Settlement and Survival Patterns of Coral Spat Across a Newly Developed Settlement Substrate

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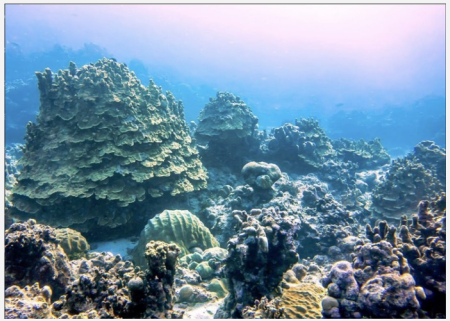
Corals

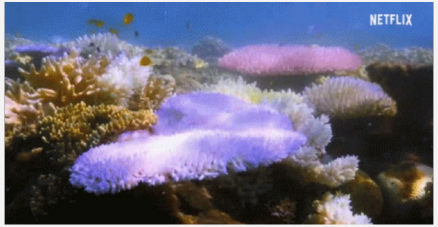
- Coral reefs are crucial to the health and biodiversity of the ocean ecosystem.
- Coral reefs are home to more than 25% of all marine life, provide coastal protection from natural disasters, and are an important source of food and economic revenue with over half a billion people relying on it for food, income, and protection.
- Coral reefs also contributes to a source of recreational and medical developments.



National Oceanic and Atmospheric Administration [NOAA]

Coral Loss

- Coral bleaching events occur with thermal stress caused by rising sea surface temperatures.
- Major global coral bleaching events occurred from 2013-2017.
- A study conducted by Mayard et al (2019), surveyed 35 coral reef sites in Saipan to understand the impacts of the major coral bleaching events in the CNMI and found a relative coral cover loss of 67% from 2012-2018.
- Restoration practices, like coral nurseries and supportive breeding, are used to help coral ecosystems recover.

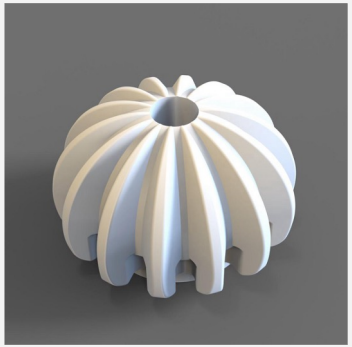


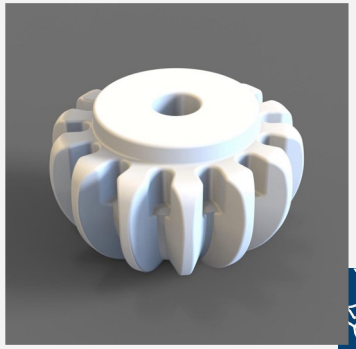
Study Objective

- Mortality rates of newly settled coral larvae and juveniles are naturally high but practices like supportive breeding can help improve their survival.
- Supportive breeding involves collecting, fertilizing gametes, and settling larvae on artificial substrates.
- Prior research has shown that microhabitat structures enhanced juvenile coral survival and growth.
- This study assesses differences in larval settlement and survival of *Acropora muricata* corals amongst various areas of a newly developed settlement substrate that resembles a small dome.
- The substrate areas being assessed include the well-lit top, ridged sides, shaded grooves, and the bottom.

Newly Developed Substrate

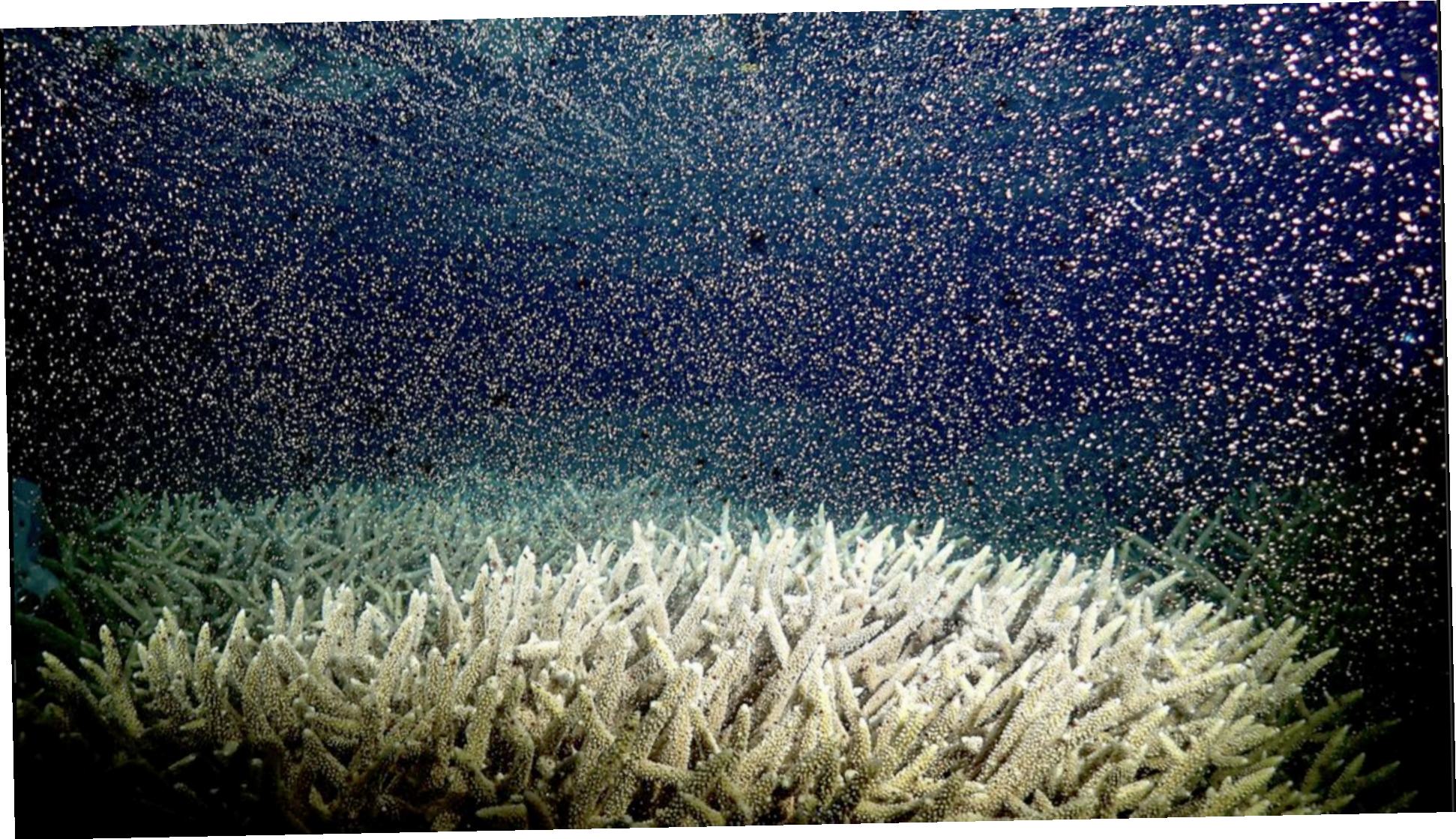
The substrates are made from cement, designed to resemble a dome with a hole in the middle to be nailed easily onto the reef. It includes ridges, shaded grooves, and other features that may help in survival as it protects the coral juveniles from things such as heat, predation, and accidental grazing.





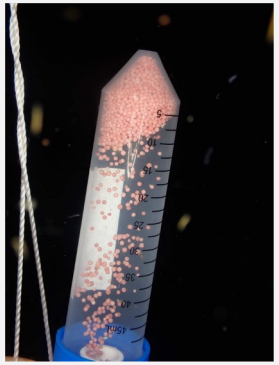
Methodology - Settling

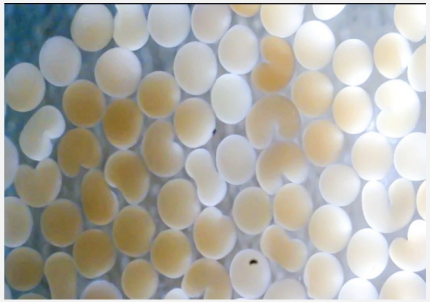
- **STEP 1:** Substrates were put onto rods and brought to the nursery for conditioning one month before spawning, which is necessary for the development of the biofilm of algae, making it favorable for the larvae.
- **STEP 2:** In May 2024, collected *Acropora muricata* coral gametes from different reef patch sites.
- **STEP 3:** Brought the gametes back to the lab, allowing them to fertilize and observing the process under the microscope.
- **STEP 4:** Once separated and fertilized, the larvae float in the water system, while the dome substrates are put in for them to settle on.

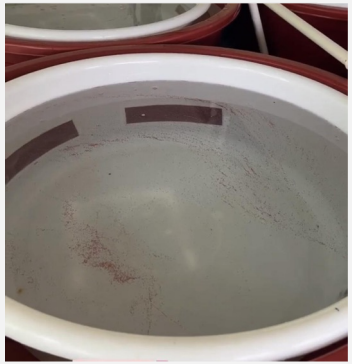


Spawning

corallite







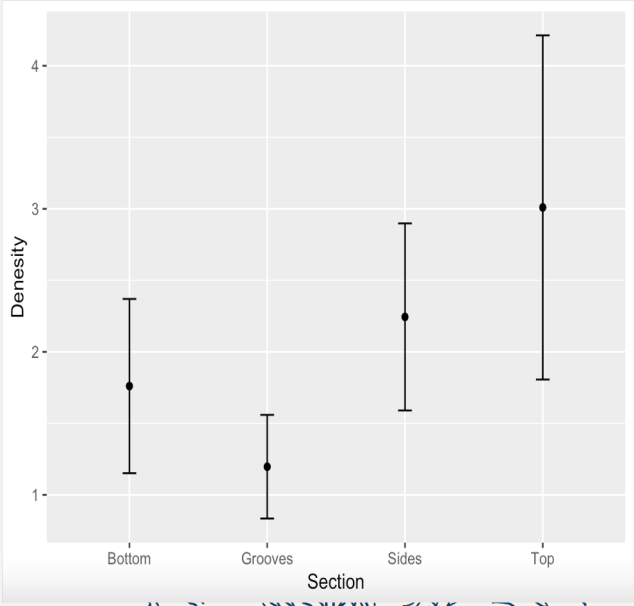
Methodology - Procedure

- A total of 30 substrates were assessed, and all settlers on each area of 30 substrates were counted under a microscope, then tagged and outplanted onto a patch reef in the Saipan lagoon.
- The substrates were retrieved after two weeks and recounted to determine if settlers on specific areas of the substrate had different short-term survival rates.

Results - Settlement Preference

- Pre outplant settlement density/ surface area of section = density of settlers per cm² which is used as a representation of settlement preference.
- The non-parametric Kruskal-Wallis rank sum test to compare median settlement rates among the different substrate areas.
- Kruskal-Wallis chi-squared = 4.134, df = 3, **p-value = 0.2474**
- As the p-value is more than the significance level of 0.05, we can conclude that there are no significant differences between the sections.

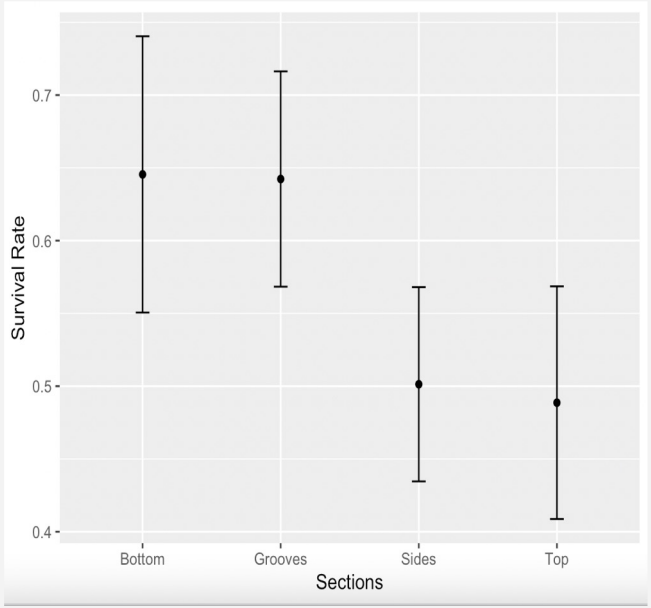
Average Density/cm²



Results - Survival Rates

- Short term survival rates: post outplant density/pre outplant density
- The non-parametric Kruskal-Wallis rank sum test was used to compare median survival rates among the different substrate areas.
- Kruskal-Wallis chi-squared = 4.1832, df = 3, **p-value = 0.2424**
- As the p-value is more than the significance level of 0.05, we can conclude that there are no significant differences between the sections.

Average Survival Rates



Implications

- This study provides information on the effectiveness of a new coral settlement substrate to be used in coral restoration efforts, which can potentially lead to other conservationists implementing these substrates too.
- This information can also aid researchers and substrate designers in better understanding coral larval settlement and survival patterns and how they are affected by biological factors such as settler density and substrate structural features.

Discussion & Conclusion

- The analysis of the settlement density and survival rates both **did not reveal a statistically significant difference** between the sections of the substrate.

- However, this is a short-term study, and a long-term study can potentially show a statistically significant difference in the long-term survival rates.

- Although there were no statistically significant differences between survival rates and settlement density, there were patterns within the two data sets.
    - Ex: The bottom and grooves had a lower settlement density but were shown to have a higher survival rate

Future Research

- Conduct a long-term study assessing beyond the initial settlement period to understand how initial settlement density on the substrate yield to long-term survival and growth.
- Investigate different materials (natural rock, artificial substrate, etc) and designs (dome shaped, tiles, etc) to see if they affect settlement and survival.
- Analyze other factors that may enhance coral larval settlement and survival beyond substrate section differences.
- Examine the role of symbionts (zooxanthellae) in larval settlement and survival.

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Thank You!

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