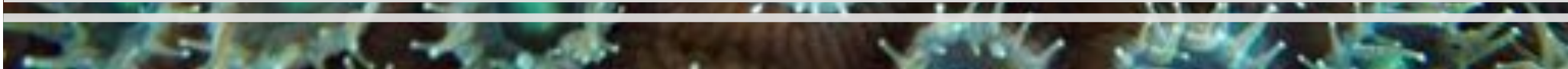


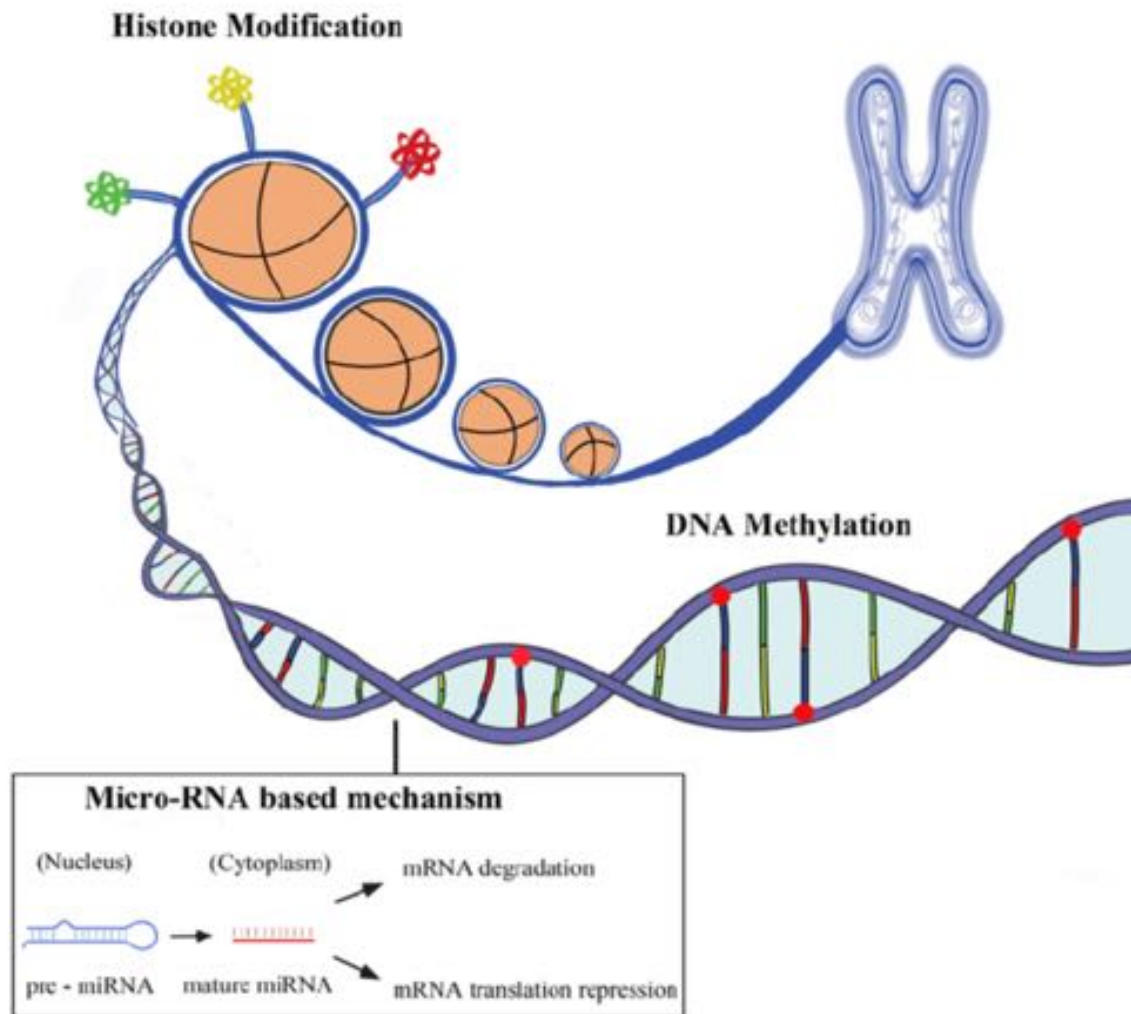


# Response of DNA methylation to environmental change in the reef coral *Porites astreoides*

Jay Dimond & Steven Roberts

University of Washington, School of Aquatic and Fishery Sciences, Seattle, WA USA

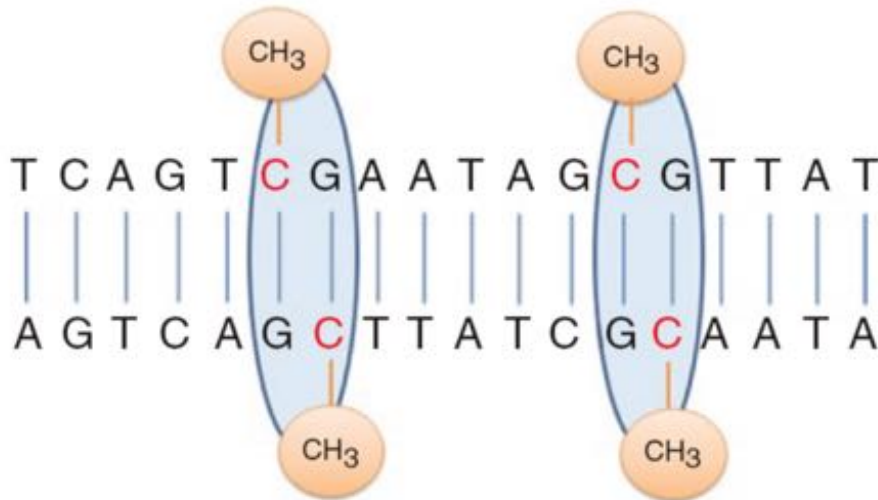




Khalil (2014)

## CpG methylation

### 5-methylcytosine (5mC)



Schroeder et al. (2011)

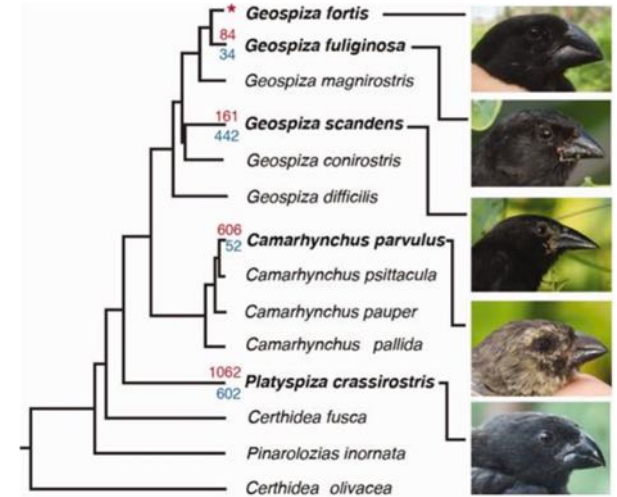
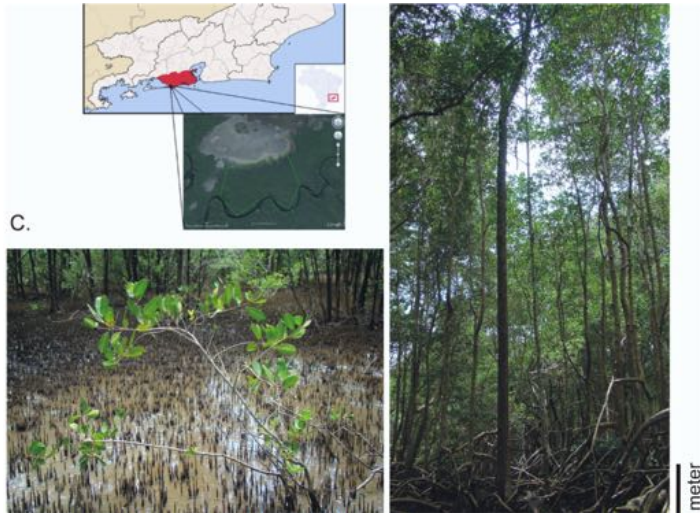
### Evidence for:

- Environmental induction
- Heritability
- Influence on transcription

### Context important

- Evolutionary
- Genomic





Lira-Medeiros et al. (2010), Simpson et al. (2011), Skinner et al. (2014), Morgan et al. (1999)



# DNA methylation and phenotype

# Why corals?

In decline globally

Need to understand mechanisms  
of adaptation & acclimatization

Sessile and very reliant on  
phenotypic plasticity





# **DNA methylation in invertebrates**

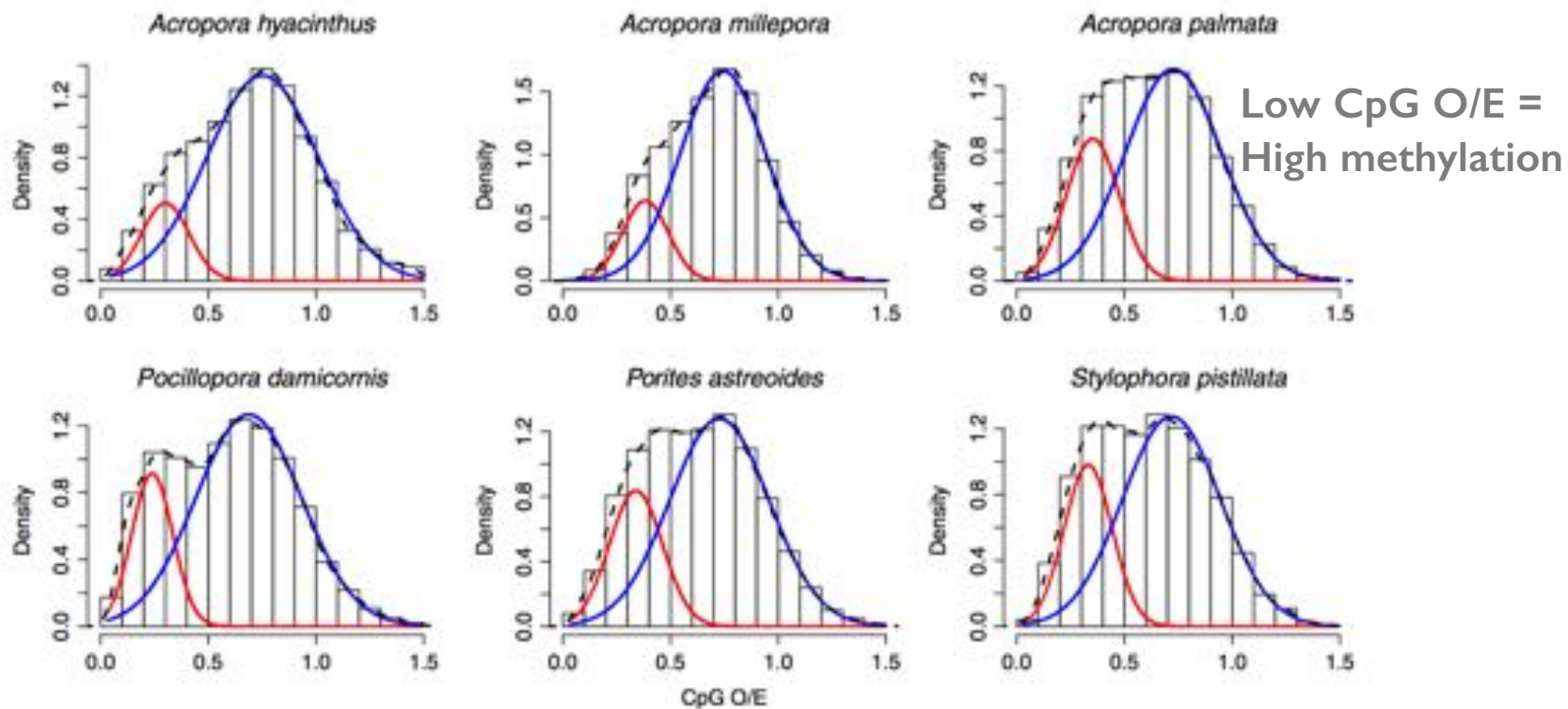
**Genomes less methylated than vertebrates**

**Methylation mostly in gene bodies**

**Function of gene body methylation not fully understood**



Corals, like other invertebrates, have distinct fractions of genes with high and low levels of methylation



Dimond & Roberts (2016)



# Hypermethylated genes

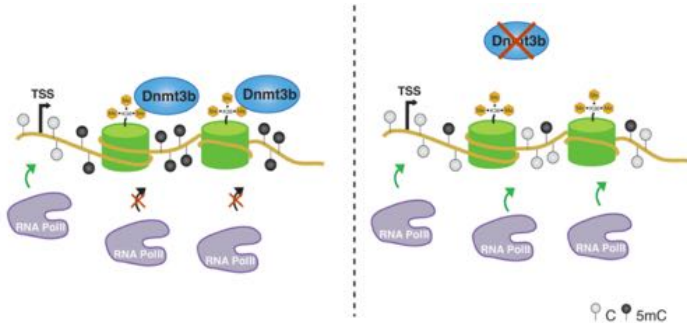
Tend to be housekeeping genes

Essential, conserved functions



5mC promotes optimal codon usage (Dixon et al. 2016)

5mC prevents spurious transcription (Neri et al. 2017)





## Hypermethylated genes

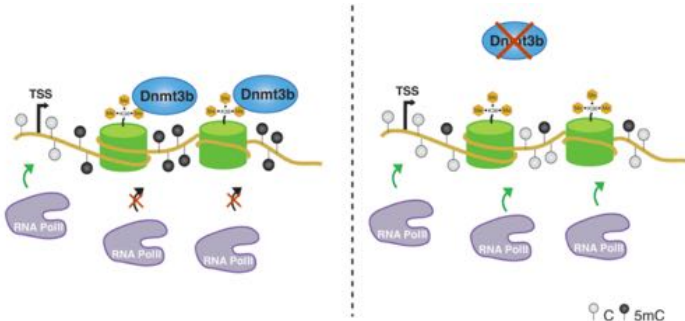
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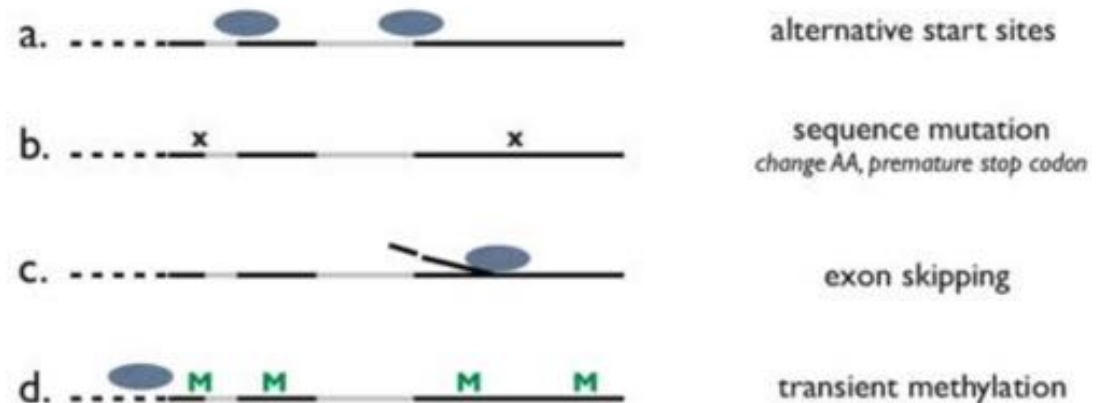
## Hypomethylated genes

Tend to be inducible genes

Associated with environmental change & exhibit plasticity



Increased transcriptional opportunities?



Roberts and Gavery (2012)

## Hypermethylated genes

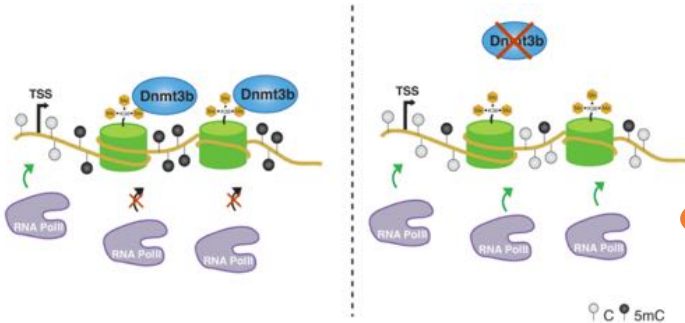
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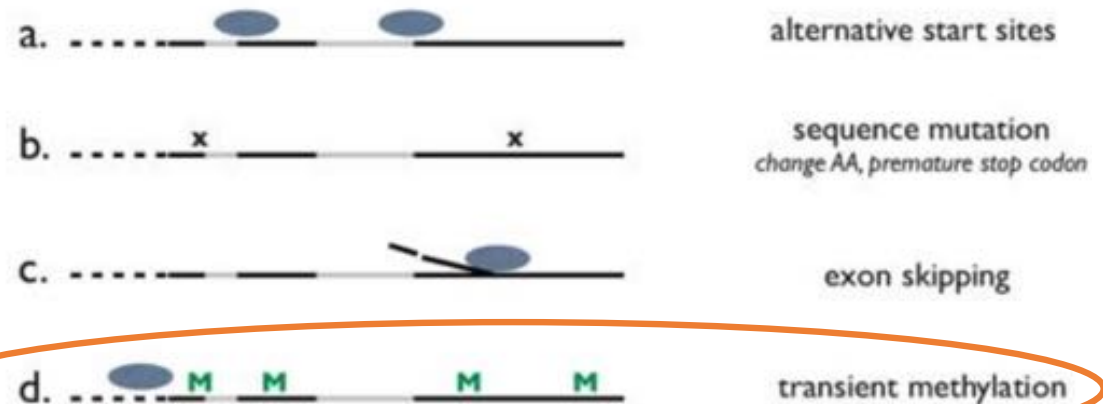
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Tend to be inducible genes

Associated with environmental change & exhibit plasticity



Increased transcriptional opportunities?



Roberts and Gavary (2012)

**How plastic is methylation in response to environmental change?**

*Porites astreoides*

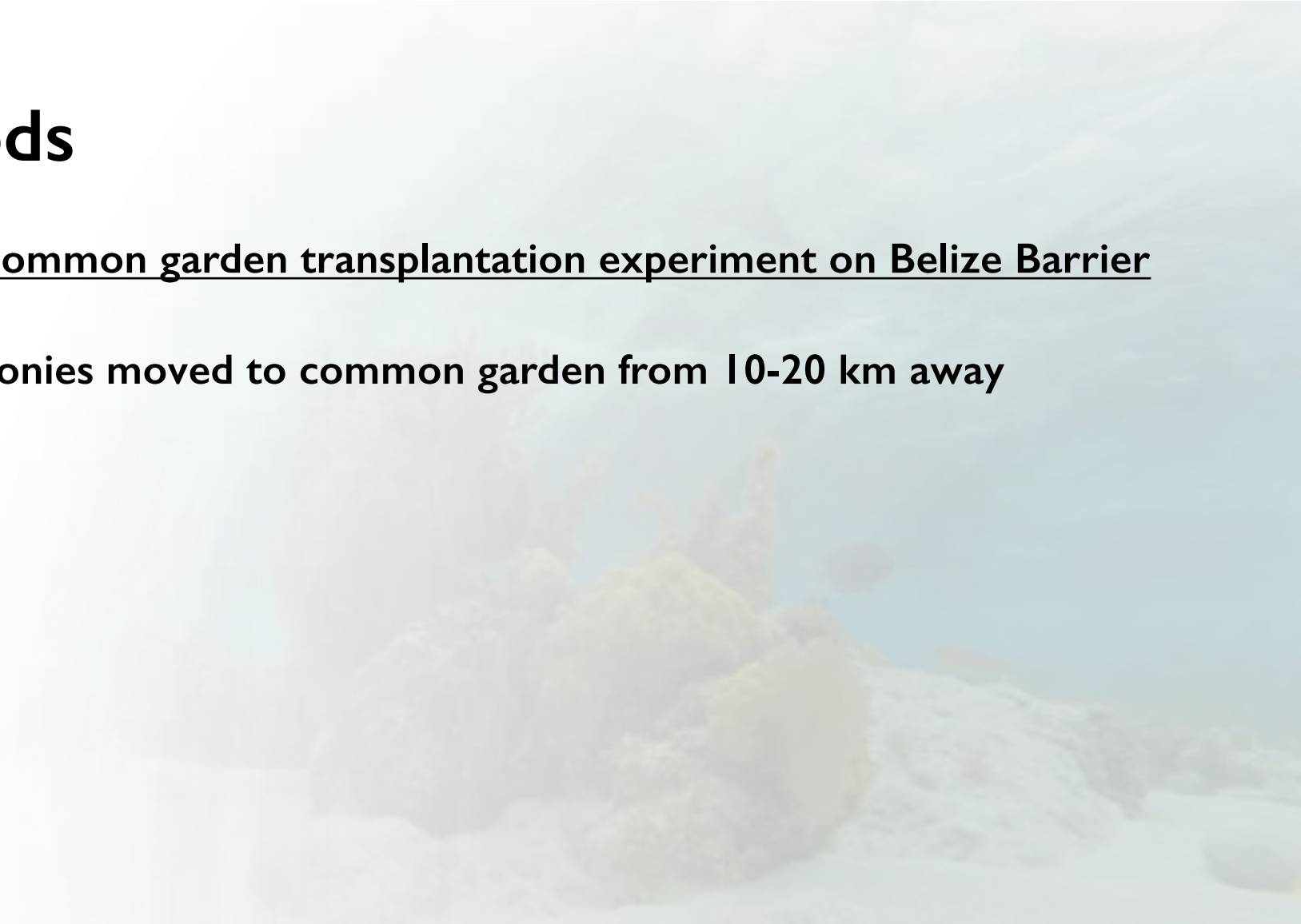




# Methods

## One-year common garden transplantation experiment on Belize Barrier Reef

- colonies moved to common garden from 10-20 km away



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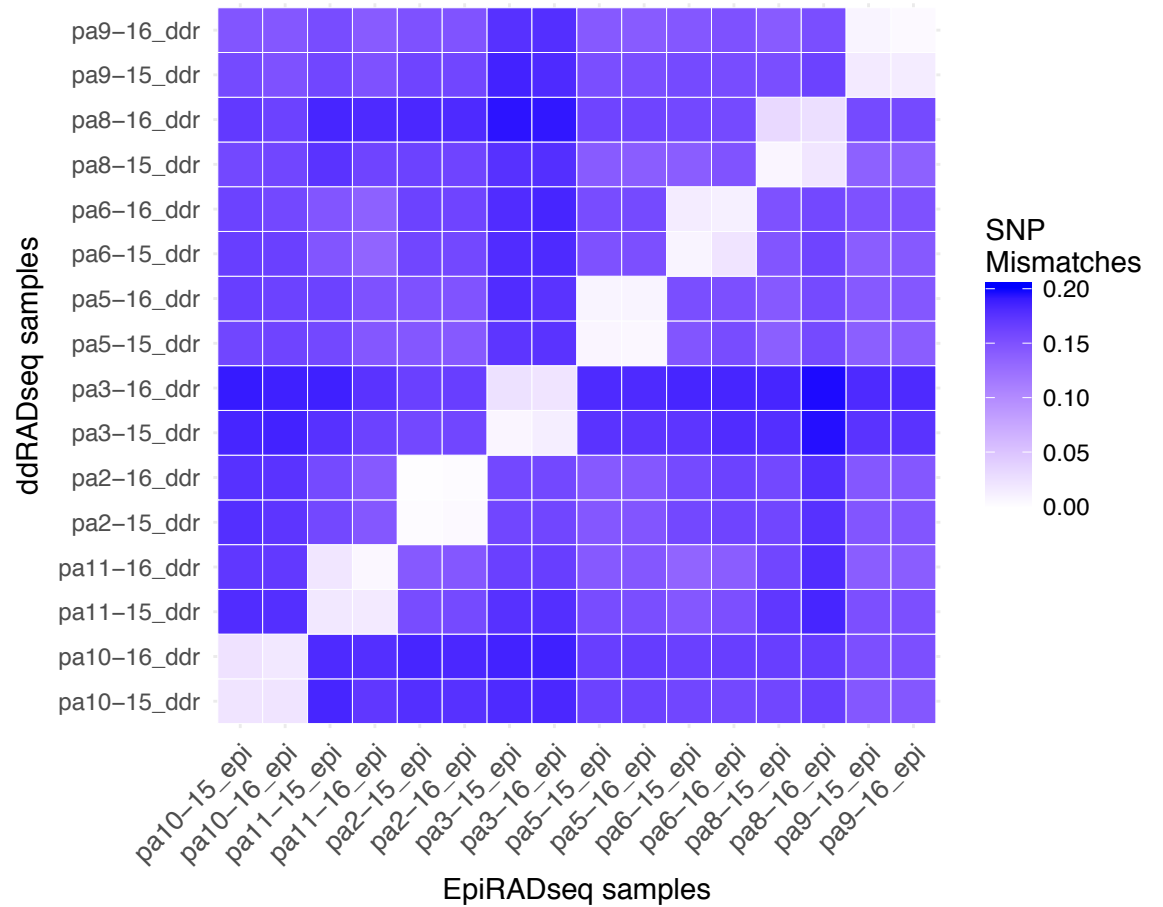
## Genome-independent assembly using iPyrad

- *Symbiodinium* Clade A genome used to remove symbiont reads



**n = 8 colonies x 2 years**

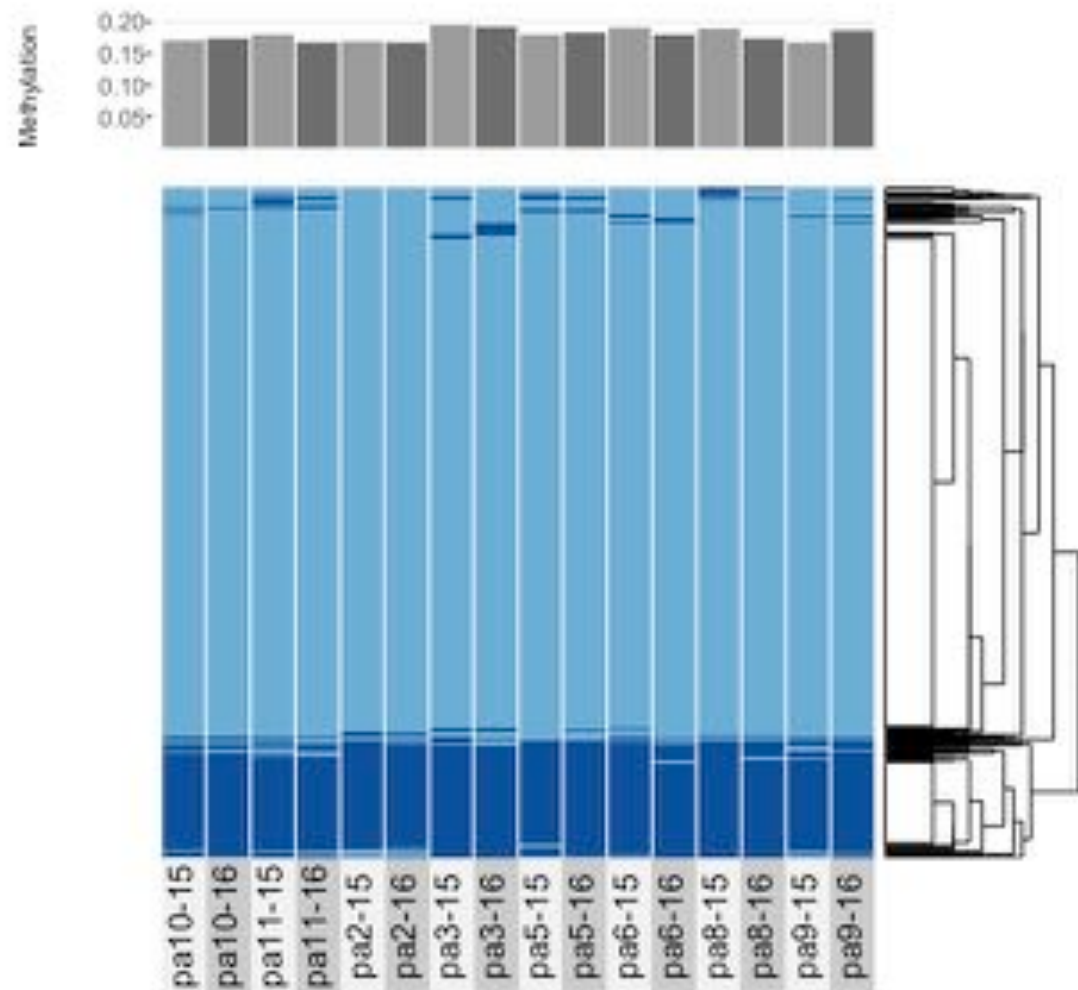
**Technical replicates  
and repeated sampling  
indicate low error**



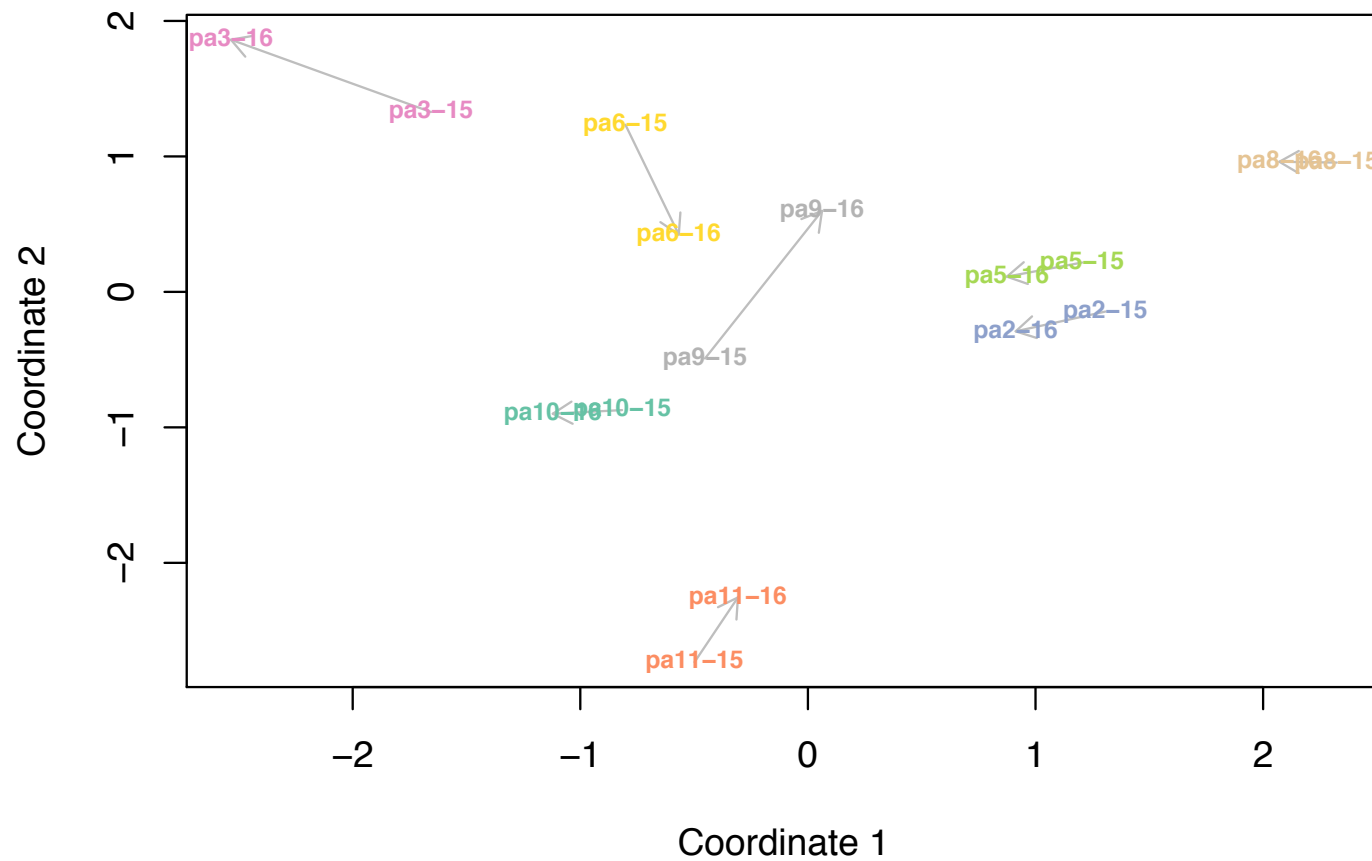
649 shared loci

Most loci either  
constitutively  
unmethylated or  
methylated

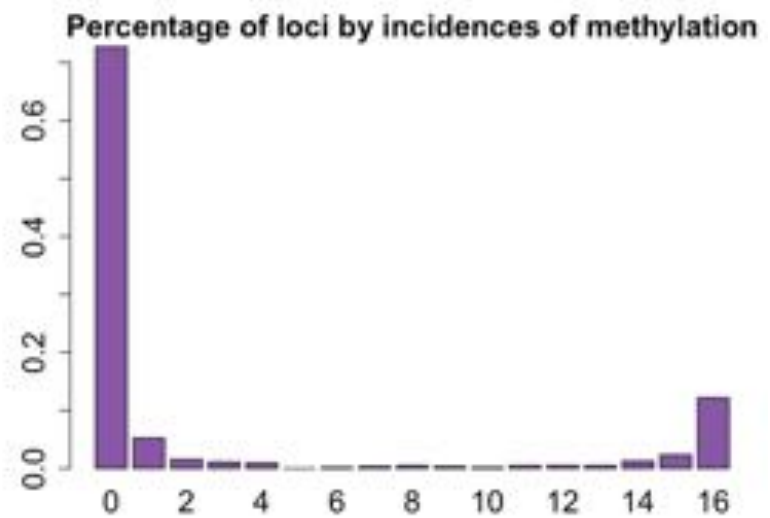
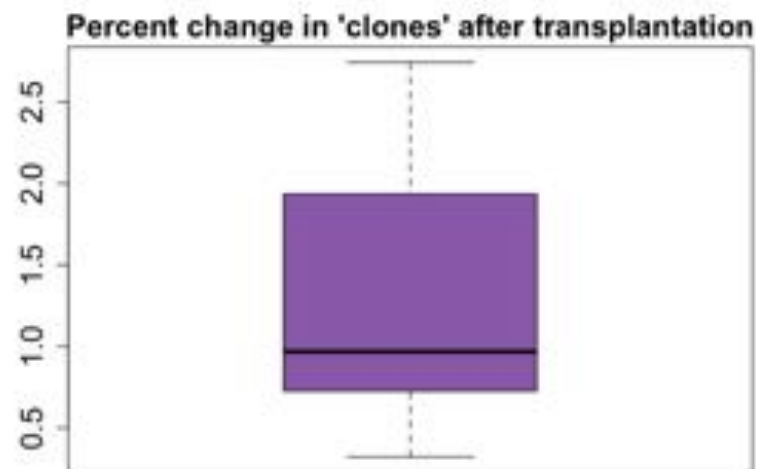
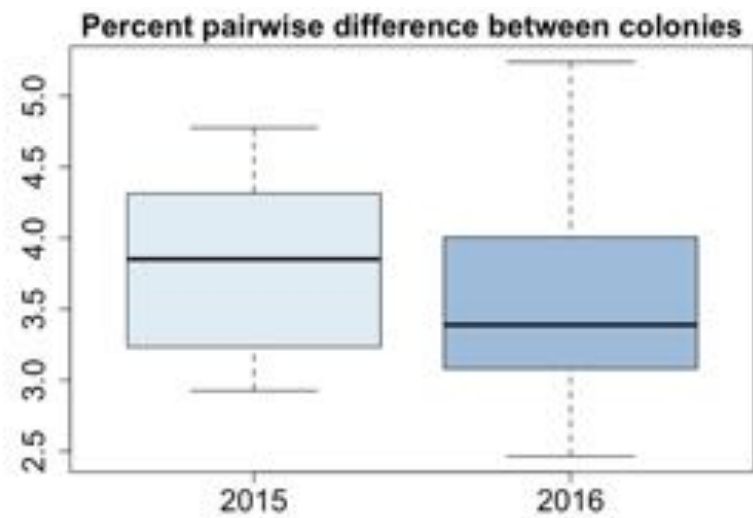
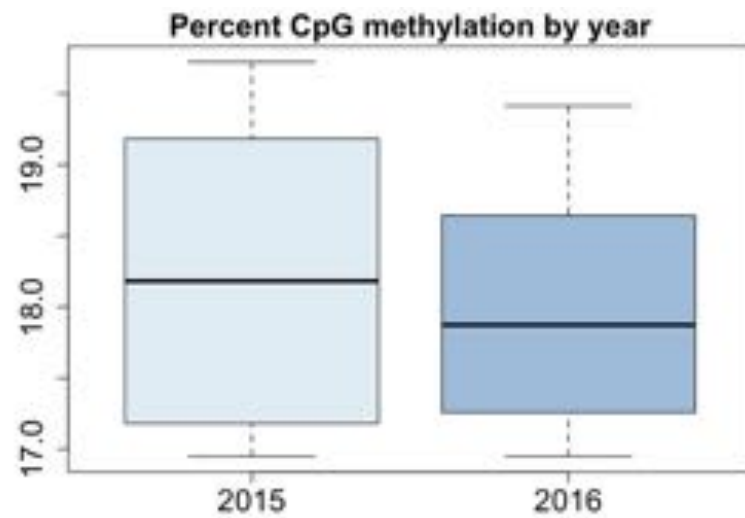
Little change over one  
year



Little change over a year; individuals tend to cluster together









Dimond et al. (2017)

**For comparison:**  
*Porites porites* complex

**18% of CpGs methylated**

**15% differentially methylated  
among colonies (n = 27)**

# Conclusions

**Methylation shows limited plasticity after one year in a novel environment**

- corroborates results of Dixon et al. in GBR *Acropora*

**Robust methods recommended for detecting these small changes**

- our method has relatively coarse resolution
- more robust methods generally require a genome



# Future directions

Which genes or elements are involved?

- *P. astreoides* genome coming soon

Is transcription of these genes altered?

- transcript abundance
  - Dixon et al. found little evidence in GBR *Acropora*
- transcript variants / alternative splicing
  - examples in other taxa

# Acknowledgements

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Adam Leaché  
Kevin Epperly  
Sam White  
Zach Foltz  
Scott Jones  
Julie Barber

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