



# **SELECTION FOR HEAT TOLERANCE IN CLAMS USING BIOMARKERS**

2012 Clam Industry Workshop

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# NEED FOR HEAT TOLERANT CLAM STRAINS

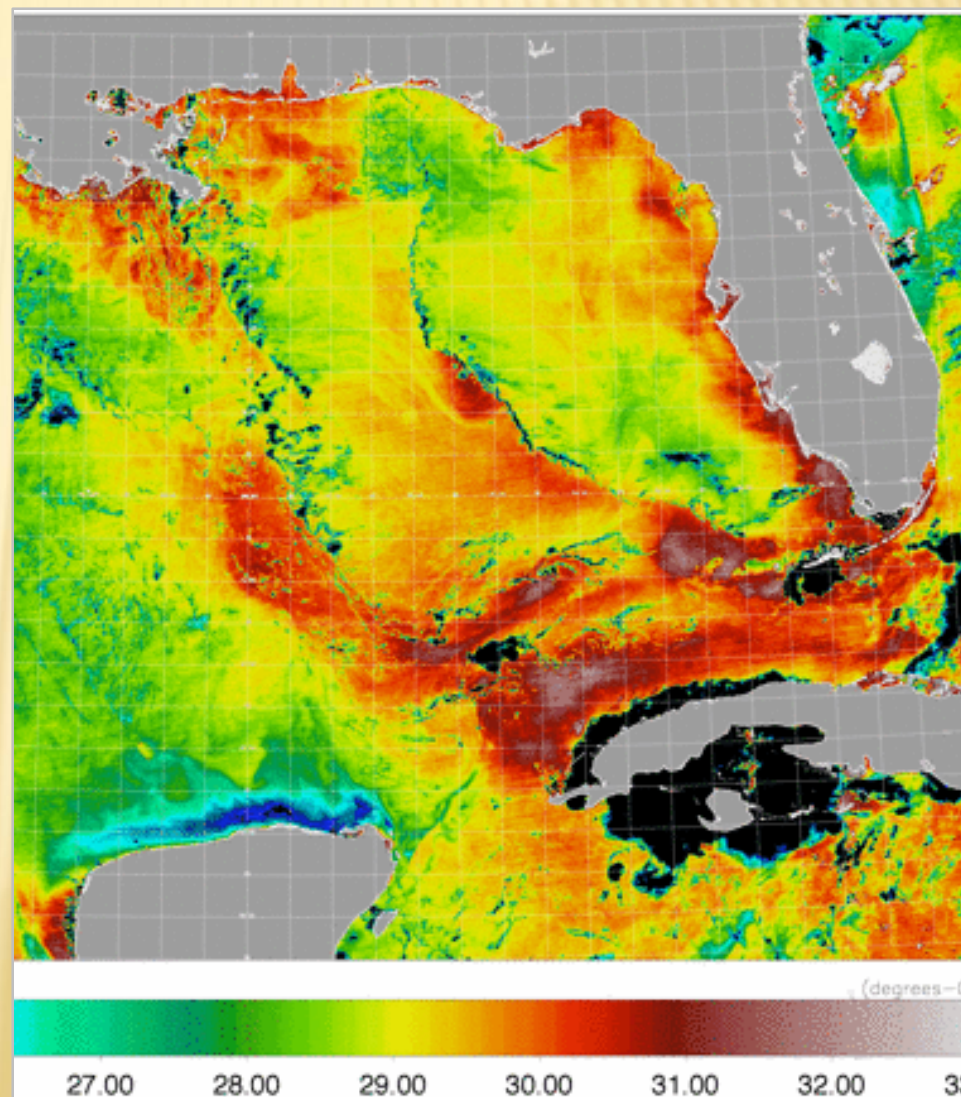


- ✘ Northern quahogs, *Mercenaria mercenaria*, are “living on the edge”
  - + Near southern limit of their natural distribution
  - + Summer water temperatures in growing areas regularly exceed 90° F
  - + Temperature-related mortalities observed in lab and field

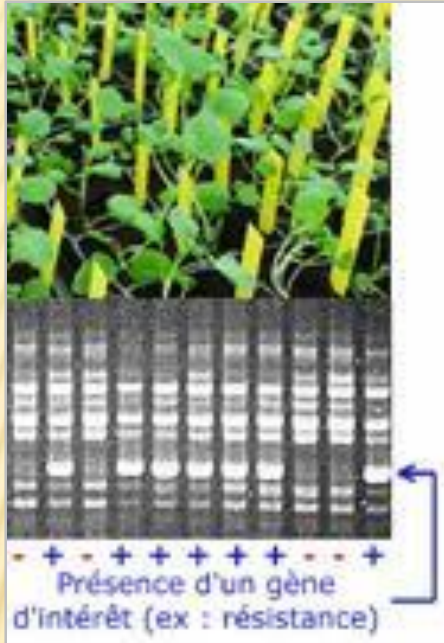


# NEED FOR HEAT TOLERANT CLAM STRAINS

- ✘ Prepare for global climate change
  - + Water temperatures in harvest areas have already increased by over  $0.5^{\circ}\text{F}$  in last 30 years
  - + Water temperatures are predicted to increase by another  $3.5^{\circ}\text{F}$  in next 100 years



# MARKER ASSISTED SELECTION



- ✘ Select parents based on markers associated with trait of interest
  - + Physiological
  - + Molecular
  - + Genetic

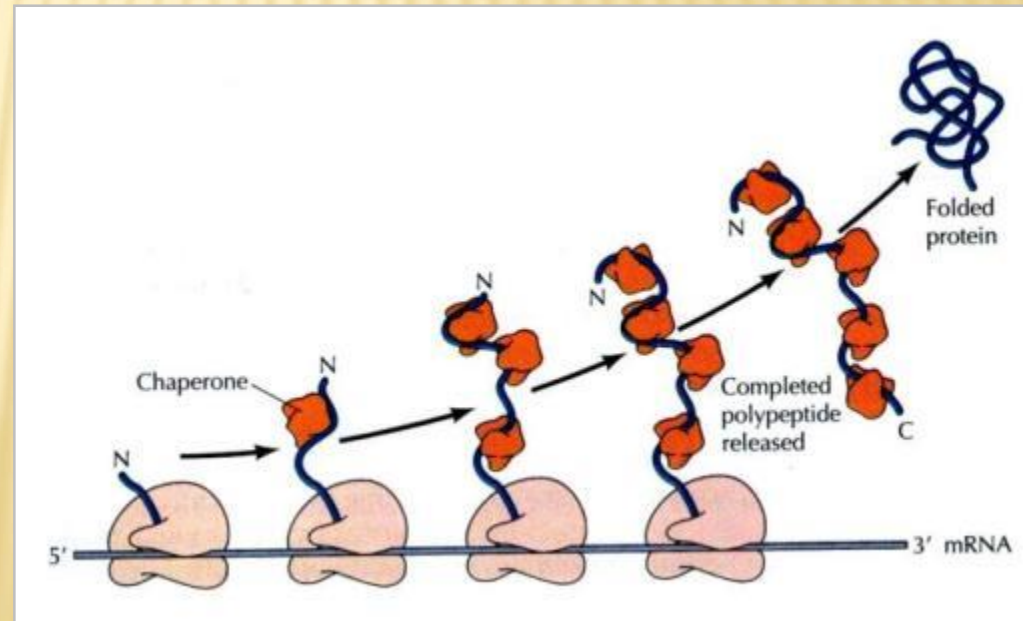


- ✘ Reduces the number of generations, families, time and space required to select for a trait



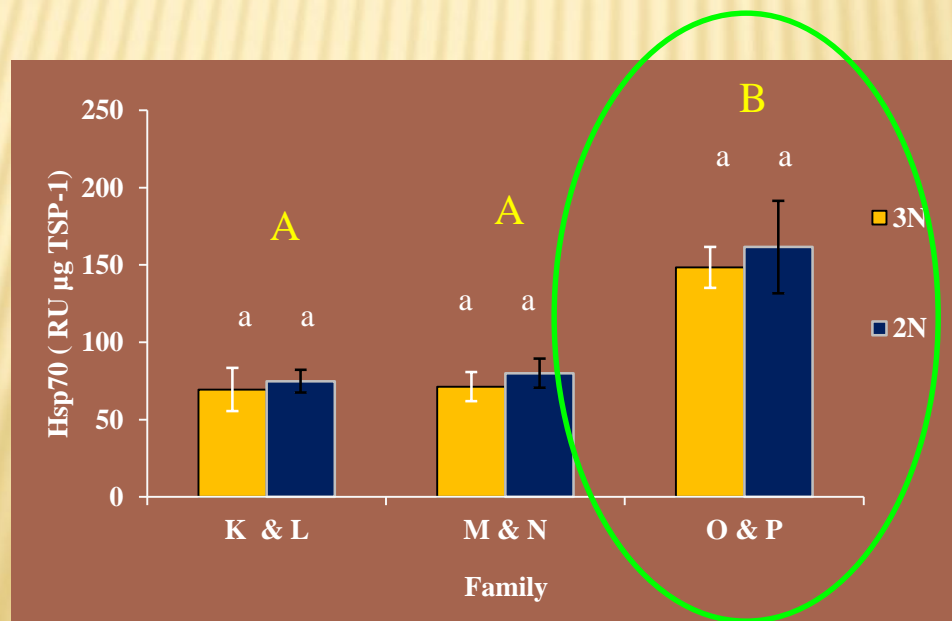
# “HEAT SHOCK” PROTEINS (HSP)

- ✘ Form, transport, and degrade proteins in cells
  - + Cognate Hsp – Cellular housekeeping
  - + Inducible Hsp – Increase in response to protein-damaging stressors
    - ✘ Temperature
    - ✘ Salinity
    - ✘ Oxygen



# COGNATE HSP AS A MARKER IN HARD CLAMS

- ✘ Level of cognate Hsp is associated with survival following temperature challenges
  - + Family with 2x Hsp had 93% survival (compared to 28% and 39%)
  - + Other studies suggest that Hsp levels are inherited



El-Wazzen, 2008

# GOAL AND OBJECTIVES

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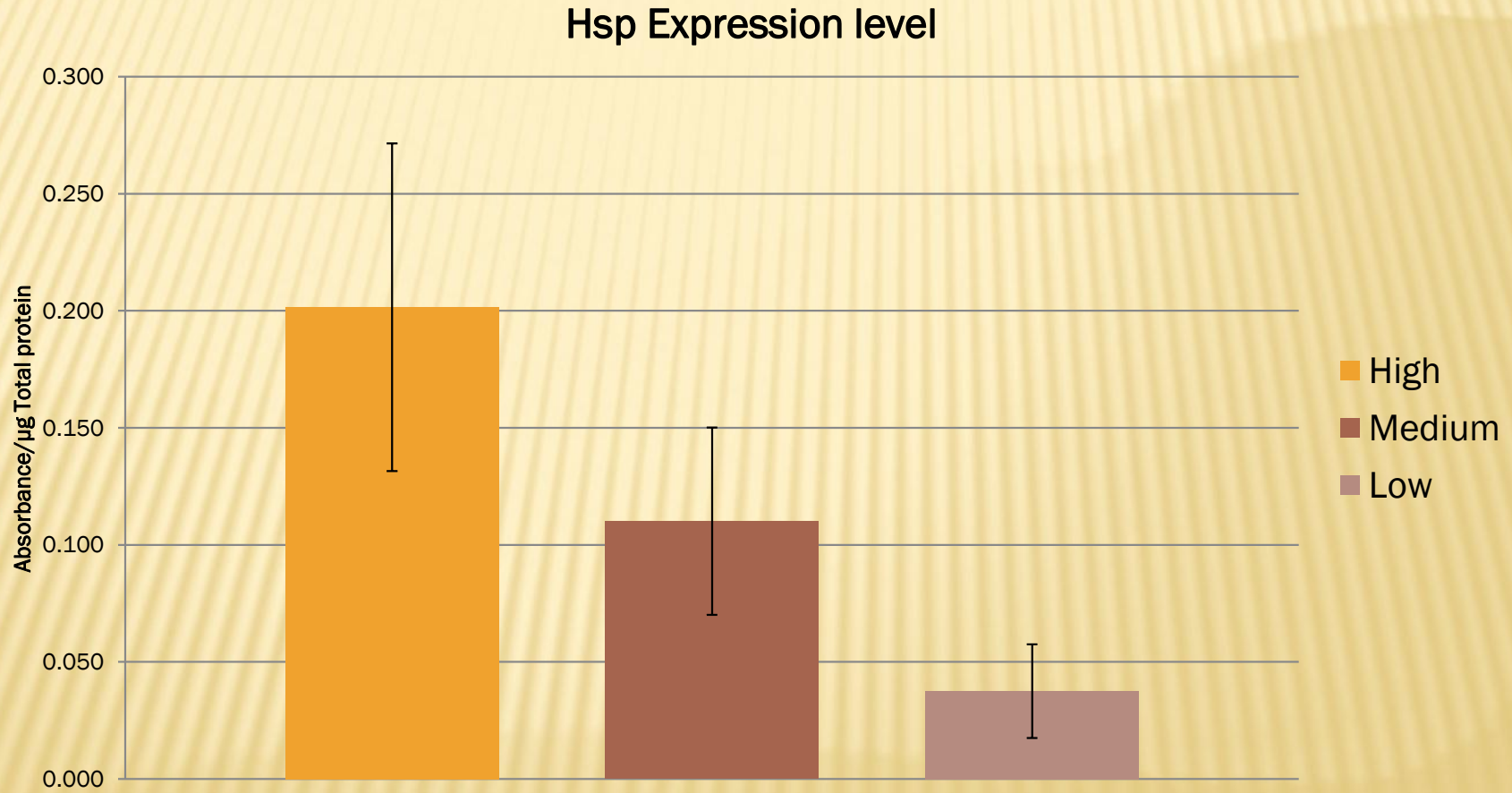
- ✘ Overall goal:
  - ✘ Assess if markers (e.g., Hsp, metabolic characteristics) can be used in selective breeding for heat tolerant hard clams
- ✘ Specific objectives:
  - + Determine if markers are consistently associated with temperature tolerance (survival, production, product quality)
  - + Determine if marker levels are inherited in hard clams





# PROGRESS - BROODSTOCK SURVEY

✘ > 500 clams from 11 hatcheries/locations





# PROGRESS - SPAWN A

**May 2011**

Produced 6 families

- 3 from High-Hsp parents
- 3 from Low-Hsp parents

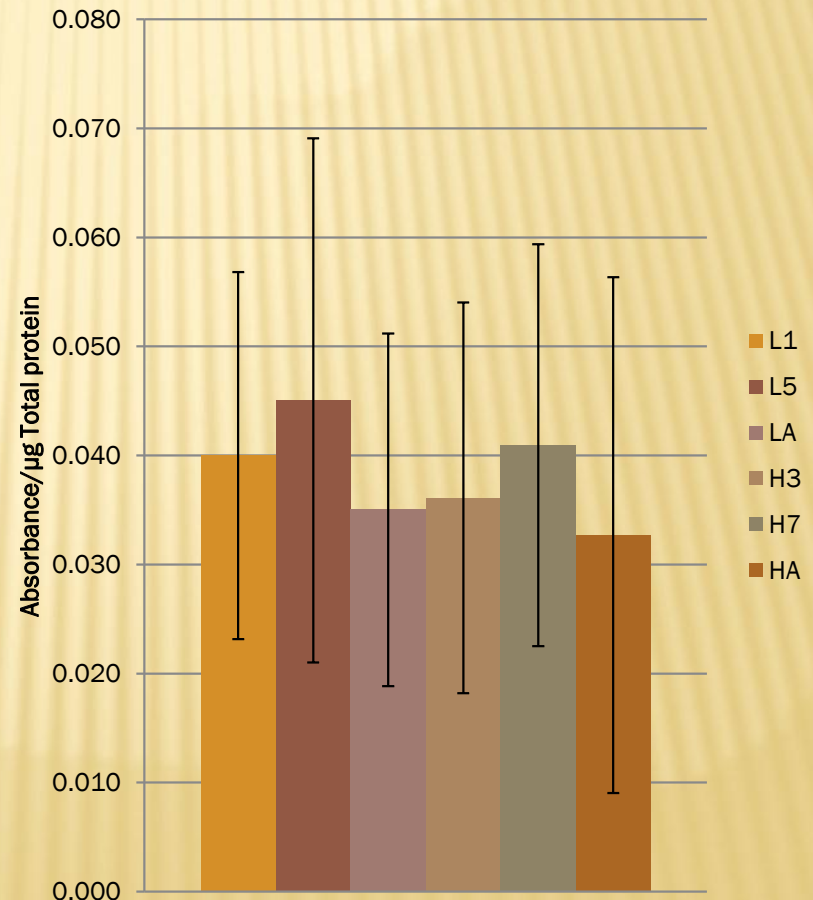
Held at HBOI

**Mar 2012**

Hsp analysis of offspring families

No significant difference in expression of Hsp between high and low groups

No significant difference in the expression of Hsp between families



# PROGRESS - SPAWN A

**May 2011**

Produced 6 families

- 3 from High-Hsp parents
- 3 from Low-Hsp parents

Held at HBOI

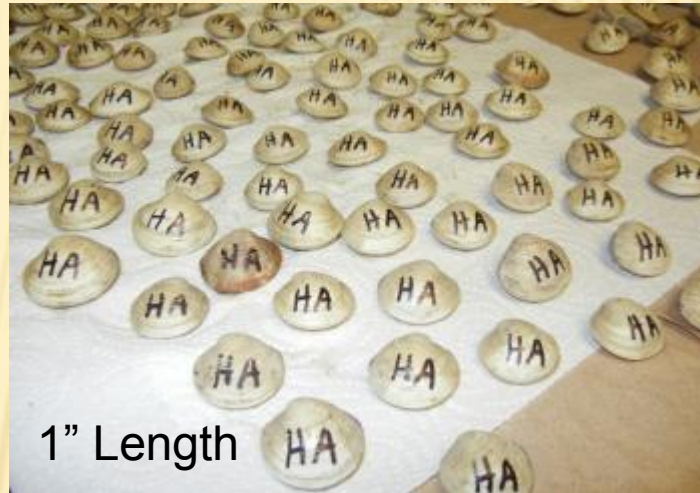
**Mar 2012**

Hsp analysis of offspring families

IRL

**May 2012**

Lab challenges  
• High T, Low S



Putative High-Hsp families  
survival

>  
1Day

Putative Low-Hsp families  
survival



# PROGRESS - SPAWN A

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Held at HBOI

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Hsp analysis of offspring families

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**May 2012**

Lab challenges

- High T, Low S

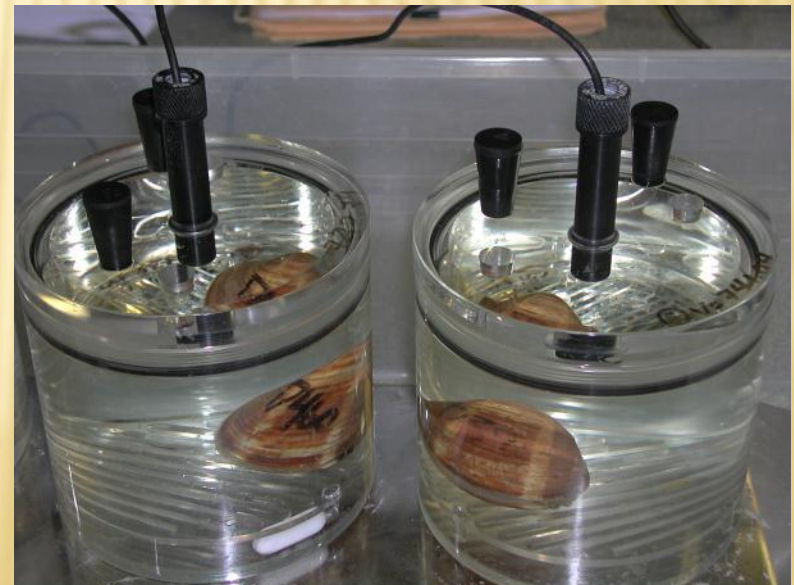
IRL

**Harvest Jan 2013**

Hsp analysis

Production characteristics

Metabolic characteristics



# PROGRESS - SPAWN B

**Dec 2011**

Produced 7 families

- 3 from High-Hsp parents
- 4 from Low-Hsp parents
  - 2 from wild stock
  - 2 from hatchery stock

Held at CK

**Sept 2012**

Production characteristics

Samples for Hsp analysis

Lab challenges

- High T, Low S

Putative High-Hsp families  
survival

=

Putative Low-Hsp families  
survival

Hatchery stock families  
survival

>  
1Day

Wild stock families  
survival





# PROGRESS - SPAWN B

**Dec 2011**

Produced 7 families

- 3 from High-Hsp parents
- 4 from Low-Hsp parents
  - 2 from wild stock
  - 2 from hatchery stock

CK

**Sept 2012**

Production characteristics

Samples for Hsp analysis

Lab challenges

- High T, Low S

CK

**Fall 2013**

Hsp analysis

Production characteristics

Shelf-life

Metabolic characteristics



# GOAL AND OBJECTIVES

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- ✘ Overall goal:
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  - + Determine if markers are consistently associated with temperature tolerance (survival, production, product quality)
  - + Determine if marker levels are inherited in hard clams





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