Oregon Department of Fish and Wildlife
Evaluation of cougar removal in Oregon
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Evaluation of cougar removal on human safety concerns, livestock damage complaints, and elk cow: calf ratios in Oregon

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ABSTRACT

The Oregon Department of Fish and Wildlife (ODFW) developed the 2006 Oregon Cougar Management Plan (CMP) to guide cougar management in Oregon. The CMP addresses human safety, livestock depredation, and conflict with other big game species using proactive, adaptive management strategies. To assess effects of administrative cougar removal, as opposed to relying on hunting and individual responses to damage and human safety complaints, three areas (target areas) were chosen to evaluate effects of cougar removal on major categories of conflict: human safety/pet concerns in Jackson County in southwest Oregon, livestock depredation in the Beulah Wildlife Management Unit (WMU) in southeast Oregon, and elk predation in the Heppner WMU in northeast Oregon. From January 2007 through April 2009, 101 cougars were administratively removed from the three areas at a total cost of $310,501, of which $201,522 were expenses for ODFW seasonal employees and contracts with USDA Wildlife Services. ODFW employees took 60 percent of all cougars administratively removed and 2/3 of the cougars were removed using dogs trained to pursue cougars. Cougar removal in the Jackson County Target Area did not fully address human safety-related conflict. Cougar removal in the Beulah Target Areas reduced cougar–livestock conflicts. Cougar removal in the Heppner Target Area positively affected elk populations. ODFW will continue to monitor Cougar Target Areas to determine the effectiveness of administratively removing cougars, and whether observed treatment effects on livestock depredation and elk calf recruitment will provide long-term benefits in the Beulah and Heppner Target Areas, respectively.

INTRODUCTION

Cougar (*Puma concolor*) populations across North America have fluctuated dramatically during historic times. From the early period of European settlement through the mid 1960s, cougars were persecuted to near extirpation primarily by state, provincial, or federal agricultural agencies. During the mid 1960s, varying but generally short periods of complete cougar protection were implemented and cougar management was transferred to respective state/provincial wildlife management agencies. With subsequent application of science-based wildlife management practices, most agency managers believe cougar populations are more robust now than at any time in recent history (Beausoleil and Martorello 2005).

This successful recovery of cougar populations in western North America presents significant challenges for management agencies. Highly valued as a hunted game species, cougars also have the potential to come into conflict with humans. Cougars can cause direct conflict through predation on livestock and pets. Although rare, cougars have attacked humans, and cougar predation can impact other wildlife populations. Stakeholders tend to have strong and often conflicting opinions, values, desires, and objectives relative to cougars. The spectrum of values and desires ranges from complete protection or preservation of cougars via hunting prohibitions or by highly restrictive regulations and management to aggressive cougar management for reducing conflict and improving other big game populations. Consequently, cougar management is often very high profile, and opposing public desires can lead to highly emotional, politically charged decision processes. Within this dynamic arena, agencies and associated decision makers must evaluate relevant biological information, assess the foregoing influences, and pursue the management approaches appropriate for their specific situation (Shroufe 2006).

Throughout western North America, hunting and hunters played a major role in the history of cougar management. Initially, unregulated hunting, extensive use of poisons, bounties, and a general “kill-on-sight” philosophy resulted in near extirpation of most cougar populations. However, in many states it also was hunters that secured protection for cougars and transferred cougar management to state wildlife management agencies. Today, hunting is a primary cougar management tool and hunters carry the bulk of the financial burden for cougar management via the purchase of hunting licenses and tags.

In Oregon, cougar management is guided by Oregon’s Wildlife Policy (ORS 496.012) which directs the Oregon Fish and Wildlife Commission to maintain all species of wildlife at optimum levels, to provide optimum recreational benefits, and to regulate wildlife populations in a manner compatible with the primary uses of the land. Legal status, management, and population levels of cougars in Oregon have undergone significant changes since the mid-1800’s. Cougars may have been extirpated by 1970 had they not been placed under management of the Oregon Department of Fish and Wildlife (ODFW) as a game mammal in 1967. Since 1967, cougar management has varied from closed seasons (no public hunting), to controlled hunting with dogs allowed in selected areas during specific times, to a harvest quota system with unlimited tag availability for areas open nearly year-round but hunting with dogs not allowed. A 1994 ballot measure (Measure 18) eliminated the public use of dogs for cougar hunting. In 1995, ODFW established six cougar management zones to administer hunting seasons (Figure 1). Cougars are currently managed under the 2006 Cougar Management Plan (CMP) adopted by the commission.

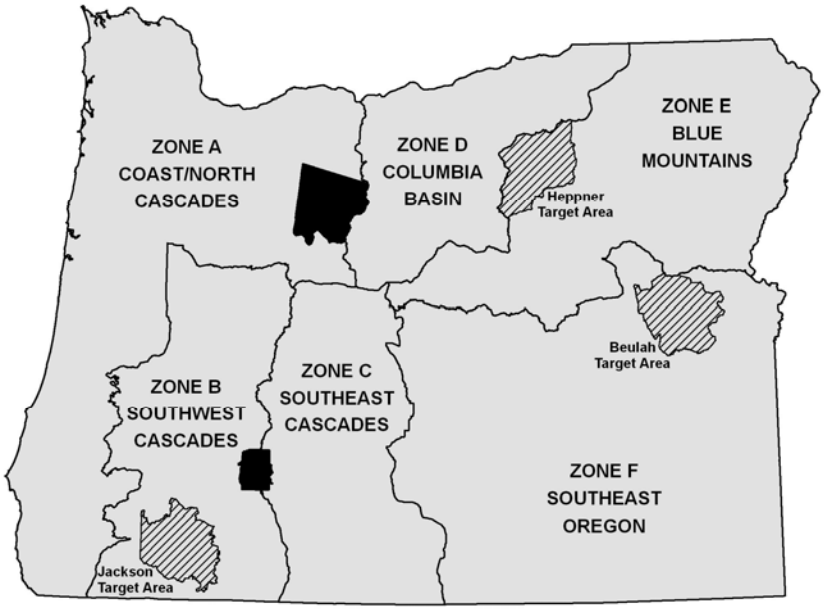

Figure 1. Cougar Management zones and location of cougar target areas in Oregon.

Oregon is not immune to the challenge of factoring human dimensions and values into management strategies. From 1990–2003, Oregon's population grew 24.4 percent (U.S. Census Bureau 2005). Statewide cougar populations also increased during that period to an estimated 5,101 (Keister and Van Dyke 2002, Oregon Department of Fish and Wildlife unpublished data). Increased human development and increasing cougar populations has led to higher than desired conflict levels in rural, suburban, and urban settings. From 1987 to 1994, ODFW recorded 187 cougars killed due to either livestock depredation or human safety/pet concerns (23.4 cougars/year). This increased to 1,052 for the period from 1995 to 2003 (116.9 cougars/year) (Table 1).

ODFW has statutory responsibility to address cougar-human conflict. Although there has not been a documented, fatal human attack by a cougar in Oregon, there are numerous examples of situations where cougars and humans have come into very close contact and cougar behaviors suggest there is a real safety concern. Some Oregon residents have expressed concerns about potential cougar attacks. Human safety concerns include situations where cougars appear accustomed to human activity and development, and are often seen during daylight hours in close proximity to houses and people. Oregon Revised Statutes (ORS 498.166) allow any person to take a cougar that is posing a threat to human safety, without first obtaining a permit from ODFW. Pet losses due to cougars in populated areas are considered a human safety concern because of the close association between pets and humans. Cougars killed for human safety/pet concerns must be reported to ODFW immediately. Cougars killed in response to human safety/pet concerns are the second highest cause of non-hunting mortality for Oregon cougars (Table 1). Statewide, human safety/pet concerns reported to ODFW increased to a high of 651 in 1999 and although declining since 1999, continue to be a concern (Table 1).

Table 1. Trend in reported conflict and associated cougar mortality in Oregon, 1994-2008.

	Reported Conflicts				Non-hunting cougar mortality			
Year	Livestock Depredation	Human Safety/Pet Concerns	Other	Total	Livestock Depredation	Human Safety/Pet Concerns	Other[a]	Total
1994	223	331	0	554	29	11	20	60
1995	285	446	11	742	41	22	12	75
1996	309	531	0	840	64	34	25	123
1997	316	482	0	798	82	20	18	120
1998	372	582	0	954	93	20	17	130
1999	421	651	0	1072	91	39	25	155
2000	369	517	56	942	120	27	17	164
2001	330	471	28	829	97	27	21	145
2002	336	409	20	765	111	25	35	171
2003	320	369	8	697	111	28	25	164
2004	149	371	27	547	95	28	35	158
2005	185	376	92	653	125	28	30	183
2006	175	226	67	468	106	26	32	164
2007	177	211	57	445	115	21	41	177
2008	157	277	57	491	108	23	52	183

[a] Includes all other causes of mortality such as hit by cars, found dead, etc.

Ranching and farming are important components of Oregon's economy. Addressing cougar–livestock conflict is an essential part of cougar management. As the cougar population increased and the human population expanded into rural and suburban areas, potential for cougar-livestock conflicts has increased. Cougars rarely cause damage to land or crops; most damage occurs when cougars take or attempt to take livestock. Oregon Revised Statutes (ORS 498.012) allow landowners (or lawful occupants) to take any cougar that is causing damage, is a public nuisance, or poses a public health risk on property they own or lawfully occupy, without first obtaining a permit from ODFW. Landowners may kill the cougar(s) causing the damage using dogs and/or with the aid of bait (ORS 498.164(4)). All cougars killed for livestock depredation must be reported to ODFW immediately.

The majority of livestock depredation complaints resulting in cougar control actions are verified because the carcass or kill site is used for trapping or starting a pursuit with hounds. Cougar complaints involving livestock are generally addressed by Wildlife Services in counties that participate in the program or by landowners or their agents in non-participating counties. Cougars killed as a result of livestock depredation is the leading cause of non-hunting mortality for cougars in Oregon, peaking at 125 in 2005 (Table 1). Cougar–livestock conflicts reported to ODFW increased to a high of 421 in 1999 and continue to be a concern (Table 1).

In accordance with Oregon's Wildlife Policy (ORS 496.012), management objectives for elk include specific population sex and age ratios. In northeast Oregon, elk (*Cervus elaphus*) calf: cow ratios have declined since the early 1990s in eight Wildlife Management Units (WMUs). Elk populations declined (Oregon Department of Fish and Wildlife 2003b) even as numbers of elk hunters and harvest have been reduced in an effort to maintain elk populations at established Management Objectives (MO). In the Wenaha and Sled Springs WMUs, cougars were responsible for 69 percent of the radio-collared elk calf mortalities, while pregnancy rates of prime-aged cows were high (Rearden 2005). There is increasing evidence that cougar predation can

limit some ungulate populations (Edelmann 2003, Harrison 1989, Hayes et al. 2000, Mathews and Coggins 1997, Myers et al. 1998, Rearden 2005, Wehausen 1996).

ACTIONS TAKEN

ODFW developed and the Oregon Fish and Wildlife Commission adopted in October 2006 the 2006 Oregon Cougar Management Plan (CMP) to guide management of cougar in Oregon during 2006-2011 (Oregon Department of Fish and Wildlife 2006). The purpose of the CMP is to maintain cougar populations while managing cougar conflicts with humans, livestock, and other game mammals. Five objectives were adopted that address the broad range of public opinions regarding cougars in Oregon. Objective 1 establishes as ODFW policy the maintenance of a statewide population of cougars that is self-sustaining and assures the widespread existence of cougars in Oregon. Objective 2 establishes maximum threshold levels for non-hunting cougar mortality associated with human safety, pet safety, and livestock depredation. Objectives 3 and 4 establish maximum threshold levels for reported conflicts associated with human safety/pet concerns, and livestock depredation, respectively. Objective 5 establishes criteria whereby action may be taken to improve populations of other game mammals.

Since its development, the CMP has garnered a great deal of interest and scrutiny. A number of local interest groups criticize the CMP and associated objectives whereas other groups support the CMP and are demanding broader implementation. As a result of the dramatically differing opinions and desires, the Oregon Legislative Assembly also is actively monitoring cougar management and implementation of the CMP. As a result, ODFW frequently provides updates on management activities and progress directly to the Oregon Legislature, and will continue to do so in the future.

The CMP was similar in design and scope to several other species-specific management plans developed by ODFW. However, a new component of the CMP was to utilize proactive, adaptive strategies to manage cougar in Oregon. One adaptive management strategy developed was to administratively remove cougars in areas where reliance on licensed hunters proved ineffective at addressing chronic conflict between cougars and human safety, livestock depredation, or ungulate population dynamics. In November 2006, the ODFW selected three areas (target areas) to evaluate the efficacy of administratively removing cougars for human safety/pet concerns, livestock depredation, and elk population recruitment from November 2006 to April 2009 (Figure 1). The Jackson County Target Area was selected due to a large number of negative interactions related to human safety/pet concerns. The Beulah Target Area was selected due to a high number of cougar-livestock conflicts. The Heppner Target Area was selected due to exceptionally low elk cow-calf ratios believed due to cougar predation.

Utilizing published research, data collected during routine cougar management activities, estimates of cougar density based on zone specific cougar population models, and habitat characteristics of each area, an annual cougar removal objective was established for each target area (Table 2). Administrative cougar removals occurred primarily during November – April each winter unless noted. All cougars were lethally removed. Data or samples collected from all known cougar mortalities in the target area included date, method of take, location (UTM), gender, reproductive status if female, and a tooth for age analysis. Animals were classified into three age classes by gender: juvenile (< 1 yr old), sub-adult (1-2 yr old), and adult (≥ 3 yr old). Age class was based primarily on cementum analysis (Trainer and Matson 1989) and secondarily using gum line recession (Laundre et al. 2000). Administratively removed animals were made available to educational institutions where possible.

Table 2. Location, purpose, size, annual objective, and activity dates for three cougar removal areas in Oregon, 2006-2009.

Target Area Name	General Location	Management Zone	Purpose	Area (mi^2)	Cougar Removal Objective	Timing of Activity
Jackson County	SW Oregon	B	Reduce human safety/pet concerns	1,123	24/year	Year-round
Heppner	NE Oregon	E	Improve ungulate recruitment	1,189	30/year	Year-round
Beulah Unit	SE Oregon	F	Reduce livestock depredation	1,175	12/year	Year-round

All known cougar mortality and all reported cougar conflicts within the target area and for the entire management zone were monitored. Criteria to measure success reducing conflict associated with human safety/pet concerns or livestock depredation was primarily non-hunting mortality resulting from those types of conflicts and secondarily the number of reported complaints received. Criteria to measure elk recruitment were based on spring calf: cow ratios estimated during annual trend counts or population modeling used to determine attainment of established population objectives. Additionally, each target area was paired with a control area where no administrative removals occurred. This allowed for an additional comparison of the results from the target areas after removal of cougars.

Cougar populations were monitored primarily using biological data collected within the target area, within the entire management zone, and cougar population modeling for the management zone. There is limited data on proactively removing cougar to accomplish specific management goals. Nevada (Ashman et al. 1983) uses a harvest rate of 30 percent for management of cougar populations. Alberta regulates its cougar harvest to be <10 percent of the population (Pall 1984, as reported in Lindzey et al. 1992). Harvest records for both Nevada and Alberta indicated that cougar populations were not declining. Anderson and Lindzey (2005) manipulated a cougar population in Wyoming and found cougar harvest composition can be used to adaptively monitor cougar populations where sex and age data are collected from harvested cougars. By monitoring the proportion of adult females in the total known mortality, cougar population trend can be inferred: when the proportion of adult females in the total mortality exceeds 25 percent for a given area, the cougar population is likely declining (Anderson and Lindzey 2005). Based on this science and the knowledge that Oregon cougar harvest was < 14 percent of the modeled population estimates for any zone-year combination, we assume that increased, proactive removal in target areas will not significantly reduce the cougar population in any given zone. When the proportion of adult females in the total mortality exceeds 45 percent, the resultant decline in a local cougar population is likely precipitous (Anderson and Lindzey 2005).

JACKSON COUNTY TARGET AREA

Study Area

The Jackson County Target Area was selected specifically to evaluate the efficacy and feasibility of increasing cougar mortality near human habitation to reduce cougar-human conflicts to acceptable levels. Jackson County was selected due to the number of non-hunting cougar mortalities and reported conflicts related to human safety/pet concerns, the proximity of cougars (and cougar habitat) to an urban environment, and the rural nature of surrounding areas. The 1,123 mile^2 area is in the south central part of Cougar Management Zone B: Southwest Cascades located in Jackson County, southwest Oregon (Figure 2). The Jackson County target areas encompassed parts of three Wildlife Management Units: Rogue, Applegate, and Evans Creek.

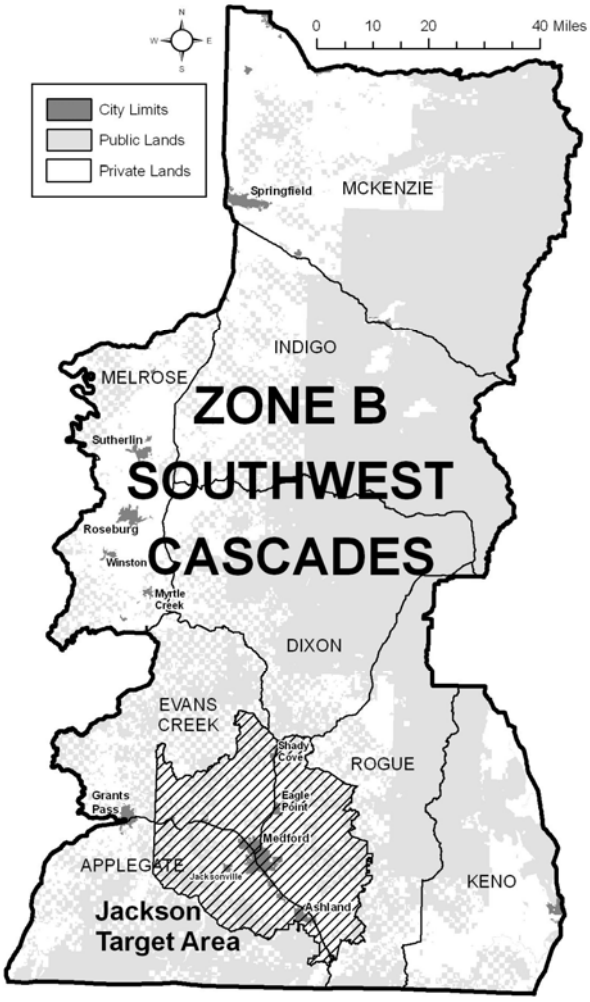

Figure 2. Location and land ownership of Jackson County Cougar Target Area.

Non-hunting cougar mortality in Zone B associated with either livestock depredation or human safety/pet concerns ranged from 12 in 1994 to 43 in 2003, averaging 32 cougars killed per year since 1994. As stated in the CMP, ODFW desires to have non-hunting mortality associated with livestock and human safety/pet concerns at or below 11 cougars killed in Zone B. Reported cougar conflicts in Zone B peaked in 1999 at 379 complaints and have averaged 245

complaints per year since 1994. The desired level for reported conflicts related to human safety/pet concerns in Zone B is 84.

ODFW began Jackson County Target Area management activities in December 2006 using foot-hold traps and snares to administratively remove cougars. In November 2007, USDA Wildlife Services was contracted to use trained pursuit dogs in addition to traps and snares, and in 2009, ODFW assisted USDA Wildlife Services with administrative removal actions. As a control comparison, data from Jackson County Target Area were compared to equivalent data from Josephine County which has similar habitats, cougar populations, and human populations.

Results

Between December 2006 and April 2009, 12 male and 12 female cougars were administratively removed (six, seven, and 11 during winters 2006-07, 2007-08, and 2008-09 respectively). The distribution of the removals within the target area was not uniform, as most were removed from larger land-ownership parcels on the outer edges of the target area (Figure 3). ODFW removed eight during the first winter of activity (2006–2007), Wildlife Services removed 14 in winters of 2007-2008 and 2008-2009; and ODFW removed an additional two during winter 2009. Twelve cougars were removed using traps/snares and 12 were removed using trained dogs. Twenty cougars were removed from private lands and four were removed from public land. Average ages of all known cougar mortality in the target area were not statistically different either between sexes or between sources of mortality (Table 3).

Non-hunting cougar mortality associated with livestock depredation or human safety/pet concerns within the target area prior to implementing administrative cougar removal was seven in 2003, 10 in 2004, and seven in 2005, respectively. In the Josephine County control area, non-hunting mortality was zero in 2003, four in 2004, and zero in 2005, respectively. During and after administrative removal, non-hunting cougar mortality (not including administrative removals) in the target area was six in 2006, six in 2007 and eight in 2008, respectively. Corresponding non-hunting mortality in the Josephine County control area was zero in 2006, zero in 2007 and two in 2008, respectively. An additional 21 cougars were killed in the target area by hunters (Table 3). During years that include the administrative removal period, there were 48, 40, and 70 combined human safety, pets/livestock/other conflicts reported within the target area, respectively, and 12, 23, and 34 conflicts reported in the Josephine County control area in 2006, 2007 and 2008, respectively.

At the zone level, combined non-hunting cougar mortality associated with livestock and human safety/pet concerns (32, 36, and 38 for 2006, 2007, and 2008, respectively) remained higher than the annual objective of 11 established in the Cougar Management Plan. The number of reported At the zone level, combined non-hunting cougar mortality associated with livestock and human safety/pet concerns (32, 36, and 38 for 2006, 2007, and 2008, respectively) remained higher than the annual objective of 11 established in the Cougar Management Plan. The number of reported cougar conflicts in Zone B related to human or pet safety initially decreased from 127 in 2005, to 58 in 2006, but subsequently increased to 113 in 2008. Number of reported conflicts remains higher than the annual objective of 84 established in the Cougar Management Plan. Percent adult females in the total mortality within the target area was 23, 18, and 21 percent for winters 2006–2007, 2007–2008, and 2008–2009, respectively. For Zone B percent adult females in the total mortality was 18, 16, and 17 percent for 2006, 2007, and 2008 respectively. Population modeling

indicates cougar population for Zone B initially dropped from 1,529 in 2006 to 1,478 in 2007 but remained essentially stable at 1,476 in 2008.

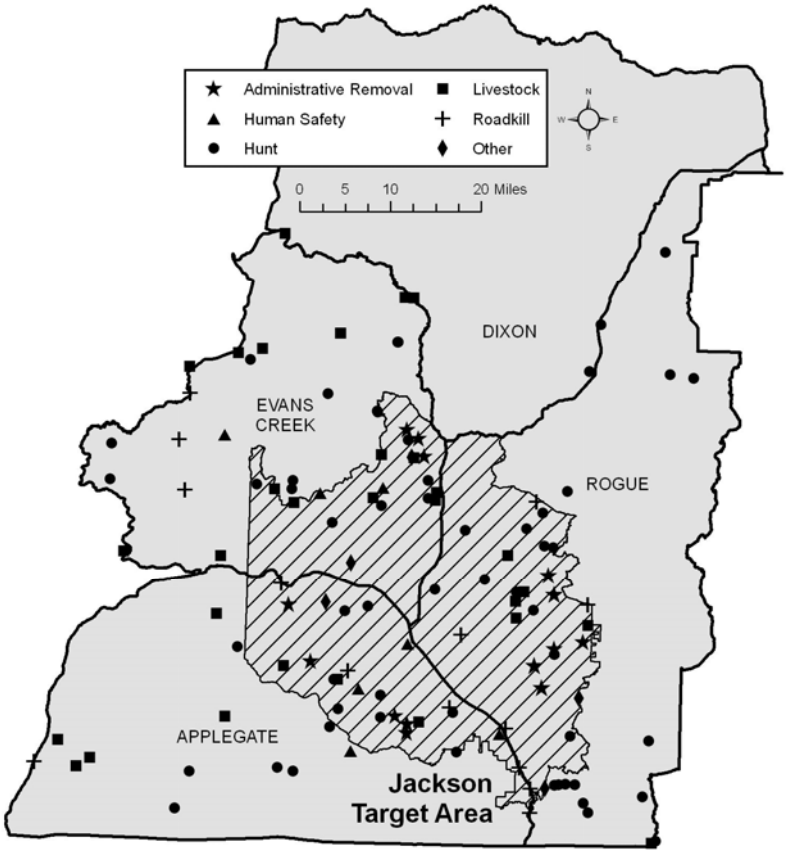

Figure 3. Distribution of known cougar mortalities in the Jackson County Cougar Target Area, Oregon, 2006–2009.

Table 3. Age class and average age by gender for all known cougar mortalities in the Jackson County Target Area vicinity, Oregon, 2006 –2009. *Age class based on gum recession for 27 animals pending confirmation with cementum analysis.*

	Female				Male			
Mortality Source	Juvenile	Sub-Adult	Adult	Ave. Age	Juvenile	Sub-Adult	Adult	Ave. Age
Administrative Removal	5	3	4	3.08	3	4	5	2.42
Hunting	0	6	5	2.82	1	4	5	3.13
Human-Pet Safety	1	1	0	0.50	0	3	0	1.03
Livestock Depredation	0	3	4	4.81	0	5	4	2.60
Other	1	0	1	2.67	0	5	0	1.75
Total	7	13	14	3.30	4	21	14	2.26

Discussion

Compared to 2003–2005 the number of cougars killed in the Jackson County Target Area because of livestock or human safety/pet concerns declined by only four during the three years of

target area implementation. Additionally, reported conflicts for human safety/pet concerns were highly variable across the three years. Similar trends were observed for non-hunting mortality and reported conflicts in the Josephine County control area.

ODFW was not able to achieve its annual cougar removal objective for the Jackson County Target Area. Only 25 percent (6 of 24) of the desired cougar removal objective was removed in 2006–2007 and 29 percent (7 of 24) of the desired cougar removal objective was removed in 2007-08. The number of administrative cougar removals increased in 2008–2009 but still only 46 percent (11 of 24) of the desired objective were removed. According to county tax records, 57.6 percent of all parcels identified within the target area boundary (excluding areas within incorporated city limits) were less than five acres in size with 93 percent of all ownerships less than 50 acres in size. Additionally, privately owned properties with potentially differing land management priorities (e.g. livestock operators, commercial timber, rural housing tracts) were interspersed between parcels of public property in a checkerboard fashion. The matrix of small private ownerships within the target area prevented adequate access to cougars. Contacting landowners to obtain permission to access these small private ownerships proved very difficult, making it nearly impossible to use pursuit with trained dogs to address human safety/pet concerns. Additionally, because of potential conflict with pets, foot hold traps and snares were rarely used. Thus activity in the Jackson County Target area did not appear to address conflict related to human safety/pet concerns in Cougar Zone B. For Zone B, both the modeled cougar population estimate (1,476–1,529) and the proportion adult females in the total mortality for Zone B (16–18 percent) suggest the cougar population was not over-exploited.

BEULAH TARGET AREA

Study Area

The Beulah Target Area was selected to evaluate the efficacy and feasibility of increasing cougar mortality near areas of livestock concentrations to reduce livestock depredation by cougars. The Beulah Target Area has a history of cougar livestock conflict. Non-hunting cougar mortality associated with either livestock depredation or human safety/pet concerns increased from one in 1995 to 21 in 2003, and has averaged 11 non-hunting cougar mortalities per year through 2009. As stated in the CMP, the desired objective is for non-hunting mortality associated with livestock and human safety/pet concerns to be at or below 11 cougars killed in Zone F per year. Reported cougar conflicts in Zone F increased from 14 in 1994 to 41 in 1999, and has averaged 24 complaints per year. The desired level for reported conflicts related to livestock depredation in Zone F is 27 annually.

This target area is found in Cougar Management Zone F: Southeast Oregon, the 1,175 mile^2 area is located in the Beulah WMU in Malheur County Oregon (Figure 4). The target area is a mix of This target area is found in Cougar Management Zone F: Southeast Oregon, the 1,175 mile^2 area is located in the Beulah WMU in Malheur County Oregon (Figure 4). The target area is a mix of public and privately held rangelands (57 percent public) interspersed with small parcels of irrigated hay fields. Cattle, sheep and horses are the primary livestock species and grazing occurs on both public and private land. Grazing rotations follow an elevation gradient with livestock concentrated at lower elevations during winter. Habitat in the Beulah Target Area consists of open conifer forest on the western edge transitioning to sagebrush steppe to the east.

Figure 4. Location and land ownership of Beulah Target Area.

The target area provides good year round habitat for mule deer, elk and pronghorn antelope (*Antelocapra americana*). In addition, the target area includes most of the primary winter range for deer, elk, and pronghorn antelope that summer at higher elevations in the Beulah and surrounding WMU's. The combination of a large ungulate prey base in proximity to livestock likely contributes to cougar–livestock conflicts.

The Malheur River WMU was selected as a comparison unit for analysis. The Malheur River WMU is located adjacent to and immediately west of Beulah WMU, and is similar in size, terrain, and habitat composition. Livestock grazing practices and land ownership also are comparable. The Malheur River WMU is 69 percent publicly owned. No administrative cougar removal occurred in the Malheur River WMU but cougar hunting was allowed and response to individual cougar related conflicts did occur.

ODFW began Beulah Target Area management activities in December 2006 but cougar removal was hampered by weather conditions and difficulty finding trained personnel during winter 2006–2007. Consequently little effort was expended and no cougars were administratively removed the first year. USDA Wildlife Services personnel were contracted to conduct target area activities during winters 2007–2008 and 2008–2009. An annual removal objective of 12 cougars was established by extrapolating modeled cougar density estimates for the cougar management zone. Removal objectives were re-evaluated each year. Traps and snares were selected as the primary tools with trained hounds to be used when access and tracking conditions would permit.

Results

Between 2006 and 2009, 15 male and nine female cougars were administratively removed (zero, 12, and 12 for winters 2006-07, 2007-08, and 2008-09 respectively). Distribution of cougar removals within the target area was not uniform (Figure 5) but was concentrated around private agricultural lands. Wildlife Services removed all 24 cougars. Sixteen cougars were removed using traps/snares, seven were removed using dogs, and one was tracked without hounds.

Thirteen were removed from private land and 11 were removed from public land. Average ages of all known cougar mortality in the target area were not statistically different either between sexes or between sources of mortality (Table 4).

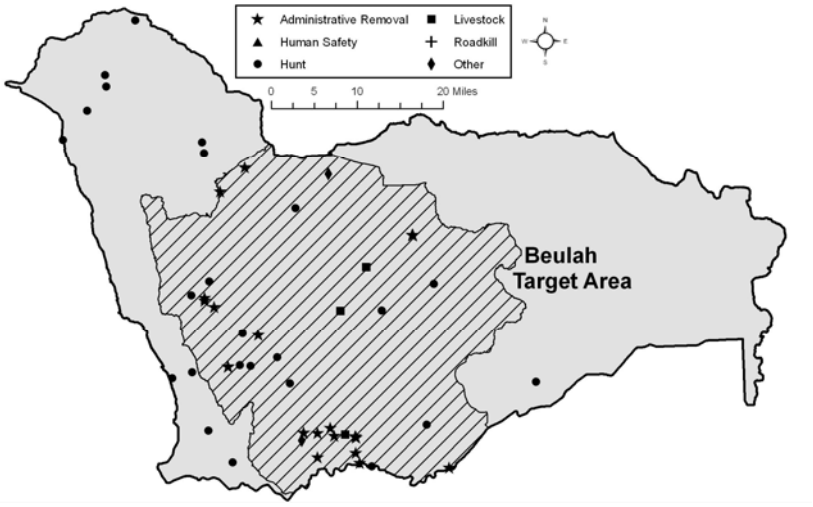

Figure 5. Distribution of known cougar mortalities in the Beulah Unit Cougar Target Area, Oregon, 2006–2009.

Table 4. Age class and average age by gender for all known cougar mortalities in the Beulah Target Area, Oregon, 2006 –2009. *Age class based on gum recession for 19 animals pending confirmation with cementum analysis.*

	Female				Male			
Mortality Source	Juvenile	Sub-Adult	Adult	Ave. Age	Juvenile	Sub-Adult	Adult	Ave. Age
Administrative Removal	0	4	5	3.89	0	3	12	4.20
Hunting	0	2	3	3.20	1	2	3	2.91
Human-Pet Safety	0	0	0		0	0	0	
Livestock Depredation	1	2	1	3.25	2	0	0	0.00
Other	0	0	0		0	1	1	2.50
Total	1	8	9	3.56	3	6	16	3.44

Prior to implementation of Beulah Target Area (2004–2006), 13 non-hunting mortalities occurred in both the Beulah WMU and the Malheur River WMU. During the administrative removal period, non-hunting mortality dropped to five in the Beulah WMU, all within the Beulah Target Area, but remained relatively unchanged at 10 in the Malheur River WMU. Similar results were observed for reported cougar-livestock conflicts. Reported conflict in Beulah WMU decreased from 16 prior to administrative cougar removals to three during administrative removals. In the Malheur River WMU, eight and six livestock depredation conflicts were reported respectively in the pre-removal and removal periods.

During 2006 and 2007, non-hunting cougar mortality associated with livestock depredation and human safety/pet concerns (12, 12, and nine for 2006, 2007, and 2008, respectively) remained higher than the annual objective of 11 established in the CMP for Zone F. Since 2005 livestock related cougar complaints have declined from 18 in 2005 to six in 2008, which met the conflict threshold of 27 or less established in the CMP. Percent adult females in the total mortality for

Beulah Target Area was 32 and 16 percent for winters 2007–2008 and 2008–2009, respectively. Percent adult females in the total mortality for Zone F were 32 and 25 percent for 2007 and 2008, respectively. Modeled cougar population trend for the zone remained relatively stable during the administrative cougar removal period (852 and 868 for 2007 and 2008, respectively).

Discussion

Observed trends in cougar–livestock conflict in Beulah WMU provide evidence that increasing cougar mortality near livestock concentrations reduces cougar-livestock conflicts. Prior to administratively removing cougars, 13 (0.36/mo) non-hunting mortalities occurred in Beulah WMU. During target area implementation, only five (0.18/mo) non-hunting cougar mortalities occurred. Reported cougar livestock conflicts showed a similar pattern: 16 reported prior to cougar removal whereas only three were reported during target area implementation. These trends were not apparent in the Malheur River WMU. After cougar removal, both parameters were met the conflict threshold values established in the CMP. Thus, administrative cougar removal activity in the Beulah Target Area appears to be reducing cougar conflict associated with livestock in Zone F: SE Oregon. For Zone F, the modeled cougar population estimate (852 and 868 for 2007 and 2008, respectively), and the proportion adult females in the total mortality within the target area (16–32 percent) and for Zone F (18–32 percent) suggest the cougar population was not over-exploited.

HEPPNER TARGET AREA

Study Area

The Heppner Target Area was selected because of the dramatic reduction in elk calf: cow ratios believed to be from cougar predation. Since 2000, elk calf: cow ratios declined in the Heppner Target Area from long-term averages of 35-40 calves per 100 cows to < 20 calves per 100 cows (Table 5). Calf ratios have been below 23 calves per 100 cows for three years (2004–2006), and elk populations have been below population objectives since 2003 (three years), thus meeting the criteria for a target area as established in the CMP. Observed bull ratios in the Heppner Target Area have been below management objective for seven of the eight years. Non-hunting mortality associated with livestock depredation and human safety/pet concerns continues to be much higher than 13 as established in the CMP.

Table 5. Trends in bull elk ratio and calf elk ratio in the Heppner Target Area Oregon, 2000–2009.

	Bulls:			Calves:		
Year	Lower 95%	100 Cows	Upper 95%	Lower 95%	100 Cows	Upper 95%
2000	9.81	9.9	10.03	34.10	36.5	38.92
2001	8.90	9.0	9.14	32.63	35.2	37.84
2002	7.27	7.4	7.47	28.05	30.4	32.71
2003[a]		8			27	
2004	5.41	5.5	5.59	16.28	18.0	19.63
2005	5.57	5.7	5.80	18.78	21.2	23.60
2006	9.83	10.0	10.06	15.49	17.1	18.69
2007	5.14	5.2	5.32	13.62	15.1	16.66
2008	7.00	7.1	7.14	28.30	29.9	31.43
2009	8.72	8.8	8.87	27.90	29.4	30.88

[a] No count data available. Estimates based on modeling.

The 1,189 mile^2 Heppner Target Area encompasses 80 percent of the Heppner WMU and includes land in Morrow, Grant, Umatilla and Wheeler counties in north central Oregon (Figure 6). The target area includes the entire Heppner WMU except for the Ritter Area south and east of the North Fork of the John Day River.

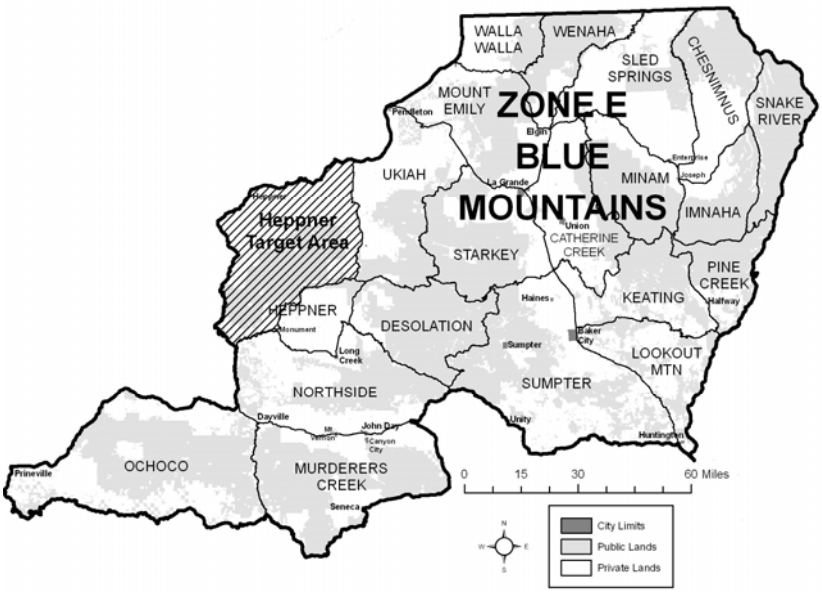

Figure 6. Location and land ownership of Heppner Unit Cougar Target Area.

Field activities began in the Heppner Target area in January 2007. The initial annual removal objective of 30 cougars was established based on extrapolation of modeled cougar density estimates for the cougar management zone to the target area. Removal objectives were re-evaluated each year. During the first two years of implementation (July 2006 – June 2007 and July 2007 – June 2008) attempts were made to remove 30 cougars per year from the target area primarily during winter months. Based on the number of cougars removed during the first two winters, and in response to the improved elk calf: cow ratios, the removal objective was reduced to 20 during the third year of implementation (July 2008- March 2009) as part of the adaptive management component of target area implementation.

Elk populations were surveyed in the Heppner Target Area after each treatment year (winter) to monitor population response to cougar removals. Elk surveys were conducted using routine and customary helicopter surveys during March or April. Elk data from the Heppner Target Area were compared to the neighboring Ukiah WMU which has experienced a similar decline in elk population and elk calf ratios.

Results

Between 2006–2009, 53 cougar (26 male, 27 female) were removed: (20, 22, and 11 for winter 2006-07, 2007-08, and 2008-09, respectively). Between 55 and 73 percent of the annual objective was removed. Most cougars (48) were removed using trained dogs but five were captured using traps or snares. ODFW personnel removed all 53 cougars. Thirty-two cougars were removed from public land and 21 were removed from private lands. During the implementation period, hunters killed an additional 28 cougars, one cougar was taken for

livestock depredation, and one was killed illegally in the Heppner Target Area (Table 6). No cougars were killed as a result of human safety/pet concerns during the same period in the Heppner Target Area. Distribution of cougar removals within the target area was not uniform (Figure 7) but instead was concentrated on elk winter ranges. Average ages of all known cougar mortality in the target area were not statistically different either between sexes or between sources of mortality (Table 6).

Elk populations in the Heppner Target Area did not respond immediately. However, in 2008 calf ratios increased 76 percent from 15 – 19:100 cows in 2006 to 28 – 31:100 cows (Table 5). Bull ratios remain below established management objective for the Heppner Target Area after three years of cougar removals. Observed calf ratios in the control WMU (Ukiah) did not have the increase during 2008 as documented in the Heppner Target Area. Ukiah WMU calf ratios were 13 calves: 100 cows, 16 calves: 100 cows, and 11 calves: 100 cows for 2007, 2008, and 2009, respectively.

Percent adult female cougar in the total mortality for Heppner Target Area was 26, 23, and 17 percent for winter's 2006–2007, 2007–2008, and 2008–2009, respectively. In Zone E: Blue Mountains, percent adult females in the total mortality were 18, 23, and 20 percent for 2006, 2007, and 2008 respectively. Modeled cougar population trend for Zone E suggests only a slight decline during the administrative cougar removal period (1,618, 1,587, and 1,572 for 2006, 2007, and 2008, respectively).

Table 6. Age class and average age by gender for all known cougar mortalities in the Heppner Target Area, Oregon, 2006 –2009. *Age class based on gum recession for **13** animals pending confirmation with cementum analysis.*

	Female				Male			
Mortality Source	Juvenile	Sub-Adult	Adult	Ave. Age	Juvenile	Sub-Adult	Adult	Ave. Age
Administrative Removal	5	10	12	3.69	7	5	14	3.60
Hunting	1	10	7	3.38	0	4	6	2.98
Human-Pet Safety	0	0	0		0	0	0	
Livestock Depredation	0	1	0	2.00	0	0	0	
Other (Illegal Kill)	0	0	1	4.00	0	0	0	
Total	6	21	20	3.54	7	9	20	3.42

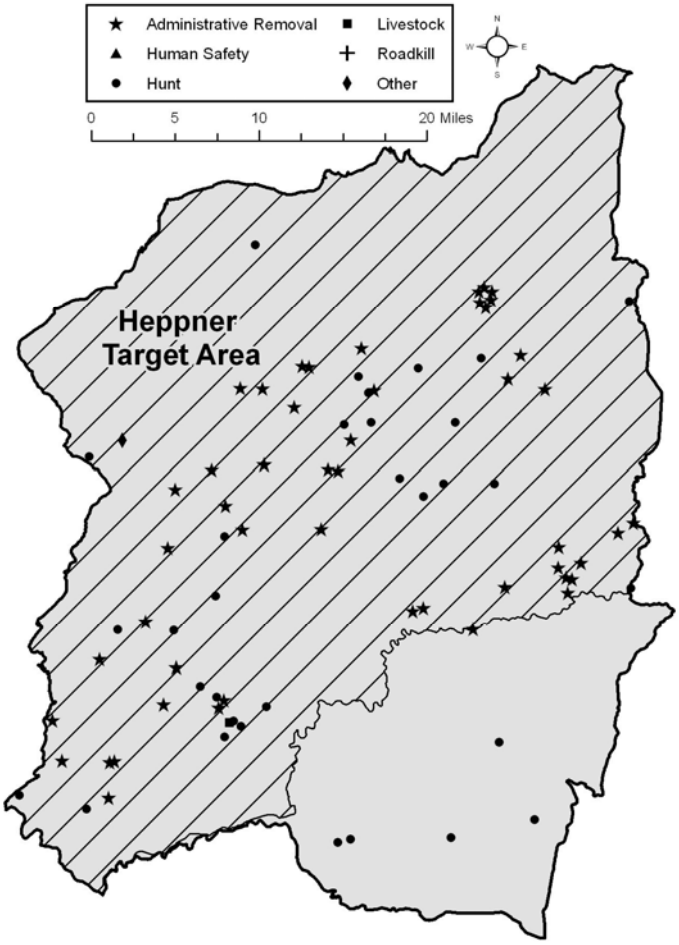

Figure 7. Distribution of known cougar mortalities in the Heppner Unit Cougar Target Area, Oregon, 2006–2009.

Discussion

The objective for Heppner Target Area was to raise the elk calf ratio to 31–35 calves: 100 cows. Administrative cougar removal appears to have had the desired affect on the elk calf ratio. Winters 2007–2008 and 2008–2009 were above average snowfall years. For winter 2008–2009, cumulative snowfall at the Heppner recording station was at least 314 percent of normal (Figure 8). Radio telemetry data from ODFW studies suggest that during above average snowfall years elk from neighboring units (Ukiah, Starkey, Desolation and Northside) migrate into Heppner Target Area to escape the snow cover (Wilt 1986). In 2008 and 2009 observed Heppner Target Area total elk counts were dramatically higher than normal years and likely included over 1,000 elk from neighboring WMUs. Considering observed 2009 calf ratio estimates for the Ukiah, Desolation, Northside, and Ritter portion of the Heppner WMUs (not part of the target area) of 11, 16, 22, and 12 respectively, it is likely the influx of elk from these WMUs lowered observed calf ratio estimates for resident Heppner Target Area elk.

Heppner WMU is one of the most popular units for hunting elk in Oregon (Johnson and Moore 1992). In 1995 when the Heppner WMU elk population was at or near management objective, there were 7,198 reported elk hunters in Heppner WMU (3,295 controlled elk hunters and 3,903 general season hunters; ODFW unpublished data). During the 2008 elk seasons, there were 5,693 reported elk hunters (1,425 controlled elk hunters and 4,268 general season elk

hunters; ODFW unpublished data). This is a difference of 1,505 hunters between elk populations at MO or below MO. Assuming that the observed 30 calves per 100 cows are recruited into the Heppner Target Area elk population, and assuming that the there are approximately 2,246 cow elk in the Heppner Target Area, approximately 600 elk have been added to the population. Of these about half will be bulls available for harvest in subsequent years. If improved calf ratios and resulting elk population trends continue, it is likely that elk hunting opportunity will subsequently increase to levels observed when elk populations were at or near MO in the Heppner WMU.

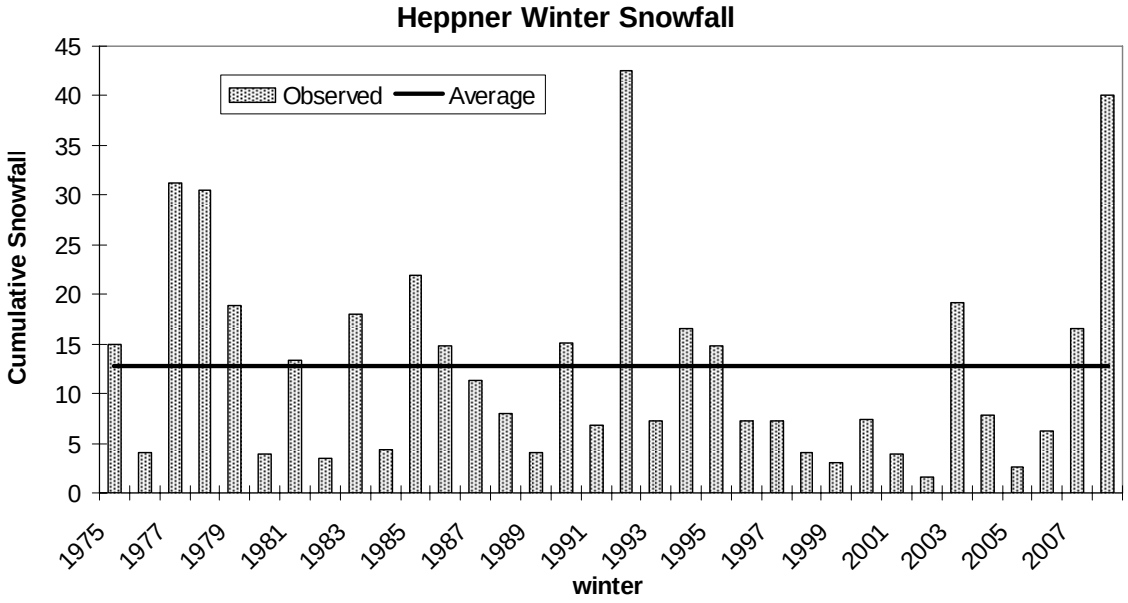

Figure 8. Annual winter snowfall at Heppner, Oregon recording station, 1975–2009.

The cougar population within Heppner Target Area likely decreased as a result of administrative removals. The number of days per cougar capture increased from 4.3 days/cougar in 2006–2007 to 8.3 days/cougar during 2008–2009. The average age of female cougars taken in the Heppner Target Area also appears to have declined from 4.7 during the first year to 2.9 (note that cougars killed during 2008–2009 are still pending age confirmation with cemetum analysis). While the overall cougar population likely declined in Heppner Target Area, the presence of cougar sign (i.e. tracks observed of adult and young of the year) found during field work throughout the year suggests a healthy, viable population of cougars persists in the target area. Additionally, public hunters continue to encounter cougars while hunting other big game species. Conversely, the cougar population within Cougar Management Zone E appears unaffected. The proportion of adult females in the total mortality both within the target area (17–26 percent) and throughout Zone E (18–23 percent) are well below the 40 to 45 percent that would be indicative of a heavy exploitation rate (Anderson and Lindzey 2005).

COST

Through April 2009, 101 cougars were removed from the three Target Areas. ODFW employees took 60 percent of all cougars killed through administrative actions in the target areas and 2/3 of the cougars were taken using trained dogs. Total cost of implementing target area cougar removal for three years was $310,501 (Table 7). During the first year, salary accounted for 78 percent of target area implementation costs. As target area activities progressed and staff became

more efficient, salary costs declined. Existing employee salaries are shown as part of implementation costs; however these are not added costs to ODFW. Therefore, real costs for implementing target area cougar removal are $201,522. No state general funds, tax dollars or federal funds were used for implementing cougar removal in target areas. All funds used for target area implementation were ODFW license fee dollars.

Table 7. Cost of implementing and conducting cougar removals in 3 cougar target areas in Oregon, winters 2006–2007, 2007–2008, and 2008–2009.

Target Area	Expenditure	06-07	07-08	08-09	Total
Jackson Cnty.	Existing Employee Salaries	$16,918	$0	$0	$16,918
	New Employee Salaries	$0	$0	$0	$0
	Supplies & Services[a]	$4,181	$40,000	$30,000	$74,181
	Jackson Cnty. Sub-Total	$21,099	$40,000	$30,000	$91,099
E. Beulah	Existing Employee Salaries	$4,656	$0	$0	$4,656
	New Employee Salaries	$7,200	$0	$0	$7,200
	Supplies & Services[a]	$8,010	$18,251	$21,915	$48,176
	E. Beulah Sub-Total	$19,866	$18,251	$21,915	$60,032
Heppner WMU	Existing Employee Salaries	$43,500	$34,064	$9,841	$87,405
	New Employee Salaries	$15,500	$18,250	$16,858	$50,608
	Supplies & Services	$13,200	$5,262	$2,895	$21,357
	Heppner Sub-Total	$72,200	$57,576	$29,594	$159,370
Target Area Total[b]	Existing Employee Salaries	$65,074	$34,064	$9,841	$108,979
	New Employee Salaries	$22,700	$18,250	$16,858	$57,808
	Supplies & Services	$25,391	$63,513	$54,810	$143,714
	Sub-Total	$113,165	$115,827	$81,509	$310,501

[a] Contract with USDA Wildlife Services during 2007-2009.
[b] Total Expenditure for all three target Areas.

CONCLUSIONS

The odds of a human being attacked or injured by a cougar are extremely low: More people are injured or killed annually by rattlesnakes, bees, and dogs than by cougars (Beier 1991). However, this does not diminish the fact that when a person is injured or killed by a cougar, the incident is a very serious situation requiring an immediate and intensive response by the wildlife management agencies. Circumstances leading to legitimate human safety concerns can be broken down into three categories: situations where cougars appear accustomed to human activity and development, cougars are seen frequently during daylight hours in close proximity to houses and people, and pets are lost due to cougars in populated areas are considered to be legitimate human safety concerns. It is reasonable to take actions preventing or minimizing the potential for these situations to escalate into incidents resulting in the injury or death of a human in Oregon due to cougars. Our efforts to reduce human safety/pet concerns due to cougars were not successful because of land ownership patterns in the Jackson County Target Area. The methods ODFW used to attempt administrative removal of cougars in urban-rural interface to reduce cougar-human conflict will likely not work in other areas with similar land-ownership patterns without an extensive outreach program to landowners to provide permission to access their properties.

Based on the 2005 two-year average value for beef cows and the market year average calf price (USDA National Agricultural Statistics Service 2006), cattle producers in Oregon lost an estimated $721,500 in potential revenue. Our efforts to administratively remove cougars from an area with high levels of livestock depredation reduced livestock related conflict in the area during the removal period, supporting the hypothesis that increased cougar mortality near areas of livestock concentrations can reduce cougar-livestock conflicts. Cattle production is a significant factor for Malheur County (US Department of Agriculture 2007). Aggressive, focused cougar removal may be a viable option for reducing livestock depredation and subsequently benefiting the livestock producer in Malheur County by reducing economic loss and potentially minimizing protection costs.

Hunting provides an important source of income for many rural economies such as found in the Heppner WMU (Dean Runyan Associates 2009). Hunting in the Heppner WMU contributed an estimated $184,444 to portions of Grant, Wheeler, Morrow, and Umatilla Counties during 2008. Based on data collected on hunters traveling to the Starkey WMU (ODFW Unpublished data) inflated to 2008 values, elk hunters spend an estimated $430.95 per trip to hunt elk in northeastern Oregon. Given that there are approximately 1,505 fewer elk hunters in the Heppner WMU compared to when elk populations were at or near MO, this represents a significant loss of income to local rural counties. Administrative cougar removal in an area of high predation rates on ungulates resulted in increased survival of calf elk as measured by end-of-winter calf to cow ratios during the removal period. Improvements in elk populations and subsequent increases in elk hunting opportunity in Heppner WMU will benefit economies that rely on this resource.

We found varying efficacy of using administrative removal of cougars as authorized in the CMP varied for the three specific types of cougar-human conflicts. Continued monitoring of livestock – cougar complaints and measuring calf to cow ratios will be required to determine duration of the effects observed during this administrative removal.

Cougars still are found in these target areas, but there is scant information on what percentage of the cougar population in each target area was removed. For example, if it is assumed that cougar density was 15 adult and sub-adult cougars per 100 mi^2 in the Heppner target area, there would have been 178 cougars in the target area. If none of the subadult and adult cougars killed by administrative removal or hunters (n = 70, Table 6) immigrated into the Heppner Target area, the cougar population was reduced by 41 percent. However, it is highly likely that some of the cougars killed immigrated into the target area during this work and the percentage reduction in the cougar population was likely less. Based on the fecundity of cougars, the calf to cow ratio for elk will likely begin to decline in 2010 as the cougar population increases. Cougar populations in the Beulah Target area are likely to respond in a similar manner and livestock depredation may potentially increase again in the future.

Table 8. Observed and desired values for non-hunting cougar mortality, number of reported human safety/pet conflicts, and number of reported livestock conflicts due to cougars in Oregon 2004-2009.

		Cougar Mortality		Human Safety / Pets		Livestock Depredation	
Zone	Year	Observed	Objective	Complaints	Objective	Complaints	Objective
A	2004	39	15	159	191	47	102
	2005	35	15	135	191	73	102
	2006	26	15	91	191	56	102
	2007	37	15	64	191	69	102
	2008	35	15	90	191	57	102
B	2004	38	11	122	84	59	69
	2005	38	11	129	84	48	69
	2006	32	11	60	84	63	69
	2007	36	11	78	84	67	69
	2008	36	11	114	84	64	69
C	2004	10	5	20	28	12	24
	2005	4	5	19	28	9	24
	2006	10	5	14	28	8	24
	2007	4	5	16	28	8	24
	2008	4	5	21	28	15	24
D	2004	5	5	19	20	4	12
	2005	26	5	24	20	16	12
	2006	27	5	18	20	13	12
	2007	24	5	7	20	12	12
	2008	16	5	4	20	14	12
E	2004	19	13	46	22	12	25
	2005	33	13	64	22	23	25
	2006	25	13	37	22	22	25
	2007	23	13	31	22	12	25
	2008	31	13	47	22	16	25
F	2004	12	11	8	54	16	27
	2005	17	11	9	54	18	27
	2006	12	11	9	54	13	27
	2007	12	11	14	54	3	27
	2008	9	11	7	54	2	27

RECOMMENDATIONS

Four of five cougar management zones are above the desired maximum threshold criteria for non-hunting cougar mortality (Table 8) indicating that conflict with cougars continues to be higher than desired as specified in the CMP. Therefore ODFW proposes continued implementation of target areas consistent with the CMP. For Beulah Target area, one more year of cougar removal is required to more adequately analyze the data. ODFW also proposes implementation of four new target areas as described below. Two new target areas will be for elk, and two for mule deer. The department is evaluating potential sites for a new target area to address human safety/pet concerns. A decision on approving one of these new target areas will be made this fall.

Ukiah Target Area

The Ukiah Target area was selected to continue efforts for elk population improvement. As required by the CMP, the ratio of calves: 100 cows has been below 23:100 since 2005 (5 years) and the elk population has been below management objective since 2004 (6 years) (Table 9). Additionally, data from Ukiah WMU were used as comparison for evaluating the Heppner Target Area. Combining analysis of three years data from Ukiah with that already collected from Heppner will strengthen analyses for this general area.

The 883 mile^2 Ukiah WMU is in Cougar Management Zone E: Blue Mountains and includes land primarily in Umatilla county. Target area activities will occur primarily on elk habitats within the forested portions of the unit. Cougar removal methods and elk population monitoring will be consistent with those implemented for the Heppner Target Area. Personnel hired to implement the Heppner Target area will be maintained to implement the Ukiah Target Area. Using estimated cougar density for the zone and habitat characteristics of each area, the initial cougar removal objective will be 35/year. As part of the adaptive management component of target area implementation, the removal objective will be evaluated annually based on the number of cougars removed and in response to elk calf: cow ratios. Elk population data will be compared back to information collected in Heppner through continued monitoring in that target area to evaluate success of cougar removal actions in the Ukiah.

Table 9. Trends in elk population and calf elk ratio in the Ukiah and Wenaha WMUs Oregon, 2000–2009.

	Ukiah WMU			Wenaha WMU		
Year	Population	MO	Calves: 100 Cows	Population	MO	Calves: 100 Cows
2000	5,500	5,000	28	1,100	4,250	12
2001	5,600	5,000	25	1,150	4,250	14
2002	5,100	5,000	33	1,400	4,250	15
2003	5,000	5,000	24	1,400	4,250	20
2004	4,800	5,000	24	1,450	4,250	16
2005	4,300	5,000	19	1,600	4,250	20
2006	4,100	5,000	19	1,600	4,250	30
2007	4,000	5,000	13	1,550	4,250	13
2008	4,000	5,000	16	1,500	4,250	16
2009	4,000	5,000	11	1,100	4,250	18

Wenaha Target Area

The Wenaha WMU Target Area also was selected for elk population improvement. As required by the CMP, the ratio of calves: 100 cows been below 23:100 for three years and the elk population have been well below management objective for a number of years (Table 9). The 420 mile^2 Wenaha WMU Target Area is also in Cougar Management Zone E: Blue Mountains and includes portions of Union and Wallowa counties. Cougar will be removed year round with most activity during winter using hounds and snares. Elk surveys will be conducted using routine and customary helicopter surveys during March or April. Volunteer agents already in place will be used to implement cougar removals. Using estimated cougar density for the zone and habitat

characteristics of each area, the initial cougar removal objective will be 20/year. As part of the adaptive management component of target area implementation, the removal objective will be evaluated annually based on the number of cougars removed and in response to elk calf: cow ratios. Elk population data will be compared to datadate collected in the Mt Emily WMU to evaluate success of cougar removal in the Wenaha WMU.

Steens Mountain Target Area

Steens Mountain Target Area was selected to address declining mule deer populations. Steens Mountain WMU was selected for more intensive management as part of Oregon's Mule Deer Initiative (MDI). Cougar predation has been suggested as a probable cause of the decline during development of a management plan for MDI. Consistent with the CMP, deer populations have been < 60 percent of population management objective for over three years (Table 10). The 1,572 mile^2 Steens Mountain Target Area focuses on mule deer winter ranges within Steens Mountain WMU in Cougar Management Zone F: Southeast Oregon in Harney County. Malheur National Wildlife Refuge is not included in the target area boundary.

Cougars will be removed using existing WS personnel in Burns, OR. Using estimated cougar density for the zone and habitat characteristics of each area, the initial cougar removal objective will be 20/year. As part of the adaptive management component of target area implementation, the removal objective will be evaluated annually based on the number of cougars removed and observed responses in mule deer populations. Mule deer populations will be monitored using routine and customary helicopter and ground surveys during March or April. Additional effort also may be required to obtain more rigorous population estimates. Mule deer population data will be compared to data from Beatys Butte or Trout Creek Mtns to evaluate success of the actions.

Table 10. Trends in mule deer population, deer fawn ratio, and buck ratio in the Steens Mountain and Warner WMUs Oregon, 2000–2009.

	Steens Mountain WMU				Warner WMU			
Year	Population	% of MO (11,000)	Bucks:100 Does	Fawns:100 Does	Population	% of MO (5,500)	Bucks:100 Does	Fawns:100 Does
2000	5,150	47%	25	67	2,562	47%	21	49
2001	6,200	56%	31	44	no data		19	66
2002	5,900	54%	22	65	1,328	24%	22	41
2003	5,600	51%	24	55	2,136	39%	13	55
2004	5,500	50%	34	44	1,630	30%	15	56
2005	5,000	45%	51	55	2,270	41%	18	70
2006	4,000	36%	29	69	1,036	19%	24	48
2007	4,300	39%	47	59	2,958	54%	14	37
2008	3,850	35%	29	35	2,389	43%	15	50
2009	3,700	34%	28	68	no data			

Warner Target Area

Warner Target Area also was selected to address declining mule deer populations. Warner WMU was selected for more intensive management as part of Oregon's Mule Deer Initiative (MDI). Cougar predation has been suggested as a probable cause of the decline during development of a management plan for MDI. Consistent with the CMP, deer populations have been < 60% of population management objective for over three years (Table 10). The 960 mile^2 Warner Target

Area focuses on mule deer winter ranges within the WMU in Cougar Management Zone F: Southeast Oregon in Lake County.

Cougars will be removed using volunteer agents in place for Lake County. Using estimated cougar density for the zone and habitat characteristics of each area, the initial cougar removal objective will be 14/year. As part of the adaptive management component of target area implementation, the removal objective will be evaluated annually based on the number of cougars removed and observed responses in mule deer populations. Mule deer populations will be monitored using routine and customary helicopter and ground surveys during March or April. Additional effort also may be required to obtain more rigorous population estimates. Mule deer population data will be compared to data from the Beatys Butte and Interstate WMUs to evaluate success of the actions.

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