HARDPAN PRONGHORN HERD MANAGEMENT PLAN PH-2

**Game Management Units
99 & 100**
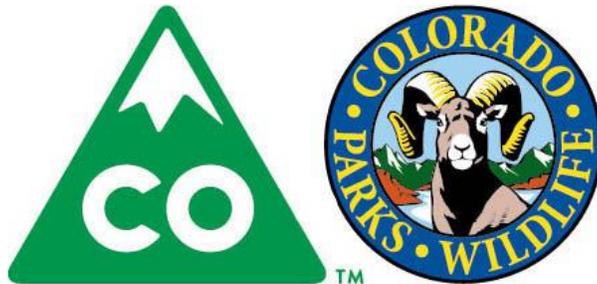
November 2018

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HERD MANAGEMENT PLAN – PH-2 (HARDPAN)
EXECUTIVE SUMMARY

GMU's: 99 and 100   **Land Ownership:** 99% Private, 1% State

Post-Season Population:

Current Objective – 1,400–1,700; *2016 Estimate* – 1,672; *Previous Objective* – 1,400–1,600

Sex Ratio (Bucks/100 Does):

Current Objective – 25–30; *2016 Observed* – 44; *2016 Modeled* – 33; *Previous Objective* – 25–30

Figure I. PH-2 Post-Season Population Estimate
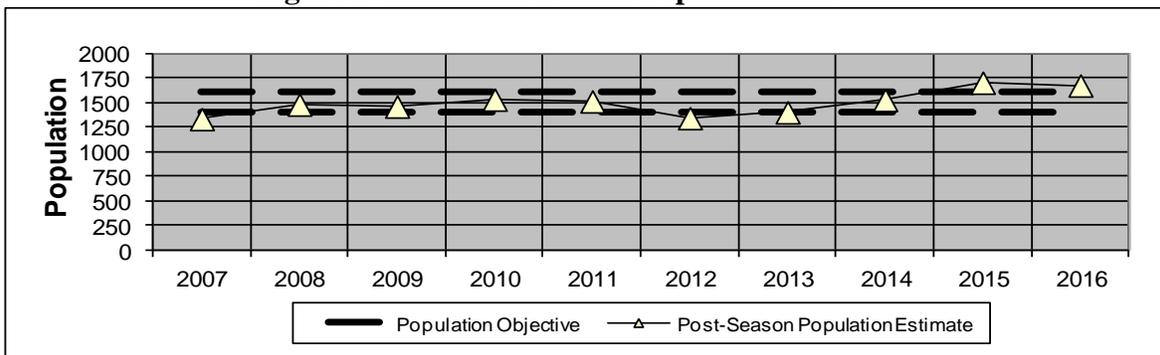
Figure II. PH-2 Harvest
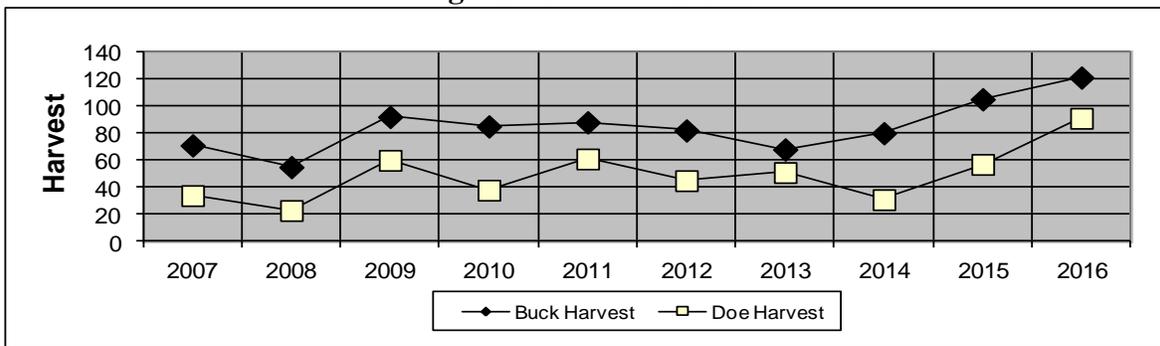
### Figure III. PH-2 Post-Season Sex Ratios
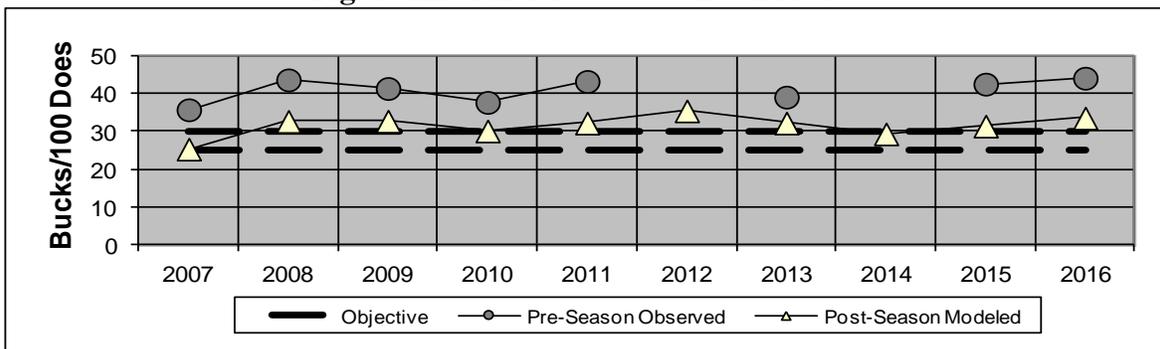
Background

Over the past decade, the Hardpan pronghorn herd has been managed under the current management plan objectives of 1,400–1,600 pronghorn and 25–30 bucks/100 does that were established in 2007. This Herd Management Plan (HMP) and the population and sex ratio alternatives presented are the result of an update and revision of that plan.

The pronghorn population in the Hardpan has experienced an increase over the last decade from a low of approximately 1,331 in 2007 to a high of 1,700 animals estimated in 2015. The 2016 post-season estimate was 1,672 pronghorn. The 5 and 10-year population estimate averages for this pronghorn herd are 1,528 and 1,495 pronghorn, respectively. Since 2007, the modeled post-season buck/doe ratio estimates have averaged 31 bucks/100 does ranging from 25 bucks/100 does in 2007 to 35 bucks/100 does in 2012. The 2016 modeled post-season estimate was 33 bucks/100 does. Observed fawn/doe ratios have varied from a low of 35 fawns/100 does in 2009 to a high of 67 fawns/100 does in 2015 and has averaged 47 fawns/100 does.

Significant Issues

The majority of public comments supported maintaining or slightly increasing the current population objective, and maintaining the current herd composition in the Hardpan pronghorn herd. Although there was some public support to slightly increase the current population level, concerns were also raised by landowners about potential crop damage and general intolerance for large numbers of animals. The majority of public input did not support reducing the herd composition objective. While changes in land use have resulted in a small decrease in the pronghorn habitat, habitat conditions are sufficient to continue to sustain a pronghorn population of the size recommended in this plan.

Management Alternatives

The CPW's preferred objectives for PH-2 are to manage for a post-season population of 1,400–1,700 with a modeled post-season herd composition of 25–30 bucks/100 does. These objectives are in line with public comments and population performance in recent years.

Other alternatives being considered in this HMP were: 1) reduce the population objective by 25% to 1,000–1,300 pronghorn, 2) increase the population objective by 25% to 1,900–2,300 pronghorn, and 3) increase the sex ratio objective to 30–35 bucks/100 does.

Strategies for Achieving Objectives

Population- To maintain the population within objective, doe harvest will be increased slightly; this will be accomplished through allocations of doe pronghorn licenses, primarily during the general pronghorn rifle season.

Herd Composition- To maintain the herd within objective, buck harvest will be increased slightly; this will be accomplished through allocations of buck pronghorn licenses, primarily during the general pronghorn rifle season.

This herd management plan was approved by the Colorado Parks and Wildlife Commission on November 16, 2018.

HARDPAN PRONGHORN HERD MANAGEMENT PLAN
PH-2 (GMUs 99 & 100)

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INTRODUCTION AND PURPOSE

Colorado Parks and Wildlife (CPW) manages big game for the use, benefit, and enjoyment of the people of the state in accordance with CPWs 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 human impacts. To manage the state's big game populations, CPW uses a "management by objective" approach (Figure 1).
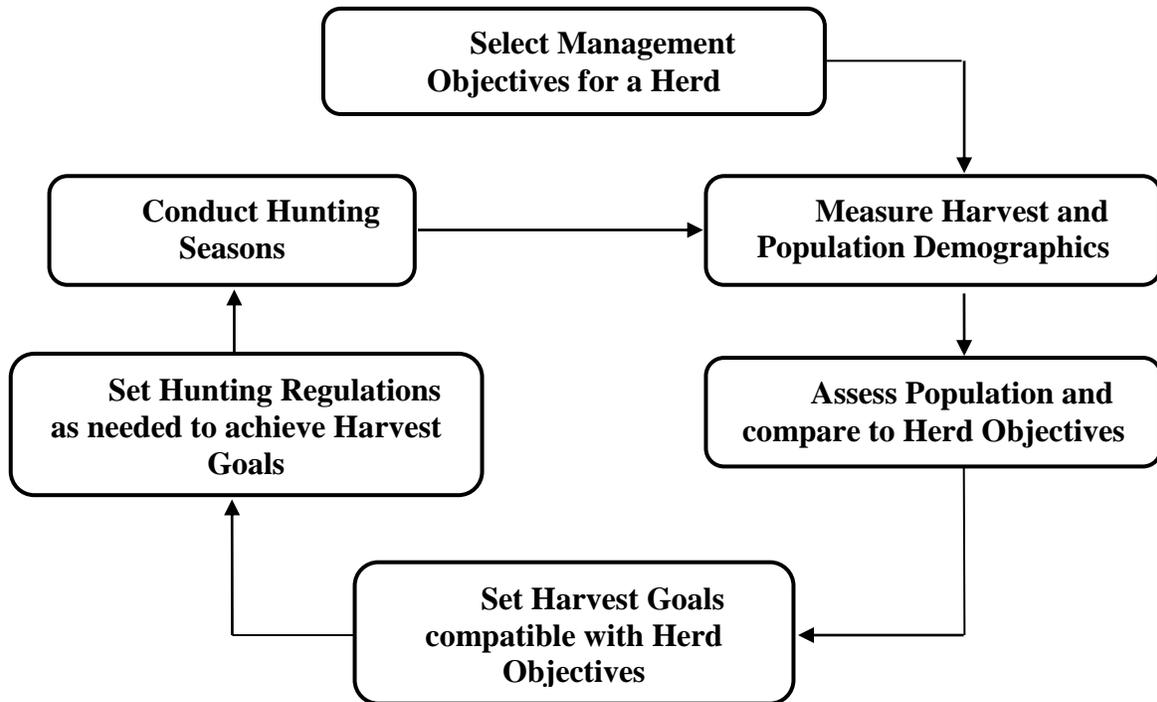
Figure 1. Management by Objective process used by Colorado Parks and Wildlife to manage big game populations by management areas.

Big game populations are managed to achieve population and sex ratio objectives established for a herd. A herd management area is the geographic area that represents the year-around range of a big game herd and includes the area where the majority of the animals in a herd are born, live, and die either as a result of hunter harvest or natural causes. Herd management area boundaries are delineated to minimize interchange of animals between adjacent herds. A herd management area may be divided into several Game Management Units (GMUs) to distribute hunters and harvest.

Management decisions within a herd are based on a Herd Management Plan (HMP). The purpose of a HMP is to establish population and sex ratio (i.e., the number of males per 100 females) objectives for the herd. The HMP also describes the strategies and techniques that will be used to reach these objectives. During the herd management planning process, public input is solicited and collected through questionnaires, public

meetings, and comments to the CPW staff and the Wildlife Commission. The intentions of CPW are integrated with the concerns and ideas of various land management agencies and interested publics in determining how a big game herd should be managed. In preparing a HMP, agency personnel attempt to balance the biological capabilities of the herd and its habitat with the public's demand for wildlife recreational opportunities.

The HMP serves as the basis for the annual herd management cycle. In this cycle, the size and composition of the herd is assessed and compared to the objectives defined in the HMP. Based on these goals, specific removal strategies are made for the coming year to either maintain the population or move it towards the established objectives (e.g., license numbers and allocation are set). Hunting seasons are then conducted and evaluated and the annual management cycle begins again (Figure 1).

The purpose of this HMP is to set population and sex ratio objectives for the Hardpan pronghorn herd. HMP are approved by the Parks and Wildlife Commission and are reviewed and updated approximately every 10 years.

HARDPAN PRONGHORN DATA ANALYSIS UNIT DESCRIPTION

Location

The Hardpan pronghorn management area encompasses approximately 2,710 mi^2 in northeastern Colorado in portions of Adams, Morgan, Washington, and Weld Counties and includes GMUs 99 and 100 (Figure 2). This area is bounded by I–76 and US 34 on the north; Colorado Highway 61 on the east; US 36 on the south; Colorado Highway 79 and 144th Ave., on the west; and on the south and west by Adams County Road 25N and 152nd Ave.

Habitat Composition

There are several habitat types within the Hardpan, including dry cropland, irrigated cropland, tall-grass prairie, sandsage/mid-grass prairie, short-grass prairie, and Conservation Reserve Program (CRP) lands. Nearly 20% of the area is comprised of sandsage/mid-grass prairie sandhills. The sandsage/mid-grass prairie is part of a sandhill complex that runs along the northern boundary of the Hardpan. The sandsage/mid-grass prairie has remained stable with little being broken out for farming or development. Quality pronghorn habitat, primarily short-grass prairie, has decreased due to conversion to cropland and changing cropping practices that emphasize corn and domestic sunflowers as an alternative to a wheat-fallow system. The largest blocks of short-grass prairie are located in the south-central portion of the Hardpan and intermixed in the sandhill complexes along the northern boundary. There are 2 small riparian systems within the Hardpan; Beaver Creek and Bijou Creek.
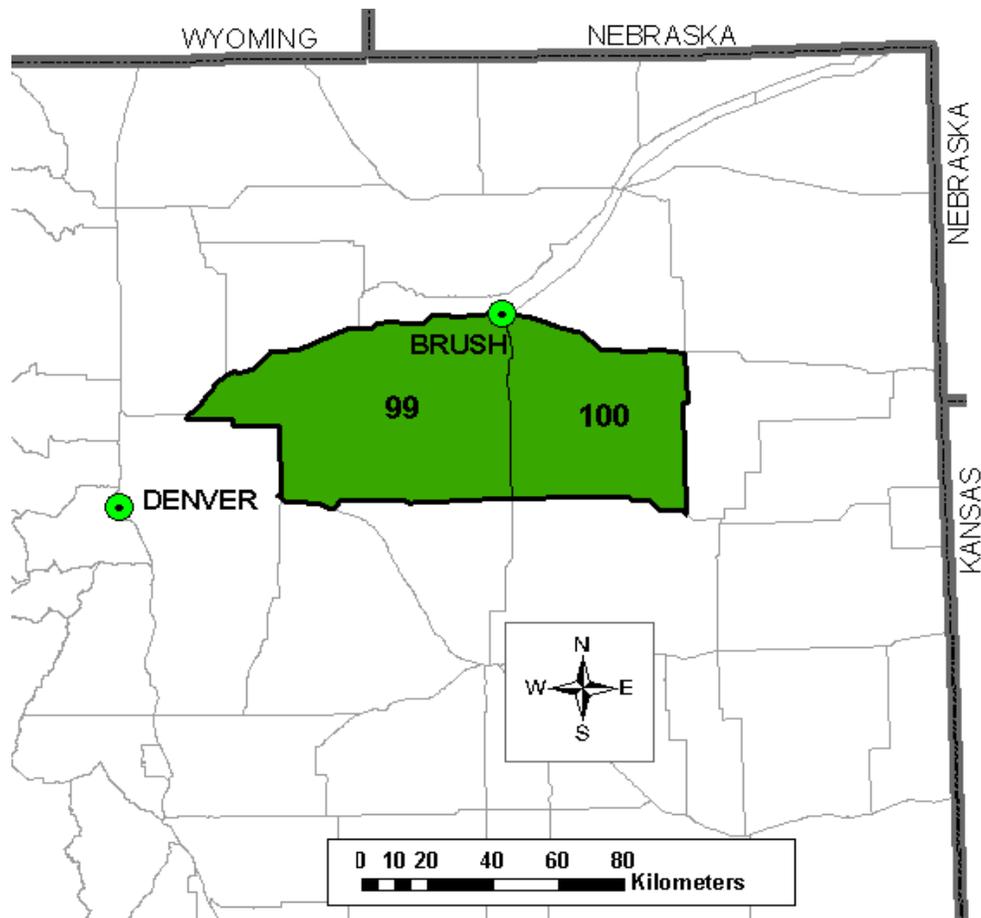
Figure 2. Geographic location of the Hardpan pronghorn management area and its associated Game Management Units in northeast Colorado.

Climate

The climate in the Hardpan is characterized by hot, dry summers and recently, relatively mild winters. Annual precipitation ranges from 13–15 inches with most occurring during intense summer thunderstorms. Snowfall can be variable in the area, but recent winters have been dry with moderate temperatures.

Land Use

Land ownership patterns within the Hardpan are typical of eastern Colorado, with the majority of this area being in private ownership. The only notable exception is the Brush Prairie Ponds State Wildlife Area owned by CPW, which comprises <1% of this management area. Land use within the Hardpan is almost exclusively agricultural based. Grazing by livestock is the primary influence on short-grass and sandsage/mid-grass prairie condition. Center pivot irrigation occurs primarily in the northwest and north-central portions of the area, including the sandhill complex. Corn, wheat, and alfalfa are the primary crops under pivot irrigation. On the western end of the Hardpan, residential development is encroaching into GMU 99, although to this point, little impact has occurred to pronghorn habitat.

HERD MANAGEMENT HISTORY

Pronghorn Distribution

Pronghorn antelope are found throughout the Hardpan. The highest densities are in the southern portion of the Hardpan and are frequently associated with shortgrass rangeland in proximity to winter wheat or wheat stubble fields. Generally, pronghorn densities are lowest in areas of intense agricultural use. During the winter months, pronghorn often concentrate near green wheat fields, which can result in complaints from landowners.

Post-Season Population Size

Estimating population numbers of wild animals over large geographic areas is a difficult and approximate science. CPW recognizes this as a challenge in our management efforts and attempts to minimize this by using the latest technology and inventory methodology available. Population estimates for pronghorn are derived using computer model simulations that involve estimates of mortality rates, hunter harvest, and annual production. These simulations are then adjusted to align on measured pre-season age and sex ratio classification surveys and, in some cases, population estimates derived from line transect surveys.

CPW recognizes the limitation of the system and strives to do the best job with the resources available. As better information becomes available, such as new estimates of survival/mortality, wounding loss, sex ratios, density, or new modeling techniques and software, CPW will evaluate these new techniques and information and use them where appropriate. The use of new information may result in substantial changes in the population estimate or management strategies. Therefore, the population estimate presented in this document should be used as an index or as trend data and not as a completely accurate enumeration of the pronghorn in this management area.

Estimated pronghorn numbers for the Hardpan pronghorn herd have increased over the last decade from a low of 1,330 in 2007 to 1,700 in 2015 (Figure 3). The pronghorn herd has experienced normal population fluctuations associated with weather conditions, hunting pressure, and population dynamics. The 5 and 10-year population estimate averages for the pronghorn herd are 1,528 and 1,495 pronghorn, respectively.

Post-Season Herd Composition

Sex ratios, expressed as bucks per 100 does, and age ratios, expressed as fawns per 100 does, have been estimated by collecting classification data from aerial surveys in late summer. Observed sex and age ratios, along with harvest estimates are used in computer simulation models to project post-season sex ratios and population, determine license allocation, predict population changes, and assess impacts of reported harvest.

Since 2007, the modeled post-season buck/doe ratio has averaged 31 bucks/100 does ranging from 25 bucks/100 does in 2007 to 35 bucks/100 does in 2012 (Figure 4). Since 2007, management strategies and license allocations have been implemented to maintain this pronghorn herd at a post-season sex ratio objective of 25–30 bucks/100 does. Observed fawn/doe ratios have varied from a low of 35 fawns/100 does in 2009 to a high of 67 fawns/100 does in 2015 and has averaged 47 fawns/100 does (Figure 4).
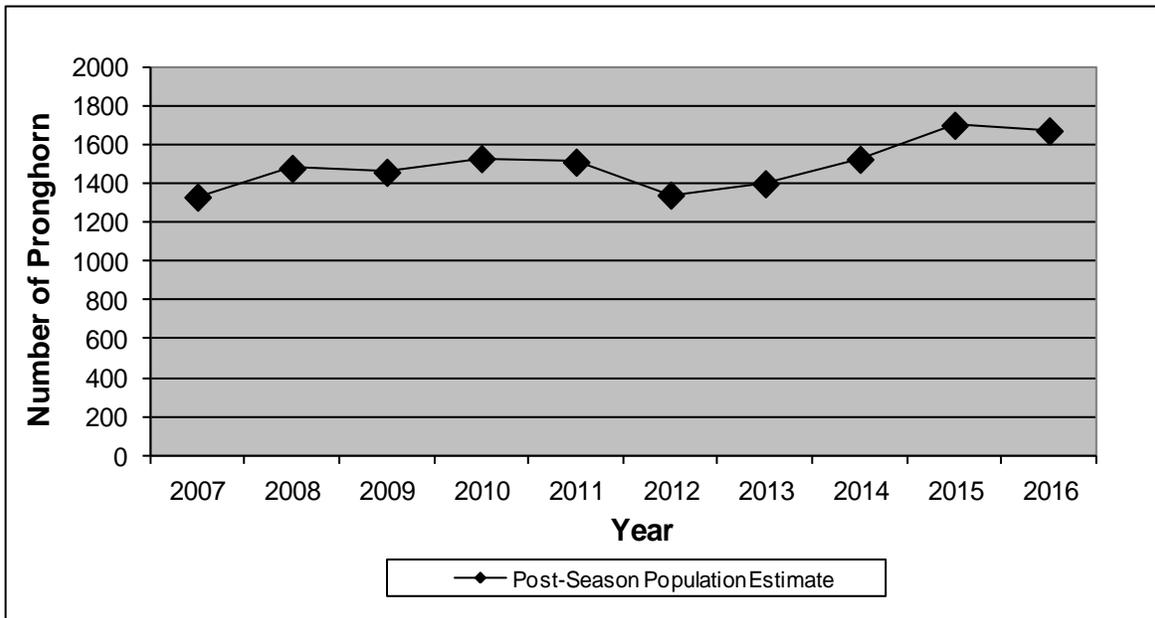
Figure 3. Post-season pronghorn population estimates for the Hardpan pronghorn herd, 2007–2016.
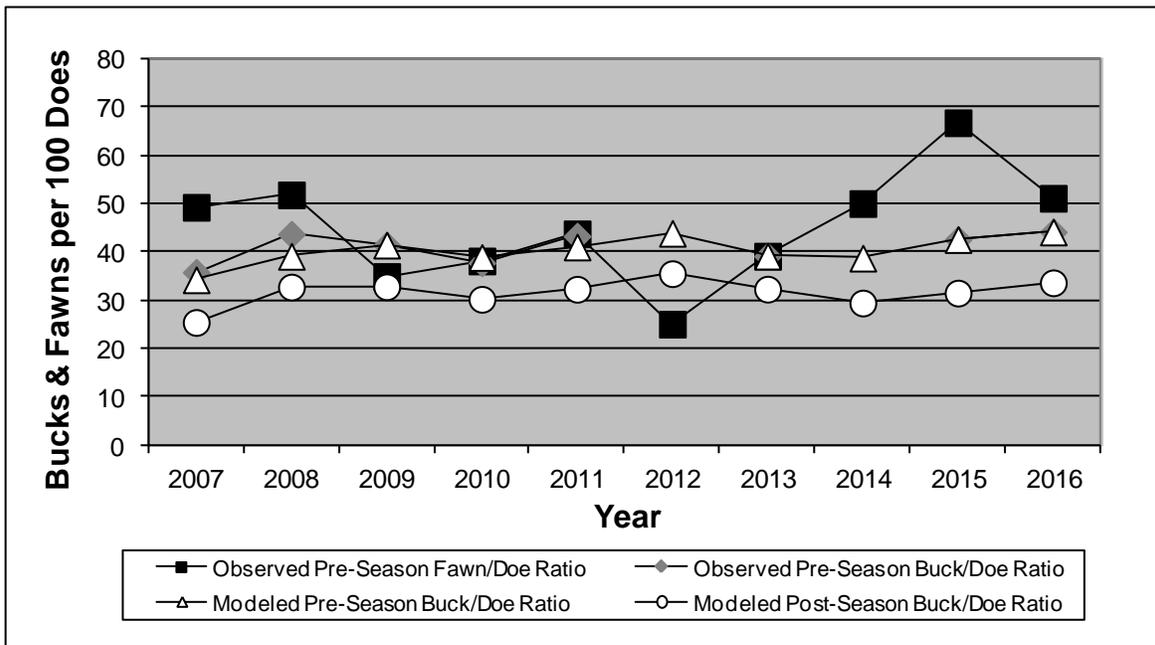
Figure 4. Observed pre-season buck/doe/fawn ratios and modeled pre- and post-season buck/doe ratio estimates for the Hardpan pronghorn herd, 2007–2016.

Harvest

Over the last 10 years, pronghorn harvest has ranged from a high of 212 animals in 2016 to a low of 78 animals in 2008 (Figure 5). Average harvest since 2007 is 134 animals. Buck pronghorn harvest ranged from a low of 55 bucks in 2008 to a high of 121

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in 2016 (Figure 5). Since 2007, the average buck harvest is 85 animals. Doe harvest has ranged from a high of 91 animals in 2016 to a low of 23 in 2008 (Figure 5). Average doe harvest for the past 10 years was 49 animals. Archery and muzzleloader seasons exist for this pronghorn herd, although neither significantly impact pronghorn harvest, accounting for 3% of the annual harvest.
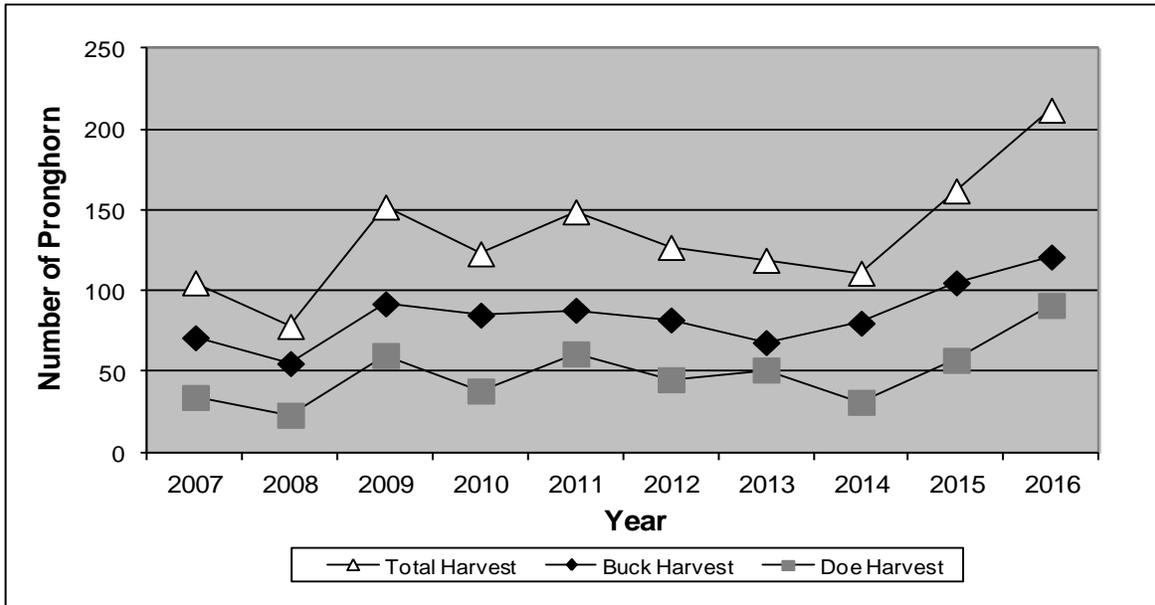
Figure 5. Total harvest and number of buck and doe pronghorn harvested in the Hardpan pronghorn herd, 2007–2016.

Hunters

The Hardpan pronghorn herd remains popular for buck hunting and as a result, the demand for antlered licenses exceeds the supply. In 2016, rifle buck licenses required 3 preference points to draw in GMUs 99 and 100 (Figure 6). Doe licenses and muzzleloader tags were drawn with 0 points, while archery licenses have remained unlimited. Landowner preference licenses for bucks and does are over-subscribed in both GMUs.
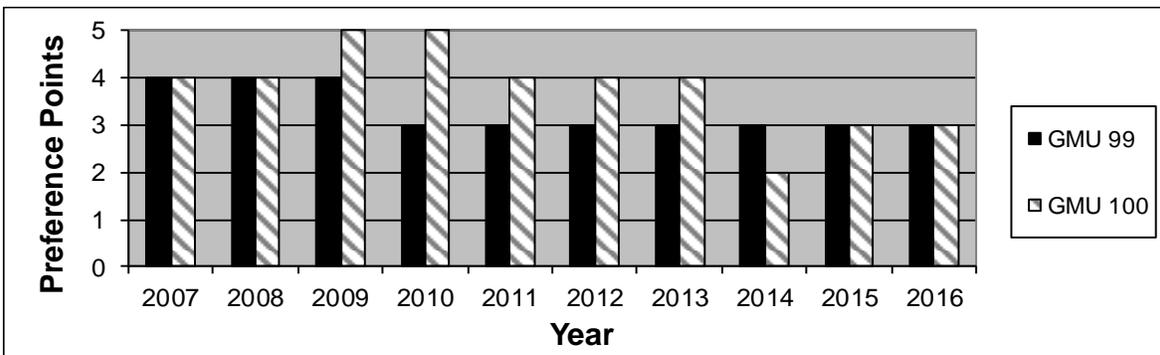
Figure 6. Number of preference points needed to draw a pronghorn buck license for the rifle season in the Hardpan pronghorn herd, 2007–2016.

The number of licenses has increased from 140 in 2007 and 2008 to 310 in 2016 (Figure 7). Since 2007, the number of buck licenses has varied from a low of 90 licenses in 2008 to a high of 155 licenses in 2016 (Figure 7). The number of doe licenses ranged from a low of 45 licenses in 2007 and 2008 to a high of 155 licenses 2016 (Figure 7).
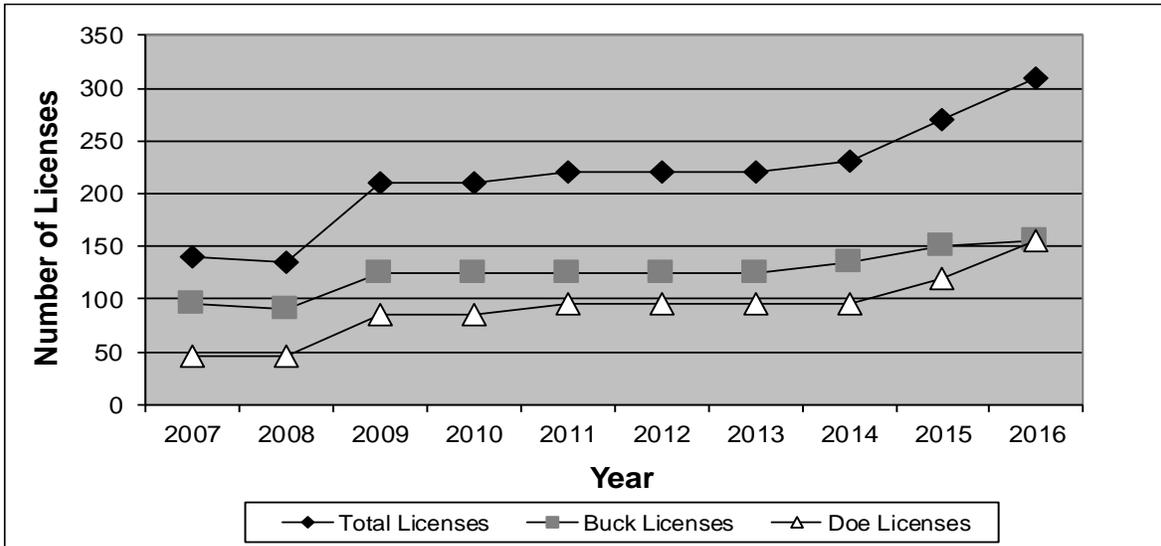
Figure 7. Total number of licenses and number of buck and doe pronghorn licenses allocated for the Hardpan pronghorn herd, 2007–2016.

Success rates for the rifle season have not exhibited a downward trend and have averaged 59% (Figure 8). The 5 and 10-year average harvest success rates for buck pronghorn are 65% and 68%, respectively. The 5 and 10-year average harvest success rates for doe pronghorn are 48% and 55%, respectively.
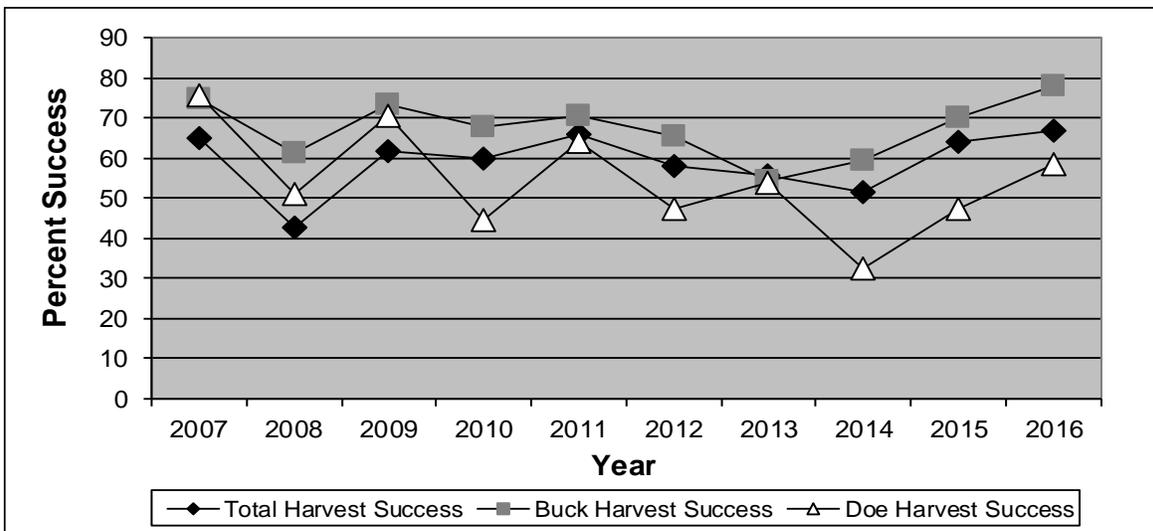
Figure 8. Total, buck, and doe pronghorn harvest success (%) in the Hardpan pronghorn herd, 2007–2016.

Past Management Strategies

From 1967 through 1980, unlimited either-sex licenses were issued for rifle hunting. In 1980, licenses were changed to specified bucks and does which remained in effect until 1986. Since 1986, a limited number of buck and doe licenses have been issued for the rifle season for the Hardpan pronghorn herd. While archery licenses have remained either-sex and available over-the-counter, muzzleloader licenses became limited in number in 2007. Over the past 5 years, the average number of archery hunters in the Hardpan was 41, resulting in a total harvest of 28 bucks and 0 does from archery hunting during that time.

CURRENT HERD MANAGEMENT, ISSUES, and STRATEGIES

Population and Sex Ratio Objectives

The 2016 post-season estimate was 1,670 pronghorn. This estimate is slightly above the current post-season population objective of 1,400–1,600 pronghorn. The 2016 pre-season observed sex ratio was 44 bucks/100 does with a modeled post-season estimate of 33 bucks/100 does, also slightly above the current post season objective of 25–30 bucks/100 does. Generally, an observed pre-season buck/doe ratio close to 40 bucks/100 does is needed to maintain a post-season buck/doe ratio of 25–30 bucks/100 does.

Current Management Strategies

The current management strategy for the Hardpan pronghorn herd is to provide recreational hunting opportunities while maintaining pronghorn numbers within the tolerance of landowners. More frequent and consistent collection of biological data has improved our ability to monitor population changes over time.

Current Management Concerns

Over the last decade, habitat quality in the Hardpan has remained relatively stable or increased. Average to above average moisture over the last 10 years has greatly improved habitat conditions since the drought years in the early 2000s. The population has responded to the improved conditions with near record fawn recruitment in 2015. Pronghorn damage is not a major issue in the Hardpan with only 3 pronghorn damage claims being filed in the past 20 years. However, landowner tolerance of pronghorn antelope is and will continue to be a consideration in setting population objectives.

PUBLIC INVOLVEMENT

The primary purpose of the herd management planning process is to determine objectives for the size and structure of the post-season population. Input for this herd management planning process was solicited through a public survey. All first-choice pronghorn license applicants from 2014–2016 for PH-2 and registered landowners were notified via postcards and encouraged to complete an online survey (Appendix A). Furthermore, a draft of this HMP was made available at the Brush CPW office and on the CPW website for review and comments.

Public comments indicated a desire to maintain the current level of quality pronghorn hunting opportunities in the Hardpan pronghorn herd (Appendix A). Also, public comments supported maintaining the pronghorn population at the current long-term population objective. The primary issues in PH-2 are to continue to provide recreational hunting opportunities while managing the population at a sustainable objective.

ALTERNATIVE DEVELOPMENT

Post-Season Population Objectives
The population objective is selected independently from the herd composition objective. The CPW acknowledges that estimating wildlife populations is an inexact science and habitat conditions and carrying capacity vary with fluctuations in weather and trends in agriculture; therefore, the long-term population objective will be expressed as a range rather than a specific number.

Alternative 1: 1,000–1,300.
Reduce the long-term post-season population objective by 25% (1,000–1,300) from the current objective. Initially, this alternative would result in an increase in pronghorn hunting licenses, but once pronghorn numbers were reduced to objective, hunting opportunity would decline. This strategy could substantially decrease hunting opportunities for both bucks and does in the long-term unless there was a strong density dependent response resulting in increased fawn production and survival. Reducing the pronghorn population to this objective would require substantial increases in doe licenses over the next 2–3 years. There would likely be long-term negative fiscal impact to individuals and businesses relying on recreational hunting. Pronghorn damage complaints would remain negligible.

Alternative 2: 1,400–1,700.
Maintain the post-season population at the current target objective of 1,600 animals. Under this alternative, a slight increase in doe licenses will be needed to reduce the population to the target objective. The demand for buck licenses will continue to be greater than the supply and the number of preference points needed to draw a license should remain at current levels. The current hunting opportunities are expected to continue with no fiscal impacts to individuals or businesses. Damage complaints are expected to remain negligible.

Alternative 3: 1,900–2,300.
Increase the long-term post-season pronghorn population objective by 25% to 1,900–2,300 animals. This objective will provide more buck hunting opportunities that are obviously in demand. However, there is substantial evidence that there is neither landowner support nor adequate habitat to support a pronghorn population of this size. Damage claims and landowner intolerance are expected to increase under this alternative. There was no public support for increasing the current long-term objective. There would likely be an increase in revenue for businesses involved with hunting recreation.

Post-Season Herd Composition Objectives
The following 2 sex ratio objectives are presented.

Alternative 1: 25–30 bucks/100 does.
    Maintain the post-season sex ratio at the current objective of 25–30 bucks/100 does. A slight increase in buck licenses would be necessary to reduce the current modeled sex ratio to objective. This objective would continue to provide recreational hunting opportunities. Hunter satisfaction would likely remain stable and the demand for buck licenses would continue at its current pace with no fiscal impacts to individuals or businesses. Public comments supported maintaining the current level of quality hunting opportunities.

Alternative 2: 30–35 bucks/100 does.
    Increase the sex ratio objective to 30–35 bucks/100 does which is a 5 bucks/100 does increase from the current objective. This alternative would result in maintaining the post-season sex ratio at current levels. The current modeled post-season sex ratio was 33 bucks/100 does, therefore no change in the number of buck licenses are necessary to maintain this objective. Buck hunting opportunities would remain at the current level. Under this alternative, the demand for buck licenses and hunter satisfaction would likely increase because of the increase in quality buck hunting opportunities.

PREFERRED OBJECTIVES

    The CPW's preferred objectives for PH-2 are to manage for a post-season population of 1,400–1,700 (**Alternative 2**) with an observed post-season herd composition objective of 25–30 bucks/100 does (**Alternative 1**).
    The majority of public comments support maintaining the current pronghorn population in the Hardpan DAU. Game damage complaints have not been an issue thus far, and are not expected to significantly increase under this alternative. The population is currently estimated to be at the upper end of the range of this objective. Thus, hunting opportunities would continue at or above the current level.
    Public comments strongly supported managing the Hardpan pronghorn herd at the current level of quality buck hunting opportunities. The 2016 post-season modeled sex ratio was 33 bucks/100 does. Therefore, slight increases in buck licenses will be needed to maintain the preferred objective range of 25–30 bucks/100 does. The Hardpan pronghorn herd is valued as a pronghorn hunting destination and hunters and landowners have encouraged the CPW to continue to manage PH-2 to maintain the current level of hunting opportunities.

PUBLIC SURVEY

Dear Interested Citizen:

Colorado Parks and Wildlife (CPW) is interested in **your input** on the management of pronghorn antelope in Game Management Units (GMUs) 99 and 100.

Your input is **a very important** part of the planning process. The information **you provide** will help guide management of the pronghorn herd for the **next 10 years!**

Please help us learn what is most important **to you** about pronghorn management in this area. Your responses are anonymous and the information you provide will never be associated with your name.

Surveys must be completed by **October 4, 2017**

Please return your survey to:
Marty Stratman
Colorado Parks & Wildlife
122 E. Edison St.
Brush, CO 80723

Game Management Units 99 and 100
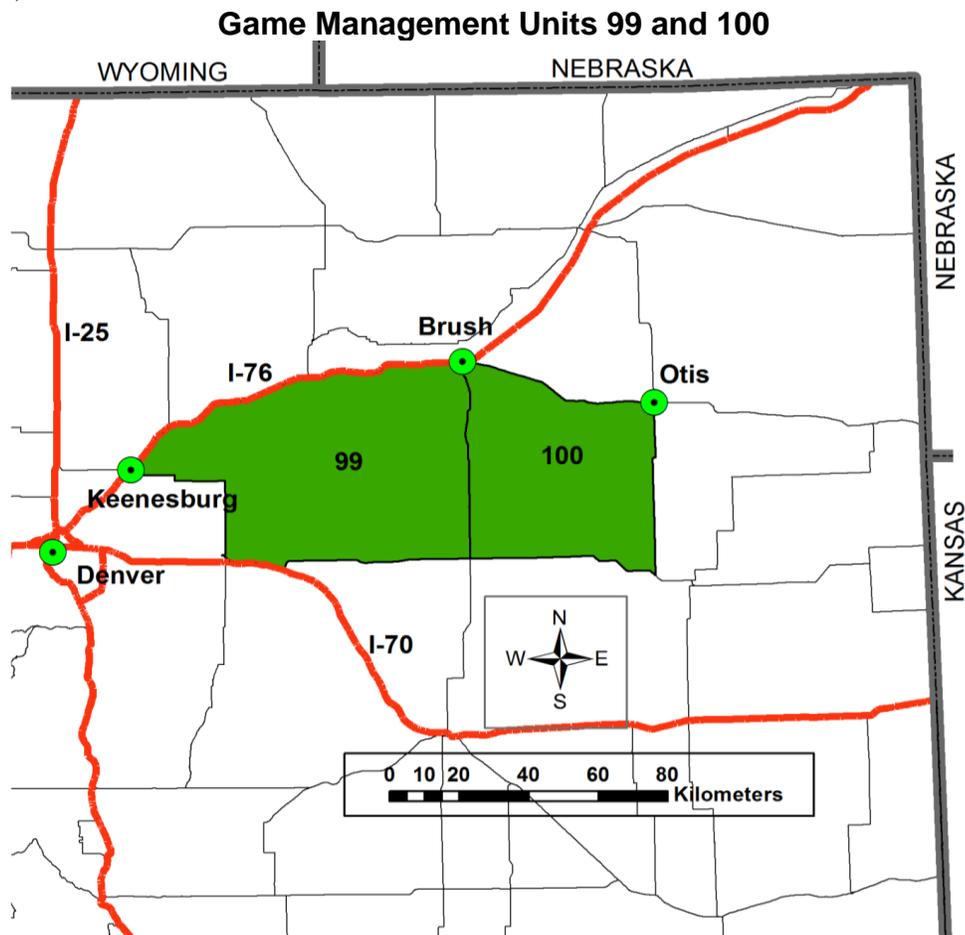
1. Do you live in GMU 99 or 100? See map above. (**112 Responses**)

   Yes – **46.4%**
   No – **53.6%**

2. Do you consider yourself to be any of the following? (**112 Responses**)

   Rancher/farmer – **33.0%**
   Hunter/sportsman – **65.2%**
   Guide/outfitter – **0.2%**

3. Do you own land in GMU 99 or 100? See map above. (**112 Responses**)

   Yes – **40.2%**
   No – **59.8%**

4. Approximately, how much land do you own in GMU 99 or 100? (**46 Responses**)
   <80 acres – **23.9%**
   80-319 acres – **10.9%**
   320-639 acres – **6.5%**
   640-999 acres – **10.9%**
   1000+ acres – **47.8%**

5. Have you received landowner vouchers through the Priority Landowner Preference Program? (**45 Responses**)

   Yes – **46.7%**
   No – **53.3%**
   I am not sure – **0%**

6. Please indicate which GMU you are most interested in? (**112 Responses**)
   GMU 99 – **57.1%**
   GMU 100 – **25.0%**
   I'm equally interested in both GMU's – **17.9%**
   Neither GMU – **0%**

7. Have you ever hunted pronghorn antelope in GMU 99 or 100? See map above. (**112 Responses**)

   Yes – **85.7%**
   No – **14.3%**

8. Overall, how satisfied were you with your pronghorn hunting experience in GMU 99 or 100? (**98 Responses**)

   Very unsatisfied – **16.3%**
   Somewhat unsatisfied – **16.3%**
   Neither unsatisfied, nor satisfied – **7.1%**
   Somewhat satisfied – **35.8%**
   Very satisfied – **24.5%**

9. Overall, how has hunting in GMU 99 or 100 changed in the last ten years? (**97 Responses**)

    It hasn't changed – **25.7%**
    The quality of bucks has increased – **16.2%**
    The quality of bucks has decreased – **12.8%**
    It is more crowded than it used to be – **21.4%**
    It is less crowded than it used to be – **5.1%**
    Other (please specify) – **18.8%**
      1. Reckless hunters, bucks about the same
      2. Hunters don't get permission and chase animals
      3. Getting permission
      4. Hard to get a tag
      5. Only hunted 1 time, so can't really say (2)
      6. Loosing areas to outfitters locking up land (7)
      7. Hunting is great in unit 100
      8. It seems like it takes a lot of preference points to draw a tag
      9. Herd seems to be smaller and bucks have decreased

10. To what extent would the following improve your pronghorn hunting experience? (Please rank with **1** being the MOST important improvement and **4** being the LEAST important improvement.) (**92 Responses**)

    Seeing larger antlered bucks –   1) **23.9%**; 2) **26.1%**; 3) **28.3%**; 4) **21.7%**
    Seeing many pronghorn of all sizes and ages – 1) **23.9%**; 2) **26.1%**; 3) **31.5%**; 4) **18.5%**
    Seeing fewer people –   1) **13.0%**; 2) **18.5%**; 3) **26.1%**; 4) **42.4%**
    Hunting with family and friends –   1) **39.1%**; 2) **29.4%**; 3) **14.1%**; 4) **17.4%**

11. How important to you is each of the following reasons to hunt pronghorn in GMU 99 or 100? (**1** being the MOST important and **4** being the LEAST important) (**92 Responses**)

    To spend time in nature –   1) **44.6%**; 2) **33.7%**; 3) **14.1%**; 4)   **7.6%**
    To obtain a trophy –   1)   **7.7%**; 2) **27.4%**; 3) **34.1%**; 4) **30.8%**
    To spend time with family/friends –   1) **63.3%**; 2) **26.7%**; 3) **10.0%**; 4)   **0.0%**
    To obtain wild game meat –   1) **52.2%**; 2) **31.1%**; 3) **16.7%**; 4)   **0.0%**
    To contribute to wildlife management –   1) **44.6%**; 2) **38.0%**; 3) **13.0%**; 4)   **4.4%**
    To reduce property damage caused by wildlife – 1) **42.4%**; 2) **27.2%**; 3) **15.2%**; 4) **15.2%**
    To contribute financially to the local community – 1) **20.7%**; 2) **32.6%**; 3) **33.7%**; 4) **13.0%**

Population Objective:
    Colorado Parks and Wildlife (CPW) strives to manage big game populations within both the biological and social carrying capacity of the herd. CPW has been managing the pronghorn herd in GMU's 99 and 100 with a population target of 1,400–1,600 pronghorn and the population is estimated to be above objective at 1,670 pronghorn. To control herd numbers and meet population objectives CPW will either increase or decrease the number of doe licenses available to hunters.

12. How would you like to see the pronghorn population be managed in GMU's 99 and 100 over the next ten years? (**108 Responses**)

    Increase greatly – **7.4%**
    Increase somewhat – **28.7%**

Stay the same – **34.3%**
Decrease somewhat – **22.2%**
Decrease greatly – **7.4%**
I am not sure. – **0%**

Buck:Doe Ratio Objective:

Pronghorn herds can be managed to maximize either the **quality** of the buck hunting experience or the **opportunity** to hunt bucks. If a herd is managed to maximize buck **quality**, there will be more mature/large bucks in the population and fewer hunters in the field (i.e., a higher buck-to-doe ratio).

If a herd is managed to maximize hunting **opportunity**, more buck licenses are typically available but there will likely be fewer mature/large bucks in the herd (lower buck-to-doe ratio). Typically, there is a trade-off between the number of licenses (**opportunity**) and the size and maturity of bucks available to hunters (**quality**).

❖ It is important to recognize that **private landowners** play an important role in the management of pronghorn in GMU 99 and 100. Currently, all of the pronghorn that make up the pronghorn herd in GMU 99 or 100 are found on private property. Meaning, access to animals on private property can influence both hunter **opportunity** and **quality** of bucks.

13. How would you like to see the number of buck licenses be managed in GMU's 99 and 100 over the next ten years? (**107 Responses**)

   a. Manage for both opportunity and quality (current management strategy). – **49.5%**
   b. Increase hunting opportunity (lower buck-to-doe ratio). *This would result in more buck licenses available, more hunters in the field, and fewer mature/large bucks.* – **15.0%**
   c. Increase hunting quality (higher buck-to-doe ratio). *This would result in fewer hunters in the field and more mature/large bucks in the population.* – **25.2%**
   d. I am not sure. – **10.3%**

14. Please use the space below to share any additional comments you may have about the pronghorn antelope herd in GMUs 99 or 100.

   1. Season should be longer to cover at least two weekends (4)
   2. Landowners should be allocated more vouchers (5)
   3. Need more public access with outfitters leasing up large tracts of land (8)
   4. Too many pronghorn in some areas need to increase licenses (9)
   5. Seeing fewer animals over the last few years (3)
   6. Landowners should draw a license more frequently than the public (3)
   7. Plenty of animals and happy with the current numbers (7)
   8. Quality of bucks has gone down (3)
   9. Split the management of the two units (1)
   10. Like to see a December doe season (1)
   11. Can't get landowner vouchers because of faulty rules with the LPP program (1)

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.

Sigmoid Growth Curve
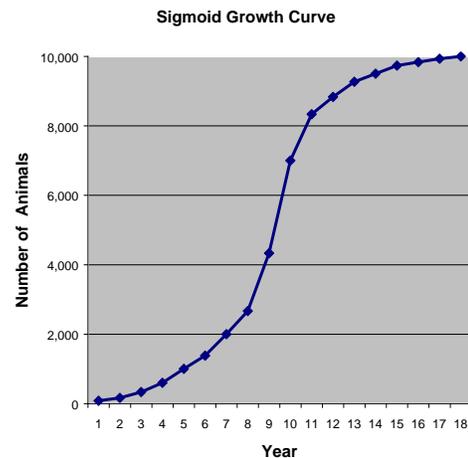
The second phase occurs when the population number is at a moderate level. This phase is characterized by high reproductive and survival rates. During this phase, food, cover, water and space are not a limiting factor. During this phase, for example, animals such as white-tailed deer have been known 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 scare 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 "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 "huntable 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.

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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.
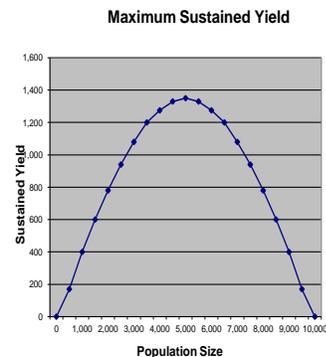
Actually managing deer and elk populations for MSY on a DAU basis is difficult if not impossible due to the amount of detailed biological information about habitat and population size required. Additionally, carrying capacity is not static, the complex and dynamic nature of the environment cause carrying 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 are 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

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