

Multi-system passive warming field chamber design and deployment

Marcella R Heineke¹, Nicholas A Fisichelli¹, Hannah M Webber¹, Brian C Zabilski², Henry W Locke³

1: Schoodic Institute at Acadia National Park 2: Columbia University 3: Colby College

Contact: MHeineke@SchoodicInstitute.org

Temperature Profiles

Temperature was the main condition manipulated in our experiment. Below are the temperature profiles for the intertidal (Figure 1) and terrestrial (Figure 2). The chambers were successful in increasing ambient air temperature during the day, but not at night because the fiberglass relies on solar energy to increase temperature. With climate change, it is expected that nighttime temperatures will increase as well, so this will be something to address in future work.

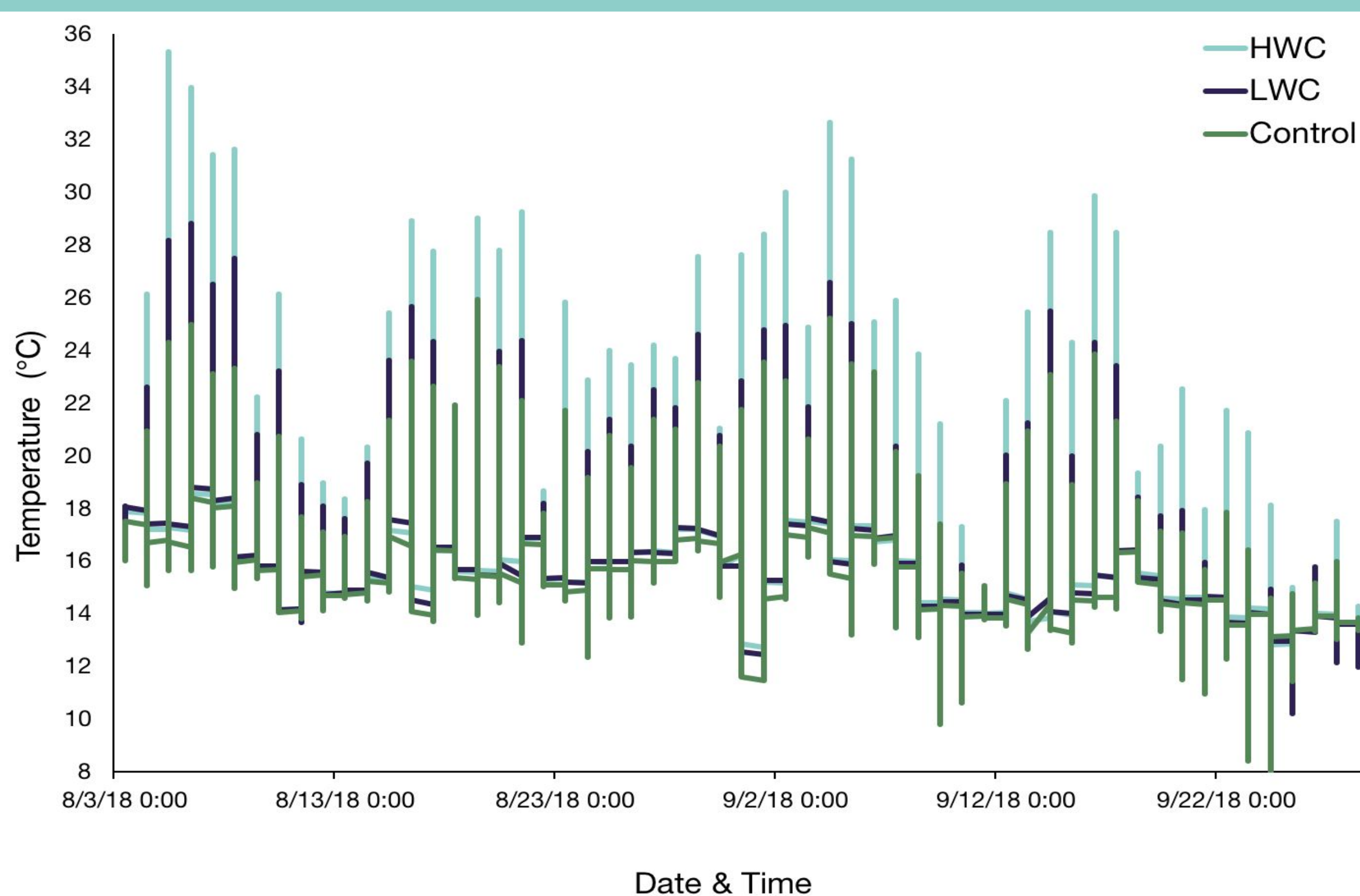


Fig 1: Intertidal temperature profile from 8/3-9/28/18.

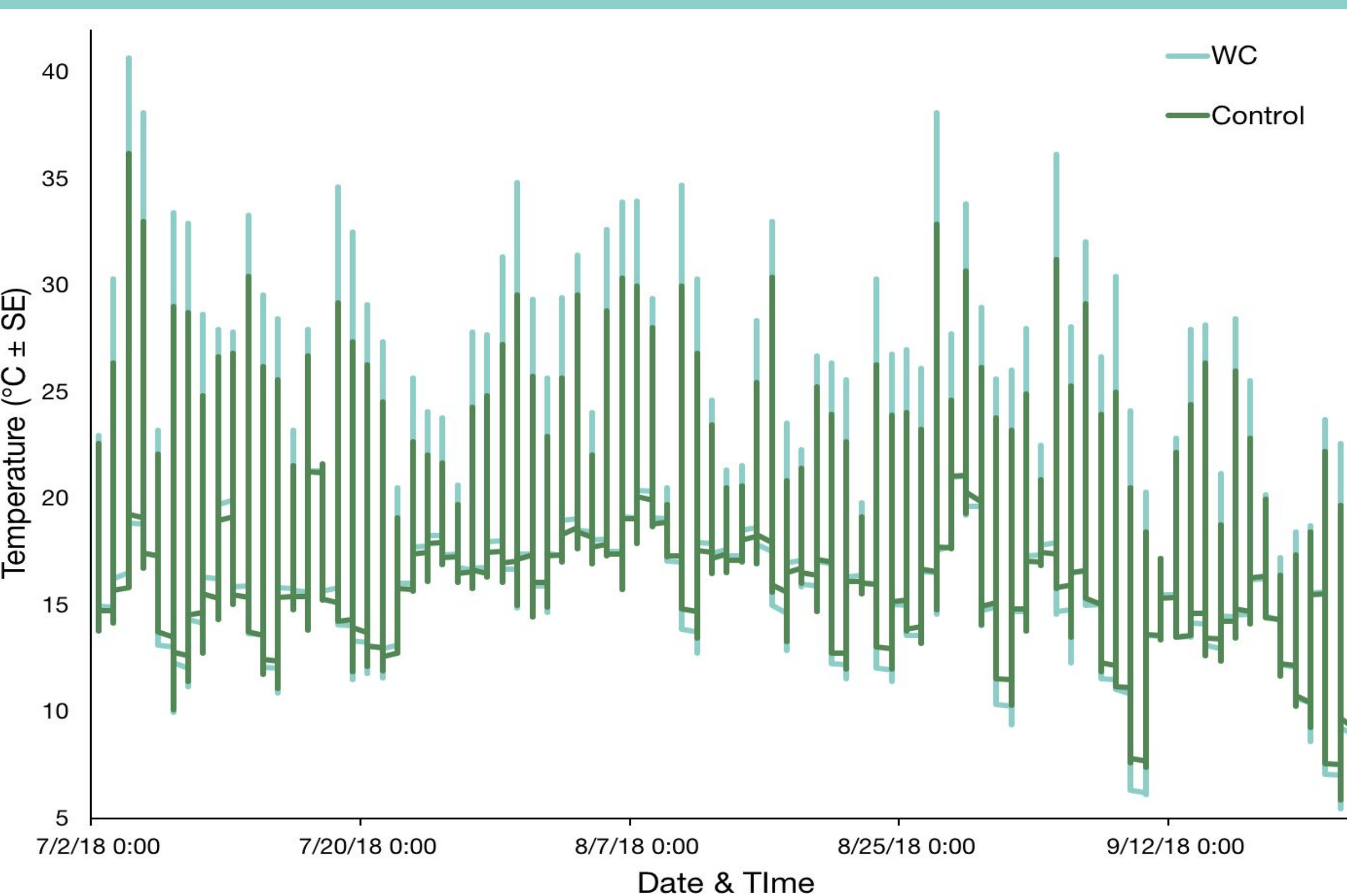


Fig 2: Terrestrial temperature profile 7/3-9/28/18. There was no change in temperature between control chamber and plot, so they were merged for data analysis ($p < 0.01$).

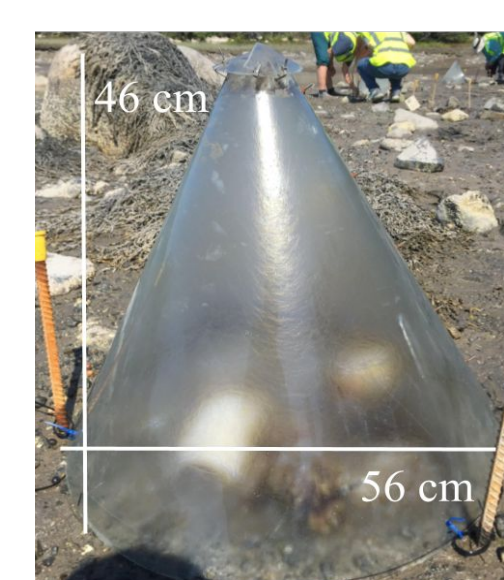
Acknowledgements

Thank you to all the staff at Acadia National Park and Schoodic Institute for the resources and support to make this research possible. A big, special thank you to Craig Pinkham and the NPS Maintenance Staff for the time, patience, and resources during the chamber building process, we could not have done it without your guidance!

Introduction

Recently, there has been a large push in climate change research for field-based experiments across different habitat types. Acadia National Park offers an exceptional location for such experiments due to the multitude of ecosystems present. The goal of this season was to design passive warming chambers (PWC) to simulate climate change in 2 ecosystems: intertidal and terrestrial. These PWCs increase ambient air temperature by 1.5-5 °C, representing modest and extreme climate change models.

Methods



High Warming Chamber (6)

0.04mm fiberglass



Low Warming Chamber (4)

0.04mm fiberglass with 4 10cm holes



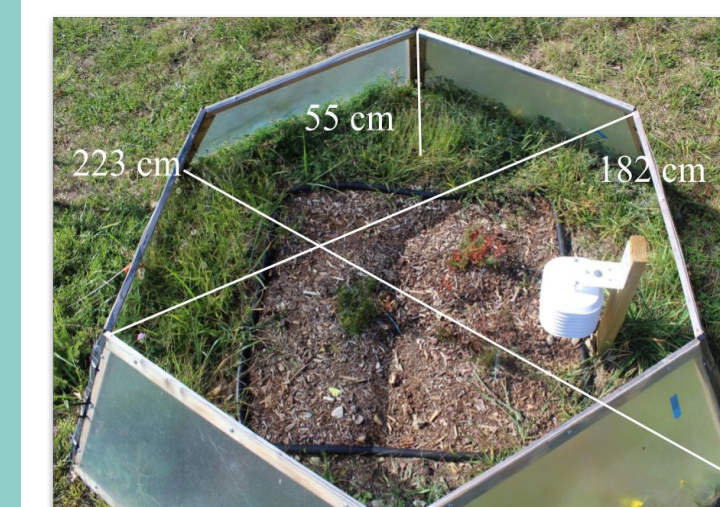
Control Plot (4)

• Inside the Chambers



• Measurements

- Abiotic:
 - Air & water temperature, light, wave action
- Biotic:
 - Alga growth & phenology, *M. edulis* & *S. balanoides* recruitment



Warming Chamber (6)

0.06mm fiberglass



Control Chamber (3)

5 mm hardware cloth



Control Plot (3)

• Inside the Chambers



• Measurements

- Abiotic:
 - Air temperature, relative humidity, soil moisture
- Biotic:
 - Plant growth & phenology, insect herbivory

Average Day

In order to better understand the temperature differences, the average temperature at an equivalent time were calculated for each system, time from daytime low tide (intertidal; Figure 3) or time of day (terrestrial; Figure 4).

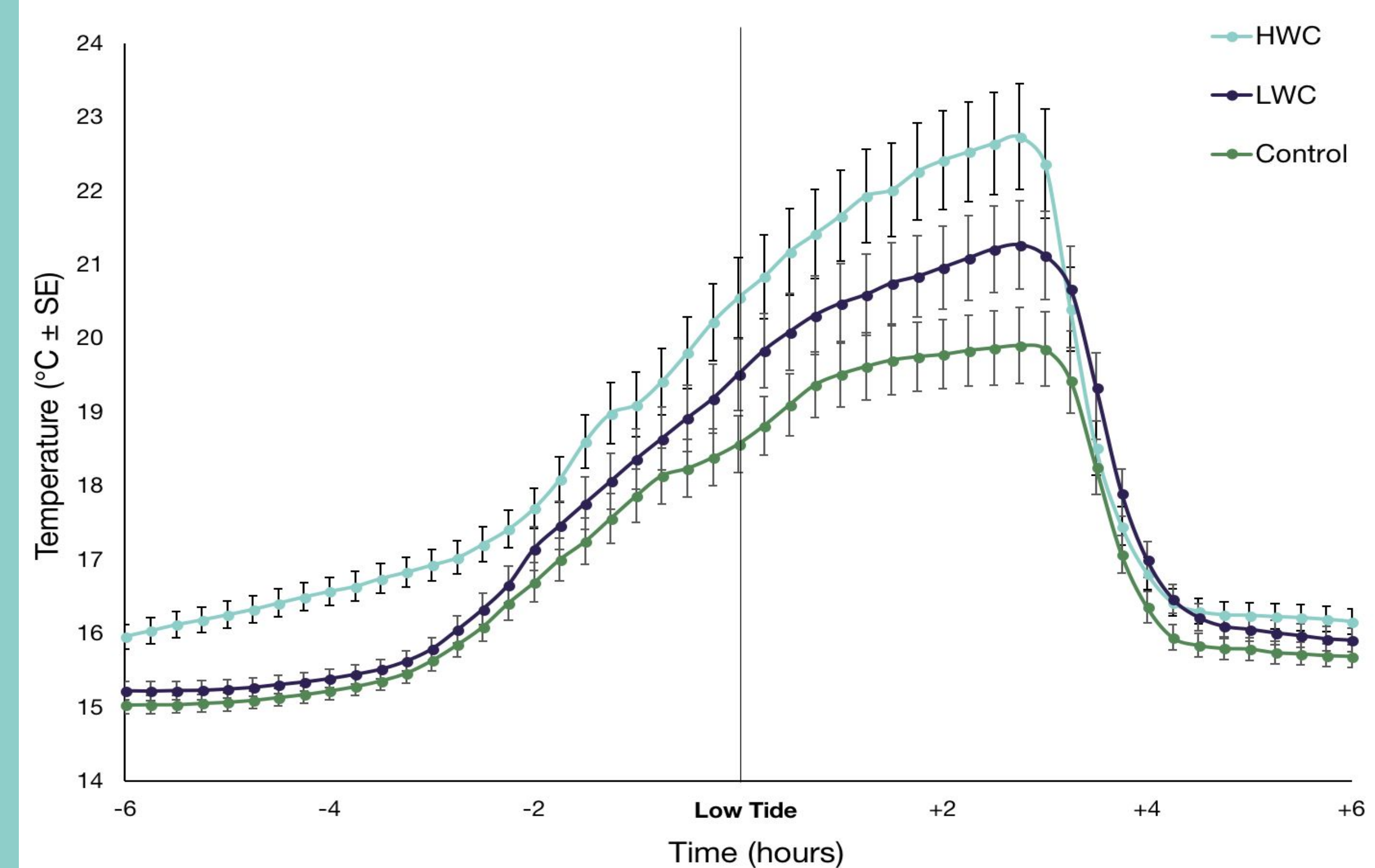


Fig 3: Average daytime tidal cycle. The High Warming Chamber (HWC) and Low Warming Chamber (LWC) were on average 2.8 and 1.4 °C warmer than ambient air temperature (Control; $p < 0.001$).

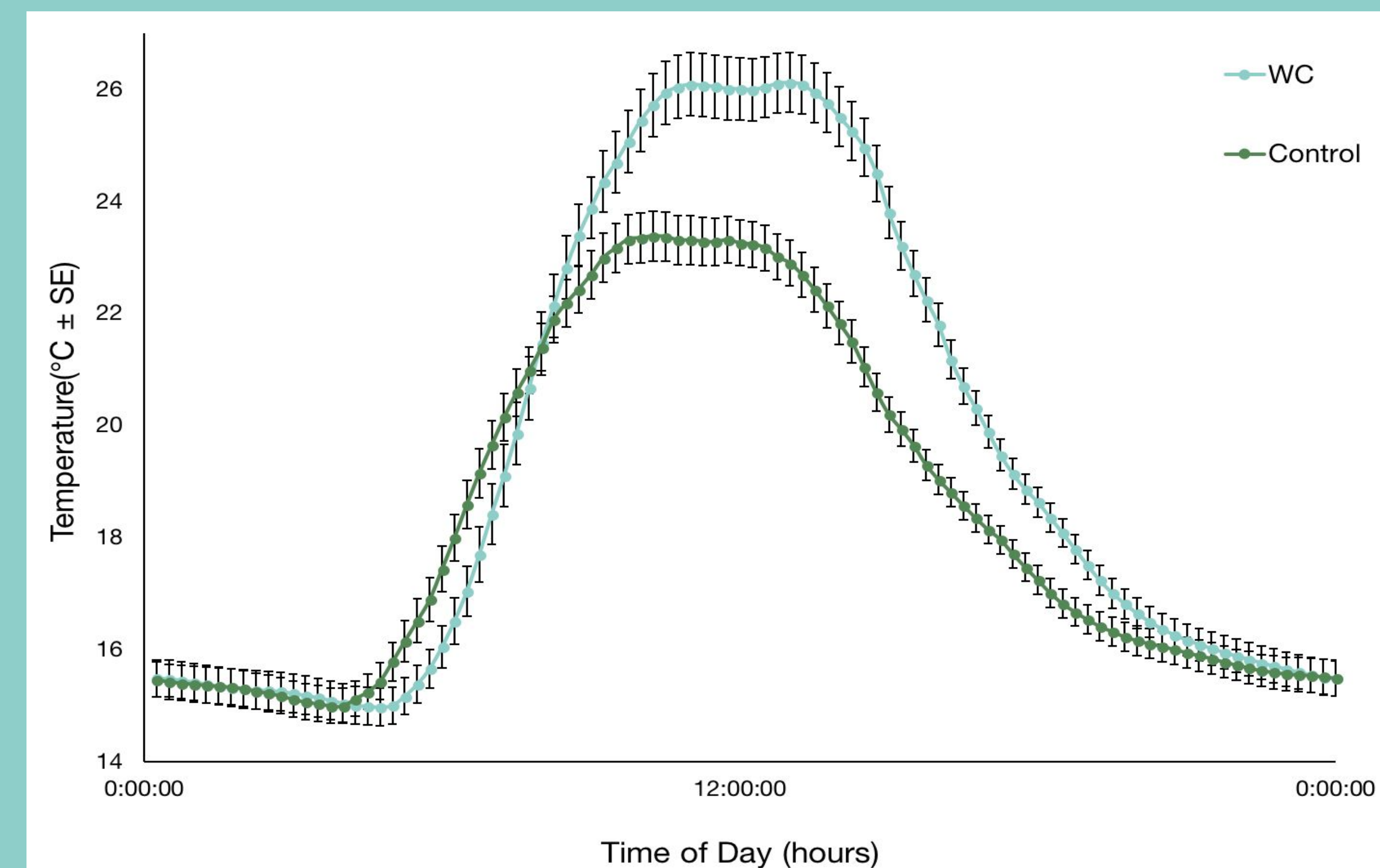


Fig 4: Average day. During the day, the average ambient air temperature of the warming chamber (WC) was 4.0 °C warmer ambient air temperature ($p < 0.01$).

Results & Future Work

The abiotic data collected across systems revealed that the chamber designs are successful in increasing daytime air temperature, without significantly changing other abiotic factors. In the future, the focus will primarily be on responses to warming in each system, including phenology, growth rates, and recruitment.