

- **Census** is the total enumeration of the animals in an area
- **index** is a number that has a proportional size to the population size – provide measures of relative density and are only used in comparisons
- **total counts** have two serious drawbacks
 - inaccurate
 - expensive
 - tend to still be used for animals that are clumped, but the clumps are far apart (e.g., elephants, African buffalo)
- **two important considerations for sample counts**
 - selection of a random, unbiased sample
 - choosing an appropriate experimental control
- **sampling** is the technique of drawing a subset of sampling units from the whole and then making deductions about the whole from the part
- **Precision** is a measure of sampling error (ability to repeat measurements); **Accuracy** is a measure of bias error (how close measurements are to the true value)
- Important – is bias constant across sampling periods – then you need precise measurements. If you need to know the density for management purposes at a given time you need precise measurements.
- Precision is most often needed and gained by using efficient sampling, rigidly standardized methods, and a large sample size
- **Bias errors** derive from systematic distortion in the counting technique, the observer's ability to detect animals, or the behavior of the animals. Often produces an undercount. Can occur from sampling schemes that do not sample all quadrats.
- **Sampling frames** divide the area into non-overlapping units
- **Sampling with replacement** random quadrats (or units) drawn, then put back in the sample and can be drawn again
- **Sampling error** – the wrong answer from sampling (not accurate) – not an error of measurement
- **Sampling without replacement** is more precise for the same sampling fraction and reflects the greater information on density of units sampled only once
- **Advantage of sampling with replacement** – up to 10 quadrats are sampled once, even if they are drawn multiple times so survey time is shorter and less expensive
- **Sampling with replacement** is used because at low precision (<15% as in most wildlife counts) the precision is similar to SWOR. It is also convenient to sample with replacement when an area is traversed repeatedly by aerial-survey transects

Transects or quadrats

- **Transects should go across the grain of the country, cross rivers rather than parallel, go up slope rather than hug the contour.** Should be oriented to sample as much as possible of the total variability of an area
- as long as the frame is oriented properly, estimates from transects are more precise than quadrats
- the more clumped the distribution of animals, the greater the gain in precision of transects over quadrats

Random or non-random sampling

- strictly random to strictly systematic