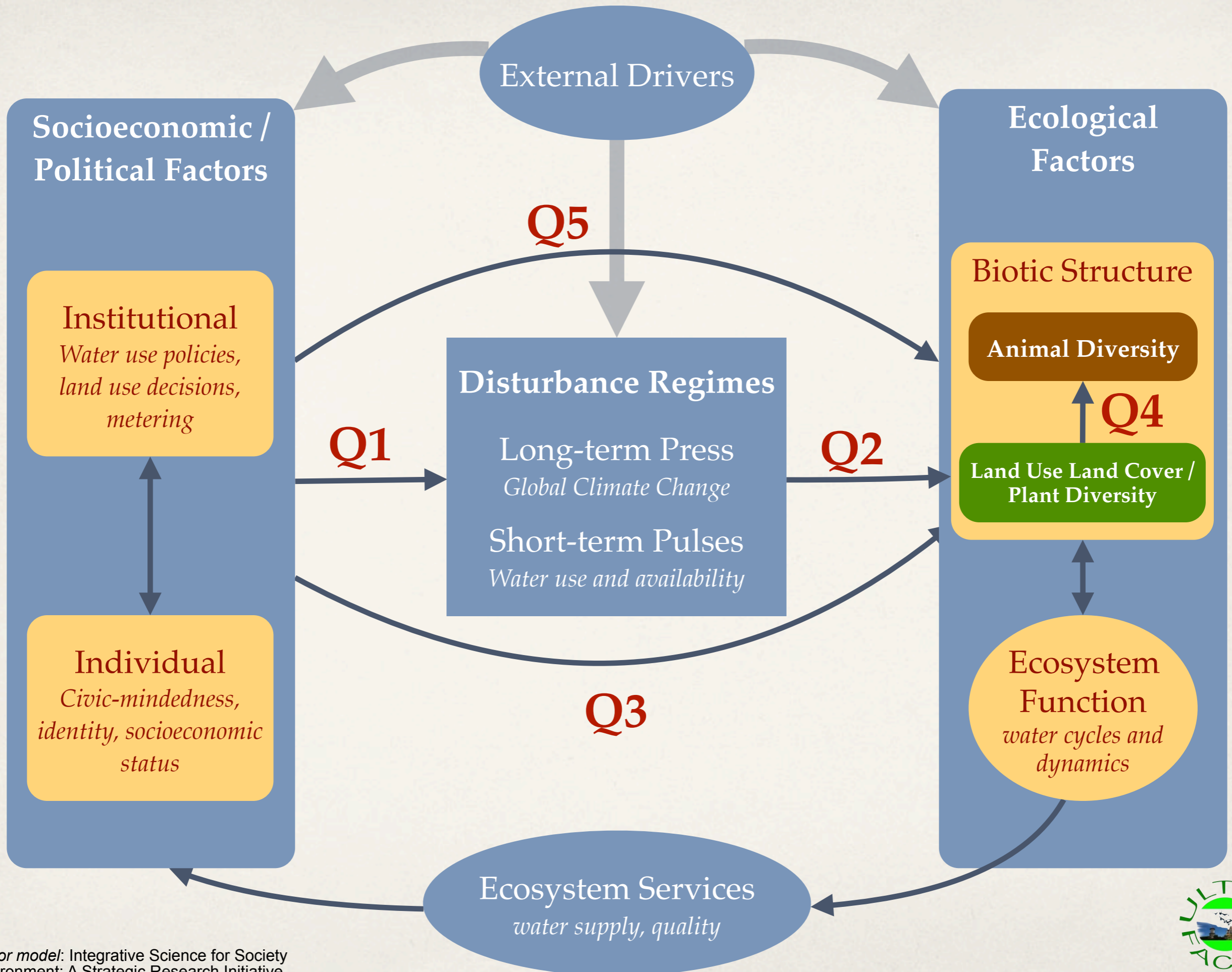
- ❖ The onset of metering in Fresno gives us a “found experiment”
- ❖ Clovis provides a “control” as an adjacent city with similar socioeconomics / demographics but >100 yrs of metering
- ❖ We have an opportunity to examine the socioecological dynamics of water use in a *Before-After-Control-Impact (BACI)* design.
- ❖ Currently in the *Before* phase, establishing baseline data



Urban Long-Term Research Area Fresno And Clovis Ecosocial Study

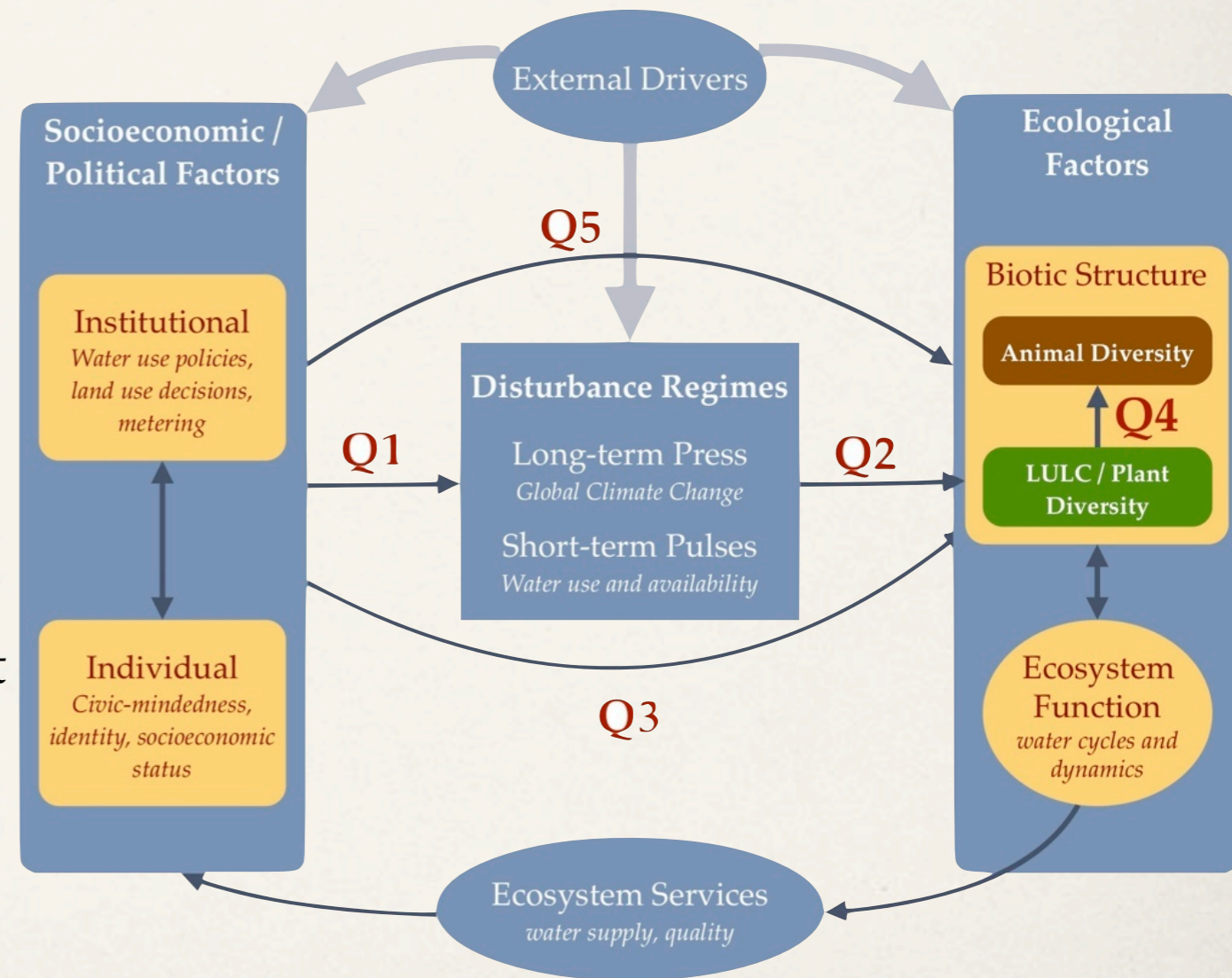


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Main Research Questions

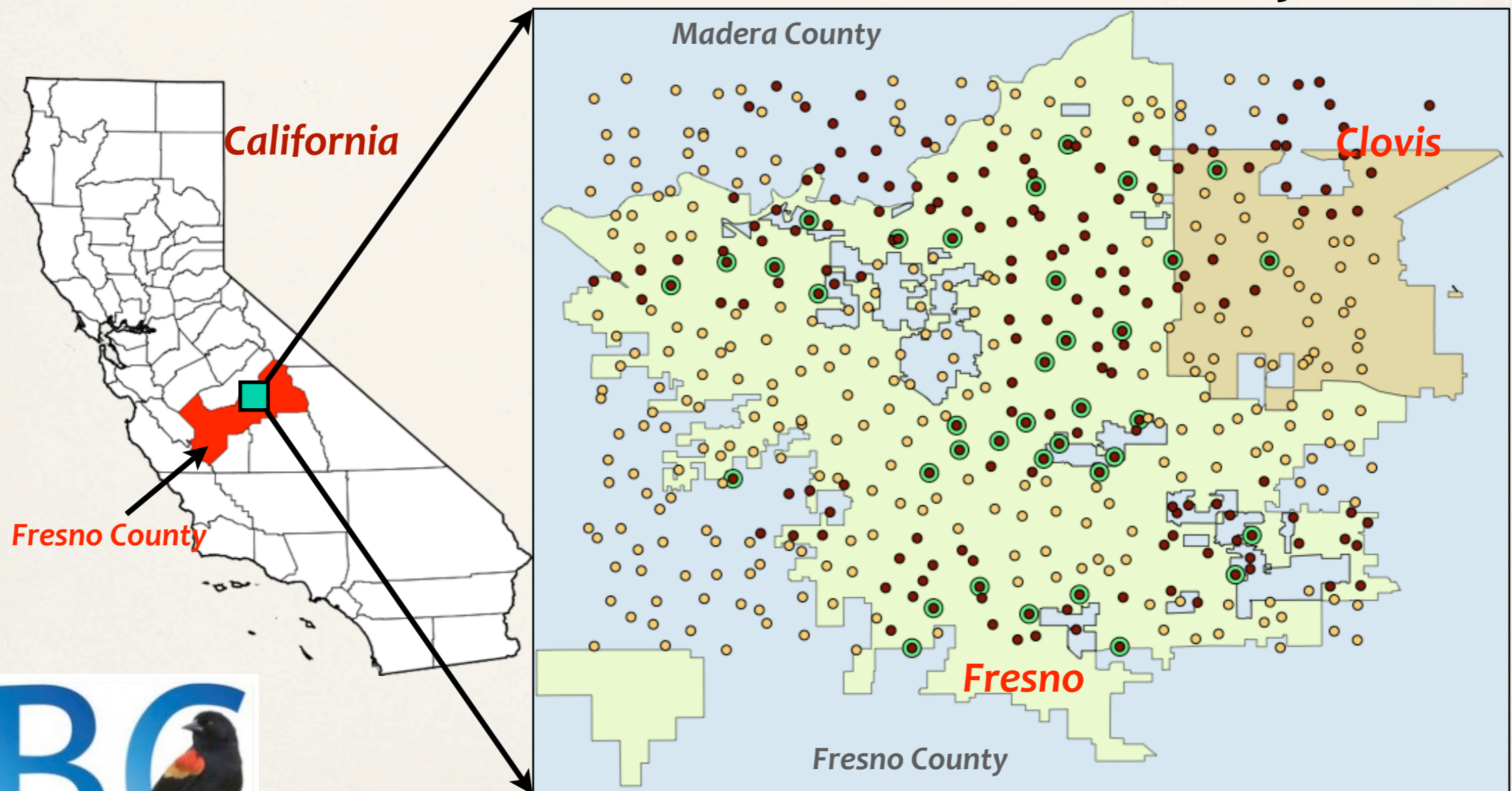
1. How are institutions of governance & individual decisions related to water use & availability in an urban SES?
2. How is water use & availability related to residential landscaping (land-use/land-cover) & plant diversity?
3. How are institutional & individual factors related to land cover & plant diversity at broader scales?
4. How does land use & plant diversity affect bird diversity in cities?
5. More broadly, how do the dynamic interactions & feedback between institutional/individual actors and an ecosystem service (water) affect ecological outcomes (i.e., plant & bird diversity)?



Study Area & Sampling Design

Fresno Clovis Metropolitan Area

ULTRA-FACES & FBC Study Area



Fresno County

California

Madera County

Clovis

Fresno

Fresno County

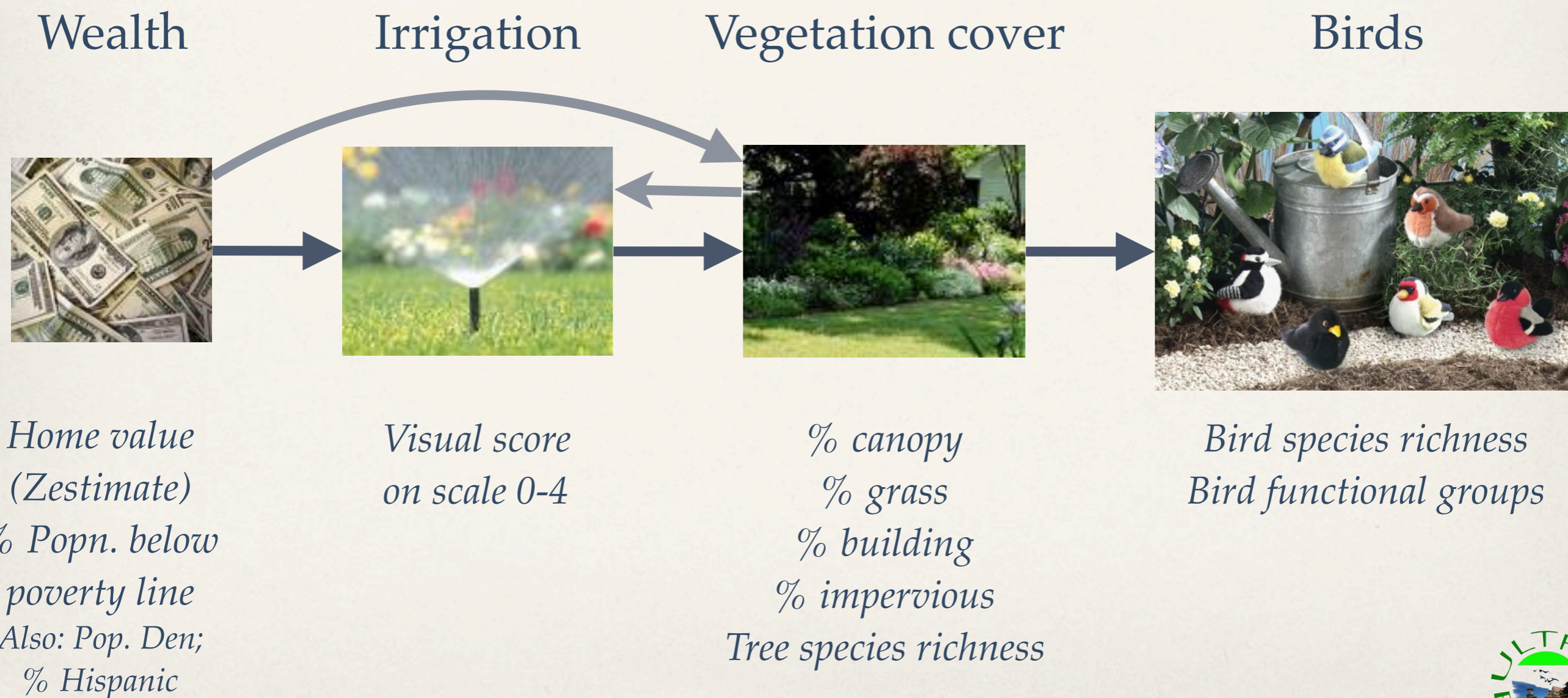
○ FBC site
(N=460)

● Censused
(in 2008)

● Core Residential
sites for bird study

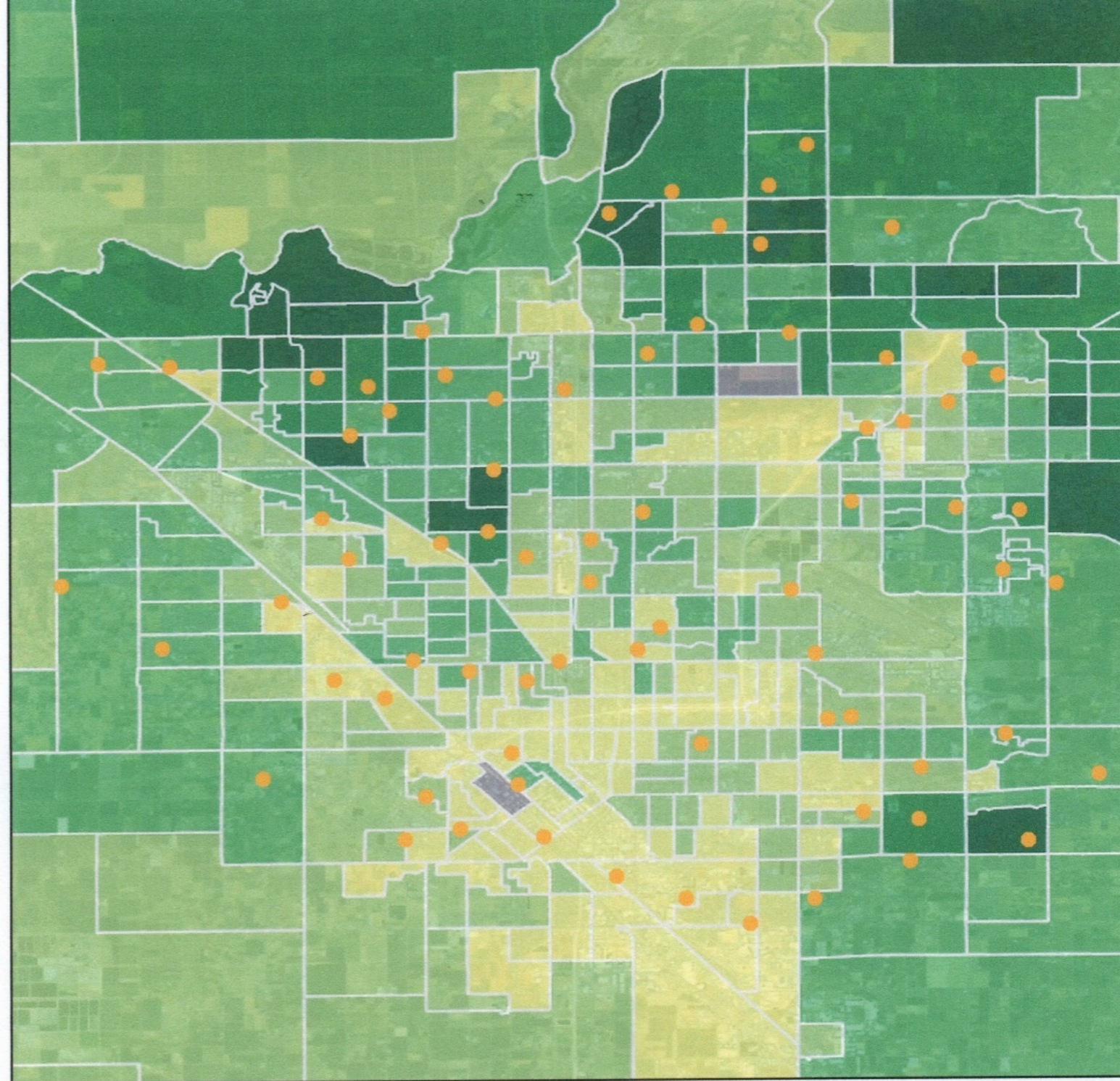


Focal pathways of interaction



Vegetation

- ❖ Subsample of FBC sites
- ❖ Sites chosen to represent wealth gradient across FCMA
- ❖ Survey of trees, ground and canopy cover, irrigation level, conducted spring 2011
- ❖ Socioeconomic, demographic variables from US Census
- ❖ Property value Zestimate from zillow.com



Legend

● ultra_social_smpl_74

Tracts

2010 Median Household Income

- \$84,001 to \$255,862
- \$70,001 to \$84,000
- \$41,001 to \$70,000 (Mean: \$55,148)
- \$27,001 to \$41,000
- \$0 to \$27,000
- Zero Population

ULTRA-Ex Social Study
Sampling Sites Distribution
(Total 74 sites)
and

2010 Median Household Income



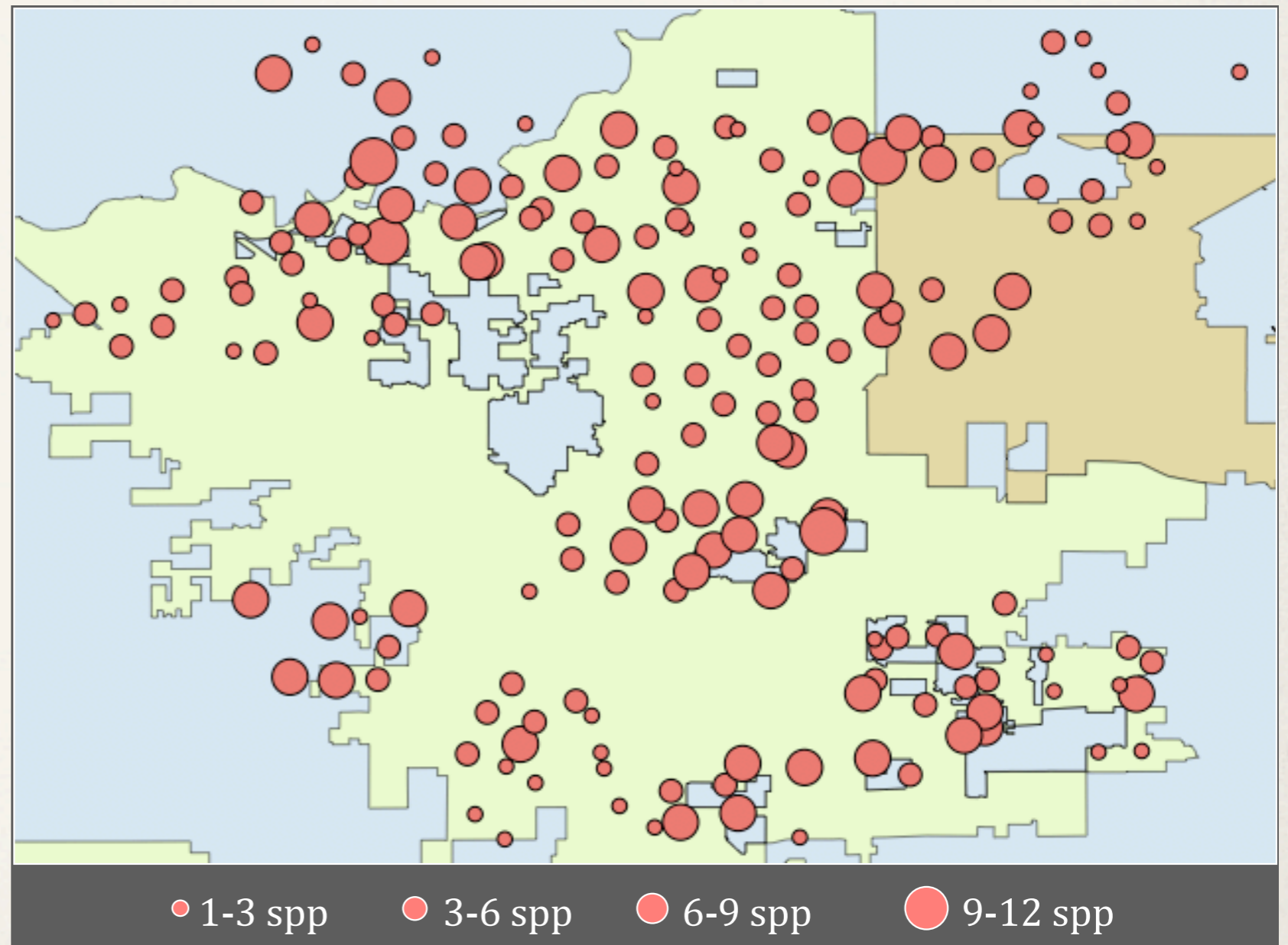
Multivariate drivers of tree species richness

Relative performance of alternative models with **human (socioeconomic/demographic/behavioral)** and **ecological (cover, biotic/abiotic)** variables to predict tree species richness. Models with $\Delta AIC_c < 7$ are shown (*per: Burnham et al 2011*).

Model	No. Param	AIC _c	ΔAIC_c	R ²
% Impervious, Pop. Den., (% Grass*Zestimate), (%Hispanic*Pop. Den.)	4	260.91	5.1	0.478
% Impervious, Zestimate, Mean Irrigation, (% Grass*Zestimate), (% Impervious*Zestimate), (Zestimate*Pop. Den.), (%Hispanic*Pop. Den.)	7	260.82	5.01	0.57
% Impervious, Zestimate, Mean Irrigation, Pop. Den. (% Grass*Zestimate), (% Impervious*Zestimate), (Zestimate*Pop. Den.), (%Hispanic*Pop. Den.)	8	255.81	0	0.641

Bird Species Richness

- In 2008
- 186 points surveyed by 30 volunteers
- 68 bird species recorded
- 3,263 total birds
- Average species richness per site **5.13 ± 0.16 SE**



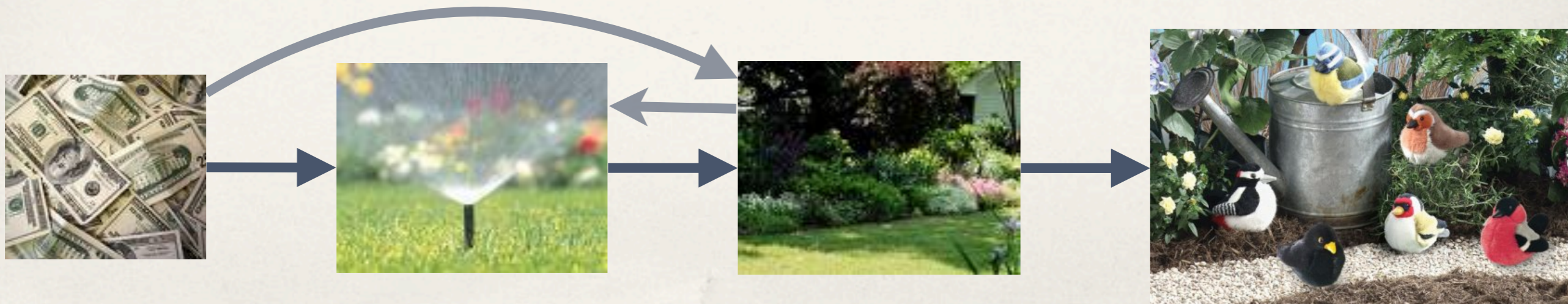
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Model	No. Param	AICc	$\Delta AICc$	R ²
% Bldg, (% Poverty*Irrigation)	2	156.85	3.26	0.293
% Bldg, (% Poverty*%Grass), (% Poverty*Irrigation)	3	154.32	0.73	0.383
% Bldg, (% Poverty*%Grass), (% Poverty*Grass Height), (% Poverty*Irrigation)	4	153.59	0	0.438
% Grass, % Bldg, (% Poverty*%Grass), (% Poverty*Grass Height), (% Poverty*Irrigation)	5	154.54	0.95	0.46
% Grass, % Bldg, Grass Height, (% Poverty*%Grass), (% Poverty*Grass Height), (% Poverty*Irrigation)	6	156.07	2.48	0.49

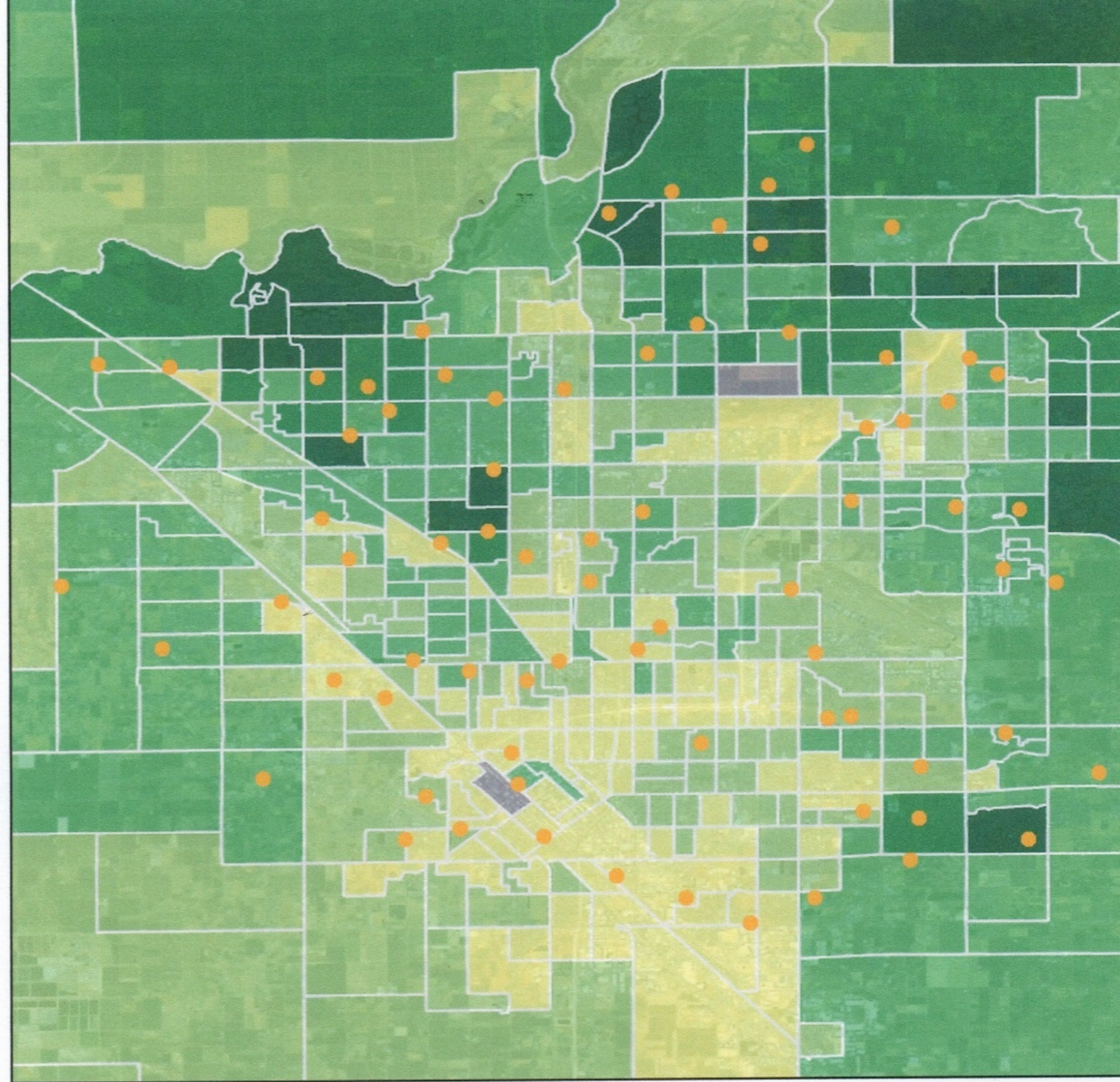
Wealth, irrigation, & urban biodiversity

- ❖ Residential irrigation increased significantly with wealth.
- ❖ **Species richness:** Multivariate results indicate that socioeconomic variables and irrigation have strong positive effects on both tree and bird species richness in combination with habitat cover variables.
- ❖ **Avian guilds:** Wealth and irrigation also strongly affect avian guild richness, with insectivores particularly sensitive to irrigation, disappearing from poorly irrigated areas.



Other pathways being studied

- ❖ Social survey of individual households (*completed, under analysis; anjones@csufresno.edu*)
- ❖ Site visits to sample homes (*in progress; hdelcore@csufresno.edu*)
- ❖ Focus group and individual interviews of institutional actors (key policy makers & implementers in city and county govt; *Fall 2011*)
- ❖ Land Use Land Cover (LULC) analysis (*preliminary*)



Legend

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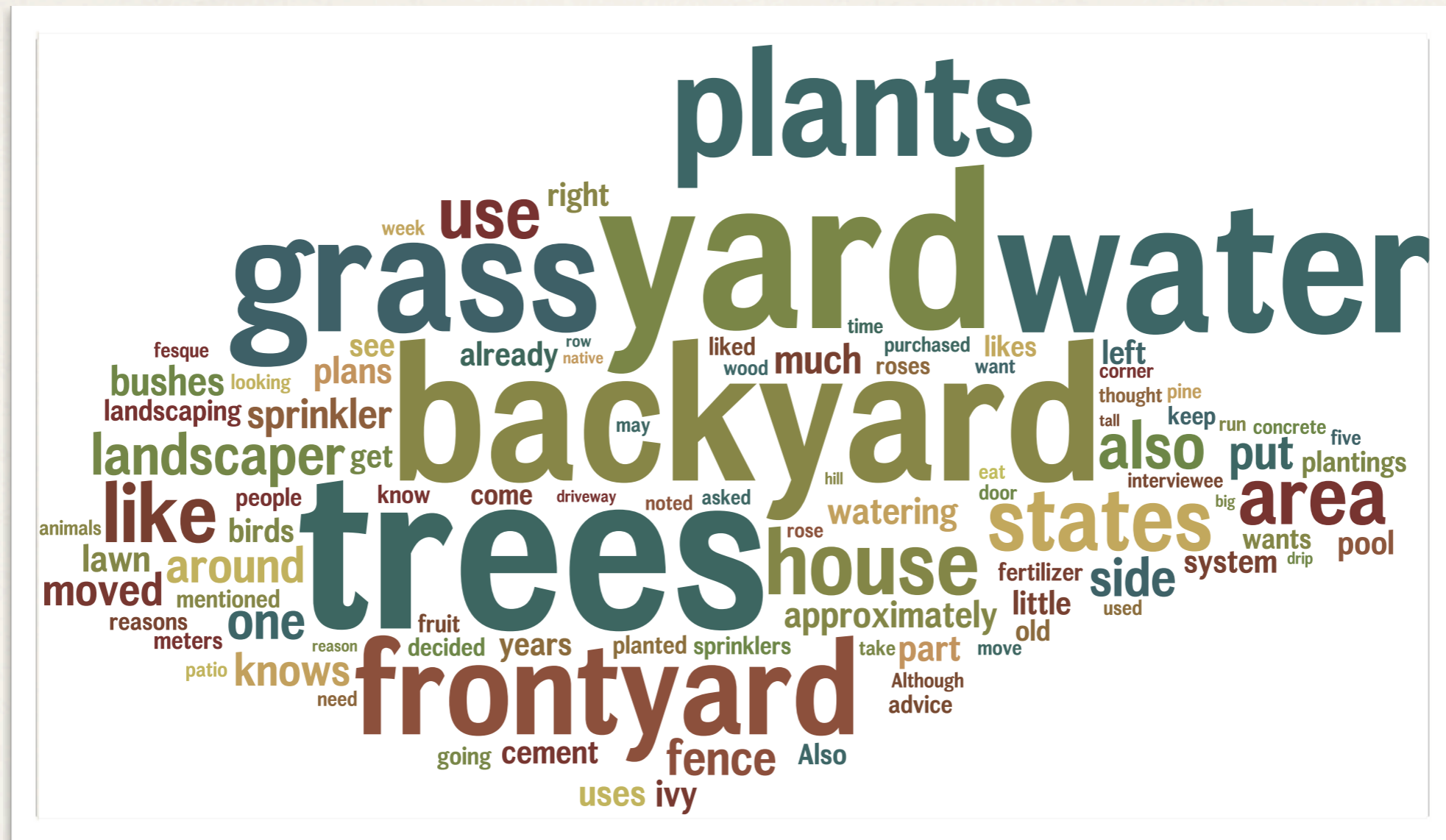
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Words from site visits...



“I always thought of myself as conservation-minded, but I don’t think looking back in retrospect that my choices for the valley have reflected that image of myself... I try to conserve water when I can but I think my choices have not been so great.”

- Homeowner cognizant of dissonance



It takes a village to study the city...

- * *Paying the bills:*

- * National Science Foundation & U.S. Forest Service (ULTRA-Ex Award # 0949036)
- * CSU Fresno: Provost, College of Science and Mathematics, Division of Graduate Studies
- * Robert and Norma Craig Foundation
- * Fresno Audubon Society
- * City of Fresno, City of Clovis, Fresno County
- * Citizen Scientists of the Fresno Bird Count!
- * *FBC coordination:* Kaberi Kar Gupta, Jenny Phillips, Pedro Garcia, Amy Krisch
- * *Database:* Xiaoming Yang
- * *Data entry:* Amer Naik, Rhiannon Perry
- * Tucson Bird Count, NiJeL.org



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