Chapter 3

White-tailed Deer (*Odocoileus virginianus*)

Greg Anderson

I. INTRODUCTION –

A. History in Wyoming – White-tailed deer are an endemic species within Wyoming. They were present throughout much of the state prior to the arrival of European settlers in the 1800's. Although particularly abundant in northeast Wyoming, white-tailed deer were also documented by trappers and explorers along the west boundary of the state in Yellowstone National Park (Anderson, 1949; Koch, 1941). Shortly after European settlement, white-tailed deer populations declined dramatically throughout Wyoming. The primary cause was unregulated hunting (Pauley and Lindzey, 1993). In the mid-1900's, the white-tailed deer population began to increase in the Black Hills region. As this population expanded between 1948 and 1953, deer were trapped and transplanted to other areas of Wyoming (Pauley and Lindzey, 1993). Since white-tailed deer thrive in agricultural environments, populations expanded rapidly throughout locations with irrigated cropland following releases.

B. Current status –

1. Distribution – White-tailed deer are currently distributed throughout Wyoming. Concentrations are greatest in the northeast and southeast corners of the state. Some concentrations are also present along the eastern edge of the Bighorn Mountains and in the Big Horn Basin. White-tailed deer are relatively uncommon within the western half of Wyoming, where they are typically confined to riparian corridors (Pauley and Lindzey, 1993). Three subspecies occupy the state. In general, O. *v. dacotensis* is found throughout much of the northeast, central and southeast portions of Wyoming. A small strip along the Nebraska border is occupied by O. *v. texanus*. The deer in western Wyoming are typically O. *v. ochrourus* (Smith and Rhodes, 1994).

2. Herd Units – The Department has delineated 6 herd units to manage white-tailed deer in Wyoming. These include: Black Hills, Central, Lance Creek, Powder River, Southeast Wyoming, and the Bighorn Basin. White-tailed deer are distributed throughout most of the Black Hills. Elsewhere, the species generally exists in isolated sup-populations along riparian corridors. The herd units, otherwise known as data analysis units (DAUs), were established primarily as a means to track harvest throughout designated regions. However herd unit boundaries do not have any intrinsic value for delimiting discrete populations of this species. Although population

objectives have been established for several of the herd units, the data collected within the DAUs is generally inadequate to support reliable population estimates. Most white-tailed deer herds are managed on the basis of recreation objectives and trend indicators such as harvest effort and success.

C. Natural History Information –

1. Range of productivity –

a. Fawn:doe Ratios – In Wyoming, annual classification samples are generally insufficient to reliably estimate fawn:doe ratios, except in the Black Hills unit. In some years, large enough samples have also been obtained in the Central and Powder River DAUs. Fawn:doe ratios from the Black Hills DAU of Wyoming and some areas within other states are listed in Table 1..

Table 1. Fawn:doe ratios within Wyoming and surrounding states.

Area	Time of Surveys	Typical fawn:doe Ratio	High fawn:doe Ratio	Low fawn:doe Ratio	Citation
Black Hills (WY)	mid-October	50:100	102:100	33:100	Anderson, 1999
Black Hills (SD)	Pre-parturition	163:100 *			Rice, 1984
North central MT	Dec./Jan.		122:100	16:100	Allen, 1968
Northeast MT	Pre-hunt, fall		112:100	64:100	Dusek et al., 1989
Northern ID	Postpartum	142:100			Will, 1973

* fetuses per 100 does, determined from road-killed deer.

Production can vary widely throughout geographic regions. Some of the variation is attributed to the age structure of the population. Dusek et al. (1989) noted fawns and yearlings contribute very little to the reproductive potential of white-tailed deer in northern latitudes. Thus, when the population contains a higher percent of yearling deer, the fawn:doe ratio will typically be lower. Their study also indicated reproduction by white-tailed deer is highly density dependent in Montana.

b. Range of Productivity – In some years, large enough classification samples were obtained from the Powder River and Central DAUs to permit comparisons. For example, 1,280 white-tailed deer were classified in the Central DAU in 1997. The data yielded a fawn:doe ratio of 91:100. Based on the large number of deer classified, this was likely a representative ratio for that year. Similarly, larger samples of white-tailed deer were classified several years in the Powder River DAU. Fawn:doe ratios there have ranged from 70:100 to 88:100.

c. Effects of Weather – Weather and forage quality affect annual recruitment of white-tailed deer in northern latitudes. Fuller (1990) determined fawn mortality increases substantially as winter snow depths exceed 16 cm. Mundinger (1981) also documented an inverse relationship between winter severity and productivity. Heavy fawn mortality is revealed by a depressed ratio of yearling bucks to does during the subsequent biological year. Rice (1984) determined white-tailed deer in the Black Hills are nutritionally stressed compared to deer in other parts of South Dakota. The poor forage quality in the South Dakota portion of the Black Hills had resulted in low recruitment for over a decade.

2. Range of natural mortality

a. Annual Mortality – Mortality of white-tailed deer has not been studied extensively in Wyoming. However, a reasonable indication can be obtained from work done in South Dakota and Montana. Mortality estimates from neighboring states are summarized in Table 2. Mortality estimates from the central Black Hills (SD) and northeast Montana also include the fall harvest.

Table 2. Mortality rates of white-tailed deer in some adjoining states.

Area	Mortality Period	Fawn Mortality	Adult Mortality		Citation
Black Hills (SD)	Annual	65%			Rice, 1984
Northern Black Hills (SD)	Annual	60%			Benzon, 1996
Central Black Hills (SD)	Annual	66%			Benzon, 1998
Central Black Hills (SD)	Annual		37%-42%		DePerno, 1998
Northeast MT	Annual	50%	22% (female) 60% (male)		Dusek et al., 1989

b. Age and Sex Specific Variation – Mortality rates of male white-tailed deer are generally higher than those of female deer. Male fawn mortality was significantly higher than female fawn mortality during two studies in the Northern and Central Black Hills (Benzon 1996, 1998). The principal cause was higher predation of male fawns during summer months. Both DePerno (1998) and Dusek et al. (1989) found mortality of adult males was also significantly higher than mortality of adult females. The higher male mortality was predominantly from harvest during fall hunting seasons.

c. Variation Around Wyoming – Mortality data other than harvest are not generally collected from the white-tailed deer herds in Wyoming. Mortality rates documented in surrounding states (Table 2) are probably representative of white-tailed deer mortality in Wyoming.

d. Effects of Weather – Weather patterns significantly affect mortality at northern latitudes. Fuller (1990) determined an inverse relationship between snow depths and fawn survival in Minnesota. Dusek (1987) also documented substantially higher white-tailed deer mortality during severe winters in Montana.

II. CENSUS

A. Pre-season Classifications

1. Aerial Surveys – Aircraft are not used to classify white-tailed deer prior to the hunting season in Wyoming.

2. Ground Surveys –

a. Rationale – Deer are classified to obtain information about recruitment as well as buck:doe ratios. Classifications of white-tailed deer are done prior to the hunting season in the Black Hills Herd Unit, but not elsewhere in Wyoming. Pre-season classifications do not appear to have any intrinsic benefit over post-season classifications. The primary reason this is done in the Black Hills relates to workloads. Personnel are required to classify mule deer after the hunting season. Therefore, due to time constraints, white-tailed deer are classified during the second half of October, just prior to the hunting season.

b. Application – White-tailed deer are typically secretive and often nocturnal. This behavior is particularly true of bucks prior to the rutting period. In order to assure bucks are adequately represented, pre-season classifications are conducted at night with the aid of spotlights. Counts begin a half hour before sunset and can continue through the night. It is helpful to have two observers with spotlights so deer can be observed from both sides of the vehicle. Spotlights should be at least 300,000 candlepower. Nighttime classifications can be conducted anytime throughout the summer (provided antler growth is sufficient to distinguish mature and yearling bucks), however surveys have typically been conducted mid-October in the Black Hills. Will (1973) indicated July was the best month for spotlight counts since antler growth was adequate by then, and bucks were more active and commonly associated with other groups of deer. In subsequent months, bucks became progressively more secretive and difficult to survey. In contrast, Department personnel have found sampling prior to mid-October is less effective, because foliage on trees and shrubs make sighting and identification more difficult.

c. Analysis of Data – The following ratios are calculated from classification data: fawns:100 does; yearling bucks:100 does; mature bucks:100 does; and total bucks:100 does. These ratios are determined for each hunt area as well as the overall herd unit. Since specific routes are monitored annually in the Black Hills DAU, it can also be useful to calculate the ratios for each route.

d. Disposition of Data – Each biologist should maintain a spreadsheet of annual classification data. Classification results should also be entered in the Job Completion Report (JCR) database for the applicable herd unit.

B. Post-season Classifications –

1. Aerial Surveys –

a. Rational – White-tailed deer are often encountered when mule deer are classified after the hunting season. By recording incidental sightings of white-tailed deer during aerial counts, the ground classification sample of white-tailed deer can be augmented without substantially increasing flight budgets.

b. Application – Although mule deer and white-tailed deer typically occupy different habitats, both species often occupy riparian areas during winter. When riparian corridors are flown to classify mule deer, personnel should separately classify and record any white-tailed deer seen in these areas. However, if a flight budget is particularly tight, observers should not deviate from routes specifically to classify white-tailed deer.

c. Analysis of Data – Combine classification data recorded during aerial surveys with data from post-season ground classifications. Calculate the following ratios: fawns:100 does; yearling bucks:100 does; mature bucks:100 does; and total bucks:100 does.

d. Disposition of Data – Each biologist should maintain a spreadsheet of annual classification data. Classification results should also be entered in the JCR database for the applicable herd unit.

2. Ground Surveys –

    a. Rational – Ground surveys are the principal method used to classify white-tailed deer in Wyoming. Much of this data is collected incidentally during mule deer classifications. Personnel may periodically expend additional effort to obtain larger classification samples of white-tailed deer. However, surveys to classify white-tailed deer are of lower priority because the species is less abundant throughout the state than mule deer

    b. Application – Classifications are conducted by driving methodically through occupied habitats at dawn or dusk. Observers stop frequently to look with binoculars or a spotting scope. In some areas, white-tailed deer are classified more effectively after dark. During nighttime surveys, it is helpful to have two observers with spotlights so deer can be observed from both sides of the vehicle. Animals are classified as juveniles, yearling bucks, adult bucks, or adult females.

    c. Analysis of Data – Classification data recorded during aerial surveys are combined with data from post-season ground classifications. The following ratios are calculated: fawns per 100 does; yearling bucks per100 does; mature bucks per100 does; and total bucks per 100 does.

    d. Disposition of Data – Each biologist should maintain a spreadsheet of annual classification data. Classification results should also be entered in the JCR database for the applicable herd unit.

C. Spring Classifications –

1. Rationale – Spring classifications are done primarily to estimate fawn survival, an indication of winter severity. Only juveniles and adults are classified. The post-winter ratio of juveniles per 100 adults is compared to a pre-winter ratio derived from classifications done either prior to, or immediately after the hunting season. Based on this comparison, managers can roughly estimate the mortality of fawns through the winter period.

2. Application – Spring classifications are normally done in March. Classifications can be conducted at dawn, dusk, or at night. Juveniles are difficult to distinguish from yearlings at this time of year so observers should take extra time as needed, to observe and correctly classify the animals. In addition, observers should have experience classifying older fawns.

3. Analysis of Data – The post-winter ratio of juveniles per 100 adults is compared to the pre-winter ratio. A significant decrease may indicate substantial mortality of fawns took place during the winter period. However, biologists should recognize possible biases are associated with

this method. Misclassification of larger fawns as adults can depress the spring ratio, resulting in an exaggerated mortality estimate. On the other hand, if pre-winter classifications were done before the hunting season, the spring ratio might not be directly comparable. Since the vast majority of deer harvested during the hunting season are adults, the actual pre-winter ratio of juveniles to adults is greater following the hunting season. In some cases, the post-winter ratio can remain larger than the ratio obtained prior to the hunting season. Such data are inconclusive, but do suggest fawn mortality would have been very low through the winter period.

4. Disposition of Data – Data from spring classifications should be stored in a spreadsheet. A summary of the data should be included in the yearly JCR for the appropriate herd unit.

D. Other Census Techniques – Currently, the Wyoming Game & Fish Department does not employ census techniques other than modeling to estimate white-tailed deer densities. A POP-II model has been developed to simulate the White-tailed deer population in the Black Hills herd, however the reliability of this model is uncertain because this population is not closed. Insufficient data are available to support reliable models for the remaining white-tailed deer herds in Wyoming. Other census techniques are costly and labor intensive. Most white-tailed deer in Wyoming occupy private lands where access is limited. The species tends to be very adaptable and resilient when conditions are favorable. Accordingly, a lesser priority is placed upon collecting population data for management. The cost and time required to census white-tailed deer are not justified in most areas of the State. Techniques used elsewhere to census white-tailed deer are listed below:

1. Pellet counts; Fuller (1992), White (1992), Fuller (1991), Mooty (1980).
2. Catch-effort models; Novak et al. (1991).
3. Aerial surveys; DeYoung et al. (1989), Teer et al. (1985).
4. Infrared-triggered cameras; Jacobson et al. (1997), Koerth et al. (1997).
5. Spotlight counts; Wood (1985).

III. HARVEST DATA –

A. Harvest Survey –

1. Rationale – Data compiled from the annual harvest survey are used to estimate hunter participation rates, hunter success and effort, and the age/sex composition of the harvest in each herd unit and hunt area. Managers rely upon this information to recommend hunting seasons including license quotas, and to answer questions from the public. Harvest estimates are also a key parameter used to model big game populations. Finally, harvest information is incorporated in several annual reports, planning reports, and economic analyses prepared by the Department.

2. Application – Refer to Appendix III (Harvest Survey).

3. Analysis of Data – Refer to Appendix III (Harvest Survey).

4. Disposition of Data – Annual harvest data are summarized and analyzed in the JCR prepared for each herd unit. Harvest estimates are also recorded in the JCR database.

B. Age Determination –

1. Field Techniques – White-tailed deer can be aged in the field based on patterns of tooth eruption and replacement. Biologists who are accustomed to aging mule deer should note white-tailed deer typically replace deciduous teeth more rapidly. By 13 months, all permanent, incisiform teeth have erupted. Therefore, yearling white-tailed deer checked in the fall (at approximately 15-18 months of age) cannot be distinguished by looking for deciduous incisiforms. Instead, yearlings are identified based on characteristics of the pre-molars. Yearling white-tailed deer retain a deciduous pre-molar with three cusps until 20 months of age. At that time, a permanent pre-molar with two cusps replaces the deciduous pre-molar (Dusek 1994). It is also possible to determine specific ages of adult white-tailed deer based on dentition wear patterns, however the technique is imprecise and subject to errors. Investigators who require a harvest age structure more precise than juvenile, yearling, and adult should carry a sample board of known age, lower jaws for reference. Kroll (1994) describes how to age adult, white-tailed deer based on the percent of dentine and enamel exposed on molariform teeth.

2. Field Checks and Check Stations –

   a. Rationale – The age structure and sex composition of the harvest are determined primarily based on data from the harvest survey. However field checks can provide useful data for detecting biases in the harvest survey (e.g., hunters underreport harvest of fawns or females). In addition, field checks provide a means of collecting more detailed age data as well as body condition data.

   b. Application – Several types of biological data can be collected from harvested animals as personnel make routine hunter contacts in the field. Depending on the area, check stations can also be established along major ingress and egress routes to increase the sample of field-checked animals. Personnel should become familiar with the Department's protocol for establishing and operating check stations (Wyoming Statute 7-17-103; also refer to Chapter 1, Attachment 1). Ideally, at least 10% of the total harvest in a herd unit should be checked in the field to comprise a meaningful sample for comparison against the harvest survey data.

c. Analysis of Data – The age structure and sex composition of animals checked in the field are compared against estimates from the harvest survey. Biologists should particularly note the proportion of juveniles documented by field checks versus the proportion reported in the harvest survey. In the past, harvest of juveniles has been underreported in the harvest survey. If major discrepancies exist, assuming the sample of field-checked animals is adequate, the biologist may consider the age and sex proportions documented by field checks as more representative of the harvest than the proportions obtained from the harvest survey. In such cases, the proportions of field-checked animals can be extrapolated to adjust the composition of the total harvest estimated from the harvest survey. The extrapolated harvest composition can also be used in POP-II models in place of the composition derived from the harvest survey. However, biologists should also recognize field check data can possibly contain biases resulting from disproportionate sampling effort either geographically (e.g., harvests on public land versus private land) or temporally (e.g., opening weekend versus later in the season). Another potential method of detecting reporting biases is to "flag" animals that are checked in the field by entering the information, including the hunter's name, into a database. If the person responds to the harvest survey, the age/sex information he reports can be compared directly against the information that was recorded during the field check.

d. Disposition of Data – Data from all field checks, along with the appropriate mortality code, should be recorded in the Wildlife Observation System. After the hunting season, wildlife management coordinators from each region should summarize the field check data and distribute it to the appropriate biologists. Biologists should include an evaluation of field check data in the annual JCR for each big game herd. This data should also be entered in the JCR database.

3. Age Determination from Cementum Annuli –

a. Rationale – At times, managers require more accurate age data than can be obtained from field checks. In these cases, the animal's actual age is determined accurately from tooth cross-sections by analyzing stained, cementum annular rings. The technique is used to determine the proportions of harvested animals within each year class of age. This information can be used to estimate the age structure of the population (adult female segment only), and can be particularly helpful during modeling exercises.

b. Application – Refer to Appendix V (Aging Techniques). Also consult Gilbert (1966) for detailed information about aging white-tailed deer based on cementum annuli.

c. Analysis of Data – Biologists should recognize samples of harvested animals are biased proportionately toward older, adult males. For this reason, it is best to obtain data from adult females to establish the age structure of the female segment of the population. Bar charts can be quite useful representations of age distribution data. Reduced or lost age cohorts resulting from weather or disease events will be clearly evident in bar charts. Investigators can use a chi-square contingency table to determine if the age structure of a population has changed significantly through several years. It is desirable to have a minimum of five observations within each age class to accurately approximate a chi-square distribution. See Zar (1974) for a more detailed discussion of chi-square analysis.

d. Disposition of Data – Enter age structure data into the JCR database. Comparisons of age structure data from different years should be depicted using charts, and discussed in the JCR for the applicable herd unit.

IV. MORTALITY ESTIMATION –

A. Incidental Observations–

1. Rationale – Mortality records obtained from incidental observations are of little intrinsic value for evaluating winter severity or other impacts to a deer population. However, biologists can often identify problems associated with road and fence crossings, disease outbreaks or other hazards by noting and recording mortalities they observe during routine activities.

2. Application – As the terminology implies, incidental observations of mortalities are recorded as time and circumstances permit. A standardized methodology is not normally followed. When biologists encounter dead animals, they should attempt to make a field determination of the cause(s). If unusual numbers of dead animals are located and the cause is not readily apparent, a necropsy should be conducted and samples collected for laboratory analysis. Alternatively, transport an entire, fresh carcass to the Department's laboratory facilities. Refer to Section V.D. of this chapter (Collection of Tissue Samples).

3. Analysis of Data – Mortality records can be plotted in a GIS database to indicate locations with unusually frequent mortalities. After such locations are plotted, biologists should attempt to identify hazards or other causes. In some cases, for example when a disease outbreak or poisoning is suspected, a systematic, follow-up survey may be necessary to document the total mortality loss.

4. Disposition of Data – All mortality records should be entered in the Wildlife Observation System (WOS) database. Field personnel with access to GIS software may choose to maintain individual databases of mortality records for various reasons, including documentation of environmental review comments. However, these individual databases should not supplant the WOS, which is the principal, statewide database of observation records.

B. Body Condition Evaluation –

1. Rationale – The ability of deer to survive winter conditions is related in part to their physiological condition as they enter the winter period. Managers can assess the potential level of winter mortality by evaluating a body condition index, in conjunction with winter severity indices. However, comparatively few, white-tailed deer harvests are checked throughout most of Wyoming. Therefore, the Black Hills is the only White-tailed deer herd in which the technique is practically applicable.

2. Application – Refer to Chapter 2, Section IV.B.2 (Mule Deer – Body Condition Evaluation).

3. Analysis of Data – Refer to Chapter 2, Section IV.B.2 (Mule Deer – Body Condition Evaluation). Body condition scores are "nominal data." In other words, the numerical scores essentially identify morphological states based on fat deposition patterns and overall appearance. They do not necessarily represent an interval scale or mathematical gradient of actual condition. In addition, the measurements fail to meet assumption regarding normally distributed data, since mostly healthy adults are checked. Samples are typically skewed heavily toward scores of 15 and 20. Accordingly, one may question whether it is valid to construct a "mean" condition score for comparisons among years. However, on a gross scale, the scores do indicate "better" or "worse" body condition. Although comparatively small changes in the average score probably have little meaning, a substantial decline would indicate an overall decline in the condition of the herd.

   An alternative, perhaps more sensitive method of analyzing body condition scores is to set up a contingency table of score frequencies, then calculate a chi-square statistic to test the assumption that proportions of different scores have changed from year to year. The score categories of the contingency table are 0, 5, 10, 15, and 20. Any categories with fewer than 5 observations should be excluded from the analysis. A significant decrease in the proportion of animals given scores of 20 in a particular year would indicate animals were generally in worse condition that year.

4. Disposition of Data – Refer to Chapter 2, Section IV.B.2 (Mule Deer – Body Condition Evaluation). Biologists should maintain spreadsheets containing body condition data from the herds they manage. The age and sex of each

animal should be recorded along with the score. Body condition data should be summarized and analyzed each year in the applicable JCR.

C. Weather Severity Indices –

1. Rationale – Severe winters characterized by above average snow depths and cold temperatures can impact white-tailed deer populations (Fuller, 1990; Mundinger, 1981). In order to consistently and quantitatively evaluate weather severity, biologists have developed indices based upon temperature and precipitation. Refer to Chapter 1, Section IV.C.1 (Pronghorn – Weather Severity Indices). Biologists use these indices primarily to incorporate weather effects into population models. In addition, weather severity indices can assist in explaining to the public why a deer population may have been impacted by a severe winter.

2. Application – Consult Reeve and Lindzey (1991) for a discussion of the winter severity index currently used by the Wyoming Game & Fish Department. Also refer to Chapter 1, Section IV.C.2 (Pronghorn – Weather Severity Indices).

3. Analysis of Data – Consult Christiansen (1991) for an explanation of how the weather severity index can be used to adjust post-season mortality severity indices in POP-II models. Also refer to Chapter 1, Section IV.C.3 (Pronghorn – Weather Severity Indices).

4. Disposition of Data – Weather severity data should be summarized and analyzed in the annual JCR for each herd unit. Post-season MSI values used to align POP-II models can be adjusted based on weather severity information.

D. Documentation of Mortality Agents –

1. Rationale – An unusual number of deer mortalities may indicate problems such as highway or railroad hazards, lethal fence designs, movement barriers, disease outbreaks, or environmental toxins. If the source of mortality can be identified and documented, it may be possible to correct the problem, or at least account for the mortality in the population model and in decisions relating to herd management. Mortality records can also be useful documentation for commenting on specific development proposals involving features that may cause similar problems.

2. Application – Refer to Section IV.A.2 of this chapter (Mortality Estimates; Incidental Observations). If an unusual number of mortalities is detected, personnel should conduct systematic surveys to assess the severity of the situation, identify the cause, and assist with planning remedial actions.

3. Analysis of Data – Whenever a problem is suspected, the biologist should create and maintain a file of mortality records and associated information to facilitate the investigation and document the event. As information is collected, the biologist should attempt to identify the source of mortality and other contributing factors. If it is available, GIS software can also help analyze spatial data in order to isolate problems.

4. Disposition of Data – Enter records of all mortalities, including codes identifying the causes, into the WOS database. Biologists who collect mortality data as part of a specific project or investigation should maintain files of this information.

V. DISEASES AND PARASITES –

A. Potential Diseases – Consult Thorne et al. (1982) for information about diseases that affect white-tailed deer in Wyoming. White-tailed deer are especially susceptible to periodic outbreaks of epizootic hemorrhagic disease (EHD) and bluetongue. These diseases often lead to significant mortality events.

B. Management – When sick and dead animals are observed, it is important to collect specimens to document the disease. Although there is no way to control or manage most diseases of white-tailed deer, biologists should at least be aware of potential implications. Hemorrhagic disease is the major pathogen impacting white-tailed deer populations in Wyoming. Managers should be prepared to respond when populations decline following an outbreak. Adult animals are particularly susceptible. The number of mature bucks in a population can decline precipitously afterward. Accordingly, hunting seasons may require adjustments reduce the harvest of bucks. Because hunting seasons are established in the spring, such adjustments are generally not possible, except on an emergency basis, until the subsequent year.

C. Identification – Outbreaks of hemorrhagic disease usually take place in late summer and early fall. If large numbers of white-tailed deer begin to die at this time of year, managers should suspect hemorrhagic disease is the cause. The vector is a biting gnat so outbreaks usually end shortly after the first hard freeze. In general, deer with hemorrhagic disease exhibit a swollen neck and tongue. Infected animals may also have ulcers on their tongue, palate, and in the digestive tract.

D. Collection of Tissue Samples – Consult Adrian (1994) for instructions regarding proper collection and handling of biological samples. Personnel should keep updated lab sample forms on hand for submitting samples to the Veterinary Diagnostics Lab in Laramie. Questions regarding sample collection and submission procedures should be directed to the Veterinary Services Section. If hemorrhagic disease is suspected, collect a blood sample from an animal that has been dead less than twelve hours. Place the blood sample in a test tube containing an anti-coagulant and keep it cool, but do not allow it to freeze.

VI. DISTRIBUTION AND MOVEMENT –

A. Incidental Observations –

1. Rationale – Records of incidental observations, accumulated through time, often help identify important seasonal habitats such as migration routes, winter ranges, and parturition habitats. This type of data can be collected in a cost-efficient manner, since personnel record incidental observations while carrying out other routine activities.

2. Application – In order to identify important seasonal habitats, personnel must diligently record observations throughout an extended period of time. Observations recorded sporadically may fail to detect important movements or shifts of habitat use that take place in response to changing weather patterns from year to year.

3. Analysis of Data – Incidental observations are unsuited for most types of statistical analysis because the data are not collected based on a systematic sampling approach. The best method of identifying patterns is to use GIS software to plot seasonally relevant observations. Well-defined movement routes and heavily used areas often become apparent when observations are displayed. However, it is important to consider biases that incidental observations can entail. Since personnel spend a lot of time in vehicles, many observations are recorded near roads. Such biases should be taken into account when recommendations are based on patterns derived from incidental sightings.

4. Disposition of Data – All records of incidental observations should be entered in the WOS database. A biologist who is attempting to delineate or refine seasonal ranges within his area of responsibility may want to maintain his own database as well. It is easier to retrieve and plot records with GIS software if they are maintained locally.

B. Other Techniques to Obtain Distribution Data –

1. Radio-telemetry – Radio-telemetry studies are done to acquire very detailed information about habitat selection and movement patterns. The technique may be justified when it is necessary to resolve important management questions such as the integrity of herd unit boundaries, locations of specific migration routes, or responses to disturbance. However, telemetry studies are expensive and time consuming. Accordingly, managers should assure the need for this type of data warrants the cost of obtaining it. A detailed

study plan and clear objectives must be developed prior to the start of any radio-telemetry study. White and Garrott (1990) provide excellent guidance regarding the design and implementation of telemetry studies.

2. Aerial Surveys – Aerial surveys can be an effective means to document distribution of white-tailed deer during winter. Flights should be scheduled during periods of deep snow when deer tend to concentrate. Important winter habitats are identified based on the locations deer use consistently when snow cover persists. In general, white-tailed deer tend to be associated with agricultural fields and riparian zones. These habitats are limited throughout much of Wyoming, so personnel may be able to record observations in such areas effectively from the ground, at a lower cost.

VII. SEASONAL RANGE CLASSIFICATIONS –

A. Rationale – Biologists often consult seasonal range maps to evaluate the potential impacts of resource development projects, land use plans, and other proposed activities. The seasonal range maps can help biologists determine conflicts potentially caused by developments within crucial habitats. The maps also provide essential documentation to support review comments and mitigation recommendations.

B. Application – Seasonal ranges are identified based upon distribution data from various sources such as telemetry studies, aerial surveys, ground surveys, and incidental observations. Observations are plotted to locate areas consistently occupied, on a seasonal basis, under normal to severe climatic conditions. Deer distributions recorded during winter flights can be particularly useful to identify important winter habitats. For the most part, white-tailed deer in Wyoming are non-migratory. Therefore, most occupied areas are classified as "yearlong" habitat. The major exception is the Black Hills, where white-tailed deer traditionally migrate between low and high elevation habitats each spring and fall.

C. Analysis of Data – Managers should always consult seasonal range maps when commenting on development proposals, land use plans, and other activities. The maps should also be reviewed before projects are planned to treat or otherwise modify deer habitats.

D. Disposition of Data – The GIS Section in Cheyenne maintains digitized, seasonal range maps, with statewide coverage, for all big game species. Biological Services can print Mylar overlays matched to BLM surface status maps (1:100,000 scale), for all herd units. Each biologist should maintain a set of seasonal range overlays covering the herd units in his district. Changes to seasonal range delineations should be made on overlays and sent with an accompanying justification to the Biological Services Section. After the changed is approved, Biological Services will make the appropriate revisions to the GIS database. Biologists who have GIS software on their local computers may also wish to retain digital copies of seasonal range delineations. However, no changes should be made to a local GIS file until Biological Services has first updated the statewide database in Cheyenne.

VIII. TRAPPING, MARKING, AND TRANSPLANTING –

A. Trapping Adults –

1. Rationale – The most common reason for trapping white-tailed deer is to attach radio telemetry transmitters or other visible markers, in order to study movement patterns, habitat selection, or mortality factors. In rare circumstances, deer may be trapped for relocation, but this is seldom justified.

2. Application – Several methods are available to capture adult, white-tailed deer. The person in charge of the project should notify the Biological Services Section regarding essential details of the capture and marking operation before it is begun. Include the following details in a letter to the Supervisor of Biological Services: purpose and location of the operation; herd unit; proposed duration of the study; dates and method of capture; numbers, sex, and age of animals to be marked; and the sizes, numbers, colors and other identifying features of all markers, collars or tags to be used. Before ordering radio-telemetry transmitters, consult the frequency database maintained by the Biological Services Section to avoid signal overlaps with other studies in the same area. Some effective capture methods are described below:

   a. Clover Traps – Clover traps are effective within areas of high deer densities, particularly in the winter. Deer are baited into the trap. White-tailed deer respond well to alfalfa bait normally used for this purpose. Consult Clover (1956, 1954) for a description of the design and operation of Clover traps. The Department has several clover traps stored at regional offices throughout the state.

   b. Aerial Net-gunning – This method of capture can be quite expensive on an hourly basis, but the overall cost may be less when personnel time is taken into account. Net-gunning may be the most effective option during the spring, summer, or fall when deer are less responsive to bait. In remote locations, net-guns are often the only practical means to capture animals. Several companies provide net-gunning services. Contact the Biological Services Section for an updated list of companies approved for contract by the Department.

c. Cannon Nets – Cannon nets can also be effective in areas of high deer density, provided the locations are accessible and animals can be easily baited. Consult Hawkins et al. (1968) for a description of this method.

3. Analysis of Data – Data from marking studies are complex to interpret and analyze. Managers should prepare a detailed study plan including well-defined objectives and an analysis procedure prior to marking any animals. It is also advisable to seek a peer review by an experienced researcher before finalizing the plan. Consult Manly et al. (1993) for direction regarding analysis of habitat selection data, and White and Garrott (1990) for discussions about survival analysis, habitat utilization, and home range estimation.

4. Disposition of Data – Studies that involve capturing and marking deer are expensive and generally conducted to answer important management questions. Accordingly, data and final results should always be published in a special, Department report. In addition, the results should be summarized in the annual JCR for the herd unit(s) involved in the study.

B. Trapping Juveniles –

1. Rationale – Refer to Section VIII.A.1 of this chapter (Trapping, Marking, and Transplanting). Also refer to Chapter 2, Section VII.B. (Mule Deer – Trapping Juveniles) for a discussion of possible biases associated with marking juvenile animals.

2. Application – Managers studying fawn behavior and survival often rely upon radio transmitters or other markers attached soon after birth. Two common methods of capturing fawns are:

   a. Hand Capture – Fawns can be captured by hand up to a few days after birth. During the parturition period (typically 1-10 June), project personnel monitor does intensively to identify animals that recently gave birth. The fawn can often be located by carefully searching the area. However, managers should consider biases potentially associated with this capture method. Typical parturition sites are in dense cover, where locating does and neonates can be especially difficult to observe. The does that are more visible may be animals that would normally have lower fawn survival rates by virtue of their habitat selection.

   b. Vaginal Implant Transmitters – To reduce the potential for biased selection of study specimens, managers may consider using vaginal implant transmitters to locate birthing sites. Bowman and Jacobson (1998) describe this technique.

3. Analysis of Data – Refer to Section VIII.A.3 of this chapter (Trapping, Marking, and Transplanting).

4. Disposition of Data – Refer to Section VIII.A.4 of this chapter (Trapping, Marking, and Transplanting).

C. Chemical Immobilization –

1. Rationale – White-tailed deer in Wyoming tend to be non-migratory. They have comparatively small home ranges and are attracted to agricultural food sources. Because of these behaviors, small numbers of deer can be captured effectively with immobilization equipment. In some instances, the food source, such as grain bales or ear corn, can serve as an effective blind from which to dart animals.

2. Application – Refer to Appendix VIII (Immobilization).

3. Analysis of Data – Refer to Section VIII.A.3 of this chapter (Trapping, Marking, and Transplanting).

4. Disposition of Data – Refer to Section VIII.A.4 of this chapter (Trapping, Marking, and Transplanting). Results of studies involving marked animals should be published in a special Department report. In addition, Veterinary Services should be notified any time immobilizing agents are used.

D. Marking Protocol – Refer to Appendix VII (Marking Techniques).

IX. MODELING –

A. Rationale – Refer to Appendix IX (Big Game Population Modeling).

B. Application – In general, efforts to model white-tailed deer herds in Wyoming have been relatively unsuccessful. White-tailed deer are widely dispersed throughout the state. Existing herd boundaries do not delineate discrete or closed populations and this violates a fundamental assumption of the POP-II model. Instead, each herd consists of numerous sub-populations scattered over broader regions. Population attributes such as productivity, mortality, and harvest pressure can also vary substantially within a herd unit. Relatively little empirical data is collected in most white-tailed deer herds. Since white-tailed deer are typically classified on an incidental basis during mule deer surveys, sample sizes are usually quite small.

C. Analysis of Data – Refer to Appendix IX (Big Game Population Modeling).

D. Disposition of Data – Refer to Appendix IX (Big Game Population Modeling).

X. DEPREDATION MANAGEMENT –

A. Issues – White-tailed deer commonly inhabit riparian areas throughout Wyoming. They often forage on or near irrigated pastures and croplands. As a result, white-tailed deer are implicated in agricultural damage more often than mule deer.

B. Management Implications – Because white-tailed deer are frequently associated with agricultural damage, depredation management becomes a common basis for herd management decisions. In most cases, managers are unable to develop reliable population estimates. Therefore, management objectives must be based upon criteria other than population size. The most logical objective is to limit damage problems while maintaining adequate recreational opportunity.

XI. WHITE-TAILED DEER HABITAT –

A. Habitat Requirements – The following references contain detailed information about habitat use by white-tailed deer in the Black Hills of Wyoming and South Dakota: Griffin et al. (1999); DePerno (1998); Benzon (1996); Sieg and Severson (1996); Stefanich (1995); Griffin et al. (1994); and Olson (1992). Additional studies of habitat use within the surrounding region include Dusek et al. (1989) and Allen (1968).

B. Interactions with Mule Deer – Sawyer and Lindzey (2000), Wood et al. (1989), Swenson et al. (1983), and Martinka (1968) studied habitat selection and competitive interactions between white-tailed deer and mule deer. Managers in Wyoming may find this information useful.

XII. JOB COMPLETION REPORTS –

A. Purpose and Content – The major purpose of job completion reports (JCRs) is to consolidate the management information and data collected from within a herd unit during the preceding biological year, and to provide an analysis of this material. As applicable, JCRs contain classification and harvest data, trend counts, mortality information, population models, browse utilization readings, seasonal range maps, a summary of management issues and concerns, special studies, and other pertinent information. The format should follow guidelines established by regional wildlife management coordinators and the Biological Services Section.

B. Disposition – Each population biologist maintains copies of annual JCRs covering the herd units in his district. In addition, each regional office maintains copies of all JCRs from within the region. The Biological Services Section and the Science Library at the University of Wyoming maintain statewide sets of JCRs. The reports also serve as references containing historical management data such as annual population estimates, age and sex ratios, harvest estimates, and other information.

XIII. LITERATURE CITED –

Adrian, W. J. (Ed.). 1994. Wildlife forensic manual. Association of Midwest Fish and Game Law Enforcement Officers. 210pp.

Allen, E. O. 1968. Range use, foods, condition, and productivity of white-tailed deer in Montana. J. Wildl. Manage. 32(1): 130-141.

Anderson, C. 1949. White-tailed deer in Wyoming. Wyoming Wildlife. 13(4): 20-22.

Anderson, G. 1999. Annual big game herd unit report: Casper Region. Wyoming Game & Fish Department, Cheyenne, WY.

Benzon, T. A. 1996. Mortality and habitat use of white-tailed deer fawns in the northern Black Hills, South Dakota, 1991-1994. Pittman-Robertson completion report no. 96-02. South Dakota Department Game, Fish and Parks. Pierre, South Dakota. 41pp.

Benzon, T. A. 1998. Mortality and habitat use of white-tailed deer fawns in the central Black Hills, South Dakota, 1994-1998. Pittman-Robertson completion report no. 98-05. South Dakota Department Game, Fish and Parks. Pierre, SD. 43pp.

Bowman, J. L. and H. A. Jacobson. 1998. An improved vaginal-implant transmitter for locating white-tailed deer birth sites and fawns. Wildlife Society Bulletin. 26(2): 295-298.

Clover, M. R. 1956. Single gate deer trap. California Fish and Game. 42(3): 199-201.

Clover, M. R. 1954. A portable deer trap and catch-net. California Fish and Game. 40: 367-373.

Christiansen, T. 1991. 1990 Job completion report. District 4, Wyoming Game & Fish Department. Cheyenne, WY. Appendix A, 464-471.

DePerno, C. S. 1998. Habitat selection of a declining white-tailed deer herd in the central Black Hills, South Dakota and Wyoming. Ph.D. dissertation, South Dakota State University. Brookings, SD. 185pp.

DeYoung, C. A., F. S. Guthery, S. L. Beasom, S. P. Coughlin, J. R. Heffelfinger. 1989. Improving estimates of white-tailed deer abundance from helicopter surveys. Wildl. Soc. Bull. 17: 275-279.

Dusek, G. L. 1994. Dentition of deer. Pages 71-75 in Duane Gerlach, Sally Atwater, and Judith Schnell eds. The wildlife series: Deer. Stackpole Books. Mechanicsburg, PA. 384pp.

Dusek, G. L., R. J. Mackie, J. D. Herriges Jr., and B. B. Compton. 1989. Population ecology of white-tailed deer along the lower Yellowstone River. Wildlife Monographs. 104: 68pp.

Dusek, G. L. 1987. Ecology of white-tailed deer in upland ponderosa pine habitat in southeastern Montana. Prairie Naturalist. 19(1): 1-17.

Fuller, T. K. 1992. Do pellet counts index white-tailed deer numbers and population change?: A reply. J. Wildl. Manage. 56(3): 613.

Fuller, T. K. 1991. Do pellet counts index white-tailed deer numbers and population change? J. Wildl. Manage. 55(3): 393-396.

Fuller, T. K. 1990. Dynamics of a declining white-tailed deer population in north-central Minnesota. Wildl. Monogr. 110: 37pp.

Gilbert, F. F. 1966. Aging white-tailed deer by annuli in the cementum of the first incisor. J. Wildl. Manage. 30(1): 200-202.

Griffin, S. L., L. A. Rice, C. S. DePerno, and J. A. Jenks. 1999. Seasonal movements and home ranges of white-tailed deer in the central Black Hills, South Dakota and Wyoming, 1993-1997. Pittman-Robertson completion report no. 99-03. South Dakota Department Game, Fish and Parks. Pierre, South Dakota. 62pp.

Griffin, S. L., J. F. Kennedy, L. A. Rice, and J. A. Jenks. 1994. Movements and habitat use of white-tailed deer in the northern Black Hills South Dakota, 1990-1992. Pittman-Robertson completion report no. 95-05. South Dakota Department Game, Fish and Parks. Pierre, South Dakota. 131pp.

Hawkins, R. E., L. D. Mortoglio, and G. G. Montgomery. 1968. Cannon-netting deer. J. Wildl. Manage. 31: 191-195.

Jacobson, H. A., J. C. Kroll, R. W. Browning, B. H. Koerth, and M. H. Conway. 1997. Infrared-triggered cameras for censusing white-tailed deer. Wildl. Soc. Bull. 25(2): 547-556.

Koch, E. 1941. Big game in Montana from early historical records. J. Wildl. Manage. 5(4): 357-370.

Koerth, B. H., C. D. McKown, and J. C. Kroll. 1997. Infrared-triggered camera versus helicopter counts of white-tailed deer. Wildl. Soc. Bull. 25(2): 557-562.

Kroll, J. C. 1994. A practical guide to producing and harvesting white-tailed deer. Stephen F. Austin State University. Nacogdoches, TX. 591pp.

Martinka, C. J. 1968. Habitat relationships of white-tailed and mule deer in northern Montana. J. Wildl. Manage. 32(3): 558-565.

Manly, B. F. J., L. L. McDonald, D. L. Thomas. 1993. Resource selection by animals: statistical design and analysis for field studies. Chapman & Hall. London, UK. 177pp.

Mooty, J. J. 1980. Monitoring deer populations in the northern forested areas of the Midwest. Pages 13-22 in Ruth L. Hine and Susan Nehls, eds. White-tailed deer population management in the north central states. Proc. 1979 Symp. North Cent. Sect. Wildl. Soc. 116pp.

Mundinger, J. G. 1981. White-tailed deer reproductive biology in the Swan Valley, Montana. J. Wildl. Manage. 45(1): 132-139.

Novak, J. M., K. T. Scribner, W. D. Dupont, M. H. Smith. 1991. Catch-effort estimation of white-tailed deer population size. J. Wildl. Manage. 55(1): 31-38.

Olson, R. 1992. White-tailed deer habitat requirements and management in Wyoming.

Pauley, G. and F. Lindzey. 1993. Historic and current distribution of white-tailed deer in Wyoming. Wyoming Cooperative Fish and Wildlife Research Unit. Laramie, WY. 69pp.

Reeve, A. F. and F. G. Lindzey. 1991. Evaluation of mule deer winter mortality in south-central Wyoming. Wyoming Cooperative Fishery and Wildlife Research Unit. Laramie, WY. 147pp.

Rice, L. A. 1984. Fawn mortality rates in South Dakota deer populations, 1977-1981. Pittman-Robertson Report W-75-R-26. South Dakota Department Game, Fish and Parks, Pierre, South Dakota. 51pp.

Sawyer, H. and F. Lindzey. 2000. Ecology of sympatric mule deer and white-tailed deer in riparian communities of southeast Wyoming. Wyoming Cooperative Fish and Wildlife Research Unit. Laramie, WY. 49pp.

Sieg, C. H. and K. E. Severson. 1996. Managing habitats for white-tailed deer: Black Hills and Bear Lodge mountains of South Dakota and Wyoming. Rocky Mountain Forest Range & Experiment Station report no. RM-GTR-274. Fort Collins, CO. 24pp.

Smith, M. H. and O. E. Rhodes Jr. 1994. The subspecies. Pgs. 90-91 in D. Gerlach, S. Atwater, and J. Schnell (eds.): Deer. Stackpole Books, Mechanicsburg, PA.

Stefanich, M. R. 1995. Movements and habitat use of white-tailed deer in the northwestern Black Hills of Wyoming and South Dakota. M.S. Thesis, University of Wyoming. Laramie, WY. 46pp.

Swenson, J. E., S. J. Knapp, and H. J. Wentland. 1983. Winter distribution and habitat use by mule deer and white-tailed deer in southeastern Montana. Prairie Naturalist. 15(3): 97-112.

Teer, J. G., D. L. Drawe, R. L. Urubek. 1985. Sampling patterns and intensities for helicopter censuses of white-tailed deer. Pages 15-24 in Samuel L. Beasom and Sheila F. Roberson, eds. Game Harvest Management. Proc. 3rd International Symposium of the Caesar Kleberg Wildlife Research Institute. 374pp.

Thorne, E. T., N. Kingston, W. R. Jolley, and R. C. Bergstrom. 1982. Diseases of wildlife in Wyoming.

White, G. C. 1992. Do pellet counts index white-tailed deer numbers and population change?: A comment. J. Wildl. Manage. 56(3): 611-612.

White, G. C. and R. A. Garrott. 1990. Analysis of wildlife radio-tracking data. Academic Press. San Diego, CA. 383pp.

Will, G. C. 1973. Population characteristics of northern Idaho white-tailed deer, 1969-1971. Northwest Science, 47(2): 114-122.

Wood, A. K., R. J. Mackie, and K. L. Hamlin. 1989. Ecology of sympatric populations of mule deer and white-tailed deer in a prairie environment. Mont. Fish Wildl. and Parks. Bozeman, MT. 97pp.

Wood, G. W., J. R. Davis, and G. R. Askew. 1985. An evaluation of 7 years of spotlight-count data on a coastal South Carolina plantation. Pages 25-35 in Samuel L. Beasom and Sheila F. Roberson, eds. Game Harvest Management. Proc. 3rd International Symposium of the Caesar Kleberg Wildlife Research Institute. 374pp.

Zar, J. H. 1974. Biostatistical analysis. Prentice-Hall Inc. Englewood Cliffs, NJ. 620pp.

XIV. Other References –

Sieg, C. H. 1990. Annotated bibliography: white-tailed deer biology and management in the Black Hills. Rocky Mountain Forest Range & Experiment Station. Rapid City, SD. 161pp.