Mortality transects are almost always completed along the same routes as pellet group and browse transects. Mortality transects simply record all deer by sex and age classes observed.

*Note:* I recommend the following method for appraising overwinter range use by mule deer. It combines and improves upon all of the above methods. I successfully used this method on the Cache management unit between 1994 and 2003.

I recommend that 15 transects be established on each deer management unit. It is estimated that the 15 transects would require an annual field time of 40 hours in the spring to collect data. Additional hours may be required in the fall to sweep the plots from any transect used by sheep in summer or fall. All transects should be placed in the vicinity of five-year permanent trend transects on critical winter range.

Each of the 15 transects are comprised of 50 plots. Plot numbers 1 and 50 are marked with six-foot T-steel posts driven into the ground as deep as possible. Plot numbers 2 through 49 are marked with 24 to 36-inch long, three-quarter-inch wide angled iron, with 6 to 12 inches remaining above the ground. All plots are spaced at 10-meter intervals in a line. Directions are given with respect to magnetic north. At each plot, a one-meter-squared circular area (radius equaling 0.56 meters) is used to count rabbit pellets, and a 10-meters-squared circular area (radius equaling 1.78 meters) is used to count big game pellet groups. All pellets are annually removed from the plots. In each plot the individual shrub nearest to the plot center, but within a maximum distance of five meters from the plot center, is located. An ocular estimate for percent overwinter utilization of the current annual growth at five percent intervals is made for each available shrub species.

Overwinter mortality is recorded from the time the investigator leaves the vehicle. Following completion of the data collection for that transect, the investigator returns to the vehicle via a different route. Using the length of the route, including the 490 meters along the transect, and the average hiking distance to the first plot plus the return distance to the starting point, and an estimated 100 meter mortality sampling width, I estimated each transect represents a mortality assessment on about a mean of 15 hectares of winter range.
Range Trend Surveys

Determining long-term changes in vegetative production, cover, and composition on winter ranges is important because the amount and types of vegetation determine the carrying capacity of the range. In cooperation with other state and federal agencies, the Utah Division of Wildlife Resources has monitored range trend throughout Utah on state and federal lands since 1957, and has been using permanently marked plots since the mid-1980s (Utah DWR 1958–2008). Permanently marked plots have the advantage of evaluating range conditions from the exact same locations. Range trend surveys are conducted on each unit on a five-year rotating basis.

Range trend is monitored during summer using between 20 and 40 transects on each of Utah’s 30 deer management units. Selected “key” areas where mule deer traditionally have established a pattern of winter use during normal weather conditions over a long period of time are normally selected as study areas by the biologist or conservation officer with the most experience on the unit. Each transect consists of five 100-foot sampling belts, with the ends permanently marked with steel rods to insure precise area sampling. Data collected at plots along the sampling belt include vegetative cover and density, species composition, ground cover, and shrub age, form, and vigor classes (Daubenmire 1959).

From these data, the trend of range conditions can be determined. Range trend data answer several questions: Is the general range condition improving, declining, or remaining the same for mule deer in winter? Are weedy species invading the range? Is shrub productivity changing? Is vegetative composition changing? Is ground cover changing, leading to possible changes in surface erosion? In general, what has been the degree of deer utilization of shrubs in winter? Does the current management plan for the area need to be altered to meet the changing range conditions?

Field Notes

Wildlife biologists, who spend considerable time in the field observing wildlife and habitat, acquire a “feel” for the ecology of the deer herd. They can detect when a herd is doing well and when it is struggling, and then
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use the hard data to back up their understanding. Before the methodologies of data collection were developed, biologists relied very heavily on the “feel of the system.” Simple field notes can be used to clarify and strengthen points for which collected data may be somewhat inadequate or even fail to clearly answer the question.

Field notes are recorded throughout the year. Records made during hiking or horseback trips or while traveling by vehicle are often used in reference to evaluate populations and are sometimes heavily relied upon for making hunting recommendations. A few examples from my field notes follow:

- June 15, 1982. Several photos of the Little Valley area on the Vernon deer unit were taken from the ridge top immediately north of the major spring and above the campground.
- February 21, 1984. In Blacksmith Fork Canyon near Left Hand Fork, several fawns were heard moaning. One fawn I approached was unable to stand. Winter mortality is high, most fawns and many adults will die before spring.
- May 23, 1990. On the large alfalfa field in Lost Creek, 13 deer and 4 elk were observed using a spotlight count about 1 hour after sunset.
- April 18, 2003. 6:10 am. Arrived at six-mile lek (sage grouse) in the dark, wind at 2 (Beaufort scale), overcast, 35 degrees F. About 8-10 birds flew off lek at first light before a good count could be taken. Weather prevented counts on other leks and spring classification deer counts.

In the first example, a visual comparison to vegetative change was obtained in an area that was later burned by wildfire. In the second example, the field observations in February supported the recruitment classification counts collected later in the spring. In the third example, all observations regarding depredation of private crops become important if the landowner feels justified in submitting a crop loss claim. The fourth example is the kind of information which often leads to the apprehension of wildlife violators. In the final example, where hard data could not
be collected, field notes may be the only reliable source of information, especially if no other counts were subsequently obtained from that particular lek. Also, the lack of deer classification data collected on that date could be back-checked and attributed to weather.

**Questionnaire Surveys**

Most statewide information on yearly deer harvest and hunter success, as well as hunter attitudes, is obtained through questionnaires. Postal service mail questionnaires are sent to randomly selected hunters immediately after the end of the specific hunts to obtain hunter success and harvest. Unfortunately, return rates of mailed questionnaires are low, usually less than 50 percent, even with repeated mailings. Harvest is calculated using only those cards returned. Non-response bias from questionnaires not returned can inflate calculated harvest figures. Mailed questionnaires are most effective for smaller hunts and hunting areas when all participating hunters are sent questionnaires. Examples of uses of mailed questionnaires, which are now rarely used, include pre-season antlerless control hunts and limited-entry hunts.

Telephone surveys virtually eliminate non-response bias and are used to assess the general deer hunts. Telephone surveys are more accurate than mailed questionnaires, especially for statewide hunts. After hunters are randomly selected, they are called on the telephone by trained operators. Generally the same hunter success and harvest data that were collected with the mailed questionnaire are obtained using a telephone survey.

Longer surveys, addressing hunter attitudes and opinions, can be obtained by both methods. However, because of the extremely low response rate to written questionnaires, telephone surveys are currently used almost exclusively.

**Applied Research**

Often the most important branch of any organization for maintaining long-term viability is its research division. In most cases, investments made into research yield benefits far exceeding the costs associated with the research. Applied research, which can be directly related to management decisions, invariably results in economic as well as long-term benefits to the resource and the resource user.
Applied research addresses problems or questions identified by management. Once a problem has been identified, the researcher writes a proposal critically defining the issues to be addressed and the scientific methods used to address the problem. Proposals often are rewritten several times until the manager and the researcher are both satisfied that the proposal will address the problem, and that the approach will answer the questions. The research is then conducted using the defined scientific methods and for the period of time specified in the proposal, with periodic progress reports submitted to the manager. In most deer management applied research, project length is usually between one and five years. At the completion of the project a final report is written, often in the form of a publication, and submitted to a technical journal.

Note: Publication of results is extremely important to maintain the results for future reference and management decisions not only within the state, but also to share research efforts, costs, and results with all other interested states and parties. For example, one of my research publications on rangeland management was referred to by a guide explaining range management methods during a Kellogg Foundation tour on the Serengeti grasslands near the borders of Tanzania and Kenya, East Africa.
Chapter 17

How to Manage a Mule Deer Herd—Essentials in Data Collections and Management Decisions

Management Limitations

During the non-hunting season, which is unfortunately most of the year, many hunters reminisce of past experiences but, probably even more often, daydream of the forthcoming hunts. Similarly, wildlife biologists in charge of managing Utah’s deer herds dream, consider, and analyze various alternatives to improve the management within their geographical areas. Certainly all managers could do a better job of understanding the wildlife resources within their areas if they were not constrained by time and money.

Consequently any discussion on “how to manage a deer herd” must be defined in terms of resources available to a herd’s management. As a practical estimate for this chapter, it is assumed the deer unit is of medium size for Utah or about 650,000 acres, and an experienced biologist can devote about one-sixth of his or her time, two months per year or 40 days, in collecting data, observing, and managing the deer herd. In reality, few if any of Utah’s 30 or so in-the-field wildlife biologists have that much time available to focus on a single species on an individual management unit.

The Blue Mountain Mule Deer Herd

The first necessary piece of information the biologist must have is the delineation of the herd boundary and unit. That is, the home ranges of deer, both summer and winter, must be defined for each individual herd
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unit. In many cases, distinct deer populations occupy different ranges on the same management unit, and these sub-populations along with their ranges should be further defined (Pac et al. 1991). Also, in some cases deer populations may occupy a common summer range but separate onto distinctly different winter ranges.

For example, the Blue Mountain summer range plateau, in northeastern Utah, lies at the eastern end of the South Slope Wildlife Management Unit, and borders the Utah-Colorado state line and Dinosaur National Monument. During the period between 1972 and 1976, mule deer were trapped and tagged on the two major winter ranges on the Utah side of the plateau: in Miners Gulch, which is on the south side of the summer range plateau, and in the Cub Creek area which is on the west side of the summer range. These two winter ranges were separated by minor geographical barriers with few if any deer found in the intermediate area. During five years of observation with over 100 marked deer, deer from both winter ranges mixed and utilized the same summer range plateau. The dispersal of both groups was random over the summer plateau, including some dispersal into Colorado and onto the Monument. However, after migration to winter ranges in late fall, the two groups remained distinct. No observations were made of deer being marked on one winter range and later being observed on the opposite winter range.

The two groups of deer on winter ranges showed different population dynamics over winter (Austin et al. 1977). As expected, because of the occupation of same summer range, both subpopulations migrated onto the separate winter ranges with similar fawn-to-adult ratios, averaging 60 for Cub Creek and 53 for Miners Gulch. However, after winter the ratios were widely different. The Cub Creek area remained essentially unchanged and averaged 59 fawns per 100 adults, but the Miners Gulch population declined to 29 fawns per 100 adults. I further postulated that the initially slightly lower fall ratio in Miners Gulch may have been due to fawn losses before classification counts were completed. Clearly, the population dynamics on the winter ranges were different between the two subpopulations.

These kinds of information are important to managers in maintaining healthy populations. If, for example the total population increased dramatically and needed to be substantially reduced to bring the herd back into balance with the winter range resources through issuing of antlerless control permits, both populations should not be equally hunted. If
the hunts were conducted in the early fall when the subpopulations occupied the common summer range, both subpopulations would be hunted equally and the manager may not achieve the harvest and total population goals for each subpopulation. Because the Miners Gulch subpopulation is much more susceptible to hunting losses, hunting on the summer range may remove an excessive number of deer from the Miners Gulch subpopulation. Furthermore, as a second management option, if the subpopulations were hunted late in the fall on winter ranges and permits were issued over the entire area, which is often the case, that part of the area with the better access would receive the majority of the hunters and hunting pressure, particularly if weather limited the access to the second area. The subpopulation with better access and more public land was the Miners Gulch, and again this option would leave the Miners Gulch subpopulation susceptible to over-harvest. The obvious solution to address an excessive number of deer in this real example would be to issue permits for each subpopulation separately, with the Miners Gulch population receiving a much more conservative number of permits issued.

This example demonstrates how excessive harvest could easily occur on a subpopulation through a management decision if the population dynamics for the separate subpopulations were unknown. Critical points to this example include the concept that subpopulations are restricted to certain ranges during only parts of the year, and consequently, are more susceptible during that period and importantly, can be over-harvested. Subpopulations and subunits, especially on winter ranges, often need to be evaluated separately. Finally, emigration, movement and reestablishment of deer populations onto winter ranges where deer numbers have been greatly reduced is extremely slow, usually taking several years, even when adjacent populations are high.

Although this example used the analysis of how a manager might use various options to address an overpopulation of deer using subunit winter ranges, the same evaluation could be considered for a low deer population. With respect to several management factors, including differences in predation, winter range forages, winter range condition, development, access, migration corridors, human harassment, and many others, the management strategy would often be different between subunits.

Most units require similar evaluations of subpopulations. On the Cache unit, for example, the deer use of winter ranges is further complicated by deer migrating from both Idaho and Wyoming onto Utah’s
Jared Austin feeds deer at a Hardware Ranch enclosure. The research determined dietary choices, activity patterns, and consumption rates of alfalfa hay.

winter ranges. To address the problem, the Cache unit has been subdivided into 10 distinct subpopulations for assessment of dynamics on the winter range. Three of those subpopulations contain a mixture of Utah-Idaho or Utah-Wyoming deer, and seven subpopulations are composed of almost all Utah deer.

**Essential Data**

Seven sets of data are usually considered essential by wildlife professionals. These data are necessary for understanding deer population dynamics and for efficient and knowledgeable management of the deer herd. These seven sets of data are:

1. Hunter harvest
2. Age and sex determination of harvested deer
3. Reproduction and sex ratio classification
4. Recruitment classification
(5) Annual winter range condition and utilization assessment
(6) Long-term winter range condition trend assessment
(7) Hunter opinion assessment

**Hunter Harvest**

The administrative segment of most wildlife agencies, including Utah, collects total harvest by management unit through the use of hunter surveys. These surveys are usually in the form of telephone interviews conducted following the hunts. These data are extremely important in assessing yearly changes in the harvest and long-term trends in harvest. These surveys determine the total number of buck and antlerless deer harvested statewide and within management units.

The accuracy of harvest data, especially the buck harvest, is essential in making population estimates and understanding the dynamics of each unit. Sometimes the accuracy of harvest data is questioned due to the inherent difficulties of data collection from a sample of hunters. Those potential inaccuracies primarily occur from non-response bias and inaccurate hunter response. Non-response bias occurs when selected hunters cannot be contacted by phone. Inaccurate hunter response sometimes occurs when hunters report harvesting a buck when they did not. Two examples of this factor lead to relatively common inaccuracies. In one scenario, two hunters in a party shoot at the same buck and they both claim the harvest even though only one tags the deer. In the second, a hunter wounds a buck and is unable to locate the animal, but reports a harvested buck. Both of these factors—non-response bias and inaccurate hunter response—generally lead to inflated harvest figures. Furthermore, regression analysis, which compares checking station data with harvest data, usually supports the probability of somewhat inflated harvest figures.

**Age and Sex Determination of the Harvest**

To obtain age and sex composition of the harvest requires observation of hunter-harvested deer during the hunts. This is usually accomplished either through randomly obtained field checks or checking stations. Checking stations are usually more effective because a larger sample can be obtained and more detailed information can be collected. As a minimum data set, all deer checked by either method should be recorded as male or female and aged as fawn, yearling, two-and-a-half years, or three-and-a-half years and
older. Ages must be determined by cutting the cheek, splitting apart the jaw, and examining the teeth for replacement and wear.

Age classification of the female population is very important in the use of modeling populations and general management of the herd. For example, a herd containing more than 20 percent does over the age of eight years would have lower reproductive rates than the same herd with less than five percent of the does exceeding eight years in age.

Whenever possible, I suggest information on carcass weight, antler parameters, physical condition and a more detailed age classification should be obtained at checking stations. These more detailed data should be collected at least once every three to five years. Although often very difficult to achieve, a minimum sample size of 15 deer should be obtained in each age and sex class. Thus, excluding fawns and using four age classes, the two sex classes, and 15 deer within each class, a minimum of 90 deer are needed for each herd unit. On buck-only units a minimum of 45 bucks are needed. On some units two or three years of combined data may be needed to obtain an adequate sample size. A practical goal for most herd units would be to check 50 bucks yearly, 100 bucks during the years of higher intensity data collection, and annually as many does as possible.

Carcass weight, or hog-dressed weight, is obtained by weighing the entire dressed carcass with viscera removed, but legs intact on a platform or hanging scale. The scale should be sensitive to half of a pound and the weight recorded to the nearest whole pound. Carcasses that have legs removed or have significant portions of the carcass removed either from bullets or knife trimming should not be used to obtain weight data.

Two measurements should be taken on antlers: the number of tines exceeding one inch excluding brow tines, and the maximum spread of the antlers. Small tines must be one inch or longer as measured from the intersecting edge of the larger beam. Maximum spread is measured from the outside edges of the rack and includes all tines.

Physical condition is usually measured by the depth of subcutaneous fat. Fat depth measured in millimeters at the xiphoid process and perpendicular to the body cavity provides an easily-obtained index that can be compared between years and units (Austin 1984).

Reproduction and Sex Ratio Classification

Post-season classification counts are obtained following the end of the big game hunts in November and are usually completed before
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Christmas. The purposes of the counts are to determine the adult sex ratio after the hunt and to obtain the reproductive rate for the previous breeding period.

Adult sex ratios vary from less than two bucks per 100 does to more than 30 bucks per 100 does. In general terms, ratios containing less than five bucks per 100 does indicate almost all bucks are being harvested during the hunts, and the buck portion of the herd is likely being overly exploited. Counts between five and ten indicate the bucks are being heavily hunted and that few mature bucks are surviving the hunt. Counts consistently in the five-to-ten range suggest that hunters may prefer some reduction in the number of bucks being harvested. Post-season counts, recording between 10 and 20 bucks per 100 does, indicate reasonable and adequate hunter pressure. At this level of hunter intensity, many mature bucks are being harvested from the management unit, but many and adequate numbers are also surviving. Most herds should be managed between 10 and 20 bucks per 100 does. At counts exceeding 20 bucks per 100 does, herd management is leaning toward trophy management and the buck segment of the herd may be under-harvested and under-utilized.

Most management units should have the goal of maintaining 10 or more bucks per 100 does during post-season classification counts. In Utah, the minimum goal of 15 bucks per 100 does has been set for most units. The difference between 10 and 15 bucks per 100 does results in fewer bucks being harvested, but with a slightly increased age and size of the harvested bucks. On a unit where the goal is 15 bucks per 100 does, if the buck-to-doe ratio decreases to between 10 and 14 bucks per 100 does for one or even two years, changes in population dynamics and harvest will probably not be discernible and alterations in management strategy are not necessary. In many cases the assumed declines may simply be due to sampling variability in the post-season classification count.

Only when the buck-to-doe ratio remains somewhat below the management goal for three or more years, or it decreases by 50 percent or more, should changes in the management strategy be considered. When the buck-to-doe ratio consistently exceeds 20 bucks per 100 does, hunter pressure is too light and the buck deer resource is being under-utilized. Only where trophy bucks are the primary goal of the manager or landowner should the post-hunt buck-to-doe ratio consistently exceed 20 bucks per 100 does. In this special case, spike bucks and bucks with 1x2 antler points should be annually culled to improve the potential for
trophy bucks, and the deer herd should also be kept considerably under carrying capacity to optimize available forage resources to promote maximum body size and antler development.

Natural mortality of adult does is very low between the fawning period and the post-season classification count, almost always measured at less than five percent and often close to zero. Typically, only hunting mortality is considered during this period. Consequently, classification ratios of fawns-to-does in the late fall represent the success of the does in bearing and rearing fawns. Conversely, fawn mortality is usually significant during this period and can be strongly influenced by several factors, including poor range conditions and excessive numbers of predators.

Early estimates for harvest and hunter success for the forthcoming year can be obtained a year in advance using the fall reproductive rate obtained from post-season classification counts. These estimates assume mild to normal overwinter losses. Classification counts in excess of 80 fawns per 100 does are considered good and an increase in harvest may be expected. Ratios less than 50 fawns per 100 does are poor and a decrease in harvest may be expected, especially if the low ratio has continued for two or more years. When only a single year of poor reproduction is realized, often enough bucks survive from the previous year such that the harvest results show very little, if any, reduction. However, because a higher portion of the available bucks are necessarily harvested to prevent a decrease in harvest, the case becomes similar to borrowing from the principle in a savings account rather than just using the interest. Therefore, unless the recruitment rate significantly exceeds mortality during the second year, the buck harvest may decline in the second year following a poor year of reproduction. Ratios of 50 to 80 fawns per 100 does can result in either an increase or a decrease in harvest from the previous year. Minimum reproductive rates of about 30 fawns per 100 adults are necessary to sustain mule deer populations.

**Recruitment Classification**

Population recruitment classification counts are determined in early spring, beginning about the time green-up occurs. Once green-up begins, with the observable new growth of rangeland grasses shortly followed by the emergence of forbs, overwinter mortality is ended by the availability of nutritious forage and warmer temperatures. Spring counts provide the manager with a major piece of information, especially for making
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hunting recommendations for the harvest of antlerless deer. When overwinter mortality is high, fawn-to-adult ratios significantly decrease between fall and spring counts, recruitment ratios are lower, and fewer, if any, antlerless deer should be harvested. Because of the increased susceptibility of fawns, a small overwinter decrease in the fawn-to-adult ratio is expected. A decrease of five fawns per 100 adults is normal and about average during average or mild winters. On management units where the population size is in balance with the range resources, significantly decreased fawn-to-adult ratios from post-season counts and occasional low recruitment rates are usually the result of winter severity coupled with predation.

Importantly, low recruitment rates can also result from an imbalance between population size and range resources. Where population size has increased to exceed the available winter range resources, consistently low recruitment rates (determined from post-winter counts) may be a chronic indicator of excessive deer numbers on limited winter ranges. Similarly on units where summer range is limiting, consistently low reproductive rates (determined from post-season counts) may be a chronic indicator of excessive deer numbers on limited summer ranges. The simple solution in both cases, almost always unpopular with hunters, is to significantly increase the harvest of antlerless deer and decrease the size of the population.

Annual Winter Range Condition and Utilization Assessment

Following spring green-up, overwinter utilization of the winter ranges must be annually evaluated. Minimum data to be collected on each herd unit must include the percentage browse utilization by each available shrub species, pellet group density, and overwinter mortality observed and recorded by age and sex classes. Plots to determine browse utilization and pellet group density must be permanently marked with steel stakes. A minimum of 50 plots per transect and 15 transects per unit are required to assess overwinter utilization. Transects should be located in the vicinities of the long-term, five-year trend transects.

Note: In addition to the transects, at one or two locations per unit, I recommended constructing a small “exclosure” to prevent livestock grazing and deer browsing. These “exclosures” are to be used as annual training sites for browse utilization estimation, to
supply an accurate evaluation of overwinter utilization obtained by comparing browsed and non-browsed plots, and to provide a demonstration site where the range conditions and utilization estimates can be explained to the public. It is recommended that each “exclosure” be located on productive winter range with at least two browse species of good density. Each “exclosure” should measure 24x24 feet with heavy posts at the corners and mid-way between the corners, and a single post in the center, for a total of nine posts. Annually one-fourth of the “exclosure” would be removed from use by installing four 12-foot-long livestock gates. The gates would simply be moved in a clockwise direction annually after range evaluation in the spring. This moveable “exclosure” would replace permanent basketed plots.

**Long-term Winter Range Condition Trend Assessment**

Changes in vegetative resources on winter ranges over many years are best determined by permanently marked plots, with data supported by exact location photo plots. The DWR has established permanent vegetative transects on critical winter range habitats for each deer unit in Utah. About 20 to 40 transects have been established on each herd unit. These plots, strategically and carefully located on important winter range sites, are read every five years by a range crew specifically trained in the methodology. Range trend data include vegetative composition, canopy cover, browse condition classes, vegetative species density, and ground cover of bare ground, litter, and rock. Data determine the long-term changes and basic health of the winter range. Data are published by DWR by herd unit as part of the Range Trend Surveys series.

The annual and long-term assessments of winter range, and summer range in areas where it is lacking, are the key data to evaluate the carrying capacity of the range and therefore to set hunting rules and regulations (Clements and Young 1997). In Utah over the last 30 years, range trend data are generally downward for most units, suggesting environmental factors are causing a negative trend, or the deer populations during some years exceeded range carrying capacity. The trend of declining condition of winter ranges is especially true for units along the Wasatch Front where winter range is limiting and spring livestock utilization is minimal.
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It is critical for the reader to realize that data from both the long-term range trends and the annual assessment of utilization must be available to managers to understand the dynamics of changes in winter range resources. Having available only the long-term data, the manager knows only the changes in range resources, but not the impacts which caused the changes. Having available only the annual utilization data, the manager knows only the annual impacts on range resources, but not the long-term trends. However, with both sets of these data, managers are able to adjust deer herd numbers to protect the range and prevent further declines in productivity, and with the same effort, ensure and maintain long-term sustainability of hunter harvest.

Hunter Opinion Assessment

The preferences, opinions, and satisfaction levels of hunters should be evaluated on a regular basis. Individual conversations, local public meetings, formal RAC meetings, management unit and statewide written or telephone surveys must all be utilized. In all cases the opinion of the average hunter must be the primary target of the opinion survey. Too often only a vocal minority, usually representing special interest groups, are heard in public and even private meetings. Where possible, and when the majority of deer hunters are clearly in favor of changes, management alternatives should be adapted to meet hunter preferences, but only when changes can be made within the biological, economic, and land stewardship constraints of technical, proper, and conscientious mule deer management.

Livestock Grazing Management

Livestock grazing is an important and essential ingredient to perpetuating or improving winter ranges (Belsky 1986). On mule deer winter ranges, livestock grazing in spring provides a growth advantage to the browse species and greatly reduces the potential for wildfire, which can destroy browse productivity. Grazing by livestock, horses, sheep, goats, or cows must be a critical part of the management plan for these ranges.

Grazing of winter ranges by livestock at moderate levels should be accomplished only for six to eight weeks in spring, on about two-thirds of the area used by deer in winter (Austin 2000). Areas rested one year should be grazed the following year. This grazing regime avoids the build-up of plants and materials that may fuel a fire. Flexibility of
grazing management is important. During wet years, grazing by livestock in spring over the entire winter range may be desirable to promote shrub growth and prevent possible wildfires. During dry years, livestock grazing may need to be reduced to prevent overutilization of understory vegetation and to prevent utilization of browse needed by deer in winter.

On summer range, if possible, livestock grazing of fawning areas, especially when fawning areas are restricted in size, should be eliminated until mid-July, or preferably until after the first of August when fawns are approaching two months of age and capable of traveling continuously with the doe. Other than fawning areas, livestock grazing of summer ranges has little negative effect on deer, but only if that grazing is maintained at a moderate level and summer range conditions are not depleted through overgrazing (Austin and Urness 1986).

On most areas within wildlife management units, deer use of private lands occurs during some portion of the year. It is often imperative for the health of the herd that wildlife managers and sportsmen, whenever possible, support and cooperate with the ranching industry. Cooperative agreements between ranchers and agencies to graze state and federal lands often lead to improved winter range conditions on private lands, decreased depredation complaints, increased accessibility to public lands, range improvements, and benefits to wildlife, ranchers, and hunters.

In my experience, ranchers, wildlife managers, and sportsmen should always be friends. Most wildlife managers and biologists, ranchers, and sportsmen recognize the beneficial effects of controlled livestock grazing, and should support grazing in all cases where it is properly regulated and controlled and not harmful to soils or habitat.

**Range Improvement**

Few, if any, of Utah’s deer units do not have areas of needed range improvements. A partial list of possible improvements includes the following 11 suggestions.

1. Old-aged stands of pinyon-juniper should be chained in a patchy pattern to increase quality and quantity of available winter range forage, but retain adequate cover.
Areas of recent fires, usually less than three years old, where winter browse was destroyed should be reseeded as soon after the fire as possible during late fall or early spring.

Areas strongly dominated by annual grasses and weeds should be plowed and furrowed just prior to the grass reaching seed viability in spring or summer, and reseeded during late fall.

Pinyon-juniper areas that were previously chained but now contain numerous small invading trees should have those trees thinned.

Summer ranges containing dense stands of lodgepole pine should be thinned or clear-cut in strips to improve the forage base and timber production.

Decadent aspen stands should be clear-cut and livestock grazing eliminated for two to three years while aspen suckers regenerate stands.

Riparian areas that are overused by excessive livestock grazing may need to be fenced.

Riparian areas that are overused by dispersed camping may need to be excluded from public use.

Small springs and seeps may need to be protected from all grazers and, where needed, water piped to a nearby water trough.

Lands owned by the DWR, and other lands managed primarily for wildlife, may need to be surveyed, marked at the corners, and fenced.

Extensive, dense stands of maple, Gambel oak, and big sagebrush should be thinned or clear-cut in small patches to improve upland habitat, especially on fawn-rearing areas.

Each manager should make a prioritized list of needed range improvements on specific geographical areas. A reasonable goal for range improvements is to attempt to annually improve about two to five percent of the acreage in need and available for rehabilitation. Treated lands must be available for wildlife utilization for at least an anticipated 20-year period. With this goal, range depreciation will likely be balanced by improvements.
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Predator Management

The four major predators of mule deer—coyote, cougar, bobcat, and black bear—either as a single species, or in the common case as a combined influence, can have a significant effect on reducing hunter harvest and curtailing population growth. The influence of predators becomes increasingly evident as deer populations decline. Indeed, at very low deer populations, a “predator pit” may develop in which the deer recruitment rate may not exceed the mortality rate and the deer population indefinitely stagnates at the low population level. In these situations, significant predator removal should be accomplished at least until the herd rebuilds to the inflection point on the population growth curve, or the point of rapid population growth. Continued predator control beyond the inflection point up to the plateau of the bell-shaped curve, when the population reaches maximum sustained yield, would give greater assurance that the deer population would not sharply decline as the predator populations recovered.

Predator management is a thorny issue in most locations of the state because of the strong emotions people develop on both sides of the predator control issue. To some, predators have very high intangible values even through they are only very rarely observed. To others, predators are considered a nuisance with only negative values. However, few people and fewer managers would prefer all predators to be extirpated from a particular unit, and conversely few people would promote unlimited predator numbers without any control. Generally from the standpoint of mule deer management, liberal hunting and trapping regulations of predators should be the usual situation, but with the necessity of the manager knowing that at least minor populations of each of these four predators are maintained on each deer unit. Furthermore, predators should only receive protected status under very low predator populations, or when predators are involved with research studies.

Elk Management

If a manager’s most important hunting species is the mule deer, and the primary management goal is to maintain healthy deer herds, elk numbers should be allowed to increase only to the point of being complimentary with the resource needs of the deer herd. When elk herds begin to
compete with deer for limited range resources, elk numbers should be reduced, or the management goals must be redefined.

Elk have a much wider range of usable forages than deer, and under limited available range will out-compete deer for forage resources. Under winter stress conditions, elk will always have higher survival rates, particularly when forage resources become over-utilized.
When elk numbers increase and begin to compete with deer, management should usually favor deer over elk in most situations for several reasons. First, many more deer can be maintained on the same winter ranges. The trade-off, in my opinion, is about five to eight deer for one elk. This trade-off favoring deer provides for much more hunter opportunity and harvest success. Also, because of the carcass size, deer can be handled by a single individual, whereas elk normally require a horse or several hunters. Second, elk create considerably greater impacts and problems than deer when associated with depredation situations. Third, because elk and cattle diets have high dietary overlap compared with deer and cattle diets, livestock operators and private landowners usually prefer to maintain larger deer herds and smaller elk herds. Fourth, because of the larger size of elk and the behavior of elk to spend the winter in large groups, damage to winter range browse forages can occur on small areas, especially if elk herds become camped for more than a few days at the same location.

Balancing deer and elk numbers on limited range resources can be perplexing. Hunters generally want more deer and more elk. Managers can only assess each situation, evaluate all important factors, and make informed judgments.

**White-tailed Deer Management**

The white-tailed deer was first verified in Cache County, Utah in 1996. In the subsequent years the white-tailed deer has rapidly expanded its range to all of northern Utah and has been observed in the Uinta Basin. At least three white-tailed bucks were harvested on the Cache Unit in 2006. Similar to elk, white-tailed deer out-compete and replace mule deer through more efficient resource use, adaptability to human activities, and one-way hybridization. Furthermore, the potential problems of diseases that are more easily carried and tolerated by white-tailed deer, but which may have much higher mortality effects for mule deer, present a possible major concern for perpetual maintenance of mule deer populations. The replacement of mule deer by white-tailed deer is obviously occurring throughout the western United States. I have observed that less than 20 years ago on some ranges outside of Utah where only mule deer were found, white-tailed deer now outnumber mule deer.
Because of direct competition, one-way hybridization, and the potential disease factors, managing for mule deer simply may require managing to reduce or even eliminate white-tailed deer from some mule deer ranges.

**Access Management**

Land management agencies and private landowners control hunter access. Wildlife managers are usually in the middle role of making hunting recommendations. Nonetheless, every management unit should maintain areas where vehicles are restricted either by road closures or natural geographic barriers, as well as other areas where vehicle access is high via numerous roads. On units or subunits with extensive vehicle access and especially where dense cover is limited, roads and areas may need to be closed or other hunter-restrictive measures instigated to maintain an adequate number of bucks in the post-season counts. I generally consider areas within one mile of a road to be accessible to vehicles, as opposed to areas further than one mile as vehicle non-access areas. For examples, if two roads are two miles apart and run parallel, all the area between the roads would be considered accessible to vehicles. If the same two roads were three miles apart, two of the miles between the roads would be considered as accessible to vehicles and one mile as not accessible.

I suggest a ratio of 60 to 40 as a general guideline for hunter access to deer habitat, with 60 percent of the unit available to vehicle access, and 40 percent requiring a hike of at least one mile. Using this ratio as an approximation, hunter access is not overly restricted, survival of sufficient bucks is assured, and the variable preferences of hunters for remote to close-to-vehicle hunting are met.

**Hunter Management**

Probably the most important and certainly the most controversial aspect of managing a deer herd is hunter management. Since total harvest and percent hunter success are the most commonly used criteria for hunt success, hunter management schemes must produce a desired harvest and reasonably high hunter satisfaction. A point of commonality among hunter management schemes, except in the specific cases of limited-entry and CWMU hunts, is the need to provide hunting opportunity for numerous hunters, far in excess of the anticipated harvest.