Impact of Heatwaves on the Arceye Hawkfish
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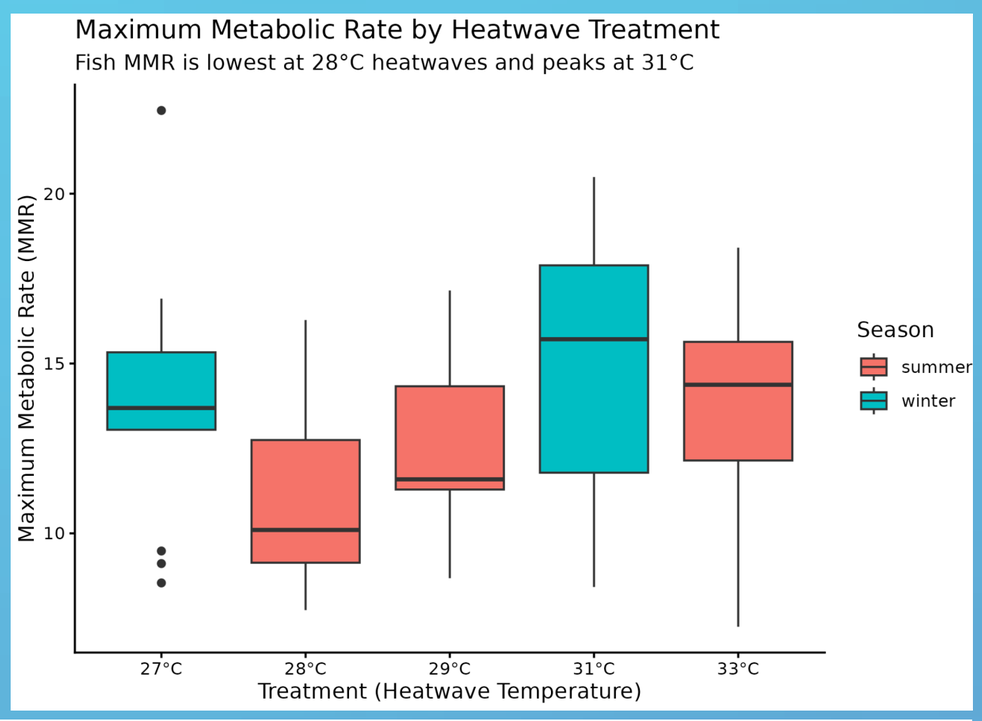
Our project analyzes a 2024 study by Van Wert et al. on the impact of marine heatwaves (a prolonged period of unusually high ocean temperatures) on the arceye hawkfish, a tropical predator. This analysis was conducted to understand the relationship between ocean temperatures and the performance of arceye hawkfish, which is especially important as ocean temperatures continue to rise due to climate change.

Research Questions

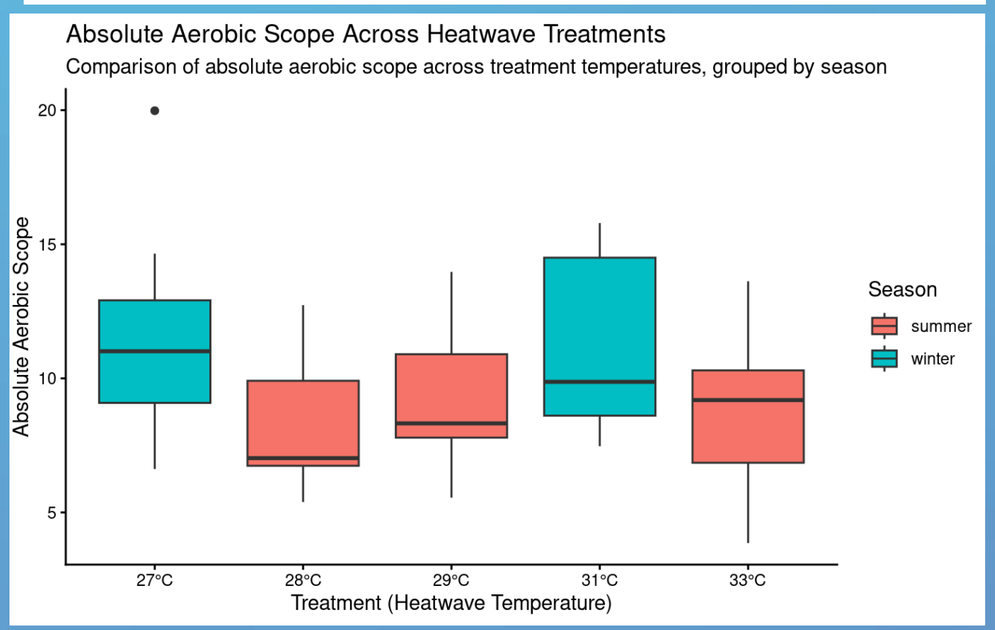
What threat do heatwaves pose to hawkfish?
Does the season (summer vs winter) have any effect on the fish's energy?

Important Definitions

- **Maximum Metabolic Rate**: The highest rate of energy expenditure an animal can sustain; often measured by the maximum rate of oxygen consumption during sustained, vigorous activity, like chasing prey or escaping a predator.
- **Standard Metabolic Rate:** The minimum metabolic rate required to maintain basic physiological functions. In our case, it's the minimum amount of energy a fish needs while calm and unstressed.
- **Absolute Aerobic Scope:** The amount of energy an organism has for activities beyond basic survival. It is calculated by the difference between an organism's maximum metabolic rate and its standard metabolic rate. A higher absolute aerobic scope means an organism has more energy available for movement, feeding, growth, or coping with stress.



- At 31°C and 33°C, both the median and spread of MMR are highest, indicating that extreme heatwaves are associated with high and variable maximum metabolic rates compared with temperatures closer to the normal 27–29°C range.
- **Winter fish generally show higher MMR than summer fish** at comparable or nearby temperatures.



- Winter fish have higher aerobic scope than summer fish, which means winter hawkfish appear more capable of handling heatwave temperatures.
- As treatments get harsher, the aerobic scope drops among winter fish.
- In summer fish, we see higher heatwave temperatures lead to slightly higher aerobic scopes.
- Hawkfish handle the treatments differently in each season, but **overall, winter fish are better able to deal with rising temperatures that impair hawkfish's ability to cope with environmental stress because they have higher aerobic scopes than summer fish.**

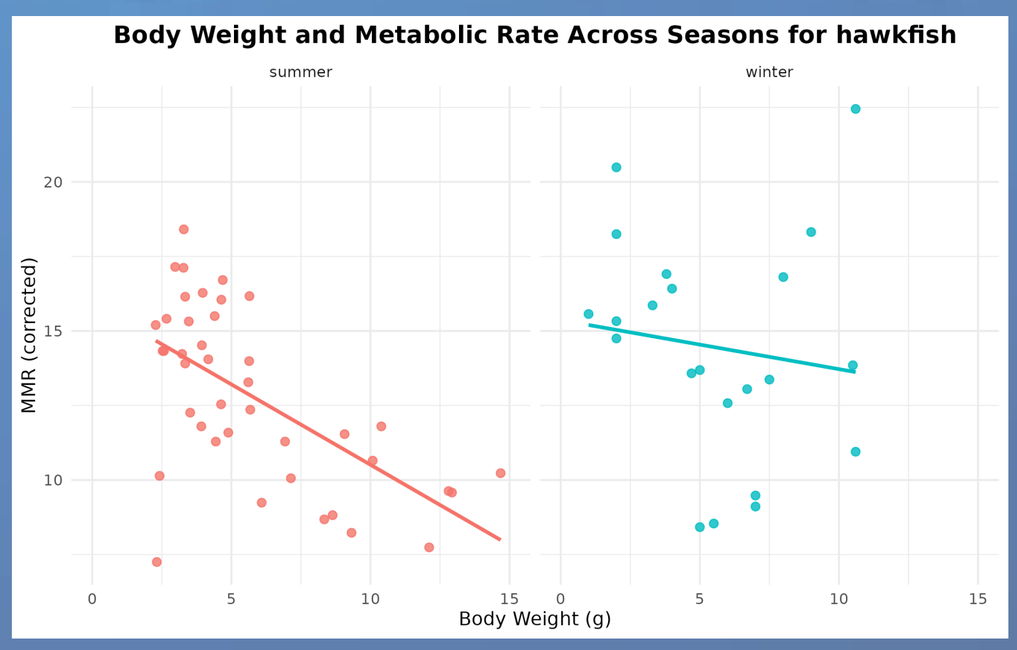
Winter:

- Hawkfish keep a stable, predictable amount of energy use.
- Energy use is only slightly affected by body weight.

Summer :

- Energy use drops much faster in heavier fish.
- The points spread out, meaning their energy output becomes unpredictable.

Take home: Heatwaves throw off the hawkfish's normal energy balance, especially in bigger fish.



Summary

- Hawkfish have **lower maximum metabolic rates**, suggesting they are experiencing **thermal stress** as a result of the high temperature.
- Hawkfish are better able to deal with heatwave treatments during the winter because they have **higher aerobic scopes** than in the summer.
- Heavier hawkfish are **less energy efficient** and become **fatigued** more quickly than smaller fish.
- Heatwaves significantly restrict the arceye hawkfish's **energy output** and **performance**, posing a **great threat** to their functioning.
- Marine heatwaves are increasing in both **frequency** and **temperature**, putting these fish more at risk than ever before[1]

[1]Marcos et al. (2025)