

# Genomic approaches to assessing ecosystem health

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# Open Science

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- You are free to Share!
- Our lab practices open notebook science



- Slides and more available

robertslab.info

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@sr320

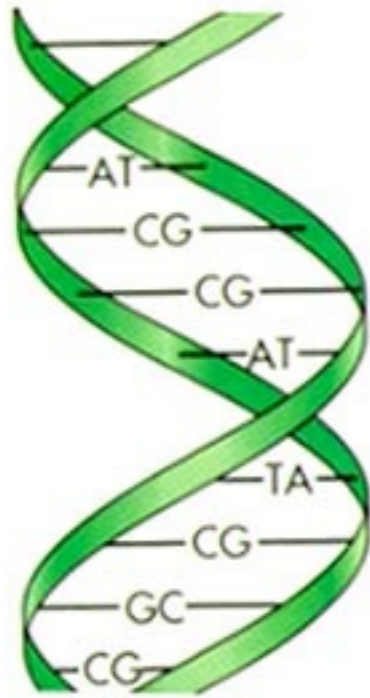
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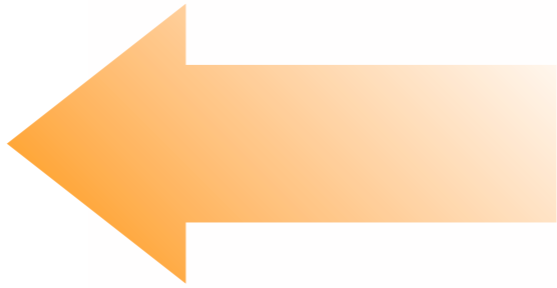
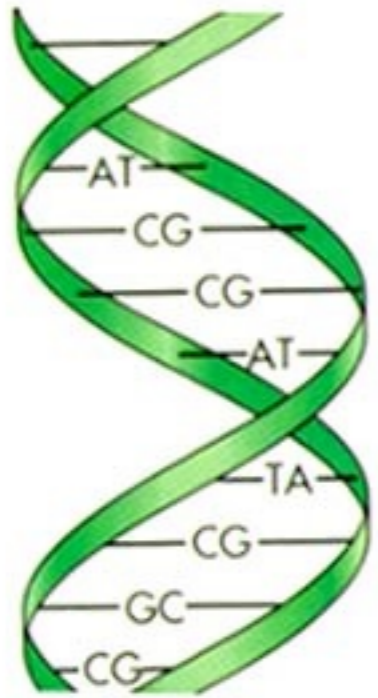
# Physiology



**Very easy to get billions of A,C,T, and Gs**



# Physiology



# Biological Indicators of Ecosystem Health

DNA Variation

Gene Expression

Proteins

*Epigenetic Alterations - DNA Methylation*



# Biological Indicators of Ecosystem Health

DNA Variation

**Gene Expression**

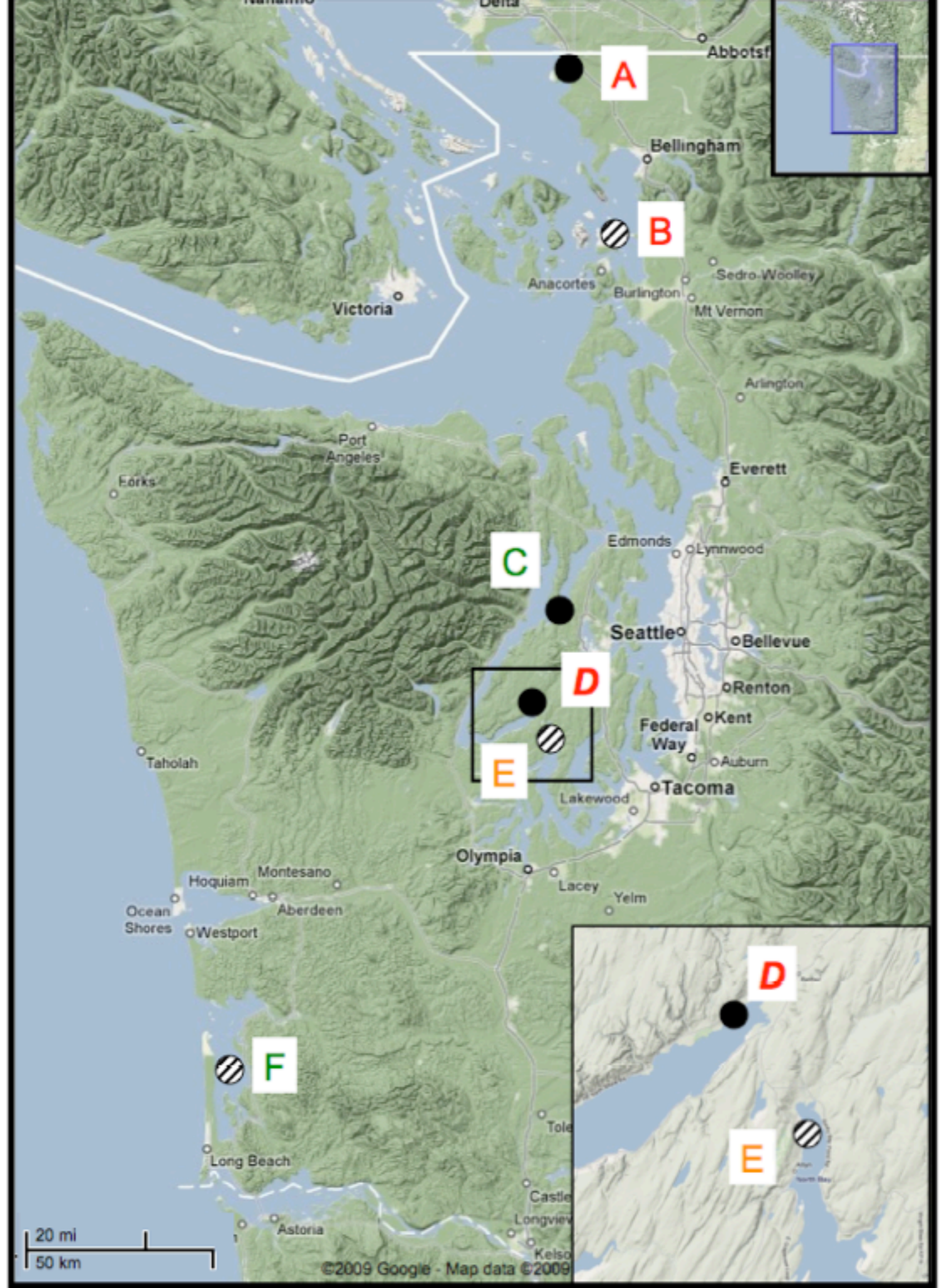
Proteins

***Epigenetic Alterations - DNA Methylation***



# Gene Expression

## Physiological Response of Oysters in Puget Sound

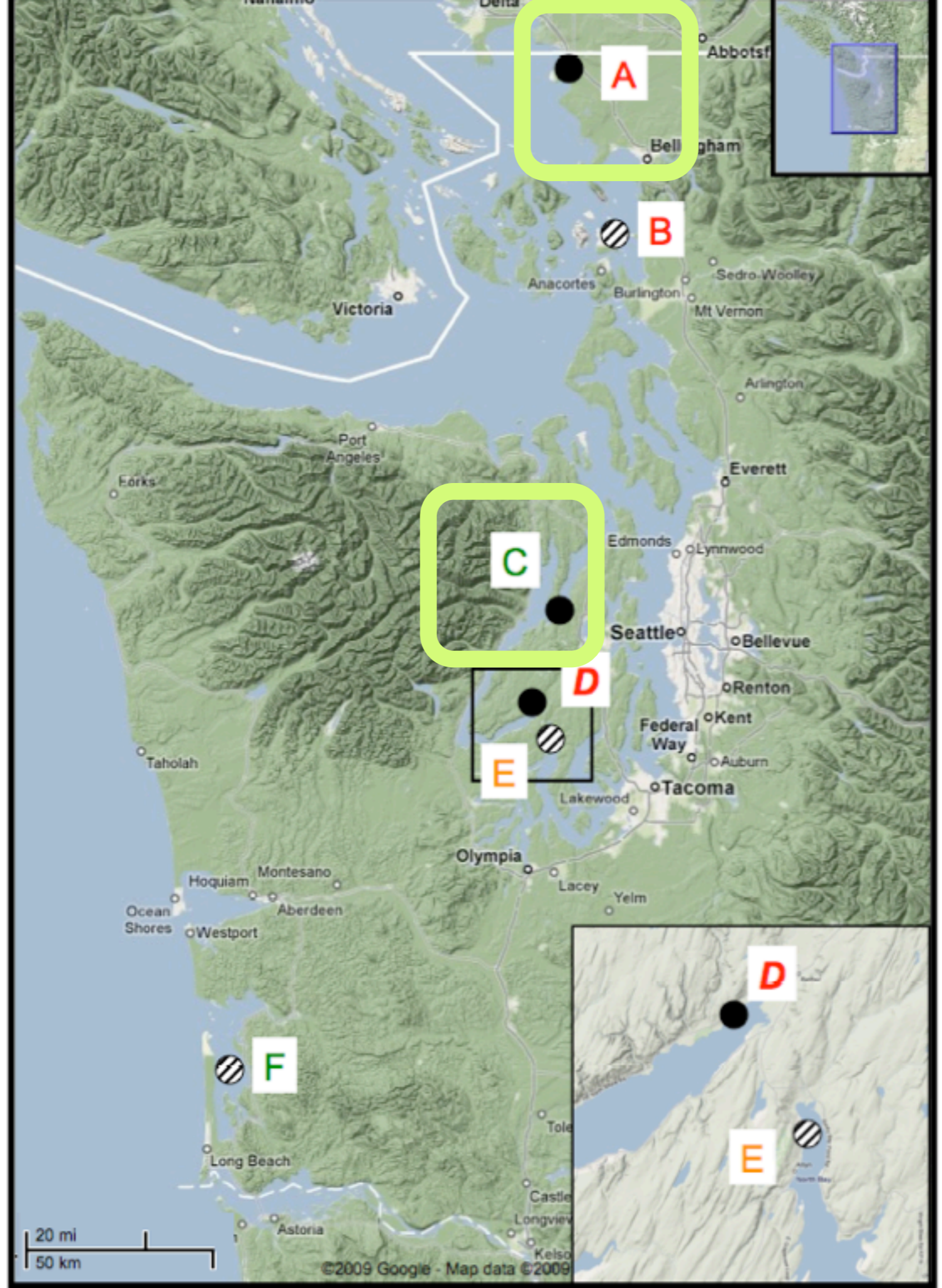


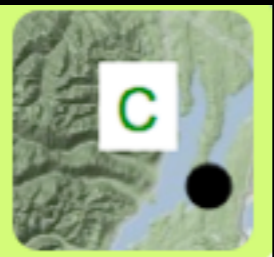
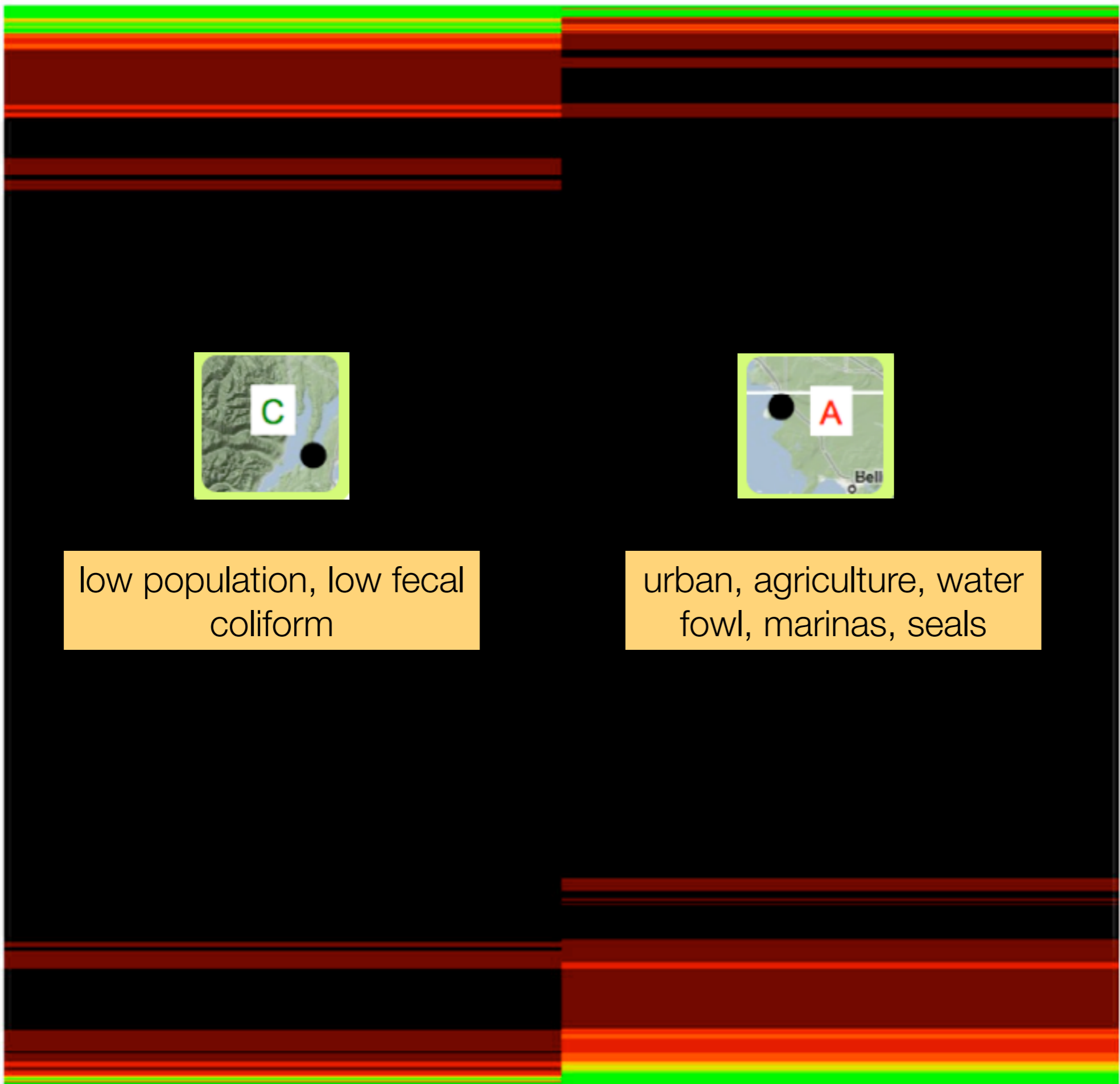


urban, agriculture, water fowl, marinas, seals



low population, low fecal coliform

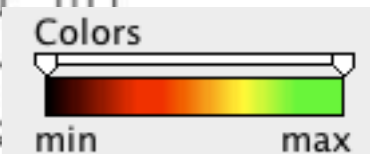
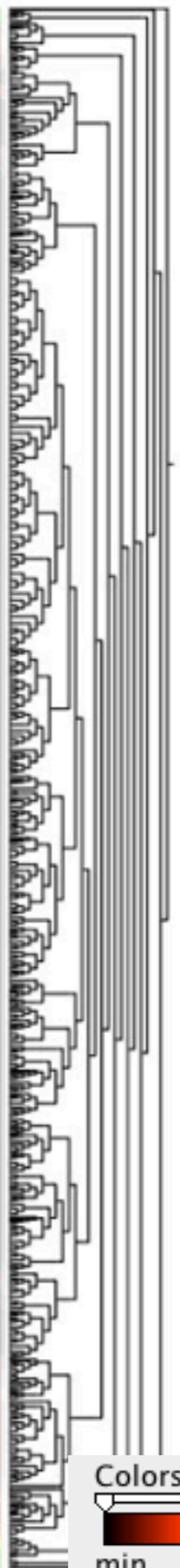


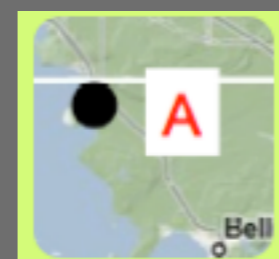
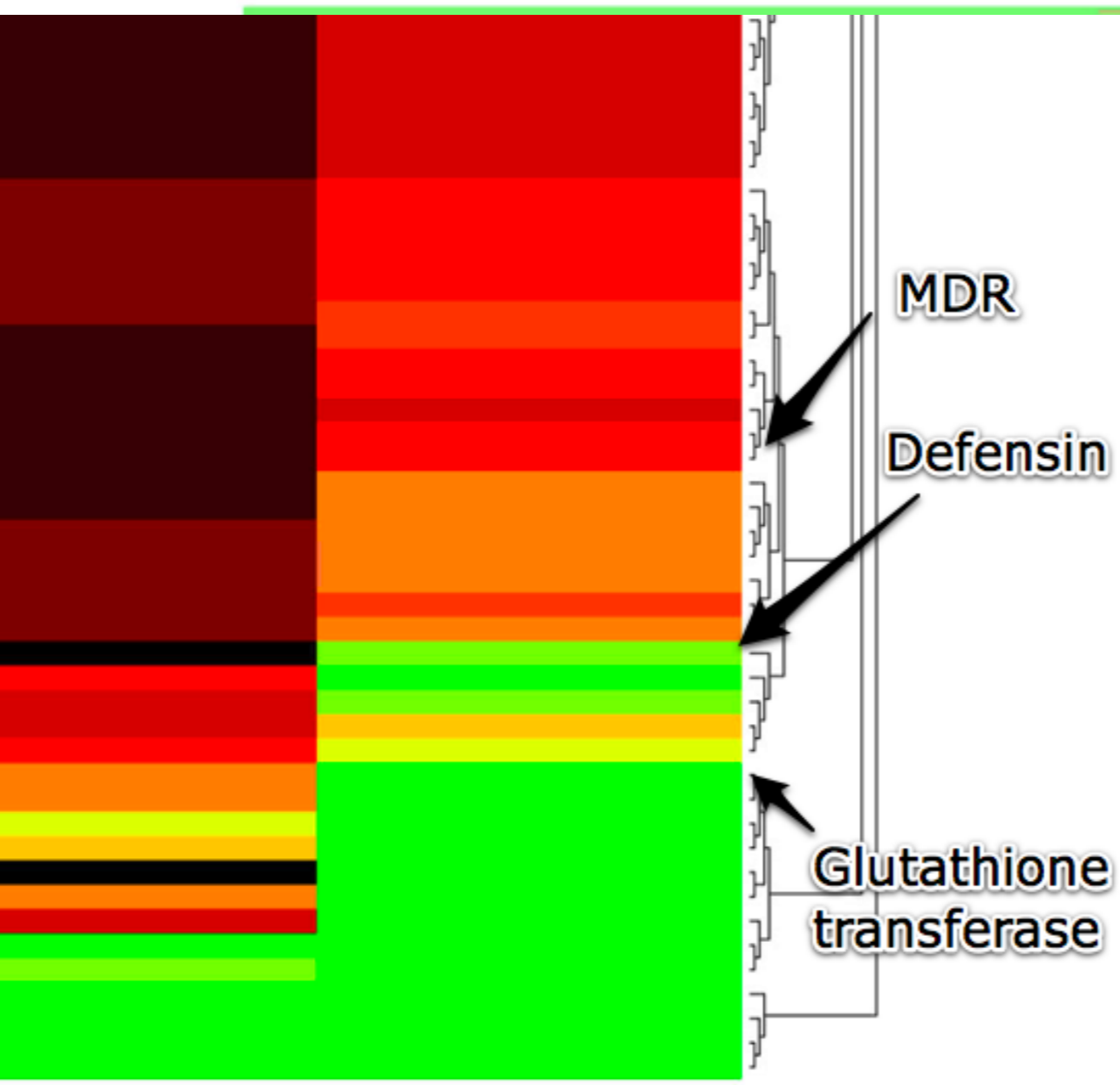


low population, low fecal coliform



urban, agriculture, water fowl, marinas, seals



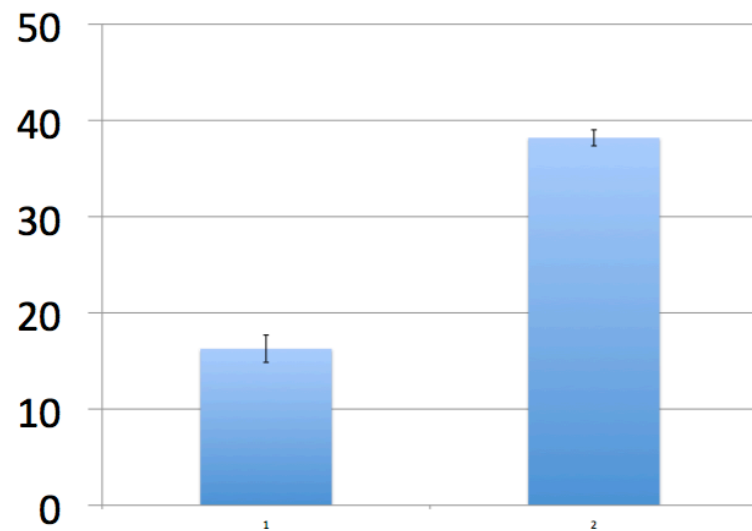


urban, agriculture, water fowl, marinas, seals

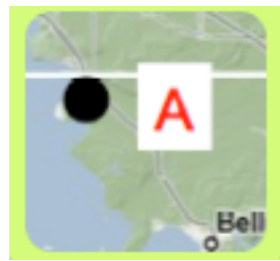
with replication / validation -> signature

# qPCR

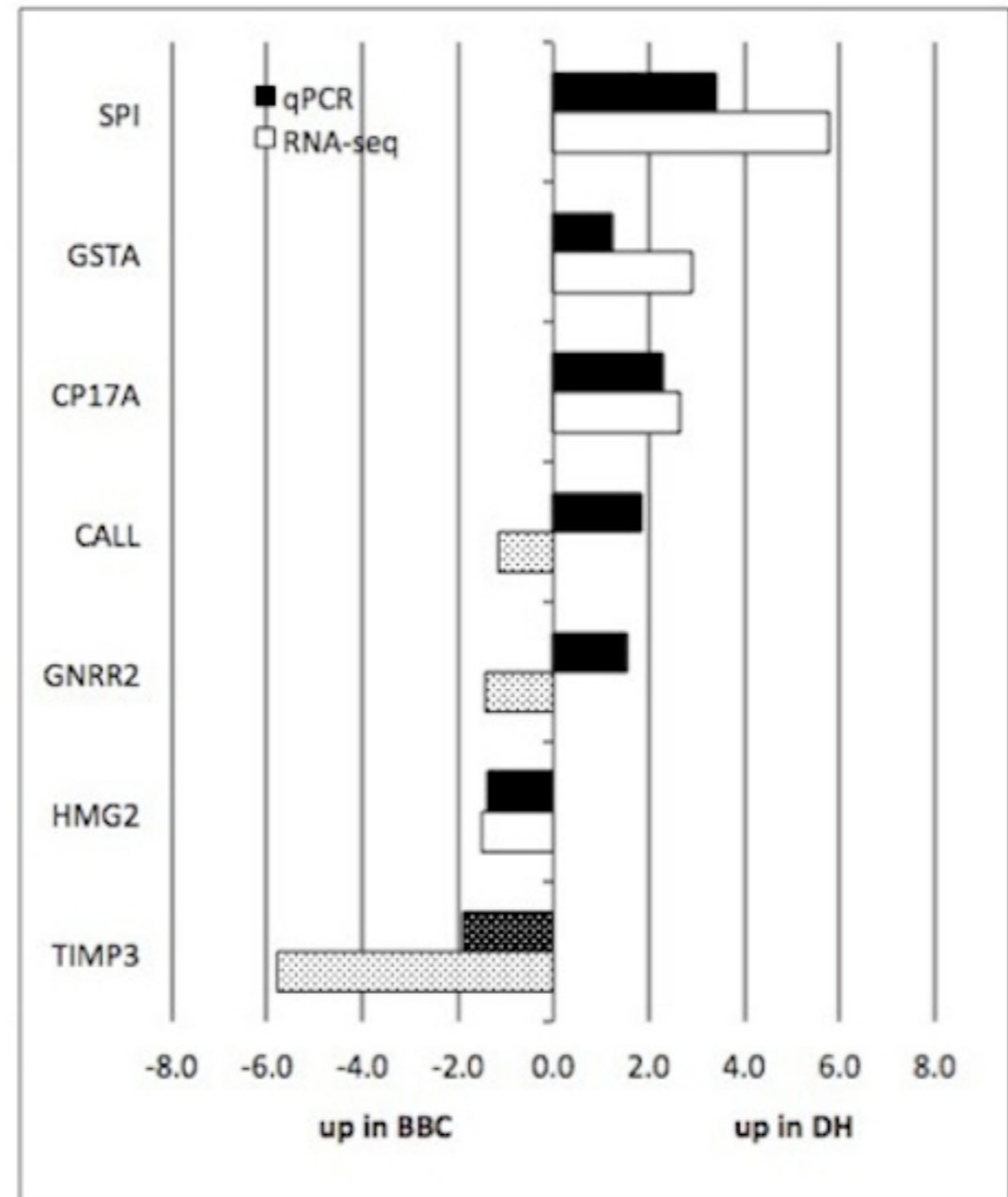
metalloproteinase inhibitor 3



low population,  
low fecal coliform

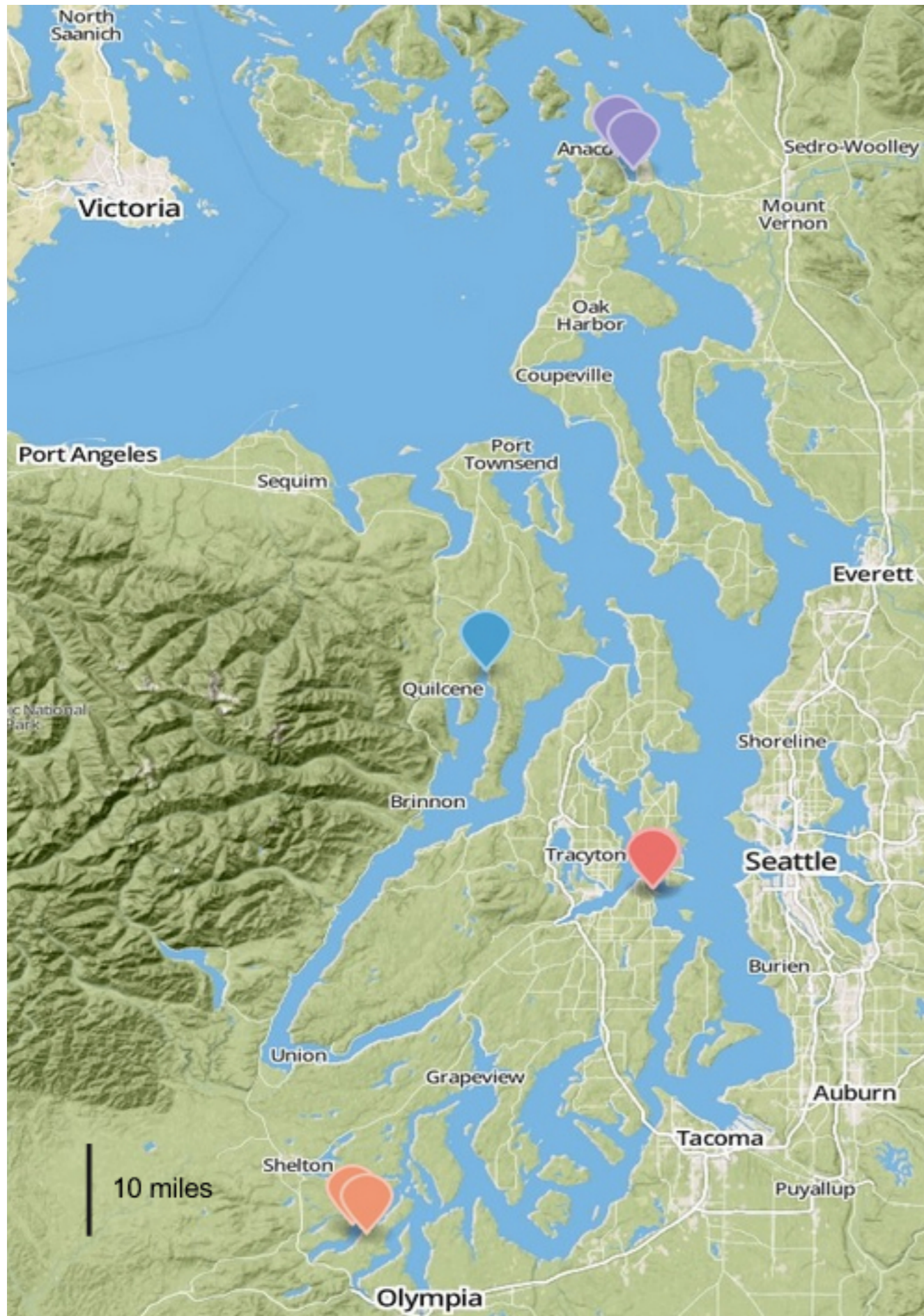


urban, agriculture,  
water fowl,  
marinas, seals



Gavery, Mackenzie; Roberts, Steven; White, Samuel (2013):  
qPCR corroboration of an RNA-Seq experiment. figshare.  
<http://dx.doi.org/10.6084/m9.figshare.683879>

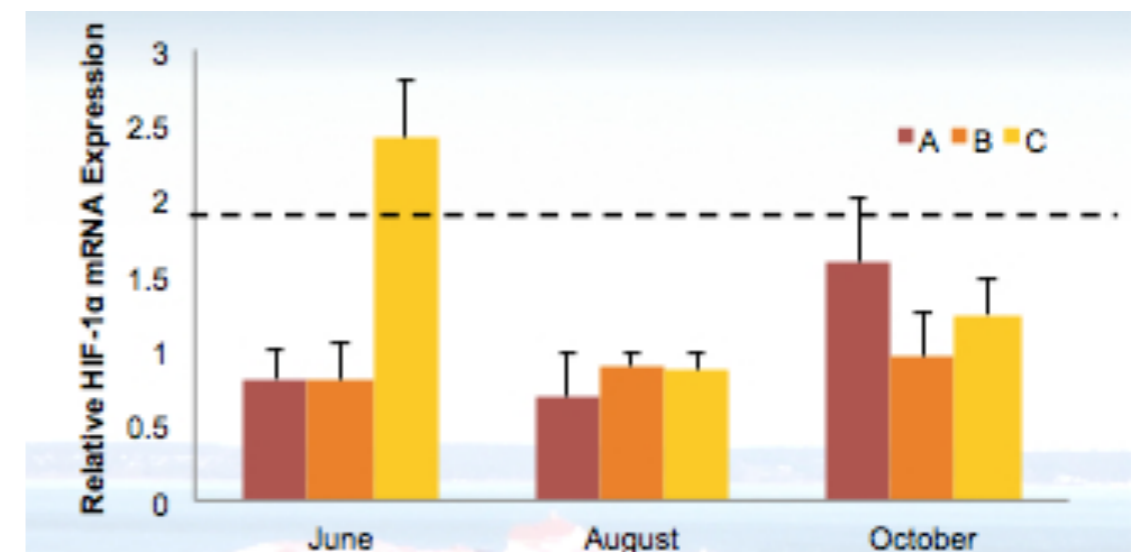
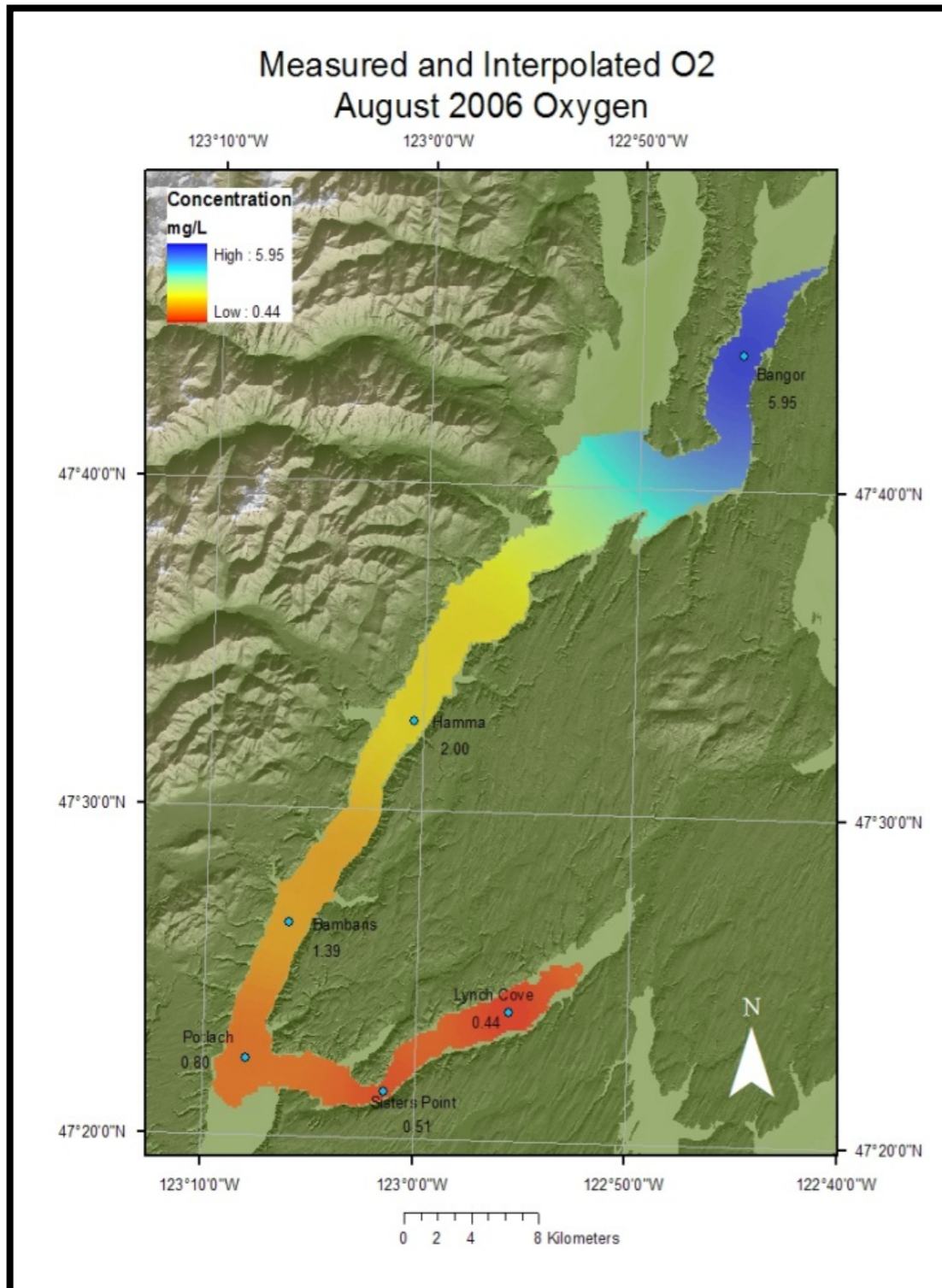
# Olympia oyster



PROPS v2



# Application of qPCR



**Very easy to get billions of A,C,T, and Gs**

**Very easy to get thousands of genes online**

# Biological Indicators of Ecosystem Health

DNA Variation

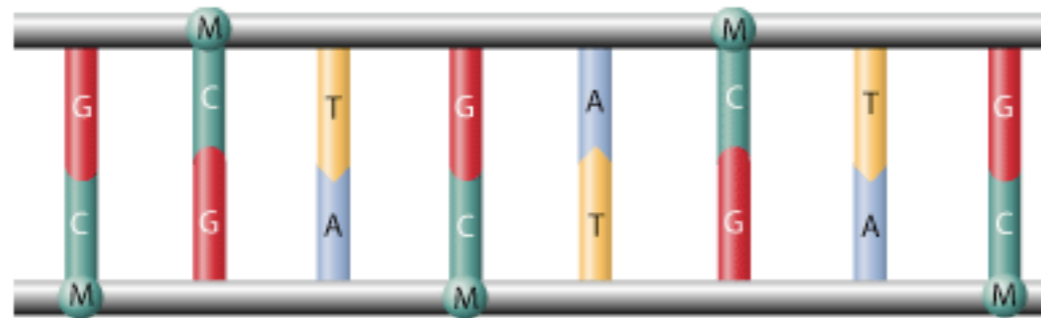
**Gene Expression**

Proteins

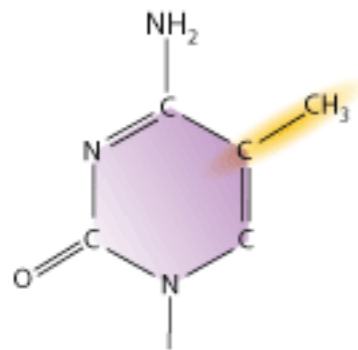
***Epigenetic Alterations - DNA Methylation***

# Epigenetic Alterations - DNA Methylation

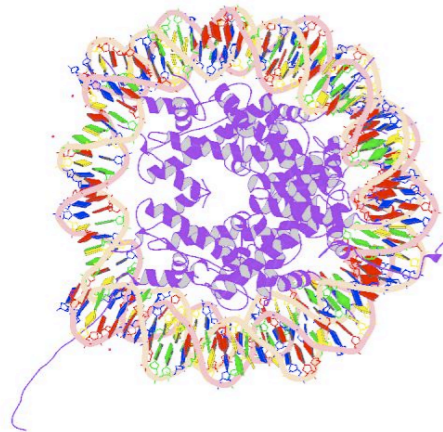
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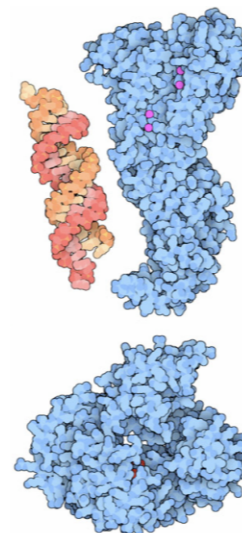
DNA Methylation



DNA methylation is the addition of a methyl group (M) to the DNA base cytosine (C).



Histone  
Modification



Small Interfering  
RNA

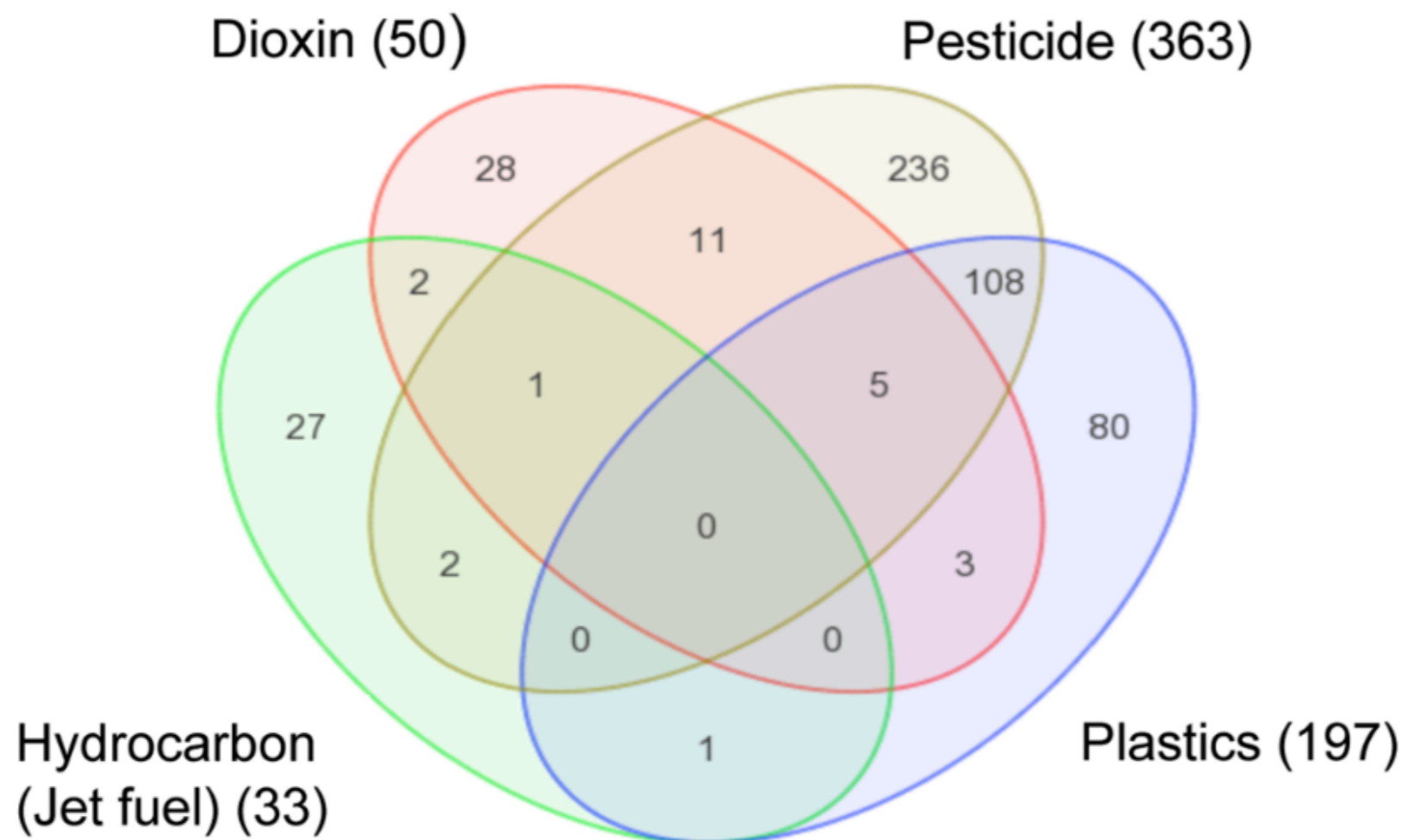
# Epigenetics

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- controls normal developmental processes
- implicated in human diseases including cancer
- possible means for adaptation of changing environmental condition
  - heritable for several generations

# Contaminants and DNA Methylation

Transgenerational differential DNA methylation regions (DMR) associated with exposures

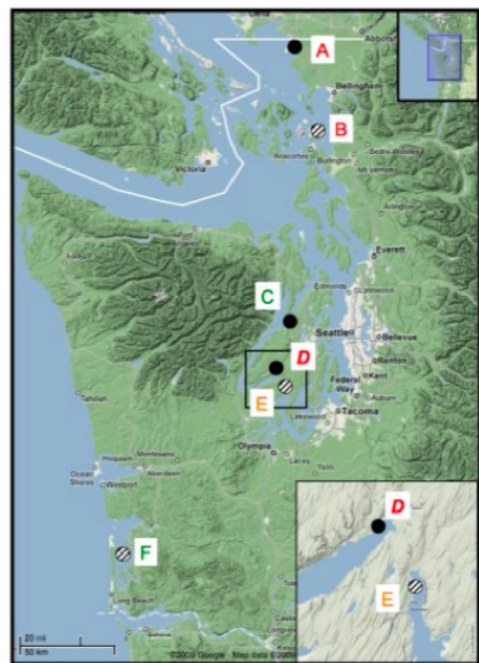


**Transgenerational Actions of Environmental Compounds on Reproductive Disease and Identification of Epigenetic Biomarkers of Ancestral Exposures**

Mohan Manikkam<sup>3</sup>, Carlos Guerrero-Bosagna<sup>3</sup>, Rebecca Tracey, Md. M. Haque, Michael K. Skinner\*

Center for Reproductive Biology, School of Biological Sciences, Washington State University, Pullman, Washington, United States of America

# DNA methylation and oysters

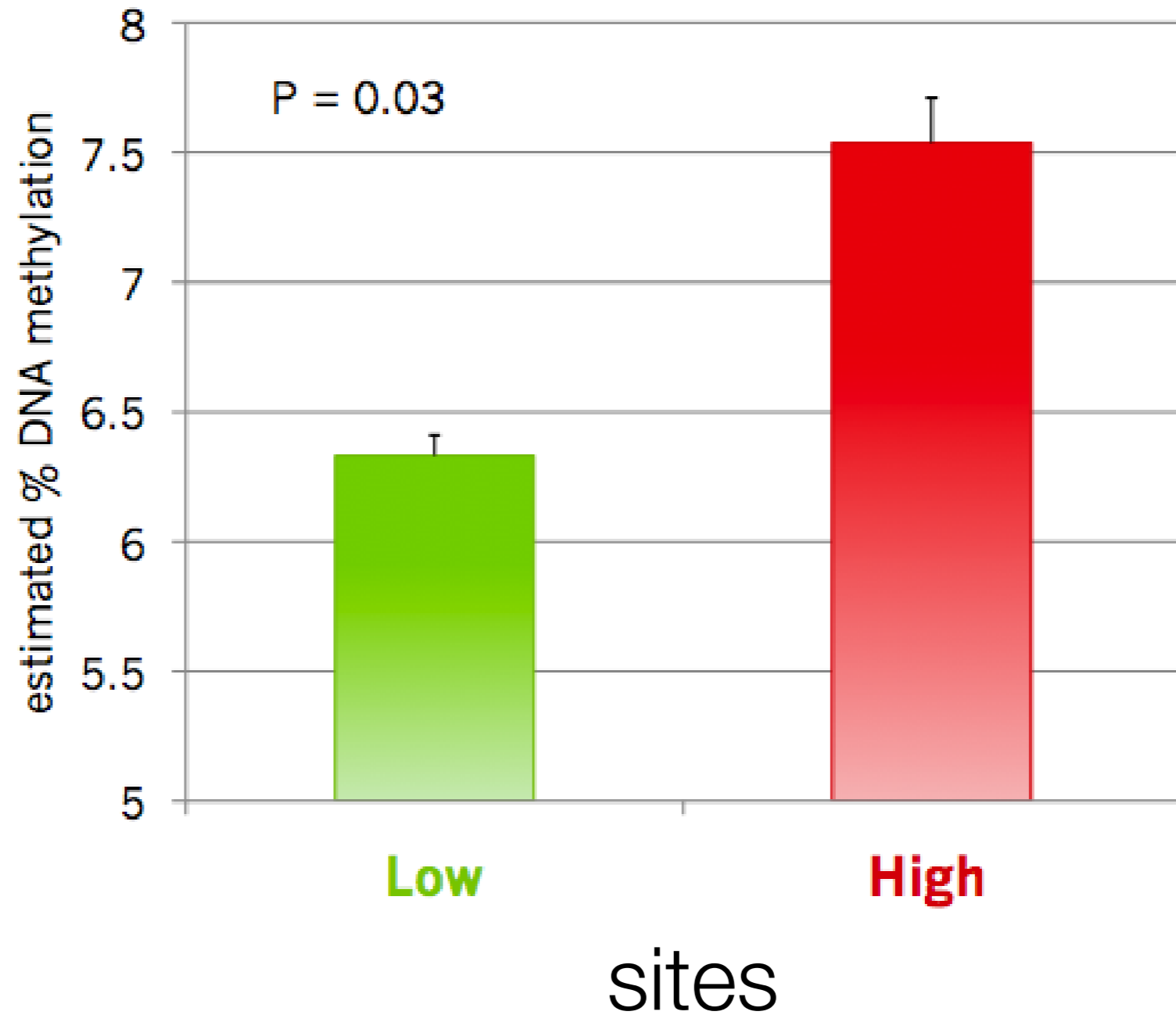


Level of concern:

- High
- Mid
- Low

Pacific oyster populations:

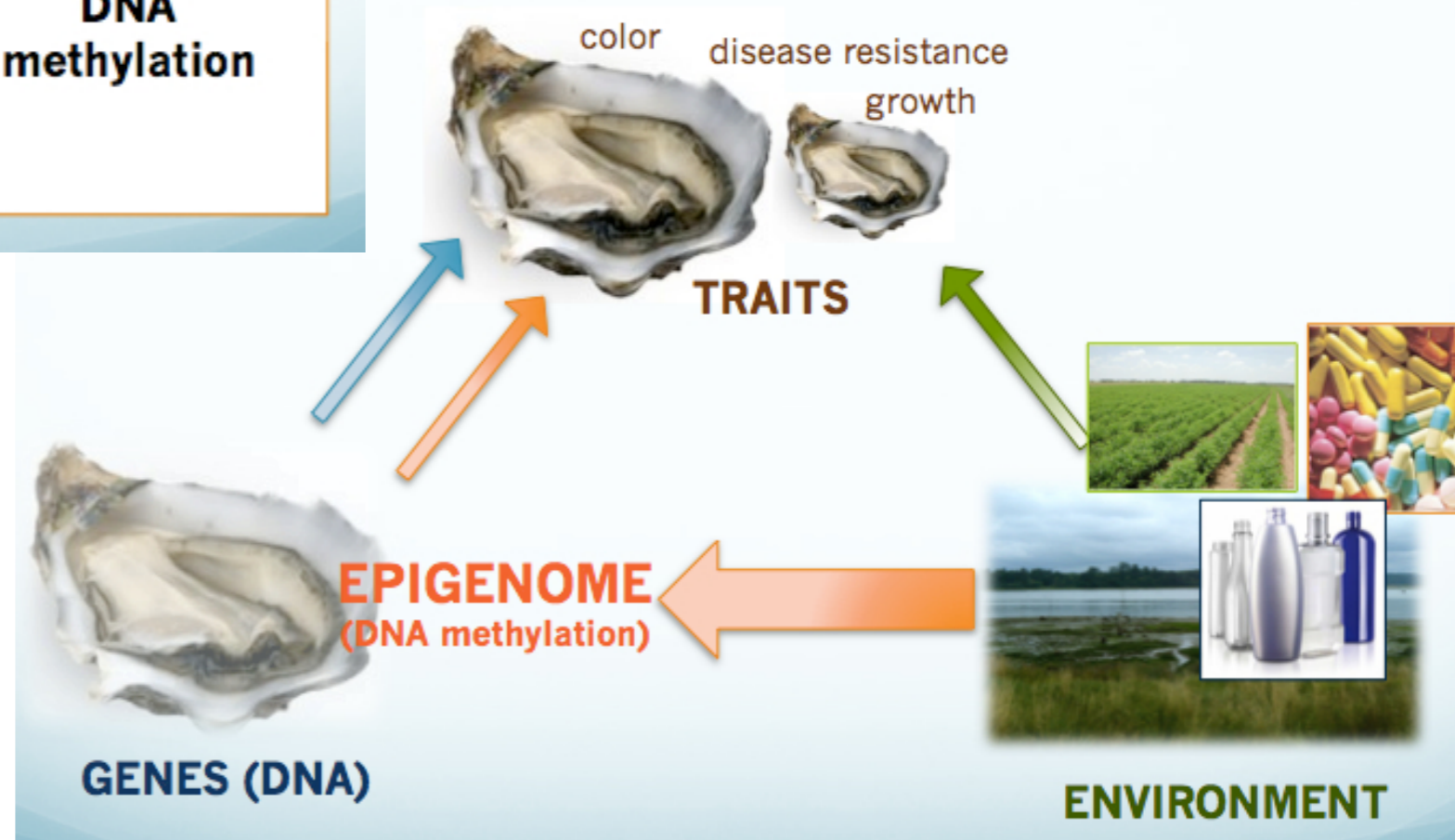
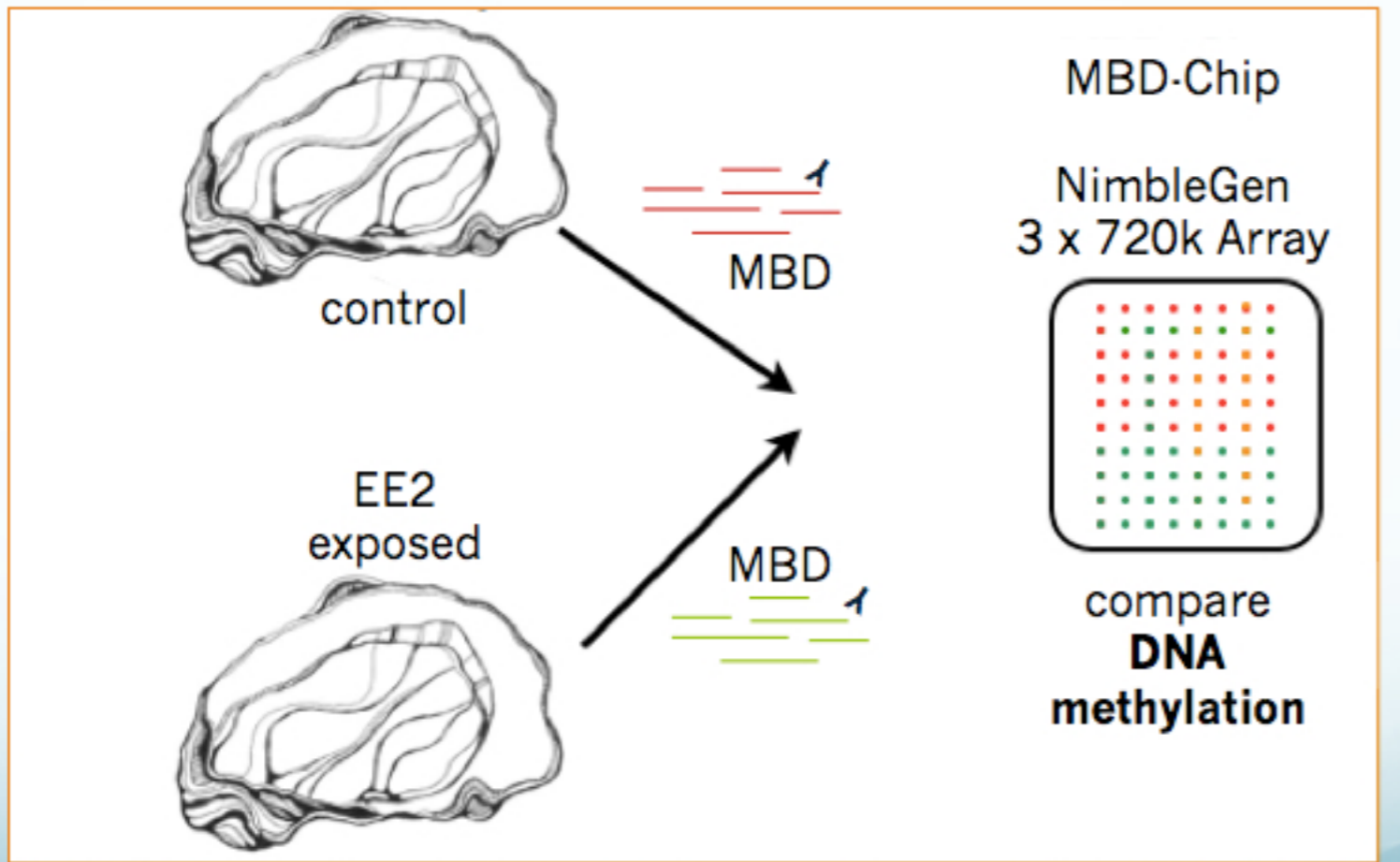
- natural set
- commercially farmed (outplanted juveniles)





# DMRs

Gavery - Friday 9:00 - #3883



# Summary

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- Sequencing technology allows for easy integration of genomic approaches into environmental studies.
- Practical implementation would involve using targeted assays\*.
- Significant lack of knowledge concerning toxins and epigenetics in marine invertebrates. This could have significant ecosystem impacts.

# Acknowledgements

Mackenzie Gavery  
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*DNA methylation*



EPA  
STAR



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Brent Vadopalas  
Jake Heare



Aquaculture Program

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