To: Peter, Steve, Leslie

From: Bill Pine

Re: Updated sampling effort from power analyses

January 17, 2019

I have been working to summarize and update the power analyses to inform field sampling. We are about 50% of the way through the low tide period for the winter. This builds on the early summary and sampling plan document I developed in the fall. At that time we agreed to adaptively sample this winter by allocating sampling effort into each strata during the first part of the winter, conduct a basic analyses of those data at about the mid-point of the winter sampling season, and then update sampling effort going forward. This is the first effort at that update and I plan on updating this again after data are available for all strata. I think a good time to update this would be after the low tides (and any sampling) that occur after February 7, 2019 as there are about 20 good predicted days of tide after that until the end of March.

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)

The Y\_SM area is scheduled to be sampled the week of January 20.

There is one small error in the data entry that I identified last night related to the maximum length of the individual transects recorded. This affects 5 transects introducing an error of <0.25m in the length of each transect. I will correct that error today. These summaries are calculated with that error, but for discussion of current field effort that error can be ignored.

Disclaimer: I am not a statistician and am mostly self-taught in this area of sampling design work. These are all approximate power analyses used to inform the possible number of samples to take. I am using 95% CI and a power of 80% in all comparisons.

Here are some summaries as of all data collected as of January 16, 2019

Table 1. This is a table that shows the length of every individual transect collected by station and date. So when the field crews go to an assigned, previously selected, bar and navigate to a start and end point, this is the length of that individual transect in meters.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| day | month | year | Season | treatment | locality | site | bar | station | transect | tran\_length |
| 8 | 11 | 2018 | Winter | rocks | LC | O | 10A | LCO10A | 6 | 22.2 |
| 8 | 11 | 2018 | Winter | rocks | LC | O | 10A | LCO10A | 7 | 22.5 |
| 8 | 11 | 2018 | Winter | rocks | LC | O | 10A | LCO10A | 8 | 22.5 |
| 9 | 11 | 2018 | Winter | rocks | LC | O | 10A | LCO10A | 9 | 23.1 |
| 9 | 11 | 2018 | Winter | rocks | LC | O | 10A | LCO10A | 10 | 23.1 |
| 9 | 11 | 2018 | Winter | rocks | LC | O | 11B | LCO11B | 11 | 22.14 |
| 9 | 11 | 2018 | Winter | rocks | LC | O | 11B | LCO11B | 12 | 22.3 |
| 9 | 11 | 2018 | Winter | rocks | LC | O | 11B | LCO11B | 13 | 22.33 |
| 27 | 11 | 2018 | Winter | rocks | LC | O | 12 | LCO12 | 14 | 22 |
| 27 | 11 | 2018 | Winter | rocks | LC | O | 12 | LCO12 | 15 | 22.4 |
| 27 | 11 | 2018 | Winter | rocks | LC | O | 12 | LCO12 | 16 | 22.5 |
| 27 | 11 | 2018 | Winter | rocks | LC | O | 12 | LCO12 | 17 | 22.96 |
| 27 | 11 | 2018 | Winter | rocks | LC | O | 12 | LCO12 | 18 | 22 |
| 7 | 11 | 2018 | Winter | rocks | LC | O | 9C | LCO9C | 1 | 22.3 |
| 7 | 11 | 2018 | Winter | rocks | LC | O | 9C | LCO9C | 2 | 22.3 |
| 7 | 11 | 2018 | Winter | rocks | LC | O | 9C | LCO9C | 3 | 21.95 |
| 8 | 11 | 2018 | Winter | rocks | LC | O | 9C | LCO9C | 4 | 22.25 |
| 8 | 11 | 2018 | Winter | rocks | LC | O | 9C | LCO9C | 5 | 22.4 |
| 8 | 12 | 2018 | Winter | control | BT | I | 1 | BTI1 | 1 | 23 |
| 7 | 12 | 2018 | Winter | control | BT | I | 2 | BTI2 | 1 | 20.9 |
| 7 | 12 | 2018 | Winter | control | BT | I | 2 | BTI2 | 2 | 17.75 |
| 7 | 12 | 2018 | Winter | control | BT | I | 3 | BTI3 | 1 | 20.2 |
| 7 | 12 | 2018 | Winter | control | BT | I | 3 | BTI3 | 2 | 19.7 |
| 8 | 12 | 2018 | Winter | control | BT | I | 4 | BTI4 | 1 | 25.8 |
| 8 | 12 | 2018 | Winter | control | BT | I | 4 | BTI4 | 2 | 30 |
| 22 | 12 | 2018 | Winter | control | BT | I | 5 | BTI5 | 1 | 21.75 |
| 22 | 12 | 2018 | Winter | control | BT | I | 5 | BTI5 | 2 | 40.94 |
| 29 | 12 | 2018 | Winter | control | LC | N | 4 | LCN4 | 1 | 22.5 |
| 29 | 12 | 2018 | Winter | control | LC | N | 8 | LCN8 | 1 | 17.5 |
| 23 | 12 | 2018 | Winter | control | LC | O | 14 | LCO14 | 1 | 23.3 |
| 23 | 12 | 2018 | Winter | control | LC | O | 14 | LCO14 | 2 | 23.46 |
| 23 | 12 | 2018 | Winter | control | LC | O | 14 | LCO14 | 3 | 23.35 |
| 22 | 12 | 2018 | Winter | control | LT | I | 1 | LTI1 | 1 | 29.8 |
| 23 | 12 | 2018 | Winter | control | LT | I | 2 | LTI2 | 1 | 22.68 |
| 23 | 12 | 2018 | Winter | control | LT | I | 3 | LTI3 | 1 | 37.5 |
| 22 | 12 | 2018 | Winter | control | LT | I | 4 | LTI4 | 1 | 34.84 |
| 22 | 12 | 2018 | Winter | control | LT | I | 5 | LTI5 | 1 | 20 |
| 22 | 12 | 2018 | Winter | control | LT | I | 5 | LTI5 | 2 | 18.75 |
| 22 | 12 | 2018 | Winter | control | LT | I | 6 | LTI6 | 1 | 18.87 |
| 23 | 12 | 2018 | Winter | control | NN | I | 2 | NNI2 | 1 | 22.85 |
| 23 | 12 | 2018 | Winter | control | NN | I | 3 | NNI3 | 1 | 17.5 |
| 23 | 12 | 2018 | Winter | control | NN | I | 3 | NNI3 | 2 | 15.5 |
| 23 | 12 | 2018 | Winter | control | NN | I | 4 | NNI4 | 1 | 13.3 |
| 5 | 1 | 2019 | Winter | control | BT | I | 6 | BTI6 | 1 | 17.75 |
| 13 | 1 | 2019 | Winter | control | LC | I | 6 | LCI6 | 1 | 22.5 |
| 13 | 1 | 2019 | Winter | control | LC | I | 8 | LCI8 | 1 | 17.5 |
| 13 | 1 | 2019 | Winter | control | LC | N | 5 | LCN5 | 1 | 20 |
| 7 | 1 | 2019 | Winter | rocks | LC | O | 15 | LCO15 | 1 | 22.1 |
| 7 | 1 | 2019 | Winter | rocks | LC | O | 15 | LCO15 | 2 | 21.14 |
| 6 | 1 | 2019 | Winter | rocks | LC | O | 9B | LCO9B | 1 | 22.5 |
| 6 | 1 | 2019 | Winter | rocks | LC | O | 9B | LCO9B | 2 | 23.18 |
| 6 | 1 | 2019 | Winter | rocks | LC | O | 9B | LCO9B | 3 | 23.8 |
| 6 | 1 | 2019 | Winter | rocks | LC | O | 9B | LCO9B | 4 | 24 |
| 6 | 1 | 2019 | Winter | rocks | LC | O | 9B | LCO9B | 5 | 22.3 |
| 5 | 1 | 2019 | Winter | control | NN | I | 1 | NNI1 | 1 | 14.5 |

Table 2. This is a table of the total transect length collected in each strata, the number of collapsed transects, and the mean length of a collapsed transect. So a collapsed transect comes from summing the number of individual transects that were taken at an individual station. So if 3 transects were taken at LCO9B then this sums those up for that station. As an example, there are 7 collapsed transects as an in the strata N\_LG.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Fishing (Y/N) | Rock (LG/SM/NA) | Strata | Total tran length sampled (m) | N collapsed transects completed | Mean collapsed transect length |
| N | LG | N\_LG | 519.01 | 7 | 74.14 |
| N | NA | N\_NA | 503.88 | 16 | 31.49 |
| N | SM | N\_SM | 113.35 | 2 | 56.67 |
| Y | NA | Y\_NA | 100 | 5 | 20 |

Table 3. Estimated mean and variance of oyster density /m2 for each strata.

|  |  |  |
| --- | --- | --- |
|  | mean | variance |
| N\_LG | 56 | 1103 |
| N\_NA | 197 | 10079 |
| N\_SM | 327 | 20200 |
| Y\_NA | 85 | 8609 |

In the sampling document I developed this fall I detailed how I used data from epochs 1-2 to develop a power analyses to inform sampling for epoch 3. Refer to that document for details. I’ve updated that analyses to use data from fall/winter 2018/2019 only based on the sampling that has been ongoing. Basically I used the mean and variance in Table 3 to calculate the number of collapsed transects needed to determine a difference in mean density for a given comparison. We may only be interested in a subset of these comparisons and not all comparisons, but I did this for all strata combinations for now.

Table 4. Estimated number of collapsed transects required for a given power.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | N\_LG | N\_NA | N\_SM | Y\_NA |
| N\_LG |  |  |  |  |
| N\_NA | 8 |  |  |  |
| N\_SM | 4 | 19 |  |  |
| Y\_NA | 157 | 11 | 2 |  |

Table 5. Estimated total length of transect in meters required for given power. I used the larger value for the mean length between the two strata being compared. So if the comparison is between N\_NA and N\_LG the average length for N\_NA is 31.49 m and for N\_LG it is 74.14, so I used 74.14 (from Table 2) x 8 (from Table 4)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | N\_LG | N\_NA | N\_SM | Y\_NA |
| N\_LG |  |  |  |  |
| N\_NA | 593 |  |  |  |
| N\_SM | 227 | 1077 |  |  |
| Y\_NA | 11640 | 346 | 113 |  |

Table 6. I summed the total length of transect already completed for each combination. So if we were comparing N\_NA to N\_LG I just summed 519.01+503.88 (values from Table 2).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | N\_LG | N\_NA | N\_SM | Y\_NA |
| N\_LG |  |  |  |  |
| N\_NA | 1023 |  |  |  |
| N\_SM | 632 | 617 |  |  |
| Y\_NA | 619 | 604 | 213 |  |

Table 7. I calculated the difference between Table 5 (theoretical distance to sample) and Table 6 (distance sampled already). This table then is the estimated additional meters of transect required for each comparison.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | N\_LG | N\_NA | N\_SM | Y\_NA |
| N\_LG |  |  |  |  |
| N\_NA | 430 |  |  |  |
| N\_SM | 406 | 460 |  |  |
| Y\_NA | 11021 | 257 | 100 |  |

Table 7 is useful because you can take a comparison such as N\_NA to N\_LG that suggests we need 430 additional meters of sampling. If the average “collapsed” transect is 31.49 m for N\_NA (from Table 2) and 74.1 for N\_LG then you can figure out by dividing 430 by 31.49 that would be about 14 more collapsed transects just from N\_LG. You could then use Table 1 to see the range of sizes for individual transects within a station and start to think about how the number of individual transects could be calculated to total the estimated length estimated that needs to be completed. In this simple example, I would actually allocate the 430m required between the two strata. Some of this may change as more data come in from each strata.

Going forward:

Need to sample Y\_SM strata.

Think about what comparisons are of interest.

N\_LG and N\_NA have about 5x more area sampled. We planned on allocating sampling effort proportional to the available area of the strata, so this should be double checked to see how we are doing.

Variance highest in N\_SM (no harvest, small rock). Strata N\_SM is also ranked 3 out of 4 in total area sampled.

Y\_NA is smallest area sampled but those samples are ongoing (Laura Adams). UF crew will also sample more in that area.