University of Mississippi

eGrove

Annual Poster Session 2022 | Annual Poster Session

10-11-2022

# Effect of Ploidy on Early Oyster Life Stage Tolerance of Salinity and Temperature

Christian Boudreaux
*University of Mississippi*, ctboudre@go.olemiss.edu

Alexz Carpenter
*University of Mississippi*

Jessica Pruett
*University of Mississippi*

Kristine Willett
*University of Mississippi*

Deborah Gochfeld
*University of Mississippi*

Follow this and additional works at: https://egrove.olemiss.edu/pharm_annual_posters_2022

## Recommended Citation

Boudreaux, Christian; Carpenter, Alexz; Pruett, Jessica; Willett, Kristine; and Gochfeld, Deborah, "Effect of Ploidy on Early Oyster Life Stage Tolerance of Salinity and Temperature" (2022). *Annual Poster Session 2022*. 4.
https://egrove.olemiss.edu/pharm_annual_posters_2022/4

This Book is brought to you for free and open access by the Annual Poster Session at eGrove. It has been accepted for inclusion in Annual Poster Session 2022 by an authorized administrator of eGrove. For more information, please contact egrove@olemiss.edu.

# Effect of Ploidy on Early Oyster Life Stage Tolerance of Salinity and Temperature

Christian Boudreaux[1], Alexz Carpenter[1]; Jessica Pruett[2]; Kristine Willett[3]; Deborah Gochfeld[2,3]

[1]Department of Biology, [2]National Center for Natural Products Research, [3]Department of Biomolecular Sciences, University of Mississippi

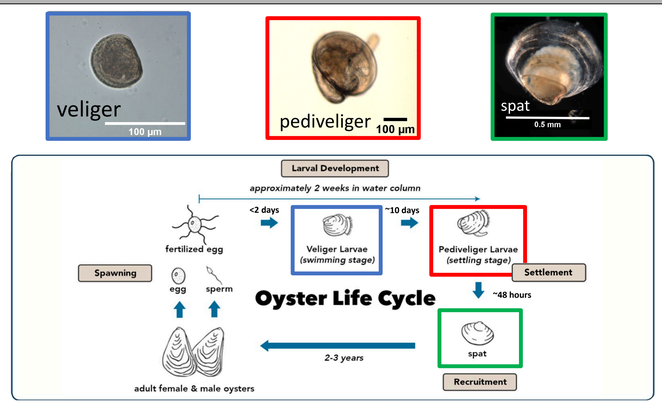
THE UNIVERSITY of MISSISSIPPI

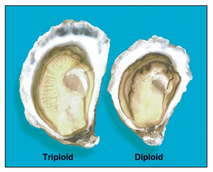
MBRACE Mississippi Based RESTORE Act Center of Excellence

## 1. Abstract

Historically, the Gulf of Mexico has been one of the largest producers of oysters in the world. In recent years the water quality effects of freshwater flooding events and the Deepwater Horizon oil spill have led to the collapse of the Eastern oyster (*Crassostrea virginica*) within this ecosystem. Efforts to restore this region are further complicated by climate change-related stressors such as elevated water temperatures. In response to this reduction in naturally available oysters, oyster farmers have begun to engage in aquaculture and search for new techniques to maximize production.[1] The triploid oyster, which has been developed to grow faster and larger and produce tastier meat, is among these efforts. This genetic variant, which has been shown to have success in other regions of the country, has undergone mass mortality events in the Gulf[2], with unknown causes. These events may be linked to high temperatures and low salinity, but little work has been done in adult oysters to verify this claim. The manner in which the highly vulnerable larval stages of the oyster respond to such stressors remains entirely unknown. Such stages are particularly crucial because triploid oysters do not occur naturally and must be bred in a laboratory setting, posing the question of which water conditions will result in the greatest survival and growth. Thus, we tested the effects of different temperatures (28°C and 32°C) and salinities (5 ppt, 10 ppt, and 15 ppt) on diploid and triploid oysters at three early life stages: veliger, pediveliger, and spat. In the veliger stage, survival was significantly higher for diploid oysters and at low temperature and salinity regardless of ploidy. Growth of veliger larvae was highest in triploid oysters at high temperature and salinity. The pediveliger larvae showed no difference in settlement across ploidy and the behavior was only significantly inhibited at high temperature and low salinity. Spat survival demonstrated a three-way interaction, where mortality varied due to ploidy, temperature, and salinity. Triploid spat displayed a greater shell height compared to diploid spat and shell height decreased with decreasing salinity, independent of ploidy. These findings will inform the oyster aquaculture industry of the optimal conditions for oyster survival and growth. A broader understanding of these stressors and their effects will allow for greater success in the revitalization of the oyster industry in the Gulf states and possible further application in the restoration of oyster reefs.

## 2. Background




Triploid oysters grow larger and faster than diploids, making them more desirable for consumption and the preferred choice for aquaculture. Recent triploid die-offs in the Gulf of Mexico, however, have caused concern for the future of their use in oyster farming. Little is known as to the cause of these mortality events in adults, and no studies have been conducted into how the vulnerable larval stages of *Crassostrea virginica* are affected by temperature and salinity stress.

## 3. Methods

| Ploidy | Temperature (°C) | Salinity (ppt) |
|---|---|---|
| Diploid | 28 | 5 |
| | | 10 |
| | | 15 |
| | 32 | 5 |
| | | 10 |
| | | 15 |
| Triploid | 28 | 5 |
| | | 10 |
| | | 15 |
| | 32 | 5 |
| | | 10 |
| | | 15 |

Each treatment was replicated five times for a total of 60 jars per experiment.

indicates ambient conditions.


~3,750 larvae per jar


~200 larvae per jar


~20 larvae per jar


Fiji software was used to assess shell growth for veligers (left) and shell height for spat (right). Pediveliger settlement (middle) was manually counted using a microscope.

## 4. Results

### Veliger Larvae

- Diploid survival is higher than triploid
- Growth decreases at lower salinities but temperature effects are dependent on ploidy

### Pediveliger Larvae

- No ploidy effect observed and settlement is significantly lower at 5 ppt and 32°C

### Spat

- Survival varies by ploidy, temperature, and salinity
- Diploid shell height is less than triploid and decreases with lower salinity regardless of ploidy

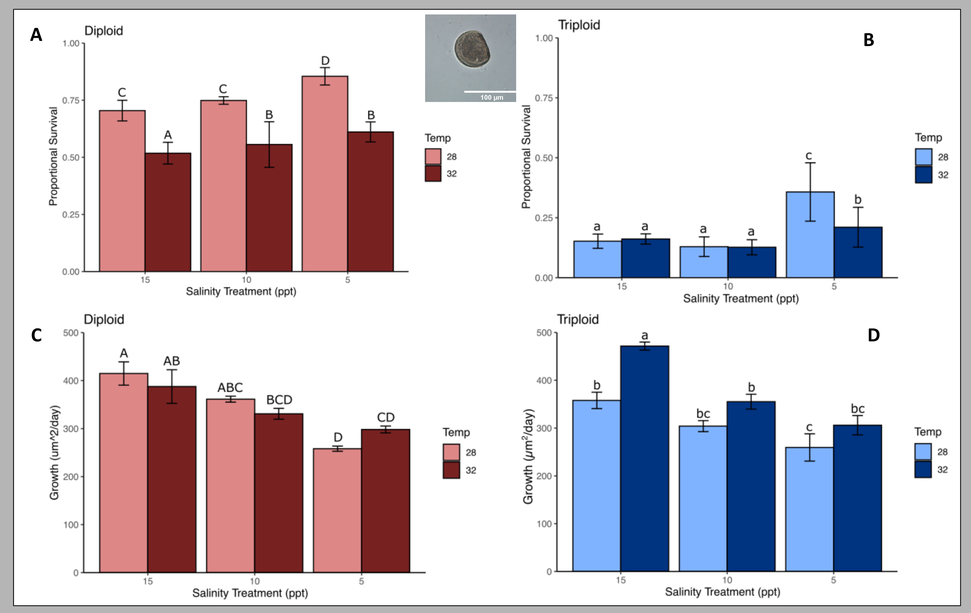



**Figure 1.** Proportional veliger survival and growth for veliger larvae of diploid (A, C) and triploid oysters (B, D), respectively. Different letters denote significant difference based on Tukey's post hoc tests ($P \leq 0.05$).

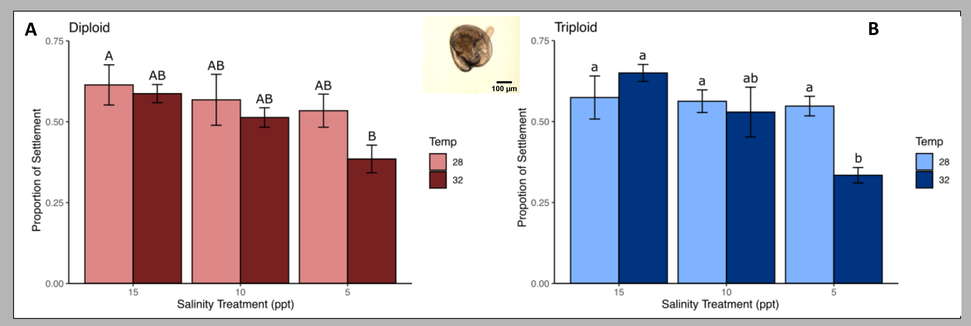



**Figure 2.** Proportion of settlement for diploid (A) and triploid pediveliger larvae (B). Different letters denote significant difference based on Tukey's post hoc tests ($P \leq 0.05$).

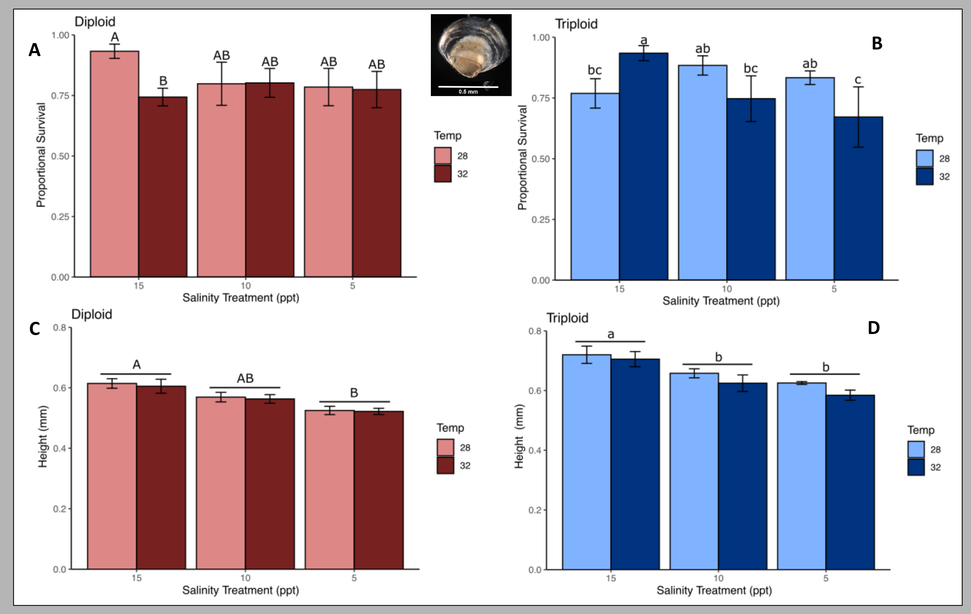
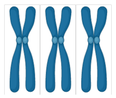



**Figure 3.** Proportional spat survival and shell height for diploid (A, C) and triploid oysters (B, D), respectively. Different letters denote significant difference based on Tukey's post hoc tests ($P \leq 0.05$).

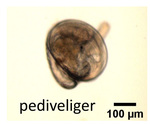
## 5. Conclusion

### Reccommended Caretaking Regimen




Salinity: 10-15 ppt
Temperature: 28°C
Achieves compromise between mortality and growth

Salinity: 15ppt
Temperature: 32°C
Maximizes growth; more larvae needed at spawn to compensate for increased mortality




Salinity: 15 ppt
Temperature: 28°C
For maximum settlement

Salinity: 15 ppt
Temperature: 32°C
For maximum settlement


Salinity: 15 ppt
Temperature: 28°C
For maximum survivability
Growth only affected at lower salinities

Salinity: 15 ppt
Temperature: 32°C
For maximum survivability
Growth only affected at lower salinities

References:

1. "Application of Triploidy to Oyster Culture on Florida's West Coast - Florida Shellfish Aquaculture Online Resource Guide." Accessed July 29, 2022. https://shellfish.ifas.ufl.edu/oyster-culture/triploidy-application-workshop/.
2. Wadsworth et al. (2019) "Elevated Mortalities of Triploid Eastern Oysters Cultured Off-Bottom in Northern Gulf of Mexico." Aquaculture 505:363-373. https://www.sciencedirect.com/science/article/abs/pii/S0044848618321185.

***Funding Disclaimer**: This project was paid for with federal funding from the U.S. Department of the Treasury, the Mississippi Department of Environmental Quality, and the Mississippi Based RESTORE Act Center of Excellence under the Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act of 2012 (RESTORE Act). The statements, findings, conclusions, and recommendations are those of the author(s) and do not necessarily reflect the views of the Department of the Treasury, the Mississippi Department of Environmental Quality, or the Mississippi Based RESTORE Act Center of Excellence.*