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 /m^2 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.