

MONTANA FISH, WILDLIFE & PARKS

Survey & Inventory Protocols for Big Game in Montana

Pronghorn Antelope

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Abstract

Survey and inventory protocols for pronghorn in Montana are described and summarized in this report. In 2011, there were 12 different survey strategies employed by biologists to monitor pronghorn populations in the state. In order, from the most common to least common, are complete coverage surveys every 3 years with production counts in years without complete coverage surveys (13 HDs), complete coverage surveys every 5 years with trend area counts in years without complete coverage surveys (13 HDs), complete coverage surveys every other year (10 HDs), complete coverage surveys periodically with annual trend counts (6 HDs), annual trend counts (4 HDs) complete coverage every 3 years with annual trend counts in years without complete coverage surveys (4 HDs), complete coverage survey every year (3 HDs), complete coverage surveys as funding allows (2 HDs), annual trend surveys with winter recruitment surveys (R-7, 6 HDs), complete coverage surveys annually with annual production counts (1 HD), annual production counts (1 HD), and complete coverage every 3 years (1 HD). In addition, most Regions that have pronghorn have check stations where hunter harvested animals are checked. S&I data is primarily used for season setting however biologists described many other uses for S&I data including; 1) informing sportsmen, FWP personnel, landowners and others in the general public about population trends, 2) descriptions of populations in land purchase or easement proposals, 3) in comments on proposed state and federal land exchange projects, 4) in comments on subdivisions, 5) for newspaper articles, 6) in comments on state and federal land use changes and 7) to inform comments on oil and gas leases and oil and gas drilling. Biologists also stressed the importance of having long-term trend data available for informed comment on unforeseen developments into the future.

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INTRODUCTION

Montana Fish, Wildlife and Parks (FWP) has the authority and responsibility to manage wildlife in the state of Montana. There are over 500 species of mammals, birds, reptiles and amphibians and FWP regulates harvest of 55 of those species that are valued for their meat, fur or as “trophies” (Montana Fish, Wildlife and Parks, 2006). In addition, FWP has the responsibility to manage other nongame wildlife for human enjoyment, scientific purposes and to ensure their survival into perpetuity. FWP personnel survey and inventory (S&I) many species of wildlife, and the data collected provides the scientific basis for management of those species and their habitat. Data collected are used to inform decisions by the Legislature, FWP Commission, other organizations with wildlife interests and governmental agencies. S&I allows FWP to monitor trends in wildlife populations in order to inform management decisions that affect 1) population abundance, 2) wildlife conflicts, 3) hunting and harvest opportunity, 4) inform habitat management and land use decisions and 5) other recreational opportunities for diverse user groups. S&I is an important part of FWP's mission which states that FWP, through its employees and citizen commission, provides for stewardship of the fish, wildlife, parks and recreational resources of Montana while contributing to the quality of life for present and future generations.

FWP has worked towards becoming more consistent with S&I protocols and has produced several documents that address protocols for individual species. The Montana Bighorn Sheep Conservation Strategy (Montana Fish, Wildlife and Parks, 2010); Management Plan and Conservation Strategies for Sage Grouse in Montana (Montana Sage Grouse Work Group, 2005); Montana Final Elk Management Plan (Montana Fish, Wildlife and Parks, 2005) and Adaptive Harvest Management (Montana Fish, Wildlife and Parks, 2001) address S&I protocols for bighorn sheep, sage-grouse, elk and deer, respectively.

In order to further improve our S&I protocols the 2004 Montana Legislature approved a new S&I specialist position for FWP which was not filled until December of 2010. The primary focus of this new position was to be on decision/operations analysis, wildlife monitoring protocols, and evaluation of data at local, regional, and statewide scales. In addition, the position was created to review existing survey protocols and provide recommendations that may modify those protocols to better meet program needs.

As a first step, this position was directed to catalog and summarize the current S&I programs for pronghorn antelope (antelope), elk and deer across the 7 FWP Regions of Montana. This effort was to focus on documenting the differences and similarities of protocols used in those surveys, and articulating how S&I data fit into wildlife management and conservation actions. Besides cataloging S&I protocols, this analysis may be used by FWP to increase efficiency and distribution of S&I dollars.

Since FWP is not centralized in its organizational structure, protocols for surveys have evolved over time and in some cases differ by Region or even within a Region by hunting district (HD). In most cases, exceptions to general S&I protocols were born out of necessity, such as requests for additional information from sportsmen or FWP commissioners; a need for data on a specific research project, research question or environmental impact statement; and/or a change in budgets or manpower availability. Often the changes in protocols involved how male animals were classified or where surveys were conducted. In many cases, once the change in protocol was made, over time, the “new protocol” became the “standard” for that area. On occasion, the reason(s) that changes were made to a “standard” protocol had been forgotten, however because long-term datasets collected in a specific format existed, new biologists often carried on the revised tradition of data collection.

FWP's S&I program addresses a broad and complex array of subjects that vary from surveys that collect data on a statewide basis to surveys that are done on a local level by biologists in a specific area for a specific reason. Some very important aspects of the S&I program that will not be discussed in detail in this document are hunter harvest surveys and hunter preference surveys, which are conducted in a centralized fashion from the FWP headquarters office. FWP's vegetation monitoring program for conservation easements and lands owned by the Department will not be discussed. Non-game monitoring by our native species biologists and wolf monitoring protocols will not be discussed. In addition, this document will not discuss in detail S&I efforts for game species other than antelope, deer and elk.

INFORMATION COLLECTION AND ASSEMBLY METHODS

To collect the necessary information on S&I protocols, interviews were conducted with most of the wildlife biologists responsible for game species management across the state. Each biologist was asked a series of questions about their S&I protocols. Biologists were asked to describe what species they surveyed, time-period for the survey, where the survey area was located, type of vehicle utilized, periodicity of the survey, and how the survey was done including time of day and flight patterns. Biologists were asked to classify their surveys to a specific type such as trend area counts, complete coverage surveys, or production counts which will all be discussed in more detail later in this document. Biologists were also asked to describe the classification data they collected, how the data were stored, and for what purposes the data were used. The primary emphasis of this undertaking was to gather information about FWP S&I protocols for deer, elk and antelope, although additional information on surveys of other species, including bighorn sheep, black bears, moose, mountain goats, furbearers, migratory game birds such as waterfowl, sandhill cranes and mourning doves, and upland game birds including sage-grouse, pheasants, and sharp-tailed grouse was gathered and may be summarized at a later date. Biologists were also asked whether or not they conducted hunter check stations, to describe what information was gathered at those check stations and how those data are stored. I also reviewed existing papers, conservation strategies, and management plans addressing S&I protocols in Montana, including but not limited to elk, mule deer, sage grouse and bighorn sheep.

In addition, each biologist was provided with a list of 20 questions that asked their opinions on the effectiveness of current survey protocols, needs they might have to improve S&I protocols and data analysis, opinions on which surveys might be eliminated, which species needed more S&I dollars for monitoring, and training needs for biologists and pilots.

The following report on antelope is one of five separate reports covering survey and inventory protocols for 1) antelope, 2) elk, 3) mule 4) white-tailed deer, and 5) a summary of the answers to the 20 questions biologists were asked.

ANTELOPE

Antelope Survey Methods

Antelope surveys are conducted in all Regions in Montana except Region 1 (R-1) which doesn't have a state administered antelope season. In the 2011 hunting season there were 65 antelope HDs in Montana. Not all HDs or Regions have antelope evenly distributed across the landscape and although R-7 geographically has the largest land mass in the state, R-6 reports the widest distribution of antelope (Table 1). In 2011 the greatest numbers of either-sex licenses were issued in R-7, but the greatest number of total licenses were issued in R-5.

Three types of aerial surveys are conducted for antelope in Montana: complete coverage surveys, trend surveys and production surveys. In complete coverage surveys all or nearly all the antelope habitat within a HD is surveyed, almost always during July, with the goals of counting all antelope in that HD and to gather information on the number of bucks per 100 does (buck:doe ratio) and number of fawns per 100 does (fawn:doe ratio). In the past, probably all antelope HDs had a complete coverage survey done periodically. In recent years, most HDs with complete coverage surveys are on a rotational schedule of 1-5 years, and several HDs are not scheduled for complete coverage surveys at all (Figure 1). Just because a complete coverage survey of a HD may be scheduled on a rotational basis doesn't mean that the survey will be completed. Because of limited budgets most Regions have to go through some type of survey prioritization exercise annually, and planned surveys may not be completed if funding is limited. In addition, manpower shortages, requirements for surveys of other species, aircraft and pilot availability, along with weather conditions can all influence whether or not a complete coverage survey is completed. Currently there are 4 HDs where complete coverage surveys are conducted annually (note HD 360 is a winter range count), 10 HDs that have complete coverage surveys conducted every other year, 18 HDs where a complete coverage survey is conducted every 3 years, 13 HDs where complete coverage surveys are scheduled to be completed every 5 years and 6 HDs where complete coverage surveys may

Table 1. Number of antelope HDs, square miles of occupied habitat, and licenses issued by Region, 2011.

Region ¹	Number HDs	Either-sex Licenses, 2011 ²	Doe/Fawn Licenses, 2011 ²	Total Licenses ²	Sq. Mi. Habitat ³
2	2	28	30	58	321
3	21	3,665	2,449	6,114	8,354
4	17	2,849	2,497	5,346	17,584
5	13	5,666	1,879	7,545	8,211
6	6	1,835	440	2,275	23,016
7	6	6,504	249	6,753	22,955
Total	65	20,547	7,544	28091	80441

¹In addition 6500 archery licenses are issued, valid in all HDs.

²License data from 2011 harvest survey records.

https://apps.fwp.mt.gov/wild/harv/hhiSearch_input.action?nav=3,0,1&mm=y.

³Habitat data, updated last in August 2008 was taken from FWP general and winter distribution maps on the FWP internal website. <https://apps.fwp.mt.gov/gis/#Wildlife>.

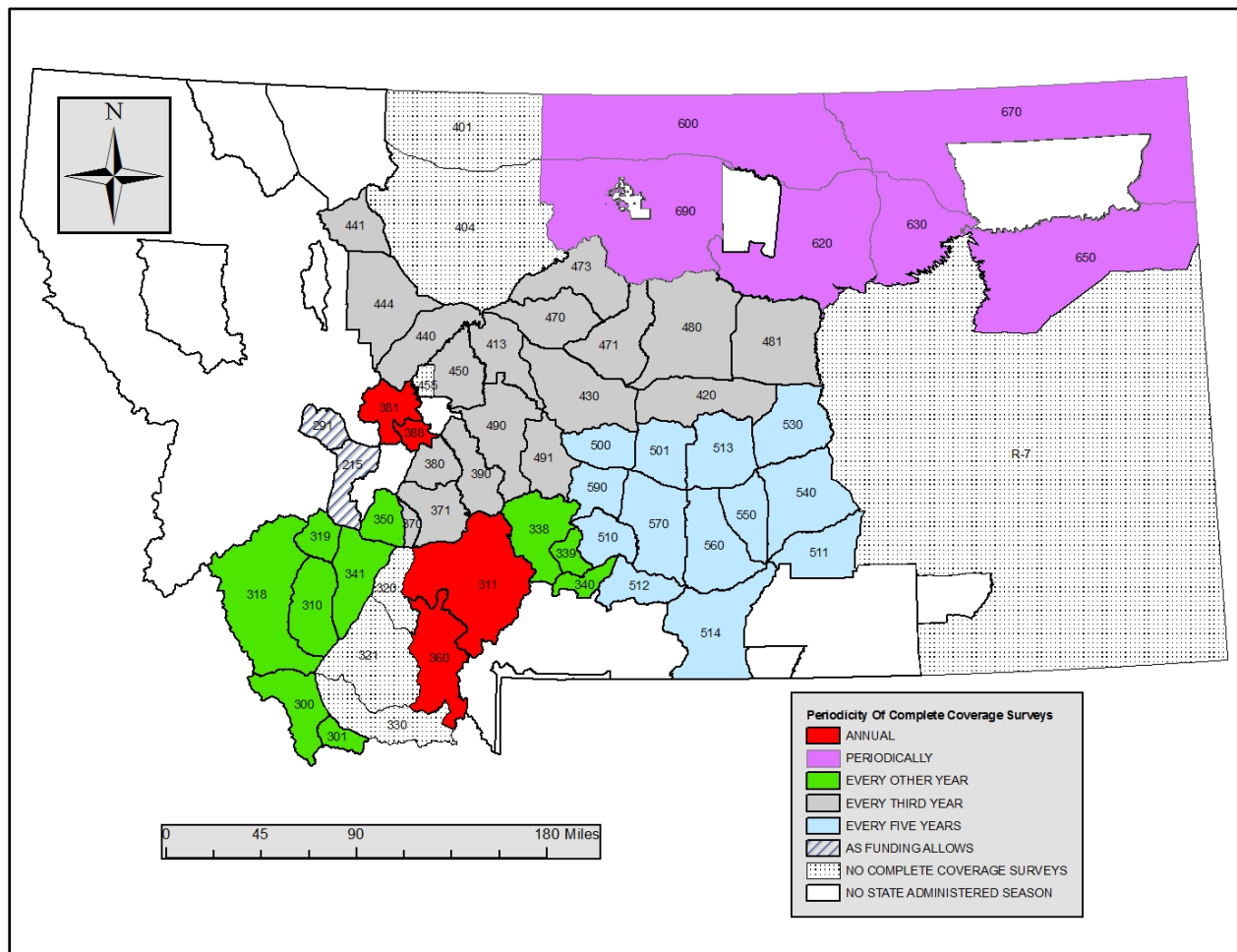


Figure 1. Schedule for complete coverage surveys by HD, 2011.

be completed periodically (Figure 1). In addition, there are 2 HDs where complete coverage surveys are conducted as funding allows and 12 HDs where complete coverage surveys have not been completed in recent history and for which there is no plan to conduct complete coverage surveys in the future.

Periodicity Of Trend Counts

- ANNUAL (POLYGON)
- NO TREND COUNTS
- NO STATE ADMINISTERED ANTELOPE SEASON

0 50 100 200 Miles

The final type of aerial survey done for antelope is the production count. In production count surveys the primary objectives are the collection of fawn:doe and buck:doe ratios. Total numbers of antelope observed are not always compared to previous counts and productivity, fawn:doe ratios, is the most

important piece of data collected. Production count surveys are done in specific areas (polygons), in the same general area on an annual basis or the survey is considered completed once a specific number of animals are classified or a specific number of hours are flown (usually 1 flight ~3.0 hours). Often production surveys are conducted in years when total surveys are not completed. Currently, there are 15 HDs in the state where July production surveys are done on a regular basis (Figure 3). In HD 360, a complete coverage survey is done annually in late winter and a summer production count is also done annually in July. Sometimes data collected during production surveys and trend surveys are nearly the same and the differences between the 2 survey types is not always clear. In general, the main difference between the 2 survey types is that the primary objective of the production survey is to gather data on fawn:doe and buck:doe ratios while the primary objective of a trend survey is to compare numbers of animals in the trend area across and among years or to predict populations of antelope in a larger area.

Figure 3. HDs where production surveys are conducted on a regular basis, usually annually unless complete coverage surveys are conducted in that HD.

Through the 2011 survey season, there were 12 different survey strategies employed by biologists to monitor antelope populations in the state (Figure 4). In order, from the most common to least common, are complete coverage surveys every 3 years with production counts in years without complete coverage surveys (13 HDs), complete coverage surveys every 5 years with trend area counts in years without complete coverage surveys (13 HDs), complete coverage surveys every other year (10 HDs), complete coverage surveys periodically with annual trend counts (6 HDs), annual trend counts (4 HDs) complete coverage every 3 years with annual trend counts in years without complete coverage surveys (4 HDs), complete coverage survey every year (3 HDs), complete coverage surveys as funding allows (2 HDs), annual trend surveys with winter recruitment surveys (R-7, 6 HDs), complete coverage surveys annually with annual production counts (1 HD), annual production counts (1 HD), and complete coverage every 3 years (1 HD). In addition there is 1 small HD, 455, where no annual aerial surveys are completed however antelope are classified from a vehicle in July to obtain fawn:doe and buck:doe ratios. A more detailed discussion of how these S&I strategies evolved can be found in the write-ups for some of the individual Regions.

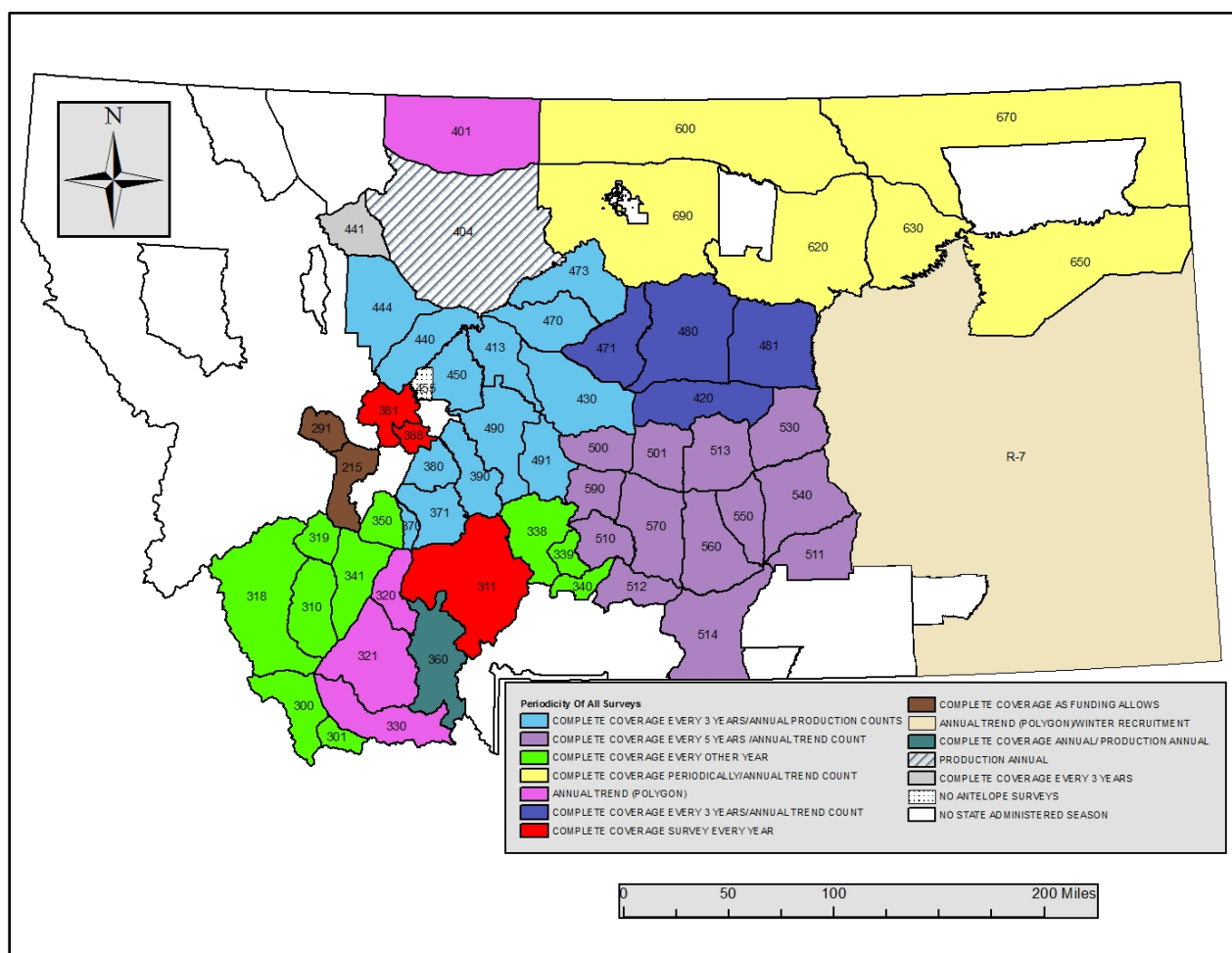


Figure 4. Survey strategies in antelope HDs, 2011.

All antelope surveys are flown with a fixed-wing aircraft, usually a Super Cub or Husky. These aircraft have 2 seats, where the observer sits behind the pilot, and the wings are above the cockpit to facilitate wildlife observations. The aircraft are designed for low-level flights where speeds can be reduced with less chance of stalling. There is nearly 100% agreement amongst biologists that the best time of the day to survey antelope is in the early morning from about ½ hour after sunrise until the antelope bed for the

day or when the airplane runs low on fuel, whichever comes first. As with any wildlife survey there are conditions that allow for longer flights and some surveys have to be cut short due to changing light and/or weather conditions. Survey conditions that facilitate the best visibility of antelope are clear, relatively cool and calm mornings. Under these weather conditions antelope tend to be grazing and are more visible than when bedded.

Nearly all antelope aerial surveys are conducted in July prior to finalizing permit levels for the following fall hunting season. Since antelope fawns will often bed separately from the larger groups of antelope prior to the first week in July most antelope surveys are not conducted until after July 4. In the late 1980's and early 1990's quota level recommendations for antelope had to be submitted by mid-August giving biologists sufficient time to complete surveys and make recommendations for quotas. Starting in the mid-1990's deadlines for submitting quota change recommendations were moved to late July. Through 2003 there were no archery only antelope licenses, and general licenses were valid during both the rifle and archery seasons. At that time the archery season coincided with the deer and elk archery season which opened the first weekend in September. In 2004, FWP began to issue archery only licenses, valid for all antelope HDs with the season beginning in the middle of August. Within a few years of that change antelope archery hunters began to complain that licenses were not issued early enough for hunters to plan their vacations to archery hunt antelope. Because of those complaints the deadline for submitting final antelope quota recommendations was moved to a date earlier in July. In 2011, the deadline for submitting quota changes to the Helena Headquarters was July 17. Quota changes had to be submitted to Regional Managers at least 2 days before the Helena deadline. Since biologists want to complete surveys before making management recommendations, there is pressure to finish surveys as quickly as possible, usually between July 5th and July 15th. In order to meet the short season setting deadline some of the survey runs are now made in the evening, 3-4 hours before sundown to sundown, under less-than-ideal light, wind or temperature conditions or prior to July 4. There are also times when surveys are completed after the season setting deadlines, and those data are used for the season setting process in the following year. In addition to the July surveys, 1 aerial survey in HD 360 and ground surveys in R-7 are done in the late winter/early spring period in March or April.

Despite the mid-summer timing of most surveys, research completed in the Yellow Water Triangle of Central Montana suggested that the best population estimates for antelope could be obtained by flying surveys in winter or spring (Watts 1990). Watts (1990) suggested that summer surveys provided poor population estimates, due to poor sightability and double counting, and if FWP's goal was to maximize harvest opportunity, then the timing of antelope surveys should be changed. A written document explaining why the recommendations of Watts (1990) were not incorporated into FWP survey protocols could not be located. Yet, implementing the Watts (1990) recommendations would be problematic because 1) biologists and pilots are already overwhelmed with winter and spring survey work on deer, elk and upland game birds while few other surveys are flown in summer, 2) summer surveys for antelope were originally initiated in the 1940's (Beer 1944) so that long-term datasets from summer surveys exist for many HDs, 3) bucks, does and fawns are easier to classify in July than in winter/spring so that the July flights would provide better estimates of fawn:doe and buck:doe ratios and 4) license levels for the following hunting season, are set shortly after flights are made, providing timely data so that necessary adjustments for emergency circumstances are possible.

In eastern Montana where terrain is relatively flat and visibility is less obstructed by terrain, biologists fly north south transects that are 1 mile apart during complete coverage and most trend area surveys. In western Montana where antelope often occupy steeper terrain, biologists are forced to decrease the distance between transects, and often transects are less than ½ mile apart. The steeper the terrain, the closer together transects have to be, and in some of the steepest terrain biologists fly along elevation contours when surveying antelope. Besides terrain affecting survey methodology, light conditions may influence transect width, with poorer light causing biologists to fly narrower transects. Since antelope are most active in the cooler early morning hours in the summer, biologists are often at the starting point of the survey area by ½ hour after sunrise. Starting surveys at ½ hour after sunrise allows the rising sun to be above the wing of the aircraft, and increases visibility to the east. In steeper terrain a later start time may be appropriate, since shadows cast by terrain features negatively affect visibility in the early morning hours. Surveys usually begin in the northeast or southeast corner of the survey area, with the surveyors

working their way west. By keeping the sun to the east of the aircraft, visibility is increased. Conversely, if flights are made in the evening, biologists usually start flying in the southwest or northwest portion of the survey area and work their way east.

Classification and Location Data Collected By Regions

There are slight variations in the classification and location data collected among the Regions. All the biologists in R-5, 6 and 7 and some of the biologists in R-3 and 4 classify bucks as yearlings or adults during summer surveys (Figure 5). Most of the biologists in the western part of the state do not differentiate between adult and yearling bucks. In 1995 some biologists started using Global Positioning System (GPS) units to record locations of antelope groups. Since those early days, GPS units have improved considerably and biologists have embraced the technology, now recording waypoints and track logs when flying most surveys. In addition biologists are now uploading to their GPS units transect routes to follow during surveys or outlines of polygons that they would like to survey within. Prior to the use of GPS units biologists marked antelope groups on maps of the areas they were surveying. Secondary data, such as numbers and locations of coyotes, raptors, and other non-target species are collected but varies, not only from Region to Region, but amongst biologists in each Region. Most biologists keep track of coyotes, and wolves in their flights, and many keep track of a wide variety of raptors, raptor nests, heron rookeries, and prairie dog towns. However, the collection of secondary data has not been

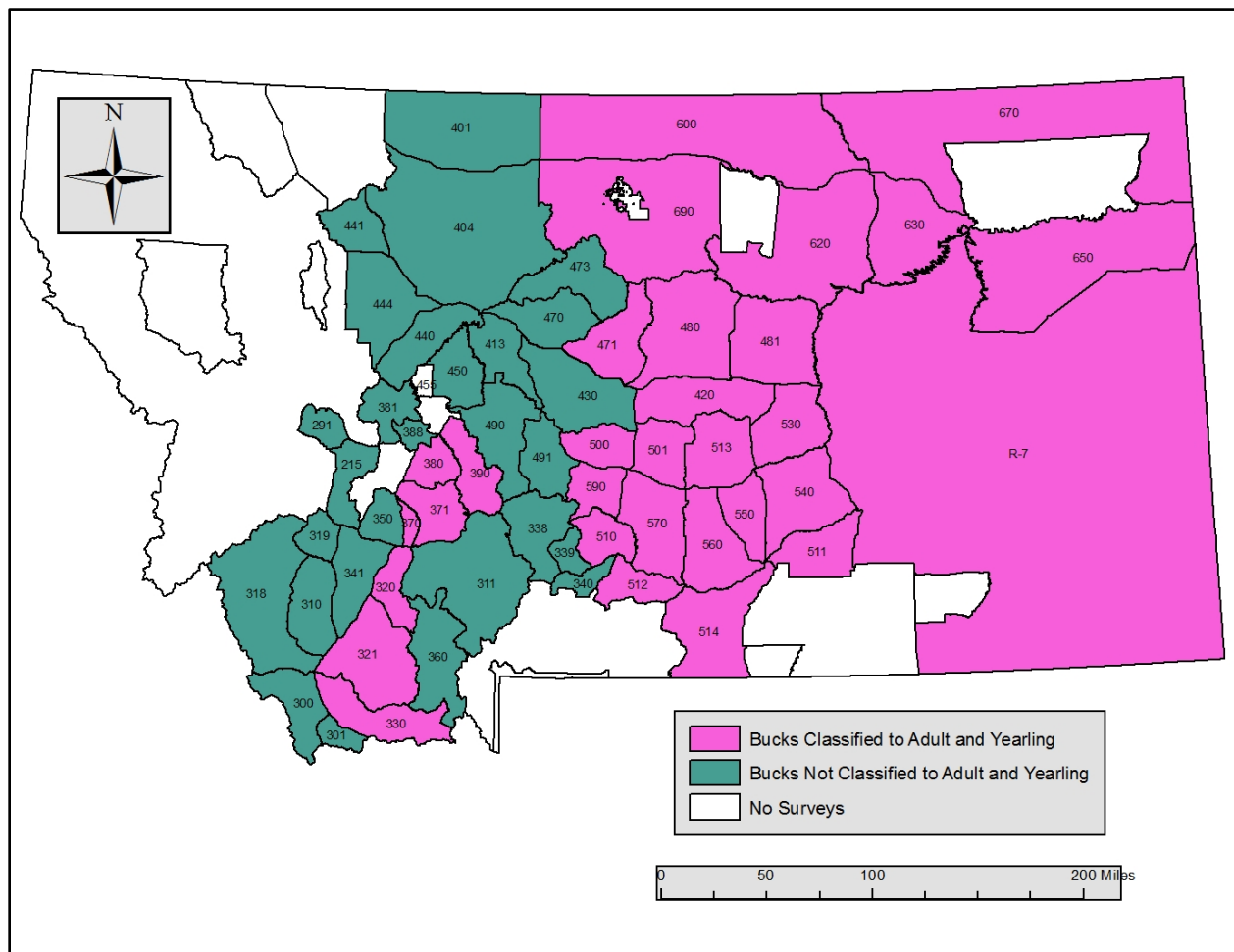


Figure 5. HDs where yearling and adult bucks are classified versus HDs where only total numbers of bucks are classified, 2011.

systematically conducted and the data are used more at the local level, rather than reported on a statewide basis.

How classification and location data have been stored varies across Regions and amongst biologists. The reason that data storage methods vary so much is that until 2012 no statewide standards have been applied to data storage and biologists devised their own methodologies for data management. These methods vary from the storage of raw data sheets in file cabinets, to biologists that combine classification and location data into databases used for mapping purposes. Biologists have used Microsoft Excel, Microsoft Word, or Microsoft Access, Dbase, ArcView, and/or ArcMap software to store their survey data. Currently FWP has been working on development of a statewide database designed to store combined classification and location data in a format that will be common amongst Regions. One of the long-term goals for having statewide databases is to enter historic data into the statewide database, but to date historical, statewide antelope survey data have not been assembled.

Antelope Check Station Data

Hunter check stations are run in all 7 Regions during the big game hunting seasons. Regions 4, 5, 6 and 7 run check stations designed to gather information specific to antelope. Antelope check stations are open on the opening and second weekends of the antelope season when there is no overlap with the general deer and elk rifle season. Most of the check stations that are open during the deer and elk general rifle season are designed to gather information on deer, elk or upland game birds however some antelope are also checked at these check stations. Data collected at check stations vary somewhat by Region. All Regions collect information on age of animals (Table 2). Age is determined by tooth eruption of the incisors and canines and antelope are placed in 1 of 5 age classes; 0.5, 1.5, 2.5, 3.5 or ≥ 4.5 years old. All Regions collect information about the sex of animals checked, and origins of the hunting party, which is usually based on county of residence and often the vehicle license numeric prefix for that county. In addition, all Regions record data on number in the hunting party, check station name, and date check station was conducted. Five of 6 Regions collect data on HD of kill and location of kill more specific than HD such as drainage, landowner or general location. In addition, 5 of 6 Regions collect data on land status of harvested animals. Land status categories vary widely across Regions with some differentiating only between private and public lands, others indicating only block management areas (BMAs) and others breaking land status into much more specific categories such as non-BMA private, BMAs, state land, Bureau of Land Management (BLM), Forest Service (USFS), Fish and Wildlife Service (FWS) and others. Five of 6 Regions collect information as to the type of tag used to harvest an animal, some recording the License Permit Type (LPT) number and some recording only whether or not the license was a doe/fawn or either-sex license. Three of the 6 Regions collect data on number in party that were successful, date of kill, off-road vehicle use, horn length, hunter ALS numbers and assign each hunting party a group number. The rest of the check station data collected are specific to only 1 or 2 Regions and are often designed to meet a specific need in that Region. Most Regions have an electronic database or databases that hold the check station data. Most Regions record information about unsuccessful hunters but data associated with unsuccessful hunters are not always entered into the electronic check station databases.

Region 2

R-2 has a total of 2 HDs that have populations of antelope which are surveyed as funding allows. One biologist is responsible for antelope surveys in this Region and these HDs have been surveyed in 4-5 of the last 10 years. The biologist in R- 2 classifies antelope to the number of does, fawns, total bucks, unclassified antelope and total antelope (Table 3). Waypoint locations for each group of antelope and track logs showing the survey flight pattern are collected and stored. The waypoint and track log data are downloaded from the GPS units through MapSource and classification data and waypoint data are combined into data tables which are stored in Excel on the biologist's computer. Because of the low numbers of antelope and low numbers of licenses issued, no check stations are run specifically for antelope in R-2.

Table 2. Check station data collected, relative to antelope.¹

Parameter	R-2	R-3	R- 4	R- 5	R-6	R-7
Check Station Name	X	X	X	X	X	X
Vehicle License/Origin of Hunter	X	X	X	X	X	X
Species	X	X	X	X	X	X
Sex	X	X	X	X	X	X
Age	X	X	X	X	X	X
Comments	X	X	X	X	X	X
Date of Check Station	X	X	X	X	X	X
Number in Party	X	X	X	X	X	X
Hunting District	X	X	X	X	X	
Landowner/Location/Drainage	X	X	X	X		X
LPT		X	X	X	X ³	X
Land Status ²		X	X	X	X	X
Number in Party Successful	X	X	X		X	X
Date of Kill	X	X	X			
Hunter Name	X	X	X			
ORV	X	X	X			
ALS Number	X	X	X			
Horn Length-1 side				X	X	X
Group Number	X				X	X
Horse Trailer	X	X				
Days Hunted		X	X			
Horn Length-2 sides						X
Resident/Nonresident/Youth	X					
Fee Charged						X
Tooth Taken		X				
Packer			X			
Biological Samples Taken		X				
Twp, Rng, & Section		X				

¹ Some questions on the check station forms were relevant to only deer, elk or other species and will be discussed in the sections on deer and elk.

² Varies by Region, see text.

³ R-6 keeps track of whether the license was valid for either-sex or for doe/fawns. The other Regions collect an actual LPT number off the license used to harvest an animal.

Table 3. Region 2 antelope surveys.

HD	Survey Type ¹	Periodicity	Classification Data Collected ²	Either-sex /Doe-Fawn Licenses, 2011
215	CC	As funding allows.	Does, Fawns, Total Bucks, Total	25/25
291	CC	As funding allows	Does, Fawns, Total Bucks, Total	3/5
Region	Total			28/30

¹ CC=Complete coverage survey.

² Biologist occasionally has groups of antelope that are unclassified does and fawns or unclassified all (does, fawns and bucks).

Region 3

R-3 has 21 antelope HDs covering an estimated 8,355 sq.mi. of antelope habitat. There are 7 biologists responsible for 2 or more antelope HDs in the Region. All 7 biologists collect waypoint and track log data in all 21 HDs that are surveyed (Table 4), however there are differences in how the survey data are

Table 4. Region 3 antelope surveys by HD.

HD	Survey Type ¹	Periodicity	Classification Data Collected ²	Either-sex /Doe-Fawn Licenses, 2011
300	CC	Biennial	Does, Fawns, Total Bucks, Total	250/100
301	CC	Biennial	Does, Fawns, Total Bucks, Total	20
310	CC	Biennial	Does, Fawns, Total Bucks, Total	200/250
311 ³	CC	Annual	Does, Fawns, Total Bucks, Total	200/250
318	CC	Biennial	Does, Fawns, Total Bucks, Total	450/500
319	CC	Biennial	Does, Fawns, Total Bucks, Total	50/25
320	Trend Area	Annual	Does, Fawns, Ad. & Yrl Bucks, Total	25/25
321	Trend Area	Annual	Does, Fawns, Ad. & Yrl Bucks, Total	225/75
330	Trend Area	Annual	Does, Fawns, Ad. & Yrl Bucks, Total	500/350
338	CC	Biennial	Does, Fawns, Total Bucks, Total	400/400 ⁴
339	CC	Biennial	Does, Fawns, Total Bucks, Total	100
340	CC	Biennial	Does, Fawns, Total Bucks, Total	100
341	CC	Biennial	Does, Fawns, Total Bucks, Total	275/150 ⁴
350	CC	Biennial	Does, Fawns, Total Bucks, Total	40/10
	CC	Annual		
360	Production Area	Annual	Does, Fawns, Total Bucks, Total	500/200 ⁴
	CC	Every third year		
370	Production Area	Off Years	Does, Fawns, Ad. & Yrl Bucks, Total	50/100
	CC	Every third year		
371	Production Area	Off Years	Does, Fawns, Ad. & Yrl Bucks, Total	75/150
	CC	Every third year		
380	Production Area	Off Years	Does, Fawns, Ad. & Yrl Bucks, Total	50/100-50 ⁴
381	CC	Annual	Does, Fawns, Total Bucks, Total	25
388	CC	Annual	Does, Fawns, Total Bucks, Total	50/100-50 ⁴
	CC	Every third year		
390	Production Area	Off Years	Does, Fawns, Ad. & Yrl Bucks, Total	75/100-75 ⁴
Region	Total			3660/2135-925 ⁴

¹ CC=Complete coverage survey.

² Biologists occasionally have groups of antelope that are unclassified does and fawns, unclassified all (does, fawns and bucks) or groups of bucks that are unclassified.

³ Nearly all the antelope habitat is surveyed in HD 311 although one large ranch that doesn't allow hunting and another smaller area west of 287 are not surveyed.

⁴ Up to this number issued only to individuals that possess an either-sex license

collected and stored within the Region depending upon the biologist in charge of the survey (Table 5).

Six of the 7 biologists use the free program DNR Garmin to download waypoints and track logs from GPS units to computers and one uses the program All-Topo. Five of 7 biologists do not classify bucks to yearling and adults, only keeping track of total bucks. Four of 7 biologists have combined classification and waypoint data for storage and analysis using 3 different programs, Microsoft Access, Excel and Word. All the biologists have the capability to make maps of individual flights and usually do in order to

Table 5. Data collection and storage of flight data by Region 3 biologists.

Biologist	Upload Wpts & Track Logs	Classification Data Collected ¹	Program Used to Combine Classification & Location Data
Boccadori	DNR Garmin	Does, Fawns, Total Bucks, Total	Microsoft Word
Brannon	All-Topo	Does, Fawns, Ad. & Yrl Bucks, Total	No
Carlsen	DNR Garmin	Does, Fawns, Ad. & Yrl Bucks, Total	No
Cunningham	DNR Garmin	Does, Fawns, Total Bucks, Total	Excel, & Shape Files for ArcMap
Fager	DNR Garmin	Does, Fawns, Total Bucks, Total	Microsoft Word
Loveless	DNR Garmin	Does, Fawns, Total Bucks, Total	Excel, & Shape Files for ArcMap
Sika	DNR Garmin	Does, Fawns, Total Bucks, Total	Access & Shape Files for ArcMap

¹ Individuals also occasionally have groups of antelope that are unclassified does and fawns, unclassified all (does, fawns and bucks) or groups of bucks that are unclassified.

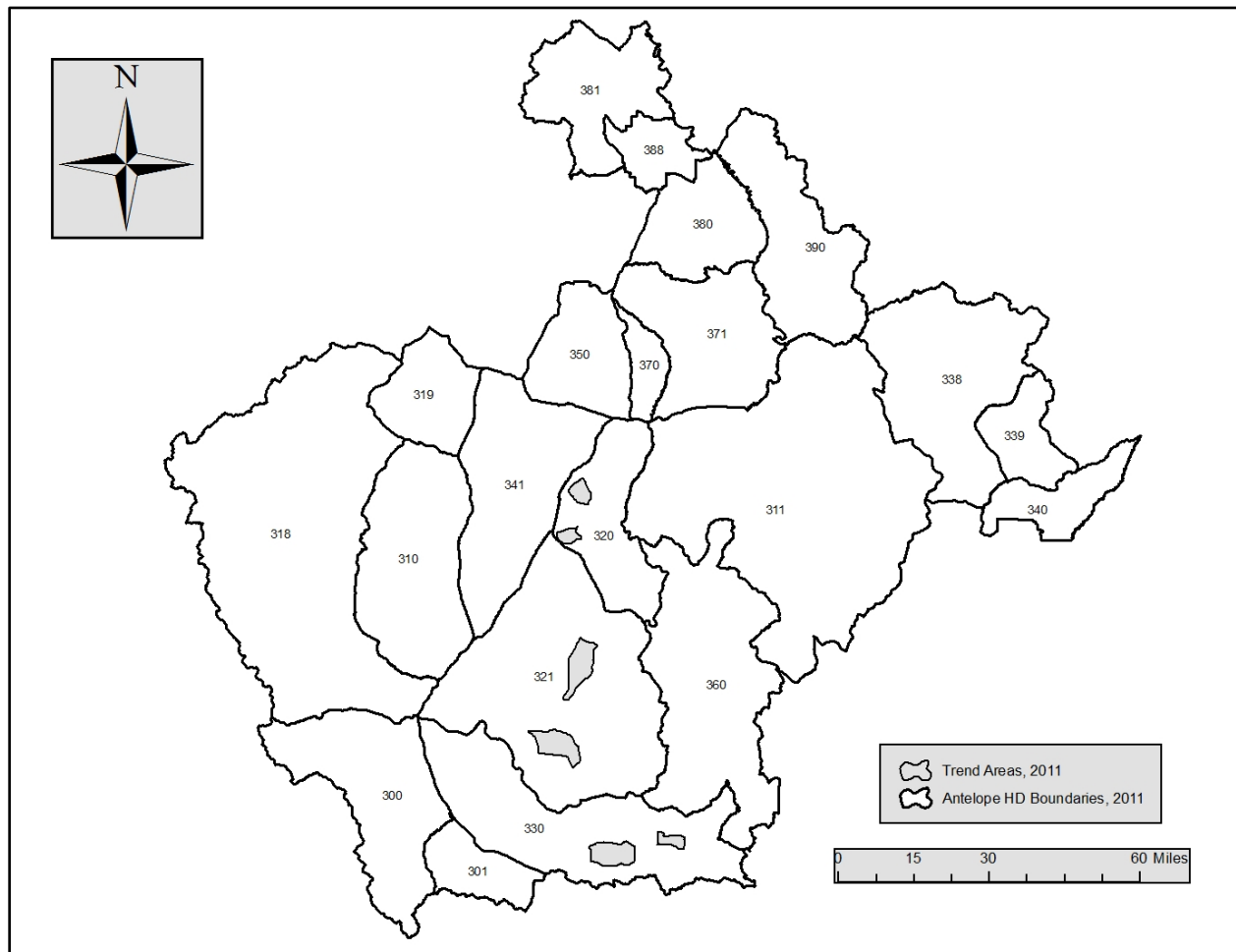


Figure 6. Location of antelope trend areas in Region 3. Complete coverage and production survey areas not displayed.

provide a flight summary following each survey. No check stations are open specifically for antelope in R-3, however a few antelope are checked at deer and elk check stations which are open throughout the deer and elk rifle hunting season. One R-3 biologist flies trend area counts in HDs 320, 321, & 330 (Figure 6).

Region 4

R-4 has 17 antelope HDs covering an estimated 17,584 sq.mi. of antelope habitat. There are 5 biologists responsible for 2 or more antelope HDs in the Region. All 5 biologists collect waypoint and track log data in the 16 HDs that are surveyed (Table 6), however there are differences in how the survey data are collected and stored within the Region depending upon the biologist in charge of the survey (Table 7). All 5 biologists use the free program DNR Garmin to download waypoints and track logs to their computers from GPS units. Four of 5 biologists do not classify bucks to yearling and adults, only keeping track of total bucks. Four of 5 biologists have combined classification data and waypoint data for a number of years using 3 different programs, Microsoft Access, Excel and Word. No check stations with long-term data sets are open specifically for antelope in R-4, however in recent years a check station has been open during the antelope season in the White Sulphur Springs area and in the recent past, a check station was open just outside of Great Falls during the antelope season. In addition, a few antelope are checked at 2 deer and elk check stations that are open during the deer and elk rifle season. Two R-4 biologists fly trend area counts in HDs 401, 420, 471, 480, & 481 (Figure 7).

Table 6. Region 4 antelope surveys by HD.

HD	Survey Type	Periodicity	Classification Data Collected ¹	Either-sex /Doe-Fawn Licenses, 2011
401	Trend Area	Annual	Does, Fawns, Total Bucks, Total	500/400
404	Production Area	Annual	Does, Fawns, Total Bucks, Total	500/300
413	CC	Every third year	Does, Fawns, Total Bucks, Total	100/200
	Production Classify 200-250	Off Years		
420	CC	Every third year	Does, Fawns, Ad. & Yrl Bucks, Total	50/25
	Trend Area	Off Years		
430	CC	Every third year	Does, Fawns, Total Bucks, Total	150/100
	Production Flight Time	Off Years		
440	CC	Every third year	Does, Fawns, Total Bucks, Total	75/50
	Production Area	Off Years		
441	CC	Every 2 to 3 Years	Does, Fawns, Total Bucks, Total	20
444	CC	Every third year	Does, Fawns, Total Bucks, Total	150/100
	Production Area	Off Years		
450	CC	Every third year	Does, Fawns, Total Bucks, Total	150/300
	Production Classify 400-500	Off Years		
455	No Surveys	No Surveys Incidental Observations	Does, Fawns, Total Bucks, Total	5
470	CC	Every third year	Does, Fawns, Total Bucks, Total	150/50
	Production Classify 200-250	Off Years		

Table 6. (cont.)

HD	Survey Type	Periodicity	Classification Data Collected ¹	Either-sex /Doe-Fawn Licenses, 2011
471	CC	Every third year	Does, Fawns, Ad. & Yrl Bucks, Total	75/25
473	Trend Area CC	Off Years Every third year	Does, Fawns, Total Bucks, Total	150
480	Production Classify 200-250 CC	Off Years Every third year	Does, Fawns, Ad. & Yrl Bucks, Total	200/25
481	Trend Area CC	Off Years Every third year	Does, Fawns, Ad. & Yrl Bucks, Total	100/25
490	Trend Area CC	Off Years Every third year	Does, Fawns, Total Bucks, Total	350/700
491	Production Flight Time CC	Off Years Every third year	Does, Fawns, Total Bucks, Total	125/150
Region Total				2850/2450

¹CC=Complete coverage survey.

² Biologists occasionally have groups of antelope that are unclassified does and fawns, unclassified all (does, fawns and bucks) or groups of bucks that are unclassified.

Table 7. Data collection and storage of flight data by Region 4 biologists.

Biologist	Upload Wpts & Track Logs	Classification Data Collected ¹	Program Used to Combine Classification & Location Data
Grove	DNR Garmin	Does, Fawns, Total Bucks, Total	Shape Files for ArcMap
Loecker	DNR Garmin	Does, Fawns, Total Bucks, Total	Excel, Word, Shapefiles for ArcMap
Lonner	DNR Garmin	Does, Fawns, Total Bucks, Total	Excel & Word
Olson	DNR Garmin	Does, Fawns, Total Bucks, Total	None
Smith	DNR Garmin	Does, Fawns, Ad. & Yrl Bucks, Total	Excel

¹ Biologists also occasionally have groups of antelope that are unclassified does and fawns or unclassified all (does, fawns and bucks) or groups of bucks that are unclassified.

Region 5

R-5 has 13 antelope HDs covering an estimated 8,211 sq.mi. of antelope habitat. There are 3 biologists responsible for 4 or more antelope HDs in the Region. All 3 biologists collect waypoint and track log data in the 13 HDs that are surveyed (Table 8). All 3 biologists use the free program DNR Garmin to download waypoints and track logs to their computers from GPS units. All 3 biologists classify bucks to yearling and adults and combine classification data and waypoint data. Once the classification and location data are combined by individual biologists it is combined together at the Regional level. Combined data were stored in Dbase IV+ for a number of years and in recent years has been moved to Microsoft Excel (Table 9). R-5 has 3 check stations that are open on opening weekend of the antelope season located in Billings, Big Timber and Broadview. Check stations are closed the second weekend of the antelope season. There are additional check stations open for the deer and elk season and some antelope are

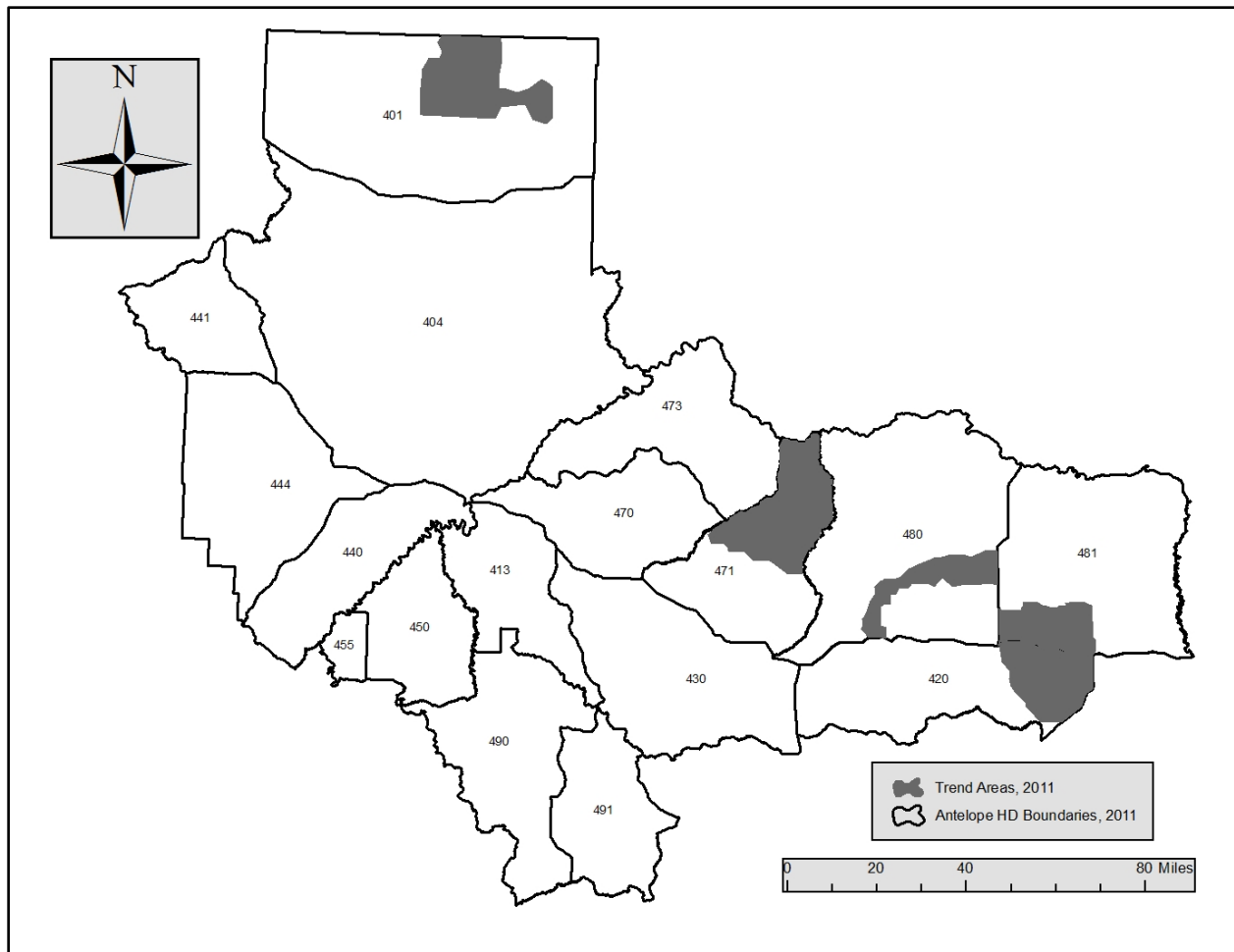


Figure 7. Location of antelope trend areas in Region 4. Complete coverage and production survey areas not displayed.

checked at these check stations. Check station data are entered and stored in a Regional Excel database.

Between the mid 1980's and 2007 antelope in each HD of Region 5 were counted as part of a complete coverage survey, a subunit survey (trend) or not surveyed on an annual basis. Each HD was divided up into subunits whose boundaries generally were along creeks or roads within the HD. In the late 80's an analysis was completed comparing the counts in a subunit, or group of subunits to the total counts within each district. Individual subunits or groups of subunits whose population trend(s) were most strongly correlated to the total population were selected for survey trend areas. A linear regression model for each HD, which used subunit counts to calculate total population estimates, was built. In some HDs, where the relationship between the subunit count and total count was strong resulting in r^2 values of 0.90 or higher, biologists felt relatively confident that the linear regression equations were providing reliable total population estimates. In other cases, r^2 values were very low and biologists lacked confidence in the linear regression equation used to estimate populations from the subunit counts. An example of this poor relationship occurred in HD 500 where the $r^2 = .316$ yet nearly 50% of the antelope habitat in that HD was flown for the trend area counts.

Most HDs, other than HDs 512 and 514, had a subunit or complete coverage survey flown in them every other year while HDs 512 and 514 were scheduled for a complete coverage survey every 5th year. There was some variability in the schedule, which was dependent upon the population trend in an individual HD,

or research that may have influenced the timing of a total survey. Typically, about 50% of the HDs were surveyed annually with a subunit or complete coverage count however in most years the biologists and game manager met to discuss the survey plan prior to the antelope survey season.

R-5 changed to their current antelope survey system in 2008. The reasons for changing to the new survey system were to decrease the number of hours dedicated to flying antelope, make sure that each

Table 8. Region 5 antelope surveys by HD, 2011.

HD	Survey Type ¹	Periodicity	Classification Data Collected ²	Either-sex /Doe-Fawn Licenses, 2011
500	CC	Every 5 years	Does, Fawns, Ad. & Yrl Bucks, Total	500/200
	Trend Area ³	Off Years		
501	CC	Every 5 years	Does, Fawns, Ad. & Yrl Bucks, Total	400/25
	Trend Area ³	Off Years		
510	CC	Every 5 years	Does, Fawns, Ad. & Yrl Bucks, Total	600/600
	Trend Area ³	Off Years		
511	CC	Every 5 years	Does, Fawns, Ad. & Yrl Bucks, Total	300/100
	Trend Area ³	Off Years		
512	CC	Every 5 years	Does, Fawns, Ad. & Yrl Bucks, Total	125/25
	Trend Area ³	Off Years		
513	CC	Every 5 years	Does, Fawns, Ad. & Yrl Bucks, Total	400/5
	Trend Area ³	Off Years		
514	CC	Every 5 years	Does, Fawns, Ad. & Yrl Bucks, Total	150/75
	Trend Area ³	Off Years		
530	CC	Every 5 years	Does, Fawns, Ad. & Yrl Bucks, Total	400/5
	Trend Area ³	Off Years		
540	CC	Every 5 years	Does, Fawns, Ad. & Yrl Bucks, Total	100/25
	Trend Area ³	Off Years		
550	CC	Every 5 years	Does, Fawns, Ad. & Yrl Bucks, Total	200/25
	Trend Area ³	Off Years		
560	CC	Every 5 years	Does, Fawns, Ad. & Yrl Bucks, Total	800/200
	Trend Area ³	Off Years		
570	CC	Every 5 years	Does, Fawns, Ad. & Yrl Bucks, Total	1000/100
	Trend Area ³	Off Years		
590	CC	Every 5 years	Does, Fawns, Ad. & Yrl Bucks, Total	700/500
	Trend Area ³	Off Years		
Region	Total			5675/1885

¹CC=Complete coverage survey.

² Biologists occasionally have groups of antelope that are unclassified does and fawns, unclassified all (does, fawns and bucks) or groups of bucks that are unclassified.

³ Trend areas are used to estimate total numbers in HD.

Table 9. Data collection and storage of flight data by Region 5 biologists.

Biologist	Upload Wpts & Track Logs	Classification Data Collected ¹	Program Used to Combine Classification & Location Data
Beyer	DNR Garmin	Does, Fawns, Ad. & Yrl Bucks, Total	Excel & Shape Files for ArcMap
Paugh	DNR Garmin	Does, Fawns, Ad. & Yrl Bucks, Total	Excel & Shape Files for ArcMap
Stewart	DNR Garmin	Does, Fawns, Ad. & Yrl Bucks, Total	Excel & Shape Files for ArcMap

¹ Biologists also occasionally have groups of antelope that are unclassified does and fawns or unclassified all (does, fawns and bucks) or groups of bucks that are unclassified.

HD in the Region had survey information on an annual basis, and to increase the accuracy of the total count estimates. Prior to 1995, biologists in R-5 recorded group locations on BLM land ownership maps as they flew surveys. Starting in 1995-96, biologists used GPS units to locate antelope groups and then downloaded the locations to the computer and added classification information about each group of antelope. Data from mapped locations were digitized into a database in the late 1990's and the same fields were added to those databases. In addition, to the fields describing the sex and age composition of the antelope groups, information such as type of count (total or subunit), date, year, time of day, etc. were recorded. Data sets of complete coverage surveys completed in July were used to conduct an analysis of the correlation between possible trend areas and total counts in the HD. The number of complete coverage surveys used for the analysis per HD varied from a low of 6 in HD 540 to a high of 13 in HD 530.

Once the data from the total surveys were checked for accuracy, 8 different grid sizes, from 5 mi. x 5 mi. increasing in size by 1 mi. x 1 mi. up to 12 mi. x 12 mi., were overlaid on the Region and all antelope locations. Individual grids were uniquely numbered, and with ArcMap 9.3 each antelope location was assigned to an individual grid of each size. Once each location had an associated grid assigned to it the number of yearling, adult, and total bucks, does, fawns and total antelope were summed in each individual grid.

Next, decisions were made as to what grids would be used for further analysis. If a grid sum for any of the monitoring parameters (yearling, adult and total bucks, does, fawns and total counts) was zero, in a specific year, that grid was removed from further analysis. A correlation coefficient (r) was calculated on the total number of antelope in every grid compared to the total number of antelope observed in the complete coverage survey that year. Once all the r-values were calculated, and grids with zero counts were eliminated, grids that had r-values of .85 or higher were selected for further analysis. There were exceptions to this method. Three HDs, 512, 513, and 550, didn't have an individual grid with r-values greater than .85, and HD 514 had such a small number of total surveys no grid(s) were selected to represent the entire population. In HDs 513 and 550 the r-values were increased above .85 by selecting 2, geographically separated, grids in each HD. In HD 512 biologists chose to do a complete coverage survey of a small portion of that HD even though it had a low r-value, and in HD 514 a grid was selected that would estimate the population of subunit 6, which provided habitat for a majority of the antelope present in the HD. Since grid boundaries were square and HD boundaries were irregular, it was possible that only a small portion of a grid would fall within the bounds of a HD. Therefore, biologists selected grids for further analysis that were for the most part within the bounds of the selected HD. Grids less than 64 mi² were not used, except in HD 512 where the antelope are found in 2 geographically isolated areas of the HD, and 33.7 mi² included the entire area of antelope habitat in one of those areas. Biologists attempted to select a grid or grids in an area where several different size grids having high r-values overlapped each other. Then slight adjustments were made to the grids, aligning their east and west boundaries with section lines. After adjusting the grid (hereafter referred to as a trend area) to the section lines biologists once again summed each of the classification parameters and calculated an r-value for each of the monitoring parameters. Additional adjustments to the trend areas were sometimes necessary to ensure that a relatively high r-value was maintained on the total count estimate after re-alignment with section lines. Biologists in R-5 believed that an accurate estimate of the total count was the most important outcome. Therefore, they selected trend areas based on their correlation with total counts, not their relationship with the other parameters. The result of this analysis was a trend area in each of the 13 HDs that make up R-5 (Figure 8). In addition, a decision was made to fly a complete coverage survey in

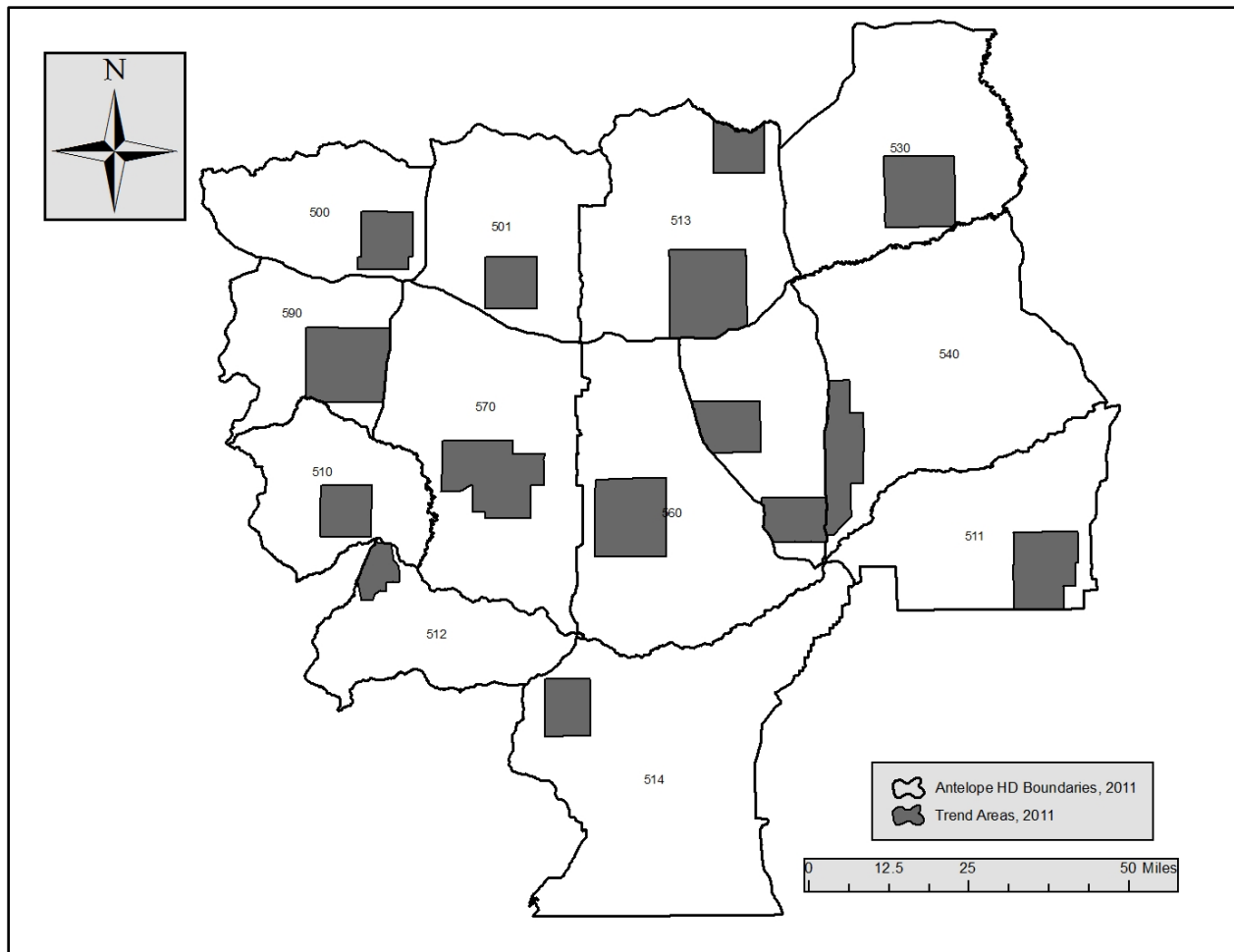


Figure 8. Location of antelope trend areas in Region 5. Complete coverage survey areas not displayed.

each HD once every 5 years to check the accuracy of the trend areas in predicting total counts of antelope.

Region 6

R-6 has 6 large antelope HDs covering an estimated 23,016 sq.mi. of antelope habitat. There are 4 biologists responsible for 1 or more antelope HDs in the Region. All 4 biologists collect waypoint and track log data in the 6 HDs that are surveyed (Table 10). All 4 biologists use the free program DNR Garmin to download waypoints and track logs to their computers from GPS units. All 4 biologists classify bucks to yearling and adults and 2 biologists combine classification and waypoint data using Excel (Table 11). R-6 has 1 check station, located in Havre, which is open on opening weekend of the antelope season and then every weekend after that until the end of the big game season. Data from this check station are entered and stored in a Regional Excel database.

All of the antelope HDs in R-6 are divided up into counting units (CUs). CU size was based on how much area could generally be flown in a single flight. Between approximately 1980 and 1989, R-6 made population estimates for antelope by expanding the selected CUs total count for that year by the proportional relationship between the CUs total and HD total counts from the most recent full-coverage survey of the HD, or by flying a complete coverage survey. R-6 began its current survey methodology, with some modifications, in 1989. Although historical records are not clear, it is likely that CUs post-1989

Table 10. Region 6 antelope surveys by HD, 2011.

HD	Survey Type ¹	Periodicity	Classification Data Collected ²	Either-sex /Doe-Fawn Licenses, 2011
600	CC	Periodically	Does, Fawns, Ad. & Yrl Bucks, Total	300/50
	Trend Area	Off Years		
620	CC	Periodically	Does, Fawns, Ad. & Yrl Bucks, Total	600/100
	Trend Area	Off Years		
630	CC	Periodically	Does, Fawns, Ad. & Yrl Bucks, Total	10/5
	Trend Area	Off Years		
650	CC	Periodically	Does, Fawns, Ad. & Yrl Bucks, Total	200/25
	Trend Area	Off Years		
670	CC	Periodically	Does, Fawns, Ad. & Yrl Bucks, Total	25/10
	Trend Area	Off Years		
690	CC	Periodically	Does, Fawns, Ad. & Yrl Bucks, Total	700/250
	Trend Area	Off Years		
Region	Total			1835/440

¹CC=Complete coverage survey.

² Biologists occasionally have groups of antelope that are unclassified does and fawns, unclassified all (does, fawns and bucks) or groups of bucks that are unclassified.

Table 11. Data collection and storage of flight data by Region 6 biologists.

Biologist	Upload Wpts & Track Logs	Classification Data Collected ¹	Program Used to Combine Classification & Location Data
Hemmer	DNR Garmin	Does, Fawns, Ad. & Yrl Bucks, Total	Excel & Shape Files for ArcView
Henry	DNR Garmin	Does, Fawns, Ad. & Yrl Bucks, Total	None
Johnson	DNR Garmin	Does, Fawns, Ad. & Yrl Bucks, Total	Excel & Shape Files for ArcView
Thompson	DNR Garmin	Does, Fawns, Ad. & Yrl Bucks, Total	None

¹ Biologists also occasionally have groups of antelope that are unclassified does and fawns or unclassified all (does, fawns and bucks) or groups of bucks that are unclassified.

were similar or the same as CUs pre-1989. Using correlation analysis the CU's that best predicted total numbers of antelope for the HD were selected to be surveyed on an annual basis. Prediction lines were developed for age and sex classes in a HD by regressing the totals for each age-sex class on the same animal class in the selected CUs. Regression estimates for appropriate sex and age classes were then summed to calculate a total population for the HD. As part of the methodology, complete coverage surveys were to be flown periodically to make sure that the CUs selected were still representative of the total number counted in the HD and if necessary new CUs would be chosen as trend areas for the HD.

Since going to this type of S&I protocol in 1989, R-6 has not done very many complete coverage surveys and in the last 15+ years the CUs have been used as trend areas for the HDs (pers. comm.. Mark Sullivan). The reasons that the CUs are now used as trend areas are the antelope specialist for R-6 that did the original analysis took a new position and at about that same time field personnel lost IT support for the software used to do the analysis. Losing both the biologist and software used to do the analysis left the new biologist in a position that made it very difficult to move forward with the established S&I protocol. In R-6 trend area counts are not used to predict the total numbers of antelope in the HDs; instead total numbers in the trend areas are compared annually. Regional personnel believe that changes in the number of antelope in the CUs are representative of what is happening in the rest of the HD although

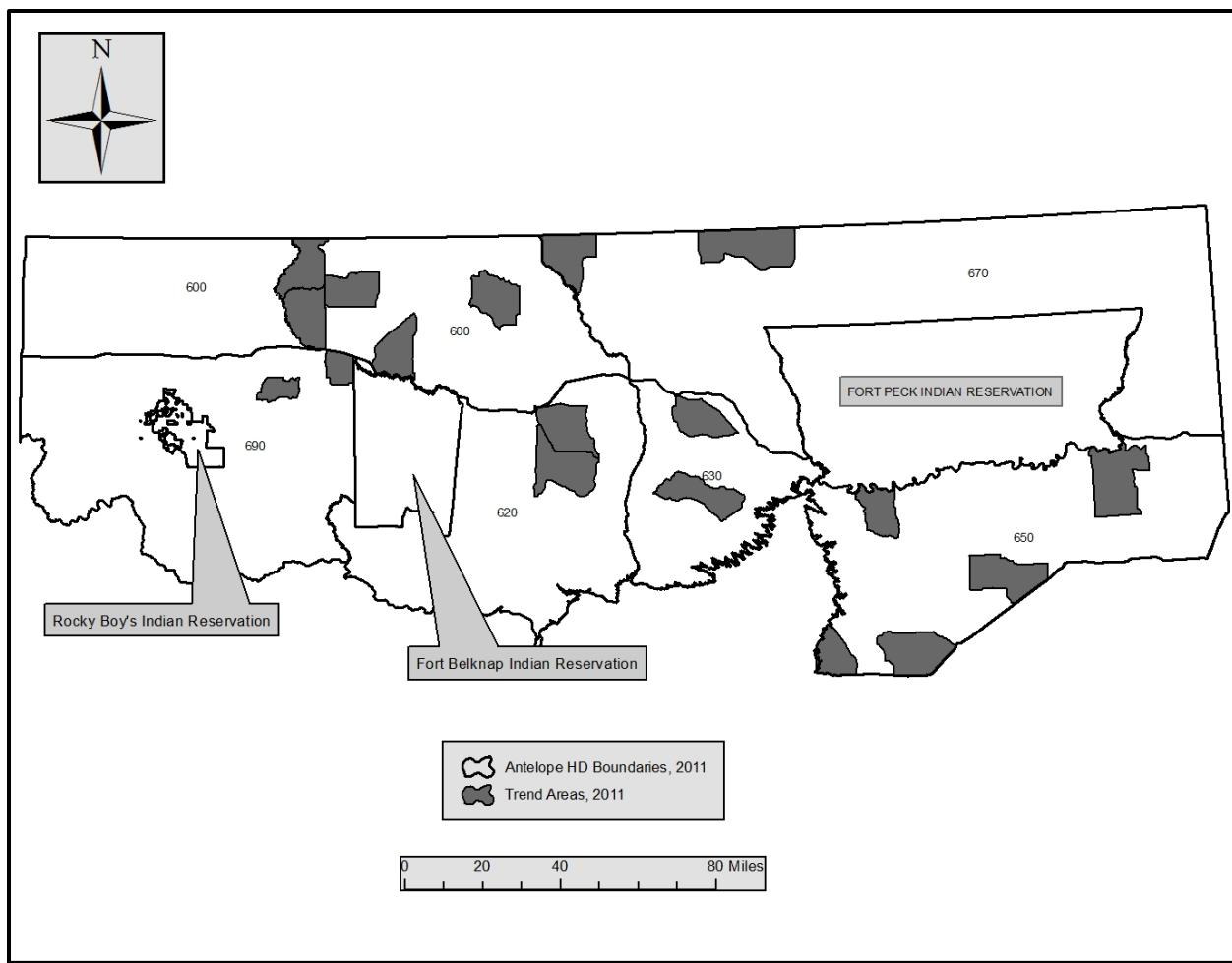


Figure 9. Location of antelope trend areas (counting units) in Region 6.

there is an interest in reviving the original S&I protocol. All 4 biologists now fly trend area counts in the 6 HDs that make up R-6 (Figure 9).

Region 7

R-7 has 6 large antelope HDs covering an estimated 22,955 sq. mi. of antelope habitat. There are 4 biologists responsible for 1 or more antelope HDs in the Region. Three of the 4 biologists collect waypoint and track log data from the 4 trend areas that are surveyed (Table 12). Three of the 4 biologists use the free program DNR Garmin to download waypoints and track logs to their computers from GPS units. All 4 biologists classify bucks to yearling and adults and 1 biologist has combined classification and waypoint data for a number of years using Excel (Table 13). Unlike the other 6 Regions, R-7 combines data from all their trend areas to make season recommendations for license levels for the entire Region. R-7 biologists also conduct surveys along designated roads in the late winter/early spring period. Data collected along these routes is different than the data collected in July. Biologists classify coming yearling bucks and does (previous year's fawns) and adult does and bucks. No waypoint or track log data are collected during these surveys. R-7 has 3 check stations that are open for the opening weekend of the antelope season located in Mosby, Hysham and Broadus. Additional check stations are open during the deer and elk rifle seasons and antelope are also checked at those check stations. Data from check stations are entered and stored in a Regional Excel database. Figure 10 shows the location of trend areas flown in R-7, not including a trend area that is flown in HD 704 as part of an energy monitoring program.

Table 12. Region 7 antelope surveys by HD, 2011.

Area	Survey Type	Periodicity	Classification Data Collected ¹	Either-sex /Doe-Fawn Licenses, 2011
	Trend Area Count		Does, Fawns, Ad. & Yrl Bucks, Total	
R-7	Spring Vehicle Production Track	Annual	Coming Doe and Buck Yearlings, & Adult Does and Bucks	6500/250 For Region
704 ²	Trend Area	Annual	Does, Fawns, Ad. & Yrl Bucks, Total	NA
Region	Total			6500/250

¹ Biologists also occasionally have groups of antelope that are unclassified does and fawns or unclassified all (does, fawns and bucks) or groups of bucks that are unclassified.

² This is an energy development study area that has been flown each year since 2008.

Table 13. Data collection and storage of flight data by Region 7 biologists.

Biologist	Upload Wpts & Track Logs	Classification Data Collected ¹	Program Used to Combine Classification & Location Data
Burt	DNR Garmin	Does, Fawns, Ad. & Yrl Bucks, Total	None
Denson	None	Does, Fawns, Ad. & Yrl Bucks, Total	None
Hidebrand	DNR Garmin	Does, Fawns, Ad. & Yrl Bucks, Total	None
Waltee	DNR Garmin	Does, Fawns, Ad. & Yrl Bucks, Total	Excel

¹ Biologists also occasionally have groups of antelope that are unclassified does and fawns or unclassified all (does, fawns and bucks) or groups of bucks that are unclassified.

Uses of Antelope S&I Data

The primary use for data collected during antelope surveys and at check stations is to provide information for managers to make annual and biennial recommendations for season setting. Season setting, which for antelope involves setting either-sex and/or doe/fawn license levels, is done on a HD basis in each Region, except R-7 where license levels are set for and valid for the entire Region. Biologists use a combination of flight survey data, check station data, harvest survey estimates and discussions with landowners, sportsmen and game wardens to support their season setting decisions. In some cases, not all of these sets of data are available for the decision making process. In the best-case season setting situation, biologists would have an estimate of how many animals were going to be available to harvest at the time the rifle season (when a majority of the animals will be harvested) opened, 3 months after surveys are conducted. They would also know how many licenses issued would result in 1 antelope being harvested, the success rates of hunters, and the number of landowners that were going to allow access to the animals. In addition, they would be able to accurately predict range conditions for the rest of the summer, which affects distribution of antelope, and the severity of the following winter which would affect both recruitment and survival into the following year's population. Biologists rarely encounter the best-case scenario for season setting, and the S&I program has evolved over time to gather information that gives the best estimate of the parameters needed to set seasons within a limited budget, under existing manpower limitations and in a timely fashion. Season setting is difficult, and biologists and game managers are charged with using their observations to predict the future for large complex systems that are under a continual state of change.

Biologists have pointed out the difficulty in estimating actual populations of big game animals (MDFWP, 2005), and they recognize that trend counts are conducted to determine the relative change in population numbers over a long time period. Biologists know that complete coverage surveys of entire HDs or for

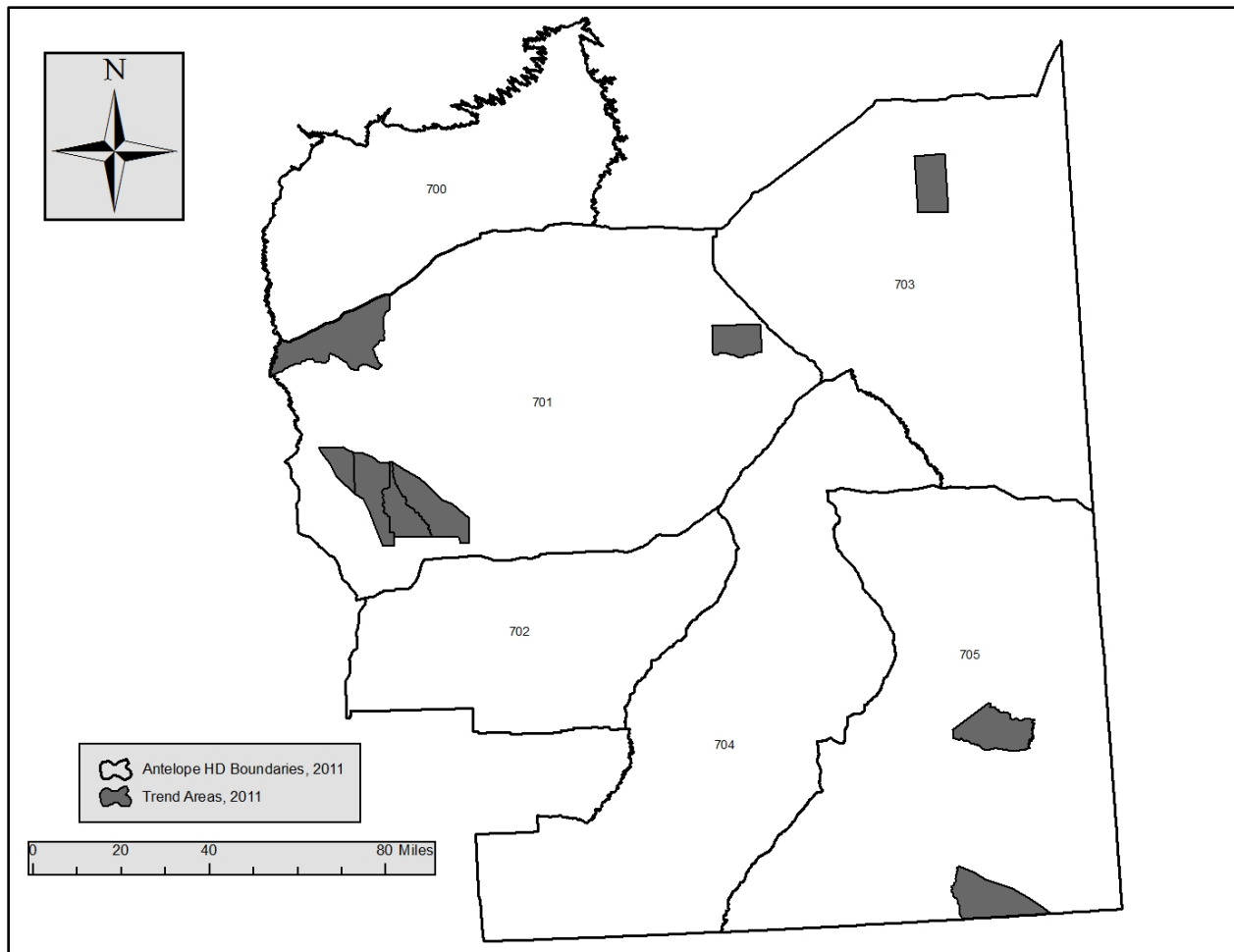


Figure 10. Location of antelope trend areas in Region 7.

that matter, trend areas, most often undercounts actual numbers of animals. By conducting surveys under similar weather conditions, at specific times of the year, and with consistent and trained biologists and pilots, biologists try to eliminate as much sampling variability as possible and note when abnormal survey conditions necessitate cautious treatment of particular counts. When considering season changes biologists look for trends in various population parameters that point in the same direction. Interpretation of data collected is not always straightforward, and in some cases trends that should logically be headed in the same direction are not.

Antelope season setting justifications contain a variety of information, somewhat dependent upon what data are collected in the given year and the type of change. For example, consider 4 HDs and 1 Region that made changes to the quota levels for antelope for the 2011 hunting season (Table 14). In all cases the manager that submitted the recommended change looked at more than 1 trend when justifying the change in the license levels. In 4 of the 5 areas a specific population objective (based on animals observed) had been established, and in all 5 areas managers took into consideration the change in population trend in the area. When reading through season justifications it is apparent that trend count data are one of, if not the most important, pieces of information collected by biologists in order to justify season changes. The reason these data are so important is that when the counts are high or above average, it is likely that the population is doing well and quota levels can be maintained or increased. It is also apparent that fawn:doe ratios are very important to informing hunting season decisions. In all 5 justifications managers discuss the observed fawn:doe ratio (Table 14). In R-7, fawn:doe ratios were based on observations made while doing spring ground surveys, whereas in the other 4 areas the

Table 14. Typical data analyzed to inform antelope hunting season change justifications in 4 HDs and 1 Region in 2011.

Parameter	Hunting Districts				
	310	490	530	620	Region 7
Population Obj.	500-600	1050	5000-5500	2.0-2.6 Sq. Mi.	
Number observed	1100	1972	1680	0.8 sq.Mi.	63% of LTA ¹
Record High Count	Current Count	Current Count	8088	1043	NU ²
Record Low Count	477	559	Current Count	Current Count	NU
\bar{x} =Fawn:Doe Ratio ³	NU	\bar{x} =55:100	\bar{x} =80:100	80-100 (Obj.)	\bar{x} =71:100
Observed Ratio ⁴	46:100	56:100	20:100	32:100	57:100
\bar{x} =Buck:Doe Ratio ³	NU	40:100 (obj.)	\bar{x} =50:100	40-50:100 (obj.)	\bar{x} =59:100
Observed Ratio ⁴	26:100	42:100	27:100	40:100	51:100
\bar{x} =Yrl Buck:Doe Ratio ³	NC ²	NC	\bar{x} =20:100	NU	NU
Observed Ratio ⁴	NC	NC	17.4:100	Very Low	NU
\bar{x} =Yrl:100 Adults (spr.) ³	NC	NC	NC	NC	103
Observed Ratio ⁴	NC	NC	NC	NC	64
\bar{x} =Harvest ³	NU	\bar{x} =379	\bar{x} =1139	NU	NU
Observed Harvest ⁴	NU	314	301	NU	NU
\bar{x} =Buck Harvest ³	NU	\bar{x} =143	\bar{x} =666	NU	NU
Observed Buck Harvest ⁴	96	153	222	NU	NU
\bar{x} =Success ³	NU	NU	NU	\bar{x} =54%	NU
Observed Success ⁴	NU	NU	NU	\bar{x} =55%	NU
\bar{x} =Days Per Ant ³	NU	NU	2.7	NU	NU
Observed Days Per Ant ⁴	NU	NU	\bar{x} =5.3	NU	NU
\bar{x} =% Adults \geq 4.5 Years ³	NA	NU	NU	NU	Bucks 38% Does 42%
Observed % Adults \geq 4.5 ⁴	NA	NU	NU	NU	Bucks 80% Does 72%
\bar{x} =Doe Yrls Checked ³	NU	NU	\bar{x} =24.4%	NU	NU
Obs. Doe Yrls Checked ⁴	NU	NU	\bar{x} =10.4%	NU	NU
Change in ES licenses	No change	Increased 75	Decreased 200 ⁵	Decreased 600	Decreased 2000
Change in D/F Licenses	Increased 100	Increased 300	Decreased 20 ⁵	Decreased 400	Decreased 1500

¹LTA=Long term average.

²NU= Not used in justification but available, NC=Not collected.

³Mean values for the HD or Region.

⁴Values observed in 2011 for the HD or Region.

⁵Numbers of licenses have been reduced by 900 either-sex and 2600 doe/fawn since 2007.

fawn:doe ratio was observed in July prior to the season. Fawn:doe ratios are so important because the numbers of fawns in the population speaks not only to the productivity in a given year but to the productivity of the habitat where the population resides. Antelope are found in a wide variety of habitats in Montana, and productivity of individual populations varies greatly. Because productivity varies greatly by habitat and across years, potential harvest rates also vary greatly, even in the same population. In addition, fawn:doe ratios collected in July are used to predict how many antelope may be recruited into the population the following spring, following the hunting season. When setting seasons it is easier to predict population declines than population increases because if fawn:doe ratios are low in July we know that they will not improve, however if fawn:doe ratios are high we can't always predict whether or not they will remain high or decline before the following spring. In general, if ratios are low in July it is assumed that we may see a declining population into the future resulting in more restrictive season recommendations. Buck:doe ratios are also calculated by biologists. In those HDs where bucks are classified to yearling and adult, biologists use information on yearling bucks to discuss the previous year's

survival of fawns, and that piece of information plays into the overall picture of what is happening in the population. Three of the 5 justifications discuss the number of yearling bucks per 100 does, number of yearlings per 100 adults or number of yearlings observed at check stations (Table 14). Biologists also use buck:doe ratios to monitor trends in buck numbers which is of interest to that portion of the hunting public that wants to kill a buck. In addition, some HDs have specific objectives set for minimum observed buck:doe ratios and either-sex license levels are set to try and stay above those objectives.

Finally, changes in seasons are also affected by what has happened in years prior to the current season change. In HD 530, where the very low antelope numbers presented and the relatively minor reduction in license numbers seem not to match one can get a feel for the magnitude in season adjustments by looking at previous year's changes. In the previous 3 season setting years 2008, 2009 and 2010 the number of either-sex licenses and doe/fawn licenses were reduced by 700 and 2575, respectively.

Check stations are also a part of our S&I program and data are collected on an annual basis. Check station data are used to verify the accuracy of the hunter harvest survey data, and to allocate total harvest generated by the harvest surveys into age-sex classes of animals, since hunters often call fawns either does or bucks when telephone surveys are conducted. Correct allocation of harvest classes is important when managers estimate expected kill rates on either-sex and doe/fawn licenses. Many of the biologists interviewed calculated an expected kill rate from each of the licenses issued in a HD. These expected kill rates were used to estimate the total number of bucks, does and fawns one might expect to be killed in a given season. This expected kill could then be compared to the current fawn:doe ratio and a prediction could be made as to whether one would expect a decline or increase in the following year's population based only on harvest rates. Because predictions of future populations rely on so many assumptions and the fact that we have no way to predict future natural mortality rates, the predictions are usually not included in season justifications but are used only to assure that there are more than enough fawns available at the time of the survey to replace the projected harvest.

Most biologists discussed how important hunter contacts were and how check stations gave them an opportunity to talk to a large number of hunters, hunting in a wide variety of habitats. Hunters helped to confirm or dispel observations made in July from the air. Check station data also provides an alternative index to recruitment as the proportion of female yearlings in the female harvest (probably a better indicator of the previous year's recruitment than the July surveys), general age structure of the population, and an index to hunter success. In addition, check stations are sometimes used to gather biological information that includes parameters on health. Check stations have been used as a place to survey hunters about their preferences for hunting, and other wildlife observations (e.g., wolf or moose observations). Check station data also informs biologists on where animals are being harvested and hunter access problems; many check stations gather data on private versus public land use and/or how many hunters are hunting on Block Management Areas (BMAs). In season setting, check station data are used both quantitatively and qualitatively. In a quantitative sense 2 of the 5 justifications used check station data to justify season setting in 2011, one to look at yearling does in the harvest and one to look at the percentage of bucks and does over 4.5 years old (Table 14). In a qualitative sense the justification for HD 490 stated that hunters, presumably at check stations, were complaining about their inability to find access and increases in license levels may be ineffective if hunters couldn't find additional access.

Besides using survey and check station data, managers rely on statewide harvest survey data collected through telephone surveys to help set seasons on an annual basis. Harvest estimates are used by biologists to help confirm trends that they are observing in the field. Total harvest and buck harvest was used to justify license quota changes in 3 of the 5 justifications compared (Table 14). Success rates are an important factor in season setting as higher success rates may indicate a greater availability or higher numbers of antelope in the population and vice-versa. In addition, information about numbers and classes of animals harvested gives biologists additional data to estimate how many harvested animals are likely to result for each license issued, which helps to inform recommendations for season changes.

Finally, season setting also has to take into consideration hunter access to the animals, hunter preferences and land-owner tolerance of both hunters and animals. Data on land-owner tolerance of both hunters and antelope may be the most difficult data to gather and often there is no systematic method to

collection and use of those data. In many cases we assume that data we collect such as success rates are surrogates for things such as land-owner tolerance of hunters or availability of antelope to hunters. In some cases parameters like this can mean one thing in one area and something different in another. Interpretation of these data can be difficult and is open to more criticism than other data we collect. Until recently, antelope numbers in the central part of the state were at record highs and often seasons were set on what was believed to be landowner tolerance of hunters, not on what level of harvest the population could sustain.

Most biologists believed that the second most important use of the S&I data, beyond season-setting, was for informing sportsmen, FWP personnel, landowners and others in the general public about antelope population trends. The public has an expectation that our management of wildlife populations is based on scientific knowledge of wildlife populations. There were many other diverse uses for the survey data collected including descriptions of antelope populations in lands proposals, in comments on proposed state and federal land exchange projects, in comments on subdivisions, for newspaper articles, in comments on state land uses such as breaking of native ground and grazing changes, and to inform comments on oil and gas leases and oil and gas drilling. In some cases funding for our survey flights comes from sources such as the oil and gas industry and may be used to describe potential impacts or to inform mitigation. Finally, biologists stressed the importance of having long-term trend data available for informed comment on unforeseen developments into the future.

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