**Evaluating the effects of space and time on sponge and coral communities in the British Virgin Islands**

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**Statement of the Problem**

This study aims to address the unanswered question of how coral and sponge communities in the Caribbean change over time. If there is no relationship between the two communities’ temporal changes, this may indicate differential resilience to environmental factors. Statistical procedures, including model selection, will be applied.

**Justification for and Significance of the Study**

Ecological communities are changing and there has been an increase in rates of biodiversity loss (Staudinger et al., 2013; Stork, 2010). Declines in biodiversity have been associated with higher levels of disturbance that affect community dynamics and species extinction (Svensson et al., 2007). A disturbance is any temporally discrete event that disrupts inter- and intrarelationships by changing resource availability (Svensson et al., 2007). Historically, the intermediate disturbance hypothesis has been used to describe how competition and intermediate natural disturbances, such as hurricanes, maintain high diversity in certain ecosystems such as tropical forests and coral reefs (Connell, 1978). This high diversity response to disturbance assumes coral reef communities can recover, but there are now additional anthropogenic factors that have compromised this ability to recover (Hughes et al., 2017). Coral reef communities are threatened by anthropogenic disturbances that vary on spatial and temporal scales, such as dredging, ocean acidification, sedimentation, overfishing, and persistent high temperatures. Some of these disturbances have been found to effect richness, abundance, and diversity of reef organisms (Habibi, Setiasih, & Sartin, 2007; Nelson et al., 2016; Stubler, Duckworth, & Peterson, 2015; J. L. Wulff, 2006).

Because communities are webs of interactions, the consequences of a disturbance can be complicated and unpredictable. Foundation species play important roles in establishing ecosystems and, in several marine ecosystems, have been attributed with maintaining biodiversity (Angelini, Altieri, Silliman, & Bertness, 2018). One approach to study these consequences is to focus on foundation species- organisms that take up much of an ecosystem’s surface area or volume and promote biodiversity through various functional roles (Angelini et al., 2018). When ecosystems are threatened by disturbance, it is intuitive to study the impacts of these disturbances on the foundation species. California mussels and seagrasses are examples of foundation species threatened by disturbances (Gaylord et al., 2011; Thomson, Burkholder, & Heithaus, 2015).

With increasing disturbance rates and declining biodiversity, much attention has been given to monitoring coral reefs around the world. Because corals provide the foundation for these ecosystems, many studies use coral diversity as a proxy for overall reef diversity (Darling et al., 2017; Stella, Pratchett, Hutchings, & Jones, 2011). It has also been suggested that sponges may be a coexisting foundational group for coral reefs (Angelini et al., 2018).

Several studies have found that coral diversity is positively correlated with fish diversity (Darling et al., 2017). Relationships between corals and other groups have been studied (Stella et al., 2011). However, there is still a lack of long-term studies of the relationships between coral diversity and diversity of other taxonomic groups. In particular, there has been a call for studies that compare coral diversity and sponge diversity because of their functional similarities, the lack of long-term studies that consider sponges, and the potential for sponges to outcompete corals when disturbance levels are higher (J. Wulff, 2001; J. L. Wulff, 2006).

Investigating whether there is a relationship between corals and sponges over time and space will provide evidence to researchers of whether or not coral dynamics are an adequate proxy for the dynamics of other taxonomic groups.

**Methodology or Procedures**

*Data Collection*

At 8 different locations around Guana Head Island in the British Virgin Islands, Forrester et al. (2015) recorded percent cover for 27 groups of corals at varying levels of taxonomic resolution. They used the linear point-intercept method and recorded the substrate or coral group every 0.25 m for 3 30-m transects at each site between June and August from 1992-2016. These point observations were converted to surface area estimates of percent cover (Ohlhorst, Liddell, Taylor, & Taylor, 1988). At the same sites, they also recorded counts for 58 groups of sponges at varying levels of taxonomic resolution. For this, they used the line intercept method for 3 30-m transects between June and August from 1993-1995, 2000-2003, and 2005-2016 (Forrester et al., 2015). For both datasets, transects were set up at a depth of approximately 10-m. In 2011, transects for the sponge counts were conducted by two observers (E. MacLean and L. Jarecki), but in all other years, there was one observer (L. Jarecki). A percent cover of zero implies there were no individuals of that coral group represented on that transect. All corals included in the analysis are live hard corals in the order Scleractinia. The sites were all fringing reefs and the only apparent difference among sites was the increased exposure to waves at the two sites to the north of the island. There are no negative values and no missing values for these datasets, but not all sites were surveyed in a given year.

*Data Management*

Before I could begin analyses, I needed to correct issues with data entry for the sponge dataset. Within program R, I removed observations for sites that were only visited once (White Bay-alt, Monkey Pt area, White Bay E, and Bigelow-south). Muskmelon and Long Point are two names for the same place, so I renamed all of these sites Muskmelon for consistency. For the same reason, I renamed Pelican and Pelican Ghut as Pelican Ghut.

*Data Analysis*

The following variables may be calculated for each dataset. Abundance is the sum of counts across all groups. Richness is the number of groups present. Simpson’s diversity index gives the probability that two randomly selected individuals will belong to different groups (1 is maximum diversity; 0 is no diversity). Shannon evenness index gives the probability that all groups that are present will have the same frequency (1 is perfect evenness; 0 is perfect unevenness).

Linear regression models comparing overall patterns across space and time

**Resources Required**

Coral dataset; Sponge dataset

**Literature Cited**

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