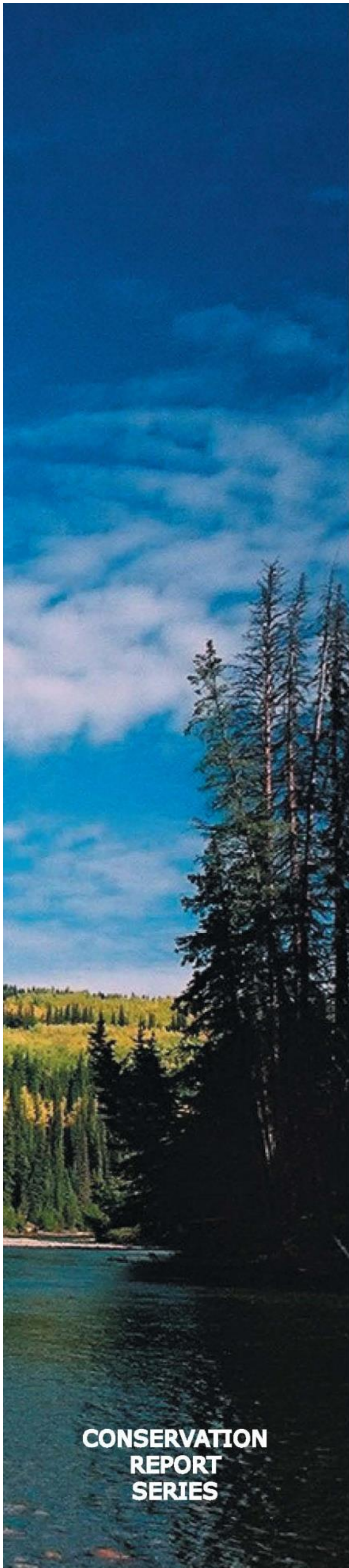

Delegated Big Game Surveys
2012/2013 Survey Season

Alberta Conservation Association

Conserving Alberta's Wild Side

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Delegated Big Game Surveys, 2012/2013 Survey Season

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Conserving Alberta's Wild Side

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EXECUTIVE SUMMARY

Alberta Conservation Association (ACA) uses levies on hunting and fishing licenses to collect and analyze population inventory data that can be used by Alberta Environment and Sustainable Resource Development (ESRD) in setting hunting and fishing seasons and regulations. Big game surveys (BGS) are currently used to determine the population status and trends for ungulates in select areas of Alberta, and provide information for setting hunting guidelines. Beginning in 2007, ACA became an active partner in delivering big game surveys, and now works collaboratively with ESRD to plan and conduct surveys and to summarize survey data. A portion of the overall survey plan is delegated to ACA for delivery (D-BGS) in collaboration with ESRD. During the 2012/2013 fiscal year, ACA funded and delivered 17[1] surveys across Alberta. These surveys included summer range trend surveys for pronghorn antelope and mountain goats, winter range trend surveys for elk, and random stratified block surveys for moose, white-tailed deer and mule deer. This document summarizes the methods used to conduct these surveys, as well as the survey results.

Key words: Alberta, aerial survey, big game, ungulates, pronghorn antelope, mountain goats, elk, moose, white-tailed deer, mule deer, population estimates

[1] All Antelope Management Areas (AMAs) were counted as individual surveys.

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The Alberta Conservation Association – Alberta Environment and Sustainable Resource Development Wildlife Program Agreement clarifies that ACA is delegated the responsibility to deliver a significant portion of the big game survey program in Alberta. Toward this end, we work collaboratively to plan surveys, collect and analyze data, and complete written summaries for the surveys conducted. We thank the following ACA and ESRD staff and volunteers who were involved in the planning and delivery of surveys in 2012/2013:

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1.0 INTRODUCTION

Alberta Conservation Association (ACA) is a non-profit, non-governmental organization that has been designated as a Delegated Administrative Organization by Alberta Environment and Sustainable Resource Development (ESRD) to assist with the responsibilities of conserving Alberta's fish and wildlife resources. A component of this partnership is the use of hunting and fishing levies to collect and analyze inventory data to better understand population trends, composition, and status, which can then be used by ESRD to set hunting and fishing regulations. Big Game Surveys (BGS) are an important method for estimating ungulate population data that is used both to set hunting allocations, and to keep the general public, and hunters in particular, informed of population trends.

Prior to 2007, ACA's role in the BGS program was limited primarily to funding survey flights, while ESRD determined the species and areas to be surveyed, conducted the surveys, and analyzed data to estimate populations, trends, and demographic parameters. In 2007, ACA became an active partner in the BGS program, and now works collaboratively with ESRD to plan and conduct surveys and to analyze and report on survey results. ESRD continues to set provincial priorities for survey locations and rotations, and uses these data to manage big game populations. A portion of the overall survey plan is delegated to ACA for delivery (D-BGS).

ACA is committed to providing detailed annual reports that describe the outcome of these surveys. Annual reports condense and combine all delegated survey information into one document, streamlining access to big game population indices for the general public, hunters, ESRD, and ACA staff. The following annual report summarizes the surveys conducted from 1 April 2012 to 31 March 2013.

During the 2012/2013 survey cycle, the Wildlife Management Branch of ESRD delegated 20 big game surveys to ACA, with a number of surveys identified as condition-dependent, pending adequate snowfall and sufficient funding. Overall, the summer and winter survey seasons were a success, with a total of 17 surveys completed. Specifically, we conducted at least one survey for moose (*Alces alces*), white-tailed deer (*Odocoileus virginianus*), mule deer (*Odocoileus hemionus*), elk (*Cervus elaphus*), mountain goats (*Oreamnos americanus*), and pronghorn antelope (*Antilocapra americana*). Details for each individual survey[2] are described in the following sections. Additional surveys were conducted by ESRD as part of their internal survey activities, but are not included in this report.

2.0 SELECTING SURVEY PRIORITIES

As the government agency responsible for managing big game within Alberta, ESRD sets the long-term priorities for big game surveys. In many cases, wildlife management units (WMUs) are surveyed on a three to five year rotational basis to enhance management decisions. Surveys may also be prioritized in order to assess the effectiveness of specific management actions, determine the effects of harsh winters, or in response to unique information requirements for a specific species or area of the province. ACA works collaboratively with ESRD to develop short-term (three year) plans for the implementation of surveys to ensure that they fall within budget constraints. In addition, because of the rarity of good survey conditions (complete snow cover, coupled with low winds and high visibility) in some areas of the province, several condition-dependent surveys are identified each year that are given priority if weather conditions are favourable.

3.0 SURVEY METHODS

The techniques used to survey Alberta's big game vary across the province according to the habits and habitats of the species of interest, weather conditions that may affect animal movement or sightability, and the safety features of various aircraft. In general, three main approaches are used, each with its own advantages and limitations.

[2] Some related surveys have been grouped into a single report section to facilitate comparison (e.g., all antelope management area surveys are in Section 4.1).

3.1 Summer range trend surveys

For some species, including mountain goats and pronghorn antelope, the contrast between their coat colour and vegetation, coupled with the openness of their habitats, allows population surveys to be conducted during summer months. Summer surveys are ideal from a harvest management perspective because they allow the population status to be assessed immediately prior to the hunting season and inherently incorporate over-winter mortality, unlike traditional winter surveys. While useful for monitoring long-term changes in big game populations, summer range trend surveys do not necessarily allow the complete enumeration of population numbers, and therefore are most useful when compared to counts from previous years to estimate trend. However, trend surveys do not provide a measure of precision around the estimate and therefore do not enable a robust comparison of population estimates among years or regions.

Mountain goat summer ranges are intensively searched by rotary-winged aircraft (helicopter) during the cool parts of the day when goats are most active and visible. In addition to recording the total number of goats seen on each mountain range complex, surveyors enumerate the number of adults, yearlings, and kids, whenever possible.

Pronghorn antelope surveys are conducted by surveying 1.6 km wide transects within long-term census blocks that have been established across pronghorn range. A minimum estimate of pronghorn density (# animals/km^2) for the survey blocks in each antelope management area (AMA) is calculated by dividing the number of animals observed by the total area (km^2) of the survey transects flown. In addition, classification by sex and age allows for estimation of buck/doe/kid ratios for each herd.

3.2 Winter range trend surveys

For some species, including elk, bighorn sheep, and bison, the presence of distinct winter ranges that are predictably occupied year-after-year provides the opportunity to conduct annual minimum population counts. These counts are used to estimate the population trend (increasing, decreasing, or stable) and key demographic information, including male/female/young ratios and the percent of males in various size categories. As with summer range surveys, winter range surveys are useful for monitoring long-term changes in big game populations, but inevitably do not provide a complete enumeration of the population, and therefore are most useful when compared to counts from previous years to estimate trend. Trend surveys also do not provide a measure of precision around the estimate and therefore do not enable a robust comparison of population estimates among years or regions.

Trend surveys are typically conducted by helicopter during ideal weather conditions, such as after a recent snowfall when winds are low. In some cases, fixed-wing aircraft may be used to locate groups of animals for subsequent counting by helicopter. The navigator directs the pilot to known traditional winter ranges, where the area is searched intensively to determine if animals or tracks are present. When animals are seen, the pilot maneuvers the aircraft so that surveyors can estimate a total count and enumerate the numbers of males, females, and offspring. These classifications may not be possible for all species, especially during late winter when many male ungulates have dropped their antlers. On ranges with large herds, the survey team may take photographs to allow for more accurate counts.

3.3 Random stratified block surveys

When possible, ACA strives to implement aerial survey approaches that provide statistically rigorous estimates of big game population numbers and densities within each WMU. In most cases, this is facilitated by using the 'Gasaway Method' (Gasaway et al. 1986) to design and implement counts in a random selection of sample units. This approach has widespread application for moose and deer in areas where the forest cover is sparse enough to allow good sightability. In addition to providing accurate population estimates, this approach often allows estimates of male/female/young ratios, as well as the relative number of small, medium, and large-antlered males, if surveys are conducted prior to antler drop.

The Gasaway Method divides a WMU or group of adjacent WMUs into smaller sample units that are approximately equal in size, and then classifies each sample unit into a stratum that describes the relative number of animals that are expected to be present within that block. Stratification can be based on counts from fixed-wing aircraft immediately prior to the intensive portion of the survey, previous knowledge of big game distribution within the WMU, or habitat features within each survey block. Following stratification, a portion of the blocks within each stratum are randomly selected for intensive searching via helicopter. During surveys, each block is thoroughly searched and surveyors classify each animal observed as an adult male, adult female, or young, whenever possible. A series of calculations allow the number of animals observed in the sample units to be converted to a population estimate for the entire WMU, and the error associated with the estimate is determined. Additional blocks are surveyed until the error is deemed acceptable (typically error is below 20% for a 90% confidence interval).

3.4 Population recruitment surveys

Total population estimates are used in conjunction with estimates of reproduction and mortality to model how a big game population may be changing throughout the year or during intervening periods between population surveys. These models can be used to track the population's rate of change, to identify appropriate harvest levels, or to predict how changes in harvest level might influence the overall population in the short and long-term. The D-BGS program contributes information to these modeling exercises by providing information on the number of offspring recruited into a population in a given year. These data may be collected by three general means. The first method involves intensively searching areas of known big game distribution and good sightability to find females. The number of offspring observed with these females is used to calculate a reproductive rate. The second method involves locating radio-collared females and recording the number of offspring observed with the associated group. This method provides more reliable data, but is less common as it is generally only associated with larger studies that have deployed radio collars for other purposes. The third method records the number of offspring observed during random stratified block or trend surveys. Although this method provides an efficient use of resources, it is usually only a secondary objective of the survey and may not provide an adequate level of data collection in all cases.

3.5 Classification by antler size

Beginning in 2008/2009, survey crews across the province began using a standardized classification system for adult male big game species (Table 1). This system allows comparisons among WMUs of the relative number of small, medium, and large-antlered big game of various species. However, because of variability in the timing of antler drop by age class across years, comparisons of the percentage of small, medium, and large males may not be possible for surveys that are conducted during mid to late winter.

Table 1. Standardized classification system used to determine antler size classes of male big game species in Alberta.

Size Class	Moose	Deer	Elk
Small	Antler pole type, usually a spike or fork; if palmated, does not extend beyond ear tip.	Spike or 2 points on one or both antlers.	Spike antlers or with light 1 to 2 point antlers.
Medium	Antlers palmated, with spread < ½ of body length.	Small to medium size antlers with 3 or more points/antler; antlers inside ears.	Small antlers with 3 to 5 points/antler.
Large	Antlers palmated, with spread > ½ of body length.	Large antlers with 4 or more points/antler; antlers outside of ears.	Large antlers with 6 to 7 points/antler, massive.

4.0 SUMMER RANGE TREND SURVEYS

4.1 Pronghorn antelope

Section Authors: Blair Seward, Mike Grue, Kim Morton, and Ed Hofman

Aerial surveys for pronghorn antelope are conducted annually to provide information on population density, distribution, and composition within a series of long-term trend survey blocks. This information is used by ESRD to extrapolate an estimate of population size for each antelope management area (AMA), which in turn influences harvest objectives for the upcoming fall hunting seasons. Recreational hunting opportunities for pronghorn antelope in Alberta are highly sought after, making the information collected during the annual aerial survey an important component of provincial pronghorn management. This summary describes data collected during the 2012 survey conducted in AMAs A to H (Figure 1).

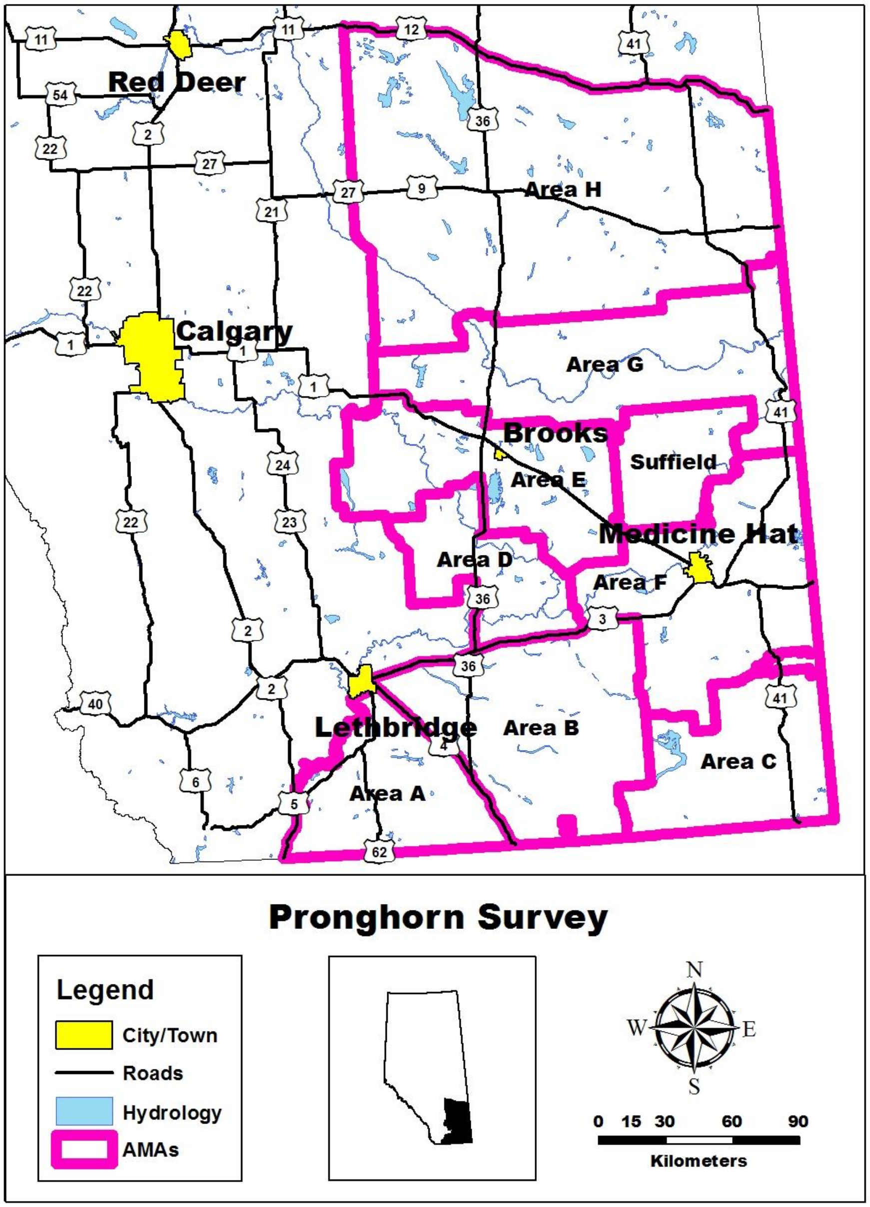

Figure 1. Location of pronghorn antelope management areas (AMA) in Alberta.

4.1.1 *Survey methods*

We conducted pronghorn antelope surveys from 11 – 19 July 2012, following an established trend survey protocol developed within Alberta. Each AMA contains designated survey blocks with fixed strip transects, which we surveyed from a rotary-winged aircraft. To reduce survey costs, we conducted non-stop, three hour flights with the support of a mobile fuelling trailer. We divided each survey day into two periods, with the first flight commencing at approximately 0800 h and the second flight beginning toward evening, after the heat of the day. The survey crew consisted of the pilot, the navigator, and two rear-seated observers in a Bell 206L helicopter. Primary observers maintained constant observation of the ground out to a distance of 0.8 km perpendicular to the flight line, on each side of the aircraft. The navigator kept the aircraft on course, recorded observations, and assisted with ground observation and herd classification, whenever possible. Observers counted all pronghorn observed on the transects, and classified the number of bucks, does, and kids, whenever possible. Counts also include individuals seen while off the center of the flight line but still within the 1.6 km strip width. This likely biased our result by placing more effort in areas with higher pronghorn density. The GPS location of all observed individuals and groups was recorded.

4.1.2 *Observed pronghorn density*

We calculated a minimum estimate of pronghorn density (# animals/km^2) for the survey blocks in each AMA by dividing the number of animals observed by the total area (km^2) of the survey transects that were flown. We did not correct for sightability; therefore, overall counts should be considered as minimum estimates. Direct comparison of trend survey results among years should be interpreted as an indication of a trend rather than a robust comparison of the actual population number.

4.1.3 *Results*

During the 2012 survey, we counted 460 bucks, 1,208 does, and 359 kids. Observed pronghorn density (# animals/km^2), buck to doe ratios, and kid to doe ratios, calculated by AMA, are presented in Table 2. This year's average pronghorn density for all AMAs is almost identical to the previous year, showing increases in some AMAs and decreases in others. Overall, observed pronghorn densities have remained lower than in 2009 and prior years, suggesting that the herd may still be recovering from a series of harsh winters and lower kid recruitment. The average ratio for all AMAs for kids/100 does was approximately equal to the previous year (2011) and closely parallels 2007 – 2009 densities.

Table 2. Comparison of pronghorn antelope survey results from 2007 – 2012.

	Antelope Management Area								
	A	B	C	D	E	F	G	H	S
2012 Survey									
Observed pronghorn density (pronghorn/km^2)	0.33	0.27	0.62	0.27	0.16	0.40	0.28	0.13	--
Bucks/100 Does	47	50	24	25	45	48	38	48	--
Kids/100 Does	50	36	19	21	14	28	42	52	--
2011 Survey									
Observed pronghorn density (pronghorn/km^2)	0.21	0.32	0.47	0.30	0.35	0.34	0.31	0.17	--
Bucks/100 Does	64	40	34	39	31	42	28	36	--
Kids/100 Does	26	40	15	8	43	34	53	53	--
2010 Survey									
Observed pronghorn density (pronghorn/km^2)	0.39	0.54	0.68	0.36	0.63	0.42	0.43	0.19	1.12
Bucks/100 Does	47	45	48	45	48	53	50	43	54
Kids/100 Does	20	33	15	17	12	26	29	37	20
2009 Survey									
Observed pronghorn density (pronghorn/km^2)	0.63	0.39	0.93	0.62	0.89	0.50	0.44	0.27	0.95
Bucks/100 Does	38	66	43	60	39	35	62	35	66
Kids/100 Does	39	58	22	42	42	35	34	29	47
2008 Survey									
Observed pronghorn density (pronghorn/km^2)	0.50	0.43	0.98	0.95	0.90	0.38	0.50	0.25	--
Bucks/100 Does	40	47	59	44	50	32	52	65	--
Kids/100 Does	21	42	28	30	27	43	47	31	--
2007 Survey									
Observed pronghorn density (pronghorn/km^2)	0.48	0.44	0.96	0.93	0.65	0.53	0.37	0.19	--
Bucks/100 Does	24	46	42	24	48	30	45	68	--
Kids/100 Does	30	67	30	52	37	37	50	39	--

"--" Area S (Suffield) not surveyed.

4.2 Wildlife Management Units 439 – 444, and 446 mountain goats

Section Authors: Mike Ranger and Jeff Kneteman

Extensive annual surveys for mountain goats have been conducted in Willmore Wilderness Park and adjacent areas since 1974. With permission from the Superintendent of Jasper National Park, the survey area was expanded (beginning in 1979) to include mountain complexes straddling the Jasper Park boundary. The objective of annual goat surveys in Wildlife Management Units (WMUs) 439 – 444, and 446 (Figure 2) is to collect data on population trends, distribution, and herd composition, and to monitor the status of these mountain goat herds.

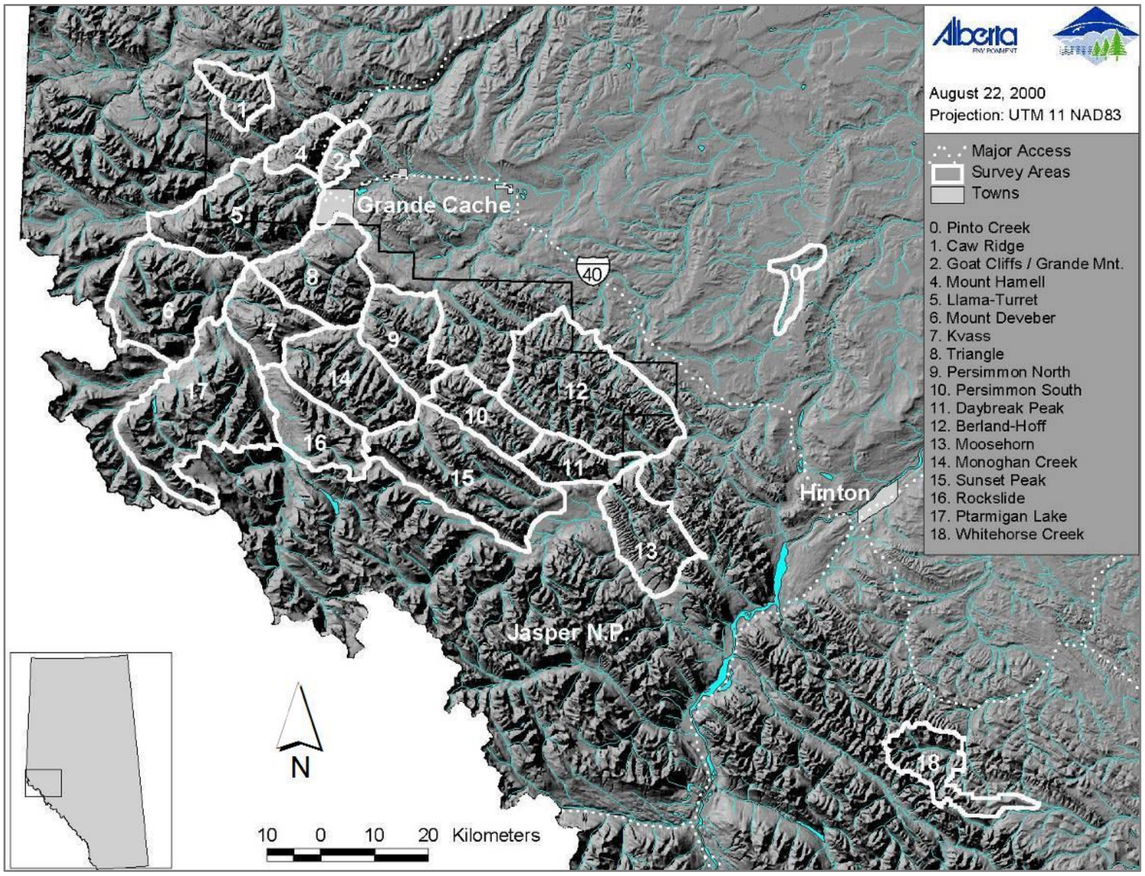

Figure 2. Location of the Wildlife Management Units 439 – 444, and 446 mountain goat survey area in Alberta.

4.2.1 Survey methods

The survey area is comprised of 17 mountain complexes and 1 canyon complex in the forested foothills of WMUs 439 – 444, and 446 (Figure 2). We surveyed 13 complexes beginning on 25 June 2012, followed by flights on 28 – 30 June, and 4 – 5 July 2012, using a Bell 206B helicopter flown counter-clockwise around each mountain complex between timberline and ridge top. Air speed ranged from 120 – 150 km/h. The left front passenger navigated, observed, and plotted checkpoints on a 1:250,000 scale topographic map. GPS locations were recorded for each group of goats. The two rear passengers observed and recorded species classifications and counts onto field datasheets. When herd size and/or location made classification difficult for observers or dangerous for mountain goats, the helicopter landed at a distance of approximately 0.8 km and we classified goats using a 20 – 45X variable spotting scope. Flights typically occurred between 0600 – 1100 h and

1600 – 2200 h during the goats' most active periods. Exact survey flight paths vary from year to year; thus, comparison of overall counts between years is cautioned and should only be considered as a long-term trend. We did not correct for sightability; therefore, overall counts should be considered as minimum estimates. These counts do not have estimates of precision, and therefore direct comparison of survey results among years or regions is difficult.

Weather conditions in this region are typically variable with high winds or low cloud cover often grounding aerial surveys for a day or more at a time. However, we were able to work within limited windows when weather conditions were considered acceptable. During the six survey days, temperatures varied from +5 to +19 degrees Celsius, cloud cover ranged from 0 – 100%, and wind speeds varied from 0 – 40 km/h. On 3 July 2012, light snow fell in portions of the survey area, potentially affecting sightability for surveys on 4 July 2012, and could have resulted in missed mountain goat observations. However, by the morning of 5 July 2012, the fresh snowfall had melted and sightability returned to levels comparable to earlier in the survey.

4.2.2 Results

In 2012, we observed a total of 431 goats (327 adults, 16 yearlings, and 88 kids) with ratios of 27 kids/100 adults, and 5 yearlings/100 adults (Table 3). For the 6 mountain complexes surveyed most frequently between 1979 and 2012 (Table 4), kid to adult ratios for 2012 were equal to the average, and yearling to adult ratios for 2012 were lower than the average. Total counts of goats on individual complexes in 2012 were higher than the long-term averages for 2 of 13 complexes surveyed (Deveber and Sunset Peak), and lower for 11 of 13 complexes surveyed (Caw Ridge, Berland-Hoff, Daybreak, Goat Cliffs, Llama-Turret, Monaghan, Moosehorn, Mt. Hamel, North Persimmon, Rockslide, and Triangle).

In 2012, total counts were higher than 2011 counts on 5 complexes (Daybreak, Deveber, Goat Cliffs, Monaghan, and North Persimmon), comparable on 3 complexes (Llama-Turret, Rockslide, and Triangle), and lower on 3 complexes (Caw Ridge, Moosehorn, and Mt. Hamel). One complex (Sunset Peak) exceeded total goats counted during the previous survey from 2008, and 1 complex (Berland-Hoff) had lower counts than the previous survey from 2009.

Table 3. Mountain goat population counts within each mountain complex of Wildlife Management Units 439 – 444, and 446 in 2012.

Complex	Adult	Yearling	Kid	Unclassified	Total
Caw Ridge	50	1	15	0	66
Berland-Hoff	3	0	0	0	3
Daybreak	18	0	5	0	23
Deveber	52	6	14	0	72
Goat Cliffs	31	0	5	0	36
Llama-Turret	39	2	12	0	53
Monaghan	36	0	6	0	42
Moosehorn	0	0	0	0	0
Mt. Hamel	23	0	8	0	31
North Persimmon	24	4	9	0	37
Rockslide	14	1	2	0	17
Sunset Peak	22	2	8	0	32
Triangle	15	0	4	0	19
Total	**327**	**16**	**88**	**0**	**431**

Table 4. Mountain goat population counts for six mountain complexes (Caw Ridge, Daybreak, Goat Cliffs, Llama-Turret, Moosehorn, and Mt. Hamel) flown on a consistent basis in Wildlife Management Units 439 – 444, and 446 from 1979 – 2012.

	Number of mountain goats				
Year	Adults	Yearling	Kid	Unclassified	Total
Jul. 2012	161	3	45	0	209
Jul. 2011	183	15	25	0	223
Jul. 2010	260	18	25	0	303
Jul. 2009	192	13	36	81	322
Jul. 2008	221	11	51	0	283
Jul. 2007	236	21	40	9	306
Jul. 2005	269	31	63	5	368
Jul. 2004	299	17	63	5	384
Jul. 2002	302	15	75	9	401
Jul. 2001	223	20	70	43	356
Jul. 1999	230	27	79	34	362
Jul. 1998	245	21	79	11	375
Jul. 1997	227	14	56	8	305
Jul. 1996	260	32	75	0	367
Jul. 1995	248	26	76	0	350
Jul. 1994	205	19	76	0	300
Jul. 1993	214	11	66	10	301
Jul. 1990	194	20	67	40	321
Jul. 1989	160	31	64	0	255
Jul. 1986	219	19	45	3	286
Jul. 1984	214	25	75	0	314
Jul. 1983	245	38	80	12	375
Jul. 1980	160	28	66	0	254
Jul. 1979	219	72	91	3	385

5.0 WINTER RANGE TREND SURVEYS

5.1 Wildlife Management Unit 212 elk

Section Author: Mike Jokinen

The elk population in Wildlife Management Unit (WMU) 212 has been increasing over the past two decades as determined by aerial surveys, incidental reports, field counts, and anecdotal landowner observations. This WMU was restricted to archery hunting; however, rifle hunts have been introduced recently in an attempt to reduce the elk population to comply with the social carrying capacity of local landowners. An aerial survey of elk in WMU 212 was conducted in January 1996, just prior to an antlerless elk rifle quota hunt. At 560 elk, counts exceeded desired levels, thus additional measures were taken to reduce the elk population through live trapping and relocation, which was deemed the preferred method for population management by the local community. In January 2002, another aerial survey was implemented, following several winters of successful elk relocations, which revealed a reduction in the elk count to 391. While the trapping program was successful in the first five years (422 elk relocated), success eventually diminished and consequently, the elk population again increased.

A third aerial survey was conducted in January 2008, following a second antlerless elk rifle quota hunt held in December 2007; the elk count then totaled 913. In December 2008, a primitive weapons antlerless elk hunt was held and another aerial survey was completed in February 2009; the number of elk observed totaled 914. This represented a 234% increase in the elk count since the 2002 survey. Following the 2009 survey, 169 elk were captured and relocated to an area west of Rocky Mountain House. Beginning in 2010, the primitive weapons hunting season was extended into January. In February 2011, another aerial survey was completed and a total of 710 elk were observed. An additional 19 elk were captured in 2012 and relocated. The successful trapping effort together with the extension of the annual primitive weapon hunt have reduced the population; however, it may be necessary to continue reducing elk numbers in this WMU through a combination of trapping, quota hunts, special license draws, and other methods in order to meet the social carrying capacity.

The results of the 2013 WMU 212 aerial survey will be used by ESRD to determine hunter permit allocations, translocation goals, and other potential management options for elk population control.

5.1.1 Study area

Elk range in WMU 212 is limited to an area southwest of the City of Calgary (Figure 3). Occasional movements of elk from adjacent WMUs into the area, or movements of elk into normally unoccupied range may occur, but the majority of wintering elk are located within an area south of Highway 22X and west of secondary Highway 552, towards the WMU western boundary. This area consists of considerable tree cover interspersed amongst farmland, rangeland, acreages, and subdivision developments. All areas offering suitable cover were surveyed, however the area is populated with many acreages and landowners that have horses, and it was necessary to avoid these areas. Most of the elk tend to be in large groups during the winter months, and are thus readily observed. There are smaller groups of bulls that often separate from the main herds and disperse into more isolated locations. However, it is expected that most of these smaller groups of bulls were observed during this survey as all suitable forested cover was surveyed.

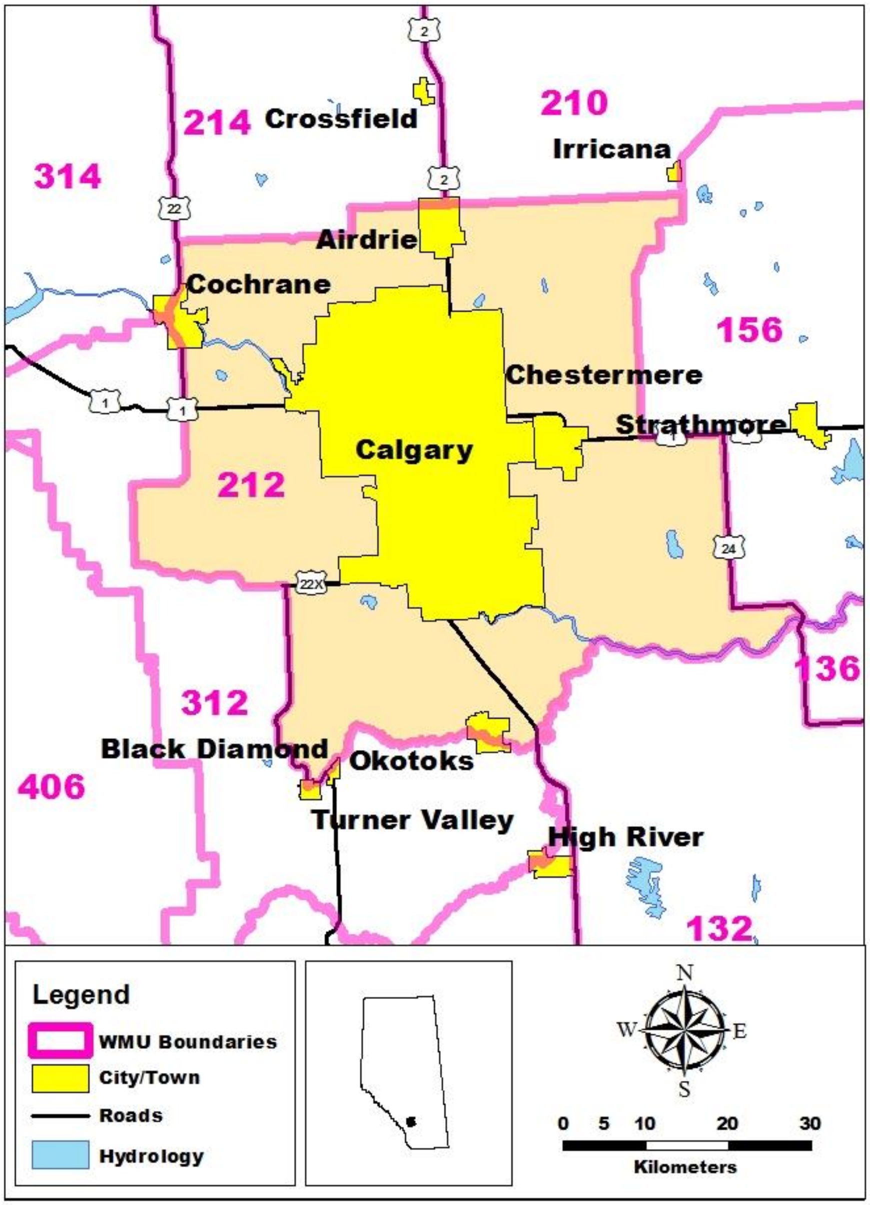

Figure 3. Location of Wildlife Management Unit 212 in Alberta.

5.1.2 Survey methods

The aerial survey was conducted on 7 March 2013 using a Bell 206B helicopter. The crew was based at a private property outside of the town of Okotoks (Highwood Helipad). The survey commenced at the north end of the WMU and transects were flown in an east to west direction to ensure complete coverage of the area. The crew was comprised of a pilot, a navigator in the front seat of the helicopter, who ensured that all suitable elk range was covered, and two observers in the rear seat on each side of the helicopter. The navigator used a laptop computer and GPS real-time tracking to assist with navigation. The navigator recorded GPS locations and observations on survey sheets, classified elk using image stabilizing binoculars, and took photographs of large elk groups. Photographs were later reviewed on a computer to get accurate total elk group counts. Rear-seated observers recorded backup GPS locations with a handheld GPS, conducted total counts of elk groups, and tallied classifications of large elk groups. When an elk herd was encountered, the aircraft would hover or circle the herd from a distance while photos were taken, and counts and classifications were made. Elk groups were seldom disturbed and often remained bedded or in the location where they were initially observed. Elk were classified into cows, calves, and bulls where possible. The bulls were further classified as small, medium, or large, based on antler size (ASRD 2010). For large groups, all identifiable bulls and calves were classified using image stabilizing binoculars, and all remaining antlerless elk were considered cows. However, it is likely that some of the antlerless animals recorded as cows were calves as large groups are challenging to classify, even when using image stabilizing binoculars.

Survey conditions were very good with overcast but bright skies, which provided excellent visibility through the forested areas. Temperatures ranged from -11 to -9 degrees Celsius. Winds were low during the survey with the highest wind speeds estimated at 5 km/h. We did not correct for sightability; therefore, overall counts should be considered as minimum population estimates and direct comparisons of survey results among years may be difficult.

5.1.3 Results

Elk observations were recorded at 15 sites during the 2013 aerial survey, ranging from a single animal to a large group of 312 individuals. Aside from the large group, elk were generally in smaller groups and were more widely dispersed throughout the survey area. The total number of elk observed during the 2013 survey was 514 (Table 5). This represents an approximate 131% increase in the elk count since the 2002 survey (391 elk counted), but a 28% reduction since the 2011 survey (710 elk). For the past two surveys, elk numbers have been decreasing from the highs previously observed during the 2008 and 2009 surveys. However, during the 2013 survey, 337 elk were observed close to the western boundary of WMU 212, but within WMU 312. Additionally, south of Highway 549, elk tracks were observed heading in the direction of WMU 312 from WMU 212. Two elk groups were observed in the general area of the tracks; one group of 33 elk, and one group of 113 elk. Overall, bull elk numbers appear to be increasing when compared to previous surveys, with a high of 102 bulls in 2013; however, this may be related to high numbers of unclassified elk in previous surveys.

Table 5. Minimum elk population counts in Wildlife Management Unit 212 from 1996 – 2013.

	Number of elk				
Year	Males	Females	Juveniles	Unclassified	Total
2013	102	342[a]	70	0	514
2011	36	413	60	201	710
2009	66	17	2	829	914
2008	37	355	81	440	913
2002	32	--	--	359	391
1996	94	--	--	466	560

[a] Some females may in fact be juveniles, misclassified during counts of larger groups.
"--" All antlerless elk were recorded as unclassified.

5.2 Wildlife Management Units 310 and 312 elk

Section Authors: Ryan Hermanutz and Mike Jokinen

Winter trend surveys for elk populations have been conducted since the mid-1970s on known elk ranges in Wildlife Management Units (WMUs) 310 and 312. The primary objective of these surveys has been to estimate the total count of elk within these units; however, important demographic attributes such as sex and age ratios have also been sampled, when possible.

5.2.1 Study area

WMUs 310 and 312 are relatively small units (1,067 km^2 and 1,761 km^2 respectively) located southwest of Calgary (Figure 4). The boundaries for these WMUs are irregularly shaped and generally follow landscape features such as watercourses, as well as anthropogenic features such as highways and forest reserve boundaries. The boundary of WMU 310 borders the Bow – Crow forest reserve to the west, secondary Highway 532 in the south, Highway 541 in the north, and Highway 2 to the east; however, only a small fraction (approximately 150 km^2) of WMU 310 is surveyed for wintering elk. The survey area is located in the very southwest corner of the WMU, east of Highway 22 and south of Pekisko Creek. The perimeter of WMU 312 is bounded to the east by highways 2, 22, and 22X, as well as the Sheep River, to the west by the Bow – Crow forest reserve, to the south by the Highwood River, and to the north by the Sarcee and Stoney Indian reservations. The majority of WMU 312 is surveyed for wintering elk with the exception of a small area in the southeast (east of Highway 22 and south of Highway 7).

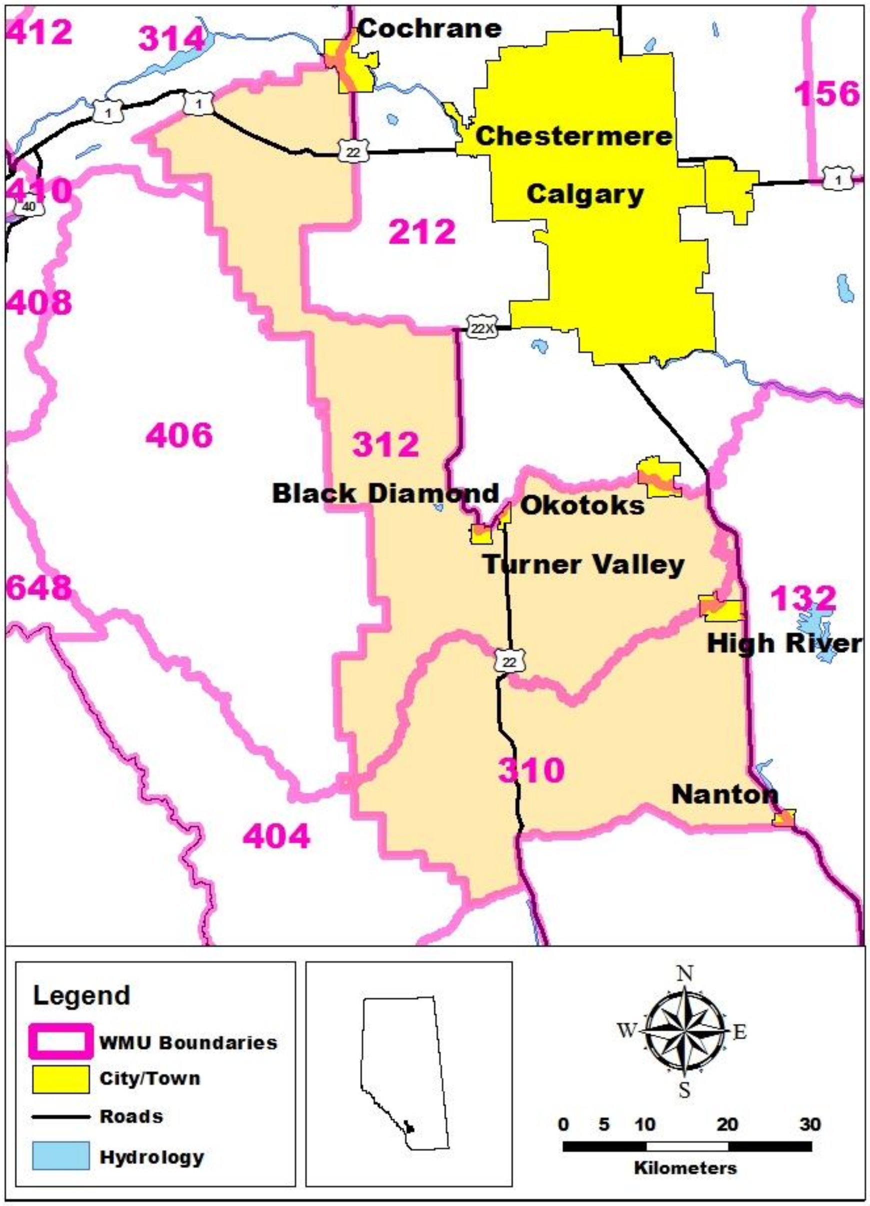

Figure 4. Location of Wildlife Management Units 310 and 312 in Alberta.

The landscape of WMUs 310 and 312 is rolling and lightly forested, lying within the Foothills Fescue, Foothills Parkland, and Montane natural subregions (Natural Regions Committee 2006). The WMUs are dominated by acreages and small farming operations, but also include numerous large farms and ranches. This region has a significant amount of ranching history (i.e., the Cowboy Trail, OH ranch, and Bar U Ranch National Historic Site). Industrial influences on the landscape include oil and gas extraction and forestry.

5.2.2 *Survey methods*

A minimum count for elk was collected using standard trend survey methods (ASRD 2010). We used elk observations and GPS tracklogs from the 2008 winter elk trend survey to target previous wintering ranges; however, we also included additional areas to ensure that elk were not missed. To ensure adequate coverage, the survey was flown using both east to west, and north to south transect lines with spacing between transects ranging from approximately 800 m to 1500 m depending on visual obstructions (valleys, ridges, forest cover).

Aerial surveys took place on 7 – 8 March 2013, using a Bell 206B helicopter. The survey crew was comprised of one pilot and one navigator in the front seat of the helicopter, and two observers in the back seat, one on each side of the helicopter. To assist with navigation and ensure all suitable elk range was surveyed, the navigator used a laptop computer and GPS real-time tracking system. The navigator recorded elk locations, logged observations on survey datasheets, classified sex and age of elk using image stabilizing binoculars, and took photographs of large (50+ animal) elk groups. Rear-seated observers recorded backup elk locations on a handheld GPS unit, conducted total counts of elk, and assisted in sex and age classification. When an elk herd was encountered, the aircraft would hover or circle the herd from a distance while photographs were taken and counts and classifications were made. Photographs were later reviewed on a computer to obtain accurate total elk group counts.

Elk were classified by sex (bull, cow, calf, or unclassified) based on presence or absence of antlers and on relative body size and shape of head. Bull elk with antlers were further classified as small, medium, or large based on standard antler classification criteria (ASRD 2010). For large groups, all identifiable bulls and calves were classified using image stabilizing binoculars and all remaining antlerless elk were considered cows. However, it is likely that some of the antlerless animals recorded as cows were calves, as large groups are challenging to classify, even when using image stabilizing binoculars. All efforts were made to limit disturbance of elk groups and minimize animal movements.

Survey conditions were very good with overcast but bright skies, which provided excellent visibility through the forested areas. Snow cover was 100%; however, snow depth in the southwest portion of WMU 310 and the north end of WMU 312 was relatively light. Temperatures ranged from -11 to +2 degrees Celsius. Winds were low during the survey with the highest wind speeds estimated at 5 – 10 km/h. We did not correct for sightability; therefore, overall counts should be considered as minimum population estimates and direct comparisons of survey results among years may be difficult.

5.2.3 Results

We observed a total of 225 elk in WMU 310 (Table 6), and 1,667 elk in WMU 312 (Table 7), for a combined total of 1,892 elk.

Elk observations were recorded at 4 sites in WMU 310 during the 2013 survey, ranging from a group of 3 animals to a large group of 199 individuals. The elk count in WMU 310 was 31% lower than the previous survey in 2008 (Table 6); however, the 2013 total is comparable to the average for the 13 surveys flown in this unit between 1980 and 2008 (Table 6). However, the 2013 elk trend count remains lower than the documented highs recorded in the early 1980s. The ratio of bulls to antlerless elk continues to increase in this WMU, while the ratio of large bulls to antlerless elk was low, similar to previous surveys. Elk tracks, likely the result of a large group, were observed along the western boundary of WMU 310, yet no elk were observed in the area; the group may have been in the adjacent WMU 404 during the time of survey.

The trend count in WMU 312 continues to increase from its low during the late 1980s, with the largest elk count to date observed in 2013 (Table 7). The 2013 totals are 70% higher than the previous survey in 2008. A large number of unclassified elk have been recorded in previous surveys, which makes comparing bull/cow/calf ratios over time difficult for this unit. In 2013, elk observations in WMU 312 were recorded at 35 locations ranging from one animal to a large group of 375 individuals. There were six groups of elk that were greater than 100 animals in size. A number of large groups of elk were observed along the eastern boundary of WMU 312, bordering WMU 212, and it is likely that some of these elk herds typically occupy WMU 212, where the count was lower this year.

Table 6. Minimum elk population counts in Wildlife Management Unit 310 from 1980 – 2013.

	Number of elk				
Year	Males	Females[a]	Juveniles	Unclassified	Total
2013	45	142	38	0	225
2008	23	98	13	190	324
2004	45	--	--	207	252
2002	21	--	--	246	267
2000	44	--	--	129	173
1998	6	--	--	109	115
1996	23	--	--	98	121
1993	**	**	**	**	137
1989	**	**	**	**	195
1987	**	**	**	**	174
1986	**	**	**	**	210
1982	**	**	**	**	343
1981	**	**	**	**	331
1980	**	**	**	**	402

[a] Some females may in fact be juveniles, misclassified during counts of larger groups.
"--" All antlerless elk were recorded as unclassified.
"**" Demographic data were not provided.

Table 7. Minimum elk population counts in Wildlife Management Unit 312 from 1980 – 2013.

Year	Number of elk				
	Males	Females[a]	Juveniles	Unclassified	Total
2013	157	1201	309	0	1667
2008	110	149	44	676	979
2004	80	--	--	733	813
2002	86	--	--	750	836
2000	99	--	--	482	799
1998	75	--	--	463	538
1996	77	--	--	642	719
1993	**	**	**	**	415
1989	**	**	**	**	442
1987	**	**	**	**	265
1986	**	**	**	**	354
1982	**	**	**	**	335
1981	**	**	**	**	265
1980	**	**	**	**	401

[a] Some females may in fact be juveniles, misclassified during counts of larger groups.
"--" All antlerless elk were recorded as unclassified.
"**" Demographic data were not provided.

6.0 RANDOM STRATIFIED BLOCK SURVEYS

6.1 Wildlife Management Unit 118 mule deer

Section Authors: Corey Rasmussen and Blair Seward

Wildlife Management Unit (WMU) 118 was surveyed as part of the aerial ungulate survey rotation for the prairies area; the last survey of this unit was conducted in 2008. As with the prior survey, this WMU was only stratified for mule deer in 2013. The number of white-tailed deer observed was recorded; however, no population estimate was calculated. Survey results will be used to estimate changes in population numbers and herd composition over time and to help determine tag allocations.

6.1.1 Study area

WMU 118 is a relatively small unit (1,971 km^2) located in the Grasslands natural region, in the SW corner of Alberta (Natural Regions Committee 2006). The WMU extends from its northern boundary at Cypress Hills Provincial Park to its southern boundary at Highway 501, and from its western boundary at the hamlet of Manyberries to its eastern boundary at the Alberta-Saskatchewan border (Figure 5). The WMU is predominately native prairie with some cultivation. Most of the mule deer wintering habitat in the WMU is associated with Lodge Creek, Manyberries Creek, and South Manyberries Creek (ACA 2008).

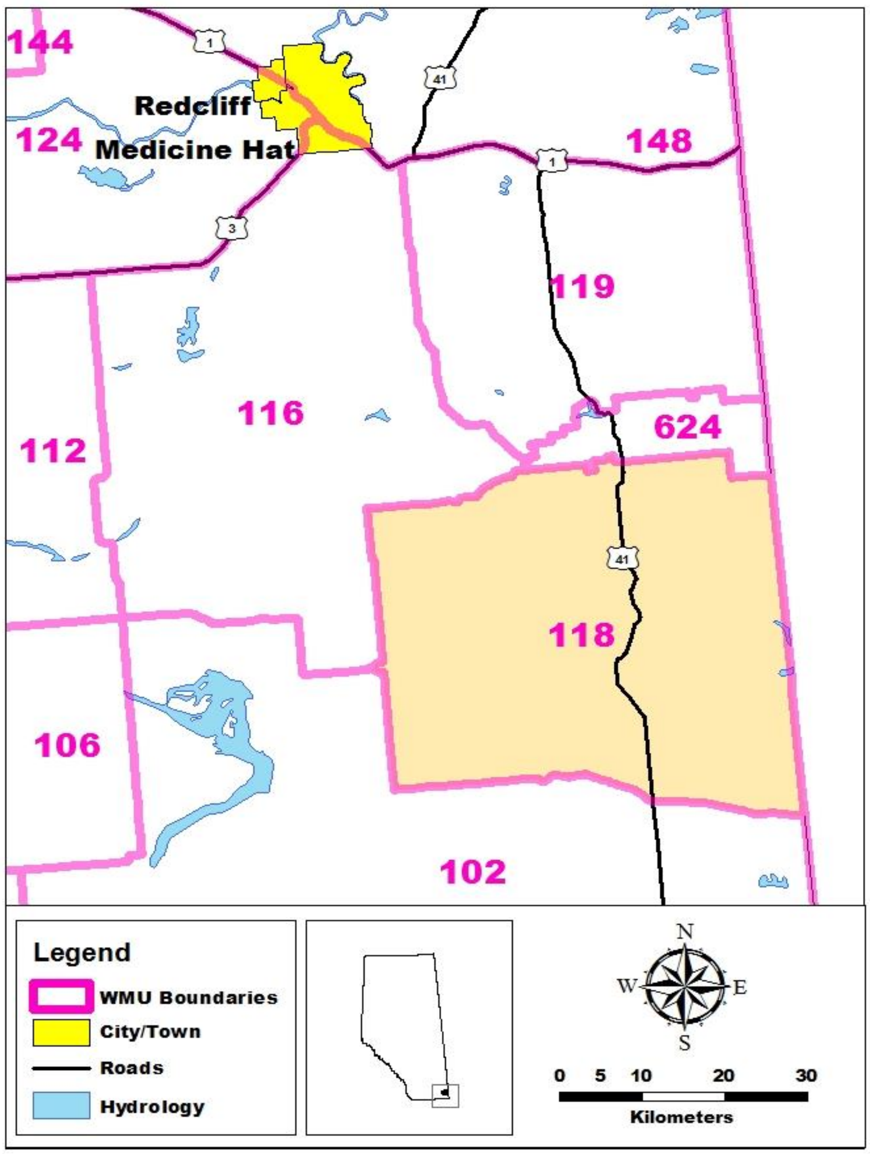

Figure 5. Location of Wildlife Management Unit 118 in Alberta.

6.1.2 Survey methods

WMU 118 was surveyed using the modified-Gasaway method (Gasaway et al. 1986; ASRD 2010). As in previous surveys, the unit was divided into 59 sample units that were 3 minutes latitude x 5 minutes longitude, as per Shumaker (2001). The WMU was stratified and surveyed for mule deer; observations of other species, including white-tailed deer were recorded, but population estimates were not derived. Both the stratification and intensive survey components were flown using a Bell 206B helicopter. Height and speed of the aircraft varied depending on wind speed and direction, vegetation cover, and topography. The survey crew consisted of a pilot, a navigator/observer, who also recorded data and communicated with the ground-based flight follower, and two observers.

Stratification of WMU 118 took place on 10 February 2013. Stratification lines were flown in an east to west direction at 1 minute of latitude intervals (Lynch and Shumaker 1995; Lynch 1997), excluding boundary lines of the sample units. All animals observed on each side of the aircraft were recorded and a GPS location was taken. Mule deer data were then plotted on the sample unit survey map and sample units were classified into 3 strata; low, medium, and high, based upon mule deer densities. Of the 59 sample units, 35 were classified as low, 12 as medium, and 12 as high.

The intensive survey of 16 randomly selected sample units (5 low, 5 medium, and 6 high) was conducted on 11 – 12 February 2013. Sample units were flown in an east to west direction with flight lines adjusted accordingly to ensure complete coverage and optimal sightability. Mule deer were classified as bucks (small, medium, and large antler size class), does, and fawns, as per ASRD 2010. Data were recorded on datasheets and later transferred into digital format. Results were incorporated into the Quadrat Survey Method Program as per Lynch (1997).

Pre-survey ground reconnaissance revealed very good snow conditions, which were maintained over the duration of the three day survey. Temperatures ranged from -10 to +1 degrees Celsius. Periods of intermittent low cloud (primarily around the Cypress Hills) resulted in some minor delays in stratification and intensive survey flights. We did not correct for sightability; therefore, overall counts should be considered as minimum population estimates and direct comparisons of survey results among years may be difficult.

6.1.3 Results

We observed 1,046 mule deer, 21 white-tailed deer, 9 moose, and 47 coyotes during the stratification flights. During the intensive survey flights a total of 1,376 mule deer were observed (234 bucks, 785 does, and 357 fawns). From this we estimated the mule deer population to be between 2,418 and 3,662 individuals (Table 8). Although evidence of antler drop was not apparent, demographic ratios must be interpreted cautiously, as the male cohort would be under-represented as males with shed antlers were recorded as does. A total of 67 white-tailed deer, 16 moose, and 46 coyotes were observed during the intensive survey flights.

Table 8. Comparison of aerial survey results for mule deer in Wildlife Management Unit 118 in 2008 and 2013.

Year	Population estimate (90% confidence limits)	Mule deer/km^2	Ratio to 100 Females	
			Males	Juveniles
2013	3,040 (±20.4%)	1.54	30[a]	45
2008	2,808 (±20.5%)	1.42	35[a]	44

[a] Demographic ratios must be interpreted cautiously, as the male cohort would be under-represented as males with shed antlers were recorded as does.

6.2 Wildlife Management Unit 300 moose

Section Authors: Ryan Hermanutz and Mike Jokinen

Moose surveys in Wildlife Management Unit (WMU) 300 have occurred on an irregular basis and have often been incorporated into other ungulate surveys. Aerial surveys that incorporated counts of moose in WMU 300 began in 1985. In that initial survey year, only 24 moose were observed; however, only one-quarter of the WMU was surveyed. The next survey to include moose occurred in 1994, when 87 moose were observed. In 1996, the WMU was stratified for moose habitat by Shumaker (1996) and surveyed for the first time to attain a moose population estimate. During this survey, Shumaker estimated the moose population to be 246 ± 22.3%, counting a total of 132 moose in 11 sample units. This WMU was surveyed again in 1998 and 2008; however these surveys focused on recording deer population information and moose observations were considered secondary. During the 1998 survey, a total of 137 moose were observed, while 96 moose were observed in 2008. It is important to note that the majority of the surveyed area during the 1998 and 2008 survey were focused on open grassland in the eastern half of the WMU, an area much less likely to be inhabited by moose.

6.2.1 *Study area*

WMU 300 is a relatively small unit (1,132 km^2) located in the extreme southwest corner of Alberta (Figure 6). General boundaries defining this unit are the Alberta – Montana border to the south, the Waterton Lakes National Park boundary and the fifth meridian to the west, Drywood Creek and Highway 505 to the north, and the Blood Indian reservation and Highway 2 to the east. WMU 300 lies within the Foothills Fescue, Foothills Parkland, and Montane natural subregions of Alberta (Natural Regions Committee 2006). Additionally, a small portion (<4 km^2 total) of this WMU is located in the Subalpine natural subregion of Alberta. This WMU is a prime example of the Waterton Lakes National Park tagline "where the prairies meet the mountains", as the rolling hills on the western portion of the unit quickly transform into smooth, open grassland. Because of this landscape, moose densities can change quickly throughout the WMU. The WMU consists of open grassland across the eastern portion, while river valleys, mixedwood forest cover types, and willow shrub communities create suitable moose habitat on the western half. The land base is almost entirely privately owned, including a large ranching community. Industrial activities include limited forestry, occurring only in the extreme southwest corner of the WMU, and gas facilities located throughout the WMU.

6.2.2 *Survey methods*

Shumaker (1996) delineated the moose survey area in WMU 300 and excluded the majority of the eastern grassland portion of the WMU, as it was assumed to provide little to no habitat for moose (Figure 6). The resulting moose survey area equates to 580 km^2 or approximately half of the total area of WMU 300. Not only did this reduce the amount of time, effort, and cost required to survey moose in the WMU, but it served to provide an estimate within the area which likely supports the majority of the moose population in the unit. The survey area and sample units identified by Shumaker (1996) were digitized in November of 2011 by ASRD, Calgary Resource Information Unit.

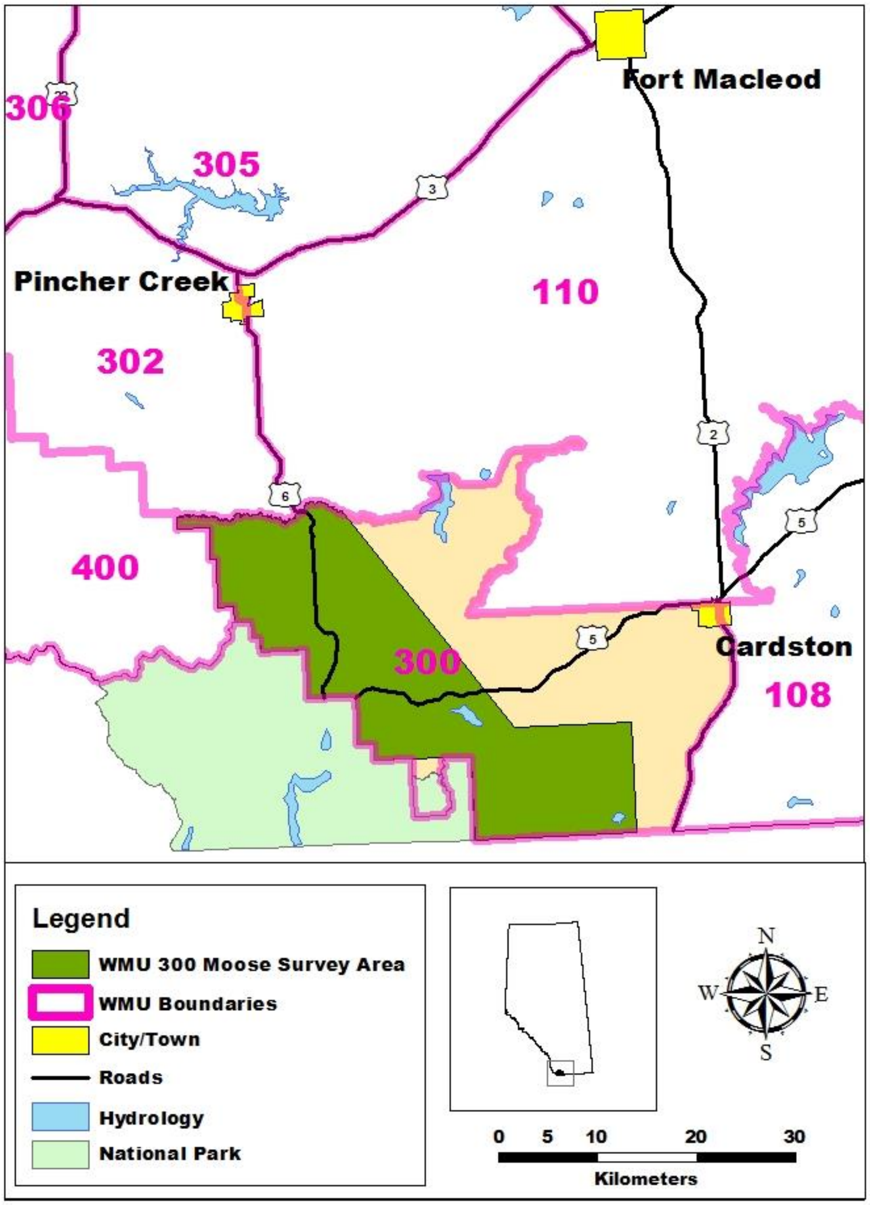

Figure 6. Location of Wildlife Management Unit 300 in Alberta.

WMU 300 was surveyed for moose using the modified-Gasaway method (Gasaway et al. 1986; ASRD 2010). The WMU was divided into 40 sample units that were 2 minutes latitude x 5 minutes longitude in size. On 4 March 2013, the moose survey area was stratified in an east to west direction at 1 minute longitude intervals, using a Bell 206B helicopter. The survey crew was comprised of a pilot and one navigator in the front of the helicopter, and two observers seated in the rear of the helicopter. The navigator used a laptop computer and GPS real-time tracking to assist with navigation, while also taking GPS locations and recording moose observations on survey sheets. Rear-seated observers scanned for moose out each side of the aircraft, recorded backup GPS locations on a handheld GPS unit, and captured survey photographs. Following the flight, moose observations were plotted onto a map in ArcGIS and sample units were classified into low, medium, and high strata based on the density of moose observed. Moose density, total moose observed, and moose habitat observed during the stratification flight were all taken into consideration when stratifying sample units.

The stratification flight was followed by an intensive survey of randomly selected sample units on 4 – 5 March 2013, using a Bell 206B helicopter. During the intensive survey flights, east to west flight lines were spaced so that observers were scanning approximately 200 m out each side of the aircraft, to ensure full coverage of each sample unit. We tallied and recorded all species observed; however, only moose were classified to age and sex (bull, cow, calf). Adult males had shed antlers by this time, but adult females were easily distinguished by their white vulva patch, and calves were distinguished by their size in relation to adults. Light brown and grey patches on the back and shoulders, often indicative of winter tick infestation, were noted.

Initially, 3 sample units from each of the three strata were flown, and data were analyzed to determine confidence intervals for the population estimate. An additional 3 sample units were flown, for a total of 12 sample units, to achieve the goal of producing a population estimate with error below 20%, and a 90% confidence interval. We did not correct for sightability; therefore, overall counts should be considered as minimum population estimates and direct comparisons of survey results among years may be difficult.

Survey conditions were excellent, with complete snow cover of 30 – 40 cm throughout the survey area. Winds were low, averaging 10 km/h and light conditions were bright with 90 – 95% cloud cover. The average temperature over the three day survey was -10 degrees Celsius.

6.2.3 Results

During the stratification flight, a total of 217 moose were observed. During the intensive survey flights, a total of 12 sample units (5 low, 3 medium, and 4 high) were surveyed. We estimated the moose population in the area surveyed within WMU 300 to be between 379 and 541 individuals (Table 9). Moose populations appear to have increased since the last survey in 1996, the only previous survey in WMU 300 conducted throughout the same area and with similar protocol. Of the 58 bulls that were observed during the intensive survey, only 2 retained their antlers, and both were classified as small, as per standard antler classification protocol (ASRD 2010). Several moose showed signs of winter tick infestation, with some infestations being fairly severe. Tick infestation appeared to increase towards the northwest portion of the unit, the area which supports the highest moose densities.

Table 9. Comparison of aerial survey results for moose in Wildlife Management Unit 300 in 1996 and 2013.

Year	Population estimate (90% confidence limits)	Moose/km^2	Ratio to 100 Females	
			Males	Juveniles
2013	460 (±17.7%)	0.41	56	46
1996	246 (±22.3%)	0.22	49	46

6.3 Wildlife Management Unit 349 moose

Section Author: Ryan Hermanutz

In December 2012, we estimated the moose population in Wildlife Management Unit (WMU) 349 using standard aerial big game survey methods (Gasaway et al. 1986; Lynch 1997; ASRD 2010). Previous surveys were completed in 1993, 1997, 2000, and 2009 using similar methods. In addition to the primary objective of estimating the total population of moose within WMU 349, we also collected data to estimate important demographic attributes such as sex and age ratios.

6.3.1 Study area

Wildlife Management Unit 349 is a relatively large unit (6,488 km^2) located in northwestern Alberta (Figure 7). The WMU is bounded to the south by Highway 43 and a small portion of the Athabasca River, to the west by Highway 43 and township ranges 20 and 21 (west of the fifth meridian), to the north by the Goose River and Goose Tower Road, and to the east by Highways 33 and 658. The landscape within WMU 349 consists of three natural subregions; Lower Foothills, Upper Foothills, and Central Mixedwood

(Natural Regions Committee 2006). This WMU is varied in topography and largely forested with a variety of mixedwood forest cover types, including deciduous mixedwood in the southern and western portions, and conifer in the central and northeastern areas. A large forest fire occurred in 1998, resulting in roughly one-third of the WMU being burned. Commercial forest values are significant in this unit; subsequently, timber harvest makes up a large portion of land use. Oil and gas activities are also quite prevalent in the WMU. Together, these industries facilitate access to the majority of the WMU through the creation of roads, pipelines and other related infrastructure. Nearly the entire WMU is comprised of crown land, with only a small portion (<1%) in the extreme southeast being privately titled.

6.3.2 Survey methods

Population estimates for moose in WMU 349 were derived using the modified-Gasaway method (Gasaway et al. 1986; Lynch 1997; ASRD 2010). Stratification flights took place on 14 – 15 December 2012 with two survey crews, each flying in Cessna 185 aircraft. Both crews consisted of one pilot and one navigator in the front of the aircraft, and two observers in the back. Stratification lines were flown in an east to west direction at 1 minute of latitude intervals (Lynch and Shumaker 1995; Lynch 1997), excluding boundary lines of the sample units. The aircraft flew at a groundspeed of approximately 150 km/h, and maintained an altitude of between 60 m and 90 m above ground level. Observers searched out either side of the aircraft and locations of moose were recorded, along with sightings of white-tailed deer, mule deer, elk, wolves, and other wildlife of interest. The locations of all animals were recorded using a handheld GPS unit.

Weather conditions throughout the stratification survey were somewhat variable with average daytime temperatures ranging from -5 to -16 degrees Celsius. Snow conditions in the entire study area were excellent, providing full ground coverage.

The WMU was divided into 139 sample units that were 5 minutes of latitude x 5 minutes of longitude in size. Sample units located on the boundary of the WMU were often irregular in shape and size. Based on observations from the stratification flights, sample units were assigned the classification of low, medium, or high depending on the relative density of moose. As a result, 43 sample units were identified as low, 68 as medium and 28 as high. A total of 15 sample units were randomly selected for intensive surveys. This selection included 5 low density, 5 medium density, and 5 high density sample units. To improve the precision of our moose population estimate, we sampled 2 additional medium density sample units, and 1 additional high density sample unit for a total of 18 sample units.

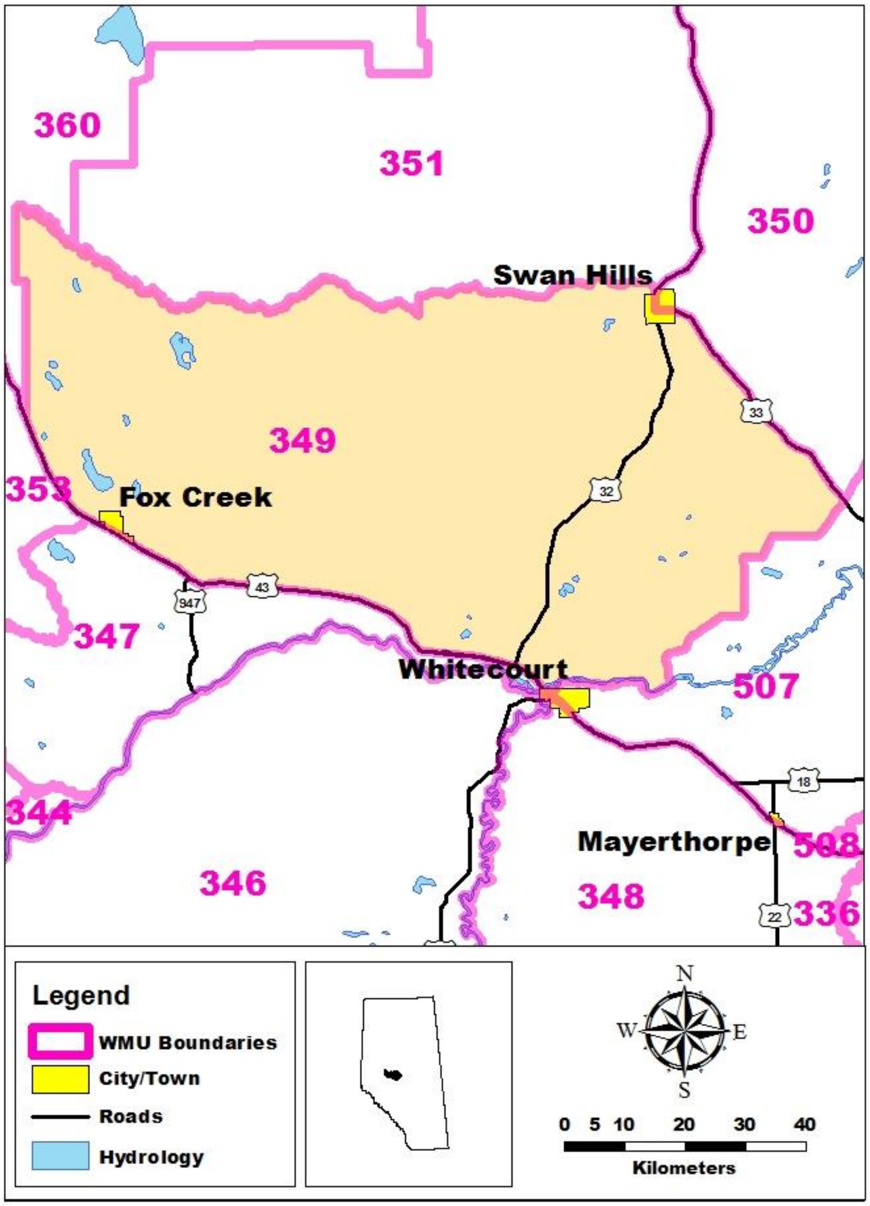

Figure 7. Location of Wildlife Management Unit 349 in Alberta.

Intensive survey flights were carried out with two Bell 206B helicopters from 16 – 19 December 2012. We flew transect lines oriented north to south and spaced approximately 400 m apart. The aircraft travelled at a groundspeed of 100 – 140 km/h, and maintained an altitude between 30 m and 50 m above ground level, depending on the cover and topography. Observers searched approximately 200 m on either side of the aircraft. Locations of individual moose, as well as sex and age (adult or juvenile), were recorded. Male and female moose were differentiated by the presence or absence of a vulva patch, and the presence or absence of antlers. Juvenile moose were identified through relative body size and length of snout. Moose with antlers were classified as small, medium, or large based on standard antler classification criteria (ASRD 2010). In addition to moose, sightings of other wildlife of interest such as deer, elk, wolves, sharp-tailed grouse, and great grey owls were recorded.

Weather patterns throughout the intensive survey were quite consistent, with average daily temperatures ranging from -12 to -21 degrees Celsius. Complete snow coverage existed for the duration of the intensive survey, resulting in excellent sightability. As a result, there were no delays in data collection due to changes in temperature or precipitation.

6.3.3 Results

We estimated the moose population in WMU 349 to range between 2,716 and 3,940 individuals (Table 10). Populations in this unit appear to have risen significantly from those estimated in 2009; however, current numbers are comparable to the long-term average when analyzing data from the five surveys completed since 1993. Of the 91 bulls that were observed during the intensive survey flights, 15 (16.5%) had shed their antlers. Of the 76 bulls observed with antlers, 31 were classified as small, 42 as medium, and 3 as large in size.

Table 10. Comparison of aerial survey results for moose in Wildlife Management Unit 349 from 1993 – 2012.

Year	Population estimate (90% confidence limits)	$Moose/km^2$	Ratio to 100 Females	
			Males	Juveniles
2012	3,328 (±18.4%)	0.51	28	28
2009	1,969 (±19.1%)	0.30	24	37
2000	3,277 (±18.5%)	0.51	29	37
1997	2,976 (±19.7%)	0.46	22	33
1993	3,911 (±18.7%)	0.65	15	48

6.4 Wildlife Management Unit 506 moose, mule deer, and white-tailed deer

Section Author: Robb Stavne

In February 2013, we surveyed Wildlife Management Unit (WMU) 506 for moose, mule deer, and white-tailed deer. In prior years, surveys had been flown for moose and white-tailed deer, but mule deer have not previously been surveyed in this unit. In addition, we collected incidental information for elk, which occur in low numbers in this WMU. Survey observations from 2013, along with information from previous surveys, assist in identifying trends in population, productivity, and sex structure. Population estimates from this survey will be used by ESRD to make management decisions and establish harvest allocations for these species.

6.4.1 Study area

Wildlife Management Unit 506 is a medium sized unit (2,191 km^2) located in central Alberta (Figure 8). This unit is bounded to the south by Highway 18, to the west by Highway 2, to the north by Highway 55, and to the east by Highway 63. The landscape within this unit is largely dominated by agriculture, primarily cropland and livestock pastures. The WMU lies within the Dry Mixedwood natural subregion of the Boreal natural region (Natural Regions Committee 2006).

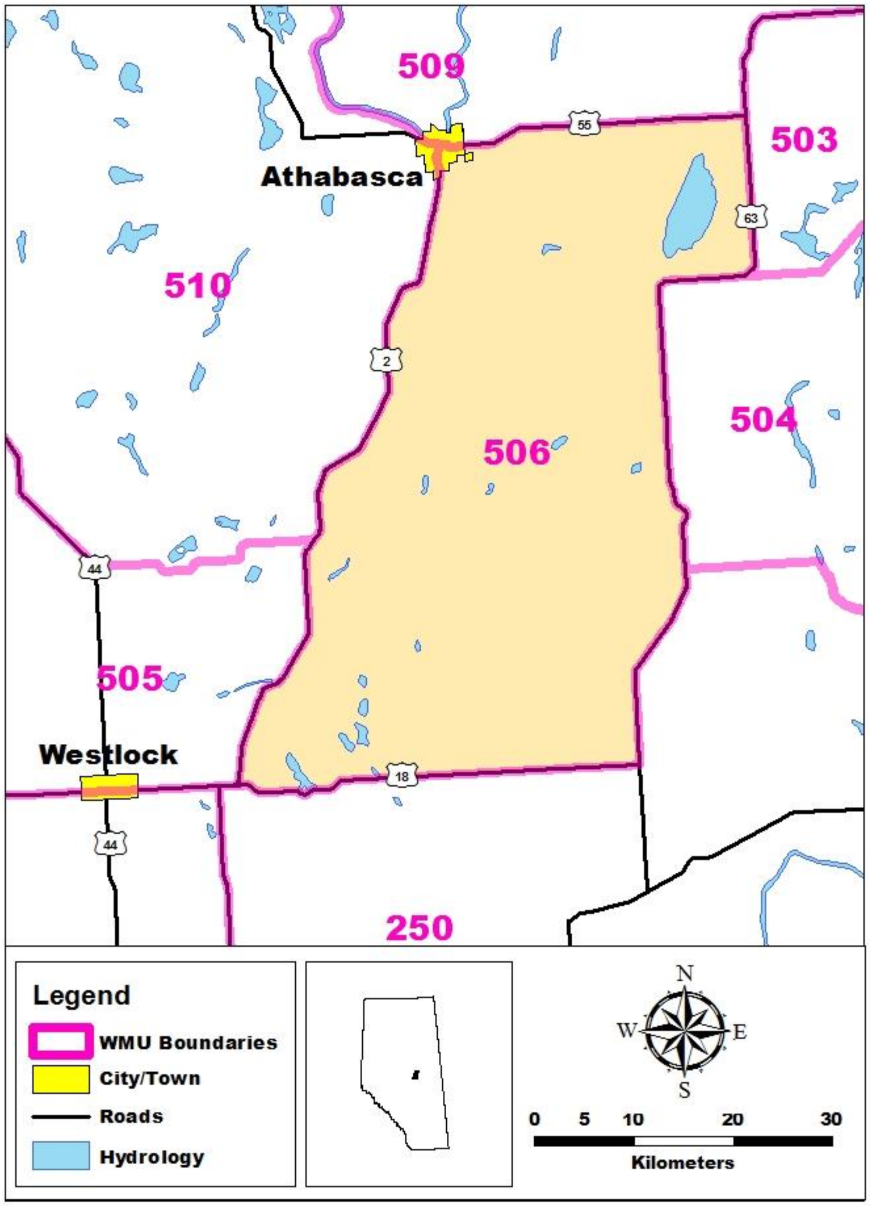

Figure 8. Location of Wildlife Management Unit 506 in Alberta.

6.4.2 *Survey methods*

Population estimates for moose, mule deer, and white-tailed deer were derived using the modified-Gasaway method (Gasaway et. al. 1986; Lynch 1997; ASRD 2010). Stratification flights in WMU 506 took place on 19 February 2013. To stratify the study area for moose and deer, two crews of one pilot, one navigator and two experienced observers flew east to west transect lines, spaced 1 minute of latitude apart, using a Cessna 185 and a Cessna 206. We did not fly lines of latitude that overlapped sample unit boundaries, in order to minimize the effect of animal movements across boundary lines in the time between stratification flights and intensive flights. The aircraft travelled at a groundspeed of approximately 150 km/h, and maintained an altitude of between 60 m and 90 m above ground level. Observers searched out either side of the aircraft and locations of moose, deer, and elk were recorded along with sightings of wolves, sharp-tailed grouse, and other wildlife of interest. Locations of all animals were recorded using a handheld GPS unit. When groups of deer were difficult to identify, the aircraft circled in order to determine species.

Temperatures throughout the day remained around -15 degrees Celsius. Winds were consistent at 15 – 20 km/h, which resulted in minimal turbulence on the flights. Cloud cover was 100%; visibility was good throughout the survey. Although much of the snow throughout the WMU had settled in the weeks before the survey, snow fall immediately prior to the survey provided good snow cover.

The WMU was divided into 77 sample units that were 3 minutes of latitude x 5 minutes of longitude in size. Sample units located on the boundary of the WMU were often irregular in shape and size. Based on observations from the stratification flights, sample units were assigned the classification of low, medium, or high depending on the relative density of animals. This was done separately for moose, mule deer, and white-tailed deer. For moose, 22 sample units were identified as low, 38 as medium, and 17 as high density. Mule deer observations were exceptionally low in number, making stratification for this species difficult. White-tailed deer were stratified as low (0 deer/km^2 observed in sample units during stratification) or high (> 0 deer/km^2). Because of deep snow conditions throughout the winter, and given the late timing of our survey, deer tended to be considerably more grouped than usual, and generally were observed close to farms where they were presumed to have access to livestock forage. A total of 15 sample units were randomly selected for intensive surveys. For moose, this selection included 5 low density, 5 medium density, and 5 high density. Mule deer were classed into 1 stratum due to extremely low numbers observed during the stratification flights. For white-tailed deer, 9 of the survey units were designated as low density, and 6 as high density.

Intensive survey flights were carried out with the use of two Bell 206B helicopters from 20 – 21 February 2013. We flew transect lines oriented east to west and spaced at quarter minute intervals (approximately 400 m apart). Aircraft travelled at a groundspeed of 100 – 140 km/h, and maintained an altitude of between 30 m and 50 m above ground level. Observers searched approximately 200 m on either side of the aircraft. Locations of individuals, as well as sex and age (adult vs. juvenile), were recorded for moose, mule deer, white-tailed deer, and elk. Male and female moose were differentiated by the presence or absence of a vulva patch. Juvenile moose were identified through relative body size and length of snout. Moose, deer, and elk with antlers were classified as small, medium, or large based on standard antler classification criteria (ASRD 2010). If adult deer were observed without antlers and clearly were not associated with a juvenile of similar species, they were recorded as unclassified. In addition to moose, deer, and elk observations, sightings of other wildlife of interest such as wolves and sharp-tailed grouse were recorded.

Daily temperatures averaged -9 and -5 degrees Celsius on the two days of intensive surveys. A warming trend predicted in the local forecast, which would quickly worsen survey conditions, made surveying additional days unfeasible. Snow conditions and visibility remained favorable throughout the intensive surveys, although delays took place on the morning of 21 February 2013 due to a prohibitively low ceiling.

6.4.3 Results

We estimated the moose population in WMU 506 to range between 723 and 999 individuals (Table 11). Populations in this unit appear to have dropped significantly from estimates in the late 1990s and early 2000s; however, they are comparable to counts observed during the 1994 survey. Of the 27 bulls that were observed during intensive survey flights, 22 had shed their antlers. Of the 5 bulls observed with antlers, 3 were classified as small, and 2 were classified as medium.

Table 11. Comparison of aerial survey results for moose, mule deer, and white-tailed deer in Wildlife Management Unit 506 from 1988 – 2013.

Species/Year	Population estimate (90% confidence limits)	Animals/km^2	Ratio to 100 Females	
			Males	Juveniles
Moose				
2013[a]	861 (±16.0%)	0.39	25	41
2003[a]	3,773 (±19.1%)	1.72	25	87
1999[a]	1,326 (±12.7%)	0.62	38	56
1998[a]	1,553 (±13.8%)	0.72	28	52
1994[b]	648	0.32	40	76
1988[b]	410	0.30	32	91
Mule deer				
2013[a]	175 (±84.9%)	0.08	9[c]	100
White-tailed deer				
2013[a]	1,459 (±36.8%)	0.67	7[c]	108
1998[a]	2,089 (±20.1%)	0.97	29	52

[a] Survey was flown using the modified-Gasaway method.

[b] Survey was flown using line transect methodology; confidence levels were not derived. Line transect survey data should not be directly compared to Gasaway survey data.

[c] Demographic ratios must be interpreted cautiously, as the male cohort would be underrepresented as males with shed antlers were recorded as unclassified.

Mule deer in WMU 506 were extremely low in numbers, with only 35 individuals observed during the intensive survey, which resulted in an estimated population of 175 individuals (Table 11); however, because a high level of confidence was not attained, this population estimate must be interpreted cautiously. Over one-third (34%) of all mule deer went unclassified, as most male deer lacked antlers, making sex and age classification particularly difficult. Specifically, only 1 small antlered mule deer was observed. From the classified portion (66%) of the sampled population, a ratio of 9 bucks per 100 does and 100 fawns per 100 does were observed. However, these demographic ratios must be interpreted cautiously, as the male cohort would be underrepresented as males with shed antlers were recorded as unclassified.

Although there is the potential that white-tailed deer numbers have declined since they were last surveyed in WMU 506 in 1998, the estimates for the two surveys do overlap. We estimated the white-tailed deer population in this unit to be between 923 and 1,996 individuals (Table 11). However, because a high level of confidence was not attained, this population estimate must be interpreted cautiously. Over one-third of all white-tailed deer went unclassified (38%), as most male deer lacked antlers making sex and age classification particularly difficult. Specifically, only 7 antlered males were observed; 5 small, and 2 medium in size. From the classified portion (62%) of the sampled population, 7 bucks per 100 does and 108 fawns per 100 does were observed. However, these demographic ratios must be interpreted cautiously, as the male cohort would be under-represented as males with shed antlers were recorded as unclassified.

Elk are uncommon in the WMU; however, their establishment within this unit is becoming evident. During survey flights, a total of 17 elk were observed, including 2 small bulls, and an unclassified herd of 15 cows and calves.

6.5 Wildlife Management Unit 508 moose, mule deer, and white-tailed deer

Section Authors: Robb Stavne and Mike Ranger

In February 2013, we surveyed Wildlife Management Unit (WMU) 508 for moose, mule deer, and white-tailed deer. In 1995 and 2002, surveys were also flown for all three species in this unit. Survey observations from 2013, along with information from previous surveys, assist in identifying trends in population, productivity, and sex structure. Population estimates from this survey will be used by ESRD to make management decisions and establish harvest allocations.

6.5.1 Study area

Wildlife Management Unit 508 is a medium sized unit (3,255 km²) located in central Alberta (Figure 9). This WMU is bounded to the south by Highway 43, to the west by the Paddle River, to the north by Highway 18, and to the east by Highway 2. The landscape within WMU 508 is largely dominated by agriculture; primarily cropland and livestock pastures. The unit lies within the Dry Mixedwood natural subregion of the Boreal natural region (Natural Regions Committee 2006).

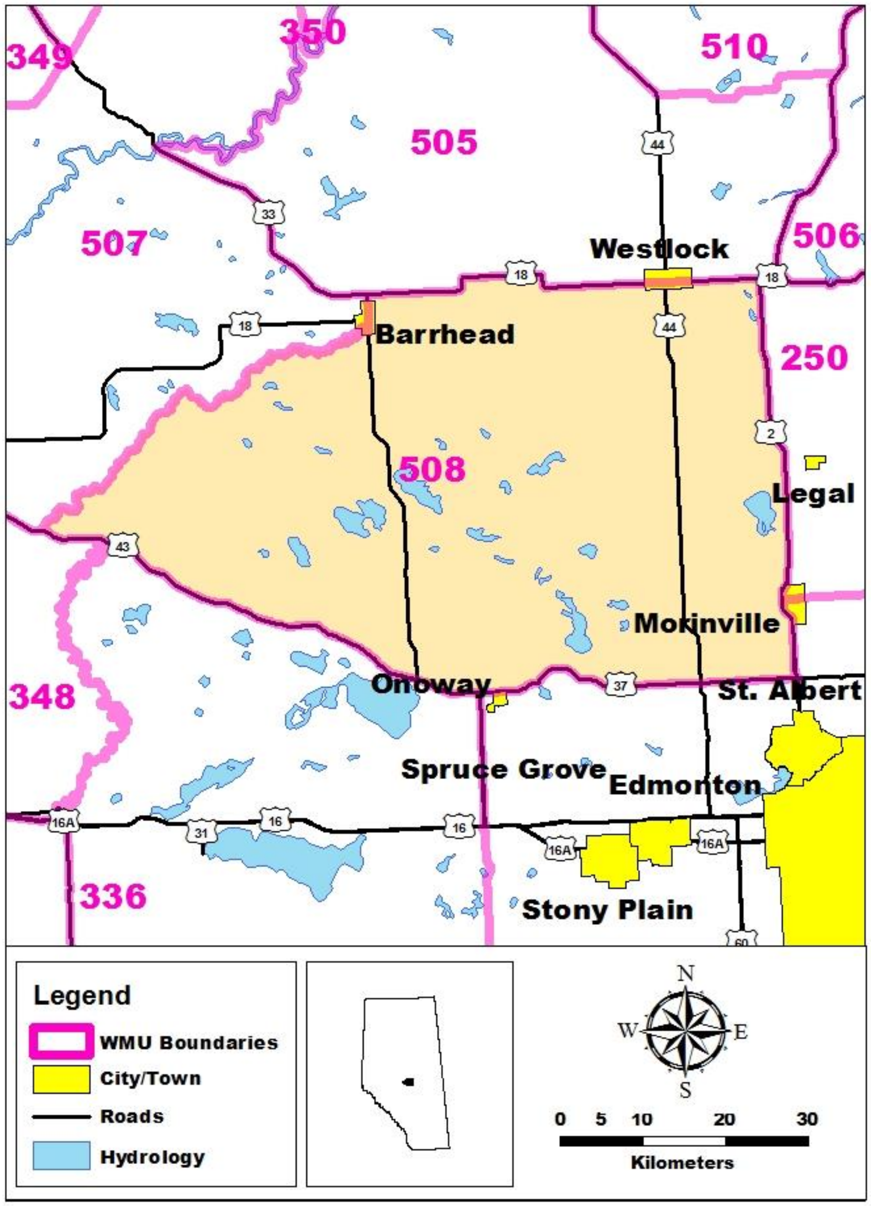

Figure 9. Location of Wildlife Management Unit 508 in Alberta.

6.5.2 *Survey methods*

Population estimates for moose, mule deer, and white-tailed deer were derived using the modified-Gasaway method (Gasaway et. al. 1986; Lynch 1997; ASRD 2010). Stratification flights in WMU 508 took place on 18 February 2013. To stratify the study area for moose and deer, two crews of one pilot, one navigator, and two experienced observers flew east to west transect lines spaced 1 minute of latitude apart, using a Cessna 185 and a Cessna 210. We did not fly lines of latitude that overlapped sample unit boundaries, in order to minimize the effect of animal movements across boundary lines in the time between stratification flights and intensive flights. The aircraft travelled at a groundspeed of approximately 150 km/h, and maintained an altitude of between 60 m and 90 m above ground level. Observers searched out either side of the aircraft and locations of moose and deer were recorded along with sightings of elk, wolves, sharp-tailed grouse, and other wildlife of interest. Locations of all animals were recorded using a handheld GPS unit. When groups of deer were difficult to identify, the aircraft circled in order to determine species.

Temperatures throughout the day remained around -9 degrees Celsius. Winds were consistent at 30 – 35 km/h from the east. Cloud cover was 100%; visibility was good throughout the survey. Although much of the snow throughout the WMU had settled in the weeks before the survey, snow fall immediately prior to the survey provided good snow cover.

The WMU was divided into 105 sample units that were 3 minutes of latitude x 5 minutes of longitude in size. Sample units located on the boundary of the WMU were often irregular in shape and size. Based on observations from the stratification flights, sample units were assigned the classification of low, medium, or high depending on the relative density of animals. This was done separately for moose, mule deer, and white-tailed deer. For moose, 33 sample units were identified as low, 57 as medium, and 15 as high density. Mule deer observations were exceptionally low in number, making stratification for this species difficult. White-tailed deer were stratified as low (0 deer/km^2 observed in blocks during stratification) or high (> 0 deer/km^2). Because of deep snow conditions throughout the winter, and given the late timing of our survey, deer tended to be considerably more grouped than usual, and generally were observed close to farms where they could access livestock forage. A total of 22 sample units were randomly selected for intensive surveys. For moose, this selection included 5 low density, 10 medium density, and 7 high density sample units. Mule deer were classed into one stratum due to extremely low numbers observed during the stratification flights. For white-tailed deer, 16 of the survey units were designated as low density, and 6 as high density.

Intensive surveys were flown with two Bell 206B helicopters from 19 – 21 February 2013. We flew transect lines oriented north to south and spaced at quarter minute intervals (approximately 400 m apart). Aircraft travelled at a groundspeed of 100 – 140 km/h, and maintained an altitude of between 30 m and 50 m above ground. Observers searched approximately 200 m on either side of the aircraft. Locations of individuals, as well as sex and age (adult or juvenile), were recorded for moose, mule deer, and white-tailed deer. Male and female moose were differentiated by the presence or absence of a vulva patch. Juvenile moose were identified through relative body size and length of snout. Moose and deer that possessed antlers were classified as small, medium, or large based on standard antler classification criteria (ASRD 2010). If adult deer were observed without antlers and clearly were not associated with a juvenile of similar species, they were recorded as unclassified. In addition to moose and deer observations, sightings of other wildlife of interest such as elk, wolves, and sharp-tailed grouse were recorded.

Daily temperatures ranged from -20 degrees Celsius at the beginning of the intensive block surveys to -4 degrees Celsius by the completion of the surveys. A warming trend predicted in the local forecast, which would quickly worsen survey conditions, made surveying additional days unfeasible. Snow conditions and visibility remained favorable throughout the intensive block surveys, although delays took place on the morning of 21 February 2013 due to a prohibitively low ceiling.

6.5.3 Results

We estimated the moose population in WMU 508 to range between 929 and 1,241 individuals (Table 12). The 2013 population estimate is significantly higher than the previous two surveys, in 1995 and 2002. Of the 45 bulls that were observed during intensive survey flights, 41 had shed their antlers. Of the 4 bulls observed with antlers, 2 were classified as small, and 2 were classified as medium.

Table 12. Comparison of aerial survey results for moose, mule deer, and white-tailed deer in Wildlife Management Unit 508 from 1995 – 2013.

Species/Year	Population estimate (90% confidence limits)	Animals/km^2	Ratio to 100 Females	
			Males	Juveniles
Moose				
2013	1,085 (±14.4%)	0.33	30	59
2002	454 (±21.4%)	0.14	47	58
1995	358 (±20.1%)	0.11[a]	27	105
Mule deer				
2013	448 (±63.2%)	0.14	75[b]	100[b]
2002	317 (±47.4%)	0.10	--	--
1995	567 (±53.4%)	0.17[a]	--	--
White-tailed deer				
2013	2,598 (±28.1%)	0.80	4[c]	104
2002	1,260 (±22.9%)	0.39	--	--
1995	2,505 (±7.6%)	0.77[a]	--	--

[a] Densities have been recalculated from original ASRD reports with updated WMU area derived in January 2013 with ArcGIS digital mapping and analysis software.
[b] Demographic ratios must be interpreted cautiously, as the small sample size of classified mule deer during this survey (33 animals) is likely too low to accurately estimate demographic ratios in this WMU.
[c] Demographic ratios must be interpreted cautiously, as the male cohort would be underrepresented as males with shed antlers were recorded as unclassified.
"--" Demographic ratios were not obtained.

Mule deer in WMU 508 were extremely low in numbers, with only 94 individuals observed during the intensive survey, which resulted in an estimated population of 448 individuals (Table 12). However, because a high level of confidence was not attained, this population estimate must be interpreted cautiously. Over two-thirds (65%) of all mule deer went unclassified, as most male deer lacked antlers making sex and age classification particularly difficult. Specifically, only 9 antlered males were observed; 4 small and 5 medium. From the classified portion (35%) of the sampled population, a ratio of 75 bucks per 100 does and 100 fawns per 100 does were observed. However, these buck/doe/fawn ratios must be interpreted cautiously, as the small sample size of classified mule deer during this survey (33 animals) is likely too low to accurately estimate demographic ratios in this WMU.

White-tailed deer numbers in WMU 508 appear to have returned to the previous estimate observed in 1995, and have increased considerably from the 2002 estimate (Table 12). In 2013, we counted 596 individuals for an estimated population between 1,867 and 3,328 (Table 12). However, because a high level of confidence was not attained, this population estimate must be interpreted cautiously. Over half (56%) of all white-tailed deer went unclassified, as most male deer lacked antlers making sex and age classification particularly difficult. Specifically, only 5 antlered males were observed; 3 small and 2 medium. From the classified portion (44%) of the sampled population, 4 bucks per 100 does and 104 fawns per 100 does were observed. However, these demographic ratios must be interpreted cautiously, as the male cohort would be under represented as males with shed antlers were recorded as unclassified.

Elk are uncommon in the WMU; however, their establishment within this unit is becoming evident. During intensive survey flights, four sightings of elk were recorded for a total of 21 elk observed throughout the WMU.

6.6 Wildlife Management Unit 526 moose, mule deer, white-tailed deer, and elk

Section Author: Ryan Hermanutz

In February 2013, we estimated moose, mule deer, and white-tailed deer populations in Wildlife Management Unit (WMU) 526 using standard aerial ungulate survey methods (Gasaway et al. 1986; Lynch 1997; ASRD 2010). Previous surveys were completed in 1999, 2003, and 2008 using similar methods. In addition to the primary objective of estimating the total population of each species within WMU 526, we also collected data on important demographic attributes such as sex and age ratios. Survey observations from 2013, along with information from previous surveys, assist in identifying trends in population, productivity, and sex structure. Population estimates from this survey will be used by ESRD to make management decisions and establish harvest allocations. In conjunction with this survey we also collected a minimum population count for elk.

6.6.1 Study area

Wildlife Management Unit 526 is a relatively large unit (7,102 km^2) located in northwestern Alberta (Figure 10). This WMU is bounded to the south by the Peace

River, to the west by the British Columbia/Alberta border, to the north by the Clear and Whitemud Hills, and Whitemud River, and to the east by Highways 35 and 2. Three natural subregions exist in WMU 526: Dry Mixedwood, Lower Boreal Highlands, and Peace River Parkland (Natural Regions Committee 2006). The landscape within WMU 526 is largely dominated by agriculture, primarily cropland and livestock pastures. The majority of remaining forest cover and native habitat exists in the northern portions of the unit, and to a lesser degree, bordering the north slopes of the Peace River valley. Most of the WMU is held under private land title, with only approximately 15% of the unit comprised of crown lands. The unit contains significant areas of high quality ungulate winter range, provided mostly by south and west facing slopes along the Peace, Clear, Eureka, and Montagneuse rivers, as well as Hines Creek. As a result, these areas have historically supported relatively high densities of ungulates.

6.6.2 Survey methods

Population estimates for moose, mule deer, and white-tailed deer were derived using the modified-Gasaway method (Gasaway et. al. 1986; Lynch 1997; ASRD 2010). A trend survey for elk, which counted individuals and herds based on both observed and suspected locations, was also undertaken. Stratification flights in WMU 526 took place on 25 – 27 January 2013. To stratify the study area for moose and deer, two crews of one pilot, one navigator, and two experienced observers flew east to west transect lines spaced 1 minute of latitude apart, using a Cessna 185 and a Cessna 206. We did not fly lines of latitude that overlapped sample unit boundaries, in order to minimize the effect of animal movements across boundary lines in the time between stratification flights and intensive flights. The aircraft travelled at a groundspeed of approximately 150 km/h, and maintained an altitude of between 60 m and 90 m above ground level. Observers searched out either side of the aircraft and locations of moose, deer, and elk were recorded along with sightings of wolves, sharp-tailed grouse, and other wildlife of interest. Locations of all animals were recorded using a handheld GPS unit. When groups of deer were difficult to identify, the aircraft circled in order to determine species.

Weather throughout the stratification flights was fairly consistent with average daytime temperatures ranging from -7 to -16 degrees Celsius. Although some light snow flurries occurred, no significant amount accumulated in the region during the survey. Snow conditions in the upland areas were good to excellent providing full ground coverage, including roughly 12 cm of fresh snow that had fallen in the previous week. In river valleys, particularly areas in which the aspect was south to west facing, snow conditions were fair to good; most of the ground was covered, but small portions of the upper slopes had melted away during a previous warming trend, which left some patches of ground slightly exposed.

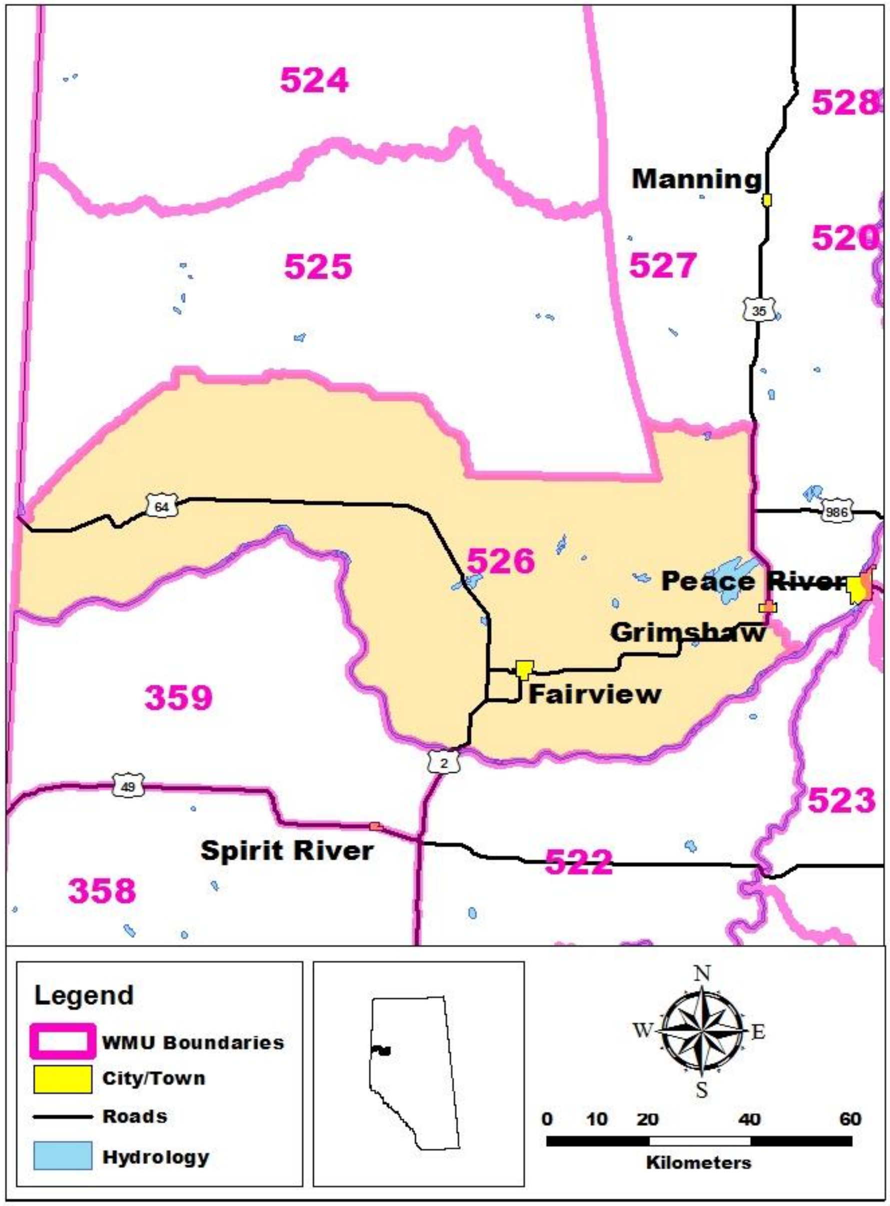

Figure 10. Location of Wildlife Management Unit 526 in Alberta.

The WMU was divided into 157 sample units that were 5 minutes of latitude x 5 minutes of longitude in size. Sample units located on the boundary of the WMU were often irregular in shape and size. Based on observations from the stratification flights, sample units were assigned the classification of low, medium, or high depending on the relative density of animals. This was done separately for moose, mule deer, and white-tailed deer. For moose, 34 sample units were identified as low, 96 as medium, and 27 as high density. For mule deer, the classification into 98 low, 33 medium, and 26 high density sample units was determined through stratification flight observations, as well as local knowledge of animal distribution, food sources, and habitat use. White-tailed deer distribution followed no particular pattern, as individuals were often linked to the location of agricultural food sources, which were inherently difficult to observe or predict across the study area. White-tailed deer were also observed in the river valleys and upland forest habitat. As such, white-tailed deer were placed into a single density stratum. A total of 18 sample units were randomly selected for the intensive survey. For moose, this selection included 5 low, 6 medium, and 7 high density sample units. For mule deer, this selection consisted of 8 low, 5 medium, and 5 high density sample units. To improve the statistical rigor of our estimate for moose and deer, we flew one additional randomly selected sample unit, which was classified as medium density for moose, and high density for mule deer.

Intensive surveys were flown with two Bell 206B helicopters from 28 January – 2 February 2013. We flew transect lines oriented north to south and spaced at quarter minute intervals (approximately 400 m apart). The aircraft travelled at a groundspeed of 100 – 140 km/h, and maintained an altitude of between 30 m and 50 m above ground level. Observers searched approximately 200 m on either side of the aircraft. Locations of individuals, as well as sex and age (adult or juvenile), were recorded for moose, mule deer, white-tailed deer, and elk. Male and female moose were differentiated by the presence or absence of a vulva patch. Juvenile moose were identified through relative body size and length of snout. Moose, deer, and elk with antlers were classified as small, medium, or large based on standard antler classification criteria (ASRD 2010). Both deer species and elk were classified by sex based on presence or absence of antlers, and age based on relative body size and snout length. If adult deer were observed without antlers and clearly were not associated with a juvenile of similar species, they were recorded as unclassified. In addition to moose and deer observations, sightings of other wildlife of interest such as wolves, sharp-tailed grouse, and great grey owls were recorded.

Weather throughout the intensive survey was fairly consistent with daily average temperatures ranging from -19 to -29 degrees Celsius. The last two days of intensive surveys were slightly warmer with daily averages of -10 degrees Celsius on 1 February 2013, and -9 degrees Celsius on 2 February 2013. Snow cover remained stable throughout the duration of the survey, which provided for consistent observing conditions.

6.6.3 Results

We estimated the moose population in WMU 526 to range between 3,679 and 5,133 individuals (Table 13). The moose population in this unit appears to have rebounded from the lowest estimate in 2008; it is statistically comparable to the 2003 estimate, and is marginally higher than the 1999 estimate. Of the 109 bulls that were observed during intensive surveys, 96 had shed their antlers. Of the 13 bulls observed with antlers, 9 were classified as small, and 4 were classified as medium.

Mule deer populations in WMU 526 were estimated to be between 3,218 and 5,104 animals (Table 13). The downward trend of the mule deer population in this unit appears to be continuing; however, there is less of a decline between 2008 and 2013, as there was between 2003 and 2008. Nearly one-half of all mule deer went unclassified (49%), as most male deer lacked antlers, thus making sex and age classification particularly difficult. Specifically, only 60 antlered males were observed; 22 small, 26 medium, and 12 large. From the classified portion (51%) of the sampled population, a ratio of 33 bucks per 100 does and 105 fawns per 100 does were observed. However, these demographic ratios must be interpreted cautiously, as the male cohort would be under represented as males with shed antlers were recorded as unclassified.

We estimated the white-tailed deer population in WMU 508 to be between 1,264 and 2,885 individuals (Table 13). White-tailed deer numbers appear to have remained relatively stable since the previous survey in 2008, and are still significantly higher than both the 1999 and 2003 estimates. However, because a high level of confidence was not attained, this population estimate must be interpreted cautiously. Over half of all white-tailed deer went unclassified (60%), as most male deer lacked antlers, making sex and age classification particularly difficult. Specifically, only 14 antlered males were observed; 2 small, and 12 medium. From the classified portion (40%) of the sampled population, 32 bucks per 100 does and 102 fawns per 100 does were observed. However, these demographic ratios must be interpreted cautiously, as the male cohort would be under represented as males with shed antlers were recorded as unclassified.

Table 13. Comparison of aerial survey results for moose, mule deer, and white-tailed deer in Wildlife Management Unit 526 from 1999 – 2013.

Species/Year	Population estimate (90% confidence limits)	Animals/km^2	Ratio to 100 Females	
			Males	Juveniles
Moose				
2013	4,406 (±16.5%)	0.62	30	49
2008	2,707 (±14.4%)	0.38	19	37
2003	3,853 (±12.1%)	0.54	37	48
1999	3,154 (±12.5%)	0.45	29	53
Mule deer				
2013	4,161 (±22.7%)	0.59	33[a]	105
2008	5,429 (±16.7%)	0.76	48	62
2003	8,503 (±13.0%)	1.20	41	124
1999	5,308 (±14.9%)	0.75	11	97
White-tailed deer				
2013	2,074 (±39.1%)	0.29	32[a]	102
2008	2,325 (±27.2%)	0.33	40	72
2003	1,398 (±22.5%)	0.20	26	120
1999	928 (±19.6%)	0.13	8	119

[a] Demographic ratios must be interpreted cautiously, as the male cohort would be underrepresented as males with shed antlers were recorded as unclassified.

During the WMU 526 survey, 26 separate sightings of elk were recorded for a total minimum count of 398 (Table 14). Of the 398 elk observed, 69 were identified as bulls, 258 were cows, and 71 were calves. Of the bull elk that were recorded, 40 were classified as small, 26 were medium, and 3 were large in size. The 2013 elk count was higher than the previous survey in 2008; however, a more frequent series of counts will be required to provide a reasonable indication of population trend over time. Caution should be taken when considering this data, as no correction for sightability was applied, which limits its utility for use as a population index (Lancia et al. 2005).

Table 14. Minimum elk population counts in Wildlife Management Unit 526 in 2008 and 2013.

Year	Number of elk				
	Males	Females	Juveniles	Unclassified	Total
2013	69	258	71	0	398
2008	51	228	41	0	320

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