9 May 2005
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Snowshoe Hare Pellet Density Plots:

A Proposed Sampling Design for the Medicine Bow National Forest, Wyoming

Synopsis

I followed three steps to assist the Medicine Bow National Forest (MBNF) develop a statistically rigorous monitoring protocol to monitor trends in abundance of snowshoe hare on the forest. Additional and related steps included providing a write-up describing the reason I selected an alpha level of 0.20 in my power analysis, and providing comments on sampling snowshoe hare pellets to account for the bias of potentially sampling cottontail rabbit pellets.

1. I provided an initial analysis to evaluate the number of subsamples needed per sampling site to reduce the proportion of mean zero counts and to improve precision of estimates.

2. I provided a further analysis examining the number of sampling sites with 5, 10, or 20 subsamples needed to obtain a power of at least 80% to detect a 10% decrease in the pellet/plot index over 10 years. This power analysis was compiled with the initial analysis of subsamples per plot into a report providing recommendations as to the number of sites and subsamples needed to sample 4 strata on the forest. Strata were initially identified as (1) medium aspen, (2) small lodgepole pine, (3) medium, large, and very large lodgepole pine, and (4) medium, large, and very large spruce-fir. *Note: the 2 lodgepole pine strata may be collapsed into 1 stratum following a decision by MBNF wildlife personnel*.

3. I met with Steve Loose on April 26 to decide upon a sampling design that would provide good coverage of the forest to represent the variety of conditions across the Sierra Madre and Snowy Range units, where most hare habitat occurs. This meeting, a follow up meeting with Greg Hayward (Region 2 Wildlife Ecologist), and a subsequent phone call with Steve led to finalization of a sampling design, which was presented to wildlife biologists from the MBNF and Routt National Forest on May 3 at the Elk Mountain Hotel in Elk Mountain, Wyoming.

Steve and I discussed 2 strategies to create a sampling design to sample snowshoe hare abundance on the MBNF. An analysis of data from the White River National Forest led to a tentative decision to sample 45 sites on the MBNF to monitor trends in the abundance of hare. The two sampling strategies we discussed were:

1. Keep 12 sites on both the Sierra Madres and the Snowy Range, from the list of sites sampled in 2004. The remaining 21 sites would be randomly selected on the 2 forest units, with 10 on one unit and 11 on the other. Aims of sampling previously sampled sites are to save time in locating plots and to have continuous data from 53% of the sites.

2. Create a completely new sampling design and frame. Possible sampling designs would be either stratified random or systematic.

Decision

Steve and I decided that it would be best to create a completely new design with a new sampling frame. This decision was based on the fact that Steve and I looked at the dispersion of sites sampled in 2004. Sites occurred in clusters of suitable forest stands. We found that 7 of 13 clusters were sampled on the Sierra Madres, while 3 of 11 were sampled on the Snowy Range. The sites on the Sierra Madres tended to be positioned in the center of that mountain range, while the Snowy Range sites were distributed better across the landscape, but were limited in number. After examining the map of sampling clusters we came to the conclusion that a more random placement of sample sites would provide better estimates and be more defensible if challenged.

Proposed Sampling Design

We propose that a stratified random sampling design be used to estimate the snowshoe hare pellets/plot index on the Sierra Madres and Snowy Mountain ranges of the MBNF. This approach maintains a probabilistic selection of sampling sites, retaining statistical rigor. It will be imperative to involve Carol Tolbert, or another GIS Specialist in the process of identifying potential sampling units (individual stands) and selection of the sampling frame (the list of all potential forest stands in each sampling quadrant meeting sampling criteria). Steps in developing a stratified random sampling design follow:

1. The first step is to delineate the area on each forest unit that can potentially be sampled. In the 2004 analysis, sampling sites were primarily in lynx analysis units and lynx linkages. It would be best to consider all available habitats regardless of association with lynx. Habitat in wilderness or roadless areas would be excluded because this habitat is not subject to management activities detrimental to hare, thus properly limiting detection of trends in hare abundance to those areas that are most likely impacted by management activities such as logging.

2. The second step, to further reduce sampling time and thus increase sampling efficiency, would be to constrain all potential habitats sampled to be within 3.2 km (2 mi) from a road. High road densities outside wilderness and roadless areas will probably mean that minimal potential habitat will be lost.

3. The third step is to identify the size of stands to place subsamples within. On the White River National Forest, Joe Doerr sampled stands that were at least 10.9 ha (27 ac) to ensure that 20, subsampling plots could be placed inside them. On the Routt National

Forest and MBNF, Melissa Miller only considered stands that were at least 5 ha to place and sample a single pellet plot. Melissa further indicated that she placed a 100-m buffer around stands to remove edge bias. A suggested compromise would be to select stands that would be large enough to place 2, 300-m sampling transects, positioned with a 60-m buffer around edges, and 120-m apart. These stands would need to be a minimum of 8.6 ha (21.3 ac) to place the 10 subsamples in. Five subsample plots are placed 60 m equidistantly apart along each 300-m transect. Two transects would be placed for strata requiring 10 subsamples. A single 300-m transect would need to be placed in the middle of each site requiring 2 subsamples.

4. The fourth step is to divide potential habitat on the Sierra Madres and Snowy Range into 10 sampling quadrants. This would be accomplished through proportional allocation. For instance, if the Sierra Madres contain 40% and the Snowy Range 60% of the pooled area between the mountain ranges, then there would be 4 sampling quadrants placed over hare habitat on the Sierra Madres and 6 placed over hare habitat the Snowy Range.

5. The fifth step is to number each stand in each stratum (aspen, lodgepole pine, and spruce-fir) within each sampling quadrant. The list of all stands that could potentially be sampled is the sampling frame. Because mountain ranges are divided into quadrants, a sampling frame should be developed for each quadrant and cover type. To avoid a potential problem of collapsing strata into large, unwieldy sampling units, it would be best to maintain the boundaries of each stand within a stratum based on the size structure of trees within the stand. This convention will facilitate maintaining a larger number of sampling units in each sampling frame and should provide field crews more definitive information on the location of stands randomly selected for sampling.

6. The sixth and final step in the sampling design is to randomly select sampling units with replacement from the numbered stands in each quadrant’s sampling frame. Following these steps will yield a stratified random sample, where estimators for the mean and variance of a sample are readily available. Simple conversions of the variance to standard errors and then to confidence intervals can be used to place a measure of variation around each yearly point estimate. An additional benefit of stratified random sampling is that managers can compute point estimates and associated variation for each stratum, thus facilitating evaluation of mean pellets/plot at the scale of individual strata.

7. The sampling design listed in the previous 6 steps is probably the most feasible design given the need to sample across landscape heterogeneity. This approach will also provide sampling crews with geographical units consisting of 3 or 4 sample stands (i.e., sampling units) in relatively close proximity. Crews could feasibly sample up to 2 sites per day, completing sampling in each quadrant in 2 days, and all quadrants in 20 days, or 4 weeks.