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Steven M. Huffaker, Director

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Progress Report

SOUTHEAST MULE DEER ECOLOGY

Study I: Influence of Predators on Mule Deer Populations

Study II: Influence of Habitat Quality and Composition Changes to Productivity and Recruitment of Mule Deer

July 1, 2004 to June 30, 2005

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PROGRESS REPORT
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STUDY: I
JOBS: 1-2
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JOB TITLE: Southeast Mule Deer Ecology
STUDY NAME: Influence of Predators on Mule Deer Populations

INFLUENCE OF PREDATORS ON MULE DEER POPULATIONS

Abstract

The intensive fieldwork phase of this investigation concluded in December 2002. Fieldwork continued on a population scale for the following 2 years to monitor population direction and fawn-doe ratios after experimental manipulation of coyote numbers ceased and lion harvest returned to a moderate rate across study areas. Primary work-time this year has centered on data entry and analysis for both the predation study and vegetation-change study.

A new experiment was designed to test the effectiveness of coyote removal on population performance immediately after a severe population reduction, such as occurred in winter 2001-2002. Units were assigned to coyote removal levels (>0.25, 0.15, and <0.05/mi^2) based on current levels of harvest for the previous work and livestock protection. Coyote harvest units were assigned as follows: High: 56, 73A, and 73 Elkhorn; Moderate: 72 and 76; Low: 71, 73 Malad, 74, and 78. Mountain lion harvest quotas were adjusted to maintain a harvest level of 3 lions/1,000 km^2 across the study area.

Coyotes were removed from 4 treatment areas (Units 55, 57, 73A, 73 Elkhorn) by helicopter net-gunning in winters 1997-2002. Beginning in 1999, ground techniques were added to removal efforts and were continued through July of each year. Non-treatment areas included Units 54, 56, 71, and 73 Malad, in which coyote removal was minimal.

Coyote scat transects have been delineated in 8 control and treatment areas. In 1998, 66 transects were completed in summer and 80 were completed in fall. Coyote transects were completed in all study units in 1999, 2000, and 2001. A total of 407 transects were completed in 1999, 188 in 2000, 187 in 2001, and 185 in 2002. Analysis of coyote density and distribution is ongoing.

Lagomorph spotlight transects and small mammal trapping transects were completed during summer each year. Highest catch rates (primarily *Peromyscus maniculatus*) were in the low-elevation sagebrush type in 1998. Small mammal catch rates (primarily *P. maniculatus*) were significantly lower in low-elevation transects in 1999-2001, then increased to 1998 levels in 2002. Lagomorph population indexes have been variable throughout the study period.

Six mountain lions were radio-collared in Units 56 and 73A in 1998. An additional 5 mountain lions were radio-collared in 1999, 2 in 2000, and 3 in 2001. No capture effort was made in 2002. Four mountain lions were captured and ear-tagged in study units outside of Units 56 and 73A. Tags were color-coded to each different unit to facilitate movement information from mountain lions that are treed by hunters but not harvested.

Aerial composition surveys were completed in all study units during December and early January. Aerial population surveys were conducted in April using the methodology outlined in Unsworth et al. (1994). Winter ranges were surveyed completely to provide data comparable to previous surveys. Mule deer adults and fawns were captured by drive-netting or net-gunning at sites uniformly distributed within the major winter ranges in Units 56 and 73A. Blood samples were drawn from 95 adult does, 12 yearling does, and 4 female fawns in 1998. Blood serum was tested for pregnancy, nutritional serum profile, and disease profile. Pregnancy results from 1998 confirmed high pregnancy rates; 98% of 2.5+-year-old and 83% of 1.5-year-old does were pregnant. None of the fawns were pregnant. Blood samples were drawn from 57 adult does and 11 yearling does in 4 units across the study area (Units 54, 56, 71, and 73A) in 1999. Pregnancy rates were 91% for 2.5+-year-old does and 100% for yearlings. Nutritional and disease panels are completed for 1999 through 2002, but results are not yet compiled. Blood sampling was expanded to all southern Idaho regions in 2000 with 301 samples drawn from does and fawns. Pregnancy results from 108 adult deer indicated 90% pregnancy rates for 2.5+-year-old does and 47% for yearling does.

In Unit 73A, June fawn-at-heel ratios were 164 fawns:100 does, 171:100, 162:100, 170:100, and 139:100 for 1998, 1999, 2000, 2001, and 2002, respectively. In Unit 56, ratios were 162 fawns:100 does, 176:100, 183:100, 180:100, and 164:100 for the same 5 years.

Analysis indicated no relationship between mule deer population rate of change and either coyote or mountain lion removal. Survival analysis indicated a minimal increase in neonate fawn survival related to coyote removal. Mountain lion removal increased survival of adult does a maximum of 5.6% in winter.

Introduction

Mule deer (*Odocoileus hemionus*) populations are highly volatile with major cycles of high and low numbers. Despite a variety of conservative or exploitive management strategies throughout the western states, mule deer populations in the 1900s followed essentially the same pattern: a gradual increase of herds beginning in the 1920s, with peaks in the late 1940s to early 1960s, then a general decline during the 1960s to mid-1970s (Denny 1976). The pattern has continued with a buildup of herds throughout the 1980s and then a general decline in the 1990s in most areas of southern Idaho and surrounding states.

This dynamic nature of mule deer populations is determined by changes in fecundity rates, mortality rates, or age structure (Caughley and Sinclair 1994). Mule deer are highly productive, with most mature does producing twins each year. The pregnancy rate for adult does ranges from 0.67 to 1.0, with the median reported of 0.96 (Connolly 1981*b*). Average fetal rates at parturition are approximately 1.6 for adults (range 1.07-2.11) and 0.6 for yearling deer (range 0.45-1.27), according to a summary table prepared by Connolly (1981*b*).

Major proximate causes of mule deer mortality are weather, human-caused, and predation. Minor causes include parasites and disease (Connolly 1981*a*). The mule deer harvest peaked in southeastern Idaho between 1988 and 1992 and then declined sharply through 1995 (Idaho Department of Fish and Game [IDFG] Southeast Region files). This decline was more pronounced than the statewide average. The harvest peak was mirrored by population trend surveys in which observed numbers were similar to the high population levels of the mid-1960s in some big game management units. In 1992, a summer drought followed by a severe winter reduced the population by 30-50% in many big game management units across the southern end of the state (IDFG files). These low levels are similar to populations observed in the mid-1970s according to trend counts of the same area.

Since that winter, populations in southeast Idaho have been stable or declining with no apparent cause, especially in Units 70, 73, and 73A. Winter ranges are moderately utilized and some traditional winter use areas are vacant. Little winter mortality was documented from 1994 to 2001, and antlerless harvest was greatly reduced or eliminated.

Bartmann (1997) has noted a general decline in fawn:doe ratios over the last 20 years in Colorado. Similar declines have occurred in Montana (Pac, personal communication) and Idaho (Unsworth, personal communication), although these ratios are often independent of population trends. Fawn:doe ratios in Southeast Region have declined from highs between 1988-1990 and remain below the long-term average. In theory, pregnancy rates and recruitment should increase with a decrease in deer density. Robinette et al. (1977) observed that does on a higher plane of nutrition had a higher pregnancy and fetal rate than does with poorer nutrition. Current recruitment rates do not follow this pattern, suggesting a problem beyond habitat and deer density. Winter survival of fawns seems to be the key to population trends, and predation is implicated as the major proximate cause of mortality (Unsworth et al. 1999).

Recent declines in deer populations have resulted in extremely conservative management and reductions in hunter opportunity. Although numbers have begun to recover in some areas (IDFG Southeast Region files), predation by coyotes and mountain lions is often one of the factors blamed for slow recovery or the suppression of deer populations in other areas. Since the ban of 1080 poison in 1972 and declaration of the mountain lion as a game animal in the 1970s, these predators probably have increased through many of the western states. Mountain lion harvest has increased 4-fold in the past 8 years in Southeast Region. The increase may also reflect an increase in deer and elk populations through the 1970s and 1980s (Western States Deer and Elk Workshop Status Reports 1997).

Simple conclusions about the role of predation are confounded by interrelated environmental variables, primarily the relationship between proximate and ultimate factors that influence prey population size, compensatory or non-compensatory mortality, and effects of buffer prey and multiple predator effects (Theberge and Gauthier 1985). Peek (1980) restated 2 competing theories of ungulate regulation: one in which stability results from an interaction between animals and the plants they eat; the other in which the stability is imposed by predators. He suggested that natural regulation of ungulate species is rarely due to 1 factor or complex of factors even within the same population. Caughley (1981) suggested that regulation by food and regulation by predators are not mutually exclusive and may be expected to act concomitantly. In a literature review, Connolly (1981*a*) cited 45 references that tended to support the hypothesis of population regulation by predators (i.e., mortality from predation was additive) and another 27 that suggested no regulation (i.e., mortality from predation was compensatory).

When low mule deer populations are a concern, predator control is often the method demanded by sportsmen to increase the huntable population. Whether or not predators are a factor in limiting deer populations has been the subject of research for several decades, and a general conclusion is that predators can limit deer numbers under some circumstances. Although the cause is usually a combination of factors, such as weather, predators, and habitat quality, predator control is often singled out as the quickest and easiest management action that can influence deer populations.

Several research studies have documented the effectiveness of predator control to improve recruitment of mule deer and antelope populations on a limited scale (Arrington and Edwards 1951; Udy 1953; Beasom 1974*a,b*; Austin et al. 1977; Guthery and Beasom 1977; Hailey 1979; Neff and Woolsey 1979; Stout 1982; Neff et al. 1985; Smith et al. 1986). This research seeks to answer this question: if predator control is implemented, either intensively or through regulated hunting, will mule deer populations increase over a relatively large area or will the increases in survival be compensated for by increases in other forms of mortality, resulting in similar recruitment?

Study Area

The study area includes Units 54, 55, 56, 57, 71, 73A, 73 Elkhorn, and 73 Malad in southern Idaho. Intensive work is underway in Units 56 and 73A. The area is characterized by isolated mountain ranges divided by wide north-south valleys. Elevations range from 1,140 to 3,150 m.

The new study area includes Units 56, 71, 72, 73A, 73 Elkhorn, 73 Malad, 74, 76, and 78 in southeastern Idaho.

JOB 1. THE INFLUENCE OF COYOTE PREDATION ON MULE DEER POPULATIONS

Methods

Experimental Design

Mule deer populations were monitored in 4 treatment (Units 55, 57, 73A, 73 Elkhorn) and 4 control (Units 54, 56, 71, 73 Malad) areas of similar habitat to evaluate the influence of coyote and mountain lion populations on deer population growth, recruitment, and survival. With this design, the effect of coyote or mountain lion density on mule deer populations will be evaluated on a large-scale area using aerial survey techniques currently in use. Concurrently, radio telemetry will be used to determine cause-specific mortality of mule deer on an intensive study area of comparable habitat to evaluate the actual predatory effect on deer survival and recruitment. The data will allow comparisons of mule deer population characteristics in relation to varying coyote and mountain lion densities.

The new experiment is designed to test the effectiveness of coyote removal on population performance immediately after a severe population reduction, such as occurred in winter 2001-2002. Units were assigned to coyote removal levels (>0.25, 0.15, and $<0.05/mi^2$) based on current levels of harvest for the previous work and livestock protection. Coyote harvest units were assigned as follows: High: 56, 73A, and 73 Elkhorn; Moderate: 72 and 76; Low: 71, 73 Malad, 74, and 78. Mountain lion harvest quotas were adjusted to maintain a harvest level of 3 lions/1,000 km^2 across the study area.

Coyote Population Manipulation

Wildlife Services personnel removed coyotes using aerial shooting in the 4 treatment areas during winter. Successive flights continued through winter. Beginning in 1999, additional ground effort was carried out through July. Coyote carcasses were collected and sent to the APHIS lab in Ogden, Utah, for stomach content analysis. No additional gunning, beyond that needed to solve specific livestock problems, took place in the control areas until 2003.

Coyote Population Index

Scat deposition surveys were conducted on each of the 4 treatment and 4 control areas. Methods followed previously published procedures (Knowlton 1985). Eighty 1.6 km transects were randomly laid out on maps in each of the 8 study areas. This number was necessary to obtain a minimum sample of 30 transects in each unit with the correct requirements for a scat transect. Differences in coyote population will be tested with the Fisher Randomization Test (Roughton and Sweeny 1982).

Deer Capture and Marking

Neonate fawns were captured with methods described by White et al. (1972), Smith (1983), and Riley and Dood (1984). Radio-collared or non-collared does exhibiting fawning behavior were observed until they fed their newborn fawns. The location was noted and researchers captured the fawn when it returned to hiding posture. In remote areas, a helicopter was used to observe a fawn until its return to a hiding posture. The researchers then captured the fawn with the direction of the helicopter pilot. Fawns were measured for aging purposes according to the criteria of Robinette et al. (1973). Measurements included weight, hind foot length, and growth-ring of front hoof.

Adult deer and 6-month-old fawns were captured in drive nets or clover traps during December-February (Table 1). Adult females and fawns were radio-collared (Table 2), ear-tagged, and hind foot and chest girth were measured. Fawns were also weighed. A blood sample was drawn from each female deer for pregnancy testing and nutritional analysis. Blood serum was analyzed for pregnancy-specific Protein-B at Bio-Tracking, Moscow; serum chemistries at Treasure Valley Lab, Boise; and serum serology at Bureau of Animal Health Labs, Boise.

Population Surveys

Aerial sightability surveys (Unsworth et al. 1994) were conducted from late March to mid-April with a Bell 47 helicopter. Composition surveys were conducted in December and early January with the same helicopter. Deer were classified as doe, fawn, yearling buck, 3-point buck, or 4+-point buck. Fawn-at-heel ratios were obtained during the fawn capture period in June. Does with fawns were watched from the ground until the observer was confident that the number of fawns present were identified. This usually involved a feeding and bedding cycle of the fawns in plain view of the observer. We evaluated the rate of population change for each unit by estimating the annual rate of change expressed as an instantaneous rate of change ($r_t = \ln(N_{t-1}/N_t)$).

Survival and Cause-specific Mortality of Deer

Adult and 6-month-old radio-collared deer were monitored every 2 days in winter and spring and approximately twice a week in summer. Neonate fawns were monitored daily through summer and fall until collars were shed. When a mortality signal was heard, cause of death was investigated within 24 hours, most often within 12 hours. Survival rates will be calculated according to Pollock et al. (1989).

Kaplan-Meier survival curves and Greenwood variance estimates were calculated to explore survival graphically and to test for differences between the 2 study areas using log rank tests (Hosmer and Lemeshow 1999). Cox's proportional hazards model was used to explore the relationships between instantaneous mortality rates and categorical and continuous, group and individual variables. Cox's proportional hazards model expresses survival in terms of the hazard function.

Cox's proportional hazards models were created for each study area because we felt too much extrapolation would have to be made to combine the study areas into 1 analysis. No coyotes were removed from Unit 56, while various numbers of coyotes and lions were removed over the 5 years for Unit 73A. We did not want to extrapolate beyond the observed values in the data because the levels of coyote removal density for each study area "did not have considerable overlap" (Ott and Longnecker 2000).

AIC was used for model comparison. Because the sample size in proportional hazards models is the number of deaths (Harrell Jr. 2001), we needed to limit the number of variables we used in our analysis. We began by examining all 1-variable models and compared them with AIC. Models having a ΔAIC <2 were considered competing models. The best 1-variable models were then combined with all of the other variables. Model building continued until the AIC did not decrease with the addition of new variables (Klein and Moeschberger 2003). All models were then compared to the model with the lowest AIC. If 2 models were competing, both were reported in the results. Correlation between variables was noted if the parameter estimates drastically changed when a new variable was added (Harrell Jr. 2001). Outliers and assumptions regarding linearity and proportionality of variables were assessed graphically using different types of residuals (Therneau and Grambsch 2000). All statistical analysis for this project was conducted using SAS/STAT software, Version 8.2 of the SAS System for Windows and the packages survival, Design, Hmisc, lattice and base in R Version 1.8.1 for Windows.

Alternate Prey Abundance

Microtine and lagomorph abundance was documented in the 2 intensive study areas. Small mammal trapping transects were established in each of the non-timbered cover types: low-elevation sagebrush, low- and high-elevation perennial grass (CRP), high-elevation mountain brush, and cultivated hay. Abundance was estimated using snap-trapping methods outlined by White et al. (1982) and Trout (1978). Lagomorph abundance was estimated with spotlight surveys as described by Trout (1978).

Results and Discussion

The intensive fieldwork phase of this investigation concluded in December 2002. Fieldwork continued on a population scale for the following 2 years to monitor population direction and fawn-doe ratios after experimental manipulation of coyote numbers ceased and lion harvest returned to a moderate rate across the study areas. Primary work-time this year has centered on data entry and analysis for both the predation study and vegetation-change study. Population and composition surveys have been conducted in the new study units to monitor effects of coyote removal within the experimental design.

Capture and Marking

Deer were not captured as part of this investigation in 2003 or 2004. Six-month-old fawns were captured in 73A for the statewide fawn-monitoring project and the information is given in that report. Mule deer adults and 6-month-old fawns were captured by drive-netting or net-gunning at sites uniformly distributed across the major winter ranges in Units 56 and 73A. Capture operations were completed between 15 December 2001 and 8 January 2002. Newborn fawns were captured between 30 May and 19 June. Number of deer captured and the resulting radio-collared samples are presented in Tables 1 and 2.

Pregnancy and Blood Analysis

Blood samples were drawn from 95 adult does, 12 yearling does, and 4 female fawns in 1998. Blood serum was tested for pregnancy, nutritional serum profile, and disease profile. Pregnancy results from 1998 confirmed high pregnancy rates; 98% of 2.5+-year-old and 83% of 1.5-year-old does were pregnant. None of the fawns were pregnant. Blood samples were drawn from 57 adult does and 11 yearling does in 4 units across the study area (Units 54, 56, 71, and 73A) in 1999. Pregnancy rates were 91% for 2.5+-year-old does and 100% for yearlings. Blood sampling was expanded to all southern Idaho regions in 2000 with 301 samples drawn from does and fawns. Pregnancy results from 108 adult deer indicated 90% pregnancy rates for 2.5+-year-old does and 47% for yearling does. Nutritional and disease panels are completed for 1999 through 2002, but results are not yet compiled.

June Fawn-at-heel Ratios

In Unit 73A, June fawn-at-heel ratios (Table 3) were 164 fawns:100 does, 171:100, 162:100, 170:100, and 139:100 for 1998, 1999, 2000, 2001, and 2002, respectively. In Unit 56, ratios were 162 fawns:100 does, 176:100, 183:100, 180:100, and 164:100 for the same 5 years.

Coyote Removal

Coyotes were removed from the 4 treatment areas (Units 55, 57, 73A, and 73 Elkhorn) by helicopter gunning in winters 1997, 1998, 1999, 2000, 2001, and 2002 (Table 4). Flights continued until <1 coyote was killed per hour flown. Additional trapping effort was maintained. Beginning in 1999, ground techniques were added to removal efforts and were continued through July of each year. Non-treatment areas included Units 54, 56, 71, and 73 Malad, in which coyote removal was minimal.

Coyote Density Estimation

Coyote scat transects have been delineated in 8 control and treatment areas. In 1998, 66 transects were completed in summer and 80 were completed in fall. Coyote transects were completed in all study units in 1999, 2000, and 2001. A total of 407 transects were completed in 1999, 188 in 2000, 187 in 2001, and 185 in 2002. Analysis of coyote density and distribution is ongoing.

Alternate Prey

Lagomorph spotlight transects and small mammal trapping transects were completed during summer each year. Highest catch rates (primarily *Peromyscus maniculatus*) were in the low-elevation sagebrush type in 2002 (Table 5). Small mammal catch rates (primarily *P. maniculatus*) were significantly lower in the-low elevation transects in 1999-2001, then increased to 1998 levels in 2002. Lagomorph population indexes have been variable throughout the study period (Table 6).

Aerial Population and Composition Surveys

Aerial composition surveys were completed in all study units during December and early January (Table 7). Aerial population surveys were conducted in April (Table 8) using the methodology outlined in Unsworth et al. (1994). Winter ranges were surveyed completely to provide data comparable to previous surveys. Populations in several of the study units were severely impacted by a dry 2001 summer followed by above-average winter snowfall. The southern-most units (56, 73 Elkhorn, and 73 Malad) experienced population declines between 43 and 53% in 2002. Analysis of treatment effects on population rate of increase is reported in Table 9. No significant difference in rate of population increase was detected between the levels of coyote or mountain lion removal through 2003 (Table 10). Aerial composition and population surveys for the new coyote removal experiment are reported for 1997-2005 (Tables 11 and 12).

Survival and Cause-specific Mortality of Marked Deer

Summer Fawns - There were 60 deaths out of 118 collared neonatal fawns for Unit 56 (non-removal), and 50 deaths out of 132 fawns for Area 73A (removal). Kaplan-Meier curves were almost significantly different between the 2 areas at the 0.05 level ($p = 0.069$). There was no best model explaining survival of neonatal fawns for the non-removal unit. Five 1-parameter models compete as the best model explaining mule deer survival. Using Score tests, none of these models are significant at the 0.05 level. Two models are competing explanations for neonatal mule deer survival in the removal unit. Both of these models were significant overall ($p = 0.00018$, $p = 0.002$). The 2 models contain density of lagomorphs and coyote removal density or a linear year trend (Table 12).

Winter Fawns - Weight for 6-month-old fawns was significantly different for each year and study area combination ($p = 0.0128$), but weight for a combination of year, sex, and study area did not change over time ($p =0.7167$). There were 60 deaths out of 143 collared fawns for Unit 56 (control) and 49 deaths out of 139 fawns for Unit 73A (treatment). There was no significant difference between survival of the 2 treatment areas ($p = 0.36$). Two models are competing explanations for survival of 6-month-old fawns in the non-removal unit (Table 14). Both models were significant ($p = 0.0006$, $p = 0.0008$). Both models contained weight as a significant predicator. Additionally, there are 2 competing models explaining survival of 6-month-old fawns for the treatment area (Table 14). Both models are significant ($p = 0.0001$). Weight, combined precipitation, and lagomorph density are important predictors of survival.

Adults - Survival of adults was very high throughout the whole study. Survival of adult does for all seasons and study areas never reached below 0.94. There was no significant difference between survival in the 2 treatment areas in either season ($p = 0.24$, 0.46). In winter, there were 19 deaths out of 270 collared animals (animal-winters) for Unit 56 (control) and 25 deaths out of 283 animals for Unit 73A (treatment). In both seasons, the best model explaining survival for the non-removal unit implied that an increase in the precipitation decreases survival (Tables 15 and 16). Animals over age 5.5 had a decreased survival rate in both seasons in the removal unit (73A). The best model for winter in the treatment area suggests that survival of adult does will increase with mountain lion removal. There are 2 competing explanations for survival in summer-autumn for the removal unit. Both lagomorphs and precipitation or small mammals are good explanations of survival. Precipitation and small mammals density are fairly correlated ($p = 0.578$).

Predation rate by coyotes

Overall predation rates by season are reported in Table 17.

JOB 2. THE INFLUENCE OF MOUNTAIN LION PREDATION ON MULE DEER POPULATIONS

Methods

Mountain lion populations will be estimated using capture and home range information from radio-collared mountain lions in Units 56 and 73A. Logan et al. (1996) concluded that the true density of mountain lions in an area could be determined from intensive capture and relocation efforts. Mountain lion track transects, as described by Smallwood and Fitzhugh (1995), will also be conducted in the intensive study areas. Population estimates of deer from Job 1 will be combined with population estimates of mountain lions into a mountain lion:deer ratio for each study area. Based on this ratio, the 8 study areas will be categorized as high or low mountain lion:deer ratios. Survival estimates of age classes of deer from Job 1 will be compared among different levels of mountain lion density and tested for differences using Kaplan-Meier procedures (Pollock et al. 1989). Alternate prey abundance from Job 1 will be tested for correlation to both survival and cause-specific mortality rates.

Results and Discussion

Mountain Lion Capture

Six mountain lions were radio-collared in Units 56 and 73A in 1998. An additional 5 mountain lions were radio-collared in 1999, 2 in 2000, and 3 in 2001. No capture effort was made in 2002. Four mountain lions were captured and ear-tagged in study units outside of Units 56 and 73A during the 3 capture seasons. Tags were color-coded to each different unit to facilitate movement information from mountain lions that are treed by hunters but not harvested. Capture and fate information is reported in Table 18. Numbers of mountain lions removed (Tables 19 and 20) includes all legal harvest from mandatory reports and all other control actions or accidents that remove a mountain lion from the study unit. Mountain lion season structure in the liberal harvest units was changed from a liberal female quota system in 1997-1998 to a general season in 1998-1999, then back to a liberal quota in 1999-2002. Female quota in the conservative harvest units has remained unchanged since 1997.

Mountain Lion Population Indices

Exploratory alterations of Smallwood and Fitzhugh (1995) track survey methods were attempted 1998-2001. Units 56 and 73A were divided into 46 km^2 quadrats and then stratified into high or low probability of finding a mountain lion track. A random sample was drawn from each stratum in Units 56 and 73A. Two days after at least a 5 cm snowfall, up to 32 km of snow-covered roads were traveled with a snowmobile in each selected quadrat. Efficiency of the survey could be increased by reducing the road distance traveled to 20 km. It was often difficult to find 32 km of road in a quadrat.

Both the mountain lion removal and track index information suggest a reduction in the mountain lion numbers in the liberal hunt units, at least for 1999 (Table 21). Age structure data obtained from removed mountain lions also suggests a high harvest rate in the liberal hunt units. The 2000 survey was not complete and should not be used for comparisons to other years. Transects were discontinued after the 2001 survey due to difficulty with snow conditions needed to standardize methodology. Both track transects in 2001 and harvest summaries in 2001 and 2002 suggest the lion populations in the conservative and liberal harvest units have returned to pre-removal levels.

Predation Rates on Deer

Overall predation rates of deer by mountain lions is presented in Table 22. The mortality associated with mountain lions is very similar to the predation rate reported for a deer population below carrying capacity by Logan et al. (1996). Mean annual predation rate of mule deer from mountain lions varied from 0.066 (1987-1990) to 0.226 (1991-1994), depending on whether deer were below or above carrying capacity in the San Andres Mountains in New Mexico (Logan et al. 1996). These rates represented 54% and 80 % of the total deer mortality of that study.

Table 1. Number of deer captured by age and unit.

	Newborn fawns		Six-month-old fawns		Adult does	
Year	Unit 56	Unit 73A	Unit 56	Unit 73A	Unit 56	Unit 73A
1998	8	12	34	25	59	57
1999	20	29	29	34	15	24
2000	32	30	30	29	18	24
2001	30	31	32	25	19	14
2002	28	30	30	30	4	6
Total	118	132	155	143	115	125

Table 2. Number of deer with functioning radio collars by age class during the capture year.

	Newborn fawns		Six-month-old fawns		Adult does	
Year	Unit 56	Unit 73A	Unit 56	Unit 73A	Unit 56	Unit 73A
1998	8	12	24	21	53	54
1999	20	29	29	34	52	61
2000	32	30	30	29	44	55
2001	30	31	32	25	51	61
2002	28	30	30	30	48	42

Table 3. June fawn-at-heel ratios. Groups are the number of does observed with fawns.

	Unit 56		Unit 73A	
Year	Groups	Fawns/100 does	Groups	Fawns/100 does
1998	20	162	21	164
1999	17	176	21	171
2000	24	183	29	162
2001	20	180	23	170
2002	22	164	28	139

Table 4. Coyotes removed from Units 55, 57, 73 Elkhorn, and 73A by Wildlife Services personnel. Cost includes contract helicopter and personnel time.

Year	Coyotes removed	Cost
1997	218	$34,106
1998	212	$40,269
1999	204	$27,030
2000	328	$47,251
2001	312	$51,009
2002	387	$49,119
2003	351	$46,813
2004	532	$54,995

Table 5. Small mammal snap-trap transects in Rockland Valley. Captures/100 trap nights.

Year	Low-elevation perennial	High-elevation perennial	Low-elevation sagebrush	High-elevation mountain brush	Hay field
1998	8.73	5.15	31.20	6.11	0.00
1999	0.00	8.18	2.52	4.26	0.83
2000		0.85	2.81	5.10	
2001		1.76	2.65	9.17	2.55
2002		0.85	41.95	0.84	28.87

Table 6. Lagomorph spotlight surveys.

	Unit 56			Unit 73A		
Year	Total km surveyed	Lagomorphs observed	Lagomorphs/ 100 km	Total km surveyed	Lagomorphs observed	Lagomorphs/ 100 km
1998	92.8	4	4.31	46.5	1	2.15
1999	92.8	13	14.00	54.4	4	7.35
2000	102.4	2	1.95	47.2	1	2.12
2001	104.0	8	7.69	46.3	2	4.32
2002	95.6	3	3.14	56.2	3	5.34

Table 7. Fawn:doe ratios from aerial composition surveys (Dec-Jan).

	Without coyote removal				With coyote removal			
Year	Unit 54	Unit 56	Unit 71	Unit 73 Malad	Unit 55	Unit 57	Unit 73A	Unit 73 Elkhorn
1997			74	74			81	63
1998		64		53[a]	56	54	58	76[a]
1999	60	68	55	63	58	51	53	56
2000	60	48	62	63	47	54	71	58
2001	60	69	62	69	60	70	79	73
2002	54	60	65	74[b]	60	57	72	69[b]
2003	55	55	32	42	50	54	48	53

[a] Sample size not large enough for reliable composition estimate.
[b] Ratios adjusted for early antler-drop using 2001 buck/doe ratios.

Table 8. Population estimates from aerial sightability surveys.

	Without coyote removal				With coyote removal			
Year	Unit 54	Unit 56	Unit 71	Unit 73 Malad	Unit 55	Unit 57	Unit 73A	Unit 73 Elkhorn
1997	2,144	2,682	978	701	773		1,033	929
1998	1,106	2,561	978	947	699	528	1,121	787
1999	1,678	3,338	1,097	942	809	374	1,578	958
2000	1,251	3,509	1,118	885	1,022	418	1,528	980
2001	1,306	4,214	920	1,622	935	337	2,100	1,387
2002	1,112	2,248	889	761	1,301	343	2,016	794
2003	1,133	1,608	840	717	927	304	1,734	762

Table 9. Mean instantaneous annual rates of change (SE) of deer herds in game management units experimentally treated to remove mountain lions, coyotes, or both.

		Coyote treatment	
		Control	Removed
Mountain lion treatment	Control	-0.021 (0.018) *n* = 27	-0.015 (0.025) *n* = 14
	Removed	-0.022 (0.014) *n* = 9	0.018 (0.038) *n* = 10

Table 10. Analysis of variance for significant differences in rate of population change over 5 years in 8 deer populations treated under a 2x2 factorial design.

Source	Sum-of-squares	df	Mean-square	F-ratio	*P*
COYOTEREM	0.014	1	0.014	1.265	0.269
LIONREM	0.007	1	0.007	0.658	0.423
COYOTEREM*LIONREM	0.000	1	0.000	0.001	0.977
Error	0.353	33	0.011		

Table 11. Fawn:doe ratios from aerial composition surveys (Dec-Jan) for new removal experiment. Coyote removal rates implemented in 2003.

	Light coyote harvest			Moderate harvest		Heavy coyote harvest		
Year	Unit 71	Unit 73 Malad	Unit 78	Unit 72	Unit 76	Unit 56	Unit 73A	Unit 73 Elkhorn
1997	74	74	69	78			81	63
1998		53[a]	67	81		64	58	76[a]
1999	55	63	56	66	63	68	53	56
2000	62	63	63	48	68	48	71	58
2001	62	69	71	66	76	69	79	73
2002	65					60	72	
2003	32	42	51	61	52	55	48	53
2004	53	43	38	59	50	67	52	55
2005	55	50	64	65	57	68	51	48

[a] Sample size not large enough for reliable composition estimate.

Table 12. Population estimates from aerial sightability surveys for new removal experiment. Coyote removal rates implemented in 2003.

	Light coyote harvest			Moderate harvest		Heavy coyote harvest		
Year	Unit 71	Unit 73 Malad	Unit 78	Unit 72	Unit 76	Unit 56	Unit 73A	Unit 73 Elkhorn
1997	978	701	2760			2682	1033	929
1998	978	947	2548	1166		2561	1121	787
1999	1097	942	1790	1826	3427	3338	1578	958
2000	1118	885	1707	2378	3467	3509	1528	980
2001	920	1622	3150	4576	5106	4214	2100	1387
2002	889	761	1405	2877	2378	2248	2016	794
2003	840	717	1449	1124	2776	1608	1734	762
2004	697	729	2852	1801		1902	1121	1401
2005	750	1090	2368	2552	3531	3970	1168	2079

Table 13. Cox's proportional hazard survival models for each study area for fawns in summer-fall.

Model	Variable	Delta AIC	*P* value	Parameter estimate	*P* value for parameter estimate	Hazard ratio: exp(B)	95% hazard ratio confidence limits
Study Area 56 (no removal)							
1	Combined precipitation	0	0.17	-0.34	0.18	0.71	0.43, 1.17
2	Weight	0.7	0.27	-0.08	0.27	0.93	0.81, 1.06
3	Year trend	0.94	0.33	-0.10	0.33	0.90	0.73, 1.11
4	Precipitation	1.48	0.52	-0.06	0.53	0.94	0.77, 1.14
5	Small mammal density	1.54	0.55	-0.005	0.56	0.99	0.98, 1.01
Study Area 73A (removal)							
1	Lagomorph density	0	0.0018	-0.123	0.046	0.88	0.80, 0.97
	Density of coyotes removed			-0.021	0.007	0.98	0.97, 0.99
2	Lagomorph density	0.195	0.002	-0.103	0.043	0.90	0.83, 0.98
	Year trend			-0.344	0.111	0.71	0.57, 0.88

Table 14. Cox's proportional hazard survival models for each study area for fawn mule deer in winter-spring.

Model	Variable	Delta AIC	*P* value	Parameter estimate	*P* value for parameter estimate	Hazard ratio: exp(B)	95% hazard ratio confidence limits
Study Area 56 (no removal)							
1	Weight	0	0.0006	-0.04	0.0047	0.96	0.93, 0.99
	Previous precipitation			0.40	0.0013	1.50	1.17, 1.91
	Year trend			0.64	0.0004	1.89	1.33, 2.68
2	Weight	0.608	0.0008	-0.03	0.0204	0.97	0.94, 0.99
	Lagomorphs			0.15	0.0022	1.16	1.05, 1.27
	Combined precipitation			0.65	0.0022	1.92	1.26, 2.91
Study Area 73A (removal)							
1	Weight	0	0.0001	-0.03	0.0661	0.97	0.94, 1.00
	Combined precipitation			0.99	0.0026	2.68	1.41, 5.09
	Density of coyotes removed			0.02	0.0434	1.02	1.00, 1.03
2	Weight	0.588	0.0001	-0.03	0.0638	0.97	0.94, 1.00
	Lagomorphs			0.11	0.0555	1.12	1.00, 1.26
	Combined precipitation			1.49	0.0001	4.43	2.64, 7.46

Table 15. Cox's proportional hazards survival models for each study area for adult does in summer-fall.

Model	Variable	Delta AIC	*P* value	Parameter estimate	*P* value for parameter estimate	Hazard ratio: exp(B)	95% hazard ratio confidence limits
Study Area 56 (no removal)							
1	Previous precipitation	0	0.026	0.57	0.038	1.77	1.03, 3.05
Study Area 73A (removal)							
1	Age	0	0.0013	0.43	0.00069	1.54	1.20, 1.97
	Lagomorph density			-0.29	0.072	0.74	0.54, 1.03
	Precipitation			0.31	0.033	1.37	1.03, 1.82
3	Age	1.84	0.0032	0.38	0.0015	1.46	1.16, 1.85
	Lagomorph density			-0.23	0.16	0.79	0.57, 1.10
	Small mammal density			0.03	0.12	1.03	0.99, 1.07

Table 16. Cox's proportional hazards survival models for each study area for adult does in winter-spring.

Model	Variables	# animals collared	# deaths	Delta AIC	*P* value	Parameter estimate	*P* value for parameter estimate	Hazard ratio: exp(B)	95% hazard ratio confidence limits
Adult does in summer-fall in Study Area 56 (no removal)									
1	Combined precipitation	270	19	0	0.018	0.96	0.0238	1.28	1.03, 1.59
Adult does in summer-fall in Study Area 73A (removal)									
1	Age	283	25	0	1E-05	0.33	0.00001	1.40	1.18, 1.65
						-0.25	0.00001	0.78	0.67, 0.91

Table 17. Overall predation rates of radio-marked deer by coyotes, 1998-2002.

	Summer: 16 May-30 Nov			Winter: 1 Dec-15 May			
	N	Killed	Predation rate	N	Killed	Predation rate	Annual rate
Unit 56 adults	271	0	0	271	1	0.0037	0.0037
Unit 73A adults	281	0	0	283	4	0.0141	0.0141
Unit 56 fawns	118	15	0.1271	143	23	0.1608	0.2879
Unit 73A fawns	132	13	0.0985	139	15	0.1079	0.2064

Table 18. Capture and fate information for marked mountain lions. Mountain lions were captured in Unit 56 unless otherwise noted.

Lion	Sex	Age	Capture date	Capture location	Fate	Date of fate	Fate location
1930	F	Ad	11/28/97	Sublett Creek	Alive		
1990	F	Ad	12/25/97	Elbow Canyon	Poaching	1/14/00	Lake Canyon
1920	F	Ad	1/7/98	Indian Creek	Hunter	2/8/01	South Heglar
1530	F	Ad	1/23/98	Houtz Canyon	Hunter	10/28/01	Houtz Canyon
1911	F	Ad	1/7/98	South Heglar	Hunter	2/27/99	Cotterel Mtn, 55
1871	M	Ad	12/12/98	Van Kamp Creek	Unknown		
1442	F	Kit	4/3/99	Ward Canyon	Natural mortality	6/3/99	Ward Canyon
1450	M	Kit	4/3/99	Ward Canyon	Hunter	12/23/99	Cow Creek, 73A
0051	F	Y	12/4/99	Indian Creek	Natural mortality	7/15/00	Indian Creek
1890	M	Ad	12/9/99	Pine Canyon	Hunter	12/10/99	Pine Canyon
0131	M	2	12/15/00	Lake Canyon	Unknown	7/30/03	Unit 55
0161	F	2	12/15/00	Lake Canyon	Alive		
1940	M	Ad	12/27/00	Sawpit/Lake Cyn	Alive		
1422	F	Kit	1/22/99	Sand Hollow, 73A	Lion predation	3/6/99	Sand Hollow
1061	F	Ad	2/5/99	Sand Hollow, 73A	Alive		
1520	F	Kit	3/22/98	Knox Canyon, 73A	Lion predation	6/1/98	Knox Canyon
Black #1	F	Y	12/9/97	South Heglar	Unknown		
Black #4	M	Kit	1/24/98	South Chapin	Hunter	2/4/00	Hawkin Res, 73A
Orange #9	F	Ad	11/7/98	Black Pine	Unknown		

Table 19. Number of mountain lions removed by land area in conservative harvest units versus liberal harvest units.

	Units 54, 55, 56, 57[a]			Units 70, 71, 73 Elkhorn, 73 Malad, 73A		
Year	# removed	Land area (km^2)	# removed/ 1,000 km^2	# removed	Land area (km^2)	# removed/ 1,000 km^2
1997	37	8,650[b]	4.28	13	7,115	1.83
1998	26	8,650[b]	3.01	27	7,115	3.79
1999	26	8,650[b]	3.01	54	7,115	7.59
2000	23	8,650[b]	2.66	24[c]	7,115	3.37
2001	18	8,650[b]	2.08	19	7,115	2.67
2002	28	8,650[b]	3.23	14	7,115	1.96

[a] Identified as conservative mountain lion harvest starting in 1998.
[b] 900 km^2 of non-mountain lion habitat has been deleted from this total.
[c] Five kittens removed in Unit 73 are not included in this total.

Table 20. Number of mountain lions removed by land area in the intensive study units.

	Unit 56[a]			Unit 73A		
Year	# removed	Land area (km^2)	# removed/ 1,000 km^2	# removed	Land area (km^2)	# removed/ 1,000 km^2
1997	8	2,369	3.38	4	1,483	2.70
1998	4	2,369	1.68	10	1,483	6.74
1999	6	2,369	2.53	16	1,483	10.79
2000	4	2,369	1.68	10	1,483	6.74
2001	5	2,369	2.11	5	1,483	3.37
2002	3	2,369	1.26	3	1,483	2.02

[a] Identified as conservative mountain lion harvest starting in 1988.

Table 21. Mountain lion track index results.

	Unit 56[a]				Unit 73A			
Year	Quadrats surveyed	Total km	Tracks counted	Tracks/ 100 km	Quadrats surveyed	Total km	Tracks counted	Tracks/ 100 km
1998	6	131.2	2	1.53	6	119.9	5	4.17
1999	13	180.5	7	3.88	6	134.0	1	0.75
2000[b]	4	74.4	0	0.00	4	48.6	1	2.06
2001	5	138.9	3	2.16	5	131.4	2	1.52

[a] Identified as conservative mountain lion harvest starting in 1988.
[b] Poor snow conditions limited track counts to high elevation, low density mountain lion areas.

Table 22. Overall predation rates of radio-marked deer by mountain lions, 1998-2002.

	Summer: 16 May-30 Nov			Winter: 1 Dec-15 May			
	N	Killed	Predation rate	N	Killed	Predation rate	Annual rate
Unit 56 adults	271	10	0.0369	271	10	0.0369	0.0738
Unit 73A adults	281	5	0.0178	283	9	0.0318	0.0496
Unit 56 fawns	118	13	0.1102	143	16	0.1119	0.2221
Unit 73A fawns	132	6	0.0455	139	18	0.1295	0.1750

PROGRESS REPORT
STATEWIDE WILDLIFE RESEARCH

STATE:	Idaho	**JOB TITLE:**	Southeast Mule Deer Ecology
PROJECT:	W-160-R-32		
SUBPROJECT:	51	**STUDY NAME:**	Influence of Habitat Quality and Composition Changes to Productivity and Recruitment of Mule Deer
STUDY:	II		
JOBS:	1-2		
PERIOD COVERED:	July 1, 2004 to June 30, 2005		

INFLUENCE OF HABITAT QUALITY AND COMPOSITION CHANGES

Abstract

Population data information has been gathered from wildlife managers concerning the population direction of deer, elk, bears, coyotes, and mountain lions for the past 30 years in Regions 4-7. Geographical Information Survey (GIS) layers of population direction by unit have been produced for each species. NALC multi-spectral satellite images have been processed with NDVI ratio to remove error and cloud cover, representing 1972 and 1990 ground cover. NALC coverage was selected using the Pheno-Calc program to determine correct dates and weather conditions to compare different phenological years. U.S. Geological Survey (USGS) maps were used to produce 3 soil-vegetation maps using U.S. Bureau of Land Management (BLM) soil survey for Bannock, Oneida, and Franklin counties. This will allow 3 dates in which to produce a change map. The satellite images are the base for the rest of the analysis.

Vegetation plots completed by BLM in 1977 were revisited during summer 2001. Two hundred sixty-five plots were completed using three 50 m line transects to determine prevalence of each plant species present, and pictures were taken. These plots will be added to 900 plots completed by BLM in 1999 to classify the 1992 and 2000 satellite images. An additional 204 ground-truthing plots were completed in the aspen and mountain shrub communities in 2002. The data from 1977 and 2001 was entered into an Access database in 2003. Summary charts of species composition change have been completed for sagebrush ecotype. The remaining ecotype summaries will be completed this coming year.

The 1970s information has been obtained from Soil Vegetation Inventory Method (SVIM), an experiment done by BLM in 1977. Maps have been produced using SVIM data for 19 quads around the Malad area. Pictures have been reprinted of different estimated vegetation plots in 1977 and have been revisited. Orthoquads will be obtained of the entire area and compared to current information.

Introduction

Quality habitat is the most significant factor determining the size and health of mule deer populations. All other factors such as weather, predators, and human-caused mortality are mitigated for or exacerbated by quality of habitat (Peek 1986). Habitat is constantly changing, moving forward in successional direction or reverse, depending on natural events or man's uses of the habitat. Specific seral stages of habitat are important to mule deer populations and may dictate the ultimate size of a population in a given area of habitat. Typical intermountain mule deer habitat includes diverse mixtures of coniferous forest, meadows, and aspen woodlands, with herbaceous understory as summer range and lower-elevation juniper-pinion forest, shrub-steppe, or shrub/grass communities as winter range (Wallmo and Regelin 1981). Browse and forbs are the major plant classes of a mule deer's diet, with browse more prevalent in winter and forbs dominating in spring and summer (Kufeld et al. 1973). Long-term habitat change will have a profound effect on deer, elk, and predator populations. Nutritional quality of forage and availability will influence pregnancy, fetal rates, and recruitment of deer. Conversion of shrub-land to grassland has been implicated as a possible cause of declining deer populations.

Livestock grazing has influenced the forage species composition on many western rangelands. Heavy grazing in the early to mid-1900s caused increases in species such as bitterbrush and forbs, which are less palatable to livestock but more palatable to deer. Deer prefer the mid-seral stages of these shrub communities with high canopy cover (Griffith and Peek 1989). This long-term change, in concert with extensive predator control and conservative hunting seasons, likely led to the high populations in the 1950s and 1960s (Peek 1986). With the passage of the 1976 Federal Land Policy and Management Act pertaining to rangeland management, livestock stocking rates decreased and grazing systems were implemented. As a result, rangeland climax species increased while shrubs and forbs decreased. The lack of natural fires due to aggressive fire control may also affect the species' composition and move communities toward a climax species-dominated type. Concurrent with improving health of federal rangelands, elk have rebounded from a low in the mid-1970s to record levels at present. There is concern that elk may have an effect on the carrying capacity of deer winter range or a direct competitive effect on deer survival.

Study Area

First Phase - Game management units in the Magic Valley and Southeast regions.

Second Phase - Include game management units in Upper Snake and Salmon regions.

JOB 1. RELATE LANDSCAPE DATA TO MULE DEER POPULATION DYNAMICS

Methods

Map acquisition

Cover type maps and databases for southeast Idaho have been obtained from BLM, U.S. Forest Service, counties, and IDFG. These maps include:

1. Multi-spectral satellite cover type maps, 1970 and present.
2. Road density maps (trails, roads, and interstates).
3. Development maps (fragmentation, habitat gain or loss).
4. Grazing history maps and allotment boundaries (use levels and species).
5. Fire history, 1939 to present.
6. Lakes and riparian areas.
7. Big game units.
8. Towns and locations.
9. Winter game units.

Population data acquisition

Wildlife managers were surveyed to obtain wildlife information related to deer at the big game management unit level. This information included:

1. Deer populations: direction at present (up, down, stable), direction versus 10 years ago, direction versus 30 years ago, percent reduction from the 1992-1993 winter.
2. Elk populations: direction at present, numbers versus 10 years ago, numbers versus 30 years ago.
3. Predator populations: density versus 30 years ago for mountain lions, coyotes, and black bears.
4. Hunting season history in each unit (framework and harvest).

The feasibility of this analysis will be examined on a limited number of GIS layers. The cover type layer will be combined with a layer describing elk populations and deer populations. The GIS layer will be created to reflect percent change in shrub and aspen cover types from the vegetation maps with another layer to reflect absolute change in elk numbers (or harvest per hunter day if numbers are not available). Deer numbers will be the dependent variable reflected as a categorical value of population direction (increase, decrease, stable). A cluster analysis will be performed on various combinations of data layers to identify patterns that influence deer populations in any direction.

Results and Discussion

Population data information has been gathered from wildlife managers concerning the population direction of deer, elk, bears, coyotes, and mountain lions for the past 30 years in Regions 4-7. GIS layers of population direction by unit have been produced for each species. NALC multi-spectral satellite images have been processed with NDVI ratio to remove error and cloud cover, representing 1972 and 1990 ground cover. NALC coverage was selected using the Pheno-Calc program to determine correct dates and weather conditions to compare different phenological years. USGS maps were used to produce 3 soil-vegetation maps using BLM soil survey for Bannock, Oneida, and Franklin counties. This will allow 3 dates in which to produce a change map. The satellite images are the base for the rest of the analysis.

Vegetation plots completed by BLM in 1977 were revisited during summer 2001. Two hundred sixty-five plots were completed using three 50 m line transects to determine prevalence of each plant species present and pictures were taken. These plots will be added to 900 plots completed by BLM in 1999 to classify the 1992 and 2000 satellite images. An additional 204 ground-truthing plots were completed in the aspen and mountain shrub communities in 2002. The data from 1977 and 2001 was entered into an Access database in 2003. Summary charts of species composition change have been completed for sagebrush ecotype. The remaining ecotype summaries will be completed this coming year.

Maps have been produced using SVIM data for 19 quads around the Malad area. Pictures have been reprinted of different estimated vegetation plots in 1977 and have been revisited. Orthoquads will be obtained of the entire area and compared to current information.

Grazing allotment maps from BLM and ICBEMP were obtained for the state of Idaho and are currently being corrected for use in this study. Information has been added to show number of animals, dates the animals were let onto the land, and dates removed. Fire data has been collected of all wildfires and prescribed and chemical burns on BLM lands from 1939-2000. Other coverages that will be added to the acquisition map will include big game units, town locations, and winter game units that have been produced by IDFG. Acquisition of maps has begun and will progress throughout the coming year.

JOB 2. WINTER RANGE NUTRITIVE VALUE OF BROWSE STANDS RELATED TO AGE

Methods

Mountain brush communities will be identified from vegetation maps developed in Job 1. These will be further divided into mahogany- or bitterbrush-dominated stands on predominantly south- and west-facing slopes. This map will be overlaid with a historic fire map to identify approximate ages of shrub stands. Twenty stands of each species in the 15- to 40-year-old age class and 20 in the 60+-year-old age class will be randomly selected for analysis.

Three 375 m^2 vegetation plots will be completed in each of the stands; information collected will include: 1) ground cover of each species present; 2) ten representative plants of the dominant shrub will be aged and all of the available current year's production removed; and 3) current year's growth will be analyzed for total production, crude protein (CP), and in-vitro dry matter digestibility (IVDMD) as described by Bishop (1997). All analyses will include a comparison of ground cover and total production between young and old stands to determine the optimum age of a browse stand.

Results and Discussion

Vegetation plots will be laid out and sampled when the habitat map from Job 1 is complete. No progress in 2004.

Acknowledgments

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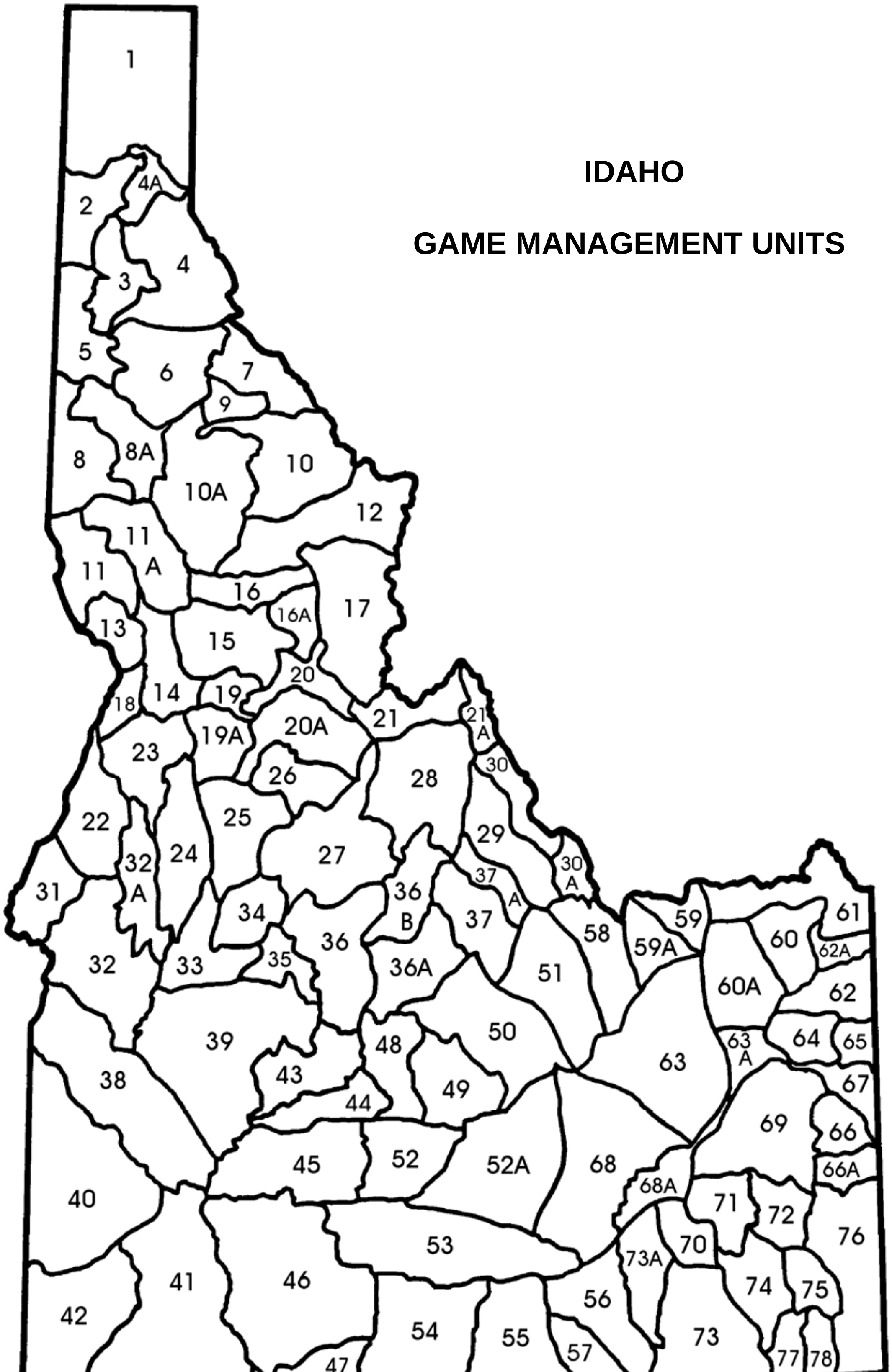
GAME MANAGEMENT UNITS



FEDERAL AID IN WILDLIFE RESTORATION

The Federal Aid in Wildlife Restoration Program consists of funds from a 10% to 11% manufacturer's excise tax collected from the sale of handguns, sporting rifles, shotguns, ammunition, and archery equipment. The Federal Aid program then allots the funds back to states through a formula based on each state's geographic area and the number of paid hunting license holders in the state. The Idaho Department of Fish and Game uses the funds to help restore, conserve, manage, and enhance wild birds and mammals for the public benefit. These funds are also used to educate hunters to develop the skills, knowledge, and attitudes necessary to be responsible, ethical hunters. Seventy-five percent of the funds for this project are from Federal Aid. The other 25% comes from license-generated funds.