Chapter 10

Mountain Lion (*Puma concolor*)

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I. INTRODUCTION –

A. Management – Efforts to manage mountain lions have changed markedly since the nineteenth century. In 1882, the Wyoming Territorial government enacted legislation awarding a bounty to persons who killed mountain lions and other predators (Wyoming Game & Fish Department 1997). Lions were hunted throughout the year and no bag limits were enforced. In 1973, mountain lions were reclassified as a trophy game animal. Since then, hunting seasons have been established, management units and hunt areas delineated, and quotas applied to regulate the number and sex of lions harvested.

A draft mountain lion management plan was written in 1997, revised in 2006, and is the current basis for managing lions in Wyoming (Wyoming Game and Fish Department 2006). The State is divided into 5 Mountain Lion Management Units (MLMUs) and further divided into 29 lion hunt areas (Fig. 1). Harvest is regulated through annual mortality quotas. A total quota is prescribed for each hunt area and a female sub-quota is also prescribed for some areas. If either quota is reached, the hunting season closes. The bag limit is 1 lion per hunter per calendar year except in area 27, where 1 additional lion may be taken each calendar year. Hunters are responsible for checking the status of the harvest quota prior to hunting. Status reports are continually updated on a recorded message that is accessed via a 1-800 statewide hotline. Within 3 days of harvest, the hunter must present the pelt and skull from each harvested lion for inspection by a Game and Fish official. The hunting season is 1 September to 31 March within all hunt areas except 15, 22, and 27, where the season is yearlong. Approximately 150-200 mountain lions are harvested annually in Wyoming. Most lions are harvested with the aid of dogs. From 1993 through 2006, dogs were used to take 91% of the lions legally harvested in the state.

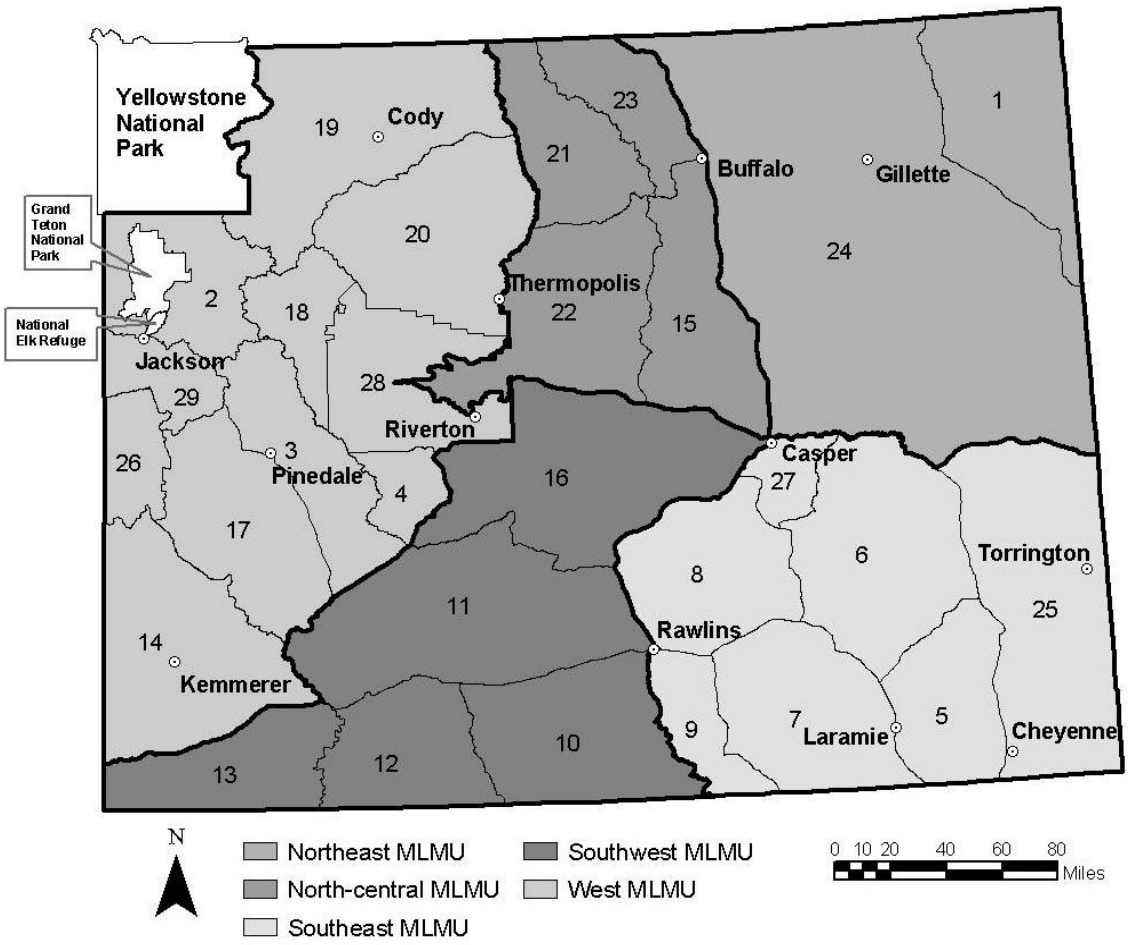

Fig. 1. Mountain lion hunt areas and management units in Wyoming.

Wyoming statutes provide that any mountain lion damaging private property can be killed by the owner or lessee of the property, or by an employee of the owner or lessee. Depredations by mountain lions are most common in locations where domestic livestock are moved seasonally to graze. Lions are capable of killing most species and age classes of livestock, however cattle less than 1 year of age and sheep of all age classes are most susceptible (Shaw 1979). Cattle depredations are a greater problem in the southwestern U.S. because calves are generally born in mountain lion habitat (Shaw 1979). In the northern Rocky Mountains, calves are born at lower elevations where lions are not as prevalent (Chuck Anderson, personal communication). Sheep are depredated whenever they are grazed in areas occupied by lions (Lindzey 1987), but most frequently during the summer months (Shaw 1979). In Wyoming from 1996-1999, 88% of depredations by lions involved sheep, 5% involved cattle, 3.3% involved horses, and 1.6% involved unknown livestock. Under State statutes, owners of livestock killed by lions receive compensation when the cause can be confirmed.

In the Western U.S., the continuing expansion of human populations into lion habitats has been accompanied by an increase in lion/human interactions (Beier 1991). From 1990-

2003, the Department removed an average of 2.9 nuisance lions annually as a result of such interactions. The Department does not limit the number of nuisance lions that can be destroyed, but all other forms of human caused mortality are deducted from the annual mortality quotas.

II. LIFE HISTORY –

A. The historic range of the mountain lion was the largest of any terrestrial mammal in the western Hemisphere, other than humans (Logan and Sweanor 2001). The mountain lion still ranges from the southern tip of South America to northern British Columbia (Logan and Sweanor 2001), but was apparently extirpated from the eastern U.S. (except southern Florida) and eastern Canada by the late 1800s to early 1900s. Between the mid 1960s and the early 1990s, mountain lion populations increased in many western states and they expanded their distribution into some of the mid-western states including Nebraska, South Dakota, and North Dakota. This expansion largely took place after mountain lions were reclassified from unregulated status to game animals in most states, and after the use of poisons was restricted beginning in the early 1970s. Similarly, mountain lions in Wyoming have increased in abundance and distribution and currently occupy most regions with timber or tall-shrub cover statewide. In the early part of the 20th century, efforts to remove mountain lions from many areas of Wyoming caused local extirpations. However, robust populations are currently found in the Black Hills of northeastern Wyoming, the pinyon-juniper country of southwestern Wyoming, and all major mountain ranges throughout the state. The recovery of mountain lions throughout Wyoming (and likely much of the species' former range) is likely due to favorable shifts in management practices and policies, and habitat conditions favoring increases of some prey (e.g., elk, *Cervus elaphus*, white-tailed deer, *Odocoileus virginianus*).

Dispersal patterns and genetic evidence suggest mountain lion populations are well connected throughout most of the western U.S. (Culver et al. 2000, Sinclair et al. 2001, Anderson et al. 2004). Males have been known to move distances in excess of 1,000 km (Thompson and Jenks 2005). These long-range movements provide a very effective means of genetic transfer helping to maintain lion populations in distant regions. In addition, much of the habitat occupied by mountain lions in Wyoming consists of mountain ranges that extend into surrounding states. This provides excellent connectivity to other habitats and lion populations. Overall, gene flow throughout the Central Rocky Mountains would indicate the region sustains one large mountain lion population with rapid genetic exchange among suitable habitat patches (Anderson et al. 2004).

B. Habitat Use

The mountain lion's broad distribution in North America attests to its adaptability and its ability to persist virtually any place with adequate prey and cover [Cougar Management Guidelines Working Group (CMGWG) 2005]. Mountain lions may be found in climates ranging from arid desert environments to temperate rainforests of the Pacific Coast. Previous studies in the western U.S. suggest mountain lions select conifer, deciduous timber, riparian, and tall shrub habitat types at mid-high elevations in steep or rugged

terrain (Logan and Irwin 1985, Laing 1988, Koehler and Hornocker 1991, Williams et al. 1995, Dickson and Beier 2002). Tall vegetation or rugged terrain provides the necessary hiding and stalking cover for securing prey and raising young (CMGWG 2005). Besides lack of prey, the only other conditions limiting lion distribution are vast, open areas with little hiding cover and severely cold winter temperatures of northern climates (Pierce and Bleich 2003).

Despite the mountain lion's broad geographic distribution and adaptability, development and habitat fragmentation can negatively impact lion populations (Beier 1993). New road construction and homes in mountain lion habitat not only reduce the amount and quality of habitat available to mountain lions and their prey [e.g., deer (*Odocoileus* spp.) and elk (*Cervus* spp.)], but also increase human presence in these areas. Increased human activity ultimately leads to more frequent conflicts and ultimately higher mortality rates of mountain lions in these areas (CMGWG 2005). Even in sparsely populated states such as Wyoming, where most lion range is still relatively intact, subdivisions, new road construction, and oil and gas development may negatively habitats occupied by mountain lions.

C. Mountain Lion Social Structure and Reproduction

The social behavior of mountain lions likely evolved to maximize individual survival and reproductive success (Logan and Sweanor 2001). Mountain lions are solitary carnivores exhibiting a polygynous breeding strategy wherein dominant males typically breed with females that reside within their home ranges (Murphy 1998). Resident males aggressively defend their territories against male intruders, whereas females allow more overlap, but express mutual avoidance (Lindzey et al. 1989, Ross and Jalkotzy 1992, Logan and Sweanor 2001). Home ranges of females tend to be large enough to provide sufficient prey for themselves and their young (~50-100 km^2, 20-40 mi^2). On the other hand, home ranges of males tend to be larger (~150-300 km^2, 60-120 mi^2), overlapping the home ranges of several females apparently to maximize reproductive success (Murphy 1998). Young females commonly express philopatric behavior (remain in their natal range) upon independence, but males typically disperse from their natal range (Anderson et al. 1992, Ross and Jalkotzy 1992, Lindzey et al. 1994, Logan and Sweanor 2001). Mountain lion densities are low by comparison to other large mammals. They range from about 10 independent (>1 year old and self sufficient) mountain lions/1,000 km^2 (386 mi^2) in arid climates such as southern Utah (Lindzey et al. 1989) to about 35 independent mountain lions/1,000 km^2 in moister regimes such as the Diablo Range, California (Hopkins 1989) and southwest Alberta (Ross and Jalkotzy 1992).

Female mountain lions typically produce their first litter when they are 2-3 years old (Anderson 1983, Ashman et al. 1983, Logan and Sweanor 2001). Although mountain lions can breed at any time of year, they exhibit seasonal birth pulses. Data from 7 studies in western North America indicate May through October is the peak period for mountain lion parturition (CMGWG 2005). Gestation lasts 82-96 days and litter size is typically 2 to 4 young. The average size of 53 nursling litters documented in New Mexico was 3.0, with 13 (26%) 2-kitten litters, 26 (49%) 3-kitten litters, and 14 (26%) 4-

kitten litters (Logan and Sweanor 2001). Other studies reported average litters of kittens <6 months old ranged from 2.2 in Alberta (Ross and Jalkotzy 1992) to 2.9 in Wyoming (Logan et al. 1986). Kittens are usually weaned at 2–3 months and typically remain with the female 12–18 months until they become independent (Pierce and Bleich 2003).

D. Food Habits and Prey Relationships

Mountain lions consume primarily large vertebrate prey. In much of North America, deer comprise the majority of mountain lion diets (Pierce and Bleich 2003), but other large ungulates such as elk, bighorn sheep (*Ovis canadensis*), moose (*Alces alces*), and pronghorn (*Antilocapra americana*) may also be consumed (Ross and Jalkotzy 1996, Ross et al. 1997, Murphy 1998, Anderson and Lindzey 2003). Although mountain lions primarily subsist on large ungulates, small mammals including porcupines (*Erethizon dorsatum*), lagomorphs (hares and rabbits), ground squirrels (*Spermophilus* spp.), and beavers (*Castor canadensis*) may also supplement mountain lion diets. Mountain lions occasionally prey on domestic livestock and pets as well. Sheep and goats are the most common domestic livestock taken by lions, but they also kill cattle, horses, and pets including dogs, and cats (CMGWG 2005).

Mountain lions can affect the trajectory of some ungulate populations. Lions were an important source of predation on a bighorn sheep population in Alberta (Ross et al. 1997) and were implicated in the decline of another bighorn population that began to avoid areas of high quality forage where it was exposed to predation (Wehausan 1996). Logan and Sweanor (2001) reported mountain lion predation was the most important, proximate factor limiting a New Mexico mule deer (*O. hemionus*) population. In this case, lion predation slowed the rate of growth during an increasing population phase, and hastened the decline when drought impacted forage quantity and condition. Mountain lions annually removed an estimated 15-20% of a mule deer population on the Kaibab Plateau, Arizona (Shaw 1980), 8-12% of a mule deer population on the Uncompahgre Plateau, Colorado (Anderson et al. 1992), and 2-3% of elk and 3-5% of mule deer in the northern Yellowstone Ecosystem (Murphy 1998). Predation by mountain lions, however, does not necessarily suppress or regulate a prey population. Suppression is more likely in systems with multiple prey and multiple predator species. In these situations, predators that would normally decrease as their prey becomes less abundant are supported by other, more numerous prey species (Pierce and Bleich 2003).

The potential effect of lion predation depends largely on the condition of the prey and its habitat. In areas where habitat is in good condition, most individuals in the prey population are likely to survive in the absence of predation. Where prey is in poor condition due to diminished forage quality, individuals are more likely to die regardless of predation. Mountain lion predation is more likely to be *additive* to other causes of mortality when ungulates are in good physical condition. Conversely, mountain lion predation is more likely to be *compensatory* when ungulates are in diminished physical condition (Logan and Sweanor 2001). Healthy prey populations typically have higher reproductive rates and offset predatory regulation by producing more young than are consumed by predators. Ungulate populations that are limited by predation (Table 1)

may benefit from increased mountain lion harvest. Populations limited mainly by habitat conditions will not likely benefit from increased harvest of mountain lions, except during the initial phases of habitat recovery. In this circumstance, reducing predation may allow the prey population to respond more rapidly to improved forage conditions. Where alternate prey is unavailable, mountain lions will decline naturally following a decrease in the primary prey (ungulate) population, regardless how liberal or conservative mountain lion harvests are (CMGWG 2005).

Table 1. Characteristics of ungulate prey populations regulated by predation and by forage conditions (from the Cougar Management Guidelines 2005, page 15).

Prey species characteristic	Population size mainly affected by predation[b]	Population size mainly affected by forage conditions
Physical condition of adult females	better	poorer
Pregnancy rate of adult females	higher	lower
Pause in annual production by adult females	less likely	more likely
Yearlings pregnant[a]	usually	seldom
Corpora lutea counts of adult females[a]	higher	lower
Litter size[a]	higher	lower
Age at first reproduction for females	younger	older
Weight of neonates	heavier	lighter
Mortality of young	additive	compensatory
Age at extensive tooth wear	older	younger
Diet quality	higher	lower

[a] Some species of ungulates may exhibit limited variability in these characteristics.
[b] These traits will be evident in *any* population that is far below carrying capacity, even if it experiences *no* predation. The manager should have evidence that predation is a limiting factor before concluding that reducing predation would increase ungulate recruitment.

III. POPULATION ESTIMATION TECHNIQUES – Population parameters such as size, density, and age and sex composition are difficult to estimate because lions are secretive and primarily nocturnal, and they exist at naturally low densities within typically rugged terrain (Wyoming Game & Fish Department 2006). The most reliable demographic information about mountain lions is obtained from radio telemetry and mark/recapture or re-sight studies (Logan et al. 1986, Lindzey et al. 1994). Population indices have also been derived from

track surveys (Van Dyke et al. 1986, Van Sickle and Lindzey 1991, Smallwood and Fitzhugh 1995, Beier and Cunningham 1996, Becker et al. 1998), and new DNA marking techniques (Ernest et al. 2000).

A. Mark-Recapture –

1. Rationale – Mark-recapture procedures involve marking a random sample of animals and then resampling to estimate the proportion of marked animals in the population. The proportion of marked animals in the sample is extrapolated based on the sample size and total number marked, to provide a population estimate. Although mark-recapture procedures are widely used to census mountain lion populations and are generally considered the most accurate method, it is often difficult to fulfill the assumptions of the method. All animals in the population must be equally susceptible to capture and no immigration or emigration can take place during the sampling period. Mark-recapture studies tend to be costly and labor intensive, limiting their application to smaller geographic areas. Managers should exercise caution when applying density estimates to other similar habitats and populations, as varying harvest intensity and other factors can influence lion demography (Lindzey 1987).

2. Application – A mark-recapture study must be designed properly to be successful. Catch rates are balanced through trap spacing (to ensure all animals have access to traps), timing and duration of trapping (to account for seasonal movements), and trap types, sets and baits (to enhance capture of trap-wise animals). Radio-transmitters may be used to detect movements across study area boundaries. Study areas should be large enough to represent a population and attributes (habitat, hunting pressure, harvest structure) should be representative of other areas to which density estimates may be applied.

   Several mark-recapture or resight methods are currently employed to estimate abundance of mountain lions. The most common approach is to capture, mark, release, and recapture lions. Trapping and handling techniques are described in Hemker et al. (1984) and Lindzey (1987). Ear-tags and radio-collars can serve as marks. Sampling to obtain recapture or resight data can be accomplished by recapture (Logan et al. 1986), aerial observations (Van Sickle 1990, Lindzey et al. 1994), or harvest monitoring (Garshelis 1990).

3. Analysis of data – Methods used to analyze mark-recapture data are described in various population ecology textbooks (e.g., Begon 1979, Krebs 1989). Analytical methods have also been devised to address unique issues, such as unequal catch rates or lack of demographic closure (Otis et al. 1978, Pollock 1982, White et al. 1982, White 1996). If radio-location data are available, the estimate can be improved by calculating the number of marked animals present during recapture efforts (Miller et al. 1987, Miller et al. 1997) or by weighting the marked proportion based upon the time each animal spends in the trapping area (Garshelis 1992). Analytical tools (e.g., Jolly-Seber) are available to address lack of demographic closure caused by births, deaths, immigration, emigration, etc. However, populations tend to be overestimated

unless the assumptions of even catch rates and geographic closure are met, or the disparities are corrected.

4. Disposition of data – The results of any mark-recapture study should be summarized in a report distributed to Regional Wildlife Coordinators and the Trophy Game Section. This information can be useful to evaluate or adjust hunting season frameworks and harvest quotas.

B. Track Surveys –

1. Rationale – Track surveys can provide an index to the abundance of mountain lions (Van Dyke et al. 1986, Lindzey 1987, Van Sickle and Lindzey 1991). Tracks in the snow are located by walking ground transects (Van Dyke et al. 1986, Van Sickle 1990, Smallwood and Fitzhugh 1995, Beier and Cunningham 1996) or by aerial observations (Van Sickle and Lindzey 1991, Becker et al. 1998). The number of unique track sets is determined to estimate the abundance of lions in a specific area.

2. Application – Observers survey a defined area either on the ground or from the air to locate all mountain lion tracks (Lindzey 1987). Tracks of individual lions are identified based on measurements or distinguishing characteristics such as missing toes (Van Dyke et al. 1986, Van Sickle 1990). The number of unique track sets is an estimate of lion density within the area surveyed. If a representative area is surveyed, the estimate can be extrapolated to calculate a regional population estimate (Smallwood and Fitzhugh 1991). Van Dyke et al. (1986) examined the probability of detecting lion tracks under various conditions.

   Tracks observed from the air cannot be assigned to individual, unmarked lions, however such observations can be used in probability sampling to estimate the density of lions within a particular area. One technique is to fly transects across the study area, perpendicular to a baseline (e.g., drainages or ridges, Van Sickle 1990, Becker et al. 1998). Each track set observed is backtracked to a point where tracks are no longer fresh, then foretracked until the animals are located (Becker et al. 1998). Becker et al. (1998) developed equations to estimate the population based on the track length in relation to the length of the baseline of the area searched (Van Sickle 1990). Using this technique, Van Sickle and Lindzey (1991) accurately estimated the number of lions in a known population. A population can also be estimated by dividing the sum of the number of individual tracks observed per survey unit by the probability of observing those tracks (Becker et al. 1998). Another method involves marking a random sample of lions with radio collars. The average distance traveled by lions parallel to the baseline is determined from the radio-collared animals. Based upon these parameters and the number of tracks detected by observers, the population can be estimated (Van Sickle 1990). Studies were done in Idaho, Utah, and Wyoming to evaluate the use of probability sampling to estimate lion populations. Results from Idaho and Utah were summarized in the proceedings of the 6th Mountain Lion Workshop published in December 2002. Anderson et al. (2003) investigated this method further using computer simulations of mountain lion

GPS data (≤6 locations/night) to simulate mountain lion tracks and reported that changes of 15-30% could be detected (90% probability) for medium-high density mountain lion populations (23-35 independent mountain lions/1,000 km^2 or 386 mi^2) depending on sampling effort (transects spaced 2 to 3 km apart). An area of about 2,000 km^2 (771 mi^2) could be surveyed in 2 helicopter days for about $8,000-$10,000. Thus, the technique would be limited to relatively small areas and likely only affordable to management agencies every few to several years.

3. Analysis of Data – Selective harvest by hunters in accessible areas can impact age and sex composition data obtained from roadside and aerial track surveys. This source of potential bias should be considered when these types of data are used to estimate lion densities. The precision of aerial track surveys is also affected by the density of lions in the area (Van Sickle and Lindzey 1991). Precision increases at higher densities.

4. Disposition of Data – Results of track surveys should be summarized in a report and distributed to Regional Wildlife Coordinators and the Trophy Game Section for use evaluating hunting season frameworks and annual mortality quotas.

C. Minimum Population Estimation from DNA Sampling –

1. Rationale – Using recent developments in DNA analysis, managers can now collect samples of hair, feces, or other tissues in the field and analyze them to establish genetic profiles of individual animals. Ernest et al. (2000) identified individual mountain lions in California by analyzing microsatellite DNA from feces collected in Yosemite National Park. Mountain lion DNA was successfully isolated from prey DNA in the feces, and was also distinguishable from DNA of other carnivore species (Ernest et al. 2000). A minimum population of mountain lions (number of unique individuals) was estimated based on his technique. The population included both resident individuals and lions traveling through the study area.

2. Application – Mountain lion scats are collected from the survey area and sent to a lab where DNA analysis is performed. By cataloging the individual genetic sequences identified from scats, a minimum population of lions can be determined, provided sufficient effort is expended to collect scats.

3. Analysis of Data – Currently, the technique involves simply tallying the numbers of individual lions represented in genetic samples collected from within an area. However, mountain lion scats can be quite difficult to locate. Intensive searches are needed to locate feces from a large number of individuals and this may make the technique impractical for most management applications.

4. Disposition of Data – The results of DNA studies should be summarized in a report and distributed to Regional Wildlife Coordinators and the Trophy Game Section for use in evaluating hunting season frameworks and annual mortality quotas.

D. Incidental Observations –

1. Rationale – Mountain lions are secretive, nocturnal, and live in rugged terrain. Consequently, incidental sightings are rare and thus a poor index of lion abundance. However, lion sign can corroborate presence or absence. Some states, including Wyoming, record numbers of lions observed and reported by hunters, but these data should be interpreted cautiously because of the potential for repeat sightings of individual lions.

2. Application – Observations of lions by Department personnel should be recorded on Wildlife Observation Forms and entered in the Wildlife Observation System (WOS) database. When each harvested lion is registered, the hunter is asked to report the number of lions he observed while hunting. This information is entered on the Mountain Lion Mortality Form (Attachment 1).

3. Analysis of data – Compilations of lion observations may be used in conjunction with other trend indicators, but not as a primary measure of abundance. Observations can be tallied on the basis of hunt areas or MLMUs, or they can be graphically displayed using GIS software. Records of lion observations can be useful when Department personnel comment on project proposals, particularly if documentation of presence or absence is needed.

4. Disposition of data – Forward records of lion observations monthly for regional Wildlife Coordinators to proof before they are entered in the Wildlife Observation System. In the past, requests for data queries and downloads were directed to Biological Services. However, the WOS has recently been reprogrammed enabling field personnel to query, sort, and download records from remote P.C. stations. Lion Mortality Forms should be forwarded to the Trophy Game Section where they are entered into the statewide Mountain Lion Database. Tallies of lions sighted by hunters are not published in the annual Mountain Lion Mortality Summary, but they can be requested from the Trophy Game Section if needed.

IV. HARVEST DATA –

A. Houndsman Survey –

1. Rationale – A survey designed to measure hunter effort and success was mailed to approximately 150 mountain lion houndsman and hunters each year through 2000. Houndsmen were requested to report the numbers and locations of lions harvested or released, the ages and sexes of lions harvested or released, the number of days they hunted in each hunt area, numbers of lion tracks passed up, and opinions regarding lion population trends. The survey was not used to estimate the total harvest, which can be determined more accurately from mandatory registration data. The survey was discontinued after 2000 due to poor response from hound handlers.

2. Application – Responses to the houndsman surveys were compiled and published in a report that was distributed to all survey respondents and others who requested the data. The results are available through the Trophy Game Section.

B. Sex/Age Determination –

1. Rationale – Information about age and sex structure is essential to successfully manage a mountain lion population. In Wyoming, criteria used to manage lions are based upon the sex and age composition of harvested lions.

2. Application – Since 1974, all successful mountain lion hunters have been required to present the skull and pelt of harvested lions to a Wyoming Game and Fish Department employee within 3 days of harvest. Data from each harvested lion are recorded on Mountain Lion Mortality Forms (Attachment 1). The following information is collected: location of kill, sex, number of days hunted, total number of lions observed while hunting, and method of take. Two premolar teeth are extracted for cross-sectioning to determine age. Generally, the second upper premolars are extracted. Exercise care to avoid breaking the roots as broken teeth are useless for aging. Hair and tissue samples are also collected for DNA analysis. Clip a small (approximately 1 cm^2) hair and tissue sample from the edge of the pelt. Place tooth and hair/tissue samples in separate small paper envelopes. Samples must be stored in a manner that allows desiccation, as moisture retention promotes spoilage. Label the envelopes with type of sample, sex and estimated age of lion, name of hunter, location, hunt area, and date. Envelopes are attached to a Mountain Lion Mortality form and mailed to the Trophy Game Section. Skulls must be presented in an unfrozen condition so teeth can be removed, and evidence of sex must remain naturally attached to the pelt for accurate identification. The vulva or penis spot can also be used to determine sex of lions. The penis spot is 4-5" anterior from the anus on males and the vulva spot is about 1" anterior from the anus on females. Information collected from harvested lions is the primary source of data used to monitor mountain lion populations in Wyoming.

3. Analysis of data – Harvest data are compiled in an annual Mountain Lion Mortality Report prepared by the Trophy Game Section after each hunting season. Reports include the harvests in each MLMU and statewide, as well as the sex composition of the harvest.

4. Disposition of data – Mountain Lion Mortality Forms are forwarded to the Trophy Game Section upon their completion. The information is then entered into the statewide mountain lion database. Annual mortality reports can be requested from the Trophy Game Section.

C. Aging Techniques – The techniques currently available to age mountain lions are approximate and sometimes subjective. However, coarsely defining age classes as young non-breeding individuals and older, probable breeders is considered sufficient to support management decisions (Lindsey 1987). Techniques currently used by the Wyoming

Game and Fish Department to age captured or harvested mountain lions are described in the following sections. No single technique is entirely reliable. A combination of techniques will provide the most dependable results.

1. Laboratory Aging Based on Tooth Cross-Sectioning –

    a. Rationale – Cementum is deposited annually in layers around the roots of mammal teeth. The cementum layers can indicate age in years (Dimmick and Pelton 1994). However, early attempts to count the cementum annuli in cross-sections of mountain lion teeth proved unreliable (Lindzey 1987). The dependability of this technique improved with advancements in lab technology and development of aging criteria specifically for mountain lions. Moody (1997) reported reasonable agreement between ages determined from cementum annuli and tooth wear in 80% of 93 cases.

    b. Technique – The cementum annuli technique involves both field and laboratory procedures. A tooth must first be extracted from captured or harvested lions. To ensure consistency, we recommend using the second upper premolar (upm2) to age mountain lions (Dimmick and Pelton 1994). This tooth is located directly behind the upper canine.

        Teeth can be removed with various dental elevators or tooth extraction devices available through veterinary supply companies. Exercise care to maintain the integrity of the tooth. In most cases, it is imperative to keep the root of the collected tooth intact (Dimmick and Pelton 1994). In addition, you should take into consideration the well being of live animals and preservation of trophy skulls. After the tooth is removed from the jawbone, keep it clean and place it in a small paper envelope that has been labeled. Send collected teeth and accompanying data forms to the Trophy Game Section where they will be cataloged and forwarded to the lab. Once at the lab, teeth will be processed and examined to determine age.

    c. Analysis and Disposition of Data – Age data are compiled by the Trophy Game Section and analyzed in the annual Mountain Lion Mortality Summary. These reports can be requested from the Trophy Game Section.

2. Field Techniques for Aging – Ages of mountain lions can also be determined from tooth wear, presence or absence of a canine ridge, and pelage characteristics. Lions can be reliably categorized into distinct age classes based on these methods. Anderson and Lindzey (2000) published a detailed photographic guide for estimating lion ages based on canine ridge, previous or current lactation, tooth wear and staining, and pelage characteristics. This guide is available through Biological Services or the Wyoming Cooperative Fish & Wildlife Research Unit. Also refer to Appendix V (Aging Techniques), Section II.E. (Mountain Lions). Anderson and Lindzey (2000) provided the following descriptions:

a. Tooth Wear, Staining, and Eruption – Note the degree of wear on the outer incisors in relation to the other incisors and note wear on the canines. The degree of tooth staining can also indicate age. The progression of tooth eruption is useful to age lions up to 16 months of age.

b. Pelage Characteristics – Spots on the tan portion of the pelage become difficult to discern by about 1 year of age and are typically gone by 2 years of age. Spots on the white underfur become difficult to detect after 2 years of age, but may be present up to 3 years of age. Bars on the inside front legs are last to disappear and may be present on 3 year old lions.

c. Canine Ridge – The canine ridge is a junction along the top of the canine tooth where the cylindrical upper portion of the tooth meets the tapered lower portion. This ridge becomes detectable at about 2-3 years of age and is the best means of differentiating between breeding age and non-breeding age males.

d. Evidence of Previous Lactation in Females – The nipples of females that have previously lactated are typically flattened or enlarged and black in color. Females that have not lactated typically have white or light colored nipples. Female mountain lions generally give birth by 24-30 months of age. The external appearance of nipples is the best means of differentiating between breeding age and non-breeding age females.

V. NON-HUNTING MORTALITY –

A. Incidental Observations –

1. Rationale – Records of non-hunting mortalities are useful to document lion presence, and to detect potential problems such as disease or hazards.

2. Application – Record all non-hunting mortalities of mountain lions, either human-caused or natural, on Mountain Lion Mortality Forms (Attachment 1). These forms should be completed to document all mortalities discovered by, or reported to the Wyoming Game & Fish Department.

3. Analysis and Disposition of Data – Records of non-hunting mortalities will be summarized in the annual Mountain Lion Mortality Summary at the conclusion of the hunting season. Natural mortalities are not counted against hunting season quotas. Human-caused mortalities are not counted if they are non-hunting (e.g., vehicle collisions). However, lions taken illegally are counted against the quotas.

VI. LION-HUMAN INTERACTIONS – A statewide protocol was adopted to manage interactions between trophy game and humans in Wyoming (Wyoming Game & Fish Department 1999). The protocol outlines specific policies and procedures the Department follows in dealing with individual lions identified as dangerous or a nuisance. To determine

an appropriate response, the Department classifies mountain lion/human interactions in one of the following categories:

- Recurring Sighting – Repeated sightings of a particular lion or group of lions close to developed areas.

- Encounter – An unexpected direct meeting, without incident, between a human and a mountain lion near developed areas.

- Aggressive Encounter – An incident during which a lion displays aggressive behavior toward a human, but the aggressive encounter doesn't result in physical injury.

- Attack – A human is physically injured or killed as a result of contact with a mountain lion.

The Statewide Protocol for Managing Trophy Game/Human Interactions outlines responses recommended for the above categories of encounters. Depending on the circumstance, appropriate responses can include no action, deterrence measures, aversive conditioning, trapping and relocation, or destruction of the animal.

When a lion/human encounter is reported, personnel are required to fill out a Trophy Game Incident Report and a Trophy Game/Human Interaction Form (Attachment 2). If the incident is a sighting, depredation, property damage, etc. that does not directly involve a human encounter, only a Trophy Game Incident Report needs to be filled out. Data from these forms are used to improve damage prevention strategies and public instruction regarding effective responses in confrontations with lions.

A pamphlet entitled, "Living in Lion Country" was published by the Wyoming Game and Fish Department in 1996. The pamphlet describes specific responses to deal with an aggressive lion and steps to minimize conflicts around developed areas. Similar information is provided in educational workshops presented by Department personnel each spring.

VII. CAPTURE AND IMMOBILIZATION – Although lions can be captured in traps or foot snares, they are most commonly treed with the use of trained dogs and then immobilized with a dart propelled by a CO_2 or .22-caliber charge (Lindzey 1987). This method of immobilization can be dangerous to both the animal and the handler and should not be attempted except with personnel present who are trained in chemical immobilization and emergency care (Pond and O'Gara 1994). For general discussions of immobilization procedures, consult Seal and Kreeger (1987) and Pond and O'Gara (1994). Recommended dosages of Telazol, Xylazine, and Yohimbine (a reversal drug for Xylazine) are listed in Attachment 3. In over 80 lion captures, only 1 lion was lost due to drug-related causes (Chuck Anderson pers. comm.). Always find appropriate sites to release captured lions, as lions recovering from immobilizing drugs are at risk if released near water, cliffs, etc. A Trophy Game Capture Form is also included in Attachment 4.

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ATTACHMENT 1

MOUNTAIN LION MORTALITY FORM

Hunt Area _____ Region _____

Date of kill: _____ TYPE: Legal_____; Illegal_____; Damage Control_____; Other_____; Unknown_____

If "Other" or "Unknown", probable cause of mortality _____

PERSON WHO HARVESTED LION: Name: _____

Address: _____ City: _____

State: _____ Zip: _____ Phone: _____ Resident: _____ Nonresident: _____

METHODS/EFFORT: Days hunted: _____ Were dogs used? (Y/N) _____ If not, how was lion harvested? _____

Was a guide/outfitter used? (Y/N): _____ Name: _____ Dog owner: _____

Number of lions observed: _____ Were you selective while hunting? (Y/N): _____ Number of lions treed and released: _____

Number of lions that were marked: _____ (Ear tag / tattoo / radio collar frequency : _____)

Number of fresh tracks not pursued: _____ (How many were single adults?: _____ How many were adults with kittens?: _____)

LOCATION/DRAINAGE: Where was lion harvested? _____

Sec: _____ Twnshp: _____ Rng: _____ UTM Zone: _____ UTM Easting: _____ UTM Northing: _____

SEX AND AGE: Sex: _____ Est. Age: _____

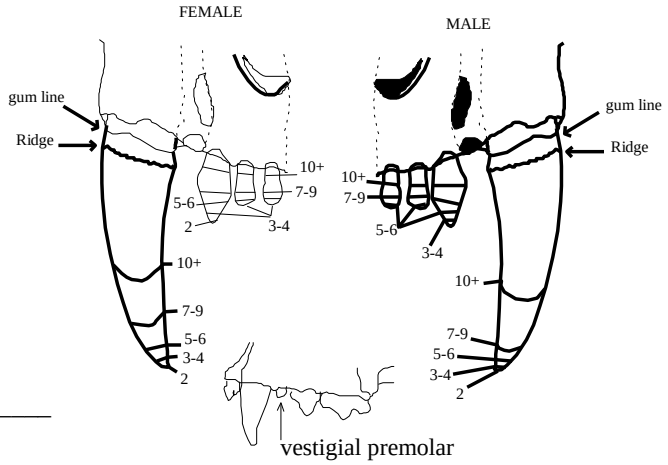
If female, presently lactating? (Y[≥2] / N) _____

Appear to have lactated in past? (Y / N) _____

Canine ridge below gumline? (Y[≥2.5] / N) _____

Any visible spotting on rear legs? (Y[≤3] / N / ?) _____

Visible bars on inside of front legs? (Y[<4] / N / ?) _____



REQUIRED SAMPLES:

Number of teeth collected: 0 1 2 Pictures of teeth (Y/N): _____

Hair/Hide sample (1/2" X 1/2") taken (Y/N): _____

Remarks: _____

_____

_____

Date record was WOFed: _____ Date Biological Services Called: _____

I, _____ of _____

being duly sworn, depose and say that I am the holder of Wyoming Mountain Lion license # _____,

and lawfully took the above lion on _____ - _____, 20_____ in Hunt Area # _____.

_____ _____ _____

Inspected by Date Hunter's Signature

Any person who makes a false statement on the registration form regarding the date the mountain lion was taken or the hunt area in which it was taken shall be in violation of this regulation and, such violation shall be punishable as provided by Title 23, Wyoming statutes for violation of Commission regulations.

ATTACHMENT 2

TROPHY GAME INCIDENT REPORT

Trophy Game Section

SPECIES: GRIZZLY BEAR BLACK BEAR MOUNTAIN LION WOLF	Record ID # Entered By: Date:
TROPHY GAME SECTION MORTALITY # CAPTURE #	ANIMAL ID# LAB AGE

DATE:_____ INVESTIGATORS:_____ AGENCY: _____

INCIDENT/CAPTURE SITE INFORMATION

SECTION_____ TOWNSHIP_____ RANGE_____

UTM COORDINATES:_____(east)_____(north) ZONE:_____ WGFD REGION: _____

MANAGEMENT UNIT:_____ HUNT AREA:_____ LANDOWNER:_____

LOCATION (Drainage etc.):_____ HABITAT:_____

AFFECTED PERSON:

NAME: _____

ADDRESS: _____

CITY:_____ STATE: _____

REPORTING DATE:_____ ZIP: _____

PHONE: _____

TYPE OF NUISANCE / DAMAGE

GARBAGE ..... _____

LIVESTOCK ..... _____

VEHICLE ..... _____

CAMP ..... _____

DEVELOPED SITE / STRUCTURAL ..... _____

PET ..... _____

HUMAN INTERACTION * ..... _____

AGE CLASS (# and sex of each)	FEMALE	MALE	UNK
ADULT	_____	_____	_____ OTHER _____
SUBADULT	_____	_____	_____
YEARLING	_____	_____	_____
YOUNG OF YR.....	_____	_____	_____
UNKNOWN	_____	_____	_____

**** Refer to Trophy Game/Human Interaction Form***

_____ESTIMATED DAMAGE

COST: $ _____

DID ANIMAL RECEIVE HUMAN FOOD REWARD?

_____ YES NO

ID MARKS:

TYPE:_____ COLOR:_____ NUMBER:_____ LOCATION: _____

ACTION TAKEN:

REPORT ONLY:_____ SITE INVESTIGATION:_____ AVERSIVE CONDITION:(type)

CAPTURE ATTEMPTED:(days) _____ ANIMAL CAPTURED:** _____ TRANSLOCATED: _____

EUTHANIZED: _____ PHOTOS:(y/n) _____ ENTERED IN WOS: _____

***** Complete a Trophy Game Capture form if an animal is captured.***

RELEASE INFORMATION: SECTION_____ TOWNSHIP_____ RANGE _____

UTM COORDINATES:_____(east)_____(north) ZONE:_____ WGFD REGION: _____

MANAGEMENT UNIT:_____ HUNT AREA:_____ LANDOWNER:_____

LOCATION (Drainage etc.):_____

DETAILS: (animal descriptions, site description, circumstances, etc.) _____

_____

(cont. on back)

WILDLIFE/HUMAN INTERACTION FORM

This form is to accompany a completed Trophy Game Incident Report form.

Complete this form only in the event of: recurring sightings or encounters near human development, or an aggressive encounter or attack

LARGE CARNIVORE: Mt. Lion; Black Bear; Grizzly Bear; Other: _____

RECORD TYPE: Mark the correct choice after reading definitions:

Recurring Sighting: repeated sightings of a particular animal or group of animals in close proximity to human developed areas (e.g., homes and campgrounds).

Encounter: an unexpected direct meeting between a human and a large carnivore without incident near human developed areas.

Aggressive Encounter: an incident where a large carnivore displays aggressive behavior toward a human, but does not cause physical injury.

Attack: When a human is physically injured or killed from contact with a large carnivore.

Recurring Sighting:_____ Encounter:_____ Aggressive Encounter:_____ Attack:_____

Age Class: Enter # and Sex of: Adults:_____ Subadults:_____ Yrlg:_____ Young:_____

If attack: Victims Name: _____ Age: _____ Fatal? Yes No

Interview Section

Call received by: _____ Date: _____ Time (military): _____

A. Activity of involved party prior to incident:

1. Hiking _____ 2. Fishing _____ 3. Hunting _____ 4. Retrieving game _____ Other: _____

B. What action did the person involved exhibit? (check all applicable)

1. Waved arms _____ 2. Backed away _____ 3. Ran _____ 4. Talked _____ 5. Shouted _____

5. Threw objects _____ 6. Fired warning shot _____ 7. Fought _____ Other: _____

C. What action did the animal exhibit? (check all applicable)

1. Watched person _____ 2. Pop jaws _____ 3. Show teeth _____ 4. Growled _____ 5. Fled _____

6. Crouched _____ 7. Bluff charged _____ 8. Attacked _____ Other: _____

D. Which of following best describe the incident? (check all applicable)

1. Surprise encounter _____ 2. Food guarding _____ 3. Defense of young _____

4. Inquisitive/habituated _____ 5. Human predation _____ Other: _____

I&E Brochure(s) Mailed: Yes No List Title(s): _____

_____

Follow-up: Public Meeting _____ Other: _____

(Narrative Report On Back)

Send original with completed Large Carnivore Incident Report to Regional Office. Regional Office will forward to Trophy Game Section.

5/15/97

WILDLIFE/HUMAN INTERACTION FORM (PAGE 2)
NARRATIVE REPORT

Required for recurring sightings and encounters near human development for trophy game species and all aggressive encounters and attacks for all species.

Date: _____ Investigators: _____

Reporting Party:_____ Address: _____

Phone: _____ **Incident/Capture Site Information:** Section:_____ Rng:_____ Tn:_____

UTM Coordinates:_____(East)_____(North) Zone:_____ WGFD Region: _____

Management Unit (DAR):_____ Hunt Area:_____ Landowner:_____

Location (drainage, etc.):_____ Habitat Type:_____

ID Marks: Type:_____ Color:_____ Number:_____ Location:_____

Action Taken: _____

Release Information: UTM: _____East _____North Zone:_____ WGFD Region:_____

Management Unit (DAR):_____ Hunt Area:_____ Location:_____

Comments:

ATTACHMENT 3

Mountain Lion Drug Dosages Using Telazol, Xylazine, and Yohimbine

Recommended dosage: Telazol – 2.2mg/lb, Xylazine – 0.45mg/lb, Yohimbine – 0.057mg/lb
***Hydrate Telazol with 2ml of sterile water/vial (500mg vial), total volume will be 2.6ml**

Body Weight (lbs)	Total Drug Dosage (mg)		Drug Volume (ml or cc)		Reversal (Yohimbine)	
	Telazol	Xylazine	Telazol	Xylazine	Dose (mg)	Volume (ml)
20	44	9	0.23	0.09	1.14	0.23
30	66	13.5	0.34	0.14	1.70	0.34
40	88	18	0.46	0.18	2.28	0.46
50	110	23	0.57	0.23	2.85	0.57
60	132	27	0.67	0.27	3.42	0.68
70	154	32	0.80	0.32	3.99	0.80
80	176	36	0.92	0.36	4.56	0.91
90	198	41	1.03	0.41	5.13	1.03
100	220	45	1.14	0.45	5.70	1.14
110	242	50	1.26	0.50	6.27	1.25
120	264	54	1.37	0.54	6.84	1.37
130	286	59	1.49	0.59	7.41	1.48
140	308	63	1.60	0.63	7.98	1.60
150	330	58	1.72	0.68	8.55	1.71
160	352	72	1.83	0.72	9.12	1.82
170	374	77	1.94	0.77	9.69	1.94
180	396	81	2.06	0.81	10.26	2.05
190	418	86	2.17	0.86	10.83	2.17
200	440	90	2.29	0.90	11.40	2.28

ATTACHMENT 4

Trophy Game Capture Form

Res. or Mngt. Date:_____ Bait:_____ Species:_____
Trap Method:_____ Agency:_____ ID # _____
Location:_____
UTM's_____E _____N Zone:_____ Mngt. Unit:_____ Hunt Area:_____
Trappers:_____

Immobilization Procedures

Drug strength(mg÷ cc)= mg/cc Dosage(total mg÷ lb)= mg/lb

Time	Drug	Dosage(cc)	Injection Site	Method	Reaction

Time animal immobile: Time Recovery Started: Time Recovery Complete:

PHYSIOLOGICAL MONITORING

Time	Respiration	Heart Beat	Temp. (F)

TAGS, WEIGHT, & AGE

Est. Weight:_____ Scale:_____
Sex:_____ Est. Age:_____ Lab Age:_____
Old Markers:_____

Tattoo:_____ Where:_____

	Number	Color	Shape
Ear Tags: **R:**			
L:			

Reproductive Status:_____

RADIO TRANSMITTER

TYPE	FREQUENCY	TRANS. #	COLOR	ATTACHED WITH:	PULSE RATE

BODY CONDITION (1-5) AND DESCRIPTION:_____
_____
_____
_____
_____

REMARKS:_____
_____
_____
_____
_____

Note: FARAD withdrawal time (time before human consumption of animal is safe) is 15 days for Telazol, 3 days for Ketamine, and 30 days for Xylazine.

RELEASE SITE:_____

Release UTM's_____E _____N Zone:_____ Mngt Unit:_____ Hunt Area:_____ Region:____

WGFD LOT #'s_____

Bear Measurements

Body Measurements (cm)

A. Total Length	
A-1. Contour Length	
B. Girth	
C. Height	
D. Neck Circ.	
E. Head Length	
F. Head Width	
F-1.Head Circ.	
F-2 Tail Length	

Foot Measurements (mm)

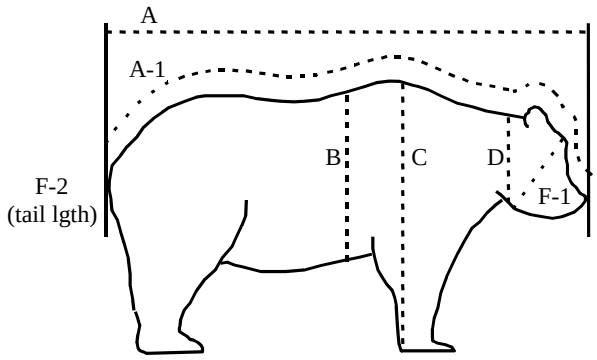
G	H	I	J	K	L	M	N

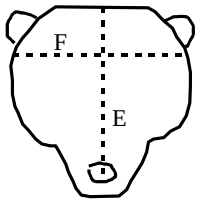
Samples Taken

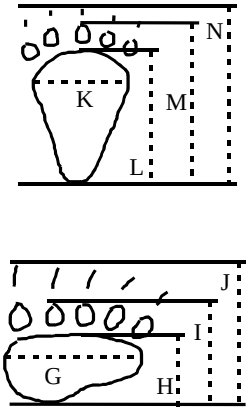
Tooth	Blood	Hair	Tissue

BIA Measurements

Reactance	Resistance	% Body Fat







Lion Measurements

Body Measurements (cm)

A. Total Length	
A-1. Contour Length	
B. Girth	
C. Height	
D. Neck Circ.	
E. Head Length	
F. Head Width	
F-1.Head Circ.	
F-2 Tail Length	

Foot Measurements (mm)

G	H	I	J	K	L	M	N

Samples Taken

Tooth	Blood	Hair	Tissue

Wolf Measurements

Body Measurements (cm)

A. Total Length	
A-1. Contour Length	
B. Girth	
C. Height	
D. Neck Circ.	
E. Head Length	
F. Head Width	
F-1.Head Circ.	
F-2 Tail Length	

Foot Measurements (mm)

G	H	I	J	K	L	M	N

Samples Taken

Tooth	Blood	Hair	Tissue

Revised 4/04