Herpetofauna and Microhabitat Characteristics of Urban and Wildland Reaches along the Salt River, AZ

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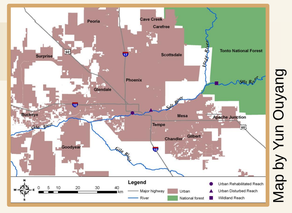
CAP LTER
Central Arizona–Phoenix
Long-Term Ecological Research

Background

- Riparian ecosystems support a high diversity and abundance of wildlife species and are used as migration corridors. Unfortunately, 70% of the riparian forests of the lower 48 states in the USA have been converted to other land uses (Turner et al. 1998).
- To mitigate for habitat loss, rehabilitation of degraded land can be performed. However, there is little published information on how rehabilitation activities impact non-avian wildlife communities in riparian ecosystems.
- Herpetofauna are an essential element for healthy ecosystems although they are understudied in riparian communities. Herpetofauna occurrence and abundance are important to monitor because herpetofauna respond to structural changes in their environment.

Study Sites

Along the Salt River, AZ, we established 24 transects along 3 reaches which vary in terms of urbanization and vegetation.



Map by Yun Ouyang

Urban Rehabilitated Reach
Phoenix Metropolitan area, recently rehabilitated

Urban Disturbed Reach
Phoenix Metropolitan area, highly disturbed

Wildland Reach
Tonto National Forest, pristine conditions

Objectives

1. Compare herpetofauna community in terms of abundance, species richness, and diversity among the 3 reaches
2. Compare microhabitat characteristics among the 3 reaches
3. Develop ecological models to predict occurrence and abundance of herpetofauna *(work in progress)*

Acknowledgments and References

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Tilman, D. and J.A. Downing. 1994. Biodiversity and stability in grasslands. Nature 367:363-365.

Turner, M.G., S.R. Carpenter, E.J. Gustafson, R.J. Naiman, and S.M. Pearson. 1998. Land use. Pages 37-61 *in* M.J. Mac, P.A. Opler, P. Doran, and C. Haecker, editors. Status and trends of our nation's biological resources. Volume1. National Biological Service, Washington, DC.

Methods

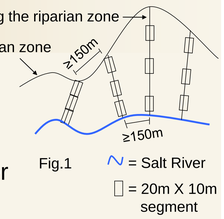


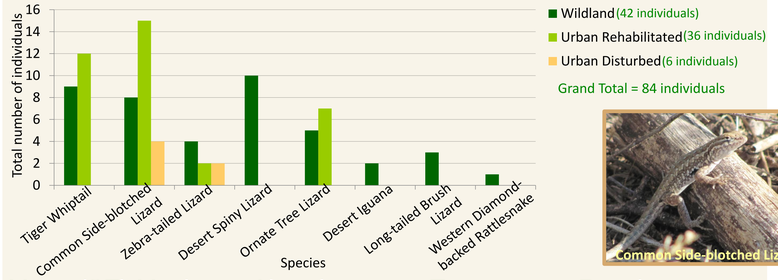
Fig.1 = Salt River; = 20m X 10m segment

- We performed herpetofauna visual surveys along 8 transects located at each reach (n=24).
- Transects were at least 150m apart, positioned 90° from stream. Three 20m x 10m segments per transect were surveyed (Fig.1).
- We collected various vegetation measurements with appropriate methods (i.e. line-intercept, etc.) to quantify microhabitat characteristics along transects.

Results - Herpetofauna

Total Number of Individual per Species per Reach

Fig. 2



Mean (SE) Maximum Abundance per Transect per Reach

Fig. 3

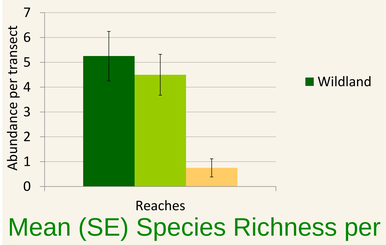


Fig. 3. Multiple Response Permutation Procedure (MRPP) and associated comparison test show that the abundance of the two urban disturbed reach is approximately 6 times lower than the abundance of the two other reaches at $p<0.001$

Mean (SE) Species Richness per Transect per Reach

Fig. 4

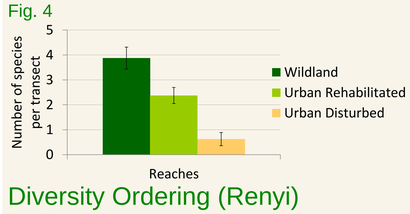


Fig. 4. MRPP and associated comparison test show that the species richness is significantly different between all reaches at $p<0.05$

Diversity Ordering (Renyi)

Fig. 5

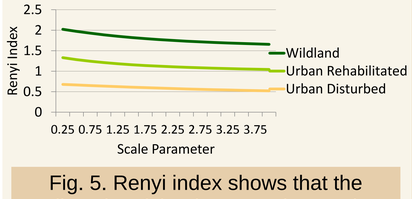


Fig. 5. Renyi index shows that the diversity of the three reaches rank consistently thus, are comparable

Diversity Indices

- Shannon-Weiner and Simpson's diversity indices were computed and compared with software "*Species Diversity and Richness 4.1.2*"
- Species diversity of the wildland reach is significantly higher than the species diversity of the two urban reaches at $p<0.05$

Results - Microhabitat

Microhabitat Characteristics

Microhabitat Characteristics	Wildland	Urban Rehabilitated	Urban Disturbed	Factor # (correlation)
Bare ground (% cover)	46.0 (3.9)	67.9 (3.2)	95.6 (1.3)	1 (-)
Litter ground (% cover)	49.6 (3.8)	30.8 (2.8)	4.2 (1.4)	1 (+)
Tree shrub* (% cover)	47.8 (5.0)	16.6 (3.7)	0.1 (0.1)	1 (+)
Overstory (% cover)	44.9 (6.6)	18.3 (5.6)	-	1 (+)
Woody debris per 10m	13.9 (1.5)	4.0 (2.5)	0.2 (0.1)	1 (+)
Vegetation species richness	11.9 (0.8)	12.0 (0.6)	2.4 (0.5)	1 (+)
Woody ground (% cover)	4.4 (0.8)	1.2 (0.8)	0.2 (0.2)	1 (+)
Shrub* (% cover)	5.6 (1.6)	3.2 (0.9)	-	1 (+)
Road/Trails (% cover)	3.3 (2.1)	12.6 (3.1)	0.4 (0.3)	2 (+)
Stem *Prosopis*/100m²	9.4 (3.2)	11.8 (3.2)	0.1 (0.1)	2 (+)
Litter depth (cm)	2.4 (0.4)	2.9 (1.3)	1.6 (0.8)	3 (+)
Subshrub* (% cover)	3.5 (1.0)	13.4 (3.0)	10.5 (2.0)	3 (+)
Tree* (%)	10.0 (4.1)	6.8 (3.7)	-	4 (+)
Burrows/200m²	28.6 (10.8)	6.1 (1.6)	2 (0.9)	4 (+)

** Refers to "growth habit" as per USDA Plant Database website*

Table 1. Mean (± SE) of microhabitat characteristics quantified along all transects per reach. Table also shows which factor the variables are loading on along with the variable correlation with the factor (positive or negative).

Principal Component Analysis; 4 Factors Explain 84.7%

Variables	Description	Wildland	Urban Rehabilitated	Urban Disturbed	p value
Factor 1	Complex vegetative cover structure	1.13 (0.13) **a**	0.02 (0.15) **b**	-1.15 (0.02) **c**	$p < 0.00001$
Factor 2	Mesquite and road/trail presence	-0.34 (0.37) **a**	0.84 (0.33) **b**	-0.50 (0.12) **a**	$p \leq 0.02$
Factor 3	Litter and <0.5m tall cover	-0.24 (0.17) **a**	-0.008 (0.55) **a**	0.24 (0.24) **a**	$p > 0.05$
Factor 4	Presence of trees, lack of burrows	-0.40 (0.49) **a**	0.55 (0.31) **a**	-0.15 (0.03) **a**	$p > 0.05$

Table 2. Mean (±SE) of Principal Component Analysis factors with eigen values ≥1. Those 4 factors explain 84.7% of the microhabitat characteristics variation. Table also shows significant differences for each factor between reaches. P values calculated with TukeyHSD at 95% confidence interval.

Conclusion

Preliminary Results Suggest:

- Rehabilitation may be beneficial for herpetofauna abundance.
- Urbanization may negatively influence herpetofauna diversity.

Implication for Practice:

- Once ecological models are developed, we will be able to make suggestions as to how to rehabilitate an area to favor herpetofauna abundance and diversity.
- Herpetofauna abundance is important to favor as herps have an important ecological role in healthy ecosystems.
- Herpetofauna diversity is also important to favor as diverse ecosystems are typically more stable, more resistant, and/or more resilient to disturbance (Tilman & Downing 1994).