Abstract: Herd classification counts have become a routine part of ungulate management and research projects. The objective of such counts is to determine population proportions, age ratios and sex ratios. These data are used as indicators of reproductive success and population recruitment or to set and evaluate harvest strategies.

The usual procedure in sampling is to classify as many animals as possible in order to improve the precision (or reliability) of the observed ratios. Since these ratios involve variation in both the numerator and denominator, appropriate procedures for calculating variance and confidence limits are not straightforward. Previous studies have emphasized two sampling plans for estimating ratio variances. The area method divides the study site into quadrats which are randomly sampled. Classified animals within each quadrat are assumed to be true estimates and the variance is calculated between quadrats. A second, more popular method, surveys the entire area and treats individual animals as the sampling unit. This approach assumes that individuals are independently and randomly sampled from the population.

We propose an alternative approach which is known in the statistics literature as cluster sampling. Applied to wildlife surveys, cluster sampling treats groups of animals as the sampling unit. This approach assumes that groups are independently and randomly sampled from the population. Treatment of individuals is shown to be a special case of cluster sampling applicable only under limited conditions. These conditions occur when groups consist of a single animal or when groups are both of constant size and homogeneous with respect to the ratio being estimated. The precision of simple random sampling estimates will be biased for most wildlife surveys. Cluster sampling produces reliable estimates of precision. Comparison of the methods are made using ground surveys of deer and aerial surveys of elk.

A complementary approach to achieve improved reliability is to conduct repeated, but independent surveys of the population. This procedure has been advocated for mark-recapture surveys and may also be extended to classification surveys. The ratio estimate is simply the ratio of the total of animals classified during all surveys. Weighted variance estimates may be used to pool the variances from the individual surveys. These pooled estimates will generally reduce the variance by the square root of the number of surveys conducted. Repeated surveys of deer indicate that pooling may have a substantial influence on the reliability of fawn-doe and buck-doe ratios.
Because animals are typically found in groups that are likely to be relatively homogeneous and variable in size, the notion that single animals are randomly and independently sampled is fallacious. As a result, the determination of reliability of ratio estimates using a simple random sampling approach will give biased results. In many cases, it appears that our judgements on the precision of the relative abundance of age and sex classes may be grossly overstated. This mis-estimation of reliability applies to management decisions and research evaluations. In addition, the estimation of abundance via techniques such as the change in ratio method will be biased if simple random sampling is used. In the usual situation, where animals naturally congregate, the application of cluster sampling should provide more realistic estimates of our knowledge of the relative population abundance from herd composition surveys.