Birdsong in Urban Environments with Varying Structures

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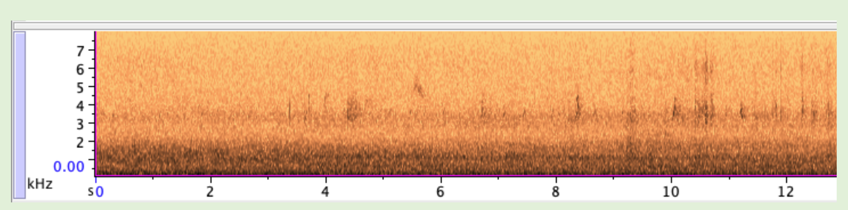
Birdsong in Urban Environments

Animals that use primarily acoustic communication face higher levels of low-frequency noise that can mask vocalizations and anthropogenic changes to vegetation and building structure that can affect how sound travels. These features also vary across different urban land use types. Songbird species such as the white-crowned sparrow have been shown to adjust their songs to the changing environment[1], prompting researchers to ask what specific variables have the most impact on this response.

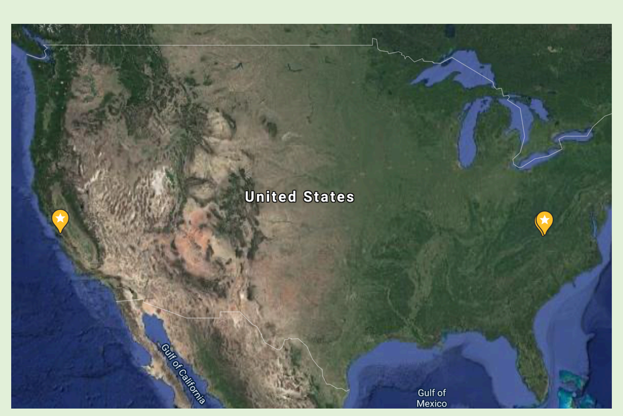
How do components of urban environments, such as building and vegetation structure, vary across different urban land use types and in turn impact bird vocalization?

Experimental Design

2 urban locations on each coast, 4 types of urban land use categories per coast



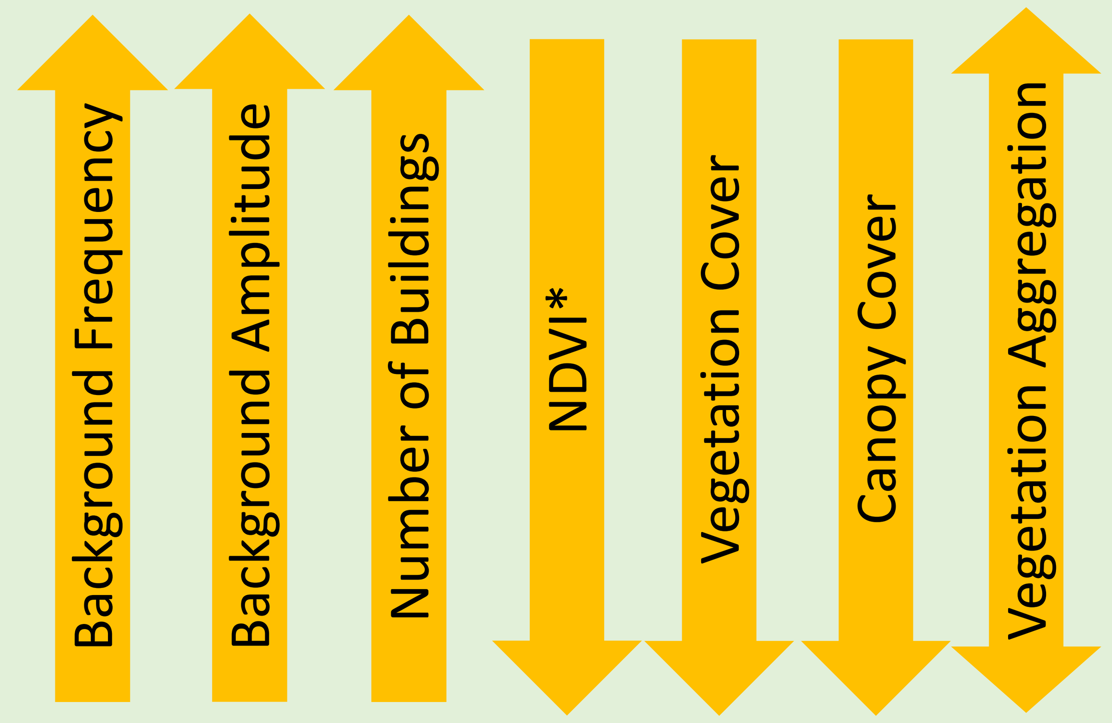
Audio processing with RavenPro.



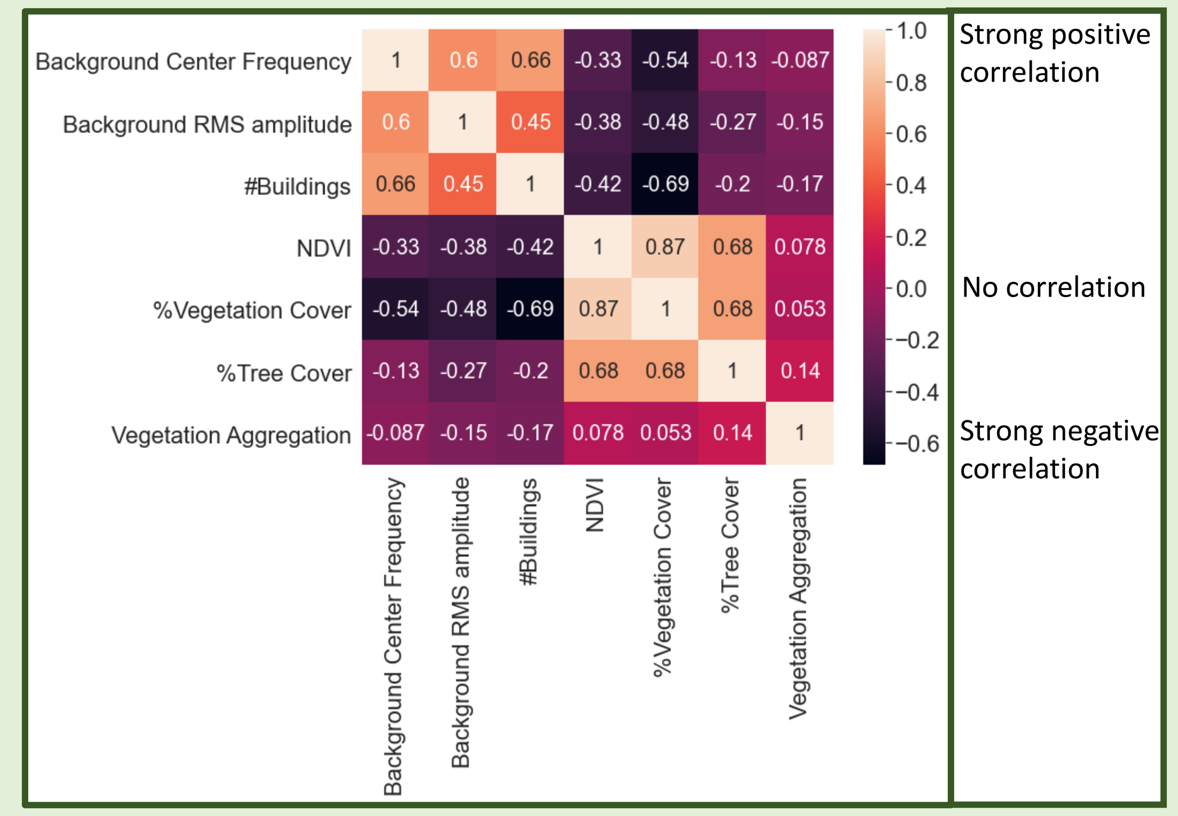
Aerial view of the bi-costal research site locations.

Aerial images from Google Maps used for analysis of physical variables. Vegetation analysis with ImageJ.

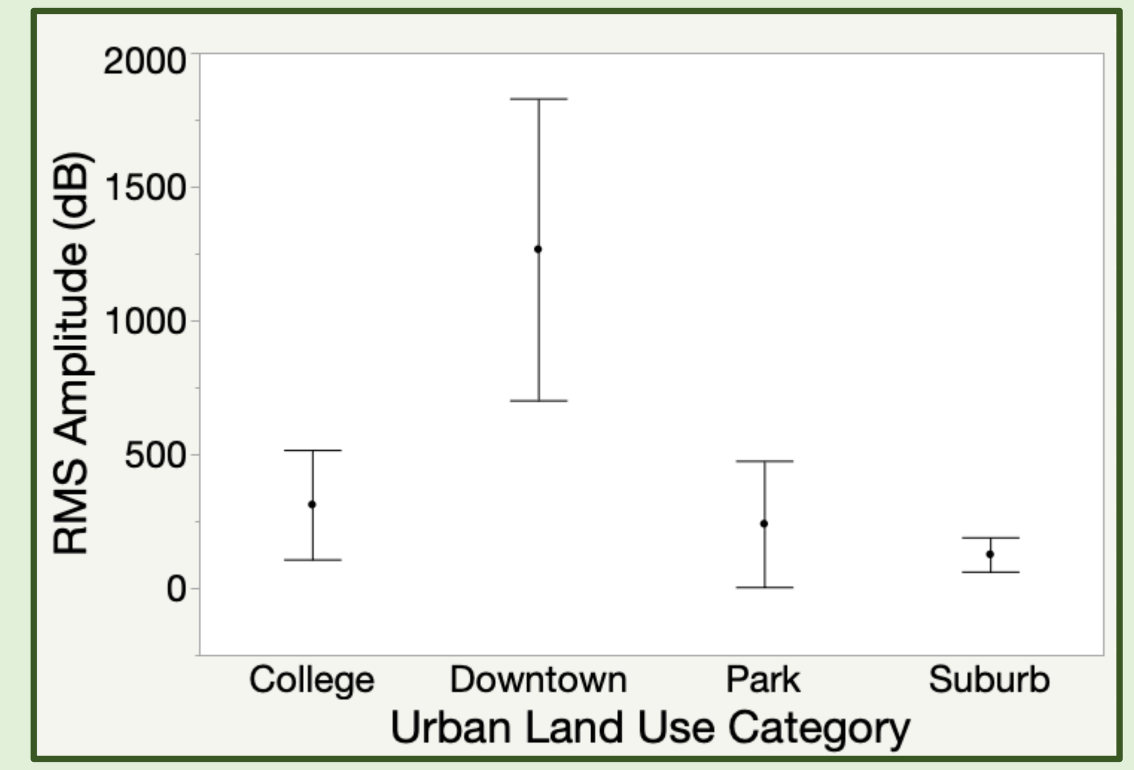
Urban Soundscapes



Expected interactions between physical properties and background ambient noise.
**Normalized Difference Vegetation Index*



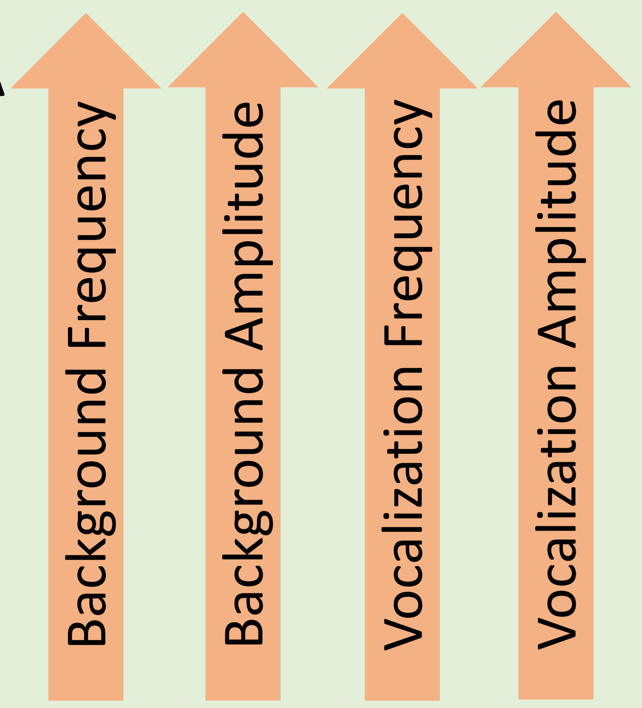
Observed interactions between physical properties and background ambient noise.

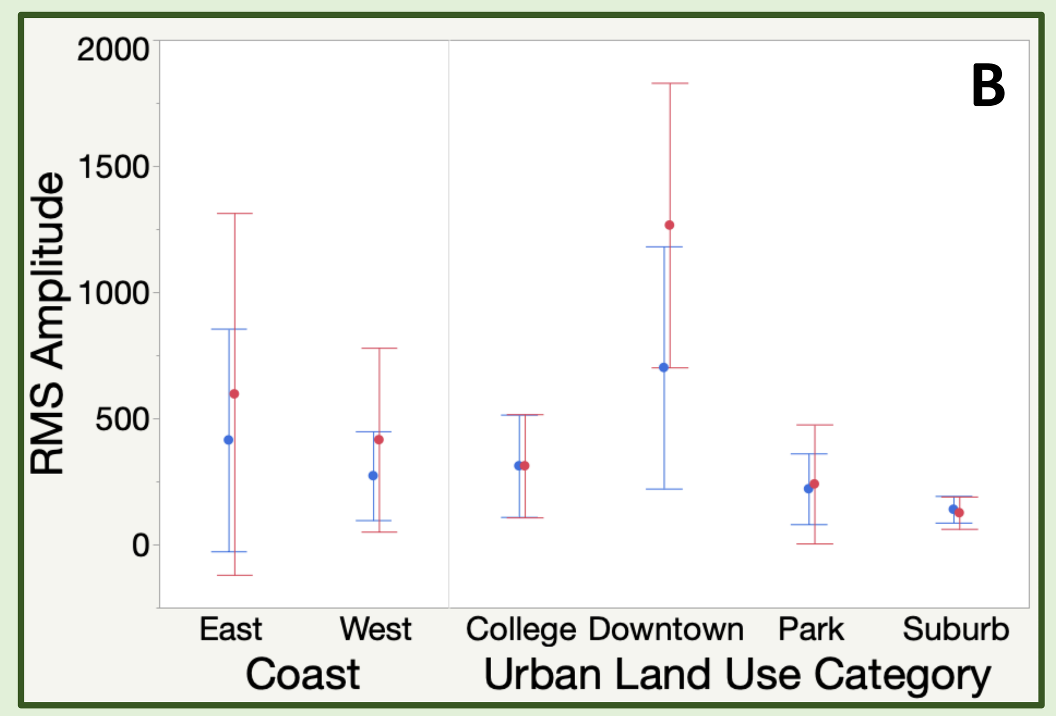


Observed mean background RMS (Root Mean Square) amplitudes across different urban land uses ($p < 0.001$). Error bars = 1SD.

Bird Vocalization Responses

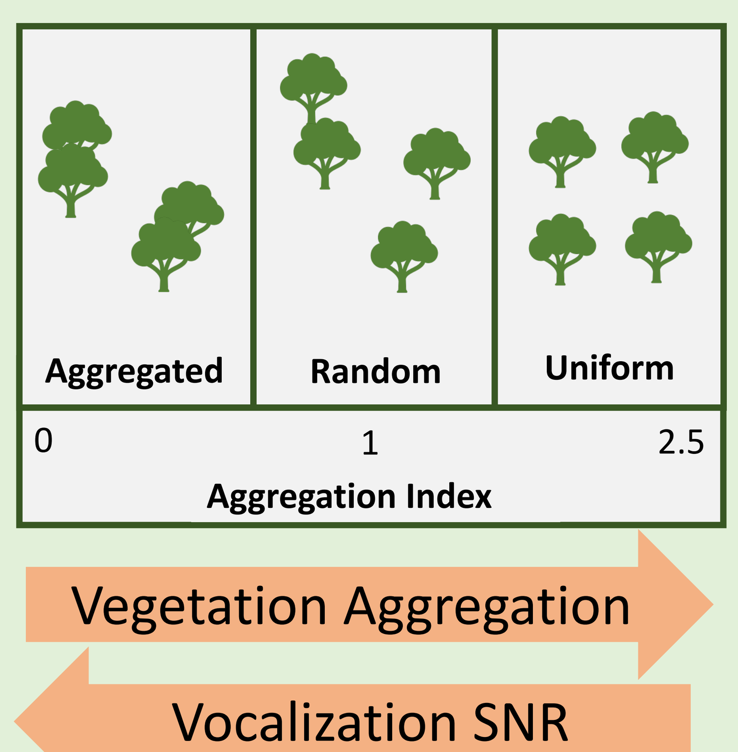
A



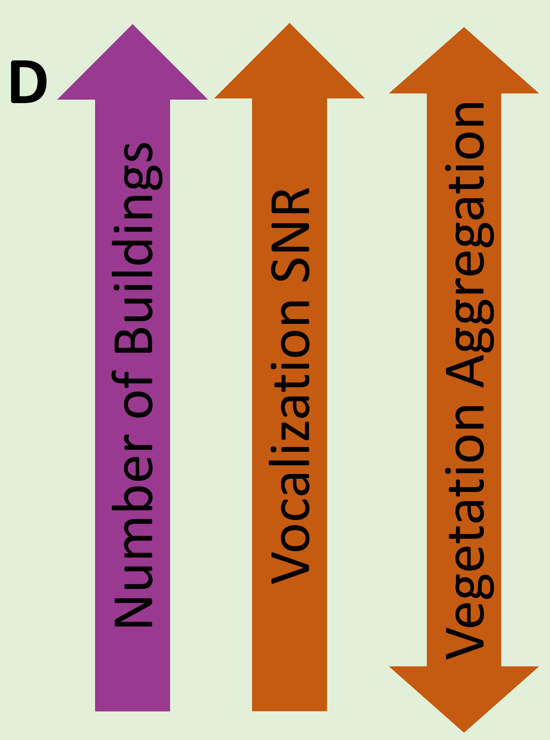


A. Expected relationships between vocalizations and background noise. **B.** Observed mean RMS amplitudes across different coast locations (***Background***: $p = 0.119$, ***Vocalization***: $p = 0.796$) and urban land uses (***Background***: $p < 0.001$, ***Vocalization***: $p = 0.205$). Error bars = 1SD.

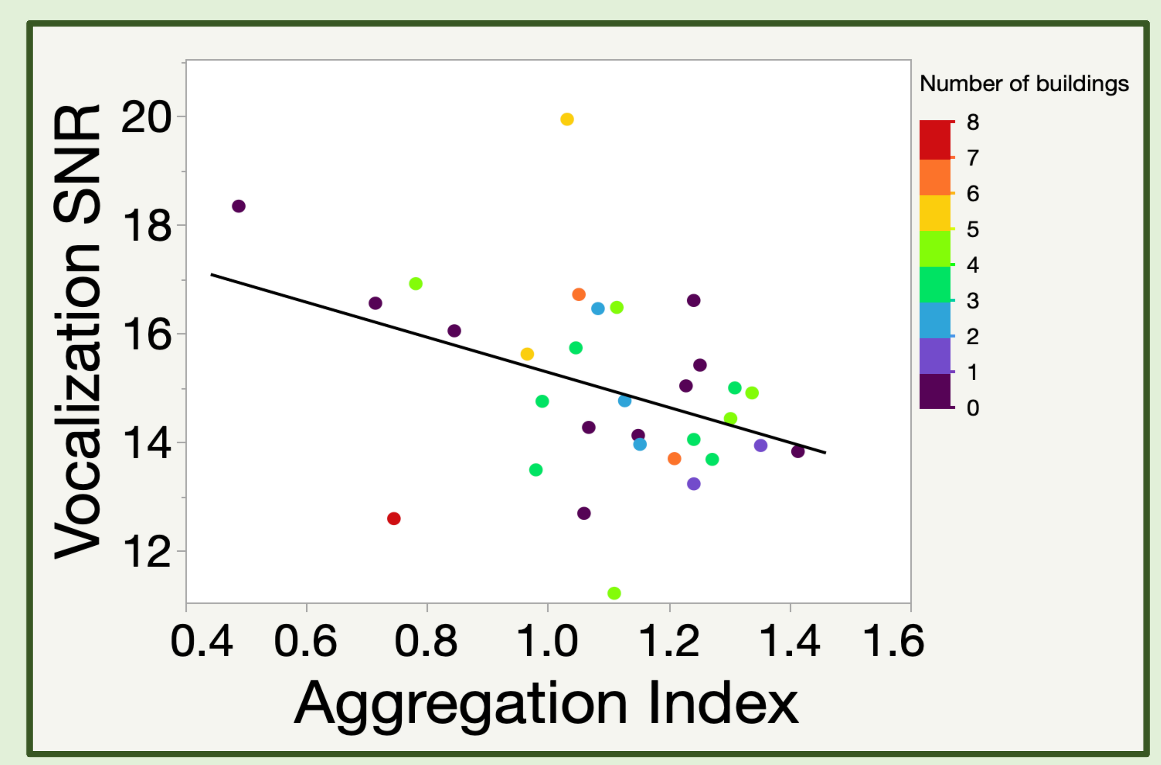
C



D



E



C. Expected effect of vegetation aggregation on vocalization SNR (signal-to-noise ratio). **D.** Expected effect of number of buildings on vocalization SNR and vegetation aggregation. **E.** Observed vegetation aggregation vs. vocalization SNR ($R^2 = 0.146$, $p = 0.03$), with number of buildings by color. Aggregation index values calculated within a 20m radius of observer using the Clark-Evans spatial test with the Donnelly modification.

Future steps

- Consider more variables:
  - Species identity
  - Proximity to highways or wildlife habitats
  - More land use categories, such as industrial.
- Further explore relationships between building density and material, vegetation structure and SNR.
- Explore connections to homeowner and socioeconomic status.

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Literature Cited

1. Derryberry, E. P., Phillips, J. N., Derryberry, G. E., Blum, M. J., & Luther, D. (2020). Singing in a silent spring: Birds respond to a half-century soundscape reversion during the COVID-19 shutdown. *Science*, *370*(6516), 575–579. https://doi.org/10.1126/science.abd5777