Science and the Environment
Prof. Marc Los Huertos
09.16.16
Individual Project Proposal

Santa Ana River: Red Algae

Frank Lyles

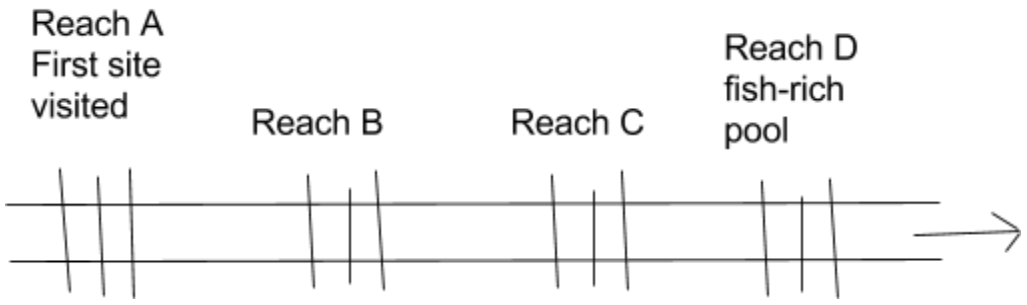
Introduction: Although my team is looking at several causal factors in the distribution of red algae in the Santa Ana River, I will be focusing specifically on the effect of Canopy Cover on water temperature and algae distribution.

Question to be addressed and hypothesis: Do differences in the density of canopy cover along the Santa Ana river appear to have statistically significant effects on a) the temperature of water along that reach of the stream and b) algal abundance in well-shaded versus well-exposed reaches?

I hypothesize that reaches well-exposed to sunlight will be both warmer and exhibit high levels of algal abundance, because periphyton will not be light-limited in their growth and elevated temperatures will discourage grazing species like the SA Sucker. It is also likely we will observe increased algal abundance with increased water temperature independent of canopy cover.

Approaches:

1. Site selection: 3 measurements 1-10m apart for 4 different reaches. Use random number generator to select distance. 12 measurements total. Reach 1 = original site visited already. Must select Reaches 2 & 3 in between. Reach 4 = fish-rich pool half hour downstream



   30 minutes to walk down to reach D where we will start, then proceed back upstream. Reaches B & C will be non-randomly selected once the team has an opportunity to survey the full length of the SA River between reaches A & D. We will deliberately choose these middle two reaches for their canopy cover characteristics, among other factors, such that hopefully: we will have one reach that is very well shaded and one that is much more exposed to direct sunlight.
2. AT EACH SITE (25 minutes each):

- Canopy cover: directly above each alage measurement, use canopy cover instrument to determine canopy cover via line intersect sampling. Record proportion of nodes covered versus not.
- Temperature: 3 measurements per site, left middle and right. Take these in water directly above where quadrat was placed.
- Time of each measurement.

Cited Methods:

While our reach selection is nonrandom in order to coordinate with other teams and get representative reaches under different conditions, within our reaches, our sites will be randomized. Platts (1983) emphasizes that random sampling is important to reduce bias.
I will use a Densiometer to measure canopy cover. Korhonen et al. (2006) suggests that although there are many different techniques for measuring canopy cover, the best ones tend to be more labor intensive. Line intersect sampling is specifically recommended as being unbiased and accurate, so densiometer is an ideal tool.

DeNicola et al. (1992) looked closely at the effects of canopy cover on periphyton abundance, and used rigorous sampling techniques four different times of day. The study observed variation both in amount of radiation reaching the water surface and the composition (relative abundance of different wavelengths) throughout the day. This project will not have the opportunity to take multiple measurements at different times of day, but is seems unlikely that algae abundance varies on a diurnal timescale.

Expected Results and Analysis

The literature on the effect of canopy cover on algae distribution is conflicting. Winkelmann et al. (2013) found a strong seasonal variation in the abundance of periphyton was influenced by light availability, although that study did not focus on spatial variation. The effects of light availability and trophic effects are interrelated, but higher light availability increased periphyton abundance. However, Scalan et al. (2015) suggests that "the penetration of incident light to the stream-bed was not a strong regulator of algal biomass." Furthermore "canopy cover and streamflow were not significantly correlated with benthic chlorophyll." Bautista et al. (2007) measured red algae responses to irradiation and found that low light stimulated more growth. But Žáková et al. (2013) found a positive relationship between elevated water temperatures and increased abundance of algae. Most studies I found on Google Scholar that dealt with this issue at all tended to lump all periphyton together, without distinguishing between algae and other benthic primary producers, or between red algae and diatoms. Clearly, this is an area that requires further research.

3. Data Analysis: Temperature, algal abundance, and canopy cover are all continuous variables.
    - I will produce linear regressions of temperature vs algae abundance.
    - I will produce linear regressions of canopy cover vs algae abundance.
    - I will produce linear regressions of canopy cover vs temperature.

Works Cited

Bautista, A. I., & Necchi Jr, O. (2007). Photoacclimation in three species of freshwater red algae. *Brazilian Journal of Plant Physiology*, *19*(1), 23-34.

DeNicola, M., Hoagland, K. D., & Roemer, S. C. (1992). Influences of canopy cover on spectral irradiance and periphyton assemblages in a prairie stream. *Journal of the North American Benthological Society*, 391-404.

Korhonen, L., Korhonen, K. T., Rautiainen, M., & Stenberg, P. (2006). Estimation of forest canopy cover: a comparison of field measurement techniques. *Silva Fennica*, *40*(4), 577.

Scanlan, A. M., Millie, D. F., Weckman, G., & Carrick, H. J. (2015). Abrupt shifts in stream algal biomass and diatom taxonomic composition along a gradient of changing land use. *Fundamental and Applied Limnology/Archiv für Hydrobiologie*, *186*(1-2), 153-169.

Platts, W. S., Megahan, W. F., & Minshall, G. W. (1983). Methods for evaluating stream, riparian, and biotic conditions.

Winkelmann, C., Schneider, J., Mewes, D., Schmidt, S. I., Worischka, S., Hellmann, C., & Benndorf, J. (2014). Top-down and bottom-up control of periphyton by benthivorous fish and light supply in two streams. *Freshwater biology*, *59*(4), 803-818.

Žáková, Z., Pum, M., Sedláček, P., Mlejnková, H., & Hindák, F. (2013). New records of Compsopogon aeruginosus (Rhodophyta) in rivers of central Europe. *Oceanological and Hydrobiological Studies*, *42*(4), 412-419.