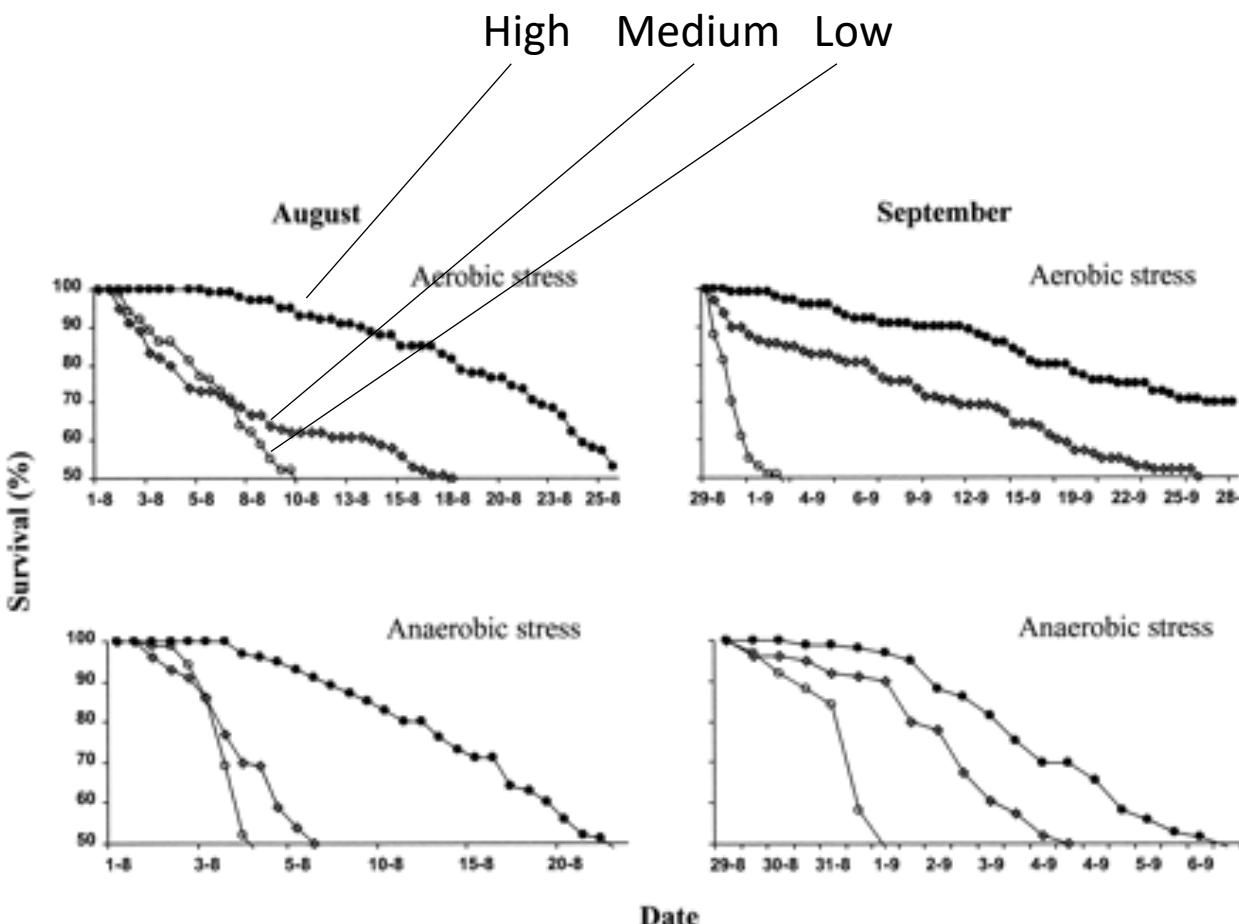


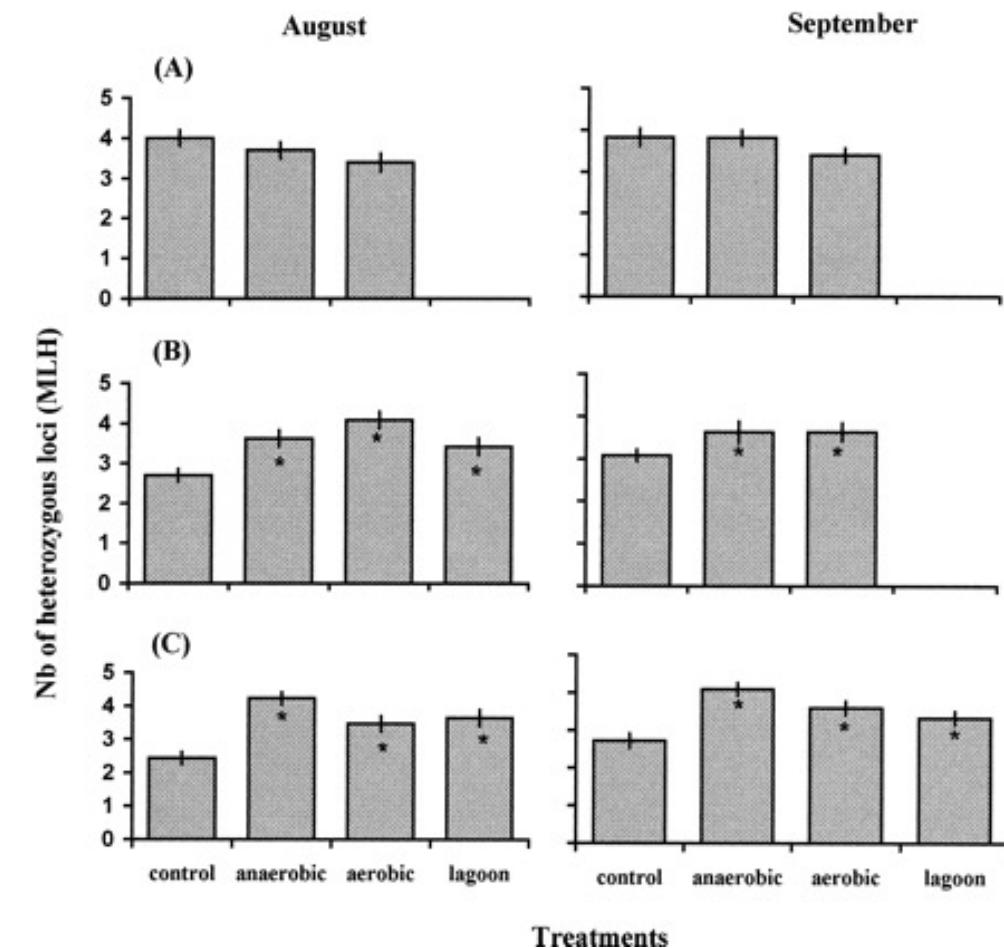
Week 7: detecting selection in genomic data

Overdominance example

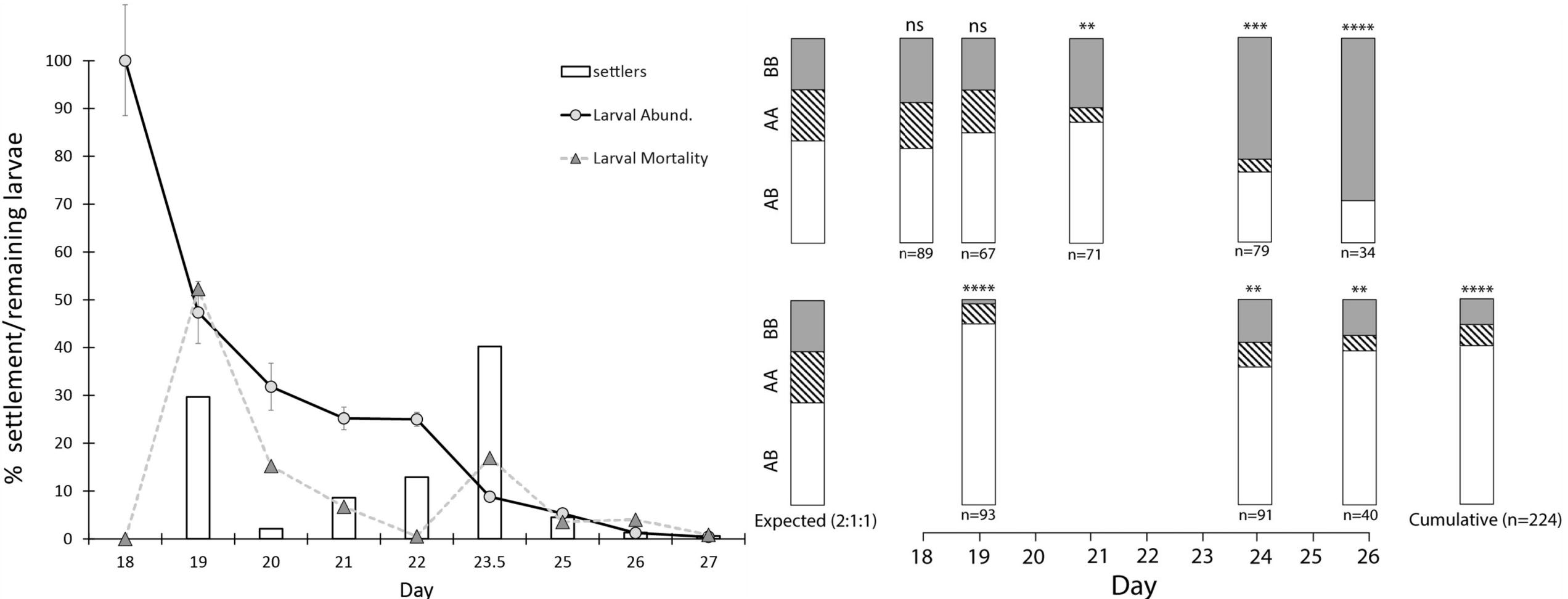
Overdominance: higher diversity → high survival
under stress in mussels



Number of heterozygous loci in survivors



Underdominance



Fine-scale temporal analysis of
genotype-dependent mortality at
settlement in the Pacific oyster
Crassostrea gigas

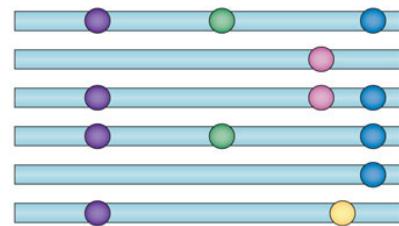
Detecting selection in genomic data

- Outlier scans
 - Basic fst based
 - More complex:
 - Bayscan, outflank, etc.
- Gene environment associations
- Cline analyses
- Experimental evolution
- Before and after studies
 - Think hurricanes, sea star wasting, etc.

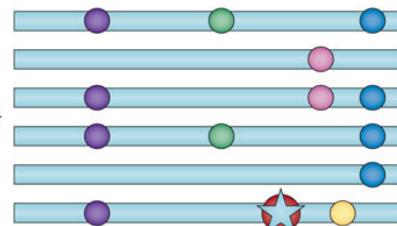
Types of selective sweeps

a Classic selective sweep

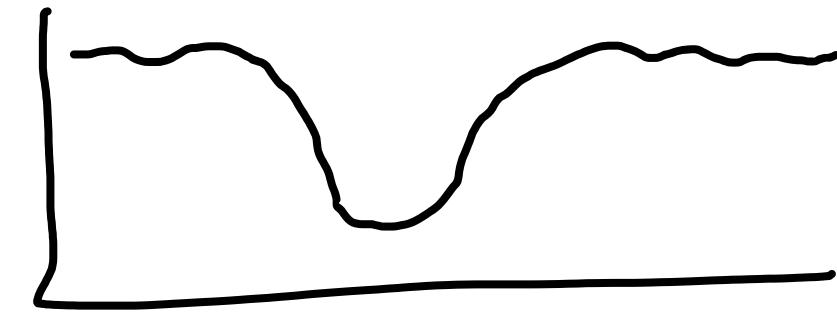
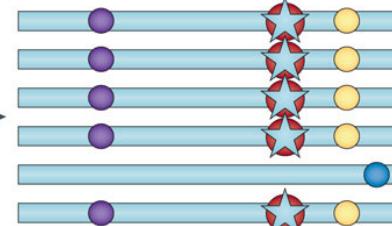
Neutral variation



An advantageous mutation arises



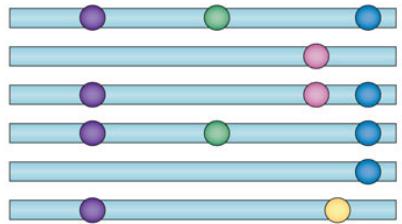
Over time, the advantageous mutation approaches fixation



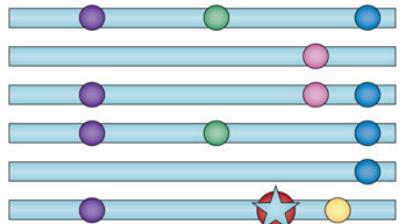
Types of selective sweeps

a Classic selective sweep

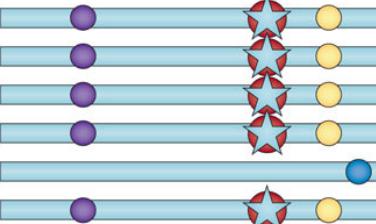
Neutral variation



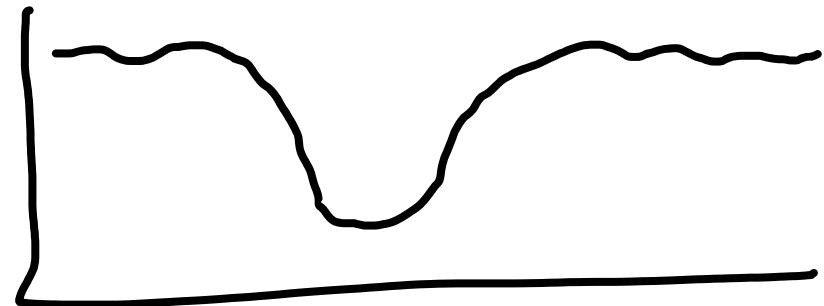
An advantageous mutation arises



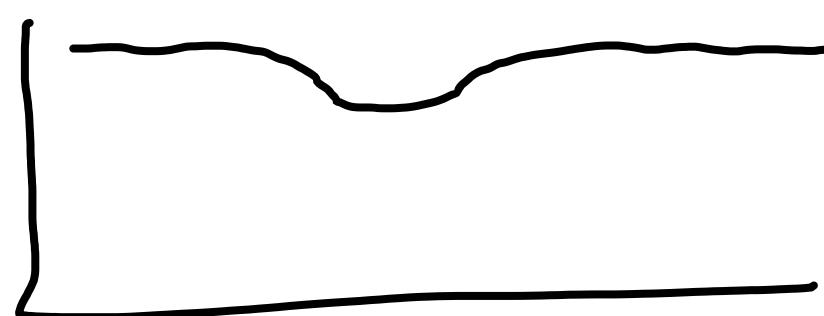
Over time, the advantageous mutation approaches fixation



Haplotype diversity



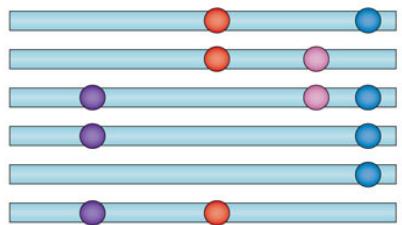
Haplotype diversity



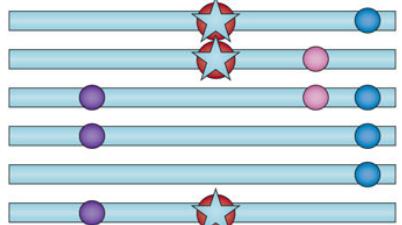
Haplotype diversity

b Selection from standing variation

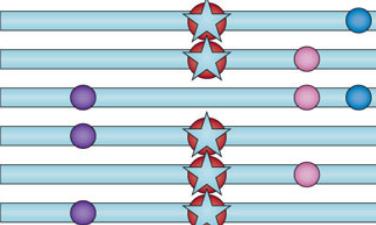
Neutral variation



A variant becomes adaptive in a new environment



Over time, the advantageous mutation approaches fixation



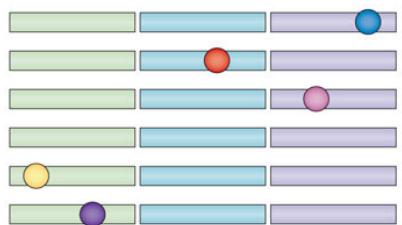
Haplotype diversity

Haplotype diversity

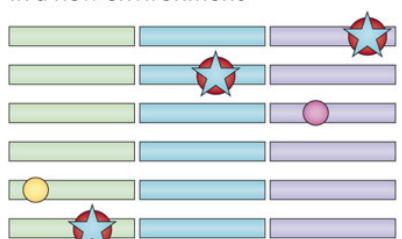
Haplotype diversity

c Selection on a complex trait

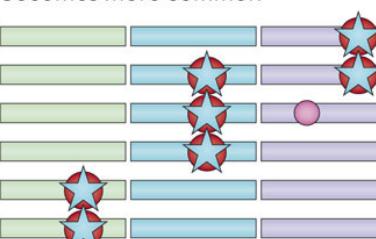
Neutral variation



A set of variants becomes adaptive in a new environment

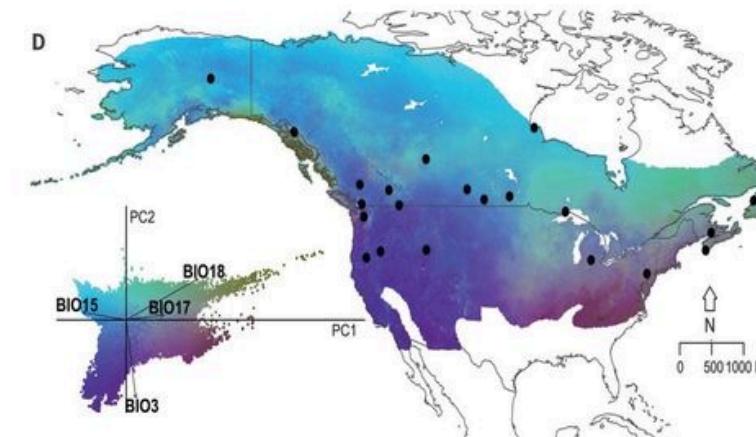


Over time, the set of variants becomes more common



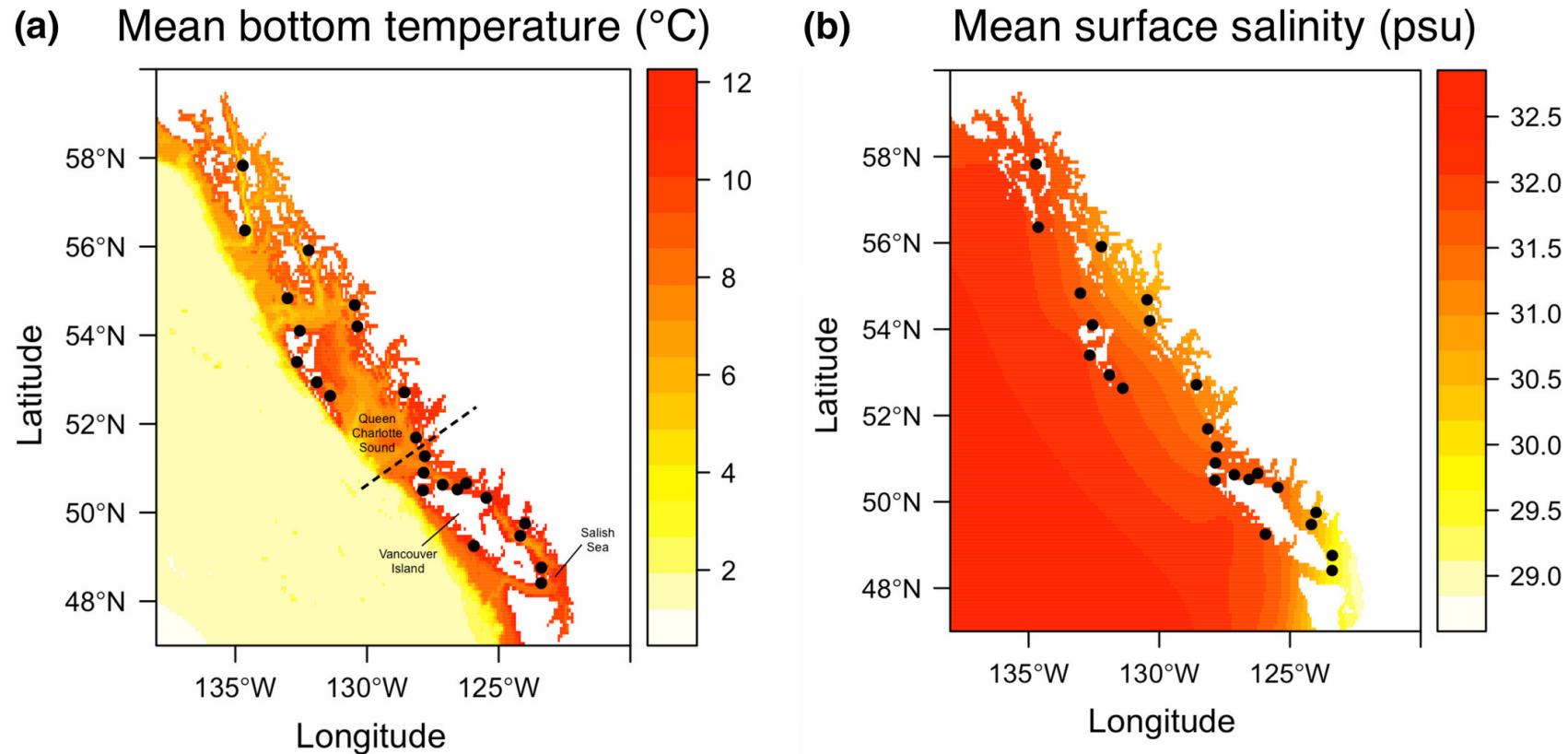
Gene environment associations

- Where is there a correlation between the environment and genetics?
- Important!
 - Must control for population structure!
- Methods:
 - Bayenv2
 - latent factor mixed models: LFMM2
 - Redundancy analysis
 - Machine learning
 - Gradient Forests, random forests



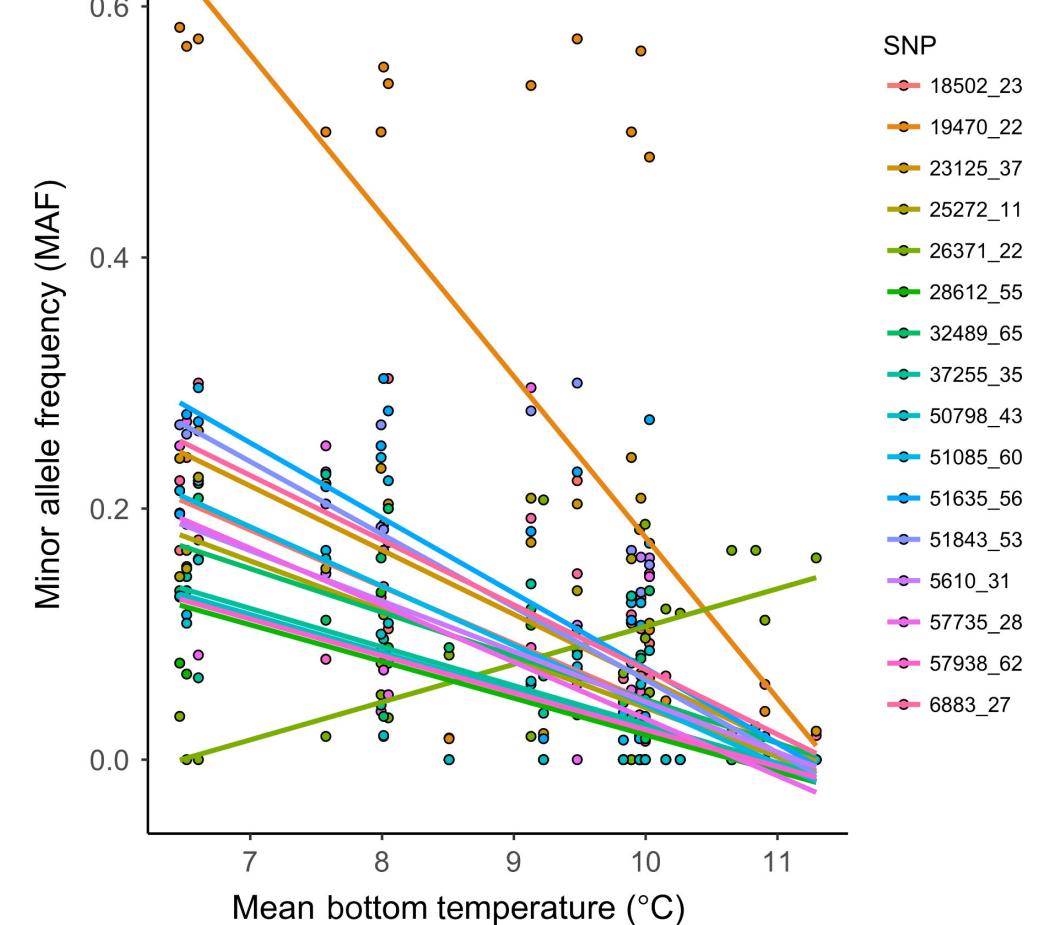
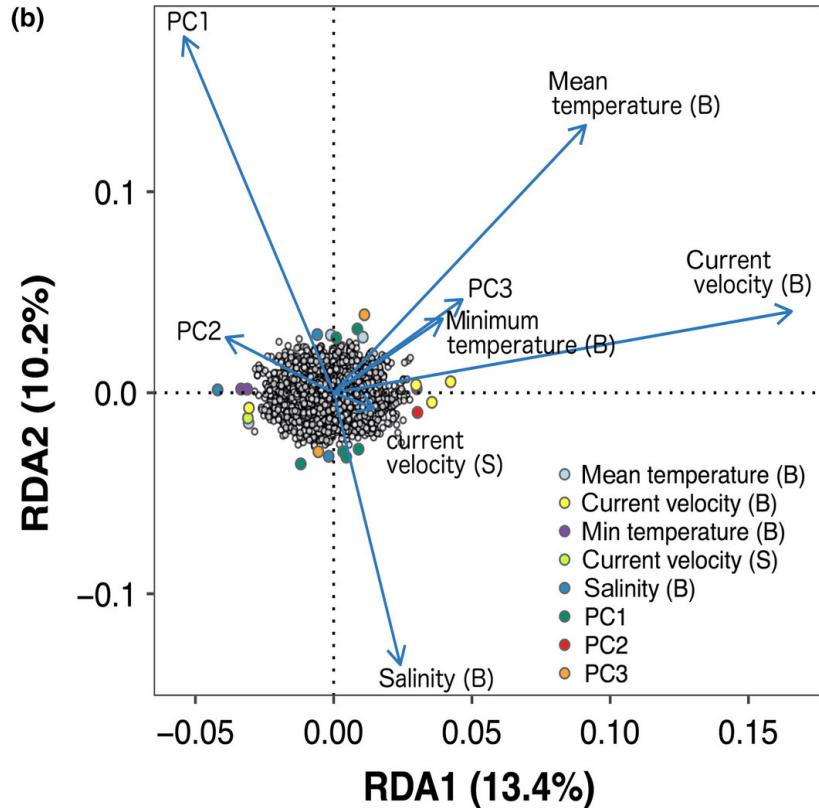
Putatively adaptive genetic variation in the giant California sea cucumber (*Parastichopus californicus*) as revealed by environmental association analysis of restriction-site associated DNA sequencing data

Amanda Xuereb¹  | Christopher M. Kimber²  | Janelle M. R. Curtis³ | Louis Bernatchez⁴  | Marie-Josée Fortin¹ 



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Before and after sampling

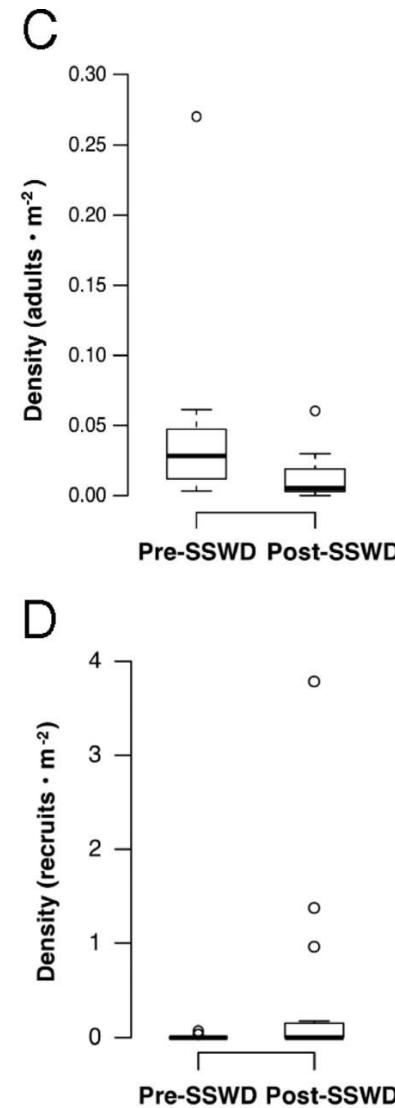
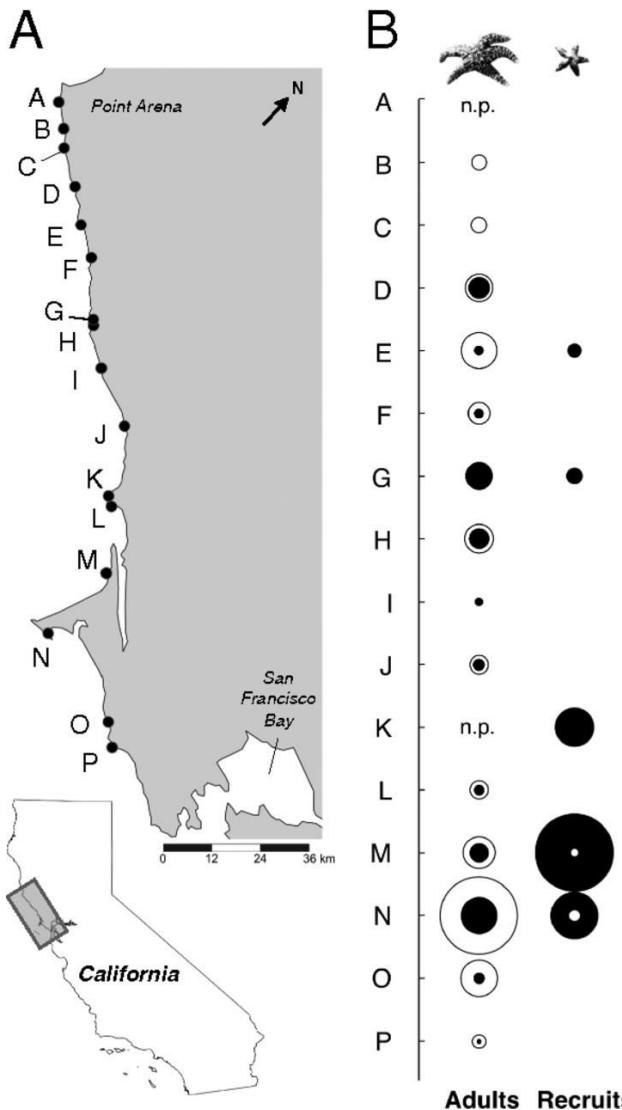


Rachael Williams



Michael Kyte

Before and after sampling

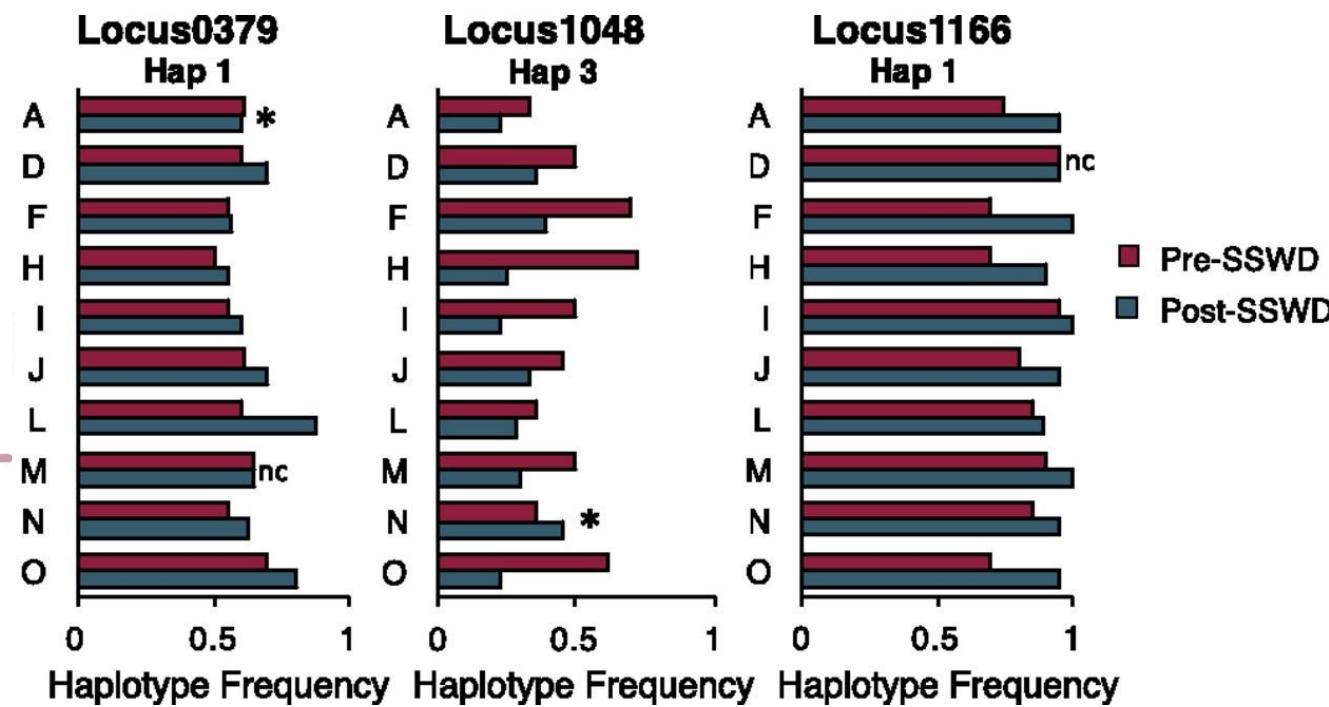
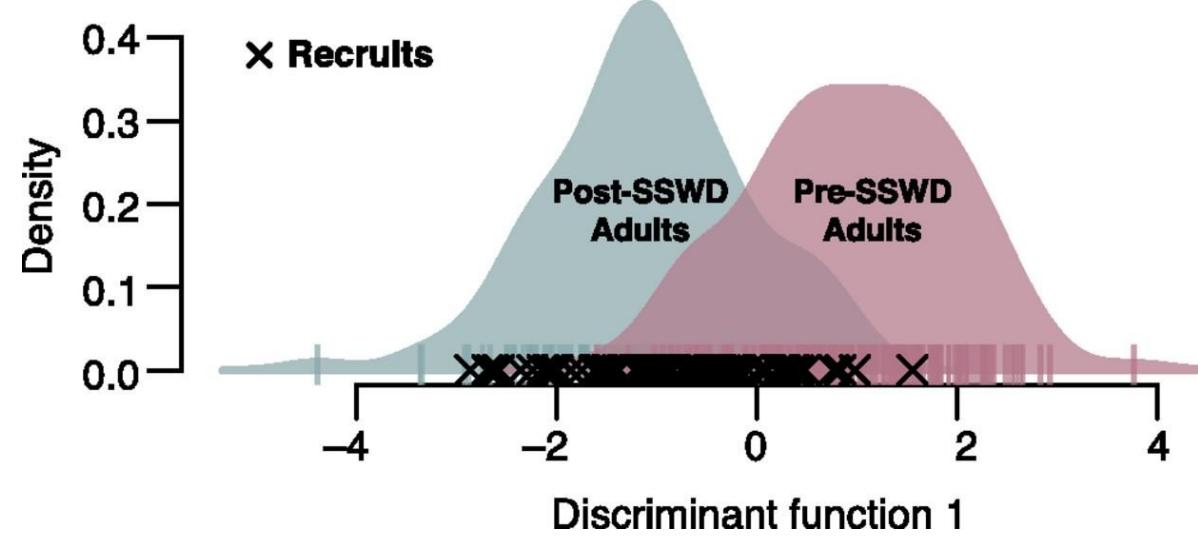


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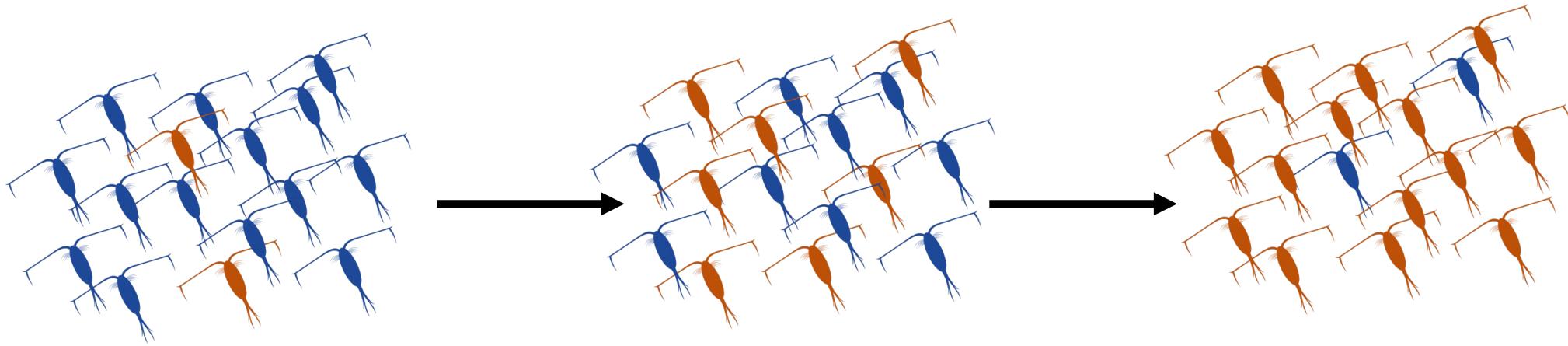
Decimation by sea star wasting disease and rapid genetic change in a keystone species, *Pisaster ochraceus*

Lauren M. Schiebelhut , Jonathan B. Puritz, and Michael N. Dawson [Authors Info & Affiliations](#)





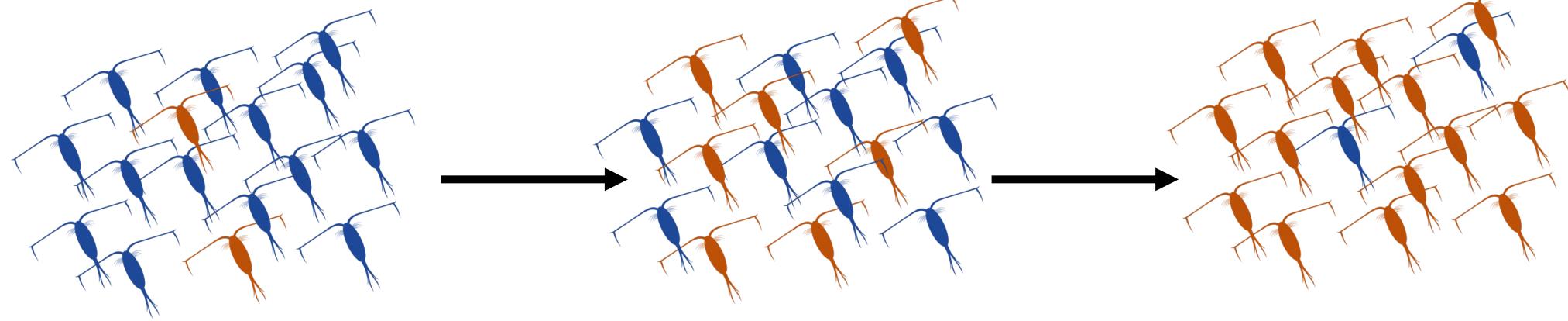
Experimental evolution/Evolve and resequence



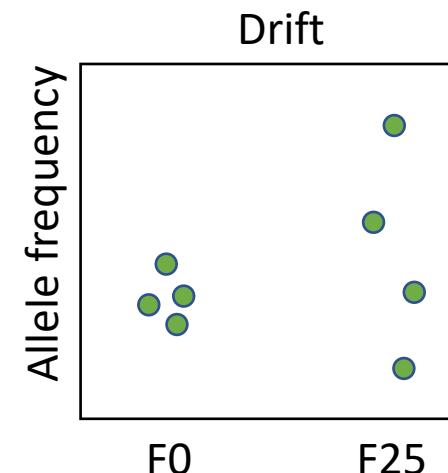
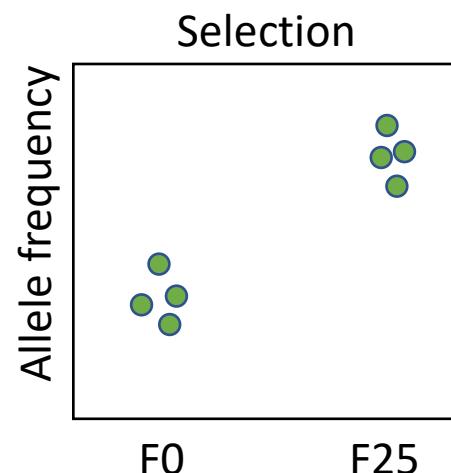
Observe evolution as it happens

Look for consistent changes in allele frequencies

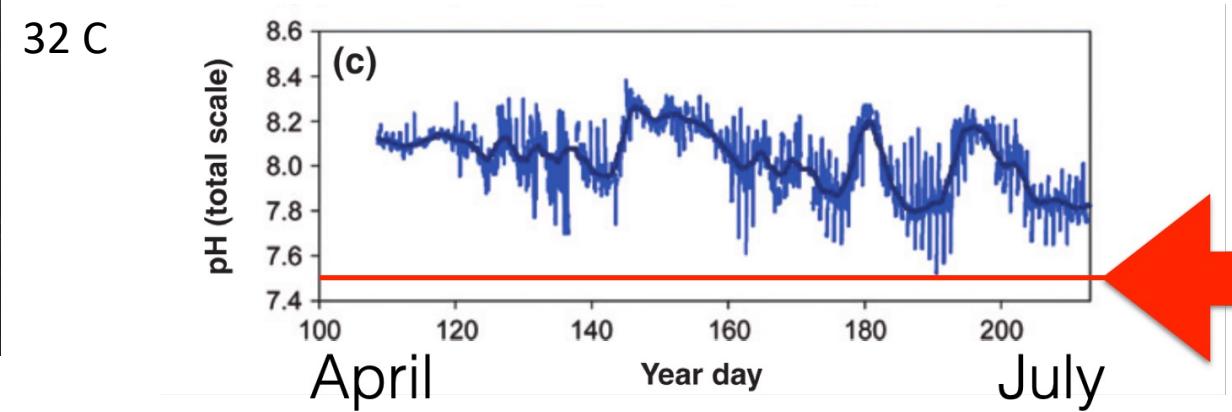
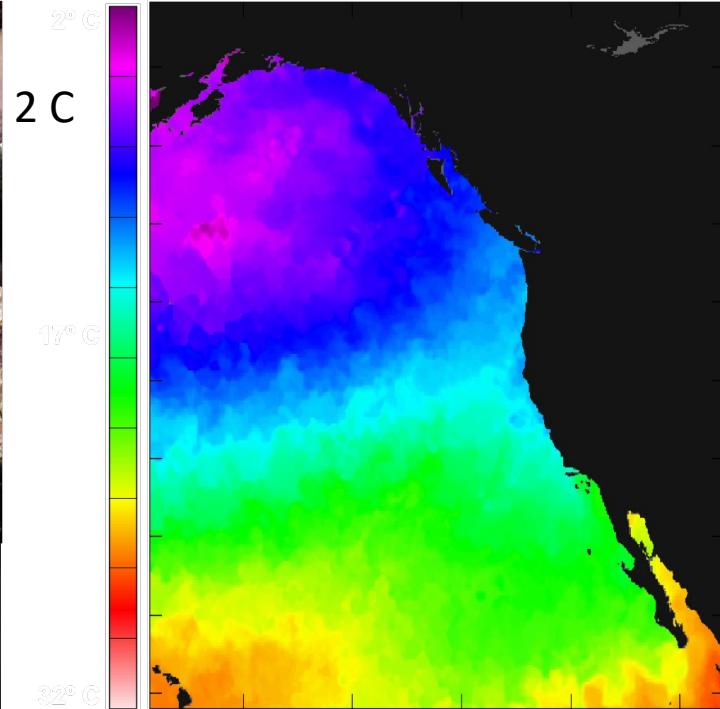
Experimental evolution/Evolve and resequence



Selection across generations



Purple sea urchin: single generation selection



Rare genetic variation and balanced polymorphisms are important for survival in global change conditions

Reid S. Brennan[†], April D. Garrett[†], Kaitlin E. Huber, Heidi Hargarten and Melissa H. Pespeni

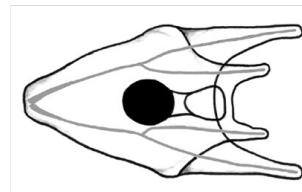
Blastula



Major skeletal growth

24 hours post fert.

4-arm pluteus

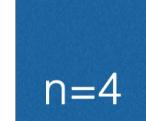


7 days post fert.

Genomic samples:



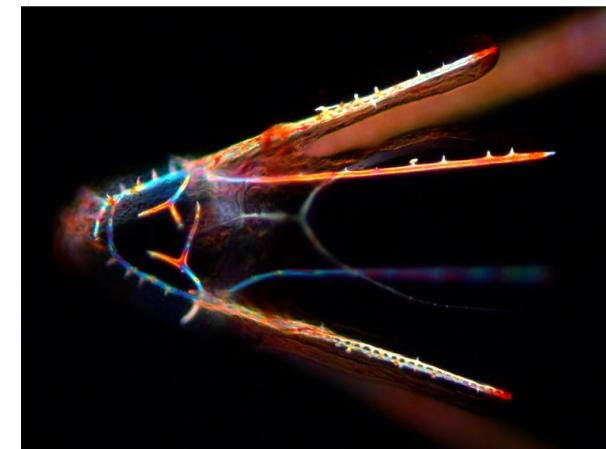
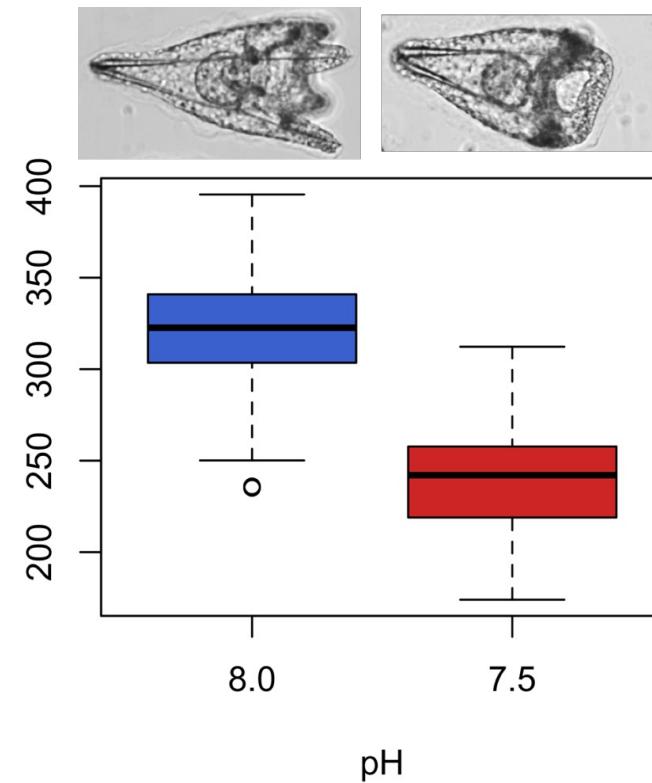
Mild: pH 8.0

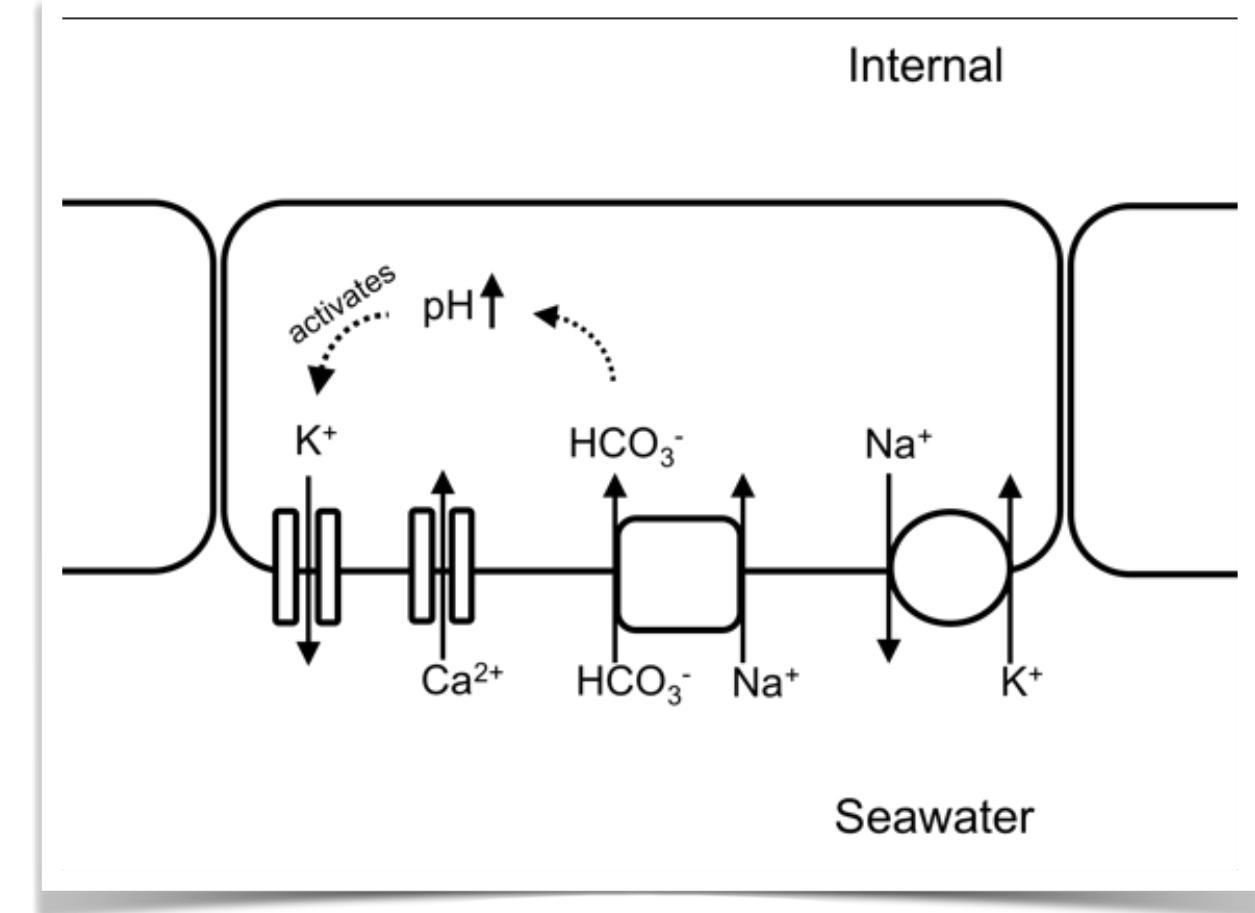
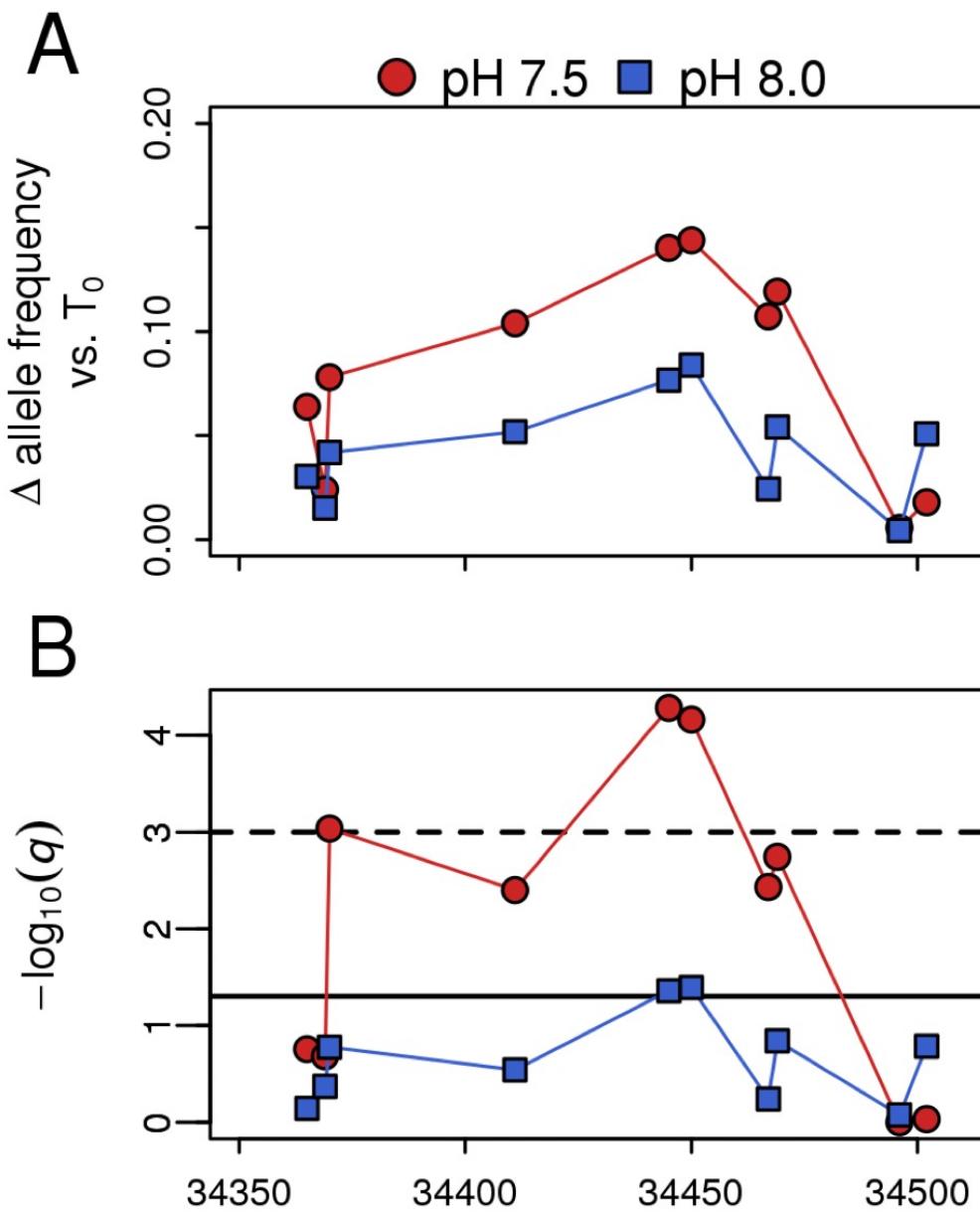


Extreme: pH 7.5



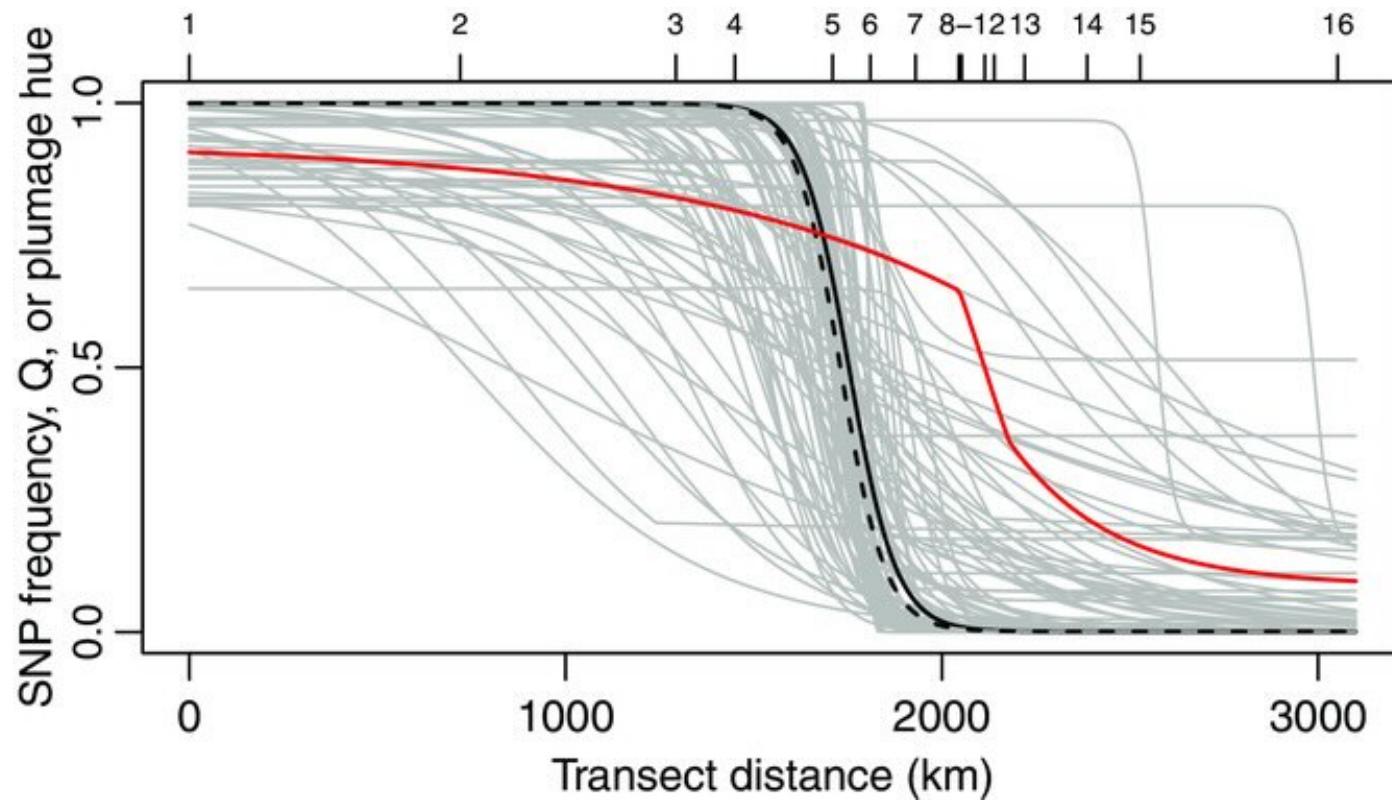
Total Body Length (micrometers)



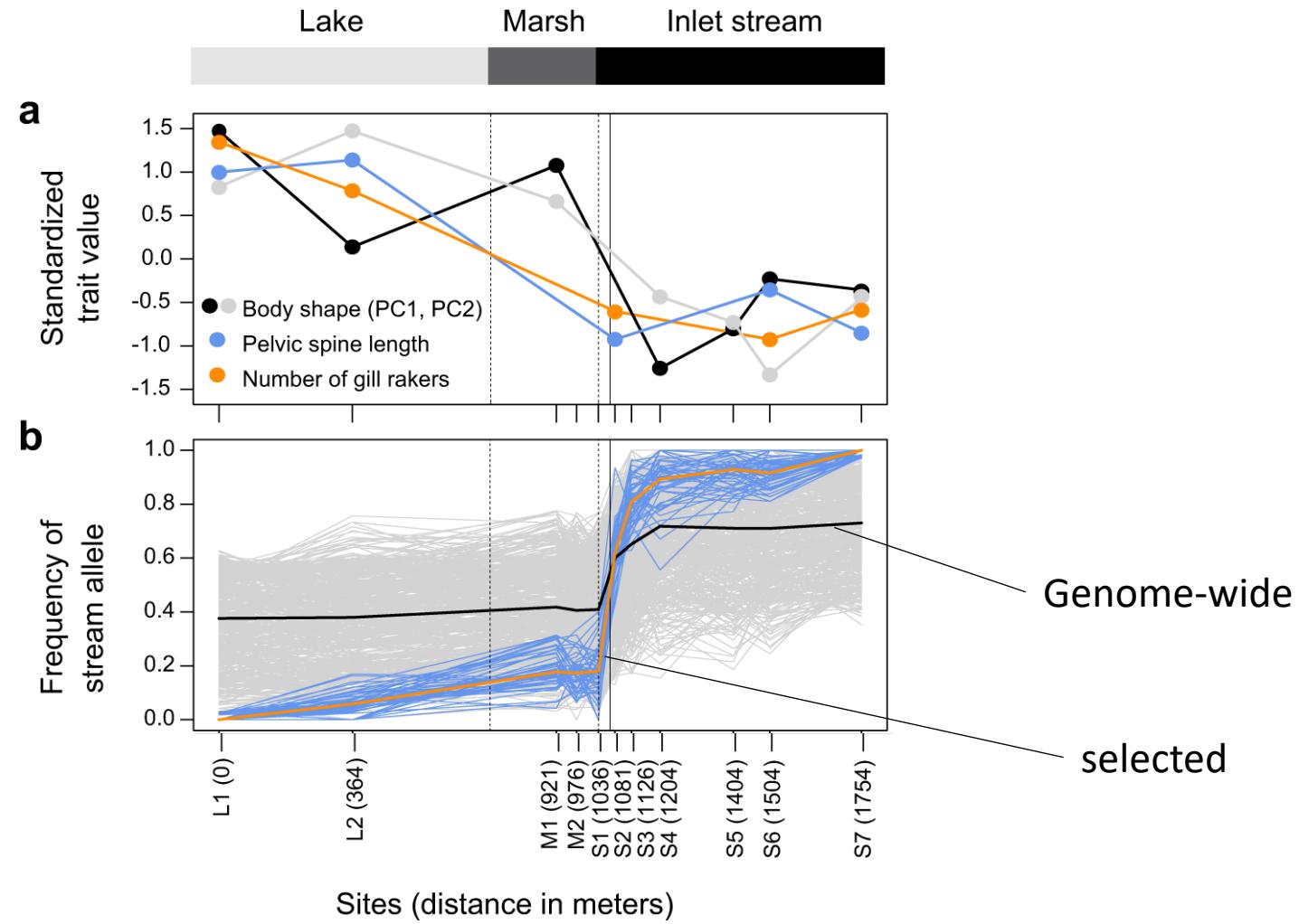
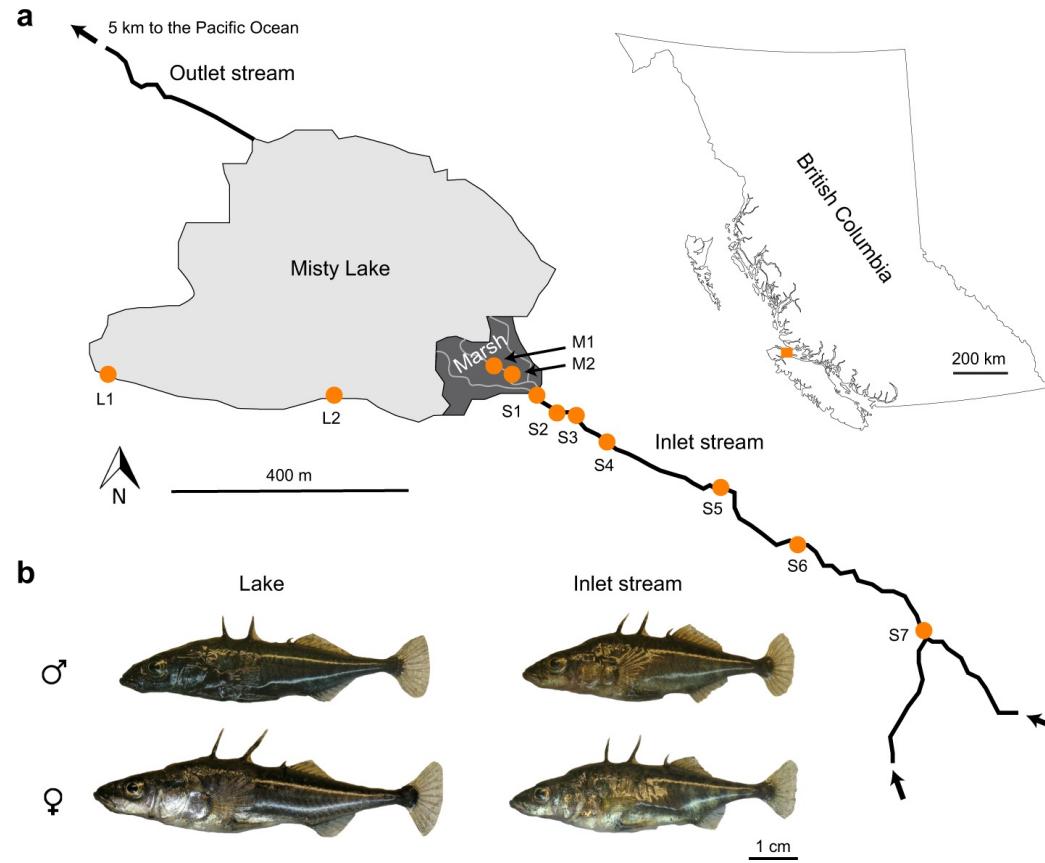


Cline analyses

- Hybrid zone:
 - Where genetically distinct populations meet, mate, and produce offspring
 - Expect neutral allele frequency transition
 - Where do you see violations of neutrality?



Cline analyses



GEA paper in 2 weeks



ORIGINAL ARTICLE | [Full Access](#)

Copy number variants outperform SNPs to reveal genotype–temperature association in a marine species

Yann Dorant✉, Hugo Cayuela, Kyle Wellband, Martin Laporte, Quentin Rougemont, Claire Mérot, Eric Normandeau, Rémy Rochette, Louis Bernatchez

First published: 17 August 2020 | <https://doi.org/10.1111/mec.15565> | Citations: 22