A COMPILATION OF MULE DEER AND ELK POPULATION DATA FOR THE SAN JUAN/CHAMA BASIN

November 2014

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INTRODUCTION

Big game hunting and wildlife-based tourism are major economic contributors to the communities located in the south San Juan Mountains, along the Colorado (CO)/New Mexico (NM) border. Many private landowners in this area actively manage their properties to benefit wildlife, specifically mule deer and elk, and big game hunting is often an integral part of their business plan. The Chama Peak Land Alliance (CPLA), which represents private landowners in the upper San Juan and Chama River watersheds, initiated this report to provide members a better understanding of the status and dynamics of the mule deer and elk herds they depend on and enjoy.

Mule deer and elk herds in the San Juan Mountains are somewhat unique in that their annual migrations can overlap 4 separate jurisdictions; each with authority to manage and harvest animals. The 4 agencies charged with managing mule deer and elk are Colorado Parks and Wildlife (CPW), New Mexico Department of Game and Fish (NMDGF), Southern Ute Wildlife Resources Management Department (SUWRMD) and Jicarilla Game and Fish Department (JGFD). This shared management responsibility prompted the 4 agencies to form the San Juan Interstate Wildlife Working Group (SJIWWG) in 1987, as a venue for sharing information and coordinating management activities.

The goal of this report was to bring together all the available information pertaining to the mule deer and elk herds on CPLA's area of interest, which I named the CPLA Project Area; and to assess the current status of those populations. This information will be used by CPLA to assist landowners in evaluating their individual wildlife management programs.

Acknowledgements

The following individuals graciously provided records for use in this report:

- Kyle Tator, Jicarilla Game and Fish Department
- Aran Johnson, Southern Ute Wildlife Resources Department
- Scott Wait, Colorado Parks and Wildlife
- Brad Weinmeister, Colorado Parks and Wildlife
- Stephanie Ferrero, Colorado Parks and Wildlife
- Nicole Quintana, New Mexico Department of Game and Fish

- Stewart Liley, New Mexico Department of Game and Fish
- Ryan Darr, New Mexico Department of Game and Fish
- Hall Sawyer, Western Ecosystems Technology, Inc.

METHODS

Project Area

The first step in this process was to describe the CPLA Project Area. Figure 1, taken from CPLA's website, is a map depicting CPLA's area of interest. It straddles the Colorado/New Mexico Border and the Continental Divide. It includes the headwaters of the Chama River, Brazos River, Navajo River, Conejos River, Rio de Los Pinos, Rio Blanco and other smaller streams. The CPLA area of interest did not conform to specified management units used by the state and tribal wildlife agencies; therefore, I had to choose which management units to include. Figure 2 shows the Game Management Units (GMU's) and Indian Reservations included in the CPLA Project Area for this report.

Colorado

Mule deer and elk in CO are managed by CPW. CPW groups individual GMUs into Data Analysis Units (DAUs) for distinct deer and elk herds. Figure 2 shows the CO DAUs included in the CPLA Project Area. GMUs 75, 751,771,77 and 78 comprise elk DAU 31 (blue); while GMUs 80 and 81 comprise elk DAU 32 (green). These same groupings of GMUs were used for analyzing mule deer populations, and were numbered deer DAU 30 (blue) and deer DAU 35 (green).

Southern Ute Indian Reservation

Mule deer and elk on the SUIR are managed by the Southern Ute Wildlife Resource Management Division SUWRMD. The SUIR encompasses approximately 680,000 acres, but is comprised of a checkerboard ownership pattern, with numerous private inholdings. The total acreage of tribal land, held in trust by the U.S. Government, is approximately 310,000 acres. The analysis of deer and elk herds on the reservation was commonly split between east side and west side segments, with the Animas River being the line of demarcation. However, for this report I used the reservation survey results as a single data set.

New Mexico

Mule deer and elk populations in NM are managed by the NMDGF. The state is divided into separate GMUs for managing harvest, and into groupings of units for population data analysis. The NMDGF combines GMUs 4,5B, 50, 51 and 52 into the north-central elk herd. Unit 5B is considered primarily winter range for the north-central elk herd. For this analysis I also included GMUs 2A, 2B, and 2C, which are considered mule deer units, and have not been surveyed for elk since prior to 2006.

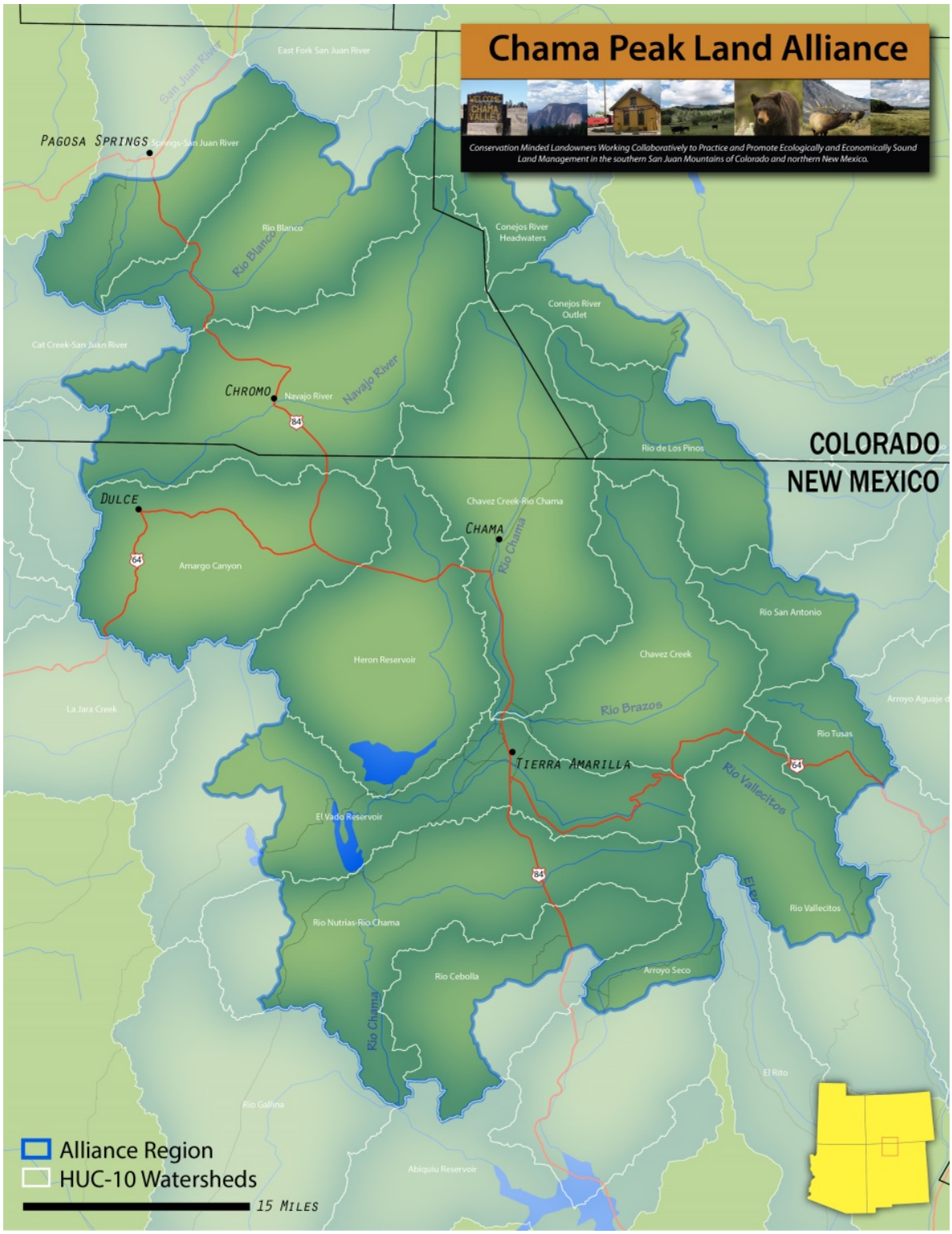

Figure 1. Map of the Chama Peak Land Alliance area of interest.

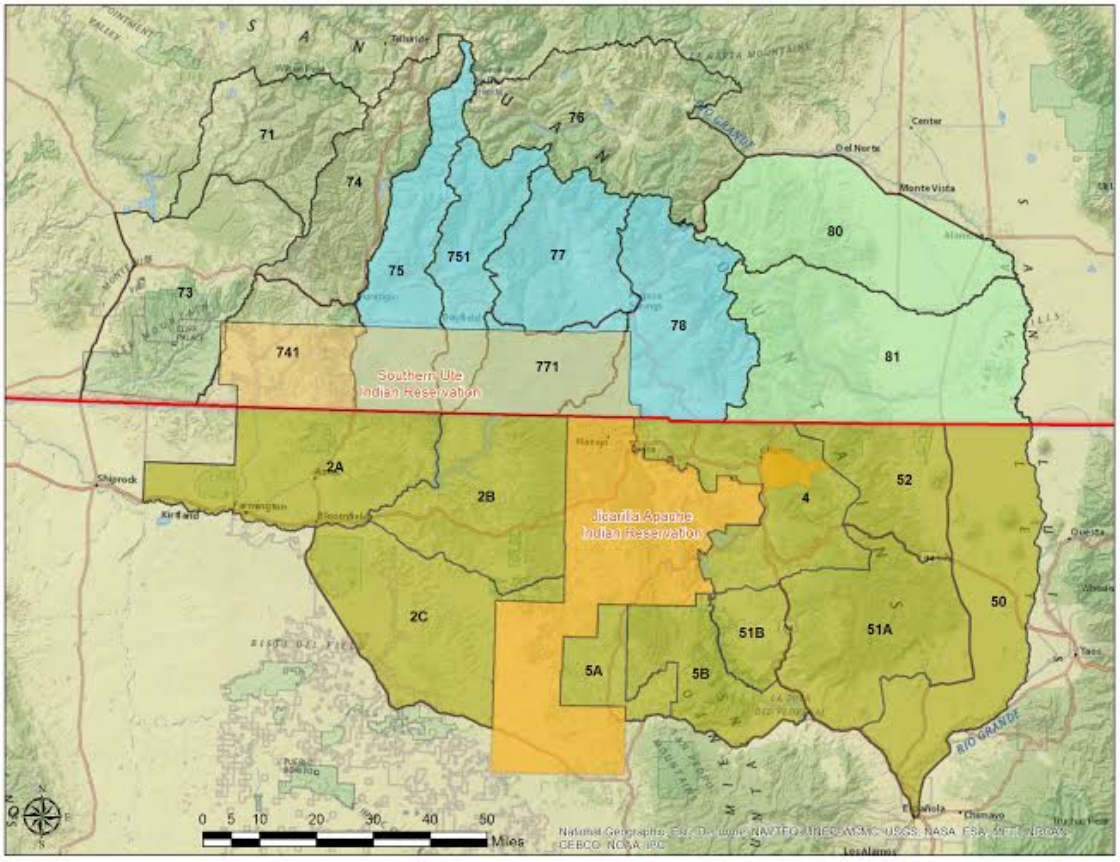

Figure 2. CPLA Project Area showing Colorado and New Mexico GMUs, and the Jicarilla Apache and Southern Ute Indian Reservations.

Jicarilla Apache Reservation

The JAR encompasses approximately 890,000 acres of land, all held in trust by the U.S. Government. There are only 2 private inholdings, totaling less than 500 acres, and all lands owned by the JAT are contiguous. Mule deer and elk are managed by the JGFD. The reservation is often split into north and south units for the purposes of hunting seasons and data analysis, but for this report I combined all the JAR information into a single data set.

Distribution and Migration

Radio-telemetry has been the primary tool for determining mule deer and elk movements, distribution and migration patterns, and numerous studies have been conducted in the CPLA Project Area by all 4 management agencies. I reviewed all of the telemetry studies conducted to date and provided a brief summary of the findings.

Population Parameters

Population parameters included age and sex classification data derived from aerial surveys. All 4 agencies routinely gathered this type of information and that allowed me to combine similar data into a single data set representative of the regional mule deer and elk populations. However, there were some significant differences in how the data were collected.

The CPW, SUWRMD and JGFD typically flew mule deer and elk classification surveys in late December or early January. These "winter" surveys sampled the herds post-hunt, and provided male:female ratios at their lowest level during the year. The NMDGF changed their elk survey techniques in 2008 and began flying the north-central elk surveys in late September. These "fall" surveys sampled the elk population prior to rifle hunting season and produced pre-harvest estimates of bull:cow ratios. That pre-hunt data was then used to model the elk population and provided estimates of elk numbers and allowable harvest.

CPW and NMDGF provided estimates of deer and elk population size; however, the complexity of migration patterns and hunting seasons within the CPLA Project Area makes estimating these populations very difficult. Most estimates of total numbers come with a wide range of values and are based on untested assumptions. Additional information, such as age of animals harvested and scores of males harvested also was collected by several of the wildlife management agencies.

Hunter Harvest

Hunter harvest was estimated differently in each of the 4 jurisdictions. CPW relied on a randomized telephone survey of hunters to estimate harvest of mule deer and elk in GMUs across the state. Their survey sampled approximately 20% of the licensed hunters statewide. The SUWD estimated hunter harvest on the SUIR from personal contacts with hunters when they pick-up their permits for the following season. This results in a sample size of approximately 75% each year. The JGFD estimated hunter harvest from a combination of hunter questionnaires, mandatory check-in of animals, and personal contacts with local hunters to achieve sample sizes of 65-100%. NMDGF initiated mandatory harvest reporting for all elk and mule deer hunters in 2006. Hunters were required to file their harvest report on-line, by a set deadline date, or they were ineligible to apply for hunts the following year. Hunters who missed the deadline could pay an additional fee to file their harvest report to retain eligibility. This system produced consistently high sample sizes of hunters in specific GMUs, often in the 90%+ range.

RESULTS

Part 1. Distribution and Migration Studies

1. New Mexico Game and Fish Department-1970's

The first use of radio-telemetry to investigate big game migration in the area was a mule deer study conducted by NMDGF in the late 1970's. Unfortunately none of the project reports were available, and the results I had were from personal communication with the original researchers (Doug Humphries and Wally Hausman, NMDGF) in the early 1980's. Mule deer were captured on winter range in Unit 2B (Middle Mesa, east of Navajo Reservoir) and fitted with VHF collars. Those deer migrated north and east to summer range in southern CO; primarily GMUs 78 and 81. This was the first study to document mule deer crossing the NM/CO border, and the pattern of deer using widely separated seasonal ranges. The researchers also noted that Navajo Lake (which began filling in 1962) represented a significant barrier to the westward migration of mule deer during winter.

2. Jicarilla Game and Fish Department-1980's

From 1983-85 the JGFD radio-collared 42 mule deer, some on reservation winter ranges on the southern portion of the reservation; and some on summer ranges located on the north half of the reservation. All but one of the mule deer migrated between summer and winter ranges, moving generally southwest to northeast (Figure 3). Mule deer from the southern portion of the reservation utilized summer ranges in NM GMUs 4 and 5 and the north half of the reservation. Mule deer that summered on the north half of the reservation wintered on the southern half, or in GMU 2B. None of the radio-collared mule deer migrated across the NM-CO border.

Forty-five elk were radio-collared on the JAR from 1987-89. Elk were captured on both summer range and winter range. Those captured during winter generally migrated north and east to summer ranges in NM GMU 4, and CO GMU's 78 and 81 (Figure 4). Elk captured during summer migrated west and south to winter ranges in GMUs 5 and 2. This study demonstrated the link between high-elevation elk summer ranges in southern CO to lower elevation winter ranges in northern New Mexico and the JAR. Bulls generally migrated to winter range earlier than cows, coincident with the decline in rutting activity and the start of rifle hunting seasons; while cow elk migrated later in response to increased snow depth.

3. Southern Ute Wildlife Resource Management Division

In the late 1980's-early 1990's 17 elk and 19 deer were captured on winter range on the SUIR and fitted with VHF collars. These elk migrated north to high-elevation summer ranges in GMUs 75, 751, 77 and 78; and several crossed the Continental Divide into GMU 76 (Figure 5). The radio-collared mule deer migrated north and east to summer ranges in the same GMUs as the elk. At least 2 elk and 2 mule deer spent a portion of one winter in NM; the elk in GMU 2B and the deer in GMU 2A. Animals collared on the west side of the reservation migrated shorter

distances between seasonal ranges than animals collared on the east side. Their summer range was located in the La Plata Mountains west of Durango, CO.

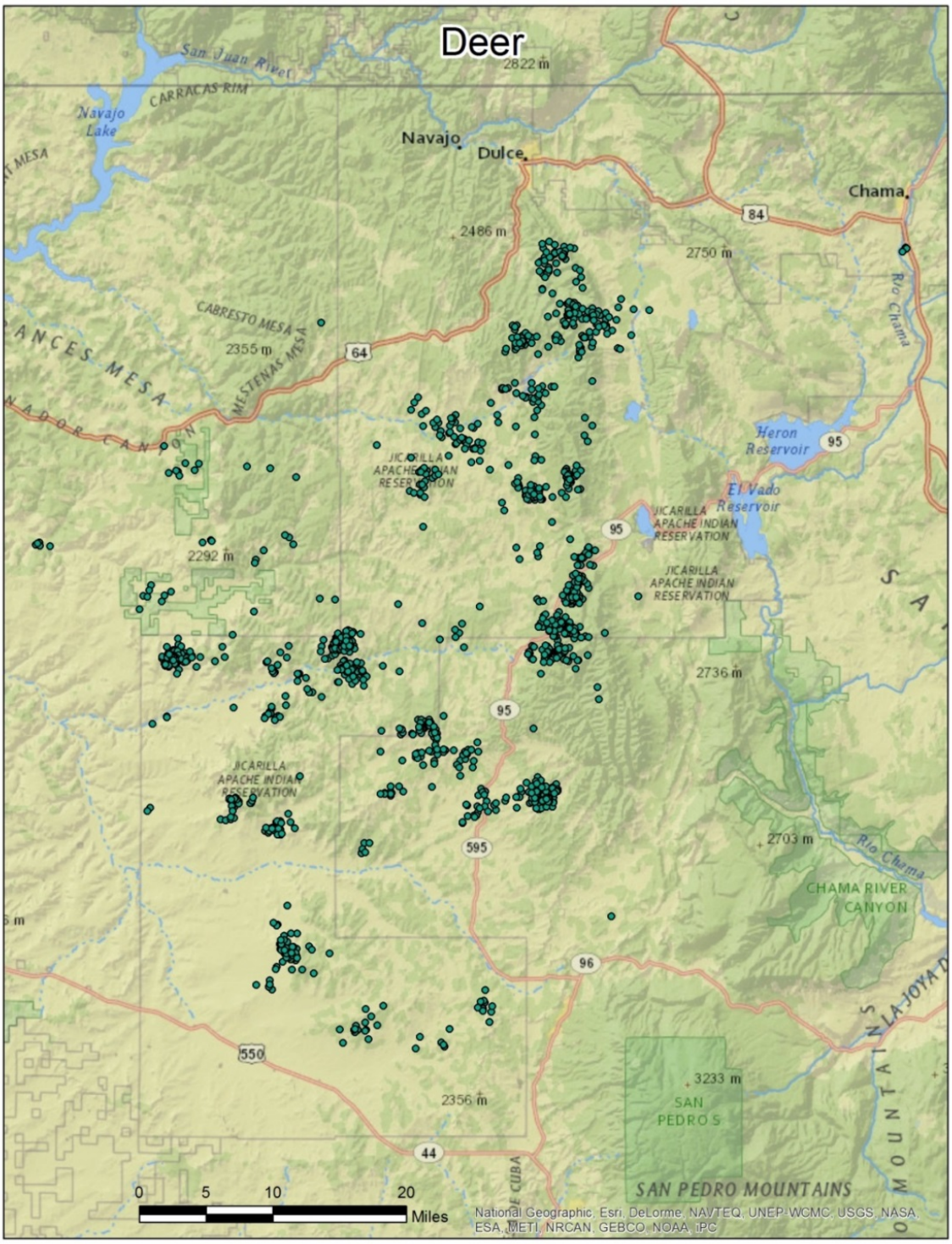

Figure 3. Locations of radio-collared mule deer, JGFD study, 1983-87.

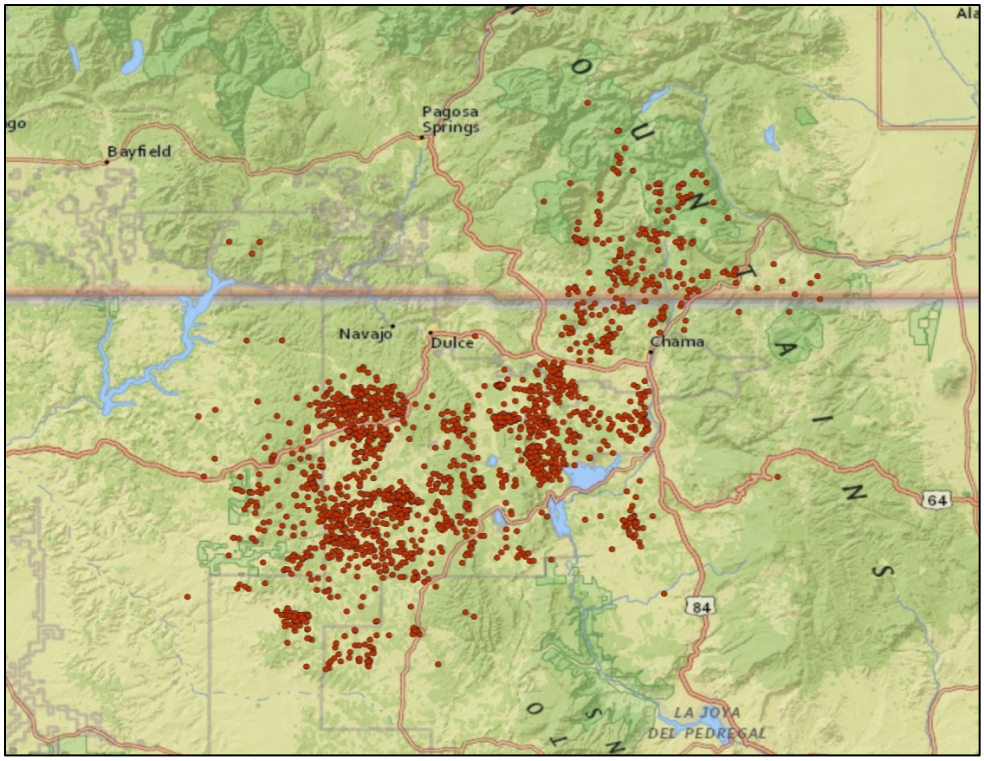

Figure 4. Locations of radio-collared elk, JGFD study, 1987-90.

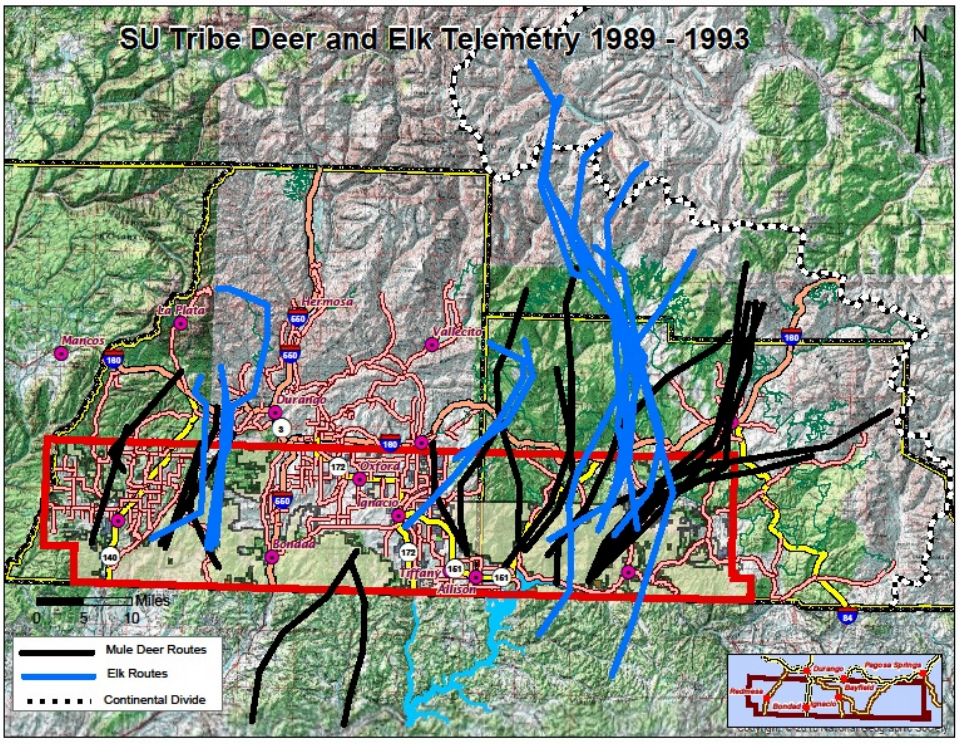

Figure 5. Mule Deer and Elk migration paths, SUIR elk and mule deer telemetry studies, 1989-1993.

4. Colorado Division of Wildlife

The CDOW conducted a number of elk radio-collaring efforts in the 1990's. The first effort consisted of 30+ elk captured between Durango and Bayfield, both north and south of US Highway 160. These elk were captured on transitional range, fitted with VHF radio-collars, and monitored from 1994-1998. This study was initiated in response to increased housing developments along US Highway 160 amid concerns about how that development might impact elk migration. All of the radio-collared elk migrated north-to-south, and none ventured south of the CO-NM border. No maps were available from this study.

A second effort involved capturing 25 cow elk on summer and transitional range near Chromo and Valle Seco. These elk were fitted with VHF collars and monitored from 1997-2002. Their summer ranges were in GMUs 78, 80 and 81 (Figure 6). Approximately half wintered on lower elevations in CO, south of Pagosa Springs, and half wintered in northern NM. Of those that wintered in NM, half stayed between Chama and Lumberton in GMU 4, and half wintered on the JAR.

Distribution of the CDOW elk overlapped considerably with that of elk from the earlier JGFD study, and clearly showed the link between summer ranges in the south San Juan Mountains and winter ranges in northern NM. Some of the radio-collared cow elk were harvested, and most of the harvest occurred during late season cow elk hunts in GMU 4 and the JAR. During the study, cow elk hunting seasons extended as late as March 31 in GMU 4, and January 31 on the JAR. Drought conditions experienced during the late 1990's/early 2000's had prompted accelerated cow harvests in both jurisdictions in response to elk impacts (perceived and real) on livestock and farm operations on private and tribal lands.

Figure 7 is a compilation of the JGFD and CDOW elk telemetry locations; and it illustrates the gradient of elk distribution along a NE-SW axis, between summer ranges in the south San Juan Mountains and winter ranges extending south of Pagosa Springs into northern NM. Some elk from both studies crossed the Continental Divide into GMUs 80 and 81. Significant staging areas for these elk included Valle Seco, Humphries and Sergeants Wildlife Areas, Coyote Park/Klutter Mountain, and the Navajo River and Rio Chamita Valleys.

5. New Mexico Department of Game and Fish/New Mexico Cooperative Fish and Wildlife Research Unit-San Antonio Mountain Elk Study

This research study, conducted by Sam Smallidge as part of his requirements for a PhD from New Mexico State University, was the first research-oriented elk telemetry study conducted in the CPLA Project Area. Beginning in 1998, 110 elk were captured on the San Antonio Mountain Winter Range, located in GMUs 50 and 52. They were fitted with VHF collars, and tracked for 3 years (Figure 8). While the majority of elk migrated between winter and summer ranges, approximately 80% of the elk remained in NM year-round. Their summer ranges were west of San Antonio Mountain, in the higher elevations of GMUs 52 and 4. Approximately 20% of the radio-collared elk migrated north, across the CO/NM border, to summer range in GMU 81. Smallidge (2003) postulated a "super population" of elk that shared

a common winter range, but inhabited a variety of different summer ranges. He also reported considerable overlap of seasonal ranges, and that winter range use depended on environmental conditions, primarily snow depth.

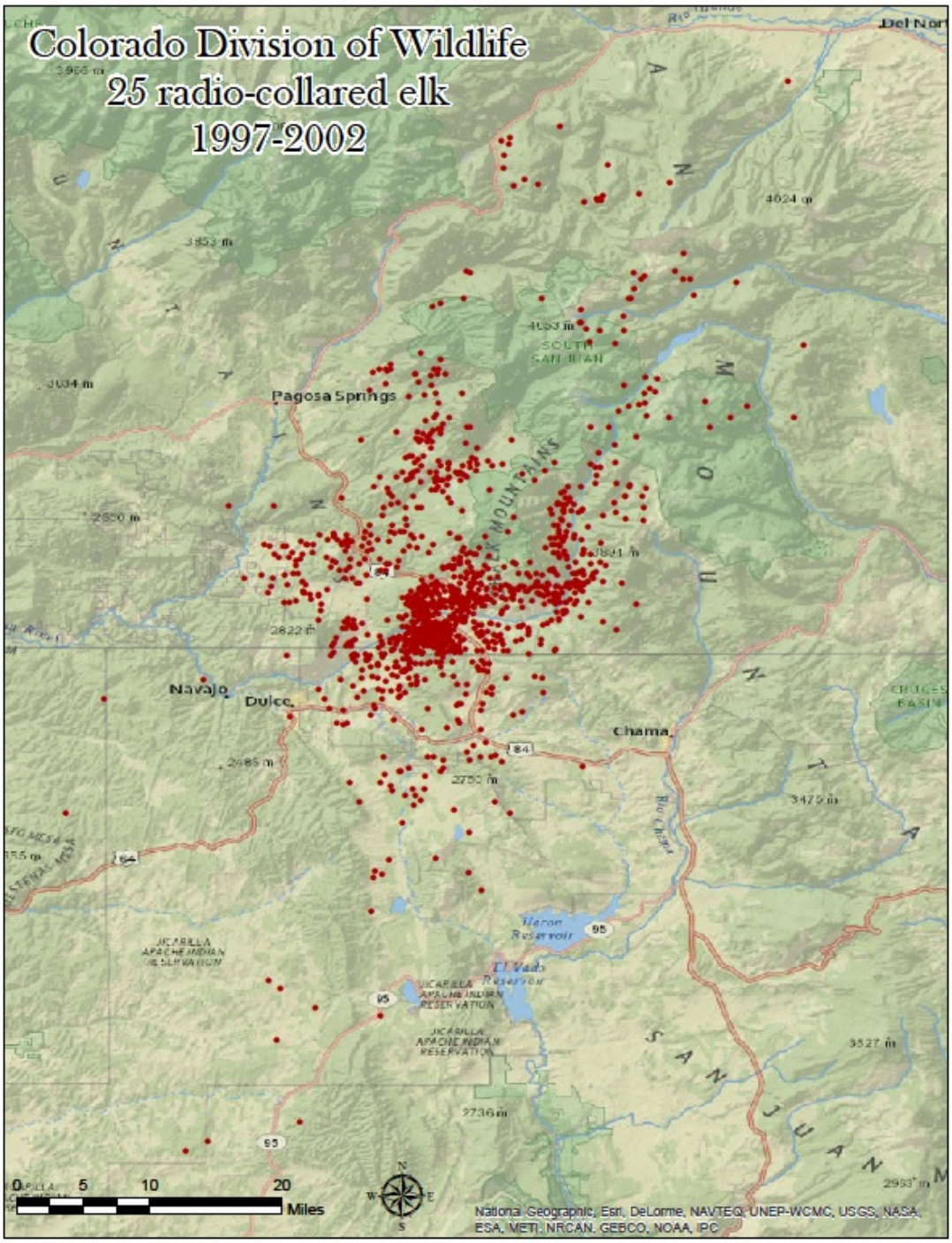

Figure 6. Locations of radio-collared elk, CDOW study, 1997-2002.

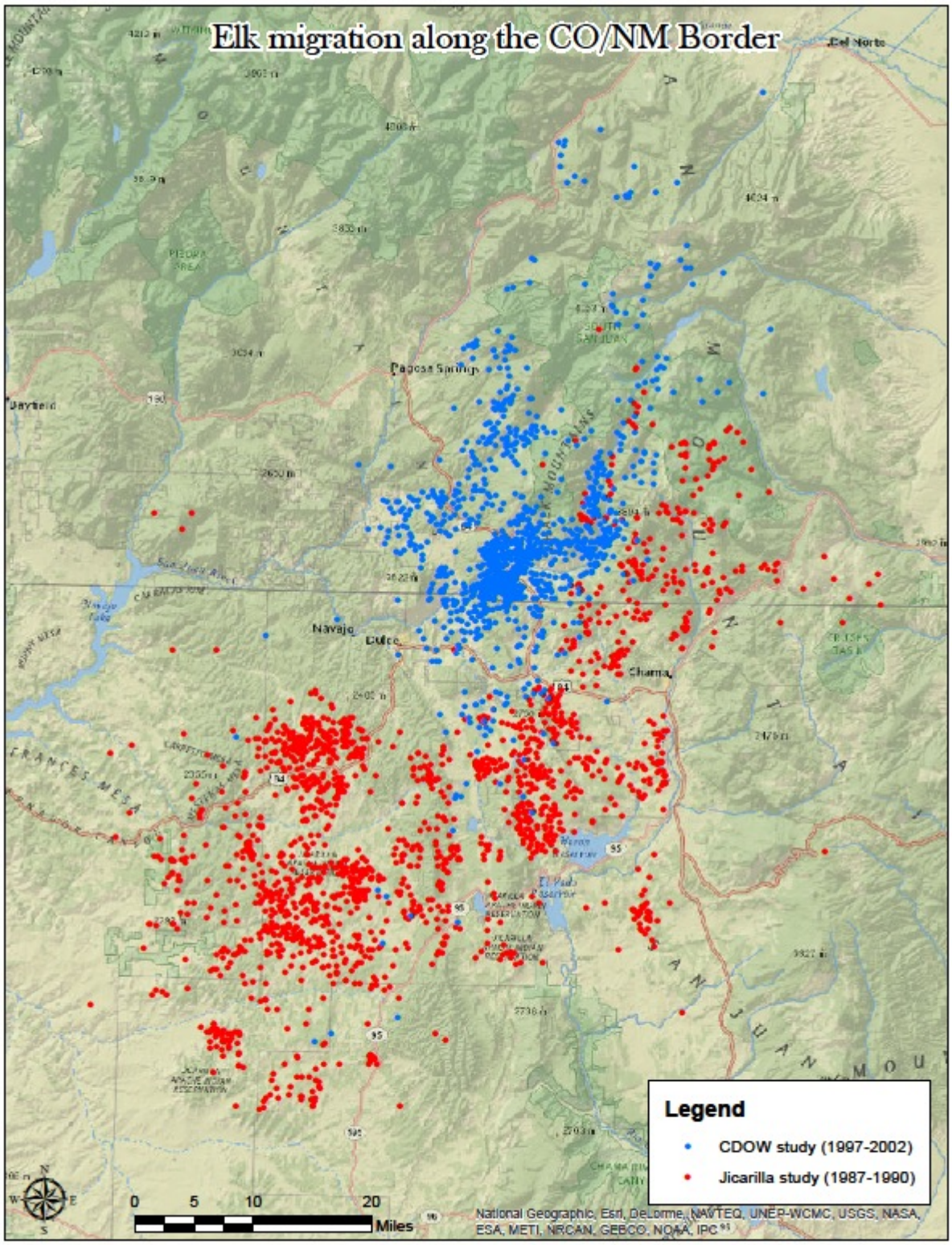

Figure 7. Relocations of elk radio-collared by CDOW and JGFD.

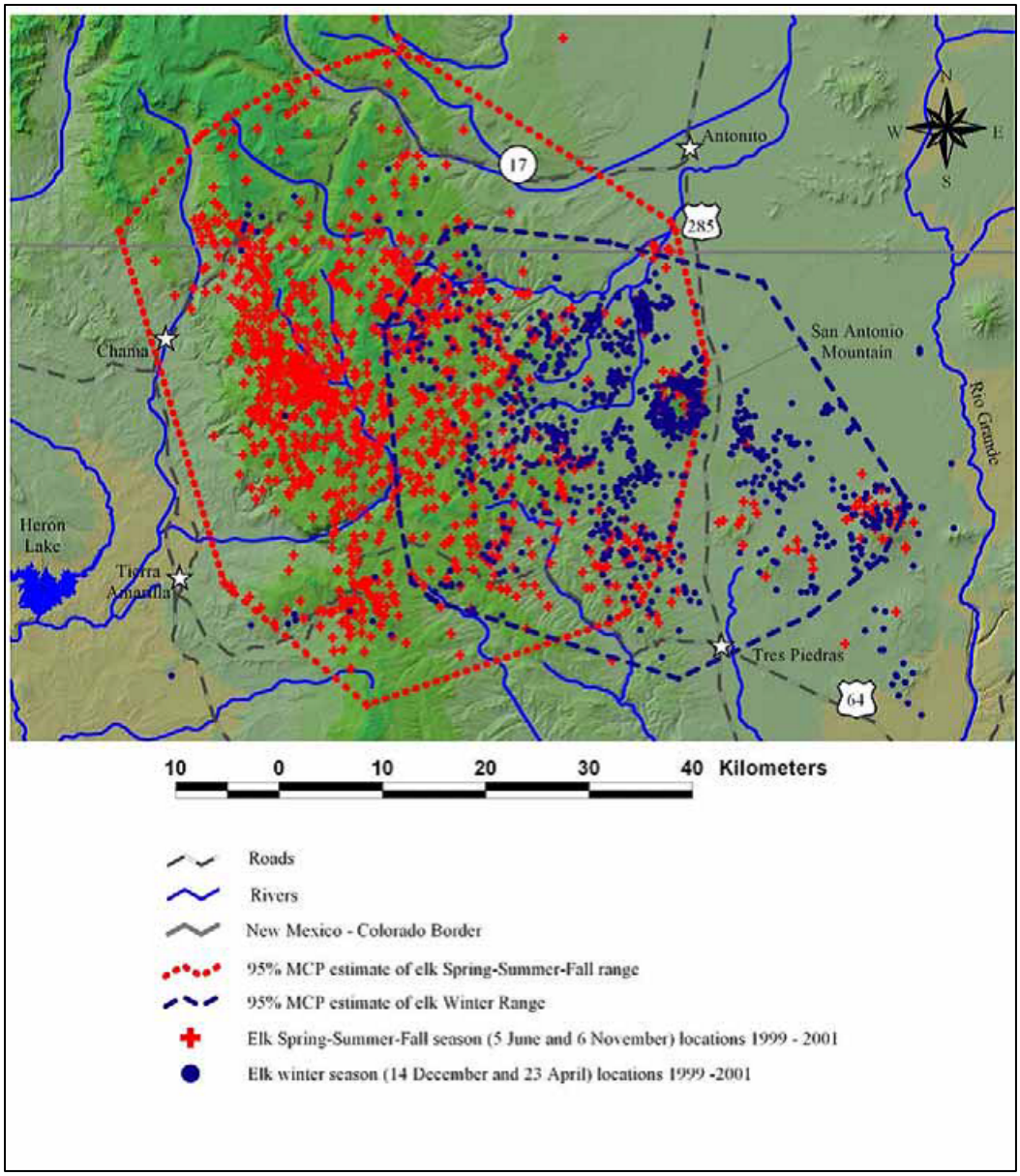

Figure 8. San Antonio Mountain elk telemetry study. Locations shown by season, 1999-2001.

There were 4 elk that completely left the study area, moving far outside the typical migration patterns. Two cows moved farther north to GMU 80 and remained there year-round. One cow elk moved southwest to the JAR and remained there. One bull elk moved northeast to the Sangre de Cristo Mountains and remained there for the duration of the study. The San Antonio Mountain Elk Study was the first in this area to utilize GPS collars. Five elk were fitted with GPS collars programmed to record locations every 5 days. Movements by these GPS collared elk did not deviate from the patterns exhibited by elk fitted with VHF collars.

6. Southern Ute Wildlife Resource Management Division-2007

A second telemetry study was conducted by the SUWRMD to determine seasonal movements of resident mule deer and elk on the west side of the reservation. In September 2007 10 elk and 7 mule deer were captured southwest of Durango, CO and fitted with VHF radio-collars. With the exception of one bull elk and one cow elk, all of the radio-collared mule deer and elk remained on the reservation year-round, and did not migrate to seasonal ranges. Mule deer averaged only 3.2 km between their summer and winter locations; while elk averaged 11.5 km. One bull elk left the reservation and moved west to the Ute Mountain Indian Reservation, south of Cortez, CO. This study illustrated a pattern that occurs on some winter ranges in the region, where non-migratory mule deer and elk reside year-round on land used as winter range by other animals. This pattern also occurs in NM and on the JAR. These animals may shift to lower elevations during winter, but they do not make the classic high-elevation to low-elevation migrations typical of many mule deer and elk in the CPLA Project Area.

7. Southern Ute Wildlife Resource Management Division-2004-2010

By far the most intensive telemetry study conducted to date was the mule deer migration study initiated by SUWRMD in 2004. This study, utilizing GPS technology, was focused on documenting mule deer distribution and migration patterns in and around the HD Mountains prior to proposed oil and gas development. The intent was to establish a baseline of mule deer distribution and migration patterns, pre-development, and then continue the study through the development phase to determine impacts to mule deer. For a variety of reasons, the oil and gas development has not yet occurred, but SUWRMD compiled an extensive record of mule deer migration over a 7-year period (2004-2010). The sheer amount of data gathered and the detailed mapping of deer movements provided a unique look at the timing of deer migrations and the exact pathways used to travel between winter and summer ranges. The GPS collars were programmed to record locations every 2 hours for 2 years. The collars detached automatically on a pre-set date and the data were retrieved.

In general the deer migrated from SUIR winter ranges north and east to high-elevation summer ranges along the Continental Divide (Figure 9). They typically followed major drainages and exhibited almost 100% fidelity to summer range among years. Fidelity to winter range was almost as strong; however, when snow depth became extreme during one year, some of the deer migrated farther south, with a few crossing the border into NM.

The timing of migration was also very predictable, with deer starting their migrations on almost the same date every year (Table 1) and arriving on their seasonal range on almost the same date every year (Table 2). The extremely small confidence intervals for the migration initiation and arrival dates indicates that mule deer migration must be triggered by something very predictable, perhaps day length, and not by local environmental factors like weather, green-up, or snow depth.

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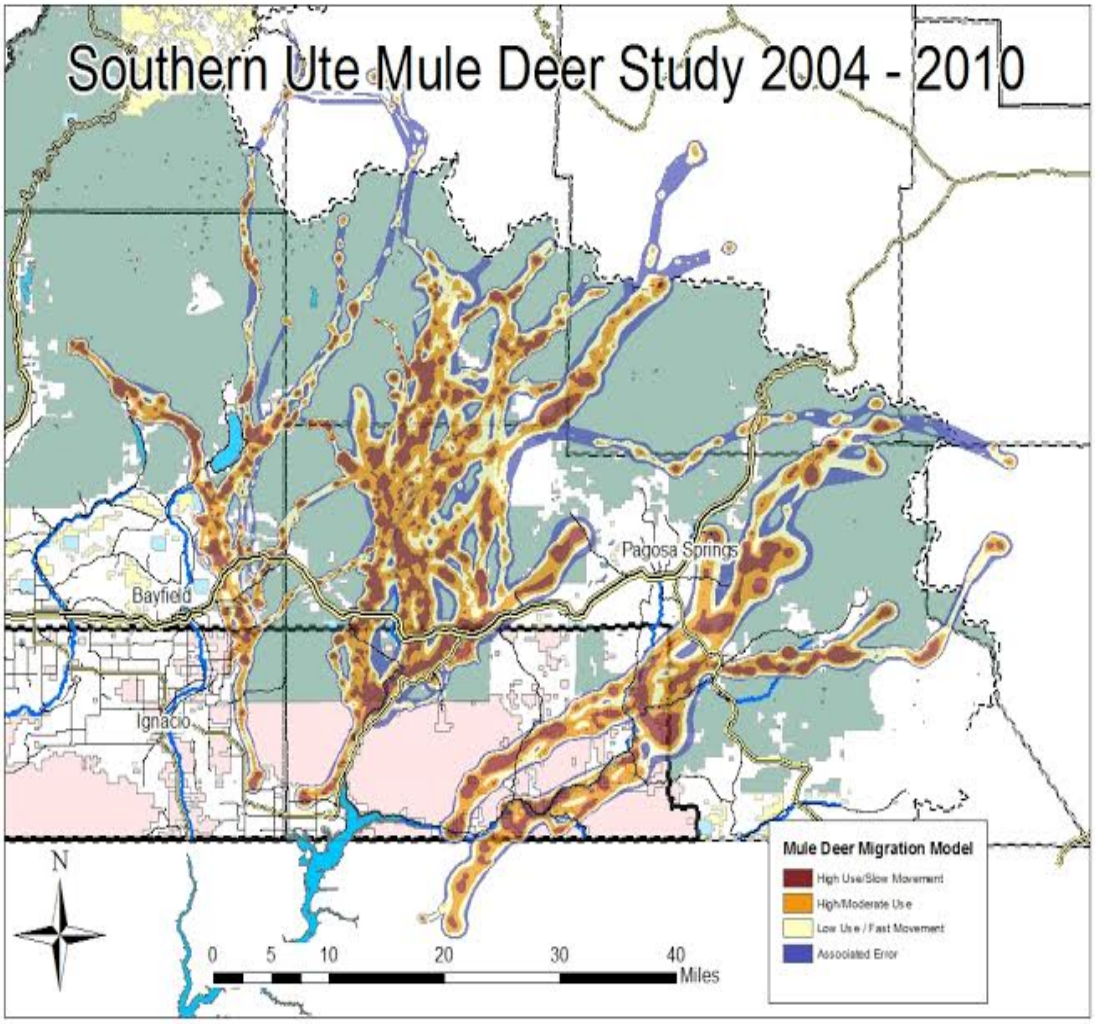

Figure 9. Mule deer migration corridors, SUWRMD GPS telemetry study, 2004-2010.

Table 1. Mule deer migration initiation dates, SUWRMD.

Migration Initiation	# Deer	# Migrations	Average Date	95% CI
Spring	96	179	May 7th	May 5, May8
Fall	87	150	Oct. 15th	Oct. 12, Oct.17

Table 2. Mule deer seasonal range arrival dates, SUWRMD.

	# Deer	# Migrations	Ave. Date	SE	95% CI
Summer Range	95	178	May 25th	1.08	May 23, May 27
Winter Range	87	150	October 30th	1.14	Oct. 28, Nov. 1

During this study mule deer averaged approximately 57 kilometers between seasonal ranges (total daily movements, not straight line distance); typically moving 4.9 km/day during spring migration and 6.4 km/day during fall migration. Deer spent an average of 18.4 days during spring migration and 15.6 days during fall migration.

Another key piece of data derived from this study was the average date mule deer crossed the highways south and west of Pagosa Springs (Table's 3 and 4). Numerous deer are killed on these highways every year, with most collisions occurring during peak migration. Knowing when peak deer crossings occur is valuable information, not only for the CO Department of Transportation, but for the public travelling those highways.

Table 3. Average date for deer crossing Highway 160, west of Pagosa Springs, CO, SUWRMD.

	# Deer	# Migrations	Ave. Day	SE	95% C.I.
Spring	77	139	May 10th	0.87	May 8, May 11)
Fall	68	113	October 29th	1.17	Oct. 27, Oct. 31)

Table 4. Average date for deer crossing Highway 84, south of Pagosa Springs, CO, SUWRMD.

	# Deer	# Migrations	Ave. Day	SE	95% CI
Spring	18	37	May 12th	1.35	May 9,May 14
Fall	18	34	October 24th	1.4	Oct. 22, Oct. 27

8. Rosa Mule Deer Study: West Incorporated, Hall Sawyer-2011

In December 2011, an intensive mule deer telemetry study was initiated by West Inc., in NM GMU 2B. The Rosa Study Area is a high density mule deer winter range located in Cabresto Canyon, just east of Navajo Reservoir. The objectives of this study were to determine mule deer migration patterns, habitat use, and survival before and during expanded energy development. The project is scheduled to continue through 2016. Figure 11 shows relocation data for 60 radio-collared mule deer does as of March 2014. Collared deer migrated north and east to summer ranges in CO, primarily east of Pagosa Springs in GMUs 77, 78, 751, 771, 80 and 81.

The most striking conclusion from this data is how mule deer from across a vast landscape of summer range in southern CO are dependent on a very small, at risk winter range in northern NM. Preliminary results on the mortality portion of the project revealed annual survival rates of 0.79 and 0.85 for adult does in 2012 and 2013, respectively.

The Rosa Project Area lies just south of where deer were captured during the 1970's NMDGF study, and the migration patterns emerging from the Rosa Study were very similar to patterns revealed by that earlier study. However, the tremendous number of locations generated by the current study substantially increased the level of detail on migration routes and staging areas.

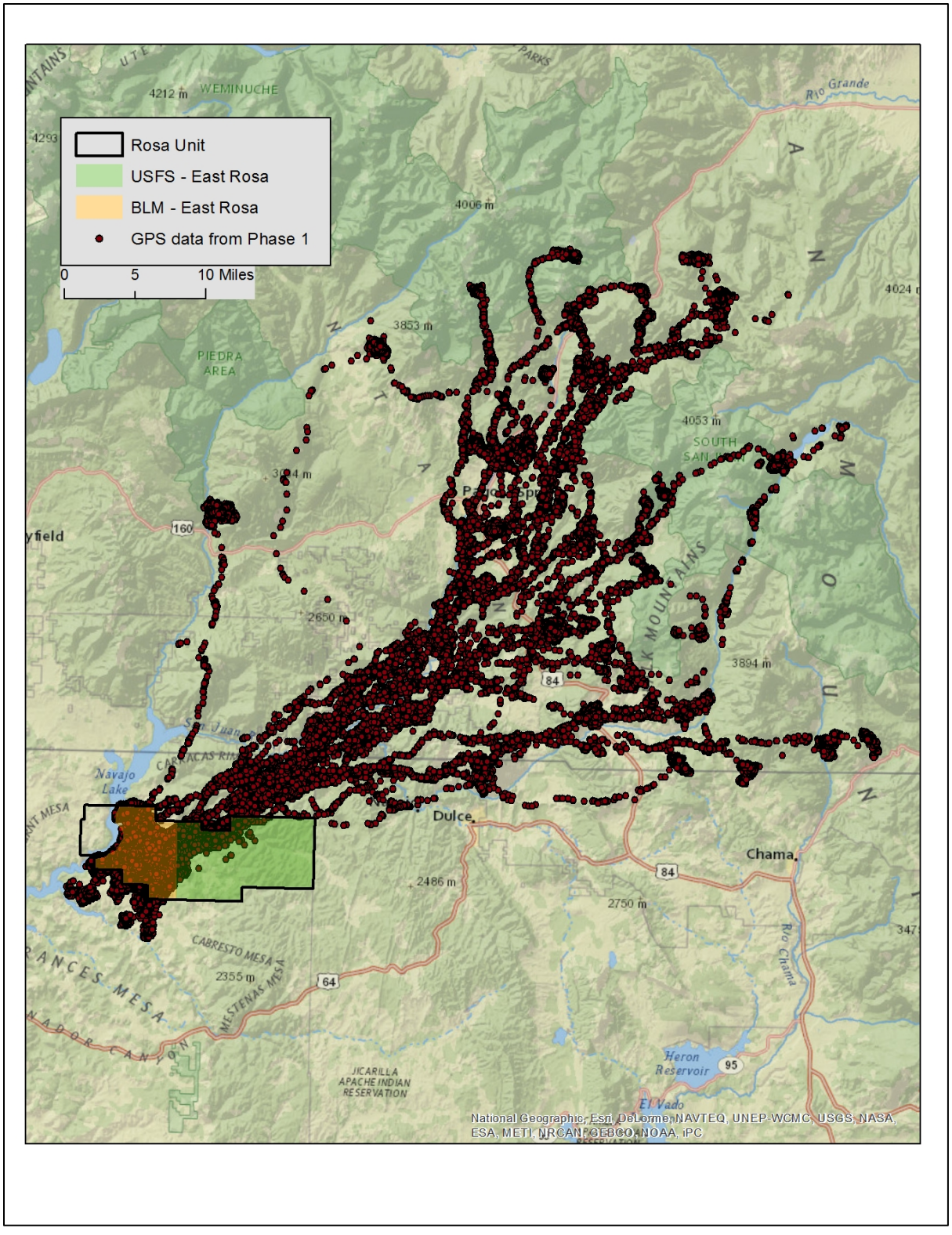

Figure 11. Relocations for 60 mule deer from December 2011 through March 2014, Rosa Deer Study, Hall Sawyer.

9. Colorado Parks and Wildlife-2012

In 2011 CPW initiated a long-term mule deer telemetry study in DAU 30, focusing on mule deer that winter between the Animas and Los Pinos Rivers. Utilizing GPS collars, this study will investigate migration patterns and statistics in relation to energy development and habitat fragmentation; and also identify critical habitats, stop-over areas and bottlenecks to assist in better managing the mule deer herd in that area. The goal was to maintain 15 GPS collars on adult does during each year of the 6-year project. Mule deer does were captured on winter range beginning in early 2012, and collars were retrieved in early December of each year.

During the first 2 years approximately half of the collared mule deer did not exhibit the twice-annual migrations between summer and winter range. Those deer moved very little and spent the entire year on the winter range. The rest of the collared deer moved north to high elevation summer ranges in the San Juan Mountains; the farthest distance moved was 41 miles. During the third year only 2 of 10 collared does migrated to summer range; one moving 6 miles north and the other moving 15 miles north. The rest remained on winter range year-round. This sedentary pattern was very similar to elk and deer previously collared on west side of the SUIR.

Thus far 10 of the collared deer have died during the study; 5 from vehicle collisions, 2 from malnutrition, 1 caught in a fence, 1 unknown, and 1 suspected lion kill. The preponderance of human caused mortalities underscored the need for identifying how human development affects migratory and resident mule deer, and for developing effective mitigation measures to minimize those adverse impacts. This study is scheduled to finish in 2016, and will complete the picture of mule deer migration patterns in DAU 30

10. Colorado Parks and Wildlife-2012

In 2012 CPW initiated an elk telemetry study based along the Continental Divide in GMUs 80 and 81, utilizing 40 VHF radio-collars and 20 GPS collars. Elk were captured on both summer and winter ranges in those GMUs. The primary objectives of the study were to improve elk population estimates and modify license allocations to achieve better elk distribution during hunting seasons. Thus far only 10 of the elk have migrated south into NM for the winter. The rest have wintered at lower elevations on the eastern portions of Units 80 and 81. This study is scheduled to continue until 2017.

11. Southern Ute Wildlife Resource Division-2013

In late 2013 the SUWRMD captured 15 elk on winter range and fitted them with GPS collars. The collars are programmed to detach after 2 years. These elk should provide the same detailed information on migration routes and timing of migration as the SUWRMD mule deer study. Figure 10 shows the preliminary results from periodic VHF locations of the GPS collared elk. Most of the cow elk moved north to summer along the Continental Divide, and 2 crossed the Divide into GMU 76. Once the collars are retrieved the GPS locations will track their specific routes used between winter and summer ranges.

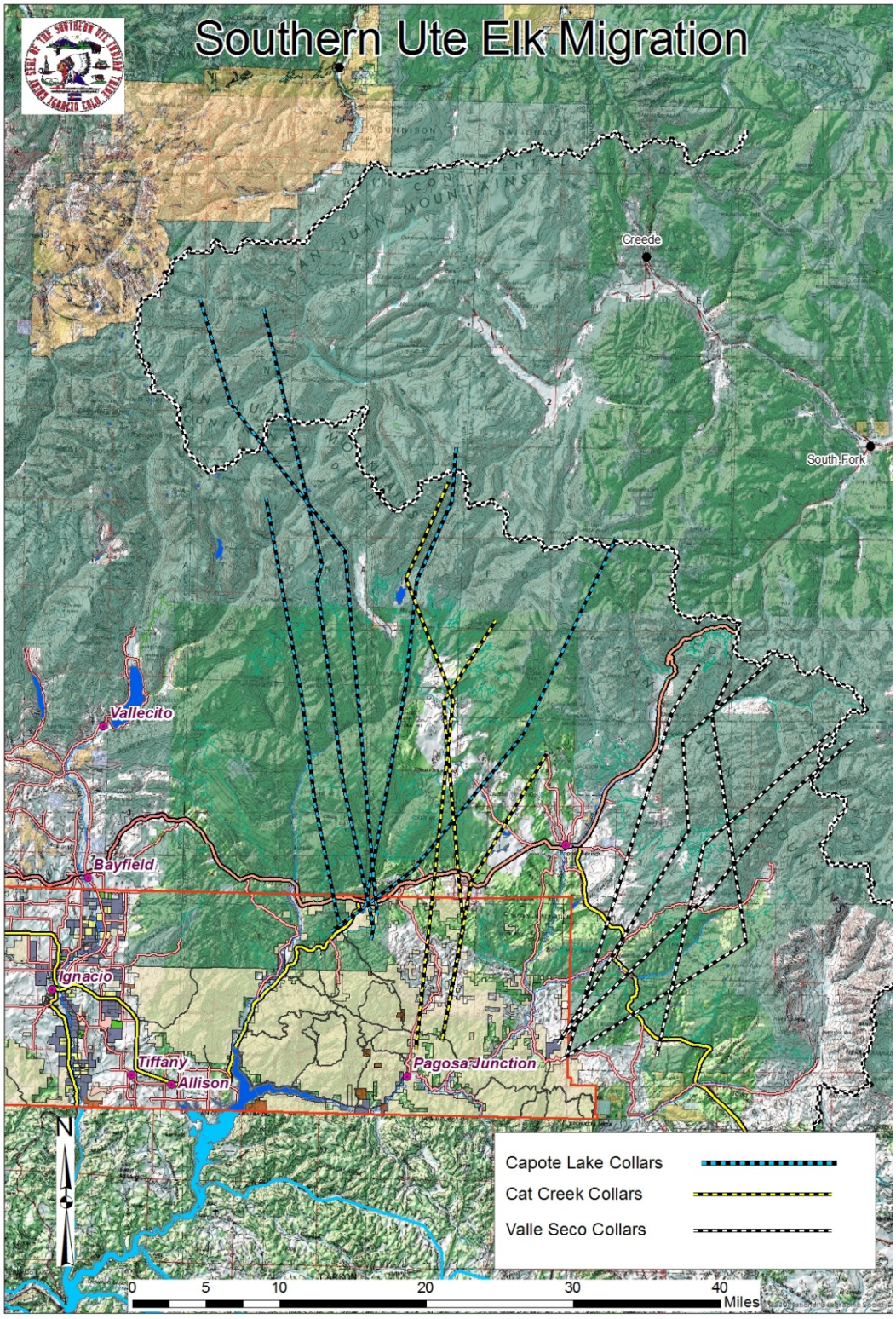

Figure 10. Migration of GPS-collared elk in 2014, Southern Ute Wildlife Resources Department.

Jicarilla Game and Fish Department-2014

In early 2014 the JGFD fitted 25 elk with GPS collars, with capture sites distributed on winter ranges throughout the JAR. This study will document elk migrations from a variety of wintering sites, many of which were not sampled during earlier studies. Preliminary monitoring via VHF receivers has revealed that some elk migrated north into CO, some moved east into the Jemez Mountains in NM, and some have remained on the JAR. The collars are scheduled for retrieval in 2016.

Part 2. Description of Mule Deer and Elk Populations

Population Parameters

Population parameters used to describe big game populations include age and sex ratios, total numbers, numbers observed per hour, age structure of harvest, and trophy potential. Age-sex ratios include the number of young:100 adult females; usually estimated mid-winter, which provides an estimate of a herd's production and recruitment of young. The number of males:100 females, also typically estimated mid-winter, reflects the level of harvest in the population. Classification data also yields estimates of yearling males:100 females, or mature males:100 females, which reflect the recruitment of yearling bulls into the population, and the availability of mature bulls for harvest. The criteria used for classifying males as mature varied among the 4 agencies; and involves using antler points, antler size and mass, and general animal appearance.

The search for fool-proof methodologies for estimating big game numbers has fueled numerous research and graduate student projects since the 1960's. This search has been driven by a fixation on numbers of animals, versus population performance parameters, for assessing status of deer and elk herds. The inherent non-randomness of elk and mule deer distribution across the landscape, their fondness for concealing vegetative cover, and their ability to hide from observers, makes them very difficult to census. In the CPLA Project Area the added complication of ingress and egress among the different jurisdictions makes the task even more difficult. Population models, using harvest figures and age:sex ratios, have been used to estimate big game population size. However, in the CPLA Project Area, most model assumptions cannot reasonably be met within a single jurisdiction; due to the biannual migration by a large segment of the mule deer and elk populations.

All 4 wildlife management agencies in the CPLA Project Area fly aerial classification surveys to determine mule deer and elk distribution and age:sex ratios. The primary differences are in the timing and sample methodology. The most common method consists of flights in late December-early January to estimate young:female and male:female ratios in the post-hunt population. These flights typically sample herds on winter range, except during unusually snow-free winters when some animals may still be on transitional range. The JGFD, SUWRMD and CPW fly surveys in this fashion. The sampling is generally non-random and flights are concentrated in areas where past experience has shown animals congregate during winter.

The proportion of the GMUs that are surveyed is dependent on snow depth, which can limit animal distribution, and by the agencies' flight budgets.

NMDGF flies the same type of surveys for mule deer, but at times in the past has employed stratified random sampling and grid flight patterns to estimate mule deer and elk population size. This technique proved to be accurate for elk surveys in southern NM, but required repeated flights to generate reliable population estimates, at significant cost. In 2008 NMDGF switched to flying elk classification surveys during late September, prior to rifle hunting seasons. The bull:cow ratios generated by these pre-hunt surveys were predictably higher than ratios estimated from the post-hunt surveys flown by the other 3 agencies, making comparisons difficult.

For this report I examined the availability of mule deer and elk data from each agency and chose to focus on the most recent years for which data were available (2006-2013). That provided an assessment of the current status and recent trends in elk and mule deer populations. In addition, the SJIWWG had compiled survey and harvest data for elk dating back to the early 1990's. This was used to examine long-term trends in the regional elk population.

Mule Deer

Age & Sex Ratios

The criteria used to classify bucks varied considerably among jurisdictions and even among observers. The CPW biologists classified bucks by age class; including yearlings, 2-year old bucks and mature bucks. The NMDGF classified bucks as either yearlings or adults. Yearlings were typically spikes, fork-horns or small 2x3s. Anything bigger was considered an adult buck. The JGFD classified bucks as either immature (less than 4x4, excluding eye-guards) or mature (4x4 or larger). However, old 3x4s or even 3x3s, with heavy antlers and large body size, were often classified as mature bucks, making the category somewhat subjective and observer biased. The SUWRMD used a combination of antler points, width and mass to classify bucks as either mature or immature, and theirs was probably the most conservative system among the 4 agencies.

Colorado

The CO portion of the CPLA Project Area encompassed 2 separate DAUs for mule deer. Deer DAU 30 included GMUs 75, 751, 77, 771 and 78, which lie east and south of the Continental Divide. Deer DAU 35 included GMUs 80 and 81, east of the Continental Divide. Table 5 summarizes mule deer survey results for DAU 30. Table 6 summarizes survey results for DAU 35, which were available only for 2009-2013. The annual count averaged approximately 1900 mule deer in DAU 30 and 800 mule deer in DAU 35.

Table 5. Mule deer survey results for CO DAU 30, 2006-2013.

Year	DAU	Buck:Doe	MB:Doe	Fawn:Doe	Total Deer	Flight Time	Deer/hour
2006	30	35	6	49	3248	30.2	108
2007	30	31	12	54	2784	23.6	118
2008	30	30	11	49	na	na	na
2009	30	52	14	52	2089	8.3	252
2010	30	25	8	46	2332	4.8	486
2011	30	28	9	54	2332	11.6	201
2012	30	27	5	45	1204	7.6	158
2013	30	31	10	55	1527	7.2	213
Average	30	32	9	51	1897	8	262

Table 6. Aerial survey results for CO DAU 35, 2009-2013*.

Year	DAU	Buck:Doe	MB:Doe	Fawn:Doe	Total Deer	Flight Time	Deer/hour
2009	35	25	12	38	1217	6	203
2010	35	21	10	39	269	3	90
2011	35	24	8	42	826	6.6	126
2012	35	19	5	48	886	3.9	228
2013	35	26	7	36	940	9.7	97
Average	35	23	8.4	41	828	5.8	149

*Data for 2006-2008 was not available.

Buck:doe ratios in DAU 30 ranged from 27-52:100 and averaged 32:100 over the past 8 years. In DAU 35 buck:doe ratios ranged from 19-26:100 and averaged 23:100. The ratio of mature bucks was similar for both DAU's, averaging 8-9:100 for the past 8 years.

The variation in fawn:doe ratios in DAU 30 was relatively low over the 8 years sampled; ranging from 45-55:100 and averaging 51:100. In this region a 50:100 fawn:doe ratio is approximately the break-even point between increasing or decreasing populations. In general, mule deer herds with a fawn:doe ratio below 50:100 tend to decline, while those with a ratio above 50:100 tend to increase. However, actual population growth or decline often depends on a wide variety of other factors. Based on the average fawn:doe ratio of 51:100 (Table 5), the

mule deer herd in DAU 30 has probably been fairly stable, but not increasing. In DAU 35 fawn:doe ratios ranged from 36-48:100, and averaged only 41:100 (Table 6). These values were indicative of a declining mule deer population.

Southern Ute Indian Reservation

The SUWRMD typically flew big game surveys in early January. Buck:doe ratios on the SUIR ranged from 25-33:100 and averaged 29:100 for the 8 years listed (Table 7). The mature buck:doe ratio ranged from 11-20:100, and averaged 16:100. Fawn:doe ratios varied from a low of 35:100 in 2008 to a high of 57:100 in 2006. The 8-year average was 50 fawns:100 does, indicating a fairly stable mule deer population.

The SUIR lies partially within and adjacent to CO DAU 30. The age:sex ratios obtained for deer wintering on the SUIR were very similar to DAU 30 (Table 5). The average buck:doe ratio on SUIR was slightly lower than in DAU 30; however, the mature buck:doe ratio was consistently higher. Mule deer harvest on the SUIR is more conservative than buck harvest on in DAU 30.

The hours of flight time flown by the SJWRD have been fairly consistent over the past 8 years, averaging 25 flight hours/year. The total number of mule deer observed dropped in 2008 (a very heavy snow-fall year), but otherwise has stayed fairly constant, averaging just under 2400 deer/year. All of the SUWRMD surveys were flown by the same individual, covering the same country, and using approximately the same amount of flight time/year. Given the consistency of survey methodology, the slight variations in the number of deer counted/hour would seem to indicate a fairly stable deer population.

Table 7. Aerial survey results for SUIR, 2006-2013.

Year	Buck:Doe	M Buck:Doe	Fawn:Doe	Total Deer	Flight Time	Deer/hour
2006	31	16	57	2323	26.50	88
2007	32	20	44	2569	30.00	86
2008	25	15	35	1694	24.42	69
2009	27	17	55	2254	26.83	84
2010	29	18	55	2817	24.75	114
2011	33	15	56	2587	24.33	106
2012	23	11	50	2731	23.33	117
2013	31	13	49	2165	22.45	96
Average	29	16	50	2393	25.33	95

New Mexico

The NMDGF surveyed mule deer in their historic core deer habitats, so not all GMUs within the CPLA Project Area were flown each year. Table 8 shows the years and units surveyed for mule deer between 2006 and 2013. GMUs 50, 51 and 52 are not considered "core" mule deer winter range and were not surveyed for mule deer. GMU 2 contains the best mule deer winter range, followed by GMUs 4, 5A, and 5B.

Table 8. Years during which NM GMUs were surveyed for mule deer.

Year	2A	2B	2C	4	5A	5B
2006	X	X	X	X		X
2007		X	X			X
2008	X	X	X	X		
2009		X	X	X	X	
2010	X	X	X			
2011		X	X	X		X
2012		X	X			
2013		X	X			

Table 9 shows the results of mule deer surveys flown by NMDGF from 2006-2013. Surveys in GMU 2 contributed most of the mule deer observed, followed by GMU 4. The fawn:doe ratios in NM exceeded 50:100 in several years, but averaged 46:100 the past 8 years; indicating a possibly declining herd. The total number of deer observed seemed to decline over time; however, the number of GMU's surveyed during any particular year was not consistent.

The buck:doe ratio decreased steadily from 31:100 in 2006, to 19:100 in 2013 (Figure 12). The mature buck:doe ratio also decreased from a high of 19:100 in 2008 to only 8:100 in 2013. The total number of bucks observed during these combined surveys dropped from 319 bucks in 2006 to only 93 bucks in 2013. All of these numbers indicate a significant decline in the proportion and number of bucks in the NM deer herd, which could be the result of either poor recruitment or increased harvest. Since most of the deer in NM were counted in Unit 2, which functions as winter range for mule deer from CO DAU 30, this decline in the buck:doe ratio has implications for CO's deer herd as well.

Table 9. Summary of NMDGF mule deer surveys, GMUs 2A, 2B, 2C, 4, 5A, 5B.

Year	Buck:100 Does	MB:100 does	Fawn:100Does	Survey total
2006	31	14	46	1824
2007	31	17	54	944
2008	28	19	42	1270
2009	27	17	28	1804
2010	24	15	41	942
2011	27	17	53	1207
2012	22	11	50	1239
2013	19	8	51	842
Average	26	15	46	1259

Jicarilla Apache Reservation

Mule deer surveys for the JAR are summarized in Table 10. Mule deer surveys on the JAR were similar to those flown by the SUWRMD, flying the same pattern every year and using the same observers. The total number of mule deer observed on the JAR declined steadily from a high of 4383 in 2006, to a low of 2168 in 2013. Fawn:doe ratios on the JAR ranged from 41-57:100 and averaged 50:100. These ratios, combined with the declining trend in total numbers, indicated a declining mule deer population on the JAR.

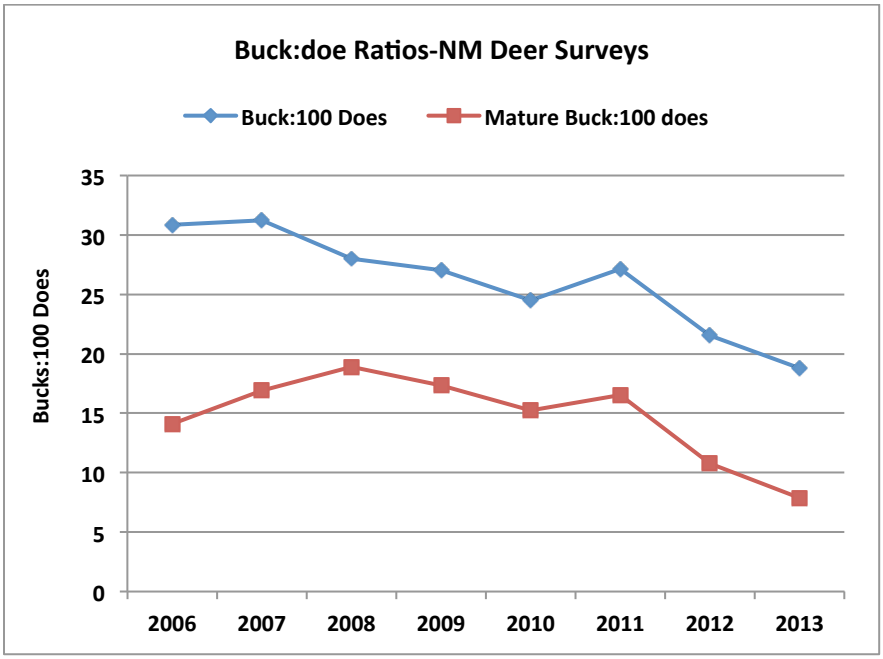

Figure 12. Mule deer buck:doe ratios in NM surveys.

Table 10. Summary of JGFD mule deer surveys, 2006-2013.

Year	Buck:Doe	MB:Doe	Fawn:Doe	Total Deer	Survey Hrs.	Deer/hour
2006	41	16	52	4384	41.3	106
2007	44	19	55	3429	37.4	92
2008	47	23	47	3176	29.7	107
2009	50	26	41	3443	34.3	100
2010	45	25	44	3049	38.1	80
2011	35	20	46	2667	33.6	79
2012	33	21	55	2582	22.0	118
2013	46	24	57	2168	23.9	91
Average	43	22	50	3112	32.5	97

Part of this decline may have been attributable to the concurrent decrease in flight hours; however, the number of deer /flight hour did not reveal a declining pattern, and actually peaked in 2012 at 118 deer/hour.

The buck:doe ratio averaged 43:100 and ranged from a low of 33:100 to a high of 50:100 (Table 10). The mature buck:doe ratio was above 20:100 for most years and averaged 22:100. The JGFD manages their mule deer herd for production of trophy bucks, and the conservative harvest was reflected in the relatively high buck:doe ratios.

Combined Jurisdictions

Since all 4 wildlife agencies flew mule deer surveys at roughly the same time (late December-mid January) the count data were combined to produce estimates for the mule deer herd inhabiting the CPLA Project Area. Table 11 shows the total number of mule deer observed during the combined aerial classification surveys. Data from 2008 were omitted since deer totals for CO DAU 30 were unavailable. Totals were unavailable for DAU 35 for 2006-2007; however, DAU 35 deer counts represented a small portion of the total CO count.

Total mule deer observed declined steadily from 11,784 in 2006 to only 7,642 in 2013, a decline of 35%. The decline was more pronounced in NM where mule deer totals dropped by almost 50% between 2006 and 2013. Figure 13 shows the annual deer numbers in both states and for the combined area, with all three trending down since 2006. However, the decline in mule deer observed during aerial classification surveys may not necessarily reflect a real decline in the mule deer numbers. Figure 14 shows the total number of flight hours expended by all 4

agencies for mule deer surveys, along with the combined number of mule deer observed per flight hour. Aerial survey flight time decreased from 117.3 hours in 2006 to only 67.8 hours in 2013. This 42% decline in flight hours is close to the 35% decline in total deer observed during the same time period. The combined number of mule deer observed per flight hour has actually increased (Figure 14), from100 deer/hour in 2006 to an average of 116 deer/hour for the past 5 years.

Table 11. Total number of mule deer classified during regional aerial surveys.

Year	30+35	So. Ute	CO Total	NMDGF	Jicarilla	NM Total	Grand Total
2006	3248	2323	5571	1829	4384	6213	11784
2007	2784	2569	5353	944	3429	4373	9726
2008	0*						
2009	3306	2154	5460	1804	3443	5247	10707
2010	2601	2817	5418	968	3049	4017	9435
2011	3158	2587	5745	1167	2667	3834	9579
2012	2090	2731	4821	1239	2582	3821	8642
2013	2467	2165	4632	842	2168	3010	7642

*Survey totals not available for DAU 30 in 2008, just age:sex ratios. No data for DAU 35 2006-2008.

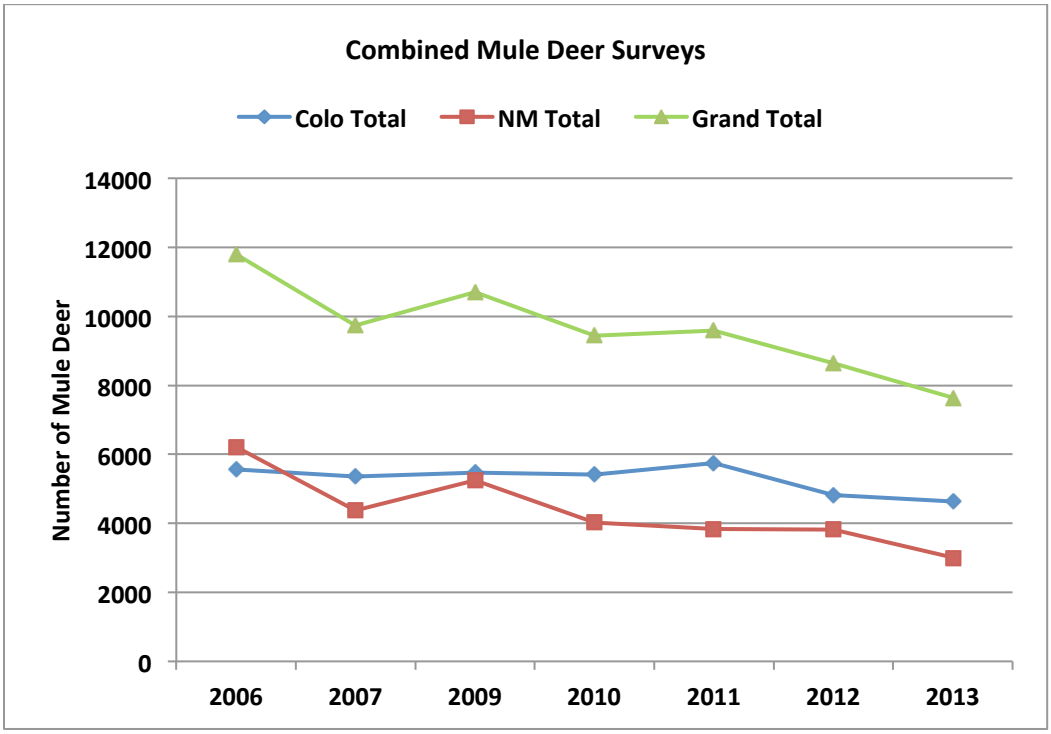

Figure 13. Total deer observed during aerial classification surveys, 2006-2013.

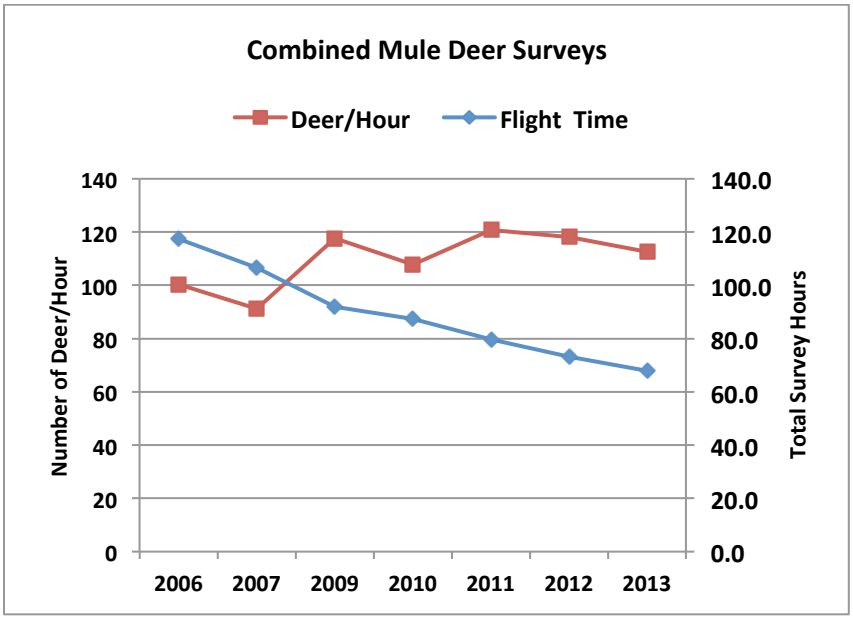

Figure 14. Total survey hours and number of deer observed per flight hour, combined data, 2006-2013.

Table 12 shows the buck:doe ratios for NM, CO and the combined CPLA Project Area. The NM figures included NMDGF and JGFD counts; and the CO figures included the CPW and SUIR counts. The buck:doe ratio was consistently higher on the NM side of the border during all years sampled, averaging 37:100. The CO buck:doe ratio averaged 29:100 and the combined area averaged 33:100. Overall buck:doe ratios for the CPLA Project Area appeared to be relatively stable or slightly declining during the past 8 years. Unfortunately the same is not true for the ratio of mature bucks:doe.

Table 12. Buck:doe ratios for NM, CO and combined surveys, 2006-2013

	COLORADO	NEW MEXICO	COMBINED
Year	Buck:Doe	Buck:Doe	Buck:Doe
2006	33	37	36
2007	32	41	36
2008	25	41	36
2009	32	41	36
2010	27	40	32
2011	30	32	31
2012	23	29	26
2013	30	37	33
Average	29	37	33

Figure 15 shows the trend in mature buck:doe ratios that has occurred in recent years among the 4 jurisdictions. A declining trend, beginning in 2009, was evident in all 4 jurisdictions, with slight rebounds in 2013. For the combined data set, the mature buck:doe ratio peaked at 20:100 in 2009; then declined steadily to 12:100 in 2012, the rebounded to 14:100 in 2013. That represents a 30% decline in the ratio of mature bucks in the CPLA Project Area's mule deer herd.

Figure 16 shows the number of mature bucks observed by all 4 agencies during aerial classification surveys since 2006. Despite the differences in how mature bucks were classified, the total number of mature bucks observed declined from 1,049 in 2010 to only 575 in 2013, the lowest number recorded during the past 8 years. All of these numbers indicate a fairly recent decline in the total number and proportion of mature bucks in the CPLA Project Area; which could be the result of increased buck harvest, decreased recruitment, or a combination of both.

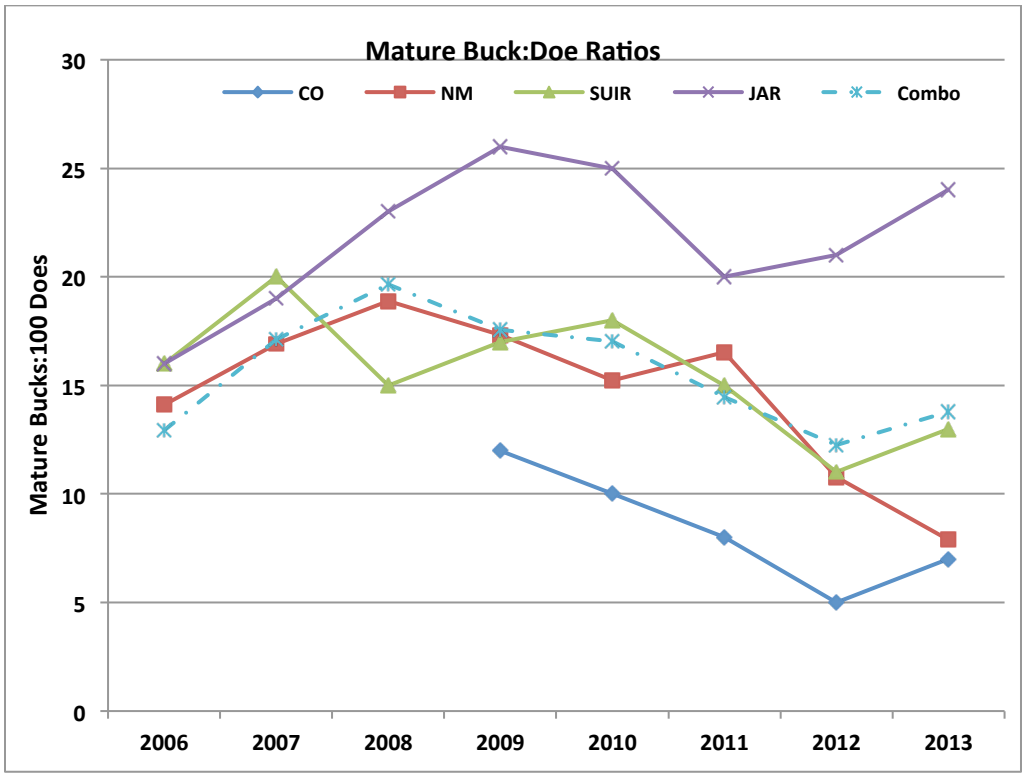

Figure 15. Trend in mature buck:doe ratios, 2006-2013.

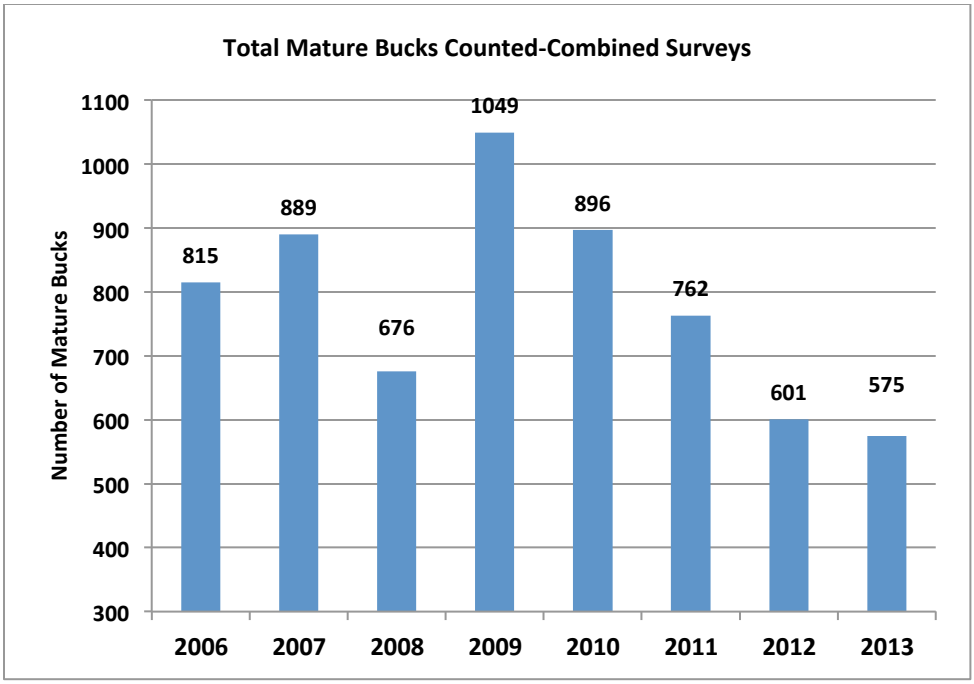

Figure 16. Number of mature bucks observed during combined aerial surveys, 2006-2013.

Table 13 shows the fawn:doe ratios for the CO, NM and combined data sets. Although the ratios differed between the states during individual years, the average for both states from 2006-2013 was 48:100. The fawn:doe ratio dropped below 45:100 only once in each state during the 8 years sampled, in 2008 in CO and in 2009 in NM. The combined fawn:doe ratio was above 50:100 during 5 of the 8 years sampled, but never exceeded 51:100. These fawn:doe ratios were indicative of a mule deer population struggling to maintain numbers, and most likely in a slow decline.

Table 13. Fawn:Doe ratios for NM, CO and combined surveys, 2006-2013.

	CO	NM	Combined
Year	Fawn:Doe	Fawn:Doe	Fawn:Doe
2006	52	50	51
2007	49	55	51
2008	35	46	42
2009	50	36	43
2010	50	43	47
2011	53	48	51
2012	48	53	50
2013	48	55	51
Average	48	48	48

Population Estimates

The only wildlife agency in the CPLA Project Area that provided estimates of the mule deer populations was CPW. Table 14 lists the estimated mule deer populations for DAUs 30 and 35, from 2006-2011. These estimates were based on modeling conducted by CPW and seem to indicate a slightly decreasing trend in deer numbers in DAU 30 and a slightly increasing trend in DAU 35.

Table 14. Estimated mule deer population, CO DAUs 30 & 35.

	2006	**2007**	**2008**	**2009**	**2010**	**2011**
DAU 30	26500	26820	25480	26050	22260	23640
DAU 35	4920	5940	5410	5170	4430	5800
Total	31420	32760	30890	31220	26690	29440

Harvest

In the NM GMUs mule deer hunting has been limited-draw, bucks-only since prior to 2006. On the JAR mule deer hunting has been limited draw, bucks-only since 1990. In CO all of the GMUs in the CPLA Project Area have been managed as limited-draw buck hunting since prior to 2006; plus limited-draw doe tags offered in recent years. The SUIR has unlimited deer tags available for tribal members, with 1 buck tag and 1 doe tag per person, per year. However, the number of tribal member hunters on the SUIR averages less than 225 hunters/year, and the numbers of tags issued and animals harvested is very low.

In the CO GMUs mule deer hunting consisted of an unlimited, month-long archery season in August/September; a limited-draw Muzzleloader season in mid-September; and 3 limited-draw rifle hunts beginning from late October-mid November (Table 15 & 16). On the SUIR there was an any-weapon mule deer hunt for tribal members from September 1—December 31. In the NM GMUs there was a limited-draw archery hunt in September, a limited-draw muzzleloader season in late September, limited-draw rifle hunts in October and November, and limited-draw archery hunts in January. On the JAR there were limited-draw archery mule deer tags in September, a limited-draw rifle mule deer hunt the last 2 weeks of October, and 10 client rifle licenses in December. The bag limit for mule deer in CO was any buck with antlers 5 inches or longer. In NM the bag limit was a fork-antlered deer. On the SUIR and JAR the bag limit was any antlered buck.

Both CO and NM also have special “Auction Tags” or “Governor’s Tags” mule deer hunters who can hunt throughout the hunting seasons. In NM, GMUs 2 and 4 are favored destinations for these hunters and each unit has produced several trophy bucks for these special tag holders in recent years.

Table 15. Approximate mule deer hunting season dates by jurisdiction.

	Archery Deer	MZ Deer	Rifle Deer
Colorado	Sept. 1-30	Sept. 12-20	Oct. 19-27, Nov. 2-10, Nov. 13-17
Southern Ute	NA	NA	Sept. 1- Dec. 31
New Mexico	Sept. 1-22/ Jan. 1-15	Sept. 24-30	Oct. 18-22, Oct. 25-29, Nov. 1-5
Jicarilla	Sept. 1-25	N1	Oct. 15-31, Dec. 1-10

Figures 17 and 18 show the distribution of buck harvest and doe harvest among the 4 jurisdictions. The SUIR and JAR accounted for less than 10% of the total buck harvest in the CPLA Project Area. CO accounted for 53% of the total buck harvest and NM accounted for 39% of total buck harvest. Colorado DAU's accounted for approximately 86% of the total doe harvest, while the remaining 14% occurred on the SUIR.

Table 16. Timing of mule deer hunts by jurisdiction, 2006-2013.

	CO	SUIR	NM	JAR
Sept 1-15	A*	R	A	A
Sept 16-30	A	R	A	A
Oct 1-15		R		
Oct 16-31	R	R	R	R
Nov 1-15	R	R	R	
Nov 16-30	R	R		
Dec 1-15		R		R
Dec 15-31		R		
Jan 1-15			A	

*A=archery hunt, R=rifle hunt

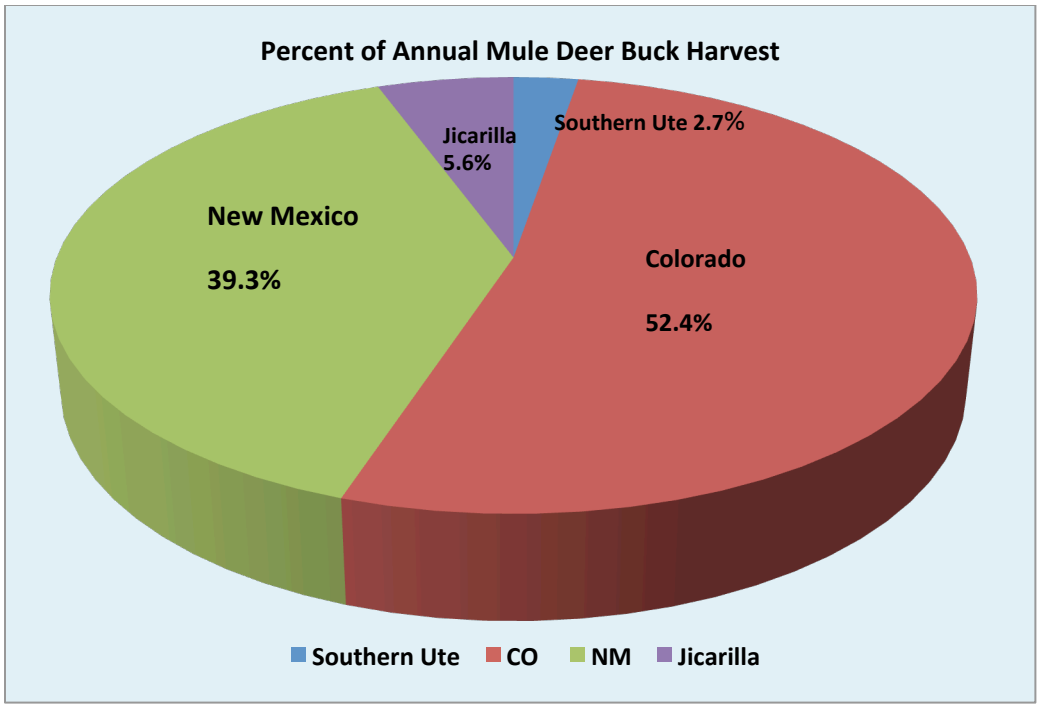

Figure 17. Percent of average annual buck harvest, by jurisdiction, 2006-2013.

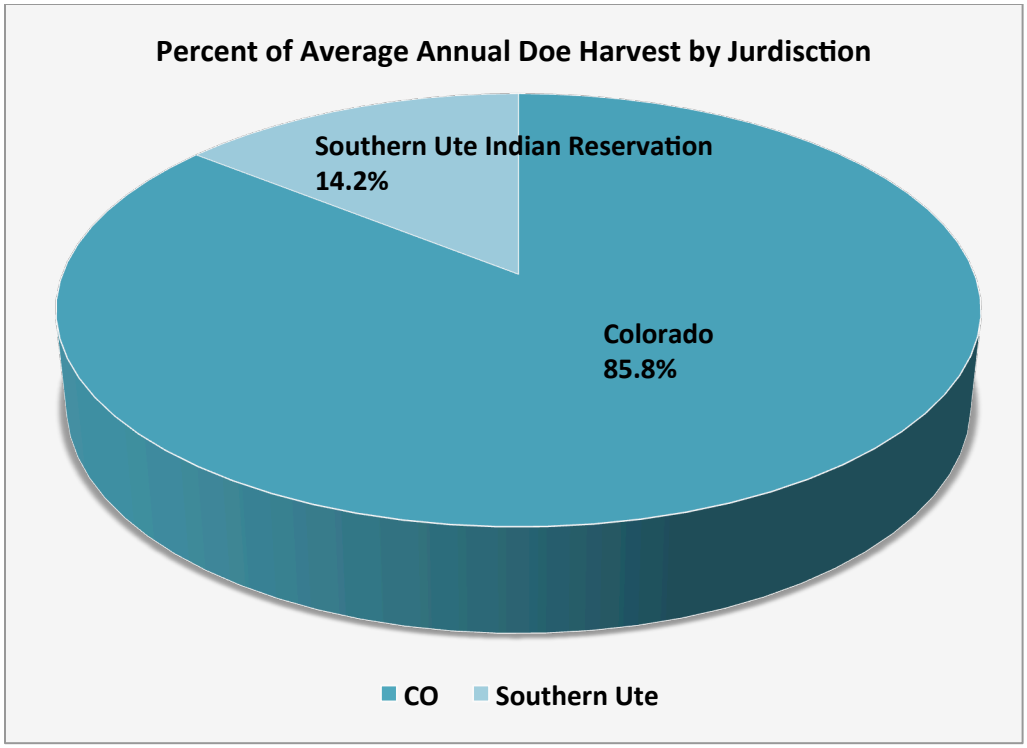

Figure 18. Percent of average annual mule deer doe harvest.

Figure 19 shows the trend in annual buck harvest in CO and NM since 2006. The JAR and SUIR harvests were included with their respective states. Annual buck harvest in CO declined from a high of 2135 bucks in 2006, to a low of 1566 bucks in 2012, and then increased to 1783 bucks in 2013. Buck harvest in NM hit a low of 1278 bucks in 2010, but has increased every year since then, reaching 1845 bucks in 2013. This increase in NM buck harvest was concurrent with the significant decline in the NMDGF mature buck:doe ratio noted earlier. Total buck harvest in the CPLA Project Area has increased steadily the past 4 years, reaching 3628 bucks in 2013 (Figure 20).

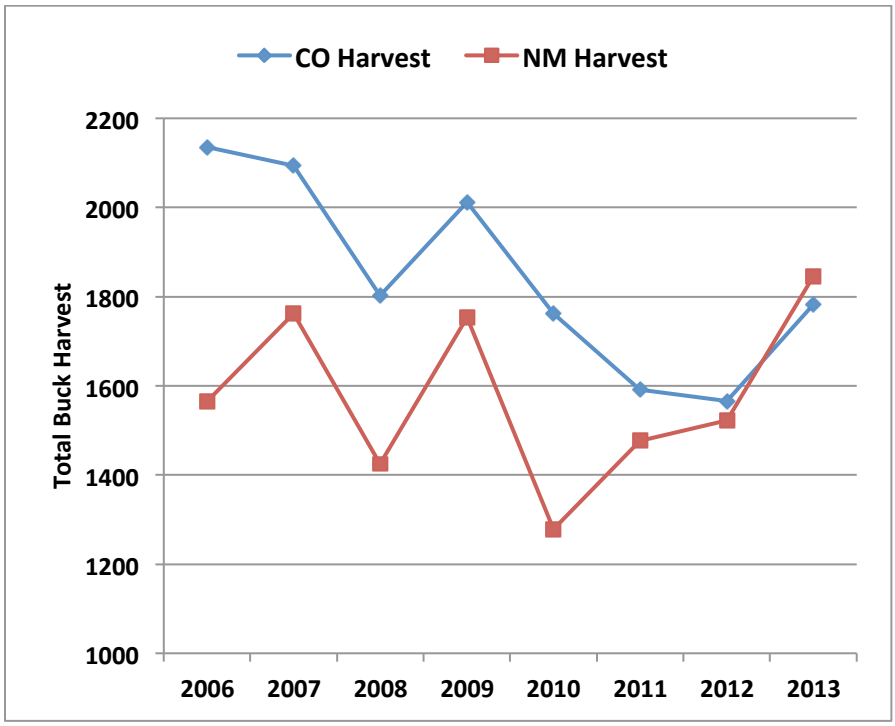

Figure 19. Annual buck harvest, CO and NM, 2006-2013.

Annual mule deer doe harvest exceeded 450 does/year from 2006-2010, then declined steadily during the past 3 years (Figure 21) to a low of 337 does in 2013. The majority of doe harvest has occurred in CO GMU's, and has averaged 408 does/year since 2006. The continued harvest of female deer in CO, especially in combination with the marginal fawn:doe ratios observed, will have a depressing effect on mule deer population growth. There have not been any does harvested in the NM portion of the CPLA Project Area since the 1970's.

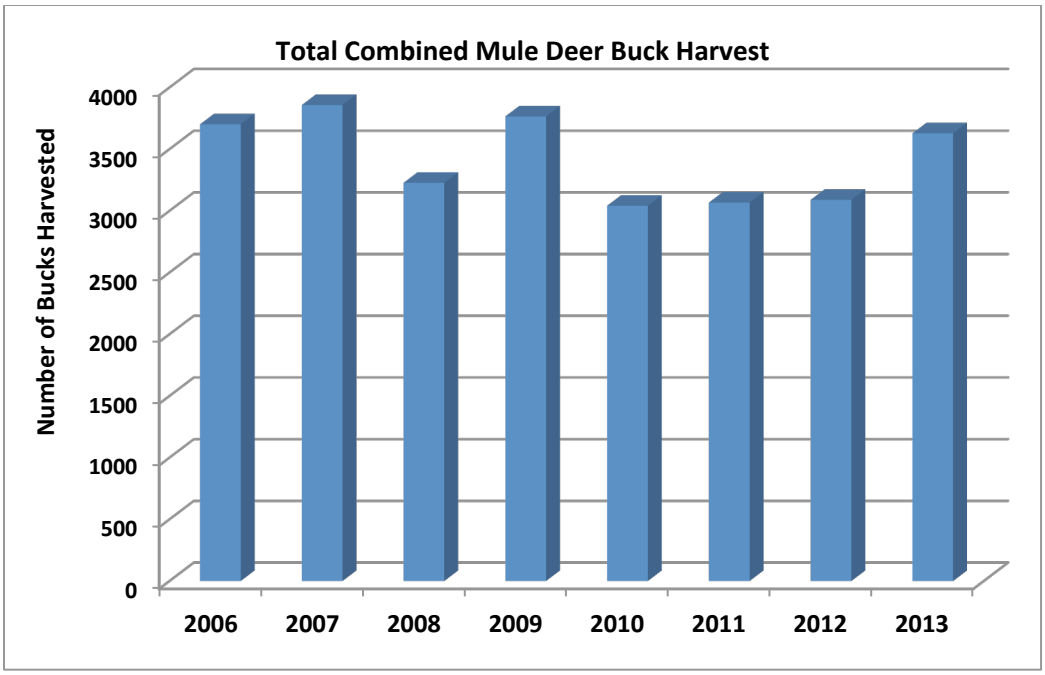

Figure 20. Annual combined mule deer buck harvest (CPW, NMDGF, JGFD, and SUWRMD) 2006-2013.

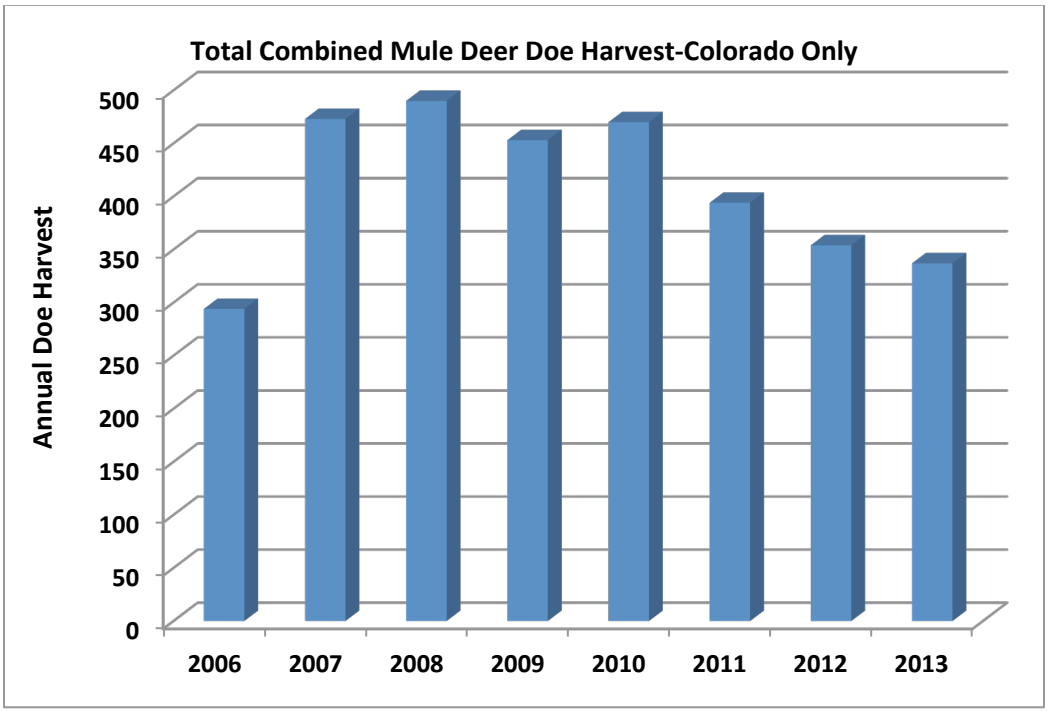

Figure 21. Annual combined mule deer doe harvest (CPW and SUWRMD) 2006-2013.

Hunter Success

Colorado Parks and Wildlife

Table 19 lists mule deer hunter success rates for DAUs 30 and 35. Hunter success was fairly consistent in both DAUs and averaged 46%. These success rates included buck, doe and fawn harvest. Bucks comprised 79-89% of the total harvest during any single year and averaged 83% of total harvest from 2006-2013.

Southern Ute Indian Reservation

Mule deer licenses were available to all tribal members on the SUIR, and must be picked up in person at the SUWRMD office in Ignacio. Each license holder was allowed to harvest 1 buck and 1 doe. The number of hunters who picked up a license averaged approximately 225/year. Of those, approximately 25% did not actually hunt; so the annual number of deer hunters afield each year was approximately 170. Table 20 lists the hunter success rates for Southern Ute tribal members from 2006-2011. The long seasons, low hunter numbers, and low hunter density undoubtedly contributed to the high success rates for mule deer hunters; which averaged 62% for bucks and 48% for does. The SUWRMD did not issue any mule deer licenses for non-tribal members.

Table 19. CPW GMUs mule deer hunter success rates, 2006-2013.

Year	DAU 30	DAU 35	Combined
2006	44%	59%	46%
2007	46%	47%	46%
2008	52%	39%	50%
2009	46%	48%	47%
2010	45%	34%	43%
2011	46%	38%	44%
2012	40%	51%	43%
2013	47%	47%	47%
Average	46%	45%	46%

Table 20. SUIR mule deer hunter success rates, 2006-2011.

Year	Bucks	Does
2006	60%	40%
2007	60%	43%
2008	50%	40%
2009	74%	60%
2010	52%	53%
2011	73%	49%
Average	62%	48%

New Mexico

Table 21 lists the sample sizes and mule deer hunter success rates for all GMUs combined. There were some gaps in the available data; however good numbers were available for GMUs 2 and 4, which together accounted for approximately 80% of the NM mule deer harvest in the CPLA Project Area. Sample size of hunters averaged 81% across all GMU's, but in specific GMU's sample size of hunters exceeded 90% in some years. The NMDGF average mule deer hunter success rate of 43% was very close to CPW's 46% success rate.

Table 21. NM GMUs mule deer hunter success rates. 2006-2013

	% Sample Size	% Success
2006	75%	48%
2007	78%	50%
2008	81%	40%
2009	90%	48%
2010	71%	31%
2011	86%	38%
2012	85%	45%
2013	83%	45%
Average	81%	43%

Jicarilla Apache Reservation

Mule deer success rates averaged 83% for all hunts combined on the JAR (Table 22). The archery hunts typically posted 30-50% success, tribal rifle hunts from 65-85%, and client hunts 80-100%. The high success rates were attributed to low hunter numbers and hunter density, high buck:doe ratios, and relatively long hunting seasons.

Table 22. JAR mule deer hunter success rates, 2006-2013.

Year	Sample Size	% Success
2006	76%	84
2007	ND	95
2008	33%	72
2009	25%	89
2010	72%	78
2011	23%	88
2012	12%	75
2013	77%	88
Average	40%	83

Age Data

The CDOW conducted a 5-year "Mule Deer Aging Project" from 2007-2011 in southwest, CO. Incisor teeth were collected from hunter-harvested mule deer bucks in GMU's 54, 61, and 62, which lie outside the CPLA Project Area; and in GMUs 80, 81, 75, 77, 78, 751, and 771, which lie within the CPLA Project Area. The average age of bucks harvested was 3.3 years old, and varied little over the 5-years sampled (Table 23).

Table 23. Mule deer buck age analysis results, CPW, 2007-2011.

Year	Sample Size	Average Age
2007	360	3.2
2008	203	3.1
2009	244	3.5
2010	310	3.4
2011	339	3.3
Average	291	3.3

The JGFD has collected age data from mule deer bucks harvested since 1990. The average age of bucks harvested on the JAR since 2006 was 4.4 years (Table 24). Approximately 95% of bucks harvested on the JAR sample were taken by tribal members under an "any-buck" bag limit. The remaining 5% were harvested by client trophy hunters and the average age of those bucks typically averaged 5-7 years old during any given year.

Table 24. Average age of mule deer bucks harvested on the JAR, 2006-2013.

Year	Sample Size	Average Age
2006	53	3.8
2007	84	4.4
2008	75	4.1
2009	125	4.4
2010	79	4.6
2011	89	4.9
2012	68	4.6
Average	82	4.4

The SUWRMD collected age data from does harvested on the SUIR since the late 1980's, including two years of heavy doe harvest that occurred in 1990 and 1991 (Figure 19). These harvests occurred during fall and early winter and probably included a mix of resident deer and winter migrants from DAU 30. Despite the small sample size, the average age of does harvested increased from 3.9 in 2009 to 5.5 in 2012. An increasing trend in average age of does harvested typically indicates reduced recruitment and a slowing of the population rate of increase.

Trophy Quality

The San Juan Basin has a well-deserved reputation for producing trophy mule deer. The Boone and Crockett Club keeps track of bucks submitted for entry into their "all-time" and "awards" record books. The minimum scores for entry in the all-time book, which is published about every 6 years, are 190 inches for a typical mule deer; and 230 inches for a non-typical mule deer. The minimum scores for entry into the awards book, which is published every 2 years, are 180 inches for a typical mule deer and 215 inches for a non-typical mule deer. Since 1993, all entries from the United States must be entered under the county where the deer was harvested. Prior to 1993 Boone and Crockett accepted entries with local names such as Chama, Pagosa Springs, San Juan National Forest, Jicarilla Apache Reservation and Southern Ute Indian Reservation. Older entries in the all-time Record Book still carry these local names. The number of animals entered into Boone and Crockett's record books is a relatively good indication of an area's potential for producing trophy-class animals.

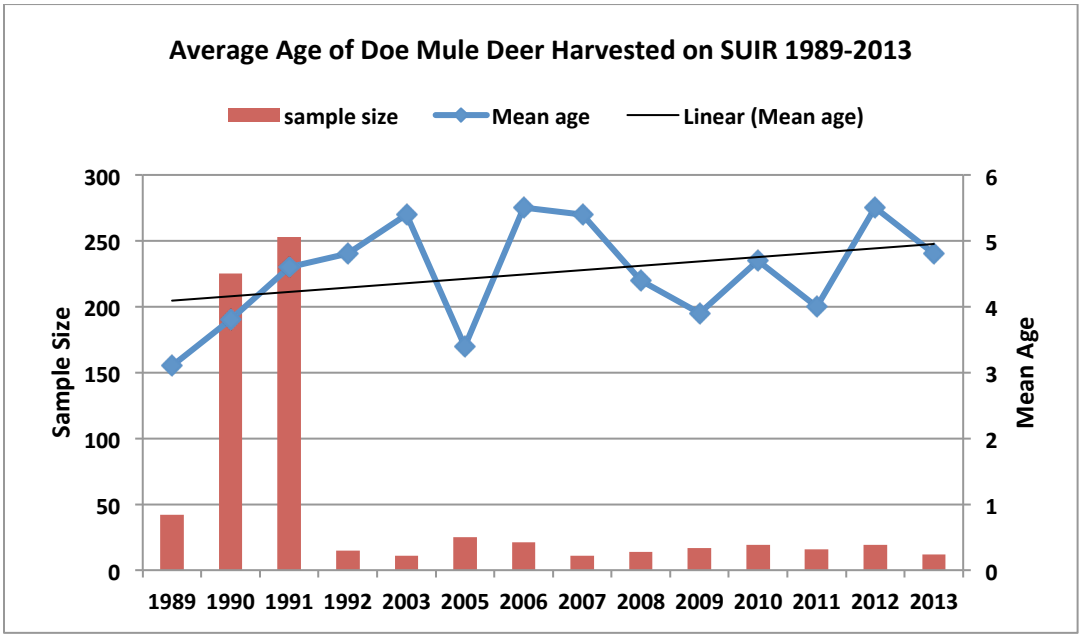

Figure 19. Average age of does harvested on the SUIR.

Table 25 lists the number of all Boone and Crockett mule deer entries since 1990 for counties within the CPLA project Area. On the NM side this included Rio Arriba and San Juan Counties and the JAR. On the CO side this included Archuleta and Conejos Counties, and the SUIR. There were 115 mule deer entered into the Boone and Crockett Record Books from Rio Arriba and San Juan Counties since 1990 and these 2 counties accounted for 95% of mule deer entries from the state of NM. In contrast, there were only 17 mule deer entered into the Boone and Crockett Record Books from Archuleta and Conejos Counties since 1990; and these 2 counties accounted for only 4% of the bucks entered from CO since 1990. Despite the comingling of mule deer across the CO/NM border, there were 7 times as many Record Book bucks harvested in the NM portion of the CPLA Project Area.

Colorado is ranked number one among states for mule deer entries; Rio Arriba County is ranked number one among counties for mule deer entries in the Record Book. The three factors that determine a buck's ability to trophy size are genetics, nutrition, and age, with genetics accounting for the greatest influence. Clearly, the CPLA Project Area has the best genetics for mule deer in the range of the species. The habitat is obviously capable of producing big deer on both sides of the border; and is probably better on the CO side of the border, given the higher precipitation levels. All that's needed to produce trophy bucks is an advanced age structure in the buck segment of the population; the result of allowing more bucks to reach maturity and express there genetics. Because of the unique genetics in this deer herd, there are few areas in either state where managing for trophy bucks could be more successful than in the CPLA Project Area.

Table 25. Boone and Crockett mule deer entries, 1990-2014.

	Typical Bucks	Non-typical Bucks	Total	% State Total
New Mexico Portion*	100	15	115	95%
Colorado Portion**	15	2	17	4%
Totals	115	17	132	23%

*NM includes Rio Arriba County, San Juan County and JAR.
**CO includes Archuleta county and C1jos County and SUIR.

ELK

Age & Sex Ratios

Colorado

The CO DAUs for elk were comprised of the same GMUs that were used for mule deer. GMUs 75, 77, 78, 771 and 751 comprised elk DAU 31, west of the Continental Divide; and GMUs 80 and 81 comprised elk DAU 32 east of the Continental Divide. Tables 26 and 27 summarize aerial survey results for DAUs 31 and 32, respectively. The total elk count in DAU 31 ranged from 1,700-4,600 elk, and averaged 3,259 elk/year. The number of flight hours flown in DAU 31 steadily decreased, from a high of 30 hours in 2006 to only 9 hours in 2013. Yet the number of elk observed per hour increased dramatically, from 154 elk/hr to 455 elk/hour; probably due to surveys focusing on known elk concentration areas. In DAU 32 total elk numbers dropped from a high of 2578 animals in 2007 to less than 1000 elk during the past 3 years.

Bull:cow ratios in DAU 31 did not change appreciably during the past 8 years, ranging from 13-16:100; with an average of 14:100. In DAU 32 the bull:cow ratio declined steadily during the past 8 years, from a high of 32:100 in 2009 to a low of 13:100 in 2013. The mature bull:cow ratios have declined in both DAUs since 2006. In DAU 31 the highest mature bull:cow ratio recorded was 3.2:100 in 2008; and the lowest value was 1:100 during the past 3 years. These are extremely low mature bull:cow ratios and they reflect very heavy harvest of bulls from this herd. In DAU 32 the mature bull:cow ratio was somewhat better, reaching a high of 12:100 in 2009, but that also dropped to only 2:100 in 2013.

Calf:cow ratios in both DAUs have exhibited declining trends since 2006. In DAU 31 the calf:cow ratio declined from a high of 42:100 in 2006 and 2007, down to only 32:100 in 2013. In DAU 32 the calf:cow ratio peaked at 38:100 in 2006, reached a low of 22:100 in 2011, and rebounded to 28:100 in 2013. The 8-year average calf:cow ratio in DAU 31 was 37:100; in DAU 32 it was 31:100.

Count data from the DAUs 31 and 32 were combined to generate the numbers and ratios in Table 28. Figure 20 shows the trend in the bull:cow and mature bull:cow ratios in the combined data. The combined bull:cow ratio declined from a high of 21:100 in 2008, to only 13:100 in 2013; and the combined mature bull:cow ratio declined from a high of 5:100 in 2009 and 2010, to only 1:100 in 2013. Both DAUs were managed for maximum hunter opportunity, with unlimited, over-the-counter bull elk licenses for the archery, second rifle, and third rifle seasons. The recent declines in the bull:cow ratios were indicative of a very heavily hunted elk population where annual bull harvest has significantly exceeded annual recruitment.

Table 26. Elk survey results west of the Continental Divide, DAU 31, 2006-2013.

Year	DAU	Bull:cow	YR Bull:cow	MB:Cow	Calf:cow	Total Elk	Flight Hrs.	#/hr
2006	31	16	12	1.4	42	4642	30.2	154
2007	31	15	8	2.8	42	3933	23.6	167
2008	31	16	6	3.2	31	2477	na	na
2009	31	13	5	3	42	3543	9.2	385
2010	31	14	7	4	33	3910	13.1	298
2011	31	14	8	1	37	2992	11.8	254
2012	31	14	7	1	36	1730	8.6	201
2013	31	13	8	1	32	4119	9.05	455
Average		14	8	2	37	3259	10.4	319

Table 27. Elk survey results east of the Continental Divide, DAU 32, 2006-2013.

Year	DAU	Bull:Cow	YR Bull:Cow	MB:Cow	Calf:Cow	Total Elk	Flight Hrs.	#/hr
2006	32	33	14	9	38	597	na	na
2007	32	24	8	5	29	2578	na	na
2008	32	36	9	9	38	1055	na	na
2009	32	32	13	12	32	753	5	151
2010	32	25	7	6	32	545	3.4	160
2011	32	15	5	7	22	700	6.55	107
2012	32	23	12	5	27	701	3.88	181
2013	32	13	8	2	28	885	23.8	37
Average		25	9	7	31	977	8.5	127

The slow decline in the combined calf:cow ratio was readily evident (Table 28), dropping from 42:100 in 2006 down to 31:100 in 2013. The calf:cow ratio averaged 35:100; which was borderline sufficient for a stable elk population. The downward trend in annual recruitment indicates a slowing of the elk herds growth rate.

Table 28. Combined elk data for DAUs 31 and 32, 2006-2013.

Year	DAU	Total Elk	Bull:Cow	YR Bull:Cow	M Bull:Cow	Calf:Cow
2006	31+32	2477	18	12	1	42
2007	31+32	4140	18	8	2	37
2008	31+32	6488	21	7	2	33
2009	31+32	4296	16	6	5	40
2010	31+32	4455	15	7	4	33
2011	31+32	3692	14	7	2	34
2012	31+32	2431	17	8	2	33
2013	31+32	5004	13	8	1	31
Average	31+32	3976	17	8	2	35

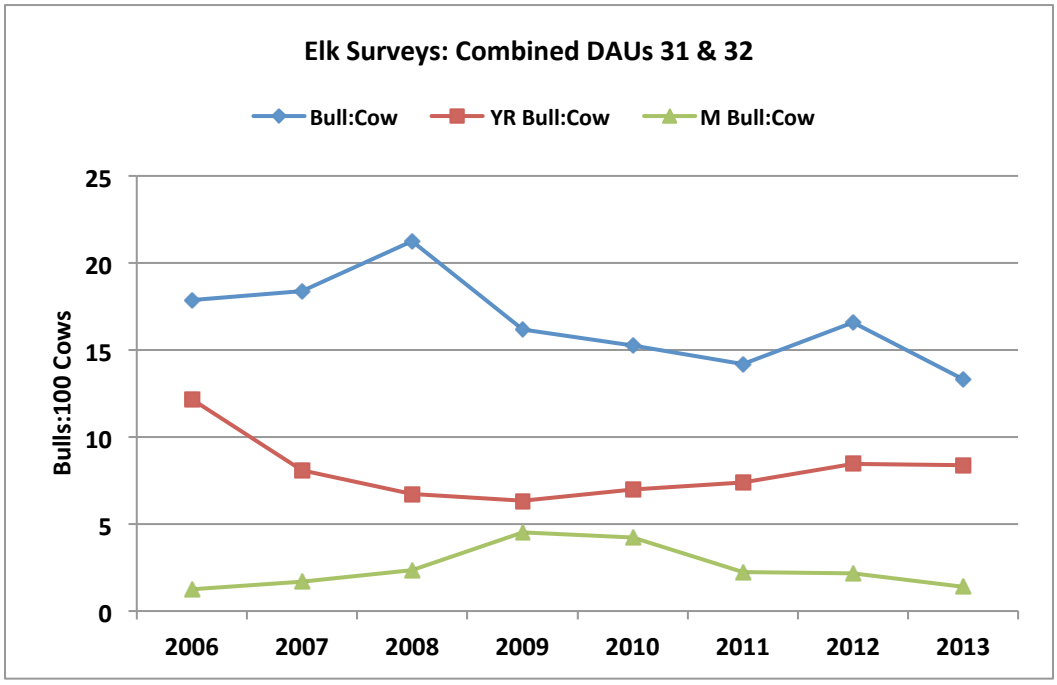

Figure 20. Trend in bull:cow ratios, CO DAUs 31 & 32, 2006-2013.

Southern Ute Indian Reservation

Elk surveys on the SUIR were flown in early January, approximately the same time as the CPW surveys in DAU 31 (Table 29). By January, elk have usually settled in their winter ranges; however, some overlap in counts between CPW and SUIR may have occurred as a result of their extensive shared boundary. The total elk count on the SUIR ranged from 1,810 to 2,968 elk and averaged 2,300 elk/year. There was somewhat of a declining trend in total elk and elk observed/hour since 2010. Total elk observed dropped from 2,968 to 2,085; and elk/hour dropped from 120 to 93.

Figure 21 shows the trend in bull:cow ratios on SUIR since 2006. The total bull:cow ratio declined for the first 3 years, but has increased slowly the past 4 years to just above 20:100. In contrast, the mature bull:cow ratio has steadily declined since 2006, from a high of 10:100 to only 4:100 in 2013. This trend was similar to the decrease in the mature bull:cow ratio in adjacent DAU31. Both indicated a decrease in the proportion of mature bulls in the elk herd in this portion of the CPLA Project Area

The calf:cow ratio on SUIR averaged 37:100, and did not show any strong trend up or down. This was identical to the average calf:cow ratio inn DAU 31, which was not surprising given the extent that elk comingle between these 2 jurisdictions.

Table 29. Elk survey results, SUIR, 2006-2013.

	Total Elk	Bull:Cow	M Bull:cow	Calf:cow	Flight Hrs.	Elk/Hour
2006	1920	26	10	42	26.50	72
2007	2429	27	10	42	30.00	81
2008	1810	18	8	27	24.42	74
2009	2337	16	6	40	26.83	87
2010	2968	18	7	33	24.75	120
2011	2555	21	6	38	24.33	105
2012	2551	18	5	34	23.33	109
2013	2085	22	4	39	22.45	93
Average	2332	21	7	37	25	93

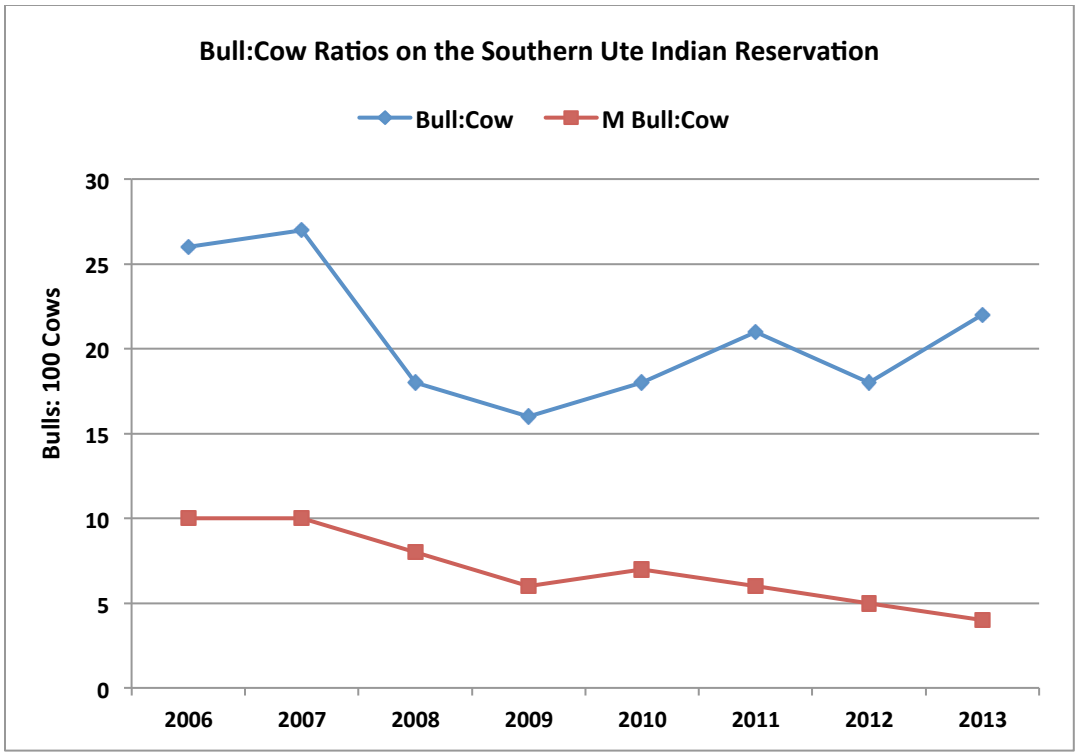

Figure 21. Trend in bull:cow ratios on SUIR, 2006-2013.

New Mexico

The combined NM GMUs 4, 5b, 50, 51 and 52 were considered the "north-central" elk herd by the NMDGF. The majority of elk counted in the north-central herd were located in GMUs 4 and 52. No elk surveys have been flown in GMU's 2A, 2B and 2C since 2006, since those GMU's are considered primarily mule deer range. Since 2008, the NMDGF has flown elk surveys in late September to obtain recruitment estimates for the resident elk herd. These pre-hunt bull:cow ratios represent the maximum for the herd. Bulls were not classified as mature or immature during these surveys.

Table 30 summarizes aerial survey results for the north-central herd. The total number of elk counted during the late September surveys (2008-2013) has ranged from 1,358-2,263 elk and averaged 1,749 elk/year; with no apparent trend. Since 2008 the bull:cow ratio averaged 37 bulls:100 but appears to be in a slightly declining trend; dropping from a high of 40:100 in 2008 to 35:100 (Figure 22). These ratios were higher than those from adjacent jurisdictions because they were flown prior to rifle hunting seasons, which is when the majority of bulls were typically harvested.

Since 2008 annual calf:cow ratios for the north-central herd ranged from 34-49:100, averaging 42:100. These ratios were generally higher than on adjacent herds in CO, possibly due to surveys being flown several months earlier. The 34:100 calf:cow ratio in 2013 was the lowest recorded since 2008.

Table 30. Survey results for NM's north-central herd, 2006-2013

Units 4,5b,50,51,52	Total Elk	Bulls:100 Cows	Calves:100 Cows
2006	261	31	42
2007	1183	59	19
2008*	1393	40	42
2009	2263	38	49
2010	1797	36	41
2011	2025	35	45
2012	1358	39	41
2013	1655	35	34
Average since 2008	1749	37	42

*Switched to flying elk surveys in September.

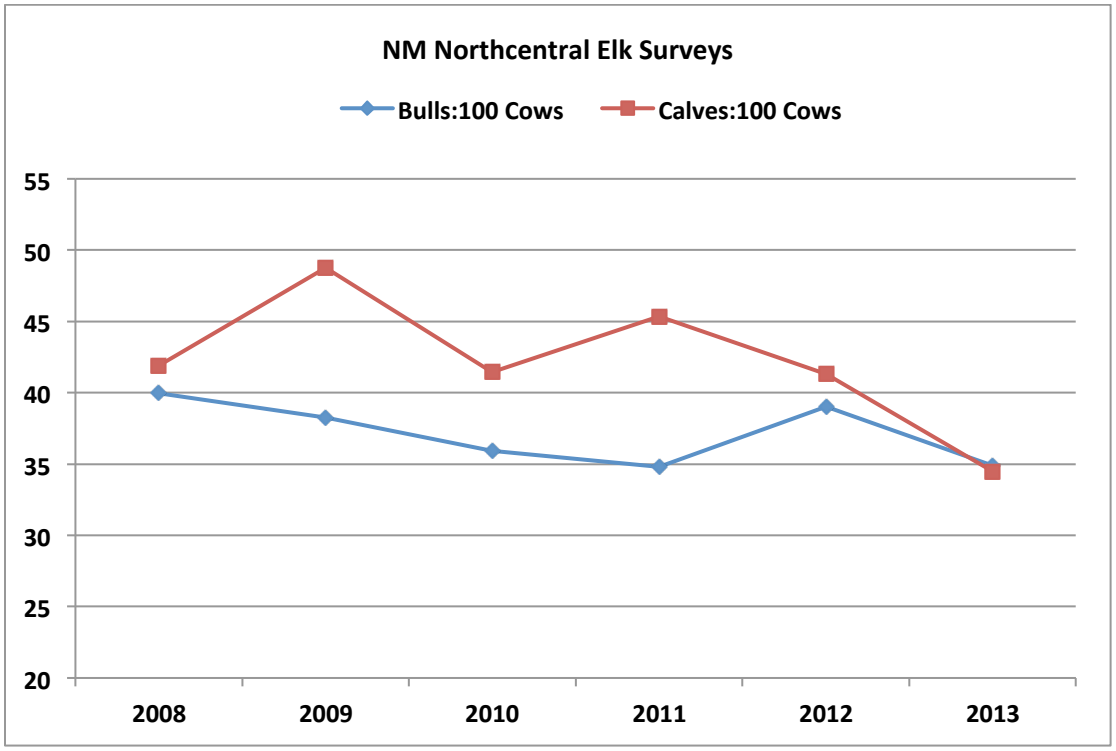

Figure 22. Bull:cow and calf:cow ratios for the north central elk herd, NMDGF, 2006-2013.

Jicarilla Game and Fish Department

Elk surveys on the JAR also were flown in early January. Total elk observed ranged from a low of 1935 elk in 2008, to a high of 6,177 elk in 2006 (Table 31). Telemetry studies have shown that elk wintering on the JAR were a combination of residents and winter migrants that moved in from southern CO and Unit 4; therefore, annual elk counts fluctuated in part due to winter severity.

The bull:cow ratio on the JAR declined from 44:100 in 2006, to 27:100 in 2013 (Figure 23). The mature bull:cow ratio exhibited a similar pattern, declining from a high of 21:100 in 2009, to a low of 9:100 in 2013. This paralleled declines in the ratio of mature bulls in the CO DAU's and the SUIR. These declines were indicative of a widespread decline in the number and proportion of mature bulls in CPLA Project Area.

Calf:cow ratios on the JAR showed the same declining trend noted for the other 3 jurisdictions (Figure 24). Although above 40:100 for all but one year, the ratio dropped to 33:100 in 2013; very similar to the CPW and NMDGF. This was the lowest calf:cow ratio recorded on the JAR since record keeping started in 1982.

Table 31. Results of elk surveys on the JAR, 2006-2013.

Year	Total elk	Bull:cow	M Bull:cow	Calf:cow	# Elk/Hr.
2006	6177	44	18	43	106
2007	3608	34	16	47	92
2008	1935	32	12	41	107
2009	2565	45	21	51	100
2010	4719	27	10	48	80
2011	3456	27	10	40	79
2012	2514	31	10	43	118
2013	2745	27	9	33	91
Average	3465	33	13	43	97

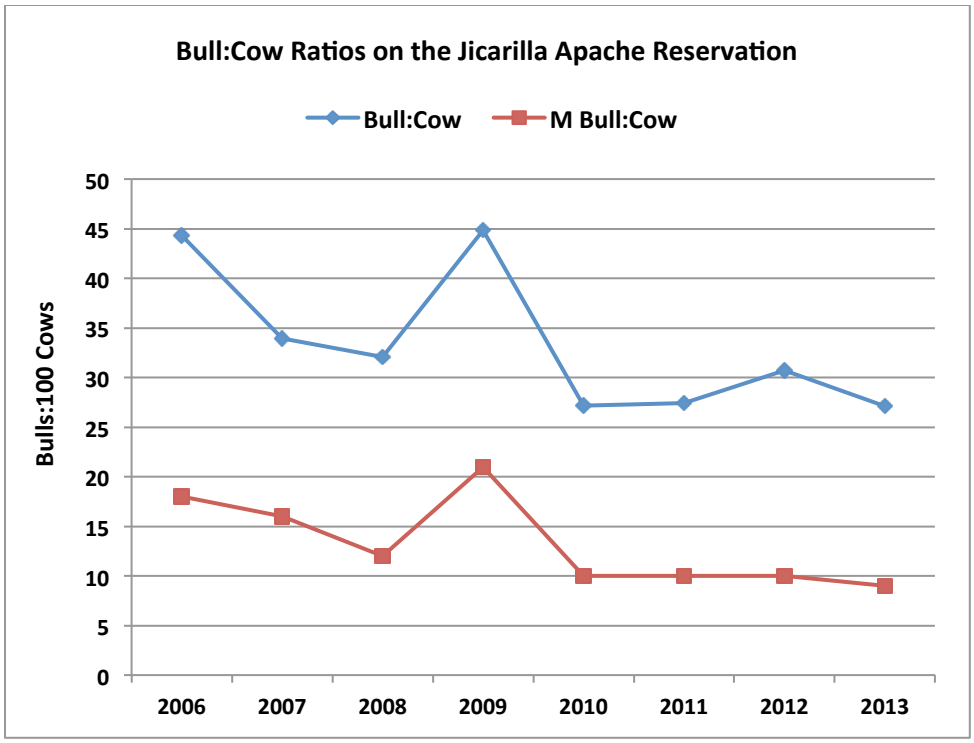

Figure 23. Bull:cow ratios on the JAR, 2006-2013.

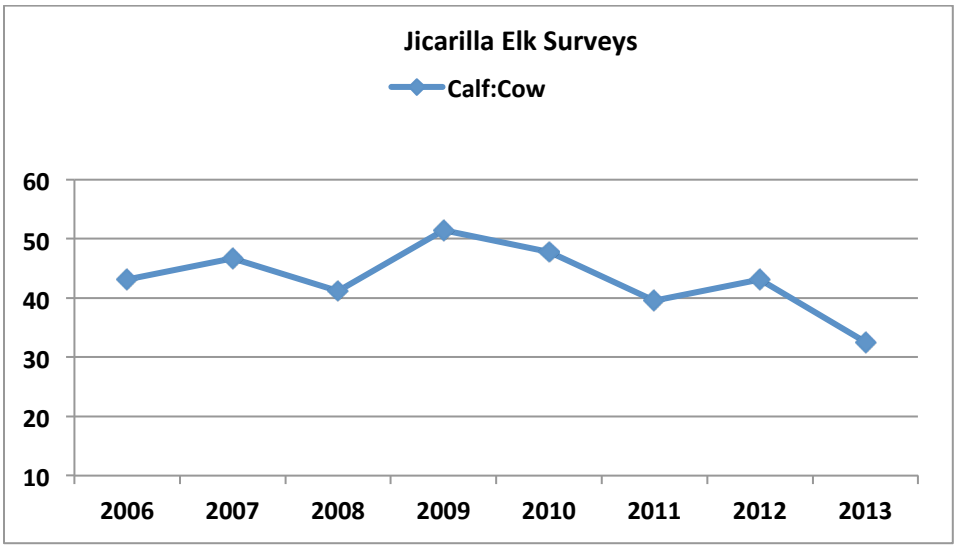

Figure 24. Calf:cow ratios on the JAR, 2006-2013.

Combined Data

Aerial survey data from all 4 jurisdictions was combined to provide a composite picture of the elk population in the CPLA Project Area. In addition, survey data compiled by the SJIWWG, dating back to the early 1990's, was analyzed to determine long-term trends for the elk herd. The original database included several CO DAUs outside the CPLA Project Area; therefore, I modified it to include only data from DAUs 31 and 32.

Figure 25 shows the total number of elk counted during regional classification surveys beginning in 1990. The count data did contain some gaps; in 2000, 2005 and 2007 no data were available from NMDGF; and in 1994, 1997 and 1998 elk were not surveyed in NM's Unit 4. Despite these gaps there were considerably more elk counted during the 1990's and early 2000's than during recent years. From 1990-2006, the annual elk count averaged 17,140 elk. Since 2006, annual elk count averaged 11,386 elk, a 34% decrease. The count data did not constitute a population estimate; however, the trend in total elk counted indicated that a substantial decline in the regional elk population has occurred during the past 10-12 years.

Figure 26 shows the recent trend in the bull:cow ratio for all classification data combined. The combined bull:cow ratio for the CPLA Project Area declined from a high of 30:100 in 2006, to the low of 21:100 in 2013. Figure 27 shows the variation in the bull:cow ratio for the CPLA Project Area since 1990. The bull:cow ratio has gone through several periods of increasing or decreasing trends over the past 23 years; however; the 21:100 ratio estimated in 2013 was the 4th lowest ratio recorded since 1990. That is despite the fact that ratios estimated since 2008 have included the NMDGF pre-hunt counts.

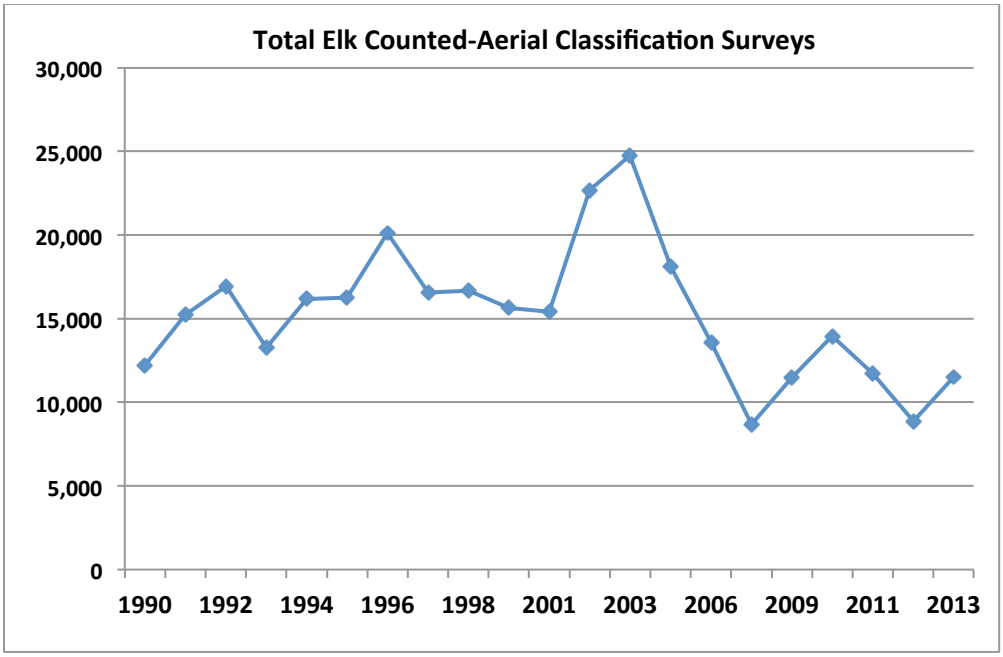

Figure 25. Total elk observed during aerial classification surveys, CPLA Project Area. This included only years where data from NM was available, 1990-2013.

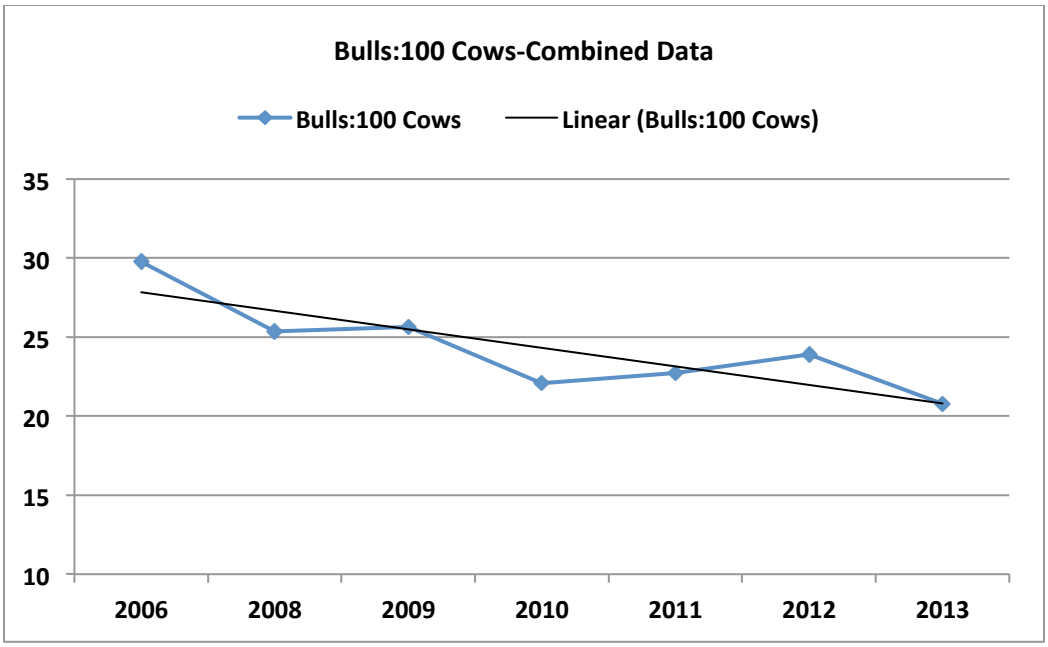

Figure 26. Recent trend in the CPLA Project Area bull:cow ratio, 4 jurisdictions combined, 2006-2013.

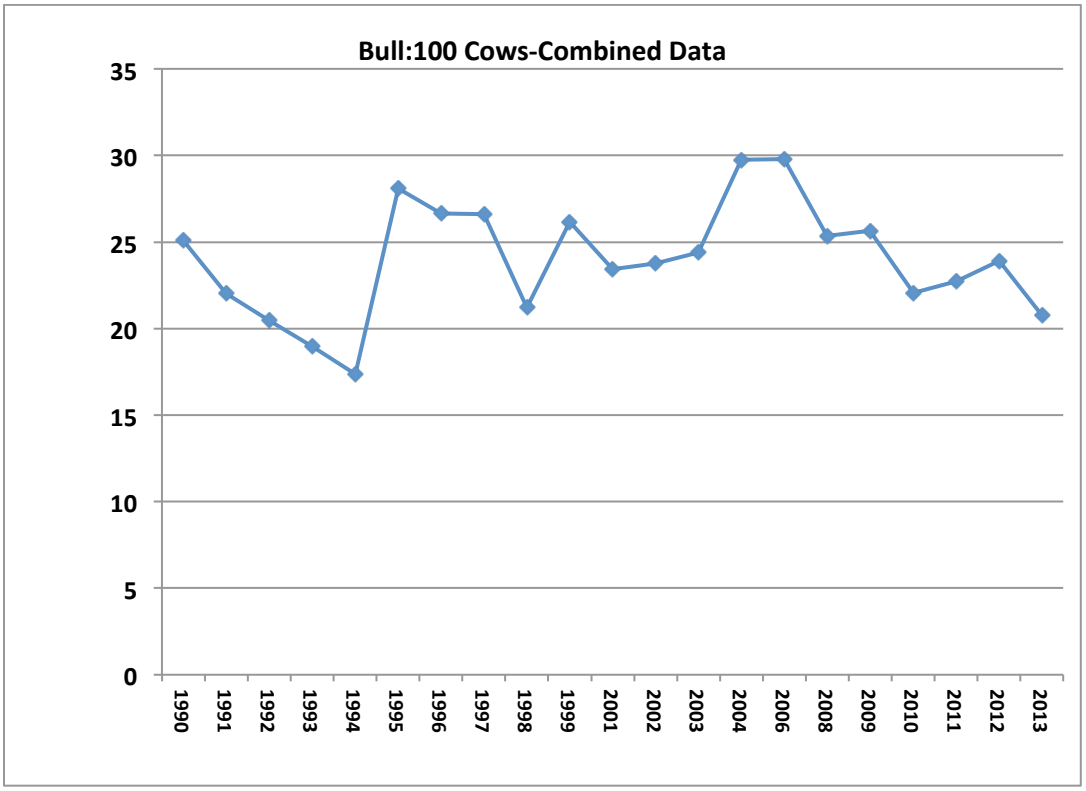

Figure 27. Bull:cow ratios for CPLA Project Area, 1990-2013.

Figure 28 shows the total number of mature bulls observed by CPW, JGFD, and SUWRMD since 2006, and the mature bull:cow ratio derived from combining count data from those 3 jurisdictions (NMDGF data did not specify mature bulls). In 2006, the combined mature bull:cow ratio was 10:100 and there were 749 bulls classified as mature by the 3 agencies. By 2013 the combined mature bull:cow ratio had declined to just 4:100, and only 255 mature bulls were classified. These figures indicate that a substantial decline in the availability of bulls, and especially mature bulls, has occurred during the past 8 years.

Figure 29 shows the trend in recruitment of spike bulls in the regional elk herd. After a significant drop between 2006 and 2007, the ratio of spike bulls:100 cows, and the total number of spikes counted has increased steadily. So, the drop in bull:cow ratios was not due to a drop in recruitment, but instead was indicative of overharvest of bulls in the regional herd.

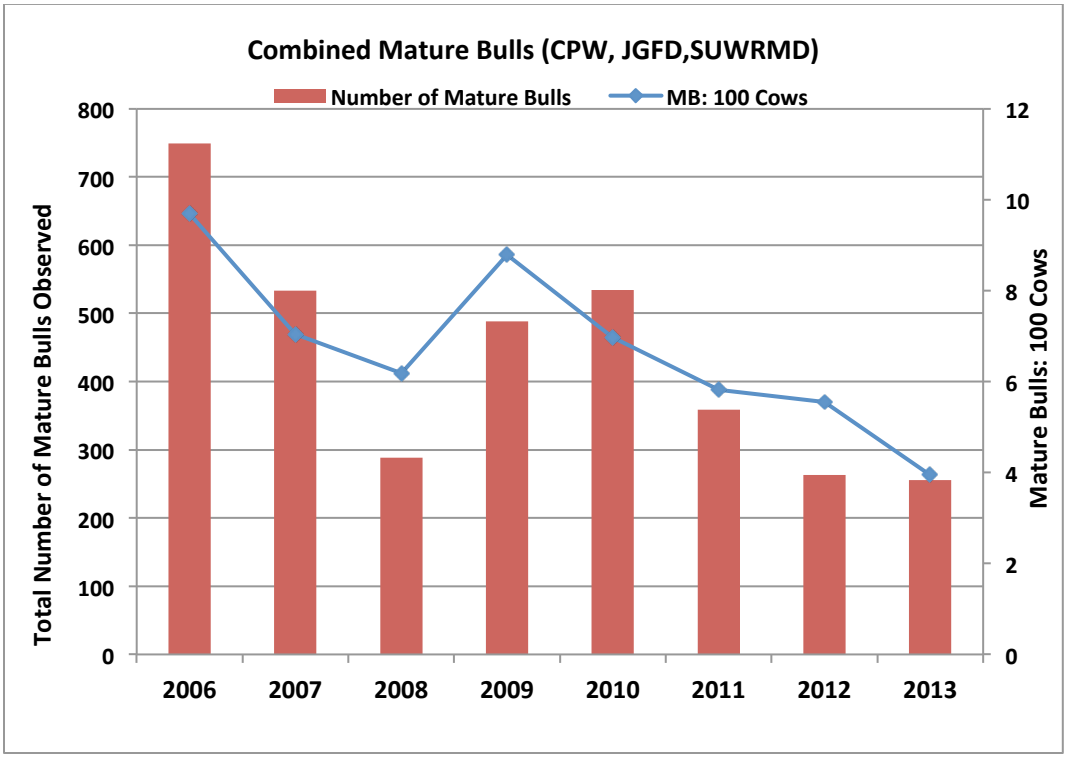

Figure 28. Number of mature bulls observed and combined mature bull:cow ratio, 2006-2013.

Calf:cow ratios from the combined data from all 4 jurisdictions is shown in Table 32. The NM ratios averaged 42:100 and the CO ratios averaged 36:100. For the combined data the calf:cow ratio dropped steadily from a high of 44:100 in 2010, to the lowest level of 33:100 in 2013. In 2013, both CO and NM data sets produced a calf:cow ratio of 33:100.

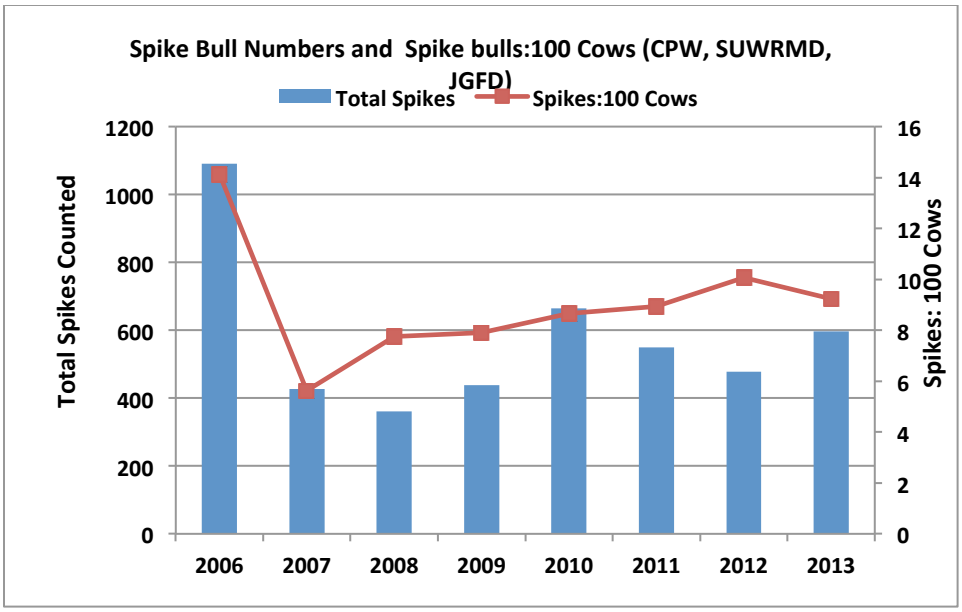

Figure 29. Trend in the number of spikes observed and spike bulls:100 cows, 2006-2013.

Figure 30 shows the historic trend in calf:cow ratios estimated for the regional elk population since 1990. Although there were gaps in the data from some GMUs the long term declining trend was readily apparent. During the 1990's, calf:cow ratios were in the 40-50:100 range, which fueled tremendous growth in the regional elk population. When extreme drought conditions hit in the early 2000's, calf recruitment plummeted to a low of 31:100in 2002. The calf:cow ratio has risen above 40:100 only 3 times since 2000, and the recent string of dry years has kept it below 40:100 for 7 of the past 8 years. In 2013, the combined calf:cow ratio of 33:100 was the second lowest ratio recorded in the last 24 years.

Table 32 . Summary of calf:cow ratios in regional elk herd. 2006-2013.

	CO	NM	COMBINED
2006	42	43	42
2007	38	40	39
2008	31	41	35
2009	40	50	44
2010	33	46	38
2011	36	42	38
2012	33	43	37
2013	33	33	33
Average	36	42	38

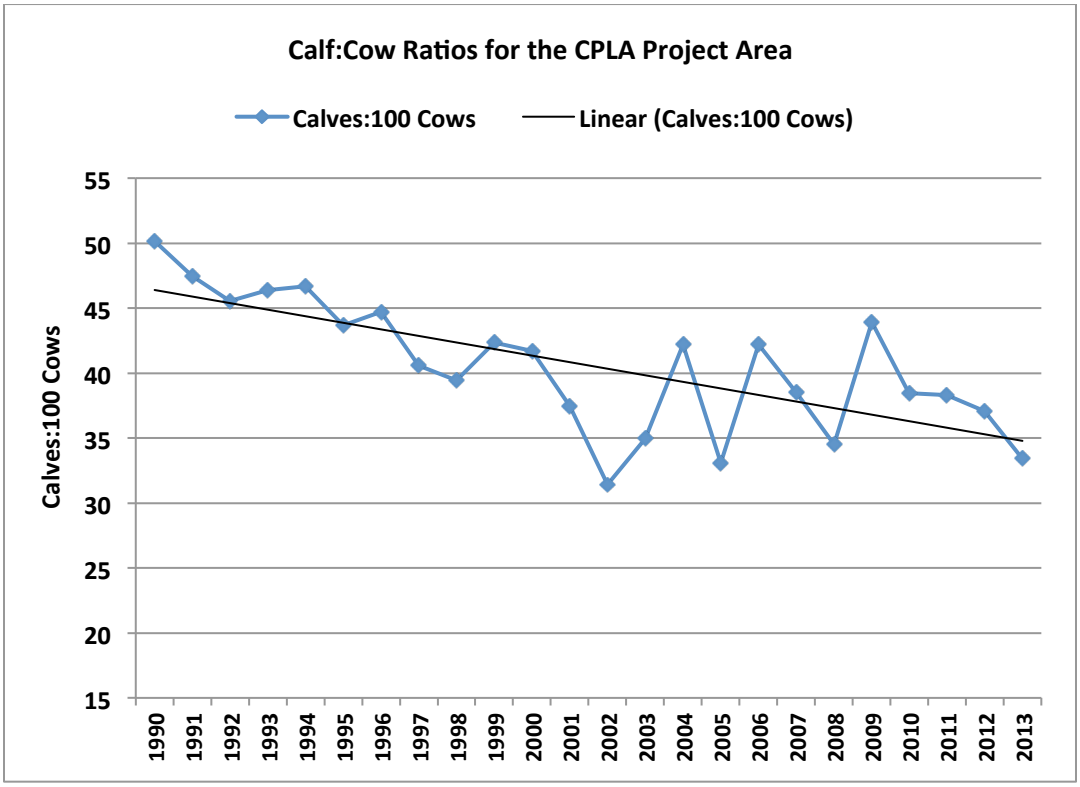

Figure 30. Combined calf:cow ratios for the CPLA Project Area, 1990-2013.

Population Estimates

Table 33 lists the elk population estimates generated by NMDGF and CPW for 2008-2011; the only years which estimates were available for both herds. Assuming the state-generated population estimates were mutually exclusive, adding these 2 estimates produced a combined population estimate of 44,560 – 46,330 elk. Table 33 also shows the percentage of the estimated populations that were counted during elk surveys. If elk counts by JGFD and SUWRMD were excluded; then 11-15% of the estimated population was counted during CPW and NMDGF surveys. If elk counts by JGFD and SUWRMD were included then annual elk surveys counted 19-31% of the estimated elk population during the years 2008-2010. Neither the JGFD nor SUWRMD generated annual population estimates for their portions of the migratory elk herds.

Table 33. Elk population estimates for CO DAU 31+32; and NM North-central elk herd.

	2008	2009	2010	2011
NMDGF population estimate*	20000	20000	20322	20322
CPW population estimate	26330	24560	24660	24890
Total Estimated Population	46330	44560	44982	45212
Total Elk Count (CPW & NMDGF)	4925	6559	6252	5717
% of population estimate counted	11%	15%	14%	13%
Total elk counted-all 4 jurisdictions	8670	11461	13939	11728
% of population estimate counted	19%	26%	31%	26%

*Median value of the high and low range of elk population estimate, 2008-2011.

Harvest

In contrast to mule deer hunting, elk hunting in all 4 jurisdictions consists of both bulls and antlerless elk (cows and calves). Hunting season structures varied considerably among the 4 jurisdictions**.**

New Mexico

Elk harvest in the NM portion of the CPLA Study Area consisted of both antlerless elk and bulls. In NM elk license were issued for both public and private land hunts. Archery hunts were in September and were 7-15 days in length. On public lands, the muzzleloader and rifle hunts were typically 5 days. There were 4-8 rifle or muzzleloader hunts per GMU; typically beginning the first Saturday in October and running into late December. Rifle hunts on private lands were 5 days long beginning October 1 and running through December 31. Private land archery and muzzleloader hunt dates coincided with public land hunts.

Public elk licenses were allocated through a limited draw process. Private land elk licenses were allocated to landowners through the E-plus system which distributes licenses based on acreage and elk use. Private landowner elk licenses can be designated by the landowner as either “ranch-only” or “unit-wide”. Unit-wide licenses can be used on any public lands within a given unit; or on any other private land with permission from the landowner. It was a common practice for smaller landowners to sell their license authorizations to guides/outfitters for use on larger ranches.

Bag limits in NM elk hunts varied among GMUs and specific hunts. For “Mature Bull” hunts, any bull other than a spike was legal. The “Antlerless” bag limit included cows and calves; and the “Either-Sex” bag limit included any bull, cow or calf.

Jicarilla Apache Reservation

On the JAR all elk licenses, excluding tribal-member cow elk, were limited and issued through drawings, or on a first-come first-served basis. Archery elk hunts were held during September. Rifle bull hunts for clients were during the first 10 days of October and the last 5 days of December. The 10-day tribal rifle bull hunt was in late November. Cow elk hunts were scheduled in November and December, ending December 31. Client cow elk hunts were 3 days in length, and the tribal cow elk hunt was several weeks. For client hunters, the bag limit for bull elk hunts was a 5x5 minimum bull; for tribal bull elk hunts, any bull was legal. The bag limit for all cow elk hunts was any cow or calf.

Colorado

CPW issued both public and private land licenses for elk hunting seasons. Public hunts consisted of a month long archery hunt in late August-September, a 9-day muzzleloader hunt in mid-September, and 4 separate rifle hunts, 5-9 days in length, beginning the second Saturday of October through late November. Archery elk licenses for the CPLA Project Area were unlimited. Muzzleloader elk licenses were limited and issued through the public draw system. Rifle bull elk licenses were unlimited for 2 of the hunts, and limited for the other 2 hunts. Limited antlerless elk licenses were available through the public draw system as well. Public land elk hunting was closed by the third week in November.

There were separate drawings for private land rifle elk licenses. The season dates for private land hunts coincided with the public hunts; plus there were an additional either-sex season, a late antlerless elk season, and an early cow elk season for private lands. All elk hunting on private land was closed by December 31.

The bag limit for all bull elk hunts, including bulls taken during the either-sex hunts, was a bull having 4 or more points on at least one antler. Spikes and bulls with less than 4 points on 1 antler were protected during all seasons. The antlerless hunt bag limit included cow elk, female calf, or male calf with antlers less than 5 inches long.

Southern Ute Indian Reservation

The SUIR had by far the simplest, most straightforward elk hunting regulations among the 4 agencies. Elk licenses for tribal members were unlimited. There was a 14-day archery elk hunt starting the last weekend in August. After that any weapon was legal until December 31. The bag limit was 1 cow elk and 1 bull elk per hunter. Additional cow tags were available for tribal members, but less than 18 additional licenses were issued each year. Despite the liberal seasons and bag limits, elk harvest on the SUIR was very low, due to the small number of tribal hunters. There were no bull elk licenses issued to non-tribal members. A limited number of late-season (January) cow elk tags were issued by random draw to Native Americans from other tribes.

Hunting Pressure

Although there were some breaks between hunting seasons, elk in the CPLA Project Area were subjected to hunting pressure almost continuously from September through December. The shortest bull elk seasons occurred on the JAR and in CO, while the longest occurred in portions of NM and the SUIR.

Elk tend to react to hunting pressure far differently from mule deer. Mule deer bucks typically restrict their movements and confine themselves to the most secure portions of their home range during hunting seasons. An elk's typical reaction to hunting pressure is to flee and put as much distance between themselves and the disturbance. Elk are far more sensitive to factors that increase disturbance, such as open road density and hunter numbers. If there are refuges where elk can escape to avoid hunters, they will seek out those areas. Large private ranches, which typically have lower hunter numbers than public land, provide refuges for elk in both CO and NM within the CPLA Project Area.

Table 34 lists the number of days elk were hunted, by jurisdiction. Some hunt dates overlapped, and the numbers presented were actual days hunting was open in each GMU. Some areas did not have specific elk hunts for muzzleloader; in CO the archery hunts overlapped the muzzleloader hunts. CO, with its season structure of 1 archery hunt, 1 muzzleloader hunt and 4 rifle hunts, had the lowest number of hunting days among the 4 jurisdictions. The exception to that was a September 1- January 31 cow elk hunt on private lands in GMU 80. The SUIR had the longest elk hunting season (122 days) but the fewest number of hunters afield. In NM, private land hunts were the most liberal in terms of hunter days; however, the long season typically allowed for lower hunter densities per hunt.

Figure 31 shows the average number of elk hunters per year in each of the 4 jurisdictions from 2006-2013, and Table 35 lists the average elk hunter density for all 4 jurisdictions. The density calculations did not take into account the proportion of each jurisdiction that was actually elk habitat, or was actually hunted, but it provided a gross comparison among jurisdictions. CO averaged nearly 3 times as many elk hunters as NM, and had a gross hunter density of 3.6 hunters/sqmi compared to NM's 1.0 hunters/sqmi. The shorter elk hunting seasons in CO also resulted in more hunters afield during most hunts than in NM. Both Indian Reservations posted hunter densities of 0.5 hunters/sqmi; and the SUIR, which had the longest hunting season, had the least crowded elk hunting conditions.

Table 34. Number of days elk were hunted by management unit.

NM-GMU	# Days Archery	# Days Rifle	Total Hunt Days
2	22	89	111
4	22	92	114
5a	22	89	111
5b	15	89	104
50	15	89	104
51	15	89	104
52	15	89	104
CO-DAU			
31	31	28	59
32	31	28	59
Unit 80 only (PR)		155	155
So Ute	14	108	122
Jicarilla	30	61	91

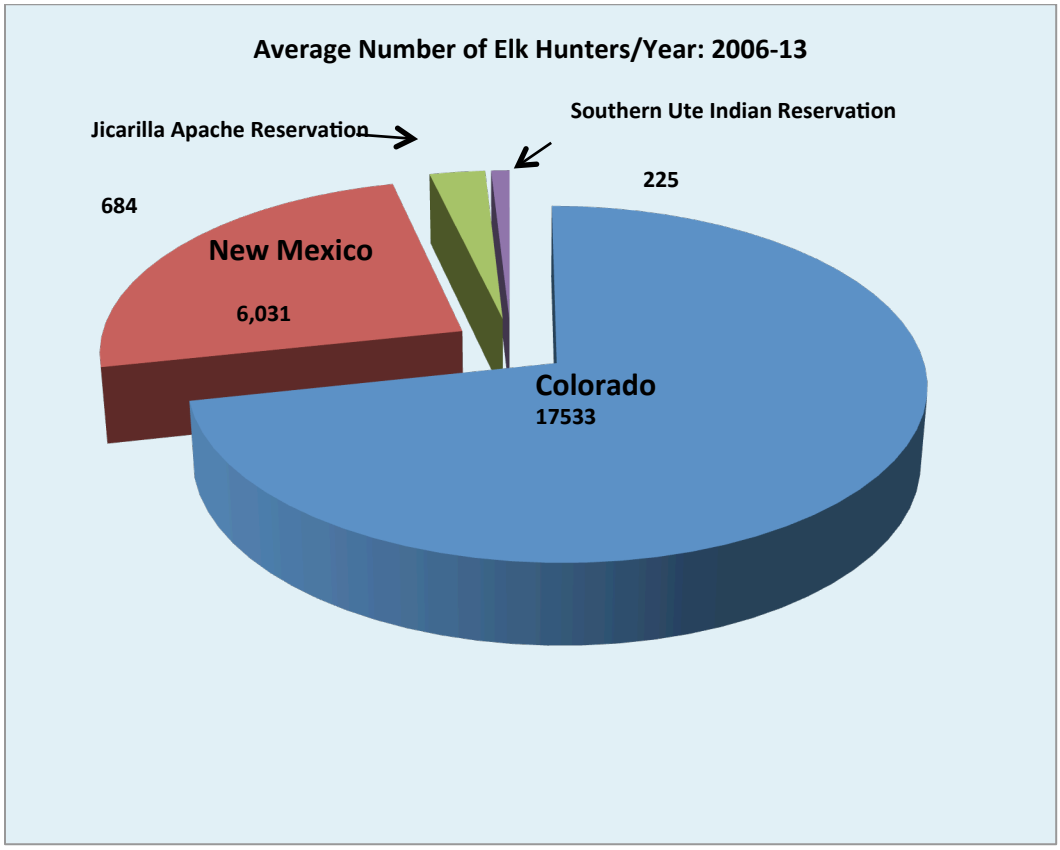

Figure 31. Average number of elk hunters per year, 2006-2013.

Table. 35. Average hunter density across all 4 jurisdictions in the CPLA Project Area, 2006-2013.

Jurisdiction	Square Miles	% Combined Area	Ave. # Elk Hunters	Ave. Hunter Density (#/sqmi)
CO	4892	39%	17533	3.6
NM	6007	47%	6031	1.0
JAR	1319	8.60%	684	0.5
SUIR	484	0.80%	225	0.5
Total	12702	100%	24473	1.9

Tables 36 and 37 summarize annual bull elk and cow elk harvest, by jurisdiction, for the CPLA Project Area. Figure 32 illustrates the trend in bull and cow harvest in the CPLA Project Area since 2006. The annual combined harvest has averaged 3651 bull elk and 2681 antlerless elk per year. Bull elk harvest has increased steadily over the past 5 years, from a low of 3,458 bulls in 2008 to 4413 bulls in 2013. Combined cow elk harvest decreased sharply between 2006 and 2008, primarily the result of significant decreases in cow elk harvest in the CO GMUs, but has remained fairly stable at approximately 2,500 cows/year since 2008.

Table 36. Annual bull elk harvest in the CPLA Project Area, 2006-2013.

Year	CPW	S. Ute	NMDGF	JIC	Total
2006	2240	36	1288	162	3726
2007	1894	34	1412	186	3526
2008	1716	36	1327	160	3239
2009	1992	31	1311	133	3467
2010	1442	24	1796	115	3377
2011	1813	33	1921	93	3860
2012	1844	30	1984	47	3905
2013	2031	30	1987	62	4110
Average	**1872**	**32**	**1628**	**120**	**3651**

Figures 33 and 34 illustrate the proportion of average annual elk harvest by jurisdiction. As expected, the 2 state agencies, which manage elk across the majority of the landscape in the project area, accounted for 90% of the average annual bull elk harvest and 83% of the average annual cow elk harvest in the CPLA Project Area. The relatively small harvest numbers from the SUIR and JAR makes them insignificant in terms of their impact on regional elk population levels or age:sex ratios.

Table 37. Annual cow elk harvest in the CPLA Project Area, 2006-2013.

	CO	S. Ute	NMDGF	JIC	Total
2006	2428	114	946	338	3826
2007	1188	123	728	424	2463
2008	938	120	718	379	2155
2009	1306	118	905	338	2667
2010	1105	114	1120	271	2610
2011	672	123	1487	279	2561
2012	647	108	1425	266	2446
2013	731	108	1519	365	2723
Average	1127	116	1106	333	2681

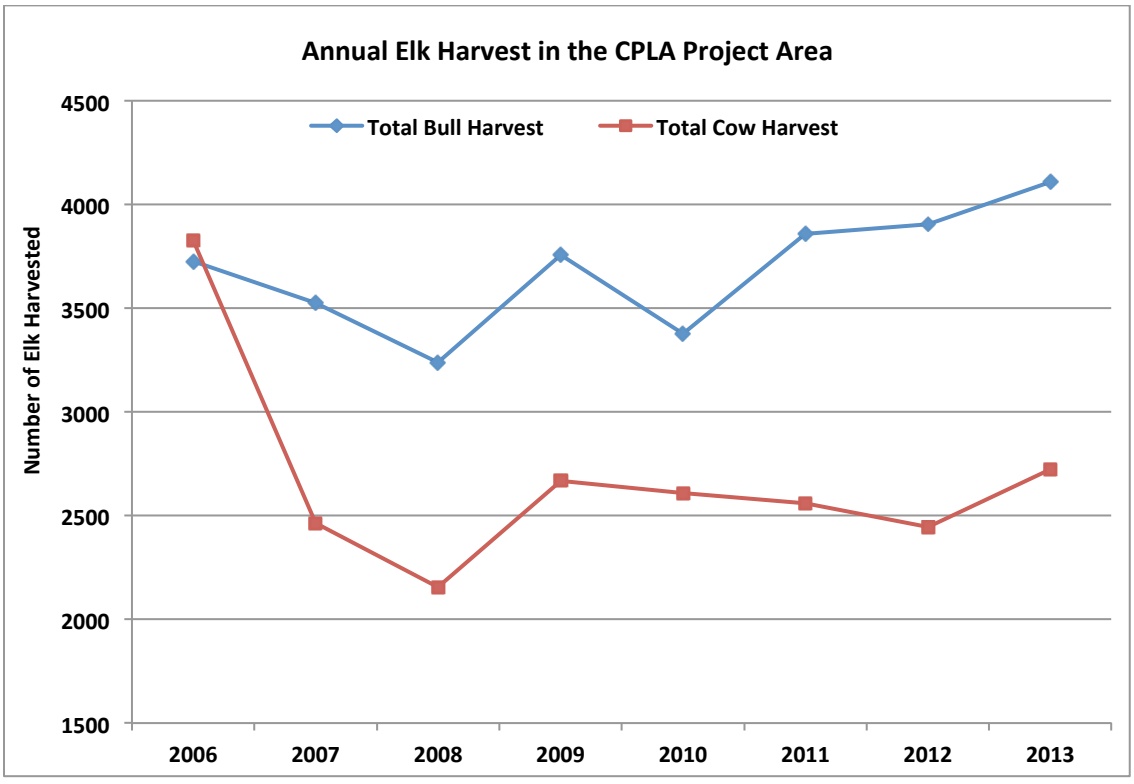

Figure 32. Annual combined bull elk and cow elk harvest, 2006-2013.

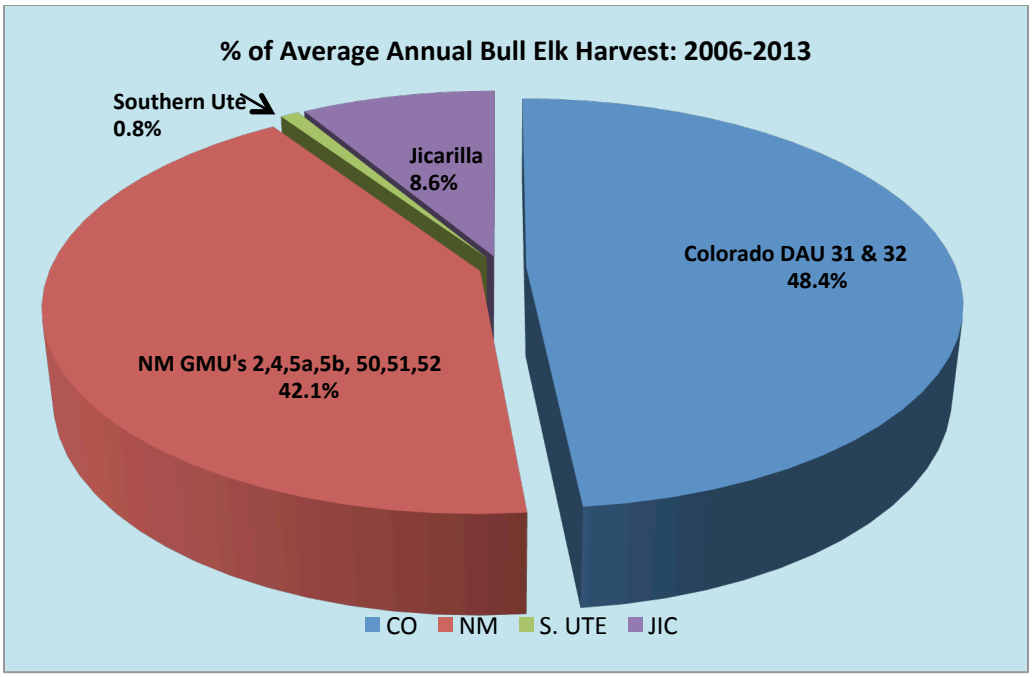

Figure 33. Average annual bull elk harvest by jurisdiction, 2006-2013.

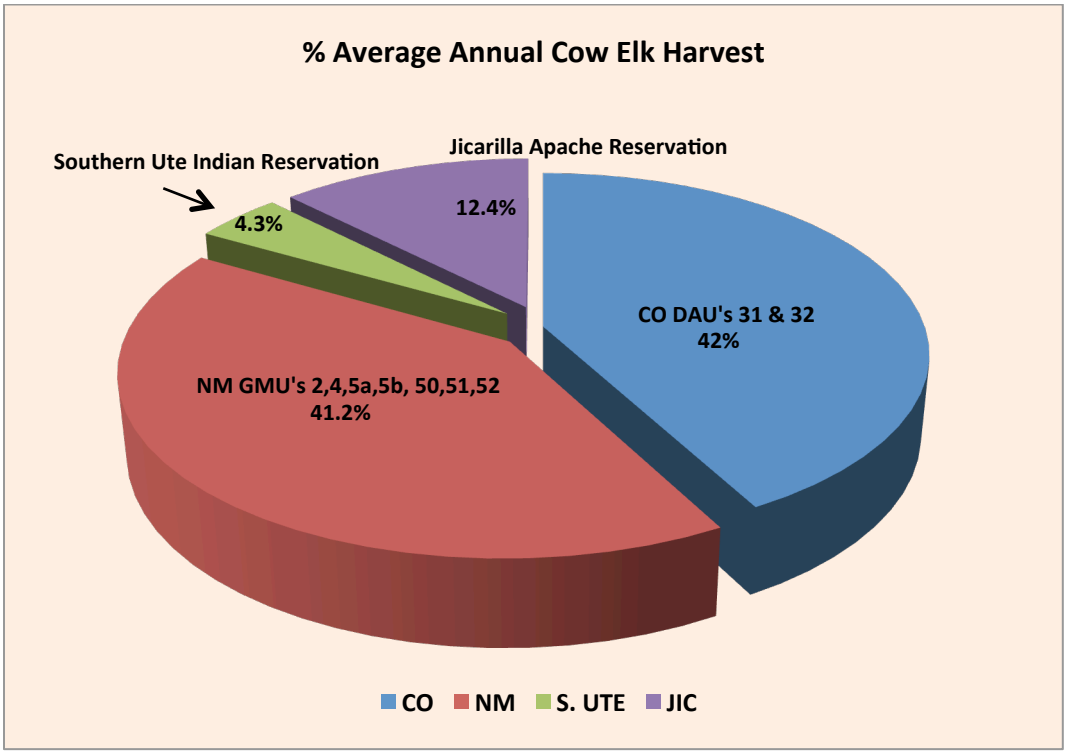

Figure 34. Average annual cow elk harvest by jurisdiction**,** 2006-2013.

Figure 35 shows the annual harvest of bull elk in CO and NM state jurisdiction hunts since 2006. In CO annual bull harvest declined from 2240 bulls in 2006 to only 1442 bulls in 2010; then increased steadily the past 3 years, reaching 2031 bulls in 2013. In NM, bull harvest was fairly stable at 1200-1300 bulls/year from 2006-2009. In 2010 NM bull harvest jumped to 1796 bulls, surpassing the CO bull harvest, and has increased slightly each year since then, reaching 1987 bulls in 2013.

Figure 36 shows the annual harvest of cow elk for all 4 jurisdictions. Cow elk harvest on the 2 Indian Reservations has been relatively stable since 2006, averaging 333 cows/year on the JAR, and 116 cows/year on the SUIR. In the CO DAUs cow elk harvest declined dramatically from 2,428 cows in 2006, to less than 740 cows/year during the last 3 years. In contrast, cow elk harvest in the NM GMU's has more than doubled in recent years, increasing from 718 cows in 2008, to 1519 cows in 2013. NMDGF is the only agency which has increased both cow elk and bull elk harvests in recent years.

Figure 37 plots total elk harvest in the CPLA Project Area since 2006. The combined elk harvest peaked in 2006 at 7,552. It then dropped to the minimum level of 5,394 elk in 2008. Since 2008 total elk harvest has steadily increased, reaching 6,833 elk in 2013.

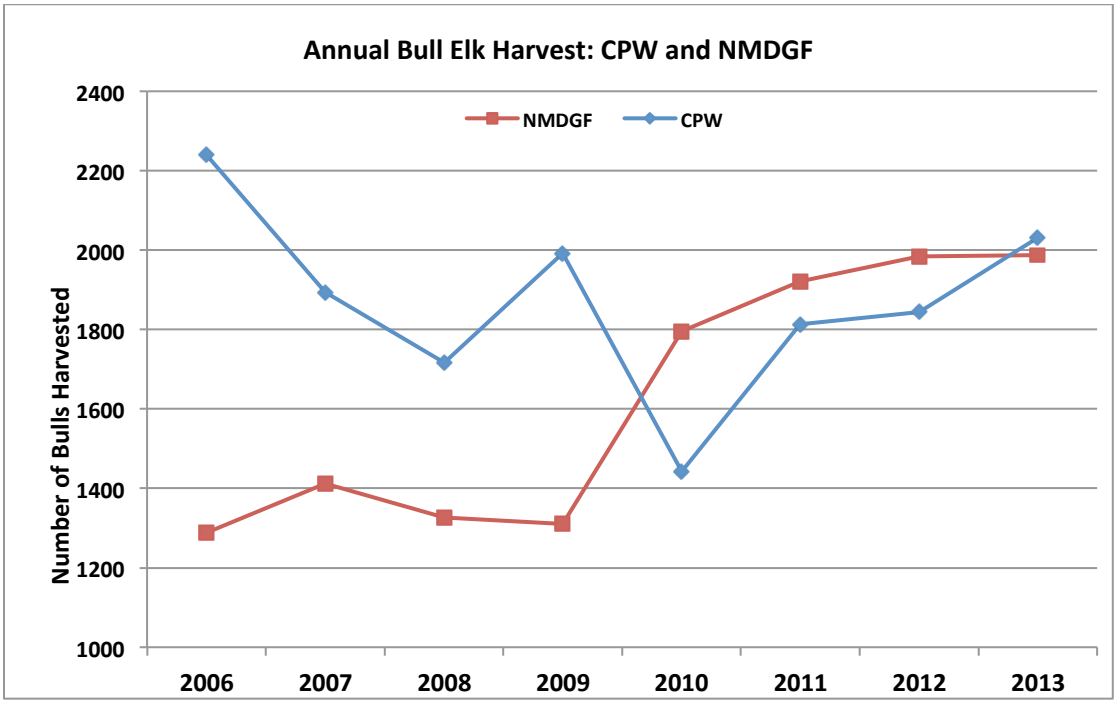

Figure 35. Trends in annual bull harvest in NM and CO state jurisdictions, 2006-2013.

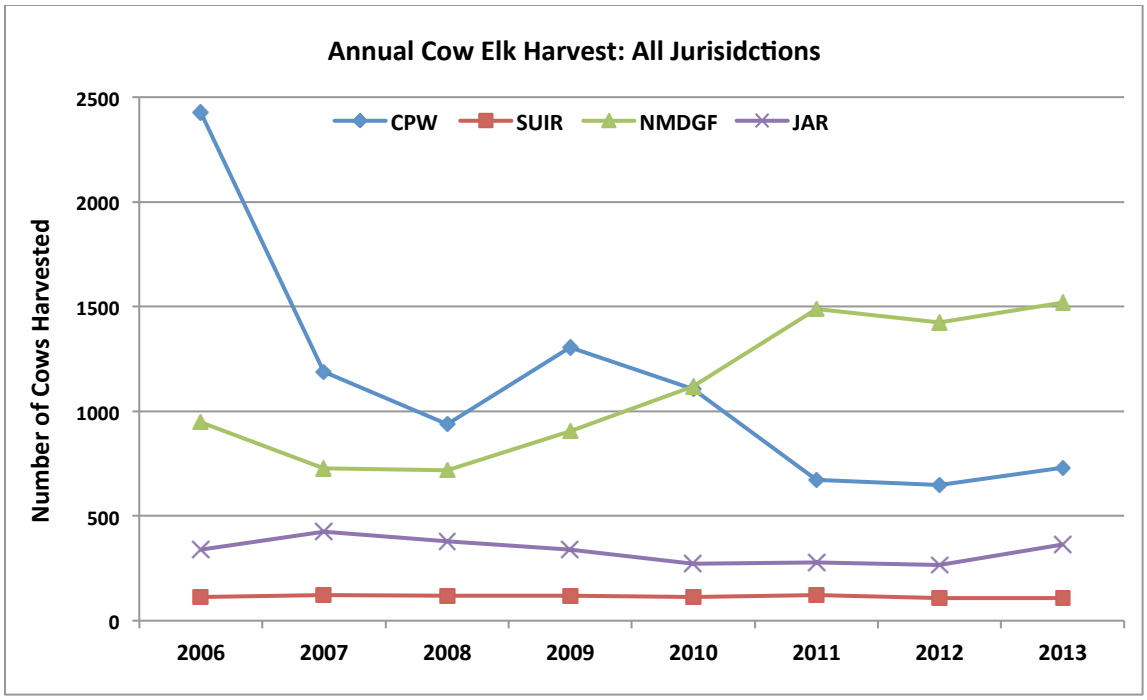

Figure 36. Annual cow elk harvest by jurisdiction, 2006-2013.

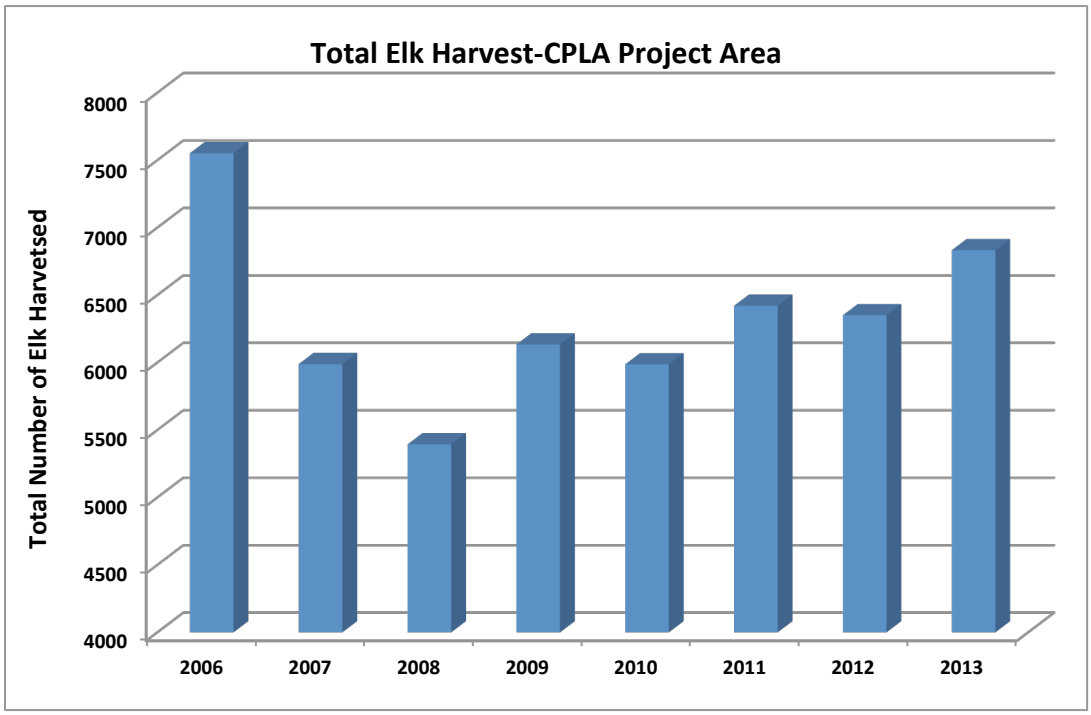

Figure 37. Total elk harvest in the CPLA project area, 2006-2013.

Figure 38 shows the historical trend in elk harvest in the CPLA Project Area. I plotted annual harvest only for those years where harvest figures from the majority of the NM GMUs were available. Annual combined bull elk harvest varied considerably from 1995-2005, from a low of 2,913 in 1995 to a high of 5,854 in 2003. Annual bull harvest stabilized somewhat after 2005, but has been increasing since 2008. The 2013 harvest of 4,110 bulls was the 4th highest recorded in the past 18 years.

The same pattern was apparent for combined annual cow elk harvest; considerable variation from 1995-2007, followed by relative stability since then, with a slightly increasing trend since 2008 (Figure 39). The high cow elk harvests during the 1990's and early 2000's were predicated on a highly productive, rapidly expanding elk population, coupled with increasing complaints of elk depredation on private lands. Drought conditions exacerbated the situation and liberal cow elk seasons were enacted by most jurisdictions to reduce the size of the elk herd.

Figure 40 shows the annual precipitation recorded at the U.S. Weather Station in Dulce, NM, which is situated roughly in the center of the CPLA Project Area. During the string of consecutive dry years, from 2000-2004, drought conditions rivaled the historic drought of the mid 1950's. Elk harvest peaked in 2003, at the height of the drought, when 11,380 elk were harvested in the CPLA Project Area.

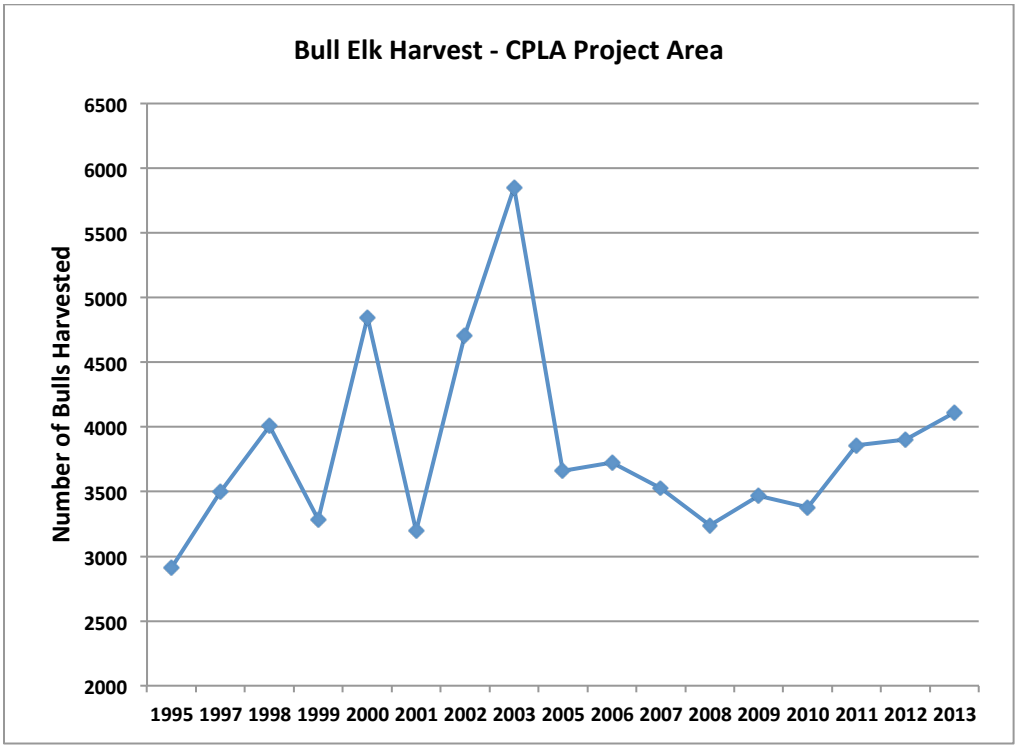

Figure 38. Bull elk harvest for the CPLA Project Area, 1995-2013.

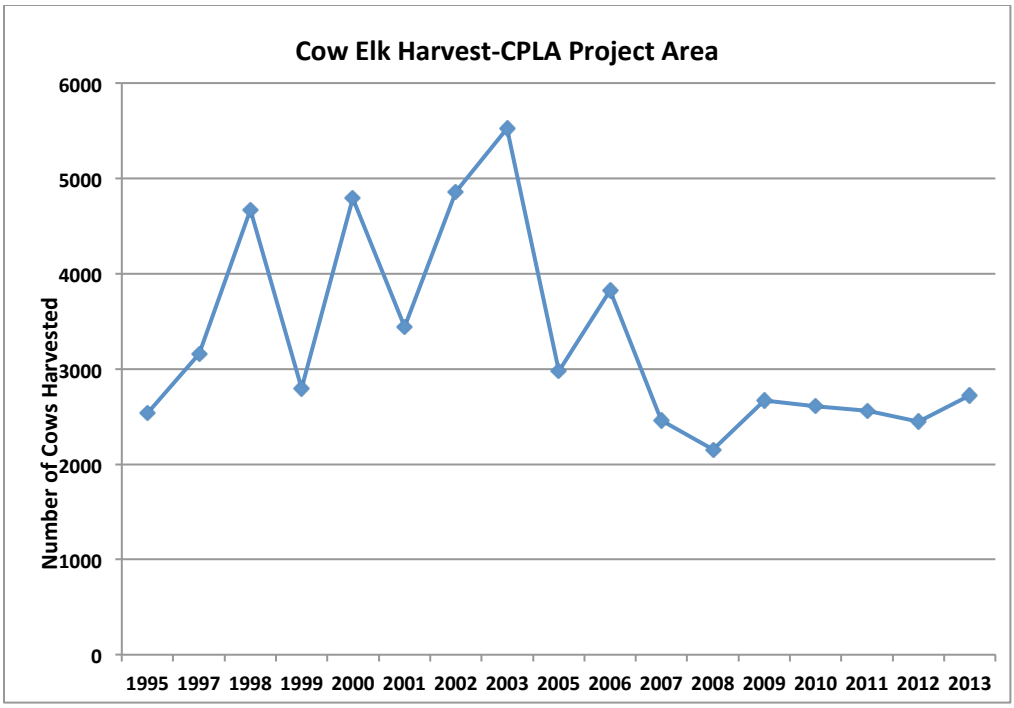

Figure 39. Cow elk harvest for the CPLA project area, 1995-2013.

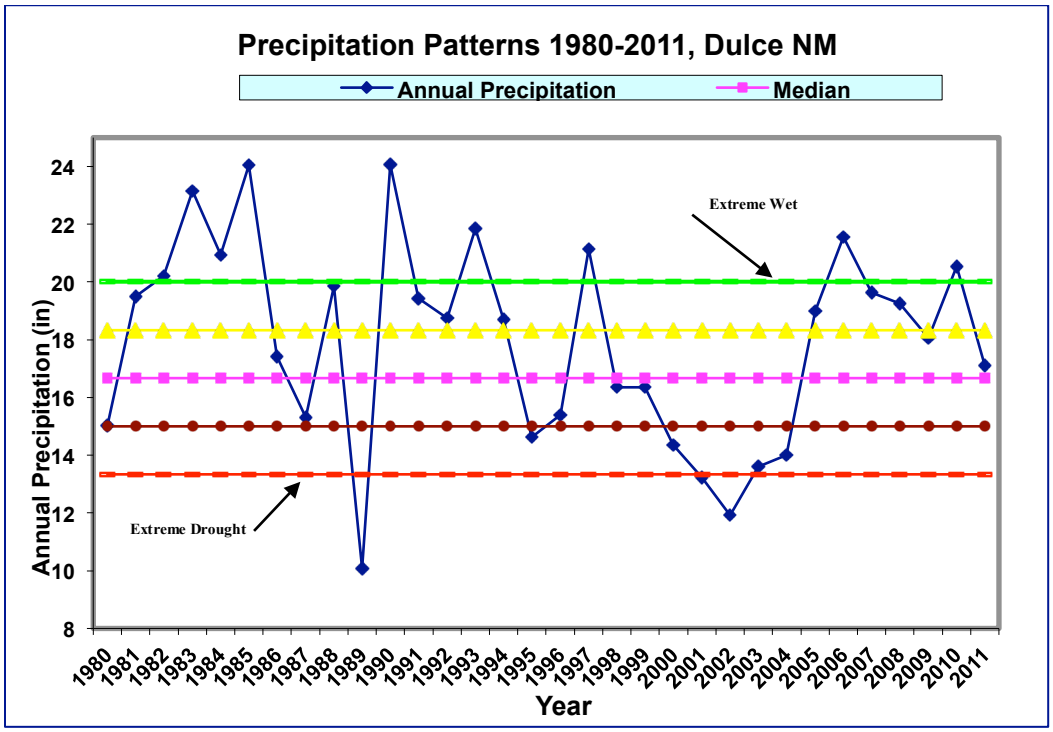

Figure 40. Annual precipitation measured at the U.S. Weather Station, Dulce, NM, showing median precipitation, and levels of drought and extreme drought. Note the consecutive drought years, from 2000-2004.

Table 37 shows the percent of bulls and cows harvested by CPW and NMDGF, compared with the estimated numbers of bulls and cows in the herd, for the period 2008-2011. Herd size was based on the population estimates provided by NMDGF and CPW. Herd composition was based on the overall average calf:cow:bull ratio for the CPLA Project Area; which was approximately 38 calves:100 cows:25 bulls. Annual harvest was based on the average annual harvest of cows and bulls by NMDGF and CPW from 2008-2011.

The averaged combined annual harvest of 3,330 bulls represented approximately 48% of the bulls available in the estimated herd of 45,271 elk. The total harvest of 5,393 elk represented approximately 12% of the total estimated herd. Although the numbers were based on rough population estimates, they revealed that an extremely high rate of bull elk harvest has occurred in recent years. This high rate of bull elk harvest was likely responsible for the recent declines in bull:cow and mature bull:cow ratios, and numbers of mature bulls being observed during aerial surveys. If these high harvest rates continue, even further reductions in the bull:cow ratios, availability of mature bulls, and quality of elk hunting can be expected.

Table 37. Average harvest of cow elk and bull elk, 2008-2011; based on combined population estimates from NMDGF and CPW, and an average herd composition of 38:100:25, bulls:cows:calves.

	% of herd	Total Elk	Annual Harvest	% Harvest
Cows & Calves	84.66%	27774	2063	7.4%
Bulls	15.34%	6943	3330	48.0%
Total	100	45271	5393	11.9%

Hunter Success

The combined elk hunter success rate for the CPLA Project Area ranged from 22-28% and averaged 26% (Table 38). This included both bull and antlerless harvest. CO posted the lowest hunter success rates, which ranged from 15-20%, and averaged 18%. The majority of hunting in CO DAUs 31 & 32 occurred on public land and most hunters were unguided. Elk hunter success on the SUIR averaged 27%. All of the bull elk hunters on the SUIR are tribal members, and their level of experience probably mirrored that of any other segment of public hunters. On the JAR, guided client hunters accounted for roughly half of the elk harvest and elk hunter success averaged 64%, the highest in the CPLA Project Area. Elk hunter success rates in NM averaged 45%, which included both private and public hunters. The majority of bull elk harvest in NM occurred in Unit 4, which consists of mostly private property where guided elk hunts and high success rates were the norm. Elk hunter success on public lands in NM ranged from 30-40%; while private land hunters enjoyed success rates close to 60%.

Table 38. Elk hunter success rates by jurisdiction, and combined, 2006-2013.

Year	CPW	NMDGF	SUWRMD	JGFD	Total
2006	**24%**	**41%**	**28%**	**70%**	**28%**
2007	**17%**	**46%**	**26%**	**80%**	**25%**
2008	**15%**	**41%**	**32%**	**72%**	**23%**
2009	**20%**	**48%**	**33%**	**67%**	**27%**
2010	**14%**	**43%**	**21%**	**57%**	**22%**
2011	**17%**	**49%**	**25%**	**63%**	**28%**
2012	**16%**	**46%**	**27%**	**50%**	**26%**
2013	**18%**	**47%**	**27%**	**69%**	**28%**
Average	**18%**	**45%**	**27%**	**64%**	**26%**

Table 39 compares the total size and proportion of bull elk and cow elk harvest for each jurisdiction within the CPLA Project Area. These numbers do not account for differences in the proportion of each jurisdiction that is actually elk habitat, but they do provide a general overview of proportional elk harvest by the 4 management agencies. Overall, each jurisdiction harvested bull and cow elk in approximate proportion to their size. CO's proportion of the harvest of bulls and cows was slightly higher than their relative size, while NM's proportion of the total harvest of bulls and cows was below their relative size within the CPLA Project Area. Both JAR and SUIR accounted for a smaller proportion of bull harvest than their relative size; and higher proportion of cow harvest.

Table 39. Proportion of total area an average annual elk harvest for each jurisdiction, 2006-2013.

Jurisdiction	Square Miles	% Combined Area	% Bull Harvest	% Cow Harvest
CO	4892	39%	48.4%	42.0%
NM	6007	47%	42.1%	41.2%
JAR	1319	10%	8.6%	12.4%
SUIR	484	4%	0.8%	4.3%
TOTAL	12702	100%	99.9%	99.9%

Age Data

Bull Elk

Figure 41 shows the average scores of 721 bull elk harvested from 1994-2009 on the JAR. Sample size for each age class is shown on the left axis. These bulls represented both resident and winter migrant bulls harvested throughout the fall and early winter. Gross score increased with age until age 7, then remained fairly constant until age 11, at just over 300 inches, then declined after that. The number of bulls killed age 10+ was very small, indicating few bulls survived much past age 9. The 2 oldest bulls in the sample were 18 and 19. The highest gross score among the 721 bulls was 372.

Table 40 shows the extreme range of scores that occurred within each age class of bull elk from this data. Even in the older age classes, some bulls grew very small racks; a reflection of the variability in genetics and nutrition that influence antler size. Bulls harvested at age 7 had an average score fairly close to the maximum. Managing for bulls older than age 7 would not result in a significantly higher average score. The greatest increase in average score occurred between ages 2 and 3, followed by an average increase of 25 inches between ages 4 and 5, and an average increase of 14 inches between ages 5 and 6.

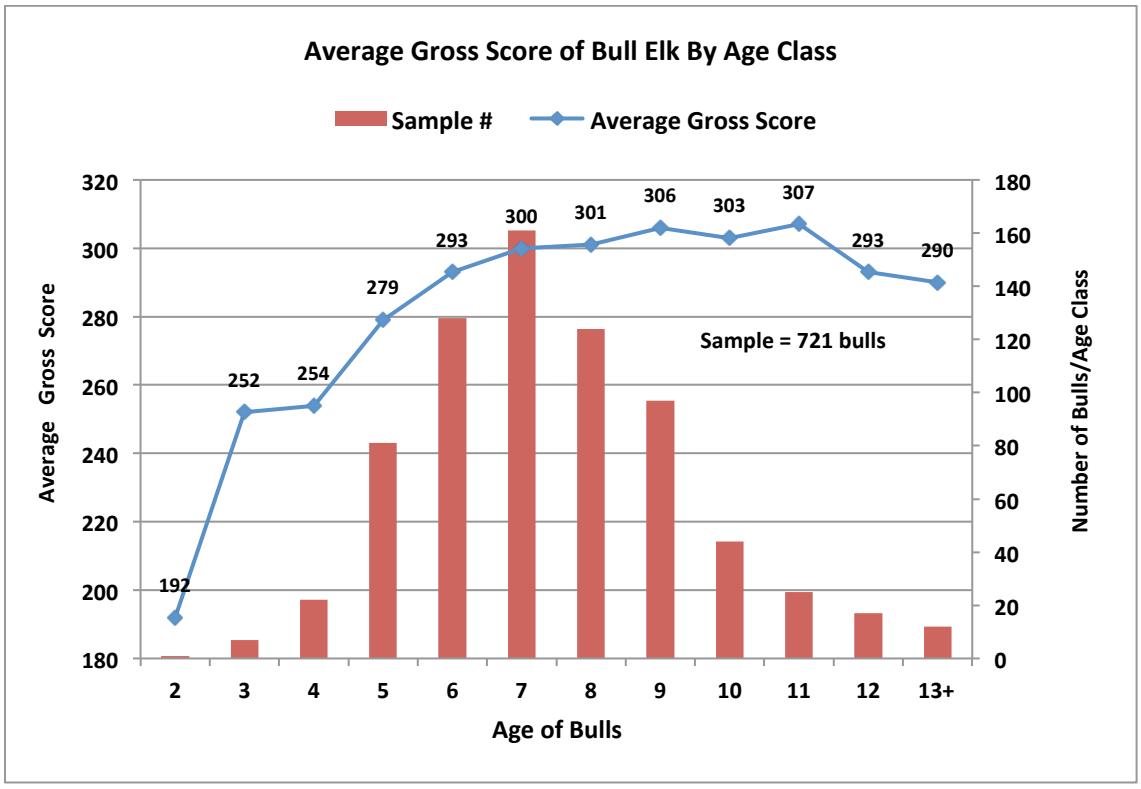

Figure 41. Average age of 721 bulls harvested on the JAR, 1994-2009.

Table 40. Ages and scores of 721 bulls harvested from 1994-2009. All score values listed are gross antler score. All bulls were aged by cementum annuli at Matson's Laboratory, Milltown, MT.

Age	# Bulls	Average Score	Median Score	Range	STD	95% CI
2	1	192	xx	xx	xx	xx
3	7	252	236	207-323	42.3	167-337
4	22	254	248	202-314	28.1	198-310
5	81	279	277	221-336	22.4	234-324
6	128	293	295	224-349	25.1	243-343
7	161	300	300	243-371	23.2	254-346
8	124	301	301	245-376	23.2	255-347
9	97	306	305	249-372	20.2	266-346
10	44	303	306	241-344	24.2	255-351
11	25	307	308	266-353	22.3	262-352
12	17	293	294	236-344	28.1	237-349
13	7	282	287	265-294	10.6	261-303
14	3	309	302	277-327	xx	xx
18	1	285	xx	285	xx	xx
19	1	305	xx	305	xx	xx

In 2009 and 2010 private landowners, hunters and outfitters in Unit 4 cooperated in efforts to determine age of bulls harvested by their clients. Tooth envelopes were provided to hunters and guides, along with instructions on how to collect the teeth and record the proper information. The teeth were analyzed at Matson's Laboratory, Milltown, MT. Results of those efforts are shown in Table 41. During both years the average age of bulls harvested was approximately 5 years old. Unit 4 is managed as an "opportunity" unit by NMDGF, where the number of licenses issued provides for maximum hunter opportunity. However, much of the hunting in Unit 4 is done by non-resident hunters who either pay for access to private land, or book with outfitters who lease private land. On most properties there was some selection for larger, mature bulls to insure client satisfaction. With an average age between 4 and 5 years old, the average scores for bulls harvested during those years was probably 260-280.

Table 41. Average age of bulls harvested in GMU 4, NM in 2009 and 2010.

Year	Sample Size*	Average Age	Age Range
2009	**168**	**4.7**	**1-11**
2010	**170**	**5.2**	**1-10**

*Excludes bulls harvested on Chama Land and Cattle Ranch (part of the JAR).

Cow Elk

Age data for cow elk were collected by JGFD and SUWRMD beginning in the late 1980's. Cows harvested on the JAR were a combination of resident and winter migrants from Unit 4 and CO DAUs 31 and 32. Sample size varied with harvest level, reaching peak numbers during the mid-1990's when cow elk harvest peaked. The average age of cow elk showed an increasing trend for the span of years sampled (Figure 42). The highest average age was 6.1 years in 2012, the lowest was 4.0 in 1993.

Figure 43 shows the average age of cow elk harvested on the SUIR since 1989. The same trend of increasing average age was apparent from this data set until a sharp drop in the 2013 sample. Cow elk harvested on the SUIR were probably a mix of resident animals and winter migrants from DAU 31. The gradual increase in average age of cows harvested on both the JAR and SUIR indicated a decreasing trend in recruitment; which was consistent with the decreasing trend in calf:cow ratios discussed earlier. Both parameters reflected a decrease in herd productivity and the annual growth rate. The lower the annual rate of increase, the less this herd is able to absorb female harvest without declining.

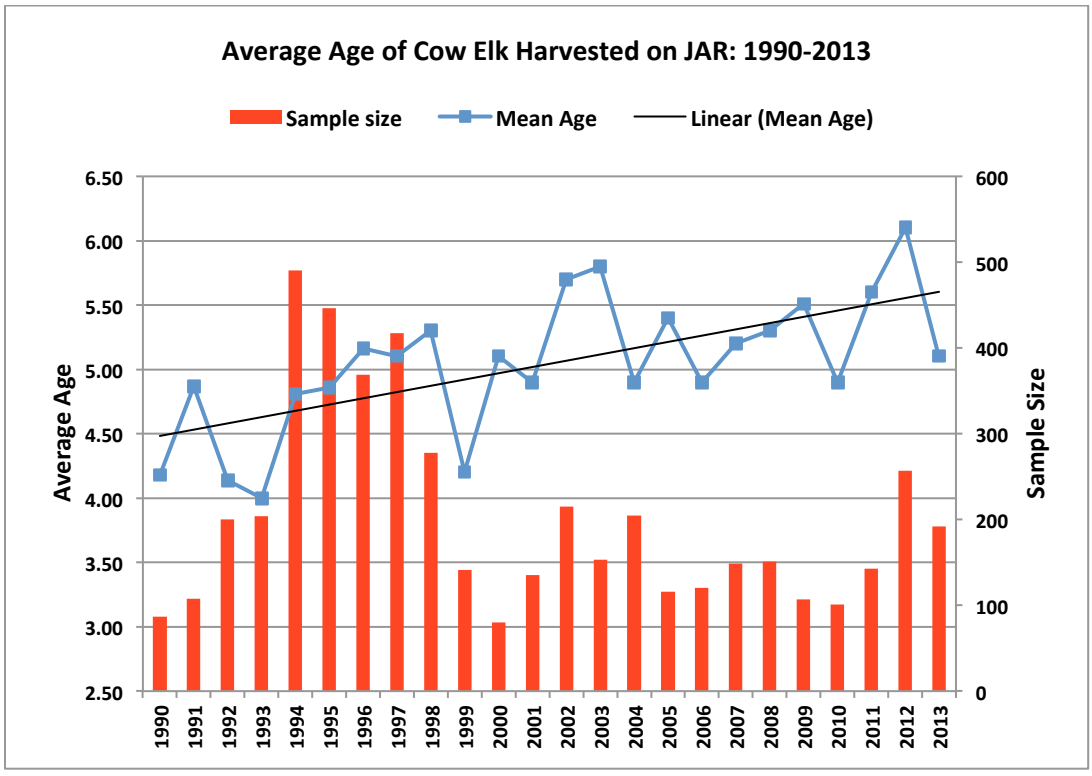

Figure 42. Trend in the average age of cow elk harvested on the JAR, 1990-2013.

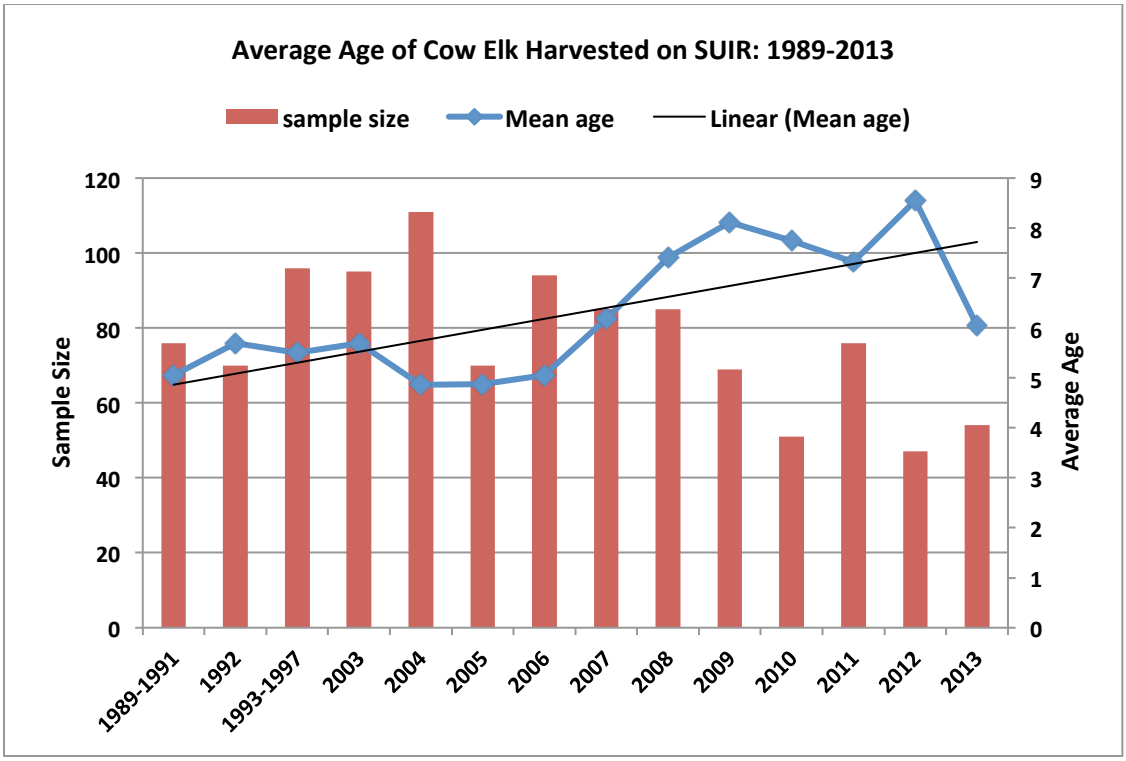

Figure 43. Average age of cow elk harvested on the SUIR, 1989-2013.

Trophy Quality

In stark contrast to mule deer, the trophy quality of elk in the CPLA Project Area was not very good. The Boone and Crockett Club's Big Game Records rank CO and NM 5th and 6th respectively, as producers of record-book typical elk; 8th and 4th respectively as producers of non-typical record book elk. There has been only 1 bull elk entered in Boone and Crockett's all-time record book from the CPLA Project Area. That bull was harvested in 1998 by an archery hunter in GMU 2. Even on the JAR, where management is focused on producing trophy elk, no Boone and Crockett eligible bulls have ever been harvested. The lack of trophy bulls from the CPLA Project Area was most likely a reflection of the poor genetics in this elk herd, coupled with high harvest rates.

SUMMARY

The migratory patterns of mule deer and elk in the CPLA Project Area have been well documented by numerous State, Tribal, and Federally funded telemetry projects. The recent application of GPS technology has revealed very specific information regarding migration routes, stopover areas, and timing of both mule deer and elk migration. There are currently 5 on-going GPS telemetry projects within the CPLA Project Area. Mule deer studies are being conducted by CPW in deer DAU 30, and by West, Inc. in NM GMU 2B. Elk studies are being

conducted by CPW in elk DAU 32, and by the JGFD and SUWRMD on their respective reservations. All of these studies will add tremendous amounts of information regarding elk and mule deer migration habits and mortality factors.

What all of these studies have shown is that the many of the mule deer and elk in the CPLA Project Area are migratory; moving twice/year between distinct summer and winter ranges. Summer range typically occurs at higher elevations, winter range at lower elevations. Distance between seasonal ranges varies from 30-70 miles, depending on where the animals were captured. The higher elevation mountains north and east of Pagosa Springs, CO function solely as summer range for mule deer and elk. Winter range areas in CO are found at lower elevations south and west of Pagosa Springs and in the eastern portions of GMU's 80 & 81.

In NM a large percentage of the landscape functions as year-round range for both mule deer and elk; but not necessarily the same animals during all seasons. There are mule deer and elk that summer in the NM GMUs and on the JAR, and these animals move to lower elevations during winter; moving south and west from the Chama Valley, or south and east towards San Antonio Mountain. These animals share winter range with migrants from southern CO. There are also some non-migratory elk and mule deer, which reside year-round at lower elevations in all jurisdictions.

The SUWRMD and Rosa mule deer telemetry studies revealed the timing of mule deer migrations to be very predictable. Mule deer begin heading for winter range in mid-October, and begin migrating toward summer range in late April/early May. Spring migrations averaged 21 days in the Rosa study and 18 days in the SUWRMD study. Fall migrations averaged 14 days in the Rosa study and 16 days in the SUWRMD study. Both studies reported strong individual fidelity to both summer and winter ranges.

Elk tended to wait until increased snow depth forced then to move to lower elevations; although some bull elk moved to winter range soon after the rut, despite the lack of snow cover. On winter range, when snow depth became excessive, both deer and elk left their traditional winters ranges and move to lower elevations. This was observed during the SUIT study, where deer moved south into NM when heavy snowfalls occurred during December. However, deer were less likely to leave their traditional winter range in response to heavy snowfalls in January or February. Individual fidelity to summer range was more consistent and predictable than fidelity to winter range for both species.

An interesting finding from the recent telemetry studies was that migration patterns for mule deer and elk have not changed significantly over the past 35+ years. The connection between mule deer winter range in GMU 2, and summer range in the San Juan Mountains, is the same during the current Rosa Study as it was during the 1970's NMDGF study. The connection between elk winter ranges in northern NM, and high elevation summer range along the Continental Divide in CO are the same during the on-going CPW and JGFD studies, as in the early 1990's JGFD and CDOW studies.

Although current migration patterns may be the same, the use of GPS technology has identified specific routes, stop-over areas, critical habitats and timing statistics that were not identified during the VHF-telemetry studies. Protection of these traditional routes and stopover areas should be top priority for mule deer and elk managers, land management agencies, private landowners, and sportsmen/conservation groups. The high elevation summer ranges in CO are primarily on National Forest, which are somewhat protected from development. Winter ranges, and a considerable portion of the migration corridors occur on all types of land ownership including tribal, federal, state and private. Energy development has already impacted a significant portion of big game winter range in the CPLA Project Area. Continued development of oil and gas resources on federal and tribal lands will undoubtedly occur, as new methodologies open up new opportunities for extraction. Impacts to small parcels of winter range can impact mule deer and elk populations inhabiting substantially larger areas of summer range.

Elk and mule deer in the CPLA Project area were hunted throughout the fall, beginning in September and ending in December, and in some cases January. These animals were hunted on summer range during the early archery and muzzleloader seasons, on transitional range during several rifle seasons; and in some instances, on winter range during late season hunts. Many animals were exposed to hunting pressure in several different jurisdictions as they moved from summer to winter range. The potential for overharvest in these deer and elk herds is significant; as evidenced by recent declines in mature bull:cow and mature buck:doe ratios.

In CO, harvest of elk and mule deer consists solely of resident animals, with residency defined as where an animal reproduces. Harvest south of the CO/NM border consists of a mixture of resident animals and winter migrants from Colorado. Determining what proportion of the NM and JAR harvests are comprised of resident versus migrant animals is probably impossible. However, coordinating this cross-jurisdictional harvest, to prevent over-harvest, should be a management priority for all 4 wildlife management agencies.

Mule Deer Status

Although the data for this project encompassed both sides of the Continental Divide, the differences in population parameters suggest that mule deer inhabiting GMUs 80 and 81 in CO represent a relatively smaller deer herd; mostly separate from the rest of the mule deer population that extends from the Continental Divide west and south into NM. No accurate population estimates were available for the regional mule deer herd; however, total numbers counted during aerial classification surveys declined across all 4 jurisdictions from 2006-2013. Those declines ranged from 17-54%, and averaged 35% among the 4 agencies. The declines were greater on the NM side of the border.

Buck:doe ratios across the CPLA Project Area were relatively stable to slightly declining , averaging 29:100 in CO and 37:100 in NM. The combined average for the CPLA Project Area was 33:100. The mature:buck doe ratios differed considerably among the 4 jurisdictions (a reflection of different harvest strategies) but trended downward in all jurisdictions, except the

JAR, where trophy mule deer management is practiced. The total number of "mature" bucks observed during aerial surveys has also trended downward, reaching its lowest level in 2013.

Fawn:doe ratios were fairly stable, averaging 48:100 in both NM and CO. The lowest ratio recorded was 35:100 and the highest was 55:100, but mostly the ratios were in the mid 40's to 50:100 range, which is borderline recruitment level for maintaining a stable mule deer population. Fawn:doe ratios in the mid 50's or higher will be needed if the goal is to increase deer numbers. The fawn:doe ratio did increase slightly the past 2 years in both states.

Both CO and the SUIR continue to harvest doe mule deer; with CO accounting for most of the harvest each year (85.6% average). Although doe harvest has declined in recent years there were 337 does harvested in 2013. Female harvest of big game is often used to decrease big game populations. A prime example was the widespread use of cow elk hunts to reduce elk herds across the southwest during the early 2000's. The mule deer population in the CPLA Project Area has declined in recent years. The continued harvest of female deer will exacerbate any future decline.

A major factor that may ultimately limit the size of the regional mule deer herd is condition of the winter range. Most of the winter range available to mule deer has experienced drought, invasion of noxious weeds, and habitat loss and fragmentation due to energy and urban development. The carrying capacity of those winter ranges will ultimately determine how many mule deer can inhabit the CPLA Project Area.

The total buck harvest has increased in recent years; while the proportion of bucks, and especially mature bucks, has been decreasing. Buck harvest declined in CO from 2006-2012, but increased slightly in 2013. Buck harvest in NM increased annually from 2010-2013. The combination of increased buck harvest and declining mature buck:doe ratios indicated over-harvest of the buck resource. If the current trend in harvest continues, further declines in the buck:doe ratio, mature buck:doe ratio, and numbers of mature bucks available for harvest will undoubtedly occur.

The trophy potential for mule deer bucks in the CPLA Project Area is phenomenal, yet only 1 of the 4 wildlife management agencies focuses on producing trophy mule deer. Rio Arriba County (primarily the JAR) is the top producer of Boone and Crockett mule deer in the entire range of the species; yet adjacent counties produce relatively few trophy bucks. We know from telemetry studies that these are not separate populations, and the potential to produce trophy bucks exists within each of the 4 jurisdictions. Few areas in the western U.S. possess the genetics for growing trophy mule deer, and wildlife management should consider managing exclusively for trophy bucks. The genetics and habitat already exist. The only element missing is advanced age structure in the bucks, which can be developed through conservative harvest.

Elk Status

There was no obvious trend in total elk numbers counted during aerial surveys from 2006-2013. Counts in the CPLA Project area ranged from 8,854-13,559 elk, and averaged 11,669 elk/year. The 2013 count was close to average. When compared to historic counts, from the 1990's and early 2000's, the decline in elk numbers was readily apparent. From 1990-2003 the average annual count for the CPLA Project Area was approximately 17,000 elk/year, and the highest count (2003) was over 24,000 elk.

Declining trends in bull:cow and mature bull:cow ratios were evident in all 4 jurisdictions and from the combined data set. Overall, the bull:cow ratio dropped from 30:100 in 2006 to 21:100 in 2013. The decline was steepest in the NM data, dropping from 44:100 down to 30:100. In CO, which posted the lowest post-hunt bull:cow ratios, the decline was less severe, dropping from 21:100 down to 16:100.

The decrease in the mature bull:cow ratios was even greater. Despite differences in criteria used to classify bulls as mature, all 3 jurisdictions which recorded mature bulls (CPW, SUWRMD, and JGFD) reported significant declines in the mature bull:cow ratio from 2006-2013. On the JAR the mature bull:cow ratio declined from 21:100 down to 9:100 in 2013. On the SUIR the ratio of mature bulls dropped from 10:100 down to 4:100 in 2013, and in CO the mature bull:cow ratio dropped from a high of 5:100 to only 1:100 by 2013. The total number of mature bulls observed by CPW, JGFD and SUWRMD during aerial surveys dropped from 749 mature bulls in 2006, to only 255 mature bulls in 2013.

These figures point to a significant decline in the proportion of mature bulls in the regional elk herd. Recruitment of spike bulls into the population has actually increased in recent years, so the only conclusion is that the bull elk segment of the migratory elk herd has been significantly over-harvested in recent years. The JAR and SUIR together account for less than 10% of the total bull harvest in the CPLA Project Area. The bulk of the bull harvest occurs during state jurisdiction hunts; split almost equally between CO (42%) and NM (41%). Both jurisdictions harvested approximately 2,000 bull elk in 2013. In NM bull elk harvest increased by 52% from 2009 to 2013, and in CO bull harvest increased by 41% from 2010-2013. Based on population estimates generated by NMDGF and CPW, approximately 48% of the bulls were being harvested each year from 2008-2011. These unusually high harvest rates were driving the significant declines in bull:cow ratios, mature bull:cow ratios, and numbers of bulls observed in the migratory elk herd within the CPLA Project Area. If the current trend continues, even greater declines can be expected.

The consistent, long-term decline in calf:cow ratios and the increased average age of cows harvested indicated reduced productivity in the elk herd inhabiting the CPLA Project Area. Current calf recruitment rates were at, if not below, the level needed to sustain the elk population. If the current recruitment rate is only sufficient for a stable elk herd, then continued harvest of cow elk will precipitate a further decline in elk numbers. Although cow harvest levels have stabilized in 3 of the 4 jurisdictions in recent years, cow harvest in the NM GMU's has doubled since 2008; and accounted for 56% of the total cow harvest in 2013.

The declining recruitment rates, increased average age of cows harvested, and declining bull:cow ratios characterize an elk herd that is in decline, and is being overharvested. Both states wildlife agencies, which account for most of the elk harvest in the shared population, manage their respective portions of the migratory herd for maximum opportunity. If current harvests levels and trends in harvest continue, further declines in elk numbers, bull:cow ratios and bull numbers can be expected. This will in turn have adverse impacts on hunter success.

Recommendations for Landowners

Landowners within the CPLA Project Area interested in managing their lands for wildlife can implement a number of habitat improvements to specifically benefit mule deer and elk. Some of the recommended practices are outlined below.

Water Distribution- Maintaining a good distribution of water sources benefits all wildlife, including mule deer and elk. Good water distribution optimizes habitat use by spreading animals across the landscape, prevents overgrazing near water sources, and reduces the distance animals must travel to water, which minimizes exposure of calves/fawns to predation. In areas without perennial water sources construction of ponds to catch run-off waters is a common technique for providing water. Maintaining approximately 4 reliable water sources per square mile is recommended. Ponds should be as large and deep as possible to hold water during drought conditions.

Forage-Providing suitable forage for mule deer and elk can hold them on a property. Since the majority of the lands within the CPLA Project Area function as summer range, maintaining adequate forage during summer is most important. Elk are primarily grazers, and utilize the same grasses as cattle. Standard range recommendations are to harvest a maximum of 35% of the annual production of grass. Another 15% is lost to trampling and insects, for a maximum of 50% utilization. Harvesting more than 50% of the annual production of grass reduces plant vigor and leads to decreased plant diversity and productivity. If livestock grazing is being used, allocate a portion of the forage for elk, while still maintaining a maximum of 35% utilization. Too many properties graze most of the available forage with livestock; then assume elk and deer can get by on what's left. Limiting livestock grazing can be beneficial to elk, overgrazing is obviously detrimental. Elk also tend to avoid areas heavily used by livestock. Rotating cattle among available pastures to always have cattle-free pastures can keep elk from vacating a property. Any grazing plan needs to be flexible enough to allow for de-stocking when range conditions deteriorate or seasonal drought limits grass production. Supplemental feeding livestock during drought only exacerbates overgrazing and range deterioration.

Grass production can be improved by reseeding deteriorated ranges, controlling noxious weeds, and thinning forests. In the CPLA Project Area Aspen forests have the best understory of grasses and forbs. Open Ponderosa Pine stands can also be productive, but overgrown

stands, dominated by small-diameter trees, provide little understory production. Mixed-conifer stands have the lowest understory production. Thinning or patch cuts in Ponderosa Pine and mixed conifer stands can increase forage production for both elk and mule deer. Aspen regeneration cuts can substantially increase browse and primary forage for mule deer and elk.

Mule deer rely on browse for the majority of their dietary intake, year-round. They will eat a wide variety of forbs if available during spring and early summer, and some emerging grasses, but providing good browse is fundamental to maintaining deer numbers. On summer range mule deer will eat snow berry, Utah service berry, mountain ceanothus, Gambel oak, antelope bitterbrush and mountain mahogany, among other species. On winter range, antelope bitterbrush, mountain mahogany and sagebrush comprise the bulk of their diet in this region. One of the best ways to increase shrub production is to open forest canopies with thinning or patch cuts. Periodic burning in established brush stands can also stimulate new production; especially in Gambel oak. Acorns produced by Gamble oak are also a good source of food for mule deer in late summer/fall.

Fencing-Fences can provide significant barriers to elk and mule deer movements; both on a daily basis when moving to forage and water sources, or during biannual migrations. There are innumerable barbed-wire fences between summer range and winter range that migrating animals must cross each year. The most common problem is animals catching their feet between the top 2 wires when jumping a fence. The following practices can minimize the loss of deer and elk to fences and ease their movements across the landscape.

- Remove all unnecessary fences, gather up old wire
- Use lay-down fences whenever possible; leaving them down during spring and fall migration
- Modify all barbed-wire fences with the bottom wire at least 16 inches above the ground; at least 12 inches between the top 2 wires, and no more than 40 inches total height
- Identify frequently used crossing points and install wood or pipe crossing structures; or place white PVC along the top wire to improve visibility
- On barbed wire fences, twisting the top 2 wires together at frequently used crossings reduces fence height and minimizes animals becoming entangled
- Use smooth wire wherever possible
- Avoid using large ornamental board fences

Disturbance-Assuming that keeping mule deer and elk on your property is a priority, minimizing disturbance during peak activity hours can minimize displacement of animals. This is especially true during intensive activities such as logging, road construction, or energy development. Restrict access to the hours of 10:00 am-4:00 pm. If logging or drilling is being done, restrict activities to single units within the ranch, maintaining areas where animals can move to and avoid disturbance. If possible, on summer range have activities conducted after animals migrate to winter range, or during winter.

Predators- Fawn production and survival is essential for a healthy deer population. Fawn production/survival is governed by habitat quality, annual variations in forage production (which is dependent on precipitation), and predation. The one part of this system that we can impact is the loss of fawns to predation. Implementing an annual trapping program to reduce predator numbers prior to fawning can effectively increase fawn survival. Encouraging mountain lion hunting can reduce lion predation on both fawn and adult mule deer. Cooperation among adjacent ranches can facilitate both trapping and lion hunting efforts. These practices are effective only if implemented annually as part of the ranch management program.

Harvest Management- One of the important findings from the telemetry studies is the high degree of fidelity mule deer and elk exhibit to their summer range. That means that animals born on a property will return there every year if they survive. This has important implications for managing animals. First, any increase in numbers on a given property will have to come from the existing animals; it is highly unlikely that improvements to habitat will pull animals from other properties. That is why maximizing survival of fawns and calves born on a property is critical to increasing deer or elk numbers. Secondly, since bucks and bulls will also return to their summer range every year, not harvesting the younger animals will allow them to mature and grow to their genetic potential (assuming they are not harvested when they leave the property). Unfortunately the migratory nature of the elk and mule deer in the CPLA Project Area makes this a questionable gamble. The size of the property, and where the animals migrate and winter, will determine if a conservative harvest strategy pays off for individual landowners.