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# Epigenetic responses to environmental stressors in *Acropora* corals, and connections to coral reef conservation.

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## Environmental Epigenetics

### Epigenetic Modifications:

- Heritable changes in gene function that do not involve changes to the DNA sequence
- Responsive to environmental changes
- Play a critical role in acclimatization and adaptation

### Epigenetics and Coral Reef Conservation:

- The ability of coral to genetically adapt to changing environmental conditions represents a critical concern, given the speed of global climate change.
- Opposed to the slow evolutionary process of adaptation through natural selection, the highly rapid and dynamic epigenetic regulation of gene function in response to environmental stress can promote acclimated phenotypes in a much shorter time.
- Epigenetic modifications may contribute to a “nursery-effect”, or an effect of the environmental conditions where a coral is raised on its ability to tolerate subsequent exposure to stressful conditions.



Coral Species



*Acropora palmata*

*Acropora cervicornis*

## Study Sites

### Urban-Impacted:

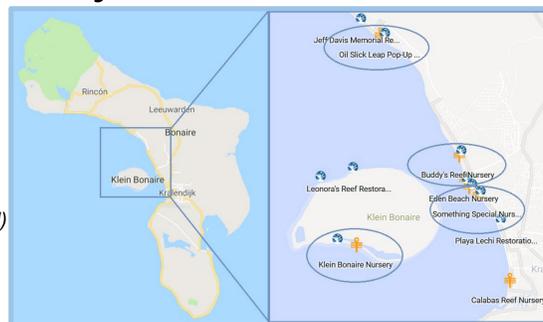
- Buddy's Reef
- Something Special

### Isolated/Pristine:

- Oil Slick Leap
- Klein Bonaire (Uninhabited)



Coral fragments in Buddy's Reef Nursery



Maps adapted from Google Maps and Reef Renewal Bonaire

- Sites are predicted to differ in environmental conditions, especially in levels of nutrient pollution from urban runoff and outflow of nutrient-enriched groundwater.
- Coral fragments are currently growing in nursery sites adjacent to each restoration study site.
- Sites maintained by Reef Renewal Bonaire

## Study 1: Seasonality

### Objective:

Assess the effects of seasonality and site-specific environmental conditions on coral epigenetic modifications and their connection with the health of two coral species: *A. cervicornis* and *A. palmata*.

### Coral Clones:

- Three genotypes of each species
  - *A. cervicornis*: 10 clones of each geno. at 3 sites
    - Buddy's Reef, Something Special, and Klein Bonaire
  - *A. palmata*: 6 clones of each geno. at 3 sites
    - Buddy's Reef, Something Special, and Oil Slick Leap
- Total of 144 Corals
- After 6 months of acclimation, coral fragments will be outplanted from the nurseries to each study site.



Clones of *A. cervicornis*, Genotype AC12, individually tagged for this project.

## Monitor Environmental Conditions

### In-situ Data Loggers:

- Temperature
- pH
- Photosynthetically Active Radiation (PAR)
- Turbidity
- Dissolved Oxygen
- Salinity

### Water Samples:

- Dissolved Inorganic Nutrients:
  - $\text{NO}_2^-$ ,  $\text{NO}_3^-$ ,  $\text{NH}_4^+$ ,  $\text{PO}_4^{3-}$
- Total Nitrogen and Phosphorous
- Heavy Metals
  - Be, Al, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Mo, Ag, Cd, Sn, Sb, Ba, Hg



Outplanted *A. cervicornis* at Buddy's Reef Restoration Site from previous Reef Renewal restoration sessions.

Experimental corals will be outplanted from each nursery to each restoration study site in Summer 2019.



Fragments of *A. cervicornis* being collected from Buddy's Reef Nursery in December 2018.

Samples of experimental corals will be collected monthly after outplanting at each site.

## Monitor Coral Health

### In-situ Data Collection:

- Growth Rate
- Branching
- Survivorship
- Photosynthesis
- Fish and Benthic Community of Adjacent Natural Reefs

### Coral Samples to Measure:

- Epigenetic Modifications (DNA Methylation and H2A.X Phosphorylation)
- Gene Expression
- Symbiont Density
- Phenotype/Fitness (e.g., Protein content)

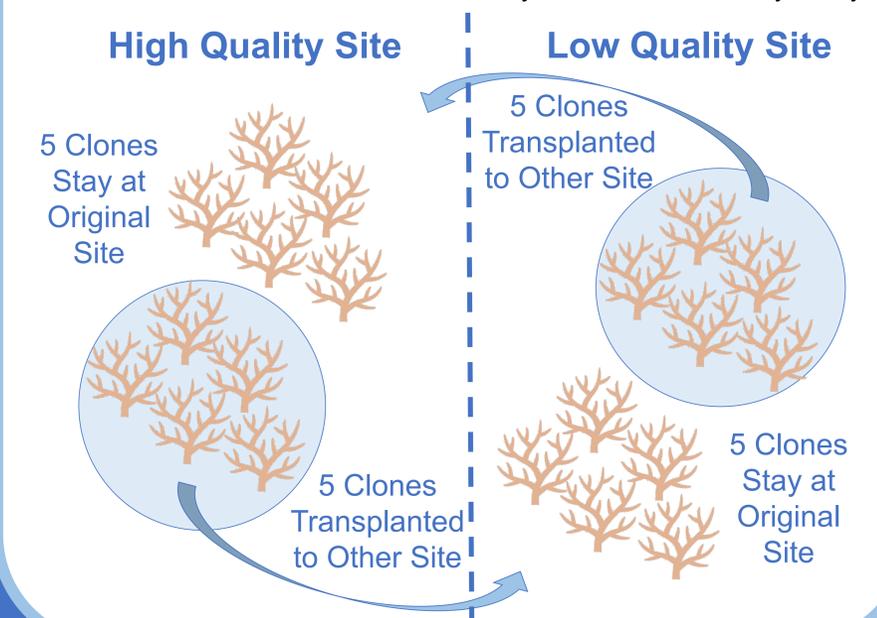
## Study 2: “Nursery-Effect”

### Objective:

Assess how the “nursery-effect” influences a coral’s ability to tolerate subsequent exposure to stressful conditions. Determine the epigenetic basis of the “nursery-effect” and compare to the effect of the genome.

### Method:

- Reciprocal transplant between two study sites
  - One “High Quality Site” and One “Low Quality Site”
    - “High” and “Low” Quality sites will be identified using data on site-specific environmental conditions collected during Seasonality Study.
- **Environmental Conditions** and **Coral Health** will continue to be monitored at both sites in the same way as in the Seasonality Study.



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