Aquaculture
3/01/2022

The contribution of summer heatwaves to 'triploid mortality' in the Pacific oyster

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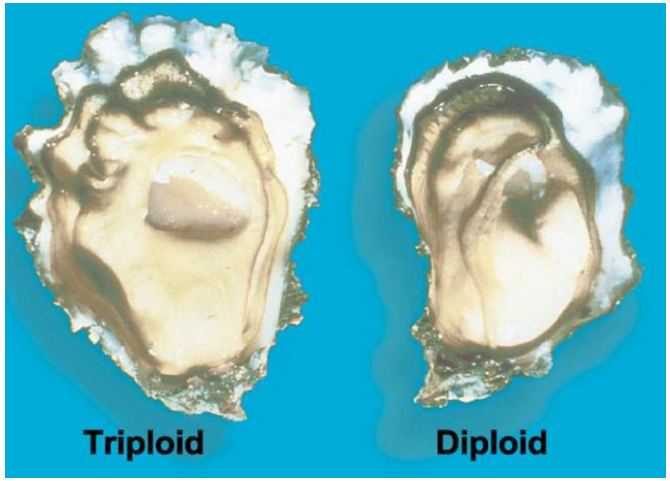
Pacific Oysters – tolerance is survival

Pacific Oyster

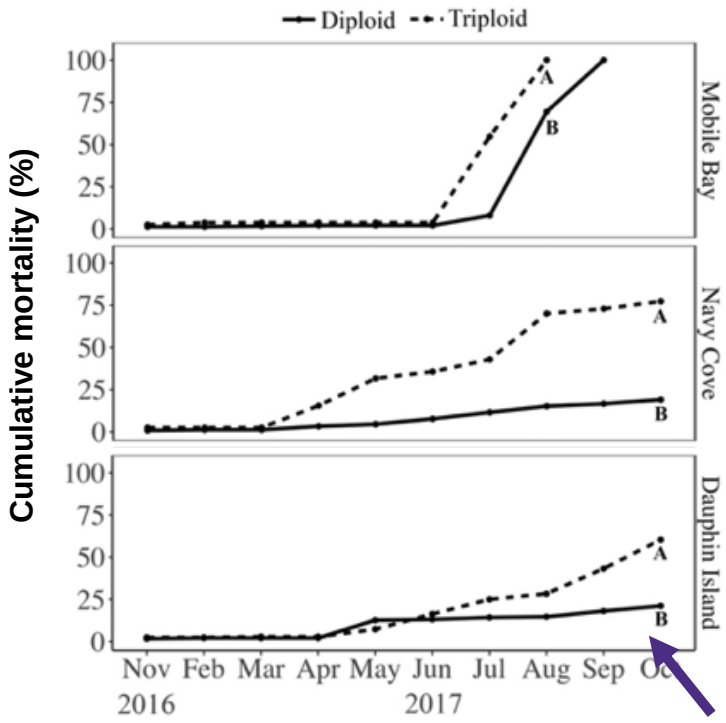
Reproductive control in Pacific oysters



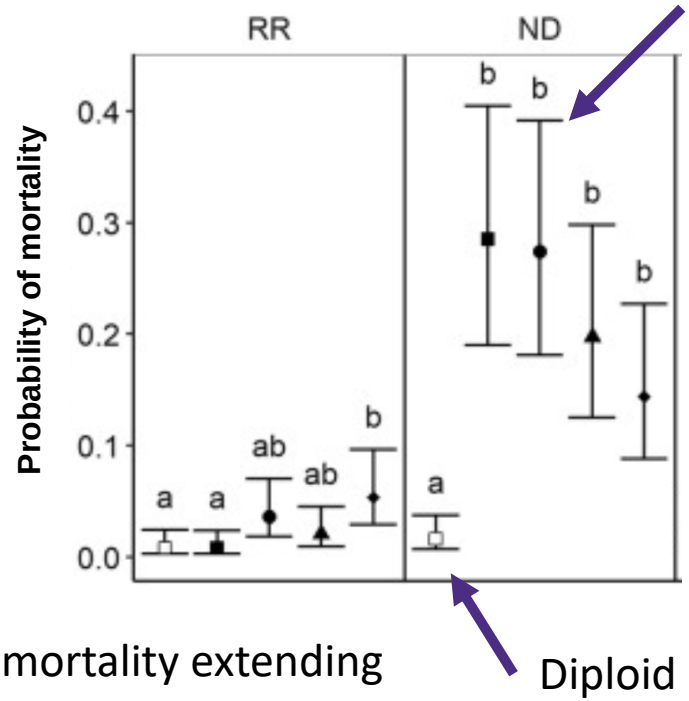
1. Various methods used to induce triploidy (tetraploid cross, heat-shock, pressure, etc.) starting in the late 1970's.
2. Triploid oysters have an extra chromosome set (3n).
3. Triploidy **significantly reduces energetic investment in gonad production**.
4. Triploid oysters have **superior growth rates.**
5. Harvesting triploids in the summer **avoids the *unpleasant* taste of 'spawny' oysters**.

Diploid vs. Triploid mortality in the field

Gulf of Mexico



Chesapeake Bay



Field mortality extending through the summer

Diploid

Wadsworth 2018; http://hdl.handle.net/10415/6074

Matt et al. 2020; doi: 10.1016/j.aquaculture.2020.735375

Marine Heatwaves

Sections

The Washington Post
Democracy Dies in Darkness

World Africa Americas Asia Europe Middle East Foreign Correspondents

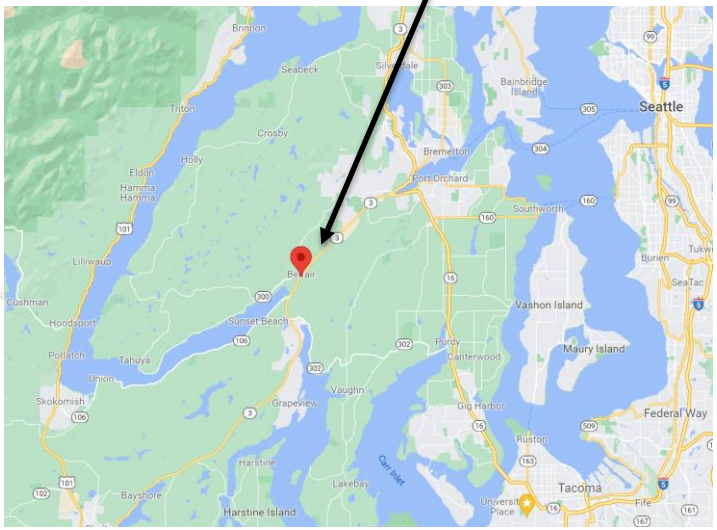
Americas

Crushing heat wave in Pacific Northwest and Canada cooked shellfish alive by the millions

June 2021

Air temp
40-45°

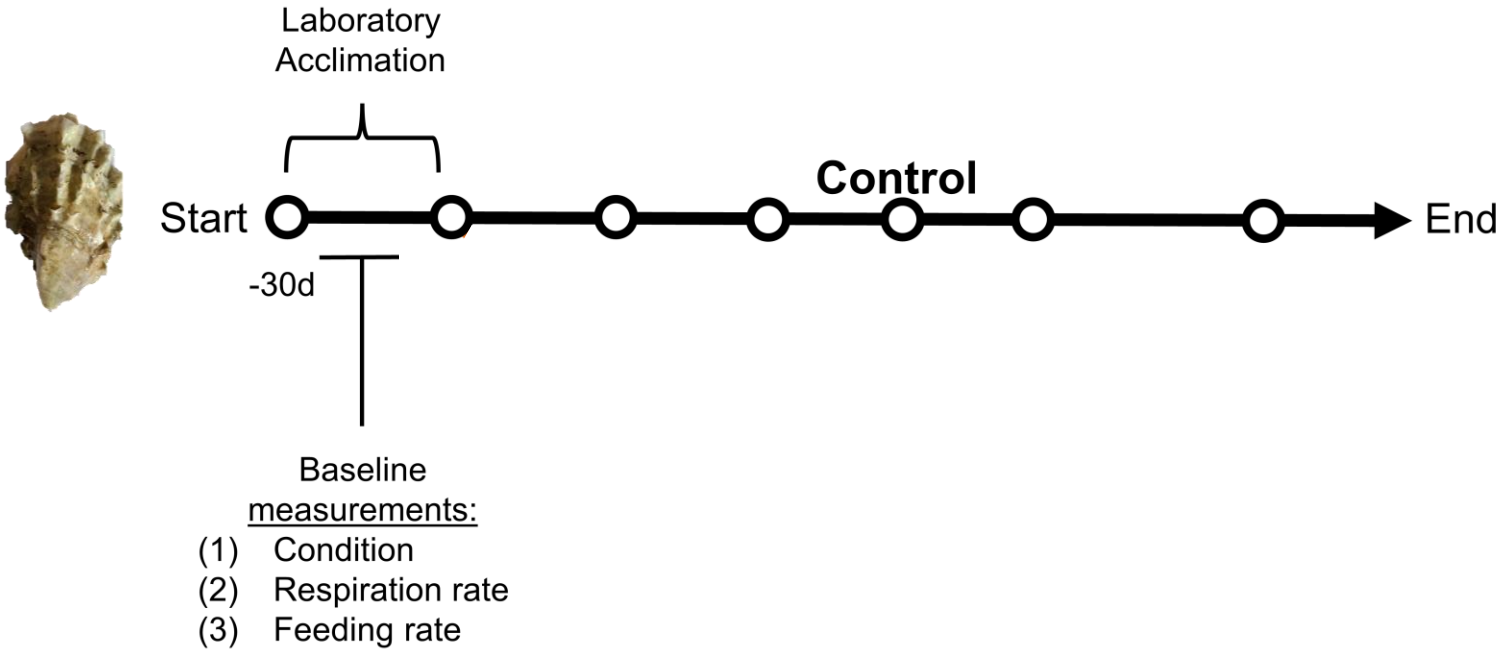
water temp
20-35°



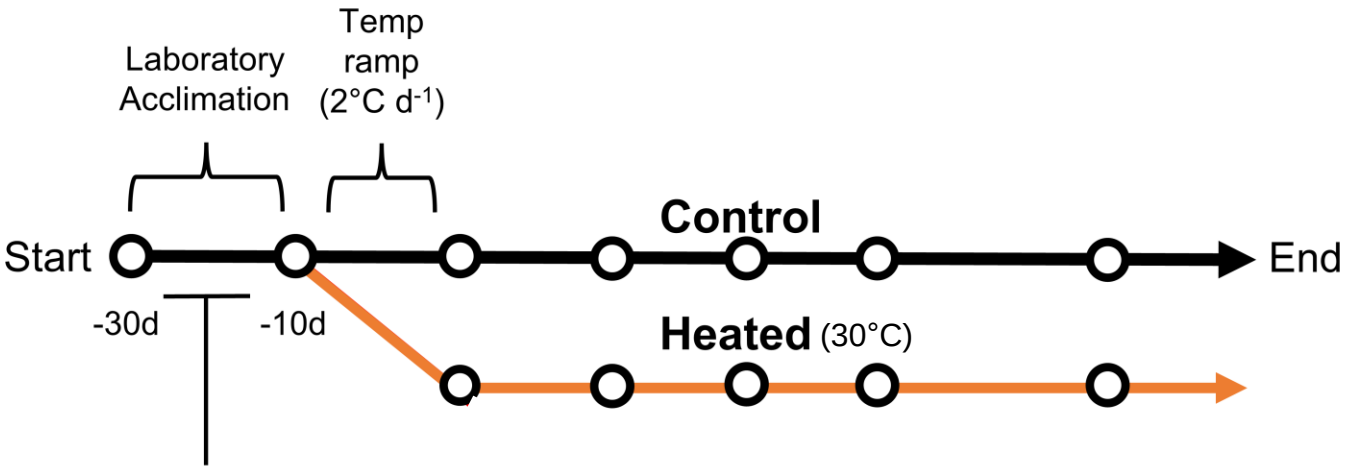
Partners:

Point Whitney Shellfish Hatchery

Experimental Design



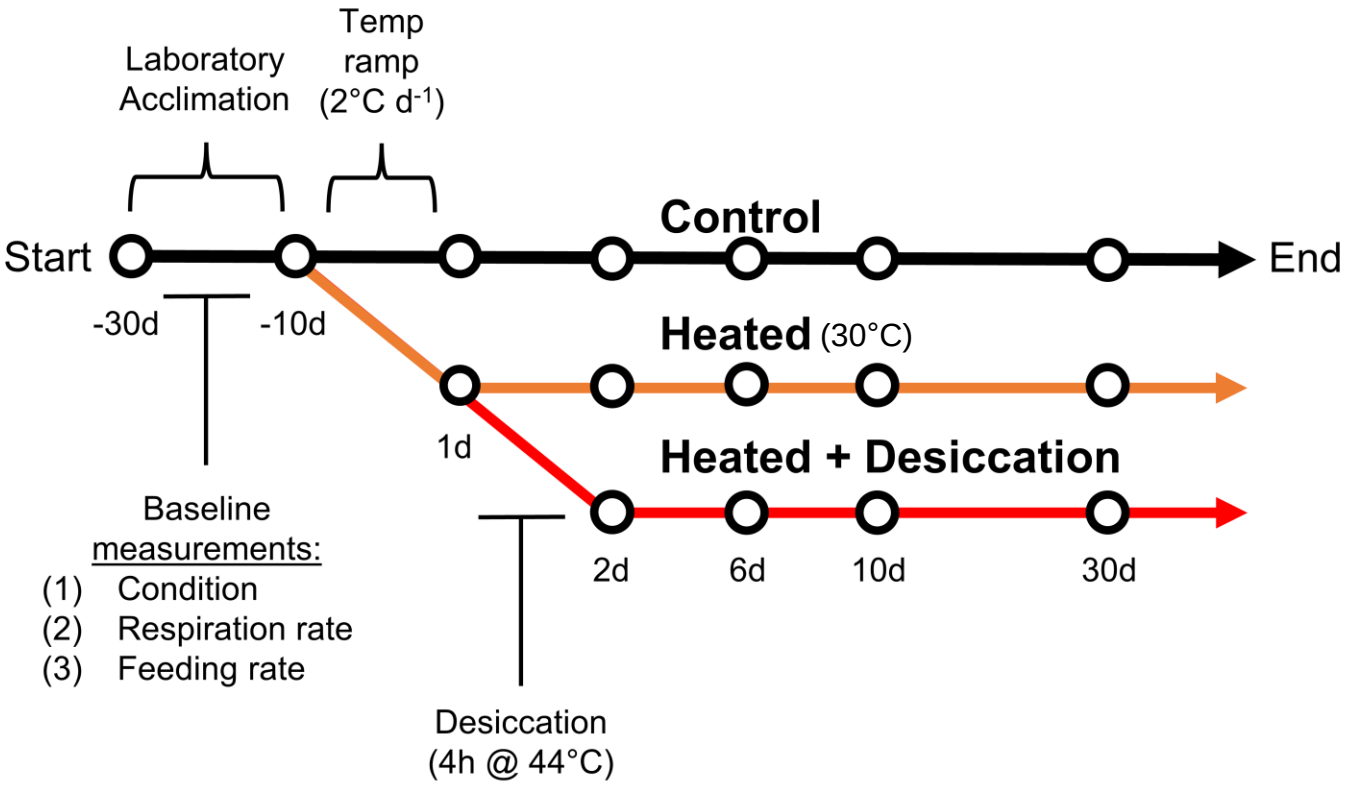
Experimental Design



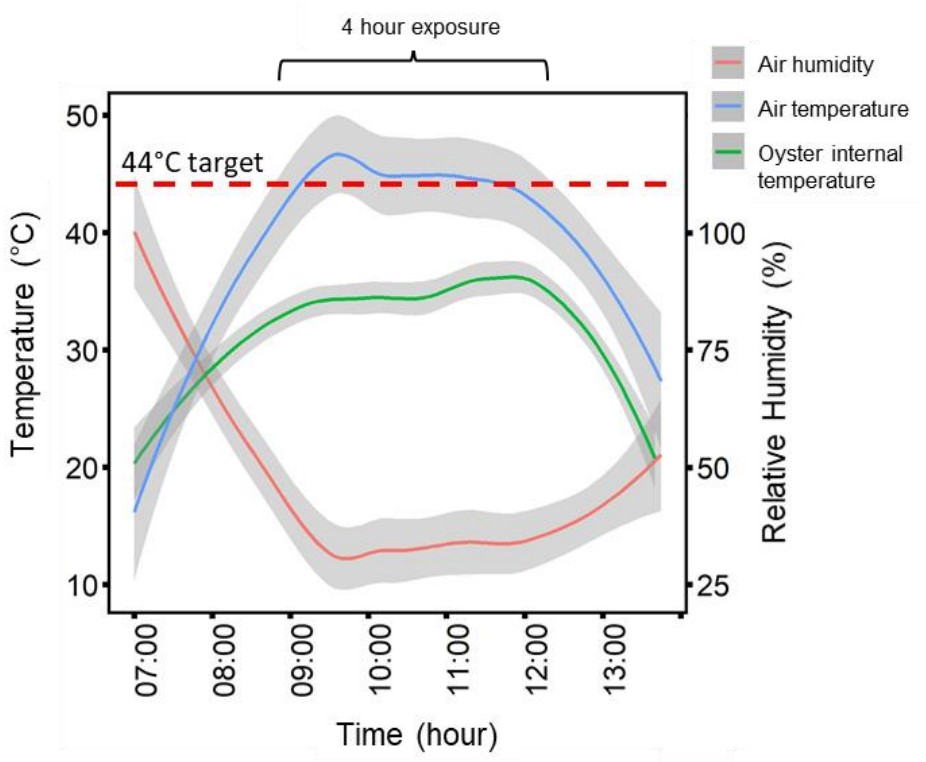
Baseline measurements:

(1) Condition
(2) Respiration rate
(3) Feeding rate

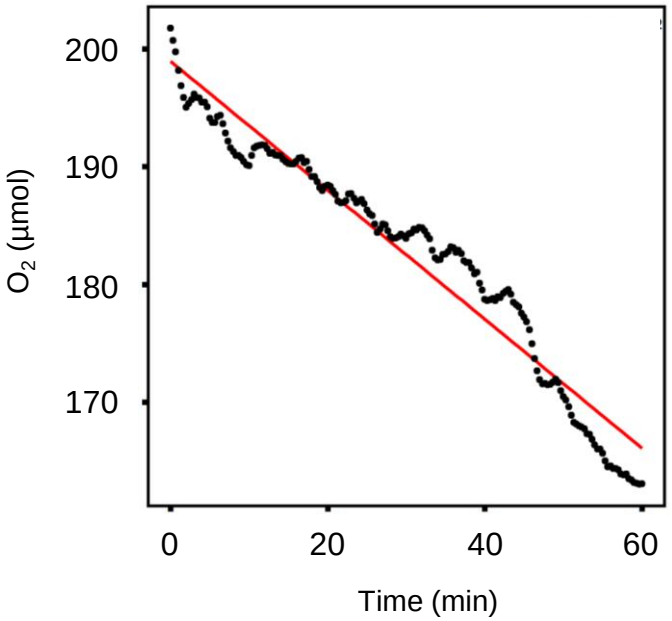
Experimental Design



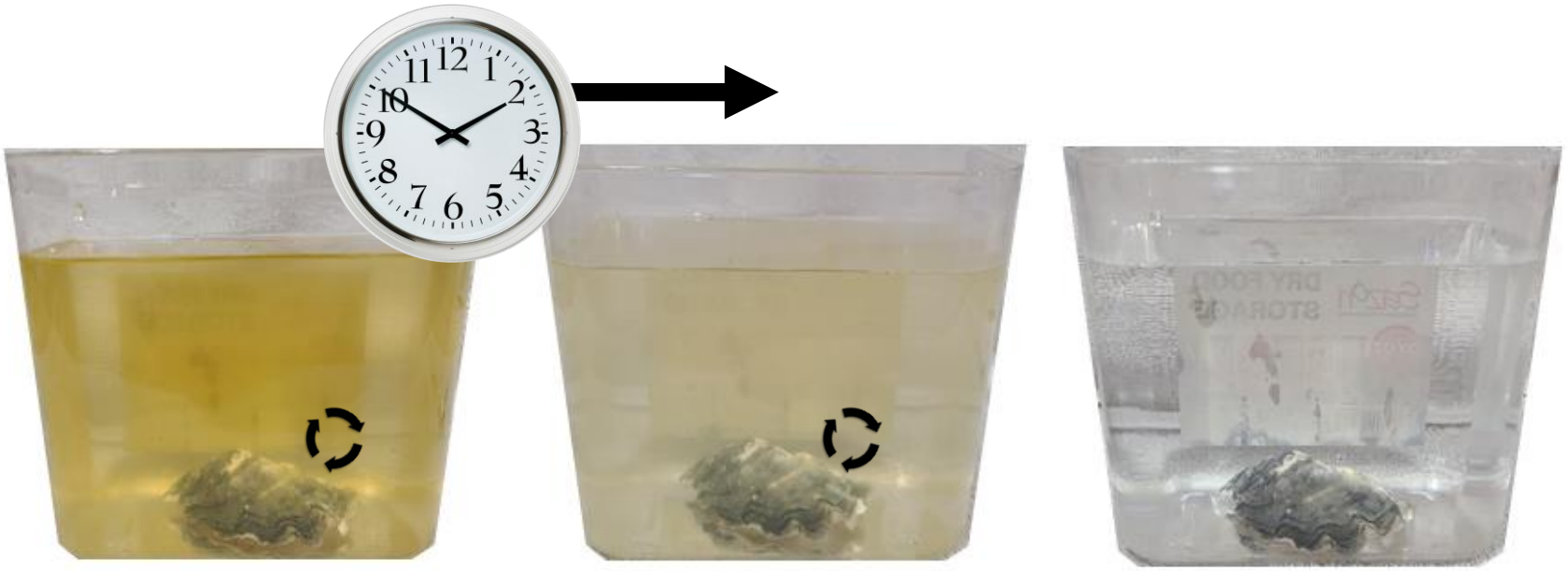
Desiccation



Respirometry



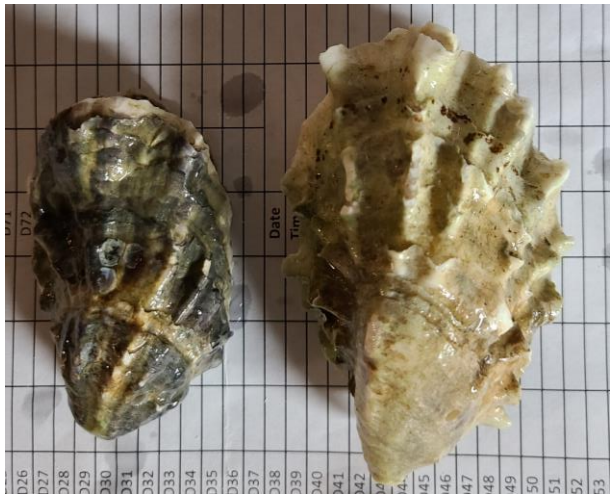
Clearance Rate

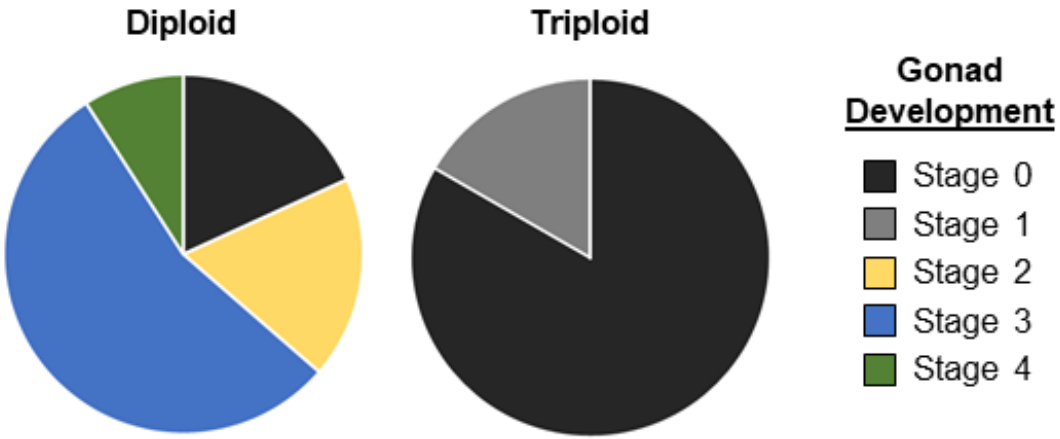


10^6 cells ml^{-1} 10^5 cells ml^{-1} 10^2 cells ml^{-1}

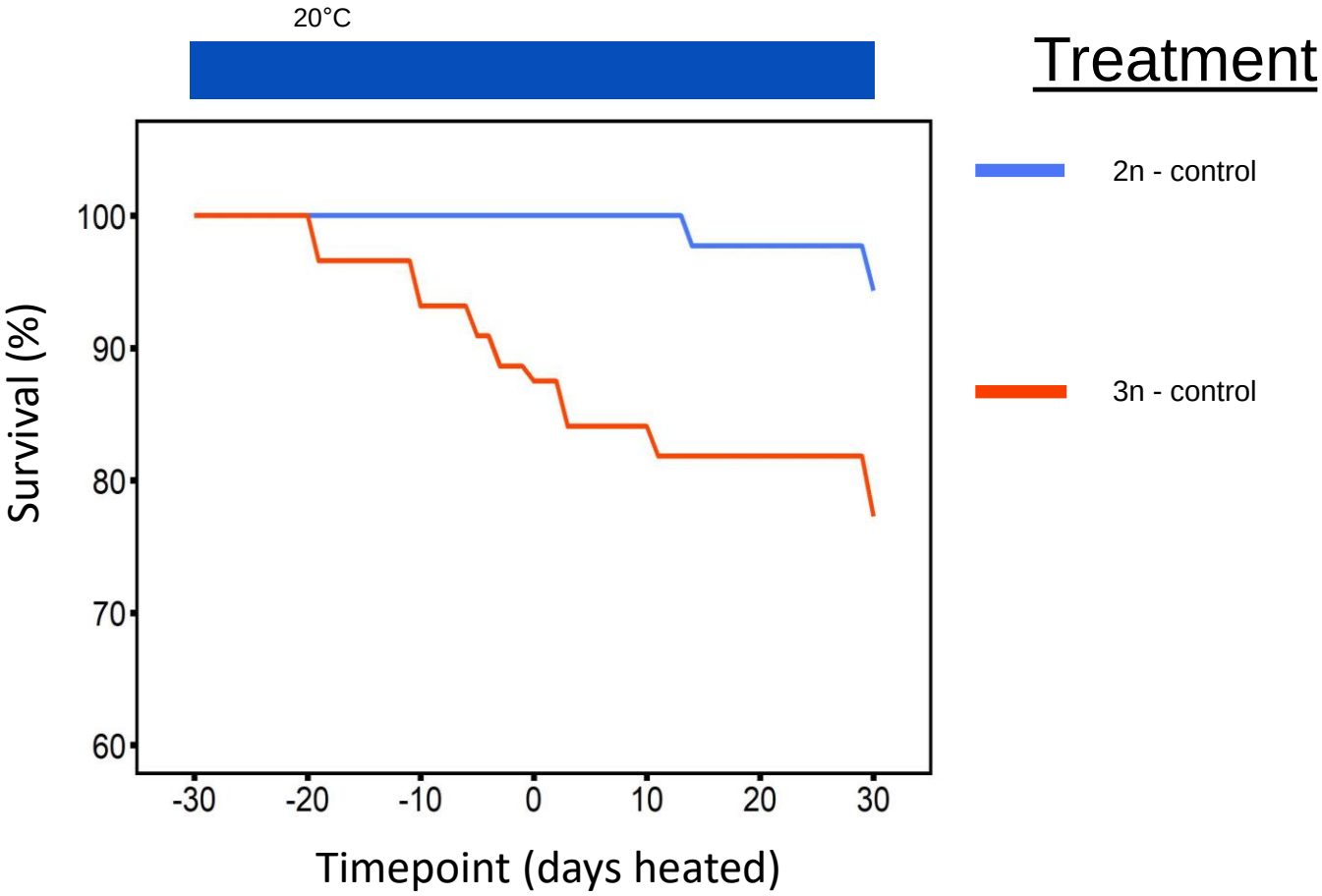
Clearance rate was defined as the amount of algae removed per unit time per oyster, corrected for oyster size

Reproductive Condition

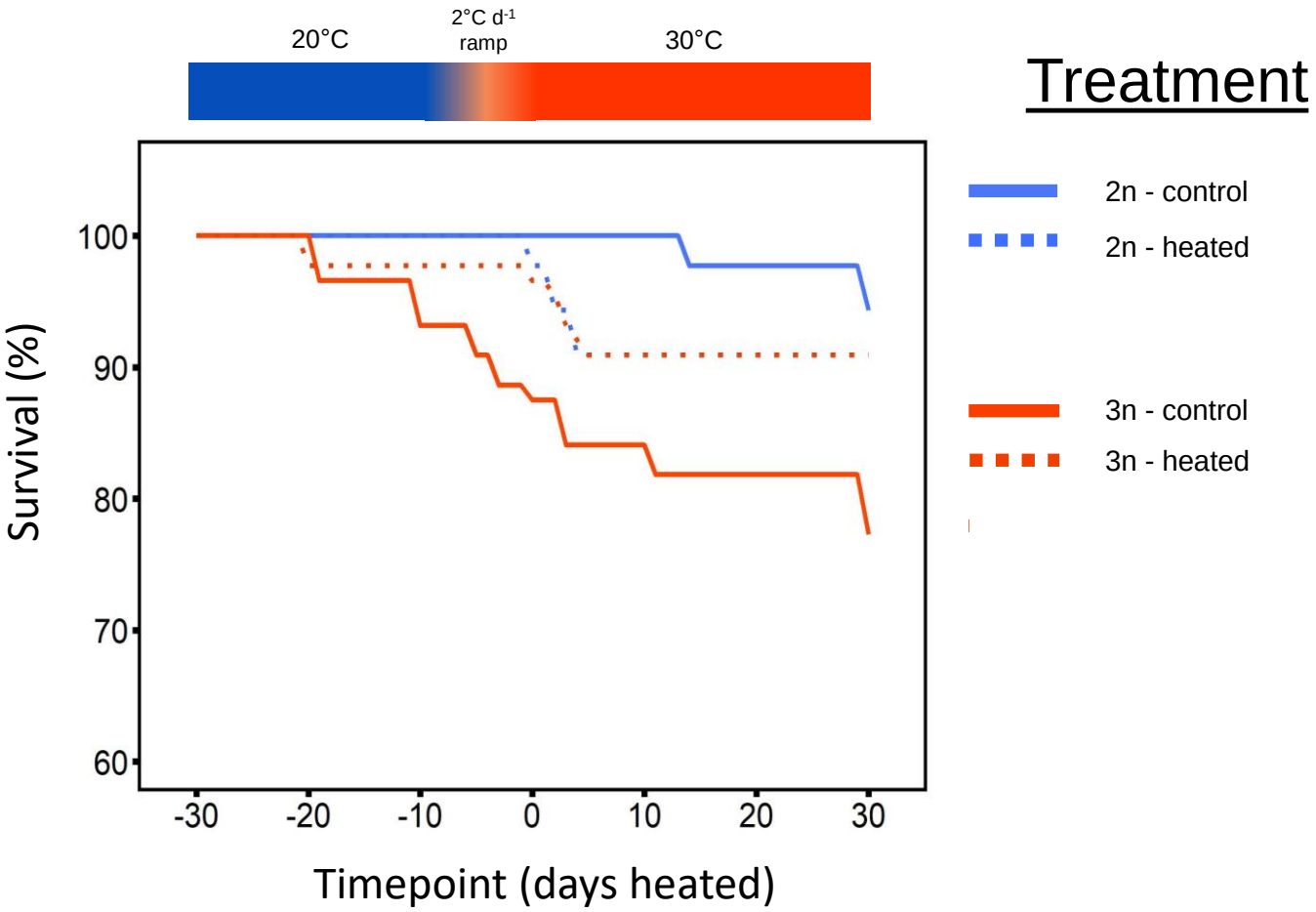




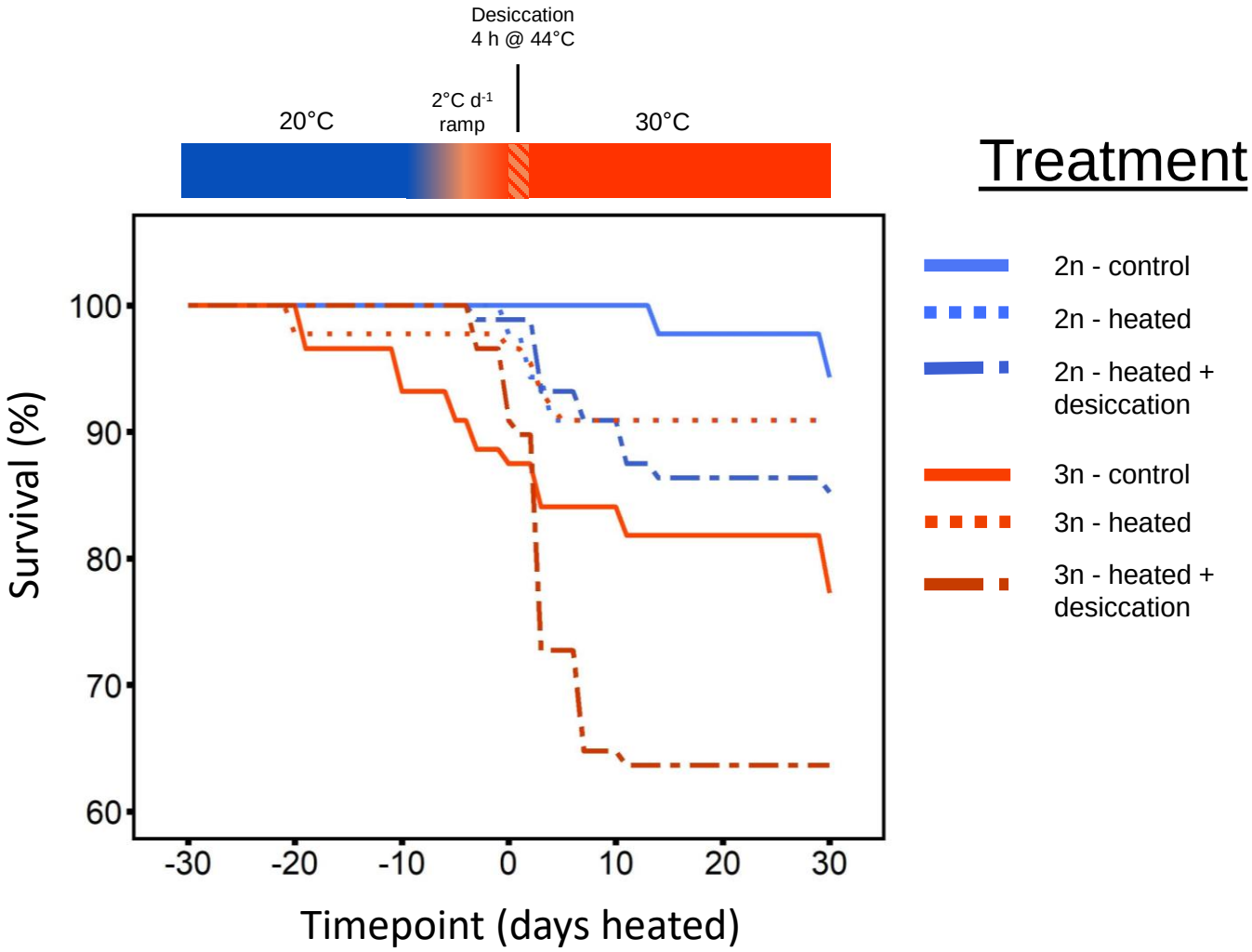
Mortality


20°C
Treatment
2n - control
3n - control
Survival (%)
100
90
80
70
60
-30
-20
-10
0
10
20
30
Timepoint (days heated)

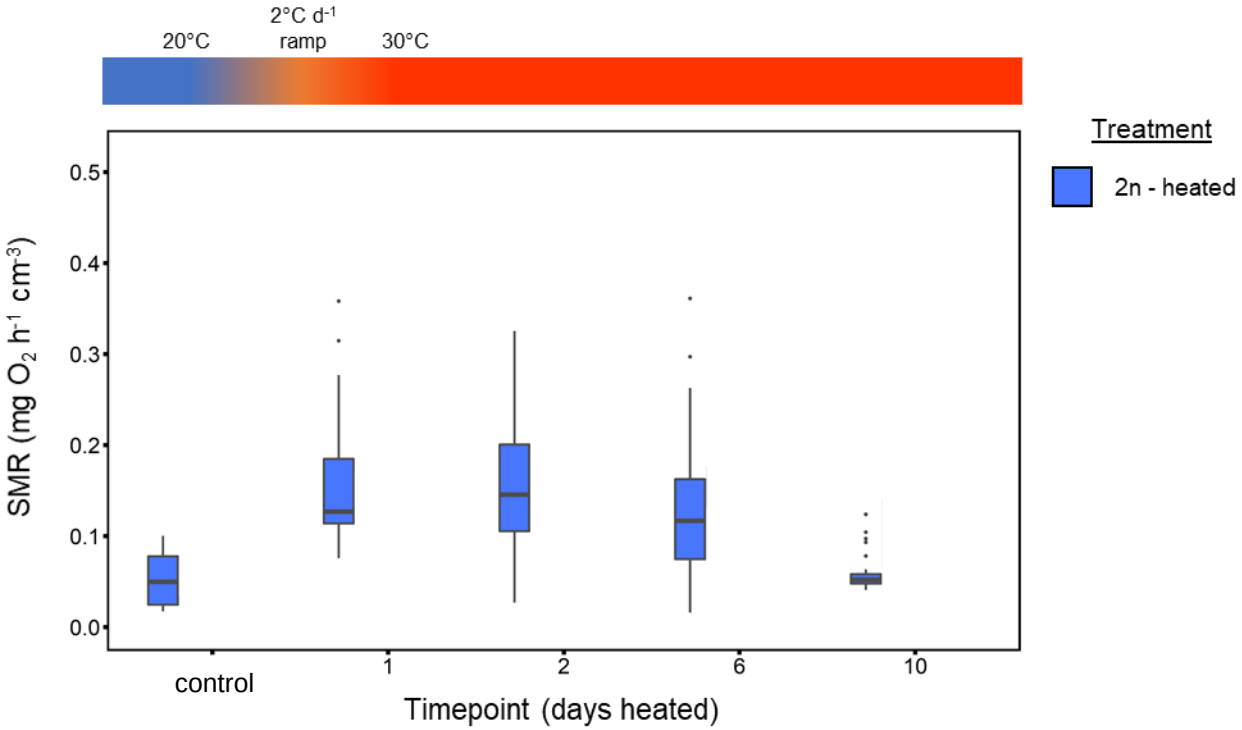
Mortality


20°C
2°C d-1
ramp
30°C
Survival (%)
100
90
80
70
60
-30
-20
-10
0
10
20
30
Timepoint (days heated)
Treatment
2n - control
2n - heated
3n - control
3n - heated

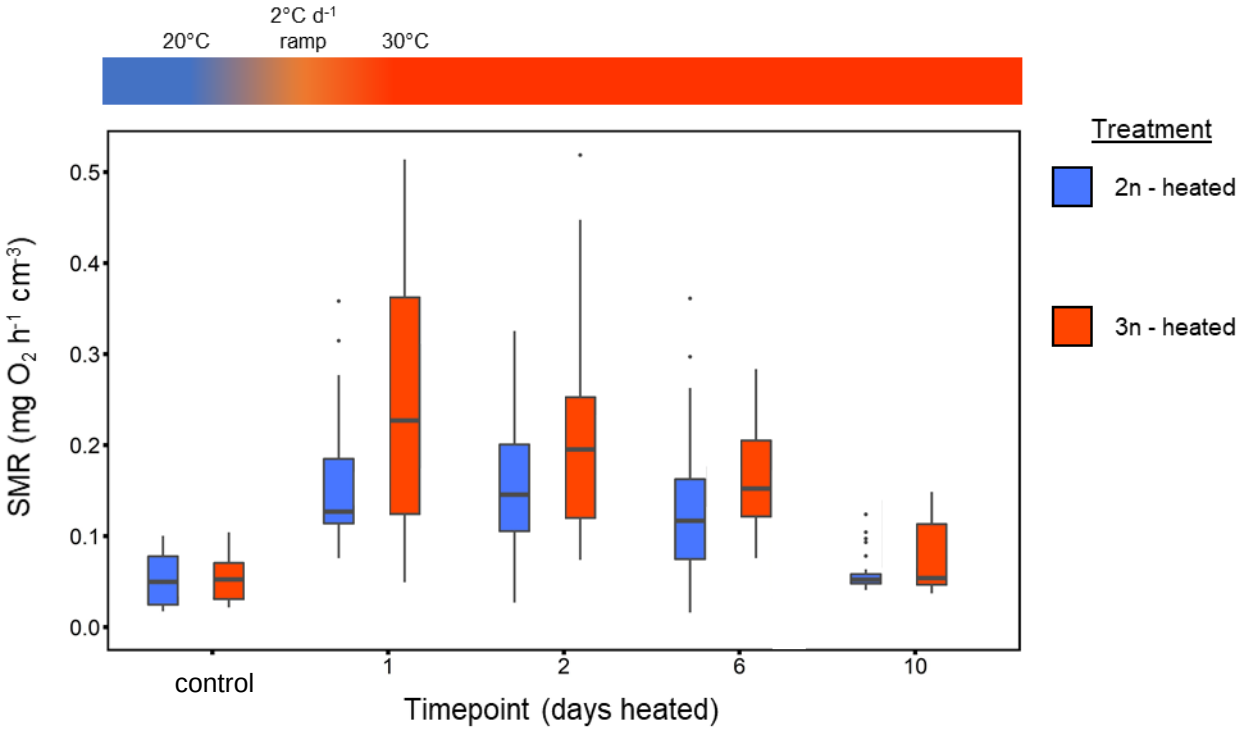
Mortality


Desiccation
4 h @ 44°C
20°C
2°C d-1
ramp
30°C
Survival (%)
100
90
80
70
60
-30
-20
-10
0
10
20
30
Timepoint (days heated)
Treatment
2n - control
2n - heated
2n - heated + desiccation
3n - control
3n - heated
3n - heated + desiccation

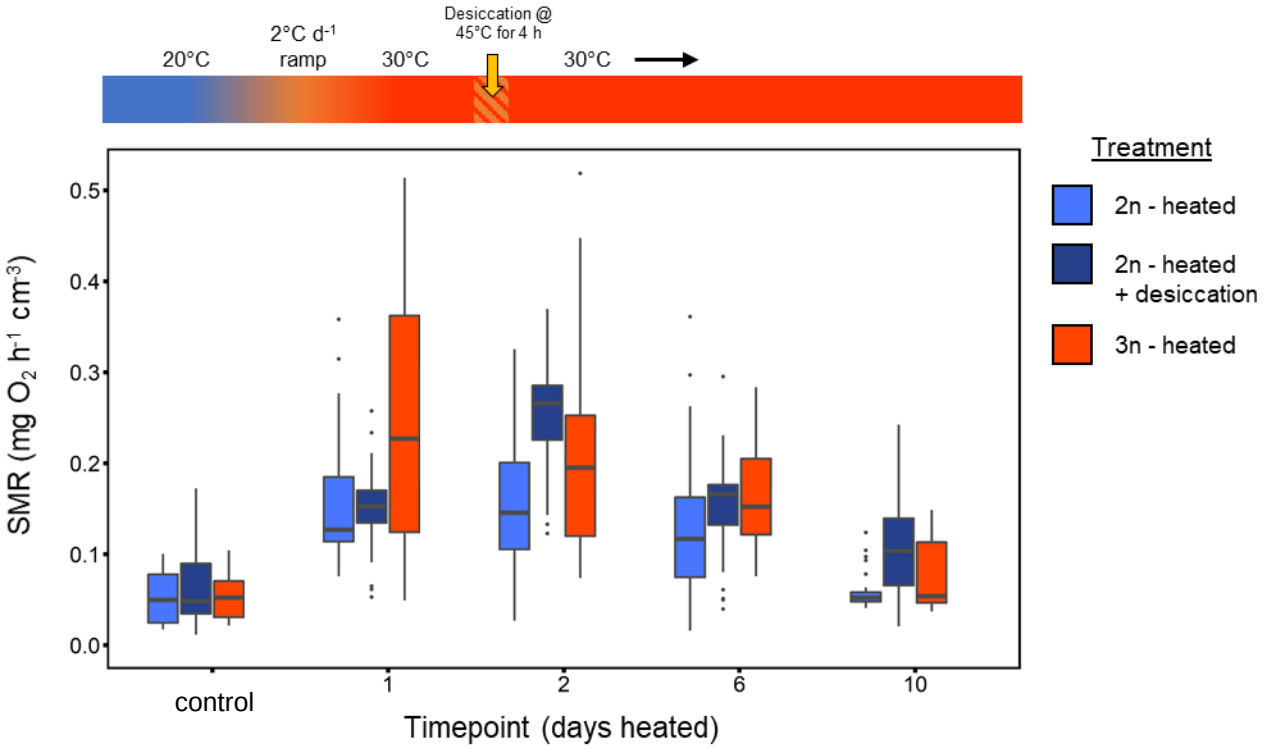
Metabolic Rate



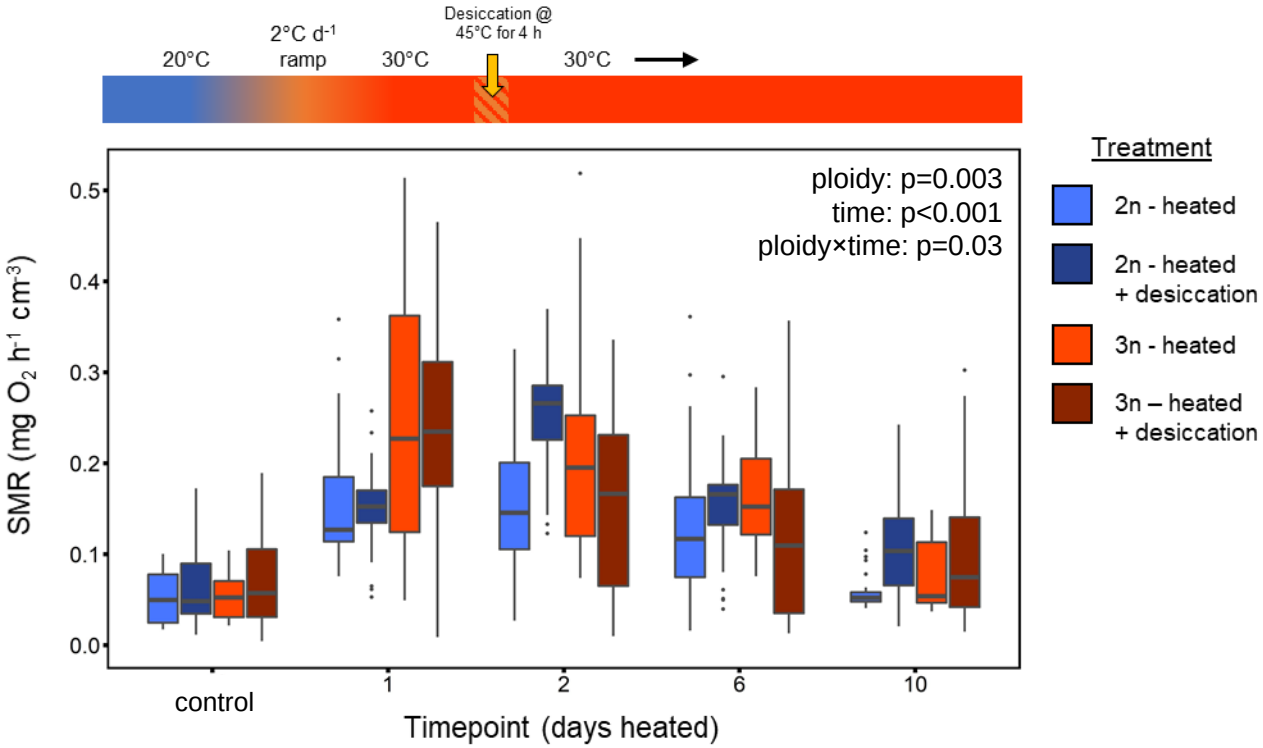
Metabolic Rate



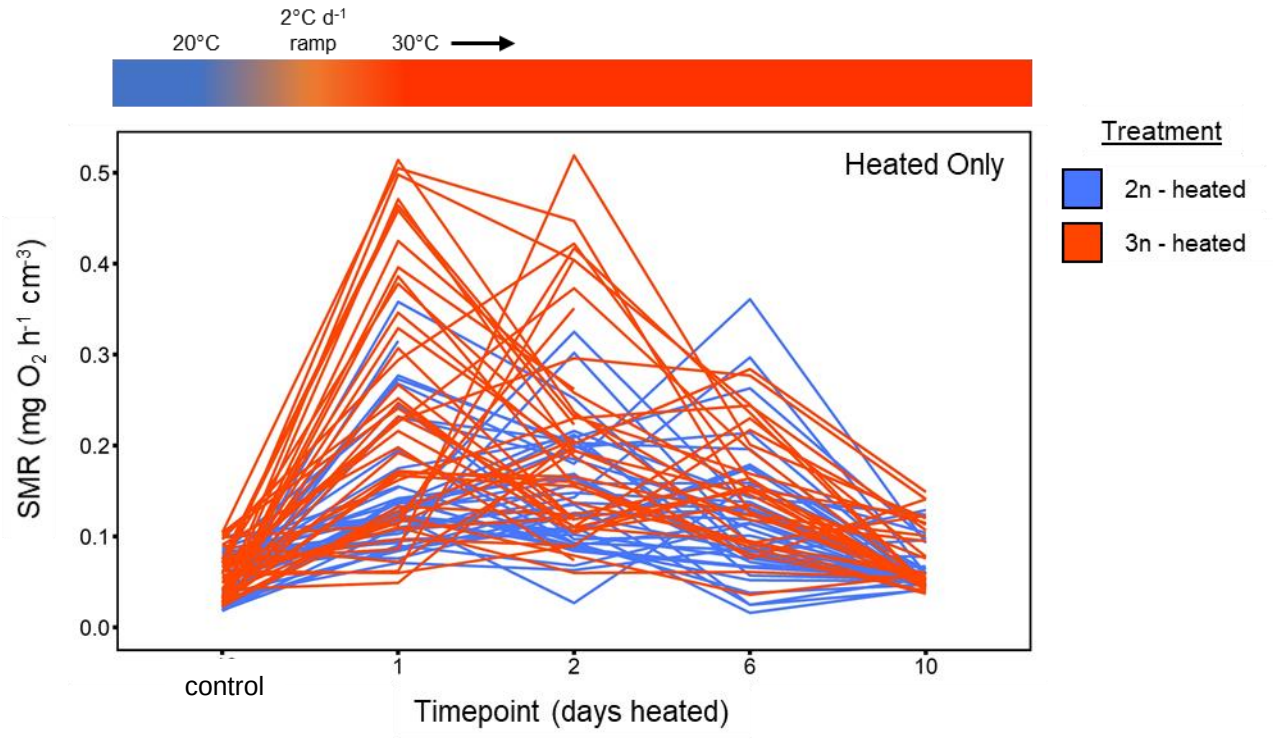
Metabolic Rate



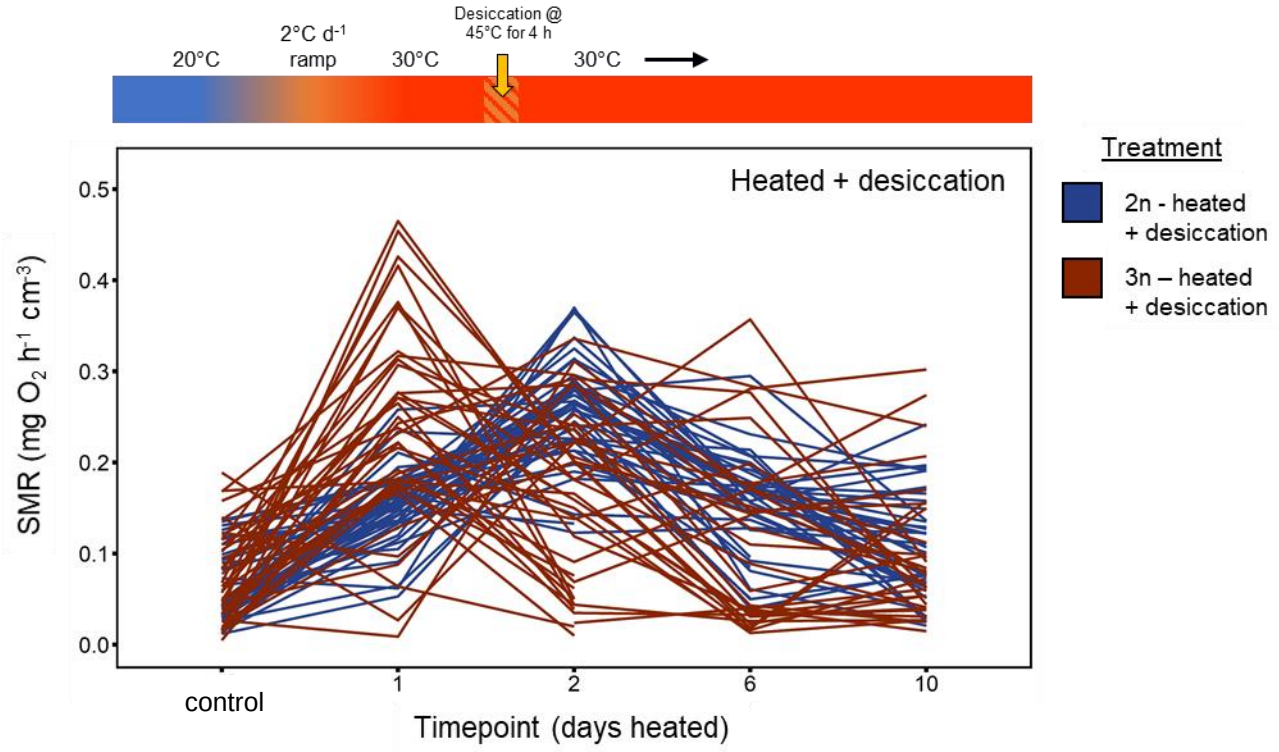
Metabolic Rate



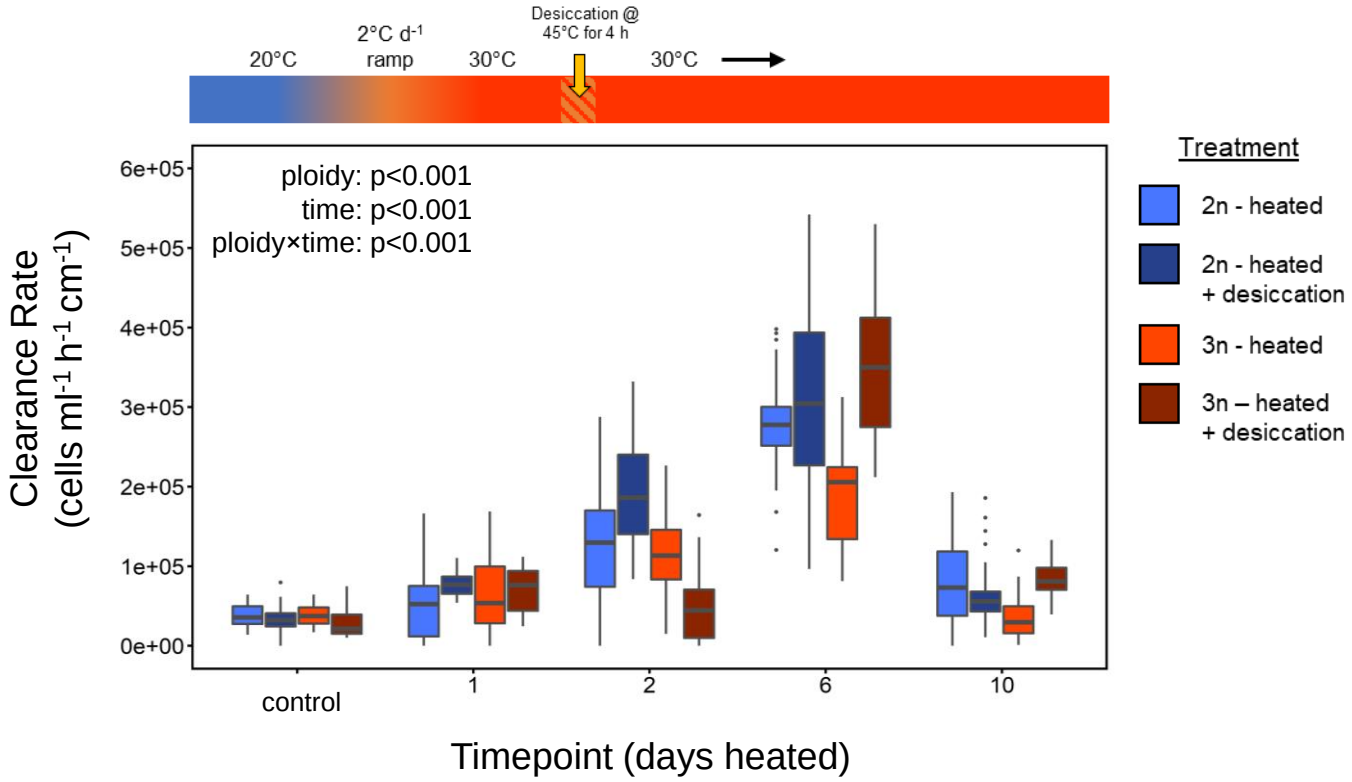
Heated


20°C
2°C d-1
ramp
30°C
Heated Only
Treatment
2n - heated
3n - heated
SMR (mg O2 h-1 cm-3)
0.0
0.1
0.2
0.3
0.4
0.5
control
1
2
6
10
Timepoint (days heated)

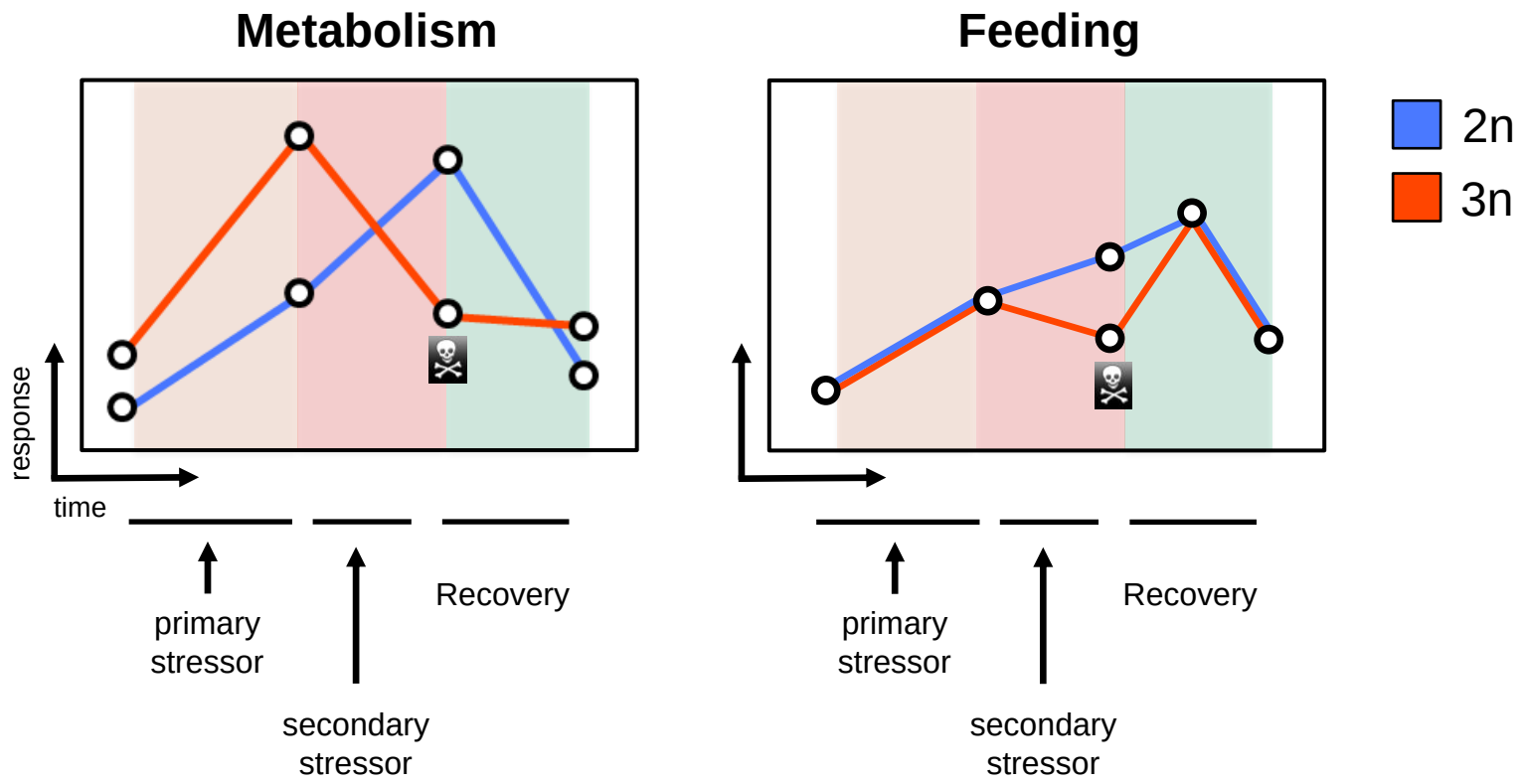
Heat + Desiccation



Clearance Rate



Summary


Metabolism
Feeding
2n
3n
response
time
primary stressor
secondary stressor
Recovery
primary stressor
secondary stressor
Recovery

Conclusions

(1) Heat stress **alone** did not result in mortality.

(2) Multiple stressors (heat + desiccation) resulted in triploid mortality, although not at levels observed in the field.

(3) Triploids underwent **metabolic depression** after multiple stress exposure

(4) Triploids exhibit depressed feeding rates immediately after stress exposure.

Partners & Funding Sources