Big Game Aerial Survey Methods

Frequently Asked Questions

Over the past several years, Manitoba's Wildlife Branch has undertaken an initiative to modernize the big game aerial survey program. In order make informed management decisions regarding hunting opportunities and conservation of big game species, it is important to have updated survey information. As part of this modernization, the Wildlife Branch is incorporating new technology to improve wildlife surveys.

Why is there a need to "modernize" the aerial survey program?

Similar to other areas of science and research, aerial survey technology has advanced rapidly over recent decades. New advances in technology can facilitate the efficient collection of reliable survey data while reducing costs and safety risks.

In 2016, the Department of Sustainable Development (now the Department of Economic Development, Investment, Trade, and Natural Resources) issued a mandate to implement effective and innovative big game surveys to improve population data for managers and increase transparency. In order to achieve this mandate, the Department committed to:

- improving communication and engagement with stakeholders, Indigenous Nations, and the public;
- incorporating new technology into the aerial survey program;
- increasing the frequency and quality of aerial surveys; and
- enhancing the data collection and data quality that results from conducting aerial surveys.

The Wildlife Branch has made progress towards this goal over recent years by transitioning from the "traditional" method to a modern distance sampling method with infrared drones and fixed-wing aircraft.

Does the Wildlife Branch annually collect updated survey data from every Game Hunting Area (GHA) to inform annual hunting and management decisions?

No, it would not be possible for the Wildlife Branch to conduct aerial surveys in all GHAs on an annual basis. The capacity to conduct surveys is restricted by funding, staff availability, large survey/management areas, and the very limited amount of time when conditions are suitable for surveys. Survey areas have usually been selected based on urgent priorities that were identified each year. This triage-based approach has resulted in surveys occurring at sporadic frequencies in various regions throughout the province over the past several decades.

How frequently have surveys occurred?

The frequency of surveys has varied throughout the province. In areas with urgent conservation concerns, surveys have occurred more frequently. The most frequently surveyed GHAs include those currently under moose conservation closures (e.g. GHAs 18/18A-C, 13/13A, 26). In each of these areas, there have been 5 traditional surveys over the past 20 years. All other GHAs have been surveyed less frequently; in some cases, the entire GHA has never been surveyed or has only been surveyed once, which means determining a population trend is not possible.

How has the Wildlife Branch traditionally conducted wildlife surveys?

Historically, a variety of survey methods have been used over the years, including Gasaway stratified random block, full coverage/total count/minimum count, strip transect, wedge, equal quadrat, or unequal quadrat methods, which means the methods were not consistent and the results are not comparable. Generally, the Gasaway stratified random block method has been the most frequently used survey approach, usually conducted by three Wildlife Branch staff onboard a helicopter. Inferences about population trends have typically been based on surveys conducted using the Gasaway method.

What is the Gasaway/“traditional” survey method?

The Gasaway stratified random block is an aerial survey method that was initially published in the 1980s (Gasaway et al. 1986). The Gasaway stratified random block method divides the study area into a grid. “Blocks” of the grid are categorized (stratified) based on the density of the survey species (e.g. low, medium, high), which requires a pre-survey stratification flight. Grid blocks are then randomly selected to be intensively surveyed (all animals within the selected block must be counted), until a sufficient number of blocks representing all strata types have been surveyed.

During the surveys, wildlife observations are collected by onboard Wildlife Branch staff (detection by the human eye). The survey results are analyzed in a specifically designed program called “Moosepop” that indicates when a “sufficient” number of blocks have been surveyed. Due to the balanced design of the grid blocks, the study area boundaries cannot be altered post-survey (e.g. for reanalysis) or between surveys (e.g. to compare results across years with different survey boundaries).

What is distance sampling?

Distance sampling is a survey method which relaxes the assumption that observers detect and count everything within the selected area. Observations are collected along transects that run across the study area. In order to accurately estimate the entire population size, the statistical model requires a sufficient number of observations (typically about 60 animals). This method assumes that all animals that occur directly on the transects are counted. Animals that are farther from the transects are less likely to be counted. We can calculate the probability of seeing an animal based on its distance from the transect. This information is used to estimate how many animals were not counted because they were too far from the transects, which can be scaled across the study area to produce an accurate population estimate. The survey results are analyzed in a reputable and commonly used statistical program called “R” that has multiple distance sampling packages such as “Distance” and “Rdistance”.

What is infrared (IR) imaging?

Unlike visual (RGB) cameras that rely on light, infrared (IR) cameras use energy/heat (aka infrared radiation) to capture an image. This method is commonly used to detect mammals, which are warmer than their surrounding environments. IR cameras can detect during poor visual conditions (e.g. darkness, fog, smoke), with limited snow cover, and through light layers of vegetation.

Are other jurisdictions using these modern methods?

Yes, most other jurisdictions in Canada are using distance sampling for wildlife surveys. For instance, in Alberta, Nova Scotia, and Saskatchewan, distance sampling is used to survey moose, elk, and deer populations. Distance sampling is also used to estimate polar bear population sizes throughout their range in Canada. Additionally, an ever-increasing number of jurisdictions and agencies are using IR technology to conduct wildlife surveys, including Nunavut, Yukon, Northwest Territories, Ontario, Alberta, Saskatchewan, Environment and Climate Change Canada, Parks Canada, and several US Federal and State agencies (e.g. North Dakota, Idaho, Wyoming, Pennsylvania, California, Nevada).

Methods Comparison

Method	Crew Required	Flight Conditions	Fuel Use	Cost* (per 1,000 km^2)	Time of Year	Data Validation
Traditional Gasaway: Helicopter	- 1 contracted pilot - 3 Wildlife Branch staff on-board - 1-2 Wildlife Branch ground crew	- During the day - No ground frost - No icing conditions - Good visibility - Calm weather - Temp range: -30C to 0C	- Uses the most fuel compared to IR fixed-wing plane and IR solar drone	- Approx. $26,000 - Plus wages of 5-7 full time staff	- When there is heavy snow cover (January - February)	- No data validation (e.g. photo or video review)
IR Fixed-Wing Plane	- 1 contracted pilot - 1 contracted biologist/operator	- Usually during the night, can also fly during the day - No icing conditions - Temp range: -30C to +10C	- Uses less fuel than a helicopter but more than a solar drone	- Approx. $15,500 - Plus wages of 2 full time staff	- When the ground is frozen (November – March/April)	- Produces video and photo evidence (IR and RGB) of all observations. - Footage reviewed to identify species, sex, and quantity of animals
IR Solar Drone	- Minimum 2 contracted staff to operate and observe drone	- Currently limited to short distances due to Transport Canada restrictions - Usually during the day (solar), can also fly during the night (battery power) - No icing conditions - Temp range: -30C to +10C	- No fuel used (solar during the day and battery powered at night)	- Approx. $30,000 - Plus wages of 2 full time staff	- When the ground is frozen (November – March/April)	- Produces video and photo evidence (IR and RGB) of all observations. - Footage reviewed to identify species, sex, and quantity of animals

*Actual cost is dependent on the exact shape of the surveyed area, reported costs are approximate for an area of 1,000 km^2.

Additional Resources:

Survey methods video:

Manitoba Big Game Surveys (youtube.com)

Web address: https://www.youtube.com/watch?v=CTQm55KaZKY

Free online distance sampling course:

Web address: https://workshops.distancesampling.org/online-course/

Published studies:

Airst, J., & Tomie, J. (2023). Comparing Moose aerial survey methods in Nova Scotia: distance sampling, density surface models, and stratified random blocks. Biodiversity Conservation and Forestry Technical Report Series, 2023-001. Nova Scotia Department of Natural Resources and Renewables.

Gasaway, W. C., DuBois, S. D., Reed, D. J., & Harbo, S. J. (1986). Estimating moose population parameters from aerial surveys. Institute of Arctic Biology. University of Alaska. Fairbanks, Alaska.

Lethbridge, M., Stead, M., & Wells, C. (2019). Estimating kangaroo density by aerial survey: A comparison of thermal cameras with human observers. Wildlife Research, 46(8), 639-648.

Peters, W., Hebblewhite, M., Smith, K. G., Webb, S. M., Webb, N., Russell, M., ... & Anderson, R. B. (2014). Contrasting aerial moose population estimation methods and evaluating sightability in west-central Alberta, Canada. Wildlife Society Bulletin, 38(3), 639-649.