Factors that Influence Population Density in Galapagos Damselfish

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Background

- Species abundance across locations and habitat types, as well as algal distribution may convey insights into trophic interaction as well as specific niches. We focused on the distributions of the yellowtail damselfish (*Stegastes arcifrons),* the ringtail damselfish (*Stegastes beebei*) and the pencil sea urchin (*Eucidaris galapagensis).*
- Damselfish survey data from 2017 suggest that the two species use habitat differently and potentially compete directly with each other and the pencil urchins for food (Butler et al, 2017).

Galapagos ringtail Damselfish (*Stegastes beebei*)

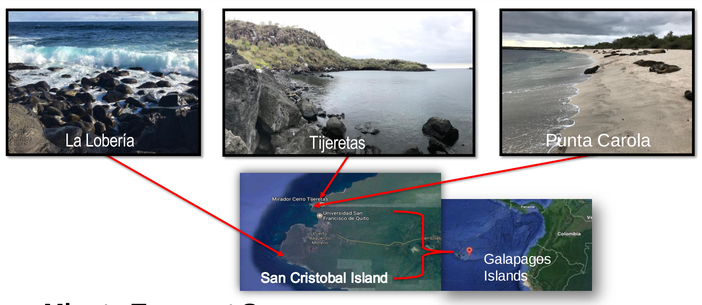
Yellowtail Damselfish (*Stegastes arcifrons)*

Pencil sea urchin *(Eucidaris galapagensis)*

Purpose

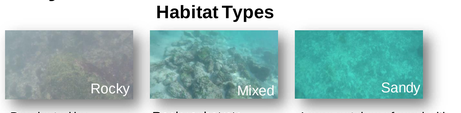
The purpose of this study was to quantify the abundance and distribution of *S. arcifrons, S. beebei, and E. galapagensis* in several bays of San Cristóbal, Galapagos.

Methodology



Three Minute Transect Survey:

Habitat Types



Dominated by rocky substrate | Rocky substrate interrupted by sand | Large patches of sand with few rocks

- Three transect locations were randomly selected for each bay. Each transect consisted of a three-minute swim along a straight path in a randomly chosen direction. The geographic coordinates were recorded at the start and finish of each transect.
- Linear displacement (m) was measured using the geographic coordinates and Google Earth.
- Four people surveyed each transect, counted damselfish, and filmed throughout the three-minute swim.

Photo cred to Butler et al, 2017

- Habitat type, algal cover and pencil urchin abundance were evaluated in 6 video freeze frames per transect.
- Video surveys of fish abundance were not comparable to real time counts due to reduced water visibility compared to 2017 .

Results

Comparing Habitat Description Across Years

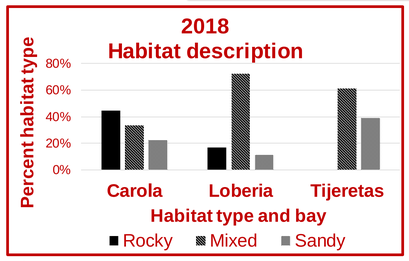


Figure 1. Randomly selected transect locations. Values are percentiles of habitats identified from video freeze frames (n=18 per bay).

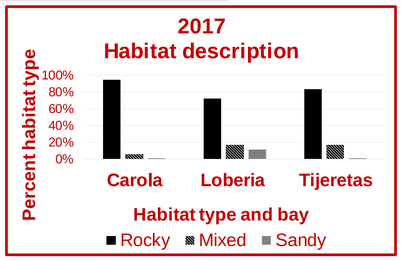


Figure 2. Haphazardly selected transect locations. Values are percentiles of habitats identified from video freeze frames (n=18 per bay).

Method Evaluation:
Haphazard transect selection (2017) did not provide the same habitat description as randomized selection (2018). Since the physical habitat is unlikely to change over time, we concluded that any difference in the data between years was a direct result of the different methods used. Therefore, no direct comparisons can be made between years.

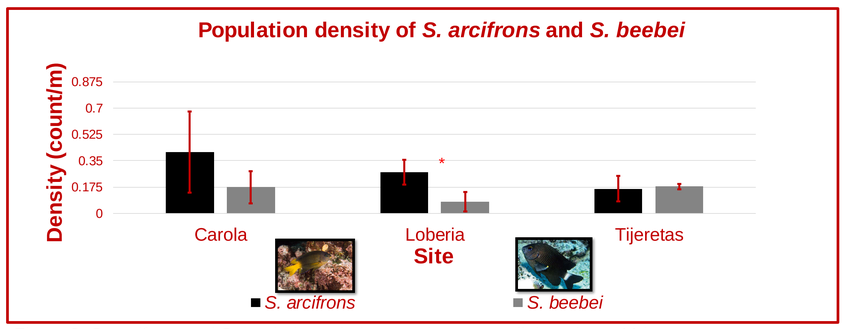


Figure 3. *S. arcifrons* and *S. beebei* population density across all three bays. Values are means ± 1 s.d. (n = 3 transects). Density was calculated per linear distance. *p < 0.05.

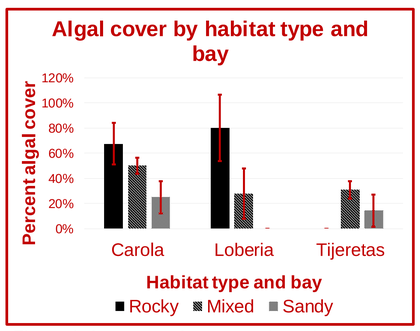


Figure 4. Algal cover is greatest in rocky habitats and least in sandy habitats. Values are means ± 1 s.d. (n = 3 transects per bay). Habitat types were identified from video freeze frames (n = 6 per transect).

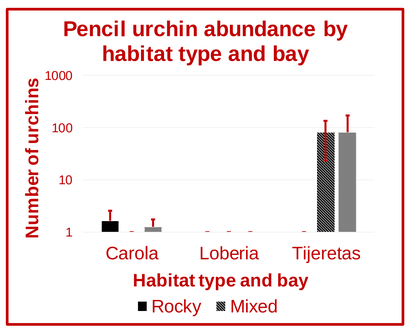


Figure 5. Pencil urchins are most abundant in Tijeretas and absent from Loberia. Values are transformed pencil urchin counts plotted on a logarithmic scale. Counts were transformed (y+1) to compensate for zero values. Error bars represent standard deviation. Pencil urchin counts were collected from video freeze frames (n=18 per bay).

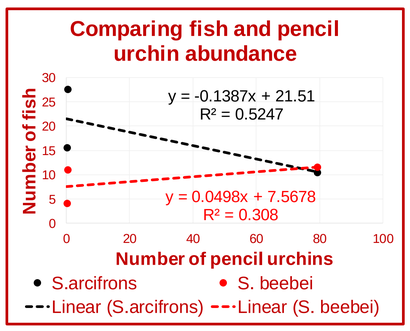


Figure 6. *S. arcifrons, S. beebei*, and pencil urchin abundances were averaged within each bay (n=3). Linear regression lines are plotted to show any correlation between *S. arcifrons* and *S. beebei* abundance with pencil urchin abundance across bays.

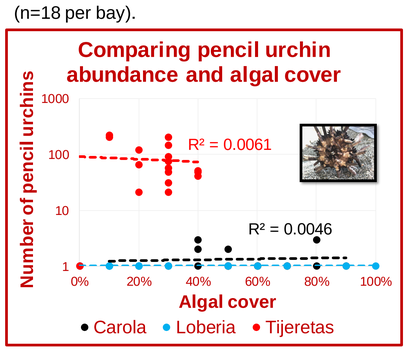


Figure 7. Pencil urchin abundance was separated by bay and compared to algal cover. Least square regression lines and R² values are plotted with colors corresponding to the bays. Pencil urchin counts were transformed (y+1) to compensate for zero values and plotted on a logarithmic scale.

Summary

- *S. arcifrons* is more abundant in bays with more rocky habitat present.
- Rocky habitat has the highest algal cover.
- Pencil urchins were 20 times more abundant in Tijeretas than elsewhere, but pencil urchins and percent algal cover are unrelated.
- There is a fairly strong negative correlation between *S. arcifrons* abundance and pencil urchin abundance.
- *S. beebei* show no preference in habitat distribution, algal cover, and they have a weak positive correlation with pencil urchins.

Conclusions and Future Directions

- The negative correlation between *S. arcifrons* and *E. galapagensis* suggests that the species may be in competition with each other.
- None of the factors tested seemed to have much influence on *S. beebei;* they may be more generalist as a species than *S. arcifrons.*
- Surprisingly, *E. galapagensis* abundance went against average algal cover and rocky habitat distribution. Other factors, yet unknown, could be heavily influencing their species abundance.
- 2017 and 2018 fish and urchin relationships have corresponding patterns, suggesting that there is a significant negative correlation between *E. galapagensis* and *S. arcifrons* and they may compete for resources.

Acknowledgments

Fish and Video Surveys: E. Carrol, M. Gomez, S. Lopez, K. Lorine, H. Phan, A. Tai.
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References

- Allen, Gerald(2006). *Stegastes beebei*[photograph]. Retrieved from http://www.discoverlife.org/mp/20q?search=Stegastes+beebei&l=spanish
- Lever, Chris(2014). Stegastes arcifrons[photograph]. Retrieved from http://chrisleverphotography.com/galapagos/
- The Pachaysana institute(2014) USFQ logo[photograph]. Retrieved from https://www.pachaysana.org/universidad-san-francisco-de-quito
- Butler, Nicholas, Durham, Sarah, and Rachel Sanchez. Spatial Distribution in Two Species of Galapagos Damselfish. *2017 Undergraduate Research Day,* 2017.