The importance of seascape structure on fish communities in the mangroves of Samoa

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1. INTRODUCTION

The type, size, and proximity of habitats are essential elements of seascape structure and have important influences on marine fauna. Mangroves are particularly vital habitats for several fish species and often contribute towards high marine biodiversity and highly heterogeneous coastal environments. Despite this importance, there have been very few studies that focus on the influence of seascape structure on mangrove fishes, and none have been conducted in Samoa. In order to develop ecologically sound mangrove management plans, it is essential to consider mangroves not in isolation, but in the context of the surrounding seascape. To this end, the goal of this thesis is to identify how seascape structure influences the community composition of fishes within Samoan mangroves. To fulfill this goal, detailed maps of the extent and distribution of mangrove forests are needed. Therefore, the objectives of this thesis are: (i) to create maps of all major mangrove forests in Samoa; (ii) to classify and map the major mangrove species in Samoa at selected sites for seascape analysis; and, by utilizing the results from the first two objectives, (iii) to discover how the spatial patterns of mangrove forests, seagrass beds and coral reefs influence the community composition of fishes within Samoan mangroves.

2. MATERIALS AND METHODS

Country-level maps of mangrove forests were created using supervised machine learning techniques on multi-spectral data collected by space-borne optical sensors aboard the Sentinel 2 satellite missions taken between the years 2016 and 2017 at the spatial resolution of 20m. Species-level maps of mangrove forests are produced by object-based image analysis using aerial imagery captured by unmanned aerial vehicles at the spatial resolution of 20cm. These maps were then used alongside remote sensing surveys to deduce nine seascape structure variables that quantify the spatial patterns of mangrove forests, seagrass beds, and coral reefs. Then, in order to identify the impact of seascape structure on fish community composition, these nine seascape structure variables were analyzed in conjunction with fish community data that were investigated by fishing using casting nets. These data were analyzed using ordination methods, diversity measures, and univariate and multivariate statistical analyses.

3. RESULTS AND DISCUSSION

A total of 374 hectares of mangrove forests were inferred and mapped in Samoa with an overall accuracy of 87%. Species-level maps consisting of the two dominant mangrove species found in Samoa were created with an overall accuracy of 97%. 1234 fishes belonging to 44 species and 22 families were caught using the casting nets. Results from multivariate statistical tests and ordination methods suggest that of the 9 seascape variables, the proximity and area of seagrass beds within a 700-meter distance of the mangrove forest edge, and the total area of *Rhizophora samoensis*, best explain the differences in fish community composition across sites. Sites with large seagrass areas in close proximity of mangrove forests, as well as those with large total *Rhizophora samoensis* area, tended to have higher levels of fish abundance and fish species richness.

4. CONCLUSION

These results give insight into the relationship between seascape structure and the community composition of fishes within Samoan mangroves. It finds that seascape structure across multiple habitats can have more pronounced effects on the community composition and diversity of fishes than structure within a habitat. From a management perspective, it is recommended that higher priority should be given to large *Rhizophora samoensis* dominated mangrove forests that have large seagrass beds in close proximity, and that at least 700 meters of the surrounding seascape should be incorporated in the design of mangrove management plans.