

Next-generation population genomics of native and aquacultured Mediterranean mussel, *Mytilus galloprovincialis*

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„Genotyping by sequencing: new tool for population genomics of native and aquacultured Mediterranean mussel, *Mytilus galloprovincialis*”

„The effects of pollution on rapid evolution and ecological change in the Mediterranean mussel (*Mytilus galloprovincialis*)”



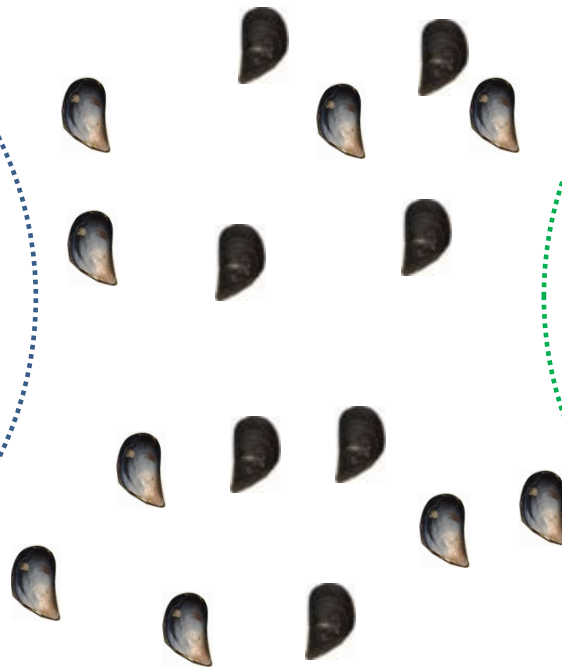
The
University
Of
Sheffield.



HIGH CONNECTIVITY BETWEEN NATIVE AND AQUACULTURED POPULATIONS



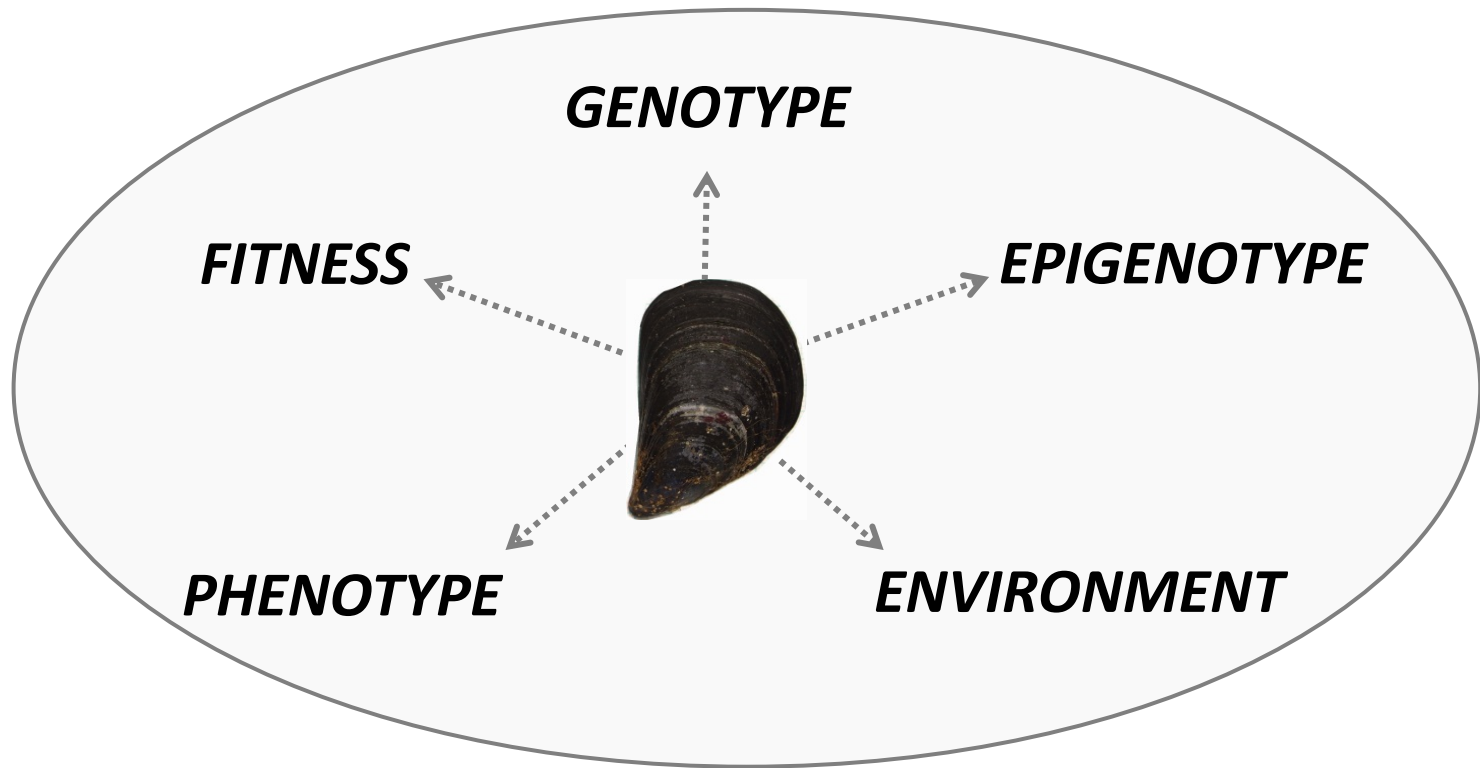
NATIVE



gametes → long lived pelagic larvae



AQUACULTURED



NGS – GENOMICS AND EPIGENOMICS

FITNESS AND MORPHOMETRY

GWAS

ENVIRONMENTAL VARIABLES

- Native and aquacultured populations
- Transplant and mesocosms experiments

An aerial photograph of a large-scale aquaculture farm. The image shows a vast expanse of blue water with numerous long, parallel rows of floating pens or cages stretching across the horizon. The pens are supported by vertical posts and appear to be filled with water. The overall scene is a dense, organized layout of aquaculture infrastructure in an open body of water.

AQUACULTURE PRACTICES

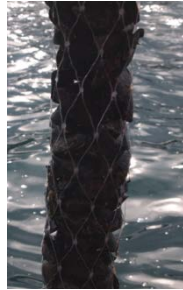
(300 000 t per year)

AQUACULTURE PRACTICES

1. Collection of natural spats - mooring ropes

2. Nylon nets

a) cotton nets



b) anti-predator protection nets

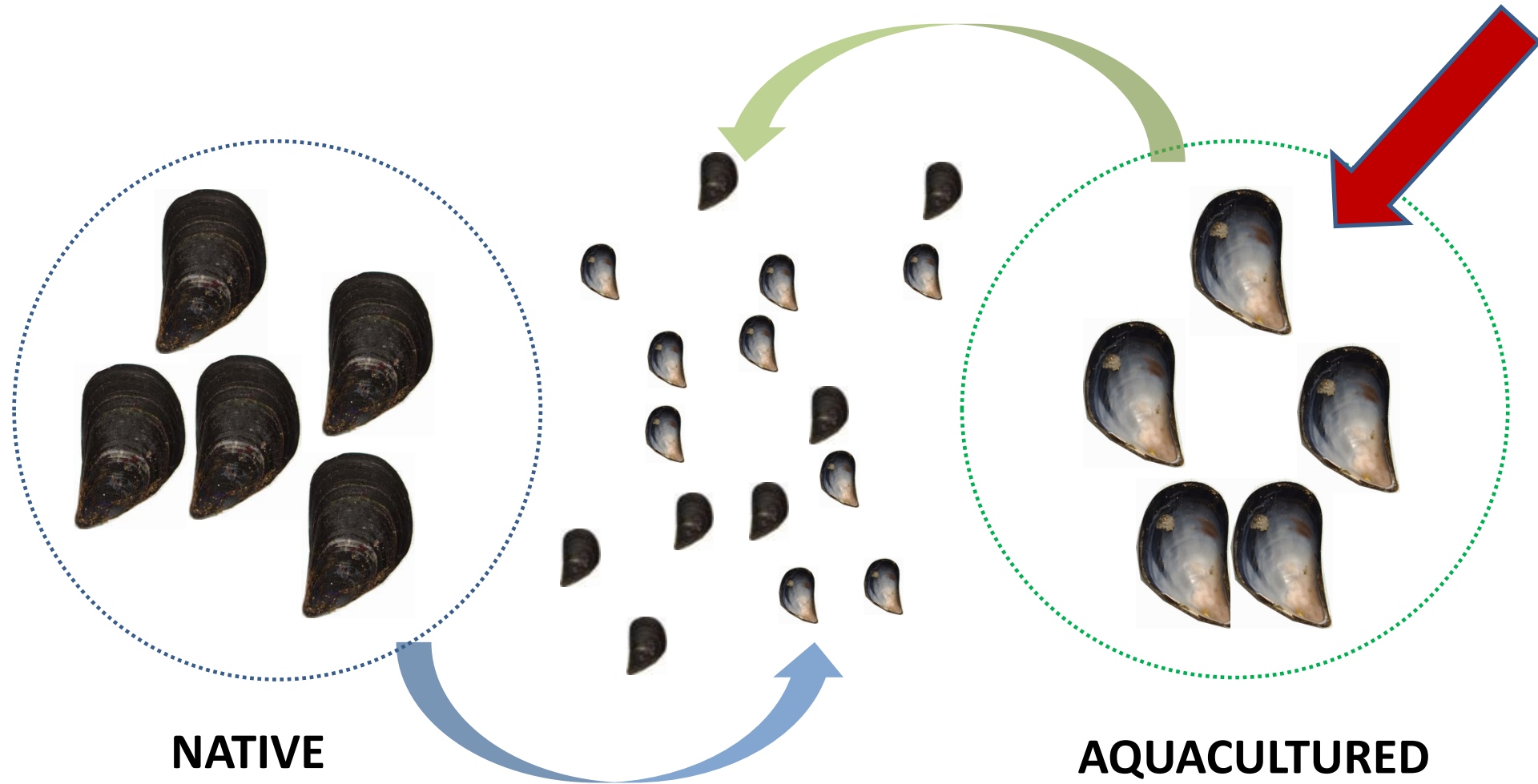


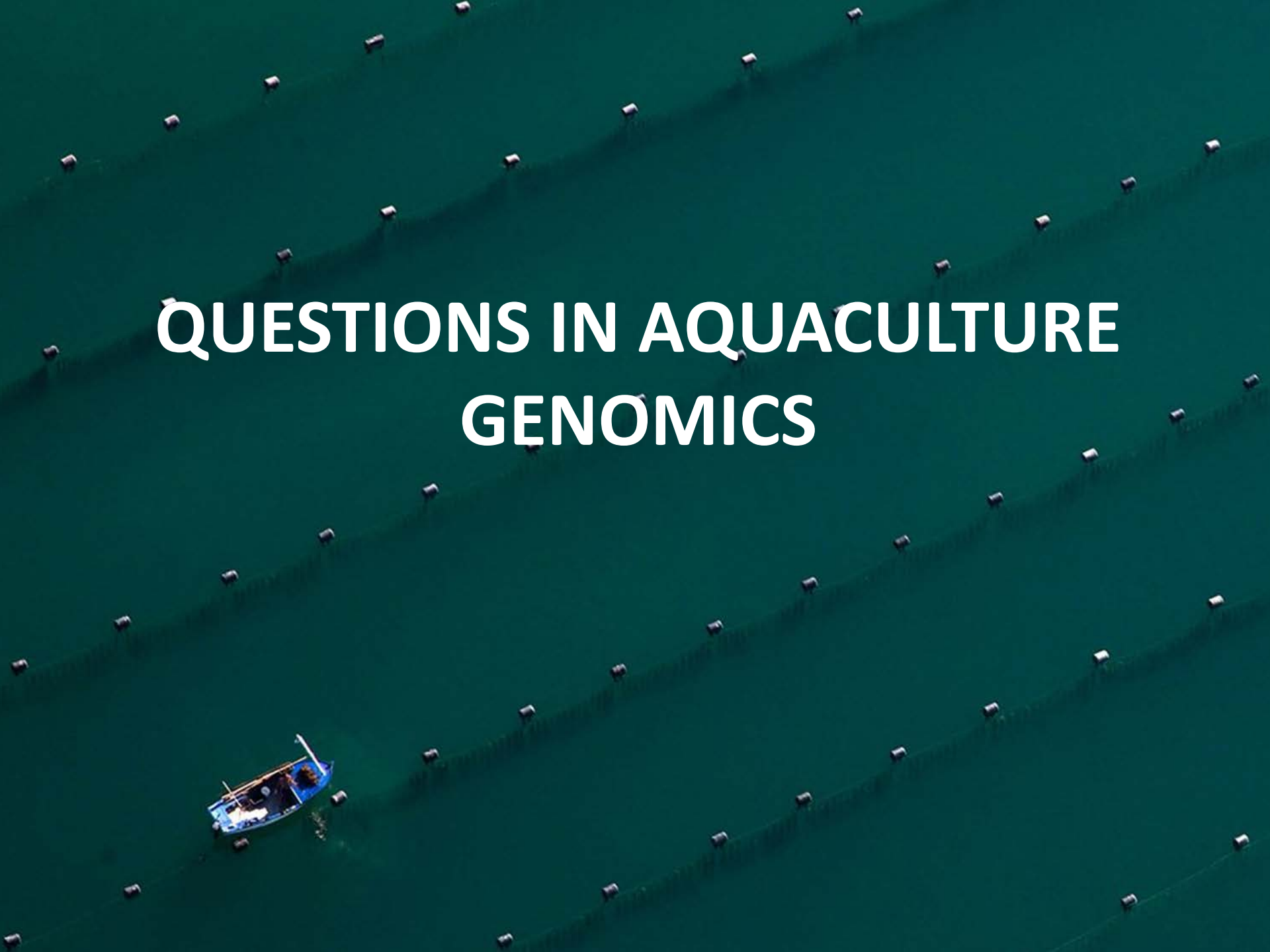
c) without anti-predator nets



DIFFERENT SELECTIVE REGIMES!

HIGH CONNECTIVITY BETWEEN NATIVE AND AQUACULTURED POPULATIONS



An aerial photograph of a vast aquaculture farm. The water is a deep, dark teal color. Numerous parallel lines of dark netting stretch across the water, forming a grid-like pattern. Small, light-colored buoys are spaced evenly along these lines. In the lower-left quadrant, a small blue boat with a white cabin is visible, moving through the water. The overall scene is a large-scale industrial operation in a natural aquatic environment.

QUESTIONS IN AQUACULTURE GENOMICS

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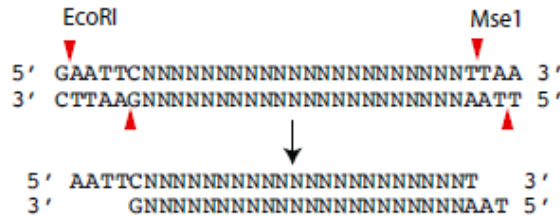
- Effect of **aquaculture practices** on *Mytilus* genomics?
- **Adaptation** and **acclimatization** to local environmental conditions?
- **Genomic basis** of fitness
- Interaction between **ecological factors** and fitness

Mytilus galloprovincialis

- Non-model species
- Genotyping by sequencing approach (RAD tags)

GENOTYPING BY SEQUENCING

1. Digest double-stranded DNA with EcoRI and MseI.



2. Ligate adaptors to fragments. Adaptors include adaptor sequence, barcode, cutsite, and protector base (adaptors in color; EcoRI on left, MseI on right).

Illumina PCR primer I (i11per1)

5' AATGATACGGCGACCACCGAGATCTACACTCTTTCCCTACACGACGCTCTTCCGATCT 3'

5' CTCTTTCCCTACACGACGCTCTTCCGATCT **ATCAGACACGCA**ATTCNNNNNNNNNT**TA**CAGATCGGAAGAGCTCGTATGCCGTCTTCTGCTTG 3'

3' TGTGAGAAAGGGATGTGCTGCGAGAAGGCTAGATAG**TCTGTGCGTTA**AGNNNNNNNNNAATGTCTAGCCTTCTCGAGCATACGGCAGAAGACG 5'

3' GAATGTCTAGCCTTCTCGAGCATACGGCAGAAGACGAAC 5'

ACACTCTTTCCCTACACGACGCTCTTCCGATCT

Illumina sequencing primer

Illumina PCR primer II (i11per2)

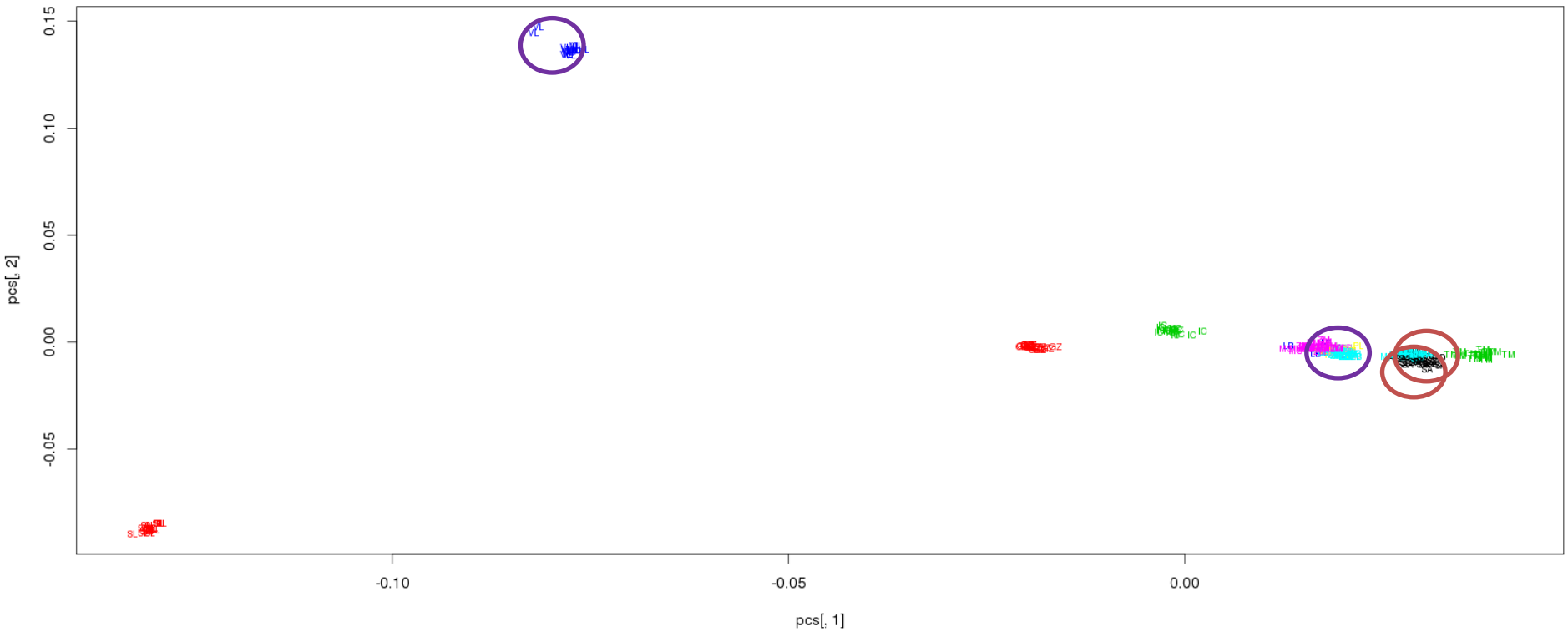
- Amplify fragments with Illumina PCR primers.
- Gel purify PCR product in the desired size range (300-400bp).
- Illumina sequencing.

ANALYSIS OF GBS DATA

1. Demultiplexing and quality control of reads
 2. *De novo* assembly of pseudoreference *Mytilus* genome
 3. Mapping the reads and SNP calling
 4. Genotype likelihoods and probabilities
- **over 800,000 SNPs across the genome!**

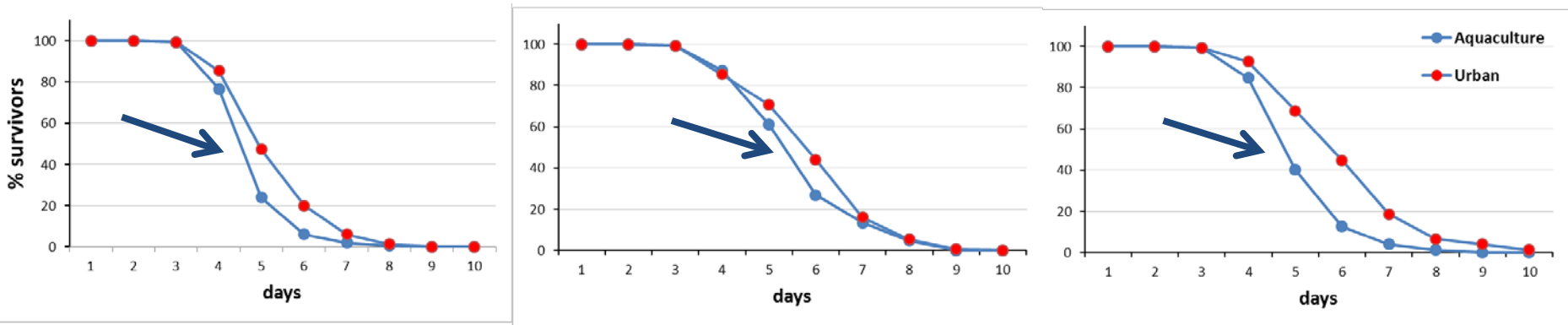
LOW IBD – ROLE OF IBA?

Preliminary results on native populations

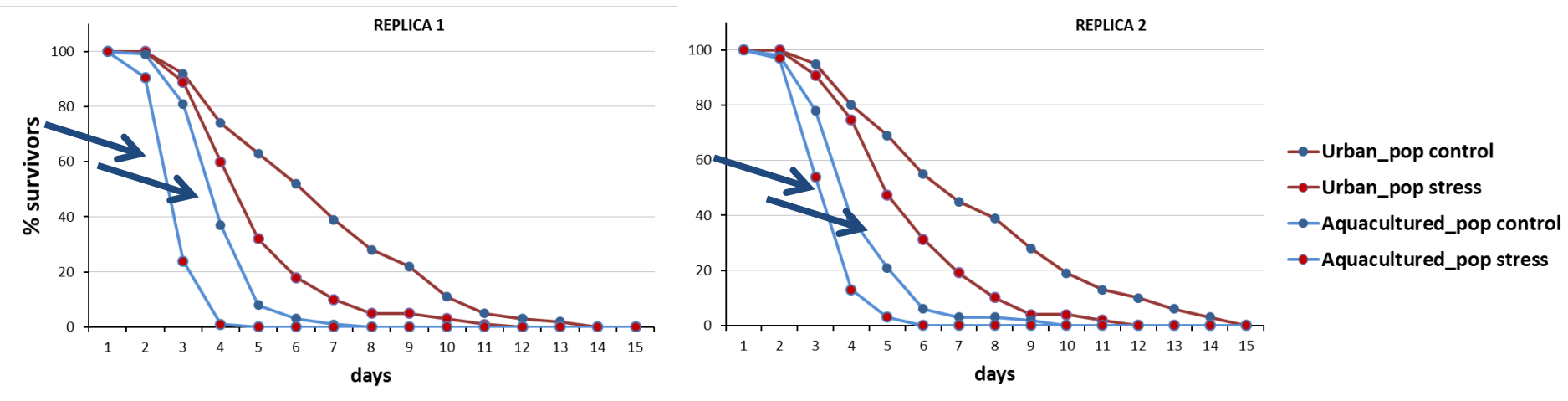


ENVIRONMENT AND GENOTYPE DEPENDENT LOWER STRESS IN AQUACULTURE POPULATIONS

TRANSPLANT EXPERIMENT – ONE AQUACULTURE POP TO THREE PAIR SITES

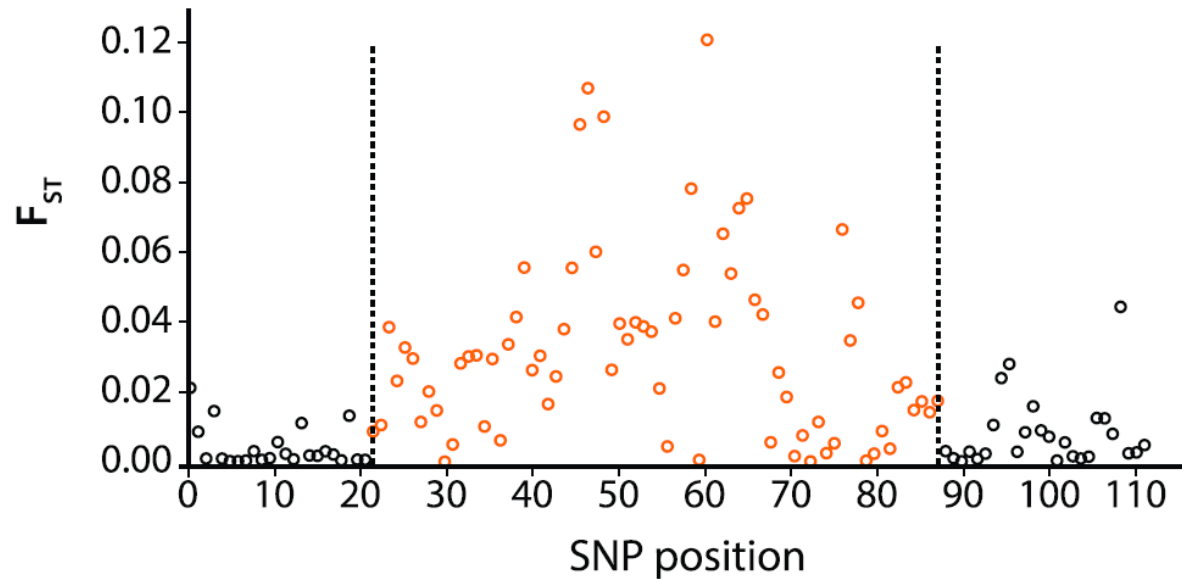


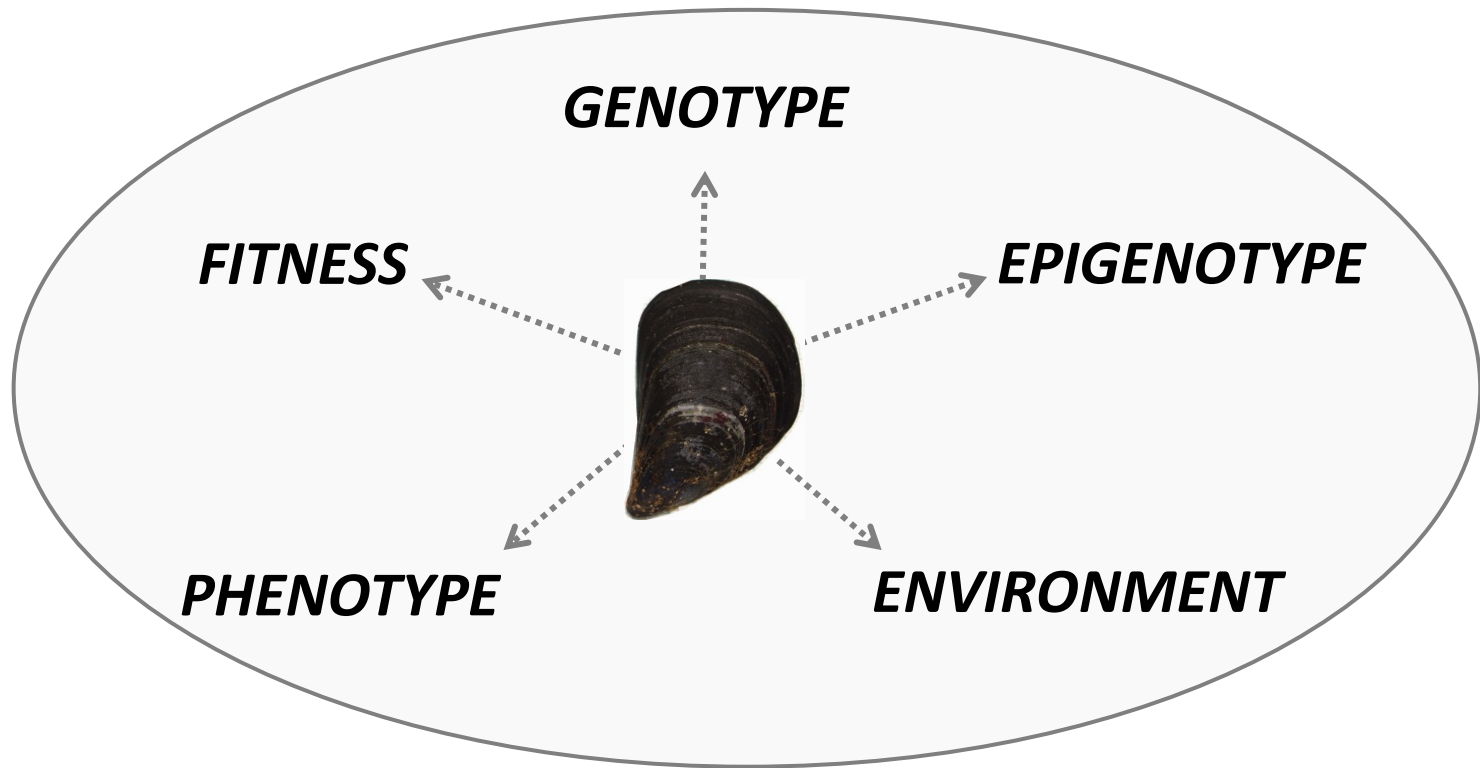
MESOCOSM EXPERIMENT – AQUACULTURE AND URBAN POP EXPOSED TO STRESS



LOCI UNDER SELECTION

Bayesian approach to detect F_{ST} outliers





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