# Comparison of Oyster Stocking Densities for Floating Bag Culture in Florida

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# Oyster Stocking Density Comparison

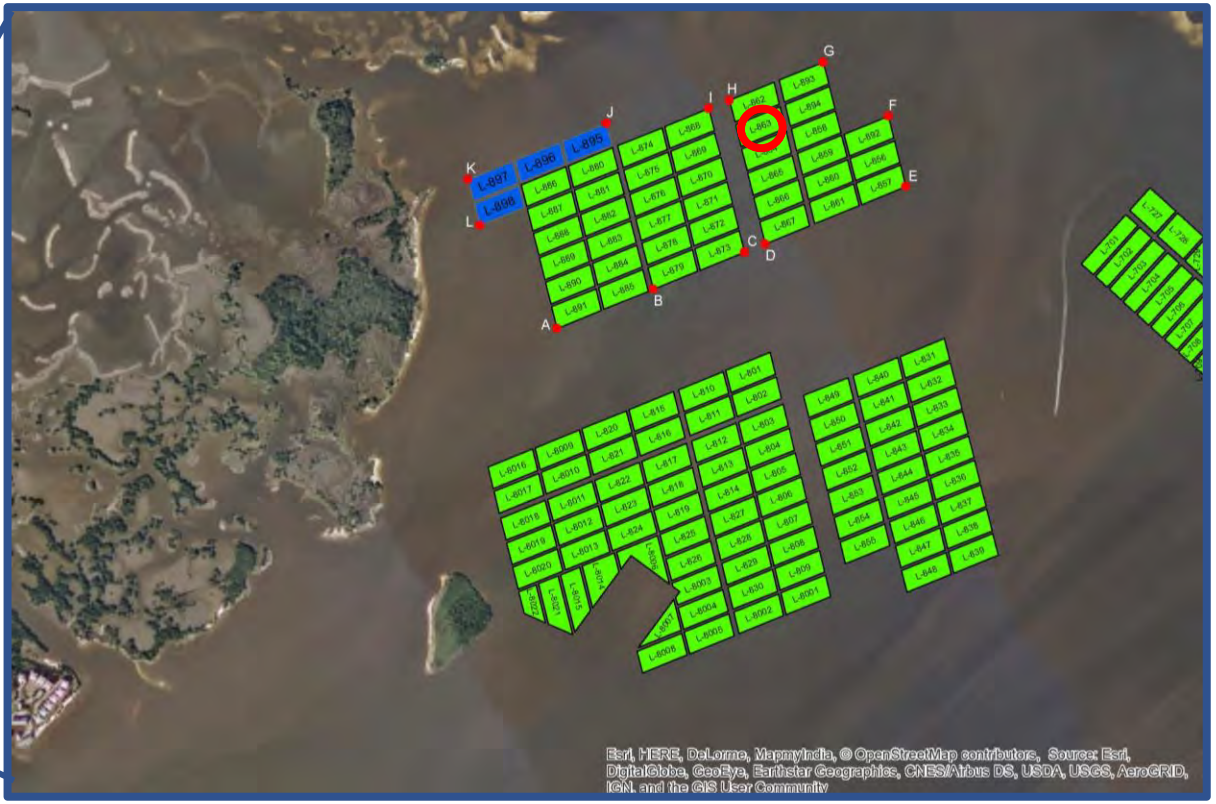
OBJECTIVES

1) Document production performance of oysters
2) Evaluate stocking densities
   a) 125, 150, 175 per bag
   b) 175, 200, 225, 250 per bag
3) Examine effects of biofouling control methods

# Location of Field Trials

- Gulf of Mexico off Cedar Key, FL
- Experimental lease within a commercial aquaculture use zone





# Field Trial 1: October 2016—April 2017

**Ploidy:**

| n=18 | n=18 |
| --- | --- |
| 2N | 3N |

**Density:**

| 2N | | | 3N | | |
| --- | --- | --- | --- | --- | --- |
| n=6 | n=6 | n=6 | n=6 | n=6 | n=6 |
| Low (125) | Medium (150) | High (175) | Low (125) | Medium (150) | High (175) |

**Timeframe:**

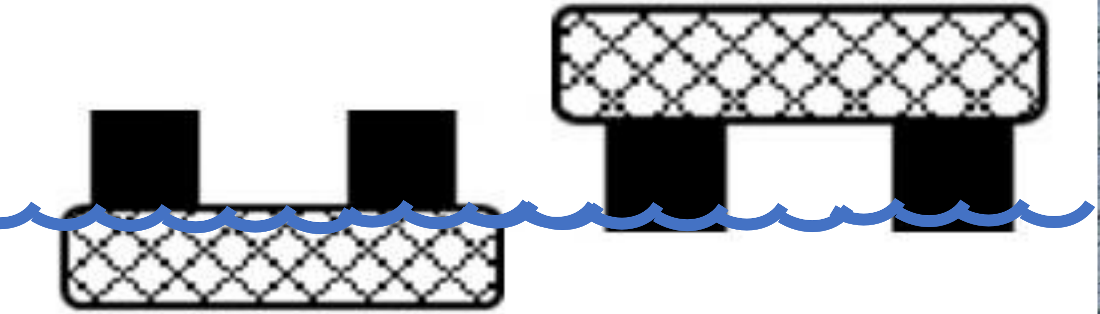
From Spawn to Harvest – 12 months

| Land based Nursery | Field based Nursery | Growout – WINTER 2016-17 |
| --- | --- | --- |
| April (Spawn), May, June, July | August, September, October | November, December, January, February, March, April |
| 3.5 months | 2.5 months | 6 months |

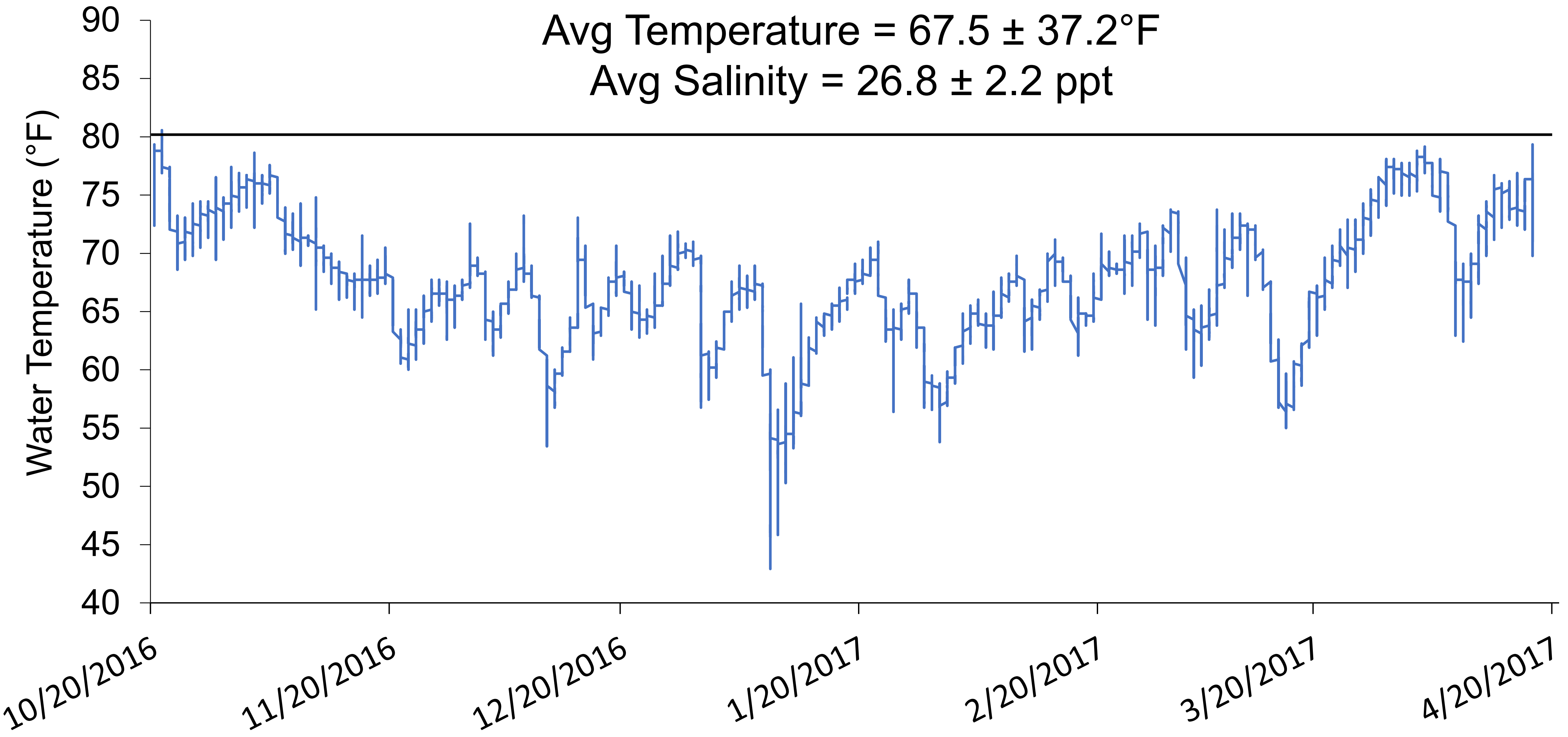
Spawn

# Stocking Info & Biofouling Control

- Stocking size:
  - o Diploids: 51 mm (2 inches) SH
  - o Triploids: 54 mm (2 inches) SH
- Stocking density: 120, 150, 175 oysters per bag
- 14 mm Vexar bags
- 4.5-inch square floats placed on top
- Weekly flipping – 24 hr aerial drying

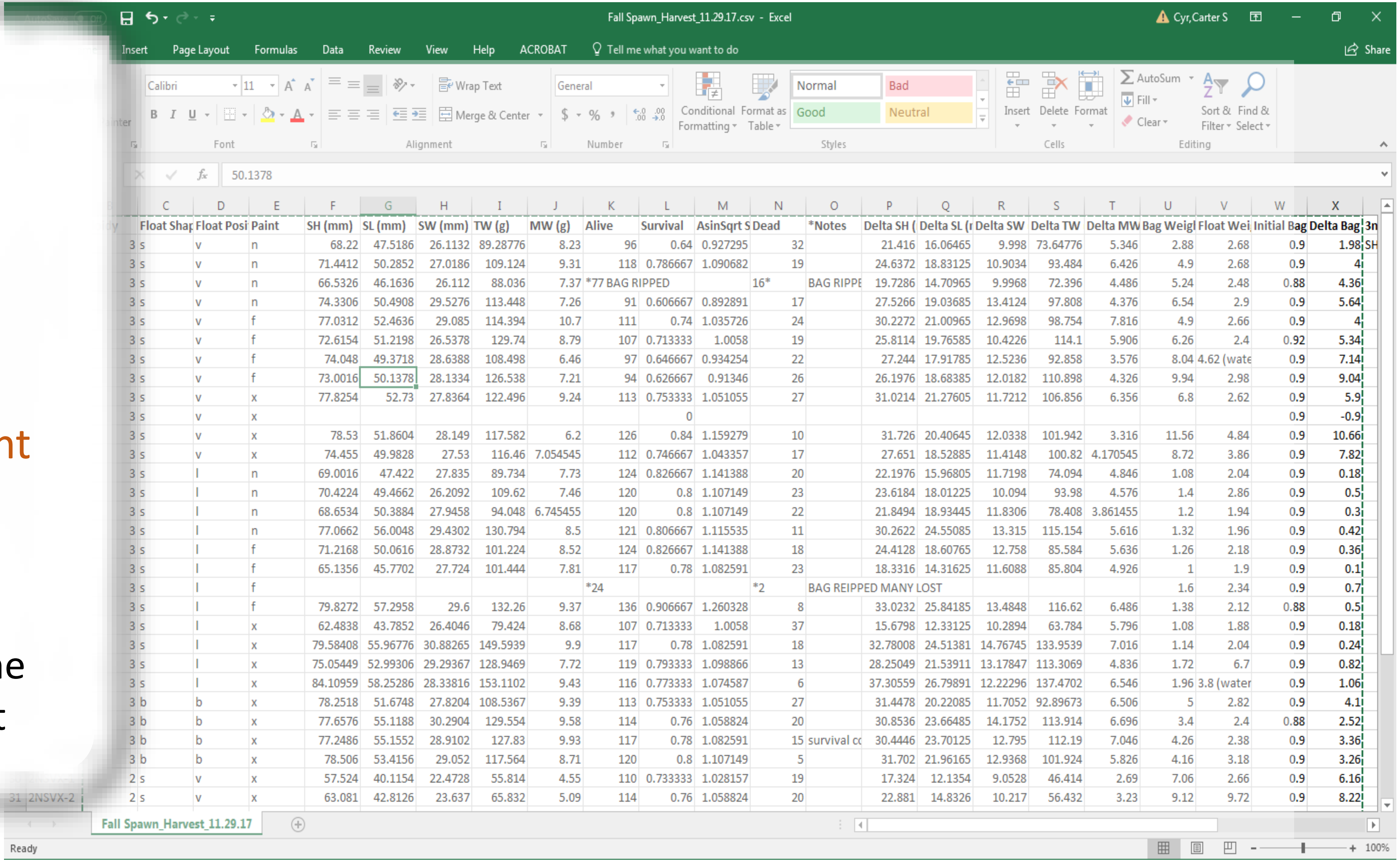



# Temperatures, October 2016 - April 2017

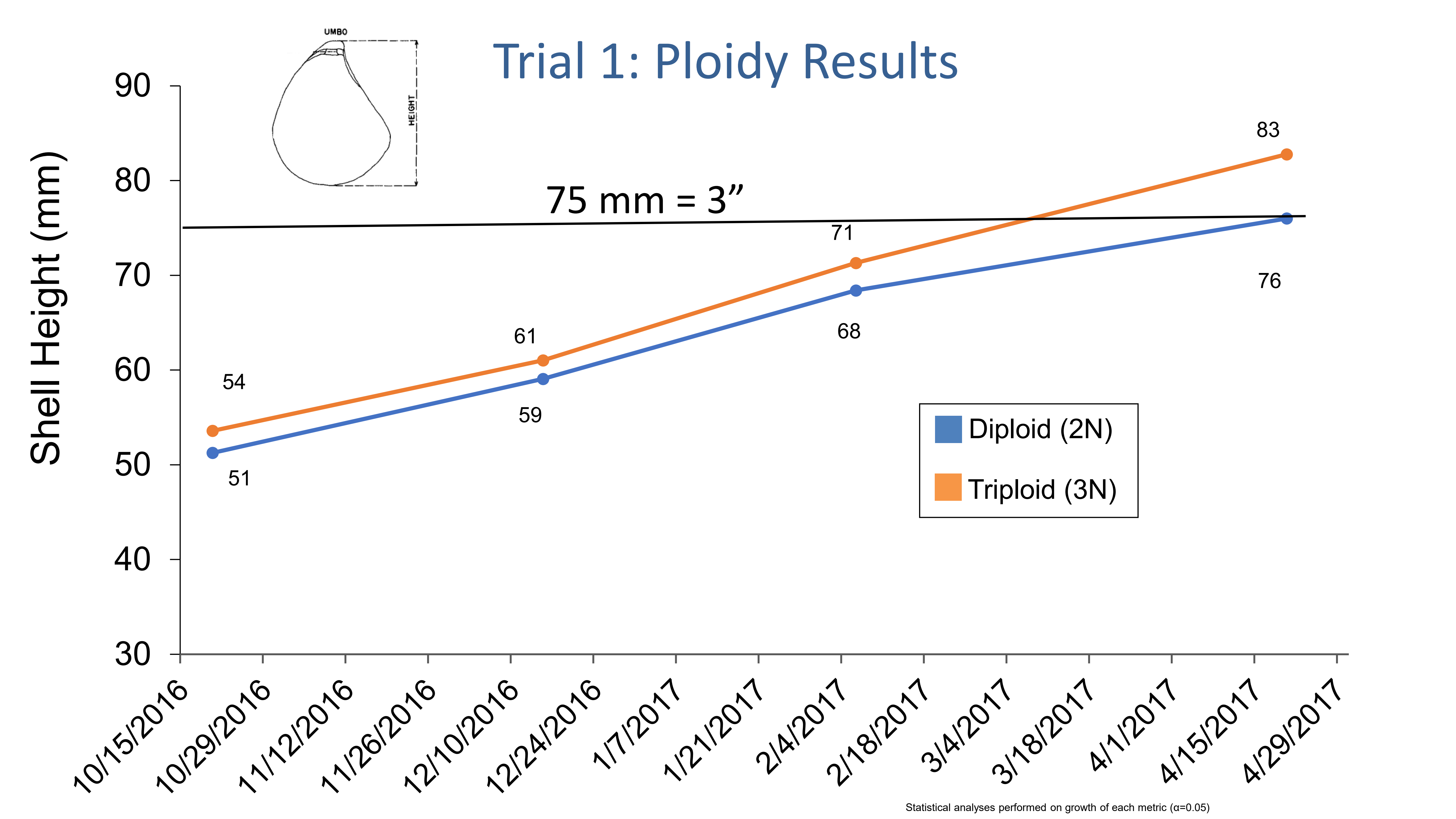


# Variables Measured: Variables Reporting

- Shell Metrics
  - Shell height
  - Shell length
  - Shell width
- Weight Metrics
  - Total
  - Meat (wet)
  - Meat (dry)
- Condition Index
- Survival
- Biofouling Weight
  - On bags
  - On oysters
- Bag Metrics
  - Oyster volume
  - Oyster height
  - Bag height
- Labor Hours



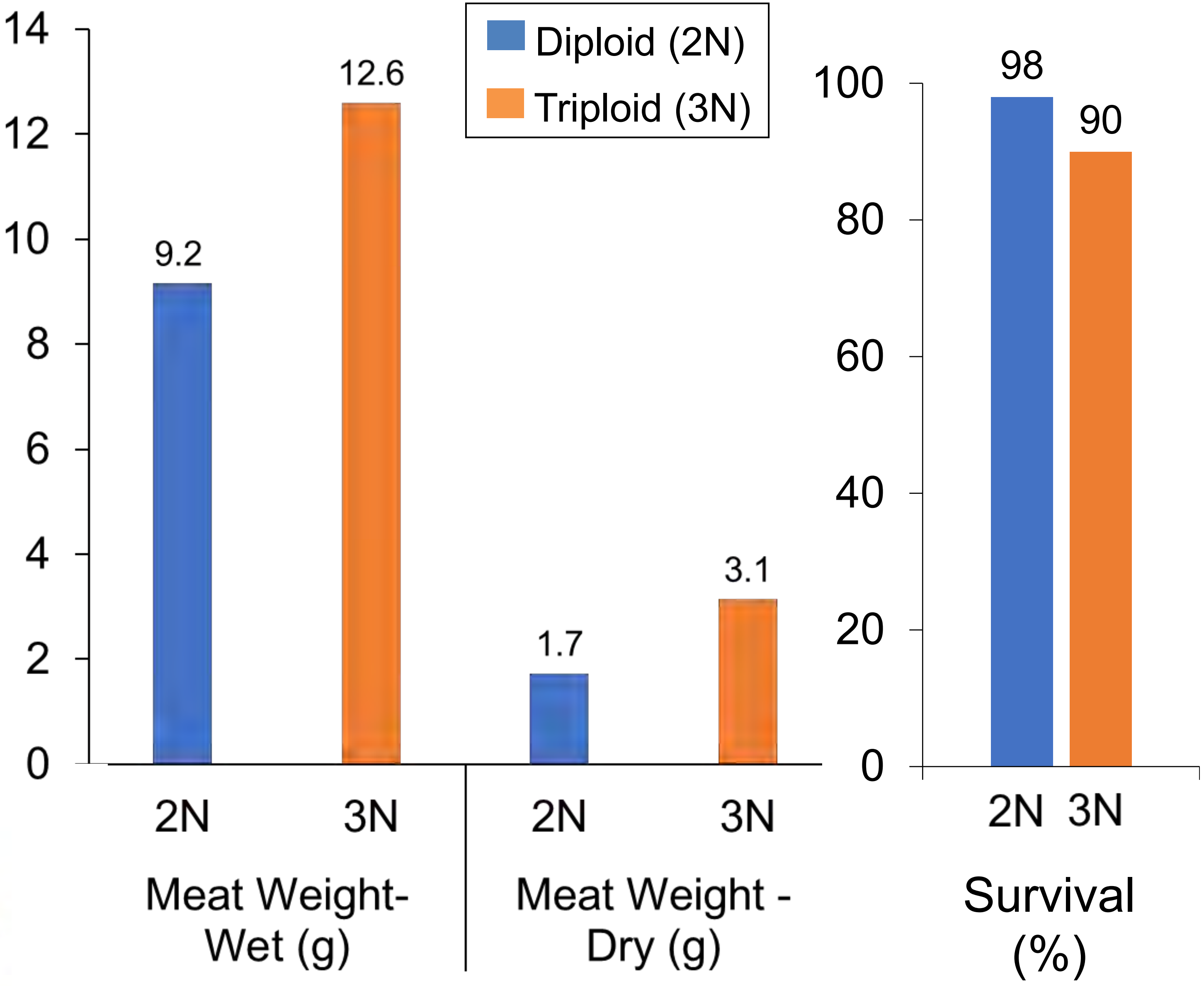

| | Float Shap | Float Posi | Paint | SH (mm) | SL (mm) | SW (mm) | TW (g) | MW (g) | Alive | Survival | AsinSqrt S | Dead | *Notes | Delta SH ( | Delta SL (r | Delta SW | Delta TW | Delta MW | Bag Weigl | Float Wei | Initial Bag | Delta Bag | 3n |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | s | v | n | 68.22 | 47.5186 | 26.1132 | 89.28776 | 8.23 | 96 | 0.64 | 0.927295 | 32 | | 21.416 | 16.06465 | 9.998 | 73.64776 | 5.346 | 2.88 | 2.68 | 0.9 | 1.98 | SH |
| 3 | s | v | n | 71.4412 | 50.2852 | 27.0186 | 109.124 | 9.31 | 118 | 0.786667 | 1.090682 | 19 | | 24.6372 | 18.83125 | 10.9034 | 93.484 | 6.426 | 4.9 | 2.68 | 0.9 | 4 | |
| 3 | s | v | n | 66.5326 | 46.1636 | 26.112 | 88.036 | 7.37 | *77 BAG RIPPED | | | 16* | BAG RIPPE | 19.7286 | 14.70965 | 9.9968 | 72.396 | 4.486 | 5.24 | 2.48 | 0.88 | 4.36 | |
| 3 | s | v | n | 74.3306 | 50.4908 | 29.5276 | 113.448 | 7.26 | 91 | 0.606667 | 0.892891 | 17 | | 27.5266 | 19.03685 | 13.4124 | 97.808 | 4.376 | 6.54 | 2.9 | 0.9 | 5.64 | |
| 3 | s | v | f | 77.0312 | 52.4636 | 29.085 | 114.394 | 10.7 | 111 | 0.74 | 1.035726 | 24 | | 30.2272 | 21.00965 | 12.9698 | 98.754 | 7.816 | 4.9 | 2.66 | 0.9 | 4 | |
| 3 | s | v | f | 72.6154 | 51.2198 | 26.5378 | 129.74 | 8.79 | 107 | 0.713333 | 1.0058 | 19 | | 25.8114 | 19.76585 | 10.4226 | 114.1 | 5.906 | 6.26 | 2.4 | 0.92 | 5.34 | |
| 3 | s | v | f | 74.048 | 49.3718 | 28.6388 | 108.498 | 6.46 | 97 | 0.646667 | 0.934254 | 22 | | 27.244 | 17.91785 | 12.5236 | 92.858 | 3.576 | 8.04 | 4.62 (wate | 0.9 | 7.14 | |
| 3 | s | v | f | 73.0016 | 50.1378 | 28.1334 | 126.538 | 7.21 | 94 | 0.626667 | 0.91346 | 26 | | 26.1976 | 18.68385 | 12.0182 | 110.898 | 4.326 | 9.94 | 2.98 | 0.9 | 9.04 | |
| 3 | s | v | x | 77.8254 | 52.73 | 27.8364 | 122.496 | 9.24 | 113 | 0.753333 | 1.051055 | 27 | | 31.0214 | 21.27605 | 11.7212 | 106.856 | 6.356 | 6.8 | 2.62 | 0.9 | 5.9 | |
| 3 | s | v | x | | | | | | | 0 | | | | | | | | | | | 0.9 | -0.9 | |
| 3 | s | v | x | 78.53 | 51.8604 | 28.149 | 117.582 | 6.2 | 126 | 0.84 | 1.159279 | 10 | | 31.726 | 20.40645 | 12.0338 | 101.942 | 3.316 | 11.56 | 4.84 | 0.9 | 10.66 | |
| 3 | s | v | x | 74.455 | 49.9828 | 27.53 | 116.46 | 7.054545 | 112 | 0.746667 | 1.043357 | 17 | | 27.651 | 18.52885 | 11.4148 | 100.82 | 4.170545 | 8.72 | 3.86 | 0.9 | 7.82 | |
| 3 | s | l | n | 69.0016 | 47.422 | 27.835 | 89.734 | 7.73 | 124 | 0.826667 | 1.141388 | 20 | | 22.1976 | 15.96805 | 11.7198 | 74.094 | 4.846 | 1.08 | 2.04 | 0.9 | 0.18 | |
| 3 | s | l | n | 70.4224 | 49.4662 | 26.2092 | 109.62 | 7.46 | 120 | 0.8 | 1.107149 | 23 | | 23.6184 | 18.01225 | 10.094 | 93.98 | 4.576 | 1.4 | 2.86 | 0.9 | 0.5 | |
| 3 | s | l | n | 68.6534 | 50.3884 | 27.9458 | 94.048 | 6.745455 | 120 | 0.8 | 1.107149 | 22 | | 21.8494 | 18.93445 | 11.8306 | 78.408 | 3.861455 | 1.2 | 1.94 | 0.9 | 0.3 | |
| 3 | s | l | n | 77.0662 | 56.0048 | 29.4302 | 130.794 | 8.5 | 121 | 0.806667 | 1.115535 | 11 | | 30.2622 | 24.55085 | 13.315 | 115.154 | 5.616 | 1.32 | 1.96 | 0.9 | 0.42 | |
| 3 | s | l | f | 71.2168 | 50.0616 | 28.8732 | 101.224 | 8.52 | 124 | 0.826667 | 1.141388 | 18 | | 24.4128 | 18.60765 | 12.758 | 85.584 | 5.636 | 1.26 | 2.18 | 0.9 | 0.36 | |
| 3 | s | l | f | 65.1356 | 45.7702 | 27.724 | 101.444 | 7.81 | 117 | 0.78 | 1.082591 | 23 | | 18.3316 | 14.31625 | 11.6088 | 85.804 | 4.926 | 1 | 1.9 | 0.9 | 0.1 | |
| 3 | s | l | f | | | | | | *24 | | | *2 | BAG REIPPED MANY LOST | | | | | | 1.6 | 2.34 | 0.9 | 0.7 | |
| 3 | s | l | f | 79.8272 | 57.2958 | 29.6 | 132.26 | 9.37 | 136 | 0.906667 | 1.260328 | 8 | | 33.0232 | 25.84185 | 13.4848 | 116.62 | 6.486 | 1.38 | 2.12 | 0.88 | 0.5 | |
| 3 | s | l | x | 62.4838 | 43.7852 | 26.4046 | 79.424 | 8.68 | 107 | 0.713333 | 1.0058 | 37 | | 15.6798 | 12.33125 | 10.2894 | 63.784 | 5.796 | 1.08 | 1.88 | 0.9 | 0.18 | |
| 3 | s | l | x | 79.58408 | 55.96776 | 30.88265 | 149.5939 | 9.9 | 117 | 0.78 | 1.082591 | 18 | | 32.78008 | 24.51381 | 14.76745 | 133.9539 | 7.016 | 1.14 | 2.04 | 0.9 | 0.24 | |
| 3 | s | l | x | 75.05449 | 52.99306 | 29.29367 | 128.9469 | 7.72 | 119 | 0.793333 | 1.098866 | 13 | | 28.25049 | 21.53911 | 13.17847 | 113.3069 | 4.836 | 1.72 | 6.7 | 0.9 | 0.82 | |
| 3 | s | l | x | 84.10959 | 58.25286 | 28.33816 | 153.1102 | 9.43 | 116 | 0.773333 | 1.074587 | 6 | | 37.30559 | 26.79891 | 12.22296 | 137.4702 | 6.546 | 1.96 | 3.8 (water | 0.9 | 1.06 | |
| 3 | b | b | x | 78.2518 | 51.6748 | 27.8204 | 108.5367 | 9.39 | 113 | 0.753333 | 1.051055 | 27 | | 31.4478 | 20.22085 | 11.7052 | 92.89673 | 6.506 | 5 | 2.82 | 0.9 | 4.1 | |
| 3 | b | b | x | 77.6576 | 55.1188 | 30.2904 | 129.554 | 9.58 | 114 | 0.76 | 1.058824 | 20 | | 30.8536 | 23.66485 | 14.1752 | 113.914 | 6.696 | 3.4 | 2.4 | 0.88 | 2.52 | |
| 3 | b | b | x | 77.2486 | 55.1552 | 28.9102 | 127.83 | 9.93 | 117 | 0.78 | 1.082591 | 15 | survival cc | 30.4446 | 23.70125 | 12.795 | 112.19 | 7.046 | 4.26 | 2.38 | 0.9 | 3.36 | |
| 3 | b | b | x | 78.506 | 53.4156 | 29.052 | 117.564 | 8.71 | 120 | 0.8 | 1.107149 | 5 | | 31.702 | 21.96165 | 12.9368 | 101.924 | 5.826 | 4.16 | 3.18 | 0.9 | 3.26 | |
| 2 | s | v | x | 57.524 | 40.1154 | 22.4728 | 55.814 | 4.55 | 110 | 0.733333 | 1.028157 | 19 | | 17.324 | 12.1354 | 9.0528 | 46.414 | 2.69 | 7.06 | 2.66 | 0.9 | 6.16 | |
| 2 | s | v | x | 63.081 | 42.8126 | 23.637 | 65.832 | 5.09 | 114 | 0.76 | 1.058824 | 20 | | 22.881 | 14.8326 | 10.217 | 56.432 | 3.23 | 9.12 | 9.72 | 0.9 | 8.22 | |


UMBO
HEIGHT
Trial 1: Ploidy Results
Shell Height (mm)
90
80
70
60
50
40
30
75 mm = 3”
54
51
61
59
71
68
83
76
Diploid (2N)
Triploid (3N)
10/15/2016
10/29/2016
11/12/2016
11/26/2016
12/10/2016
12/24/2016
1/7/2017
1/21/2017
2/4/2017
2/18/2017
3/4/2017
3/18/2017
4/1/2017
4/15/2017
4/29/2017
Statistical analyses performed on growth of each metric (α=0.05)

# Trial 1: Ploidy Results

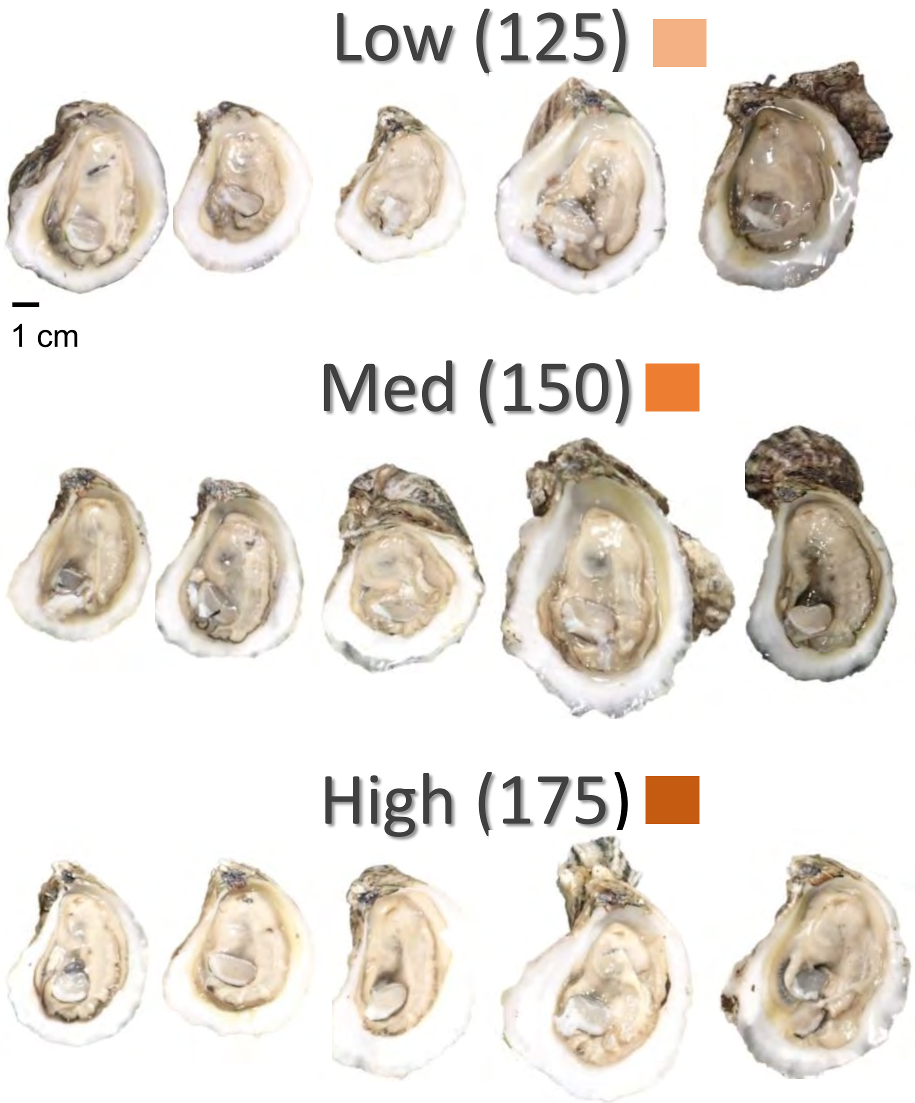
2N

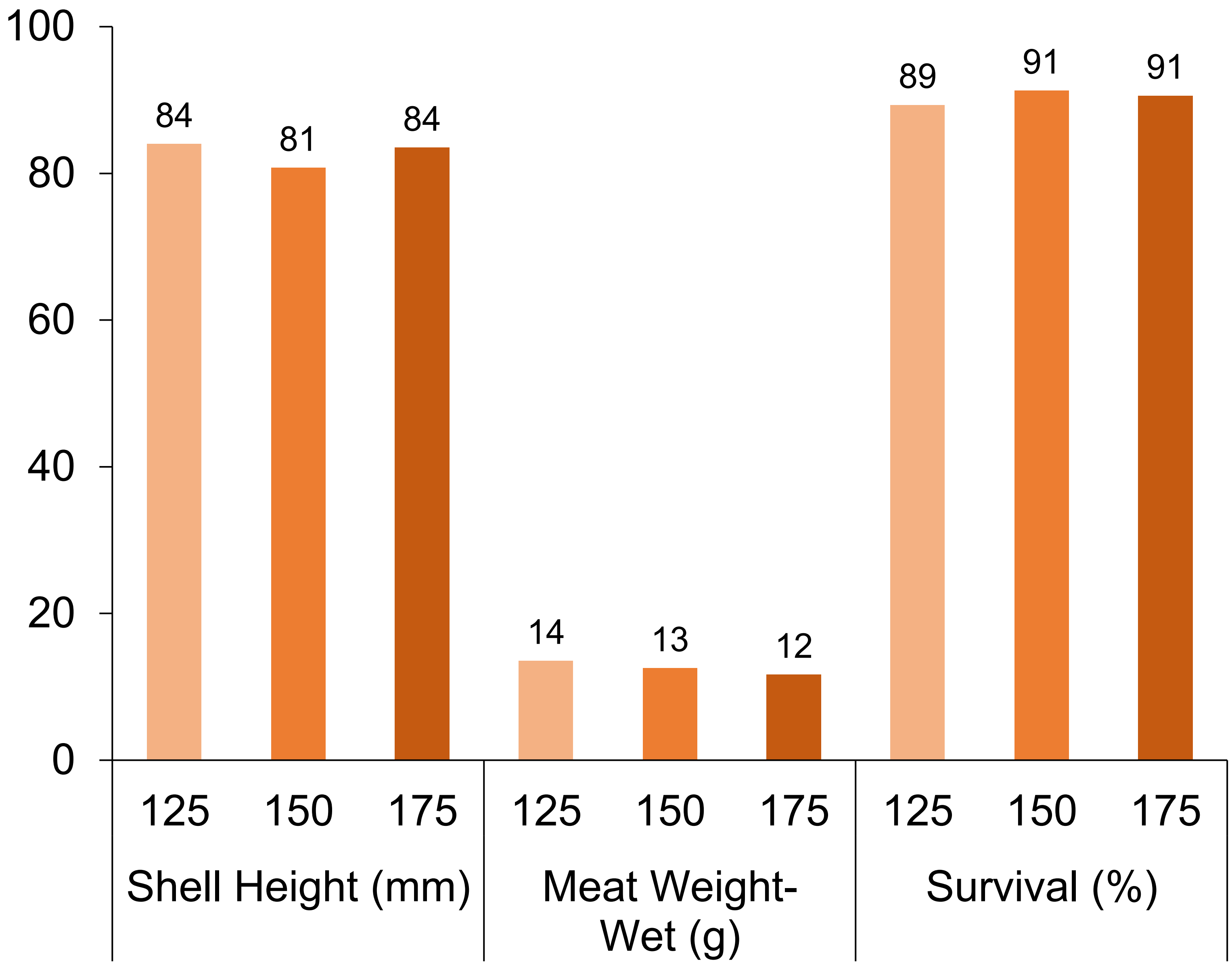

3N



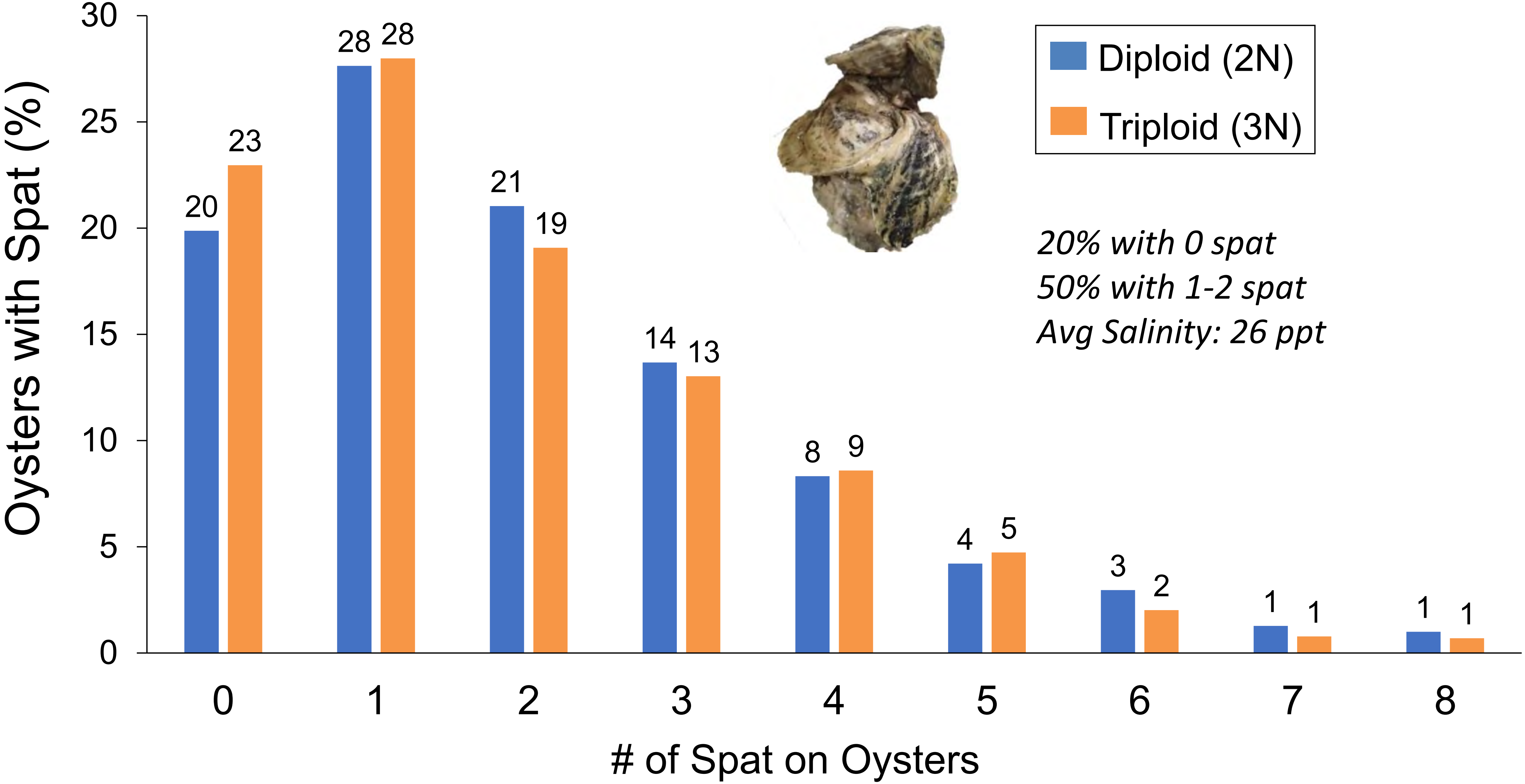

Statistical analyses performed on growth of each metric (α=0.05)

# Trial 1: Stocking Density Results



# Trial 1: Biofouling on Oysters



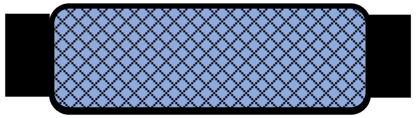
# Trial 1: Biofouling on Oysters at Harvest

98% of oysters were saleable after culling

# Field Trial 2: October 2018 - June 2019

**Ploidy:** 3N

**Gear Type:** Floating Bags



**Stocking Density:** 175 | 200 | 225 | 250

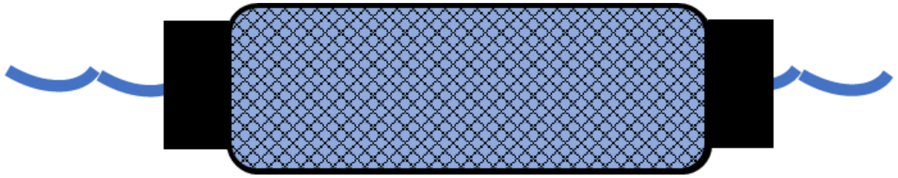
**Timeframe:** From Spawn to Harvest – 13 months

| Nursery | | | Field Nursery | | Growout: WINTER 2018-19 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| June | July | August | September | October | November | December | January | February | March | April | May | June | |
| 2.5 months | | | 2.5 months | | 8 months | | | | | | | | |

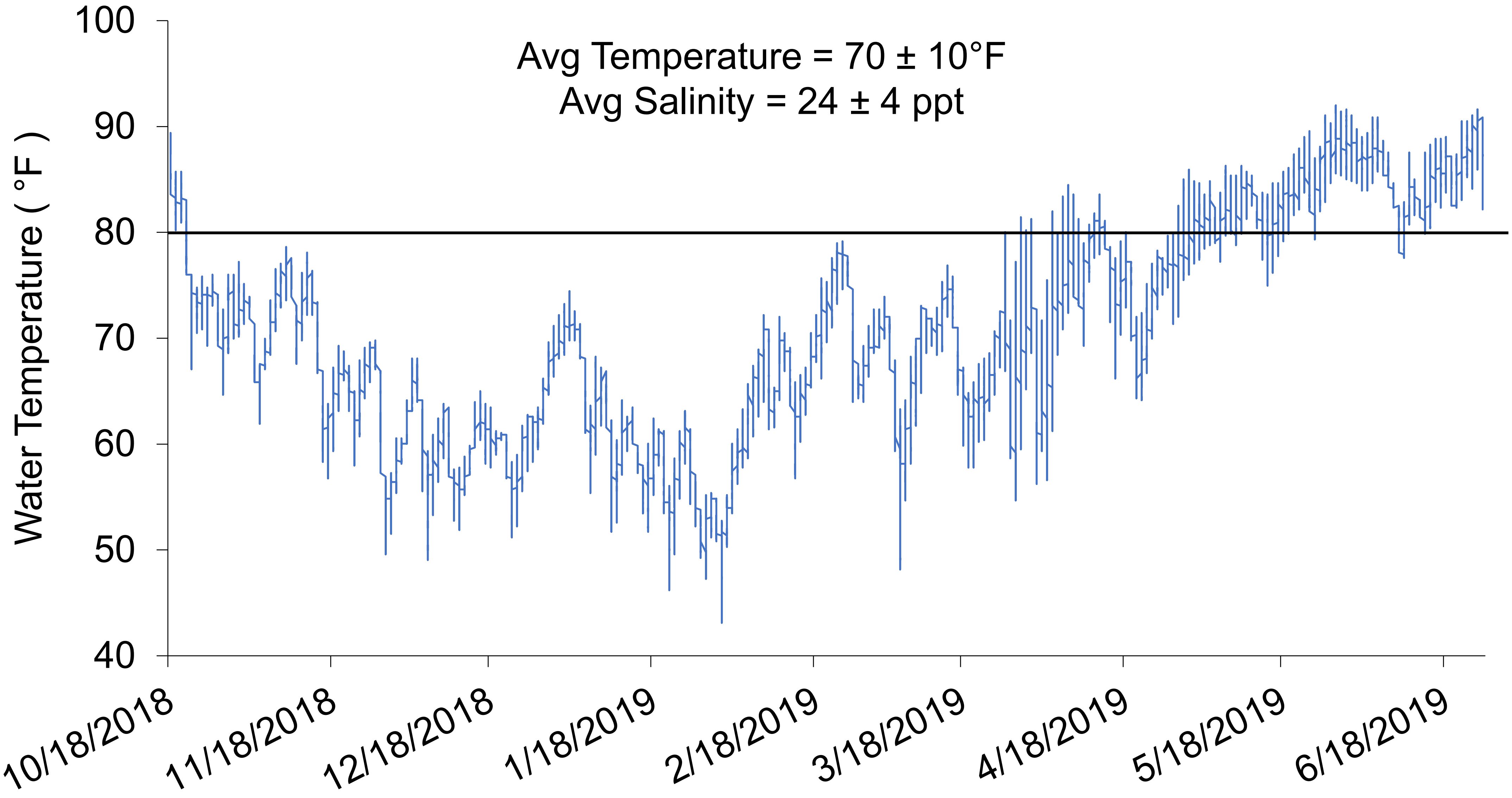
Spawn

# Stocking Info & Biofouling Control

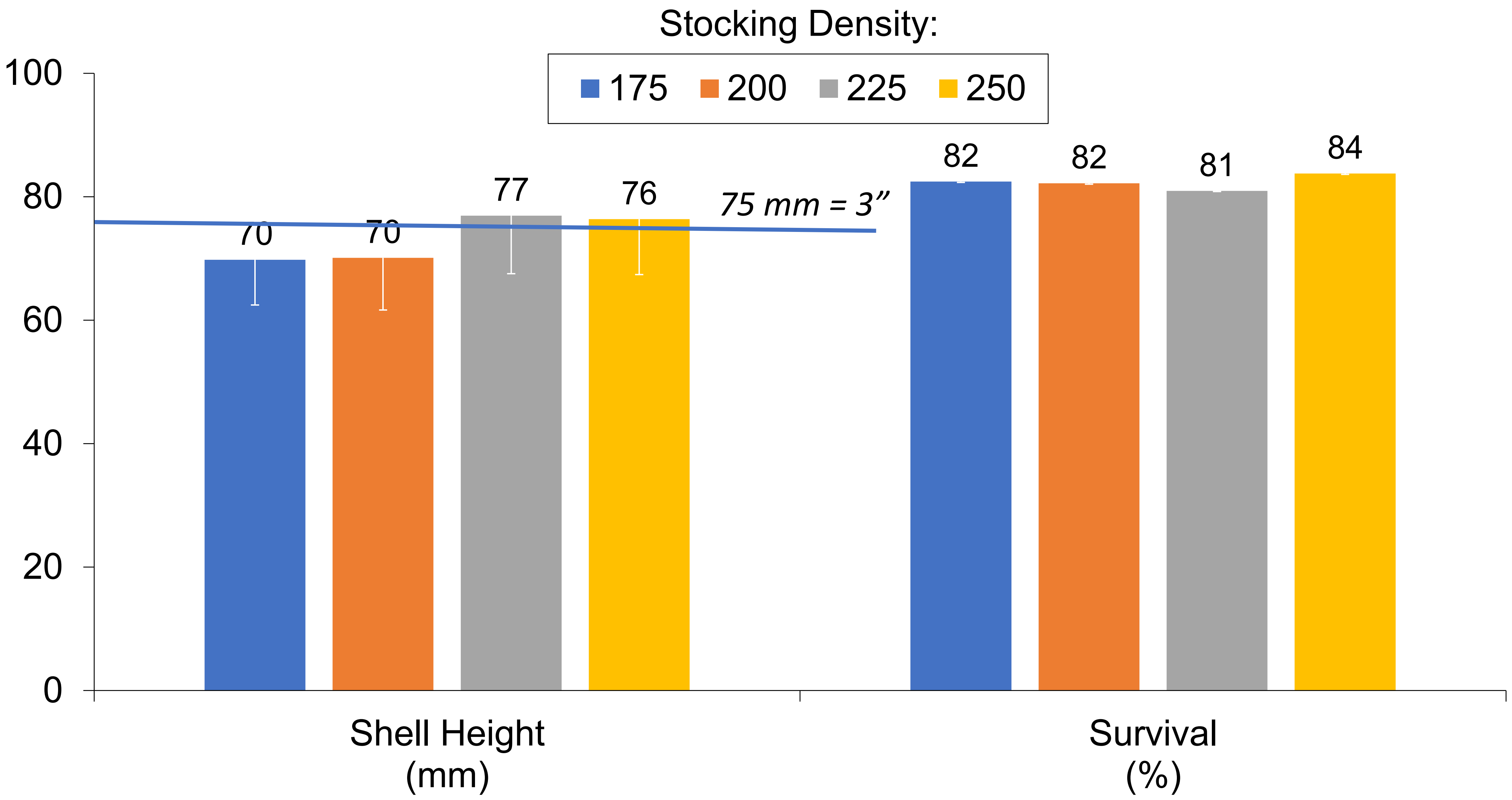
- Stock size: 41 mm (1.6 inches) SH
- Stocking density: 175, 200, 225, 250 oysters per bag
- 14 mm Vexar bags
- 4.5-inch square floats placed on sides of bags
- Weekly flipping - does not require flipping back or "unflipping"



# Temperatures, October 2018 - June 2019



# Trial 2: Stocking Density Results



# Oyster Shell Shape



| | Shell Height (SH) | | Shell Length (SL) | | Shell Width (SW) |
|---|---|---|---|---|---|
| **Preferred Ratio:** | **3** | **:** | **2** | **:** | **1** |

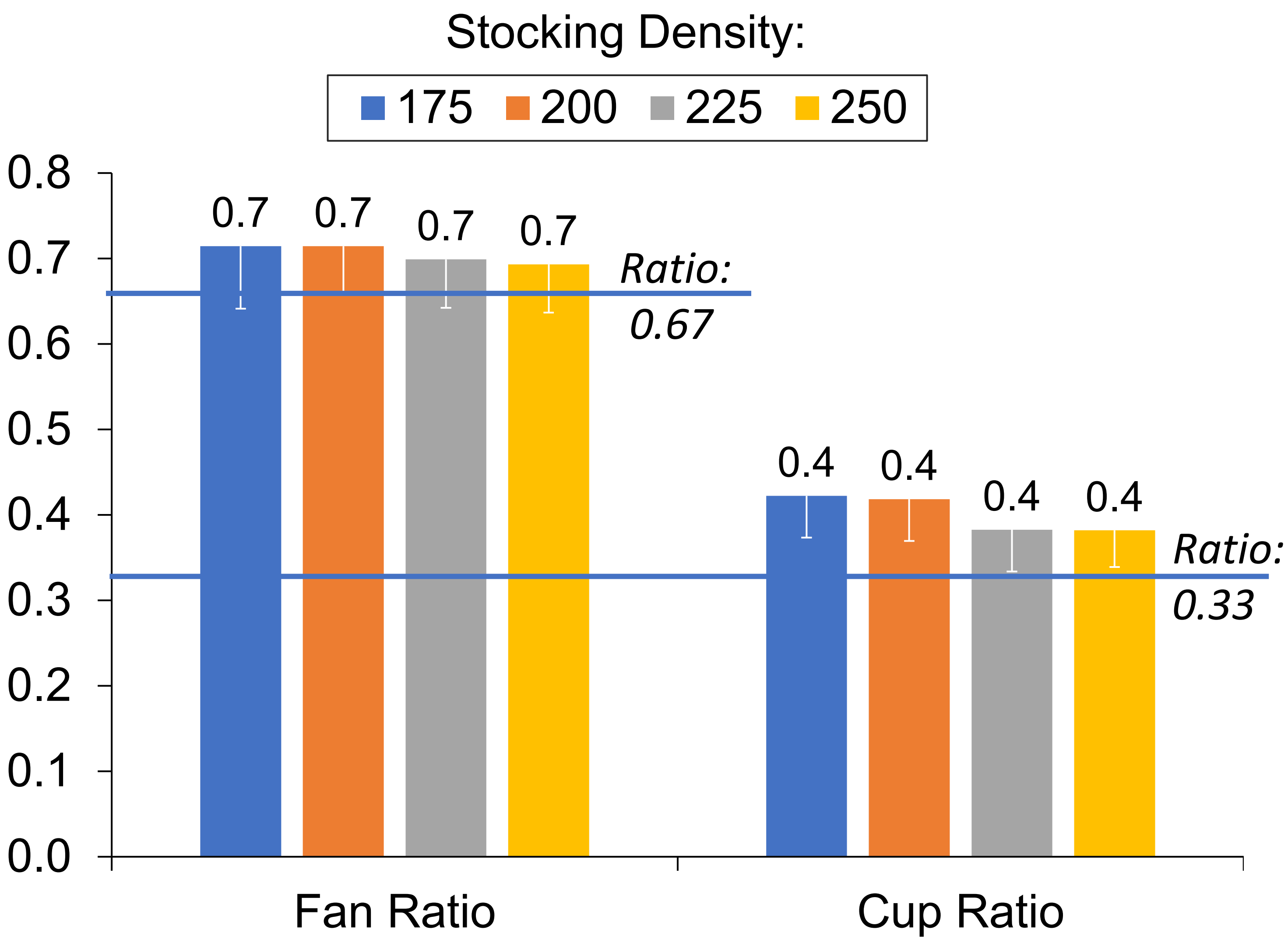
Fan Ratio

SL/SH = 2/3 = 0.67

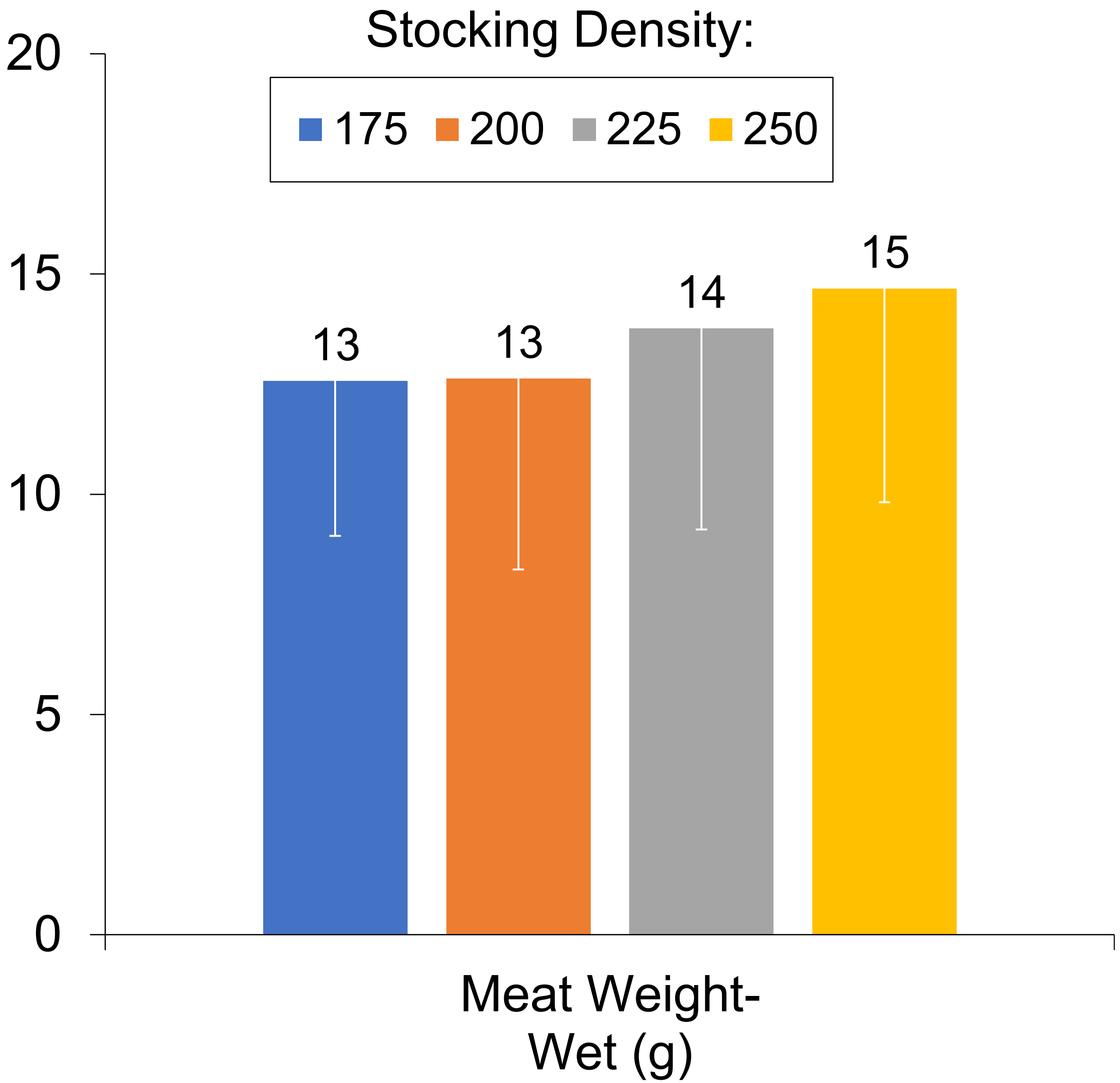
Cup Ratio

SW/SH = 1/3 = 0.33

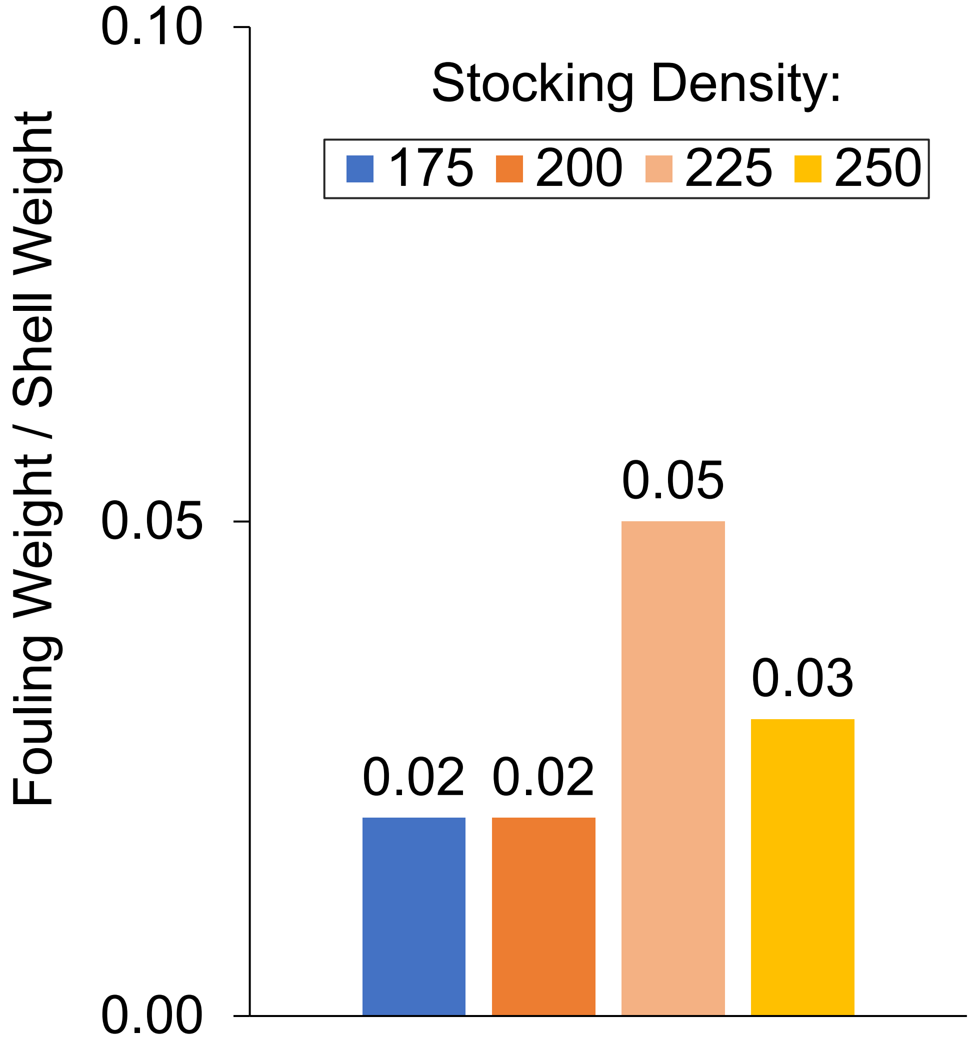
# Trial 2: Oyster Fan / Cup Ratios




# Trial 2: Weight Measurements

# Trial 2: Biofouling on Oysters

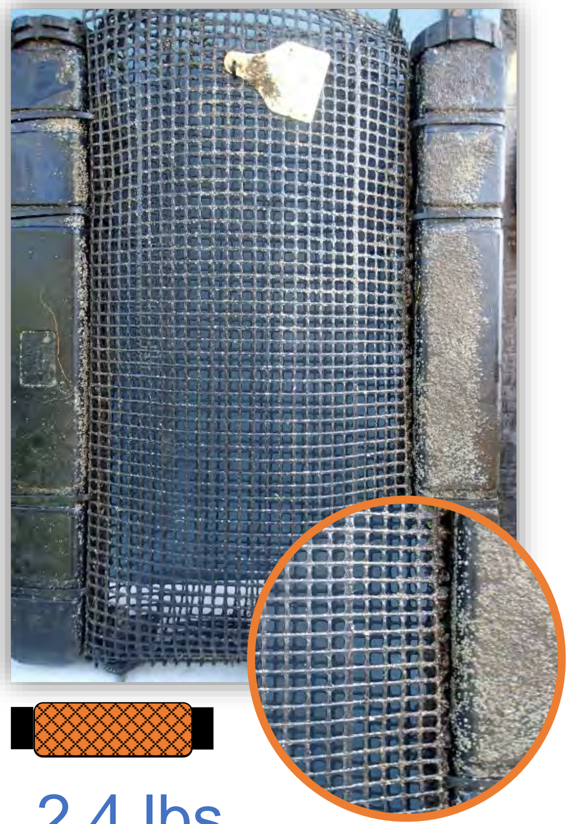



# Trial 2: Biofouling on Bags

Stocking Density:

175 | 200 | 225 | 250

2.1 lbs



2.4 lbs

2.4 lbs

2.2 lbs

# Summary: Production

- No differences in growth and survival of diploid and triploid oysters cultured at densities of 125, 150 and 175/bag
- Higher shell height and meat weight of triploid oysters cultured at densities of 225 and 250/bag
- Growth (4.5 mm/month) of triploid oysters was similar for both trials
- Survival (89-91%) of triploid oysters was higher in Trial 1 compared to Trial 2 (81-84%)

# Summary: Biofouling

- Biofouling on oysters and gear was low and similar across stocking densities
- Bags with floats attached to sides do not need to be flipped back reducing labor and costs by 50%
- Biofouling management effective over a “Winter” growout period in Florida

# Summary

- Results suggest growers may stock as high as 250 oysters per final growout bag
- **BUT** increased bag weight
  - o Places added tension to lines
  - o Possibly reduces effectiveness of aerial drying
  - o Can be problematic during inclement weather conditions and storms