

# Assessing *Hemigrapsus Oregonensis* Glucose Metabolism under Temperature and Nutrient Stress

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# Introduction

How glucose levels change over time in *H. oregonensis* under different temperature conditions, and how these patterns reflect metabolic processes

- Glucose absorption and metabolism
- How temperature works as a stressor

Asses how can we use a glucometer as an available resource for monitoring glucose

- 0.5  $\mu$ L sample
- detection 20-600 mg/dL

Understanding how thermal stress impacts glucose metabolism is key for future conservation



# Crustaceans metabolism can be sensitive to thermal stress

## Plummeting Bering Sea crab populations

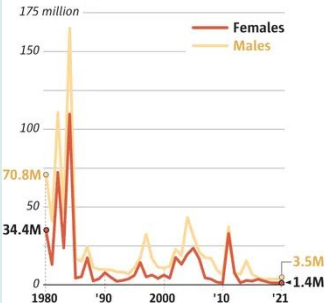
Snow crab and king crab have long been mainstays of commercial harvests.



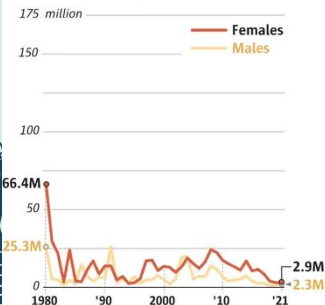
Red king crab  
*Paralithodes camtschaticus*

Long-term decline in mature red king crab populations (for Bristol Bay District)

### IMMATURE RED KING CRAB



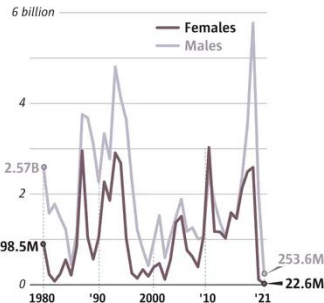
### MATURE RED KING CRAB



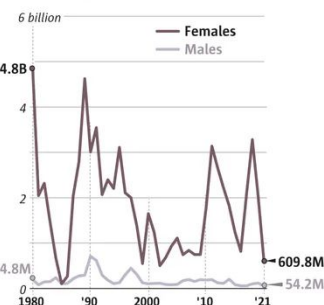
Snow crab  
*Chionoecetes opilio*

Sharp drops in snow crab populations (all districts)

### IMMATURE SNOW CRAB



### MATURE SNOW CRAB



Source: Surveys conducted by NOAA Fisheries

MARK NOWLIN / THE SEATTLE TIMES

## Increasing Temperature

Recent crab declines have been linked to starvation because of warming oceans, which caused a big disturbance within aquaculture

## Metabolic Rates

This is due to the increase of metabolic rates leading to starvation, where the demand for food is higher than the supply.

Fisheries, N. (2023, December 5). *Research confirms link between snow crab decline and marine heatwave*

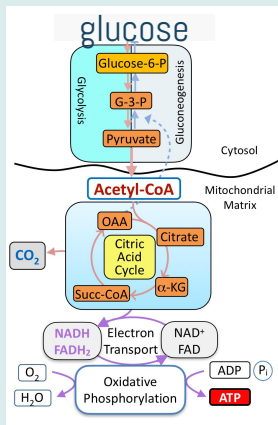
<https://www.fisheries.noaa.gov/feature-story/research-confirms-link-between-snow-crab-decline-and-marine-heatwave>



# Metabolism Background

## Glucose Metabolism

Upon feeding and intake of carbohydrates, blood sugar spikes. This leads to the mobilization of glucose to various tissues, allowing glycogen storage in their muscles or their hepatopancreas.



## Crustaceans

However, decapods metabolism is controlled by neurons called the stomatogastric ganglion. This control on transit time varies by species and environmental factors.



## Fed State

After meals and metabolism energy is readily available and fueling energetically intensive processes like protein synthesis



## Fasted State

Mobilization of stored energy is crucial, because within their environment food availability can be unpredictable

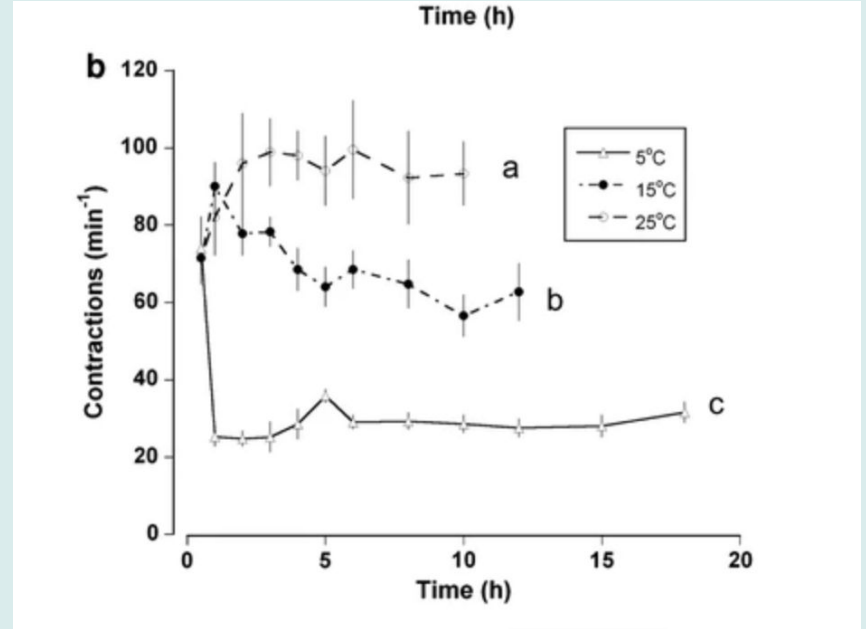
McGaw, I. J., & Curtis, D. L. (2012). A review of gastric processing in decapod crustaceans. *Journal of Comparative Physiology B*, 183(4), 443–465. <https://doi.org/10.1007/s00360-012-0730-3>

Hu, A. S. L. (1958). Glucose metabolism in the crab, *Hemigrapsus nudus*. *Archives of Biochemistry and Biophysics*, 75(2), 387–395. [https://doi.org/10.1016/0003-9861\(58\)90437-5](https://doi.org/10.1016/0003-9861(58)90437-5)



# How can temperature increase metabolism?

The pyloric region of a decapod crustacean is where movement of food is controlled into the hepatopancreas. Within this figure we see an increase in pyloric contractions with an increase in temperature



Green crabs *Carcinus maenas* contraction rate with varying temperatures.

McGaw, I. J., & Curtis, D. L. (2012). A review of gastric processing in decapod crustaceans. *Journal of Comparative Physiology B*, 183(4), 443–465. <https://doi.org/10.1007/s00360-012-0730-3>



# Research Question and Hypothesis

## Research Question

How does thermal stress affect glucose levels in *Hemigrapsus oregonensis* under different feeding states?

01

## Null Hypothesis

There is no significant difference in glucose levels in crabs experiencing thermal stress

02

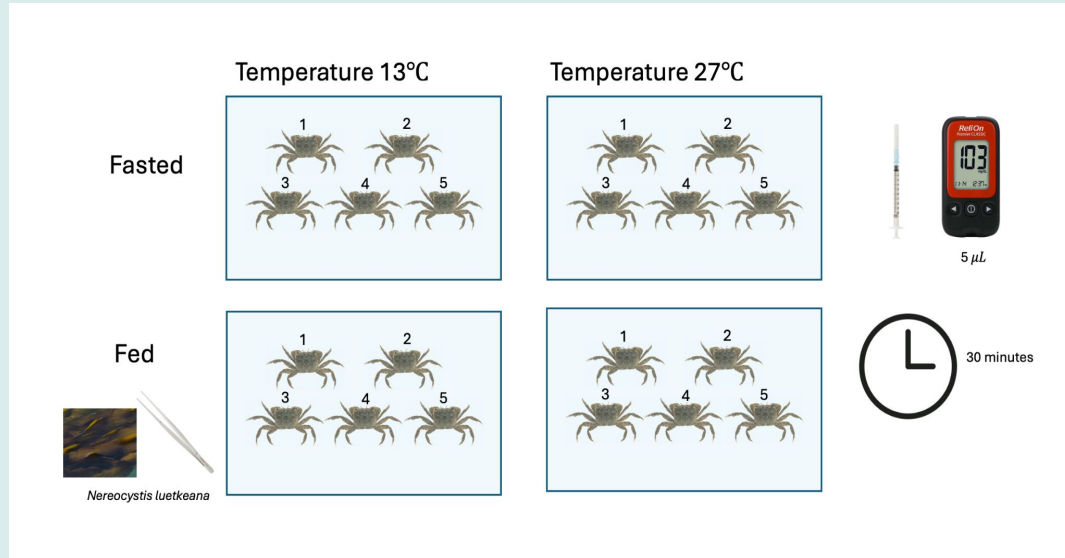
## Alternative Hypothesis

Crabs under thermal stress will display altered glucose levels within feeding states

03



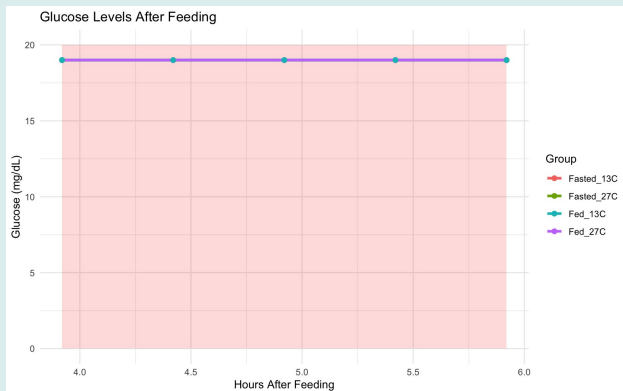
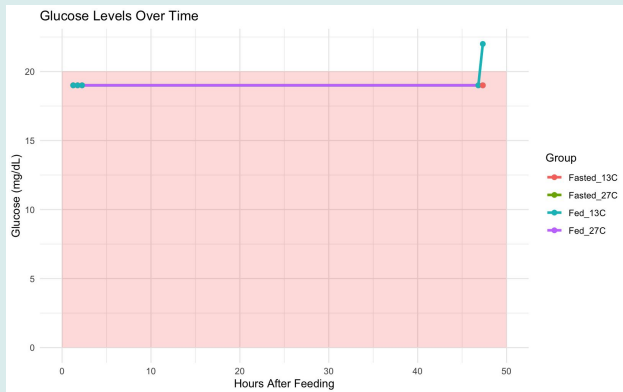
# Experimental Design & Methods



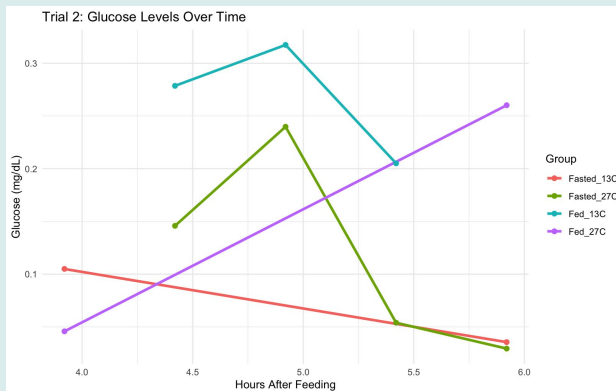
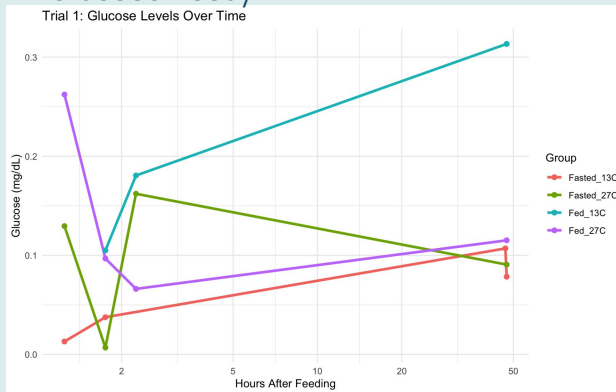
- Fed groups received bull kelp at lab start
- Hemolymph was extracted every 30 minutes
- Measured glucose by glucometer
- Extra hemolymph was saved for assays
- 5 readings per group, 25 total
- 2 trials: 1.25 and 4 hours post-feeding first reading°C

# Results:

## Glucometer



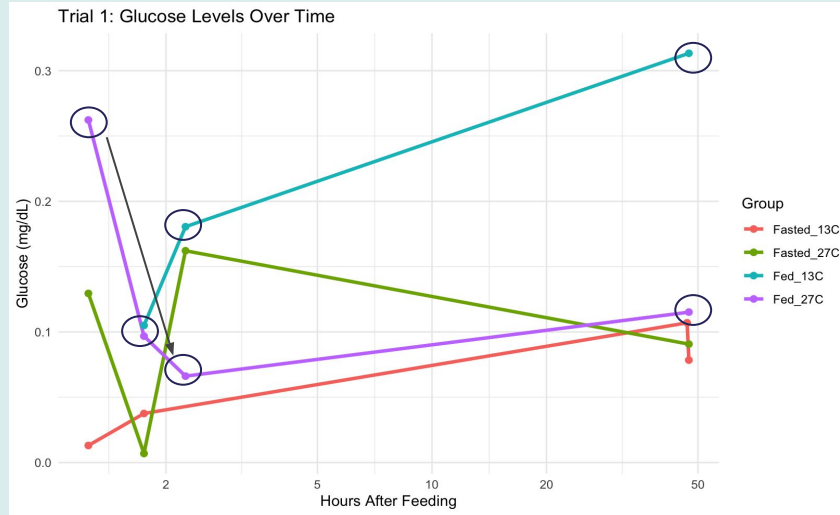
## Glucose Assay



- Fed 13°C & 27°C ended with the highest levels of glucose
- Glucometer result and glucose assay matched fed 13°C being the highest
- Missing data points from too small sample amount for glucose assay



# Interpretation/Conclusion:



- Trial 2: Only two data points for Fed 27°C group, leading to high uncertainty

The Fed 27°C had a sharp decrease while Fed 13°C increased, this finding may align with the heightened transit time that depleted this glucose, as McGaw (2012) concluded with increase in temperatures.

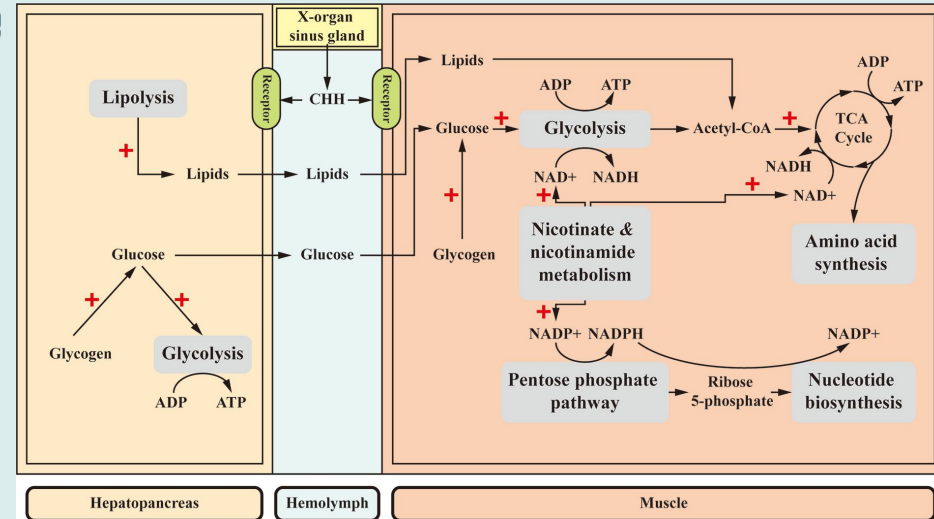
Sample size was too small, and lost of amount of hemolymph for glucose assays led to a lost of the realized trend for visualization and interpretation



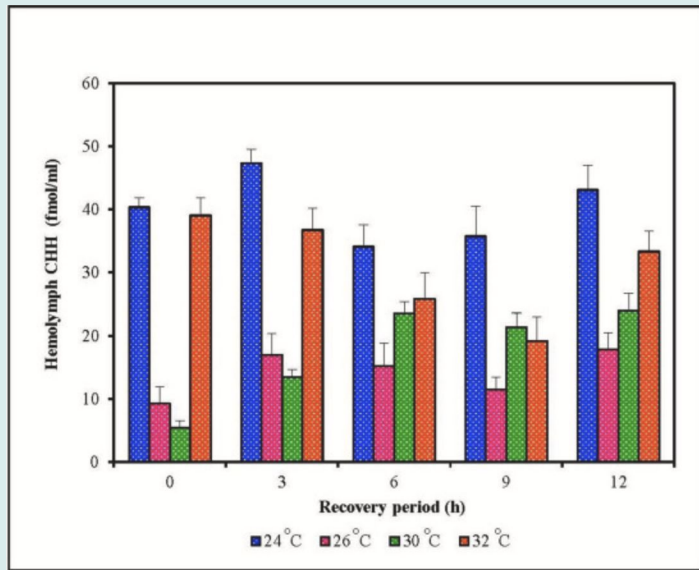
# Another Stress response Considered

## Crustacean Hyperglycemic Hormone

- Directly impacts the levels of glucose in the hemolymph
- When a stressful event occurs, this hormone is excreted through a sinus gland breaking down glycogen



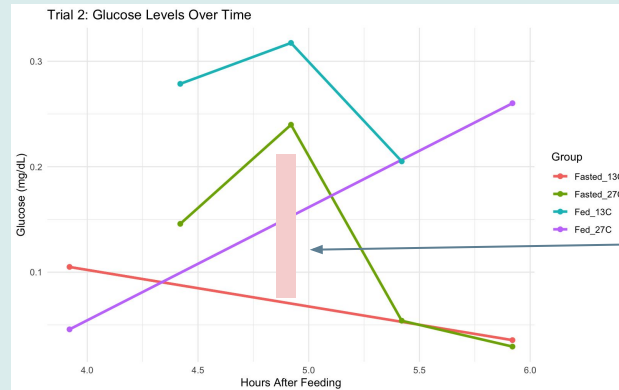
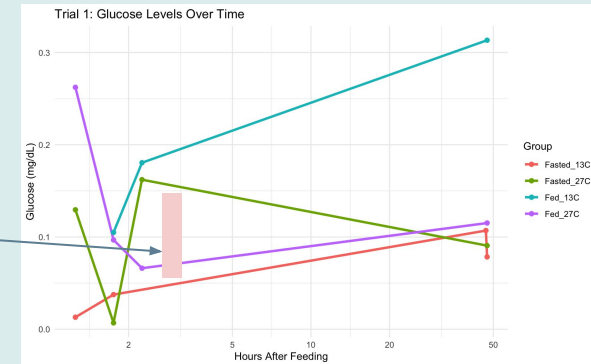
# How may CHH impact glucose levels within thermal stress?



Blue swimmer crab *Portunus pelagicus* levels of CHH in varying temperatures, highest CHH at the temperature extremes



Higher levels of glucose in Fasted 27°C compared to Fasted 13°C



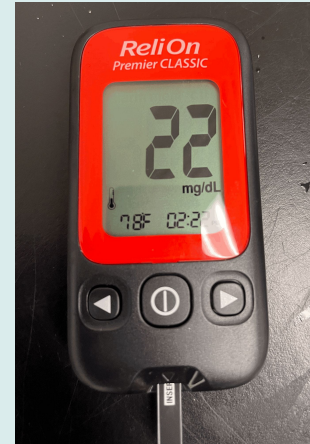
This trend may be due to an increase in CHH as a stress response leading to that higher glucose levels



# Future Work

Future applications for the use of glucose monitors in the field is promising

Though most of our results were too low to read, organisms with higher glucose levels, or the use of a more sensitive glucometer would be a fast, efficient way of glucose monitoring in the field.



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# Thanks!

Do you have any questions?



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