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We promote the advancement of land stewardship through ranching, science, and education.

Aerial Surveys for Large Mammals in South Texas: Are Conventional Surveys Good Enough?

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It is question that has perplexed land and wildlife managers for centuries – "How many animals are there on my land?" Knowing the answer to such a simple question makes setting things such as harvest goals and habitat management plans much more **accurate** and effective. In theory, this should be a relatively straightforward question to answer. But in practice, this is a much more complicated and challenging question than it first appears. This difficulty should really come as no surprise – we even have problems counting our own human **population** every ten years during **census** time in the U.S.

Many methods have been developed to **estimate** the **population** of white-tailed deer (*Odocoileus virginianus*) and other large mammals. Pellet group counts, track counts, infrared thermal imagery, night spotlighting, aerial surveys, infrared cameras, and mark-resight/recapture techniques – all have their merits and disadvantages.

In South Texas, aerial surveys are widely used to survey deer and **estimate populations**. The most common is the conventional distance sampling (CDS) method. Unlike raw counts, this method accounts for unseen animals during flights as a function of how far away the animal is when it was first seen. More recently, CDS has been combined with mark-recapture techniques, in a method termed mark-recapture distance sampling (MRDS), to account for visibility **bias**. A potential downside of the MRDS method when compared to CDS is that it requires two independent observers rather than one. Animals seen by a single observer are considered marked, and if seen by a second independent observer, are considered recaptured.

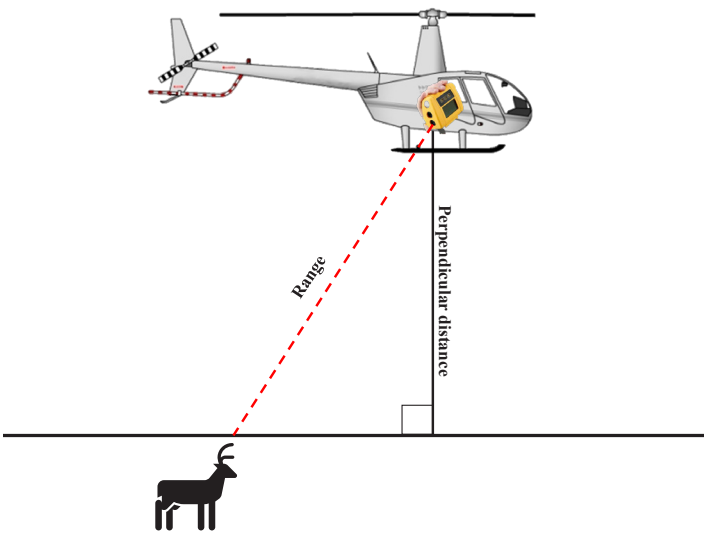


Diagram of distance sampling which is used in aerial surveys by East Foundation researchers.
Image Credit: Andrea Montalvo

There is a need for a more **accurate** and **precise** survey method for large mammals on South Texas

KEY TERMS

POPULATION
A group of animals of the same species occupying a given area (pasture, ranch, etc.) at a given time.

ABUNDANCE
Number of individuals.

POPULATION DENSITY
Number of individuals per unit area.

POPULATION TREND
Change in numbers of individuals over time.

CENSUS
A total count of an animal population.

POPULATION ESTIMATE
A numerical approximation of total population size.

POPULATION INDEX
A statistic that is assumed to be related to population size.

DETECTION PROBABILITY
The probability that an individual animal within a sampled population is detected.

ACCURACY
Is a measure of bias error, or how close a population estimate taken from a sample is to the actual abundance.

BIAS
The difference between an estimate of population abundance and the true population size. In aerial surveys, bias can be caused by numerous factors including visibility, availability, and observers.

PRECISION
Is a measure of the variation in estimates obtained from repeated samples.

TRANSECT
A straight line along which measurements or observations are made.

PERPENDICULAR DISTANCE
The shortest distance between a transect (line) and observed individual (point).

CLUSTER SIZE
Number of individuals in a group that is observed.

rangelands, particularly as it relates to changes in visibility **bias** within or among years. The MRDS method appears promising but requires additional technical and logistical consideration to preserve observer independence and track resightings. Herein, we evaluated and compared the effectiveness and feasibility of the CDS and MRDS techniques on South Texas rangelands.

In 2013, the East Foundation, together with the Caesar Kleberg Wildlife Research Institute at Texas A&M University Kingsville, embarked on a study aimed at determining the effectiveness and feasibility of the MRDS method. Our main purpose was to compare methods and develop large mammal aerial survey recommendations for landowners, ranchers, and wildlife managers in South Texas needing to know – "How many animals are there on my land?"

Aerial surveys using a helicopter platform on East Foundation lands.
Image Credit: Wyman Meinzer

We conducted aerial surveys for deer, nilgai antelope (*Boselaphus tragocamelus*), collared peccary (*Pecari tajacu*), and wild pigs (*Sus scrofa*) across four ranches – San Antonio Viejo (~149,800 acres), El Sauz (~27,100 acres), Santa Rosa (~18,600 acres), and Buena Vista (~ 15,100 acres). Our surveys occurred over two years in November 2013, February 2014, November 2014, and February 2015.

November surveys occurred prior to leaf drop and the hunting season – when deer surveys traditionally occur. February surveys occurred after leaf drop – when large mammals were more visible. Each ranch was flown once during each season with a helicopter. Detailed methods can be found in Annala (2015) and Peterson et al. (2020).

A summary of our key finding follows. First, the MRDS **density estimates** were about 10% greater than CDS and other **estimates** yet were not statistically different. Second, deer and nilgai **population estimates** were 22–59% lower during the November surveys than the February surveys, suggesting availability **bias** occurred. For example, changes in nilgai **population estimates** between seasons may have been caused by nilgai movements – seasonal movements likely occurred between surveys resulting in changes in **population** sizes. Third, **population estimates** for collared peccary and wild pigs were inconsistent, in part because few of these animals were observed. Lastly, the MRDS method performed reasonably well; however, the added costs and challenges associated with maintaining the independence of two observers should be weighed against the small increase in **precision** of **population estimates**.

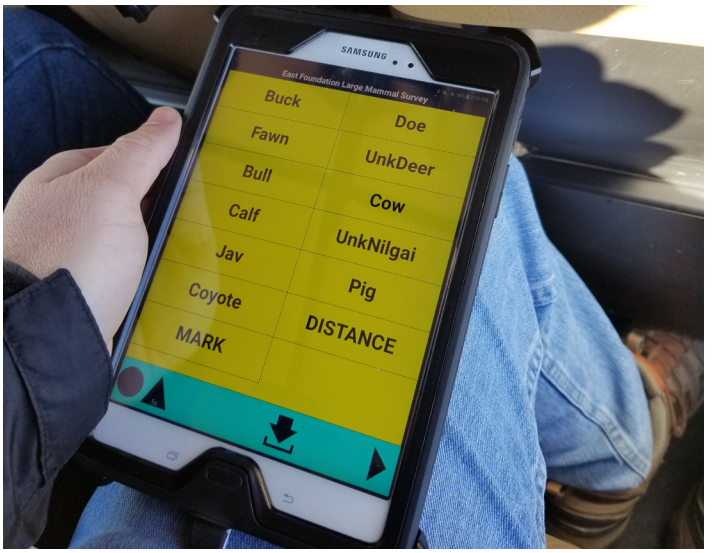
Landowners interested in determining how many animals are on their land and **population trends** across years should use the CDS method. For most applications, the CDS method is superior because of the reduced cost, convenience of data entry and analysis, survey methodology, and reduced individual observer **biases** from

using multiple observers. However, when using the CDS method, **population estimates** and standard errors should be increased by 10% to account for imperfect **detection** on the survey line. In situations, such as scientific applications, in which **precise estimates** are required landowners should consider using the MRDS method, acknowledging that it is more expensive and has associated complexities and potential **biases**.

Aerial surveys using a helicopter platform on East Foundation lands.
Image Credit: Wyman Meinzer

In addition, we recommend the following best practices when conducting aerial surveys for large mammals in South Texas:

1. **Surveys should be conducted annually to monitor trends over time.** This will allow managers to assess impacts of drought, habitat management actions, or other factors in increments that are biologically meaningful. Additionally, annual surveys should be conducted during the same time of the year to ensure that you are comparing apples to apples. The East Foundation conducts our aerial surveys in February because we do not harvest deer (no pre-season **estimates** needed), **detectability** is higher, and **population estimates** are more reliable.
2. **Survey design should use evenly spaced transects.** Ideally, these **transects** should run north to south so that surveys are not flown into the sun. Placement of **transects** should have a random starting point.
3. **Survey coverage should be based on ranch size.** For deer and nilgai – larger ranches, such as the San Antonio Viejo, should be flown at 10–25% coverage, whereas medium-sized ranches (such as El Sauz, Santa Rosa, and Buena Vista) should be flown at 50–75% coverage. If a ranch is flown at 100% coverage, we recommend flying every other **transect** on first pass, then returning to survey the skipped **transects** later in the day to reduce the likelihood of double counting.
4. **Pencils and paper datasheets with handheld GPS units are the most efficient and reliable form of data collection.** Our observers noted that this method was easier to use than a computer-based data collection system. Using pencil and paper allowed for multiple observations in a short amount of time with the ability to multitask, whereas our computer-based system often malfunctioned.



Tablet and software format used by East Foundation researchers to record aerial survey data.
Image Credit: Landon Schofield

5. **Observers must be adequately trained to perform all aspects of aerial surveys. Perpendicular distance, cluster size**, sex and age of all animals, and observer name should be recorded in the field. Any habitat information should be added later during data entry and post-processing. It is important to record **cluster size accurately** when using the CDS method.

Reliable methods to **estimate** or **index** large mammal **population** size is important for their management but challenging to obtain. Time and effort should be spent on the front end when designing the survey, and the same methods should be used year after year so that **trend** data can be compared more **accurately** over time.

The East Foundation is committed to conducting research that makes a difference and addressing applied research questions – such as, how best to count animals on South Texas rangelands. We anticipate that this commitment will produce future Management Bulletins aimed at advancing land stewardship.

SUGGESTED CITATION

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