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This response was prepared following discussion with Carol Tolbert on May 23, 2005 about application of statistical sampling designs when establishing a sampling frame and randomly selecting sampling units with a GIS. In this case, we were selecting forest stands as sampling units, which will be used to place plots where snowshoe hare (*Lepus americanus*) pellets will be monitored to evaluate changes in abundance on the Medicine Bow National Forest, Wyoming. My definitions of sampling components are based on those of Scheaffer et al. (1996) and Thompson et al. (1998). To illustrate, I use components of the snowshoe hare sampling design on the Medicine Bow National Forest. The purpose of any sampling design is to compute parameter estimates to make inferences to a population of interest. For snowshoe hare, managers will use annual mean counts from an index of pellets per plot to test for a decline in the trend of the snowshoe hare population on the Forest over a 10-year period. This index represents density of hares because it computes the ratio of hare pellets counted within $2.32\text{-m}^2$ sampling plots.

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### Statistical Sampling Design Concepts

*Element* – An element is an object on which a measurement is made or some type of information is recorded. For snowshoe hare, fecal pellets are the elements of that sampling design, and the information recorded is how many of them there are in $2.32\text{-m}^2$ sampling plots.

*Sampling unit* – Sampling units are nonoverlapping collections of elements from a population. For snowshoe hare, sampling units are forest stands at least 8.6 ha (21.3 ac) in size. The size of these stands provides a large enough area to place at least 10 subsample plots at predetermined spacing distances and is also large enough to encompass 1 snowshoe hare home range.

*Sampling Frame* – A sampling frame is a complete list of sampling units that can be randomly selected for inclusion in a sample. For snowshoe hare, the sampling frame is the list of all stands at least 8.6 ha (21.3 ac) for each specific cover type (aspen, lodgepole pine, or spruce-fir) by stand size strata within a geographic quadrant on the Medicine Bow National Forest.

*Sample* – The collection of sampling units drawn from the sampling frame. For snowshoe hare, the sample will be 45 sampling units (forest stands), distributed among aspen, lodgepole pine, and spruce-fir and randomly selected within sampling frames compiled for 10 sampling quadrants distributed among the Sierra Madres and Snowy Mountain ranges.

*Sampled population* – Those elements contained in a sampling frame. One must be careful when making inferences, because they can only be made to the area from which the sampling frame was constructed. If the sampling frame is cast across the extent of the target population, then the sampled population is equivalent to the target population. If the sampling frame was only developed for a portion of the forest, then it is not equivalent. Because stands representing some structural classes of aspen and spruce-fir were not included in the sampling frame, then inferences of snowshoe densities can only be made to the cover type and structure classes included in the sampling frame.

*Target Population* – All elements within a defined spatial and temporal time interval. For snowshoe, the target population is all snowshoe hare on the forest stands of interest for monitoring hare abundance on the Sierra Madres and Snowy Range portions of the Medicine Bow National Forest. In many cases, the target population may only be a portion of a biological population, and thus it is important to delineate where and when the target population was found in space and time.

*Stratification* – Stratification is the process of grouping sampling units into groups with similar characteristics. The purpose of stratifying sampling units is to reduce variation, thus improving precision of estimates. Because precision is associated with sample size, stratification leads to reduced costs associated with sampling fewer sampling units. For snowshoe hare, we used cover type by stand structure classes to stratify sampling units. Pellet counts within strata are similar, thus lowering variation within strata and ultimately within parameter estimates. More precise estimates will permit better detection of trend in snowshoe hare pellet densities.

**Literature Cited**

Scheaffer, R.L., W. Mendenhall III, and R. L. Ott. 1996. Elementary survey sampling, 5th ed. Duxbury Press, Boston, MA.

Thompson, W. L., G. C. White, and C. Gowan. 1998. Monitoring vertebrate populations. Academic Press, San Diego, California, USA.