

Spatially Constrained Rarefaction in Reservoir Environments

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Introduction:

- Rarefaction analysis is commonly used to assess species accumulation with additional sampling effort, but spatial autocorrelation can cause over-estimation of species diversity if strong distance-decay relationships exist
- Spatially constrained rarefaction (SCR) analysis accounts for spatial autocorrelation when estimating species accumulation across spatially distributed sampling sites (Figure 1)

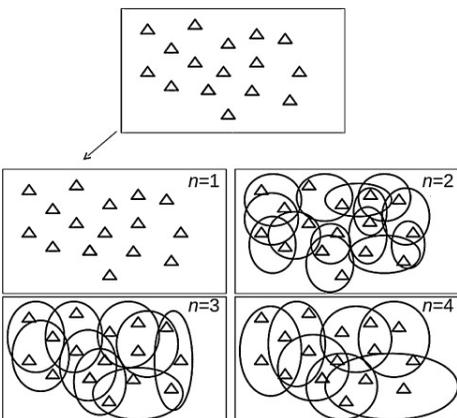


Figure 1. Conceptual diagram for SCR illustrating that nearest neighbor sites are grouped during species richness estimates (Figure from Bacaro et al. 2012)

Objectives:

1. Apply SCR to data collected by students over fine spatial extent of Lake Conroe reservoir
2. Apply SCR to data collected by agency over entire extent of Lake Conroe reservoir

Study Area:

- Lake Conroe is a 20,118-acre reservoir on the West Fork of the San Jacinto River, Texas
- The student-led work took place in small area during 2019 and the agency-led work covered all of Lake Conroe during 2017 and 2019 (Fig. 2)

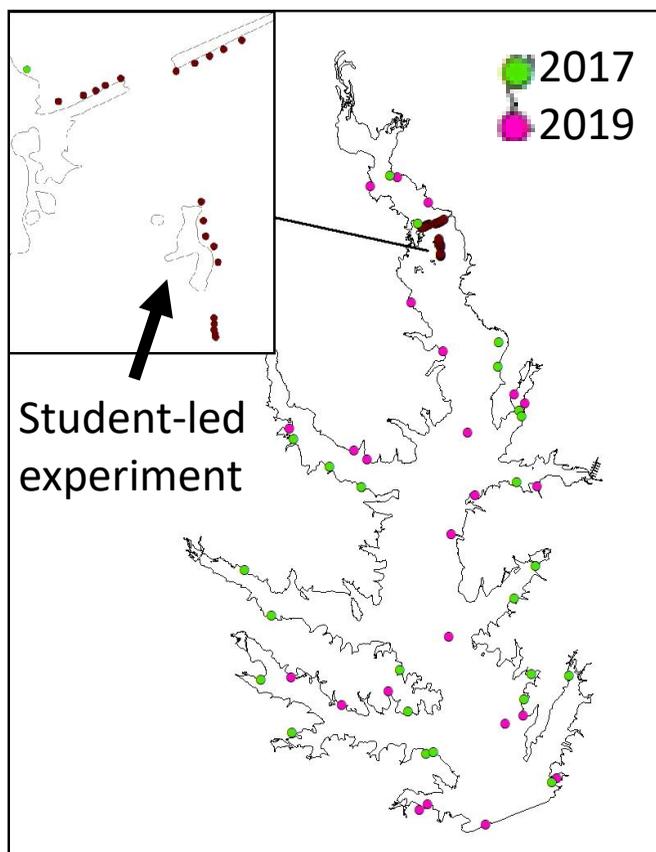


Figure 2. Map of Lake Conroe showing sites utilized in the student- and agency-led experiments.

Student Led Methods:

- We sampled two habitats, sunken timber and rip-rap, at night using 1-minute electrofishing intervals capped at 10 minutes per habitat
- After each minute of electrofishing, captured fish species and counts were collected (Fig. 3)
- We constructed species accumulation curves to describe the species richness per unit effort



Figure 3. Undergraduate students Cade Cottar, Lauren Yancy, and Wyatt Stinebaugh (left to right) during electrofishing surveys on Lake Conroe.

Agency Led Methods:

- TPWD conducted experiments in 2017 and 2019
- Fish assemblage composition was assessed every 5 minutes of electrofishing for a total of 120 minutes both years
- There were 24 randomly sampled spatially distributed stations across Lake Conroe
- Species counts were collected as well as individual specimen counts
- Target game fish species weights and lengths were collected
- The same SCR analysis was conducted on the agency data for 2017 and 2019 independently

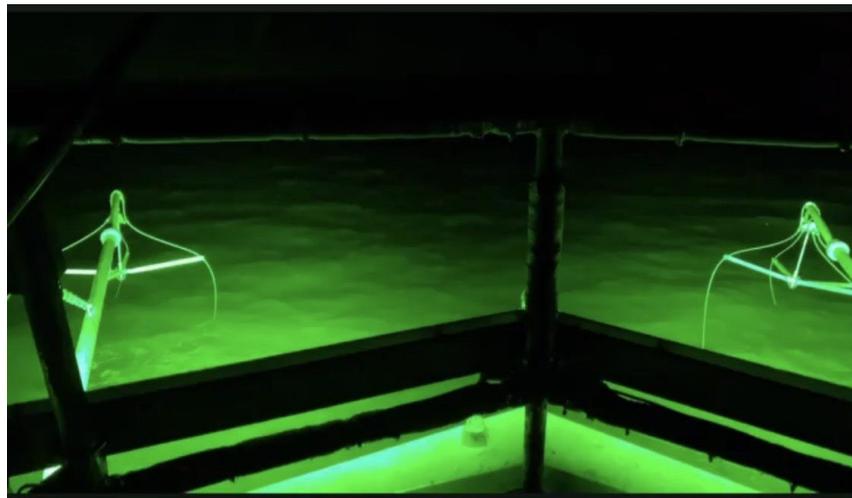


Figure 6. Electrofishing equipment used for the agency led experiment.

Results:

- The student-led experiment showed initially slower accumulation of species with SCR but an asymptote was reached with less effort (Fig. 7)
- The agency-led experiment showed consistent patterns, particularly for 2019 (Fig. 8)
- There was stronger agreement between non-spatial and SCR for the agency-led experiment

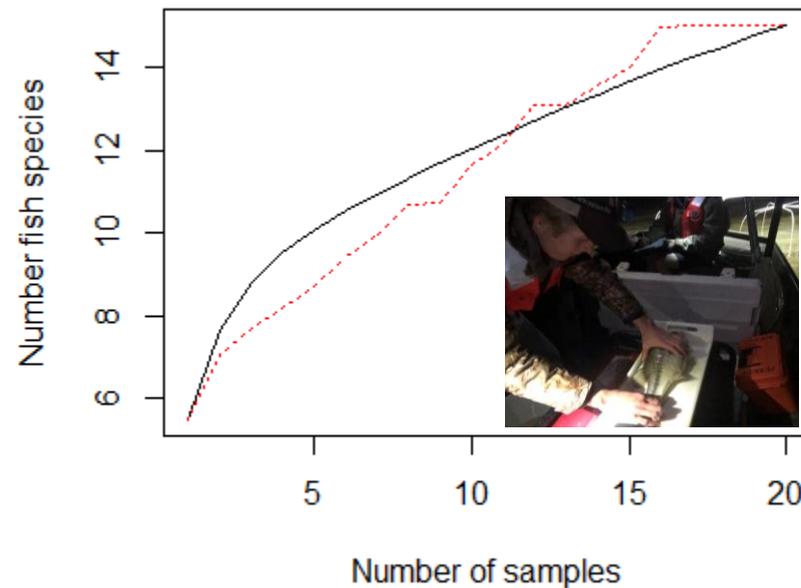


Figure 7. Species accumulation curve from the student-led experiment showing increase in the number of species (y-axis) across increasing electrofishing effort (x-axis) for traditional (black line) and spatially constrained (red line) rarefaction.

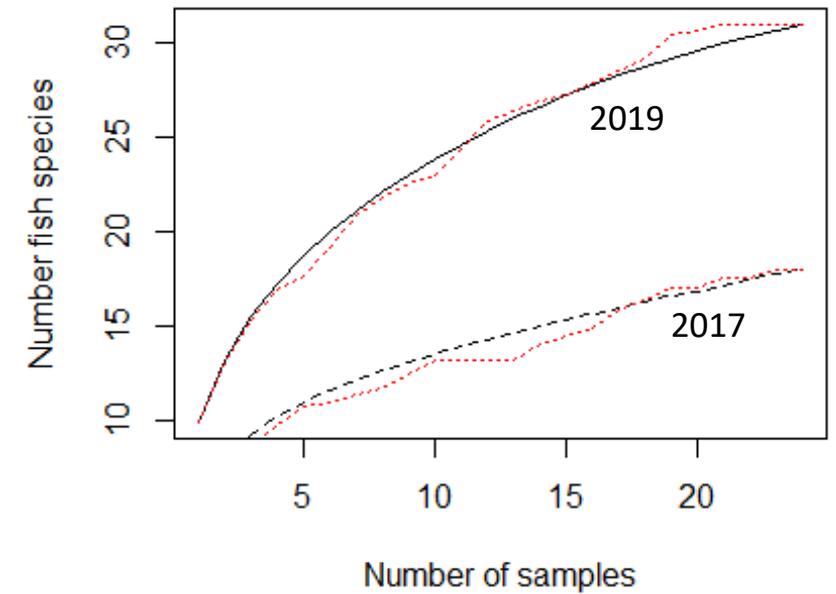


Figure 8. Species accumulation curve from the agency-led experiment in both 2017 & 2019.

Conclusion:

- Spatial autocorrelation may more strongly affect species richness estimates at finer scales
- Spatial autocorrelation is less obvious in broad scale experiments with randomly selected sites covering an entire reservoir

Reference:

Bacaro et al. (2012). The spatial domain matters: Spatially constrained species rarefaction in a Free and Open-Source environment. *Eco. Comp.* 12:63-69.