Linking residential landscape, socioeconomic status, and perceptions to bird diversity

Riley Burnette[1], Paige Warren[2], Susannah Lerman[3], Heather L. Bateman[1], Kelli Larson[4,5], Jessica Hoffmann[4]

[1]College of Letters and Science, Arizona State University; [2]Dept Environmental Conservation, UMass-Amherst; [3]USDA Forest Service Northern Research Station; [4]School of Sustainability, Arizona State University; [5]School of Geographical Sciences and Urban Planning, Arizona State University

Background

- Cities represent a patchwork of landscape design and social attributes, which can potentially impact biodiversity and human interactions with wildlife.

- Phoenix **residential neighborhoods that mimic the desert support a richer native bird community** and residents report greater levels of satisfaction with their backyard birds (Lerman and Warren 2011).

- **The question remains whether these relationships are stable over time.**

Research Questions

1. How have neighborhood satisfaction, residential landscape, and bird diversity changed over time?

2. Has the relationship between residents' self-reported satisfaction of bird variety and native species richness persisted?

3. What factors best account for variation in Phoenix bird communities?

Methods

- We used data from PASS and field measurements of the bird community to connect two data collection periods: PASS 2 (2006) and PASS 3 (2011).

- Bird Surveys: One point-count per neighborhood (n=39), visited 12 times per PASS survey.
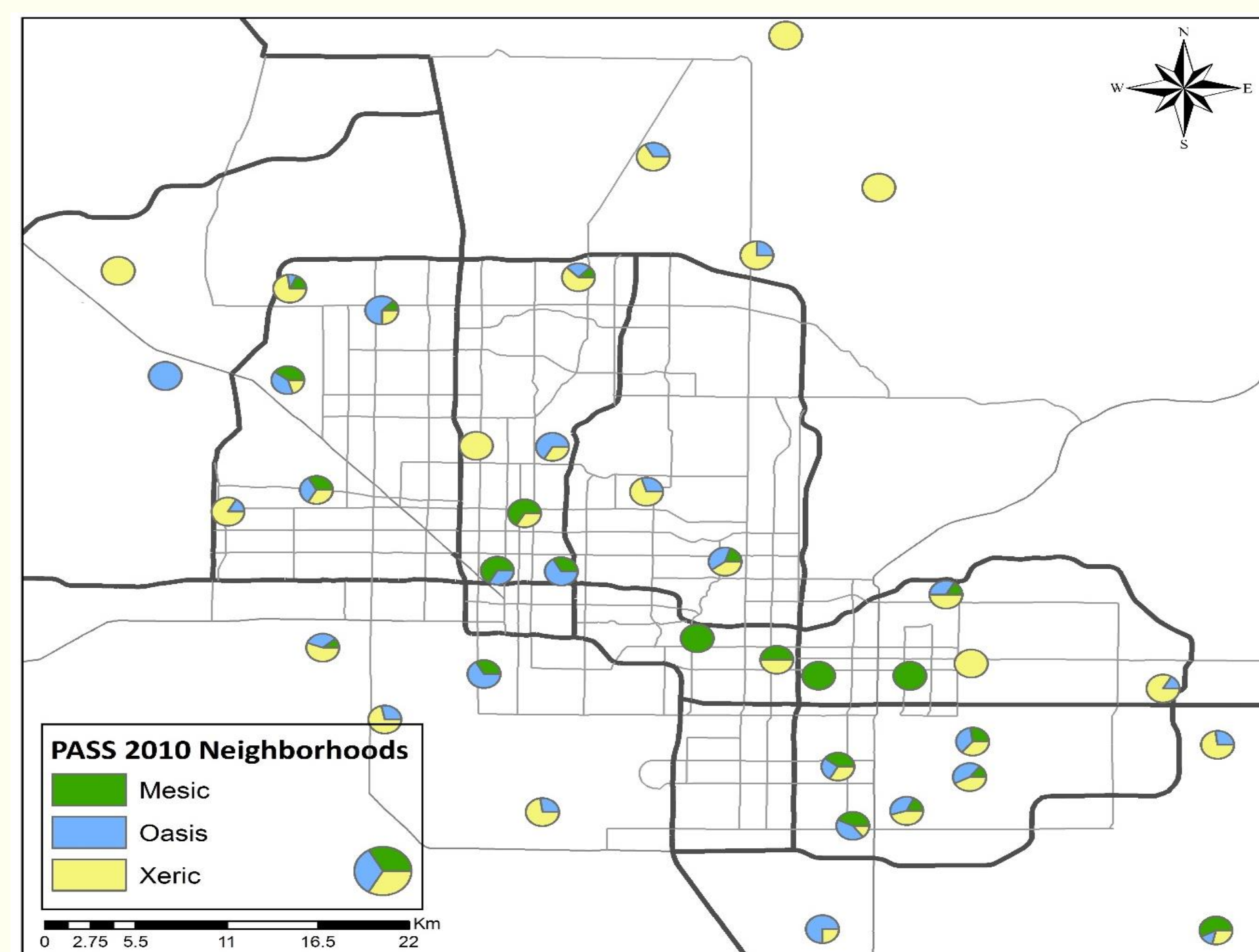
Study Area

Figure 1. The distribution of long-term bird monitoring locations within Phoenix Area Social Survey (PASS) neighborhoods. Landscape type reflects repeat respondents answer regarding their landscaping for both front and back yards from the 2010 PASS survey.

Results

Research Question 1

- The percentage of respondents that were satisfied with bird variety in their neighborhood decreased by 13% between the two time periods (Generalized Linear Model: $r=-0.45$, $t_{280}=-2.59$, $P<0.009$).

- Bird richness declined by almost 3 species per neighborhood (t-test: $t_{38}=7.1$, $P<0.0001$).

- The majority of desert specialists declined in occupancy, generalist and non-native species did not change. Non-native species had the highest percent of species that increased in occupancy (Figure 2).
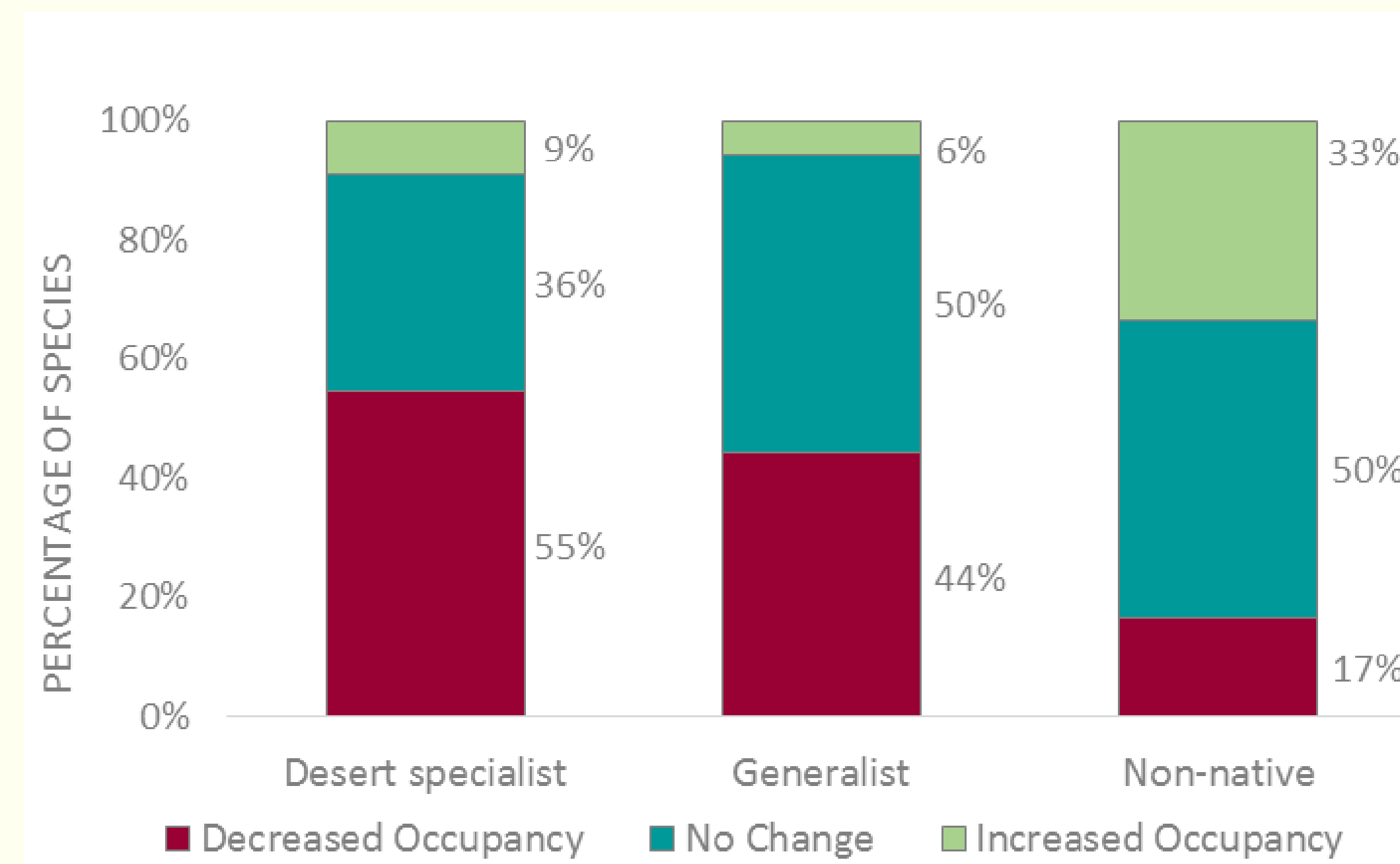

Figure 2. Occupancy modeling results summarized per guild in Phoenix between PASS 2 and PASS 3 time periods. Percentage shows number of total species per guild that either decreased, remained unchanged, or increased in occupancy.
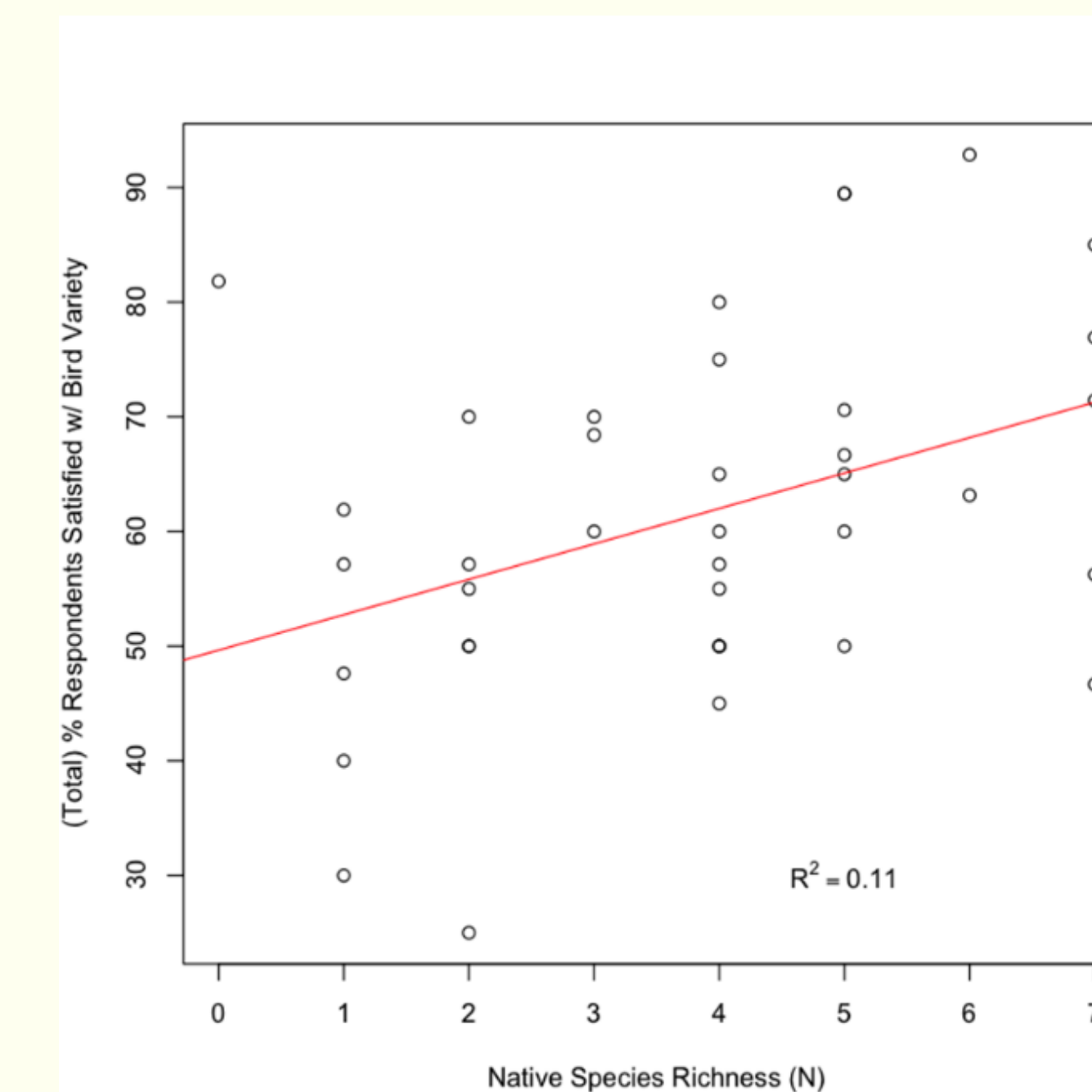

Figure 3. The relationship between native species richness and reported satisfaction of respondents with bird variety per neighborhood for the PASS 3.

Research Question 2:

- The correlation between neighborhood satisfaction and native species richness was consistent between PASS 2 and PASS 3, but had a weaker correlation ($r^2=0.11$, $F_{37}=6.14$, $P<0.02$; Figure 3).

Research Question 3:

- Yard type continued to be an important factor in accounting for variation in bird communities (Figure 4).

- Desert specialists were positively associated with xeric landscaping, non-native species were positively associated with neighborhoods containing mesic yards.

- The guild- yard type pattern was consistent between the PASS 2 and PASS 3 survey periods
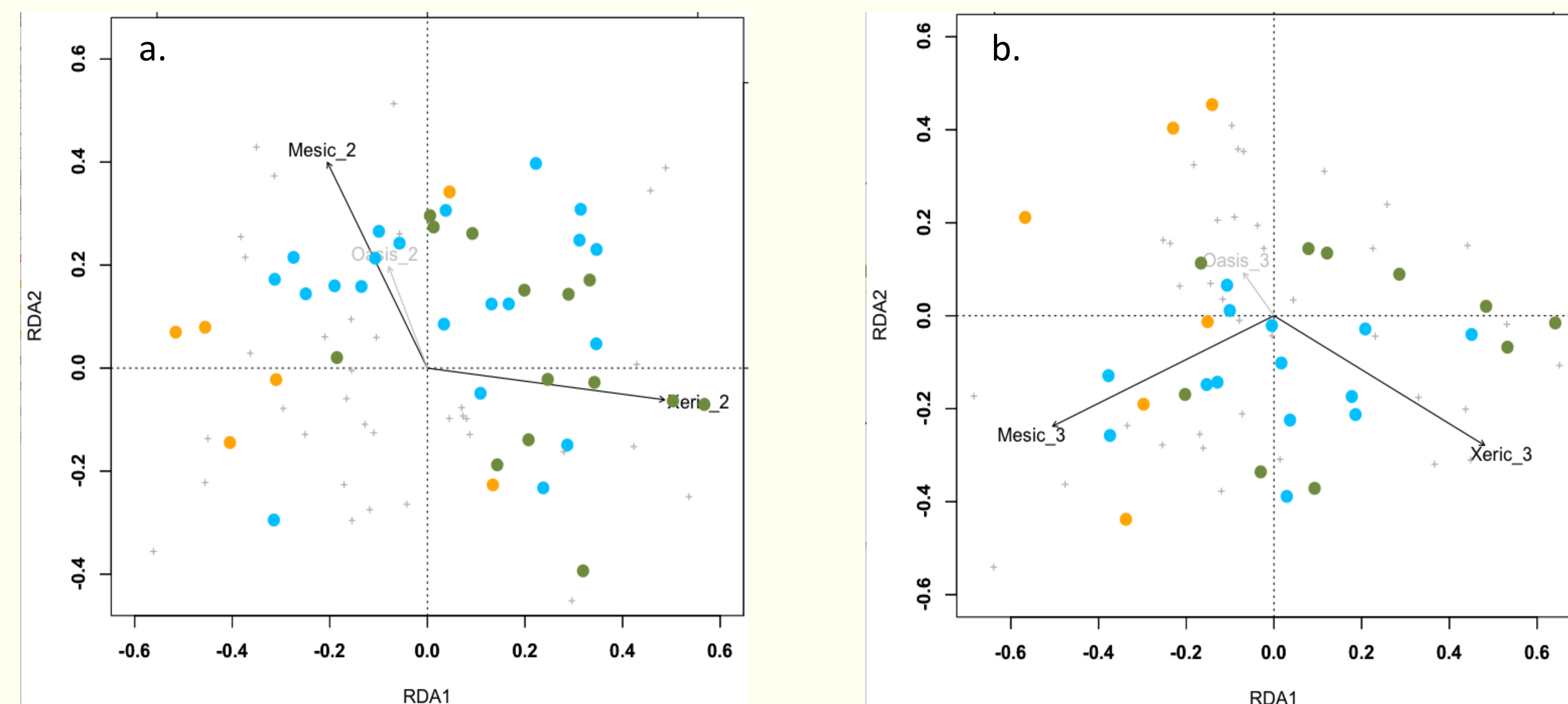

Figure 4. RDA ordination diagram of the relationship between native bird species and parcel landscape variables. Crosses represent sites. Green species are desert birds, blue species are generalist birds, and orange species are invasive birds. (a) PASS 2006 ordination gradient of mesic to xeric yards on RDA1. (b) PASS 2011 ordination gradient of mesic to xeric yards on RDA1.

Landscape Type

Neighborhood residents self-reported yard type in the PASS surveys was comparable to ecologically measured groundcover (Table 1).

- The patterns in residential landscape parcel were analyzed for respondents reporting mesic, oasis, and xeric yards (General Linear Model).

Table 1. General linear regression models for measured environmental variables (predictor) for percentage of reported parcel and front yard landscape type in each Phoenix, Arizona neighborhood for PASS 2006 survey. Bolded yard type models are tending towards significance at $P<0.10$

Model	R²	Variables	β	SE	t-value	p-value
Parcel Mesic*	0.07	% Mesic	0.10	0.06	1.68	$P<0.1000$
		Intercept	10.02	2.72	3.69	$P<0.0001$
Parcel Oasis	0.02	% Oasis	0.18	2.95	1.04	$P<0.3000$
		Intercept	16.83	0.17	5.71	$P<0.0001$
Parcel Xeric*	0.40	%Xeric	0.48	0.11	4.40	$P<0.0001$
		% Desert	0.60	0.18	3.29	$P<0.0020$
		Intercept	12.64	6.57	1.92	$P<0.0600$
Front Yard Mesic*	0.36	% Mesic	0.29	0.06	4.57	$P<0.0001$
		Intercept	7.78	2.90	2.69	$P<0.0100$
Front Yard Oasis*	0.08	% Oasis	0.33	0.18	1.78	$P<0.0800$
		Intercept	18.50	3.16	5.85	$P<0.0001$
Front Yard Xeric*	0.53	%Xeric	0.59	0.10	5.87	$P<0.0001$
		% Desert	0.66	0.17	3.97	$P<0.0001$
		Intercept	10.89	6.01	1.81	$P<0.0800$

Conclusion

- Native species richness, occupancy, and residents' satisfaction with bird variety all decreased.

- Desert specialists were negatively associated with Mesic yards.

- Patterns were consistent over time.

- By understanding what factors are important for biodiversity we can manage cities in a way that is beneficial for native biota and human well-being.

Acknowledgements