Sampling Project Proposal Chris Clark and Leslie Gains-Germain

**Background**

Reintroduction efforts for pacific salmon are currently under way in the North Fork Lewis River basin, found in south west Washington state. An early step in evaluating potential salmonid reintroductions includes quantifying the available habitat, and relating that habitat to species-specific needs (Anderson et al. 2014). However, the quantification, interpretation, and estimated effect of the habitat on reintroduced salmonids can be influenced by both the method used to collect habitat data, and the scale at which the data are collected.

**Goals & Objectives**

We are interested in evaluating the stream habitat in the study area but also realize the potential for an additional task; Using empirical data to better understand the bias and precision of estimates using different sampling designs. In order to conduct a simulation study that evaluated different sampling designs, we used a census survey design to collect spatially continuous stream habitat data. During post processing of this data we broke the continuous data set into discrete reaches based on common methods used in fisheries research. With this dataset we were able to begin evaluating various study designs . However, we soon realized we were using designs with equal probability sampling, and that this may not be the most beneficial approach, as reach lengths are not equal, thus an approach that allowed sampling with probability proportional to reach length was of interest. To begin using unequal probability sampling designs we needed to know the inclusion probabilities for each reach within each stream in order to calculate the Horvitz-Thompson estimates of the stream means.

**Proposed design**

*Target Population*: All 16 streams that empty into the Yale and Merwin Reservoirs

*Study Population*: All 109 reaches within the 16 streams that empty into the Yale and Merwin Reservoirs

*How we will determine which units are in the proposed sampling design:* We will select a stratified random sample of reaches, where the 16 streams are the strata, and the reaches within each stream will be selected with probability proportional to reach length. Sampling will be done without replacement.

Here, we propose a simulation study to estimate the inclusion probabilities for reaches within each stream when sampling with probability proportional to reach length within each strata, without replacement. Specifically:

1) First we will simulate 100000 stratified random samples of reaches using unequal probability sampling as described above.

2) For each individual reach, we will calculate the total number of samples that contain that reach out of the 100000 simulated samples.

3) We will use the proportion of samples that include a particular reach to estimate the inclusion probability for that reach.

*Research Goal*: The goal of this study is to estimate the inclusion probabilities for all reaches found in streams that empty into Yale and Merwin reservoirs when collecting a sample of reaches using the sampling design above. While the primary goal of this study may be limited in scope, it is a necessary step to further evaluate a variety of sampling designs using the same dataset in a larger simulation study.

We will consider four sets of sample sizes in our simulations, representing 10, 20, 30, and 40% of reaches in each stream. The following table shows the true total number of reaches in each stream, and the four sets of sample sizes we will consider.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Stream | True #reaches | 10% | 20% | 30% | 40% |
| Brooks | 17 | 2 | 3 | 5 | 7 |
| Buncombe Hollow | 9 | 1 | 2 | 3 | 4 |
| Bypass | 11 | 1 | 2 | 3 | 4 |
| Dog | 1 | 1 | 1 | 1 | 1 |
| Cougar | 8 | 1 | 2 | 2 | 3 |
| Cape Horn | 2 | 1 | 1 | 1 | 1 |
| Indian George | 7 | 1 | 1 | 2 | 3 |
| Jim | 2 | 1 | 1 | 1 | 1 |
| Lower Speelyai | 1 | 1 | 1 | 1 | 1 |
| NF Souixon | 2 | 1 | 1 | 1 | 1 |
| Ole | 6 | 1 | 1 | 2 | 2 |
| Panamaker | 2 | 1 | 1 | 1 | 1 |
| Souixon | 8 | 1 | 2 | 2 | 3 |
| Speelyai | 23 | 2 | 5 | 7 | 9 |
| WF Speelyai | 5 | 1 | 1 | 2 | 2 |
| Wtrib Speelyai | 5 | 1 | 1 | 2 | 2 |