Examining the Effects of Varying pH Conditions on the Early Development of the Painted Sea Urchin, *Lytechinus pictus*

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Global Climate Change Impacts Marine Organisms

Greenhouse Gas Emissions

Ocean Acidification & Temperature Rise

Sea Urchin Population Impacted
Does early exposure to varying pH alter the tolerance of *Lytechinus pictus* larvae to an acute heat stress event?
Understanding the Physiological Performance of *L. pictus* Under Various Conditions

Successfully raise viable sea urchin offspring

Manipulate multiple variables such as temperature and acidity

Lay down the framework for further research of *L. pictus*
*Lytechinus pictus* as a Model Organism
Research Methods

1. Spawn Urchins

2. Raise Them in Buckets With Varying pCO2 levels

3. Introduce Heat Stress
1. Spawn Urchins

Inject Potassium Chloride

Sperm

Eggs

Successful Fertilization
2. Raise Them in Buckets With Varying pCO2 Levels

<table>
<thead>
<tr>
<th>Treatment</th>
<th>pCO2 (µatm)</th>
<th>pH</th>
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<tbody>
<tr>
<td>High pCO2</td>
<td>1136.4</td>
<td>7.65</td>
</tr>
<tr>
<td>Low pCO2</td>
<td>586.2</td>
<td>7.91</td>
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</table>
3. Introduce Heat Stress

Alive / Dead?
Normal / Abnormal?

Cooler °C  Hotter °C
Parameters Measured

Morphology

Thermal Tolerance

Developmental Success
High pCO2 Survivability

LT50 31.6°C
Individuals That Develop in More Acidic Conditions Show Higher Tolerance to Thermal Stress

![Graph showing survival rate vs. temperature for High and Low pCO2 conditions. At LT50, survival rate drops significantly for both conditions, but High pCO2 shows slightly higher tolerance at 31.6°C compared to Low pCO2 at 31.1°C.]

- **High pCO2 Survivability**
  - LT50: 31.6°C

- **Low pCO2 Survivability**
  - LT50: 31.1°C
Individuals That Develop in More Acidic Conditions Show Higher Tolerance to Thermal Stress

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<tr>
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<th>Low pCO2 Survivability</th>
<th>High pCO2 Abnormality</th>
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<tr>
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<td>31.6°C</td>
<td>31.1°C</td>
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<tr>
<td>AT50</td>
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Relevance of Tolerance Under Warming Seas

![Graph showing temperature vs. proportion alive/normal for normal and abnormal larvae.](image1)

- **Normal Larvae**
- **Abnormal Larvae**

The graph illustrates the average summer temperature from 2014-2016 and the South Carolina maximum summer temperature for 2015.
Conclusions

- Urchins that developed under more acidic conditions had higher tolerance to a thermal stress event than those that developed under less acidic conditions.

- Potential cross tolerance exhibited in urchin individuals.

- Abnormal development may soon become prevalent with increase in the frequency of marine heat waves.
Future Directions

- Analyze morphometrics data
- Explore other parameters such as gene expression, proteins, and lipids
Acknowledgments

Dr. Gretchen Hofmann

Terence Leach