

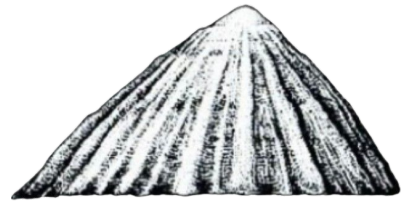
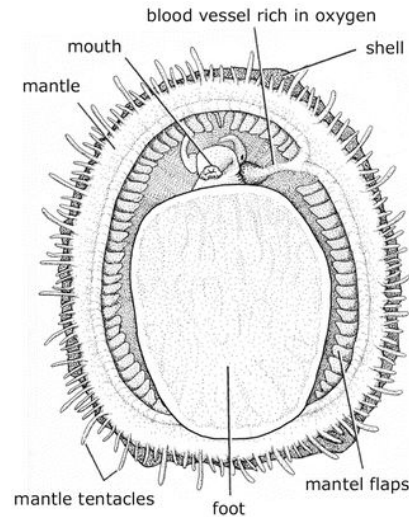
Vertical Distribution and Thermal Tolerance of 'Opihi makaiauli

Amelia Hart



‘Opihi makaiauli: *Cellana exarata*

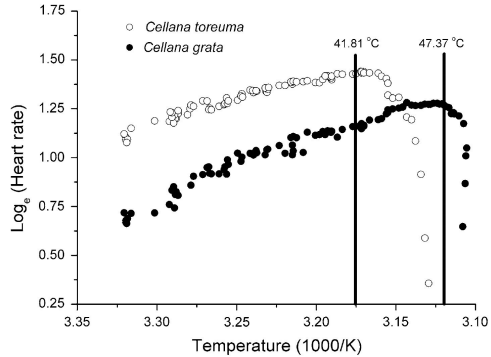
- Habitat: Hawai‘i Rocky Intertidal Zones
 - Molluscs with a **muscular foot** to suction to rock
 - **Important for ecosystem structure:** eat algae on rocks, creating more surface area for other intertidal species
- Culturally Significant
 - Symbolize *strength* and *resilience*
 - Traditional hawaiian dish
- Over-harvested
 - **Konohiki** - traditional overseers of natural resources in Hawai‘i
 - Protected ‘opihī from being over-harvested
- **Climate Change**
 - Species could be pushed to thermal limits
 - Loss of endemic species
 - loss negatively impacts ecosystem
 - Algae blooms



Goals

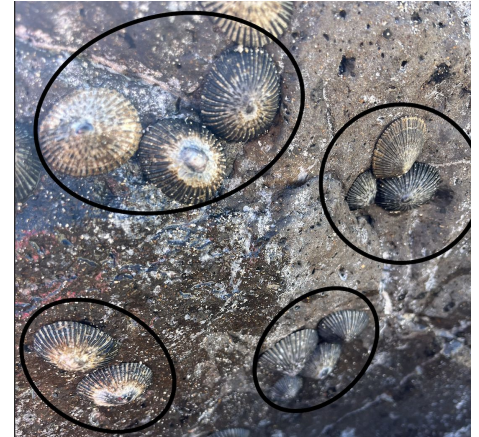


Understand **thermal limits** of blackfoot 'opihi



Dong & Williams, 2011

To find evidence of **physical adaptations** to thermal stress



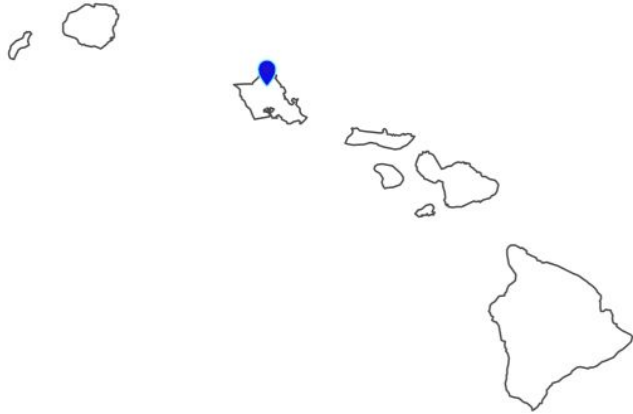
To find evidence of **behavioral adaptations** to thermal stress



Sample Site: Field Data

Location: Mōkapu, Oahu

Type: Rocky Intertidal Zone



Field Measurements: Vertical Distribution

3 Transects:

- Two meters wide
- Mauka to Makai

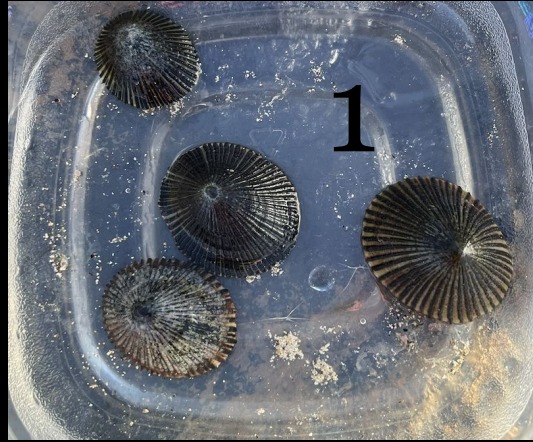
Measurements:

- Lower Intertidal Limit: Distance to Crustose Coralline Algae (CCA)
- Size: Length and Width (mm)
- Illuminance: sunlight hitting 'opihi
- Shell and Body Temperature
- 'Opihi clumping: 'Opihi within 5cm

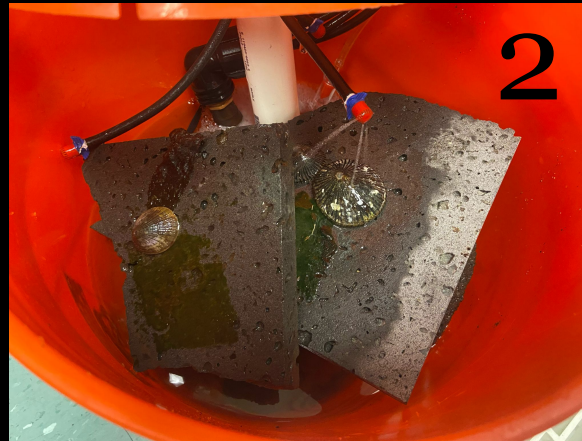


Thermal Tolerance: Monitoring Heart Rate

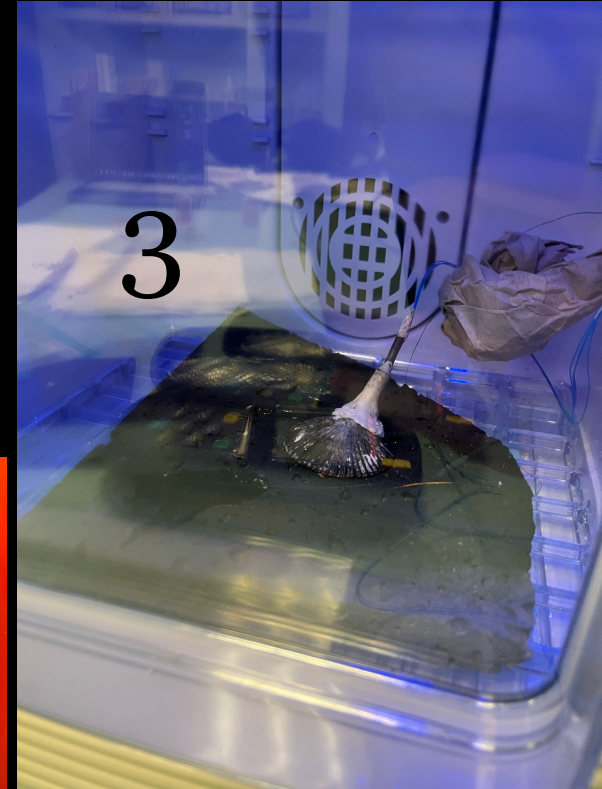
1 - Collection: 4 ‘Opihi picked from intertidals across O‘ahu



2 - Acclimation: placed in tide simulation bucket for 1 week in lab



3 - Measurement: ‘Opihi heart rate and body temperature were monitored as temperature was gradually increased



Body Temperature vs. Illuminance

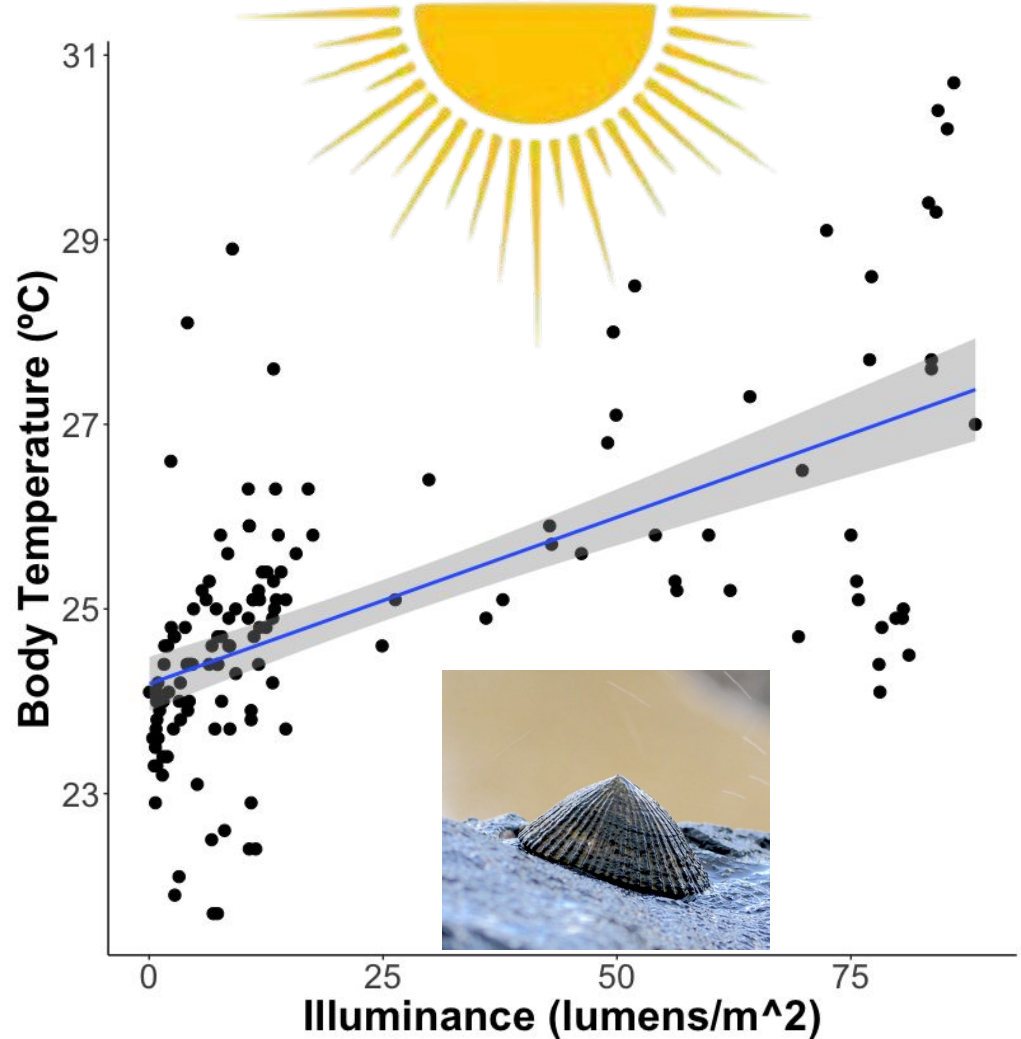
- clear and significant trend
- As Illuminance increases, so does body temp
 - Trend was expected

Physical Adaptations:

- Taller shell = retains less heat
- Flatter shell = retains more heat

Behavioral Adaptations:

- Move away from hotter places
- Cluster together to prevent water loss

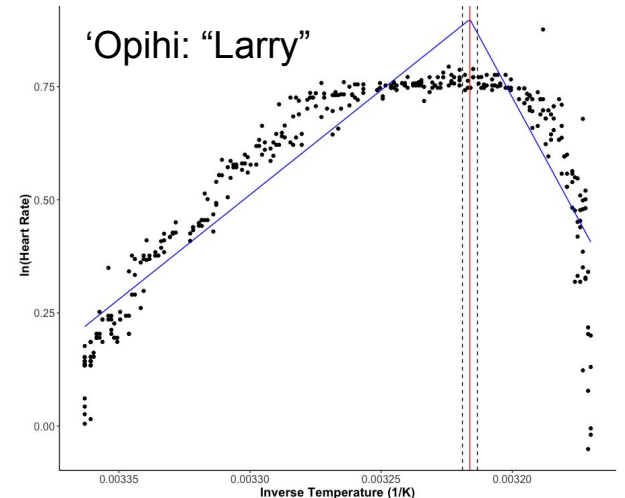
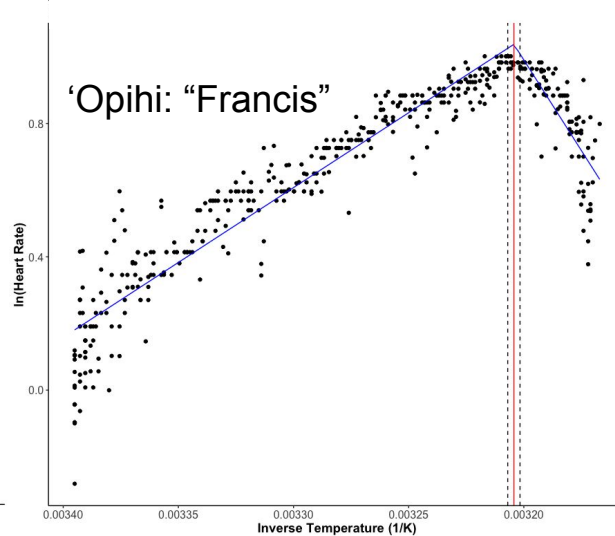
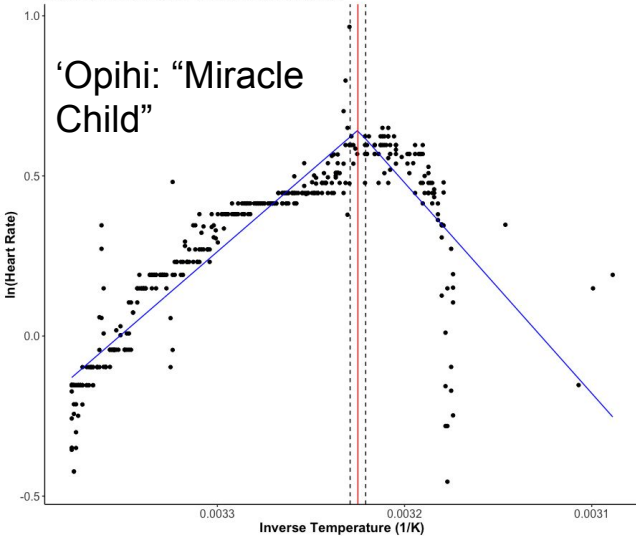
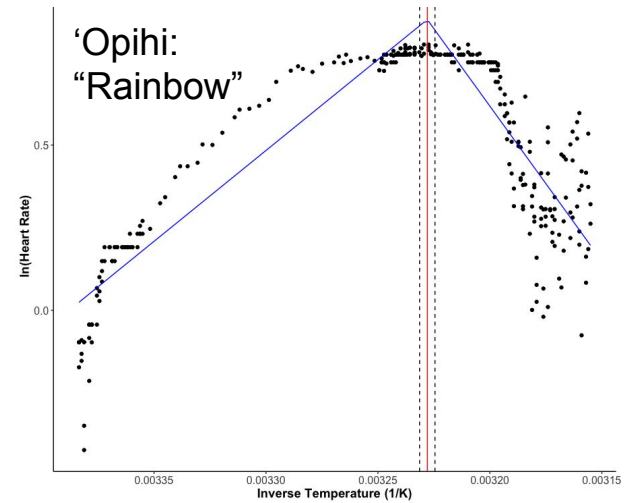


Finding Arrhenius Breakpoint Temperature (°C):

- Sublethal temperature where heart rate stops increasing and starts a steep decline.
- Dotted line = 95% confidence interval

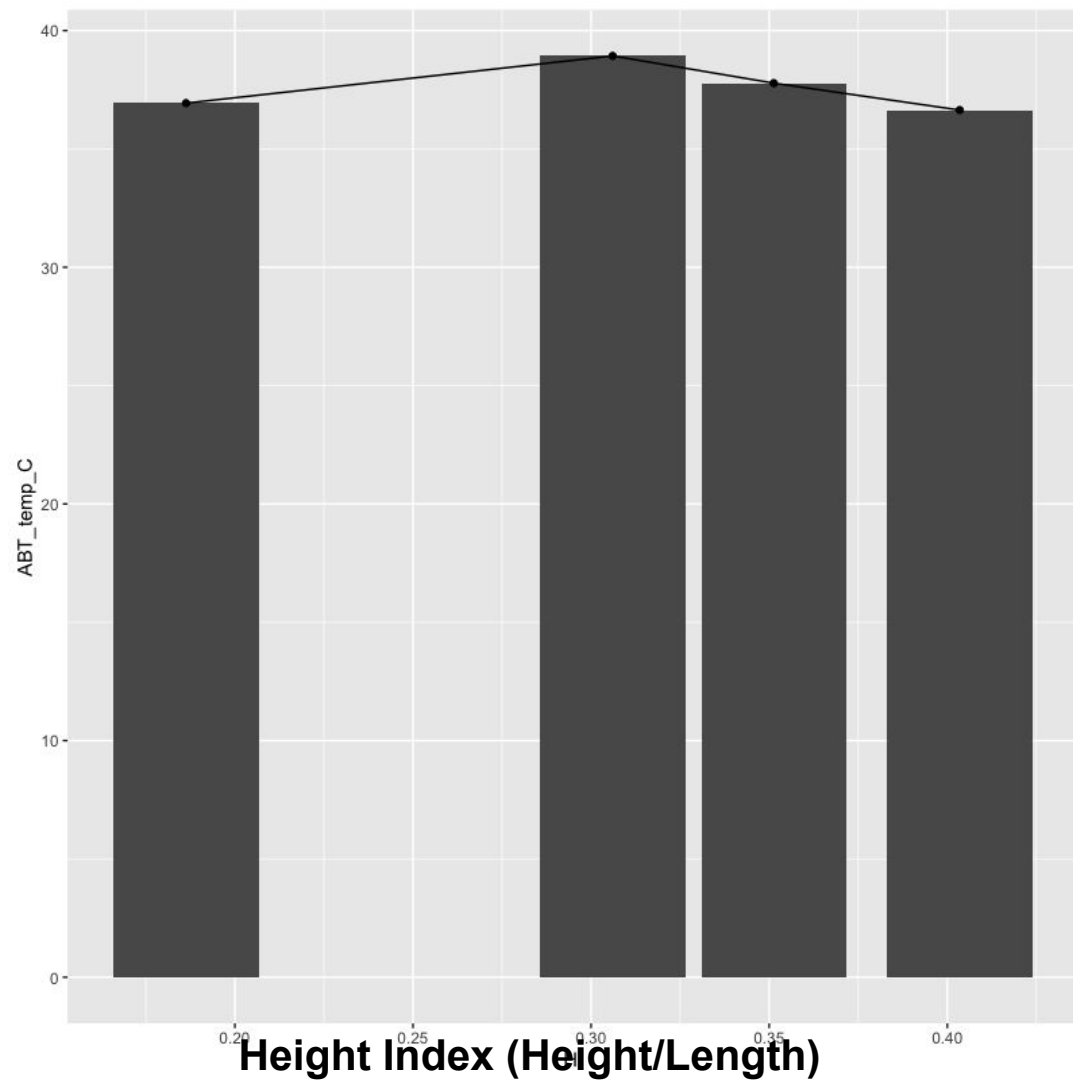
Miracle Child: 36.93°C Francis: 38.93°C

Larry: 37.78°C Rainbow: 36.64°C

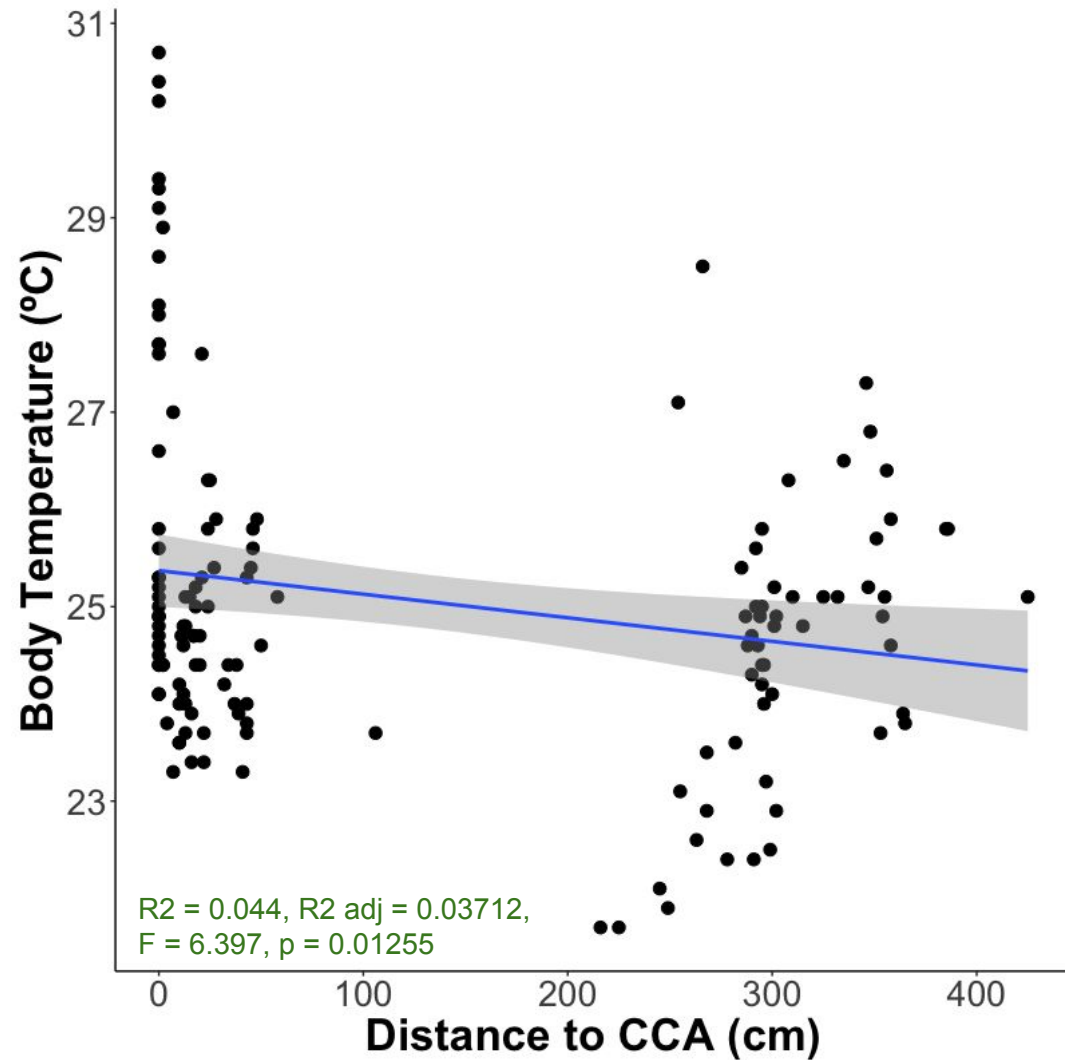


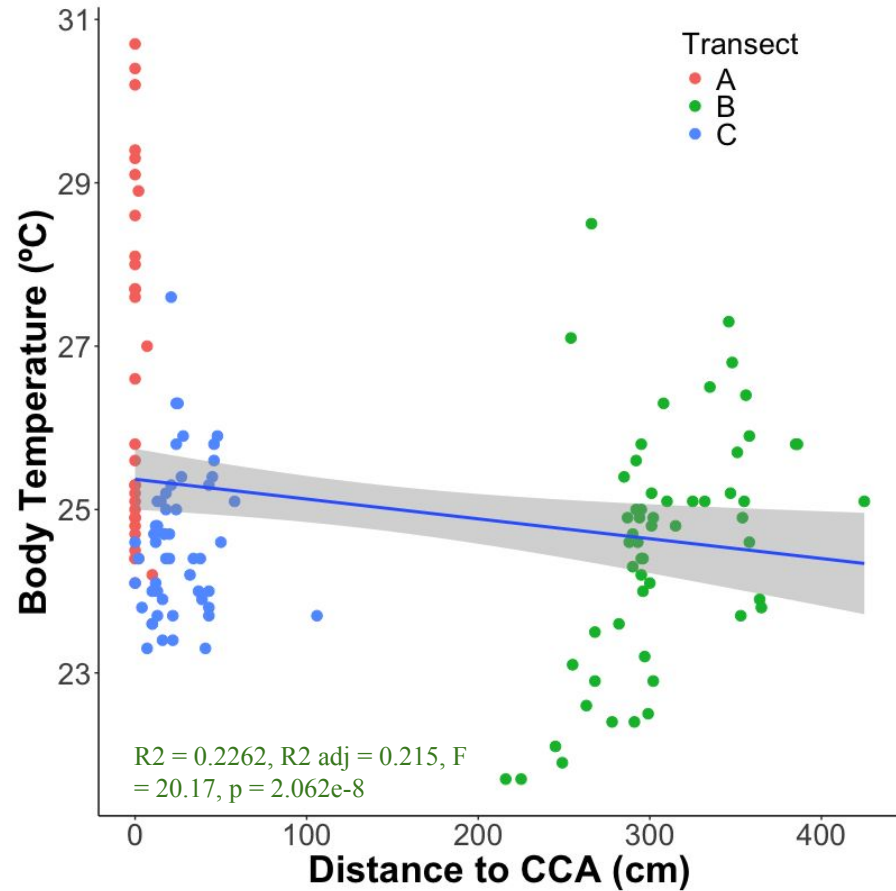
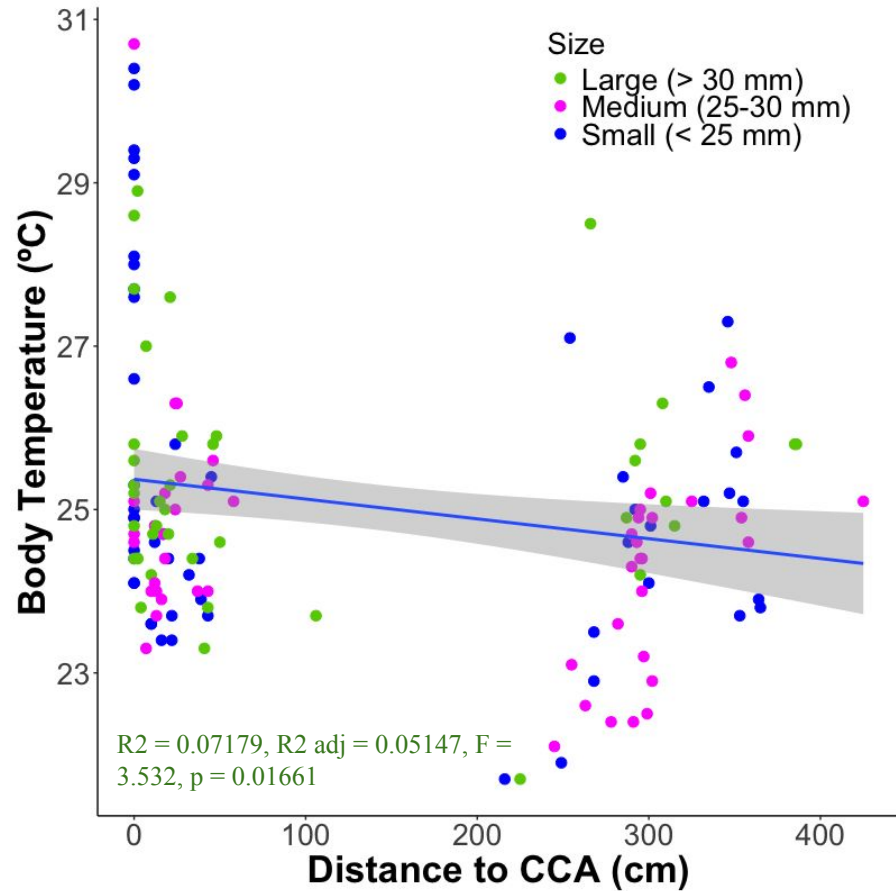
Breakpoint Temperatures (ABT) Vs. Height Index (Hi)

- 'Opihi with lower height indices had higher breakpoint temperature
 - Doesn't support hypothesis
- Sample size limited
 - Might not be representative of wide enough biological range

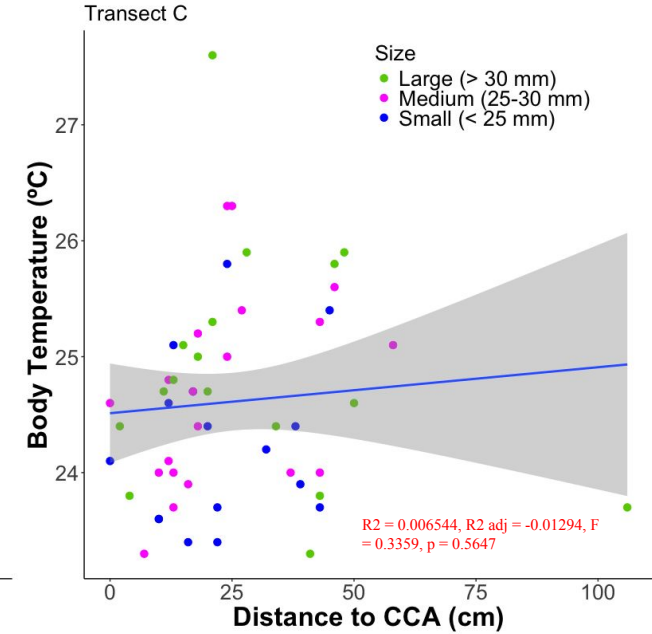
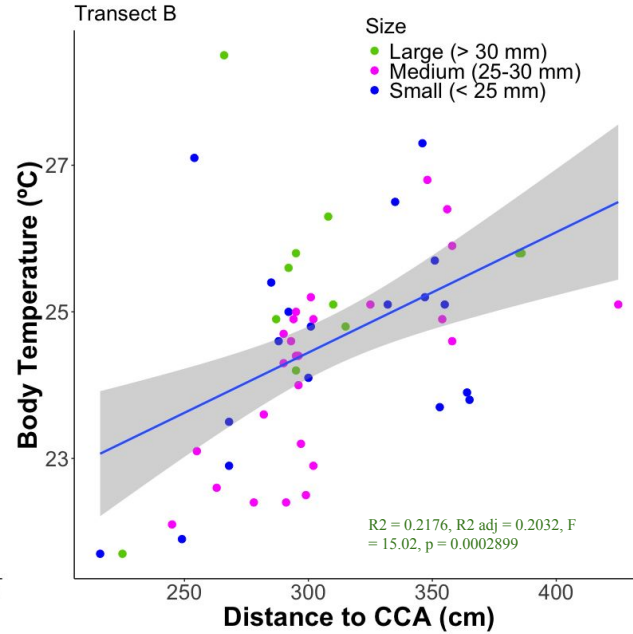
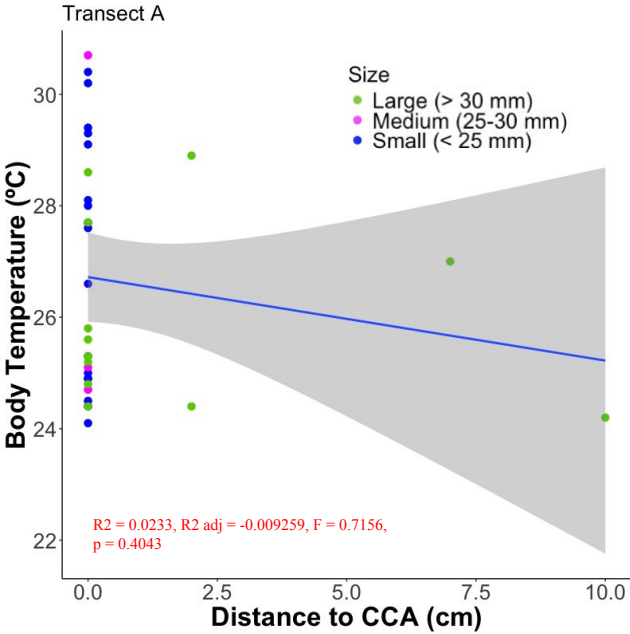


The vertical distribution showed two distinct clumps. Could transect or size have an impact?



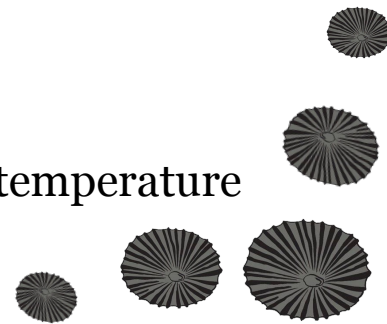
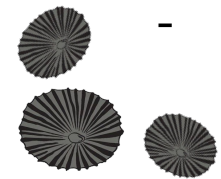


Size (left) did not appear to have a clear impact on the distribution, but site location (right) seemed to show clear pattern.



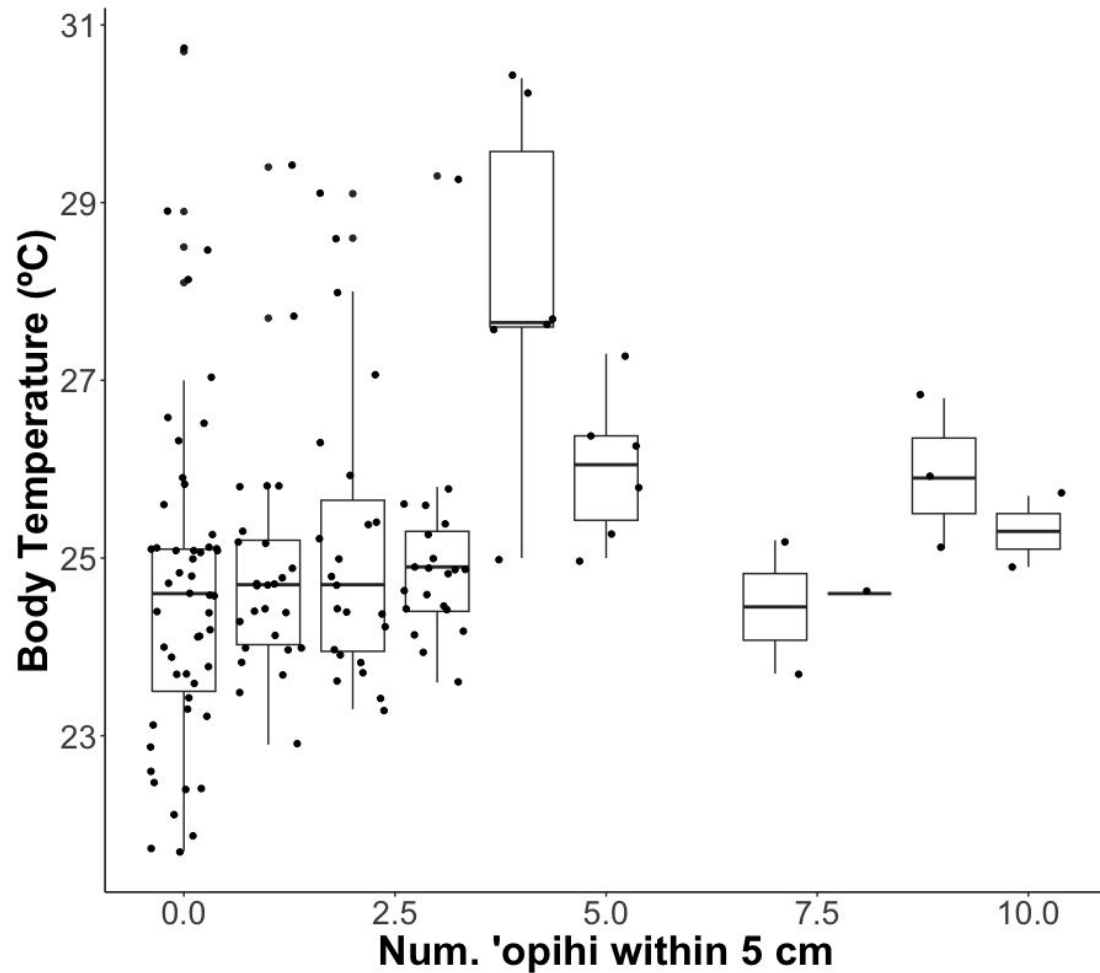
Transect Trends: Distance to Crustose Coralline Algae

- **Hypothesis:** temperature increases higher in the distribution
 - could potentially be supported with more transects
- Individually looking at transects shows **possible trend:**
 - Transect B and Transect C show a small trend of increased body temperature higher in intertidal



Clumping Behavior in 'Opihi

- reasons for clumping
 - Reproduction: broadcast spawners
 - prevent water loss -> lower body temperature in clumps
- Didn't show expected trend
 - Narrower range of body temps in clumps





Conclusions:

Thermal tolerance limit of 36-39°C

- not close to field data max body temperature

Physical adaptations increasing tolerance was not evident in the data

Behavioral Adaptations:

moving from hot areas

- Not shown in overall results
- Trend appeared in 2 transects (significant in 1)

Clumping

- Body temperature narrowed with increasing clumping

THANK YOU!

