North Pacific Deep-Sea Scleractinian Reproduction: Implications of a Rising Aragonite Saturation Horizon

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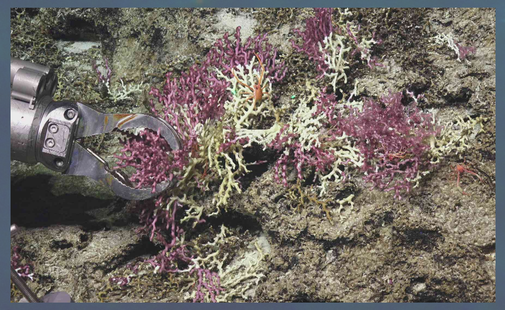
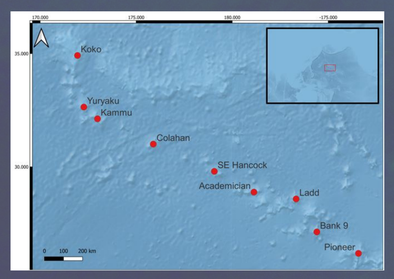
Abstract

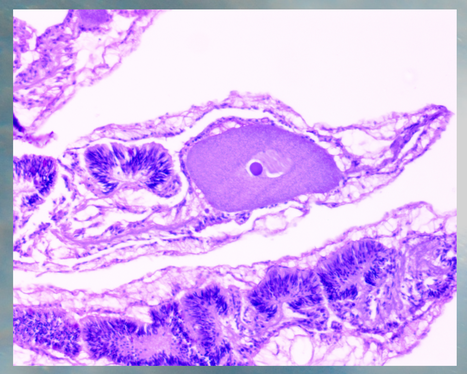
- Despite the challenges of high carbonate dissolution rates, a rising aragonite saturation horizon (ASH), and the absence of other deep-sea reefs in the nearby Pacific, Scleractinian corals can form reefs in the North Pacific deep sea that are important biodiversity hotspots.
- Establishing a pattern of deep-sea scleractinian coral reproduction presents an important gauge for their general health.
- Scleractinian corals also have multiple reproductive modes which can be a combination of hermaphroditic/gonochoric and broadcast spawning/ brooding. These reproductive choices may have an important impact on survival rates within their changing environment.
- As a result of ocean acidification the ASH is shoaling and changes in the total reproductive output of corals on the North Pacific is a consequence of particular interest.
- To understand the reproductive output of scleractinian corals, we analyzed corals collected by remotely operated vehicles during the fall of 2021 and 2022.

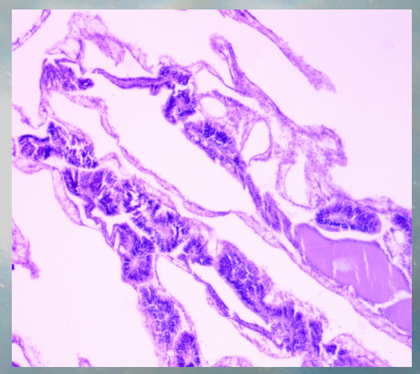


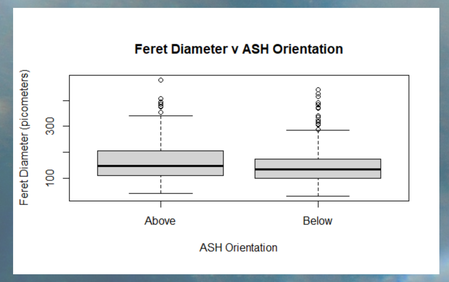
Methods

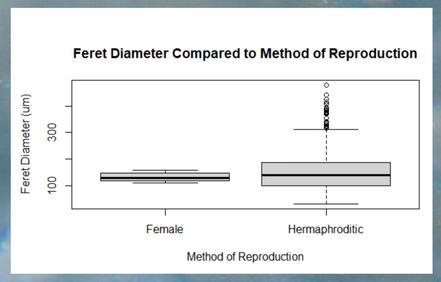
- Samples from a series of North Pacific deep-sea seamount reefs, ranging in depth from 480 - 1731 meters, were initially collected using ROV Nereus (2016-2017) and ROV Lu'ukai (2021) and placed in 10% formalin.
- Individual polyps were separated and dissected using histological processes at 8um after which individual slides were photographed under a compound microscope where individual oocytes could be clearly seen.
- We then measured the area of each oocyte with a nucleus in Image J and that area was then converted to feret diameter.
- We then compared the average diameter of those oocytes grown below the estimated ASH against those grown above using a generalized linear mixed effects model







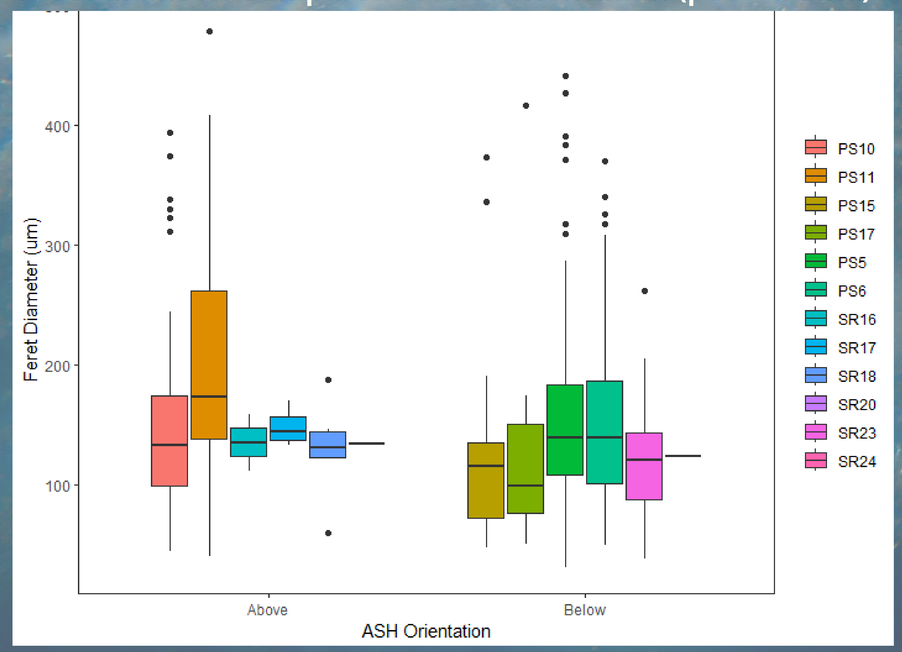




Results

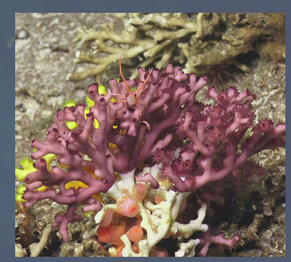
- Without regard for the pooling affect on the data there was a statistically significant change in oocyte size in favor of eggs above the ASH p= 0.0102
- However, when a generalized linear mixed effects model of the data was run in R, there was no statistically significant difference in oocyte size between those above and below the ASH.

Feret diameter compared to ASH orientation (pooled data)



Discussion

- Interestingly, before the data was analyzed as pooled, the t-test saw a significant difference between the ferret diameter of those eggs above and below the ASH. This suggests that being from the same coral influences the size of the egg. This is a logical conclusion, as larger eggs will generally come from corals with more energy for reproduction. However, although the data is pooled by the presence of multiple eggs in one coral, given more data this pooling could actually prove significant. If a coral generally has larger eggs, although this may skew the data, it could still be an overall indicator for corals below or above the ASH having better health.
- Also, despite having a small sample size of gonochoric females we decided to compare the diameter of female oocytes to hermaphroditic ones. Considering the limited energy deep-sea corals have access to, we expected corals that produce both sperm and oocytes would have statistically smaller oocytes. However, there was no statistical difference in oocyte size between females and hermaphrodites. This could indicate that hermaphrodites would be more fit when it comes to reproduction because they produce both gametes as well as oocytes that can compete with oocytes from female corals. However, this abundance of energy could be compensated for by females in other ways.



A Unique Coral

- *E. rostrata* as a newly discovered Hermaphrodite
- Variation in color leading to the classification of different species of *Enallopsammia*

Acknowledgements

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