February 19, 2019

Here are a few graphs and tables to update the last bit of sampling (samples collected through February 19, 2019).

Take home: Y\_SM variance has continued to stay below mean. Even though there have not been a lot of samples on Y\_SM, this has been a consistent result. N\_SM has had an increase in the variance with the sampling this week. N\_SM is a good site for additional sampling as it must be highly variable (see last plot, box plots on side). At N\_SM with additional sampling the variance may only increase making power lower. This was hinted at last week. Y\_NA and N\_NA are too similar in mean and too high in variance to detect difference with much power no matter how much sampling occurs based on what I’ve seen so far.

These tables and estimates are different than the ones from last week because of additional sampling + a correction in one of the names on a sampling location. Differences are mostly from additional sampling.

To review the naming, we are sampling with strata defined by whether the area is open or closed to fishing (Y/N) or the status of rocks (Large[LG], Small [SM], or wild without rocks [NA].

Possible strata

Strata Description

N\_LG No harvest, large rock

N\_NA No harvest, no rock (wild bar)

N\_SM No harvest, small rock

Y\_NA Yes harvest, no rock

Y\_SM Yes harvest, small rock (has not been sampled)

Y\_LG Yes harvest, large rock (not a possibility as large rocks only used in closed harvest areas)

This is what these data from winter 2018-2019 look like (data1 from data processing script). These are the “collapsed” transects such that multiple transects on an individual boar are pooled.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| day | month | year | season | treatment | locality | site | bar | station | count\_live | tran\_length | area | density | strata |
| 8 | 12 | 2018 | Winter | control | BT | I | 1 | BTI1 | 897 | 23.0 | 3.5 | 255.9 | N\_NA |
| 7 | 12 | 2018 | Winter | control | BT | I | 2 | BTI2 | 1108 | 38.7 | 5.9 | 188.1 | N\_NA |
| 7 | 12 | 2018 | Winter | control | BT | I | 3 | BTI3 | 1326 | 39.9 | 6.1 | 218.1 | N\_NA |
| 8 | 12 | 2018 | Winter | control | BT | I | 4 | BTI4 | 627.5 | 55.8 | 8.5 | 73.8 | N\_NA |
| 22 | 12 | 2018 | Winter | control | BT | I | 5 | BTI5 | 3988 | 62.7 | 9.6 | 417.4 | N\_NA |
| 5 | 1 | 2019 | Winter | control | BT | I | 6 | BTI6 | 815.5 | 17.8 | 2.7 | 301.5 | N\_NA |
| 6 | 2 | 2019 | Winter | control | LC | I | 1 | LCI1 | 1650 | 45.4 | 6.9 | 238.5 | N\_NA |
| 7 | 2 | 2019 | Winter | control | LC | I | 2 | LCI2 | 1534 | 32.2 | 4.9 | 312.6 | Y\_NA |
| 7 | 2 | 2019 | Winter | control | LC | I | 3 | LCI3 | 1104 | 23.8 | 3.6 | 304.4 | Y\_NA |
| 23 | 1 | 2019 | Winter | control | LC | I | 4 | LCI4 | 1909 | 22.5 | 3.4 | 556.7 | Y\_NA |
| 7 | 2 | 2019 | Winter | control | LC | I | 5 | LCI5 | 942 | 20.4 | 3.1 | 303.0 | Y\_NA |
| 13 | 1 | 2019 | Winter | control | LC | I | 6 | LCI6 | 454 | 21.5 | 3.3 | 138.6 | Y\_NA |
| 7 | 2 | 2019 | Winter | control | LC | I | 7 | LCI7 | 853 | 21.7 | 3.3 | 258.4 | N\_NA |
| 13 | 1 | 2019 | Winter | control | LC | I | 8 | LCI8 | 96 | 19.0 | 2.9 | 33.2 | Y\_NA |
| 7 | 2 | 2019 | Winter | control | LC | I | 9 | LCI9 | 695 | 22.2 | 3.4 | 205.1 | Y\_NA |
| 6 | 2 | 2019 | Winter | control | LC | I | 10 | LCI10 | 1686 | 38.2 | 5.8 | 289.6 | Y\_NA |
| 6 | 2 | 2019 | Winter | control | LC | I | 11 | LCI11 | 302 | 17.9 | 2.7 | 111.0 | Y\_NA |
| 5 | 2 | 2019 | Winter | control | LC | I | 12 | LCI12 | 1106 | 36.1 | 5.5 | 201.1 | Y\_NA |
| 22 | 1 | 2019 | Winter | control | LC | I | 13 | LCI13 | 3421.5 | 71.3 | 10.9 | 314.9 | Y\_NA |
| 23 | 1 | 2019 | Winter | control | LC | I | 14 | LCI14 | 1501 | 22.8 | 3.5 | 432.9 | Y\_NA |
| 23 | 1 | 2019 | Winter | control | LC | I | 15 | LCI15 | 638 | 20.8 | 3.2 | 201.3 | Y\_NA |
| 4 | 2 | 2019 | Winter | control | LC | I | 16 | LCI16 | 427.5 | 24.0 | 3.7 | 116.7 | Y\_NA |
| 4 | 2 | 2019 | Winter | control | LC | I | 17 | LCI17 | 189 | 14.7 | 2.2 | 84.7 | Y\_NA |
| 5 | 2 | 2019 | Winter | control | LC | I | 18 | LCI18 | 1813 | 68.2 | 10.4 | 174.5 | Y\_NA |
| 5 | 2 | 2019 | Winter | control | LC | I | 19 | LCI19 | 153 | 22.2 | 3.4 | 45.2 | Y\_NA |
| 7 | 2 | 2019 | Winter | control | LC | N | 1 | LCN1 | 109 | 29.9 | 4.6 | 24.0 | Y\_NA |
| 7 | 2 | 2019 | Winter | control | LC | N | 2 | LCN2 | 693 | 32.8 | 5.0 | 138.8 | Y\_NA |
| 7 | 2 | 2019 | Winter | control | LC | N | 3 | LCN3 | 146 | 19.9 | 3.0 | 48.1 | Y\_NA |
| 29 | 12 | 2018 | Winter | control | LC | N | 4 | LCN4 | 35 | 22.0 | 3.4 | 10.4 | Y\_NA |
| 13 | 1 | 2019 | Winter | control | LC | N | 5 | LCN5 | 700 | 21.8 | 3.3 | 211.2 | Y\_NA |
| 23 | 1 | 2019 | Winter | control | LC | N | 6 | LCN6 | 2275 | 32.4 | 4.9 | 460.7 | Y\_NA |
| 7 | 2 | 2019 | Winter | control | LC | N | 7 | LCN7 | 611 | 13.3 | 2.0 | 301.4 | Y\_NA |
| 29 | 12 | 2018 | Winter | control | LC | N | 8 | LCN8 | 58 | 17.5 | 2.7 | 21.7 | Y\_NA |
| 4 | 2 | 2019 | Winter | control | LC | N | 9 | LCN9 | 4 | 36.1 | 5.5 | 0.7 | Y\_NA |
| 27 | 11 | 2018 | Winter | rocks | LC | O | 12 | LCO12 | 358.5 | 111.9 | 17.0 | 21.0 | N\_LG |
| 23 | 12 | 2018 | Winter | control | LC | O | 14 | LCO14 | 4612 | 70.1 | 10.7 | 431.6 | N\_SM |
| 7 | 1 | 2019 | Winter | rocks | LC | O | 15 | LCO15 | 1506 | 43.2 | 6.6 | 228.5 | N\_SM |
| 21 | 1 | 2019 | Winter | rocks | LC | O | 20 | LCO20 | 385 | 87.1 | 13.3 | 29.0 | Y\_SM |
| 22 | 1 | 2019 | Winter | rocks | LC | O | 21 | LCO21 | 714 | 129.0 | 19.7 | 36.3 | Y\_SM |
| 8 | 11 | 2018 | Winter | rocks | LC | O | 10A | LCO10A | 1098 | 67.2 | 10.2 | 107.2 | N\_LG |
| 9 | 11 | 2018 | Winter | rocks | LC | O | 10A | LCO10A | 521 | 46.2 | 7.0 | 74.0 | N\_LG |
| 9 | 11 | 2018 | Winter | rocks | LC | O | 11B | LCO11B | 276 | 66.8 | 10.2 | 27.1 | N\_LG |
| 6 | 1 | 2019 | Winter | rocks | LC | O | 9B | LCO9B | 674.5 | 115.8 | 17.6 | 38.2 | N\_LG |
| 7 | 11 | 2018 | Winter | rocks | LC | O | 9C | LCO9C | 905 | 66.6 | 10.1 | 89.2 | N\_LG |
| 8 | 11 | 2018 | Winter | rocks | LC | O | 9C | LCO9C | 256 | 44.7 | 6.8 | 37.6 | N\_LG |
| 30 | 1 | 2018 | Winter | control | LT | I | 1 | LTI1 | 445 | 27.5 | 4.2 | 106.2 | N\_NA |
| 22 | 12 | 2018 | Winter | control | LT | I | 1 | LTI1 | 692 | 29.8 | 4.5 | 152.4 | N\_NA |
| 23 | 12 | 2018 | Winter | control | LT | I | 2 | LTI2 | 190 | 22.7 | 3.5 | 55.0 | N\_NA |
| 23 | 12 | 2018 | Winter | control | LT | I | 3 | LTI3 | 883 | 37.5 | 5.7 | 154.5 | N\_NA |
| 22 | 12 | 2018 | Winter | control | LT | I | 4 | LTI4 | 1323 | 34.8 | 5.3 | 249.2 | N\_NA |
| 22 | 12 | 2018 | Winter | control | LT | I | 5 | LTI5 | 1412 | 38.8 | 5.9 | 239.1 | N\_NA |
| 22 | 12 | 2018 | Winter | control | LT | I | 6 | LTI6 | 594 | 18.9 | 2.9 | 206.6 | N\_NA |
| 5 | 1 | 2019 | Winter | control | NN | I | 1 | NNI1 | 233.5 | 14.5 | 2.2 | 105.7 | N\_NA |
| 23 | 12 | 2018 | Winter | control | NN | I | 2 | NNI2 | 911 | 22.9 | 3.5 | 261.6 | N\_NA |
| 23 | 12 | 2018 | Winter | control | NN | I | 3 | NNI3 | 156 | 33.0 | 5.0 | 31.0 | N\_NA |
| 23 | 12 | 2018 | Winter | control | NN | I | 4 | NNI4 | 571 | 13.3 | 2.0 | 281.7 | N\_NA |

Simple table defining strata and information on total transect length sampled, number of collapsed transects, mean length of collapsed transect. A collapsed transect occurs when multiple transects are measured on one reef in a given sampling trip. Those transects are then summed by length and counts and considered one transect.

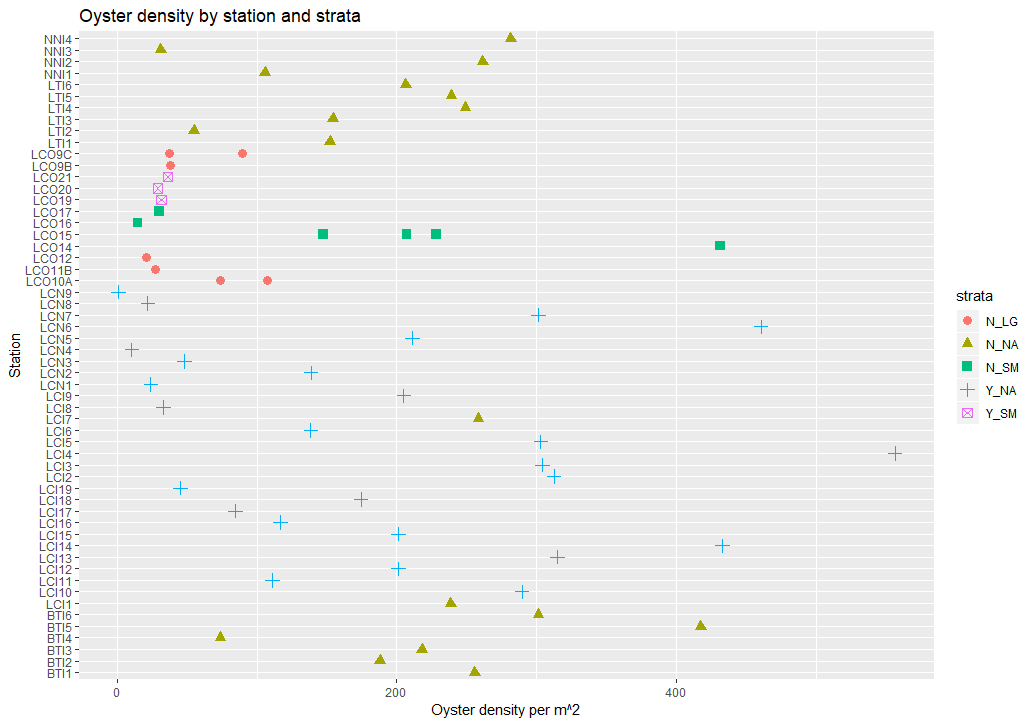
|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Fishing (Y/N) | Rock (LG/SM/NA) | Strata | Total tran sampled (m) | N collapsed transects completed | Mean collapsed transect length m |
| N | LG | N\_LG | 519.01 | 7 | 74.14 |
| N | NA | N\_NA | 570.93 | 18 | 31.72 |
| N | SM | N\_SM | 215.19 | 6 | 35.87 |
| Y | NA | Y\_NA | 723.3 | 26 | 27.82 |
| Y | SM | Y\_SM | 332.44 | 3 | 110.81 |

Estimated number of collapsed transects required for given power

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | N\_LG | N\_NA | N\_SM | Y\_NA |
| N\_LG |  |  |  |  |
| N\_NA | 7 |  |  |  |
| N\_SM | 25 | 460 |  |  |
| Y\_NA | 19 | 2939 | 1184 |  |
| Y\_SM | 2 | 2 | 2 | 2 |

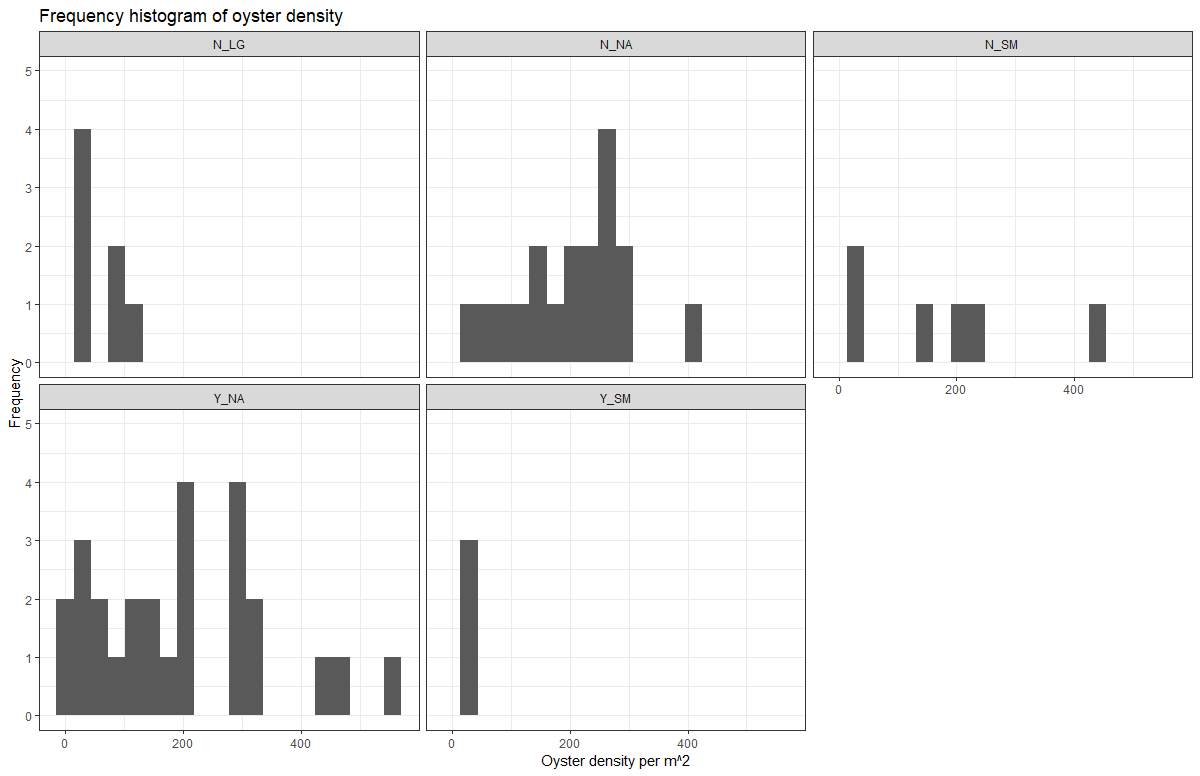
The best way to interpret this is that it is really hard to detect a difference between Y\_NA and N\_NA. This is because the variance is so high (see below). For Y\_SM don’t be misled, there have been few samples (2 collapsed) and the variance is less than the mean. Maybe that will hold and that makes it easier to detect differences. Maybe it won’t hold. Y\_SM needs more sampling.

A graph of density by station color/shape coded by strata.



This is important because it shows the “spread” within each strata (shape and color). So for Y\_NA the density estimates are highly variable, that’s why there is a huge spread. Compare that to Y\_SM (but note only 2 samples taken). N\_NA seems to perhaps be falling out a little bit between BTI complex and NN/LT complex. You can sort of see this bifurcation in the histogram in the next plot. This is where the spatial autocorrelation in the samples will be important to incorporate.

Below is just a histogram of density by collapsed transect



Simple summary stats of oyster density (per m^2) overall (all strata combined)

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NobsTotal | Mean | Median | Sd | Var | CV | Se | L95se | U95se | Bstrapmean | L95bstrap | U95bstrap |
| 60 | 171.36 | 153.44 | 132.2 | 17475.55 | 0.77 | 17.07 | 137.91 | 204.81 | 170.99 | 138.81 | 203.03 |

Simple summary stats by strata of oyster density (per m^2). Note I calculate t-test based confidence intervals and bootstrap based intervals.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| .id | NobsTotal | Mean | Median | Sd | Var | CV | Se | L95se | U95se | Bstrapmean | L95bstrap | U95bstrap |
| N\_LG | 7 | 56.35 | 38.23 | 33.57 | 1126.76 | 0.6 | 12.69 | 31.48 | 81.22 | 56.03 | 33.33 | 77.65 |
| N\_NA | 18 | 204.91 | 228.3 | 96.66 | 9343.38 | 0.47 | 22.78 | 160.25 | 249.56 | 204.85 | 161.19 | 250.97 |
| N\_SM | 6 | 176.65 | 177.32 | 153.04 | 23420.75 | 0.87 | 62.48 | 54.2 | 299.11 | 177.83 | 74.14 | 293.56 |
| Y\_NA | 26 | 193.94 | 187.81 | 150.2 | 22560.13 | 0.77 | 29.46 | 136.2 | 251.67 | 194.08 | 142.32 | 250.98 |
| Y\_SM | 3 | 32.25 | 31.45 | 3.72 | 13.87 | 0.12 | 2.15 | 28.04 | 36.47 | 32.28 | 29 | 36.32 |

Here is another box plot (using ggplot style for fun). I turned this box plot “on its side” so density is on the “x” and the graph orients such that zero is bottom left. Other box plot aspects are the same

