

Background

The barnacle *Chthamalus fissus* is a foundation species in the rocky intertidal zone. This zone is vulnerable to the effects of climate change and human activity;¹ thus, collecting baseline demographic data on barnacles will be useful for comparison with future studies when warming is predicted to increase. While other studies have demonstrated that *C. fissus* reproduce year-round, and more frequently in the summer,^{2,3} the timing of reproduction might also be related to lunar phase,³ as many biological processes such as egg production and larval release are timed during darker lunar phases (around quarter or new moons), to minimize predation by visual predators.⁴ This is the first study to quantify barnacle reproductive output, an important component for understanding population dynamics, in Southern California.



How does barnacle reproductive output vary with size, season, and reproductive timing?

Data Collection Method

Barnacles were collected nearly monthly and preserved in 100% ethanol. 100 from each month were dissected with a Leica S9i microscope.

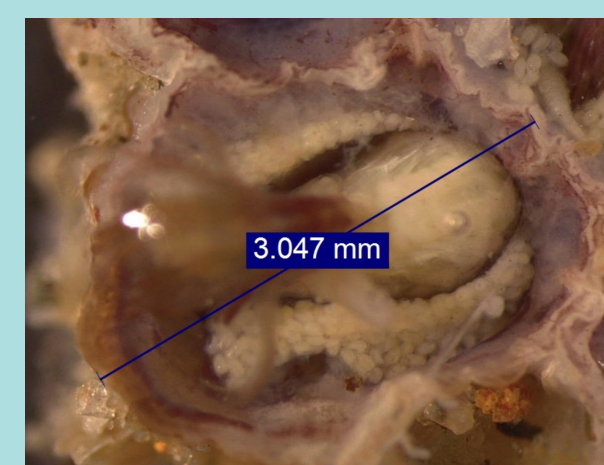


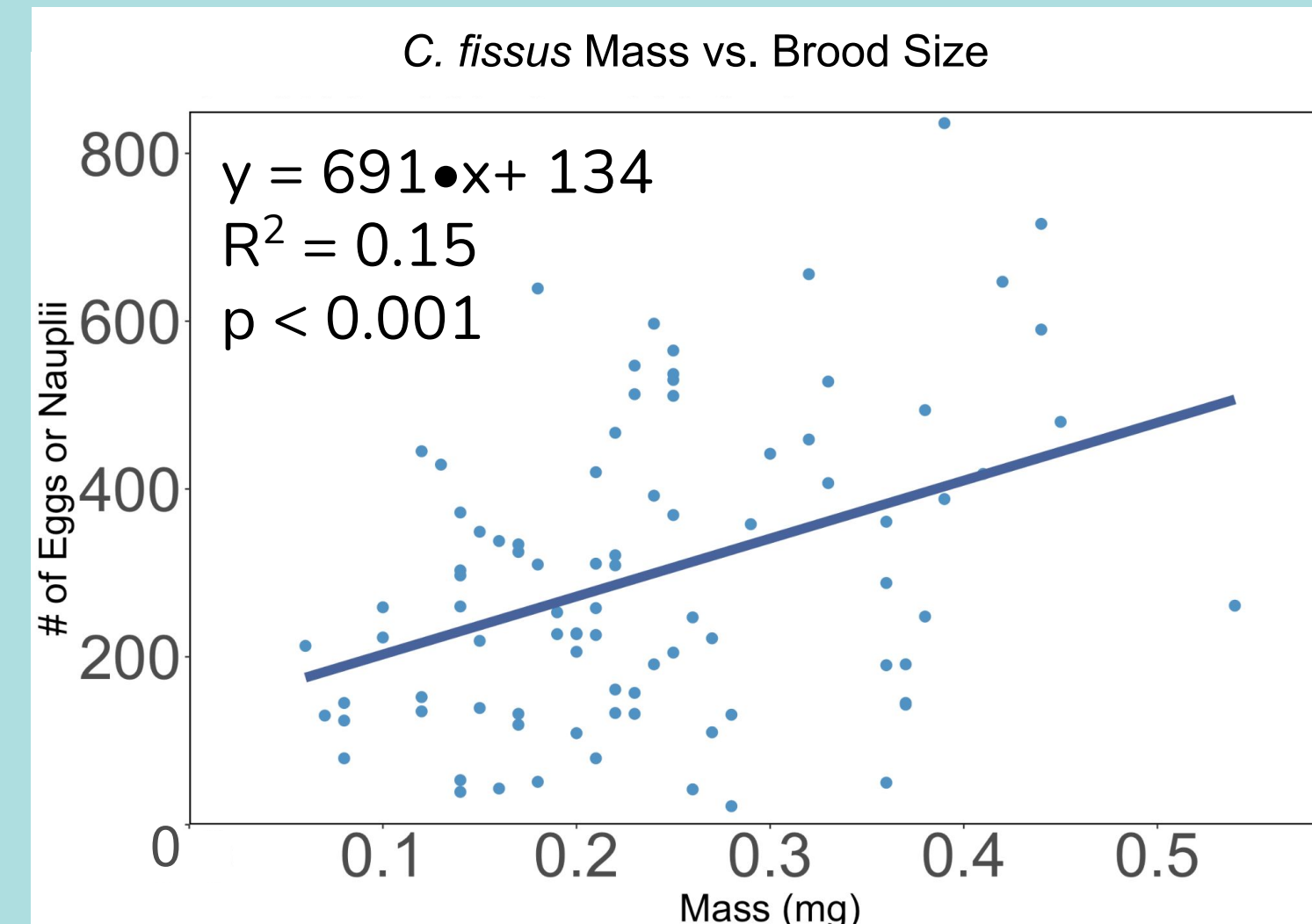
Figure 1. Barnacle & Leica measurement

Measured diameter using Leica App Suite V4.12 (Fig. 1) & counted parasites

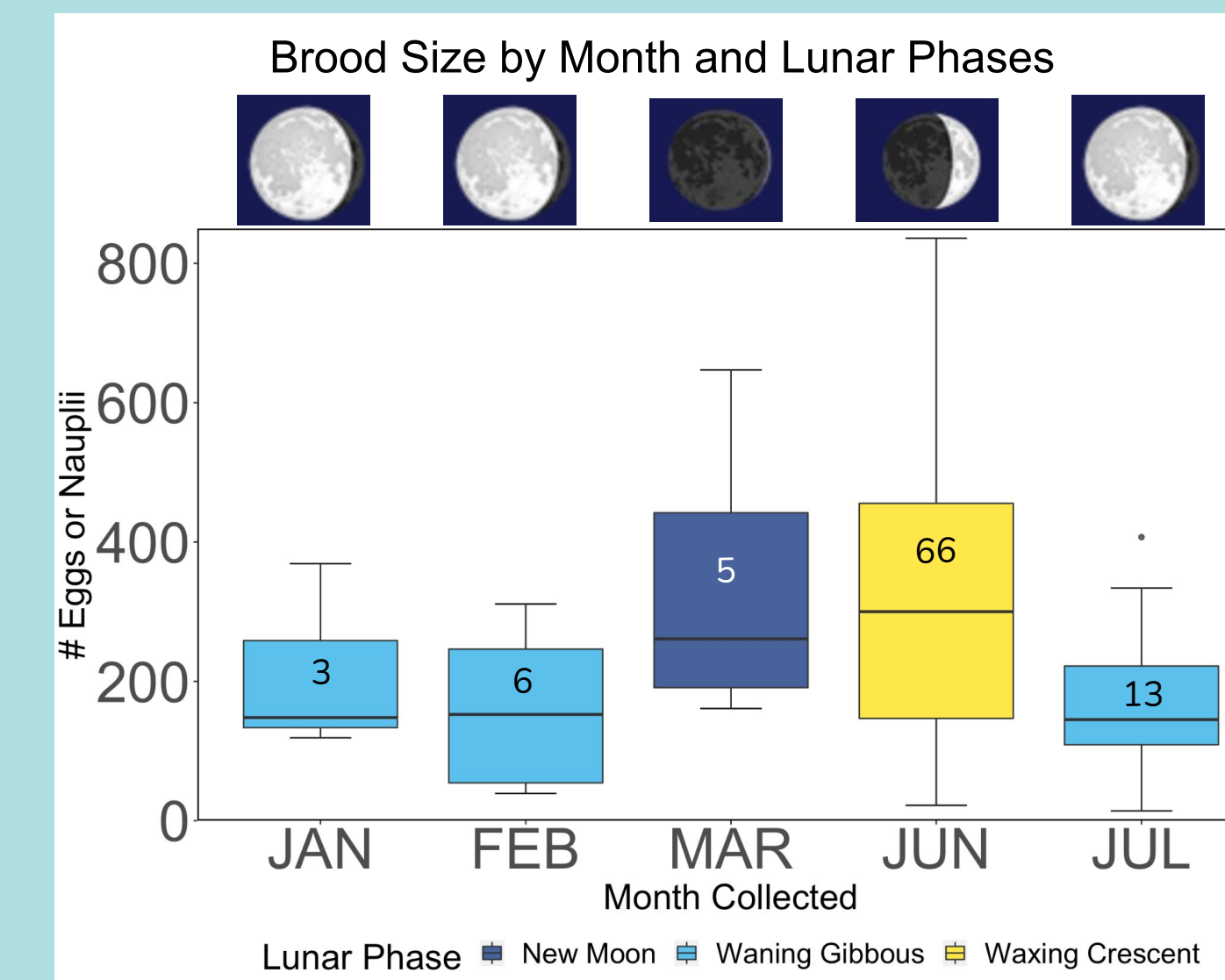
Recorded reproductive stage, counted eggs and nauplii

Removed, dried, and weighed body to quantify mass

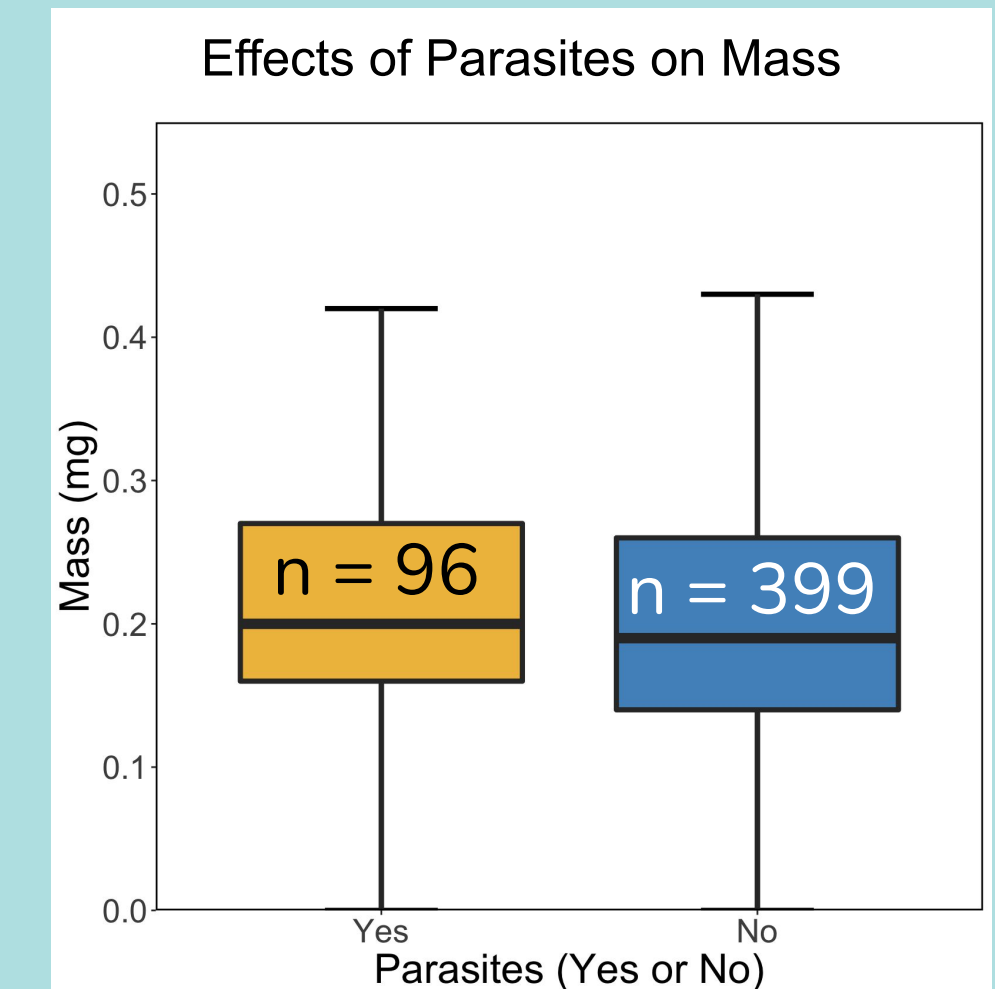
Factors Affecting Brood Size



Predicting brood size based on mass and time is valuable for population modeling.

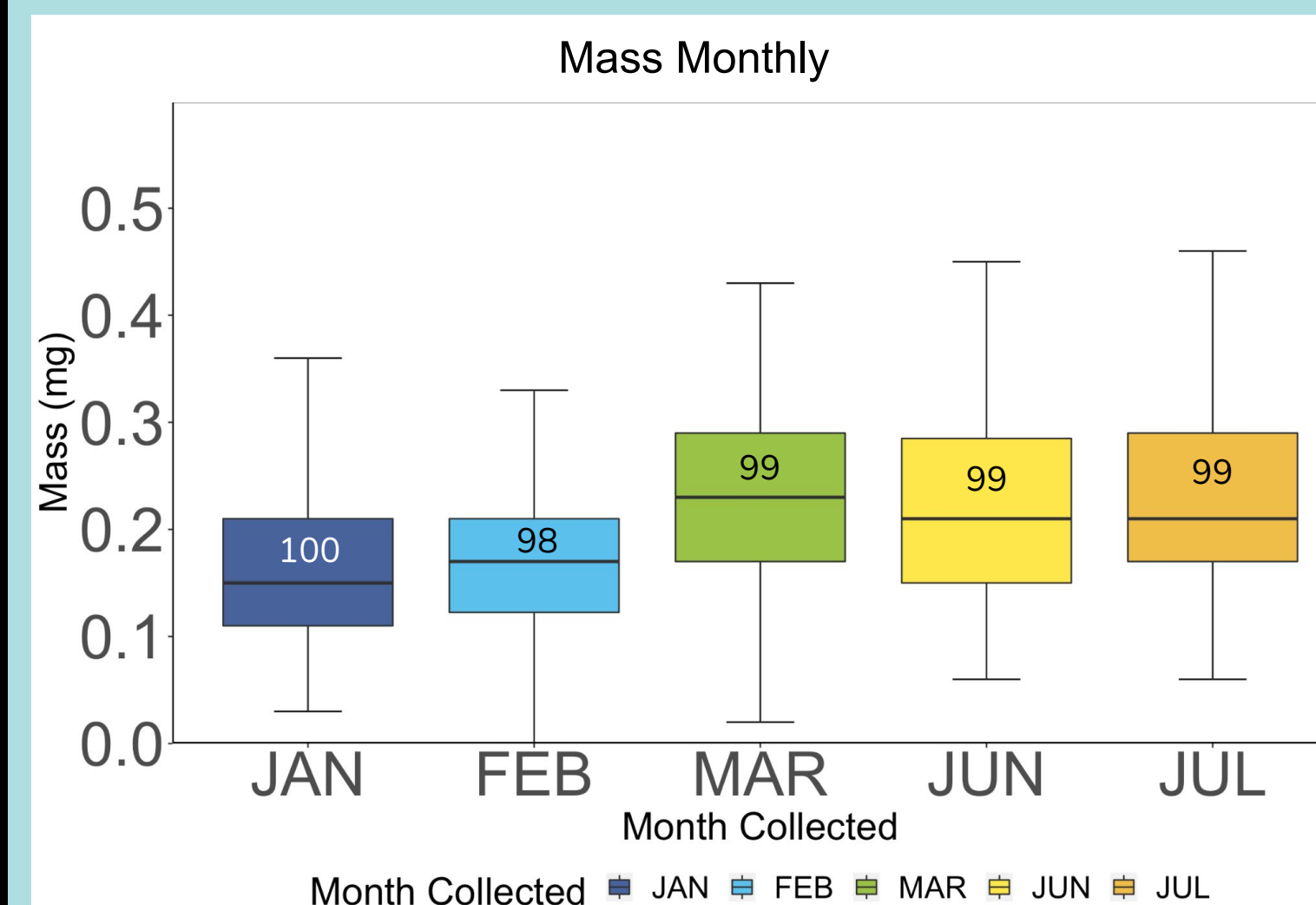


Brood size was larger in June and may be correlated with lunar phase, but lunar phase sample size was small. Sample size shown in boxes. ⚠️ (ANOVA, $p = 0.02$)

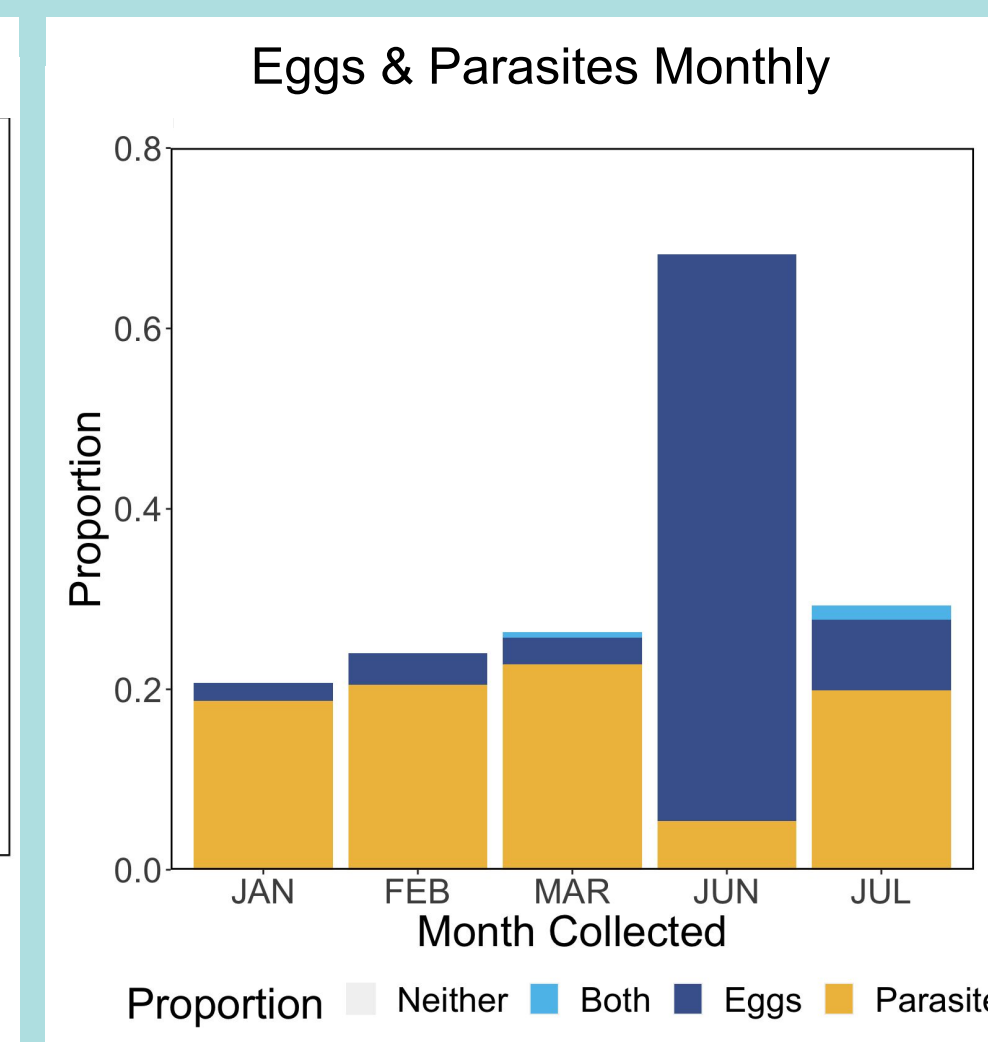


Isopod parasites did not affect mass/show preference for larger barnacles. Sample size shown in boxes. (ANOVA, $p = 0.15$)

Seasonal Variation



March through July barnacles had larger mass than January & February barnacles. Sample size shown in boxes. (ANOVA, $p < 0.0001$)



In June, more barnacles had eggs and fewer had parasites. (Eggs $\chi^2 F < 0.001$) (Parasites $\chi^2 F < 0.001$)

***C. fissus* masses are larger in the spring and summer months than in the winter, which could affect brood size.**

Implications

We found a potential correlation between lunar phase and brood size, similar to the correlation between proportion of brooding individuals and lunar phase found in another study.³ Thus, lunar phase should be considered as a factor in future studies of *C. fissus* reproductive output and timing. While in a previous study parasites preferred larger barnacles,⁵ parasites and mass were not correlated in this study. However, the month with the lowest parasites corresponded to the highest brood size, suggesting that parasite abundance varies with time and might also impact reproductive output.



Photo by Sara Timney

Acknowledgments

Nathalie Reynolds, Emily Zavacki, Anthony Basilio, Russ Harrel, Reed College Undergraduate Research Opportunity Grant

Literature Cited

1. R. C. Thompson, T. P. Crowe and S. J. Hawkins 2002. Rocky Intertidal Communities: Past Environmental Changes, Present Status and Predictions for the next 25 Years. *Environmental Conservation*, vol. 29 (2): 168–191
2. Hines, Anson H. 1979. The Comparative Reproduction Ecology of Three Species of Intertidal Barnacles. *Reproductive Ecology of Marine Invertebrates*, vol. 9: 213–234
3. Jane Weinstock. In prep. Periodicity in *Chthamalus fissus* Reproduction Does Not Guarantee Periodicity in Settlement.
4. Shima, J., Osenberg, C., Alonzo, S., Noonburg, E. & Swearer, S. 2022. How moonlight shapes environments, life histories, and ecological interactions on coral reefs. *Emerging topics in life sciences*
5. Blower, S. M., and J. Roughgarden. 1988. Parasitic Castration: Host Species Preferences, Size-Selectivity and Spatial Heterogeneity. *Oecologia*, vol. 75 (4): 512–515