

# Metabolic Responses of Pacific Oysters (*Crassostrea gigas*) to Repeated Heat Stress Events

Christina Zhang<sup>1</sup>, Steven Roberts<sup>2</sup>, Ariana Huffmyer<sup>2</sup>

1. Department of Biochemistry, 2. Department of School of Aquatic and Fishery Sciences, University of Washington, Seattle, WA



## Background

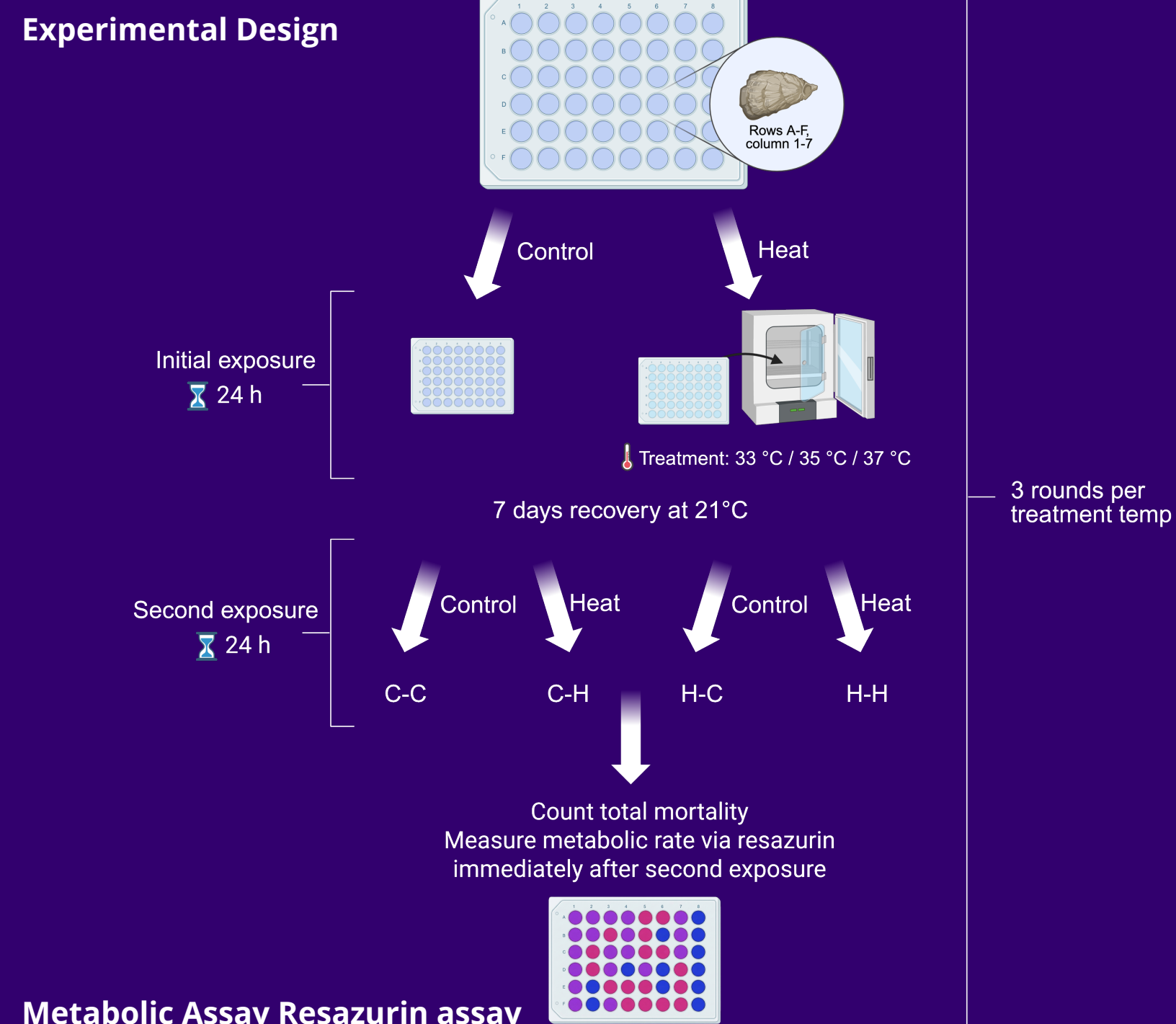
- Climate change amplifies the frequency and severity of marine heatwave events in intertidal communities (Wernberg et al., 2025)
  - Summer = low tide + peak heat = thermal stress further intensifies (Román et al., 2020)
- Examining organism responses to repeated thermal stress is crucial
- Thermal priming (nonlethal) in bivalves = improves tolerance to more intense future stress (Chen et al., 2026, Clegg et al., 1998)

## Research Question

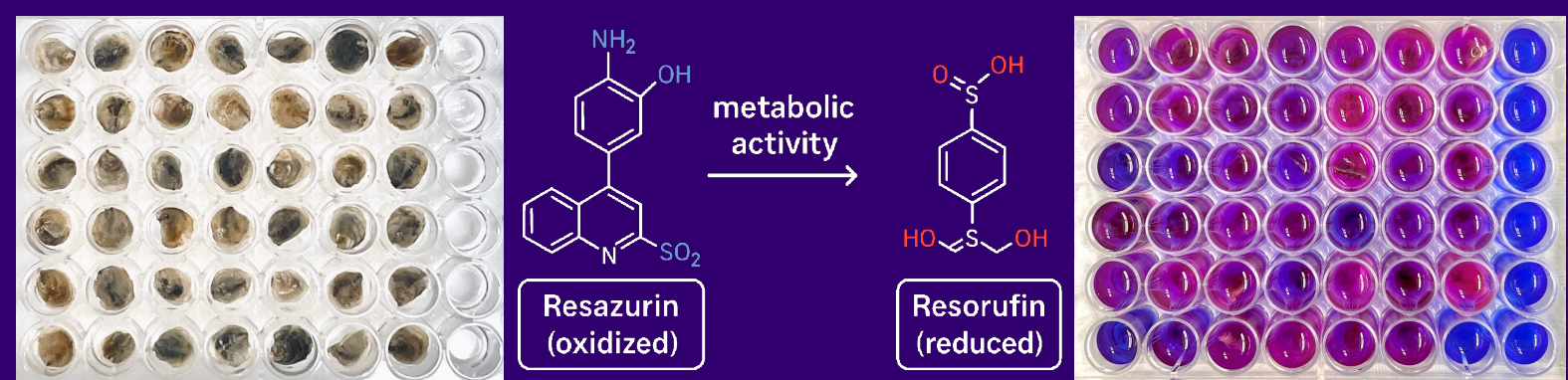
- Metabolically, how do oysters respond to repeated heat stress events?

## Methodology

- Pacific oyster seedlings (6–10 mm, diploid, obtained from Jamestown S’Klallam Seafood)

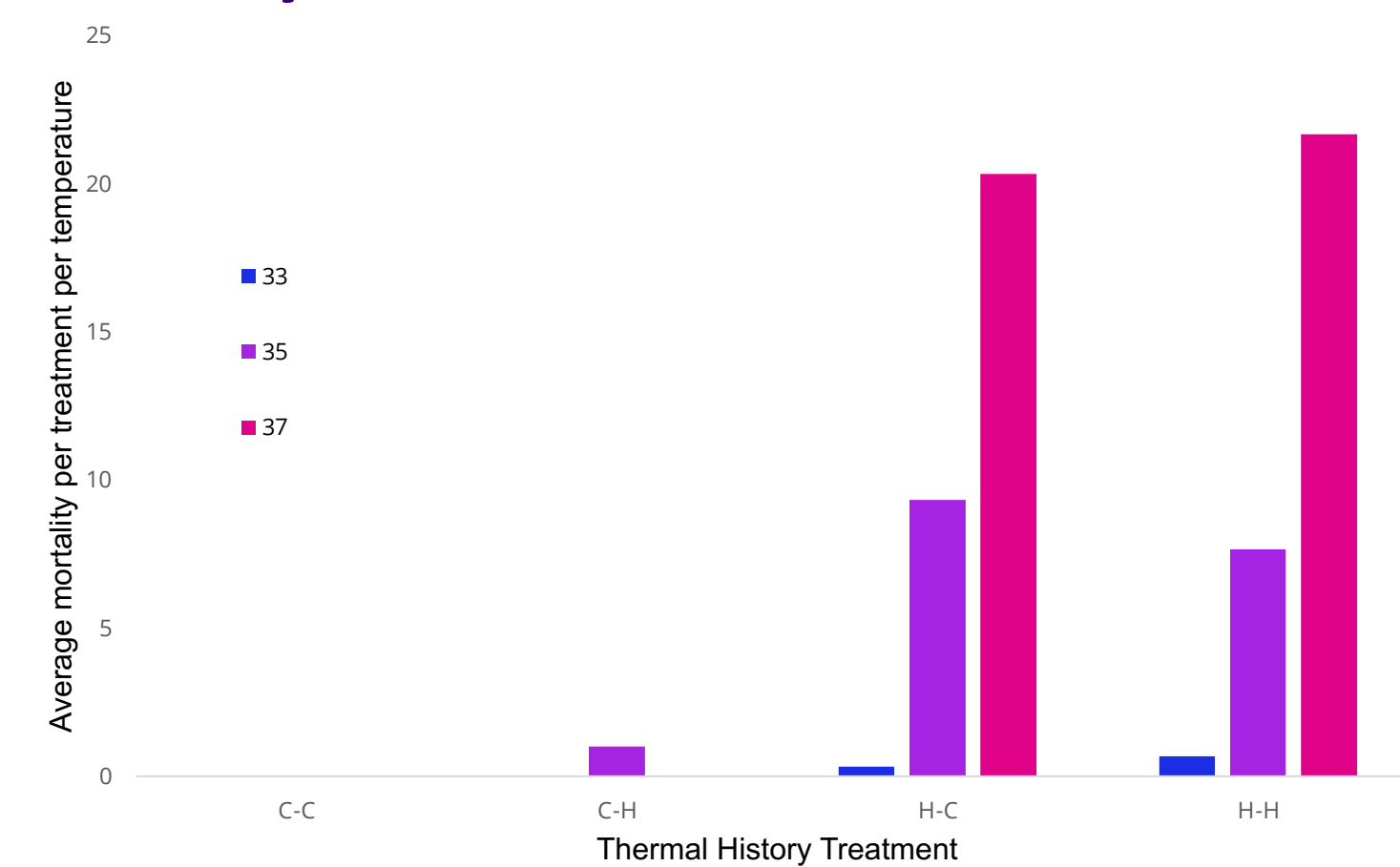


- a redox-sensitive dye used to quantify metabolic activity with fluorescence color change (Candeias et al., 1998; O’Brien et al., 2000)
- Blue (oxidized, low activity) Pink (reduced, high activity)
- Resazurin reduction reflects total metabolic activity via pathways that accept electrons from NADH oxidation (NADH → NAD<sup>+</sup>) (Huffmyer et al., 2025)



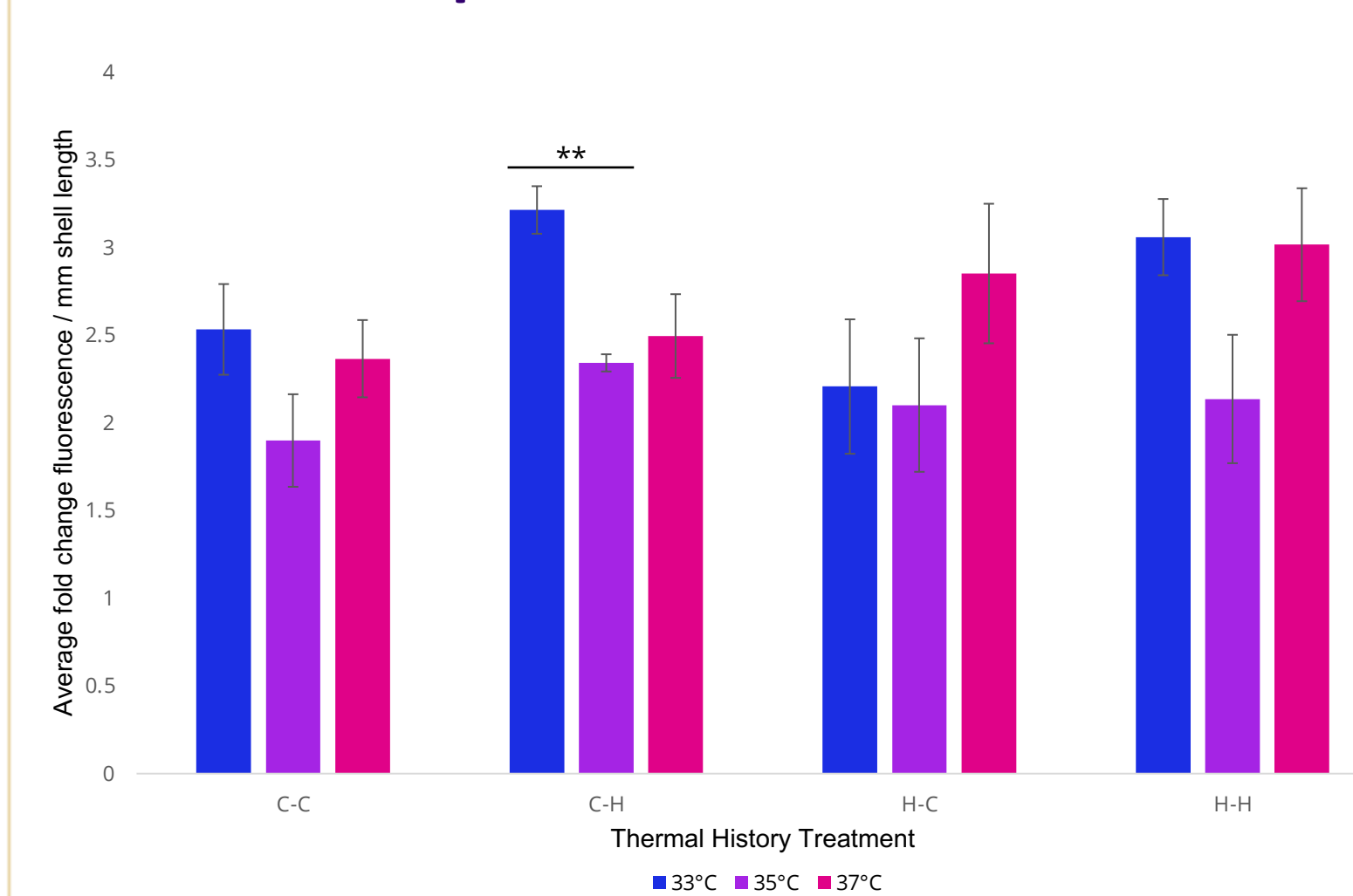
## Result

### Mortality



- No mortality due to being in the plates or the lab temperature (C-C)
- Higher mortality as temperature increases

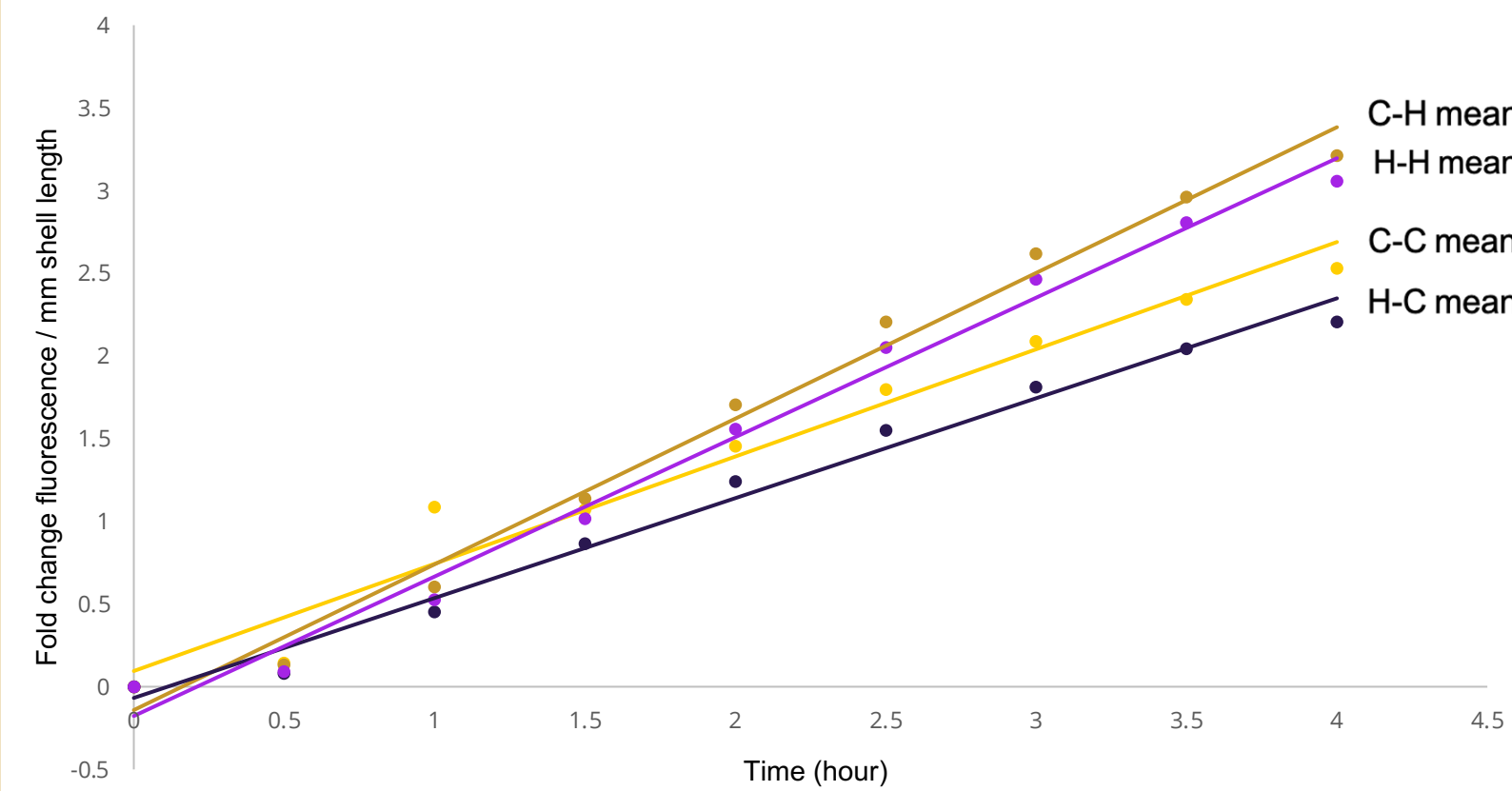
### Metabolic response to thermal stress events



- Oysters that are not primed are more reactive at 33 °C (C-H) than primed oysters (H-H)
- Higher metabolic activity at 33 °C likely reflects increased cellular demand for thermal stress responses
- Lower metabolic activity at 35 °C may be due to strategic metabolic depression
- Uses a lot of energy to mitigate stress at the highly stressful temperature of 37 °C

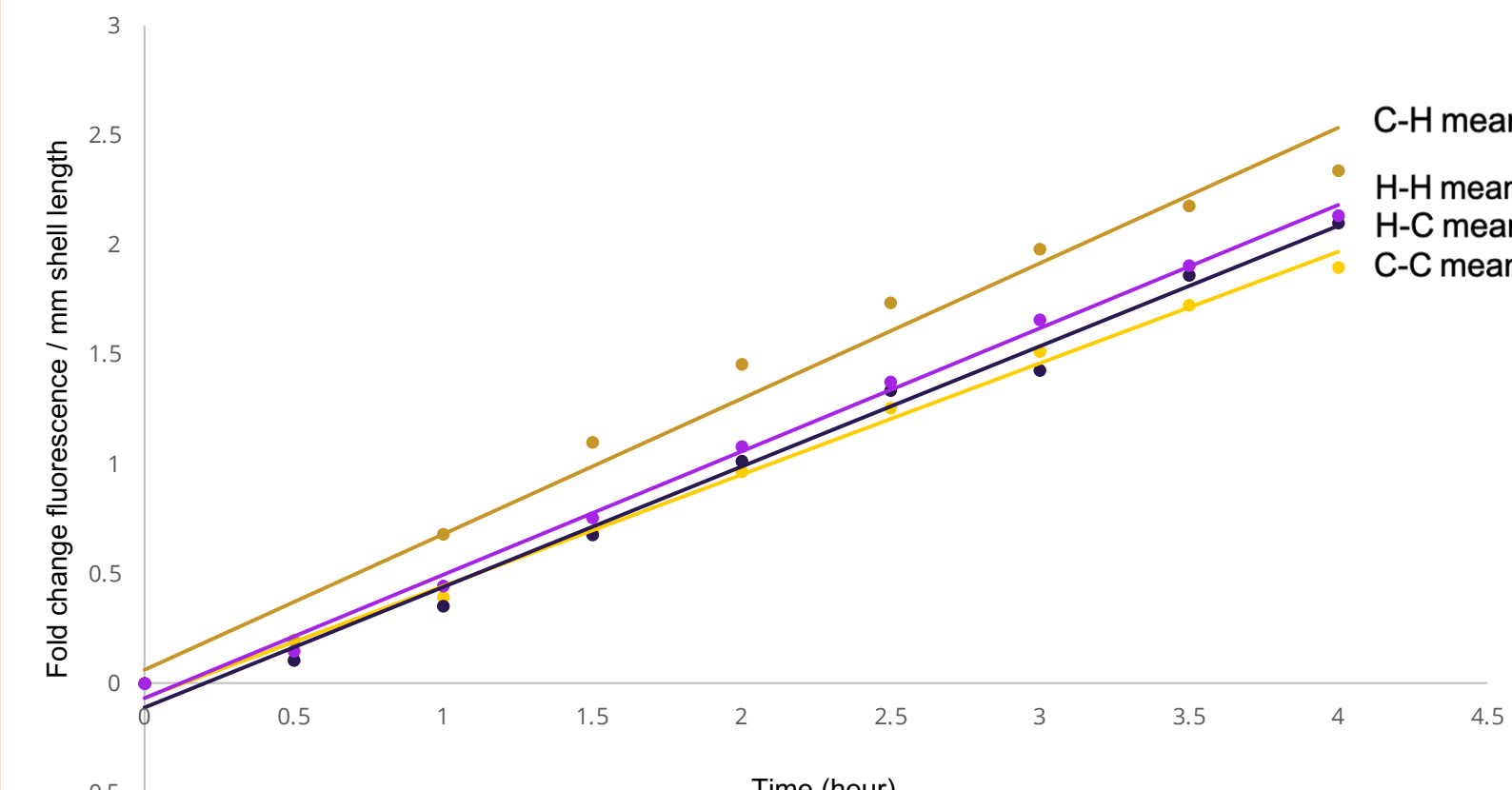
## Temperature dependent priming effect

### 33 °C



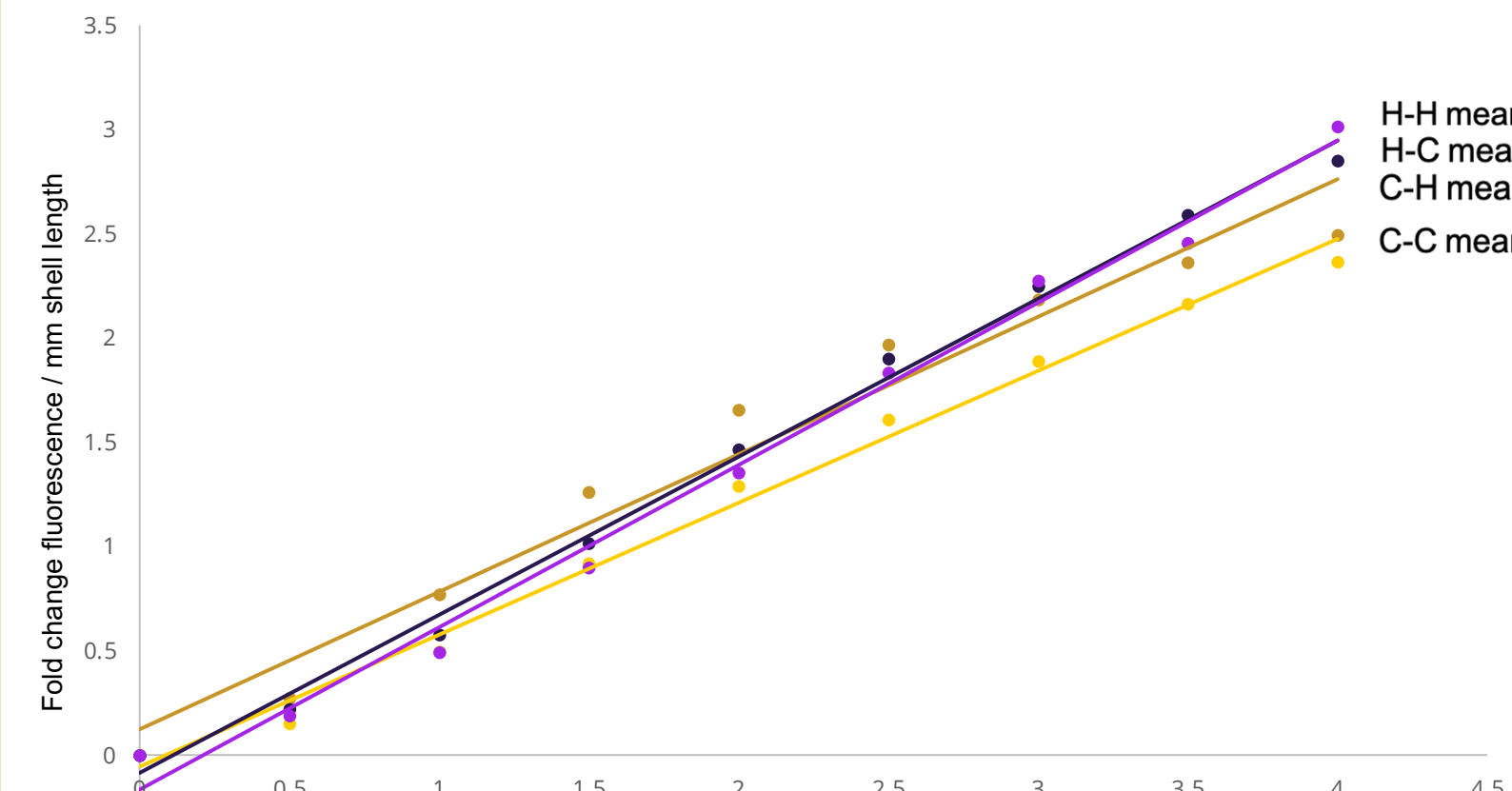
- Weaker thermal priming lowers the metabolic response (H-H < C-H)

### 35 °C



- Stronger thermal priming lowers the metabolic response (H-H < C-H)

### 37 °C



- Priming increases metabolic response (H-H > C-H)

## Conclusion

- Mortality increases under heat-waves
- The effect of temperature is based on thermal history shaped by both heat exposures
- When temperature is too high ( $\geq 37$  °C), the stress response overrides the priming effect
- When temperature is  $\leq 35$  °C, primed oysters exhibit an overall lower metabolic response than unprimed oysters
- Primed oysters may be more metabolically tolerant

## Future Research Focuses

- Mechanisms of metabolic tolerance due to priming
  - Reduced production of heat shock proteins occurs as a stress response (Piano et al., 2022)
  - Greater metabolic depression indicates a higher likelihood of survival (Huffmyer et al., 2025)
- Mechanisms of extreme heat response
  - Metabolic dysfunction occurs at extremely high temperatures due to denaturation of proteins/enzymes, preventing regulation of metabolic levels (Lepock, 1993)
  - Changes in respiration affect metabolism: the transition from aerobic to anaerobic pathways is less pronounced at higher temperatures (Li et al., 2017)

## Acknowledgements

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