

KIOWA PRONGHORN HERD MANAGEMENT PLAN

**DATA ANALYSIS UNIT PH-35
Game Management Units 104 & 105**



**Heather Halbritter
Colorado Parks and Wildlife
Terrestrial Biologist
6060 Broadway
Denver, CO 80216**

Approved by the Colorado Parks & Wildlife Commission, November 2012

DAU PH-35 (Kiowa)

Executive Summary

GMUs: 104 and 105

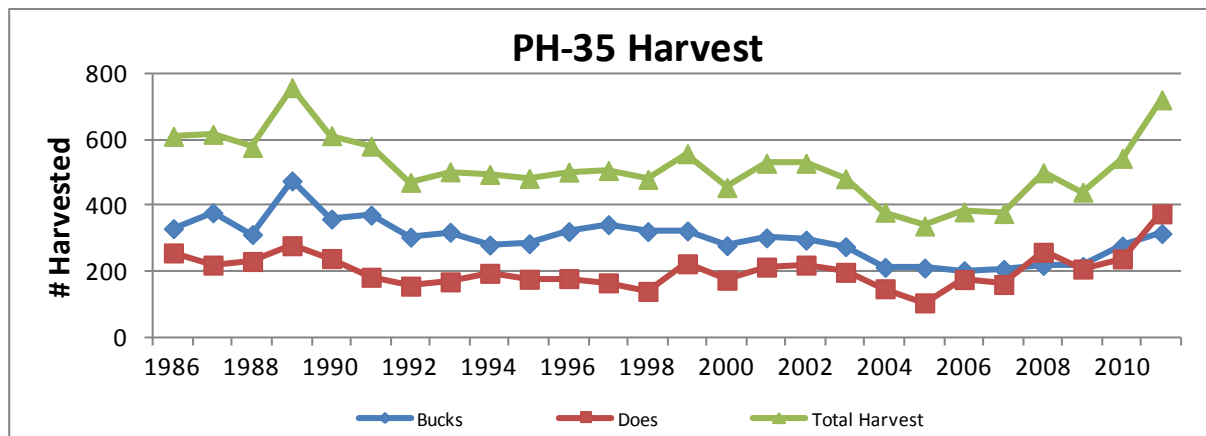
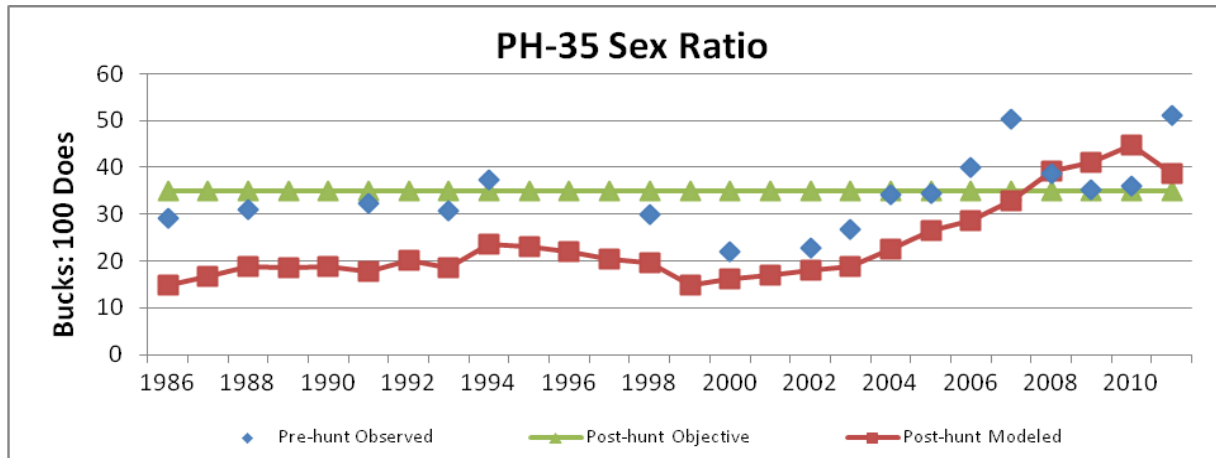
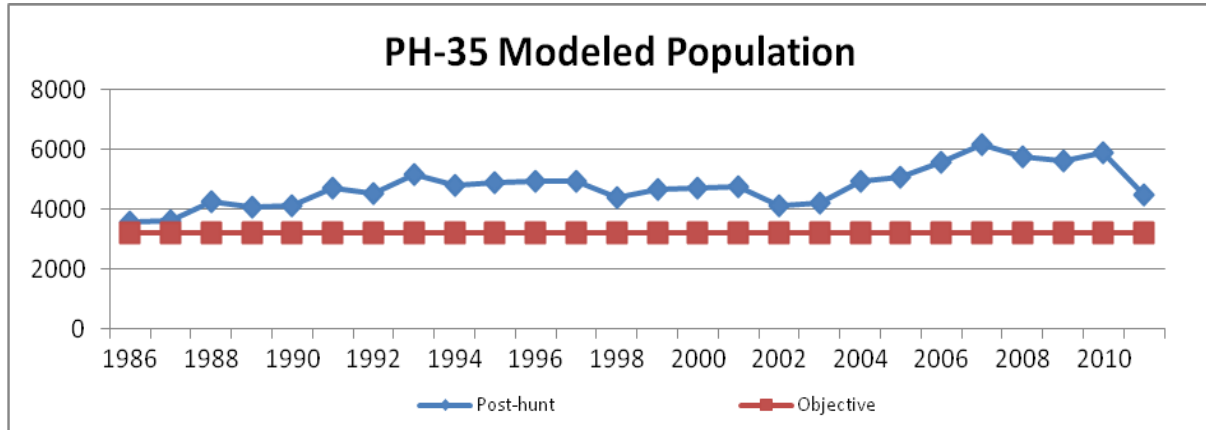
Land Ownership: 8,194 square miles (97% private, 2% State Land Board)

Posthunt Population: Previous Objective 3,200 2011 Estimate 4,477

Current Objective 4,000-5,000

Posthunt Sex Ratio: Previous Post-hunt Objective 35 2011 Pre-hunt Observed 51

Current Post-hunt Objective 30-35 2011 Post-hunt Modeled 39



Background

PH-35 contains Game Management Units (GMU) 104 and 105. Historically this Data Analysis Unit (DAU) included GMU 51, however due to urban development there are very few, if any, pronghorn left there. PH-35 covers parts of Douglas, Elbert, Arapahoe, and Adams Counties. The habitat is primarily shortgrass prairie with cottonwood-willow riparian habitat in water drainages, scattered oakbrush shrublands, open ponderosa pine forests, and cultivated croplands. Much of the northwest part of the DAU is urban, including the cities of Denver and Aurora, with many suburban/exurban developments. Most of the suitable pronghorn habitat is on privately owned land, and there is no hunting allowed on limited public lands in GMU 104 and 105.

The current population and sex ratio objectives are 3,200 pronghorn and 35 bucks: 100 does. The 2011 post-hunt population estimate in PH-35 is about 4,477 pronghorn and post-hunt modeled sex ratio is 39 bucks: 100 does. The use of a new population estimation survey technique in 2008 and 2010 indicated the population was actually larger than had previously been modeled. Incorporation of the new population data further refined the PH-35 population model indicating reevaluation of the population objective relative to updated population estimates was needed.

Significant Issues

Urban encroachment has impacted pronghorn habitat in this DAU. A large amount of formerly occupied habitat has been lost or fragmented to the point that it supports few or no pronghorn. Habitat loss and fragmentation has primarily impacted GMU 104, where the density of pronghorn has decreased, and occupied habitat has shifted to the east over the past several years.

In recent years there has been concern with game damage complaints and although only 2 game damage payments have occurred in the past 14 years, every effort is made to mitigate damage prior to paying for it. Several damage/dispersal hunts are conducted each year to help alleviate conflicts with pronghorn on private lands. In 2012, late season doe hunts will be implemented as another tool to address game damage.

Management Alternatives

The current 2011 post-hunt population estimate is 4,477 animals with a modeled post-hunt ratio of 39 bucks: 100 does. Three alternative population and sex ratio objectives are being considered for PH-35.

Population Objective Alternatives:

Alternative 1: 3,000-4,000 (contains previous objective; ~25% reduction from current estimate)

This alternative would be a decrease from the current population estimate and initially provide greater hunter opportunity with increased licenses until the objective was reached.

Alternative 2: 4,000-5,000 (contains current estimate)

This alternative would be consistent with the current population estimate and would reflect similar license trends.

Alternative 3: 5,000-6,000 (~ 20% increase from current estimate).

This alternative would be a 20% increase from the current population estimate and there would be a reduction in licenses initially to allow the population to reach this level.

Herd composition- Post-hunt Sex Ratio Objective Alternatives:

Alternative 1: 25-30 bucks: 100 does

This alternative is a significant reduction from the current estimate and slightly lower than the current objective.

Alternative 2: 30-35 bucks: 100 does (contains current objective)

This alternative contains the current objective at the upper end of the range and would be a decrease from the current composition status.

Alternative 3: 35-40 bucks: 100 does (contains current objective and 2011 post-hunt estimate)

This alternative contains the current objective at the lower end of the range and the current composition status.

Preferred Alternatives

Population Alternative #2: 4,000 – 5,000

Composition Alternative #2: 30 – 35 bucks: 100 does

Considering that the majority of public comment supported status quo, recent wildlife damage concerns, and revised population estimation methods, it is recommended to maintain the population at or slightly below the current estimate. Although localized game damage issues may still occur in dry years, damage/dispersal hunts can be conducted to help alleviate these concerns. The recommended composition alternative is below the current post-hunt sex ratio, but represents a more realistic and sustainable management objective.

KIOWA PRONGHORN HERD MANAGEMENT PLAN

Data Analysis Unit (DAU) PH-35
Game Management Units (GMU) 104 & 105

TABLE OF CONTENTS

Executive Summary.....	ii
Introduction and Purpose.....	1
Description of DAU.....	3
Location.....	3
Climate.....	5
Vegetation and Habitat Use.....	5
Landownership.....	8
Herd Management History.....	10
Population Size.....	10
Herd Composition.....	11
Harvest.....	13
Hunters.....	14
Current Herd Management.....	15
Current Post-hunt Population.....	15
Current Composition.....	15
Current Management Strategies.....	15
Game Damage.....	16
Management Issues and Strategies.....	16
Development of Management Alternatives.....	17
Preferred Objectives and Alternatives.....	18
Literature Cited.....	19
Appendix A: Public Input Questionnaire.....	20
Appendix B: Population Dynamics Review.....	25

INTRODUCTION AND PURPOSE

Colorado Parks and Wildlife (CPW) manages wildlife for the use, benefit and enjoyment of the people of the state in accordance with the CPW's Strategic Plan and mandates from the Parks and Wildlife Commission and the Colorado Legislature. Colorado's wildlife resources require careful and increasingly intensive management to accommodate the many and varied public demands and growing impacts from people. To manage the state's big game populations, the CPW uses a "management by objective" approach (Figure 1). Big game populations are managed to achieve population objective ranges and sex ratio ranges established for Data Analysis Units (DAUs).

COLORADO'S BIG GAME MANAGEMENT BY OBJECTIVE PROCESS

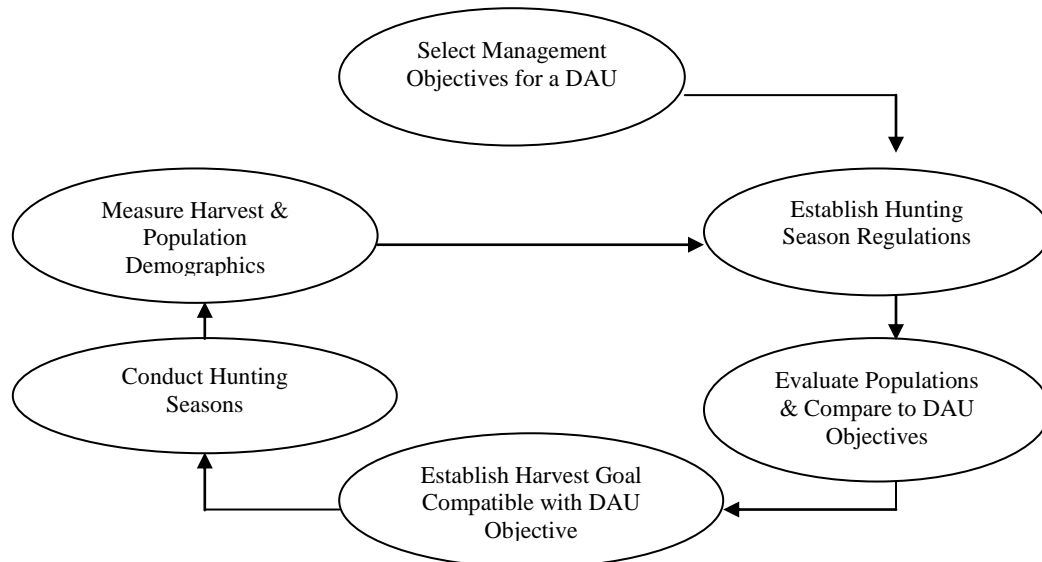


Figure 1. Management by objectives process used by the CPW to manage big game populations on a DAU basis.

The purpose of a DAU plan is to provide a system or process which will integrate the plans and intentions of CPW with the concerns and ideas of land management agencies and interested publics in determining how a big game herd in a specific geographic area, DAU, should be managed. In preparing a DAU plan, agency personnel attempt to balance the biological capabilities of the herd and its habitat with the public's demand for wildlife recreational opportunities. Our various publics and constituents, including the U.S. Forest Service, the Bureau of Land Management, hunters, guides and outfitters, private landowners, local chambers of commerce and the general public, are involved in the determination of DAU population and herd composition objectives and related issues. Public input is solicited and collected by way of questionnaires, public meetings and comments to the Parks and Wildlife Commission.

A Data Analysis Unit or DAU is the geographic area that represents the year-around range of a big game herd and delineates the seasonal ranges of a specific herd while keeping interchange with adjacent herds to a minimum. A DAU includes the area where the majority of the animals in a herd are born and raised as well as where they die either as a result of hunter harvest or natural causes. Each DAU usually is composed of several game management units (GMUs), but in some cases only one GMU makes up a DAU.

The primary decisions needed for an individual DAU plan are how many animals should exist in the DAU and what is the desired sex ratio for the population of big game animals e.g., the number of males per 100 females. These numbers are referred to as the DAU population and herd composition objectives, respectively. Secondly, the strategies and techniques needed to reach the population size and herd composition objectives also need to be selected. The selection of population and sex ratio objectives drive important decisions in the big game season setting process, namely, how many animals need to be harvested to maintain or move toward the objectives, and what types of hunting seasons are required to achieve the harvest objective.

DESCRIPTION OF DAU PH-35

Location

The Kiowa pronghorn DAU encompasses an area of 8,194 square miles in east-central Colorado and is bordered by I-25 to the west and I-70 to the east out to the town of Limon (Figure 2). The southern boundary is the Elbert-El Paso County line and U.S. Hwy 24. The DAU encompasses parts of Adams, Arapahoe, Douglas, and Elbert counties. PH-35 is comprised of GMU's 104 and 105. Historically GMU 51 was included in this DAU, however pronghorn use and available habitat in this GMU has declined in recent years and can no longer sustain a viable population. In addition to much of the Denver metropolitan area and the Denver International Airport, this DAU includes the towns of Castle Rock, Kiowa, Elizabeth, Parker, Bennett, Deer Trail, and Agate.

The topography in PH-35 is primarily relatively flat prairie of the high plains. I-25 comprises the western boundary and there are several small tributaries that flow from the mountains and foothills into the river. Cherry Creek is the largest tributary in this DAU that supplies water to reservoirs near Denver. Most of the waterways to the east are intermittent, but several creeks that feed into the South Platte River are important influences on topography, habitat and land use patterns in the area. East, West, and Middle Bijou creeks, Kiowa creek and Box Elder creek are several drainages that generally flow north to south throughout the DAU.

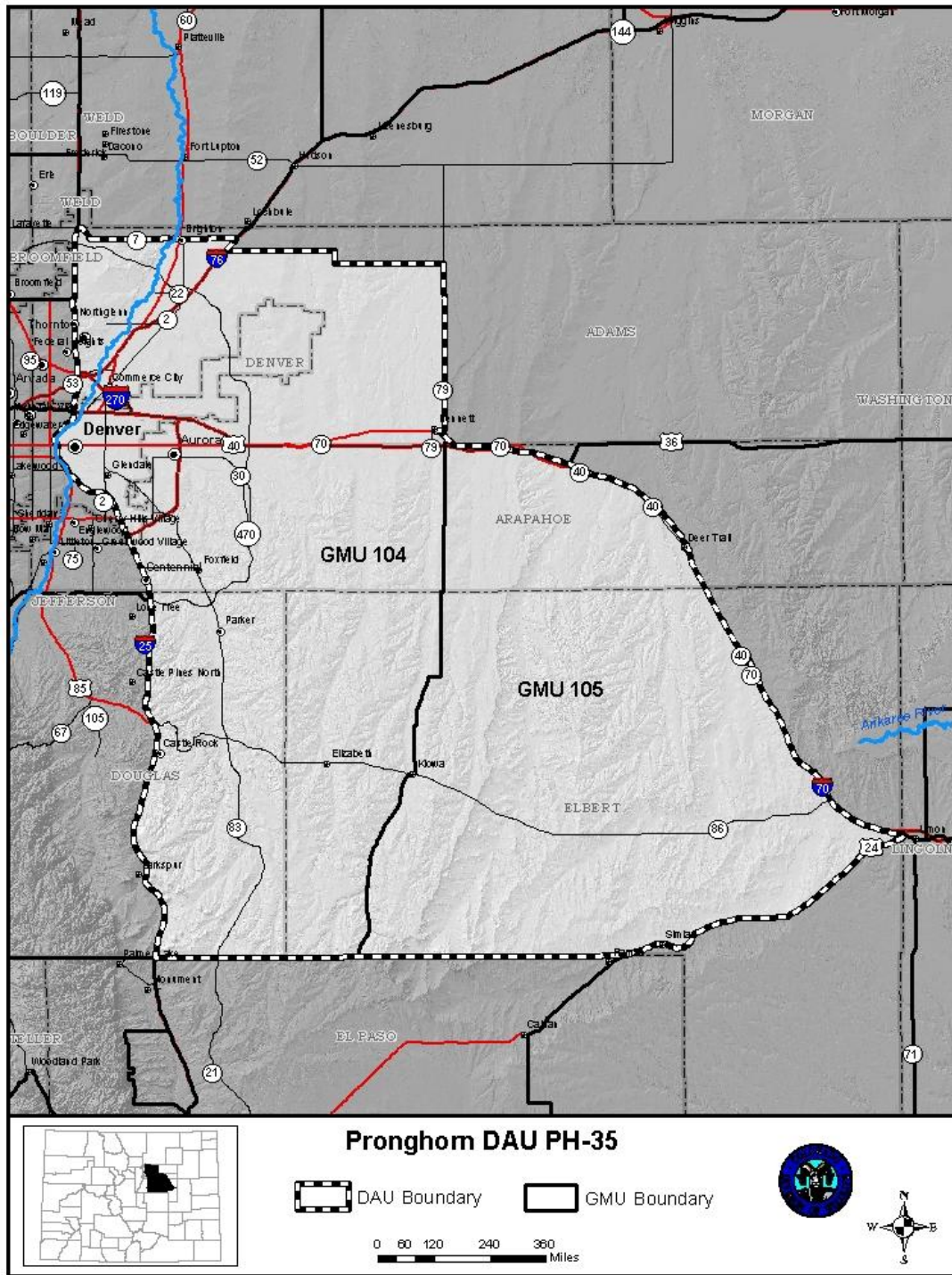


Figure 2. PH-35 Geography and GMU Boundaries

Climate

Climate on the eastern plains in PH-35 is semi-arid, with average annual precipitation of approximately 14 to 18 inches per year. Typically there are a few large snow events, mostly in the late winter or early spring. The snowiest months are March and April. A wide range of temperatures and conditions can be experienced during the winter. Warm sunny days are not uncommon, but severe winter storms can occur.

Blizzards often have little impact on pronghorn survival if warm sunny weather allows rapid snowmelt. However, if multiple storms and/or prolonged cold weather follow a storm, negative impacts on pronghorn survival may occur. Such a situation occurred in the winter of 2006-07, when multiple snowstorms were followed by prolonged cold temperatures.

Summers in this area tend to be hot and dry. Summer days are often hot, with daily high temperatures reaching the mid- to upper-90s. Daily monsoon rains as afternoon thundershowers are not unusual, but this pattern does not occur in all years. Seventy to eighty percent of annual total precipitation falls during the period of April through September (<http://ccc.atmos.colostate.edu/climateofcolorado.php>).

Vegetation and Habitat Use

There are several habitat types in the Kiowa Creek DAU, including urban, shortgrass prairie, ponderosa pine woodland, cottonwood-willow riparian, dryland agriculture, and irrigated agricultural. In the eastern part of the DAU the most common habitat type is shortgrass prairie interspersed with ephemeral streams supporting cottonwood –willow riparian habitat. In the southwest portion of the DAU there is a mix of mid-elevation grasslands, shrubs such as scrub-oak and mountain mahogany, and open ponderosa pine forest. The northwest part of the DAU is urban, including the Denver metropolitan area and surrounding areas.

The majority of the pronghorn within this DAU are concentrated in the open grasslands in GMU 104 and 105 (Figure 3). Most of the pronghorn in GMU 104 are in the eastern half of the GMU where there is less development. This pattern of pronghorn distribution has become more obvious over the years as development has occurred at an increasing rate and spread farther to the east of Denver. Most of the suitable pronghorn habitat is on privately owned land.

CPW conducted a study from 2005-2007 in which a total of 78 doe pronghorn were radio-collared within the boundaries of DAU PH-35. Locations from radio-telemetry data provided some valuable information on pronghorn movement and survival rates. Highway 24 is the southern boundary of the DAU and data has shown it may not be enough of a physical barrier to prevent movement in and out of the DAU, especially during periods of severe winter weather. The winter of 2006-2007 was unusually cold and experienced heavy snowfall which resulted in high mortality and unusual movements of collared pronghorn. Almost half of the marked pronghorn left the DAU during this bad winter and some moved as far away as GMUs 118 and 119, located south and

southeast of Colorado Springs. Survival rates of those collared animals that left the DAU that winter were greater than those that stayed within the DAU boundaries. Pronghorn that stayed within the DAU had a 68% survival rate whereas those that left the DAU had a 97% survival rate. The majority of collared pronghorn did stay within the DAU for the first 2 years of the study, however during the winter of 2006-2007 greater movements were recorded, likely due to the snow depth in the western part of PH-35.

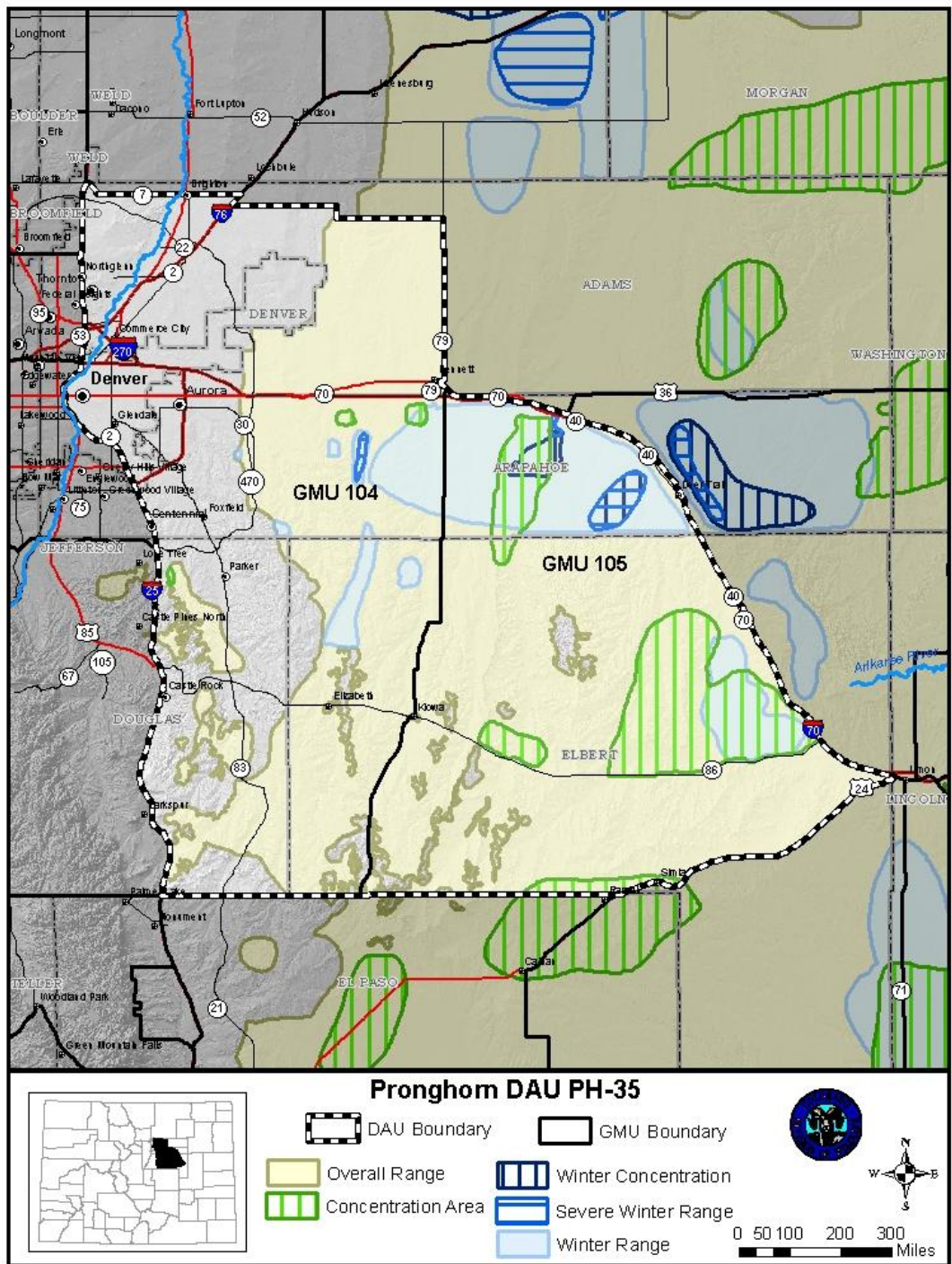


Figure 3. PH-35 Pronghorn Habitat

Land Ownership and Use

PH-35 covers over 2.5 million acres and 97% is private land (Figure 4). Two percent is state owned property scattered throughout the DAU with the majority of it belonging to the State Land Board. Much of GMU 104 is densely populated metropolitan land, especially the central-western part of the unit which includes Denver and associated suburbs. Recent development has extended from Denver and has reduced or fragmented pronghorn habitat, particularly to the south and east of the metro area. The unit also includes lower density residential developments around Parker, Elizabeth, and Castle Rock that are experiencing increasing residential and commercial development. Portions of GMU 104 farther away from Denver are used for grazing or cropland. Land use in GMU 105 is primarily ranching and farming, although residential development has increased in parts of GMU 105. Winter wheat is the primary agricultural crop grown in PH-35 with sunflower, grass hay/alfalfa, corn, and safflower comprising the majority of other crops. Recently wind energy projects have been proposed to the east of the DAU and it is possible that wind energy will eventually be developed within GMU 105.

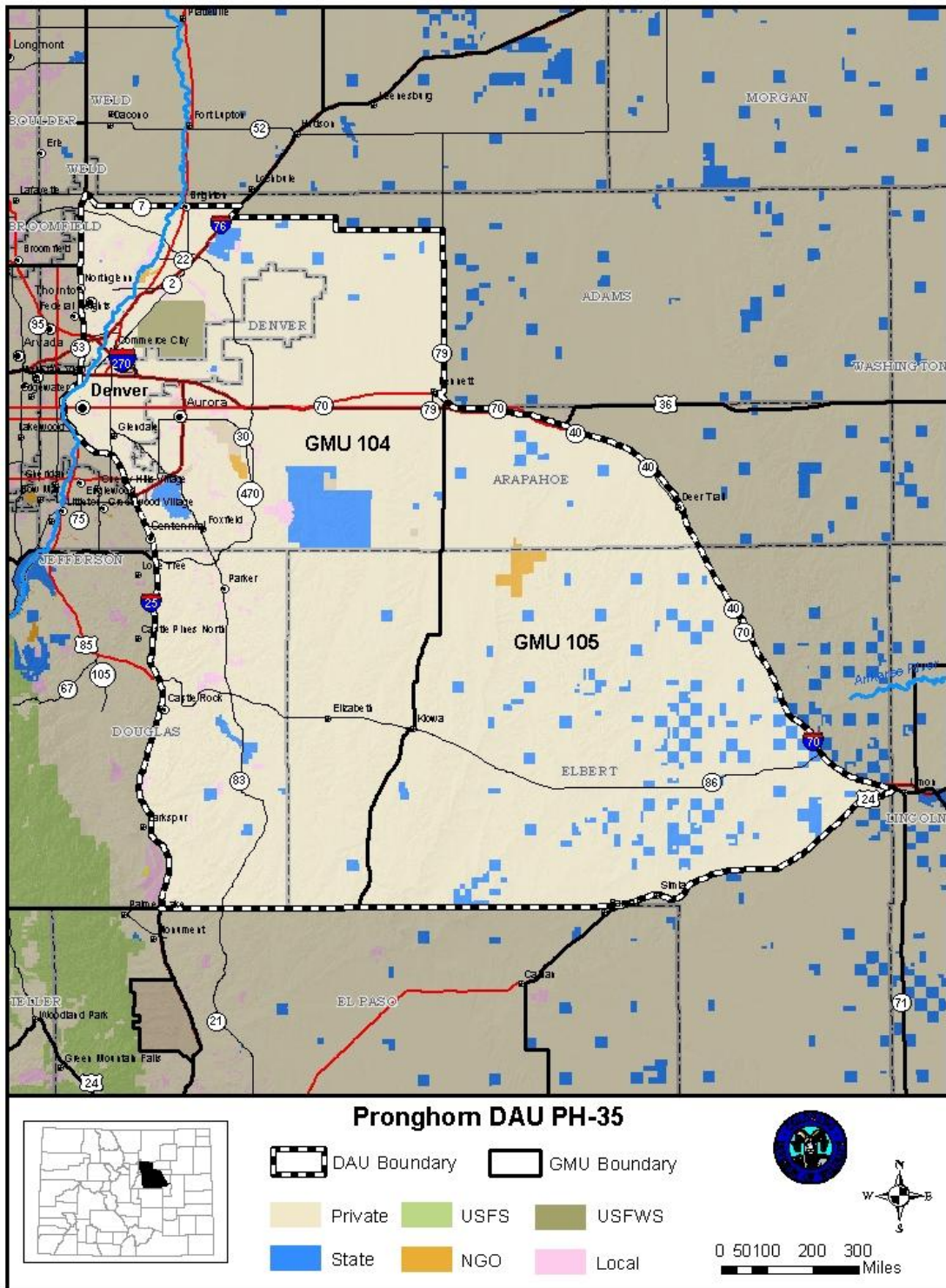


Figure 4. PH-35 Land Ownership

HERD MANAGEMENT HISTORY

Population Size

Estimating population numbers of free-ranging wildlife over large geographic areas is a developing science. Numerous studies have been conducted in closed settings, with known numbers of animals available to be counted by surveyors and in all cases only a portion of the animals were actually counted. The CPW recognizes that providing precise and accurate estimates of Colorado's wildlife populations is a difficult and challenging task. As new techniques in estimation and modeling become validated, and as new data and survey methods provide better estimates of population parameters, CPW will strive to integrate these changes into management strategies and protocols. It is important to note that any time population estimation or herd composition survey protocols are changed; these adjustments may result in significant changes in the parameter being measured. These changes typically will be a product of the technique used, not a real change in the parameter of interest. Numbers presented in this document should be considered as estimates with variability, and therefore should be viewed over time and not as absolutes.

In recent years a new method was developed to estimate pronghorn population numbers while providing an estimate of precision. Distance sampling is a widely used method for sampling the abundance of various wildlife species and relies on the principle that animals are more likely to be seen if they are closer to an observer than if they are farther away. Aerial line transect sampling is one type of distance sampling that has been developed specifically for estimating populations of pronghorn (Johnson et al. 1991, Johnson and Lindzey 1990, Guenzel 1997). Application of this new population survey method within PH-35 in 2008 and 2010 indicated the pronghorn population was larger than previously modeled. The addition of new population data was used to further refine the PH-35 population model and to reevaluate the current population objective. The current objective of 3,200 was selected without the benefit of recent distance sampling based population estimates and as a result comparisons of the current objective and the current model estimates should be viewed on a relative basis.

Based on the newly refined population model, the pronghorn population in PH-35 has ranged from a low of approximately 3,400 in 1986 to a high of approximately 6,300 in 2007 and recent population estimates are just below 4,500 (Figure 5). The population has remained relatively stable until around 2003 in which it began to increase until 2007. In recent years there has been a slight decline in the population and last year there was a sharp decline likely related to low fawn recruitment brought on by a significant drought across the eastern plains.

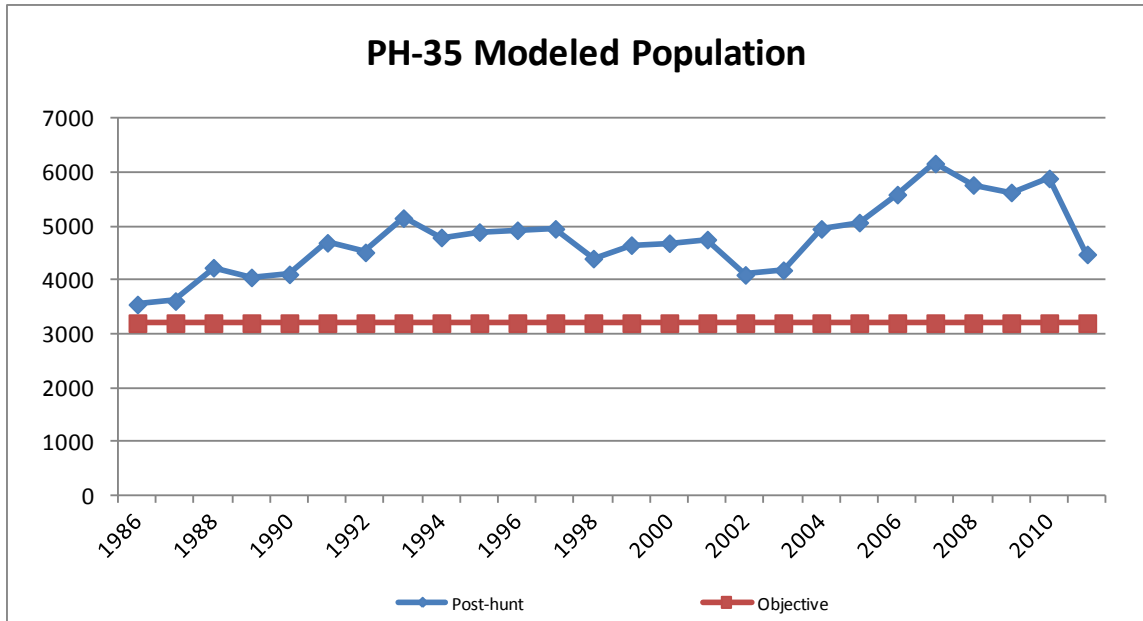


Figure 5. PH-35 Posthunt Population Estimate

In 1994 a population estimate obtained from quadrant sampling estimated the population at 5,889 animals. In 2008 and 2010 distance sampling using the aerial line transect method was used to estimate the pronghorn population in PH-35. Those two estimates were similar with an estimate of 6,275 in 2008 and 5,753 in 2010. These estimates showed that previous modeling efforts underestimated the number of pronghorn in PH-35.

Herd Composition

Sex and age ratios are estimated by fixed-wing line transect surveys, typically conducted every year in late July or early August. The post-hunt sex ratio objective is currently 39 bucks per 100 does. Observed sex ratios have been as low as 22 bucks: 100 does and as high as 51 bucks: 100 does in 2011 (Figure 6).

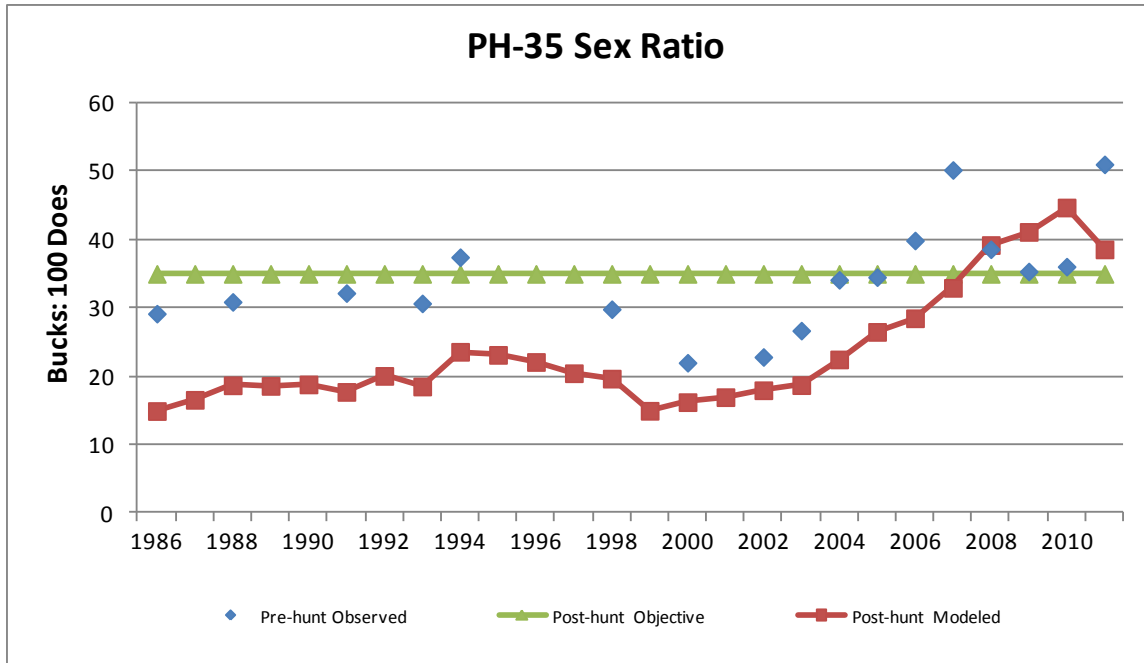


Figure 6. PH-35 Sex Ratio

Observed fawn:doe ratios have varied from a high of 72 fawns: 100 does in 1993 to a low of 27 fawns: 100 does in 2002 and again in 2011 (Figure 7). A severe drought in the early 2000's is thought to have been a factor in the unusually low fawn ratios in 2002 and 2003. Fawn recruitment improved, as indicated by higher observed ratios from 2005–2007, however drought conditions returned in 2011 again resulting in low fawn recruitment.

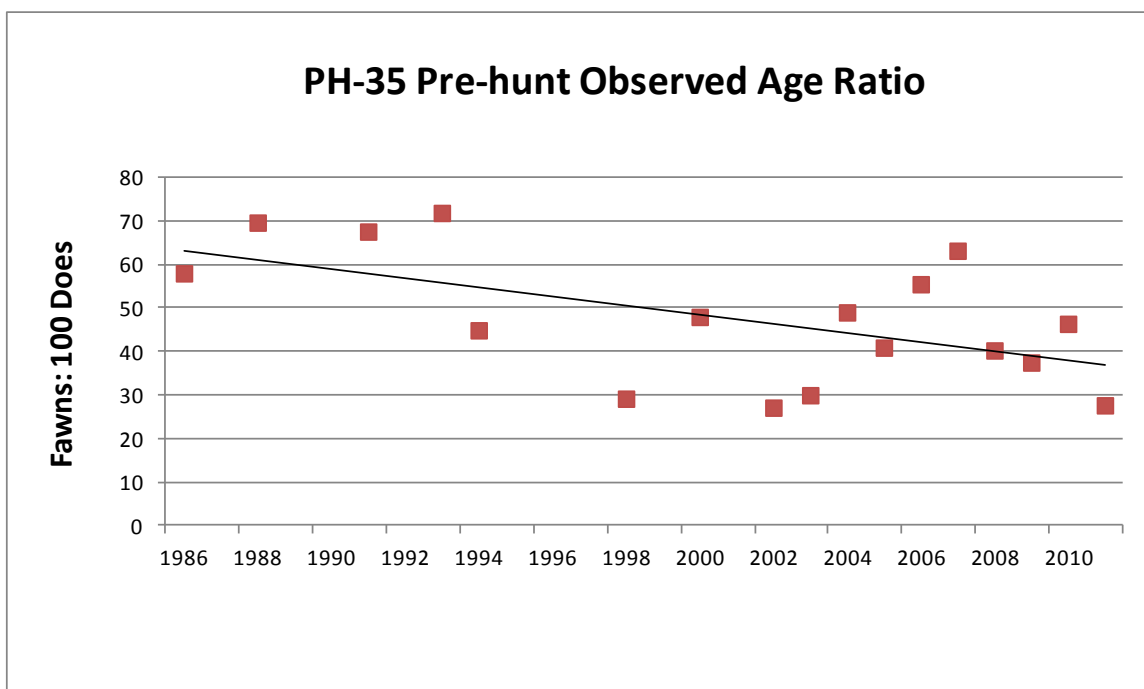


Figure 7. PH-35 Pre-hunt Age Ratio

Harvest

In the last 25 years, harvest has ranged from a high of over 750 pronghorn in 1989 to fewer than 350 in 2005 (Figure 8). This is somewhat reflective of the number of licenses available for the DAU. Average harvest was 469 pronghorn over the past 10 years and 517 since 1986, and the most recent harvest in 2011 was a total of 722 pronghorn. Buck harvest ranged from 475 bucks in 1989 to only slightly over 200 bucks in 2006. Average buck harvest was 242 for the past 10 years and 297 since 1986. Buck harvest in 2010 and 2011 was at 277 and 315, respectively, and reflected the increase in license numbers. Prior to that rifle buck license numbers remained unchanged from 2004 until 2010. Doe harvest has ranged from a low of 128 in 2005 to a high of 375 in 2011. Since 2008 doe harvest has increased due to the increased number of licenses as management has focused at reducing the herd size.

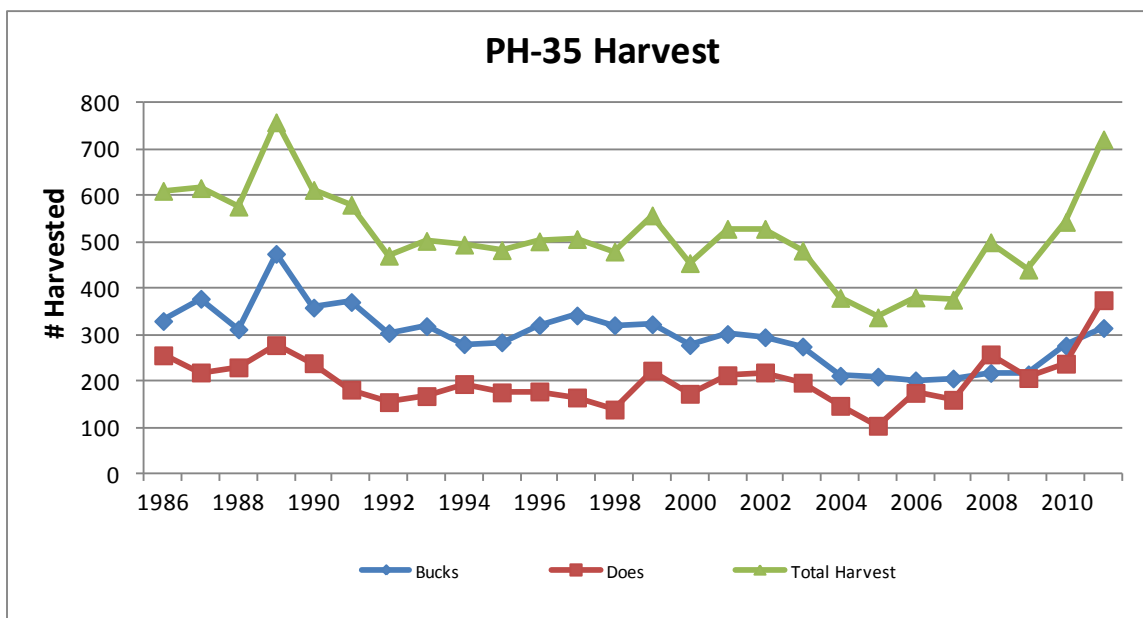


Figure 8. PH-35 Harvest

GMU 104 and 105 have been limited license units for rifle hunters since there has been an open season. Archery hunting in the entire DAU is unlimited during the statewide archery season. Limited muzzleloader hunting licenses were statewide until 2006. Limited licenses for muzzleloader specific to DAU PH-35 have been in effect since 2007.

In addition to a limited number of licenses available, hunter distribution and participation is also limited by access, as all hunting is by permission on private or State Land Board property. Areas open to hunting will probably continue to decline with increasing housing developments on small acreages, especially in GMU 104.

All limited licenses sell out before they go to leftover so although there are limitations with hunting on private land, it appears that hunters are able to gain access to private property and use the licenses that are available. Large tracts of land are leased for pronghorn hunting and the DAU attracts pronghorn hunters who are willing to pay for access to private land.

Hunters

PH-35 is a popular unit because of the close proximity to major urban areas of the Front Range. The number of hunters has ranged from over 900 in 1999 to fewer than 600 in 2005 (Figure 9). Doe licenses can be drawn with no preference points. The number of preference points required to draw a buck license has increased in recent years. Only 1 preference point was required to draw a rifle buck license for either GMU 104 or 105 until 2004. A GMU 104 and 105 buck license currently requires 2 preference points.

Harvest success rates, calculated by the number of pronghorn harvest divided by the number of hunters, have exhibited a slightly increasing trend over the last 14 years (Figure 10). PH-35 success rates by method are similar to other units statewide with buck rifle success ranging from a low of 67% in 2002 to a high of 97% in 2010. Doe rifle success has always remained lower and has ranged from 46% in 2000 to 76% in 2008.

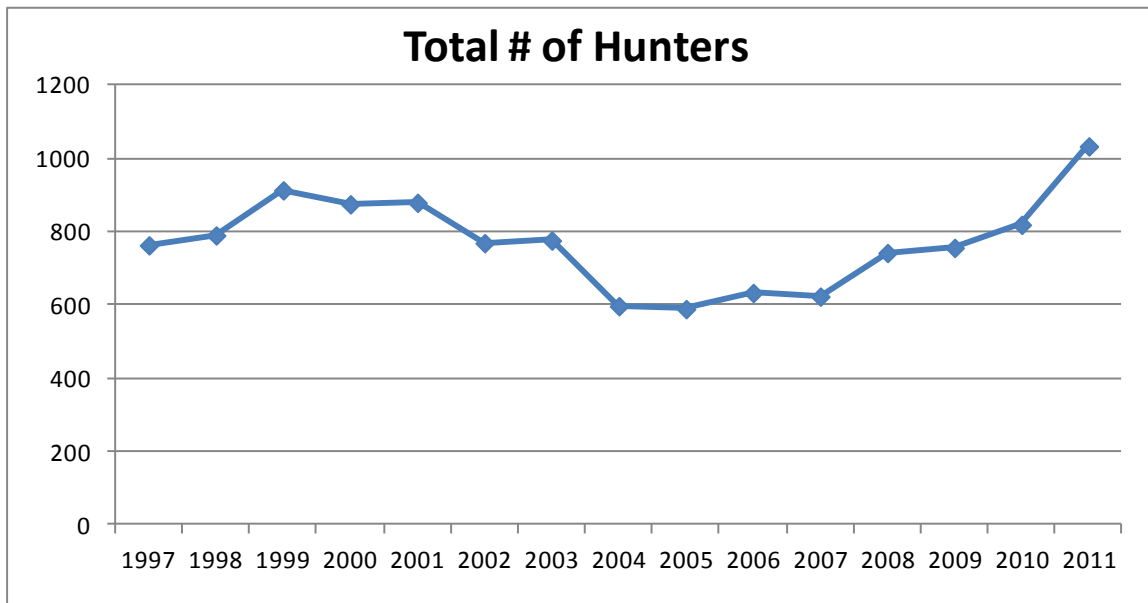


Figure 9. Total Number of Hunters in PH-35

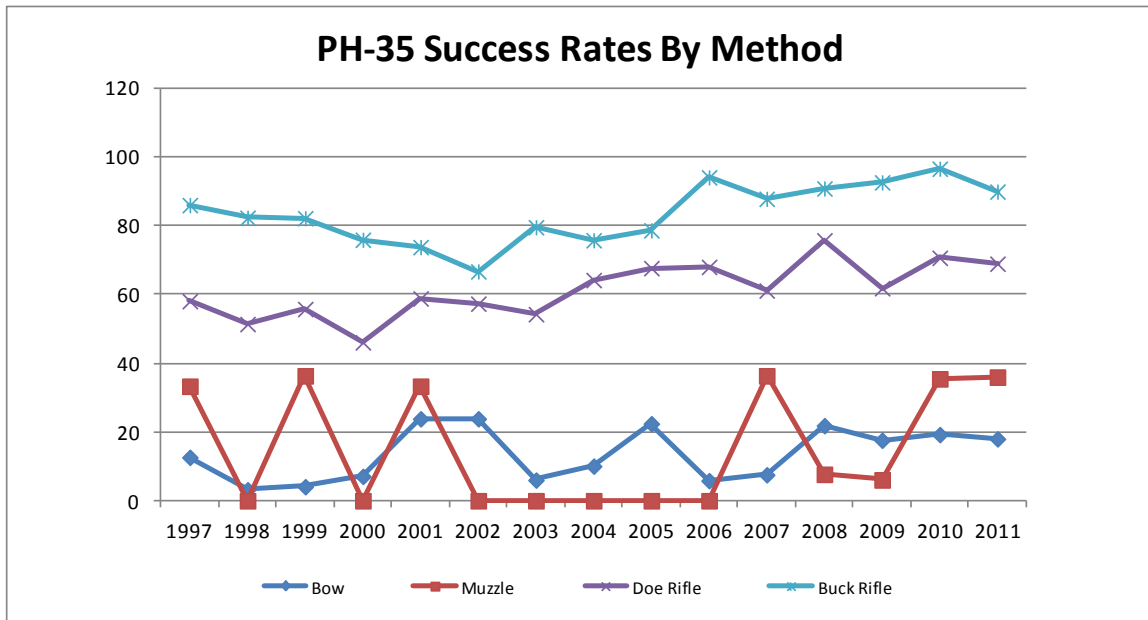


Figure 10. Success Rates by Method in PH-35

CURRENT HERD MANAGEMENT

Current Post-hunt Population

The 2011 post-hunt estimate for PH-35 was approximately 4,477 pronghorn, which is above the current population objective of 3,200 pronghorn. This population estimate is based on the PH-35 population model along with observed data from aerial inventories. As previously discussed, new aerial population survey methods employed in 2008 and 2010 indicated pronghorn numbers were greater than previously modeled. This new information was used to refine the population model resulting in higher population estimates.

Current Composition

Annual computer modeling estimates a 2012 pre-hunt sex ratio of 44 bucks: 100 does. The most recent 5-year average observed pre-hunt sex ratio (2009–2011) is 42 bucks: 100 does. The corresponding 5-year average modeled post-hunt ratio is 39 bucks: 100 does, which is slightly above the current composition objective.

Current Management Strategies

The management strategy for this DAU is to provide quality buck hunting opportunities while minimizing conflict between pronghorn and landowners. The refined population estimate for this DAU based on updated sampling techniques has shown the herd to be over the previous objective. License numbers have been increased with an emphasis on doe hunts and future management will focus on managing the herd to a level that is compatible with the ecological and sociological carrying capacity.

Game Damage

In recent years damage complaints have increased when pronghorn congregate on landowner properties resulting in reduced crop yield. Most complaints have been received due to large numbers of pronghorn damaging green wheat fields in the winter. Dry winter weather often contributes to these problems.

Pronghorn damage on winter wheat has primarily been addressed by hazing and conducting damage/dispersal hunts in late winter on specific properties where conflicts occur. The hunts are intended to disperse animals rather than harvest a large number of pronghorn. A late season doe hunt for GMU 105 was approved by the Parks and Wildlife Commission in 2012 to provide wildlife managers and landowners another option to redistribute and harvest pronghorn after the regular rifle season.

High concentrations of pronghorn in winter are part of normal seasonal movements and will occur regardless of the overall population size. Therefore, conflicts cannot necessarily be prevented by reducing the size of the pronghorn population and in many cases dispersal/damage hunts are the most effect way to specifically target conflicts.

MANAGEMENT ISSUES AND STRATEGIES

Issue Solicitation Process

The primary purpose of the DAU planning process is to determine population size and composition objectives. Input was solicited through a press release to local papers and the CPW website advertising a public meeting in Byers on August 18, 2011. A public survey was developed and handed out to meeting attendees (Appendix A). In addition to the public meeting, postcards with a link to the survey on-line, were mailed to a list of hunters who drew a license in GMUs 104 and 105 during the 2009 and 2010 season and also to landowners enrolled in the Big Game Priority Landowner Preference program. Paper surveys were provided for those who preferred not to complete the survey on-line. The deadline to complete the survey was October 15, 2011. The draft plan was also available on the CPW website in February 2012 for a 30 day public comment period.

The public meeting was attended by 8 individuals and 7 surveys were returned. Just over 1300 postcards were mailed to landowners and hunters informing them of the on-line survey. We received a total of 101 responses with 16 people requesting a paper survey be mailed to them.

Issue Identification

Survey results are mixed and reflect views from hunters, non-hunters, and landowners with varying amounts of acreage. Complete results of the survey are listed in Appendix A. Approximately 60% of respondents live within GMUs 104 and 105 and 48% (25 respondents) own, lease, or manage property there. Twenty-four landowners responding to this survey own at least 1 section (640 acres) or greater. Ninety percent of respondents hunt pronghorn within GMUs 104 and 105. The majority of the public responding to the

survey feels we should keep the pronghorn population at current levels and are satisfied with current management in regards to available buck licenses and number of hunters in the field. Twenty-one percent of respondents would like to see a slight increase in the number of pronghorn and 19% would like to see a slight decrease in the population.

Additional comments were provided on the management of pronghorn in this unit and several common themes are listed below:

- Would like to see an increase in the population
- Have seen an increase in the number of big bucks
- Would like to see an increase in the number of landowner vouchers
- Too much private land is being leased to outfitters
- Difficult to draw a license
- There are too many pronghorn
- Would like to see more access to private land
- Would like an increase in doe licenses

DEVELOPMENT OF MANAGEMENT ALTERNATIVES

Management Alternatives

Current 2011 post-hunt population estimate is 4,477 animals with a modeled post-hunt ratio of 39 bucks: 100 does. Three alternative population and sex ratio objectives are being considered for PH-35.

Population Objective Alternatives:

Alternative 1: 3,000-4,000 (contains previous objective; ~25% reduction from current estimate)

This alternative is approximately 25% lower than the current population estimate and contains the previous objective. Under this alternative there would initially be more opportunity to hunt, particularly for does, but after the population reduction, hunting opportunity would decrease in order to stabilize the population. Game damage issues may decrease at this population level. However, winter concentration will likely still occur and may result in localized conflicts especially during winter drought conditions.

Alternative 2: 4,000-5,000 (contains current population estimate)

The current population estimate is in the middle of this range and would reflect current management status with similar license numbers and hunting opportunity. Game damage concerns may be reduced at this slightly lowered population level compared to higher numbers in the recent past. However, winter concentration will likely still occur and may result in localized conflicts especially during winter drought conditions.

Alternative 3: 5,000-6,000 (~ 20% increase from current estimate)

This alternative would represent a 20% increase from the current population level and would result in a reduction in license numbers until the population reaches this level. Game damage concerns would continue with a pronghorn population at this level.

Herd composition- Post-hunt Sex Ratio Objective Alternatives:

Alternative 1: 25-30 bucks: 100 does

This alternative is a significant reduction of the current estimate. This would result in fewer bucks in the population and a smaller number of large mature bucks. Initially there would be an increase in the number of buck licenses issued, however, once the sex ratio reaches objective buck licenses, and thus hunting opportunity, will be reduced.

Alternative 2: 30-35 bucks: 100 does (contains current objective)

This alternative is equal to the current objective at the upper end of the range and would be a decrease from the current composition status. This objective will still provide some quality buck hunting opportunities and initially would require an increase in licenses until the sex ratio is brought down to objective. Preference points needed to draw a buck hunt would likely remain similar to current levels and may even decrease.

Alternative 3: 35-40 bucks: 100 does (contains current objective and 2011 post-hunt estimate)

This alternative is equal to the current objective at the lower end of this range and contains the current composition estimate at the higher end of this range. This objective may require a slight increase in buck licenses based on the desired population objective and preference point requirements would likely be similar or even decrease from current levels.

Preferred Alternatives

Post-hunt Population Level and Herd Composition-Sex Ratio Objective Alternative

Population Alternative #2: 4,000 – 5,000

Composition Alternative #2: 30 – 35 bucks:100 does

New survey techniques revealed that the population has been above the previous objective for several years and therefore the old objective of 3,200 is no longer relevant. The majority of the public preferred that the population remains at the current level, however, approximately 20% desired a decrease in the population and given the game damage concerns there is justification to maintain or slightly reduce the population. Population alternative #2 allows for a slight reduction in the current population and is a balance between managing wildlife damage conflicts and providing hunting opportunity

as desired by the public. Game damage can continue to be specifically targeted with hazing, dispersal hunts and late season doe hunts.

Composition alternative #2 is within range of the previous objective and reflects the public's desire to keep the sex ratio status quo. The current post-hunt composition estimate is above this alternative, however recent increases in doe licenses to bring the population down to a desired level has contributed in an increase in the sex ratio. This alternative represents a more sustainable sex ratio over time while still providing ample quality hunting opportunity.

LITERATURE CITED

- Guenzel, R. J. 1997. Estimating pronghorn abundance using aerial line transect sampling. Wyoming Game and Fish Department, Cheyenne. 176 pp.
- Johnson, B. K. and R. J. Guenzel. 1990. Guidelines for estimating pronghorn numbers using line transects. Wyoming Game and Fish Department, Cheyenne. 30 pp.
- Johnson, B. K., F. G. Lindzey, and R. J. Guenzel. 1991. Use of aerial line transect surveys to estimate pronghorn density. *Wildlife Society Bulletin* 19: 315–321.

Appendix A. Survey used for public input during DAU outreach process. Results and percentage of respondents selecting each response inserted into survey.

OPPORTUNITY FOR PUBLIC COMMENT ON PRONGHORN MANAGEMENT

In Data Analysis Unit (DAU) PH-35
Pronghorn Game Management Units (GMUs) 104 and 105

Dear Interested Citizen:

Wildlife managers at the Colorado Parks and Wildlife (CPW) are updating the pronghorn management plan for the following eastern plains Game Management Units (GMUs): 104 and 105. The CPW is seeking your input on the future management of this herd. The information you provide through this survey will influence pronghorn management strategies and objectives in the area.

Please take a few minutes to fill out this short survey. Your responses are private and will not be associated with your name or address in published reports. While your response to this questionnaire and any of the questions is completely voluntary, you can help us effectively manage pronghorn and pronghorn hunting in Colorado by sharing your experience and views. You may skip any questions you do not feel comfortable answering. If you have any questions about this survey, please feel free to contact us.

Thank you for your participation.

Sincerely,

Heather Halbritter
6060 Broadway
Denver, CO 80216
Heather.Halbritter@state.co.us
303-291-7367

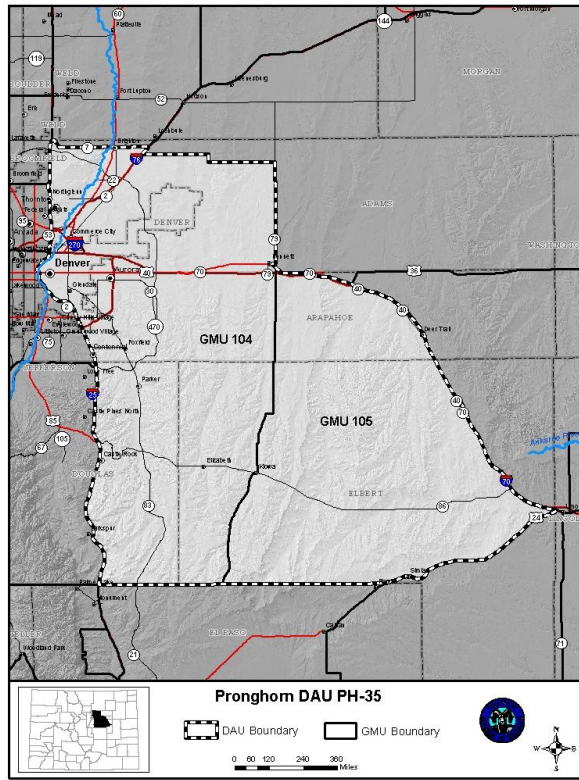


Figure 1. Pronghorn DAU PH-35

Population Objectives: The Division strives to manage big game populations within both the biological and social carrying capacity of the herd. The biological carrying capacity is the number of animals that can be supported by the available habitat. The social carrying capacity is the number that will be tolerated by the people who are impacted by the herd (hunters, wildlife viewers, landowners). A population objective is set at a number which attempts to balance these two carrying capacities. When populations are above objective, the Division increases hunting license numbers (primarily female licenses) to bring the population closer to objective through increased harvest. When populations are below objective, the CPW can decrease the number of hunting licenses to allow the population to increase.

1. Would you like the number of pronghorn in GMUs 104 and 105 to: (based on 101 responses)

21% Increase slightly

11% Increase greatly

41% Stay the same

19% Decrease slightly

7% Decrease greatly

2% No opinion

Male:Female Ratio Objective: Decisions about how many and what type of pronghorn hunting permits to issue are included in the pronghorn management plan. Permits can be issued in a way that maximizes either the number of buck hunting licenses or the number of bucks available to hunters, or some compromise between the two. In general, a decrease in the number of buck hunting licenses could make buck permits more difficult to draw but may limit competition and interference among hunters and increase buck harvest rates. Conversely, an increase in the number of buck hunting licenses could make buck licenses easier to draw but could increase competition among hunters and decrease buck harvest rates.

2. For the purposes of pronghorn hunting, should GMUs 104 and 105 be managed for:
(based on 101 responses)

22% Increased **quality** of hunting opportunity (fewer buck licenses available, fewer hunters in the field)

29% Maximum **quantity** of hunting opportunity (more buck licenses available, more hunters in the field)

47% Status quo (satisfied with current management)

3% No opinion

3. Do you hunt pronghorn in GMU 104 or 105? (based on 100 responses)

90% Yes 10% No

If yes, how did you obtain your license? (based on 90 responses)

80% on a regular draw license

17% on a landowner voucher for the property I own or manage

7% on a landowner voucher for another property

2% on a family only landowner license

4. Do you live within GMU 104 or 105? (based on 101 responses)

60% Yes 40% No

5. Do you own, lease, or manage property in GMU 104 and 105? (based on 100 responses)

48% Yes 52% No

If yes how much? (based on 49 responses)

39% <160 acres

12% 160-639 acres

- 14% 640-1199 acres
- 20% 1200-2399 acres
- 8% 2400-3999 acres
- 6% 4000+ acres

6. Have pronghorn caused damage to your crops or other property in the last 5 years?
(based on 72 responses)

- 60% No
- 19% Yes, light damage
- 13% Yes, moderate damage
- 4% Yes, severe damage
- 4% Prefer not to answer

If yes, when does the majority of damage occur? (based on 26 responses)

- 35% Spring
- 27% Summer
- 54% Fall
- 27% Winter

What type of crops/land did pronghorn cause damage to on your property? (based on 27 responses-multiple answers selected so percentages do not add up to 100)

- 22% Winter wheat
- 0% Corn
- 41% Alfalfa/hay
- 67% Fences
- 48% Pasture land
- 7% Other

Please specify _____

7. Do you lease your property to outfitters? (based on 60 responses) 5% Yes
95% No

8. Whom did you allow to hunt pronghorn on land you control in the last 5 years? (based on 57 responses)

- 32% No one

- 60% Family, friends, and neighbors
- 16% Public hunters who paid no access fee
- 5% Hunters or outfitters who have leased the land or paid an access fee

9. How has the number of hunters you allow to access your property changed in the last 5 years? (based on 56 responses)

- 73% No change in hunter access
- 20% I allow MORE hunters access to my property
- 4% I allow FEWER hunters access to my property
- 4% I have CLOSED my property to hunters

Please feel free to leave us any additional comments regarding pronghorn management in GMUs 104 and 105.

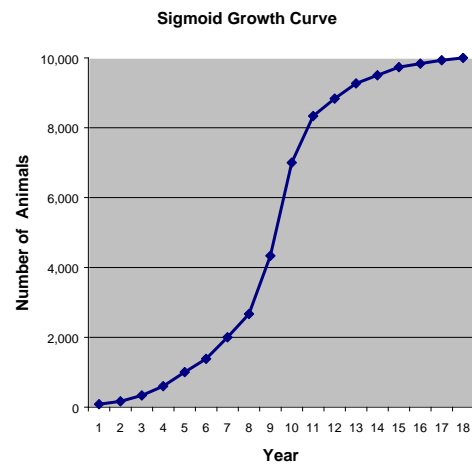
A total of 39 additional comments were submitted.

Appendix B: Population Dynamics, Maximum Sustained Yield, and Density Dependence

Numerous studies of animal populations, including such species as bacteria, mice, rabbits, and white-tailed deer have shown that the populations grow in a mathematical relationship referred to as the "sigmoid growth curve" (right). There are three distinct phases to this cycle. The first phase occurs while the population level is still very low and is characterized by a slow growth rate and a high mortality rate. This occurs because the populations may have too few animals and the loss of even a few of them to predation or accidents can significantly affect population growth.

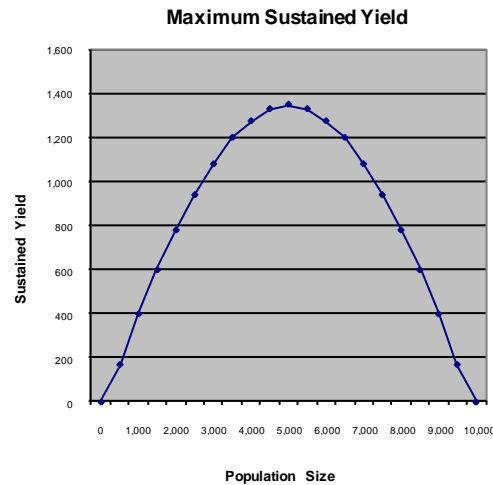
The second phase occurs when the population number is at a moderate level. This phase is characterized by high reproductive and survival rates. During this phase, food, cover, water and space are not a limiting factor. During this phase, for example, animals such as white-tailed deer have been known to successfully breed at six months of age and produce a live fawn on their first birthday and older does have been known to produce 3-4 fawns that are very robust and healthy. Survival rates of all sex and age classes are also at maximum rates during this phase.

The final or third phase occurs when the habitat becomes too crowded or habitat conditions become less favorable. During this phase the quantity and quality of food, water, cover and space become scarce due to the competition with other members of the population. These types of factors that increasingly limit productivity and survival at higher population densities are known as density-dependent effects. During this phase, for example, white-tailed deer fawns can no longer find enough food to grow to achieve a critical minimum weight that allows them to reproduce; adult does will usually only produce 1-3 fawns; and survival of all deer (bucks, does and fawns) will decrease. During severe winters, large die-offs can occur due to the crowding and lack of food. The first to die during these situations are fawns, then bucks, followed by adult does. Severe winters affect the future buck to doe ratios by favoring more does and fewer bucks in the population. Also, because the quality of a buck's antlers is somewhat dependent upon the quantity and quality of his diet, antlers development is diminished. If the population continues to grow it will eventually reach a point called "K" or the maximum carrying capacity. At this point, the population reaches an "equilibrium" with the habitat. The number of births each year equals the number of deaths, therefore, to maintain the population at this level would not allow for any "hunnable surplus." The animals in the population would be in relatively poor body condition, habitat condition would be degraded from over-use, and when a severe winter or other catastrophic event occurs, a large die-off is inevitable.



What does all this mean to the management of Colorado's big game herds? It means that if we attempt to manage for healthy big game herds that are being limited by density-dependent effects, we should attempt to hold the populations more towards the middle of the "sigmoid growth curve." Biologists call this point of inflection of the sigmoid growth curve the point of "MSY" or "maximum sustained yield." In the example below, MSY, which is approximately half the maximum population size or "K", would be 5,000 animals. At this level, the population should provide the maximum production, survival, and available surplus animals for hunter harvest. Also, at this level, range habitat condition should be good to excellent and range trend should be stable to improving. Game damage problems should be lower and economic return to the local and state economy should be higher. This population level should produce a "win - win" situation to balance sportsmen and private landowner concerns.

A graph of a hypothetical deer population showing sustained yield (harvest) potential vs. population size is shown (right). Notice that as the population increases from 0 to 5,000 deer, the harvest also increases. However, when the population reaches 5,000 or "MSY", food, water and cover becomes scarce and the harvest potential decreases. Finally, when the population reaches the maximum carrying capacity or "K" (10,000 deer in this example), the harvest potential will be reduced to zero.



Also, notice that it is possible to harvest exactly the same number of deer each year with 3,000 or 7,000 deer in the population. This phenomenon occurs because the population of 3,000 deer has a much higher survival and reproductive rate compared to the population of 7,000 deer. However, at the 3,000 deer level, there will be less game damage and resource degradation but lower watchable wildlife values.

Actually managing deer and elk populations for MSY on a DAU basis is difficult if not impossible due to the amount of detailed biological information about habitat and population size required. Additionally, carrying capacity is not static, the complex and dynamic nature of the environment cause carrying capacity to vary seasonally, annually, and trend over time. In most cases we would not desire true MSY management even if possible because of the potential for overharvest and the number of mature of bulls and bucks is minimized because harvest reduces recruitment to older age classes. However, the concept of MSY is useful for understanding how reducing densities and pushing asymptotic populations towards the inflection point can stimulate productivity and increase harvest yields. Knowing the exact point of MSY is not necessary if the goal is to conservatively reduce population size to increase yield. Long-term harvest data can be used to gauge the effectiveness of reduced population size on harvest yield.

Research in several studies in Colorado has shown that density-dependent winter fawn survival is the mechanism that limits mule deer population size because winter forage is

limiting (Bartmann et al. 1992, Bishop et al. 2009). Adult doe survival and reproduction remain high but winter fawn survival is lower at higher population sizes relative to what the winter habitat can support. The intuition to restrict, or even eliminate, female harvest in populations where productivity is low and when populations are below DAU plan objectives is counterproductive and creates a management paradox. In that, for populations limited by density dependent processes, this “hands-off” type of management simply exacerbates and perpetuates the problem of the population being resource limited, and countermands the goals and objectives of the DAU plan. As Bartmann et al. (1992) suggest, because of density-dependent processes, it would be counterproductive to reduce female harvest when juvenile survival is low and increase harvest when survival is high. Instead, a moderate level of female harvest helps to maintain the population below habitat carrying capacity and should result in improved survival and recruitment of fawns. Increased fawn recruitment allows for more buck hunting opportunity and a more resilient population.

Thus, the key for DAU planning and management by objective is to set population objectives in line with what the limiting habitat attributes can support. A population objective range aptly set must be below carrying capacity.

Literature Cited

- Bartmann, R.M., G.C. White, L.H. Carpenter. 1992. Compensatory mortality in a Colorado mule deer population. Wildlife Monographs No. 121. 39 pp.
- Bishop, C.J., G.C. White, D.J. Freddy, B.E. Watkins, and T.R. Stephenson. 2009. Effect of enhanced nutrition on mule deer population rate of change. Wildlife Monographs No. 172. 28 pp.