Preregistration

Preregistration for reproducing Gooding et al. 2009

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Study Information

Title	Preregistration for reproducing Gooding et al. 2009 Effects of Increasing Temperature on Sea Star Growth
Description	As ectotherms, marine invertebrates are entirely dependent on their environment to control and regulate their body temperature. Many key physiological processes and rates that dictate the performance and fitness of invertebrates are temperature-dependent, and shifts in thermal regimes, and the associated performances responses by affected species, can lead to population- and community-level changes (Bruno, Carr, & O'Connor, 2015; Vasseur et al., 2014). Human-driven climate change and warming are not only contributing to warmer waters in the worlds oceans, but

are also leading to extreme temperature events and heatwaves to occur more frequently and with greater intensity (Oliver et al., 2019). The ochre sea star, *Pisaster ochraceus*, is a keystone predator found in many rocky intertidal zones in the Northeast Pacific, and has demonstrated behavioural and physiological changes with altered seawater temperatures that have important implications for their impacts on intertidal zone community structure (Gooding, Harley, & Tang, 2009; Paine & Paine, 2008; Sanford, 1999). Testing how *P. ochraceus* responds to a range of seawater temperatures that includes future extremes will allow researchers to better understand how this important predator's physiology, behaviour, and associated community-level effects may change in a warmer world (Kordas, Harley, & O'Connor, 2011). The goal of this project is to conduct a replication study on the impacts of seawater temperature on the growth of *P. ochraceus* and its consumption of a common prey species, the bay mussel *Mytilus trossulus*, originally conducted by Gooding and colleagues as part of a larger study examining the impacts of elevated seawater temperature and CO_2 on the growth, feeding behaviour and calcification rates of *P. ochraceus* (Gooding et al., 2009). By replicating the temperature-specific experiments on *P. ochraceus*, we hope to provide further support to the importance of seawater temperatures, and the implications of climate change, on the physiology and ecology of this keystone species.

Hypotheses Increasing seawater temperatures has had well-documented positive relationships with the physiological rates of a number of marine invertebrates. If seawater temperatures increase incrementally but do not exceed a physiological threshold, we expect to see a positive, linear relationship between seawater temperature and the growth and consumption rates of *P. ochraceus*.

Design Plan

We plan to run growth trials under different set temperatures for juvenile sea stars *P. ochraceus*.Individuals will be collected and initial wet mass will be determined. Each star will be randomly assigned to temperature treatment between 5 - 21 degrees calcium. Individuals will remain in their treatment tank for 8 weeks, being fed ad libitum for the duration. At the end on the 8 weeks, individuals will be reweighed and relative growth will be determined. We will then determine if there is a correlation between growth rate and tank temperature.

Study type **Experiment**. A researcher randomly assigns treatments to study subjects, this includes field or lab experiments. This is also known as an intervention experiment and includes randomized controlled trials.

Blinding No blinding is involved in this study.

Study design Juvenile *P. ochraceus* will be reared in the lab, at temperatures ranging from 5 - 21 °C. We will use twenty-four tanks, 246L in volume, with recirculating water to house seastars. Two seastars will be placed inside each tank, contained in their own tupperware with mesh sides and tops to ensure water flow, for a total of 48 seastars. Relative growth of the 2 seastars inside a single tank will be averaged, thus tank is the independent unit in this design.

Randomization Each of the 48 seastars used in this study will be randomly assigned to tanks.

Sampling Plan

We plan to sample 48 individuals, this size complies with our lab space constraints of 24 available tanks. Specimens will be collected in January from Jericho Beach, Vancouver.

Existing data **Registration following analysis of the data**. As of the date of submission, you have accessed and analyzed some of the data relevant to the research plan. This includes preliminary analysis of variables, calculation of descriptive statistics, and observation of data distributions. Please see cos.io/prereg for more information.

Explanation of existing data We have simulated date based on the previous study, including review of summary statistics. This was to ensure that using the same methods this experiment was replicable.

Data collection procedures	Enter your response here.
Sample size	Enter your response here.
Sample size rationale	Enter your response here.
Stopping rule	Enter your response here.

Variables

Manipulated variables	Enter your response here.
Measured variables	Enter your response here.
Indices	Enter your response here.

Analysis Plan

Statistical models	Enter your response here.
Transformations	Enter your response here.
Inference criteria	
Data exclusion	Enter your response here.
Missing data	Enter your response here.

Exploratory analyses (optional)	Enter your response here.

Other

Other (Optional)	Enter your response here.

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