The Cost of Travel Impact of Tourism on Coral Reef Health in Oahu, Hawaii



Figure 1. Analysis of Commercial Harbors. Euclidean distance calculated from the two commercial harbors on Oahu, Island.

Hotel Density **Hotel Density** 0 5 10 20 Kilometers (meters) Hotels .00000003 .00000014 .00000069 .00000097 .0000001 .00000012

map: Coastline from Hawaii Statewide GIS Progran Figure 2. Analysis of Hotel Density. Kernel density for hotel around Oahu Island calculated.

Distance from MDS



Figure 3. Analysis of Marine Dumping Sites. Euclidean distance calculated for marine dumping sites around Oahu, Island.

Background

The Hawaiian marine tourism industry brings in 800 million dollars per year (Davidson et al 2003). However, the industry poses numerous threats to the island's coral reefs. High volumes of **Healthy Coral** visitors participating in recreational activities causes physical damage to the reef (Wiener, Needham, Wilkinson 2009). Sedimentation from the development of hotels can also prevent coral from photosynthesizing. Pollution from both cruise ships and marine dumping sites **Dead Coral** (MDS) can kill coral through disease and coral bleaching. Dead reefs can recover from these threats if protected properly. Oahu Island is the most populated of the Hawaiian islands with the largest commercial port, Honolulu Harbor, therefore it's reefs are particularly vulnerable (NOAA 2018). Using Hawaiian GIS data this project maps and analyzes the vulnerability of coral reefs on Oahu, Hawaii due to tourism.

Data

Three vector polygon layers from ArcGIS Hub were used to show the geographical location of coral reefs, MDS, and commercial ports. A vector point layer from ArcGIS Hub was used to show the geographical locations of hotels on Oahu. A vector polygon layer was used from the State of Hawaii Office of Planning GIS database to show the geographical locations of NOAA marine protected areas (MPA) around Oahu.

Methods

A weighted raster risk analysis was preformed for coral reefs using ArcMap10.7.1. Euclidean Distance was calculated for commercial ports and MDS and reclassified from 0-5, 5 being closest to the site. Kernel density was calculated for the hotels layer and reclassified from 0-5, 5 being the highest density. The Raster Calculator tool was used to add the vulnerability scores for the three risk layers and to create a weighted total vulnerability score. The distance from ports was weighted 50%, the hotel density was weighted 30% and the distance from MDS was weighted 20% to reflect differing amounts of ecological stress placed on coral reefs by each risk factor. The weighted vulnerability score raster was then clipped to the coral reef polygon to show coral reef vulnerability to tourism around Oahu.





Basemap: OahuLandsat15m from State of Hawaii Office of Planning Figure 4. Calculated risk analysis for coral vulnerability on Oahu. A weighted raster calculation was used to add the risk scores of ports (50%), hotel density (30%) and MDS (20%).

Results and Discussion

Both commercial ports on Oahu Island are located on the southern side of the island (Fig. 1). One of the marine dumping sites is also located on the southern shore with the other located on the eastern shore of the Island (Fig. 2). The highest density of hotels is in the southern part of the island near Honolulu Harbor where the majority of large cruise ships dock (Fig. 3). Due to all three risk factors being located near each other in the southern part of the island the coral that is most vulnerable to tourism is around the south part of the Island near Honolulu harbor and extending east (Fig. 4).

The NOAA MPA's are mainly in areas where coral has a low vulnerability score and only includes a small portion of the most vulnerable coral in the south. The MPAs around Hawaii mainly restrict commercial and recreational fishing which does address the main risk factors of tourism (Wiener et al. 2008). The results of this project should be used to create a more effective MPA to protect vulnerable reefs. Future research should look at dive and snorkel sites in it's analysis as well as analyze other Hawaiian Islands.



Coral Reef Vulnerability To Tourism

References Evelyn Roozee Fall 2019

Data Sources

ArcGIS Hub, State of Hawaii Office of Planning Hawaii Statewide GIS

Projection

NAD_1983_HARN_UTM_Zone_4N

Resources

Davidson,, K., Hamnet, M., & Minato, C. (2003). Economic Value of Hawaii's nearshore reefs. Honolulu: Social Science Research Institute, University of Hawai'i.

NOAA. (2018). Coral reef condition: A status report for the Hawaiian Archipelago. NOAA Coral Reef Conservation Program.

Wiener, C., Needham, D., Wilkinson, P. (2008). Hawaii's real life marine park: interpretation and impacts of commercial marine tourism in the Hawaiian Islands . Current Issues in Tourism Vol. 12.





