A functional genomics approach to assessing ecosystem health and resilience in keystone bioindicator species

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PICES 2013 Annual Meeting, 17 October 2013

Mytilus species

Image redrawn from Springer & Crespi 2007, doi 10.1111/j.1558-5646.2007.00073.x

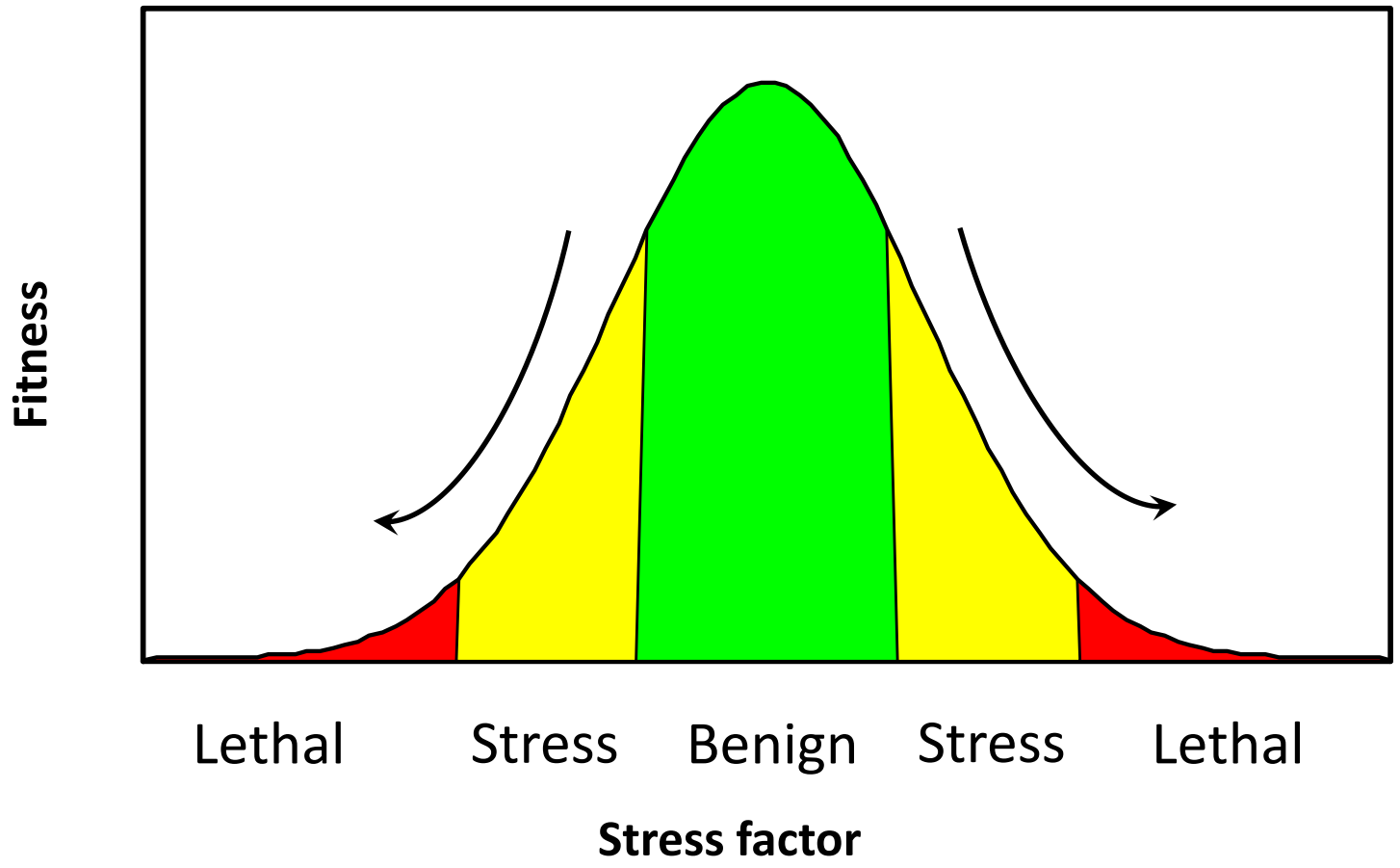
Project background

Taylor Shellfish

John Rowley

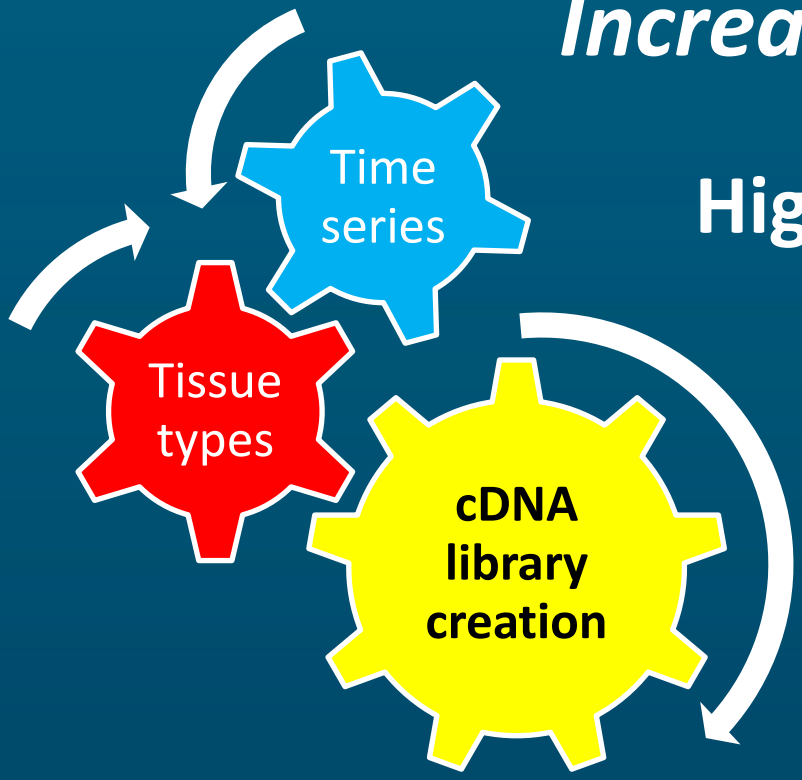
Good market opportunities, mortality events

Cause and effect

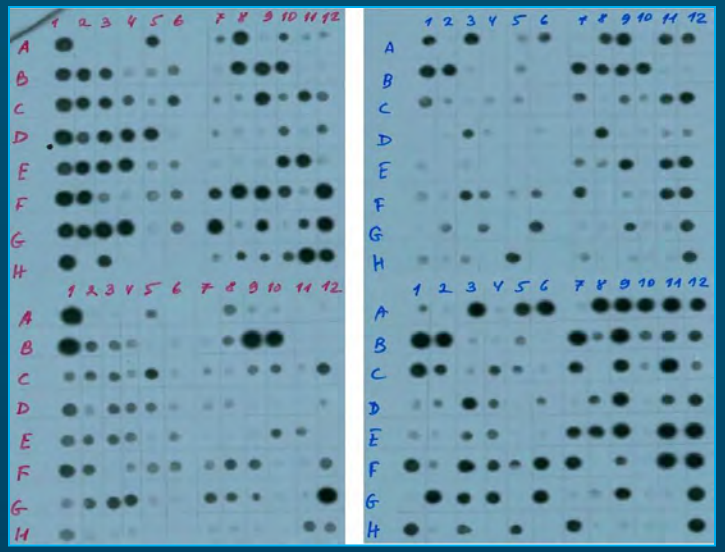


Redrawn from Sørensen JG and Loeschcke V (2007). J. Biosci. 32(3):447-456.

Increase genomic information



Highly normalized and **subtracted libraries** (both species)

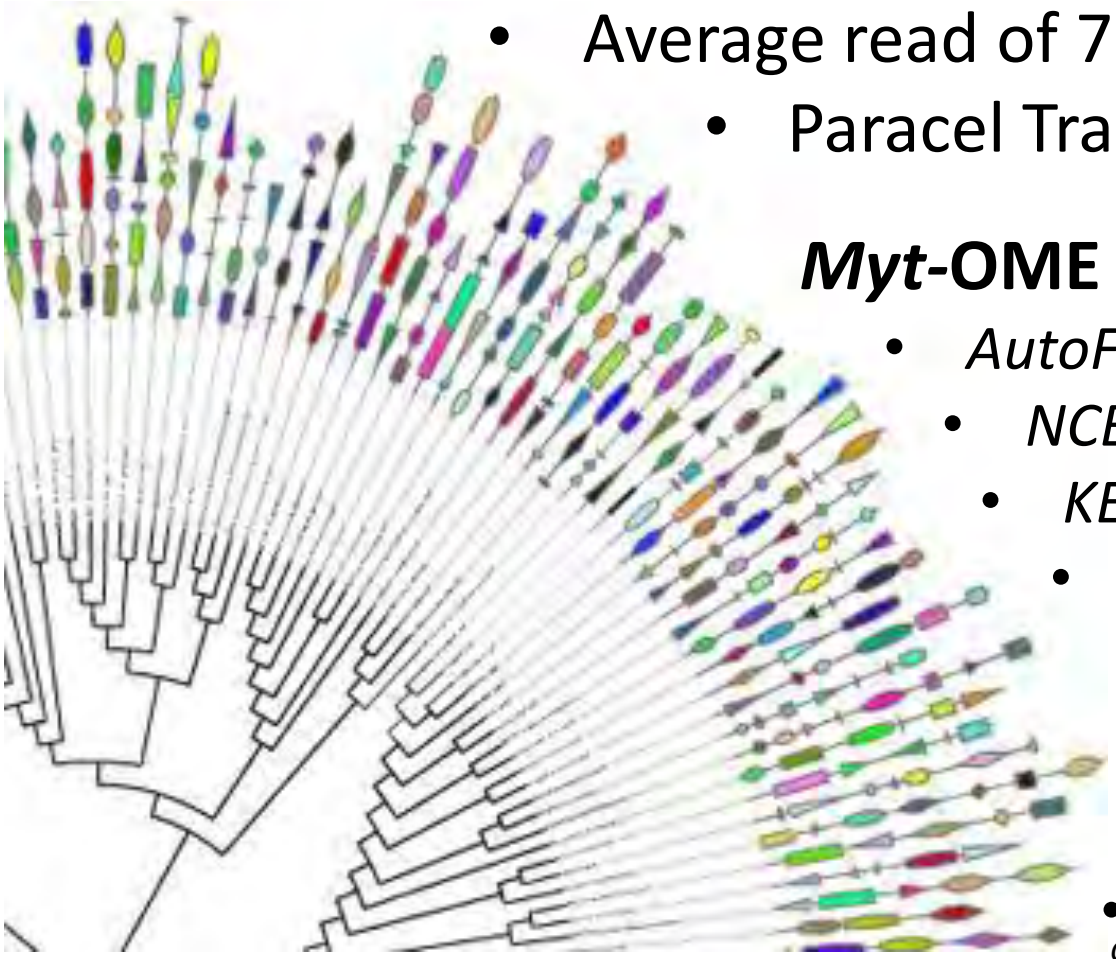


stress control

Bi-directional Sanger **sequencing** (~18K clones)

Myt-OME bioinformatics

35,157 Expressed Sequence Tags (ESTs)



- Average read of 750 bases
- Paracel Transcript clustering

Myt-OME sequence annotation

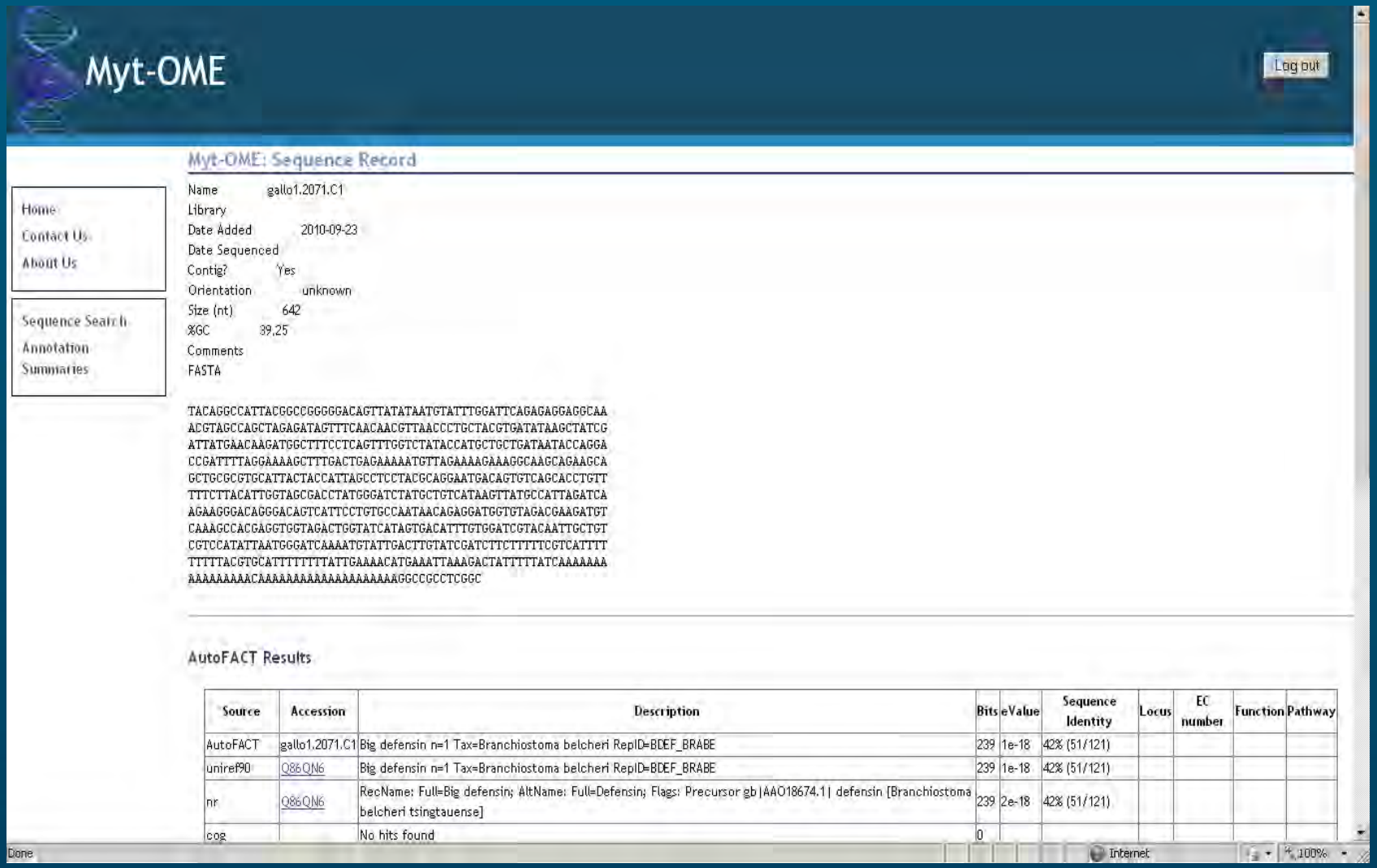
- *AutoFact*
- *NCBI*
- *KEGG, Pfam, LSU, SSU*
- *mollusca_pro and mytibase*

NCBI GenBank non-project sequences

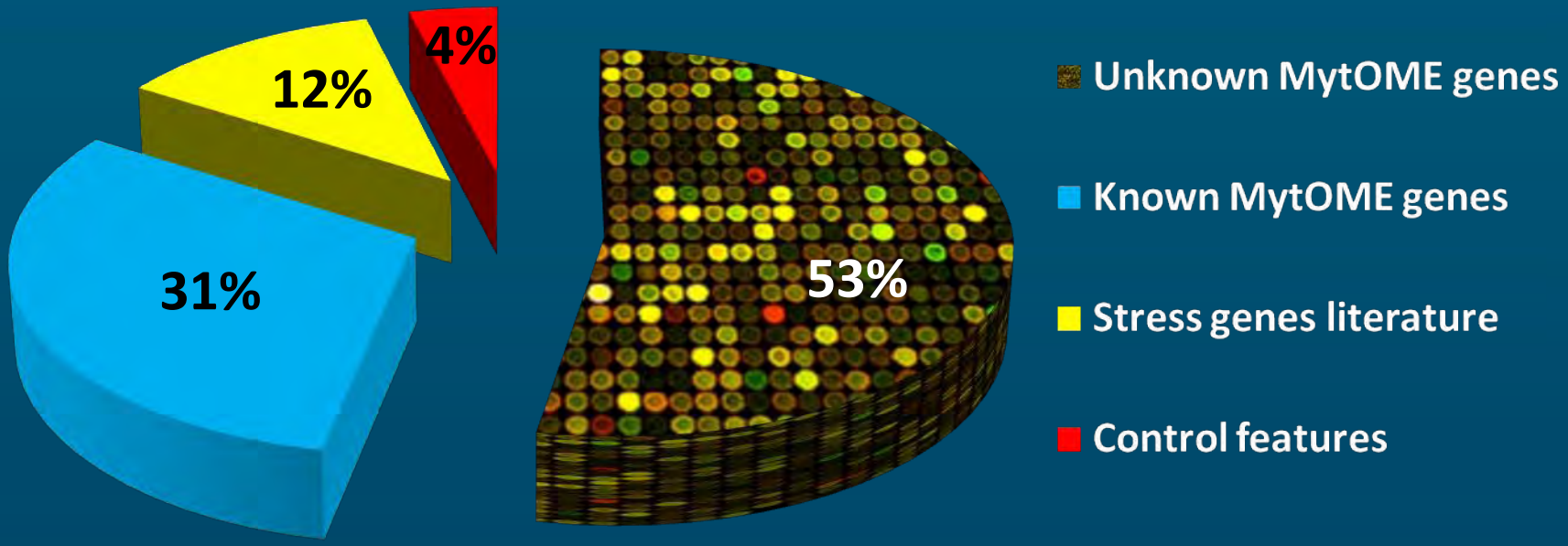
- *Annotation by AutoFact*

csc.uvic.ca

www.mytome.ca

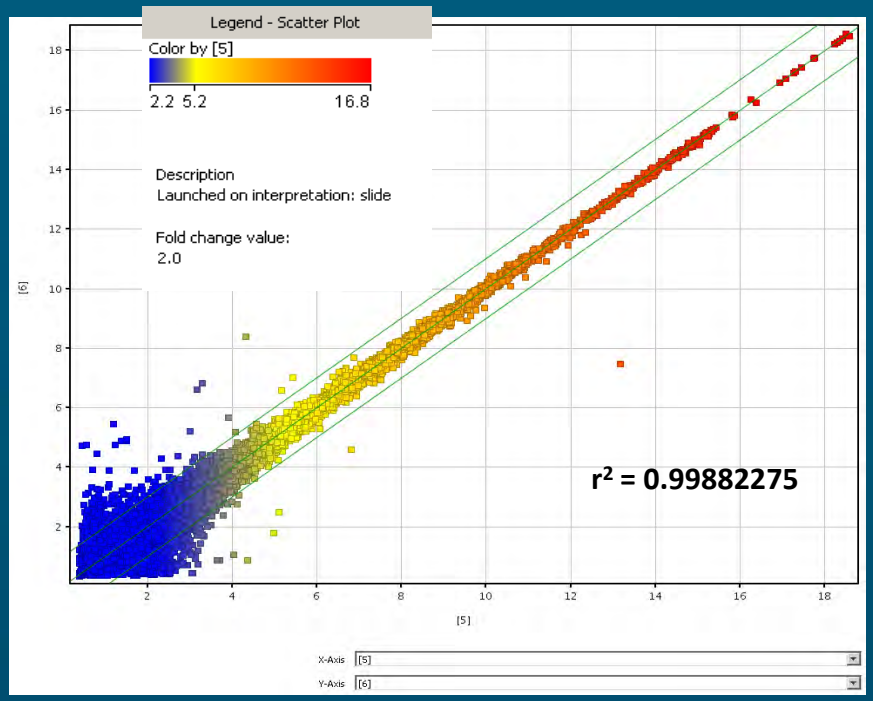


Myt-OME microarray

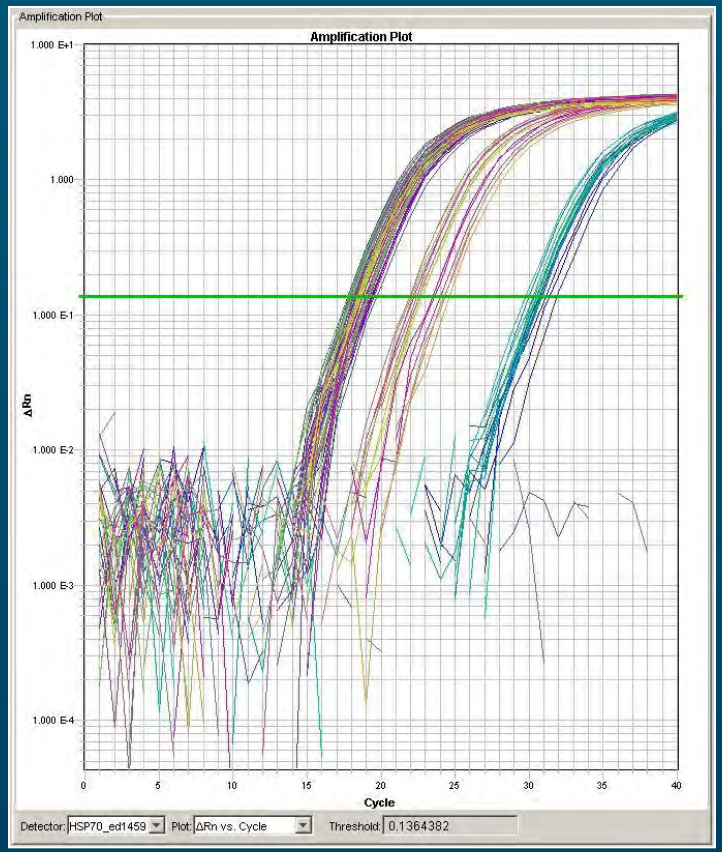


AMADID number and eArray to facilitate collaboration / modifications

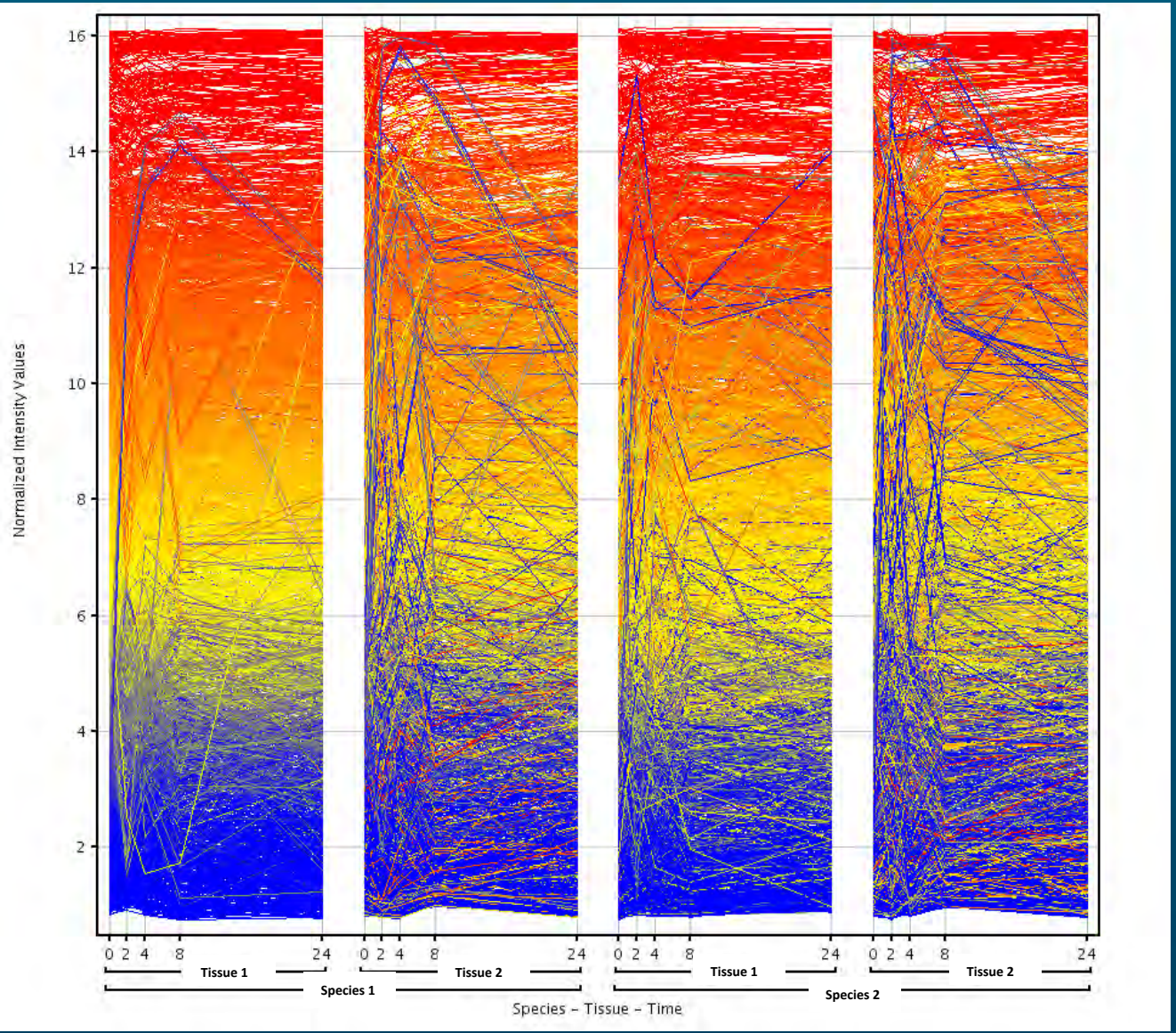
Microarray image: db.cse.ohio-state.edu



Tool performance – *highly consistent*



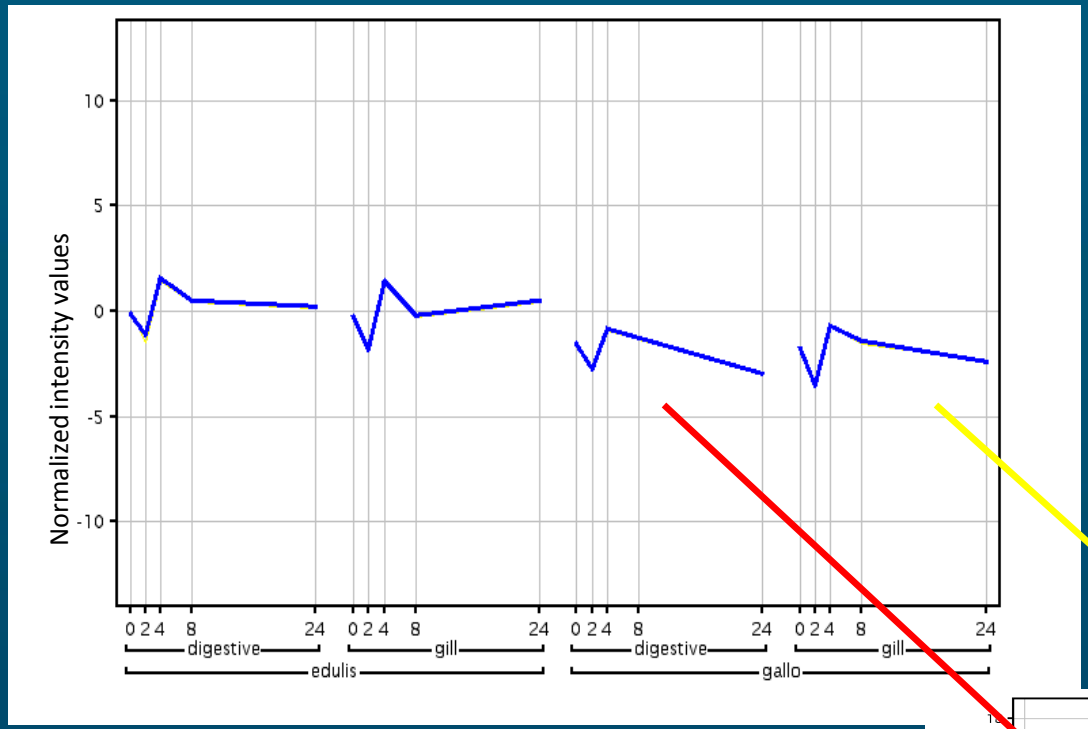
- **Real-time qPCR**
- **Genes of interest and housekeeping genes**
- Strong correlations with microarray data


Normalized Intensity Values
16
14
12
10
8
6
4
2
0 2 4 8 24 0 2 4 8 24 0 2 4 8 24 0 2 4 8 24
Tissue 1
Tissue 2
Tissue 1
Tissue 2
Species 1
Species 2
Species – Tissue – Time

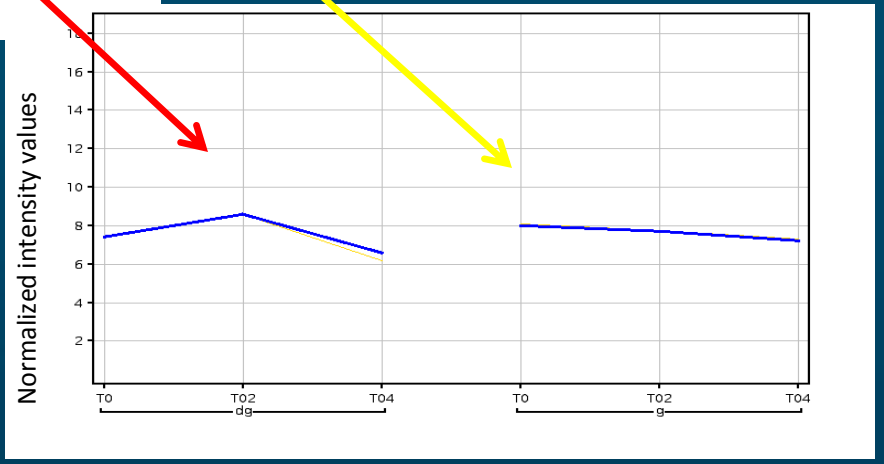
high

low

Differential stress responses

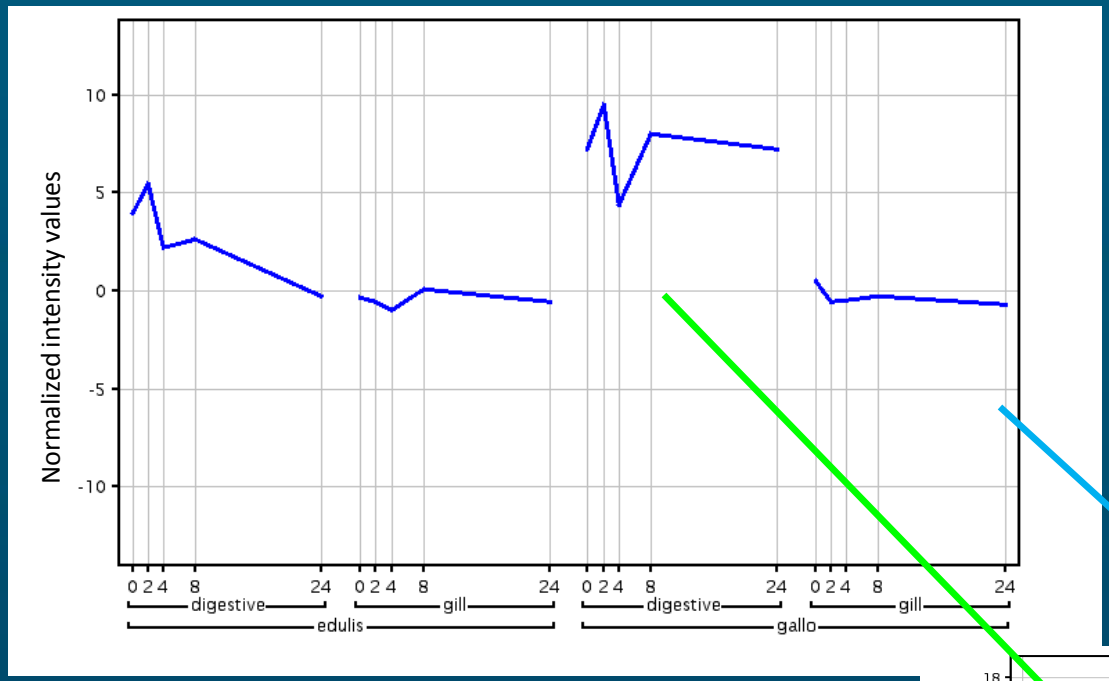


Thermal shock

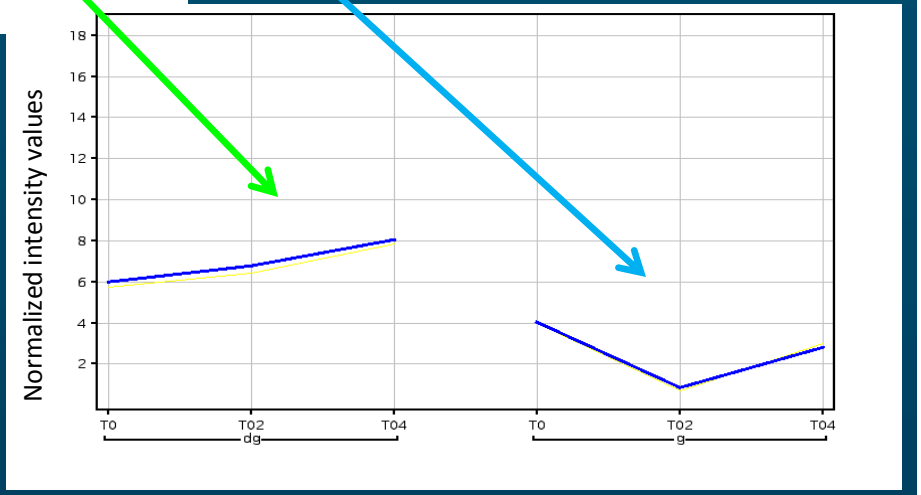


Physical stress

Differential tissue responses

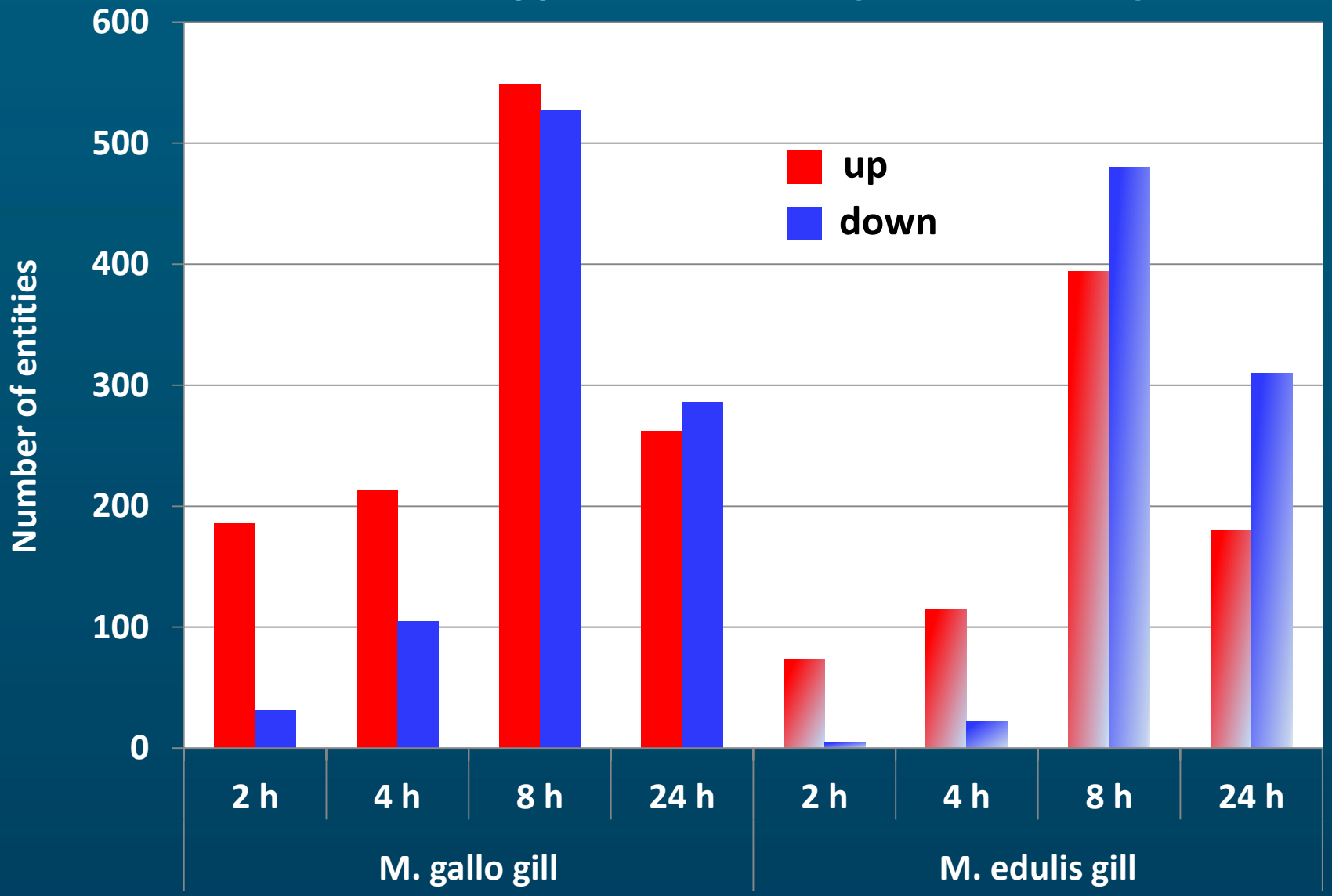


Thermal shock

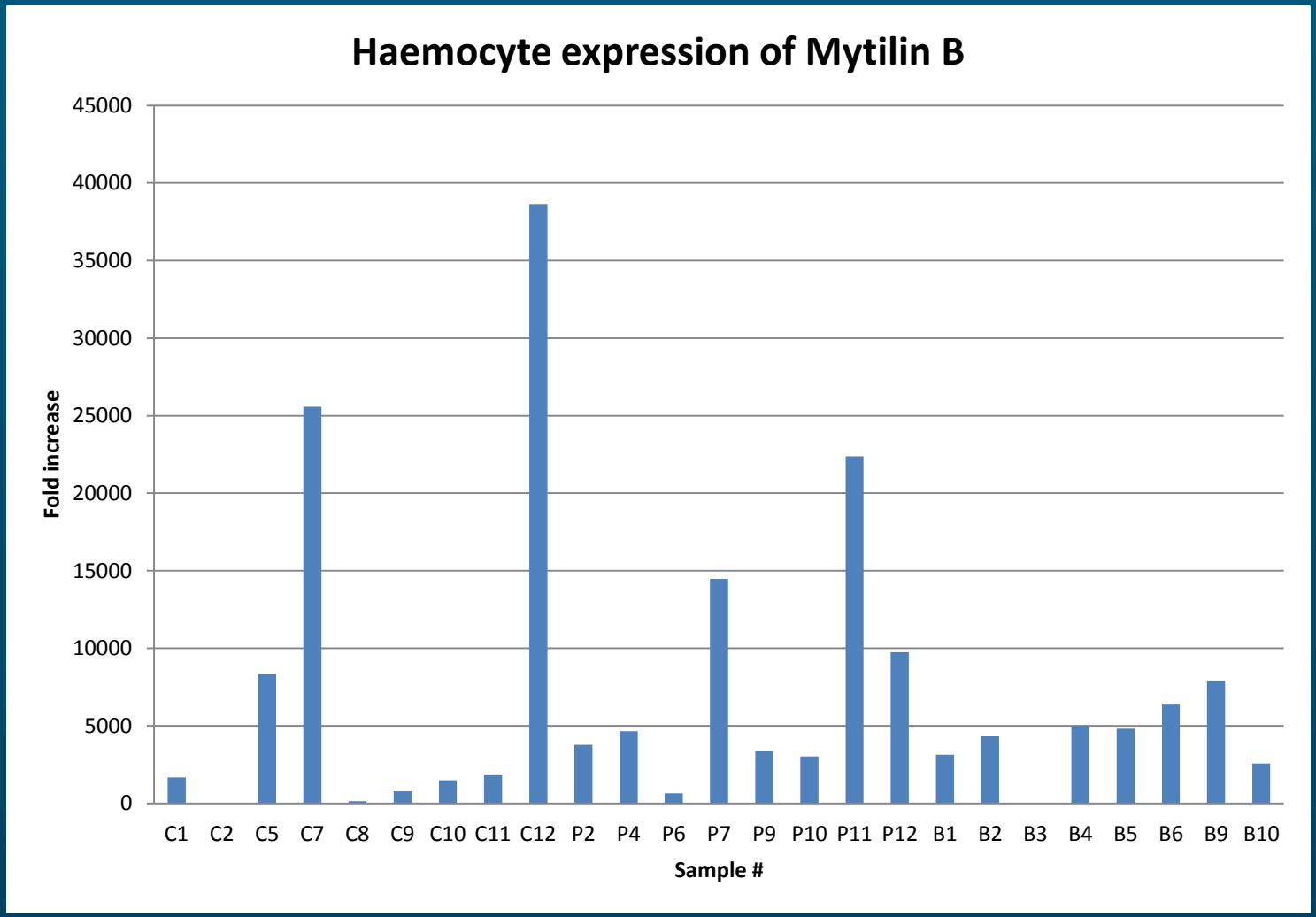


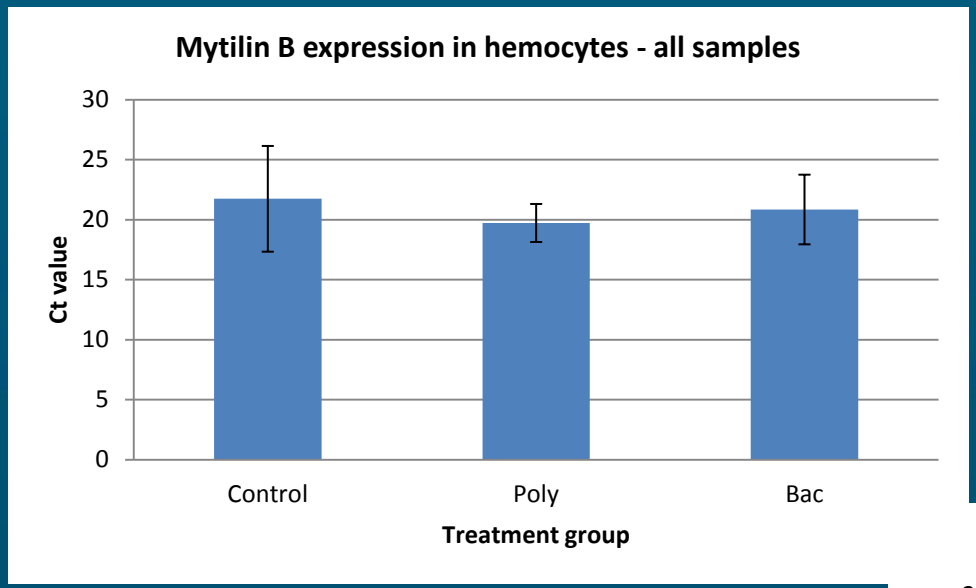
Physical stress

Differential species expression

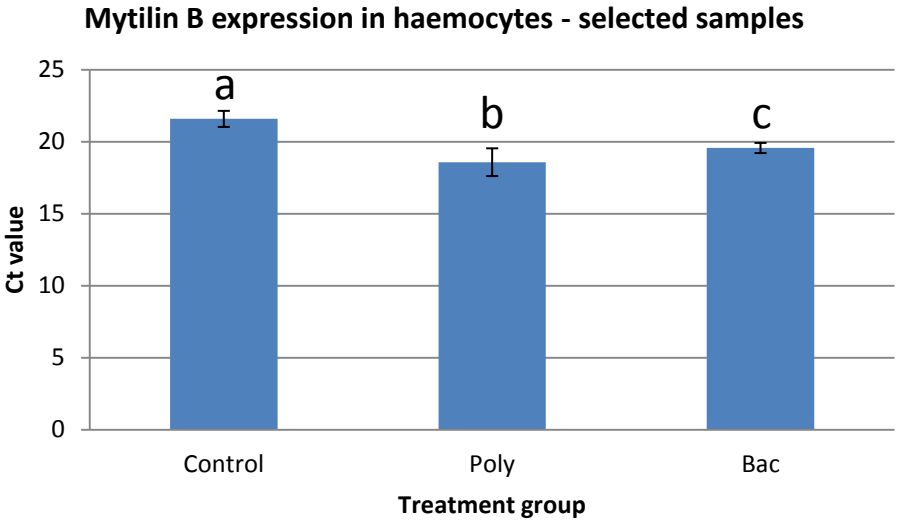


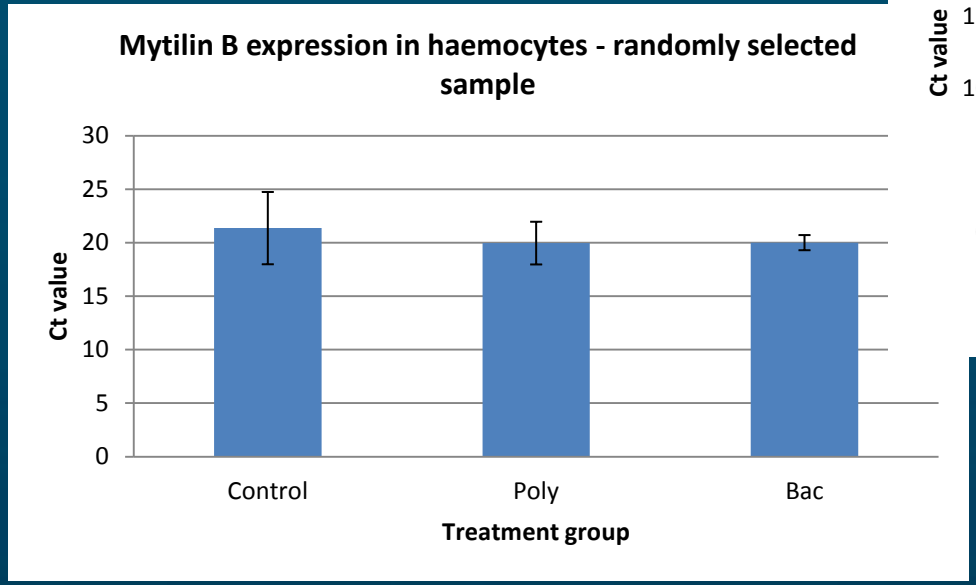
Individual variability



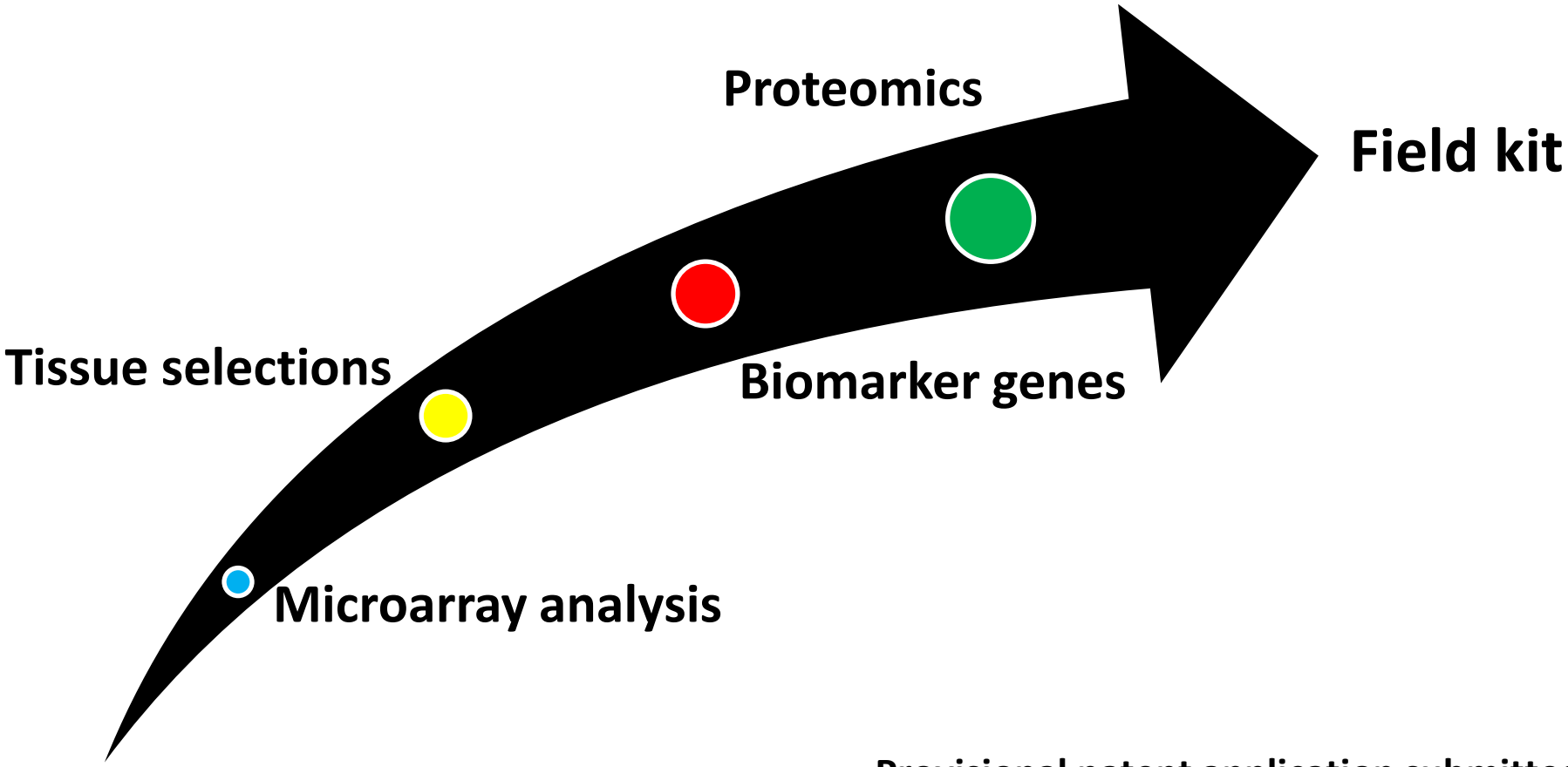


Important consideration of sample pooling and significance reporting





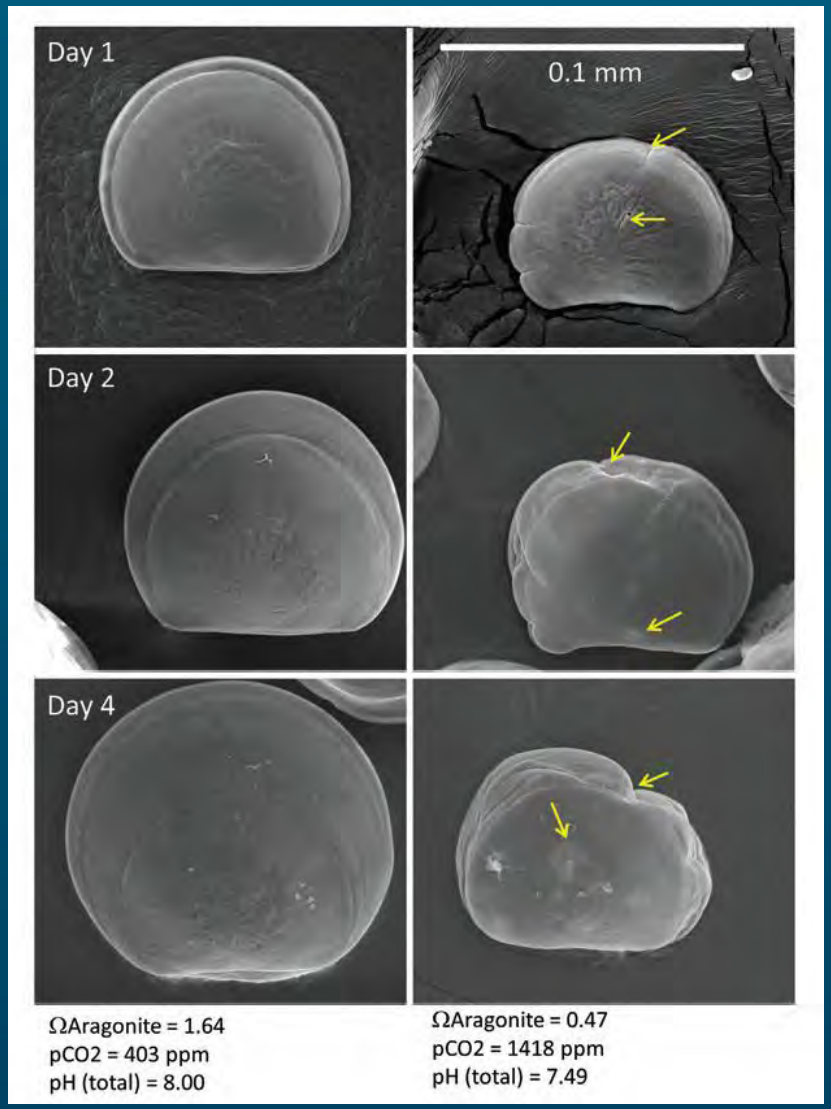
Ultimate goals



Provisional patent application submitted

Finding and using the biomarkers……..

Ocean acidification



- Decrease in pH of the oceans, caused by uptake of anthropogenic CO_2 from the atmosphere
- Organisms using calcium carbonate (**aragonite** or calcite) most susceptible
- **Shellfish larvae and juveniles vulnerable**
- **Species differences?** Broodstock development
- Increased land activities exacerbating effects

Brunner / Waldbusser. Taken from Washington State Blue Ribbon Panel on Ocean Acidification, Nov 2012

Wastewater management

'Compounds of concern' *includes*

endocrine disrupters, pharmaceutical and personal care products, microplastics, heavy metals and polycyclic aromatic hydrocarbons.

New methods of determining biological impacts

Diagnostic tool for field and lab

Improvement in civil engineering processes

www.waterencyclopedia.com

Monitoring

- **Upland impacts**
- **Seasonal population sizes**

theguardian.com

http://www.kitimatlngfacility.com/Project/project_site.aspx

- **New industrial developments**
- **Toxicogenomics**
- **Broader ecology questions**

Thank you

Funding agencies*:* Genome British Columbia, Fisheries and Oceans Canada, Western Economic Diversification, Centre for Shellfish Research, Taylor Shellfish Canada, and the BC Innovation Council

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