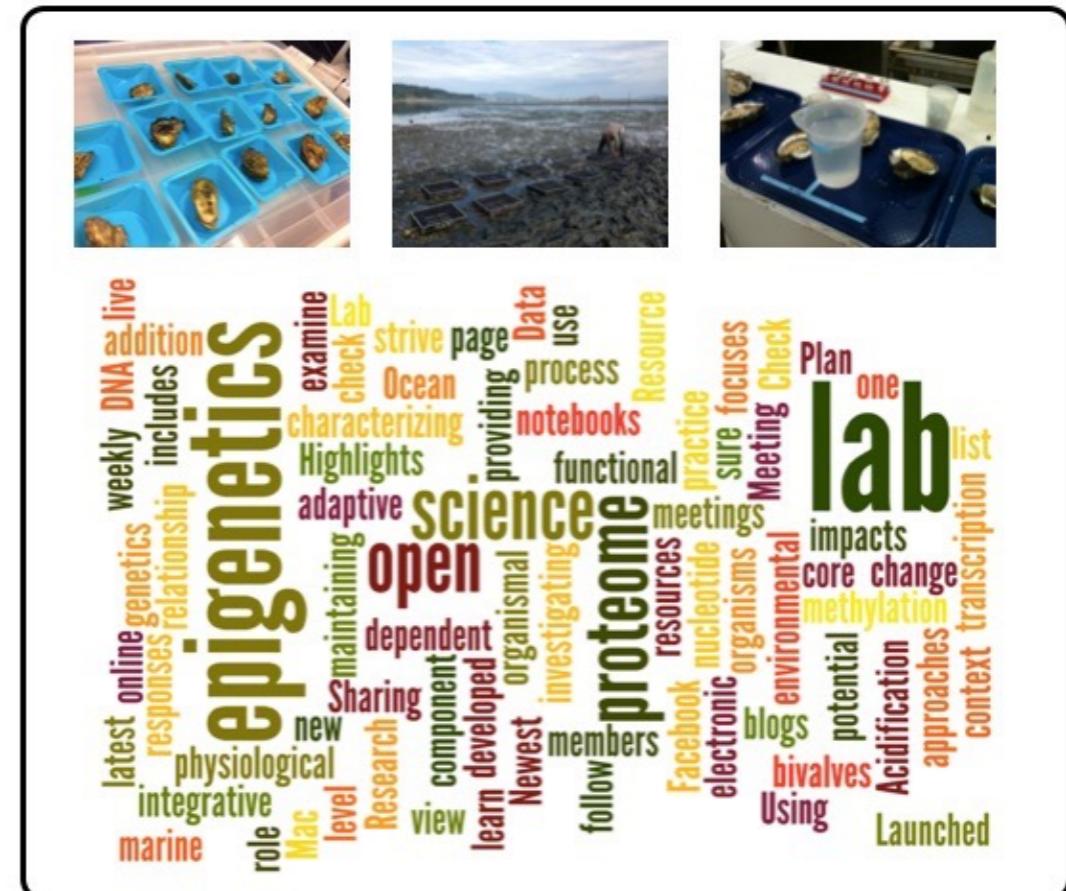


Towards a functional understanding of DNA methylation in shellfish

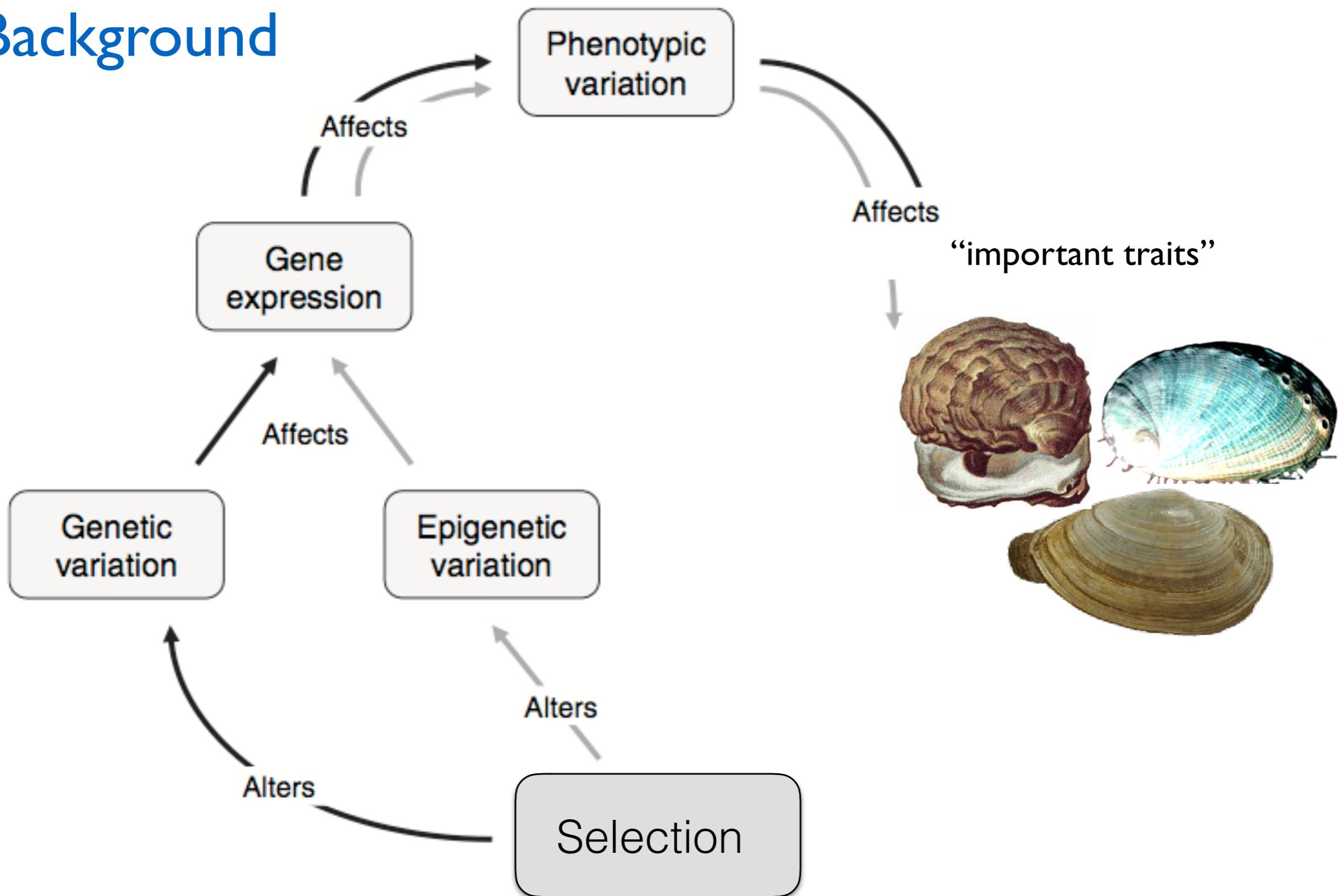
Steven Roberts

Kenneth K. Chew Endowed Professor
University of Washington
School of Aquatic and Fishery Sciences
robertslab.info

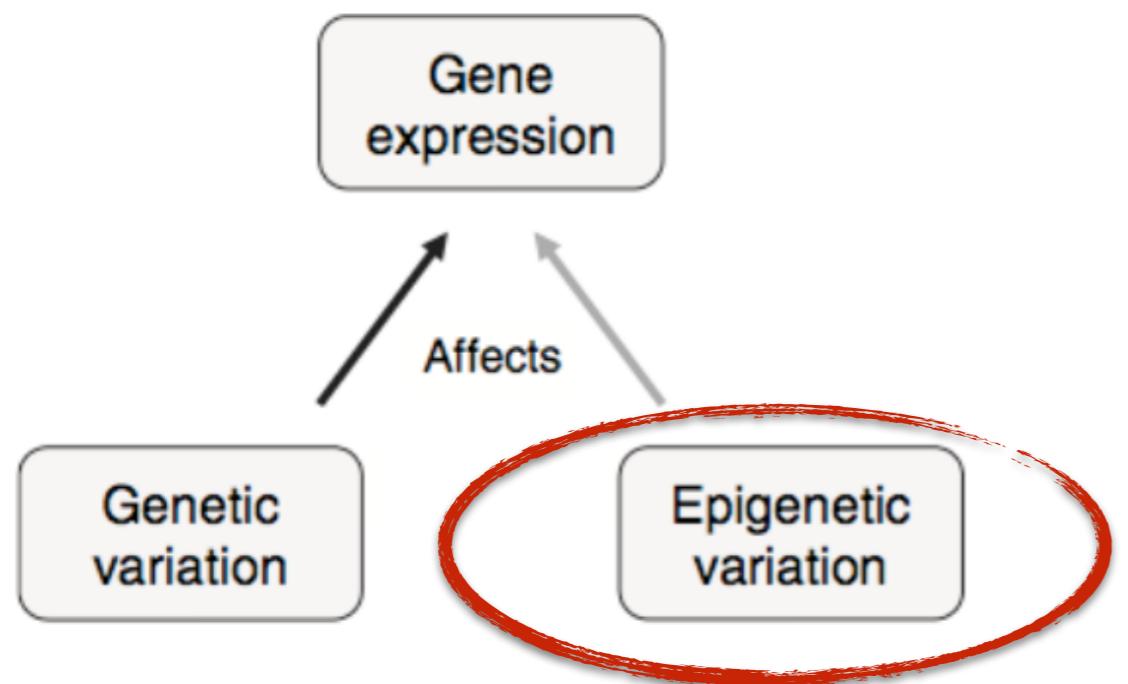
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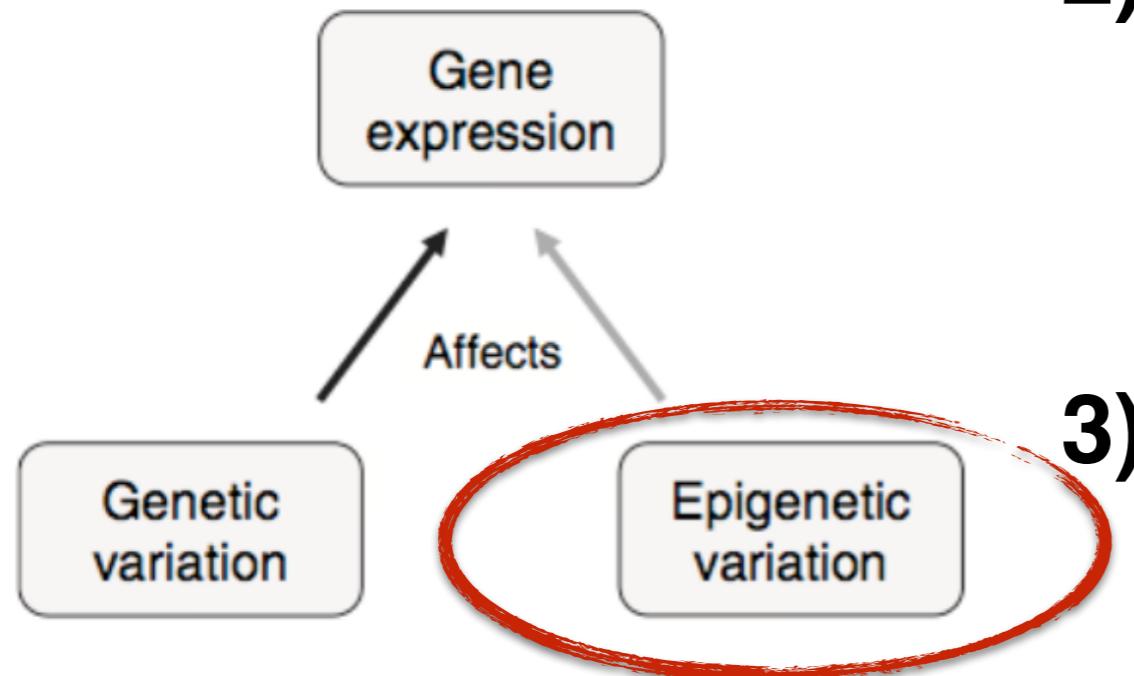
Background



Big Questions

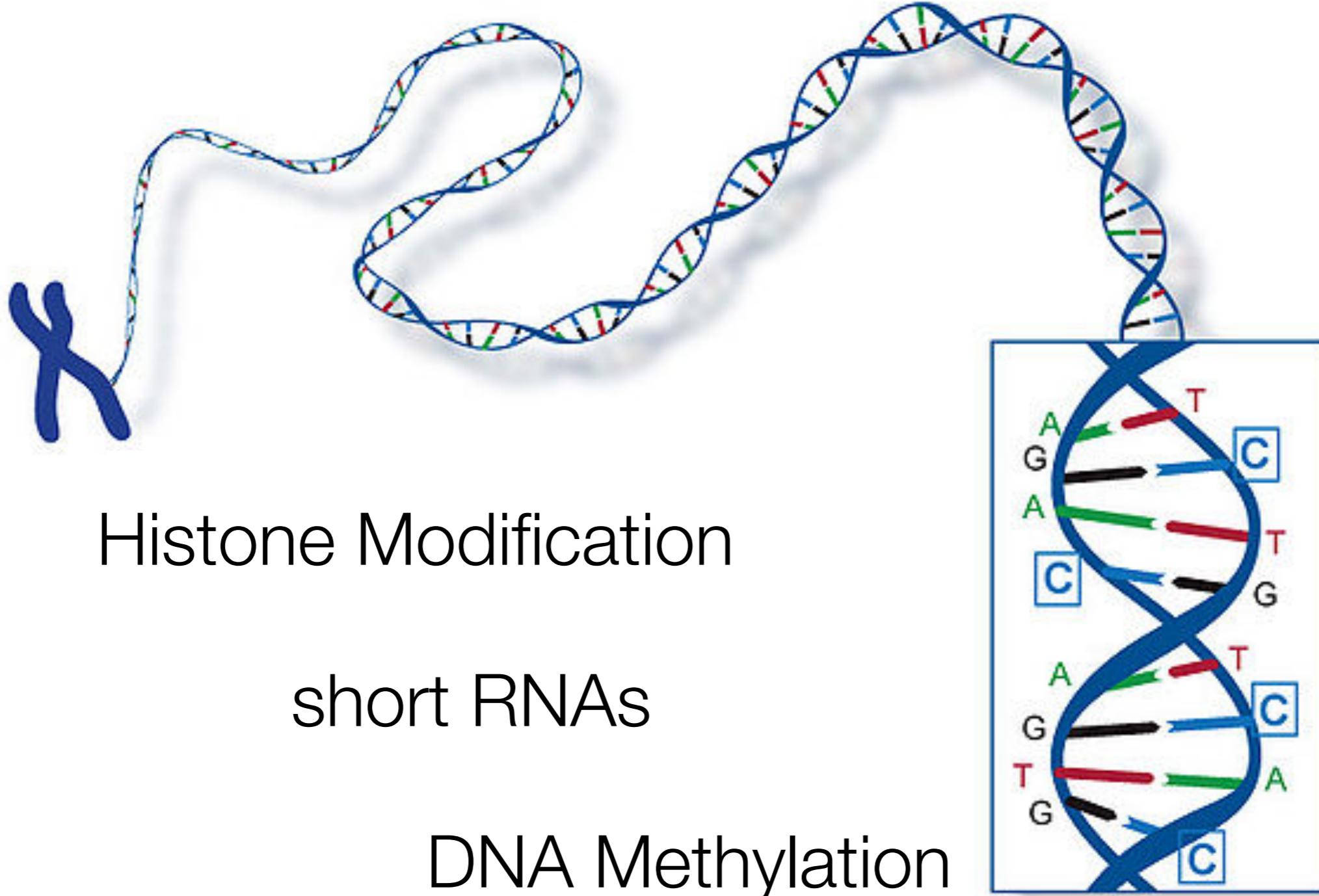


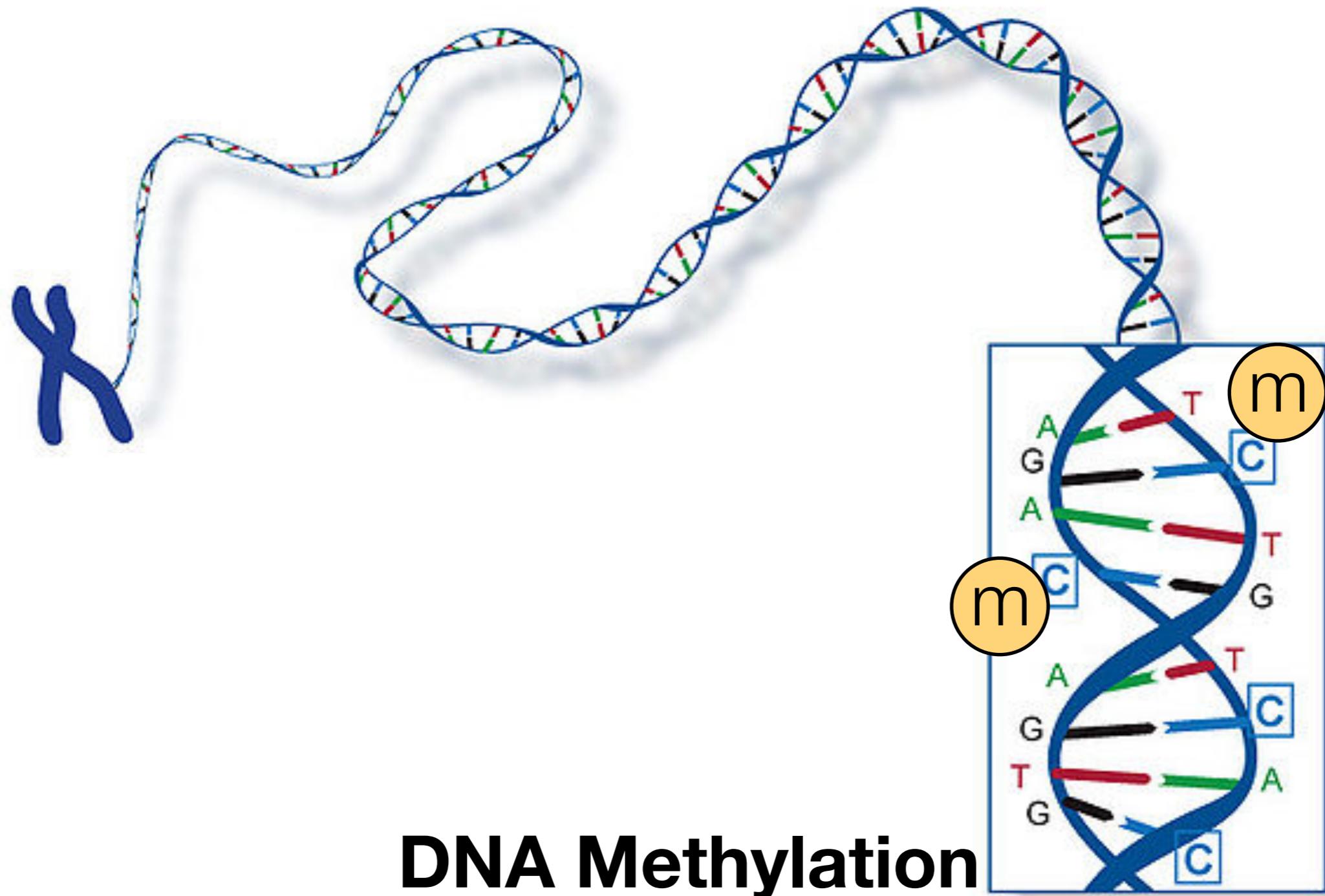
Big Questions



- 1) To what degree is epigenetic variation heritable?**
- 2) Is epigenetic variation independent of genetic variation?**
- 3) How do environmental conditions influence epigenetic variation?**
- 4) What type of epigenetic phenomenon contributes most to phenotype?**

Epigenetics





Outline

Methylation landscape

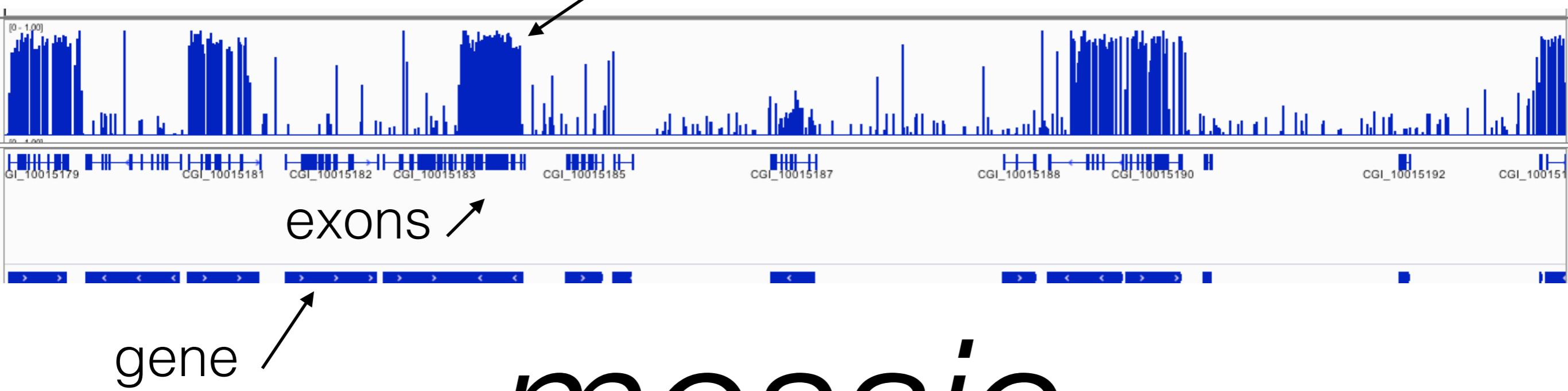
Population studies

Environmental change

- 1) To what degree is epigenetic variation heritable?
- 2) Is epigenetic variation independent of genetic variation?
- 3) How do environmental conditions influence epigenetic variation?

Methylation landscape

DNA methylation level (0-100%) @ cytosines



mosaic

associated with gene bodies

Methylation landscape

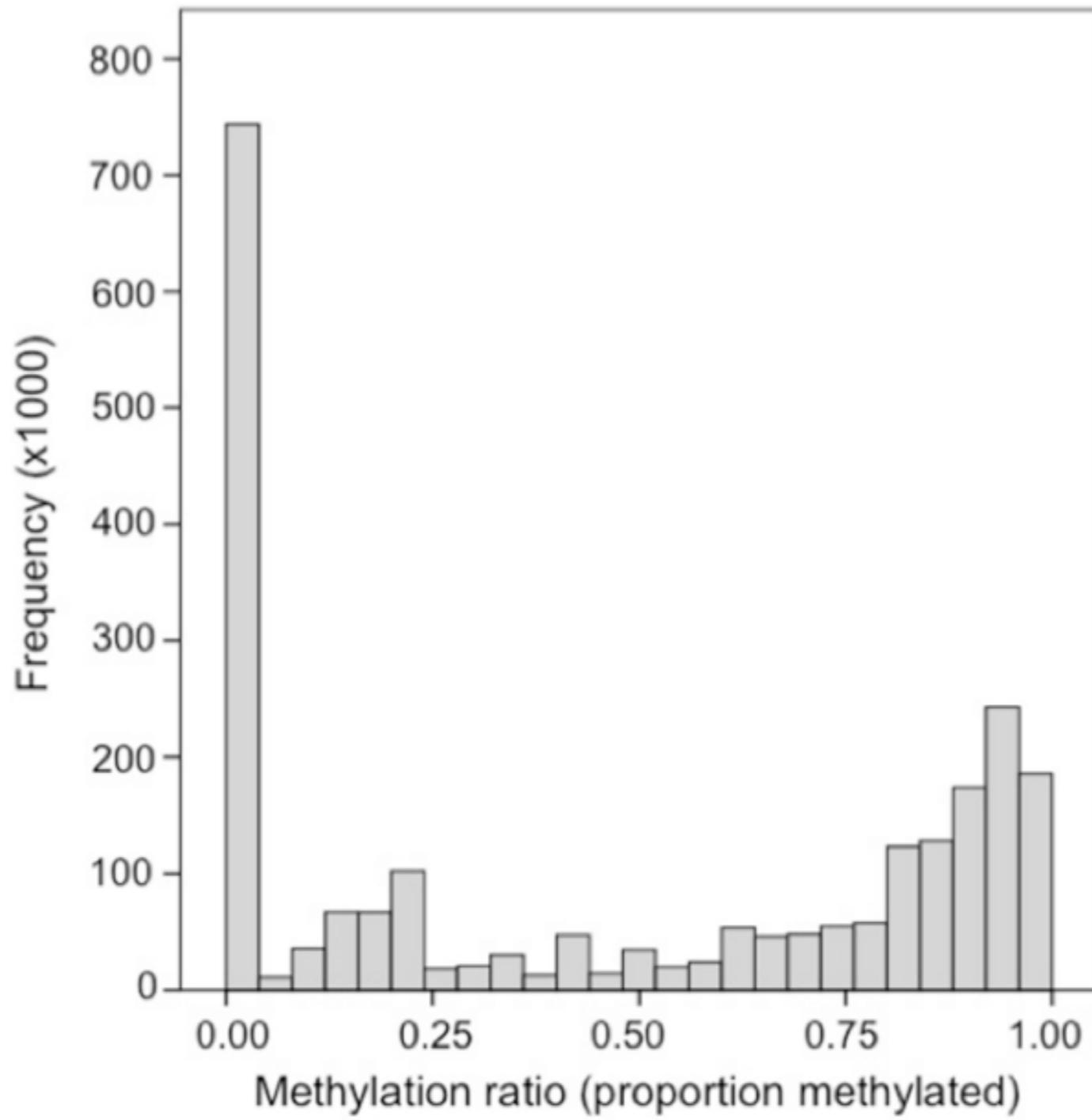
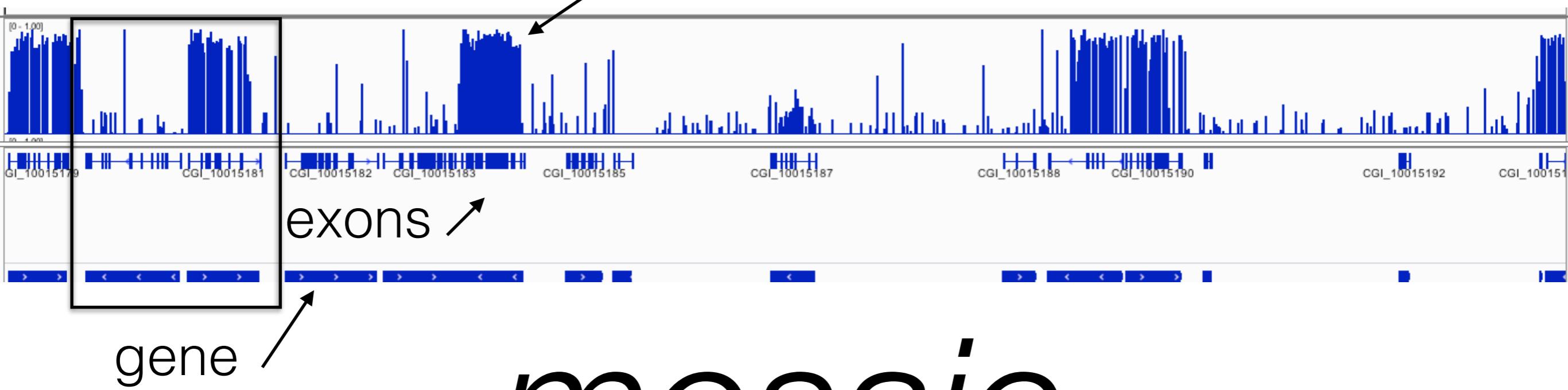


Figure 1 Frequency distribution of methylation ratios for CpG dinucleotides in oyster gill tissue. A total of 2,625,745 CpG dinucleotides with $\geq 5 \times$ coverage are represented.

Methylation landscape

DNA methylation level (0-100%) @ cytosines

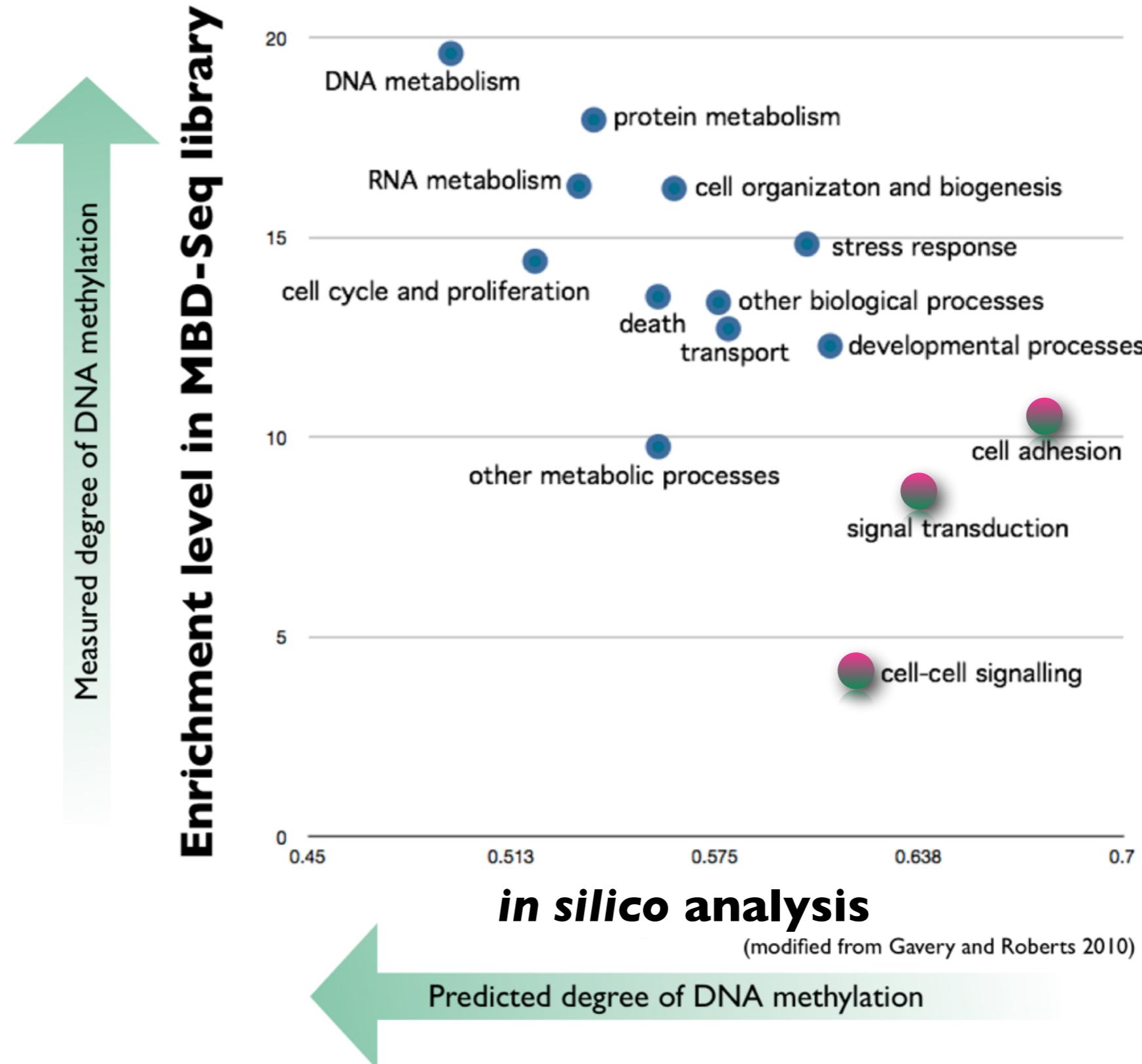


mosaic

Why are only a subset of genes methylated?

associated with gene bodies

Methylation landscape



Outline

1) To what degree is epigenetic variation heritable?

Methylation landscape

2) Is epigenetic variation independent of genetic variation?

Population studies

3) How do environmental conditions influence epigenetic variation?

Environmental change

Population studies



Reciprocal Transplant Experiment



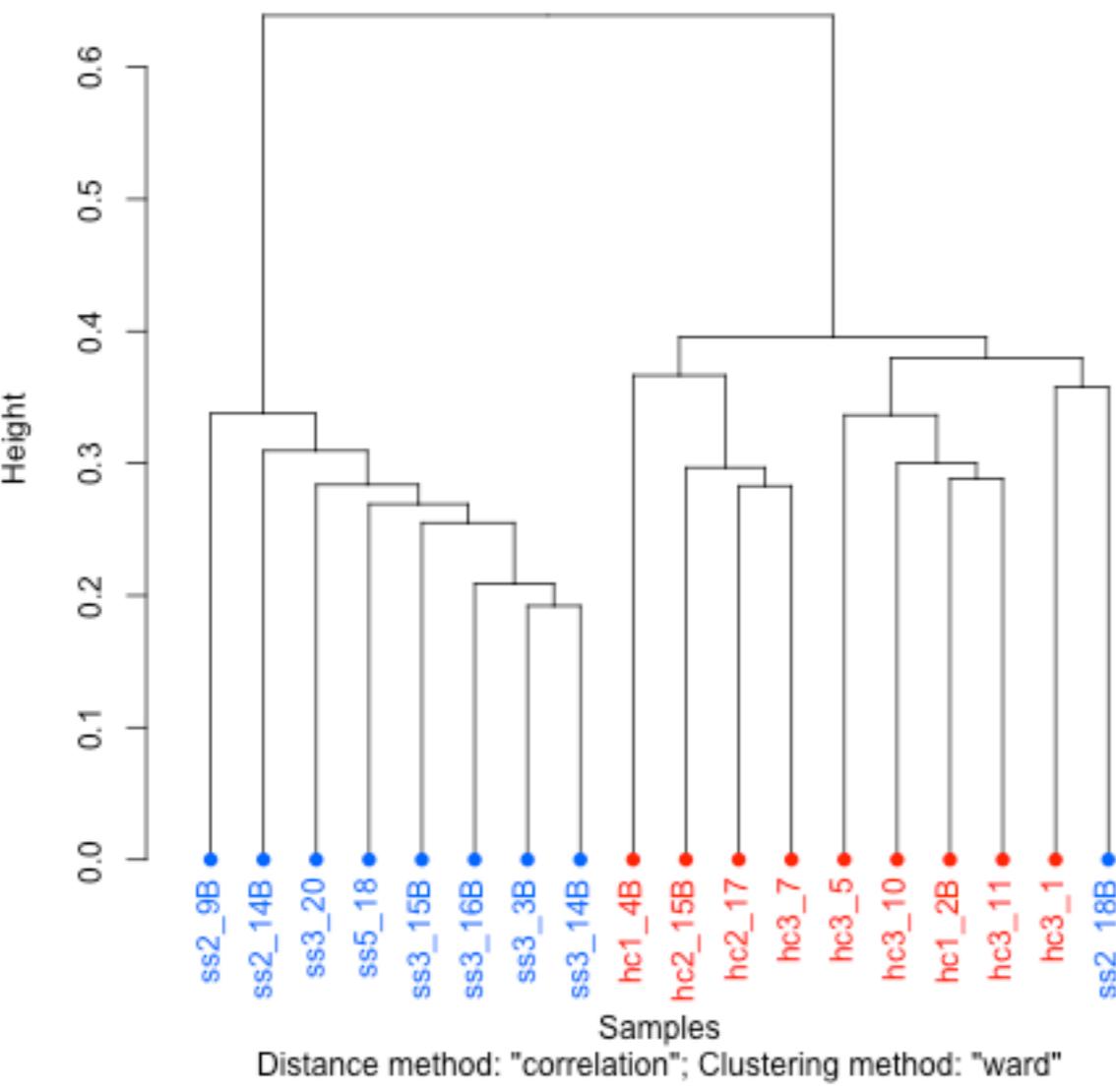
Manchester

Population studies



Reciprocal Transplant Experiment

CpG methylation clustering



Manchester

Population studies



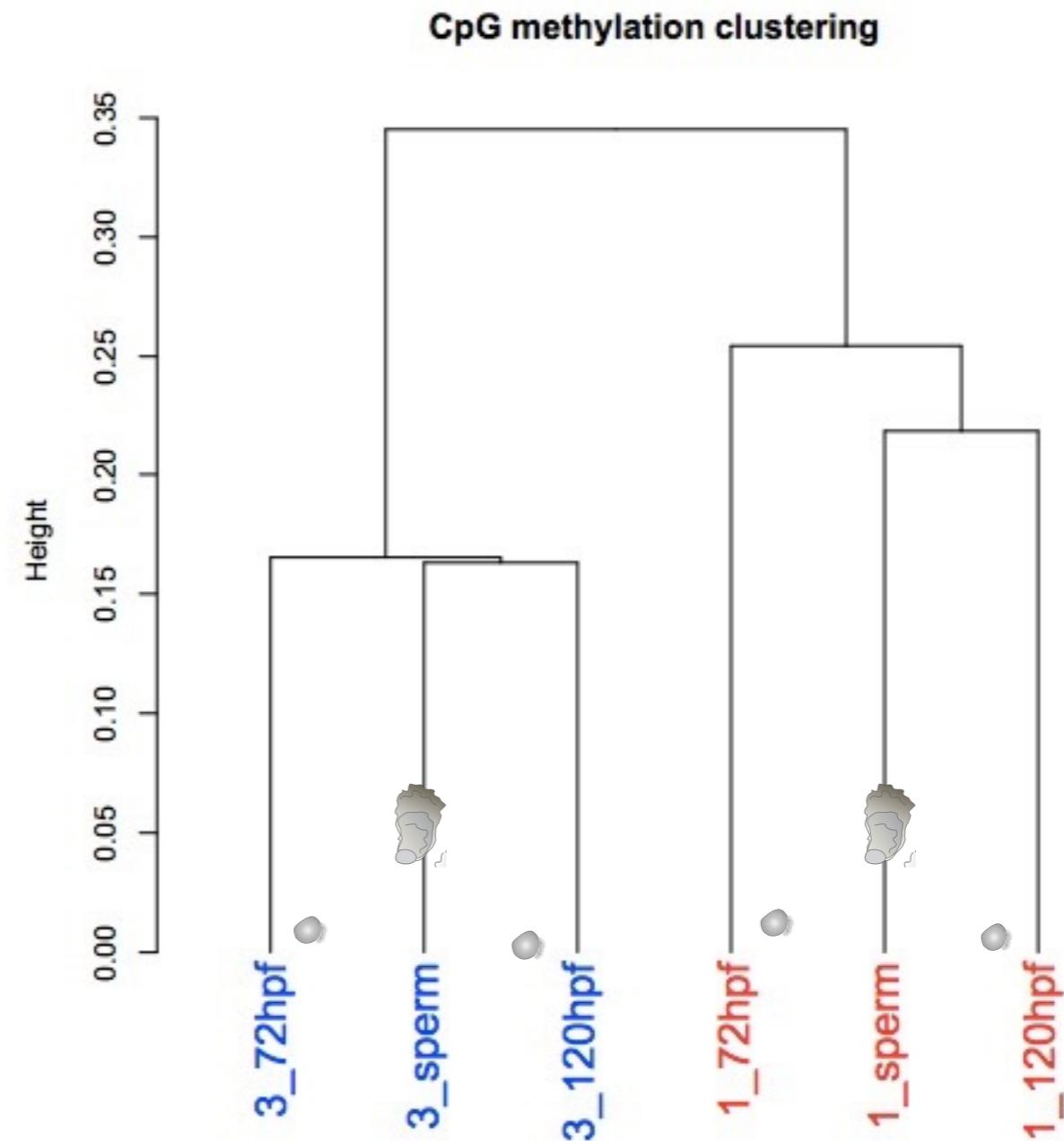
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New Results

Indication of family-specific DNA methylation patterns in developing oysters

Claire E. Olson , Steven B. Roberts

doi: <http://dx.doi.org/10.1101/012831>



Outline

1) To what degree is epigenetic variation heritable?

Methylation landscape

2) Is epigenetic variation independent of genetic variation?

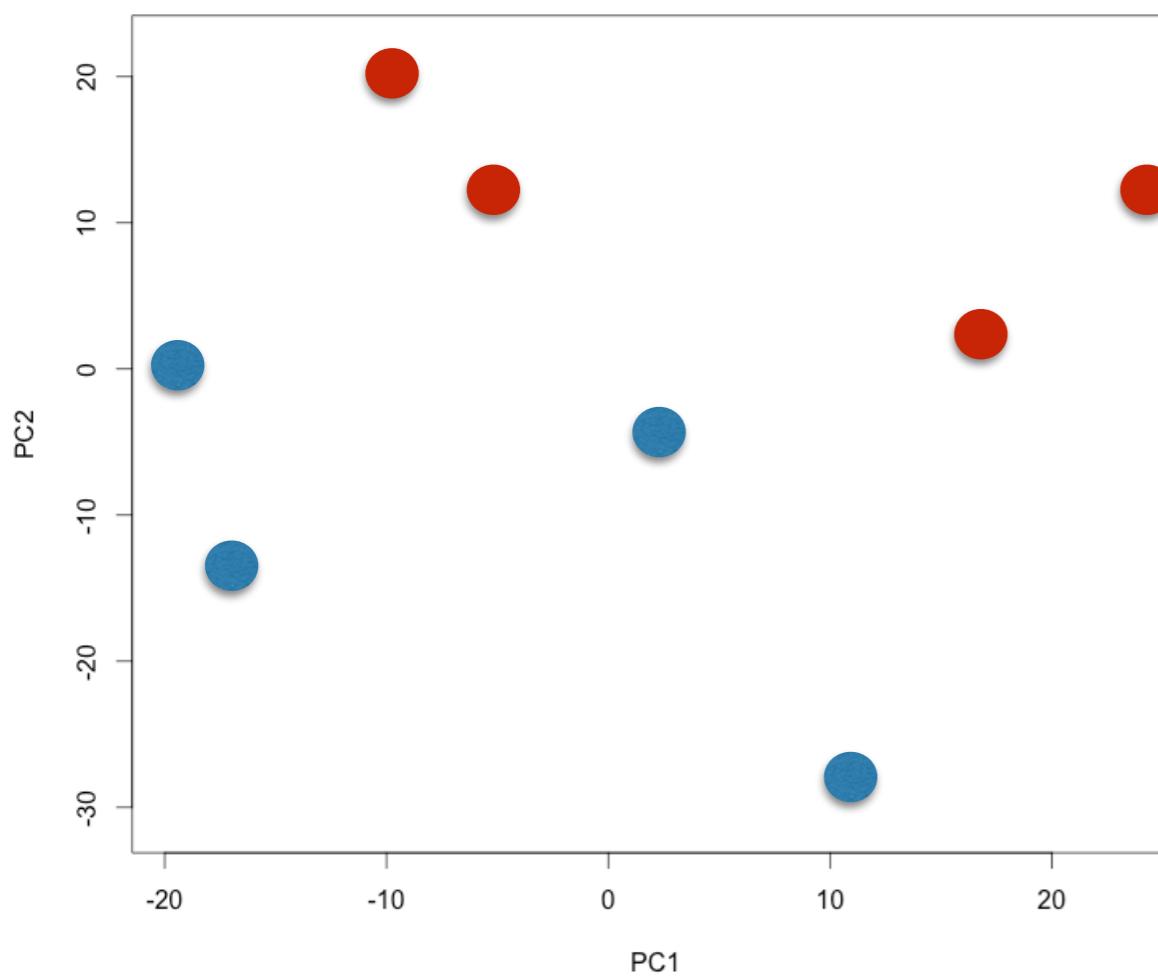
Population studies

3) How do environmental conditions influence epigenetic variation?

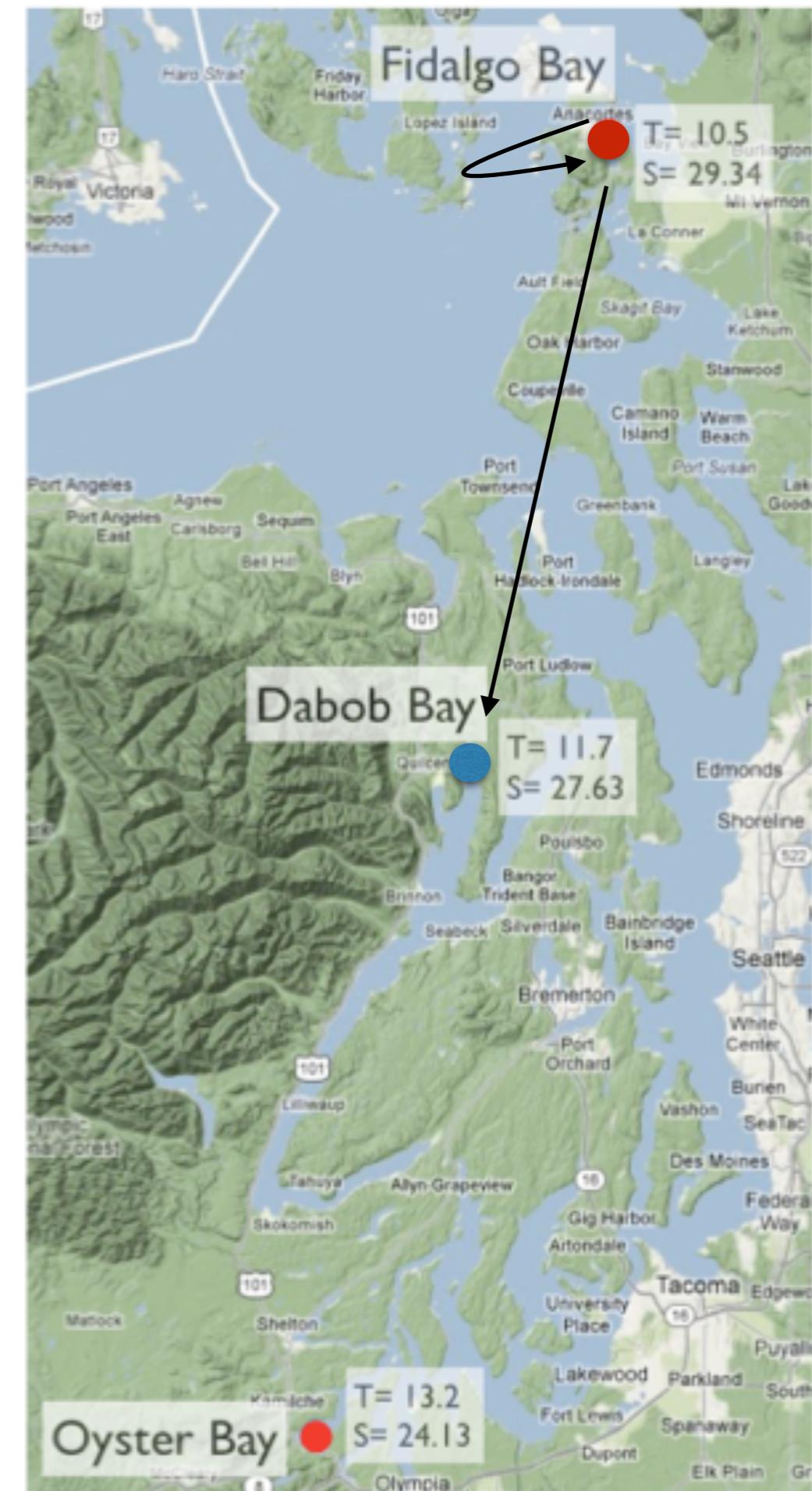
Environmental change

Environmental change

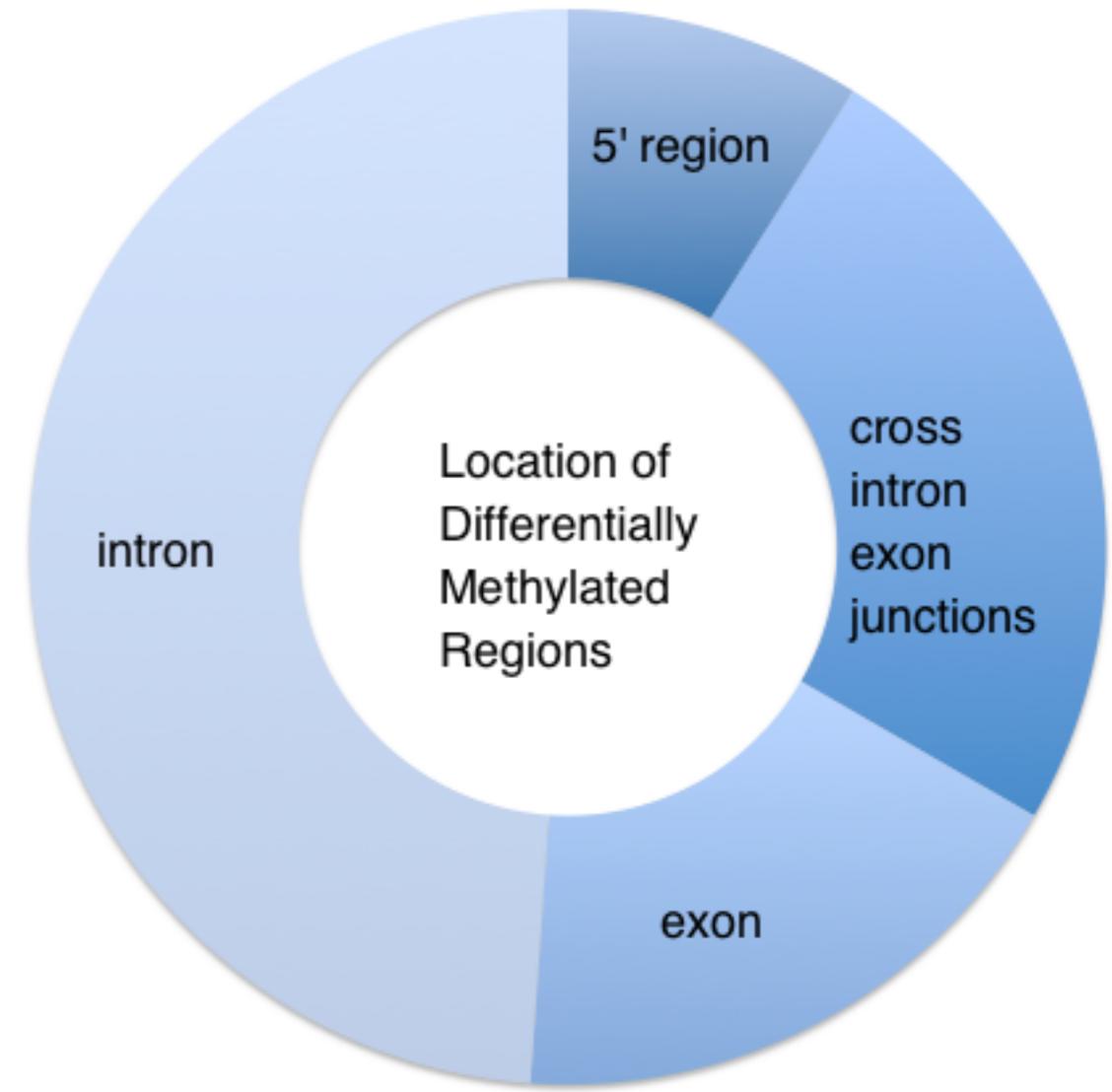
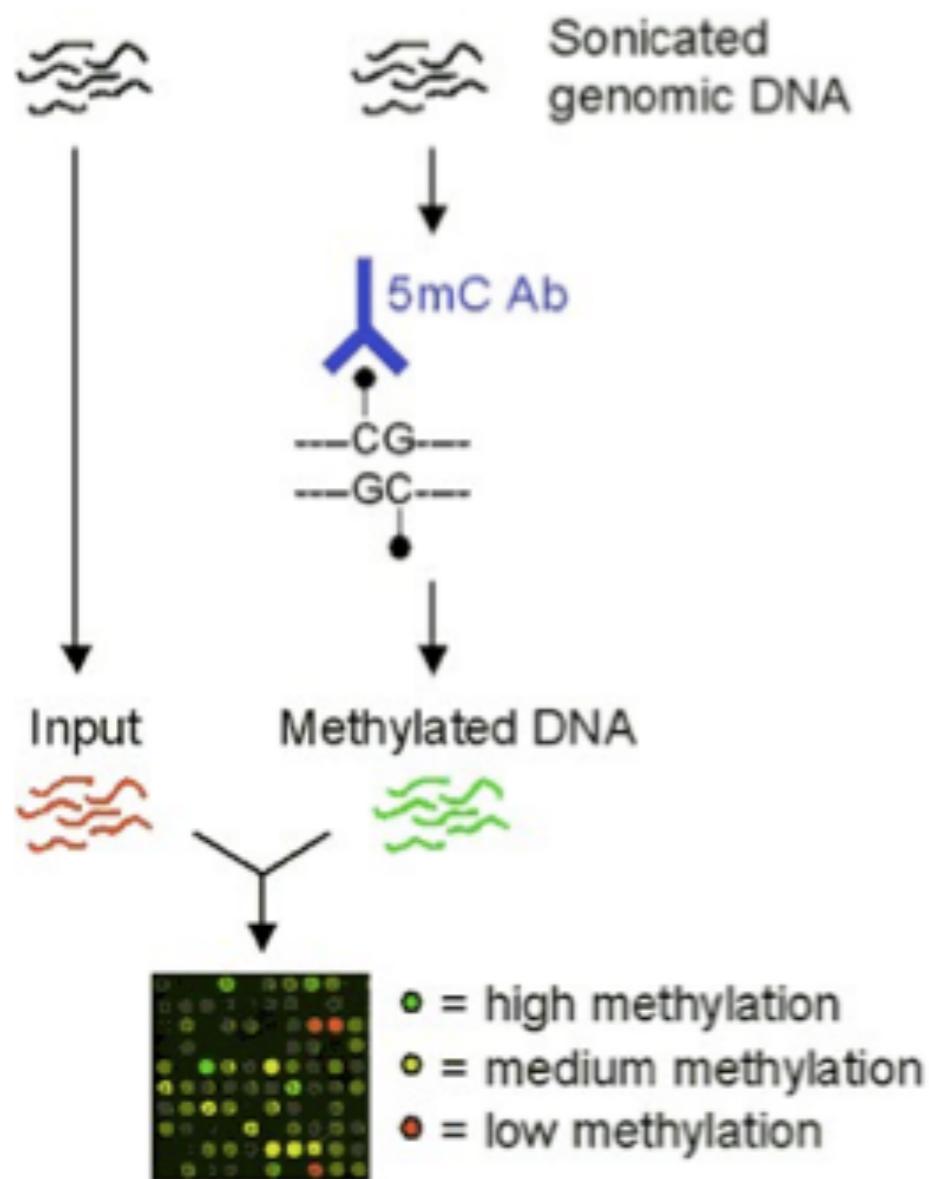
CpG methylation PCA Analysis



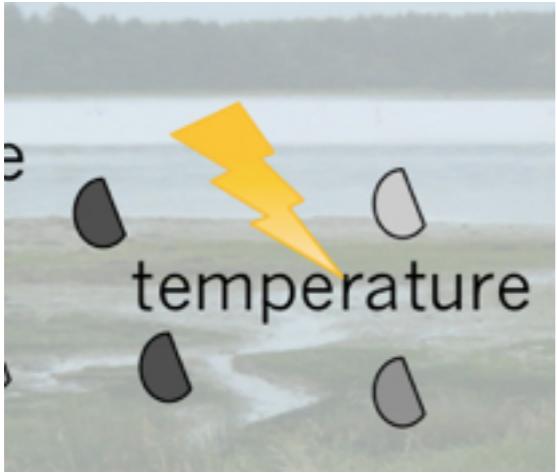
DNA methylation
siblings grown different sites



Environmental change



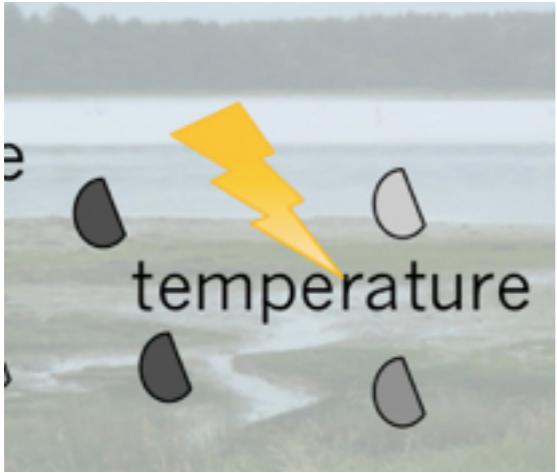
Environmental change



stochastic or targeted?

Oyster	Hypo-methylated	Hyper-methylated
2	7224	2803
4	6560	3587
6	7645	4044

Environmental change



stochastic or targeted?

Oyster	Hypo-methylated	Hyper-methylated
2	7224	2803
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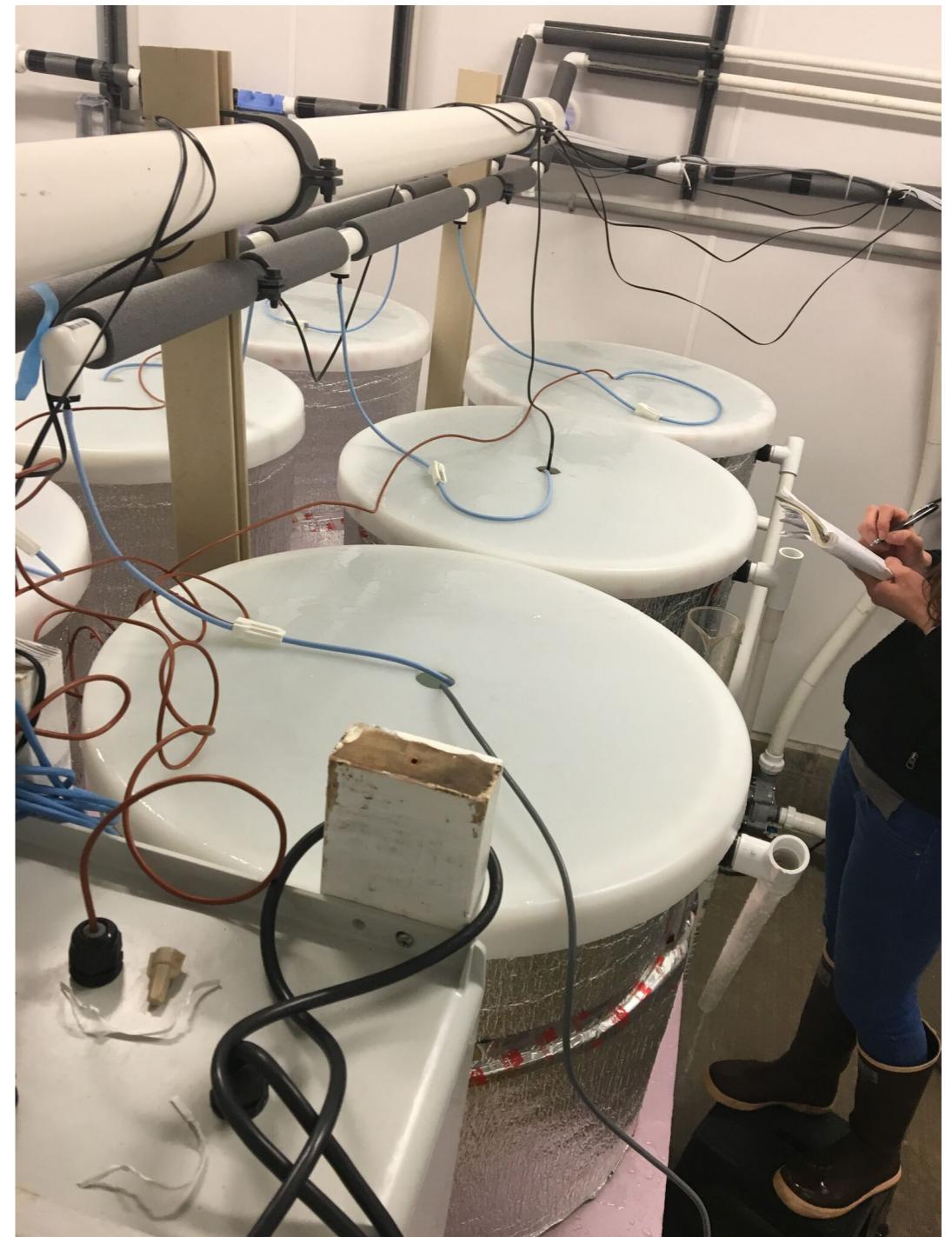
No obvious association
with genome feature
including *differentially
expressed
genes*

Environmental change

Very new ~~data~~

Selection

Ocean Acidification



Day 10

Proportion of sequences in pooled
larvae sample with given allele (G vs A)

Day 1

Control: Random Mortality

~42% ACGCTGATCGT

~38% ACGCTAATCGT

~42% ACGCTGATCGT
~38% ACGCTAATCGT

Day 10

High $p\text{CO}_2$: Non-random
Mortality

~80% ACGCTGATCGT

~20% ACGCTAATCGT

Day 1

Ambient $p\text{CO}_2$
Ambient temperature

High $p\text{CO}_2$
Ambient temperature

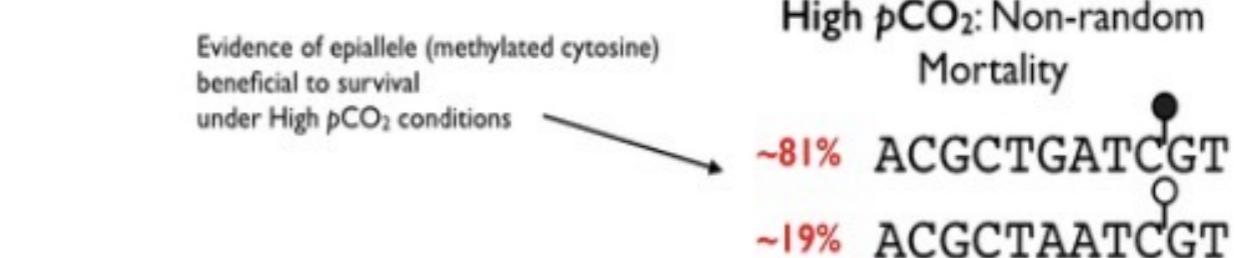
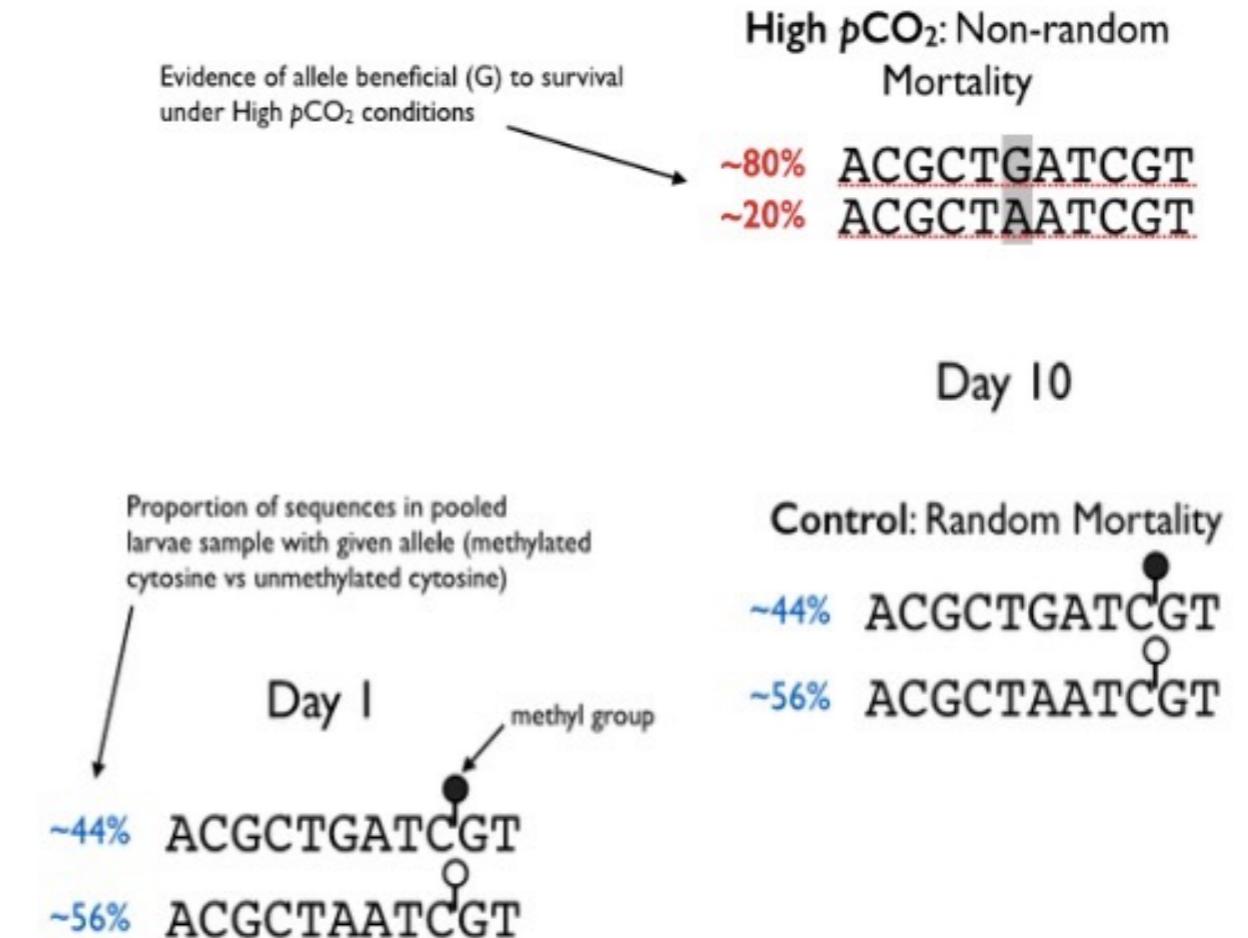
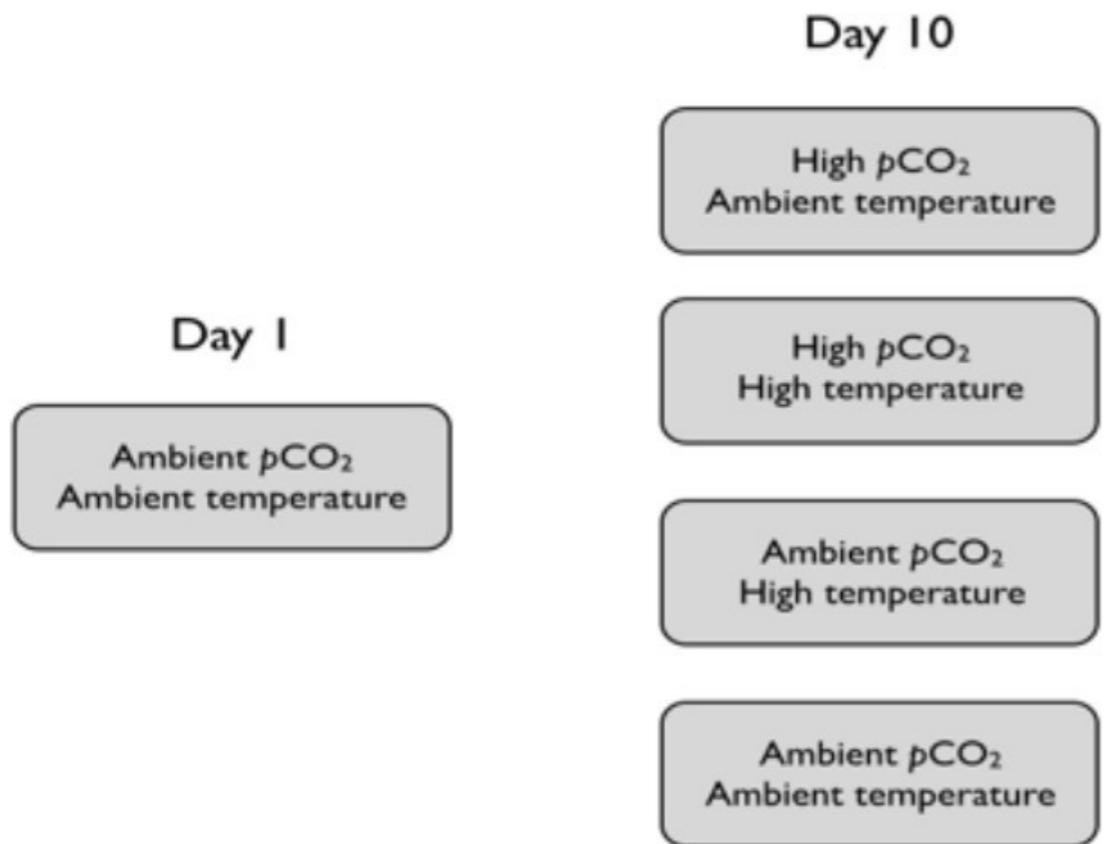
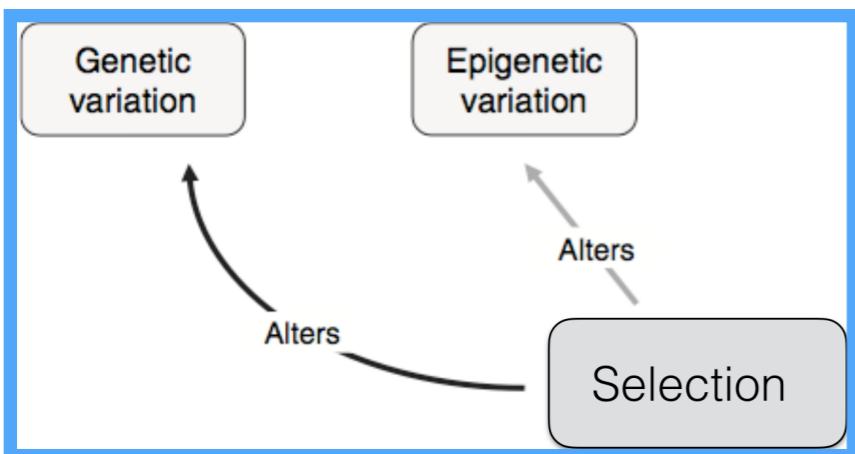
High $p\text{CO}_2$
High temperature

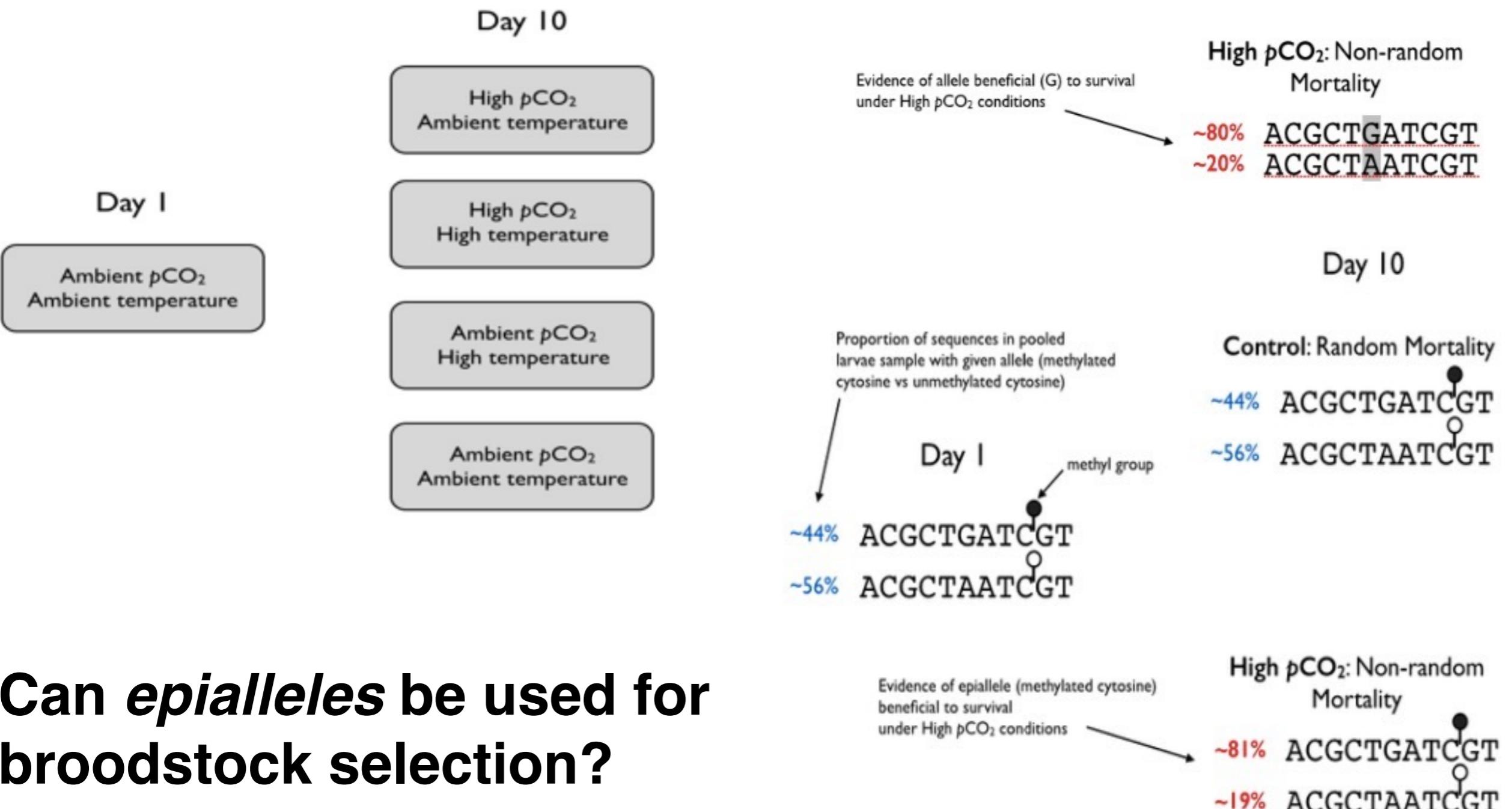
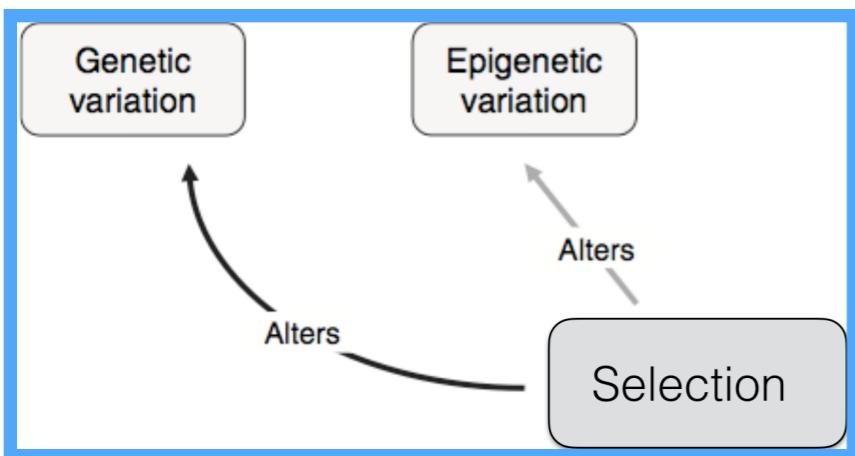
Ambient $p\text{CO}_2$
High temperature

Ambient $p\text{CO}_2$
Ambient temperature

Evidence of allele beneficial (G) to survival
under High $p\text{CO}_2$ conditions

→





Can *epialleles* be used for broodstock selection?

Summary

Particularly in *shellfish*, epigenetics should be given considerable attention in understanding and optimizing phenotype.

Acknowledgements

Mackenzie Gavery

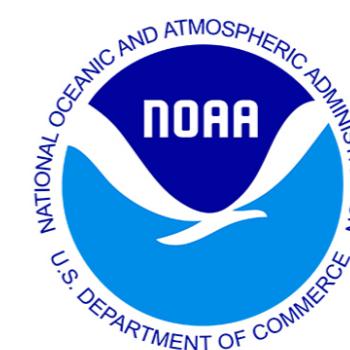
Claire Olson

Sam White

Brent Vadopalas

Hollie Putnam

Laura Spencer



slides, data & more @
github.com/sr320/talk-unjr-2016