March 13, 2019

This is a summary document for LCR sampling through Februay 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 highest variance. 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. See Figures 1 and 3 for good examples of this.

Next steps will be re-do the GLM analyses using counts as the response and controlling for effort as an offset. This will be done across all epochs and then will develop a new analyses for a within epoch comparison for winter 2018-2019. Working to develop covariates for use in within epoch comparison including salinity and elevation. Thinking about how incorporating distance to each other measurements for each station.

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 bar are pooled, even if collected across multiple days.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| obs | season | treatment | locality | site | bar | station | count\_live | tran\_length | Area m^2 | Density m^2 | strata |
| 1 | Winter | control | BT | I | 1 | BTI1 | 897 | 23 | 3.5052 | 255.905511811024 | N\_NA |
| 2 | Winter | control | BT | I | 2 | BTI2 | 1108 | 38.65 | 5.89026 | 188.107146373844 | N\_NA |
| 3 | Winter | control | BT | I | 3 | BTI3 | 1326 | 39.9 | 6.08076 | 218.064847157263 | N\_NA |
| 4 | Winter | control | BT | I | 4 | BTI4 | 627.5 | 55.8 | 8.50392 | 73.7894994308507 | N\_NA |
| 5 | Winter | control | BT | I | 5 | BTI5 | 3988 | 62.69 | 9.553956 | 417.418711160068 | N\_NA |
| 6 | Winter | control | BT | I | 6 | BTI6 | 815.5 | 17.75 | 2.7051 | 301.467598240361 | N\_NA |
| 7 | Winter | control | LC | I | 1 | LCI1 | 1650 | 45.39 | 6.917436 | 238.527685691635 | N\_NA |
| 8 | Winter | control | LC | I | 10 | LCI10 | 1686 | 38.2 | 5.82168 | 289.607123716865 | Y\_NA |
| 9 | Winter | control | LC | I | 11 | LCI11 | 302 | 17.86 | 2.721864 | 110.953376068753 | Y\_NA |
| 10 | Winter | control | LC | I | 12 | LCI12 | 1106 | 36.09 | 5.500116 | 201.086667990275 | Y\_NA |
| 11 | Winter | control | LC | I | 13 | LCI13 | 3421.5 | 71.3 | 10.86612 | 314.877803668651 | Y\_NA |
| 12 | Winter | control | LC | I | 14 | LCI14 | 1501 | 22.75 | 3.4671 | 432.926653399094 | Y\_NA |
| 13 | Winter | control | LC | I | 15 | LCI15 | 638 | 20.8 | 3.16992 | 201.266908944074 | Y\_NA |
| 14 | Winter | control | LC | I | 16 | LCI16 | 427.5 | 24.04 | 3.663696 | 116.685445517314 | Y\_NA |
| 15 | Winter | control | LC | I | 17 | LCI17 | 189 | 14.65 | 2.23266 | 84.6523877348096 | Y\_NA |
| 16 | Winter | control | LC | I | 18 | LCI18 | 1813 | 68.16 | 10.387584 | 174.535291363227 | Y\_NA |
| 17 | Winter | control | LC | I | 19 | LCI19 | 153 | 22.21 | 3.384804 | 45.2020264688886 | Y\_NA |
| 18 | Winter | control | LC | I | 2 | LCI2 | 1534 | 32.2 | 4.90728 | 312.596794965847 | Y\_NA |
| 19 | Winter | control | LC | I | 3 | LCI3 | 1104 | 23.8 | 3.62712 | 304.373717991133 | Y\_NA |
| 20 | Winter | control | LC | I | 4 | LCI4 | 1909 | 22.5 | 3.429 | 556.722076407116 | Y\_NA |
| 21 | Winter | control | LC | I | 5 | LCI5 | 942 | 20.4 | 3.10896 | 302.995213833565 | Y\_NA |
| 22 | Winter | control | LC | I | 6 | LCI6 | 454 | 21.5 | 3.2766 | 138.558261612647 | Y\_NA |
| 23 | Winter | control | LC | I | 7 | LCI7 | 853 | 21.66 | 3.300984 | 258.407795978411 | N\_NA |
| 24 | Winter | control | LC | I | 8 | LCI8 | 96 | 19 | 2.8956 | 33.1537505180274 | Y\_NA |
| 25 | Winter | control | LC | I | 9 | LCI9 | 695 | 22.24 | 3.389376 | 205.05249343832 | Y\_NA |
| 26 | Winter | control | LC | N | 1 | LCN1 | 109 | 29.86 | 4.550664 | 23.9525484632572 | Y\_NA |
| 27 | Winter | control | LC | N | 2 | LCN2 | 693 | 32.77 | 4.994148 | 138.762407521763 | Y\_NA |
| 28 | Winter | control | LC | N | 3 | LCN3 | 146 | 19.9 | 3.03276 | 48.1409673037101 | Y\_NA |
| 29 | Winter | control | LC | N | 4 | LCN4 | 35 | 22 | 3.3528 | 10.4390360295872 | Y\_NA |
| 30 | Winter | control | LC | N | 5 | LCN5 | 700 | 21.75 | 3.3147 | 211.18049898935 | Y\_NA |
| 31 | Winter | control | LC | N | 6 | LCN6 | 2275 | 32.4 | 4.93776 | 460.735232170053 | Y\_NA |
| 32 | Winter | control | LC | N | 7 | LCN7 | 611 | 13.3 | 2.02692 | 301.44258283504 | Y\_NA |
| 33 | Winter | control | LC | N | 8 | LCN8 | 58 | 17.5 | 2.667 | 21.7472815898013 | Y\_NA |
| 34 | Winter | control | LC | N | 9 | LCN9 | 4 | 36.12 | 5.504688 | 0.726653354377214 | Y\_NA |
| 35 | Winter | rocks | LC | O | 10A | LCO10A | 1619 | 113.4 | 17.28216 | 93.6804195771825 | N\_LG |
| 36 | Winter | rocks | LC | O | 11B | LCO11B | 276 | 66.77 | 10.175748 | 27.123313195256 | N\_LG |
| 37 | Winter | rocks | LC | O | 12 | LCO12 | 358.5 | 111.86 | 17.047464 | 21.0295208718435 | N\_LG |
| 38 | Winter | rocks | LC | O | 14 | LCO14 | 4612 | 70.11 | 10.684764 | 431.642664264742 | N\_SM |
| 39 | Winter | rocks | LC | O | 15 | LCO15 | 3390.5 | 169.84 | 25.883616 | 130.9901985874 | N\_SM |
| 40 | Winter | rocks | LC | O | 16 | LCO16 | 52 | 22.95 | 3.49758 | 14.8674226179244 | N\_SM |
| 41 | Winter | rocks | LC | O | 17 | LCO17 | 209 | 45.37 | 6.914388 | 30.2268255701011 | Y\_SM |
| 42 | Winter | rocks | LC | O | 19 | LCO19 | 557.5 | 116.31 | 17.725644 | 31.4516076256524 | Y\_SM |
| 43 | Winter | rocks | LC | O | 2 | LCO2 | 945 | 20.86 | 3.179064 | 297.257305924008 | N\_LG |
| 44 | Winter | rocks | LC | O | 20 | LCO20 | 385 | 87.12 | 13.277088 | 28.9973223044089 | Y\_SM |
| 45 | Winter | rocks | LC | O | 21 | LCO21 | 714 | 129.01 | 19.661124 | 36.3153195107258 | Y\_SM |
| 46 | Winter | rocks | LC | O | 3 | LCO3 | 358 | 18.02 | 2.746248 | 130.359676183651 | N\_LG |
| 47 | Winter | rocks | LC | O | 4 | LCO4 | 953 | 22.1 | 3.36804 | 282.953884158145 | N\_LG |
| 48 | Winter | rocks | LC | O | 8A | LCO8A | 319 | 15.2 | 2.31648 | 137.708937698577 | N\_LG |
| 49 | Winter | rocks | LC | O | 9B | LCO9B | 674.5 | 115.78 | 17.644872 | 38.226403682611 | N\_LG |
| 50 | Winter | rocks | LC | O | 9C | LCO9C | 1161 | 111.2 | 16.94688 | 68.5081855775222 | N\_LG |
| 51 | Winter | control | LT | I | 1 | LTI1 | 692 | 29.8 | 4.54152 | 152.371893110677 | N\_NA |
| 52 | Winter | control | LT | I | 2 | LTI2 | 190 | 22.68 | 3.456432 | 54.9699806042763 | N\_NA |
| 53 | Winter | control | LT | I | 3 | LTI3 | 883 | 37.5 | 5.715 | 154.505686789151 | N\_NA |
| 54 | Winter | control | LT | I | 4 | LTI4 | 1323 | 34.84 | 5.309616 | 249.170561486932 | N\_NA |
| 55 | Winter | control | LT | I | 5 | LTI5 | 1412 | 38.75 | 5.9055 | 239.099144864956 | N\_NA |
| 56 | Winter | control | LT | I | 6 | LTI6 | 594 | 18.87 | 2.875788 | 206.55208242054 | N\_NA |
| 57 | Winter | control | NN | I | 1 | NNI1 | 233.5 | 14.5 | 2.2098 | 105.665671101457 | N\_NA |
| 58 | Winter | control | NN | I | 2 | NNI2 | 911 | 22.85 | 3.48234 | 261.605701913081 | N\_NA |
| 59 | Winter | control | NN | I | 3 | NNI3 | 156 | 33 | 5.0292 | 31.0188499164877 | N\_NA |
| 60 | Winter | control | NN | I | 4 | NNI4 | 571 | 13.3 | 2.02692 | 281.708207526691 | N\_NA |
|  |  |  |  |  |  |  |  |  |  |  |  |

Table of total transect length sampled (m) by strata

|  |  |
| --- | --- |
| strata | total tran length sampled (m) |
| N\_LG | 595.19 |
| N\_NA | 570.93 |
| N\_SM | 262.9 |
| Y\_NA | 723.3 |
| Y\_SM | 377.81 |
|  |  |

Counts of individual transects to check to see if match white board (Steve’s counts). They seem to match.

|  |  |
| --- | --- |
| Strata | Frequency of transects |
| N\_LG | 27 |
| N\_NA | 25 |
| N\_SM | 12 |
| Y\_NA | 29 |
| Y\_SM | 17 |

Number of collapsed transects. This totals 60 which are the 60 rows in the data file on the previous page.

|  |  |
| --- | --- |
| strata | number\_collapsed\_trans |
| N\_LG | 9 |
| N\_NA | 18 |
| N\_SM | 3 |
| Y\_NA | 26 |
| Y\_SM | 4 |

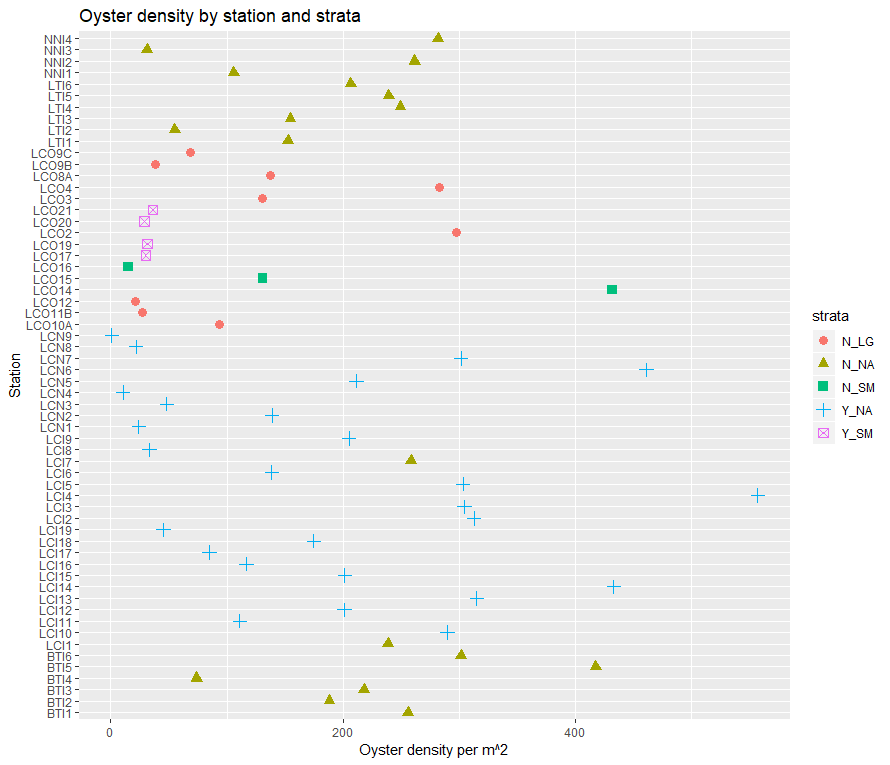
Mean length (m) of collapsed transects. I probably should be reporting the area and not the length, but as the width is fixed it is just a relative scaler.

|  |  |
| --- | --- |
| strata | mean\_tran\_length |
| N\_LG | 66.13 |
| N\_NA | 31.72 |
| N\_SM | 87.63 |
| Y\_NA | 27.82 |
| Y\_SM | 94.45 |

Variance in length of collapsed transects

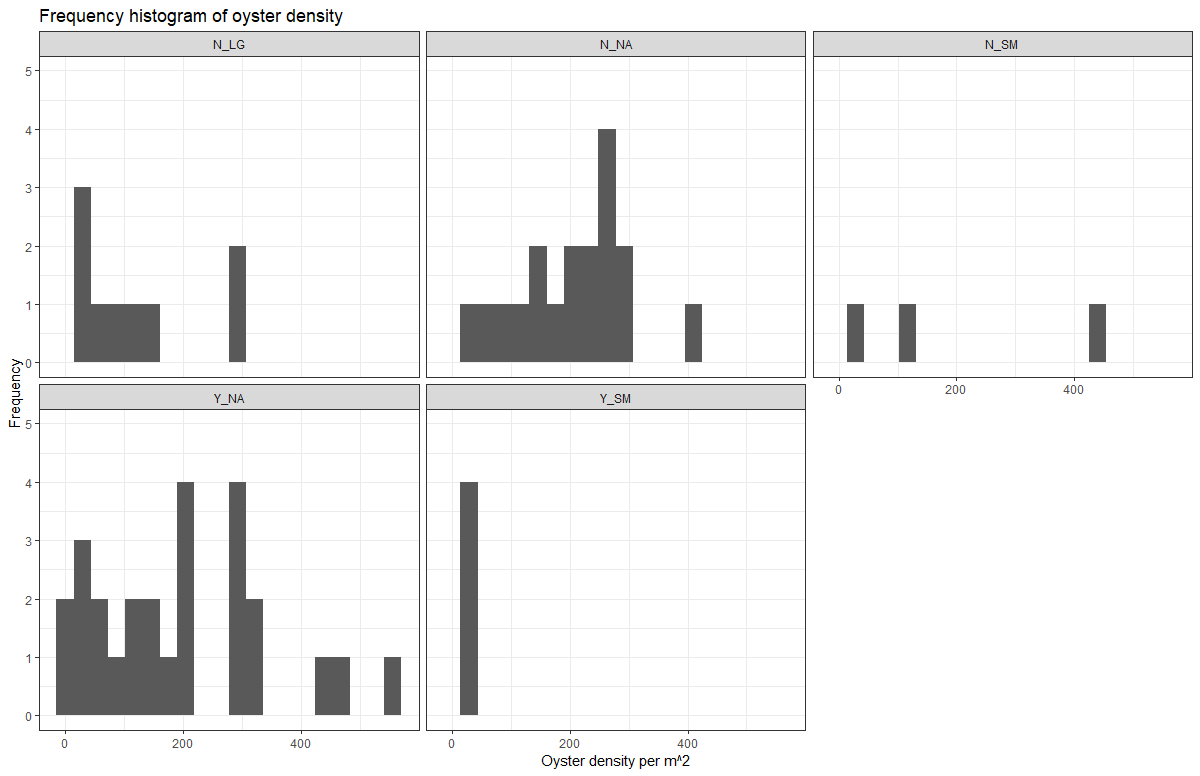
|  |  |
| --- | --- |
| strata | var\_tran\_length |
| N\_LG | 2214.87 |
| N\_NA | 192.5 |
| N\_SM | 5624.47 |
| Y\_NA | 196.97 |
| Y\_SM | 1378.28 |

Figure 1. A graph of oyster density (m^2) by station color and 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 (only 4 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.

Figure 2. Histogram of oyster density (m^2) in each collapsed transect by strata.



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 | 175.53 | 153.44 | 132.51 | 17559.81 | 0.75 | 17.11 | 142 | 209.07 | 175.48 | 142.77 | 208.02 |

Simple summary stats by strata of oyster density (per m^2). Note I calculate t-test based confidence intervals and bootstrap based intervals. Note the negative value for the lower 95 confidence intervals for N\_SM. That’s because it is not normally distributed – that’s why I calculate bootstrap CI.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| .id | NobsTotal | Mean | Median | Sd | Var | CV | Se | L95se | U95se | Bstrapmean | L95bstrap | U95bstrap |
| N\_LG | 9 | 121.87 | 93.68 | 104.17 | 10851.97 | 0.85 | 34.72 | 53.81 | 189.93 | 120.04 | 61.28 | 186.87 |
| N\_NA | 18 | 204.91 | 228.3 | 96.66 | 9343.38 | 0.47 | 22.78 | 160.25 | 249.56 | 204.53 | 157.53 | 247.64 |
| N\_SM | 3 | 192.5 | 130.99 | 215.09 | 46263 | 1.12 | 124.18 | -50.9 | 435.9 | 198.86 | 14.87 | 431.64 |
| Y\_NA | 26 | 193.94 | 187.81 | 150.2 | 22560.13 | 0.77 | 29.46 | 136.2 | 251.67 | 193.14 | 137.96 | 253.92 |
| Y\_SM | 4 | 31.75 | 30.84 | 3.21 | 10.28 | 0.1 | 1.6 | 28.61 | 34.89 | 31.62 | 29.6 | 34.79 |

Figure 3. Box plot of oyster density (m^2) by strata (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. Look at the strange shape of these box plots. Remember how to interpret a box plot, these are not confidence intervals. The top/bottom of the box tells you that 25% of the data are greater than this value. So the top of the box is the upper quartile and the bottom of the box is the lower quartile. The median line inside the box tells you that 50% of the data are greater than this value. The top/bottom of the whisker are the greatest value excluding outliers. Outliers are defined as dots above the whisker and those are 1.5 times the upper quartile.

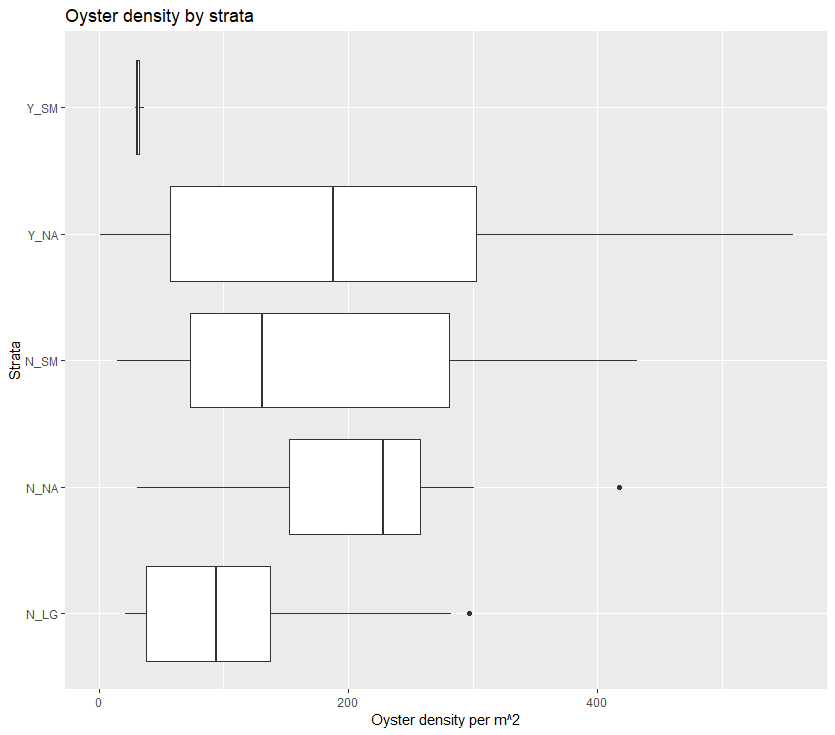


Figure 4. Boxplot of density overall.

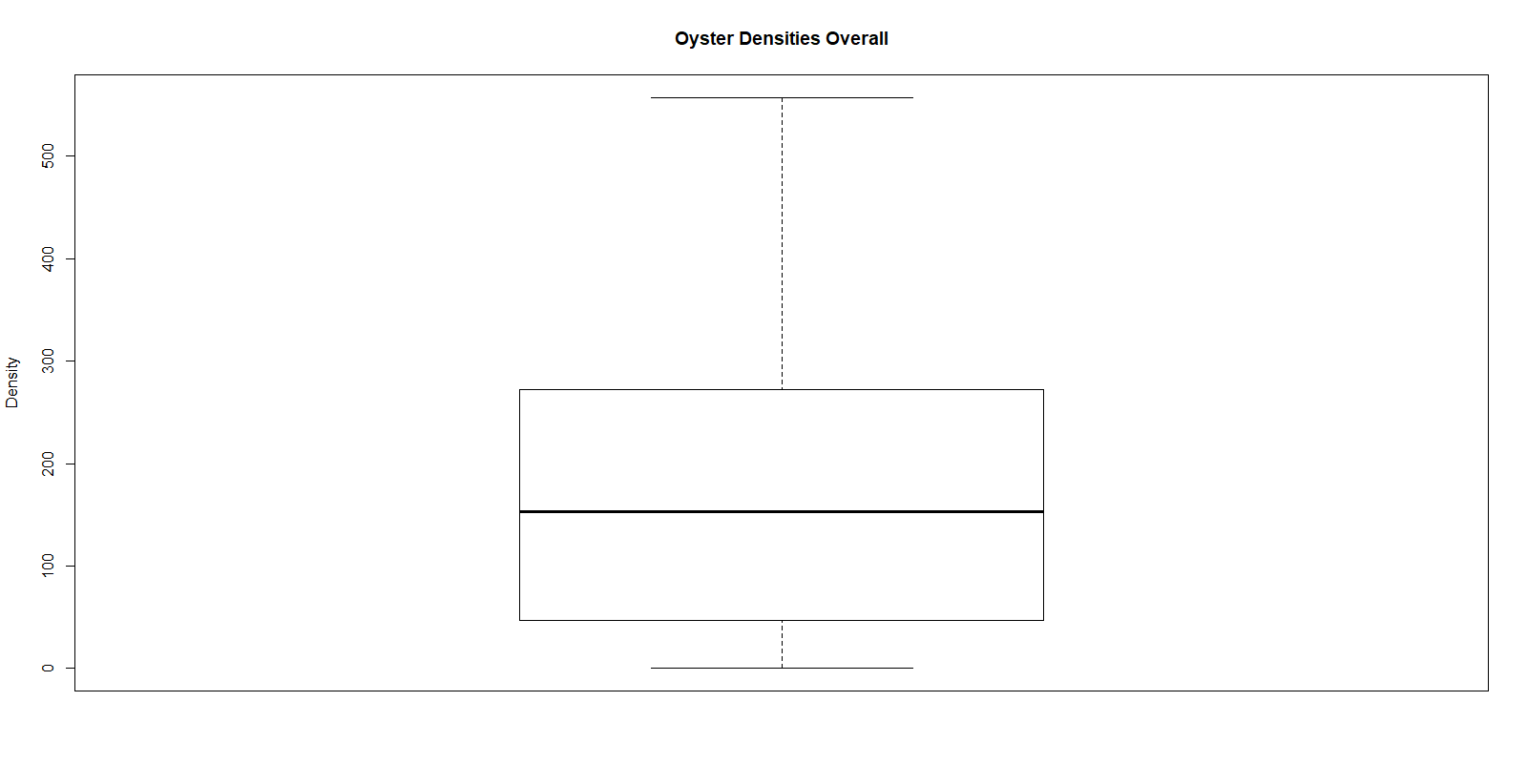


Figure 5. Boxplot of oyster density by locality.

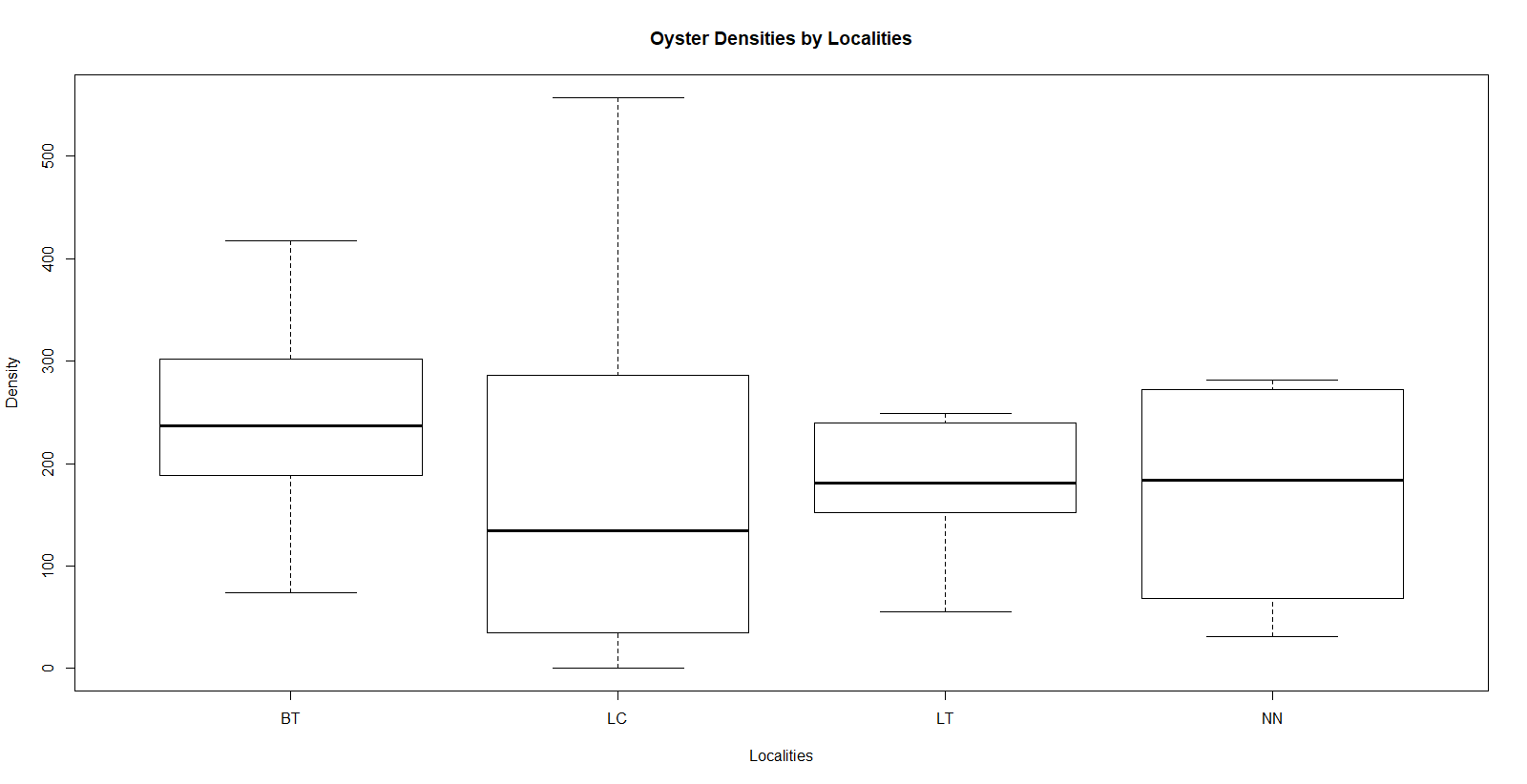


Figure 6. Boxplot of oyster density by treatment.

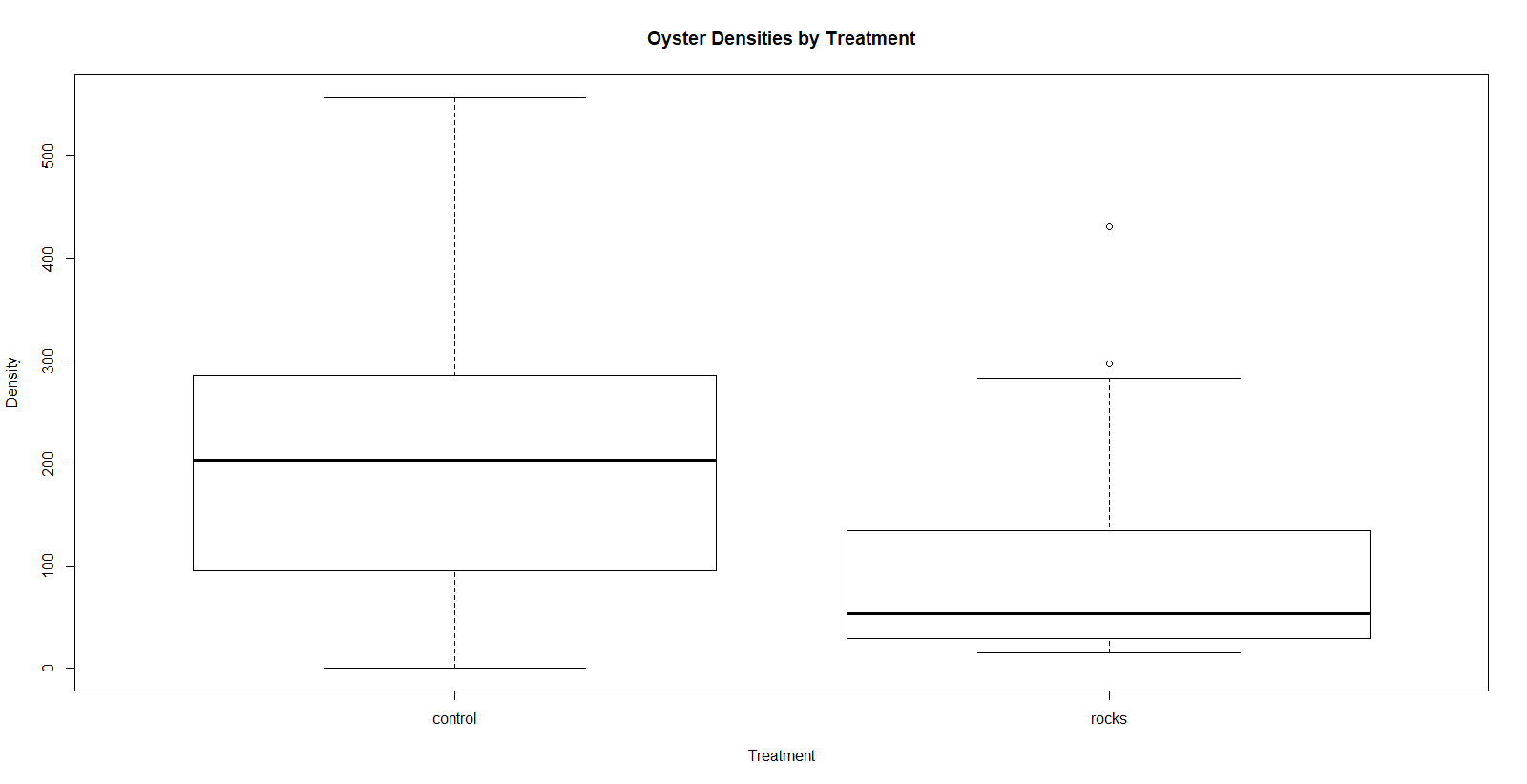


Figure 7. Boxplot oyster densities by site.

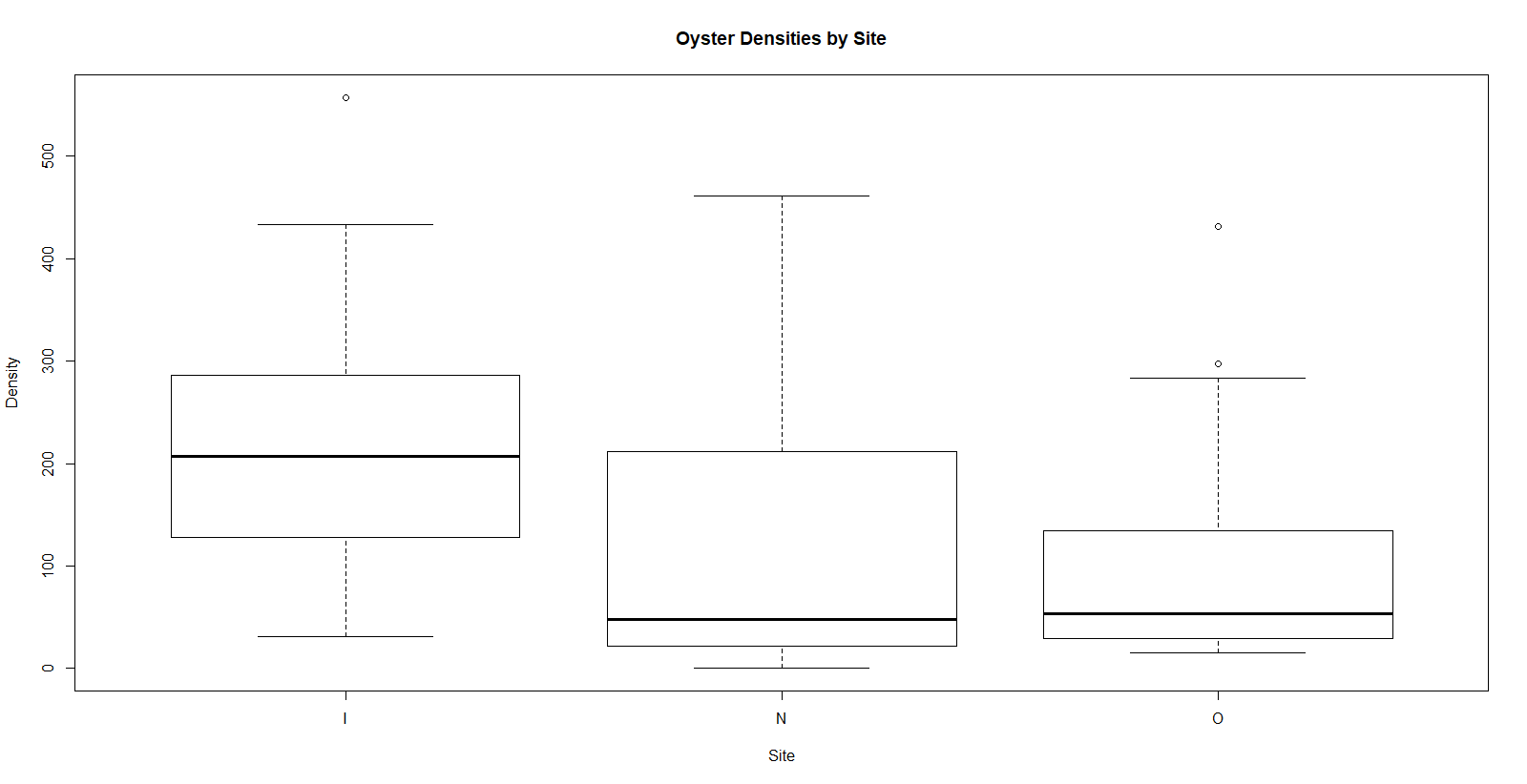


Figure 8. Histogram of collapsed transect lengths (m).

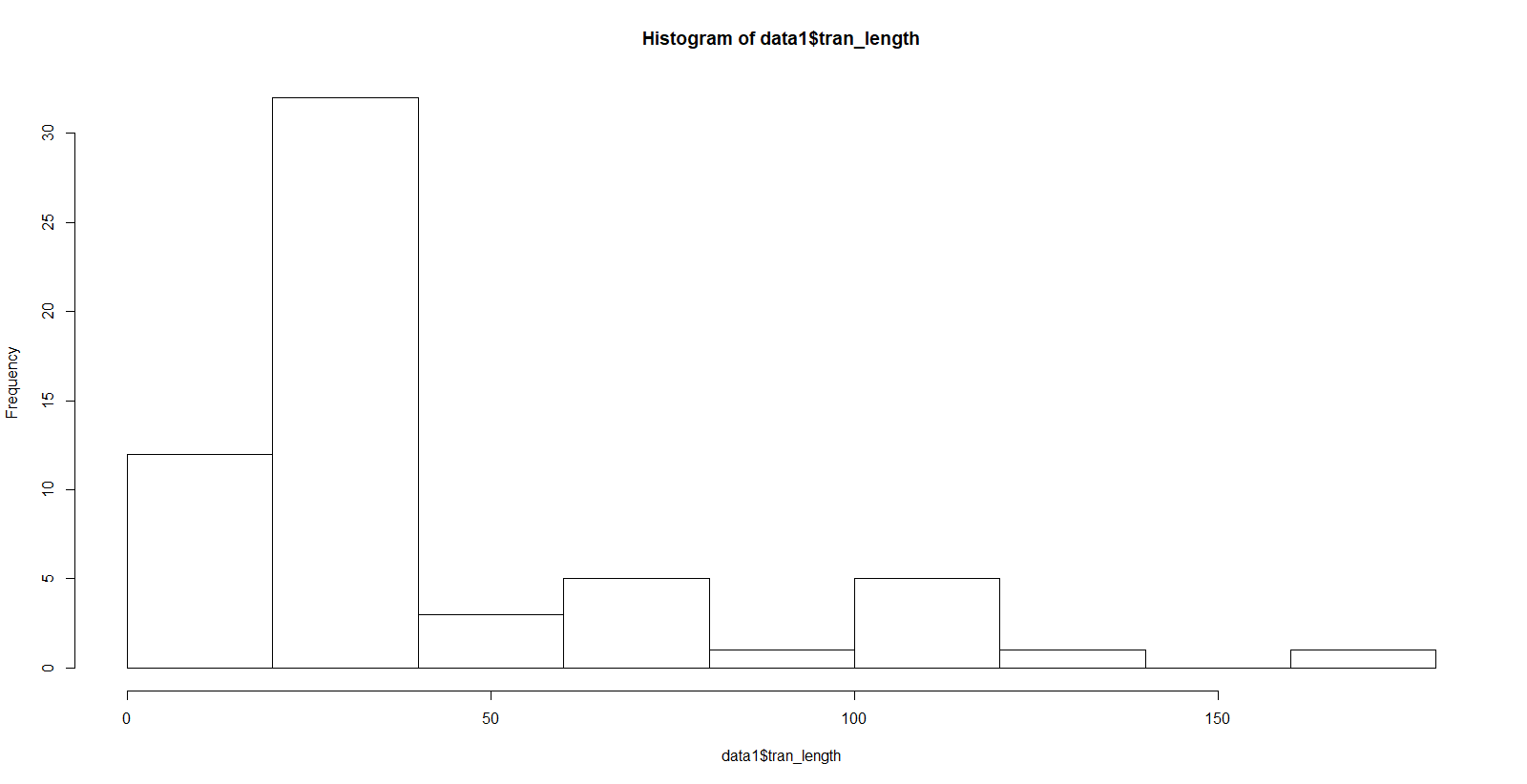


Figure 9. Histograms of collapsed transect length by locality

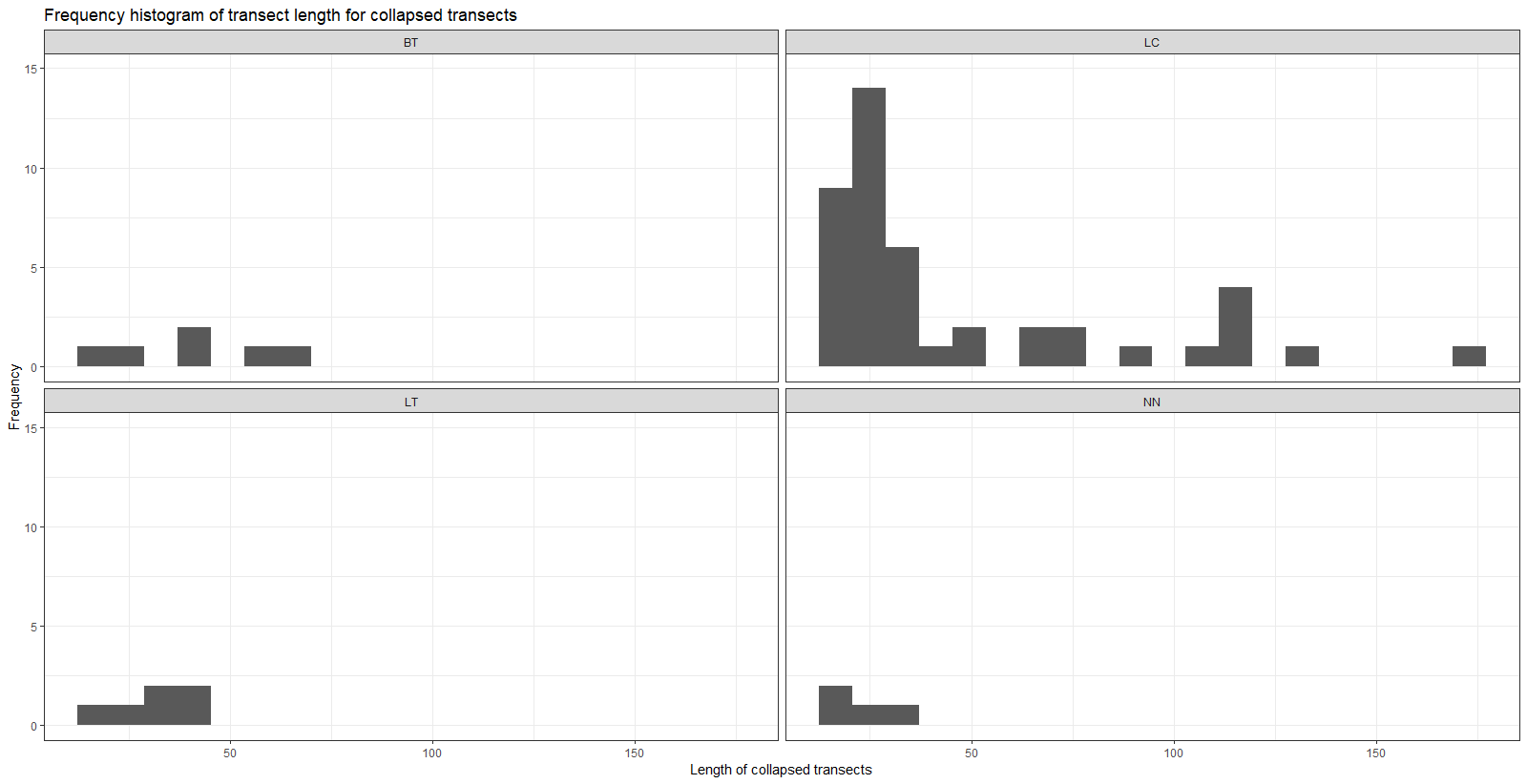


Figure 10. Histogram of collapsed transect lengths by strata

