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Environmental effects on algal biodiversity and biomass on intertidal rocky shores in the Galápagos Islands, Ecuador

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Introduction

- The intertidal ecosystem is the area of the shore that is exposed during low tide and covered with water during high tide. This zone provides food resources for many organisms.
- If algal growth depends on thermal conditions, nutrient supply, and/or herbivory, then we can isolate each condition to study the impact it has on algal biodiversity and biomass
- Top down grazing (animals that feed on the plants) can have a strong impact on algal diversity.
- The main three types of algae present on the intertidal regions in the Galápagos Islands are red, green, and brown algae.
- Green algae usually dominates the rocky intertidal areas, but when removed by grazers there is room for the slower growing red and brown algae.

Methods

- Our observation sites were located on Isla San Cristóbal, Galápagos Islands, Ecuador.
- 72 4x4" polyurethane plate were installed into the rocky shore using two 3" screws in each plate.
- This experiment contained three different nutrient conditions; one third was fertilized with nutrients that was replenished often, one third was stocked with nutrients that was not replenished, and one third was without nutrients.
- Two thermal conditions; one black plate and one white plate.
- Two Herbivory conditions; caged and uncaged
- Our data and conclusions come from the previous experiment done on Genovesa Island in June 2016.
- This data was analyzed using R studio statistical package (R Core Team, 2015). Analysis of variance were calculated for plate color and grazers.
- A two-way analysis of variance (ANOVA) for significance of conditions studied.

Marine iguana (*Amblyrynchus cristatus)*

Figure 1. Mean wet biomass (grams) ±SE, grazed versus ungrazed. A significant difference was found between grazed and ungrazed plates ($F_{2,38}$=21.437, p<0.001).

Results

- The data supports the hypothesis that top-down herbivory affects the biomass of green algae (Figure 1).
- The data supports the hypothesis that top-down herbivory affects the percent coverage of both red and brown algae (Figure 4)
- The data did not support the hypothesis that thermal stress or nutrient level affects the biomass or biodiversity of algae.

Figures 2,3 (Above): Two examples of the plates recovered from Genovesa, June 2016. Left plate was uncovered, allowing for grazing. Right plate was caged, preventing grazing.

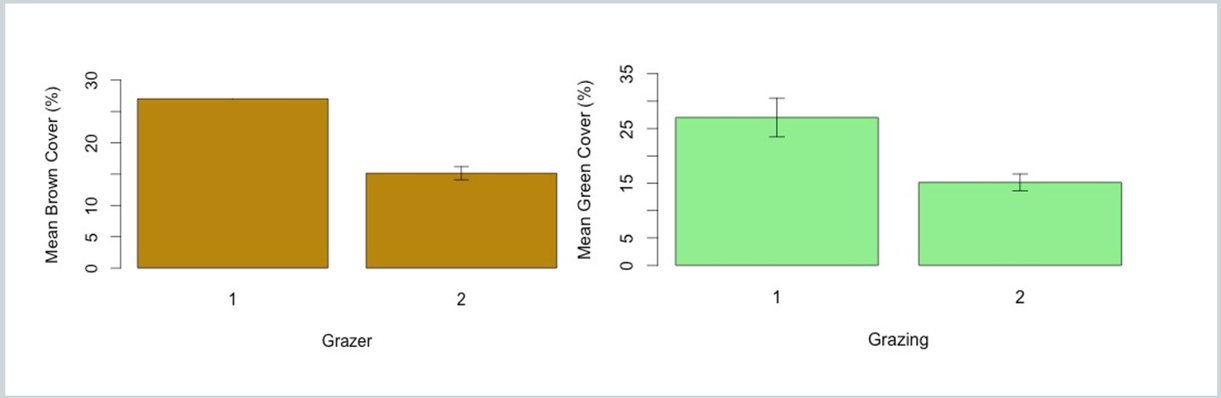
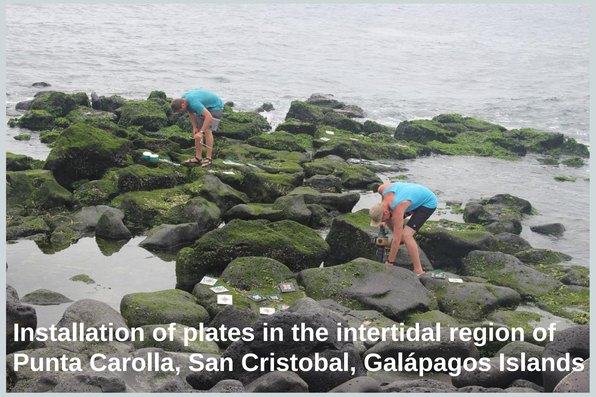


Figure 4. Percent coverage between plates of Brown and Green algae ±SE (excluded for brown grazed because zero-length arrow is of indeterminate length), grazed versus ungrazed. A significant difference was found for brown and green algae (brown$F_{2,38}$ =3.84 P=0.05, green$F_{2,38}$=4.99 P<0.05).



Installation of plates in the intertidal region of Punta Carolla, San Cristobal, Galápagos Islands

Discussion

- The presence of grazers proved to be a significant variable in each of the three types of algae; marine iguanas are known to eat the leafy foliage of the green algae, making room for the slower growing brown and red algae.
- Top-down herbivory played a significant role in the biomass of green algae and percent coverage in both green and brown algae specifically; grazing of leafy foliage on green algae reduces biomass significantly while freeing space for an increase in percent coverage of the other types of algae
- Changes in thermal and nutrient conditions did not have a significant effect on biomass or percent coverage of algae, contrary to what was hypothesized

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