MOUNTAIN LION DATA ANALYSIS UNIT L-6
MANAGEMENT PLAN

GAME MANAGEMENT UNITS
15, 25, 26, 34, 35, 36, 43,44,45,47,444,471

NORTHWEST REGION

Prepared for:
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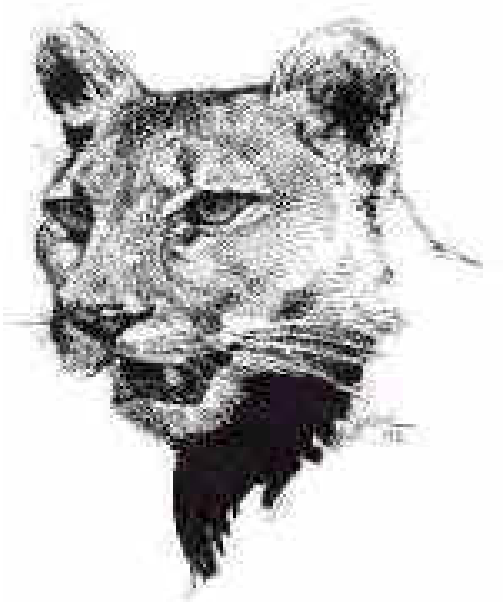

November 2004

DESCRIPTION OF DAU, HABITAT AND PAST MANAGEMENT

Location

DAU L -6 is located in west-central Colorado just west of the Continental divide. (Figure 1) I- 70 bisects the DAU from east to west. The north-west portion of the DAU contains

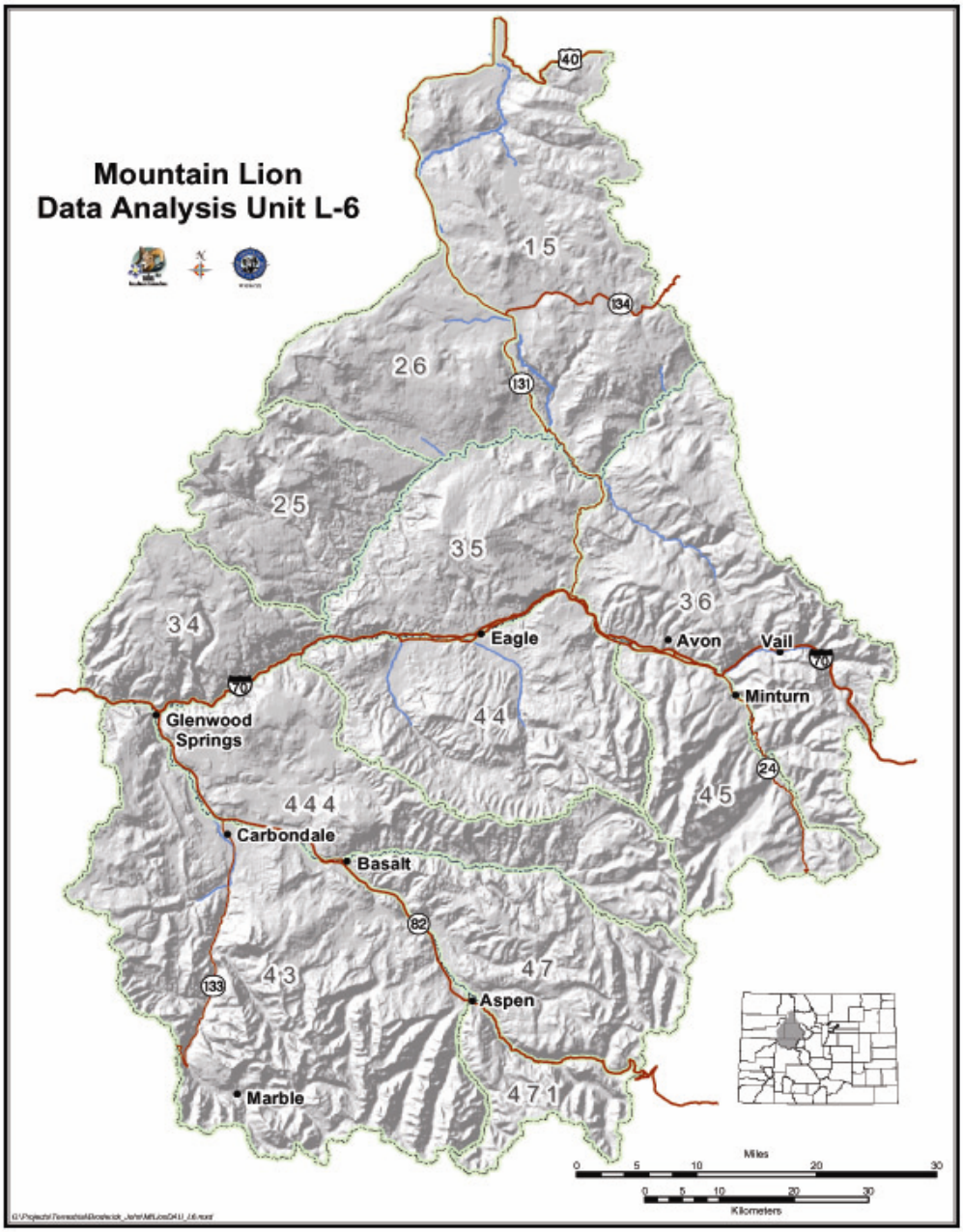

Figure 1

all the lands that drain into the lower Colorado River from Gore canyon to Glenwood

canyon (GMU's 15, 25, 26, 34, and 35). The south- western potion of the DAU comprises of the area drained by the Roaring Fork, Crystal, and Frying Pan Rivers (GMU's 43, 44, 47,444 and 471). The south-eastern portion of the DAU includes the area drained by the Eagle River including Gypsum creek and Brush creek (GMU 44); the Lake creeks and Homestake creek (GMU 45). Finally the north-east portion of the DAU includes the west half of the Gore Mountains, Red and White Mountain and the Piney river drainage (GMU 36).

The total area of L-6 is approximately 11,978 square kilometers. (4624 sq. miles). The DAU is approximately 74% public land, 25 % private property, and 1% state land board (Figure 2).

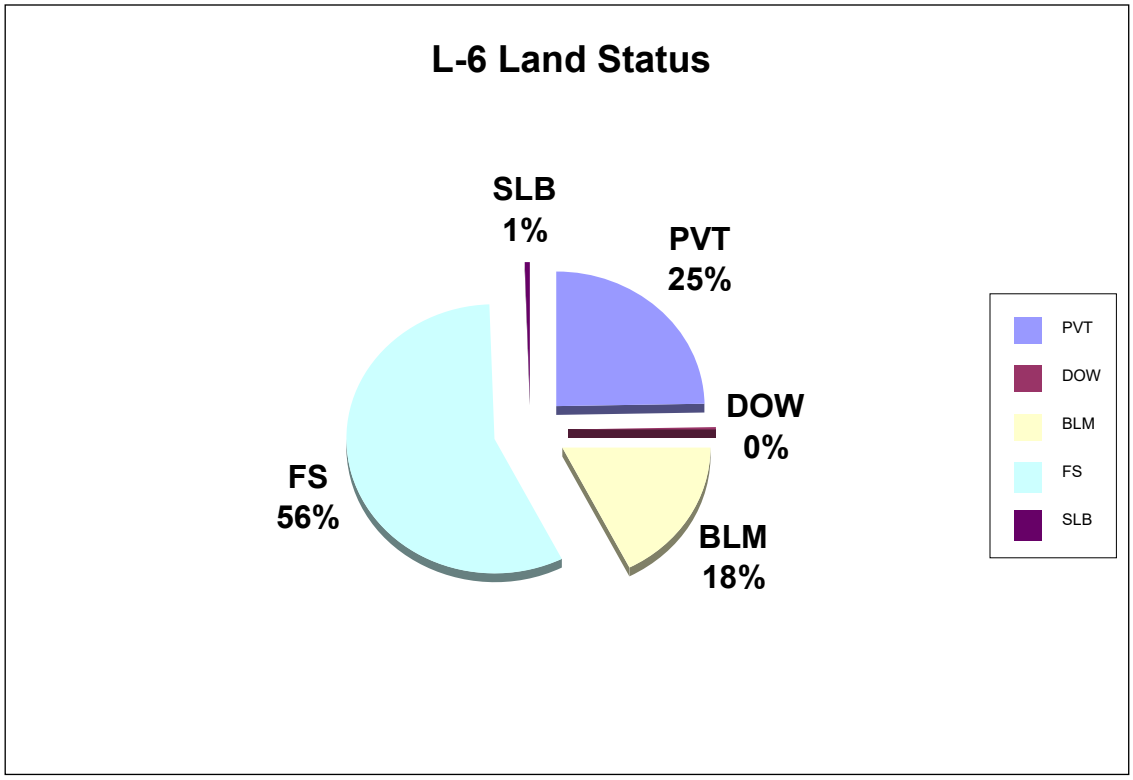

Figure 2

Bureau of Land Management (BLM) land represents 18 % of the public land with the United States Forest Service managing the other 56 %. The private lands are concentrated along the I- 70 corridor and along the Roaring fork and Crystal rivers.

Habitat

This DAU contains a complete range of mountain lion habitat. The lower canyons (5700 ft. elev.) and side drainages of the Colorado River from Canyon Creek to Gore Canyon; the lower elevations along the Piney River; and the lower drainages below Red and White Mountain is considered to be excellent terrain for mountain lion in that it is bisected by numerous canyons and rugged terrain that meets year around lion requirements for food and cover. The south side of the DAU contains some excellent mountain lion habitat in the canyons on the lower Roaring Fork and Crystal River drainages, lower Frying Pan River, and the lower Eagle River area (south of the Eagle

River from Dotsero to the town of Eagle). At the other extreme is the high elevation spruce fir sub-alpine fir and alpine tundra habitats of the Gore, Sawatch and Elk mountain ranges which puma infrequently occupy.

Mountain lion are primarily associated with the lower elevation habitats in the DAU among the rocky, steep canyons. The vegetation in these areas varies in relation to altitude and aspect, but is typical of high desert vegetative communities. Pinion-juniper woodlands dominate the landscape. Gamble's oak, serviceberry, mountain mahogany interspersed with aspen and Douglas fir pockets are common in the unit. Mountain shrub- sagebrush communities are typical in the medium elevations of the DAU. The higher elevations contain spruce-fir and alpine tundra habitats

Human development

With the exception of the Interstate 70 corridor, the northern portion of the DAU has not experienced the tremendous growth in land development compared to other areas in the mountains. There are a few small towns and communities that include Burns, Wolcott, McCoy, State Bridge, Toponas, Yampa and Radium. The southern portion of the DAU however, has experienced a tremendous growth in land development. Some of the highest human densities in the mountains occur in this area along the I-70 corridor and in the Roaring Fork Valley. Major towns in this part of the DAU include - Vail, Avon, Eagle, Gypsum, Glenwood Springs, Carbondale, Basalt, Snowmass Village and Aspen.

Research shows mountain lions inhabit large geographic areas due to the innate characteristics and social habits of the species. Therefore, this Lion Data Analysis Unit (DAU) L-6 combines two previous lion DAU's (L- 6 and L-10) into one large area. Utilizing a geographically larger DAU area increases the probability that the boundaries of the management area encompass the actual life processes of the puma population. Increasing the geographic area to a size similar to the area in which the life history of puma population unfolds increases the veracity of the base line data which the CDOW collects. The larger geographic scale of analysis is especially appropriate for Puma management in relation to: Analysis and monitoring of population trends, estimation of lion and prey densities, assessment of management actions, and preservation of refuge areas. Further, the dispersal of juveniles and the immigration of transients signifies the importance of considering lion populations management on a regional basis (Logan, et al. 1986).

MANAGEMENT HISTORY

Historically, this area supported a large mule deer population. Since the mid-1960's, deer numbers have declined but have had a cyclic behavior. This area still supports good populations of mule deer compared to other areas of the state. Elk populations have been steadily increasing since the turn of the century. DAU L-6 contains three entire Elk DAU's (E-12, 15, 16), and a portion of E-6 (White River Elk herd). DAU L-6 contains five entire deer DAU's (D-8, 13, 14, 43, 53).

Prior to 1965 mountain lions were an unprotected species in Colorado. Mountain lion could be killed at any time and for any reason. In fact, bounties where paid for lion carcasses. In 1965 mountain lion were classified as a big game animal in Colorado. Thus, a license was required to hunt lions and annual seasons and quotas were established. Until the early 1980's the interest and participation in mountain lion hunting

was minimal. Since the mid 1980's the number of hunters in DAU L-6 has increased to approximately sixty per year.

Harvest and Management Statistics

The CDOW has assembled pertinent management data going as far back as 1980. Data includes harvest, quotas, success rates, and harvest by sex of animal. Similar information is also available for animal damage control kills and other mortality such as road kills.
Presently, season dates for lion hunting are from January 1st until March 31st and from the 1st day after the close of the regular deer and elk seasons until December 31st. New harvest quotas begin on January 1st of each year.

Mountain lion annual harvests as well as quotas have increased substantially over the last 25 years. In the early 1980's only 5 puma were harvested from the entire area defined by L-6, but by the year 2000, as many as 20 lion where being harvested annually. The most recent 5-year average for puma harvested in this DAU is 24 lion, with the 10-year average harvest equaling approximately 22 lion. The percent of female lion harvested has a 5 and 10 year average of 41%.

Populations

The L-6 lion population projection is based primarily on two factors; defining the area of suitable lion habitat within the 4624 sq. miles of the DAU and applying a probable lion density for that same area. Based on a comprehensive review of lion research literature, Logan and Sweanor (2001) offer a range of lion densities observed on projects from throughout the western United States. Given the similarities between Colorado and states/provinces such as Wyoming, New Mexico, Alberta, British Colombia and Idaho, densities were extrapolated from those studies to arrive at a low density estimate of 0.02 lions/sq.km. and a high density estimate Lion habitat within DAU of 0.046 lions/sq.km.

In almost all cases in Colorado, lion habitat overlaps with the range of their principle food source, mule deer. However, in western Colorado, elk provide an additional prey based for lion. Anderson (2003) documented elk being a significant prey item, especially for adult male lion. Recently, elk research projects conducted by CDOW in the Rifle area and field observations by CDOW personnel and outfitters confirm elk kills by lion are not unusual.

The lion population estimate for DAU L-6 was determined by delineating the area of the DAU classified as winter range for deer, elk and bighorn sheep. A high lion density estimate was attributed to this area (1617 sq. miles). The area of the DAU above 10,500 feet (1517 sq miles) was excluded from the analysis because puma infrequently occupy or utilize these high mountain habitats, where snow accumulations limit the presence of a prey base. A medium lion density was attributed to the area of the DAU that was below 10,500 feet in elevation, was not considered winter range, but still contained lion habitat (1169 sq. miles). Finally a low lion density was attributed to the remaining habitat within the DAU (320 sq. mile). The calculated population projection from this analysis of available lion habitat (Figure 4) in L-6 was determined to be approximately 301 lion.

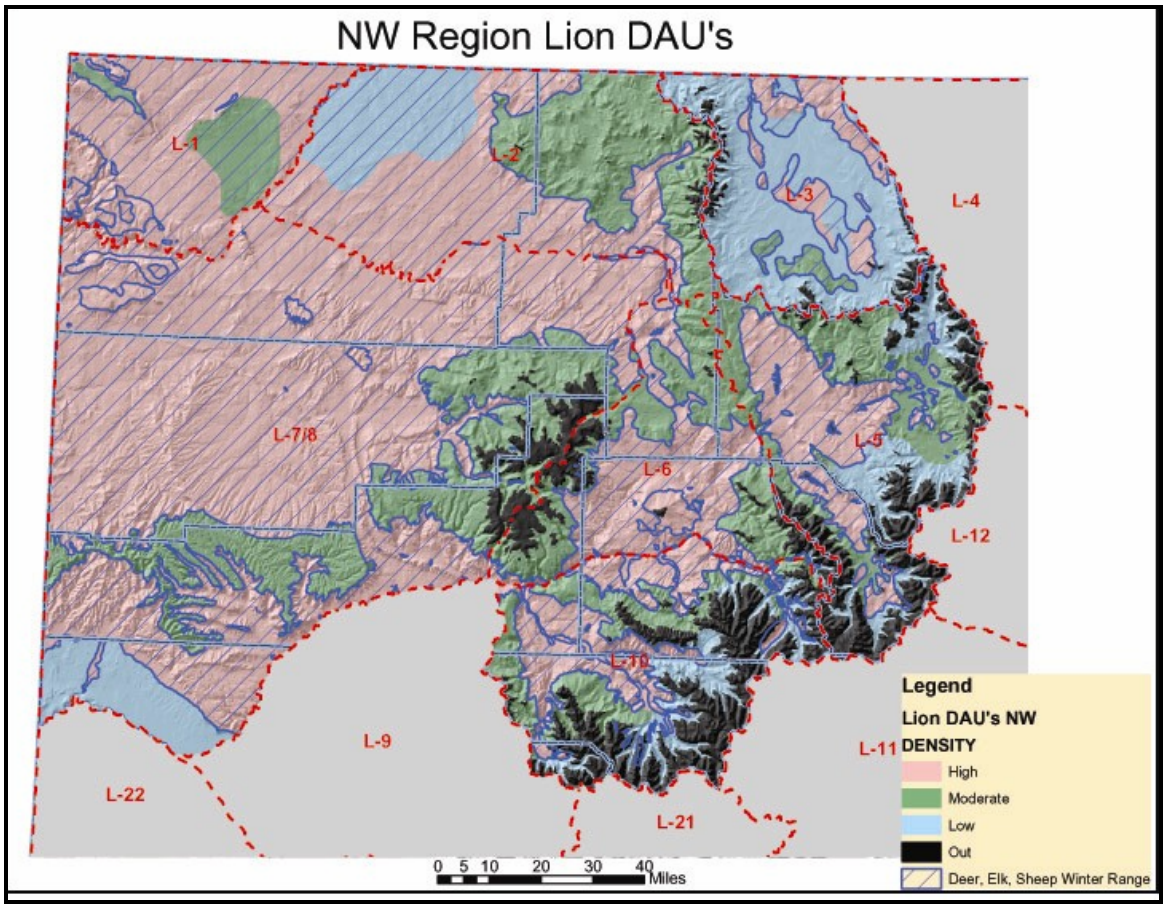

Figure 4

Population Management Alternatives and Outcomes

Harvest Potential

Logan and Sweanor (2001) and Ross and Jalkotzy (1992) reported that kittens, or dependent young, comprised approximately 33-34% of the total population. Given this information, an estimate of the huntable population of lion in the Dau would be 202 lion. (301* 33%= 99 juveniles, 301-99=202 independent lion). Using the portion of the projected population that are independent (adults and sub-adults) lion, an acceptable level of mortality within a DAU can be estimated. An annual harvest of 8-15% of the total legal population (adult and sub adult) would be considered biologically sustainable (Logan and Sweanor (2001). Table one illustrates the various harvest scenarios for L-6.

Annual Mortality Rate	8%	12%	15%	18%	20%
Hunter Harvest	15	23	29	35	39
Non-hunt Mort.	1	1	1	1	1

Total Mortality	16	24	30	36	40

Table 1. Number of lion harvested at variable mortality rates.

Cougar populations appear fairly resistant to moderately high levels of harvest as indicated by Anderson's (2003) research. The caveat being, that "adjacent populations facilitate recovery through immigration and that adult female survival provides female recruitment" (Anderson 2003).

Anderson (2003) also stated, "The most likely factor to inhibit cougar population reduction from harvest is limited hunter access creating local refuges. In these situations, inaccessibility will dictate the degree of resiliency in that population to hunter harvest…"

Refuge areas

A geographic review of Dau L-6 shows five wilderness areas (Hunter Frying pan, Holy Cross, Maroon Bells, Flattops, and Gore) totaling approximately 511 square miles; one BLM area (King Mountain) managed for non – motorized recreation totaling 19 square miles; and another seventeen parcels, totaling 300 square miles, of roadless public land identified in the White River National Forest Plan 2002. Large portions of the wilderness areas are suitable habitat for mountain lion, and much of the acreage identified in the White River Forest Plan, as roadless, are mid to low elevation lands that also contain good mountain lion habitat.

Monitoring

Population monitoring will be accomplished primarily from data collected as a part of the mandatory check of lions harvested. The estimated age of the animal will be determined using techniques outlined by Anderson and Lindzey (2000). Specifically, priority should be given to evidence of previous lactation, annuli aging of premolars, presence of a canine ridge and presence or absence of fore leg bars (Anderson 2003).

Anderson (2003) in his study of the sex and age characteristics of cougar populations documented that, "population decline followed predictable removal patterns of the more vulnerable/ abundant classes until the least vulnerable class, adult females were most abundant in the harvest", and that, "Moving from harvests consisting primarily of sub adults to adult males and finally to adult females suggests previous population decline" Therefore, if the percentage of adult females in the harvest begins to increase, and the average age of females in the harvest begins to decline then harvest restrictions would be warranted until male lions and sub adult lions comprised the majority of the harvest, indicating a recovering lion population.

Game Damage Objective

Figures 5 and 6 illustrate the number and dollar amount of game damage claims over time in DAU L-6. The 5-year average for the number of mountain lion claims is 2. The 10-year average is 3 claims. The 5-year average for the dollar amount paid for mountain lion damage is $905.00 dollars. The 10-year average is $2,179.00 dollars. In certain

years the damage to domestic sheep by lion can approach $10,000.00 dollars.

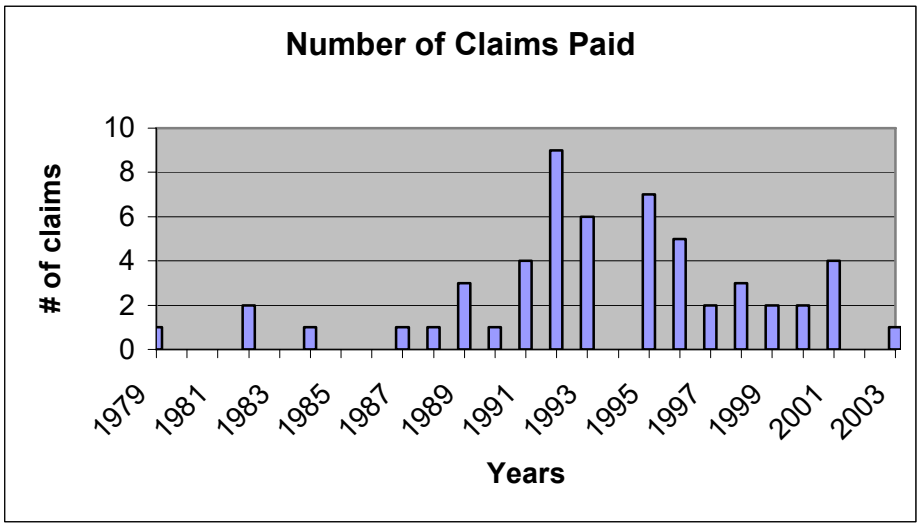

Figure 5

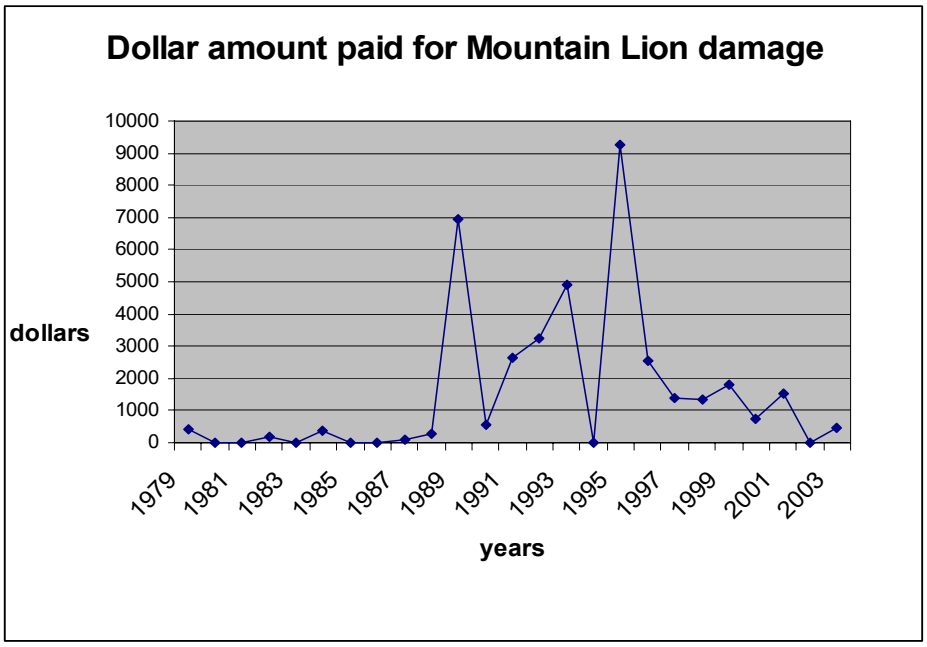

Figure 6

Game damage will be managed by targeting offending lions on an as needed basis. The CDOW has an effective working relationship with Wildlife Service including a contract for annual damage control assistance.
Most claims can be minimized and or mitigated through effective communication with the livestock operators, landowners and CDOW.

Monitoring of game damage claims will occur on an annual basis. Significant increases in game damage may induce harvest objective changes. Most likely the GMU quota will

be amended to focus harvest in the area of damage.

Key Management Issues – An issue raised by the publics reviewing mountain lion management in Colorado has centered upon the ability of CDOW to manage cougar populations in the context of a "metapopulation" As defined by McCullough (1996), "a metapopulation is a population distributed in subpopulations across a set of suitable habitat patches typically isolated in a matrix of unsuitable habitat, in which each sub population in each patch has a non trivial probability of extinction. Anderson (2003) investigated the genetic structure of cougar populations across the Wyoming basin to include genetic samples from cougars as distant as southwest Colorado. The conclusions of his research indicate that, "Cougars in the central Rocky Mountains exhibit high gene flow and low structure presumably because high male dispersal suffices to maintain connectivity between subpopulations". Further, Anderson states, "our findings in the central Rocky Mountains are more consistent with a large panmictic cougar population exhibiting rapid interchange among subpopulations."
CDOW believes that managing mountain lion populations on a large geographic scale which incorporates refuge areas, and maintains healthy sex and age ratios among the lion populations will be sufficient to preserve genetic viability among Colorado's puma population.

Another management issue raised by the general public concerns mountain lion –human interactions. There is the potential that as the human population increases, along the I-70 corridor and in the Roaring fork valley the potential for human –mountain lion interaction will increase.

Preferred Management Strategy – Stable increasing

The preferred management strategy for L-6 is to maintain an acceptable annual mortality rate, including hunting and non-hunting, in a range between 8% and 15% of the huntable population. This rate of removal would maintain or possibly increase the population of mountain lions. Quotas will be determined annually based on harvest success and other mortality factors. The long-term goal in L-6 is to maintain a healthy sustainable puma population while providing continued opportunity for sport harvest, minimizing human-lion conflicts and mitigating domestic livestock loss by lion.

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L-6 DAU Plan Amendment July 2011

Because of the increasing number of lion sightings and livestock/pet/bighorn sheep conflicts in lion DAU L-6, Area personnel believe that the lion density in the DAU is higher than estimated previously in the original 2004 DAU plan. The lion population estimate and harvest objectives are reexamined in this L-6 DAU plan amendment.

Lion population estimate

In the current (2011) estimate, we included areas up to 11,500 feet elevation as potential lion habitat and we used averages of population densities and age/sex composition from published demographic studies of mountain lions in multi-prey systems (Table 1; Seidensticker et al. 1973, Logan et al. 1986, Ross and Jalkotzy 1992, Spreadbury et al. 1996, Logan and Sweanor 2001, Cooley et al. 2009, Robinson and DeSimone 2011).

Areas within deer, elk, and bighorn sheep winter range that are below 11,500 feet elevation (4,150 km^2) were considered high quality lion habitat and were assumed to have a lion density of 4.5 lions/100km^2. Areas not within winter range and up to 11,500 feet elevation (4,631 km^2) were considered medium quality lion habitat with an assumed lion density of 3.5 lions/100 km^2. Areas classified in the Basinwide habitat cover type map as developed, agricultural, rangeland, and other open habitat types (values 1-6, 9-11, 12, 13, 19, 20, and 96-99) that were below 11,500 feet (762 km^2) were considered low quality lion habitat with an assumed lion density of 2.0 lions/100 km^2. Areas classified as water (value 114) in the Basinwide map, as well as areas above 11,500 feet, totaled 871 km^2 and were considered non-habitat for lions. See Figure 1 for a map of lion habitat quality in L-6.

These densities, extrapolated to the foregoing areas, yield a projected population of 365 total lions. Assuming 61% of the population to be independent (adult and subadult) lions (Table 1), an estimated 223 independent lions are available for harvest.

Harvest objective

Based on the estimate of 223 adult and subadult lions in the population, at an 8-15% total mortality rate, which is described in the DAU plan as an assumed sustainable mortality rate for stable/increasing management, 16 to 31 lions (average of 24) could be harvested annually (Table 3). Under a more liberal harvest strategy, assuming a total mortality rate of 12-15%, the annual harvest would be 24 to 30 lions (average 28) (Table 3).

To attempt to address localized lion conflict issues by managing the overall DAU population size through harvest, we chose the more liberal harvest mortality rate of 12-15% as a harvest objective. Whether this approach will lead to fewer lion conflicts is yet unknown. Therefore, we will monitor the level of human conflicts and game damage claims on an annual basis. Sex and age composition of the harvest will continue to be monitored to determine whether an increase in harvest results in a change in the age and sex composition of harvest, which may be suggestive of changes in population size (Anderson and Lindzey 2005).

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Location	Area km²	Adult M		Adult F		Subadults		Kittens		% kittens			Total lions/100 km²			Source
		low	high	low	high	low	high	low	high	low	high	mean	low	high	mean	
Idaho	520	3	3	2	6	0	5	1	7	17%	33%	25%	1.2	4.0	2.6	Seidensticker et al. 1973
Wyoming	741	3	3	7	9	1	7	13	17	54%	47%	51%	3.2	4.9	4.0	Logan et al. 1986
Alberta	780	4	5	8	12	2	10	6	18	30%	40%	35%	2.6	5.8	4.2	Ross and Jalkotzy 1992
British Columbia	540	1	2	4	4	2	4	11	11	61%	52%	57%	3.3	3.9	3.6	Spreadbury et al. 1996
New Mexico (TA)	703	4	6	3	9	0	5	3	15	30%	43%	36%	1.4	5.0	3.2	Logan and Sweanor 2001
New Mexico (RA)	1356	7	11	6	16	1	5	6	23	30%	42%	36%	1.5	4.1	2.8	Logan and Sweanor 2001
Washington (NE)	722												2.1	4.8	3.5	Cooley et al. 2009
Washington (Central)	655												2.5	4.8	3.6	Cooley et al. 2009
Montana	915											30%	2.2	3.6	4.0	Robinson and DeSimone 2011
									average:	37%	43%	39%	2.2	4.5	3.5	
									% independent lions:	63%	57%	61%				

Table 1. Lion age/sex composition and population densities in multi-prey systems of the western U.S.

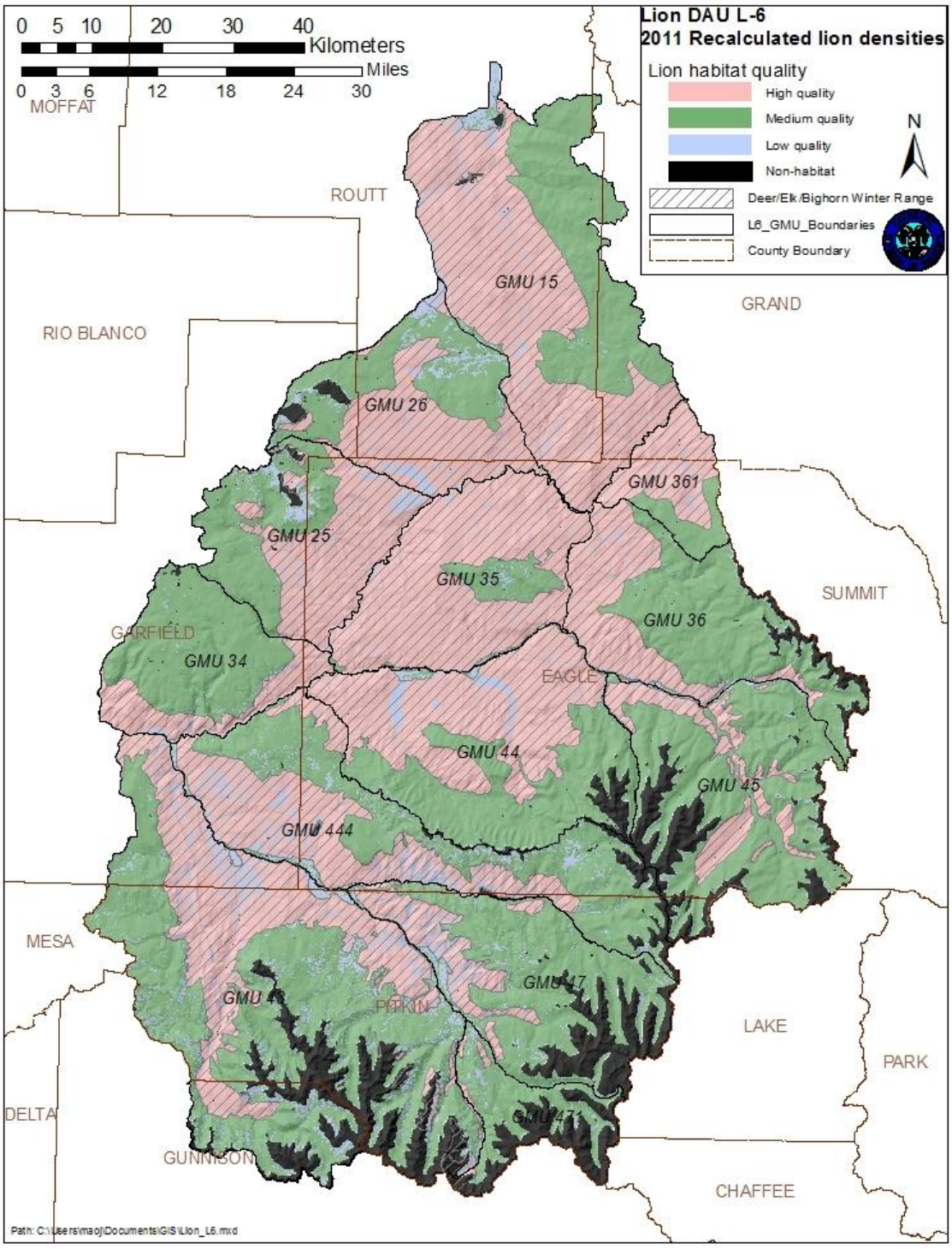
Habitat quality	Area_km^2	Assumed lion density (lions/100 km^2)	Estimated number of lions of all age classes	Estimated number of adult & subadult lions (assuming 61% of total population)
High	4,150	4.5	187	
Medium	4,631	3.5	162	
Low	731	2.2	16	
Non-habitat	871	0	0	
L-6 total	10,383		365	223

Table 2. Estimated lion population in DAU L-6.

Mortality type	Annual Mortality Rate			Average annual mortality at 8-15% range	Average annual mortality at 12-15% range
	8%	12%	15%		
Total mortality (2011 recalculation)	18	27	33	26	30
Non-hunt mortality objective	3	3	3	3	3
Harvest Objective (2011 recalculation)	15	24	30	23	27
Old harvest objective (2005-2010/11 seasons)	15	23	29	22	

Table 3. Total mortality and harvest mortality at various annual mortality rates. The past harvest objective was based upon 8-15% mortality, or 15-29 lions harvested (average 22 lions). The new harvest objective calculation would be an average of 24 lions harvested (based on a 8-15% total mortality) or 28 lions harvested (based on a more liberal harvest of 12-15% total mortality)

Figure 1. Lion habitat quality in DAU L-6. High quality habitat is considered ato be areas within deer, elk, and bighorn sheep winter range below 11,500 feet elevation. Medium quality habitat is areas outside of big game winter range and below 11,500 feet. Low quality habitat is considered areas of urban development and open rangeland below 11,500 feet. All areas above 11,500 feet are considered non-habitat.


Lion DAU L-6
2011 Recalculated lion densities
Lion habitat quality
High quality
Medium quality
Low quality
Non-habitat
Deer/Elk/Bighorn Winter Range
L6_GMU_Boundaries
County Boundary
N
0 5 10 20 30 40
Kilometers
0 3 6 12 18 24 30
Miles
MOFFAT
ROUTT
RIO BLANCO
GRAND
SUMMIT
GARFIELD
EAGLE
MESA
PITKIN
LAKE
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