# Quantifying Impacts of Terrigenous Sediment on Coral Reef Health and Morphology Using Remote Sensing and Machine Learning
# 1.Identifying Sources of Sediment

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## Background

Erosion, with associated sedimentation of reefs and loss of habitat for marine and coastal species, is one of the most pressing environmental challenges in Hawaii. Identifying hotspots of soil erosion guides management on land, but limited work has been done connecting land cover to coral reef health and morphology. We propose a novel approach to improve accuracy by connecting sedimentation source to sink using Unmanned Aerial Vehicles (UAVs), Unmanned Surface Vehicles (USVs), local knowledge, and machine learning. We showcase the terrestrial image acquisition process and outputs.

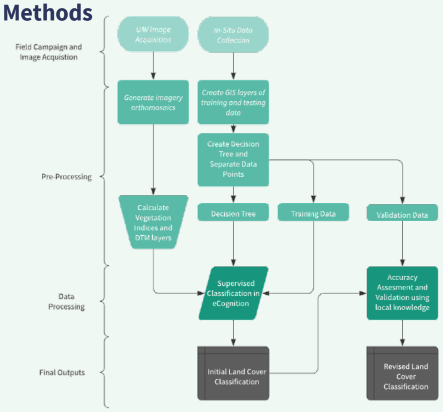
Imagery products are classified using machine learning to quantify vegetation across the system. Local knowledge is used to refine the classified models. This technique can provide information on spatial patterns of erosion hotspots and associated factors that may increase erosion rates. These data are critical for management decisions.

The ahupuaʻa of Kaʻamola has been divided among multiple leases, with the largest lease being used for agricultural grazing. Besides this portion of land used for agricultural grazing, the rest of the land has remained relatively untouched by cattle. Cattle are kept out of adjacent land using cattle guards and fences. These preventative measures delineate the land between areas that are grazed and areas that are not grazed.

## Specific Aims

- Identify key differences between land managed for grazing and land that is not managed for grazing
- Identify possible factors that increase risk of erosion for the landscape
- Create a baseline land cover classification for change detection analyses

## Methods



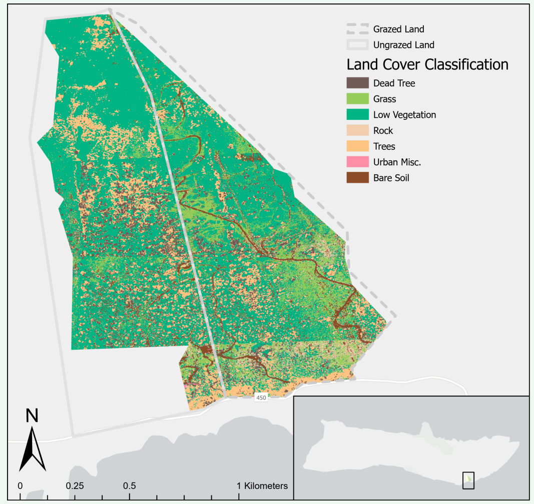




**Figure 1.** The completed land cover classification showing the overall distribution of the seven different land cover types within the Non-Grazed land (west half) and the Grazed land (east half). Image acquisition was split between four days due to the size of the study area. Areas within the study area but without a land cover classification represent areas where the imagery stitching software was unable to accurately merge the images. Image acquisition was split between four days due to the size of the ahupuaʻa and limitations of the drone. Overall accuracy for the four sections, from the top moving down, is: 74.28%, 93.67%, 87.39%, 95.72%.

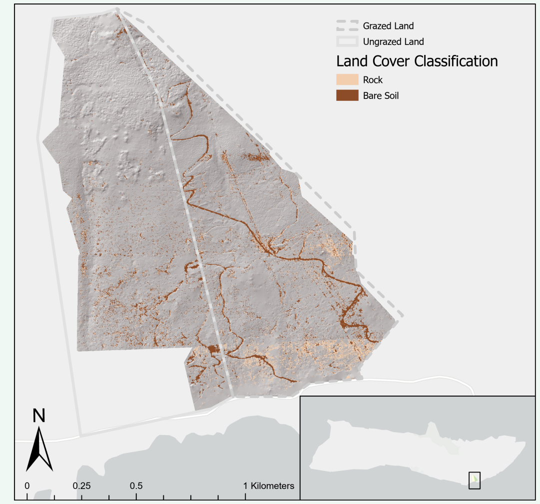
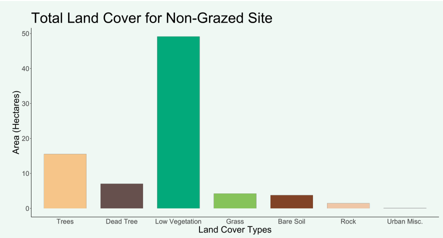



**Figure 2.** This map overlays bare soil and rocks over a hillshade of the study areas. A clear pattern of bare soil and rock is present along make shift roads on the grazed area while the distribution of bare soil and rock is scattered along the non-grazed area.



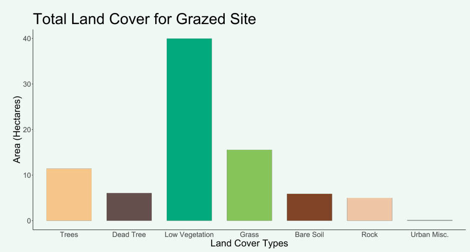




**Figure 3 and 4.** Total area of each land cover type in hectares.

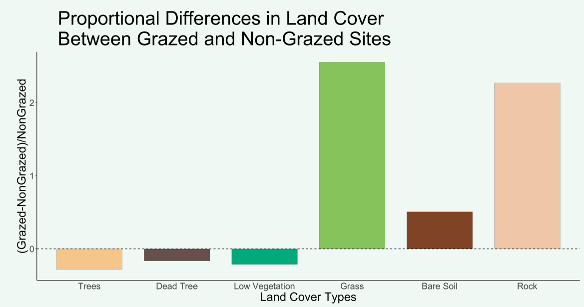



**Figure 5.** Proportional differences between the Grazed and Non-Grazed areas. Grass and rock land cover types are proportionately present in the Grazed area more than two times in the Non-Grazed areas. Tree cover in the Grazed area also represents less than fifty percent of that in the Non-Grazed area.

## Discussion

- The large proportion of grass and exposed rock in the grazed area can be attributed to how the land has been historically managed for grazing
- Poorly planned roads that are used in managing the grazed land create further stress on the ground cover and may increase risk of erosion

## Future Directions

- Benthic surveys of the reef in front of Kaʻamola will be surveyed using a USV (pictured on the right)
- Benthic cover classifications and interpolated water quality maps will be created from surveyed data
- Hot spot analysis will be performed using the outputs above