Evaluation of larval survival and settlement rate of low salinity tolerant Eastern oysters.

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Vulnerability Of Coastal Areas

- **Effects of climate change:**
  - Sea-level rise/heavy storms
  - Erosion and flooding
  - Loss of natural and built habitats

Maryland Sea Grant

- **As global temps rise:**
  - Sea levels will continue to rise
  - Storms will amplify/intensify/occur with greater frequency

- **Resulting in continued:**
  - Erosion of shorelines
  - Property damage
  - Infrastructure damage
  - Population displacement

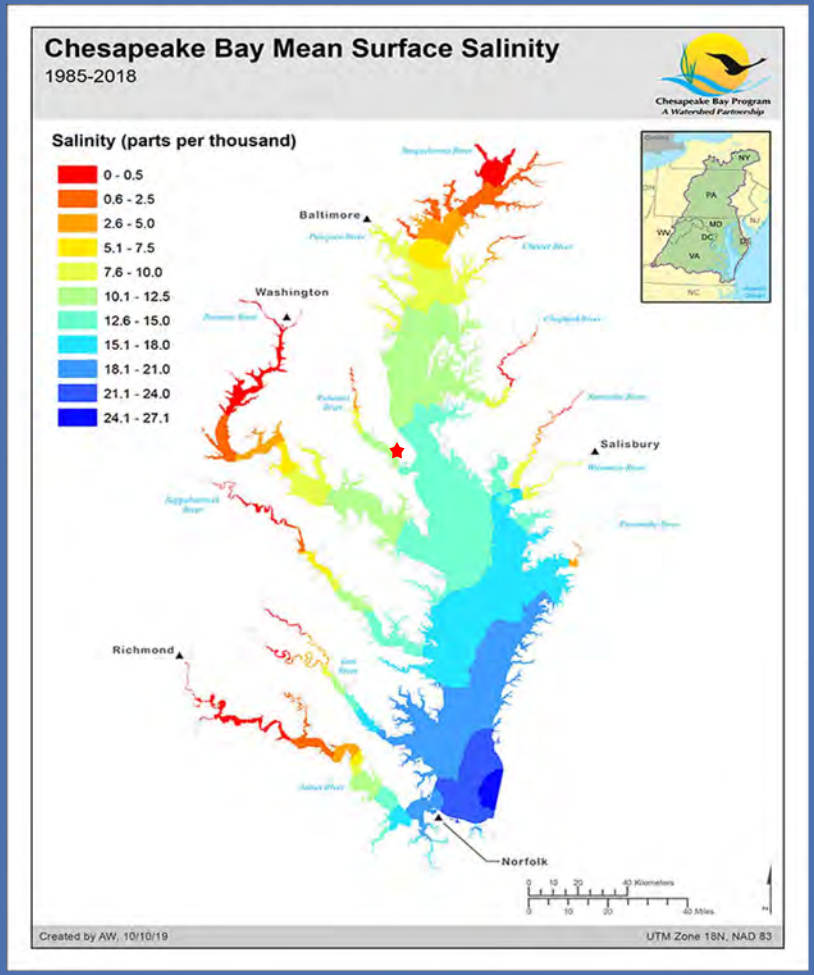
Importance of Oysters in Living Shorelines

- Filter and remove excess nutrients (dead zones)- successful reefs remove 7x more nutrients than watersheds without reefs
- Creation of habitat for crabs and fish- increase in populations
- Support the economy and seafood industry- job creation
- Improve appearance of the Bay

NOAA Fisheries

Salinity Gradient

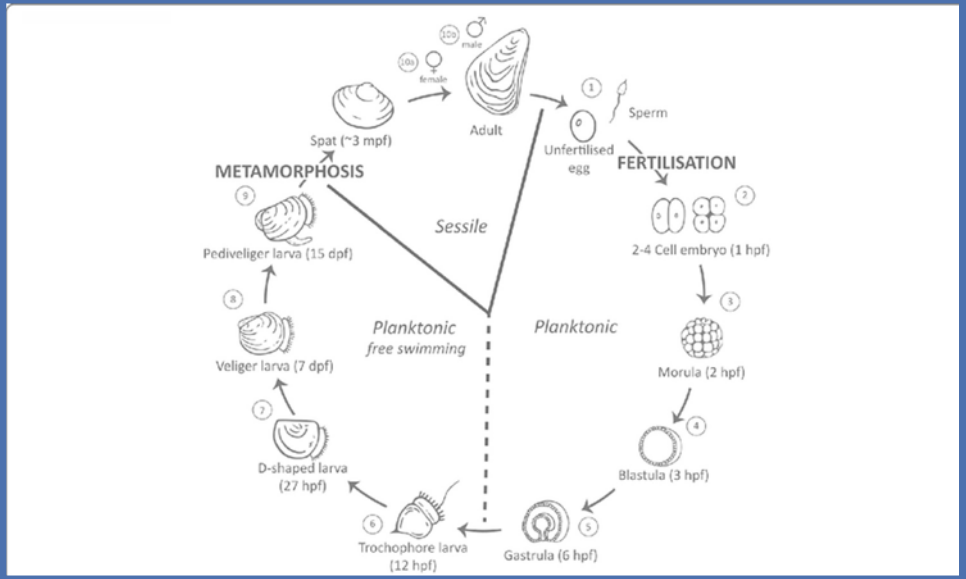
- Salinity varies throughout the Chesapeake Bay
- Eastern oysters are found all throughout the Chesapeake Bay in a wide variety of salinities
- Highest at the mouth of the Bay and lowest at the top and in rivers
- Melting snow in spring months causes a decrease in salinity
- Salinity increases as there is less rainfall



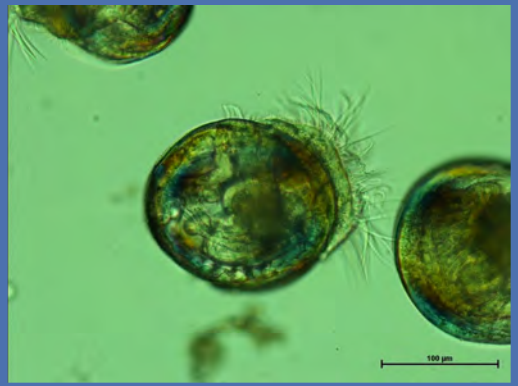
Chesapeake Bay Program

Oyster Larvae

- Fertilized egg – trochophore – D stage – veliger– pediveliger
- Range from 60 um to 300 um throughout larval stages
- Important structures:
  - Cilia- feeding and moving in larval stages
  - Gut- holds and digests algae (indication of health)
  - Eyespot- appears when larvae are ready to settle, helps orient
  - Foot- appears when larvae are ready to settle, helps larvae set on substrate



https://www.researchgate.net/figure/Life-cycle-of-the-Pacific-oyster-Crassostrea-gigas-Numbers-1-10-represent-sampling_fig1_308763544

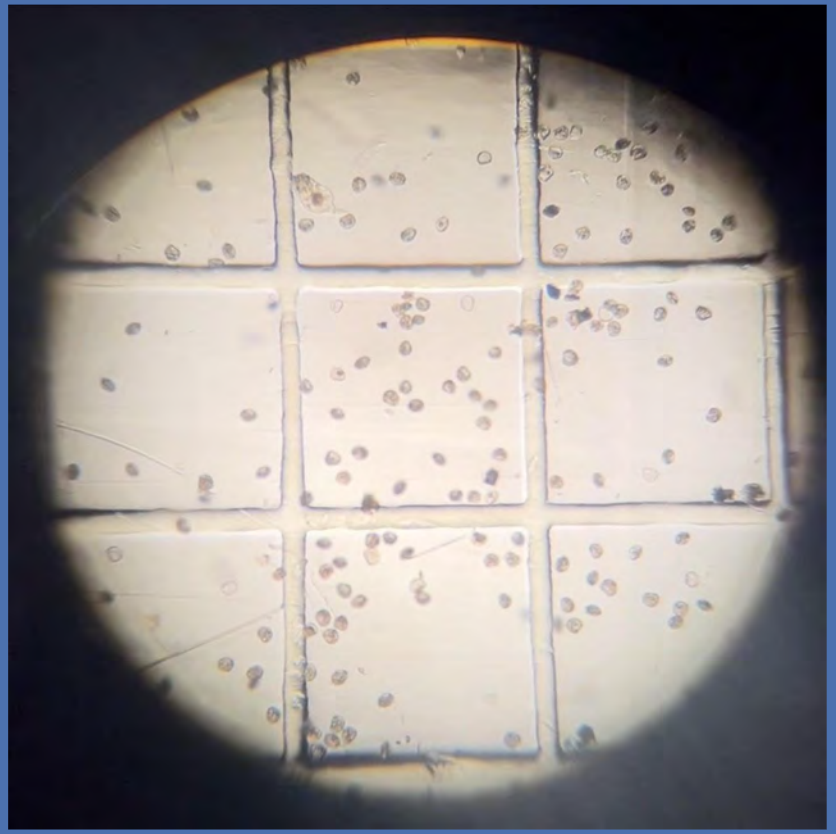


Native Olympia Oyster Collaborative

Larvae Survival Experiment

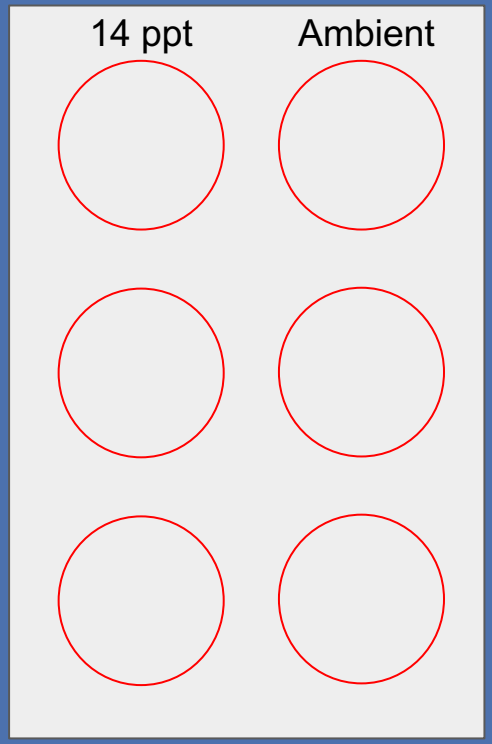
Objective

Determine the survival rate of low salinity tolerance oysters (LST) and wild type Maryland oysters (MDW) at two salinity levels:
artificial seawater ~14ppt and ambient river water ~10ppt

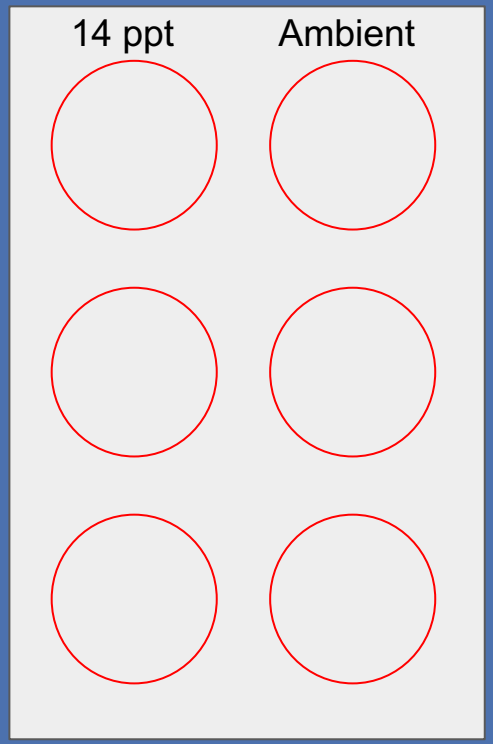


Spawning

- Method of spawning- strip spawning
- Surgically removing gametes using scalpel
- Egg and sperm are combined
- Allows for controlled fertilization

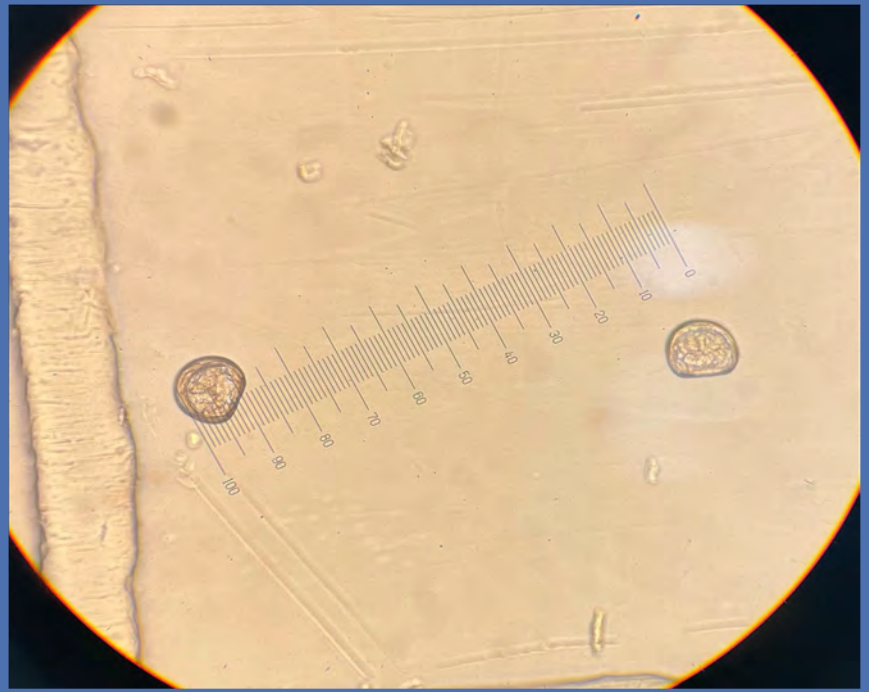


Maryland Wild Type
Oysters



Low Salinity Tolerance
Eastern Oysters

The survival and growth rates of each oyster larvae are measured three times a week.



Date: 6/24/22

PEARL
Larval Data Sheet

Hatchery Personnel- Drop: _____ Count: _____

CULTURE NAME LS 2N #1 Tank # Bucket 11 Ambient

Day of Culture: 11 Previous Count: 91K

Salinity 10.74 ppt
Air Temperature _____ °F
Water Temperature 23.4 °C
pH 8.14 DO 6.76 mg/L

Top Screen Larvae Screen Size: 46 µm Beaker Volume (mL): 400

HEALTH: Poor ☐ Moderate ☒ Healthy ☐

Notes: (active/non active larvae, light or dark guts, dead shell, etc.) Some dead shell, little activity, dark guts,

Counts: Sample size (100µL)- multiplier 10 i.e. Average Counts x 10 x Beaker Volume (mL) = Total Count

6 9 9 Average: 8 Total Count: 32K

Sizes- Measure 10 larvae (µm) *put * next to size if eyed, # for foot* Harvest? Y/N Harvest Total _____

100 | 85 | 90 | 100 | 120 | 90 | 90 | 95 | 90 | 110

Average size: 98 µm **Growth** (Today's av. growth - previous av. growth) 6 µm

Bottom Screen Larvae Screen Size: 41 µm Beaker Volume (mL): 150

HEALTH: Poor ☐ Moderate ☒ Healthy ☐

Notes: (active/non active larvae, light or dark guts, dead shell, etc.) dark guts, Some dead shell, non active

Counts: Sample size (100µL)- multiplier 10 i.e. Average Counts x 10 x Beaker Volume (mL) = Total Count

5 4 16 / 4 4 1 Average: 3 Total Count: 4,500

Sizes- Measure 10 larvae (µm) *put * next to size if eyed, # for foot*

90 | 100 | 85 | 120 | 80 | 125 | 85 | 100 | 110 | 105

Average size: 100 µm **Growth**_____µm **Combine with top size?** Y/N **Discard?** Y/N

Today's TOTAL Count (add totals from top and bottom, *if combining*) _____

Survival:

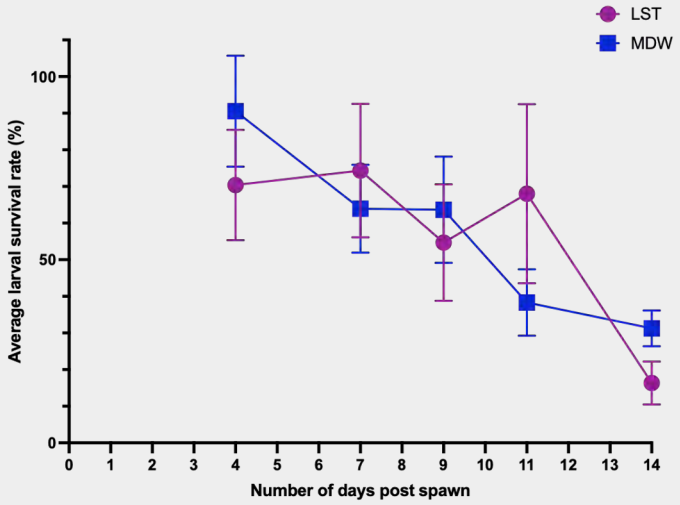
TOTAL count 36,500 /previous count _____ = _____ x 100 = 401 %

Reduce? Y/N *(Spawning: 50 eggs/mL, day 2: 10 larvae/mL, day 7: 5 larvae/mL, day ≥14: 2.5 larvae/mL)*

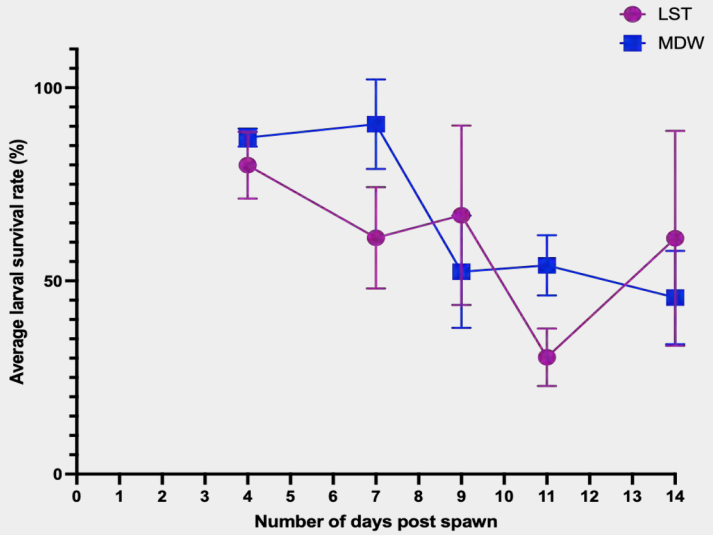
5,000

New Total Count 36,500 7.3L

Larval Survival Results



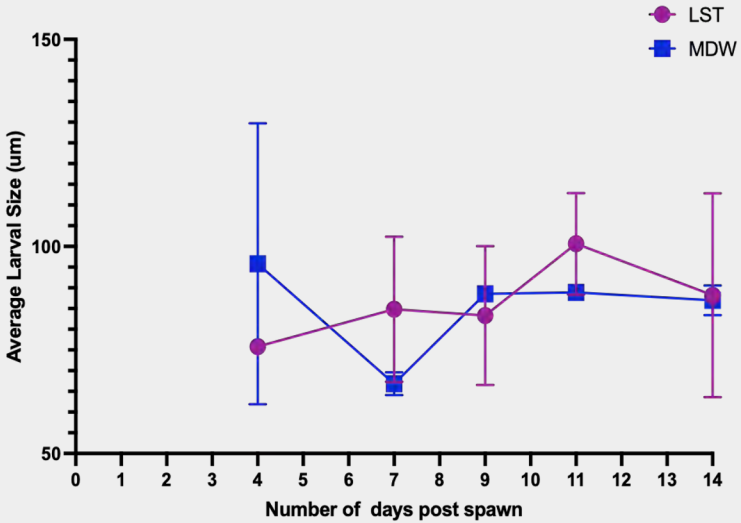
Ambient conditions
(~10 ppt)



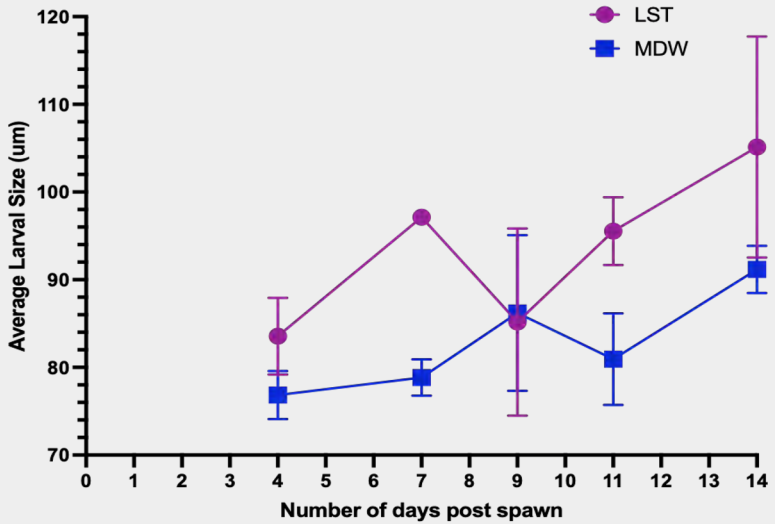
High salinity
conditions (14 ppt)

Larval survival showed no significant difference between the two lines and was highly variable throughout the duration of the experiment.

Larval Growth (size) Results



Ambient conditions
(~10 ppt)

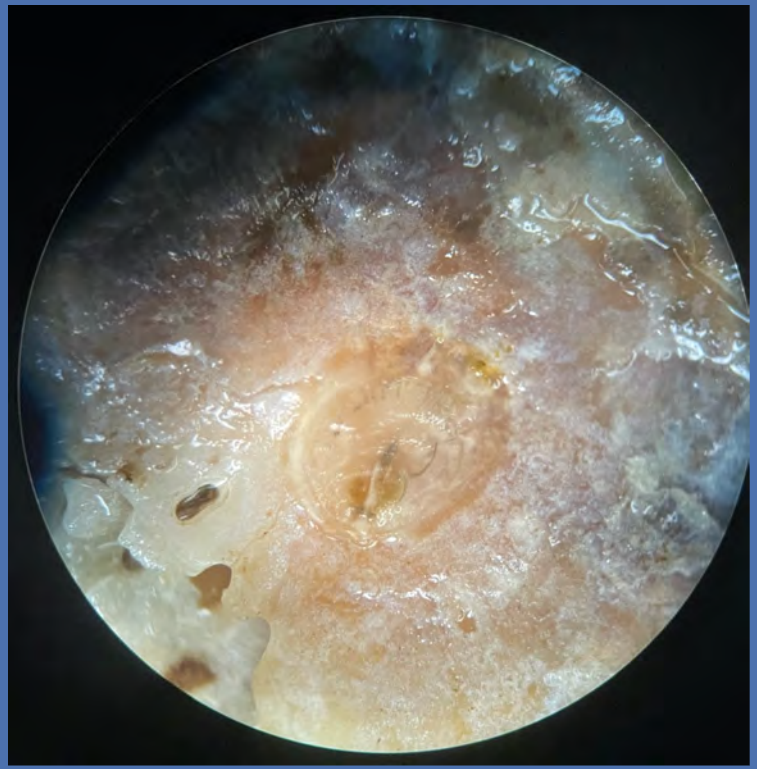


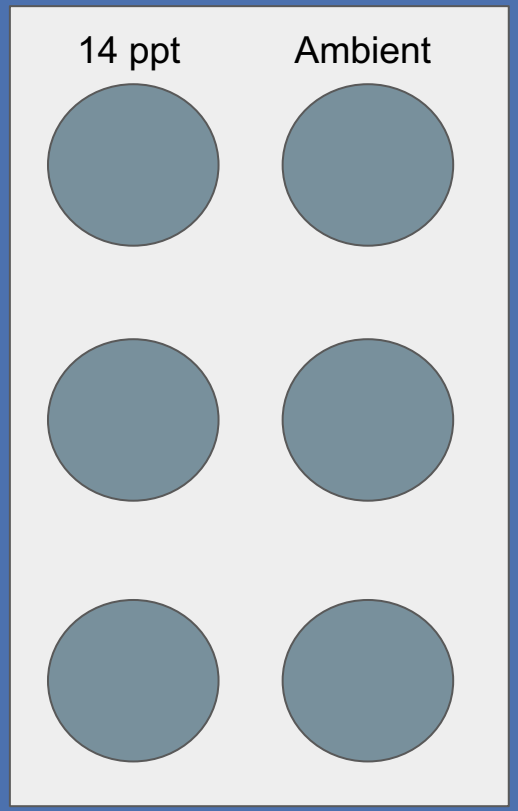
High salinity conditions
(14 ppt)

Larval growth showed no significant difference between the two lines and was highly variable throughout the duration of the experiment.

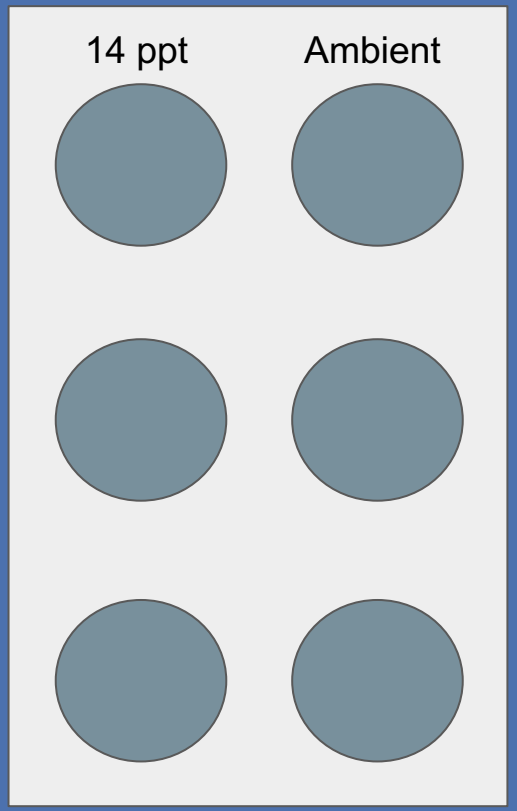
Settlement Experiment

Objective - Determine the settlement rate of low salinity tolerance (LST) and wild type Maryland oysters (native) at two salinity levels:
artificial seawater ~14ppt and ambient river water ~10ppt



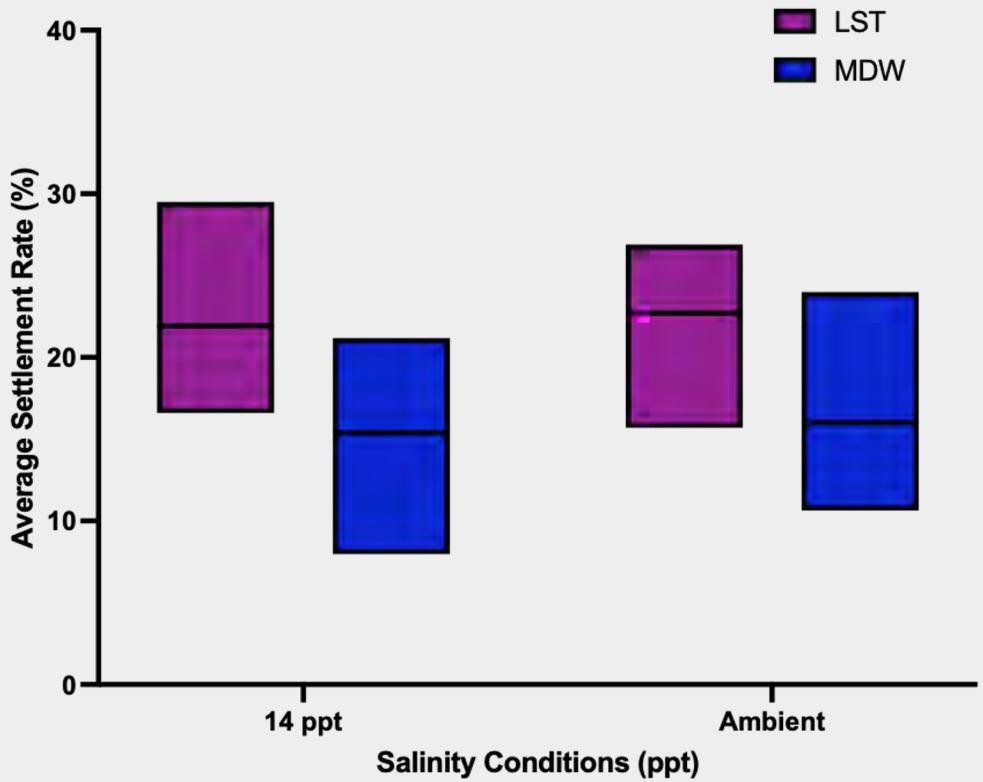


Horn Point Hatchery
LOLA Larvae



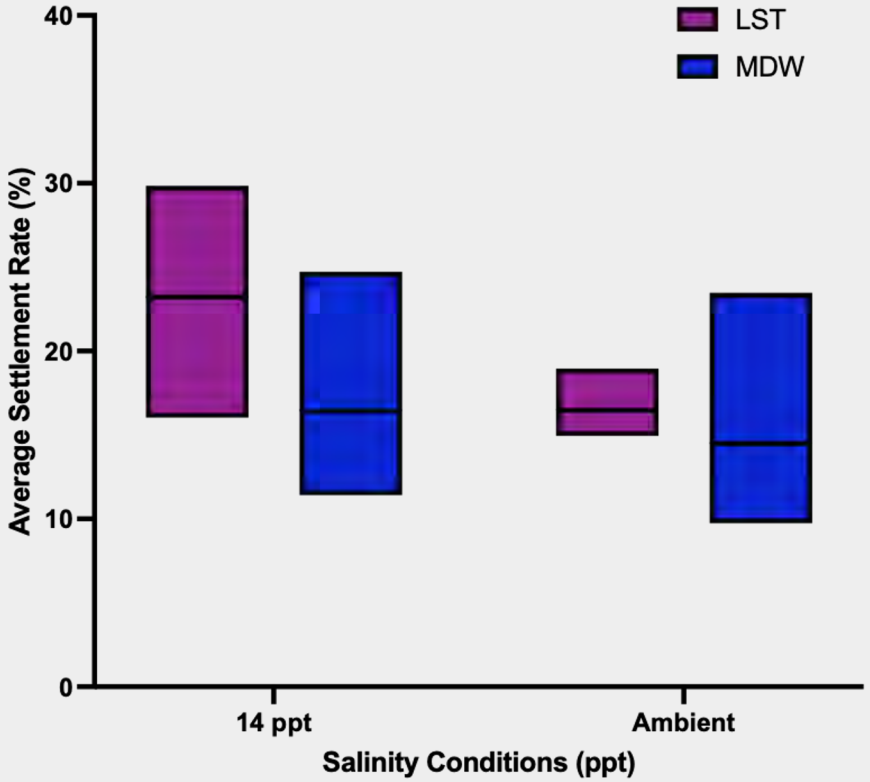
Piney Point Aquaculture
Center Larvae

Larval Settlement Results- 2 weeks post settlement



While LST means are higher, settlement rate p-value and ANOVA showed no significant difference 2 weeks post settlement.

Larval Settlement Results- 1 month post settlement



While LST means are higher, settlement rate p-value and ANOVA showed no significant difference 4 weeks post settlement.


7 days post settlement


12 days

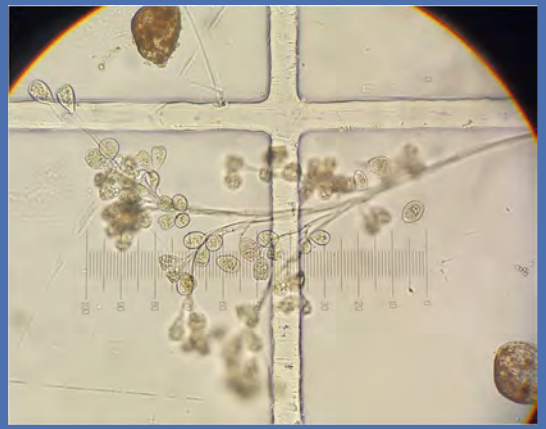

17 days


21 days


24 days

Water Quality and Effects on Larvae

- Contaminants outcompete larvae for space, food, and other resources
- Detrimental to larval health and growth
- Major cause of mortality in larval cultures



Microscopy UK

Clustering During Settlement

- Major variability between amount of spat on each shell
- Spat compete for space and food during growth
- Less spat grow to adulthood

Culture Name	Spat Count										Average	Settlement Rate
HPL #1 Amb	99	66	44	24	42	23	40	86	43	44	51.1	25.5%
HPL #2 Amb	27	10	31	24	40	9	49	46	19	59	31.4	15.7%
HPL #3 Amb	58	20	76	107	40	52	27	25	44	89	53.8	26.9%
HPL #1 14 ppt	21	60	48	43	13	4	93	41	63	7	39.3	19.65%
HPL #2 14 ppt	58	39	57	59	11	24	14	15	26	29	33.2	16.6%
HPL #3 14 ppt	45	87	56	18	79	93	29	35	40	108	59	29.5

Culture Name	Spat Count										Average	Settlement Rate
PPAC #1 Amb	4	1	14	4	9	31	5	72	48	16	20.4	10.64%
PPAC #2 Amb	44	9	22	34	29	12	14	46	8	40	25.8	13.46%
PPAC #3 Amb	16	16	34	160	6	101	22	74	17	14	46	24%
PPAC #1 14 ppt	4	2	8	8	13	36	16	31	9	26	15.3	7.98%
PPAC #2 14 ppt	77	88	18	35	13	32	57	29	25	32	40.6	21.18%
PPAC #3 14 ppt	37	51	13	37	21	109	32	10	9	9	32.8	17.11%

Data Conclusions

- LST and MDW lines showed similar survival, growth and settlement rates.
- Survival, growth and settlement were highly variable within the culture- no significance
- Salinities were fairly similar, may see more differences with more drastic differences in salinity
- Contaminants to cultures can be detrimental to health of larvae
- Best method for oyster reef restoration- spawning from oysters native to that location

Acknowledgements

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ANY OTHER QUESTIONS?

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