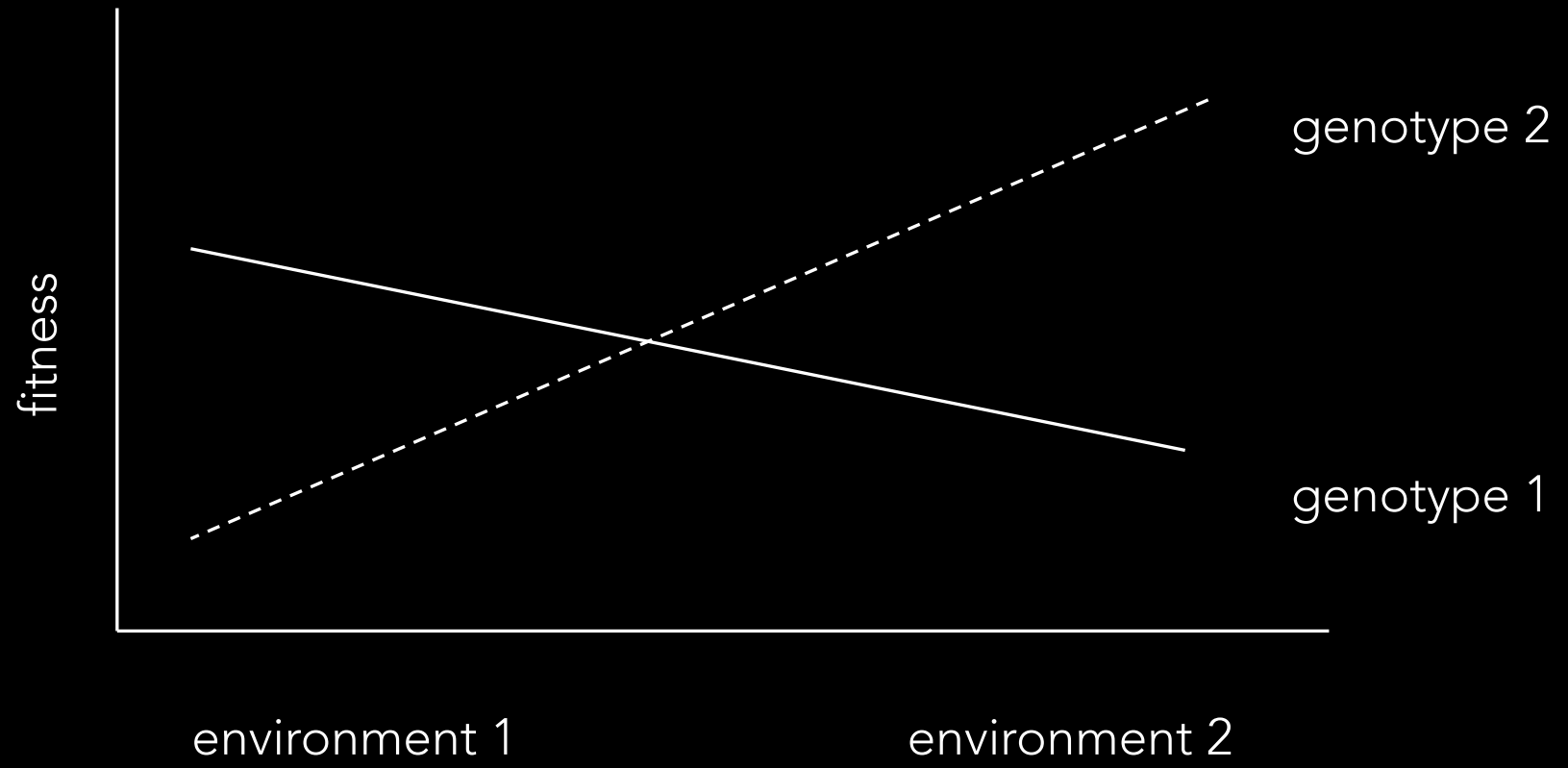
Local Adaptation in the S

Morgan Kelly
Louisiana State University



- het
  env
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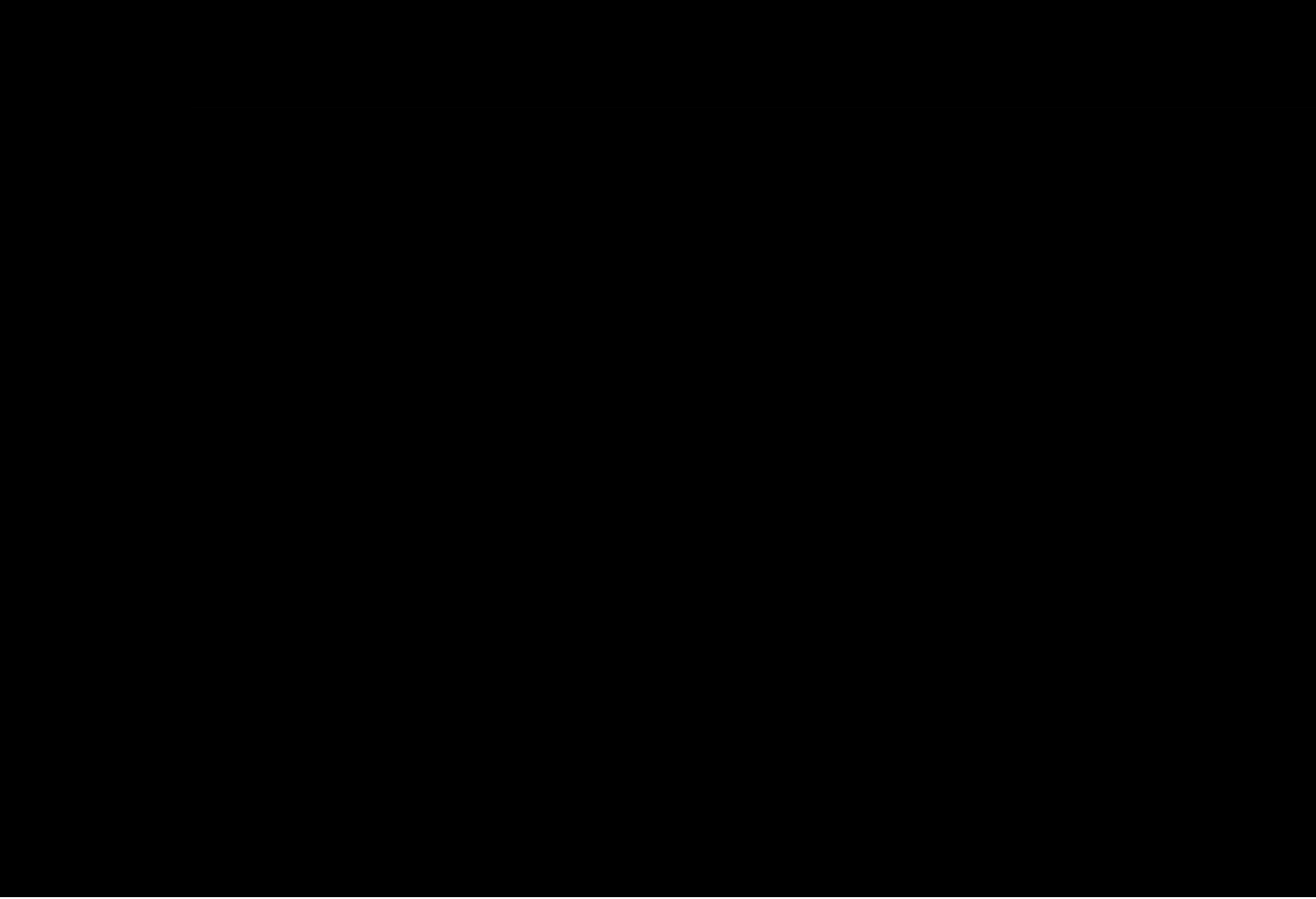
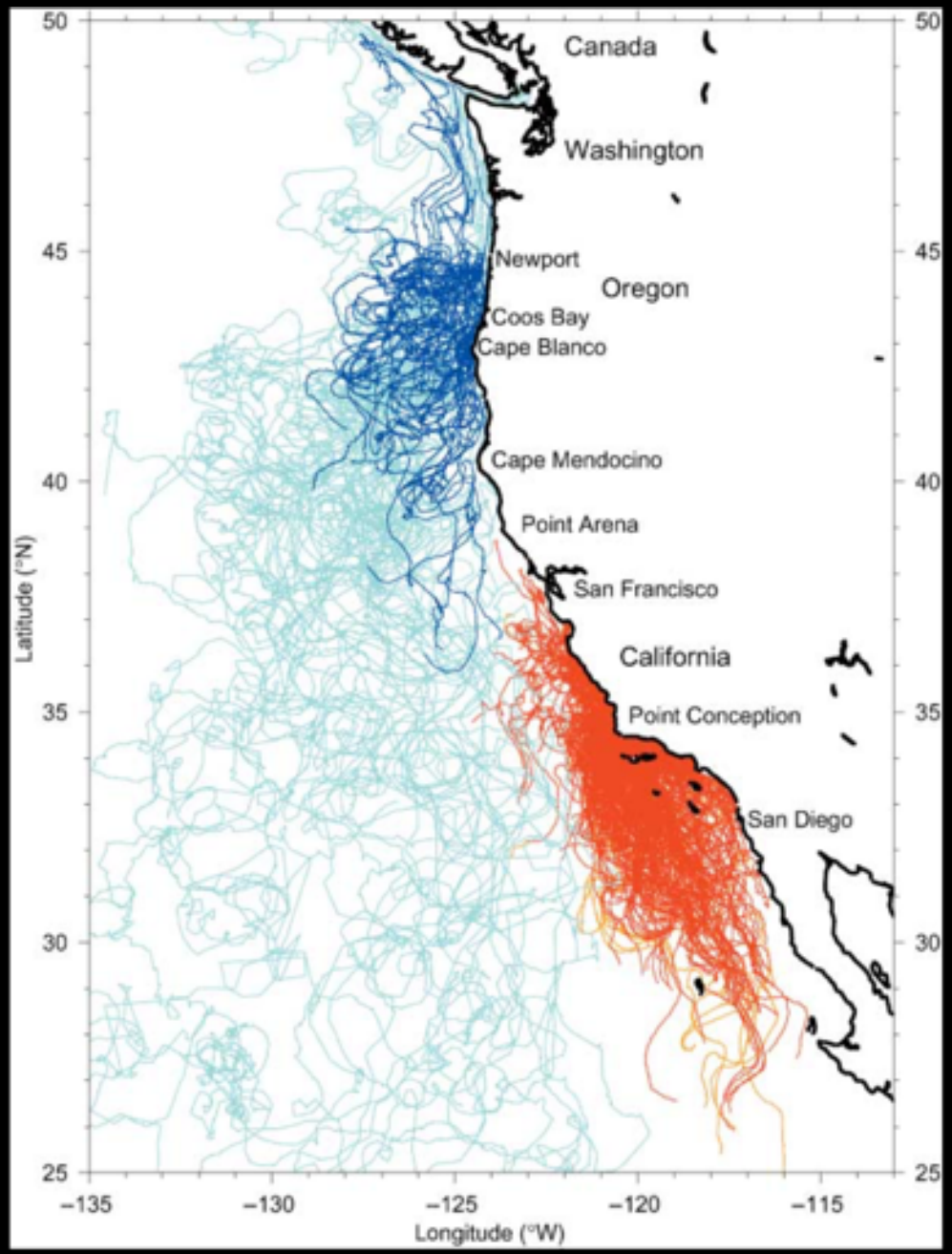
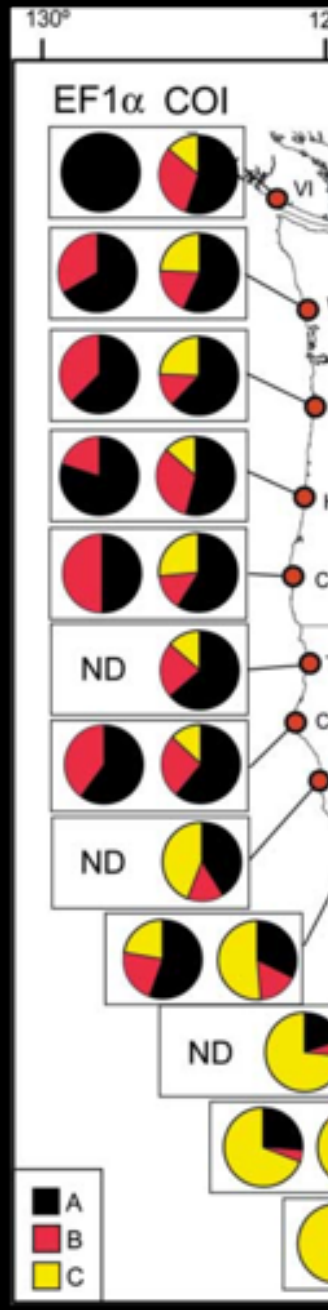
Kawec



Sotka et al 2004: Genetic clines and geographical variation in gene flow in *Balanus glandula*



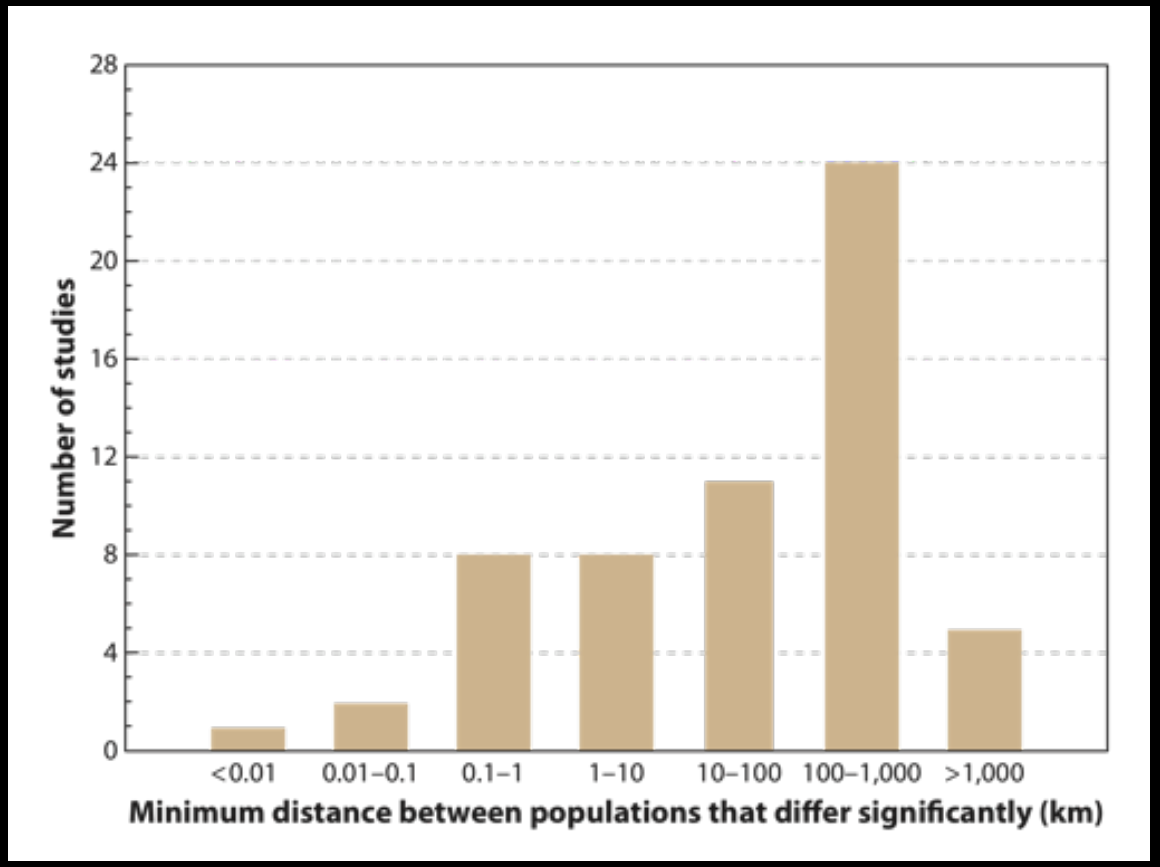


Many examples of local adaptation in marine systems

Balanophyllia: Griffiths et al 2019

Astrangia: Aichelman et al 2019

Balanus: Wares and Scockzen 2019



Sanford and Kelly 2011

and many more…

Porite

Gracil

Idothe

Many examples of local adaptation in marine systems

Balanophyllia: Griffiths et al 2019

Astrangia: Aichelman et al 2019

Balanus: Wares and Scockzen 2019

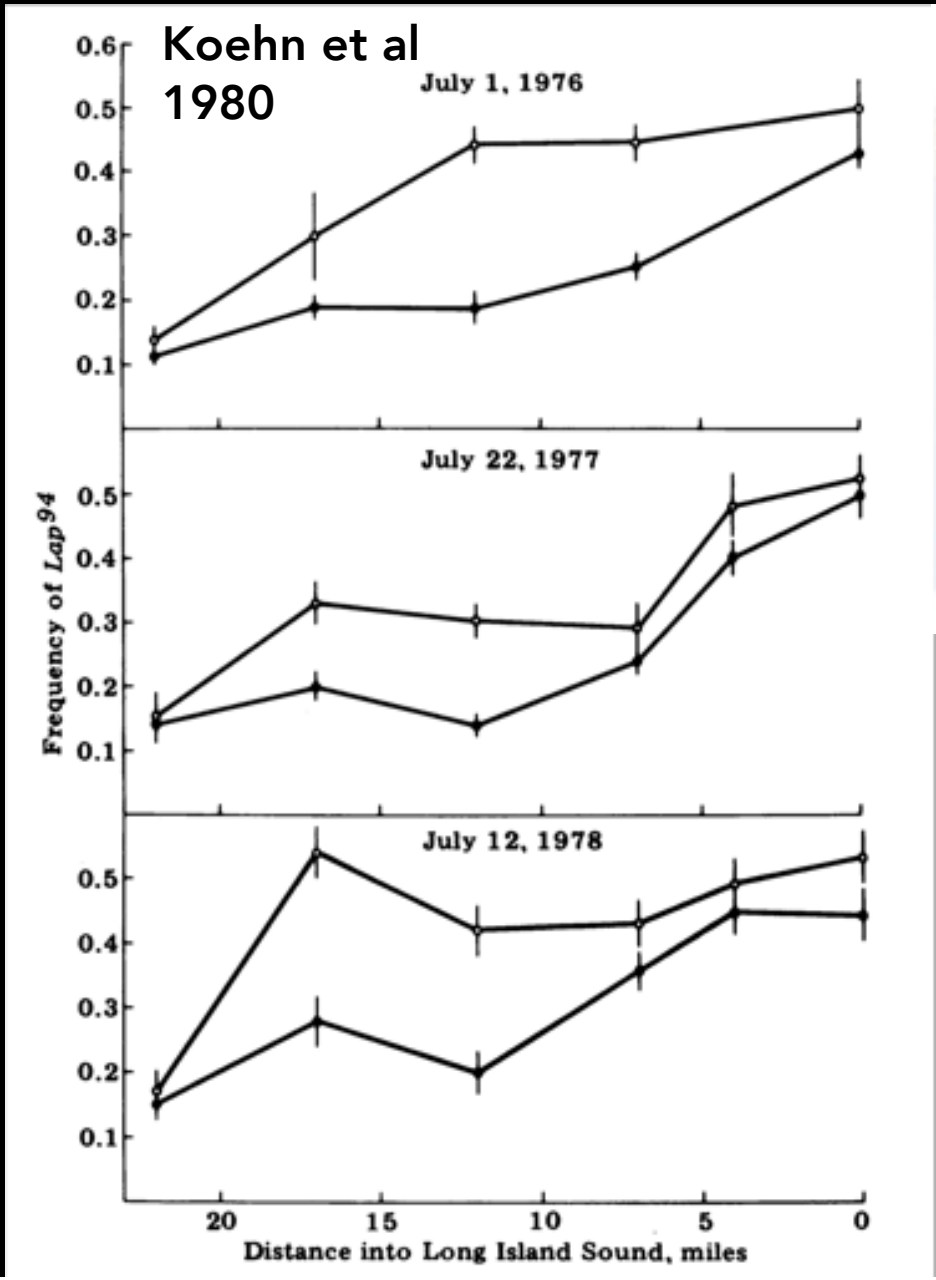
gene expression, physiology, survival, growth rate, chemical defense, reproduction, genetic divergence…

Porite

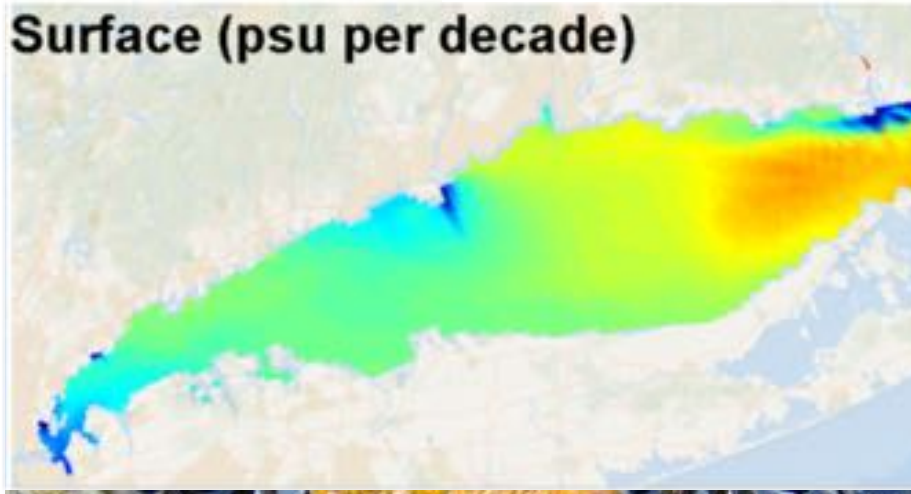
Gracil

Idothe

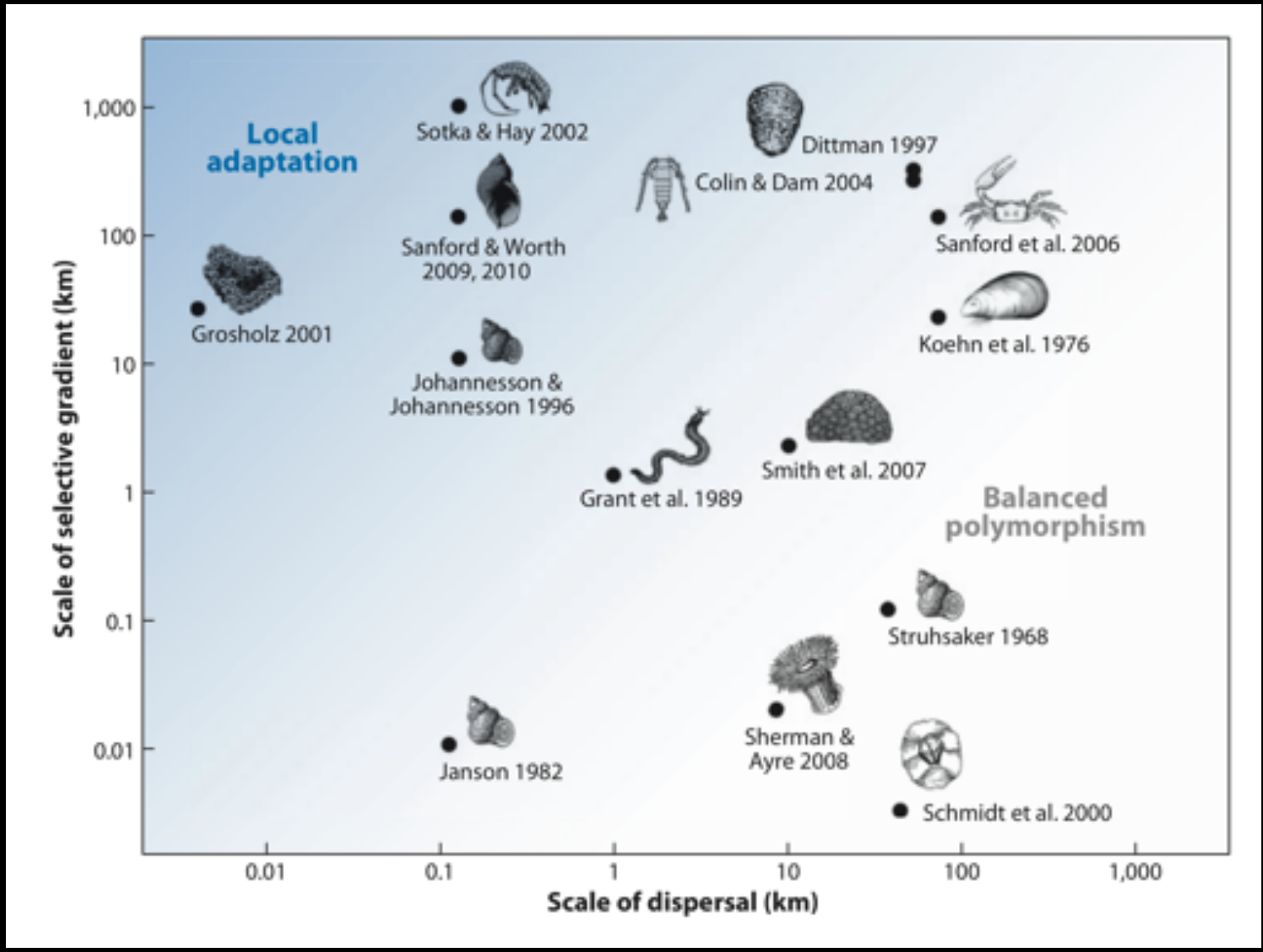
Post-settlement mortality



Georgas

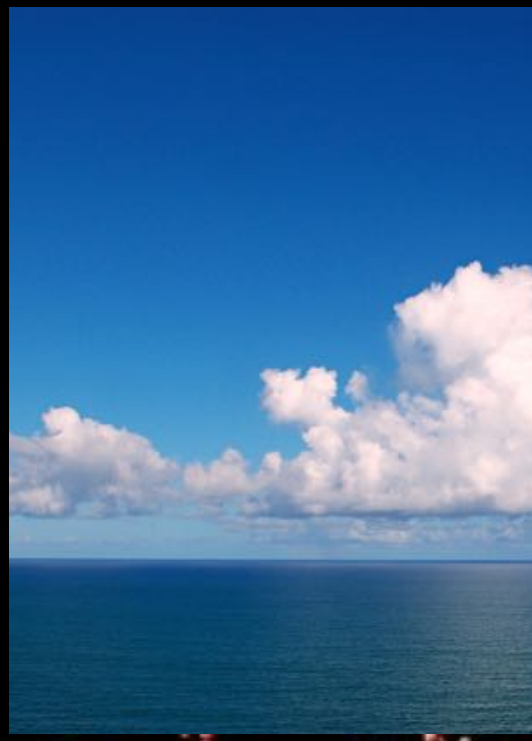


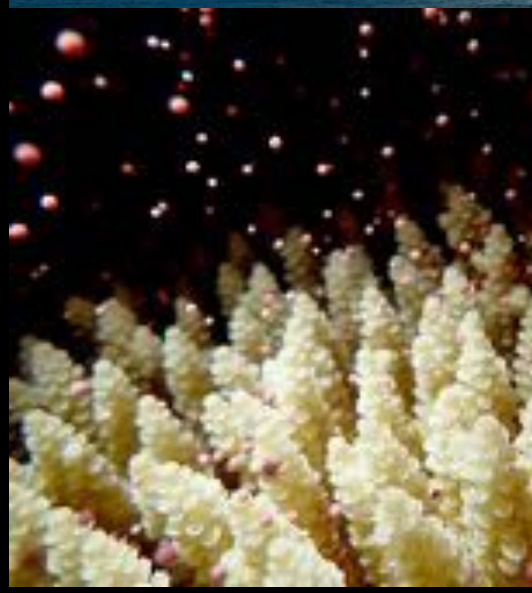
Importance of post-settlement mortality: scale heterogeneity relative to scale of dispersal



Does Local Adaptation Work Differently in the Sea?

- Scale of heterogeneity
- Scale of dispersal
- Large effective population sizes
- Distinct larval and adult habitats





Selection during larval phase in eastern oysters

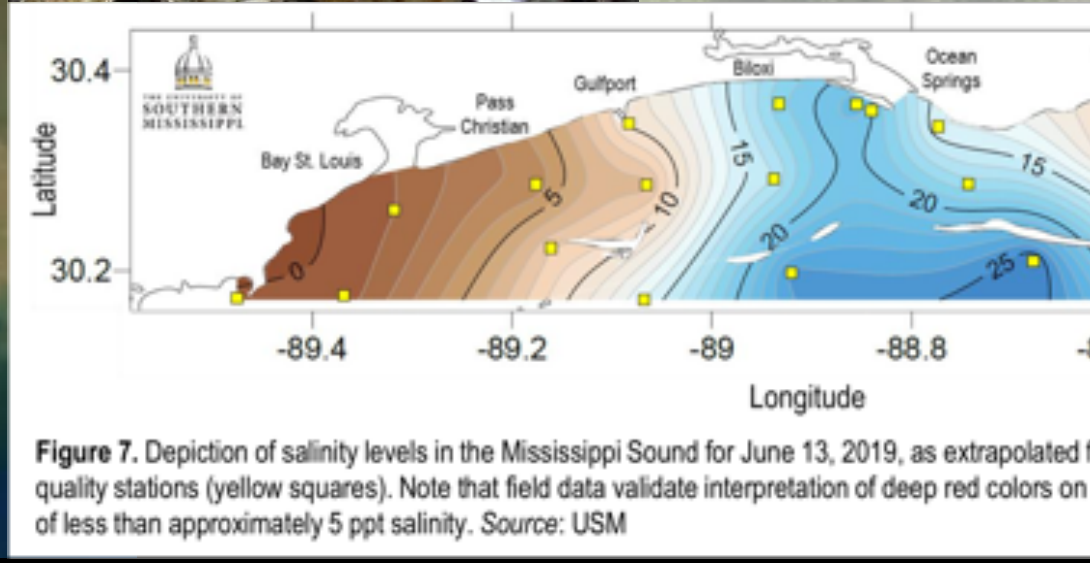
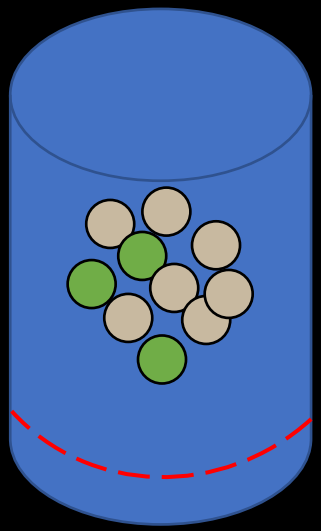


Figure 7. Depiction of salinity levels in the Mississippi Sound for June 13, 2019, as extrapolated f
quality stations (yellow squares). Note that field data validate interpretation of deep red colors on
of less than approximately 5 ppt salinity. *Source:* USM

600,000

Start
Subsample



Low salinity
7 ppt
12 hours

Swimming

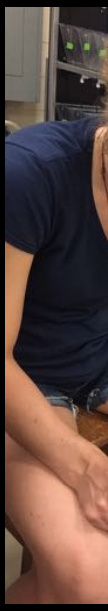
"Dead"
70-99%

Hypothesis:

Genetic variation for survival exists at low salinities within populations

Prediction:

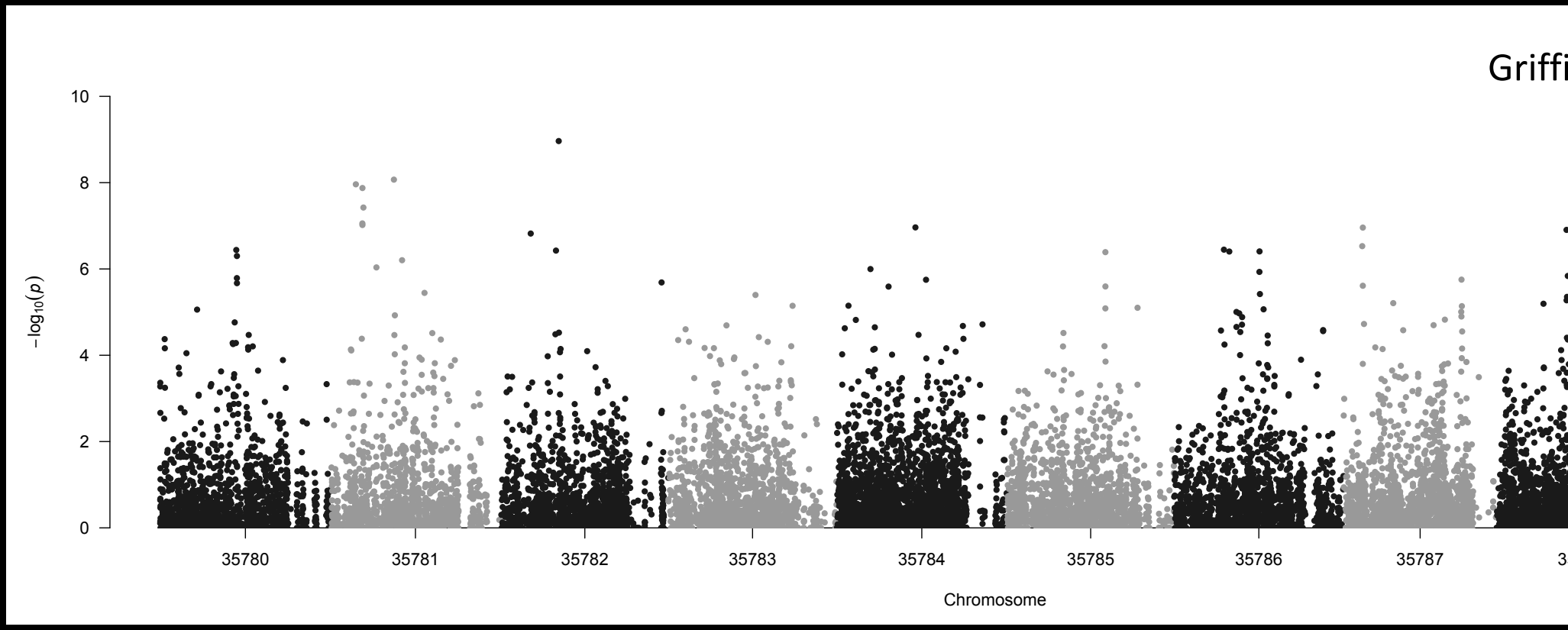
Selection will result in Δ allele frequencies in salinity tolerance genes



Joan

Allele frequency changes during low salinity s event

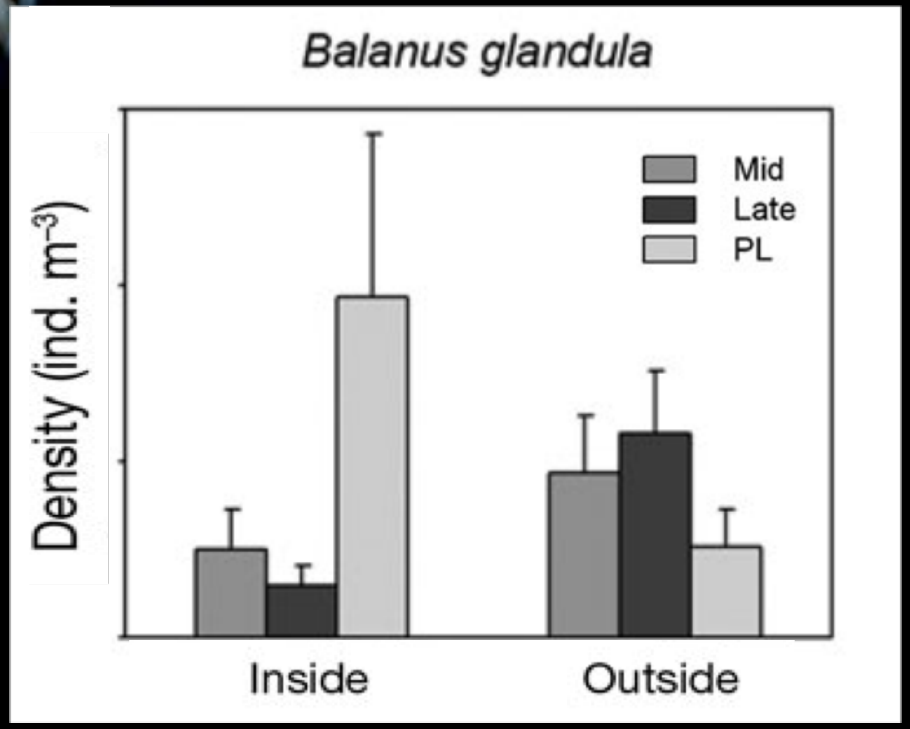
- 20 genes show significant changes in the frequency of on
- Loci consistent across 5 experimental crosses



But larval and adult habitats often diffe

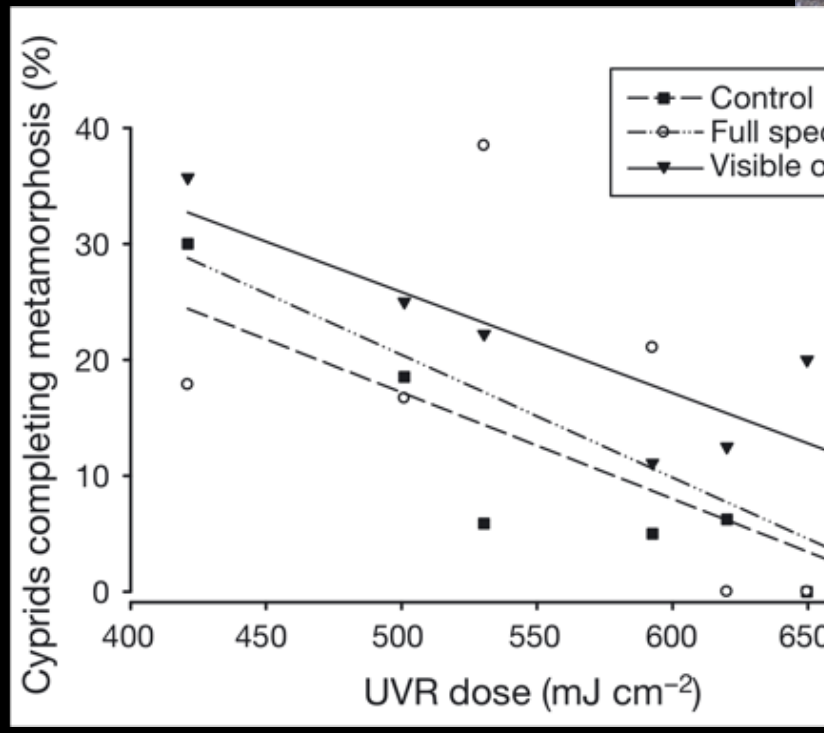
Different traits determine survival of larval vs. adult barnacles

larval retention



Morgan and Fisher 2010

thermal stress



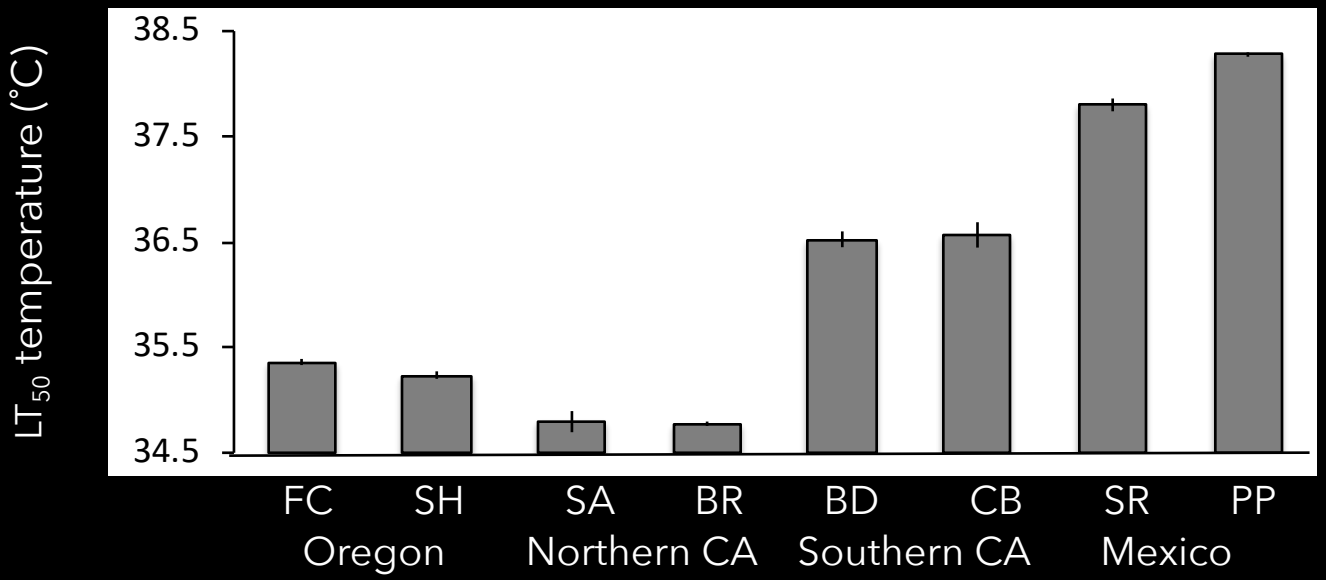
Gosselin and Jones

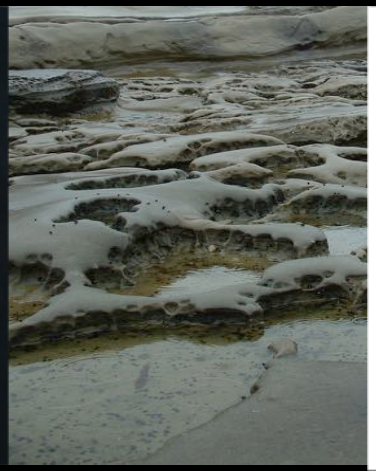
And sometimes you just win the lotte

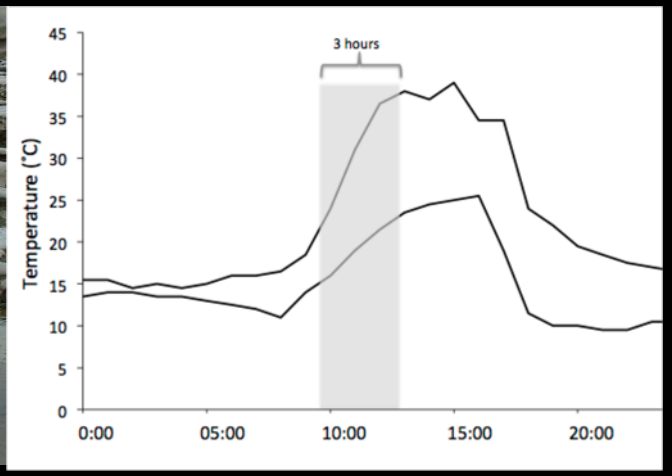
Hedge

Implications for conservation: environmental niche

be broad at the species level, narrower within populations.







Kelly

Implications for conservation: environmental niche

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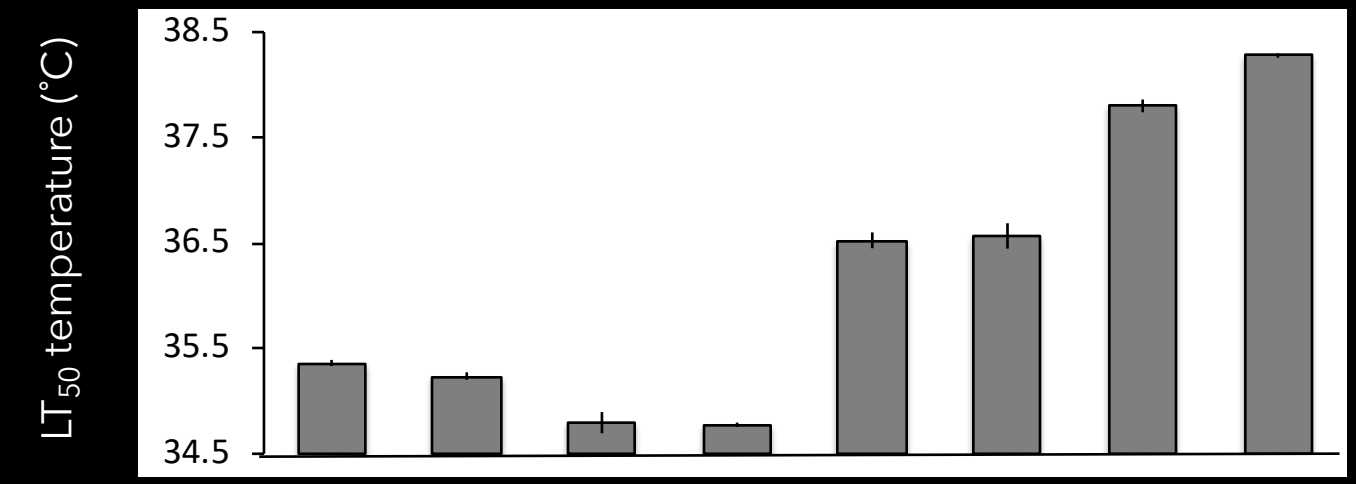
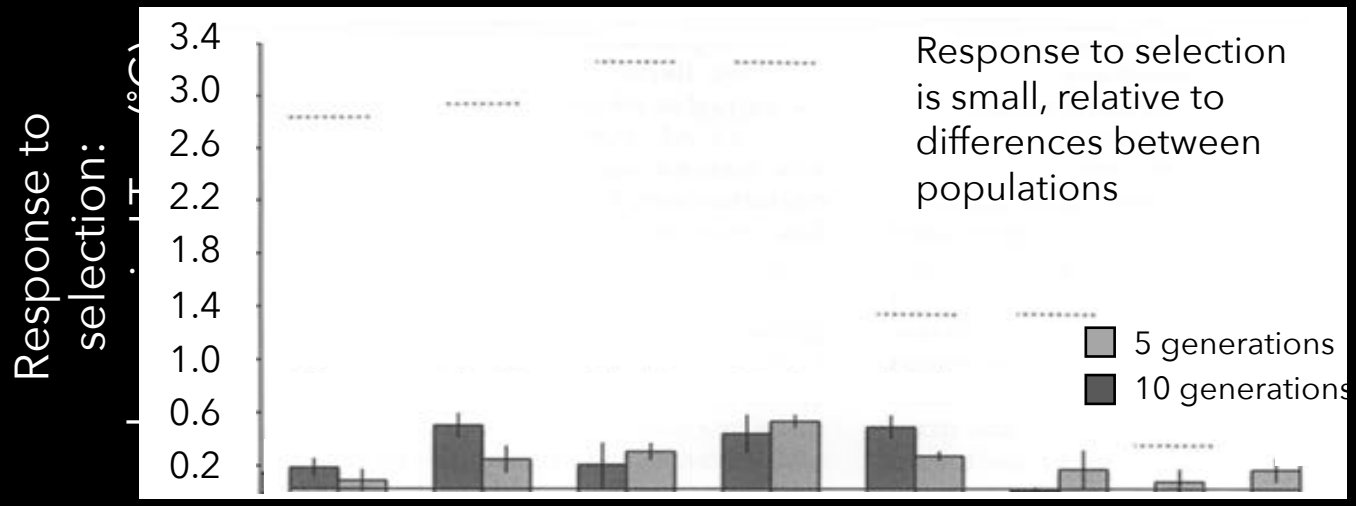
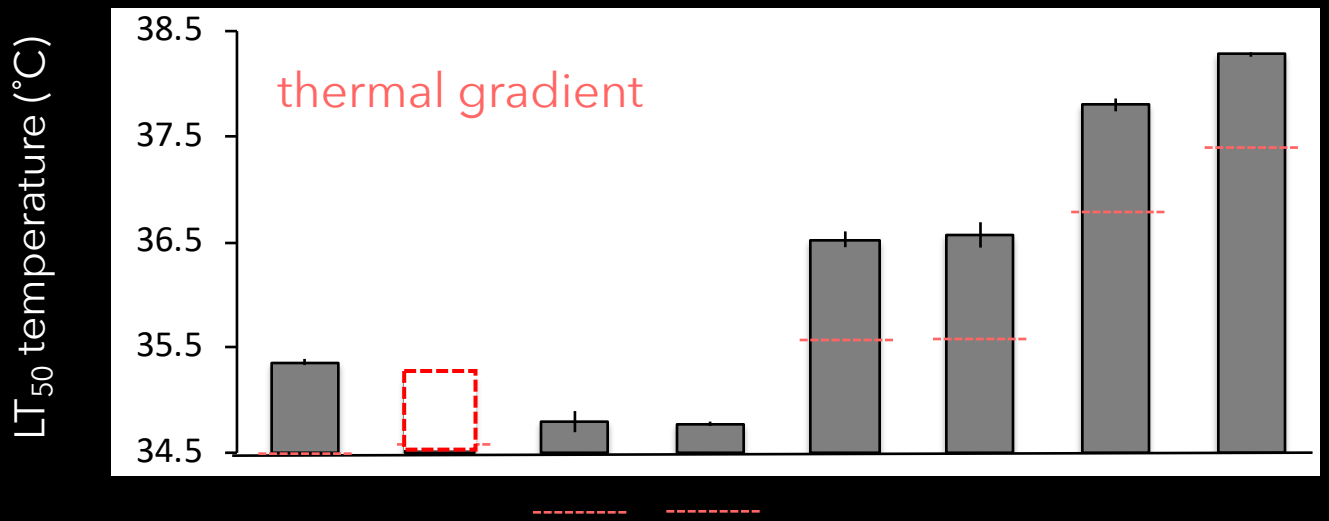




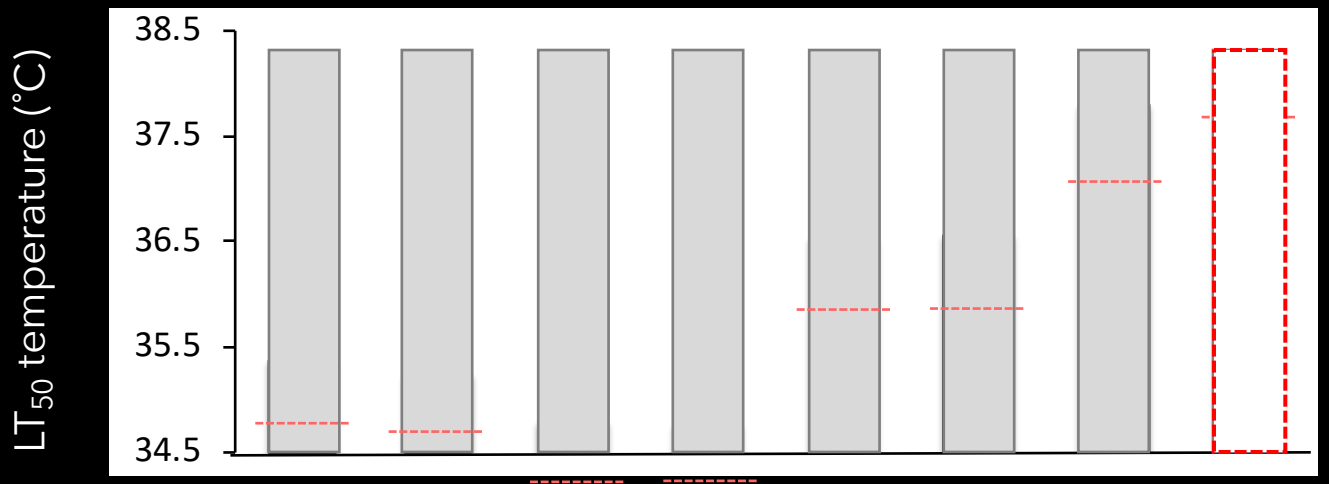
Kelly

A nested niche may alter response to climate change

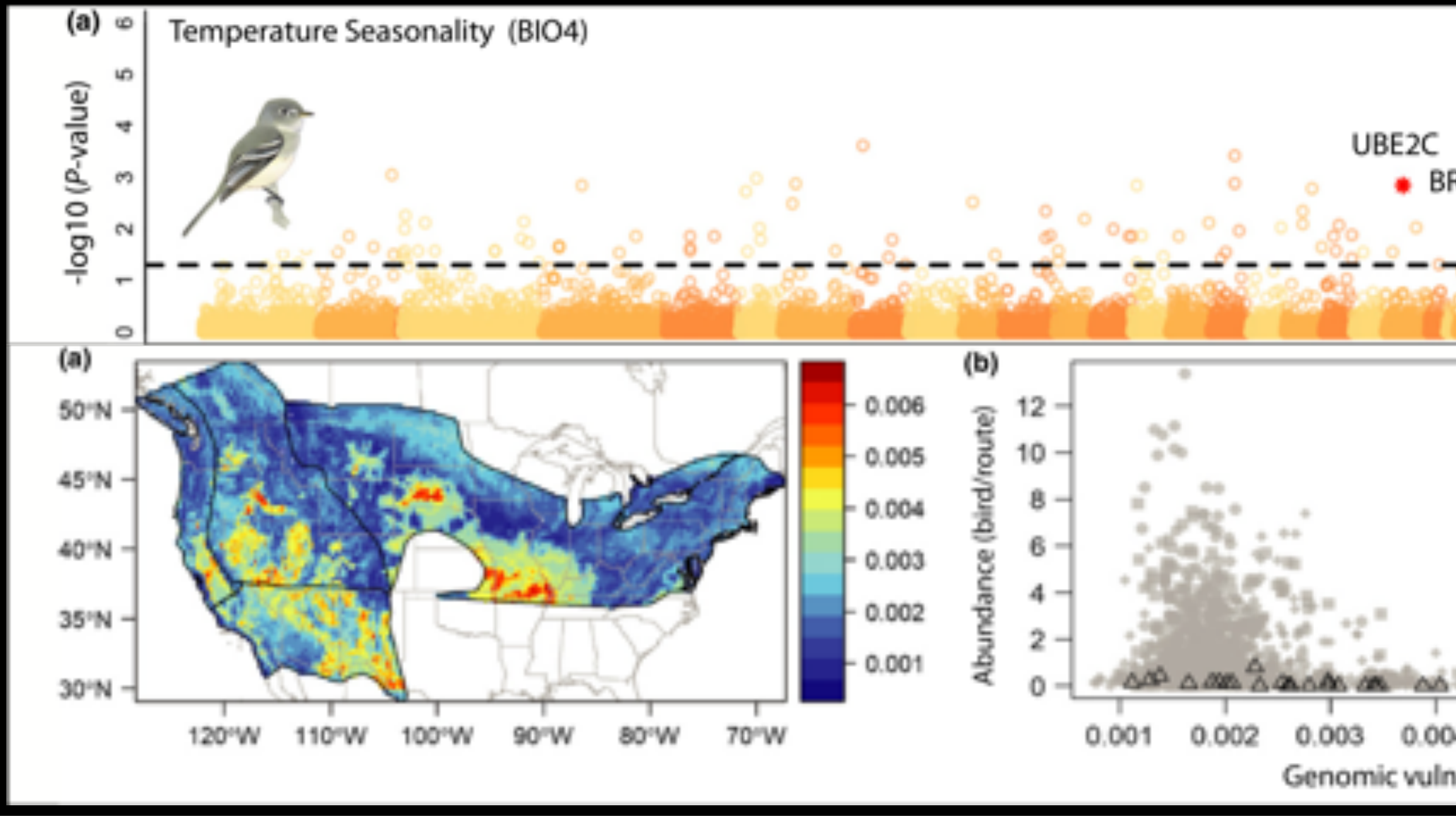
Nested niche → warming increases the vulnerability of all populations equally



No differentiation among populations → warming leads to poleward range contraction



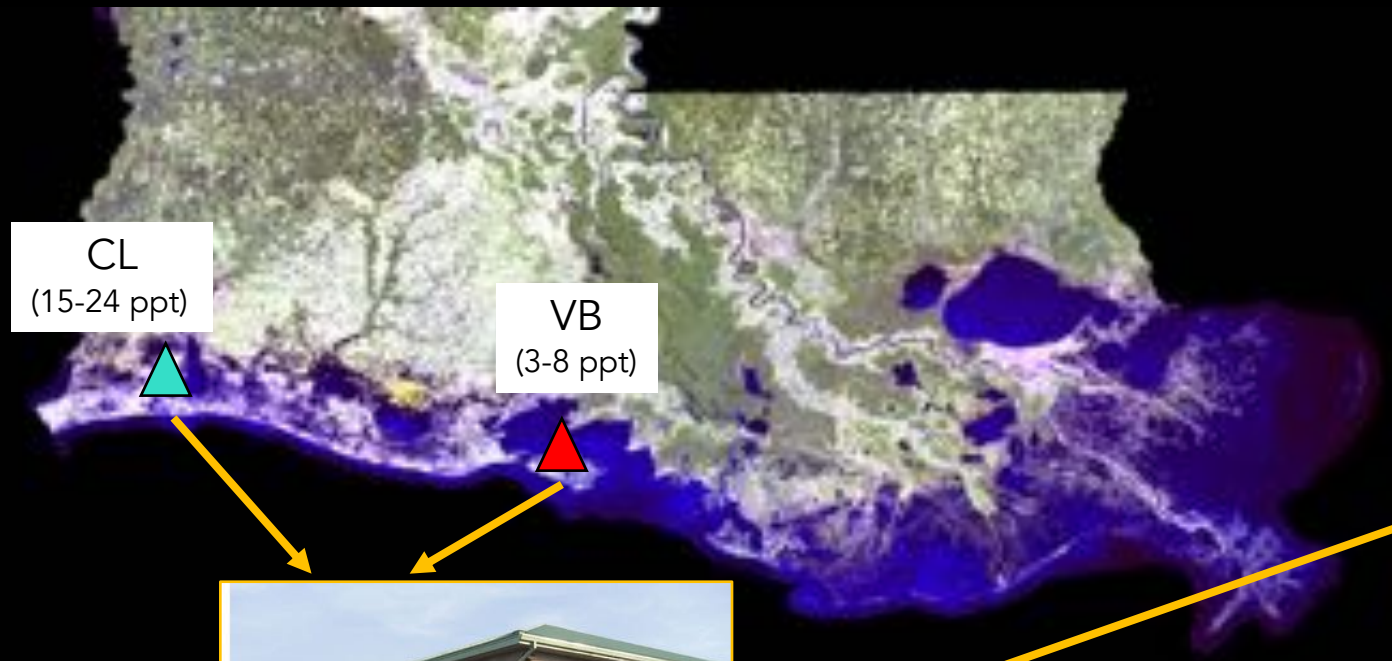
Ruegg, Bay et al 2018: Ecological genomics predicts
vulnerability in an endangered southwestern songbird



Ongoing questions

- what gradients do organisms care about
- relative utility of genomics vs. phenotypi measurements and reciprocal transplants
- relationship between adaptation to grad in space and the capacity for adaptation environmental changes through time.

Local adaptation to salinity in eastern oysters?

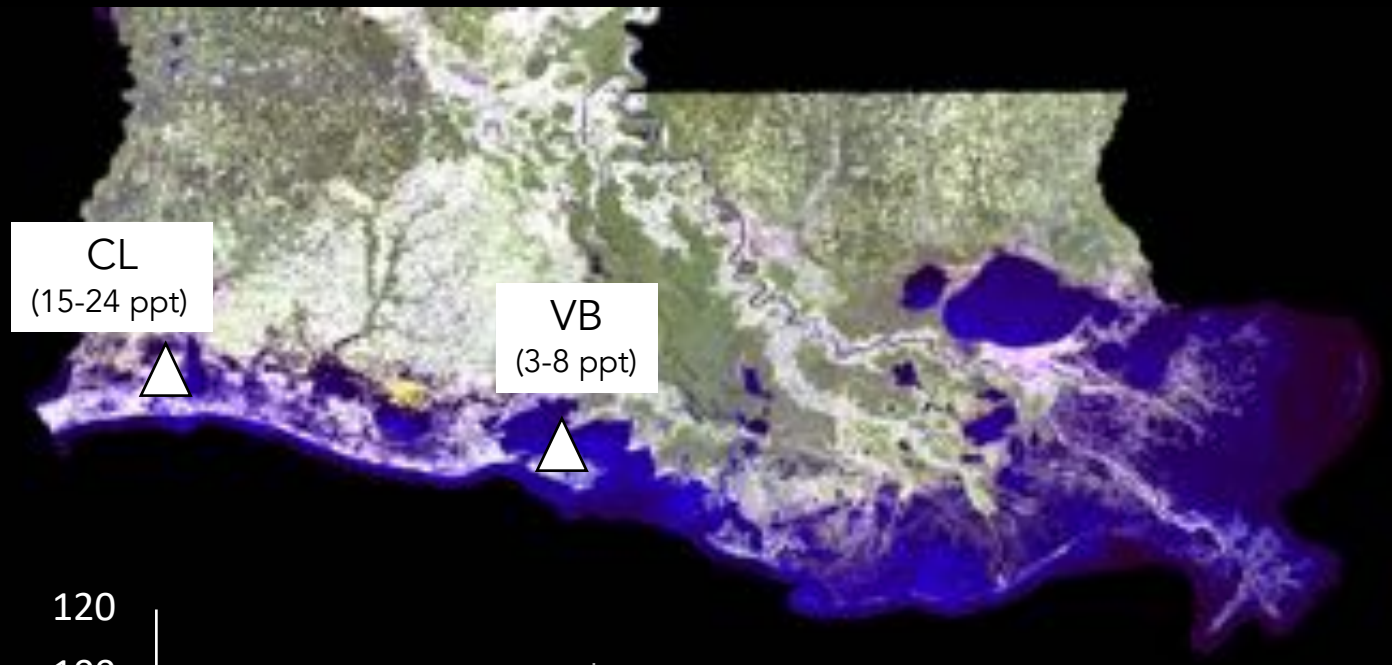


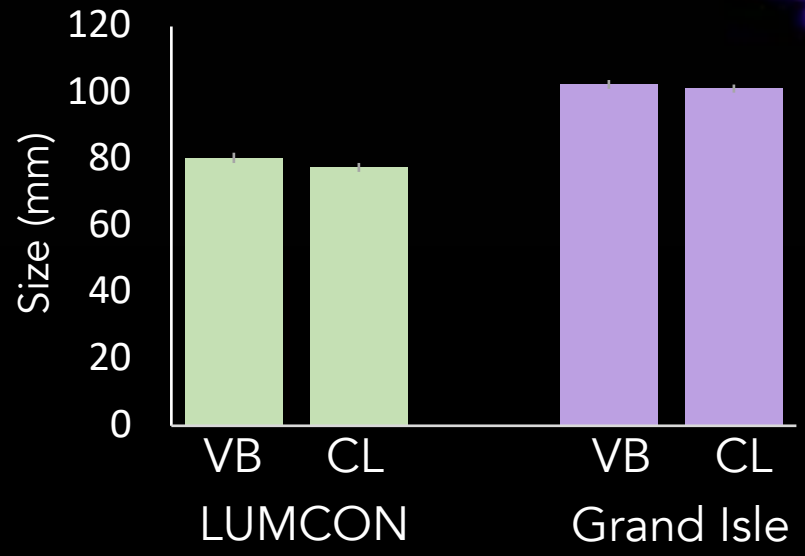
Spawning
at Grand Isle Hatchery

Out-plant
to low and high salinity site

Photo: Virginia Shutte

Local adaptation to salinity in eastern oysters?





Site***

$F_{1, 263} = 289$

Population n.s..

Population x Site n.s..

Out-plant

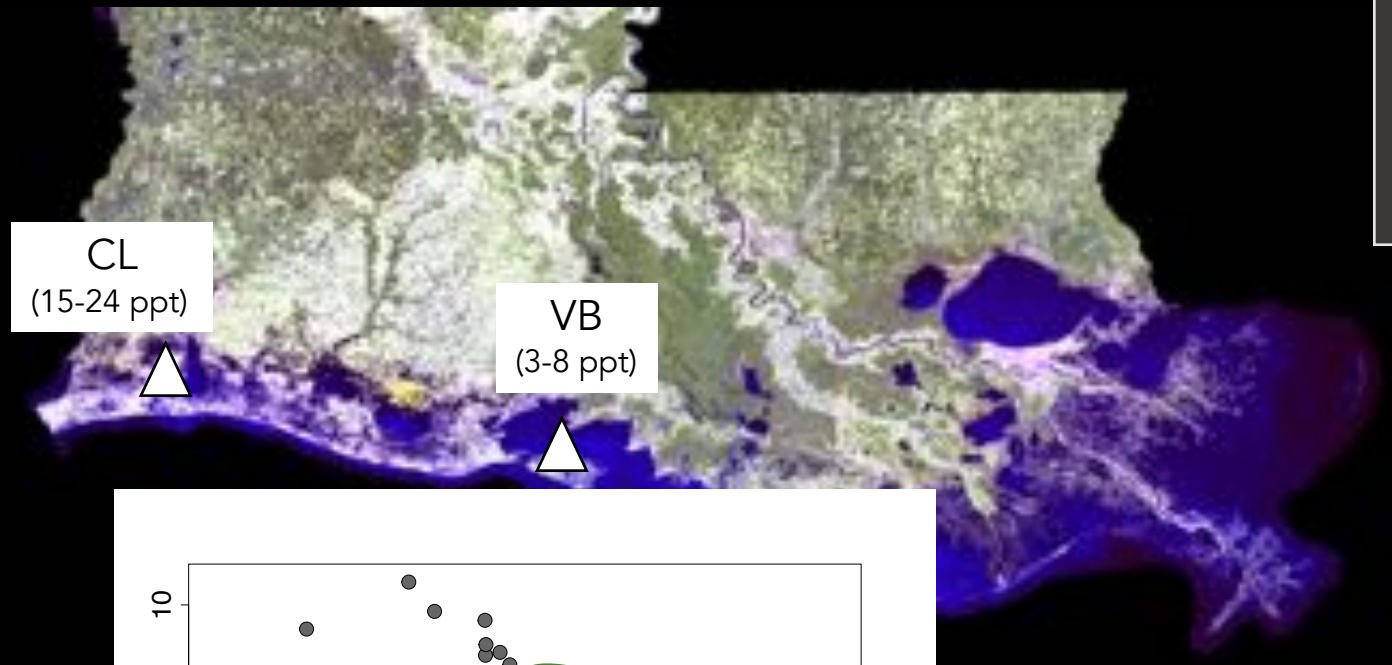
to low and high salinity site

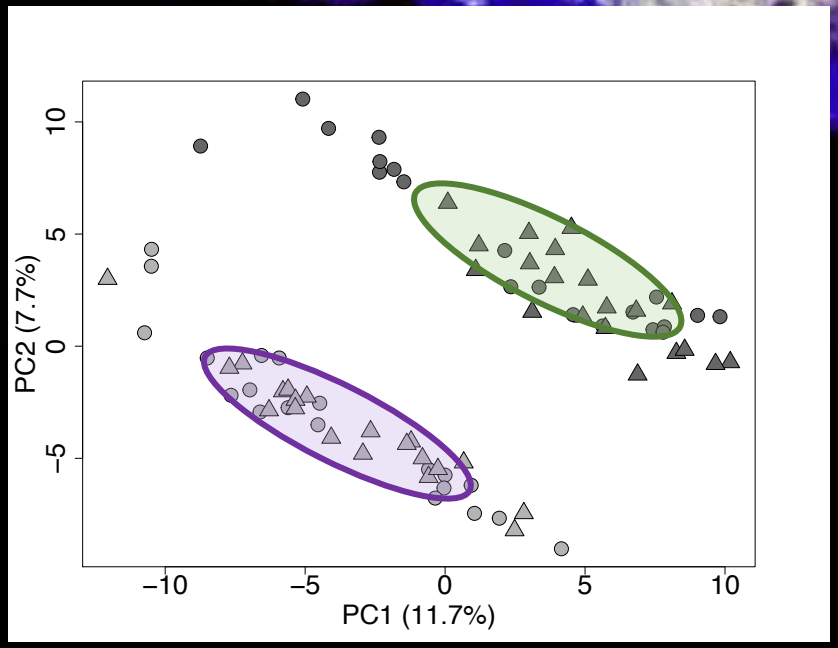
Photo: Virginia Shutte

Local adaptation to salinity in eastern oysters?

Global gene e

Separation of ex
patterns by site,
source populatio



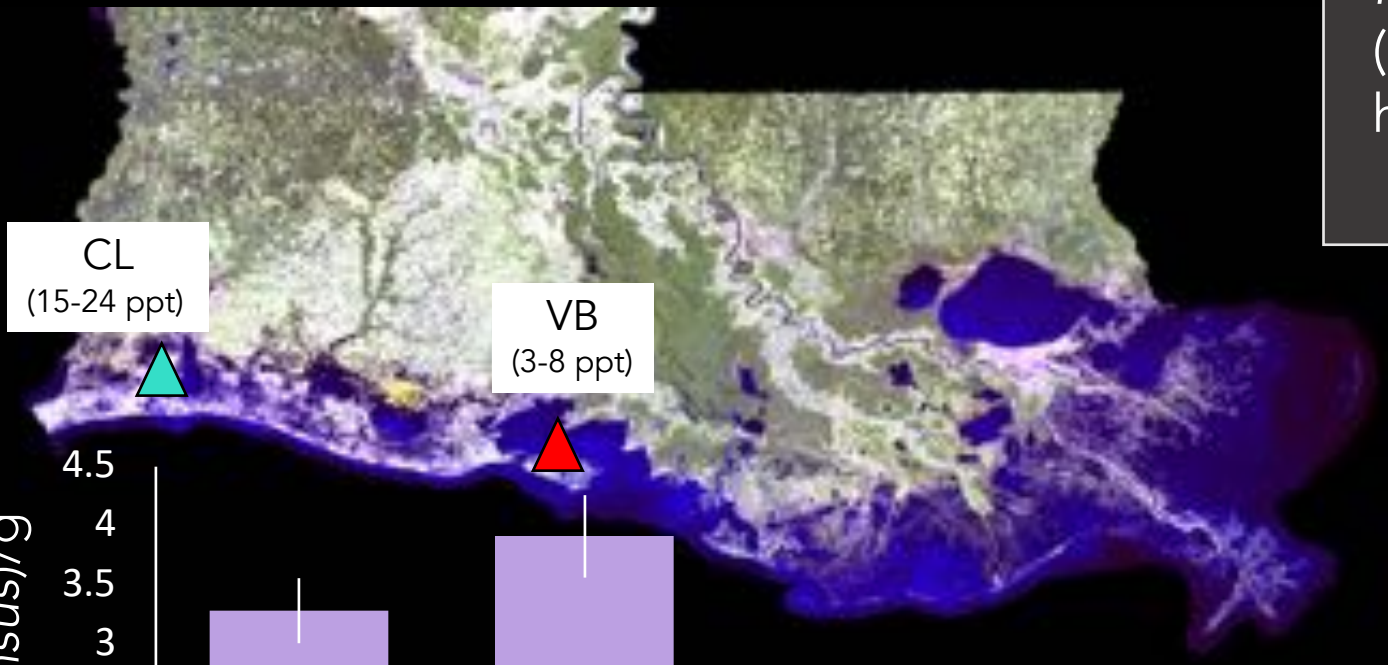


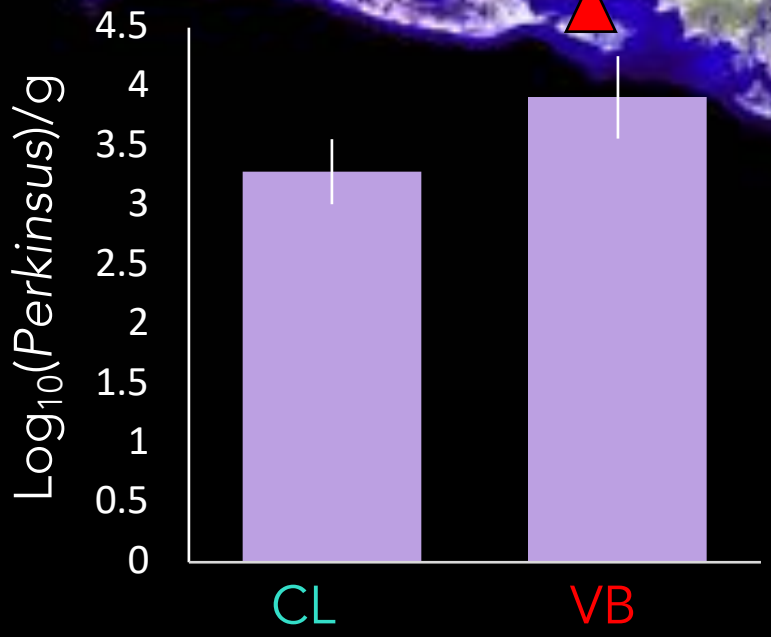
▲ VB
● CL

Local adaptation to disease pressure

Histology

Lower abundance of *Perkinsus marinus* (dermo) in oysters from high salinity population.





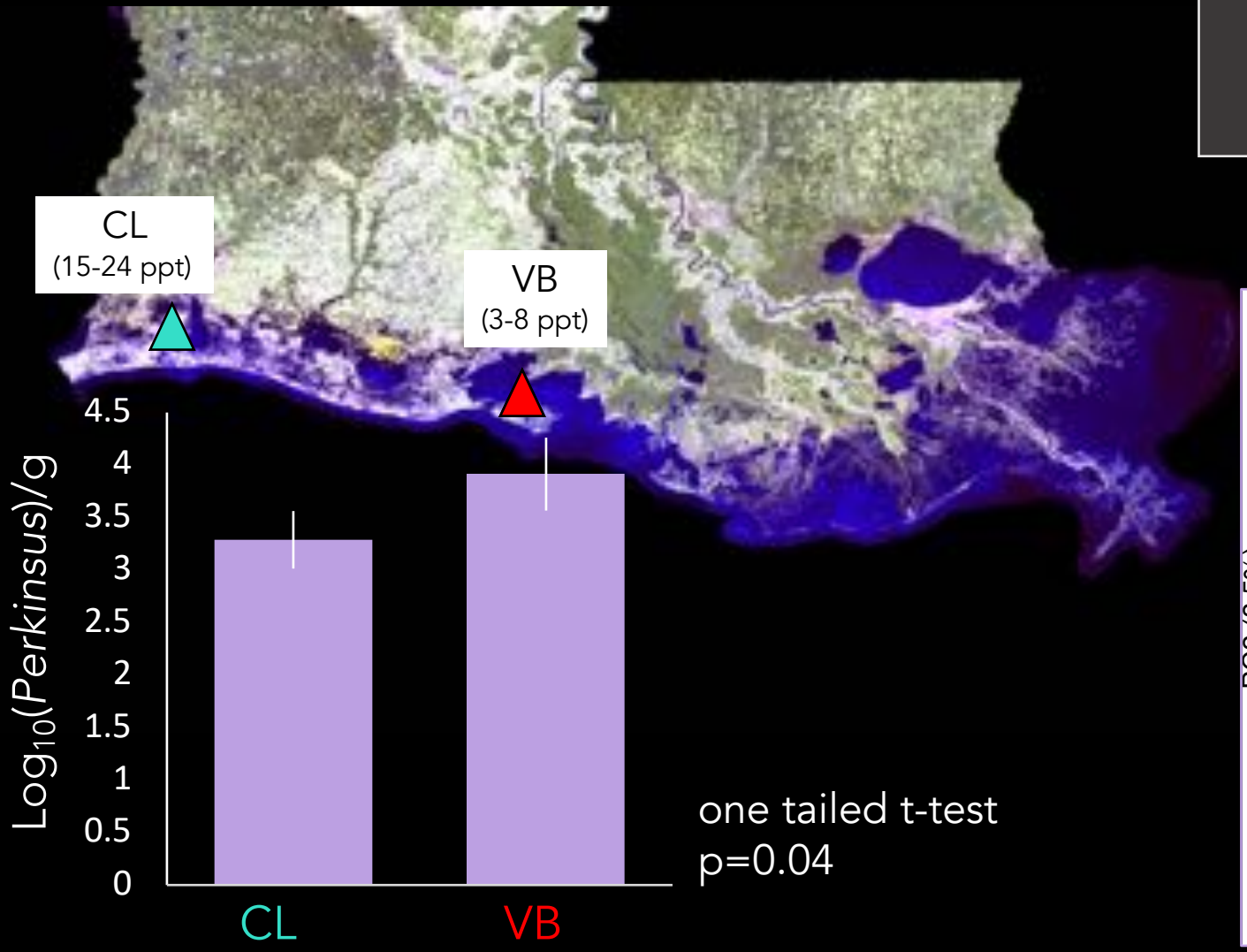
one tailed t-test
p=0.04

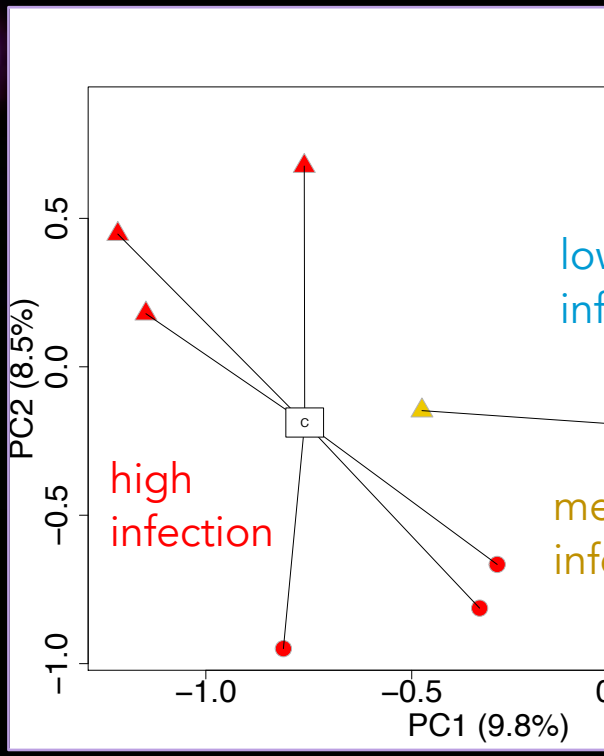
**histology by Dr. Sandra Casas-Liste*

Local adaptation to disease pressure

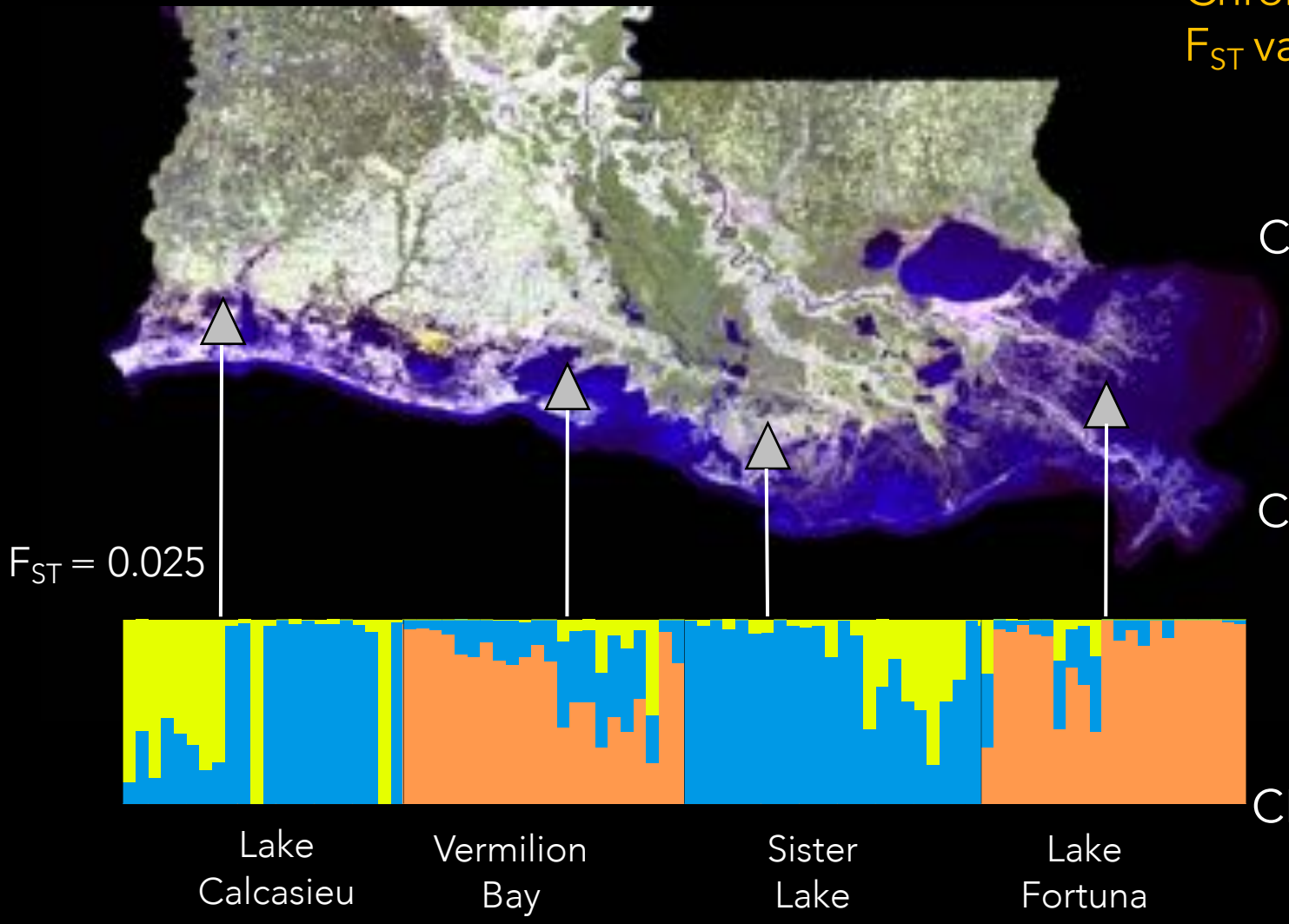
Histology + Tag

Differences in expres
among populations,
highest infection inte





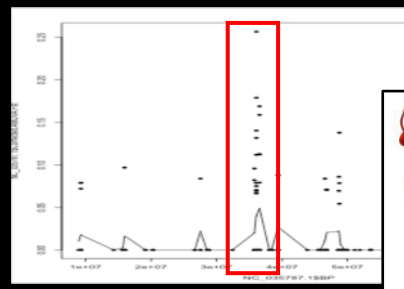
Genetic basis for difference in disease tolerance



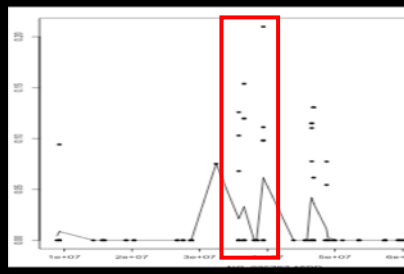
Chromosome 8
F_{ST} values

LOC1111069
domain-conta

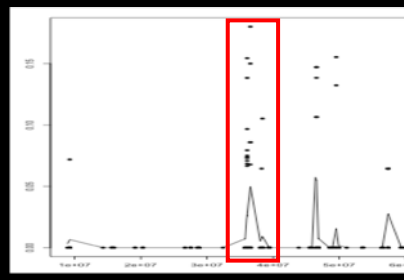
CL vs LF



CL vs SL



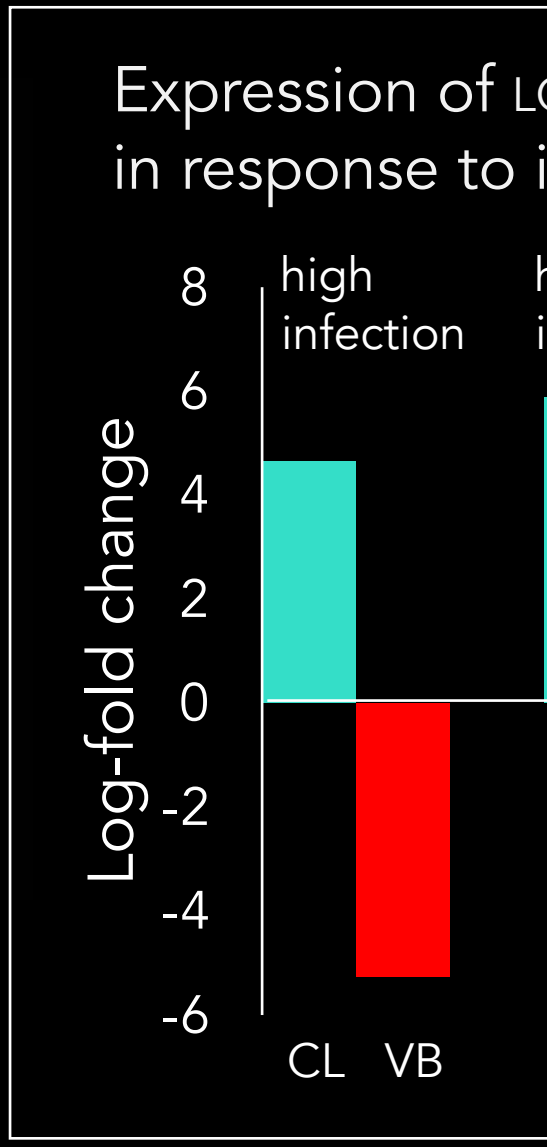
CL vs VB



Genetic basis for difference in disease tolerance

Immunity in
- Pacific oyster (Zhang et al 2011)
- scallops (Li et al 2015)
- razor shells (Liu et al 2014)





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Hollis Jones
Kyle Sirovy
Kevin Johnson
Yasmeen Kawji
Devin Comba
Megan Guidry

LSU Department of Biological Sciences

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