Determining the Role of Epigenetics in Variations of Plasticity and Thermal Tolerance in *T. californicus*

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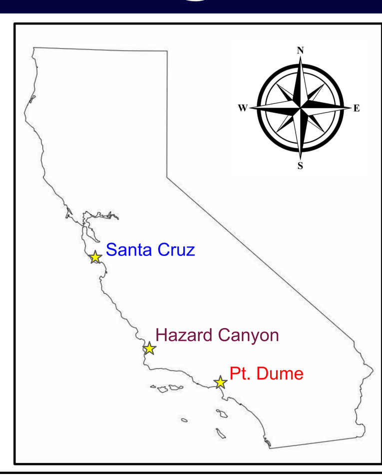
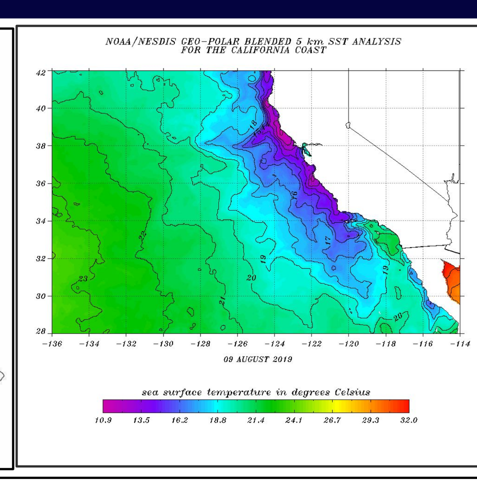
Introduction

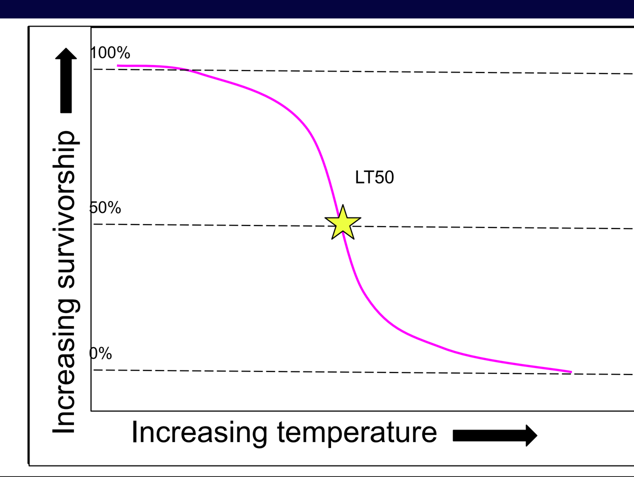
Increased ocean temperatures can act as a driving selective pressure and negatively affect the fitness of marine organisms. Phenotypic plasticity, the capacity of a single genotype to exhibit variable phenotypes across different environments, can drive acclimatory response. Plasticity can vary between different species and populations, however, how these differences evolve is still poorly understood. Plasticity is partially attributed to epigenetic processes such as DNA methylation, a cellular-level process that regulates the quantity and variability of a gene's expression. Thus, epigenetic pathways may have diverged among populations with differences in plasticity. The intertidal copepod *Tigriopus californicus* displays varying levels of (i) thermal tolerance and (ii) plasticity in thermal tolerance between populations, with both tolerance and plasticity increasing as latitude decreases[1]. This makes *T. californicus* an excellent model to study adaptational changes in plasticity between populations of a species, as well as what role DNA methylation plays in these differences.

Background





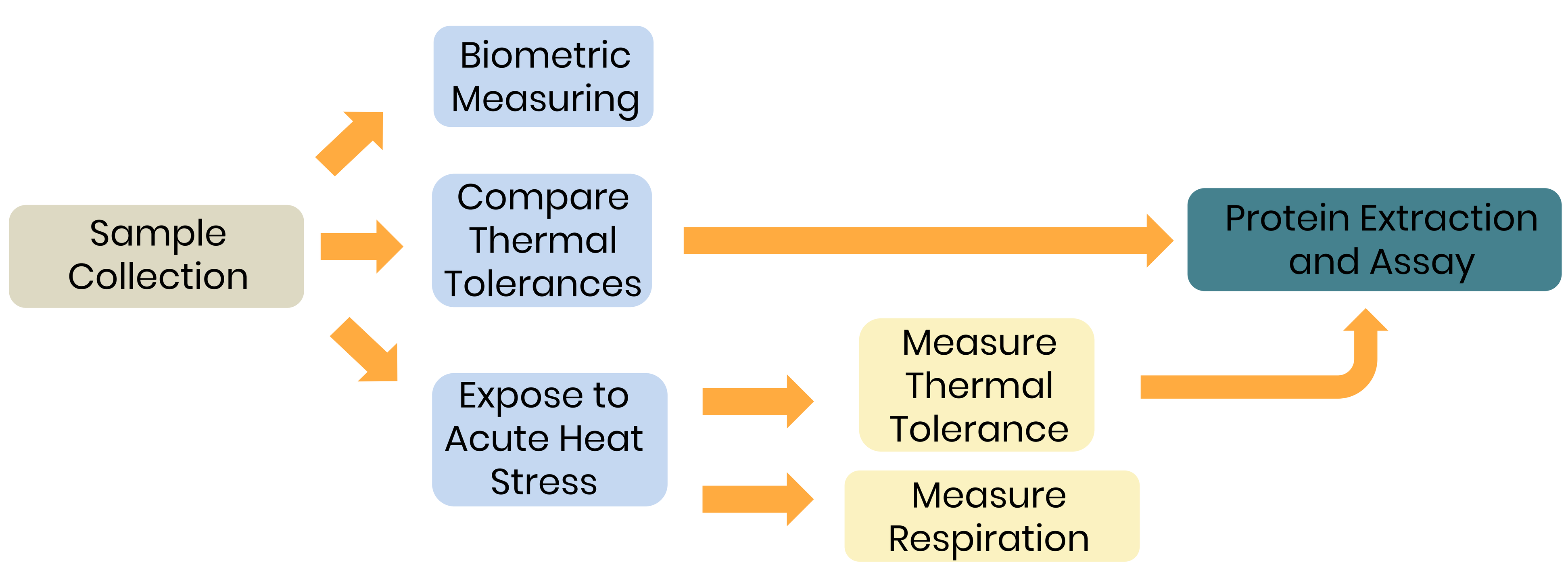
Collection Sites:
Samples were collected from populations at different latitudes to compare differences in morphology, physiology and plasticity



Thermal Tolerances:
A mock graph detailing Lethal Temperature 50 (LT50). LT50 is calculated by plotting survival fraction of *T. californicus* samples across a temperature gradient

***Tigriopus californicus*:**
An intertidal copepod that inhabits the California coast. Populations are mostly isolated and widely dispersed, minimizing gene flow between them

Methods



- Samples were collected from Pt. Dume (southernmost) Hazard Canyon, and Santa Cruz (northernmost)
- Cephalothorax lengths were measured using males and females from each population
- Samples from Pt. Dume and Santa Cruz were placed in one of three water baths (22, 25, and 28°C) for one hour
- LT50 and respiration rates were measured to determine the effect of heat stress

Results

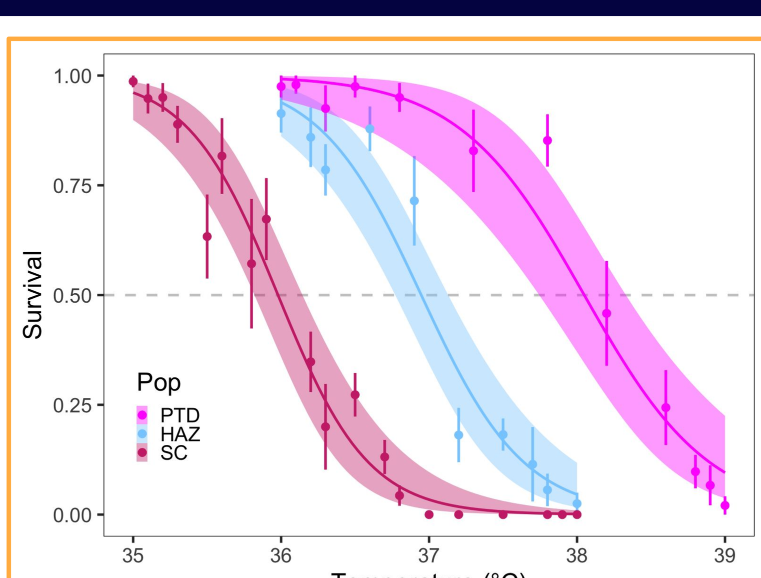


Fig. 1: Thermal tolerances of different populations of T. californicus.
The mean proportion of survival is plotted across different 1 hr temperature treatments. Populations are differentiated by color. Shaded regions denote 95% confidence intervals around the fitted logarithmic curves. Vertical error bars depict +/- SE.

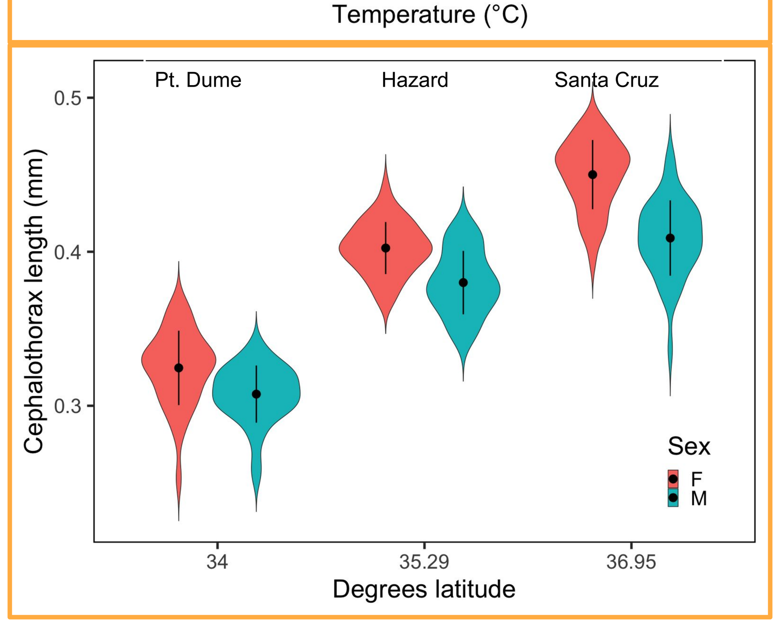


Fig. 2: Differences in cephalothorax length between population and sex.
Cephalothorax lengths in mm were plotted across increasing latitude. Violin graphs display distribution of body size within each population. Sexes are differentiated by color. Black dots depict mean lengths of each population. Vertical error bars depict +/- SD.

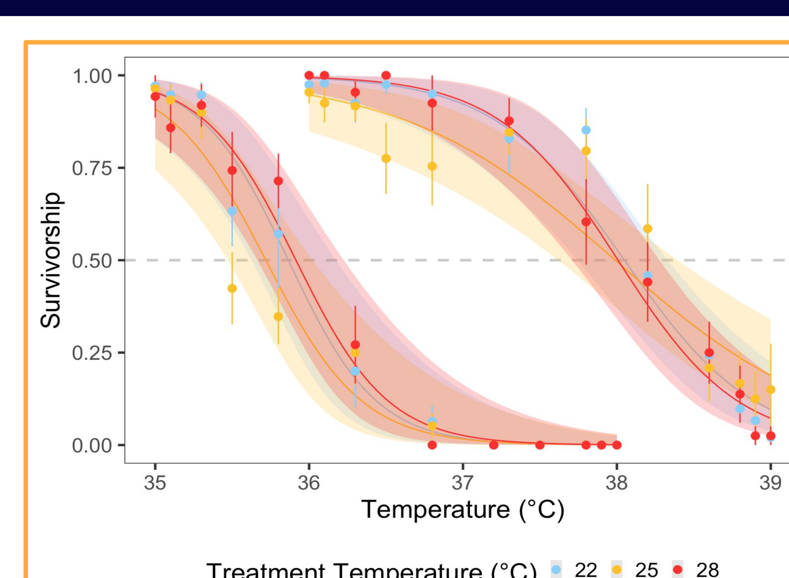


Fig. 3: Changes in LT50 After Exposure to Acute Heat Stress.
The mean proportion of survival after heat stress is plotted across different 1 hr temperature treatments. Color denotes temperature of heat stress. Shaded regions denote 95% confidence intervals around the fitted logarithmic curves. Vertical error bars depict +/- SE.

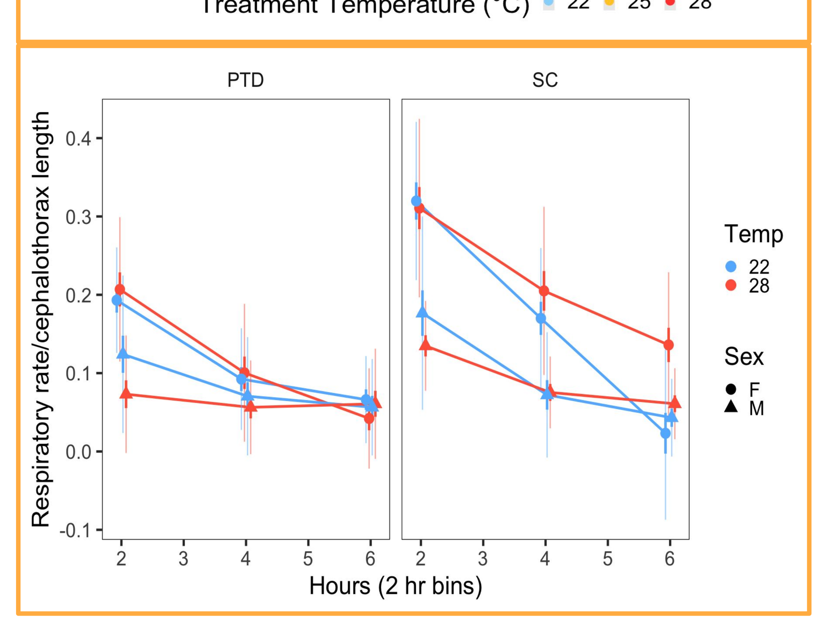


Fig. 4: Respiration pates between population and sex, adjusted for size.
Body length-adjusted respiration rate as change in umol O_2/L over time is plotted across binned time intervals, population and sex. Wide error bars depict +/- SE. Narrow error bars depict +/- SD. Color denotes treatment temperature. Point shape denotes sex.

Conclusion

The results of our experiment demonstrated that populations of *T. californicus* from both northern and southern latitudes did not alter their thermal tolerance in response to acute heat stress. In contrast to studies on developmental plasticity, our findings demonstrate that *T. calfornicus* exhibits developmentally plastic changes in thermal tolerance but not plastic changes following acute changes in temperature.

Body size varied across latitudes and sexes. Individuals from higher latitudes were larger than those from lower ones, and females from any population were larger than males. Size differences between females and males increased with latitude, suggesting differences in sex-specific selective pressures that may affect thermal tolerance.

Respiration rates appear to be related to latitude and sex. Santa Cruz had higher O_2 consumption compared to Pt. Dume. Females displayed higher O_2 consumption than males. Interestingly, Santa Cruz females were the only group to exhibit significant increases in respiratory rate under high temperature.

Acknowledgements

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