

Kristin Robinson & Xavier Silva, PhD.

University of Minnesota: Twin Cities & SIT Ecuador: Comparative Ecology and Conservation

Background

- Spiders (Araneae) are used as bioindicators to assess environmental and arthropod community change
 - Spiders are generally the main arthropod predator¹
 - Predators not only face environmental change themselves but also rely on lower trophic levels experiencing these pressures¹
- Neotropical cloud forest spider diversity is severely understudied
 - The only cloud forest spider researchers in Ecuador, Dupérré & Tapia, already described many new species just in the last 5 years^{2,3,4}
- The Tumbes-Chocó-Magdalena bioregion, or Chocó cloud forest, is a biodiversity hotspot in the Western Andes with high endemism (Fig. 1)
 - Estimated to have already lost 30% species richness since the 1500s⁵
 - Projected to lose 10% more between 2005 to 2095⁵
 - Threats: climate change, deforestation, agriculture, and edge effects⁶
- Spider diversity and their use as bioindicators are needed to better understand the effects of climate change and deforestation on arthropod community composition overall



Figure 1. Map of the study site at La Hesperia. Location of La Hesperia in relation to Quito. Red highlight shows Chocó bioregion.

Araneidae (orb weaver):
Eriophora sp. eating a cockroach
La Hesperia, Ecuador
Photo by Kristin Robinson



Results

1) Overall Family Composition

12 days of data collection at 4 transects:

- 1,318 individuals
- 16 families
- 33 genera
- 188 morphospecies

Sample predicted to be 92.18% of total diversity (Chao estimate⁷)

2) Altitude Effect on Diversity

- High altitude transect:
 - Least diverse (Fig. 4)
 - Highest space web abundance, one of least diverse guilds (Fig. 5)
 - Highest abundance of Theridiidae (61.5%)

3) Land Use Effect on Diversity

- Land use transect:
 - More diverse than control (Mid transect) (Fig. 4)
 - Highest orb web abundance, the most diverse guild (Fig. 5)
 - Araneidae (orb web) as most abundant (36.5%) followed by Theridiidae (26.5%)
 - Significantly less canopy cover and less leaf litter depth (One-way ANOVA, $p < 0.05$)

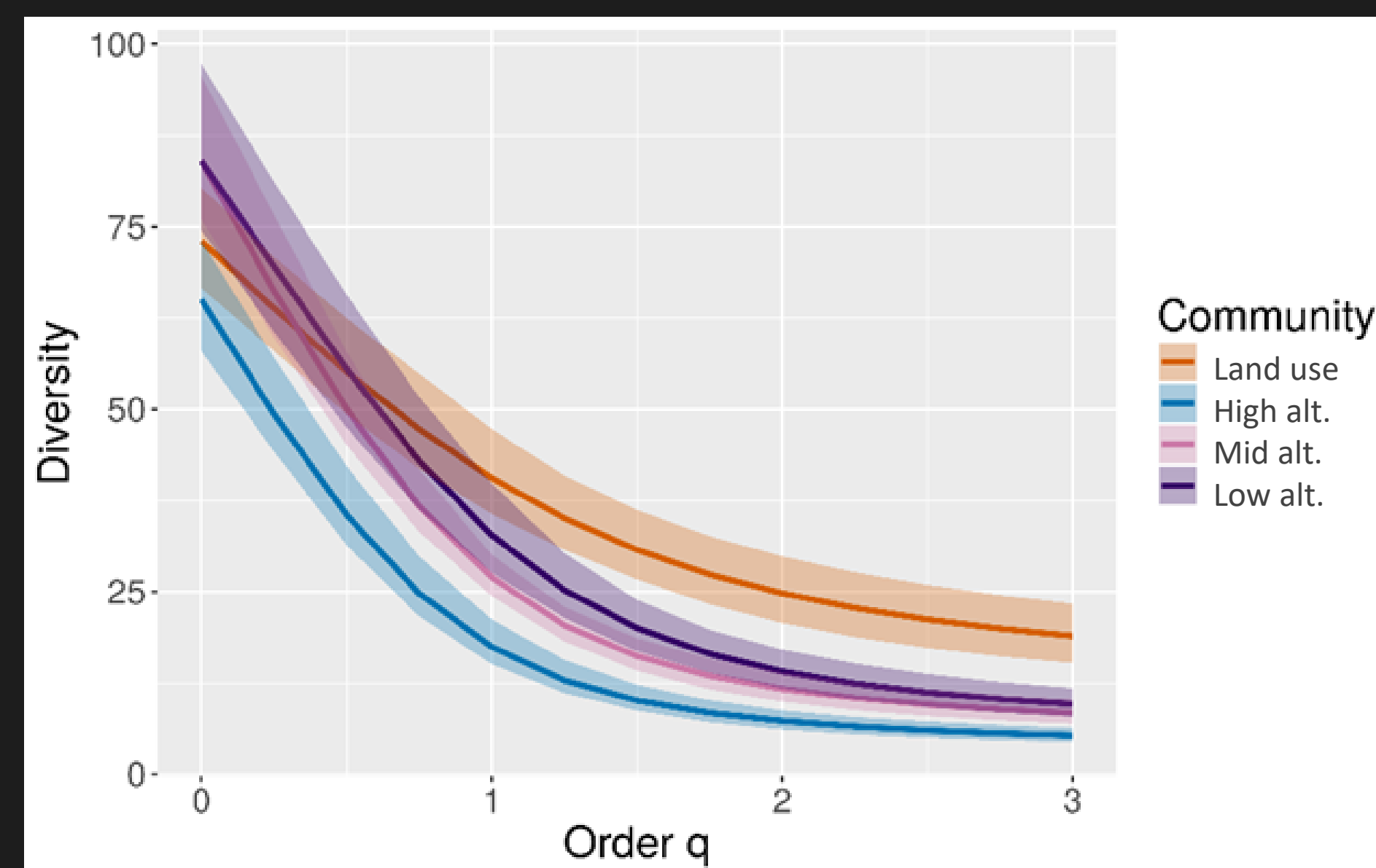


Figure 4. Diversity profile of all transects. The diversity of the 4 transects compared to continuous q values: species richness ($q=0$), the Shannon diversity index ($q=1$), and the Simpson diversity index ($q=2$). The faded area is the 95% confidence interval.

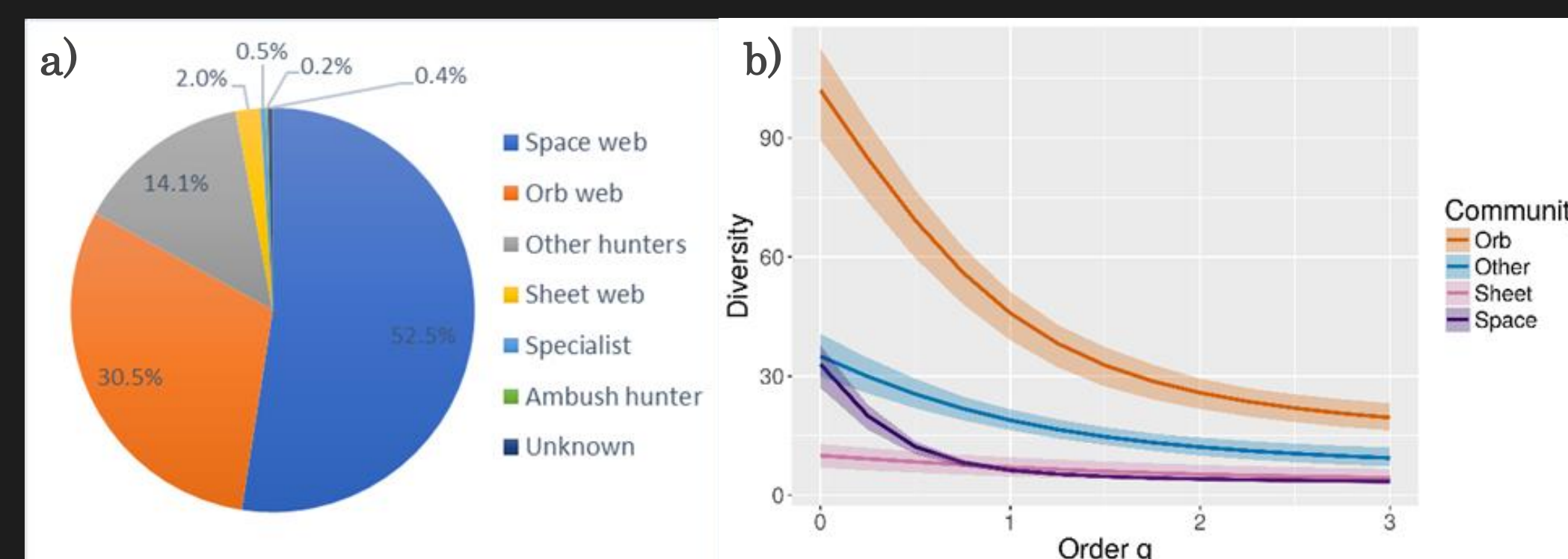


Figure 5. Guild abundance and diversity. Space web (Theridiidae, Pholcidae), orb web (Araneidae, Tetragnathidae, Uloboridae, Synotaxidae), other hunters (Ctenidae, Anyphaenidae, Clubionidae, Erigoninae, Saltidae, Scytodidae), sheet web (Linyphiinae), specialist (Mimetidae, Trachelidae, Pisauridae: Dolomedes sp.), and ambush hunter (Thomisidae). a) Abundance of each guild across all transects. b) Diversity profile of the four most abundant spider guilds using continuous q values: species richness ($q=0$), Shannon diversity index ($q=1$), and Simpson diversity index ($q=2$). The faded area is the 95% confidence interval.

Conclusions

1) Overall Family Composition

- This study established baseline spider composition at La Hesperia.
 - Important to compare diversity to other areas to examine deforestation impacts on arthropods
 - As well as the impact on ecosystem resilience to climate change, loss of ecosystem services, and ecosystem functioning.

2) Altitude Effect on Diversity

- Highest altitude had the lowest diversity
 - Majority were 2 morphospecies of subsocial spiders (Fig. 4)
 - Subsocial: juvenile siblings share natal nest and hunt together. Adult mothers do not share nests or communally care for offspring
 - Typically, subsocial are more common at higher altitudes in comparison to low altitude social spider relatives^{8,9}

3) Land Use Effect on Diversity

- Land Use Transect had the most diversity
 - Most orb weavers are generalists, resilient to disturbance
 - May support intermediate-disturbance hypothesis: an intermediate level of disturbance results in higher diversity, while more or less disturbance has less diversity¹⁰
 - Mild disturbance can increase vegetation complexity¹¹
 - This is main determining factor in spider diversity¹²

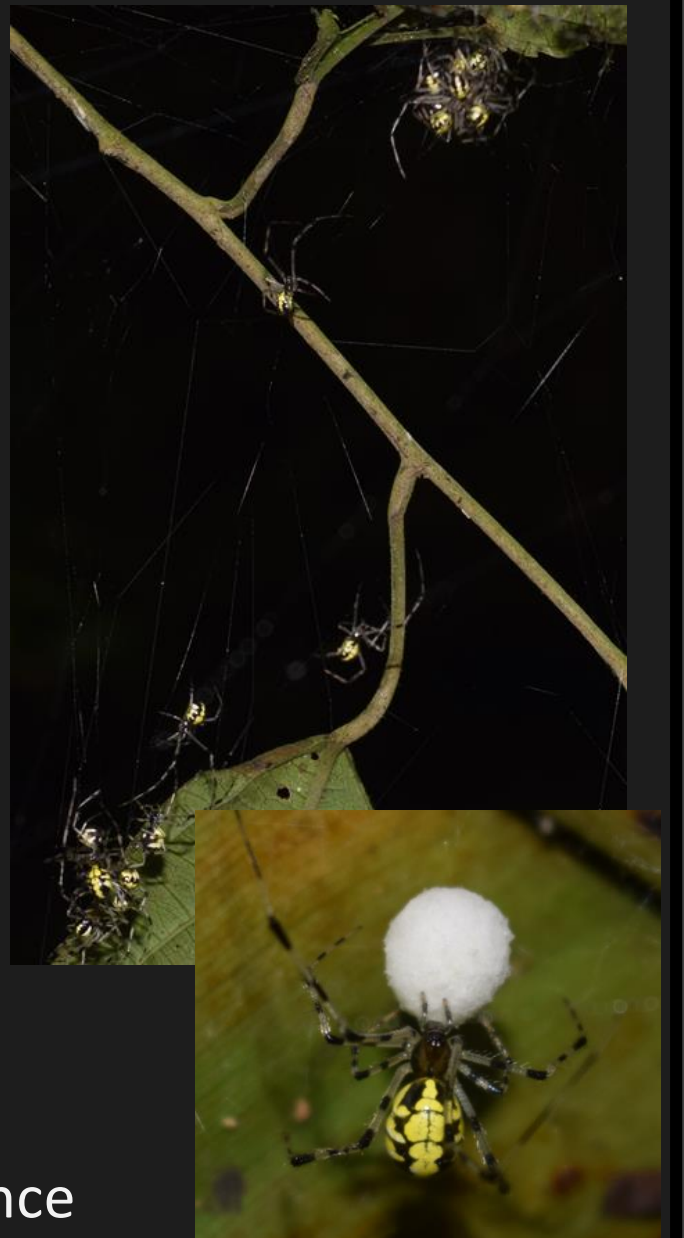


Figure 6. Subsocial Spider: Theridiidae (cob web spider): Theridion sp. Most abundant species in this study. Top: Juveniles exhibiting subsocial behavior. Bottom: Lone mother caring for egg sac. All photos taken by Kristin Robinson

Objectives

- Provide information about spider families and genera in La Hesperia Reserva Natural in the Chocó cloud forest
- Investigate altitude's effect on spider diversity
- Land use effects on spider communities

Methods

Study Site

- La Hesperia Reserva Natural, Pichincha province, Ecuador, is in the Chocó bioregion (Fig. 1).

Nocturnal Transects

- Four transects (150m long, 2m wide, 1.5m high) (Fig. 2)
 - High Altitude=1501m
 - Mid Altitude=1371m
 - Low Altitude=1201m
 - Land Use=1367m
- Recorded avg. canopy cover & leaf litter depth
- Sampled at night via macrophotography for all spiders 1mm and larger (Fig. 3)

Guilds

- To assess diversity based on ecological niche, spiders were classified to genus level and into guilds based on hunting strategies¹

Figure 2. Transects. a) Satellite-view of exact location of transects in the forest using Google Earth. b) This diagrams one part of the mid altitude transect at eye-level in cloud forest (150m long, 2m wide, and 1.5m tall)

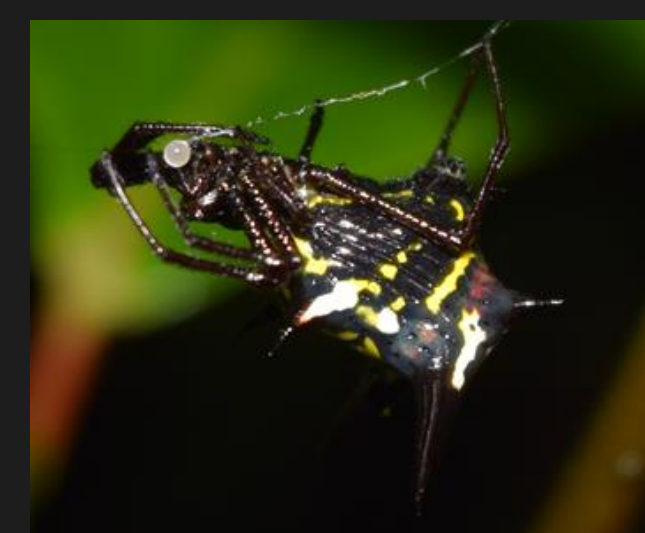
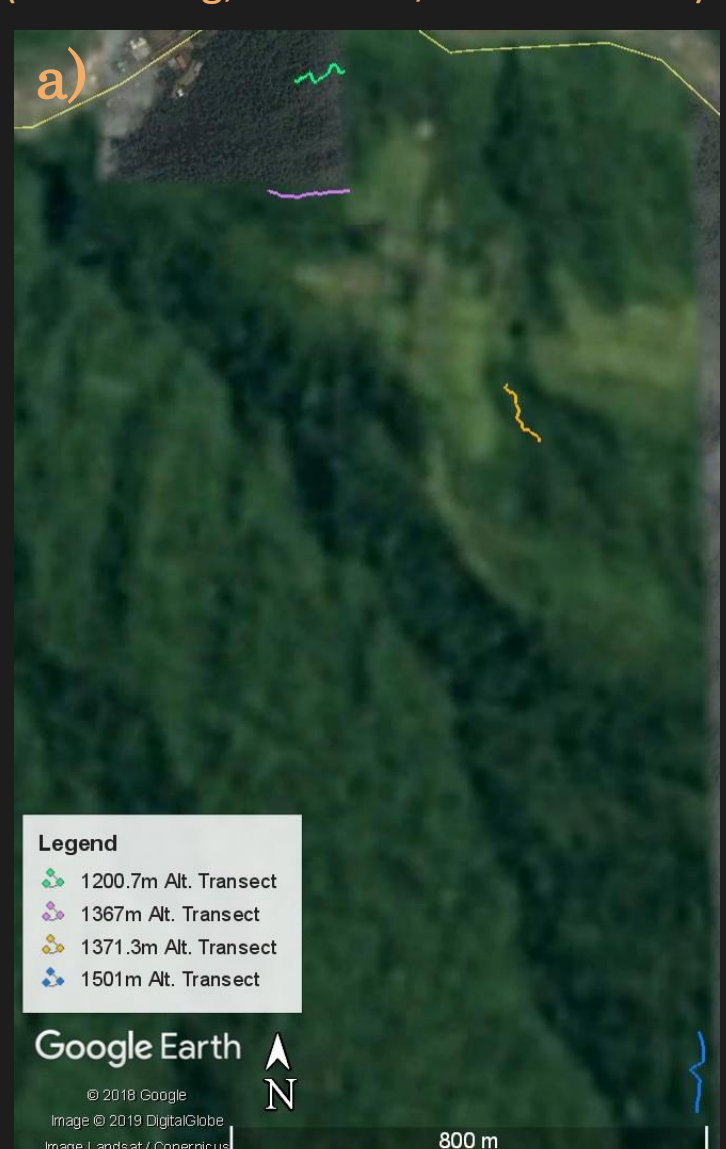


Figure 3. Example of macro-photography. Lateral view of Araneidae (orb weaver): Micrathena sp. Photo by Kristin Robinson



Future Studies

- Subsocial spider species
- Spiders as effective bioindicators of land use effects on arthropod communities
- Fill gap of knowledge of spider diversity in the Chocó

References

- Cardoso, P., Pekár, S., Jocqué, R., & Coddington, J. A. (2011). Global patterns of guild composition and functional diversity of spiders. PLoS ONE, 6(6). <https://doi.org/10.1371/journal.pone.0021710>
- Dupérré, N. (2015). Description of a new genus and thirteen new species of Ctenidae (Araneae, Ctenidae) from the Chocó region of Ecuador. Zootaxa, 4028(4), 451–484. <https://doi.org/10.11646/zootaxa.4028.4.1>
- Dupérré, N., & Tapia, E. (2016). Overview of the Anyphaenids (Araneae, Anyphaeninae, Anyphaenidae) spider fauna from the Chocó forest of Ecuador, with the description of thirteen new species. European Journal of Taxonomy, 255, 1–50.
- Dupérré, N., & Tapia, E. (2017a). On some minuscule spiders (Araneae: Theridiosomatidae, Symphytognathidae) from the Chocó region of Ecuador with the description of ten new species. Zootaxa, 4341(3), 375–399. <https://doi.org/10.11646/zootaxa.4341.3.3>
- Newbold, T., Hudson, L. N., Hill, S. L. L., Contu, S., Lysenko, I., Senior, R. A., ... Purvis, A. (2015). Global effects of land use on local terrestrial diversity. Nature, 520, 45–69.
- Conservation International. (2005). Ecosystem Profile: Chocó-Manabí Conservation Corridor: Colombia and Ecuador. Retrieved May 6, 2018, from https://www.cepf.net/sites/default/files/final_choco-darier-westernecuador_choco_ep.pdf
- Chao, A., Ma, K. H., & Hsieh, T. C. (2016). INEXT (INterpolation and EXtrapolation) Online. Program and User's Guide published at [http://chao.stat.nthu.edu.tw/wordpress/software_download/Purcell, J. \(2011\). Geographic patterns in the distribution of social systems in terrestrial arthropods. Biological Reviews, 86, 475–491. https://doi.org/10.1111/j.1469-185X.2010.00156.x](http://chao.stat.nthu.edu.tw/wordpress/software_download/Purcell, J. (2011). Geographic patterns in the distribution of social systems in terrestrial arthropods. Biological Reviews, 86, 475–491. https://doi.org/10.1111/j.1469-185X.2010.00156.x)
- Purcell, J., & Avilés, L. (2007). Smaller colonies and more solitary living mark higher elevation populations of a social spider. Journal of Animal Ecology, 76, 590–597. <https://doi.org/10.1111/j.1365-2656.2007.01228.x>
- Roxburgh, S., Shea, K., & Bastow Wilson, J. (2004). The Intermediate Disturbance Hypothesis: Patch Dynamics and Mechanisms of Species Coexistence. Ecology, 85(2), 359–371.
- Teodoro, A. V. et al. (2011). Early succession arthropod community changes on experimental passion fruit plant patches along a land-use gradient in Ecuador. Agriculture, Ecosystems and Environment, 140, 14–19.
- Jiménez-Valverde, A., & Lobo, J. M. (2007). Determinants of local spider (Araneidae and Thomisidae) species richness on a regional scale: Climate and altitude vs. habitat structure. Ecological Entomology, 32(1), 113–122.

Acknowledgements

I want to thank and acknowledge:

- The people of La Hesperia, especially Alexandra Hoeneisen & Diego Pullugando
- Satyra Kent & Amanda Riley
- My mentors: Xavier Silva, Javier Robayo, & Diana Serrano
- SIT Study Abroad: School for International Training
- International UROP funding



Ctenidae (wandering spider): Cupiennius sp. Photo by Kristin Robinson