**Introduction**

Climate change creates an urgent need to understand the relationship between biological communities and climate (Wrona et al. 2006). As concentrations of greenhouse gases rise, the atmosphere retains more infrared radiation resulting in rising global temperatures (IPCC 2014). A warmer atmosphere is more energetic which intensifies the Hydrological Cycle (i.e. patterns of precipitation and evaporation); wet regions become wetter and dry regions become drier (Allen & Ingram 2002). Simultaneously, the frequency and intensity of extreme weather events are expected to increase (Held et al.2006). The predicted shifts in precipitation regimes will have significant effects on ecosystems, especially in arid and semi-arid regions (Grimm et al. 2013). However, it is unclear how ecosystems will respond or adjust to changes in the Hydrological Cycle. So, it is important to understand interactions between internal ecological processes and external conditions (Gunderson 2000).

Community assembly is constrained by abiotic and biotic filters (Davis et al. 1999, Pockman and Sperry 2000). Species have physiological tolerances which limit their distribution across environmental gradients (Whitaker 1962). Environmental conditions that act as abiotic filters included temperature, precipitation, and disturbance regime. However, formalizing and quantifying the role of environmental filters in community assembly remains disjointed due to the vastly different scales of existing biogeographical and community ecology studies (Weiher et al. 2011). Linking the processes of abiotic filters along environmental gradients to local community processes enhances our ability to predict assembly.

Studying differences in biological communities along a gradient of climate conditions can provide insights for predicting ecosystem responses to climate change. Observational surveys in climate research study existing patterns on a spatial gradient and use a space-for-time substitution to infer temporal trends (Duune et al.2004). But the space-for-time substitution assumes that observed ecological differences are the solely a product of corresponding changes in climate. Previous biogeographical studies have revealed processes of biological dispersal, habitat heterogeneity, and evolution, and recent investigations on climate gradients have implications for biological responses to climate change. The current body of literature indicates that biome shifts occur across temperature and latitudinal gradients (De Frenne et al.2013). These studies are large in scale, covering vast distances in order to capture the climate gradient, but the precise mechanisms for change are more difficult to ascertain due to covarying environmental variables (e.g., elevation, geology, human impacts). These confounding variables hinder the detection of climate-ecology relationship using space-for-time substitutions along a climate gradient. There is a demand for climate change studies that utilize a space-for-time substitution need to reduce confounding environmental variables (i.e. temperature, elevation, and underlying geology) to delineate the intricacies of climate-ecosystem relationships.

The Texas Coastal Prairie (TCP) is a prime candidate for climate-ecology research. The Western Gulf coastal grasslands are a subtropical ecotone that spans Louisiana, Texas, and northern Mexico’s coastal areas. The climate becomes more arid going down the Texas coast and into North Mexico. In this region the annual rainfall changes from 55cm•yr-1 (semi-arid) to 135 cm•yr-1 (sub-humid) within 300 km (Falcone 2011), but there are minimal changes in elevation, air temperature, and underlying geology. Thus, studying natural ecosystems that span the TCP maximizes the ability to detect relationships between precipitation and ecosystem processes.

Stream communities are sensitive to changes flow magnitude and variability which are directly controlled by precipitation regime (Kormos et al. 2016). The frequency and intensity of flood and/or droughts is directly regulated by precipitation regime (Hyrabayashi et al. 2008). Additionally, annual rainfall regulates terrestrial vegetation along the TCP. As conditions become wetter, there is an observable ecological shift from Thornwood groves in the semi-arid West to Live oak forests Towards the East (Chapman & Bolen 2018). This shift in streamside vegetation along a precipitation gradient indicates an indirect pathway in which precipitation can influence stream biota. The riparian zone regulates nutrient, carbon and light inputs to streams that fundamentally alter stream primary production and carbon cycling (Schade et al. 2001). However, these climate-mediate regulatory pathways remain highly deductive. Here, I investigate fish and macroinvertebrate assemblages in 13 streams spanning an iconic precipitation gradient to identify mechanisms linking precipitation to patterns of biological diversity and composition.

The first objective is to identify patterns in diversity and composition of fish and macroinvertebrates communities that correspond to changes in precipitation. Annual precipitation is hypothesized to positively correlate with community diversity. Humid precipitation regimes are expected to create more stable environmental conditions by creating habitat heterogeneity and predictable flow regimes which promote the development of greater biodiversity (Boulton et al. 1992). The second objective is to identify environmental drivers that mediate the effects of climate on community processes. Evapotranspiration by riparian vegetation combined with low annual precipitation is expected to correspond with higher solute concentrations and low oxygen concentrations in semi-arid streams (Tabbachi et al. 2000).

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