Aerial Wildlife Survey Report

Wildlife Management Unit 354 Moose Survey - 2013

Executive summary

Alberta Fish and Wildlife surveyed the moose population in WMU354 using distance sampling methods to estimate population density in February 2013. In total we surveyed 51 transects for a total survey effort of 510km. Across all strata the encounter rate was 0.176 moose/km (90%CI 0.142-0.219), the estimated density was 0.64 moose/km^2 (0.51 – 0.82), and the estimated population size for the unit was 1618 moose (90%CI 1276 – 2051). The calf ratio was 0.28 (90%CI 0.22 – 0.34) and the bull:cow ratio was 0.23 (90%CI 0.15 - 0.31). Both bull and calf ratios were within the range of values reported from the past 35 years, although the calf ratio was lower than average. Distance sampling methods provided an efficient and cost-effective alternative to Gassaway methods. We intend to implement this methodology across WMUs where moose densities are sufficiently robust and anticipate that doing so will expedite the frequency with which we can monitor our ungulate populations.

1. Introduction

1.1. Background

A population census has not been conducted in WMU 354 since 1997. The unit was modified by splitting the larger former boundary of WMU354 into two units now identified as WMU353 to the south and WMU354 in the north. A calf season was implemented in 1998 as an experimental approach to both provide additional opportunity and manage fluctuations in moose populations associated with parasitic (e.g. winter tick) and weather events without compromising the existing resource. There is concern that a calf season will reduce the number of bull moose available for the limited entry special licences by reducing the survival rate of bull calves. Therefore there was strong incentive to execute a survey when funds were available. Our funding did not allow us to conduct a Gassaway survey to estimate moose density therefore we used distance sampling methods to complete this survey.

1.2. Objective

This study was designed to estimate the population size and density of moose, the adult sex ratio, and calf ratio within WMU354. We implemented changes to both the design and execution of distance sampling methods and we report on the practicality of implementation and efficacy of these methods.

2. Methods

2.1. Study area

The general boundary of WMU354 is delineated by the Forestry Trunk Road to the west, the Simonette River to the north, the Canfor 7000 Road to the south, and east along several physical features and land survey boundaries near Grassy and Long Lake (Figure 1, refer to wildlife regulation for specific details). This study area encompasses dry mixedwood (9%), central mixedwood (59%) and lower foothill (32%) subregions

(Natural Regions Committee 2006). Stand composition within the mixedwood subregions are largely deciduous leading while stands within the foothills subregion are generally dominated by spruce and pine species.

Figure 1. The Simonette River Wildlife Management Unit No. 354 (orange) is located southwest of Valleyview.

2.2. Survey design and sampling methods

Transects were generated within WMU354 using ArcGIS Desktop and ET Geowizards (Python script provided Appendix A). Seventy-five 10km transects were generated from a randomly generated point within the boundary of WMU354 in a random cardinal direction (i.e. 0○, 90○, 180○, or 270○). The orientation of transects was constrained to only cardinal directions to favour instrument navigation by the aircraft pilot. The generated transects were constrained from occurring within 1.2km of any other transect. Each transect was assigned a sequential integer number representing the random seed order that will be used to prioritize the survey of transects according to the random design. Transects were stratified into high cutblock density and low cutblock density (Figure 2). The high cutblock density strata generally correspond to the boundaries of the lower foothills ecoregion where forest harvest has been intensified to offset habitat restrictions to the core of the Little Smoky caribou range.

Transects were prioritized according to their seed order. Surveys were conducted in a Bell 206 Jet Ranger with rear bubble windows with a survey crew of 3, excluding the pilot. Transects were flown at approximately 300ft AGL and 80 knots. Survey conditions that were recorded upon commencing the transect include temperature, percentage cloud cover, precipitation (none, low, medium, high, fog), and each survey crew member and their position in the aircraft. The author's experience suggests that if the front observer does not restrict their focus to the centreline a gap results in the detection function on the transect line. Although this 'hole' on the transect line can be dealt with by fitting a gamma distribution to the detection function (Becker and Quang 2009), this cannot be achieved in program Distance 6.0. Further, although left truncation can resolve some of the issues of detection error on the transect line this option should not be used unless absolutely necessary. Therefore the front left observer restricted their observations to the floor window at the front of the cockpit and only a small portion of the left window (up to 50m from the centreline of the aircraft), the rear left on the survey window beyond 50m, and the rear right observer was responsible for all areas on the right side not within 50m of the centreline.

A waypoint was collected from the transect line when an animal was detected and the flight path was continued until the aircraft was perpendicular to the observed animal group before leaving the transect to avoid gaps in survey effort along the transect. Once perpendicular the aircraft left the transect line to measure the exact location of the observation, and classify all animals by sex, age class and antler class. All animals within 30m of the original observation were considered the same group and for groups larger than 1 individual the centre point between animals was collected as the location (Buckland XXXX). It is pertinent to emphasize that it was important to collect exact location coordinates of all groups even when the animal group was perceived to be directly on the transect line to avoid a large spike in the detection function for observations close to the transect line.

Additional covariate measurements collected at each observed group included crown closure (0-30%, 31-70%, 71-100%), activity (bedded, standing, moving), snow cover (bare ground, low vegetation showing, complete snowcover), light intensity (flat, bright), terrain slope (flat, moderate, steep) (Peters et al. 2013).

2.3. Analysis techniques

Distance from the transect line was calculated by simple subtraction because all transects were oriented on either true north or west and the geographic coordinates of all observations were collected in Universal Transverse Mercator. All further analyses were conducted within Program Distance 6.0 (Thomas et al. 2010). Model fit was assessed using Akaike Information Criterion, QQ-plots, and Kolmogorov-Smirnov , Cramer-von mises family, and Chi-square goodness of fit tests. Right truncation was used if either outliers in the distance continuum were observed or relatively small observed frequencies were noted in the chi-square goodness of fit test. A half-normal key with cosine adjustment terms is the preferred default model used for the detection function but other keys and adjustment terms were evaluated as per Buckland et al (2001). If there was no notable improvement in the fit of the the detection function, precision, and the estimate was unchanged the half-normal cosine default was stayed.

3. Results

Fifty-one transects were surveyed during 12.2 total billable flying hours on Feb 6 and 7, 2013 (Figure 2). In total 198 moose were classified from 106 independent groups of moose (a single moose is considered a group of one) with 510km of survey effort. In total, 37 bull (18.8%), 130 cow (66.0%), and 30 calf (15.2%) moose were observed across all transects. Stratifying transects by high cutblock density versus low cutblock density and fitting the detection function with a uniform key with cosine adjustment terms improved precision and AICc (Table 1). The expected chi-square values at the largest observed distances were not much smaller than 1 (minimum value 0.90) and no inflation was observed in the density estimate when 15% truncation was applied to the best model (0.63 with truncation versus 0.62 moose/km2 without truncation). Therefore we did not find evidence of inflated values resulting from limited observations at extreme values and the fit of the model was not improved with right truncation, therefore observations at the largest observed distances were not truncated. Further little evidence exists that the model fit was improved with the application of the uniform rather than a half-normal model key, and improvements in the fit and precision, however enticing, likely represent noise within the data rather than a better fit to the sample data. Therefore for the sake of consistency we report on the half-normal model key with cosine adjustments. The effect of group size on detection probabilities at distance was significant (slope -0.348, SE 0.17,,p= 0.02) and a size-biased regression method was applied to the resulting estimates, however including cluster size as a covariate did not improve model fit or affect the resulting estimates greatly (Table 1).

Table 1.

Parameter estimates and Akaike-information indices for the leading models. Upper and lower confidence limits are based on a 90% confidence interval. Density units are moose/km2. Model names are constructed with the detection function model keys (HN = half-normal, UN = uniform) and adjustement terms (Cos =cosine, SP= simple polynomial, H=hermite) and either stratification (S) and associated levels (0=no stratification, 1= 2 strata), or either cluster size as a covariate (MCDS) with (CS, S) or without stratification.

Model	N	D	CV	DLCL	DUCL	NLCL	NUCL	AIC	k
HN(Cos)S(1)	1618	0.644	0.144	0.508	0.816	1276	2051	1294.39	1
UN(Cos)S(1)	1554	0.618	0.128	0.500	0.765	1256	1922	1293.96	1
HN(Cos)MCDS(CS)	1621	0.645	0.145*	0.487	0.808	1224	2032	1291.77	2
HN(Cos)MCDS(CS,S)	1611	0.641	0.146*	0.473	0.781	1189	1963	1293.74	3
UN(SP)S(1)	1556	0.619	0.137	0.493	0.777	1240	1953	1295.29	2
HN(H)S(1)	1618	0.644	0.144	0.508	0.816	1276	2051	1294.39	1
HN(Cos)S(0)	1550	0.617	0.151	0.480	0.791	1550	1989	1294.39	1

*Variance cannot be estimated empirically when multiple covariates are used therefore we estimated variance with non-parametric bootstrapping, resampling transects for 100 iterations.

The estimated moose density was 0.64 moose/km2 (CV 0.14, 90%CI 0.51 – 0.82) and the total population size within WMU354 was 1618 moose (CV 0.14, 90%CI 1276 – 2051). The encounter rate across all strata was 0.176 moose/km (CV .129, 90%CI 0.142-0.219). The strata-specific observed density was 0.51 (CV 0.18, 90%CI 0.38 – 0.69) and 0.33 moose/km2 (CV 0.17, 90%CI 0.25 - 0.44), and encounter rate was 0.29 (CV

0.16, 90%CI 0.22 – 0.39) and 0.19 moose/km (CV 0.15, 90%CI 0.15 - 0.24) in high and low cutblock density, respectively. The estimated detection probability across all transects was 51.0% (CV 0.08, 90%CI 0.45 – 0.58) with an effective strip width of 284m (CV 0.08, 90%CI 250 – 322).

The calf:cow ratio was 0.28 (SE 0.039, 90%CI 0.22 – 0.34) and the bull:cow ratio was 0.23 (SE 0.049, 90%CI 0.15 - 0.31) for 106 classified groups. The estimated number of bulls in the total population was 304 bull, 1068 cow, and 246 calf moose. Most bulls had dropped their antlers therefore antler classification was not possible. While not always an indication of winter tick infestation, hair loss was observed in 3 moose, or 1.8% of the population (Percentage of body with hair loss was estimated at 5%, 10% and 20%). While hair loss is not conclusive of tick infestation it can provide an indication of tick prevalence and is most informative when data are collected late in the year, such as February.

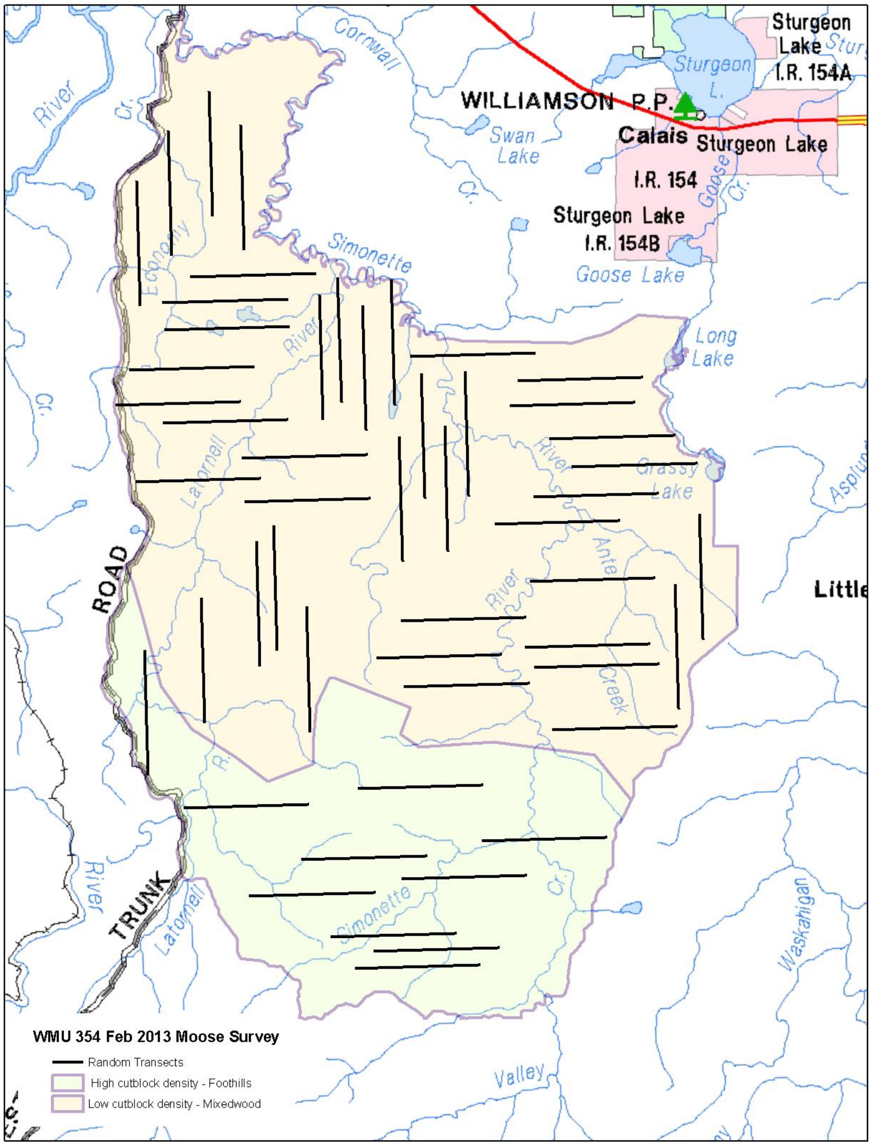

Figure 2. Fifty-one randomly generated transects were flown in WMU 354 on Feb 6 and 7, 2013. The lower foothills ecoregion with higher cutblock density is defined by the green fill, and the boreal mixedwood ecoregion with relatively less cutblock density is represented by the tan fill.

4. Discussion

Moose density was similar 0.64 moose/km2 (90%CI 0.51-0.82) to the 0.56 moose/km2 (90%CI 0.46 - 0.66) reported by Lynch (1997), although the 1997 density is reported for a much more marginal habitat across a much larger area. Limited resources did not permit the survey of WMU354 between 1997 and 2013 therefore it is difficult to establish recent trends. However, data from the previous 35 years suggests that the bull ratio has remained unchanged and the calf ratio is lower than average but within the limits observed across years (Table 2).

Due to the limited data we are unable to determine the influence of the calf season on calf ratios in light of confounding factors. For example, the moose population in 1997 would have been at peak levels evidenced by the dramatic winter tick collapse of 1998. Productivity and recruitment may have been higher due to milder winters, fewer roads, less natural predation (there was an intense wolf management program along the Simonette River in the 1980's). The limited entry draw for calf moose was implemented to assess the effects of a hunter take of calves on populations but we have limited rationale or incentive to continue this season. Although we expect that human harvest is not the dominant cause of calf mortality it is unclear how much influence it had on the lower than average calf ratio. Further, some suggest that the quality of a trophy antler season can be negatively affected by a concurrent calf hunt (Xu and Boyce 2010). Therefore, although the calf ratio is variable among years (Table 2) and alone is not an indication of the health of the population we find it prudent to eliminate the limited entry draw for calf moose in 354.

Table 2.

Summary of the observed classification of moose, and bull and calf ratios from previous surveys in the vicinity of WMU 354.

Year	Authors	Total sample	Bulls	Cows	Calves	Bull	Calf
1978	Bjorge and Gunson (1989)	119	12	80	27	0.15	0.34
1979	Bjorge and Gunson (1989)	158	22	104	32	0.21	0.31
1980	Bjorge and Gunson (1989)	168	14	105	49	0.13	0.47
1981	Bjorge and Gunson (1989)	172	24	118	30	0.20	0.25
1997	Lynch (1997)*	301	44	178	79	0.25	0.44
2013	Russell and Stepnisky (2013)	197	37	130	30	0.23	0.28

*Survey conducted in current boundaries of WMU353 and WMU354 but only data from blocks that fall within the current boundaries of WMU354 are included

4.1. Application to future management direction

Distance from the transect line was calculated by simple subtraction because all transects were oriented on Distance sampling methods provide a suitable alternative to Gassaway surveys for estimating population size, density and providing sex and age ratios. Winter ungulate surveys are challenged by financial cost, staff availability, and suitable weather conditions. Aerial ungulate surveys are prioritized according to ESRD's critical management concerns. We focus limited resources on units with high use, or obvious management concerns and often must neglect robust surveys of units with lower densities, fewer special licences (antlered only) or no pressing management concerns. This hinders our ability to react to changes in game populations in some WMUs. Many of the WMUs in the Upper and Lower Peace region contain sufficiently high densities of moose (and other species) and/or have high sightability at distance (farmland units) and therefore provide an excellent opportunity to implement distance sampling. At high moose densities, distance sampling methods provide significant savings when compared to our current Gassaway survey design, and therefore, the implementation of these methods will allow us to fly multiple WMUs in units with typical, or higher densities, (> 0.15 moose/km2) and therefore increase the frequency of coverage within our survey rotation. We have not been able to fly WMU 354 since 1997 due to limited funds. More frequent surveys will improve our ability to identify concerns in population trends, respond to changes within populations, evaluate the effect of management regulations on populations, and develop and validate population models for each WMU.

While the efficacy of distance sampling on moose populations in green zone, or more forested WMU's has been examined in the Upper Peace (Russell 2008, Peters et al. 2013, Stambaugh 2012) and proven robust it is unclear how this method will perform in more agricultural WMUs. However, distance sampling methods should be more appropriate in environments where sightability factors such as vegetation cover are reduced. Therefore we expect this method to perform well in WMU's within the white zone.

The efficacy of this method for deer and elk in Alberta are unknown. Distance sampling has been applied to populations that exhibit clustered distributions with success and we anticipate that with informed stratification this method will perform well in deer. Currently we survey elk with minimum total counts; however distance methods will allow us to measure precision as well. It is our opinion that this method will prove adequate in areas where these species are at high densities and where detection rates are reasonable. However, because precision is directly proportional to the number of observed clusters rather than sampling effort these species may require much more sampling than for moose. Methods for moose and deer will need to be modified and tested in the field. Before commencing surveys on deer and elk we should conduct a power analysis using the encounter rates observed in previous surveys where a density or total count is available to inform the feasibility of distance sample for these species. Also, methods that will address the difficulty of defining the limits of highly clumped distributions to clearly define the limits of a group to avoid counting individuals outside the observed group while not on the transect will need to be considered.

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