2017
Oregon Cougar Management Plan

Oregon Department of Fish & Wildlife
October 2017

EXECUTIVE SUMMARY

October 2017

The 2017 Oregon Cougar Management Plan updates the 2006 Oregon Cougar Management Plan. This update will guide Oregon's cougar management, and provides strategies for resolution of human conflicts with cougars.

This plan revision process was initiated in April 2016 when two panels of invited stakeholders provided testimony and written recommendations at the April Commission meeting. Next steps included stakeholder meetings in late summer and a staff presentation and public testimony at the October Commission Meeting. Informal/impromptu communications occurred with local sporting groups, state agencies, landowner groups, wildlife researchers, and other interested parties throughout the entire duration of this process.

The draft plan chapters include information on Oregon cougars; cougar management objectives; and cougar management goals incorporated into an adaptive management approach for the future. These chapters contain a significant amount of information and data on cougar biology, population trends, research findings, damage and conflict, and management activities.

Similar to the 2006 Plan, this draft plan establishes objectives that seek to maintain viable and healthy cougar populations in Oregon, reduce conflicts with cougars, and manage cougars in a manner compatible with other game mammal species.

Objective 1 seeks to manage the state's cougar population at a level well above that required for long term sustainability. Achieving and monitoring this objective is complicated but empirical data and numerous indices can be used to assess population status. Because the minimum population objective is well above the level of sustainability, and because of the demonstrated resilience of cougar populations (Cougar Management Guidelines, 2005, page 40), exact counts of cougars are not necessary to achieve Objective 1. To accomplish this objective, several strategies have been employed. Zone management with mortality quotas will be used to ensure harvest does not reduce the population below objective levels. Harvest can occur at three levels of intensity to allow for maintenance of source and sink populations. Two indicators of cougar abundance will be used. A deterministic, density dependent population model, which utilizes data collected from all cougar mortalities in Oregon, will be used for predicting outcomes on a short-term basis in an adaptive management approach (Cougar Management Guidelines, 2005, page 58). Proportion of adult females in the harvest will also be used to monitor cougar population trajectory. In addition, data will continue to be collected in more intensive, smaller scale research studies (Cougar Management Guidelines, 2005, page 77) as well as developing alternative population models that could incorporate stochastic variability for each zone.

Objectives 2 – 3 address solving conflict. The primary strategy to solve conflict since 1995 has been to give advice and, when necessary, remove the problem animal. While damage and conflict have remained relatively stable in much of Oregon, conflict has increased as cougars have expanded into previously unoccupied habitats of human habitation. Human population increases in some parts of the state have exacerbated the problem. Steps necessary to achieve these objectives are straightforward and do not depend on cougar population estimates. In addition to advice and removal of specific cougars, specific areas with elevated conflict may also be targeted to reduce conflict by reducing cougar numbers. These targeted areas are intended to create a buffer of low

cougar density, thereby reducing conflict.

Objective 4 seeks to achieve established management objectives for other game mammal species. Only those Wildlife Management Units (WMU's) where elk or deer populations are below established management objectives, have shown a history of decline and lack of ability to sustain themselves, and where evidence indicates cougar predation is a primary factor may be targeted for cougar population reduction. For bighorn sheep, areas around specific herds will be targeted when evidence indicates cougar predation is a primary factor.

All management activities will be carried out in an adaptive management approach, as suggested in the Cougar Management Guidelines (2005, pages 74 and 81), which allows for monitoring, evaluation, and changes in management based on results. Those strategies that are not successful at meeting stated objectives would be modified or discontinued. Numerous indicators will be used to monitor success. Total mortality, hunter harvest success rates, and biological data will continue to be collected. These data will contribute to population modeling for each Cougar Management Zone. Cougar-human conflict will continue to be monitored using non-hunting mortalities and complaints concerning human safety, pets, and livestock. Research projects will collect information on movements, density, predation rates, and will be able to better detect other factors such as disease.

ODFW's mission is to protect and enhance Oregon's fish and wildlife and their habitats for use and enjoyment by present and future generations. Cougar management is complicated by the dichotomy of sentiment toward cougars among Oregon residents. This plan presents ODFW's strategy to meet its mission and incorporate public attitudes and desires. It is a plan that will be updated and rewritten as agency policies, new biological data, and human and/or cougar populations change.

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PURPOSE OF THE PLAN

The mission of Oregon Department of Fish and Wildlife (ODFW) is to protect and enhance Oregon's fish and wildlife and their habitats for use and enjoyment by present and future generations. This plan was developed to provide ODFW guidance for managing Oregon's cougar populations and to accomplish ODFW's mission and statutory requirements.

Oregon Department of Fish and Wildlife first developed a plan for cougar management in 1987 (Oregon Department of Fish and Wildlife 1987) and was subsequently updated in 1993 (Oregon Department of Fish and Wildlife 1993) and 2006 (Oregon Department of Fish and Wildlife 2006). The 2006 Plan has served as a valuable guiding document for most areas of cougar management in Oregon. However, since adoption in 2006, there have been significant changes in Oregon's cougar population and the scientific knowledge available for cougar management, therefore a plan update is necessary. The purpose of this plan is to update the 2006 Plan using current knowledge, population estimates, and results of recent Oregon research to guide future cougar management in Oregon. This plan is not a broad document on cougar behavior and ecology across their range in North and South America; books such as Cougar Ecology and Conservation by Hornocker and Negri (2010) better address those topics.

ODFW has the complex task of balancing public demands for the appropriate management of cougar populations. In particular, sustaining cougar populations and managing cougar impacts to human safety, livestock, and other game mammal populations are paramount considerations for ODFW. ODFW will focus efforts to:

1) Recognize the cougar as an important part of Oregon's wild fauna, valued by Oregonians;
2) Maintain sustainable cougar populations within the state; and
3) Conduct a management program that:
    a. meets statutory obligations,
    b. minimizes negative interactions between humans and cougars,
    c. manages cougars consistent with other game mammals, and
    d. incorporates the desires of the public.

CHAPTER I: INTRODUCTION

The largest member of the cat family in Oregon, the cougar is known by many names: panther, puma, catamount, and mountain lion. Historically, the cougar had one of the most extensive distributions of any North American wildlife species (Nowak 1999b).

Although many Oregonians may never see a cougar, they find satisfaction in the knowledge that cougars still remain in Oregon and that their existence is not threatened. The public entrusts Oregon Department of Fish and Wildlife (ODFW) with management responsibility for cougars and depends on ODFW to provide for the animal's continued existence into the future. ODFW recognizes the cougar as a valuable part of Oregon's native fauna. An integral part of a complex biological system, the presence of cougars is an indicator of Oregon's ecological health.

Two important considerations in cougar management are biological carrying capacity and social tolerance levels. Biological carrying capacity is defined as the maximum number of individuals a given unit of habitat can support over time. Cougar carrying capacity is primarily dependent on prey presence and abundance. Some Oregonians would like to have cougar populations managed at biological carrying capacity while others want cougar populations reduced. Social tolerance levels require ODFW to consider biological and social considerations when establishing population objectives for any wildlife species. Because of the social constraints resulting from wildlife impacts to private or public land management, population objectives are not normally set at biological carrying capacity. Wildlife management in Oregon has always considered wildlife-human conflicts. A key objective in Oregon's cougar management strategy involves minimizing conflict between humans and cougars. ODFW is obligated to manage the state's wildlife (Oregon Revised Statute (ORS) 496.012), and respond to situations where wildlife poses a threat to human safety or inflict property damage (ORS 498.012, ORS 498.164).

One challenge facing wildlife managers involves factoring growing human populations into wildlife management strategies. In the decade following adoption of the 2006 Plan (2006-2015), Oregon's human population grew 9.75 percent to approximately 4.03 million (U.S. Census Bureau 2017). Statewide cougar populations also have increased during that period and are frequently encountered in areas of human habitation. Increased human development, combined with increasing cougar populations, has led to a continual increase in conflict in rural, suburban, and urban settings.

A 2002 survey of 360 Oregon residents from six southwest Oregon counties (Jackson, Douglas, Curry, Coos, Josephine, and Klamath) identified a clear dichotomy in public opinions about cougars (Chinitz 2002). Oregonians support a robust cougar population and nearly 64% of respondents said they believe occasional contact with cougars should be accepted as part of living in the Pacific Northwest. However, nearly 75% of the same respondents strongly agreed with the statement, "No matter what the government says, I should have a right to kill a cougar that I think is a threat to people." Most survey respondents (who were almost evenly split between rural and small-city residents) expressed the belief that cougars are a sign of a healthy environment, and would be excited to see a cougar in the wild. However, a high proportion of the same respondents reported that they would feel a threat to their personal safety, and would want the animal killed if it appeared in their neighborhoods.

A similar survey of Washington residents found 84% supported predator reduction to address human safety (Duda et. al. 2002). Roughly 70% of urban Colorado residents in a 1996

study said they believe "…authorities should take steps to control the number of mountain lions coming into residential areas along the Front Range" (Zinn and Manfredo 1996).

In the 1990s, Oregon residents stated their desire to see cougar hunting managed similar to other game mammal species (deer, elk, pronghorn, bighorn sheep, mountain goat, and bear). A 1994 ballot measure (Measure 18) eliminated the public use of dogs for cougar hunting even though hunting with dogs is generally considered the most effective and selective method.

However, Measure 18 specifically maintained provisions that allow employees of county, state, and federal agencies to use dogs while acting in their official capacities. Another ballot initiative in 1996 that failed, Measure 34, also would have affected cougar management. One aspect of Measure 34 would have repealed Measure 18 and re-instituted the use of dogs for public cougar hunting.

The cougar management challenge facing Oregon wildlife managers is two-fold: (1) to continue managing and studying cougars in a way that contributes comprehensive data usable in an adaptive resource management model, and (2) to work continually on programs to better educate Oregonians about cougars. Oregonians, through participation in ballot measures and through ongoing interactions with ODFW, have shown a clear desire to be involved in cougar management. ODFW's ability to manage cougars effectively is underpinned by an obligation to develop an informed, educated citizenry to help craft management decisions.

Until 1967, cougars were legally classified as a predator in Oregon and were therefore unprotected. Viewed as a threat to the livestock industry, cougars were often killed through bounty programs (Appendix A). The estimated statewide cougar population was approximately 200 animals in 1960 (W. Aney, 1973, letter on file at ODFW, Salem). Some speculate cougars might have been extirpated from the state by 1970 without receiving game mammal status and subsequent protection by the then Oregon State Game Commission in 1967 (W.W. Aney, 1973, letter on file at ODFW, Salem).

Cougars are very difficult to observe and count due to their secretive nature and characteristic low population density. While some people believe cougars are few in numbers, having not observed one themselves, recent sightings and encounters near major urban areas has brought significant attention to these populations. Current estimates, based on population modeling and field research, indicate 6,493 cougars of all age classes inhabited Oregon in 2015. Trends in non-hunting mortalities and complaints also suggest cougar populations have increased and expanded their range.

A number of laws affect cougar management (Appendix D) and provide ODFW direction on which to base current management goals. ORS 496.004 classifies the cougar as a game mammal and gives ODFW management responsibility. ORS 496.012, the Wildlife Policy, directs ODFW to manage wildlife "...to provide the optimum recreational and aesthetic benefits for present and future generations of the citizens of this state...." ORS 498.012, the Wildlife Damage Statute, allows a landowner or lawful occupant of the land to take any cougar that is causing damage, is a public health risk, or is a nuisance without first obtaining a permit from ODFW. Hunting seasons for and removal of specific animals in conflict with humans are ways ODFW meets its statutory obligation to maintain cougar populations, address public safety and livestock damage, and provide recreational opportunities.

Oregon's first cougar management plan was adopted in 1987 to guide cougar management through 1992. An updated cougar management plan was adopted in 1993 and again in 2006. This 2017 update discusses the current status, management goals, and objectives for cougar and addresses newly identified concerns since the 2006 Plan. Where applicable, management strategies have been developed to address the new concerns.

Revision of this plan was initiated in February 2016 when the timeline was first presented to the ODFW Commission Meeting in Tigard, Oregon. Two panels of invited stakeholders representing cougar advocacy groups, hunter organizations, and landowner/producer groups provided testimony and written recommendations at the April 2016 Commission Meeting in Bandon, Oregon. Topics highlighted included identifying the impacts of recreational hunting, threats to long-term population conservation, evaluation of the use and impact of target areas, cougar impacts on game mammals and livestock, and addressing cougar damage and conflict.

These same stakeholders were contacted again in September 2016 for input and provided greater emphasis and insight into the information they presented at the April Commission meeting. Some stakeholders reemphasized recommendations to eliminate target areas and incorporate new research findings and emphasized a request for the plan to prioritize additional research projects and to use scientific findings to evaluate removing cougars to increase hunting opportunities. Throughout that time, informal and impromptu communications occurred with other sporting groups, state agencies, landowner groups, wildlife researchers, and other interested parties.

An update on public engagement and a revised timeline were presented at the October 2016 Commission Meeting in La Grande, Oregon. Public testimony was also taken at that time. Writing, editing, and data summaries and analyses for the plan began shortly thereafter.

ODFW staff attended the Western Association of Fish and Wildlife Agencies Mt. Lion Workshop in May 2017. Research findings and other information presented at the workshop aided in identifying any missing plan components and was incorporated into the plan.

A draft plan was shared with the public a few weeks prior the August 2017 Commission Meeting in Salem, Oregon. At that meeting, an informational presentation on the draft plan was provided, public testimony was received, and Commission discussion with staff occurred. Following that meeting, the draft was updated to address topics addressed by the Commission and stakeholders and was sent to cougar researchers and managers in the western United States for comment. Received comments were reviewed and suggestions were incorporated into the draft plan.

A few weeks prior to the 2017 October Commission meeting in Prineville, Oregon, a final draft was shared with the public. At that meeting, a presentation on the draft plan was provided and public testimony received. The updated plan was adopted at that time.

CHAPTER II: INFORMATION ON OREGON COUGARS

History and Range

Historically, cougars had the broadest distribution of any mammal in the Western Hemisphere with a range that included most of North America, all of Central America, and most of South America (Nowak 1999b) with as many as 32 recognized subspecies (Culver et al. 2000). Twelve to 15 subspecies have been recognized as occurring in North America (Young and Goldman 1946, Verts and Carroway 1998, Culver et al. 2000, Logan and Sweanor 2000). According to Verts and Carroway (1998), three of the fifteen subspecies occur in Oregon. However, due to extensive habitat connectivity, gene flow, and persistent populations within and around Oregon, cougars are appropriately managed at the species level as opposed to the subspecies level.

In Oregon's early history, cougars were characterized as abundant or common throughout most of the forested parts of the state (Bailey 1936). Journals also report that cougars were present in the mountainous portions of southeast Oregon such as Steens Mountain (Bailey 1936), although they likely occurred at much lower densities. Settlement, and burgeoning timber and agricultural industries created conflicts between human interests and cougars. As a result, bounties were placed on cougars as early as 1843; annual bounties of 200 or more cougars were not uncommon (Appendix A). Bounties and unregulated take caused cougar numbers to decline markedly from historic levels by the 1930s; numbers continued to decrease through the late 1960s. Only 27 cougars were bountied in the final bounty year (1961; *see* Appendix A for full history of cougar management in Oregon) and all sources of information indicate populations have been rapidly growing ever since (*see* Population Modeling and Trends).

Cougars are currently distributed throughout the state of Oregon including the portions of the Willamette Valley and High Desert of southeastern Oregon (Figure 1). However, their density varies considerably across the landscape, even within geographic areas of relatively similar habitat. Variability in population density likely reflects the local distribution of their primary prey (Pierce et al. 2000) and a land tenure system of territoriality and temporal avoidance (Seidensticker et al. 1973, Elbroch et al. 2015).

For management purposes, Oregon is divided into 6 cougar management zones that were delineated to include similar habitats, human demographics, land use patterns, prey base, and cougar density (Figure 2). The six cougar zones average 16,195 mi^2 (range 8,465 mi^2 in Zone D to 28,003 mi^2 Zone F) and consist of multiple Wildlife Management Units (WMU) (Figure 2).

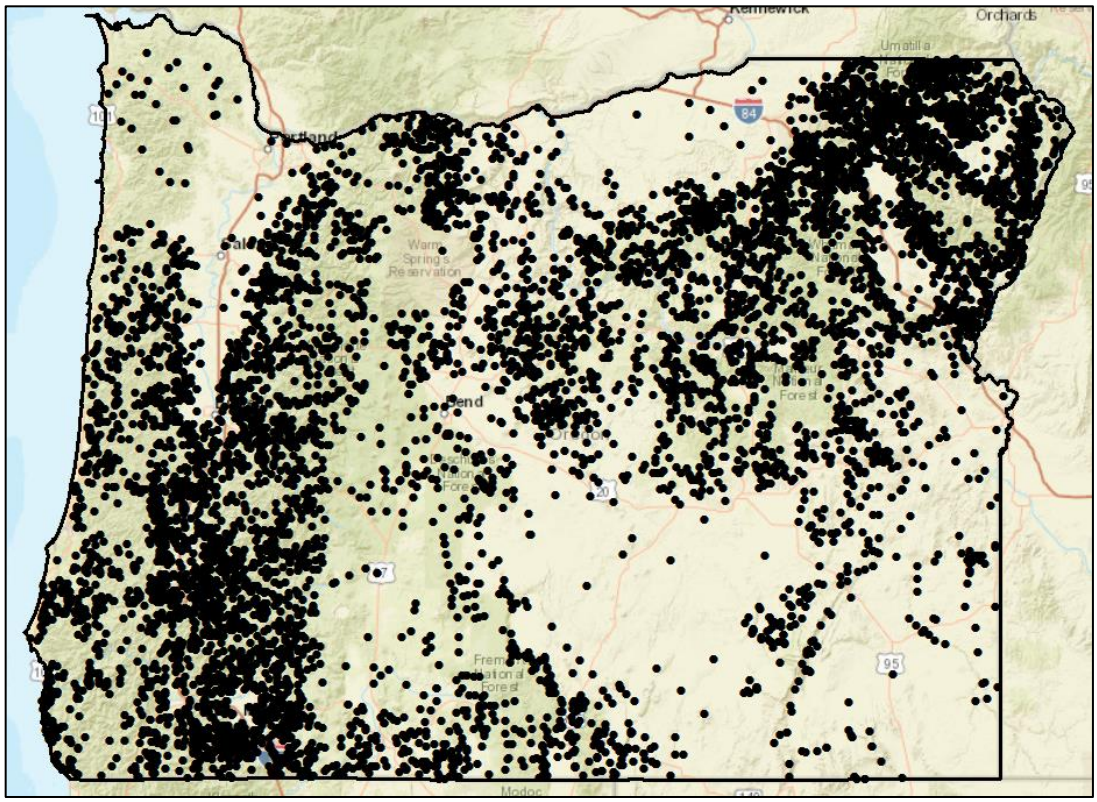


Figure 1. Locations of all known cougar mortalities in Oregon 1987-2015.

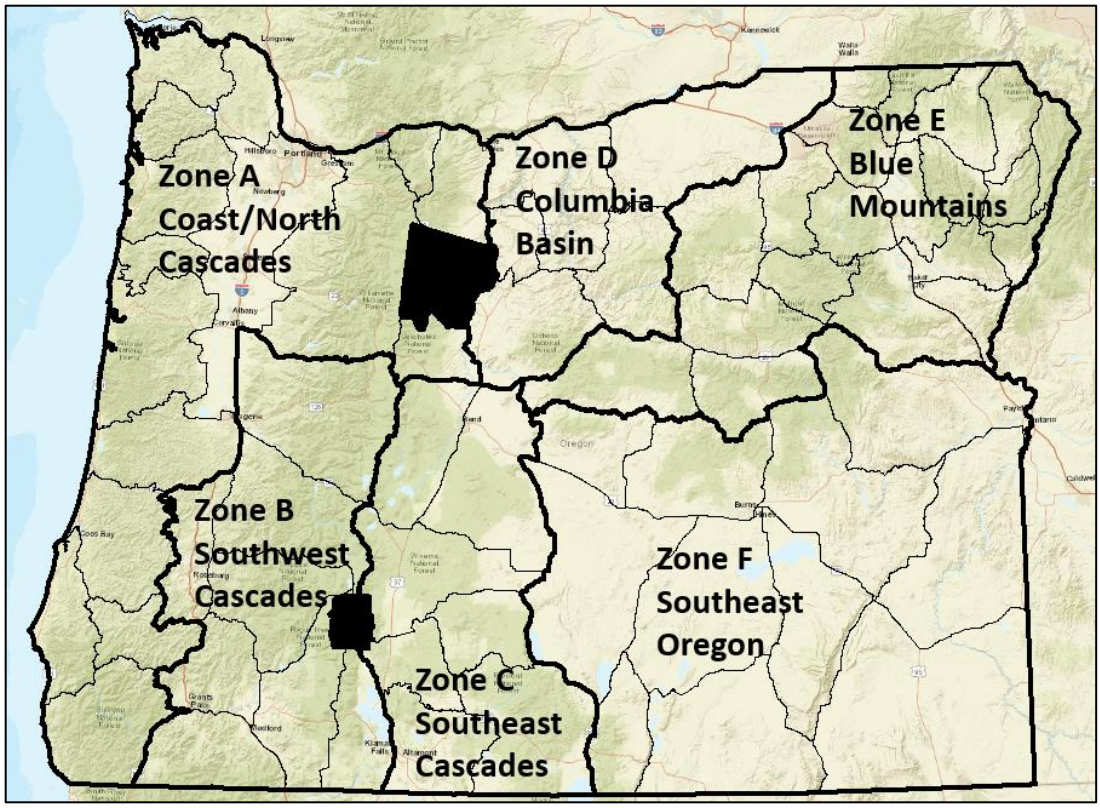


Figure 2. Location and name of the six Oregon cougar management zones. Wildlife Management Units (WMUs) delineated by thinner black lines.

Reproduction and Productivity

Factors affecting cougar productivity (number of kittens born each year) include age at first breeding, birth interval, litter size, sex ratio, and longevity. Seidensticker et al. (1973) believed young females usually breed only after establishing a home range. Females have been documented as breeding for the first time at 17 to 24 months of age (Logan and Sweanor 2001). Based on 1,864 female cougar reproductive tracts examined by ODFW from 1987 – 2016, 40% of age class 2 (n = 690), 75% of age class 3 (n = 359), 86% of age class 4 (n = 246), 86% of age class 5 (n = 178), 91% of age class 6 (n = 127), and 94% of all females age 7 and older (n = 264) had reproduced (Oregon Department of Fish and Wildlife, unpublished data).

Cougars can reproduce throughout the year (Ross and Jalkotzy 1992, Logan and Sweanor 2001) however a preponderance of births have been documented between the warmer months of May through October (Cougar Management Guidelines Working Group 2005, Laundré and Hernandez 2007, Jansen and Jenks 2012, Oregon Department of Fish and Wildlife, unpublished data). Gestation lengths are approximately 90 days (Logan and Sweanor 2001). After first breeding, females normally breed soon after loss of kittens or dispersal of their litter (Lindzey 1987) causing birth intervals to vary. Birth intervals vary but range between 12 and 24 months (Hornocker 1970, Lindzey 1987, Lindzey et al. 1994, Robinette et al. 1961).

Female cougars may have one to six kittens per litter, but average two to three kittens per litter (Eaton and Velander 1977, Ashman et al. 1983, Logan et al. 1986). Based on the examination of 225 reproductive tracts from pregnant female cougar during the period 1987 – 2016, mean litter size for Oregon was 2.74 kittens per litter (Oregon Department of Fish and Wildlife, unpublished data). This value was consistent with 2.78 kittens/litter based on placental scars (n = 858) and 2.80 kittens/litter based on corpora lutea (n = 434). Sex ratio of kittens at birth is normally equal (Johnson and Couch 1954, Logan et al. 1986, Tanner 1975, Logan and Sweanor 2001). Due to a relatively high reproductive potential, cougars can quickly replace individuals lost from the population.

Dispersal and Connectivity

Dispersal is an important adaptive mechanism for cougars for several reasons: it helps local populations avoid extreme inbreeding, enhances outbreeding, minimizes potential competition for food and mates, increases the likelihood of recolonizing unoccupied habitats, and minimizes the risk of extinction in isolated populations (Logan and Sweanor 2000). Cougar offspring become independent of the female between 9–21 months of age (Beier 1995, Logan et al. 1996, Logan and Sweanor 2000, Sweanor et al. 2000) with littermates usually independent within 0–1.5 months of each other (Logan et al. 1996). Male offspring typically disperse at higher rates than females (Logan and Sweanor 2000, Sweanor et al. 2000) and disperse farther than females with reported mean dispersal distances of 2.2–76.6 km (1.36–47.6 mi) for females and 19.0–139.8 km (11.8-86.87 mi) for males (Beier 1995, Logan and Sweanor 2000, Sweanor et al. 2000).

Dispersal direction appears random and large expanses of unsuitable habitat can be crossed (Logan and Sweanor 2000). However, favorable habitats are used to link dispersal movements (Logan and Sweanor 2000) and established habitat corridors may be important for isolated populations (Beier 1995). Understanding the connectivity between populations is an important component in the management of cougars, particularly when the species is managed in a metapopulation framework where sink populations are dependent on source populations. Recent exercises in identifying cougar habitat statewide (Appendix F) have suggested high continuity

between cougar habitats. Assuming habitat models and maps are realistic, habitat connectivity appears to be a major factor to cougar populations in southeastern Oregon where cougar habitat is scattered and less abundant. In that area, connectivity is facilitated by riparian and montane habitats. Because of these dispersal patterns, most males recruited into a population are immigrants, and immigration may constitute as much as 50% of the recruitment into a population (Logan and Sweanor 2000).

Data from the southern Cascade Mountains of Oregon (Oregon Department of Fish and Wildlife, unpublished data) documented dispersal movements of 29 radio-collared cougars and found the mean movement distance from the natal home range center to the farthest documented location was greater for males (82 km [51 mi]) than females (36 km [22 mi]). Dispersal direction was random. Twenty-six dispersing young survived to establish an independent home range (IHR). Dispersing females required an average of 55 days to establish an IHR compared to 103 days for males. No males established an IHR adjacent to their natal home range while 78% of the female IHRs were adjacent to or overlapped natal home ranges.

Landscape Genetics

Cougar dispersal characteristics, especially for males, are often sufficient to maintain high gene flow rates, even across interstate highway corridors (Sinclair et al. 2001) and large expanses of inhospitable habitat (Anderson et al. 2004). However, large urban areas may represent a barrier to gene flow among populations (Ernest et al. 2003, Sinclair et al. 2001).

Using 383 tissue samples collected throughout Oregon in 2001-2007, Musial (2009) observed two genetically clustered subspecies, generally divided between eastern and western Oregon (Figure 3). The separation of these two groups, generally occurring along the eastern foothills of the Cascades, is attributed to limited forest cover and relatively flat landscape. Genetic mixing between these groups in Oregon is common in the area of separation (i.e. where both groups meet). Warren et al. (2016) conducted a similar analysis in Washington and identified one subspecies occurring in the Cascades and another in the Blue Mountains. Studies identifying cougar subpopulations in the other surrounding states of California (Ernest et al. 2003), Nevada (Andreasen et al. 2012), and Idaho (Balkenhol et al. 2014) appear to align (or at least not refute) Musial's subpopulation delineations.

In the Oregon study, no distinct anthropogenic barriers were apparent, but Interstate 5 and high human densities in western Oregon may be affecting cougar dispersal due to an observed increase in genetic divergence between cougars across those areas (p 52-53, Musial 2009). These anthropogenic factors are not prohibiting cougar dispersal and gene flow at a population level, thus a source-sink metapopulation remains intact and threats of inbreeding are reduced. Cougars are not managed at the subspecies level in Oregon, however maintaining dispersal and gene flow across Interstate 5 and between the two subpopulations, especially around areas of human development (e.g. Redmond and Bend), may be a management priority should information suggest zone populations are in danger of falling below objectives.

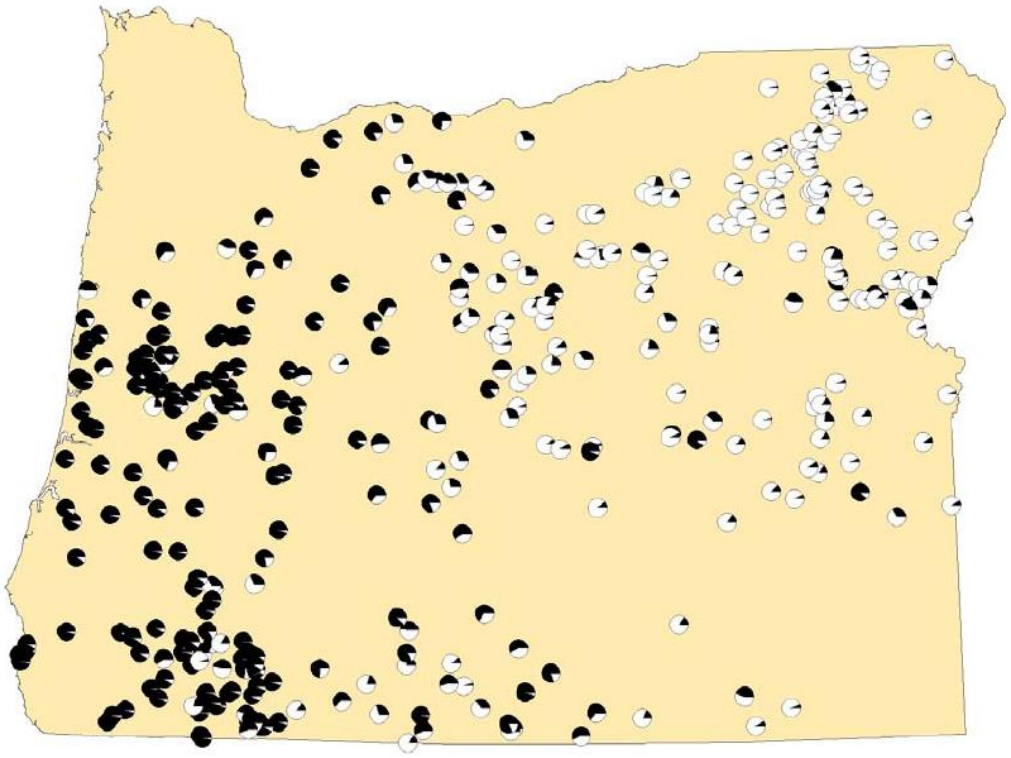


Figure 3. Distribution of genomic ancestry coefficients in Oregon as based on analyses of 11 microsatellite loci (K=2). Pie charts show relative contribution of each cluster to the genomic content of each individual (N=383). There are two clear genetic clusters in Oregon (black and white clusters), but genetic mixing (pie charts of black and white) suggests regular gene flow between the two clusters. Figure from Musial (2009).

Density

Cougar density is influenced by a combination of prey distribution and availability (Pierce et al. 2000) and tolerance for other cougars (Seidensticker et al. 1973). Generally, prey availability is related to quantity and quality of available habitat for the species. Due to cougars' territoriality and dependence on prey availability, cougars typically do not reach density levels observed in many other wildlife species.

Varieties of techniques have been used to estimate cougar densities throughout their range. The most rigorous methods rely on intensive radio telemetry and capture-recapture (Logan and Sweanor 2000). Further, how density is reported varies considerably, ranging from simple calculations using all ages of cougars for an area to reporting only resident adults (i.e. adult males, juvenile and adult females) contributing to the population. Reported cougar densities are highly variable across their range (Table 1) and caution must be used when comparing values as study areas and techniques can vary greatly (Quigley and Hornocker 2010). Cougar research conducted in Oregon has found some of the highest cougar densities in western North American (Table 1). The intensity of these efforts, use of multiple proven techniques, and similarity to recent studies lends high confidence to Oregon cougar density estimates.

Through numerous cougar research projects (*see* Oregon Cougar Research section), a number of density estimates have been calculated in areas of northeast and southwest Oregon. Most of these estimates come from intensive telemetry studies in combination with harvest monitoring. In northeast Oregon, study results indicate densities (all age classes) of 3.9/100 km^2 (10.0/100 mi^2) in the Catherine Creek Unit of the Blue Mountains (Mark G. Henjum, 1995, Oregon Department of Fish and Wildlife, personal communication). Yearling and adult cougar densities were estimated between 2.3 – 4.6/100 km^2 (6.0 – 11.9 animals/100 mi^2) in the Wenaha and Sled Springs study sites in NE Oregon (Findholt et al. *In Review).* In southwest Oregon, cougar density (all ages) was 2.7/100

km^2 (7/100 mi^2) in the Jackson Creek study (Oregon Department of Fish and Wildlife, unpublished data) and densities of yearling and adult cougars ranged from 0.9 – 2.2/100 km^2 (2.3 – 5.7/100mi^2) in the Steamboat study and 1.0 – 1.4/100 km^2 (2.6 – 3.6/100mi^2) in the Toketee study (Johnson et al. *In Review*).

Table 1. Cougar density as reported throughout the species western geographic range.

	Density (#/100 mi^2)		Density (#/100 km^2)		
State or Province	Resident Adults	Total Cougars	Resident Adults	Total Cougars	Citation
Alberta, Canada	3.9 -5.7	7 - 12.2	1.5 - 2.2	2.7 - 4.7	Ross and Jalkotzy 1992
British Columbia, Canada	2.3-2.8	9-9.6	0.9-1.1	3.5-3.7	Spreadbury 1996
California, USA		23.8		9.2	Sitton 1972
California, USA		13.5		5.2	Neal et al. 1987
California, USA		8.5 - 10		3.3 -3.9	Hopkins 1989
Colorado, USA		2.8		1.1	Anderson et al. 1992
Colorado, USA	0.8 - 3.7			0.3 - 1.3	Lewis et al. 2015
Idaho, USA	2.6 - 4.4	4.4 - 9.1	1.0 - 1.7	1.7 - 3.5	Seidensticker et al. 1973
Montana, USA		9.6 - 17.4		3.7 - 6.7	Russell et al. 2012
Montana, USA	3.1 - 6.0	5.7 - 10.4	1.2 - 2.3	2.2 - 4.0	Robinson et al. 2014
Montana, USA		11.7 - 13.6		4.5 - 5.2	Proffitt et al. 2015
Nevada, USA		2.6 - 4.1		1.0 - 1.6	Ashman et al. 1983
New Mexico, USA	2.1 - 5.4	4.4 - 11	0.8 - 2.1	1.7 - 4.3	Logan et al. 1996
Oregon, Catherine Creek 1995		10		3.9	Henjum 1995 per. comm.
Oregon, Jackson Creek 2001	4.4	7	1.7	2.7	ODFW unpublished data
Oregon, Steamboat 2002-04	2.3 - 5.7		0.9 - 2.2		Johnson et al. (In Review)
Oregon, Toketee 2002-04	2.6 - 3.6		1.0 - 1.4		Johnson et al. (In Review)
Oregon, Sled Springs 2002-07	6.5 - 11.9		2.5 - 4.6		Findholt et al. (In Review)
Oregon, Wenaha 2002-07	6.0 - 10.6		2.3 - 4.1		Findholt et al. (In Review)
Oregon, Mt. Emily 2011	5.7 - 14.0	8.3 - 19.9	2.2 - 5.4	3.2 - 7.7	Davidson et al. 2014
Oregon, Mt. Emily 2012	5.2 - 16.1	7.3 - 22.8	2.0 - 6.2	2.8 - 8.8	ODFW Unpublished Report
Texas, USA		17.3		6.7	Parsons 1976
Utah, USA	0.8 - 1.6	1.6 - 3.6	0.3 - 0.6	0.6 - 1.4	Lindzey et al. 1994
Utah, USA	3.1 - 8.3		1.2 - 3.2		Choate et al. 2006
Washington, USA	1.0 - 1.8	2.3 - 3.9	0.4 - 0.7	0.9 - 1.5	Lambert et al. 2006
Washington, USA	6.0 - 6.7	13.0	2.3 - 2.6	5.0	Robinson et al. 2008
Washington, USA	4.1 - 4.8	8.5 - 12.9	1.6 - 1.9	3.3 - 5.0	Cooley et al. 2009[a,b]
Washington, USA	4.9 - 5.7	5.4 - 6.7	1.9 - 2.2	2.1 - 2.6	Beausoleil et al. 2016
Wyoming, USA	3.6 - 3.9	9.1 - 12	1.4 - 1.5	3.5 - 4.6	Logan et al. 1986
Wyoming, USA	6.2 - 8.8		2.4 - 3.4		Anderson and Lindzey 2005

Other proven, yet less intensive techniques have also been used to estimate cougar densities in Oregon. Davidson et al. (2014) estimated cougar densities in the Mt. Emily Unit of the Blue Mountains using scat dogs. For this technique, trained dogs are used to locate and collect cougar scat and this is repeated multiple times in that area. DNA is then extracted from these scats to identify

individual cougars, resulting in a spatial capture-recapture analysis. This study estimated sub-adult and adult cougar densities at 2.2 – 5.4/100 km^2 (7.5 - 9.1/100 mi^2) and total cougar densities at 4.2 - 4.8/100 km^2 (10.9 - 12.4/100 mi^2). At the time of writing, one effort is underway in Douglas County in southwest Oregon to estimate cougar densities using tissue-collecting darts (i.e. biopsy darts). Similar to the scat dog technique, that DNA-based spatial capture-recapture analysis uses tissues samples collected from treed cougars to model cougar density (Beausoleil et al. 2016). Both techniques may provide less expensive and short duration techniques for reliably estimate cougar densities.

Cougar Interactions with Ungulates

Oregon has native populations of elk, mule deer, white-tailed deer, black-tailed deer, pronghorn, bighorn sheep, mountain goats, and moose. These ungulates have high social, biological, economic, and recreational value in Oregon, and an important food source for native carnivores. Revenue generated from hunting is important to rural communities (Martin and Gum 1978, Fried et al. 1995, Sarker and Surry 1998), and license and tag sales provide funding for wildlife and conservation activities implemented by ODFW (Geist et al. 2001). Consequently, managers are presented the challenge of maintaining ungulate populations that are capable of sustaining carnivore populations and recreational hunting opportunities for the public, while minimizing agricultural damage.

In addition to their recreational and economic importance, ungulates also play an important role in shaping and structuring ecological communities. Large herbivores consume large amounts of plant biomass that can influence vegetation and ecosystem structure (Hobbs 1996, Augustine and McNaughton 1998, Weisberg and Bugmann 2003, Wisdom et al. 2006). Furthermore, large herbivores are important for conservation of sustainable carnivore populations (Wolf and Ripple 2016). In some situations, large carnivores can influence herbivore population abundance and behavior, which may affect lower trophic levels and ecosystem structure (Ripple and Beschta 2004, Berger et al. 2008, Ripple et al. 2010, Estes et al. 2011, Newsome and Ripple 2014, Ripple et al. 2015, Wilmers and Schmitz 2016, Winnie Jr and Creel 2016).

There is a large body of literature to suggest a complex suite of abiotic, bottom-up, and top-down forces including hunter harvest, predation, primary productivity, and climatic conditions may be limiting or regulating factors of ungulate population dynamics (Crête 1999, Melis et al. 2009, Griffin et al. 2011, Brodie et al. 2013, Johnson et al. 2013). In some instances, non-predation related mechanisms, such as high levels of harvest by humans, extreme summer or winter weather, or habitat changes may be the ultimate driver of ungulate population dynamics (Vucetich et al. 2005, White and Garrott 2005, Wright et al. 2006, Middleton 2012, Brodie et al. 2013, Middleton et al. 2013). These factors may work independently or synergistically to effect ungulate populations and the relative magnitude of each effect may differ depending on local conditions. Consequently, the relative effects of cougar predation in Oregon may be situation dependent and influenced by additional localized or regional factors. Despite Oregon's unique climate and assemblage of predators and prey, there is a large body of literature upon which the potential effects of cougars on native ungulate populations may be assessed. Although cougars have a wide diet that extends beyond ungulates, ungulates are the primary driver for cougar populations. This section will provide a summary of potential effects of cougars on ungulate populations in Oregon.

Deer

Predation effects on deer appear to be largely influenced by the relation of deer to ecological carrying capacity (Ballard et al. 2001). Populations near carrying capacity, while heavily preyed

upon, does not respond well to predator control (Ballard et al. 2001), and predation mortality is largely compensatory. When deer populations are below carrying capacity, predation has the potential to be additive and predators will have a larger effect on deer populations. In general, it is broadly thought that deer populations tend to be regulated by factors other than predation (Ballard et al. 2001, Forrester and Wittmer 2013, Bergman et al. 2015b). Consequently, it is not expected that cougar predation alone will have a strong, direct effect on Oregon's deer populations.

Mule Deer and Black-tailed Deer

Throughout their range in western North America, mule deer or black-tailed deer are the primary prey of cougars (Iriarte et al. 1990). Further, monitoring of mule deer survival indicates that cougars are usually a large source of mortality for mule deer in Oregon (Mulligan 2015, Walsh 2016; ODFW, unpublished data) and elsewhere (Unsworth et al. 1999, Bishop et al. 2005, Hurley et al. 2011). In Oregon, studies of cause-specific mortality of mule deer indicate that cougars are a large mortality source for deer. In south-central Oregon, cougars were the most common source of predation mortality of adult deer (Mulligan 2015). At the Starkey Experimental Forest and Range from 2011-present, cougars were secondary to coyotes for the majority of mortality of juvenile mule deer (Walsh 2016; ODFW, unpublished data). In western Oregon, cougars were the primary source of mortality for adult black-tailed deer (ODFW, unpublished data). Consequently, it is widely thought that cougars may have negative effects on mule deer populations. While cougars are clearly an important source of mortality for deer, the degree to which predation is additive versus compensatory will determine the effects of predation on mule deer. In general, it is thought that most predation on deer is compensatory (Ballard et al. 2001).

The age class and sex of mule deer killed by cougars varies throughout the year, with fawns being most frequently killed during summer and early fall, adults most commonly killed during winter, and males most frequently killed immediately following the rut when they are in reduced nutritional condition (Knopff et al. 2010). In Oregon, a similar pattern of seasonal predation was observed in the Blue Mountains; however, cougar predation on fawns was selective during winter (Clark et al. 2014). Selective predation has the potential to be additive mortality, but further research is needed to clarify this relationship in deer, particularly during winter when deer are nutritionally stressed (Bishop et al. 2009). In general, research has indicated that predation on deer is largely compensatory mortality and predation has minimal effects on deer populations (Ballard et al. 2001); however, when deer are below ecological carrying capacity, predation may be additive (McNay and Voller 1995, Hurley et al. 2011). Research conducted on deer indicates that environmental conditions and nutrition, not predation, are typically the primary drivers of mule deer survival, recruitment, and population growth (Ballard et al. 2001, Forrester and Wittmer 2013, Bergman et al. 2015a, Bergman et al. 2015b).

Some evidence exists that cougars may have strong limiting effects on mule deer or black-tailed deer populations. In Washington, increasing populations of white-tailed deer (Robinson et al. 2002, Cooley et al. 2008) have potentially contributed to negative effects on mule deer. Cougars in this area preyed upon white-tailed deer and mule deer during winter at low elevations and then followed mule deer to summer ranges where predation pressure on mule deer increased as predation on mule deer was selective during summer (Cooley et al. 2008). This led to the conclusion that increasing white-tailed deer populations were supporting a larger cougar population that selectively preyed upon and negatively affected mule deer populations. This situation was also suggested in British Columbia, where cougars increased in response to increasing white-tailed deer populations and cougar predation on mule deer was selective (Robinson et al. 2002). These conditions combined

to contribute to population declines of mule deer. This situation has the potential to occur in many areas in northeast Oregon, where mule deer and white-tailed deer are sympatric and white-tailed deer are increasing in numbers and distribution (ODFW, unpublished data). If this scenario observed in Washington and British Columbia were to arise, reduction of white-tailed deer numbers or cougar numbers may be required to benefit declining mule deer.

Through a manipulative experiment that reduced both coyote and cougar numbers to assess effects of predator removal on mule deer populations, it was found that mule deer survival and recruitment increased following cougar removals (Hurley et al. 2011). This suggested cougar predation was at least partially additive so long as the deer population was below ecological carrying capacity. Despite increases in survival and recruitment, mule deer populations had a weak positive response to cougar reductions (Hurley et al. 2011). However, this effect was small and severity of winter conditions ultimately appeared to be a stronger driver of mule deer population dynamics. In another manipulative study, cougars were relocated and response of mule deer was monitored (Logan and Sweanor 2001). In both the area where cougar numbers were reduced and the control area, mule deer numbers increased until the onset of drought conditions. During the drought, cougar predation appeared to contribute to the population decline, but predation appeared to be largely compensatory because the drought reduced ecological carrying capacity. These manipulative studies supports conclusions reached in reviews of factors influencing deer populations that suggest deer are primarily limited by nutritional and environmental conditions and predation is largely compensatory form of mortality that has minimal influence on deer populations (Ballard et al. 2001, Forrester and Wittmer 2013, Bergman et al. 2015a, Bergman et al. 2015b).

Cumulatively, research suggests cougar predation is a potential factor limiting mule deer populations, but is ultimately environmental conditions and nutrition is likely the drivers of mule deer populations. Despite this, there is evidence that under certain scenarios where predation is additive (McNay and Voller 1995, Hurley et al. 2011) or in cases where empirical evidence suggests cougars are the cause of deer population declines, deer populations may benefit from reduced cougar populations. Mule deer populations that are currently below ecological carrying capacity are likely to receive the greatest benefit from reduced cougar populations because predation may be additive in these scenarios (McNay and Voller 1995, Hurley et al. 2011); however, where deer are near environmental carrying capacity will receive little benefit from cougar population reductions (Ballard et al. 2001, Bergman et al. 2015b). Given the strong effect of environmental conditions (e.g., drought, severe winter) on mule deer populations (Forrester and Wittmer 2013), it may also be beneficial to reduce predation effects following severe environmental conditions that reduce mule deer population size. This will alleviate predation pressure and potentially allow mule deer populations to recover to management objectives or ecological carrying capacity faster than would be expected.

Elk

Elk are usually a secondary prey item in diets of cougars (Ruth and Murphy 2010b). The large body size of adult elk reduces their risk of predation by cougars and cougar predation is typically focused on the juvenile age class. Historically, cougar predation has not been implicated as a strong limiting factor on elk populations (Ruth and Murphy 2010b). Predation by cougars did not prevent elk populations from increasing in Idaho (Hornocker 1970) or Utah (Lindzey et al. 1994). Cougars are known to kill adult elk, but predation by cougars on elk is typically focused on juveniles (Knopff et al. 2010, Clark et al. 2014). Several studies have investigated cause-specific mortality for elk and have usually found minimal levels of predation caused by cougars. In northern Yellowstone,

predation on adult elk (Evans et al. 2006) and calves (Singer et al. 1997, Smith and Anderson 1998) was minimal. Elk calf survival studies in Idaho indicated bears were the primary source of calf mortality and cougar predation was limited (White et al. 2010). Meta-analyses of adult (Brodie et al. 2013) and juvenile (Griffin et al. 2011) indicated cougar predation was minimal in most elk populations in the western United States compared to other predators and sources of mortality.

More recently, evidence suggests cougars may have strong limiting effects on elk populations. In Oregon, Clark et al. (2014) found that cougar diets were dominated by deer, but cougar predation on juvenile elk was strongly selective during summer. Further, cougars were the single largest source of juvenile elk mortality in Oregon, and juvenile survival declined as cougar densities increased (Rearden 2005, Johnson et al. In Review). This pattern is not unique to Oregon, as cougars were also the primary source of mortality of juvenile elk in southwest Washington (Myers et al. 1999). A similar pattern was recently observed in the Bitterroot Mountains in Montana, where high density cougar populations (Russell et al. 2012) contributed to cougar predation being the primary source of mortality for juvenile elk (Backus 2014). This suggests that cougars may negatively affect recruitment of juvenile elk into the adult population. Using herd composition data to assess recruitment in Oregon, it was observed that recruitment declined as cougar densities increased (Johnson et al. 2013). In most elk populations, adult survival is critical for population growth, but adult survival tends to be high and relatively constant (Raithel et al. 2007). In contrast, juvenile survival is highly variable and this variation explains most variation in population growth rates of elk (Raithel et al. 2007, Harris et al. 2008). Clark (2014) simulated the effects of variable cougar density on population growth rates of elk and found that variation in cougar densities explained the majority of variation in population growth rates of elk in Oregon. Further, it was found that at high cougar densities (>4.0 cougars/100 km^2) that are occasionally observed in Oregon, cougars could contribute to population declines of elk. This suggests that reductions in cougar numbers may be required to benefit declining elk populations. Through computer simulations, it was found that reducing cougar densities would in fact have a positive benefit to elk populations and have minimal effects on viability of cougar populations (Clark 2014). However, benefits of cougar reductions were short-lived as cougar populations quickly recovered at a localized scale and predation pressure on elk was increased to pre-treatment levels. This may suggest that ongoing cougar population reductions or maintenance of reduced cougar populations could be required in some areas to benefit elk populations.

Bighorn Sheep

Bighorn sheep occur in small groups with naturally fragmented distributions and somewhat isolated populations. These conditions can make bighorn sheep populations vulnerable to effects of predation. Typically, cougar predation on bighorn sheep is sporadic and usually consists of a few individual cougars that have specialized on bighorn sheep (Ross et al. 1997, Logan and Sweanor 2001). Since the 1990's cougar predation has increasingly been documented as a strong limiting factor on bighorn sheep populations (Kamler et al. 2002, Ruth and Murphy 2010b). Cougar predation on bighorn sheep is likely to have the greatest effect in areas where bighorn sheep and mule deer are sympatric and increased cougar predation is typically associated with declines in mule deer populations (Hayes et al. 2000, Schaefer et al. 2000), which are the primary prey of cougars where they occur (Iriarte et al. 1990). Cougar densities are low in areas where mule deer densities are low, therefore bighorn sheep populations tend to experience little cougar predation in these situations (Andrew 1994, Schaefer et al. 2000). Following mule deer population declines, the potential exists for cougars to negatively affect bighorn sheep through increased predation. In these situations, removal of cougars from the area may benefit bighorn sheep populations.

Cougar predation has apparently be the causal mechanism behind failures of some bighorn sheep translocation or reestablishment programs (Kamler et al. 2002, McKinney et al. 2006a). These situations may occur in areas where alternate prey, typically mule deer, are available and the deer populations decline, causing cougars to intensify predation on bighorn sheep (Hayes et al. 2000, Schaefer et al. 2000, Ballard et al. 2001). Experimental removal of cougars indicated cougars were a limiting factor of bighorn sheep in Arizona (McKinney et al. 2006b) and New Mexico (Logan and Sweanor 2001). Also, in both of these areas, declines in mule deer attributable to drought apparently caused cougars to increase predation on bighorn sheep and negatively affected the bighorn sheep population. In these situations, lethal control of cougars may be warranted to reduce impacts on isolated or recently established bighorn sheep populations.

Cougar predation is expected to be most variable and potentially important for bighorn sheep populations for bighorn sheep populations fewer than 200 (Ross et al. 1997) or 100 individuals (Logan and Sweanor 2001). These smaller populations have the potential for cougars to kill a large percentage of the population, generating negative effects for the populations. Some cougars are specialist predators of bighorn sheep and the effects on bighorn sheep by individual cougars may be substantial and independent of cougar density (Ruth and Murphy 2010b). Predation on bighorn sheep by individual cougars is highly variable and can vary annually (Hornocker 1970, Ross et al. 1997, Logan and Sweanor 2001) which may result in large negative effects to sheep populations in some years. In situations where cougar predation is negatively effecting bighorn sheep populations, selective removal of cougars in the range of the bighorn sheep population may alleviate these effects. For example, targeted removal of individual cougars to reduce predation was successful at reducing predation on bighorn sheep while minimizing effects to cougar populations (Ernest et al. 2002).

Mountain Goat

Mountain goats occupy relatively open, steep, alpine terrain with minimal stalking cover for cougars to kill them successfully. While cougars have been documented killing mountain goats (Knopff et al. 2010), this is a rare occurrence and it is not expected that cougars will have a large effect on mountain goat populations. Similar to bighorn sheep, mountain goats naturally occur in small, fragmented, and isolated populations. Consequently, the potential exists that a cougar specializing on mountain goats could negatively affect small, isolated populations of mountain goats. However, no evidence has been documented of cougars negatively effecting mountain goats to date.

Pronghorn

Pronghorn typically utilize flat, open grassland or sagebrush steppe habitats. Given the lack of stalking cover in these areas, it is unlikely that cougars will be successful at killing many pronghorn and as a result, pronghorn are typically not an important prey species for cougars (Byers 1997, Ruth and Murphy 2010b). The lone exception to this scenario is where pronghorn may occupy more forested and rugged terrain. Vulnerability to cougar predation increases when pronghorn utilize these areas (Ockenfels 1994, Logan and Sweanor 2001). For example, in Yellowstone National Park, ten pronghorn were killed by four female cougars in steep and rocky terrain with tree cover, with a single female cougar killing seven pronghorn (Ruth and Buotte 2007). This suggests predation on pronghorn may be a learned or specialized behavior, similar to bighorn sheep. Given the ineffectiveness of cougars hunting pronghorn and the low prevalence in cougar diets, it is unexpected that cougars will have a substantial population level effect on pronghorn in Oregon.

Moose

Oregon has a small (~100 individuals) resident population of moose located in northeast

Oregon that may be subject to predation from cougars. The large body size of moose, largely impedes cougars from preying on moose, particularly adult moose. While cougars are known to prey upon moose, they typically kill juveniles and predation on adults is rare (Ross and Jalkotzy 1996, Kunkel et al. 1999, Anderson and Lindzey 2003, Knopff et al. 2010). Cougar predation on moose appears to be largely compensatory to other sources of mortality because most juvenile moose killed by cougars had low femur fat levels (Ross and Jalkotzy 1996). Given that most predation on moose by cougars is focused on juveniles, is largely compensatory, and is rare on reproductively valuable adults that drive population growth, it is unlikely that cougars will have a substantial effect on moose populations in Oregon. However, given the small population size of moose, an individual cougar that specializes on moose, could have a population level effect, similar to those patterns observed in isolated populations of bighorn sheep.

Cougar Interactions with Other Carnivores

Interactions between carnivores can shape carnivore community structure and composition and ultimately influence the effects of carnivores on prey species. Dominant carnivores may exclude or reduce the abundance of other predators through interference competition, such as direct killing, aggressive interactions, territorial marking, as well as exploitive competition in which carnivores compete for prey or other resources (Crabtree and Sheldon 1999, Crooks and Soule 1999, O'Neill 2002, Glen and Dickman 2005, Berger and Gese 2007, Ritchie and Johnson 2009) High dietary overlap between carnivores can be detrimental for subordinate predators and may lead to malnourishment, as well as antagonistic encounters and intraguild predation as competitors pursue the same prey (Donadio and Buskirk 2006, Ruth and Murphy 2010a). These interactions are heightened as competitors converge when shared prey is scarce (Begon et al. 1996, Donadio and Buskirk 2006, Glen et al. 2007). Competition among species is most likely to occur between more closely related species, species with similar body size, and when dietary overlap between species is greater (Polis et al. 1989, Polis and Holt 1992).

Cougar-Wolf Interactions

Wolves and cougars are both obligate carnivores that focus their predation on large ungulates, which suggests a high degree of competition is likely to occur between the species. Given this potential, interactions between cougars and wolves have been widely examined, but definitive conclusions regarding interactions have yet to be made in many cases. Wolves are dominant to cougars in areas of sympatry, consequently, the recolonization of Oregon by wolves may influence cougar population size and distribution, habitat use, kill rates, and prey use, which are likely to have cascading effects on ungulate populations that will be difficult to predict. Kortello et al. (2007) found cougars avoided areas recently visited by wolves, but a gross-scale home range analysis showed a high degree of spatial overlap between the two predators. In comparison with pre- and post-wolf conditions, it was observed that cougars shifted to more rugged areas associated with the bottoms of steep river canyons (Buotte et al. 2005, Ruth et al. 2017). Cougars in Yellowstone National Park also condensed the size of their home ranges after wolves were restored, presumably to avoid interactions (Buotte et al. 2005). During winter, cougars and wolves were able to maintain distinct use of habitat, despite the fact that their home ranges converge as they seek prey that migrate to lower elevations or areas with milder conditions (Alexander et al. 2006). In Banff National Park and other areas of the Canadian Rocky Mountains, wolves consistently used gentle-sloped valley bottoms associated with high elk densities, while cougars descended from higher elevations as winter progressed and rarely accessed the valley floor, opting instead to remain on the adjacent hillsides (Alexander et al. 2006). Evaluation of wolf and cougar kill sites also provides evidence for spatial partitioning and exploitation competition between the two carnivores. In the northern range of

Yellowstone National Park, Kauffman et al. (2007) observed that in the winter, wolf hunting grounds were snow-covered, grassy areas of level terrain compared to cougars. Similarly, in the Madison Range, Montana, wolf kill sites occurred in open and gentle-sloped riparian habitat, which is more suitable for long pursuits (Atwood et al. 2007). By contrast, sites of cougar-kills were located on steeper terrain and were more structurally complex vegetation (Atwood et al. 2007). Similar topographical differences between the predators' kill sites were noted in the Salmon River Mountains, Idaho (Husseman et al. 2003). This spatial partitioning of habitat by wolves and cougars may change diets and prey use of cougars (Elbroch et al. 2015).

As the dominant predator in direct interactions due to their numerical advantage, wolves are effective in usurping cougar-killed prey. Wolves consistently scavenge cougar killed prey, but cougars rarely visit or scavenge wolf killed prey (Kunkel et al. 1999, Kortello et al. 2007). Although data are limited, similar results were observed in the Blue Mountains of Oregon (ODFW, unpublished data). Usurping of cougar kills has the potential to increase kill rates of cougars as they must make additional kills in an attempt to meet their basic energetic requirements. Increased kill rates by cougars could have important implications for prey populations, especially if cougar predation is selective on a particularly important age class of ungulate or if cougars selectively prey upon a low density ungulate population. However, cougar kill rates appear to be relatively constant across a range of prey systems (see summary in Knopff et al. 2010) and were nearly identical in areas with (Knopff et al. 2010) and without wolves (Clark et al. 2014). This likely occurs because kill rates are driven by energetic requirements of cougars (Knopff et al. 2010) and kleptoparasitism of cougar kills by wolves are relatively rare, at least in Oregon to date (ODFW, unpublished data). This suggests that cougars are likely to have similar kill rates following wolf colonization in Oregon.

Ruth (2004a) compared cougar diets before and after YNP's wolf reintroduction and revealed few differences, however this research concluded at the onset of dramatic elk declines (Yellowstone Center for Resources 2011). At the time of their study, Kunkel et al. (1999) did not note any changes in cougar prey selection after wolves recolonized and prey availability was declining in Glacier National Park (GNP); they speculated this was because there was still adequate prey biomass available for both carnivores. In contrast, interference and exploitation competition with wolves apparently altered cougars' diets in BNP (Kortello et al. 2007) and the GYE (Elbroch et al. 2015). As elk populations declined, cougars trained their diets on mule deer and bighorn sheep, while wolves continued to specialize in elk (Kortello et al. 2007). In Oregon, cougars in the Mt. Emily Wildlife Management Unit have similar diets before (Clark et al. 2014) and after (ODFW, unpublished data) wolves colonized the area, where cougar diets are dominated by deer, but cougars selectively prey on juvenile elk during summer. Cougars in northeast Oregon have a strong limiting effect on elk populations through selective predation on juvenile elk in the absence of wolves (Clark 2014) and the addition of wolves could lead to increased predation pressure on elk from two predators if cougar population size is not influenced by wolf recolonization.

Wolf-killed cougars have been documented in a number of locations. In Yellowstone National Park, Ruth (2004a) discovered that 23% of cougar mortalities were attributed to wolves. Cougars killed by wolves have also been documented in Glacier National Park (Boyd and Neale 1992, Kunkel et al. 1999, Ruth 2004b) and Banff National Park (Kortello et al. 2007). Wolves also demonstrated non-lethal aggressive behavior towards cougars. For instance, cougars have been chased and treed by wolves (Ruth 2004b, Akenson et al. 2005; ODFW, unpublished data). Observations of cougars killing wolves are less common (Ruth 2004a, Jimenez et al. 2008) and cougars typically only prevailed in interactions involving solitary wolves (Ruth and Murphy 2010a). In Oregon, wolves have killed young (<3 month) cougar kittens, but have not yet been observed to

kill adult cougars (ODFW, unpublished data). Although significant competition between wolves and cougars was noted in the northern range of Yellowstone National Park, cougar survival rates 10 years after wolf reintroduction remained unchanged from the pre-wolf time period (Ruth et al. 2011). Conversely, Kortello et al. (2007) noted depressed cougar survival rates (0.51) in Banff National Park. In all study areas where wolves co-existed with cougars, necropsies of dead cougars revealed severe malnourishment (Ruth 2004b, Akenson et al. 2005, Kortello et al. 2007). Orphaning, malnutrition, and wolf-caused mortality of cougar kittens occurred more frequently following recolonization of the northern range of Yellowstone National Park by wolves (Ruth et al. 2011). Without emigration from nearby source areas, cougar populations may decline because of direct wolf-induced mortality, starvation resulting from prey competition, and slowed reproduction and recruitment (Kunkel et al. 1999, Ruth 2004a, Kortello et al. 2007). However, the degree to which this is directly related to wolf recolonization is not well understood and further research is needed.

Cougar-Coyote Interactions

While both carnivores, cougars and coyotes are not closely related and have vastly different body sizes, and substantial differences in diet and habitat use. Consequently, it is not expected that cougars and coyotes will have a high degree of competition for resources. Further, competitive interactions between these two species have been rarely studied, and empirical evidence to define interactions is lacking. Interactions between the two species are most likely to occur at cougar kill sites where coyotes may attempt to scavenge remains of cougar killed prey. For example, in one study, coyotes visited 40% of cougar killed prey (Koehler and Hornocker 1991). In these scenarios, given their larger body size, cougars are usually dominant to coyotes and may kill coyotes while defending their prey (Ruth and Murphy 2010a). However, it was reported that coyotes would displace cougars from kills in areas coyote populations were not controlled by humans (Harrison 1990). In these situations, maternal female cougars killed more frequently due to this displacement from kill sites by coyotes (Harrison 1990).

It is not well documented if coyotes have killed cougars during direct interactions. In contrast, cougars frequently kill coyotes at kill sites while defending food resources (Koehler and Hornocker 1991, Murphy et al. 1998, Arjo and Pletscher 1999, Ruth and Murphy 2010a). This situation has been well documented in Oregon and cougars also killed coyotes away from ungulate kill sites (Clark et al. 2014). Given that cougars are dominant to coyotes at kill sites and cougars readily kill coyotes, but the reciprocal situation is not observed, it is unlikely that competition with coyotes has any population level effect on cougars. However, cougars may have some effect on coyote populations, but further study is needed to quantify this relationship.

Cougar-Black Bear Interactions

Black bears are omnivores that have diverse diets that have minimal overlap with cougars for most of the year (Ruth and Murphy 2010a), with a possible exception being during ungulate parturition periods where bears frequently kill juvenile ungulates (Ballard et al. 2001, White et al. 2010, Griffin et al. 2011, Monteith et al. 2014). Consequently, it may be expected that competition between these two species is minimal. However, black bears frequently scavenge and usurp kills from other carnivores including cougars (Knopff et al. 2010, Ruth and Murphy 2010a, Clark et al. 2014). Cougar kill sites are the most likely area that the two species will interact and cougars are subordinate to black bears at kill sites and tend to avoid direct interactions with bears (Ruth and Murphy 2010a). Bears, with enhanced olfactory senses, have been able to detect cougar kills in as little as four to six hours after the kill (Ruth and Buotte 2007). Grizzly bears and black bears have been observed to visit 15% and 33% of kills of cougars in Glacier and Yellowstone National Parks,

respectively (Murphy et al. 1998). In Oregon, it was observed that during periods of the year when black bears are active, they visit up to 40% of cougar kills in a single month (Clark 2014, Clark et al. 2014) and were documented usurping cougar killed elk calves within 24 hours of the kill during an elk calf survival study (Rearden 2005, Johnson et al. In Review). It has been speculated that black bears may increase kill rates of cougars by usurping kills (Murphy et al. 1998); however, empirical evidence for this claim is lacking. Most variation in kill rates of cougars is primarily explained by either proportion of juvenile ungulates in their diet (Knopff et al. 2010) or the size of prey (Clark et al. 2014).

Lethal encounters between black bears and cougars have been rarely documented. While cougars are known to occasionally kill black bears (Knopff 2010, Knopff et al. 2010) and has been documented in Oregon (Clark et al. 2014), this appears to be a rare occurrence (Ruth and Murphy 2010a). This is not surprising because cougars and black bears likely have minimal levels of competition given their lack of dietary overlap for most of the year and that cougars are usually subordinate to bears at kill sites (Ruth and Murphy 2010a). Consequently, it is unlikely that there are any population level effects on cougars or black bears attributable to intraguild predation between the two species.

Cougar-Bobcat Interactions

While more closely related than other carnivore species in Oregon, cougars are approximately 5-6 times larger than bobcats and have a diet dominated by large mammals compared to bobcats (Koehler and Hornocker 1991, Leopold and Kraussman 1986, Ruth and Murphy 2010a). Consequently, competition between the two species is likely minimal. This low level of dietary overlap likely minimizes competition between the two species. Unlike other carnivore species, bobcats rarely scavenge. Consequently, interactions between cougars and bobcats at kill sites will be rare. In situations where this occurs, bobcats will be subordinate to cougars given their smaller body size. Evidence to suggest cougars kill bobcats is rare, but some instances have occurred during winter when dietary overlap may be greater or when bobcats are more likely to scavenge cougar kills (Koehler and Hornocker 1991). This also holds true in Oregon, where no evidence has been documented to indicate cougars are a major source of mortality for bobcats. During periods of reduced small mammal abundance, competition between cougars and bobcats may increase, which may result in higher levels of competition and intraspecific strife (Ruth and Murphy 2010a). Given their small body size compared to cougars, it is extremely unlikely that bobcats would be a source of mortality for cougars. Consequently, competition with bobcats is unlikely to have any substantial population level effects on cougars.

Cougar Habitat

In much of Oregon, cougar habitat selection coincides with the habitat used by their primary prey, deer and elk. Forested areas, canyons or rugged mountainous terrain, and areas with high prey populations are preferred while flat, wide-open areas with no cover (grasslands, desert flats) are avoided. This is consistent with Seidensticker et al. (1973) who described optimum cougar habitat suitability in Idaho as a combination of abundant prey and suitable cover (vegetation and/or terrain) for successful stalking. Habitat management activities that negatively affect deer and elk populations likely pose the most significant limitation to cougar populations. By retaining important habitat components within intensively managed habitats, it is possible to maintain healthy populations of both cougars and their prey. Road management programs designed to limit disturbance to deer and

elk are appropriate in areas of high road densities. Forest management practices that increase forage for deer and elk will likely also benefit cougars.

ODFW's Catherine Creek Study in northeast Oregon examined cougar's use of specific habitat components. Results suggested over 90 percent of locations used by cougars during the day were characterized by rock outcroppings and/or downed logs beneath a forested canopy. Field observations also suggested cover is important for bedding sites and stalking prey. Several female den sites were also associated with these habitat components. During winter, cougars tended to avoid areas of deep snow, as did their prey species. Instead, cougars were found where prey was abundant in forested areas with multi-storied canopy cover where snow depths were less.

Habitat Distribution

Cougars are widely distributed throughout Oregon in every habitat type that offers topographic or vegetative cover. Relatively flat agricultural areas like the Willamette, Rogue, and Umpqua Valleys are used by cougars, but are limited to areas in or adjacent to riparian corridors and wooded areas. It is likely cougars use these valleys in conjunction with forested areas in the surrounding foothills. The best habitat and highest densities of cougars are found in northeast and southwest Oregon (Figure 4, Figure 5) where deer and/or elk are abundant. Those populations have likely served as population sources for other areas of the state. The habitat in northwest and southeast Oregon may not be as optimal as the northeast and southwest, but there are areas with the right combination of habitat and prey populations to sustain high numbers of cougars. The number of cougar complaints and mortalities are increasing in northwest Oregon (Figure 10, Figure 11, Chapter IV) so areas once presumed to be of lower habitat quality are in fact sufficient for establishment. Likewise, southeast Oregon (cougar Zone F) contains lower densities of cougars relative to northeast and southwest Oregon; however, the high desert habitat is consistent with cougar habitats found throughout much of the Great Basin.

Two different efforts have attempted to estimate cougar habitat statewide using Oregon cougar data or Geographic Information Systems (GIS) habitat layers. Musial (2009) reclassified and overlaid five landscape variables (human population density, major roadways, forested cover, roadless wilderness areas, and slope) to identify cougar habitats at broad spatial scales. The mapped product (Figure 4) suggests much cougar habitat occurs in northeast and western Oregon; however, the majority of southeastern Oregon is devoid of habitat. An obvious component missing from the exercise is the inclusion of some measurement of or surrogate for cougar prey.

Another effort consisted of ODFW using the locations of hunter-harvested cougars from 1995-2016 to create a habitat model (Resource Selection Probability Function) and map (Appendix F). Habitat variables included a mix of topographic, land cover, ungulate distribution, and land ownership map layers. The mapped product suggests large, contiguous areas of cougar habitat in western and northeastern Oregon with noticeable gaps occurring in large residential areas. Although created at a statewide scale, the model identifies numerous corridors and blocks of cougar habitat within the high desert region of southeastern Oregon.

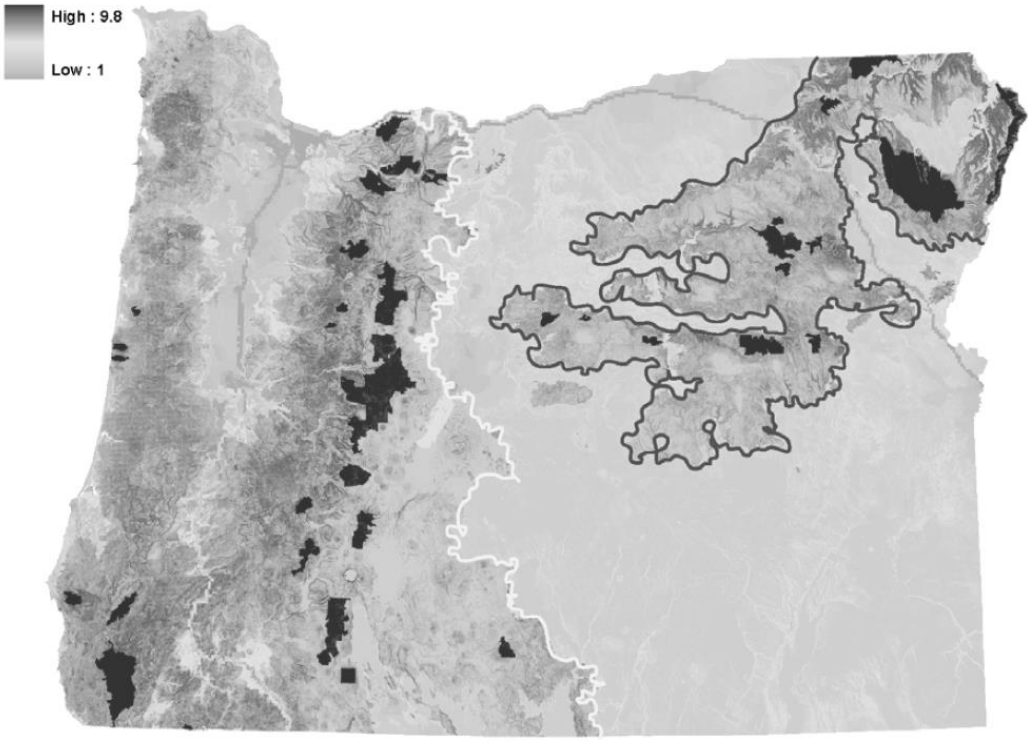


Figure 4. Distribution of suitable cougar habitat in Oregon as identified by Musial (2009). Habitat variables included human density, major roadways, forested cover, wilderness areas, and slope. Darker areas designate more suitable cougar habitats whereas lighter areas are less suitable habitats. Figure from Musial (2009).

Cougars and Urban Landscapes

Cougars currently occupy much of the cougar habitat in the state, but cougars are expanding into lower quality habitats such as urban areas of human habitation. At the same time, urban areas are expanding due to human development and commonly occur in cougar habitats. Urban cougar habitats primarily consist of suburban and exurban areas. Suburban environments occur on the edge of a city or town while exurban environments are more widely spaced residential areas that often contain many natural features. Cougars have proven to be highly adaptable to human disturbance. The increasing number of complaints ODFW receives about cougars in populated and developed areas is a testament to this adaptability. Assuming adequate cover for movement and dispersal, there is no reason to doubt that cougars are capable of utilizing urban habitats in Oregon.

Numerous research projects have occurred in recent years to investigate cougars in urban environments. Most have demonstrated that cougars of all sexes and age classes (not just young males) are capable of utilizing urban habitats (Beier et al. 2010, Burdett et al. 2010, Kertson et al. 2013, Moss et al. 2016). Cougars in urban environments prey on abundant synanthropic wildlife and domestic animals, thereby having a more diverse diet than cougars in more rural/wildland areas that more heavily rely on large-bodied native prey (Beier and Barrett 1993, Blecha 2015, Moss et al. 2016). Cougar use of habitats and movements in urban settings do not substantially differ from rural/wildland settings, however the permeability of development due to housing density and roads is a significant factor in influencing movement (Orlando 2008, Beier et al. 2010, Burdett et al. 2010, Kertson et al. 2011, Riley et al. 2014 Lewis et al. 2015, Moss et al. 2016).

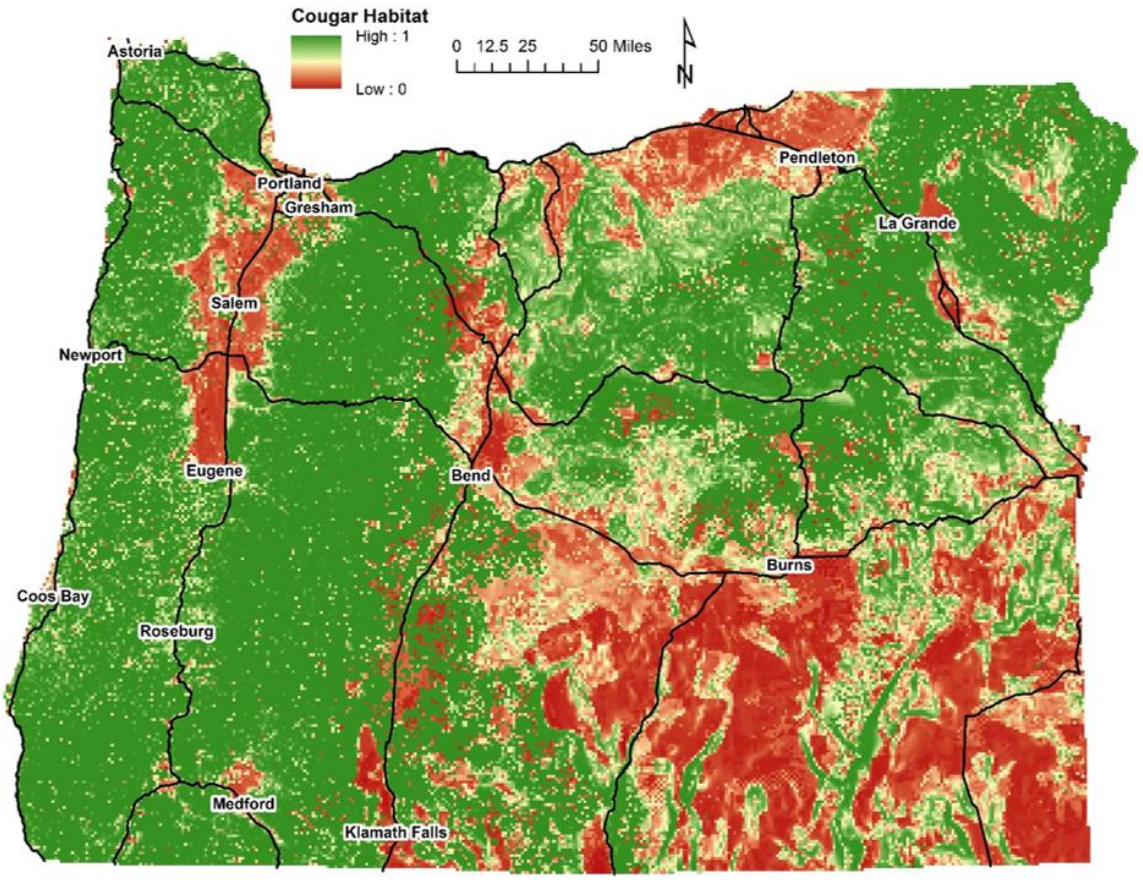


Figure 5. Distribution of potential habitat use of cougars in Oregon based on hunter-harvested mortality locations from 1995-2016. Habitat use was modeled using a Resource Selection Probability function and environmental predictor variables that included land cover, big game habitat, land ownership, elevation, aspect, slope, and terrain ruggedness. Major cities and highways are shown for reference.

Information on Oregon urban cougars is limited to records of sightings, complaints, and mortalities, but recent research elsewhere may be helpful in urban cougar management. Burdett et al. (2010) used cougar habitat and housing-density models to predict the future distribution of cougar habitat following continued human development. A similar technique and exercise could aid in better understanding how cougars will respond to the rapid growth and development seen in many parts of Oregon. Kertson et al. (2011, 2013) examined cougar habitat use and human interactions in residential and wildland areas between the Seattle Metroplex and the Cascade Mountains in Washington. Many similarities can be made between that study area and the foothills surrounding the Willamette Valley, therefore findings by Kertson et al. may serve useful in areas of western Oregon.

Regardless of the type of urban environment, human health and safety has been and will continue to be the top priority for ODFW. The ODFW Wildlife Damage Database (*see* Complaints section) serves in documenting and monitoring cougar activities in urban and rural settings. ODFW's Incident Response Guidelines (Appendix B) directs staff when responding to cougar-human interactions. Past plan directives have included efforts to reduce cougar populations near urban areas in order to reduce or eliminate the probability of incidents of cougar-human conflict. Due to issues

such as limited land access and available hunting tools, cougar reductions in those areas have not been practical. Therefore, Oregon urban cougar management currently focuses on proactive education, complaint recording and monitoring, and addressing human-cougar interactions as they arise. Future research in human dimensions may be helpful to incorporate public input on determining acceptable thresholds and responses to cougars residing in urban landscapes.

Age and Sex Structure

ODFW evaluates sex and age structure of cougar mortalities to monitor overall cougar population health and all known cougars killed or found dead are to be checked in at an ODFW office.

Trends in sex structure can be very insightful. Males commonly comprise a larger proportion of harvest due to four primary reasons: (1) adult males have larger home ranges than adult females and young males tend to disperse farther than young females increasing the probability of hunters encountering them; (2) cougar hunters preferred males to females because males tend to be larger; (3) cougar hunters recognized females are the reproductive base of a population; and (4) hunters are not allowed to take spotted kittens and females with spotted kittens during hunting seasons. Indeed males comprise a larger proportion of the hunter harvest in Oregon. From 1987 to 1994 when the use of dogs were legal for hunting cougar, 60% of annual hunter harvested cougars were males but dropped to 51-52% once dogs were prohibited (Table 3). That change is due to hunting of cougars with dogs allows for more selectivity than other hunting techniques (Anderson and Lindzey 2005, Zornes et al. 2006). This is further supported by a higher percentage of females currently taken during the hunting season than before 1994 (Table 3).

Table 2. Long-term averages of total cougar mortality, proportion of mortality by hunting and non-hunting sources (damage, human safety/pet, roadkill, administrative removal, and other combined), and proportion of males and females in the hunter harvest in Oregon 1987-2016. From 1987-1994, the use of dogs for hunting cougars was legal.

Years	Average Annual Mortalities	Proportion Non-Hunting Mortalities	Proportion Hunting Mortalities	Hunting Proportion Males	Hunting Proportion Females
1987-1994	195	0.19	0.81	0.60	0.40
1995-2005	307	0.52	0.48	0.52	0.48
2006-2016	488	0.46	0.54	0.51	0.49

Table 3. All known Oregon cougar mortalities recorded 1987-2016.

	Mortality by Source								Proportion by Source						
Year	Hunting	Livestock Damage	Human Safetv/Pet	Roadkill	Administrative Removal	Illegal Take	Other	Grand Total	Hunting	Livestock Damage	Human Safety/Pet	Roadkill	Administrative Removal	Illegal Take	Other
1987	129	8	2	1			2	142	0.91	0.06	0.01	0.01	0.00	0.00	0.01
1988	136	13	3	5		2	3	162	0.84	0.08	0.02	0.03	0.00	0.01	0.02
1989	116	15	1	7		2	4	145	0.80	0.10	0.01	0.05	0.00	0.01	0.03
1990	201	29	3	10		3	5	251	0.80	0.12	0.01	0.04	0.00	0.01	0.02
1991	124	22	4	4		3	5	162	0.77	0.14	0.02	0.02	0.00	0.02	0.03
1992	184	17	3	6		3	13	226	0.81	0.08	0.01	0.03	0.00	0.01	0.06
1993	162	20	7	15		2	4	210	0.77	0.10	0.03	0.07	0.00	0.01	0.02
1994	199	29	11	9		5	6	259	0.77	0.11	0.04	0.03	0.00	0.02	0.02
1995	22	41	22	7		1	4	97	0.23	0.42	0.23	0.07	0.00	0.01	0.04
1996	43	64	34	13		3	9	166	0.26	0.39	0.20	0.08	0.00	0.02	0.05
1997	61	82	20	9		3	6	181	0.34	0.45	0.11	0.05	0.00	0.02	0.03
1998	111	93	20	8		6	3	241	0.46	0.39	0.08	0.03	0.00	0.02	0.01
1999	169	91	39	13		3	9	324	0.52	0.28	0.12	0.04	0.00	0.01	0.03
2000	188	120	27	10			7	352	0.53	0.34	0.08	0.03	0.00	0.00	0.02
2001	220	98	27	12		1	8	366	0.60	0.27	0.07	0.03	0.00	0.00	0.02
2002	232	110	26	20		5	10	403	0.58	0.27	0.06	0.05	0.00	0.01	0.02
2003	248	111	28	16		3	6	412	0.60	0.27	0.07	0.04	0.00	0.01	0.01
2004	265	95	28	15		7	13	423	0.63	0.22	0.07	0.04	0.00	0.02	0.03
2005	224	125	28	12		3	15	407	0.55	0.31	0.07	0.03	0.00	0.01	0.04
2006	289	106	26	12		6	14	453	0.64	0.23	0.06	0.03	0.00	0.01	0.03
2007	309	114	21	19	52	4	18	537	0.58	0.21	0.04	0.04	0.10	0.01	0.03
2008	272	109	23	19	34	11	24	492	0.55	0.22	0.05	0.04	0.07	0.02	0.05
2009	274	110	31	15	21	11	11	473	0.58	0.23	0.07	0.03	0.04	0.02	0.02
2010	240	99	25	14	79	7	18	482	0.50	0.21	0.05	0.03	0.16	0.01	0.04
2011	241	139	23	12	71	1	19	506	0.48	0.27	0.05	0.02	0.14	0.00	0.04
2012	253	130	46	17	56	9	19	530	0.48	0.25	0.09	0.03	0.11	0.02	0.04
2013	292	148	24	9	36	7	15	531	0.55	0.28	0.05	0.02	0.07	0.01	0.03
2014	209	124	27	16		1	8	385	0.54	0.32	0.07	0.04	0.00	0.00	0.02
2015	233	133	23	24		4	16	433	0.54	0.31	0.05	0.06	0.00	0.01	0.04
2016	267	151	18	19	71	5	13	544	0.49	0.28	0.03	0.03	0.13	0.01	0.02
Total	5913	2546	620	368	420	121	307	10295	0.57	0.25	0.06	0.04	0.04	0.01	0.03

Many wildlife species can be aged using characteristics of one or more of their teeth. Many large mammalian wildlife are commonly aged by tooth replacement and wear patterns or analysis of growth rings in the tooth that result from differential cementum deposition rates associated with annual periods of good (summer) and poor (winter) nutrition. Rings created in the tooth root during periods of poor nutrition can be microscopically identified and number of rings in the cross section

of the root usually corresponds to the animal's age. Cougars are more difficult to age than other game mammal species using this method because they generally do not have annual poor nutrition periods that effect cementum deposition rate in the tooth. Ashman et al. (1983) presented criteria for a general classification of cougar age groups based on physical characteristics of the tooth, however, it failed to provide managers with an age distribution of the adult segment of the population.

ODFW developed a cementum analysis technique for aging cougars (Trainer and Matson 1989) and has been examining cementum deposition layers in the second premolar tooth (PM2) since 1987. Validated on known age cougars, the technique was correct within one year of actual age (Trainer and Golly 1992). The technique provides a method to sample cougar population age structure, facilitate population modeling efforts, and monitor and analyze overall population status. This technique is not without flaw (Hiller and Tyre 2014), therefore gum recession measurements are obtained and other aging techniques would be used should they be developed and proven.

Age distribution of known cougar mortalities is an indicator of population status and the impact of mortality on a population. The presence of young cougars in the harvest indicates reproduction is occurring and that mortality rates are conservative enough to allow females to reach reproductive age. Therefore, high percentages of young in the harvest with few older age class animals may indicate low exploitation rates. Conversely, it may indicate higher levels of exploitation if this occurs after harvest rates have removed older aged animals. Likewise, the presence of older cougars in the harvest suggests harvest rates are conservative enough to allow a sector of the population to reach older age classes. If excessive removal was occurring from a small or declining population, fewer cougars would be found in the older age classes over time.

Age, sex, and trend data suggesting excessive cougar mortalities in Oregon are not present. Age data from Oregon's cougar mortalities indicate that both young and old are represented in the population (Table 4). Greatest representation was found in the younger age classes indicating a growing population. The 1- and 2-year old age classes are most susceptible to mortality because they are often dispersing thus making them more vulnerable to hunting and conflict (damage, human safety/pet) due to increased chances of encountering humans (Trainer and Golly 1992). Cougars less than one year of age may be taken on damage, but are for the most part protected from hunting and not represented in large proportions. Anderson and Lindzey (2005) found that cougar populations did not begin to decline until adult (3+) females comprised at least 25% of the harvest. At the zone level, ODFW has an objective of maintaining a 3-year average proportion of adult females in the total mortality at no more than 25–35%. That objective is commonly achieved as most zones do not see 3-year averages in that 25-35% range (Table 5).

Table 4. Age distribution of known mortalities (all sources) and known ages of cougars in Oregon 1987-2015. Cougars of unknown age are not represented.

	Number Killed By Age Class											Proportion Killed By Age Class										
Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10+**	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10+**
1987	3	17	38	22	16	12	8	4	2	3	3	0.02	0.13	0.30	0.17	0.13	0.09	0.06	0.03	0.02	0.02	0.02
1988	8	36	43	25	19	4	6	3	3	1	2	0.05	0.24	0.29	0.17	0.13	0.03	0.04	0.02	0.02	0.01	0.01
1989	6	21	49	24	7	10	9	4	4	3	5	0.04	0.15	0.35	0.17	0.05	0.07	0.06	0.03	0.03	0.02	0.04
1990	16	26	48	48	30	23	14	6	8	2	13	0.07	0.11	0.21	0.21	0.13	0.10	0.06	0.03	0.03	0.01	0.06
1991	7	14	31	20	23	20	16	8	8	6	5	0.04	0.09	0.20	0.13	0.15	0.13	0.10	0.05	0.05	0.04	0.03
1992	13	9	34	31	31	33	22	14	10	6	18	0.06	0.04	0.15	0.14	0.14	0.15	0.10	0.06	0.05	0.03	0.08
1993	9	10	42	25	24	18	21	13	11	10	11	0.05	0.05	0.22	0.13	0.12	0.09	0.11	0.07	0.06	0.05	0.06
1994	8	32	38	40	28	20	27	11	10	9	19	0.03	0.13	0.16	0.17	0.12	0.08	0.11	0.05	0.04	0.04	0.08
1995	9	22	18	17	7	7	2	1	1	3	4	0.10	0.24	0.20	0.19	0.08	0.08	0.02	0.01	0.01	0.03	0.04
1996	13	37	33	19	13	10	8	5	4	3	4	0.09	0.25	0.22	0.13	0.09	0.07	0.05	0.03	0.03	0.02	0.03
1997	12	37	39	14	18	13	9	10	5	4	6	0.07	0.22	0.23	0.08	0.11	0.08	0.05	0.06	0.03	0.02	0.04
1998	25	53	42	29	23	17	9	3	6	2	9	0.11	0.24	0.19	0.13	0.11	0.08	0.04	0.01	0.03	0.01	0.04
1999	35	76	68	42	31	20	12	7	8	2	9	0.11	0.25	0.22	0.14	0.10	0.06	0.04	0.02	0.03	0.01	0.03
2000	36	65	73	52	27	22	18	14	8	4	14	0.11	0.20	0.22	0.16	0.08	0.07	0.05	0.04	0.02	0.01	0.04
2001	22	73	81	42	34	38	21	13	7	5	11	0.06	0.21	0.23	0.12	0.10	0.11	0.06	0.04	0.02	0.01	0.03
2002	27	100	85	52	35	22	21	17	6	5	9	0.07	0.26	0.22	0.14	0.09	0.06	0.06	0.04	0.02	0.01	0.02
2003	30	91	101	55	39	25	16	9	13	5	6	0.08	0.23	0.26	0.14	0.10	0.06	0.04	0.02	0.03	0.01	0.02
2004	33	97	104	61	29	25	13	19	4	5	12	0.08	0.24	0.26	0.15	0.07	0.06	0.03	0.05	0.01	0.01	0.03
2005	37	96	94	53	33	17	24	11	3	2	16	0.10	0.25	0.24	0.14	0.09	0.04	0.06	0.03	0.01	0.01	0.04
2006	27	113	118	66	35	21	19	15	6	3	8	0.06	0.26	0.27	0.15	0.08	0.05	0.04	0.03	0.01	0.01	0.02
2007	51	88	127	88	52	33	19	19	18	8	12	0.10	0.17	0.25	0.17	0.10	0.06	0.04	0.04	0.03	0.02	0.02
2008	53	84	106	92	30	30	30	15	8	7	14	0.11	0.18	0.23	0.20	0.06	0.06	0.06	0.03	0.02	0.01	0.03
2009	62	67	107	79	51	30	18	16	18	8	6	0.13	0.15	0.23	0.17	0.11	0.06	0.04	0.03	0.04	0.02	0.01
2010	40	75	96	86	53	29	40	17	7	13	14	0.09	0.16	0.20	0.18	0.11	0.06	0.09	0.04	0.01	0.03	0.03
2011	58	87	112	92	43	38	16	8	15	6	14	0.12	0.18	0.23	0.19	0.09	0.08	0.03	0.02	0.03	0.01	0.03
2012	65	107	133	85	37	31	22	11	9	8	5	0.13	0.21	0.26	0.17	0.07	0.06	0.04	0.02	0.02	0.02	0.01
2013	58	129	134	58	38	39	20	18	13	6	7	0.11	0.25	0.26	0.11	0.07	0.08	0.04	0.03	0.03	0.01	0.01
2014	36	98	93	51	34	30	19	7	0	3	3	0.10	0.26	0.25	0.14	0.09	0.08	0.05	0.02	0.00	0.01	0.01
2015	43	88	92	52	44	32	22	14	7	11	11	0.10	0.21	0.22	0.13	0.11	0.08	0.05	0.03	0.02	0.03	0.03

Table 5. Three-year averages of annual proportions of adult (≥3 yr. old) females of known ages for all sources of mortality by cougar zone in Oregon, 1987–2015.

3 year Span	Zone A	Zone B	Zone C	Zone D	Zone E	Zone F
1987–1989	13.9	15.6	0.0	0.0	21.5	33.3
1988–1990	6.2	17.1	0.0	0.0	19.3	0.0
1989–1991	6.8	19.2	13.3	0.0	24.3	0.0
1990–1992	17.5	20.9	13.3	0.0	29.1	0.0
1991–1993	21.7	21.6	20.0	0.0	28.3	0.0
1992–1994	27.3	25.5	15.0	0.0	29.5	0.0
1993–1995	23.8	19.1	15.0	0.0	29.9	0.0
1994–1996	20.1	14.9	13.1	4.8	29.4	0.0
1995–1997	12.9	8.8	10.3	4.8	27.5	3.7
1996–1998	12.2	14.0	22.4	11.4	25.7	7.4
1997–1999	14.0	16.8	22.2	6.7	27.1	13.1
1998–2000	17.0	16.5	25.6	13.3	26.7	15.9
1999–2001	17.6	14.8	19.2	9.4	27.3	21.6
2000–2002	13.9	15.0	19.4	21.1	28.0	21.9
2001–2003	13.1	13.9	17.8	21.9	24.5	24.5
2002–2004	10.2	13.6	16.0	23.6	22.6	19.3
2003–2005	15.3	12.5	24.9	16.2	19.0	18.2
2004–2006	12.2	16.0	24.7	13.1	20.0	14.7
2005–2007	12.5	16.0	25.8	18.0	20.9	21.1
2006–2008	11.9	17.0	16.5	23.2	22.6	26.1
2007–2009	15.3	19.2	14.7	26.2	24.2	28.1
2008–2010	17.2	18.9	11.4	26.4	26.7	24.3
2009–2011	17.1	18.5	13.8	27.1	28.6	22.6
2010–2012	15.9	14.1	16.4	23.5	25.9	22.0
2011–2013	13.7	14.0	21.0	20.0	22.0	21.1
2012-2014	12.1	12.4	20.2	17.4	21.5	14.4
2013-2015	12.2	12.7	16.6	22.6	22.2	12.3

Hunting and Hunter Harvest

License and Tags

Cougar tags can be purchased by anyone with a hunting license and tag purchases have been growing for many years (Table 6). During 1997, the Oregon State Legislature decreased the cost of a cougar tag from $51.00 to $10.00 and created the Sports Pac license option for residents, which automatically issued a cougar tag with purchase of this license package. In 2010, cougar tags were set to $14.50 and then adjusted to $15.50 in 2016 for both resident and non-resident hunters. If a hunter purchases their general season cougar tag prior to the established tag sales deadline, they may also purchase an additional general season cougar tag for $15.50.

Hunting Techniques and Harvest

Currently, most cougars are harvested by hunters that randomly encounter a cougar while hunting for other species, but are in possession of a cougar tag. In 2015, of the reporting cougar tag holders that harvested a cougar, 66% did so while pursuing other game. Hunter harvest has remained relatively stable for over a decade and average annual statewide harvest was 261 (range 209-309) from 2004-2016. Hunter success rates are low with current harvest techniques and range from 1-2%.

Hunting techniques used to target cougars in Oregon are limited to calling and tracking. The use of hounds for hunting cougars is widely considered the most effective technique for harvesting cougars (Cougar Management Guidelines Working Group 2005, Zornes et al. 2006) and hunting metrics with dogs (e.g., cougars treed/day) has been observed to be the most informative metric for determining population trends in Utah (Wolfe et al. 2016). However, the passing of an Oregon ballot initiative (Measure 18) banned the use of dogs as a legal cougar hunting method in 1994. Current hunter success varies from year to year and is dependent on factors such as the presence of snow that helps hunters positively identify cougar tracks from non-target wildlife species. Snow can also help discern between adults, kittens, and adults with kittens (the latter two are illegal to harvest). Road density also greatly affects hunting success by facilitating hunter access. Although hunters are widely distributed in Oregon, hunting pressure is limited or nonexistent in areas of difficult terrain or limited road access (Figure 1). This may result in *de facto* refugia where habitats open to hunting have relatively low hunting mortality rates and serve as a population source and refuge (Stoner et al. 2013, Cooley et al. 2011).

Hunt Structure

The hunting season structure for cougars has changed over the last 30 years from a limited duration, controlled hunt format to a yearlong, zone quota system. Starting in 2010, the general season begins January 1 and so long as zone quotas have not been reached, hunters can harvest up to two cougars if they purchased an additional cougar tag. Protections for dependent young are in place as it is illegal to take spotted kittens or females with spotted kittens.

Successful hunters must present the pelt with skull and proof of sex attached at an ODFW office within 10 days of harvest. ODFW collects harvest data during this mandatory check-in process, including a tooth and gum measurement to age individual cougars. The reproductive tract of female cougars is also required for collection of reproductive data. Cougar pelts are sealed with a uniquely numbered tag. This process is required for cougars taken for any purpose, including damage, human safety, or known road-killed animals.

Cougars are managed at the zone-level in Oregon to account for large home ranges, long dispersal distances, and large differences in landscape features (Cougar Management Guidelines Working Group 2005, Cooley et al. 2011). The state is divided into 6 cougar management zones (mean size = 16,195 mi^2) and were created by identifying similar habitats, human demographics, land use patterns, prey base, and cougar densities. These six zones follow Wildlife Management Unit (WMU) boundaries and each zone consists of numerous WMUs. Within these zones, cougar population sources (areas of surplus individuals) and sinks (areas deficient of individuals) likely occur as part of cougar metapopulations (group of spatially separated populations of the same species that interact through dispersal, Levins 1969). Transitioning from cougar harvest objectives at the zone level to those at the WMU or Data Analysis Unit (DAU) level (common management scales for most other big game species) could be considered in the future should more information become available (e.g. local densities, habitat, prey, other carnivores, etc.) and new information dictate harvest management at that scale.

Cooley et al. in Managing Cougars in North America (2011) identify two similar approaches for incorporating metapopulations in cougar hunting management. The first is zone management where three types of zones are identified: control zones where cougar reductions are the objective; hunting zones that provide hunting and harvest opportunities; and refuge zones where no hunting occurs (Logan and Sweaner 2001). Note those zone concepts are very different in size and function than the six Oregon cougar zones. The other approach is source-sink management that consists of only two zones: source areas that are closed to hunting and sink areas that are opening to hunting (Laundré and Clark 2003).

Cougar management in Oregon has implemented portions of both approaches and without deliberate creation and classification of those zones/areas (exception being target areas). Although open to hunting, numerous areas of Oregon receive no cougar hunting pressure (e.g. wilderness areas), contain cougar habitat, are well-distributed throughout the state, and likely serve as refuge and population sources. Other areas experience relatively high mortality levels to hunter harvest and other sources. Should those mortalities exceed certain levels (see below) then those areas may function as population sinks. Target area efforts were implemented to reduce cougar populations, similar to a control zone (Logan and Sweaner 2001), and function as a population sink.

Zone quotas have been in place since 1995 and quotas currently (2017) exist not as an objective, but rather a mortality cap so cougar populations do not fall below plan objectives (*see* Chapter III). Since the adoption of the 2006 Cougar Plan, all known mortalities (e.g., hunter-harvest, damage take, human-safety take, administrative removal, and road-killed) count toward zone quotas. If a zone quota is met, that zone is closed to hunting and target area administrative removals for the remainder of the year, but the zone does not close to take related to livestock damage and human safety. Quotas have been met in Zone E in 2001 and 2002, Zone D in 2002, and Zone A in 2011, 2012, and 2013. Zone quotas are adjusted periodically to account for cougar population growth but are in place to ensure harvest does not reduce cougar populations below minimum population objectives (*see* Chapter III). Based on the April 2017 cougar model update, from 2006-2016, annual zone quotas represented on average 13% of the modeled state population of all age classes, but over that time an average of 4% mortality from hunting and 8% mortality from all sources occurred (Appendix E).

Impact of Hunting on Cougar Populations

It is well documented that hunting can affect cougar populations; however, the type of impact is contingent upon the level of mortality. Published literature indicates light hunting can have little impact on cougar populations and may be compensatory (i.e. hunting mortality is compensated by reduction in natural mortality, reproductive output, or immigration), but at a higher level of harvest, hunting mortality becomes additive with no compensation and a total net increase in cougar mortality (Cooley et al. 2009b, Quigley and Hornocker 2010, Wolfe et al. 2015, Robinson et al. 2014). Such a situation may have been occurring in the Catherine Creek area of northeast Oregon prior to Measure-18 where a low survival rate of male cougars was observed (Clark et al. 2014).

Calculating and identifying the point between compensatory and additive mortality is very challenging, so most research projects are limited to documenting population trends at various harvest levels. Ashman et al. (1983) noted a sustained total annual mortality of at least 30 percent in Nevada and believed under "moderate to heavy exploitation (30%-50% removal)" cougar populations on their Nevada study areas had the "recruitment capability of rapidly replacing annual losses." Anderson and Lindzey (2005) concluded cougar populations would be stable or increasing as long as adult female harvest was ≤ 25% of the harvest, and with an annual harvest of more than

25% of the total cougar population. Anderson and Lindzey (2005) found after a 66% population reduction by hunting in Wyoming, the cougar population recovered in numbers within 3 years with approximately 18% of the cougar population harvested annually.

Recent research conducted in western North America also found that impacts are contingent on the level of harvest and subsequent total population mortality. Studies in portions of British Columbia, Idaho, Montana, Utah, and Washington set out to determine if hunting mortality was additive or compensatory. For all of these studies, hunting was the major source of cougar mortality and the use of hounds was a legal method of harvest. These studies observed an additive effect of hunting on cougar populations when hunting mortalities were high (proportion of annual population taken via hunting: 22%, Robinson et al. 2014; 24% High Hunted area, Cooley et al. 2009b; 30% adults and subadults, Choate et al. 2006; 38% Lambert et al. 2006; 40%, Stoner et al. 2006) and if those mortality levels continue for multiple years, cougar mortalities (hunting and non-hunting) may threaten long-term population viability. These areas of high proportional mortalities may serve as population sinks with high immigration and little-to-no emigration occurring. Cooley et al. (2009a) observed high immigration of young males, mitigating population reduction due to hunting, and yielding no net change in cougar density. Due to that zero net change in density, authors emphasize the importance of monitoring other demographic attributes (e.g. sex and age structure) as not to fail to detect a population orienting in a downward trajectory. Cougar research conducted in areas with low hunting mortality (11%, Cooley et. al 2009a; 17% Wolfe et al. 2015) observed stable or growing cougar populations with surplus juveniles emigrating out of the study areas. Wolfe et al. (2015) documented a compensatory effect of hunting on cougar populations due to a decrease in natural mortality.

Impact of Hunting on Population Trajectory in Oregon

The level of cougar harvest in Oregon varies by year and zone, however all data suggests current harvest has marginal impact on the statewide cougar population. Hunting is the highest known mortality source annually statewide and is frequently the top source in most zones although non-hunting mortalities are comparable in many zones (Table 3).

Harvest mortalities and all mortalities are low relative to Oregon cougar population estimates. Based on deterministic model population estimates (April 2017), annual hunter harvest is 4% of the statewide population and zone harvest rates range from 4-10% from 2006-2015 (Appendix E). Because hunting prohibits the harvest of spotted kittens and female cougars with spotted kittens, examining harvest of adult populations is insightful. Using a conservative assumption of cougar adulthood (i.e. females 2 and older, males 3 and older), average annual hunter harvest for 2006-2015 is 5% of adult cougars statewide with zones ranging from 1-10% (Appendix E). Over that same period, annual total mortality statewide (sum of hunting and non-hunting mortalities) was 8% of the statewide population (5-18% by zone). Relative to the before mentioned published studies, these mortality rates are far below what is considered heavy harvest and suggest cougar mortalities in Oregon (hunting and all sources) are not additive.

Using empirical data collected in Oregon from 2002-2011, deterministic and stochastic models were composed to estimate cougar population growth rates in northeast Oregon under current harvest conditions (i.e. illegal to use dogs; *see* Growth Rates). For both models, the population growth rate was 1.17; meaning cougar populations were projected to increase at an annual rate of 17% (Clark 2014). That growth rate exceeds the estimated total mortality rate for northeast Oregon (Zone E), suggesting hunting and all mortality sources were not limiting cougar populations in that zone. Washington assumes uniform intrinsic growth rates statewide based previous cougar studies

(Beausoleil et al. 2013). Applying the same practice to Oregon, hunting mortality rates (and mortality rates of all sources) rarely near or exceed 17% in a given zone.

Table 6. Cougar hunting tags, effort, and harvest in Oregon by year, 2004-2016.

Year	Total Tags	Number Reported	Estimated Hunter Numbers	Reported Hunting	Reported Harvest	Harvest Check In	Success Rate
1987	457		337			166	49.3%
1988	442		325			132	40.6%
1989	451		356			144	40.4%
1990	471		363			155	42.7%
1991	482		365			155	42.5%
1992	517		391			187	47.8%
1993	560		413			160	38.7%
1994	588		358			144	40.2%
1995	385		316			34	10.8%
1996	779		661			45	6.8%
1997	935		863			61	7.1%
1998	11,761		9,378			153	1.6%
1999	14,564		13,428			157	1.2%
2000c	22,386		19,097			136	0.7%
2001	28,447		26,383			220	0.8%
2002	32,126		13,935			230	1.7%
2003	34,135		28,315			241	0.9%
2004	34,071		No Hunter Survey			265	
2005	38,079		No Hunter Survey			224	
2006	38,719		No Hunter Survey			289	
2007	41,813		No Hunter Survey			309	
2008	43,211		No Hunter Survey			272	
2009	45,375		No Hunter Survey			274	
2010	48,776		No Hunter Survey			240	
2011	50,889		No Hunter Survey			241	
2012	53,698	39,371	15,256	11,182	214	253	1.7%
2013	55,082	40,315	14,435	10,654	237	292	2.0%
2014	56,114	42,795	14,238	10,893	178	209	1.5%
2015	57,344	44,362	13,965	10,813	212	233	1.7%
2016	57,987	45,688	13,879	10,939	248	267	1.9%

Total Tags- the number of General and Additional cougar tags issued
Number Reported- number of reports received in mandatory reporting for cougar tag holders
Estimated Hunter Numbers- the estimated number of hunters based on mandatory reporting data
Reported Hunting- of the hunters that reported, this is the number of reports where the hunter stated they went hunting
Reported Hunting- of the hunters that reported hunting, this is the number of reports where the hunter harvested a cougar
Harvest Check In- the number of hunted cougars checked in by ODFW
Success Rate- the number of cougars harvested by the number of estimated hunters

Table 7. Hunt and damage/livestock cougar mortalities for each cougar zone 1987-2016.

	Zone A		Zone B		Zone C		Zone D		Zone E		Zone F		
Year	Hunting	Damage/Safety	Hunting	Damage/Safety	Hunting	Damage/Safety	Hunting	Damage/Safety	Hunting	Damage/Safety	Hunting	Damage/Safety	Total
1987	10	5	45	3					74	2			139
1988	16	3	58	10				1	61	1	1	1	152
1989	6	1	50	8					60	7			132
1990	14	8	112	18					74	6	1		233
1991	4	3	49	11	4				67	12			150
1992	14	9	81	6	4	1			85	4			204
1993	16	8	65	11	10				71	7		1	189
1994	28	15	79	12	10		3		75	13	4		239
1995	1	23	7	20		1			13	18	1	1	85
1996	8	32	11	34	3	3	4	3	15	26	2		141
1997	18	33	11	30	4	1			21	36	7	2	163
1998	28	33	15	27	9	1	4	1	45	44	10	7	224
1999	30	20	27	35	15	7	3	1	74	51	20	16	299
2000	32	46	29	33	7	7	9	5	84	45	27	11	335
2001	25	47	37	28	20	10	9	4	98	25	31	11	345
2002	28	47	32	34	12	9	15	4	102	30	43	12	368
2003	36	40	28	43	15	6	10	7	116	23	43	20	387
2004	42	39	28	38	14	10	16	5	131	19	34	12	388
2005	38	35	28	38	19	4	11	26	91	33	37	17	377
2006	47	26	43	32	22	10	12	27	127	25	38	12	421
2007	49	37	57	35	30	4	18	24	111	23	44	12	444
2008	52	37	40	34	20	4	16	16	109	32	35	9	404
2009	61	28	33	39	21	4	16	19	113	24	30	27	415
2010	55	39	41	43	17	1	14	13	92	20	21	8	364
2011	60	51	42	58	10	4	14	17	93	21	22	11	403
2012	67	40	37	60	13	7	14	19	101	23	21	27	429
2013	72	49	67	68	15	3	18	28	96	8	24	16	464
2014	52	42	30	64	15	1	7	16	77	12	28	16	360
2015	52	51	42	47	16	8	13	24	79	18	31	8	389
2016	83	70	35	60	13	2	12	14	92	17	32	6	436
Total	1044	917	1259	979	338	108	238	274	2447	625	587	263	9079

Illegal Kill

Both the 1987 and 2006 Cougar Management Plans directed ODFW and the Oregon State Police (OSP) to monitor the level of illegal harvest. Illegal take is always a top priority for ODFW and the public. Oregon House Bill 4046 from the 2016 Oregon Legislative Regular Session increased the penalty of the unlawful killing of a cougar from $1,000 to $7,500. ODFW has yet to find illegal killing to have a widespread nor long-term negative biological impact on Oregon's cougar population. The extent of illegal cougar kills is difficult to quantify, however current regulations and research findings provide valuable insight on the topic.

Mandatory check-ins of cougars creates good opportunities to identify and monitor legal and illegal activities. Current regulations require any person taking a cougar via hunting or on damage to bring the hide and head of all cougars, and reproductive organs from females to an ODFW office. ODFW collects information and biological samples, and attaches an ownership seal to the hide. This seal must remain with the hide until the hide is processed. This requirement distinguishes a legally harvested cougar (marked with a seal) from one that is not (unmarked) for easier identification by enforcement officers. Taxidermists are well aware of these seal requirements, therefore it is unlikely illegally killed cougars are being processed for taxidermy. ODFW also collects information pertaining to the hunt or damage situation when hunters check in their cougar. This information provides OSP data related to that occurrence should they receive reports of illegal hunting activity. From 1988-2015, the number of cougar mortalities statewide due to illegal activity averaged 4 per year (range 0-11; Table 3) and less than 1% population mortality statewide (range 0.08-0.16%) using deterministic model estimates. Illegal kills are incorporated into the Keister and Van Dyke (2004) cougar population model (*see* Population Modeling and Trends) in order to account for that mortality source.

Illegally killed animals left where they were killed are difficult to document however, radio telemetry studies are indeed capable of documenting those occurrences. Numerous intensive radio telemetry studies have been conducted in Oregon (Table 14), and over 300 cougars have been monitored yet only 14 instances of illegal killing were observed. During seven years in the ODFW Catherine Creek Study, 1 cougar was illegally killed (n = 56 radios monitored). In the 9-year Jackson Creek study, 7 illegal kills of radio-collared cougars were recorded and accounted for 10.8% of all documented deaths (n = 113 radios monitored, 65 mortalities). No illegal kills were recorded during the 3-year North Umpqua study (Toketee and Steamboat study sites) in southwest Oregon (n = 26 radios monitored). In a study conducted in a similar area, Gagliuso (1991) found 3 of 8 radio-collared cougars were killed illegally between 1985 and 1987. More recently, Clark (2014) observed no illegal kills of cougars while monitoring 25 cougars over two years in the Mt. Emily area of northeastern Oregon.

Damage and Safety Mortalities

The number of cougars killed in Oregon due to livestock damage or human safety/pet conflict has been stable statewide and in eastern Oregon, but has been increasing in western Oregon. The average number of cougars taken annually on damage/safety statewide has increased from 23 cougars per year in 1987-1994, to 121 per year in 1995-2005, and 150 per year in 2006-2016 (Table 8). Over the same time, cougar populations have been increasing and expanding into new areas, some highly susceptible to conflict (e.g. urban, agricultural landscapes). Such is the case in western Oregon (Zone A and Zone B, Table 9) where the majority of Oregon's human population resides and small- and medium-sized livestock (e.g. goats, sheep) (*see* Zone A and Zone B in Chapter IV: Adaptive

Management). From 2006-2016, damage and safety mortalities comprise 31% of annual known cougar mortalities (Table 3) and the majority (80%) are the result of cougars killed as a result of causing damage to livestock (Table 8).

Table 8. Number of cougars taken on livestock damage and human safety/pet conflict in Oregon.

Year	Damage	Safety	Total	Year	Damage	Safety	Total
1987	8	2	10	2002	110	26	136
1988	13	3	16	2003	111	28	139
1989	15	1	16	2004	95	28	123
1990	29	3	32	2005	125	28	153
1991	22	4	26	2006	106	26	132
1992	17	3	20	2007	114	21	135
1993	20	7	27	2008	109	23	132
1994	29	11	40	2009	110	31	141
1995	41	22	63	2010	99	25	124
1996	64	34	98	2011	139	23	162
1997	82	20	102	2012	130	46	176
1998	93	20	113	2013	148	24	172
1999	91	39	130	2014	124	27	151
2000	120	27	147	2015	133	23	156
2001	98	27	125	2016	151	18	169

Administrative Removals

Cougars taken within a target area to reduce conflict with wildlife populations or human safety/pets are classified as administrative removals. Each target area has clear goals and objectives, including the number of cougars to be removed from the area, therefore administrative removal numbers are contingent on target area objectives. Eleven target area efforts have occurred or are currently underway at the time of writing and cougars taken annually ranged from 21 to 79 (Table 3). Those mortalities consisted of 7-16% (average 10.25%) of known cougar mortalities in those 8 years (Table 3).

Other Human-Related Mortality

Cougar mortalities due to vehicle collisions averaged 16 per year and comprised just 3% of known mortalities statewide from 2006-2016 (Table 3). While relatively stable statewide, roadkill numbers are increasing in Zone A where humans, roads, and cougars are increasing in abundance. Other mortality sources include accidental take, euthanasia for humane reasons, or unknown as the animal was found dead, and averaged just 16 per year statewide from 2006-2016 (Table 3).

Table 9. Number of cougars taken on livestock damage or human safety/pet conflict by Oregon cougar zone.

Year	Zone A	Zone B	Zone C	Zone D	Zone E	Zone F	Total
1987	5	3			2		10
1988	3	10		1	1	1	16
1989	1	8			7		16
1990	8	18			6		32
1991	3	11			12		26
1992	9	6	1		4		20
1993	8	11			7	1	27
1994	15	12			13		40
1995	23	20	1		18	1	63
1996	32	34	3	3	26		98
1997	33	30	1		36	2	102
1998	33	27	1	1	44	7	113
1999	20	35	7	1	51	16	130
2000	46	33	7	5	45	11	147
2001	47	28	10	4	25	11	125
2002	47	34	9	4	30	12	136
2003	40	43	6	7	23	20	139
2004	39	38	10	5	19	12	123
2005	35	38	4	26	33	17	153
2006	26	32	10	27	25	12	132
2007	37	35	4	24	23	12	135
2008	37	34	4	16	32	9	132
2009	28	39	4	19	24	27	141
2010	39	43	1	13	20	8	124
2011	51	58	4	17	21	11	162
2012	40	60	7	19	23	27	176
2013	49	68	3	28	8	16	172
2014	42	64	1	16	12	16	151
2015	51	47	8	24	18	8	156
2016	70	60	2	14	17	6	169

Cougar Health Concerns: Diseases, Parasites & Toxins

Increasing information has been gained on current health threats facing wild cougars, but still remains difficult to evaluate on a broad scale. Most documented information was collected from captive held cougars or those euthanized because of safety issues or aberrant behavior. Most studies have been unable to examine a large sample of cougars and in many cases, documentation of disease, parasites, or toxin exposure is from examination of a single cougar. Cougars are susceptible to most of the pathogens found in domestic felines (Foley et al. 2013). These pathogens include feline calicivirus and herpesvirus, feline coronoavirus, feline leukemia virus, feline panleukopenia and heartworm. Exposure to disease can be indicated based on a positive serologic test even though there may not be clinical signs or mortality associated with the disease. Cougars have also been

documented to have their own form unique form of feline immunodeficiency virus (FIV), which has currently not been shown to cause disease (Biek and Poss 2002). Puma lentivirus has also been documented in Washington, Oregon and California cougars in addition to other wild felids across North and South America (Evermann et al. 1997; Olmsted et al. 1992). Similarly, this retrovirus does not appear to cause significant health issues for affected cats, but has been used as a model to look at contact between cougar populations and host pathogen coevolution. There is evidence that cougars occasionally produce antibodies to canine distemper virus (CDV) but the only virulent strains causing clinical signs and mortality in wild felids have been seen in East African lions in 1994 and 2001 (Beineke et al. 2015). Cougars have occasionally been diagnosed with the rabies virus and should be considered as a possible diagnosis in neurologic cases especially in rabies-endemic areas. The significance of these infections or exposure on a population scale is largely unknown and is an issue for future investigation.

Bacterial diseases occur in cougars but are generally acquired directly or indirectly from their prey. Cougars have been documented to serve as susceptible hosts to the plague bacterium (*Yersinia pestis*) (Tabor and Thomas 1986, Paul et al. 1994). The principle mode of transmission is via a flea bite and causes high morbidity and mortality from systemic infection in affected animals. The disease is more prevalent in cougars when deer populations are low and they consume more rodent prey (Smith 1994). Oregon had a recently confirmed case in 2017 from a young kitten found dead on the eastern side of the state (unpublished data).

More documentation exists on cougar parasites than diseases because of persistence of parasites, the ability to detect it in cougars after death, and the common presence of parasites in most wildlife species. Several parasites have been found in cougars and many appear related to the prey they consume. One nematode found at a fairly high prevalence in Oregon and implicated in the deaths of several radio-collared cougars in the state is the nodular stomach worm. Seventy-three percent of dead cougars between 2003 and 2010 were identified with the nematode, identified as *Cylicospirura subaequalis* (Ferguson et al. 2011). The nematode has been found to cause granulomatous lesions in the proximal intestine and pyloric region of the stomach and has been implicated in deaths of several radio-collared cougars in Oregon. A number of other nematodes, helminths, cestodes and protozoa have also been detected, although not usually causing primary mortality.

Toxin exposure is a more recent health concern to cougars on the landscape. In the past decade, there have been multiple cases of anticoagulant rodenticide (AR)-related exposure and mortality in California mountain lions, some with severe cases of secondary mange infections. (Riley et al. 2007). Oregon also documented the first case of a large mammalian predator being directly affected by lead exposure (Burco et al, 2012). Such cases bring to the forefront unintended consequences of human / wildlife interactions.

Other Natural Mortality Sources

Cannibalism, infanticide, and territorial fighting have been documented in cougars (Robinette et al. 1961, Cougar Management Guidelines Working Group 2005). Recently, interest has grown in a possible connection between hunter harvest levels and cougar infanticide (Keehner et al. 2015). It is theorized that high removals of (primarily male) cougars due to hunting creates a void that is filled by dispersing juveniles and results in territorial instability and increased chance of these new males killing kittens. Although not directly studied, Cooley et al. (2009b) documented events of plausible infanticide (6 kittens of 3 litters) by other cougars in a population experiencing high hunting mortalities but no infanticide in a population experiencing low hunting mortalities. Ruth et al. (2011) documented less infanticide in a cougar population during a time of greater territorial stability.

However, the impact of varying hunting levels is not as clear due to the introduction of wolves and researchers documented resident males causing infanticide.

Of 72 kittens monitored in Oregon, nine kittens died before one year of age and infanticide was the leading cause of mortality (n=5), but kitten survival was very high (Clark 2011). Infanticide is not uncommon even in unhunted populations (Beier and Barrett 1993, Logan and Sweanor 2001) and Oregon cougar mortality levels are low relative to areas studied by Cooley et al. (2009b) (*see* Hunting and Hunter Harvest section). Until the subject is better understood, it is difficult to say if and how the topic of human cougar mortalities and infanticide applies to Oregon cougar populations.

The highest cause of natural mortality for young males in the Jackson Creek study (southwest Oregon) was intra-specific killing, apparently by larger adult males. In the Catherine Creek study (northeast Oregon), one cougar was found dead from wounds consistent with being killed by another cougar. In the northeast Nutrition-Predation study, one unmarked yearling male was found killed by a radio-collared adult male.

Mortalities due to injuries or starvation are difficult to document in cougar populations, in part because they occur infrequently. In the Catherine Creek study (*see* Chapter III), one radio-marked cougar was found dead with a broken sternum, presumably from being kicked by an elk. In the Jackson Creek study, 7 of 113 radio-marked cougars monitored during December 1992 – September 2003 died because of injuries (Oregon Department of Fish and Wildlife, unpublished data). Starvation often occurs to injured animals. No radio-marked cougars in Oregon are known to have starved without previous injuries. Frequently, cougars in poor body condition are killed on livestock or pet complaints. Had they not been killed, these individuals may have died of starvation.

Cougars interact with bears and wolves and wolves have been documented killing cougars (Cougar Management Guidelines Working Group 2005). Research in northeast Oregon, where cougars and wolves are both being monitored, has not observed any direct mortality between those species. However, as wolves continue to expand throughout Oregon, cougar mortalities by wolves may occur.

Cougar Complaints

Cougar complaints consist of the contacts received by ODFW and USDA Wildlife Services (WS) regarding conflict with cougar. ODFW has been recording complaints for over 30 years, although a standardized reporting system was implemented in 2001. ODFW currently manages complaints in the ODFW Wildlife Damage Database and there have been a few updates to the database with the most recent occurring in 2017.

The Wildlife Damage Database has 18 primary complaint types to describe the particular complaint. The complaint types are grouped into three main categories: Safety, Damage and Other. Cougar complaints primarily fall within the main categories of Damage and Safety. Specifically, complaints concerning damage to livestock and human/pet safety. Livestock complaints include physical injuries and predation of livestock, and concerns for livestock safety in areas where a cougar or cougar sign has been observed. Human safety complaints include concerns for humans where people have encountered a cougar, a cougar or cougar sign is observed in populated areas, or cougars have lost their wariness of humans. Pet complaints are recorded when pets are killed or injured by a cougar or when a cougar or cougar sign has been observed in close proximity to pets. Complaints not readily identifiable in one of these categories are counted as other. Sightings reported to ODFW with no discernable concern expressed by the reporting person are not counted as a complaint. Numerous other details are included in the database including if the complaint was verified, the

complaint occurred inside city limits, the complaint was a repeat occurrence, and the estimated cost of pet/livestock loss. All of these additional details aid in quantifying the situation at hand and help determine the appropriate response. ODFW staff evaluates each complaint and respond within established legal and policy frameworks and Appendix G provides a summary of how ODFW responds to complaints. At every opportunity, ODFW provides advice and education to the public to reduce current and future conflict.

Not all complaints can be verified as actual cougar conflicts due to the large number of complaints ODFW receives, staffing limitations, cougars do not always leave detectable sign, and complaints are not always reported in a timely fashion. Even when cougar sign is evident, it often disappears within a day or two because of weather, or activities by other animals, people, or equipment. Therefore, complaints reported to ODFW by the public may not actually involve cougars. However, the increasing use and availability of trail cameras, cell phone cameras, and home security systems are creating much more opportunity for species identification and confirmation.

The majority of cougar complaints reported to ODFW are addressed primarily by providing advice on precautionary measures that reduce risk and future conflict, and providing information on legal provisions that allow for taking the cougars causing the concern. Cougar complaints involving livestock, the primary complaint type (Table 11), are generally addressed by WS in counties that participate in the program, or by landowners or their agents in non-participating counties. The majority of cougar-human safety concerns are not verified and do not result in control efforts. However, verified complaints, where threats to human safety are considered high, are addressed by any combination of law enforcement, WS, ODFW, or ODFW agents (Appendix B). All cougars taken on damage or human safety are entered into the damage database, even if no correspondence occurred prior to the animal being checked in.

Table 10. Cougar complaints by Oregon Cougar Management Zone as reported to ODFW, 2007-2016. Cougar sightings are not included in records. Data as of May 1, 2017 and subject to change as new information becomes available.

Year	Zone A	Zone B	Zone C	Zone D	Zone E	Zone F	Total
2007	156	171	30	20	46	30	453
2008	179	197	37	19	67	16	515
2009	154	172	26	15	46	19	432
2010	181	213	11	13	33	14	465
2011	202	239	13	13	25	8	500
2012	140	200	17	13	30	19	419
2013	132	163	14	13	21	16	359
2014	140	217	12	7	14	14	404
2015	225	161	22	12	16	8	444
2016	233	143	17	11	13	4	421

With the exception of Zone A, cougar complaints are stable or declining across much of Oregon (Table 10). ODFW staff speculates that declining cougar complaints may be due to the local public being familiar with how to live with cougars, they know how to resolve their issue, or they are familiar with their legal options. On the other hand, cougar complaints have been increasing in

areas of cougar population growth, where human-cougar interactions are a relatively new occurrence, or the local public is unexperienced with how to live with cougars (e.g. Zone A).

Some studies have indicated a relationship between intensive cougar removals and an increase in livestock depredation and human-cougar conflicts due to an influx of juvenile males (Cunningham et al. 1995, Peebles et al. 2014). Male cougars can be associated with damage (Torres et al. 1996) and it is generally accepted that juveniles of most wildlife species have a higher probability of conflict. However, research results vary and a good deal of uncertainty remains on the topic. Due to higher energy requirements, female cougars with young kittens were more likely to enter urban environments in search of wild or domestic prey in the front range of Colorado (M. Alldredge, Colorado Department of Parks and Wildlife, personal communication). Kertson et al. (2013) studied cougar–human interactions in western Washington and reported that interactions were associated with individual behavior and not necessarily a product of a demographic class. Regarding relationships between take and conflict, Hiller et al. (2015) used Oregon data to model cougar conflict and suggested that conflict (measured by cougars taken on damage) decreased with increasing hunter-harvest or at worst remained constant at low to average cougar densities. Also, complaints are low in areas with historically high harvest (Zone E, Table 10), and all complaints and cougars taken on damage declined following target area removals (Table 12).

Table 11. Cougar complaints by category as reported to ODFW, 2007-2016. Cougar sightings are not included in records. Data as of May 1, 2017 and subject to change as new information becomes available.

Year	Livestock	Human Safety	Pets	Other	Total
2007	169	155	51	78	453
2008	166	236	41	72	515
2009	157	194	37	44	432
2010	167	230	30	38	465
2011	206	217	34	43	500
2012	190	181	36	12	419
2013	194	128	19	18	359
2014	184	172	27	21	404
2015	217	190	27	10	444
2016	222	161	28	10	421

Table 12. Cougar complaints received by ODFW before, during, and after target area implementation where cougars were removed to reduce conflict. Complaints through 2016 were available, therefore quantifying complaints 4- and 5-years post-treatment for target areas ending in 2013 was not possible.

Target Area	Years of Removals	Pre-Treatment			During Removals	Post-Treatment		
		5 Years	4 years	3 years		3 years	4 years	5 years
Beulah	2007-2010	48	39	25	12	13	16	16
Heppner	2007-2009	7	4	4	4	4	4	6
Jackson	2007-2009	642	533	417	199	229	282	351
Steens	2010-2013	5	4	3	1	0	*NA*	*NA*
Ukiah	2009-2013	14	12	9	3	1	*NA*	*NA*
Warner	2009-2013	24	22	13	9	4	*NA*	*NA*
Wenaha	2010-2013	14	11	9	3	3	*NA*	*NA*

Survival

Information on kitten survival is highly variable and is likely due to substantial differences between study areas, small sample sizes, and bias associated with the initial age of kitten monitoring (i.e. days old vs. months old). The largest study of kitten survival in North America (N = 157) yielded annual survival estimates of 0.64 (New Mexico; Logan and Sweanor 2001). ODFW researchers collected kitten survival data in northeast and southwest Oregon and observed kitten annual survival rates ranging from 0.66 to 0.79 (Clark et al. 2015). Those estimates are similar to values reported in one Washington study (0.72; Cooley et al. 2009b) but are higher than rates reported in California (0.45–0.52; Beier and Barrett 1993), Greater Yellowstone Ecosystem (0.46–0.59; Ruth 2004b, Ruth et al. 2011), Montana (0.42; DeSimone and Semmens 2005), Idaho (0.42; Lopez-Gonzalez 1999) and other Washington studies (0.57; Lambert et al. 2006, 0.59; Robinson et al. 2008, 0.31 Cooley et al. 2009b).

Cougars have been radio-collared in Oregon since 1989, which provided an opportunity to conduct a retrospective analysis to assess causes of mortality and estimate cougar survival rates. Cougars were monitored in three distinct study areas: 1) Catherine Creek in northeast Oregon (1989-1996), Jackson Creek in southwest Oregon (1993-2002), and Wenaha, Sled Springs, and Mt. Emily (WSM) in northeast Oregon (2002-2011). Hunting mortality was the most common cause of death of cougars at the Catherine Creek and WSM study areas. In contrast, natural mortality was the most common cause of death at Jackson Creek. Survival rates of adult males during the Catherine Creek study when hunting cougars with dogs was legal, was substantially lower (0.57) than observed in either Jackson Creek (0.78) or WSM (0.82) when hunting cougars with dogs was illegal (Clark et al. 2014). Survival rates of adult females were similar at Catherine Creek (0.86), Jackson Creek (0.85), and WSM (0.85) regardless of hunting regulations (Clark et al. 2014). Sub-adult male cougars had lower survival rates than adult males, but sub-adult females had similar survival rates as adult females. These survival rates are some of the highest reported in western North America (Table 13).

Table 13. Summary of gender-specific point estimates of sub-adult and adult cougar survival under various hunting regulations in western United States during 1988 – 2011. Table from Clark (2014).

	Survival rate				Management		
	Sub-adult		Adult				
State	Male	Female	Male	Female	Hunted	Dogs allowed	Source
Arizona	NA	NA	0.12 - 1.00	0.00 - 0.81	Yes	Yes	Cunningham et al. 2001
Montana	NA	NA	0.29	0.65	Yes	Yes	Ruth 2004
New Mexico	0.56	0.88	0.91	0.82	No	NA	Logan and Sweanor 2001
Oregon	0.56	0.86	0.56	0.86	Yes	Yes	Clark et al. 2015- Catherine Creek
	0.86	0.86	0.86	0.86	Yes	No	Clark et al. 2015- Catherine Creek
	0.6	0.89	0.78	0.85	Yes	Yes[b]	Clark et al. 2015 - Jackson Creek
	0.45	0.88	0.82	0.84	Yes	No	Clark et al. 2015 – Wenaha, Sled- Springs, Mt. Emily
Utah	NA	NA	NA	0.71	Yes	Yes	Lindzey et al. 1988
Washington	0.34	0.34	0.33	0.77	Yes	Yes	Lambert et al. 2006
	0.63	0.59	0.34	0.67 - 0.73[c]	Yes	Yes	Robinson et al. 2008
	0.51	0.76	0.64	0.87	Yes	No	Cooley et al. 2009a
	0.54	1	0.45	0.66	Yes	Yes	Cooley et al. 2009b

[a] Range of annual survival estimates.

[b] Hunting cougars with dogs was legal during the first 2 years of the study and illegal the last 8 years of the study. No differences in survival were observed between changes in hunting regulations.

[c] Lower estimate is for females > 6 years old. Upper estimate is for females 4 - 6 years old.

Growth Rates

Clark (2014) estimated population growth rates for cougars in northeast Oregon. Empirical estimates of cougar vital rates were used to build a model to estimate deterministic and stochastic population growth rates. This was done for two different time periods: when hunting cougars with dogs was legal (1989-1994) and illegal (2002-2011).

Mean growth rates from model estimates all exceed 1.0, indicating a growing population. Model cougar populations in northeast Oregon that were hunted with dogs increased at a deterministic growth rate of 1.18 and a mean stochastic growth rate of 1.21. Similarly, model cougar populations subjected to hunting without dogs increased at a rate of 1.17 per year under both deterministic and stochastic population models. Given that hunting cougars with dogs typically results in increased harvest and reduced survival rates of cougars, it was unexpected that the cougar population subjected to hunting with dogs was increasing at a faster rate than one that was not hunted

with dogs. However, cougar populations in Oregon were subjected to low harvest rates when hunting cougars with dogs was legal and harvest was male biased. This resulted in high survival rates of female cougars and as population growth rates were seen to be most sensitive to changes in female survival, high population growth rates occurred.

Wildlife management objectives can include a stationary population (i.e., growth rate = 1.0) (Beausoleil et al. 2013). To create a model cougar population with a growth rate of 1.0, Clark (2014) found that mean annual survival rates of both sexes and all age classes of cougars could be reduced as much as an additional 12% compared to survival estimates at that time. Given the success rates of cougar hunting without the use of dogs, that level of mortality is highly unlikely to occur in northeast Oregon.

Oregon Cougar Research

Cougar research has been conducted in Oregon for many decades (Table 14) and ODFW has conducted four research projects one with two separate study sites (Figure 7). Research has provided information for many biological parameters needed to model cougar populations, establishing population density in two management zones, and greater understandings of the relationship between cougars and their prey.

Catherine Creek Study

ODFW initiated a study in the Catherine Creek WMU (Union County, Figure 7) in 1988 to determine cougar population density. Additional objectives included documenting cougar diet productivity, survival, dispersal, and effects of hunting on the population. Hunting regulations at that time included controlled hunting and use of dogs.

Between January 1989 and April 1995, 72 cougars were captured and 58 individuals were radio-collared during seven capture seasons. Thirty-eight bi-monthly telemetry flights were conducted between December 1991 and July 1993 to estimate the cougar population. Population estimates showed seasonal differences that likely reflected the migratory nature of the cougar prey base, primarily mule deer and elk. The average minimum population estimate for the WMU during the summer-fall period was 23.6 cougars (range 20-27). The winter-spring average minimum population estimate was 16.8 (range 8-23). The average annual minimum population estimate was 19.3 (range 8-27). Twelve adult females produced 19 litters with 42 kittens (14M, 24F and 4 unclassified). Litter size averaged 2.21 with births documented during all months except May and November. Peak birth months were March and September. Age at first breeding for three known age adult females was 21, 22, and 23 months.

Twenty-seven mortalities of radio-collared cougars were documented. Five different mortality causes were determined, with hunting accounting for 67% of all cougar deaths. Documented deaths did not all occur within the study area, but included radio-collared cougars that dispersed or were otherwise outside the study area boundary. Hunting accounted for 18 cougar deaths within the study boundary and included 11 radio-collared and seven unmarked cougars.

Jackson Creek Study

In December 1993, ODFW initiated the Jackson Creek study (Douglas County, Figure 15) to determine cougar population parameters in the south Cascades. A total of 113 cougars (58 male, 55 female) were captured and radio-collared during 11 capture periods between December 1992 and May 2003. When the study ended in 2004, 33 cougars were being monitored, 65 had died (37 males, 28 females) and 15 were unaccounted for (transmitter failure was suspected in some cases). Regulated hunting during the study varied greatly. During the first 2 years, hunting was regulated

via controlled hunt drawing with limited tags and the use of dogs was legal. After passage of Measure 18 in 1994, use of dogs was prohibited statewide and cougar hunting opportunity has gradually shifted to longer, general cougar seasons and increasing numbers of cougar tags. Cougar density estimates on the Jackson Creek study ranged from 13.9 total cougars/100 mi^2 in 1999 to 7 total cougars/100 mi^2 in 2001.

Percentage of mortalities due to a single cause varied annually. Prior to Measure 18 in 1994, legal harvest was the highest mortality cause. After 1997, natural mortality (particularly disease/parasites) was the highest mortality cause for adult and sub-adult cougars. Between May 2000 and June 2002, 14 natural-caused mortalities were documented. During the early study years (1993- 1997) the percentage of radio-collared cougars that died annually was variable, and reached nearly 70% during 1996 when eight of 12 radio-collared cougars died. During 1998-2002, more than 30 cougars were marked, and fluctuations in annual mortality were less erratic. Additional data analyses on capture, home range size and overlap, reproduction, sub-adult dispersal, population density estimates, age-specific survival rates, and causes of mortality are currently being conducted.

Toketee, Steamboat, and Sled Springs-Wenaha Project (Elk Nutrition-Predation Study)

In northeast Oregon, elk recruitment (calf:cow ratio) has declined from >50 calves per 100 cows to < 20 calves per 100 cows in some management units. Concomitantly, elk populations have declined below management objectives in spite of management efforts to increase both recruitment and population numbers. In contrast, in southwest Oregon, the calf:cow ratios have traditionally been around 30 to 40 calves per 100 cows, and populations have been stable (southwest Oregon). Possible explanations for these disparate results have included simple random events causing populations to fluctuate naturally; density-dependent limitations of elk population size as habitat conditions have changed; and elk population declines as a result of increased predator abundance. This research was designed to examine how two factors, carnivore (black bear, cougar) density and elk nutritional condition may act independently or interact to affect calf recruitment. Elk nutritional condition and landscape carrying capacity was used as a surrogate to habitat quality. This research approach was conducted in both northeast and southwest Oregon (Figure 7) to provide a broad geographic and physiographic contrast.

The cougar component of this research had two primary objectives: (1) to estimate movements, survival, and densities of cougar on the study sites in southwest and northeast Oregon, and (2) to test whether predation by cougars is an additive or compensatory source of mortality for elk calves in southwest and northeast Oregon. Methods included capturing and radio-collared cougars within the study sites and estimating densities based on home range size, movements, and capture effort. Cougar densities of sub-adult females and adult males and females in the Toketee study areas varied between 2.4 to 5.8 cougars per 100 mi^2 (0.91 to 2.24 cougars/100 km^2). In the Sled Springs-Wenaha study sites, subadult females and adult male and female cougar densities varied between 5.8 to 11.1 cougars per 100 mi^2 (across 2 study areas from 2001 to 2008. Average density was 8.6 cougars per 100 mi^2 (3.3 cougars/100 km^2) for the 6 years. Applying the average density across Sled Springs or Wenaha Wildlife Management Units, the estimated cougar population was 100 cougars including sub-adult females, adult males, and adult females. Sub-adult males were not included in the estimate because they were transient (not permanent resident within the study area). Hunting was the most common source of cougar mortality during this study and high levels of human harvest at a localized scale translated into reductions in cougar density. Survival of radio-collared juvenile elk increased as cougar density decreased. The highest survival rates of elk calves were in the Toketee study area where cougar density was the lowest of the four study sites. These

two research projects have resulted in the completion of one Master's of Science degree through Oregon State University, four papers published in peer reviewed journals (additional manuscripts are being prepared or are in review), and numerous presentations at professional meetings.

Mt. Emily Project

The most recent cougar research project implemented by ODFW is the Mt. Emily project conducted during 2009–2012 in northeast Oregon (Figure 7). This project was developed with five primary objectives: 1) to investigate the diet, kill rates, and prey selection of cougars; 2) to develop methods to estimate cougar populations; 3) to compare survival and mortality patterns of cougars from 3 studies conducted from 1989 to 2011; 4) to develop a population model for cougars that can be used to evaluate management scenarios that incorporates hunting, immigration, and emigration; and 5) to develop a population model for elk incorporating cougar predation rates and nutritional components for elk. Data collection has been completed for these objectives.

ODFW captured and radio-collared 25 adult cougars with GPS collars to identify potential kill sites through field investigation of clustered locations of individual cougars. The results of this study indicated cougars killed more frequently during summer when their diets were dominated by juvenile ungulates, females killed more frequently than males, and females with kittens killed more frequently than those without kittens. Female cougars had a larger percentage of deer in their diets (~80%) than males (~50%). While deer comprised about 70% of the prey items, cougars did not show selection for any age or sex class of deer during summer, but selectively preyed upon fawns during winter. Cougars did show a strong selection for elk calves during summer, but did not show patterns of selection for any age class or sex of elk during the remainder of the year. A manuscript describing this objective was published in the Journal of Wildlife Management (i.e., Clark et al. 2014).

A second manuscript was also published in the Journal of Wildlife Management (i.e., Davidson et al. 2014) on a method to estimate cougar populations using DNA samples from cougars. In this work, innovative methods were developed that relied on using dogs trained to locate cougar scat from which DNA could be isolated to identify individuals. Density estimates were among the highest reported in western North America (*see* Density section). Using recent statistical advances in estimating populations, this method may provide a useful tool to estimate cougar populations. Rather than relying on multiple-year capture-recapture efforts, cougar population estimates can be obtained in less than 1 year.

To date the Mt. Emily cougar research has resulted in one Ph.D. being granted through Oregon State University, three published manuscripts, one manuscript is in the peer review process, two additional manuscripts are being prepared, and there have been numerous presentations at professional meetings.

Other Projects and Analyses

A third and fourth manuscript were published in the Journal of Wildlife Management (i.e., Clark et al. 2014) and Northwest Science (i.e., Clark 2011), respectively, from the Mt. Emily study and other studies. These manuscripts summarize survival rates of cougars under different management scenarios (pre- and post-Measure 18) by sex and age class. Survival rates of male cougars varied across three study areas (Catherine Creek 1989–1997; Jackson Creek 1993–2001, Wenaha-Sled Springs-Mt. Emily 2001–2012); with male survival lowest during periods it was legal to hunt cougars with dogs. Survival rates of female cougars and cougar kittens were similar among study areas. Human-caused mortality was the primary cause of mortality in northeast Oregon

(~70%), regardless of whether it was legal to hunt cougars with dogs, however, disease and natural mortality were the primary causes of cougar mortality (~70%) in southwest Oregon. Survival rates in both areas were similar, suggesting cougar harvest is at least partially compensatory for natural mortality. Further, survival rates of radio-collared cougars in the post-Measure 18 era in Oregon are high and only slightly below survival rates reported for cougar populations that were lightly hunted in and adjacent to Yellowstone National Park (Ruth 2004, Ruth et al. 2011) and in the San Andres Mountains, New Mexico (Logan and Sweanor 2001). The high survival rates of cougars in Oregon provide evidence that cougar populations are sustainable and not threatened by hunting.

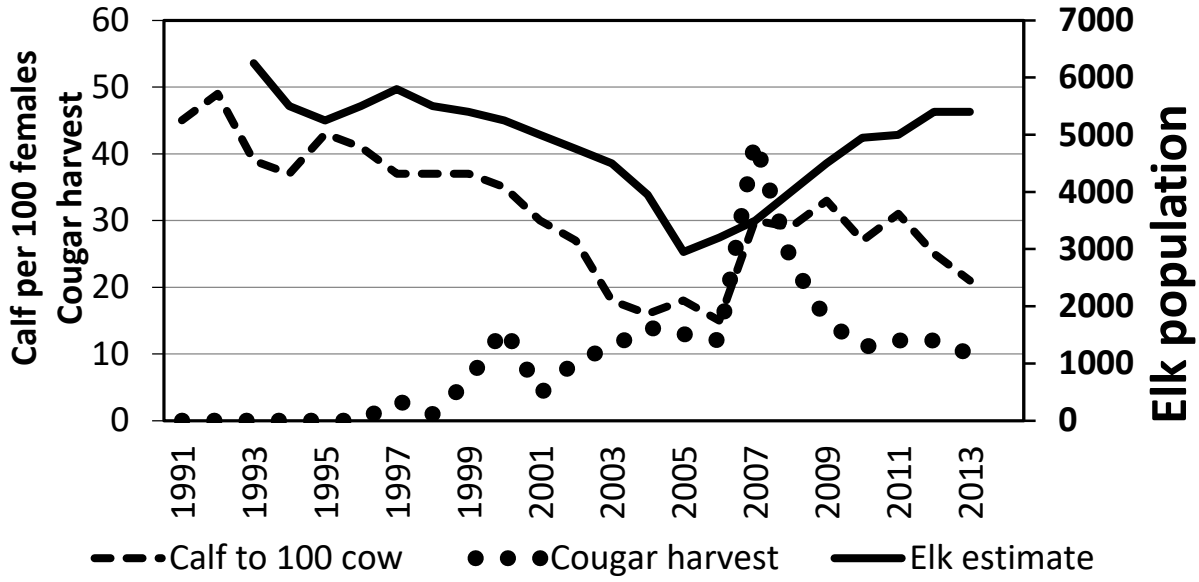


Figure 6. Trend in elk population and cougar harvest for the Heppner Cougar Target Area.

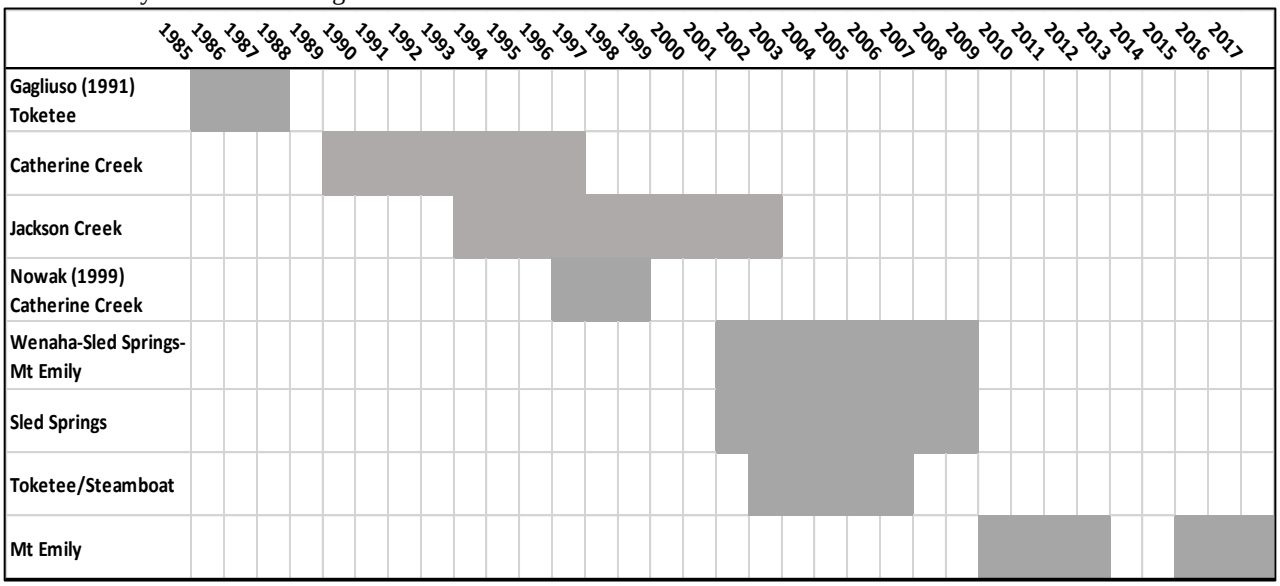
A fourth analysis (Chapter 5 *in* Clark 2014) estimates cougar population growth rates under a variety of management scenarios and how quickly a local cougar population can recover from heavy exploitation such as demonstrated in the Heppner Target area (Appendix J). Evaluation of data from the Heppner target area indicated that with removal of 50% of cougars, the elk population responded rather quickly (Figure 6). Observed calf ratios increased from the teens to the low 30's. The elk population increased from about 3,000 to over 5,000. Modeling incorporated information from the body of cougar research conducted in Oregon and adjacent states. Results indicate that even in the absence of immigration, cougar populations can recover to pre-reduction numbers within a little as five years. With moderate rates of immigration, cougar populations can recover within about two to three years.

Finally, and expanded analysis of combined elk and cougar population data from multiple units within the region suggests that elk population growth rates are most sensitive to survival of adult females but variability in growth rates is best explained by variability in calf survival. Hunter harvest of cows, and cougar density explained the majority of variation in adult female survival and calf survival, respectively, and ultimately on population growth rates of elk. Pregnancy rates of adult females and other abiotic factors had minimal effects on elk population growth.

The Mt. Emily project was restarted in late 2014, with data collection continuing into 2017. The current research is occurring following the establishment of wolves in the Mt. Emily WMU.

The objectives of the current research are to determine the effects of wolves on cougar diets, kill rates, habitat use, survival, and densities. Any potential changes that are observed will guide cougar management in the presence of wolves and identify potential effects on deer and elk populations.

Table 14. Time span of substantial field-based cougar research projects conducted in Oregon. The Mt. Emily study is still underway at time of writing.



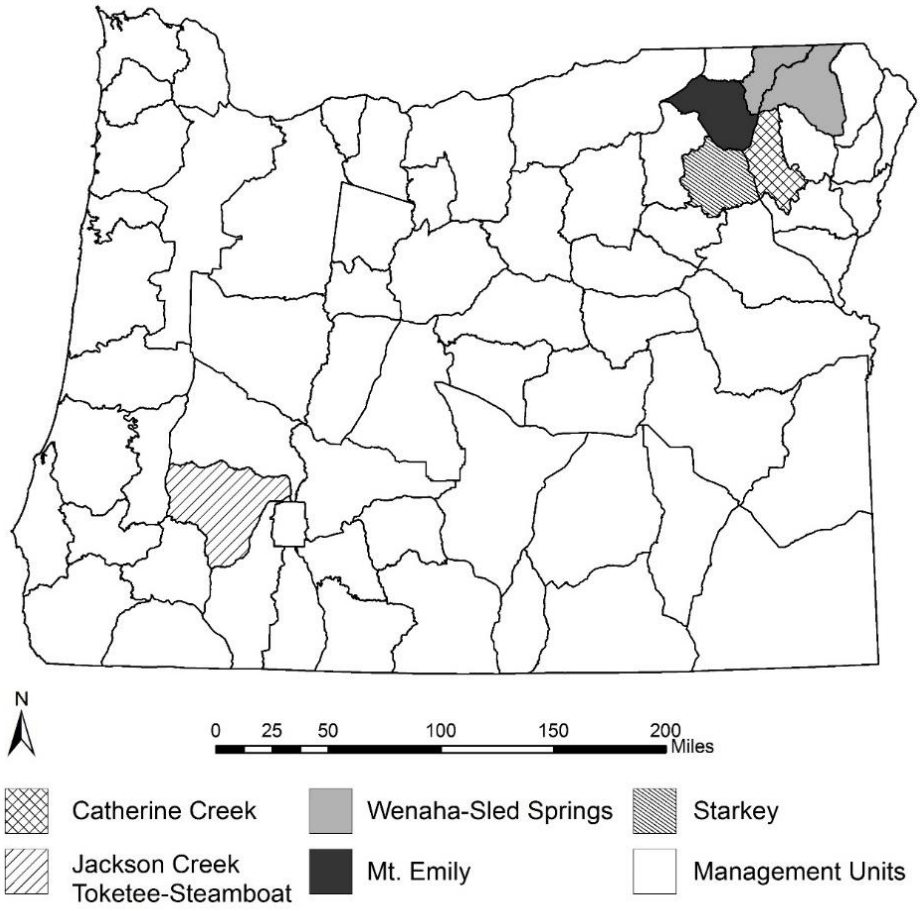


Figure 7. Locations of Oregon study areas where cougars were researched and monitored. Major ODFW projects include the Catherine Creek study (1989-1996), the Jackson Creek study (1993-2002), the Toketee and Steamboat Studies (2002-2006), the Wenaha-Sled Springs-Mt. Emily Study (2002-2011), and the Mt. Emily Study (2009-2012 and 2015-2017). Non-ODFW studies include Gagliuso (1991) who monitored cougars from 1985-1987 in the Toketee area and Nowak (1999a) who monitored cougars from 1996-1998 in the Catherine Creek area.

On-going and Upcoming Projects

Additional research was initiated in 2017 in and adjacent to the Starkey Experimental Forest and Range. The objectives of this research are to: 1) identify the role of cougar predation on mule deer populations, 2) develop and modify techniques to non-invasively estimate cougar and other carnivore populations, and 3) document competitive interactions between cougars and other native carnivore species.

An effort to quantify cougar density in portions of the Dixon, Evans Creek, Indigo, and Melrose WMUs of southwest Oregon is currently underway. This study uses DNA collected from treed cougars using biopsy darts that collect a tissue sample without killing the cougar. Those samples and samples collected from cougar mortalities are used in a mark-recapture analysis.

A cougar study will begin in the fall of 2017 in the Alsea WMU, which is located in the mid-coast range west of Corvallis. The objectives of this research are to: 1) identify cougar densities through telemetry and scat dog analysis, 2) identify home range size of adult cougars, and 3) identify diet through scat analysis.

Published Literature/Reports on Cougars in Oregon

A number of studies or reports on Oregon cougars have been completed since 1971 and are listed below:

Akenson J. A., M. C. Nowak, M. G. Henjum, and G. W. Witmer. 2003. Characteristics of mountain lion bed, cache and kill sites in northeastern Oregon. pages 111-118 in S. A. Becker, D. D. Bjornlie, F. G. Lindzey, and D. S. Moody editors, Proceedings of the Seventh Mountain Lion Workshop. Lander, Wyoming.

Brodie, J., H. Johnson, M. Mitchell, P. Zager, K. Proffitt, M. Hebblewhite, M. Kauffman, B. Johnson, J. Bissonette, C. Bishop, J. Gude, J. Herbert, K. Hersey, M. Hurley, P. M. Lukacs, S. McCorquodale, E. McIntire, J. Nowak, H. Sawyer, D. Smith, and P. J. White. 2013. Relative influence of human harvest, carnivores, and weather on adult female elk survival across western North America. Journal of Applied Ecology 50:295-305.

Carter, C.N. 1998. Fiscal effects of voter initiatives to ban certain methods of bear and cougar hunting: Oregon's experience. Human Dimensions of Wildlife 3(2):29-41.

Chinitz, A.E. 2002. Laying the groundwork for public participation in cougar management: a case study of southwestern Oregon (*Puma concolor*). M.S. Thesis, University of Oregon, Eugene, OR. 158 pp.

Clark, D. A. 2014. Implications of cougar prey selection and demography on population dynamics of elk in northeast Oregon. PhD Dissertation. Oregon State University, Corvallis, Oregon.

Clark, D. A., G. A. Davidson, B. K. Johnson, and R. G. Anthony. 2014. Cougar kill rates and prey selection in a multiple-prey system in northeast Oregon. Journal of Wildlife Management 78:1161-1176.

Clark, D. A., B. K. Johnson, and R. G. Anthony. In Prep. Population growth rates and simulated responses of cougar populations to density reduction under variable immigration and emigration. Wildlife Biology.

Clark, D. A., B. K. Johnson, and R. G. Anthony. In Prep. Response of a large herbivore to top-down and bottom up forcing. Journal of Applied Ecology.

Clark, D. A., B. K. Johnson, D. H. Jackson, M. Henjum, S. L. Findholt, J. J. Akenson, and R. G. Anthony. 2014. Survival Rates of Cougars in Oregon From 1989 to 2011: A Retrospective Analysis. Journal of Wildlife Management 78:779-790.

Clark D. A., B. K. Johnson, and D. H. Jackson. 2015. Monthly and annual survival rates of cougar kittens in Oregon. Northwest Science 89:393-400.

Cook, R. A., J. G. Cook, D. J. Vales, B. K. Johnson, S. M. McCorquodale, L. A. Shipley, R. A. Riggs, L. L. Irwin, S. L. Murphie, B. L. Murphie, K. A. Schoenecker, F. Geyer, P. Briggs Hall, R. D. Spencer, D. Immell, D. H. Jackson, B. L. Tiller, P. J. Miller, and L. Schmitz. 2013. Regional and seasonal patterns of nutritional condition and reproduction in elk. Wildlife Monographs 184:1-45.

Davidson, G. A., D. A. Clark, B. K. Johnson, L. P. Waits, J. R. Adams. 2014. Estimating cougar densities in northeast Oregon using conservation detection dogs. Journal of Wildlife Management 76:1104-1114.

Ebert, P.W. 1971. The status and management of the felids of Oregon. Pgs. 68-71 *in*: Jorgensen, S.E. and L.D. Mech. Proc. of a Symposium on the native cats of North America, their status and management. U.S. Dept. Int., Fish and Wildlife Service, Twin Cities. MN.

Findholt, S. L., and B. K. Johnson. In revision. Estimating cougar population abundance in northeast Oregon: a comparison of two methods. Wildlife Society Bulletin.

Gagliuso, R.A. 1991. Habitat Alteration and human disturbance: their impact on cougar habitat utilization in southwest Oregon. M.S. Thesis. Oregon State Univ., Corvallis. 112 pp.

Griffin, K. A. M. Hebblewhite, H. S. Robinson, P. Zager, S. M. Barber-Meyer, D. Christianson, S. Creel, N. C. Harris, M. A. Hurley, D. H. Jackson, B. K. Johnson, W. L. Myers, J. D. Raithel, M. Schlegel, B. L. Smith, C. White, and P. J. White. 2011. Neonatal mortality of elk driven by climate, predator phenology and predatory community composition. Journal of Animal Ecology 80:1246-1257.

Harcombe, D. W. 1976. Oregon Cougar Study. Oregon Department of Fish and Wildlife, Portland, OR. 62 pp.

Hiller. T.L. and A.J. Tyre. 2014. Comparison of two age-estimation techniques for cougars. Northwestern Naturalist 65:77-82.

Hiller, T. L., J. E. McFadden-Hiller, S. R. Jenkins, J. L. Belant, and A. J. Tyre. 2015 Demography, Prey Abundance, and Management Affect Number of Cougar Mortalities Associated with Livestock Conflicts. Journal of Wildlife Management 79:978-988.

Ingram, R. 1984.Oregon-cougar status report. Pgs. 53-55 *in*: J. Roberson and F. Lindzey (eds.) Proc. of the Second Mountain Lion Workshop. Utah Div. Wildl. Res. and Utah Coop. Wildl. Research Unit. Zion National Park. 271 pp.

Jackson, D. H. In Prep. Dispersal characteristics of juvenile cougars in southwest Oregon. Northwest Science.

Johnson, B. K., P. K. Coe, R. L. Green. 2013. Abiotic, bottom-up, and top-down influences on recruitment of Rocky Mountain elk in Oregon: a retrospective analysis. Journal of Wildlife Management 77:102-116.

Johnson, B. K., D. H. Jackson, R. C. Cook, P. K. Coe, J. G. Cook, S. L. Findholt, S. N. Rearden, D. A. Clark, and J. H. Noyes. *In Review*. Roles of maternal condition and predation on survival of juvenile elk in Oregon. Wildlife Monographs.

Keister, G. P. Jr. and W. A. Van Dyke. 2002. A predictive population model for cougars in Oregon. Northwest Science 76(1):15-25.

Kohlmann, S.G. and R. L. Green. 1999. Body size dynamics of cougars (*Felis concolor*) in Oregon. Great Basin Naturalist 59(2): 193-194.

Lukacs, P. M., M. Hebblewhite, B. K. Johnson, H. Johnson, M. Kauffman, K. M. Proffitt, P. Zager, J. Brodie, K. Hersey, A. A. Holland, M. Hurley, S. McCorquodale, A. Middleton, M.S. Mitchell, M. Nordhagen, J. J. Nowak, D. P. Walsh, and P. J. White. In Review. Declines in juvenile elk recruitment across the western United States are associated with recolonizing predators, habitat, and climate conditions. Journal of Animal Ecology.

Maser, C. and R.S. Rohweder. 1983. Winter food habits of cougars from northeastern Oregon. Great Basin Naturalist 43(3):425-428.

Maser, C. and D.E. Toweill. 1984. Bacula of mountain lion (*Felis concolor*), and bobcat (*Felis rufus*). Journal of Mammalogy 65(3):496-497.

Musial, T. S. 2009. Evolutionary and landscape genetic structure of *Puma concolor* in Oregon. MS Thesis. Portland State University, Portland, Oregon 70 pp.

Nowak, M.C. 1999. Predation rates and foraging ecology of adult female mountain lions in northeastern Oregon. M.S. Thesis, Washington State Univ. Pullman, WA. 75pp.

Nowak, M.C., T.E. Taylor, and G.W. Witmer. 2000. Prolonged scavenging by a female mountain lion in northeastern Oregon. Northwest Naturalist 81(2):63-65.

Oregon Department of Fish and Wildlife. 1987. Oregon Cougar Plan. Oregon Department of Fish and Wildlife, Portland, Oregon. 23 pp.

Oregon Department of Fish and Wildlife. 1993. Oregon's Cougar Management Plan 1993-

1998. Oregon Department of Fish and Wildlife, Portland, Oregon. 33 pp.
Oregon Department of Fish and Wildlife. 2006. Oregon Cougar Management Plan. Oregon Department of Fish and Wildlfie, Salem, Oregon. 135 pp.
Rausch, R.L., C. Maser, and E.P. Hoberg. 1983. Gastrointestinal helminths of the cougar, *Felis concolor* L., in northeastern Oregon. Journal Wildlife Diseases 19(1):14-19.
Rearden, S. N. 2005. Juvenile survival and birth-site selection of Rocky Mountain elk in northeastern Oregon. M.S. Thesis. Oregon State University, Corvallis. 105 pp.
Rearden, S. N., R. G. Anthony, and B. K. Johnson. 2011. Birth-site selection and predation risk of Rocky Mountain elk. Journal of Mammalogy 92:1118-1126.
Toweill, D.E. 1986. Notes on the development of a cougar kitten. The Murrelet 67:20-23.
Toweill, D.E. and C.E. Meslow. 1977. Food habits of cougars in Oregon. Journal Wildlife Management 41(3):576-578.
Toweill, D. E. and C. Maser. 1985. Food of cougars in the Cascade Range of Oregon. Great Basin Naturalist 45(1):77-80.
Toweill, D. E., C. Maser, L.D. Bryant, and M.L. Johnson. 1988. Reproductive characteristics of eastern Oregon cougars. Northwest Science 62(4):147-150.
Toweill, D.E., C. Maser, M.L. Johnson, and L.D. Bryant. 1984. Size and reproductive characteristics of western Oregon cougars. Pgs. 176-184 *in*: J. Roberson and F. Lindzey (eds.) *In*: Proc. of the Second Mountain Lion Workshop. Utah Div. Wildl. Res. and Utah Coop. Wildlife Research Unit. Zion National Park. 271 pp.
Trainer, C.E. and G. Matson. 1989. Age determination in cougar from cementum annuli counts of tooth sections. Pg. 71 *in*: R.H. Smith (ed.) Proc. of the Third Mountain Lion workshop. Arizona Chapter, The Wildlife Society and Arizona Game and Fish Department, Prescott, Arizona. 88pp.
Tyre, A.J., T.L. Hiller, and J.E. McFadden-Hiller. In Prep. Using age-at-harvest population reconstructions for management of cougars in Oregon. Journal of Wildlife Management.
Van Dyke, W.A. and M. Henjum. 1983. The cougar in northeastern Oregon. Oregon Wildlife 38(3):8-10.

Additionally, there are several Federal Aid in Wildlife Restoration annual reports prepared by ODFW staff related to cougar research in Oregon.

Population Modeling & Trends

Use of population models for wildlife management is a common practice where possible. Models have routinely, and successfully, been used for elk, deer, and pronghorn in Oregon and other western states. Properly used, models are tools to help make management decisions and model reliability depends on quality of input data, which often depends on sample size. Often times trends and indices of abundance, products of population models, are far more prudent and useful than exact population estimates (Caughley 1997).

Deterministic Model

Since 1995, ODFW has used a published, deterministic, density-dependent population model to monitor cougar populations (Keister and Van Dyke 2002). The model is used for evaluating short-term harvest scenarios, as recommended in the Cougar Management Guidelines (2005, page 58). The cougar model utilizes extensive, long-term data collected from cougars in Oregon. The model incorporates measured productivity and observed mortality (all sources including illegal take) to calculate changes in the cougar population. A model sensitivity analysis was completed to determine

factors most important in affecting population change and to give an indication of model precision. During the sensitivity analysis, model performance was consistent with changes in the biological parameters used in the model.

During development of the 2006 Plan, the Keister and Van Dyke (2002) model was updated with new data collected in Oregon and again tested for performance and validity (see Oregon Department of Fish and Wildlife 2006 for testing techniques). In addition, models were created for each of six cougar zones and each model incorporates zone-specific parameters such as habitat and density. The statewide cougar population estimate is the sum of the six zone estimates. Each zone model is updated annually using cougar mortality data and any new biological information if available. Because the model reconstructs past populations, enough time must have passed to include all ages of cougars present at that time. Therefore, caution should be used when considering use of recent year estimates for management decisions. These zone and statewide estimates provide insight on population trends and determining potential impacts of management activities and mortality sources, but less attention is given to exact population estimates.

The model has indicated growing cougar populations across the Oregon for many years (Figure 8). When considering all the research and biological information available such as mortality rates, proportions of adult females in total mortalities, age structure, survival rates, growth rates, distribution, densities, reproductive rates, and other factors, the model's indication of growing cougar populations is thoroughly supported. Published literature also supports the model's suggested growth, particularly those identifying population responses to varying mortality rates. Oregon estimated mortality rates fall far-below the rates reported to reduce population growth rates to below 1.0 (i.e. population decline) (Anderson and Lindzey 2005, Robinson et al. 2014, Cooley et al 2009a,b, Choate et al. 2006, Lambert et al. 2006, Stoner et al. 2006, Wolfe et al. 2015).

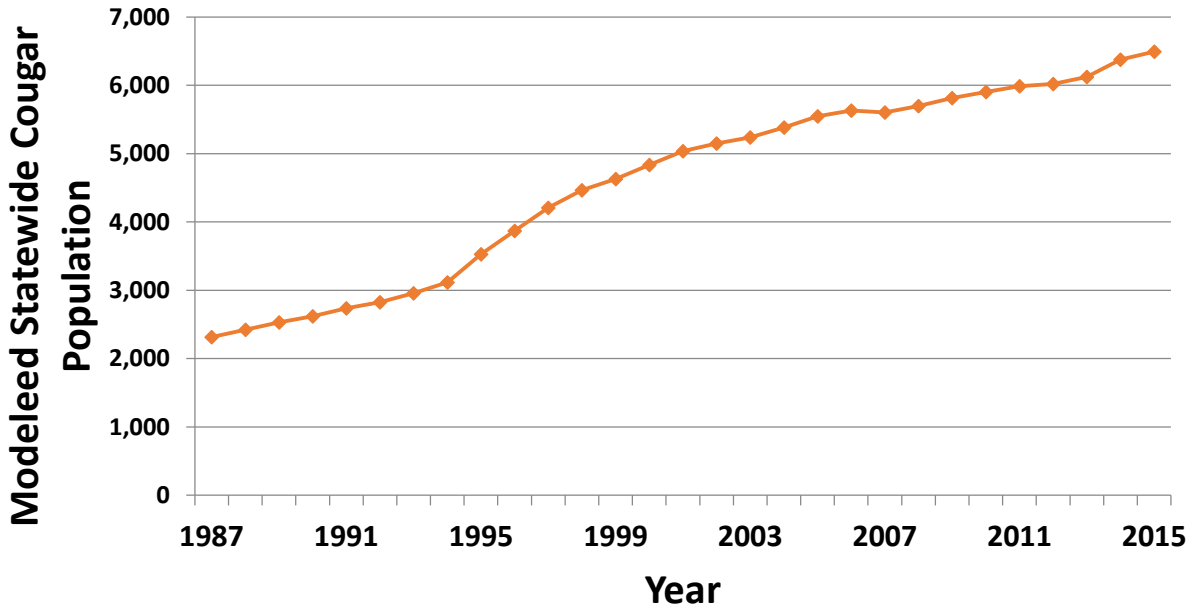


Figure 8. Modeled statewide population abundance of cougars in Oregon during 1987–2015, based on results from the deterministic, density-dependent population model.

The deterministic model includes a density-dependent factor that results in a slowing of cougar growth rates as population numbers begin to reach the maximum number the area can support (i.e. carrying capacity). That estimate of carrying capacity is the product of cougar density and habitat. The statewide maximum cougar estimate is approximately 7,609 cougars across all age classes (~3,800 adults), but this estimate could change should new information on densities or habitat become available. The statewide model estimate for 2015 was 6,493 cougars across all age classes (~3,300 adults) (update April 2017). After decades of population growth, cougar populations in 5 of 6 zones are nearing those maximum levels and therefore the model suggests populations are relatively stable (Figure 8, Figure 9). In Zone A, however, the model suggests populations are growing, as 2015 estimates are roughly 63% of the zone maximum (Table 15).

Table 15. 2015 cougar zone and statewide population estimates relative to maximum cougar estimates (i.e., carrying capacity) for each area. Estimates include all cougar age classes. Based on model estimates (April 2017), Oregon cougar populations are at 85% of estimated statewide carrying capacity.

	Zone A	Zone B	Zone C	Zone D	Zone E	Zone F	Statewide
2015 Population Estimate	989	1,475	1,001	384	1,698	946	6,493
Estimated Maximum	1,568	1,567	986	466	2,037	985	7,609
Proportion Maximum	0.63	0.94	1.02	0.82	0.83	0.96	0.85

Confidence intervals allow an interpretation of the accuracy of an estimate and the impact of variability from demographic and environmental components. Because there is no random variability in a deterministic model, it is not possible to calculate intervals for the population estimate. Species other than cougar, which are more visible and lend themselves to direct estimation methods on an annual basis, are usually modeled with stochastic models that incorporate demographic and environmental variability. Nevertheless, one effort to create a stochastic model for Oregon cougars is currently being conducted by non-ODFW researchers (Tyre and Hiller *in prep*). Assuming the model performs well and is valid, it would serve as another tool for monitoring and evaluating Oregon cougar populations.

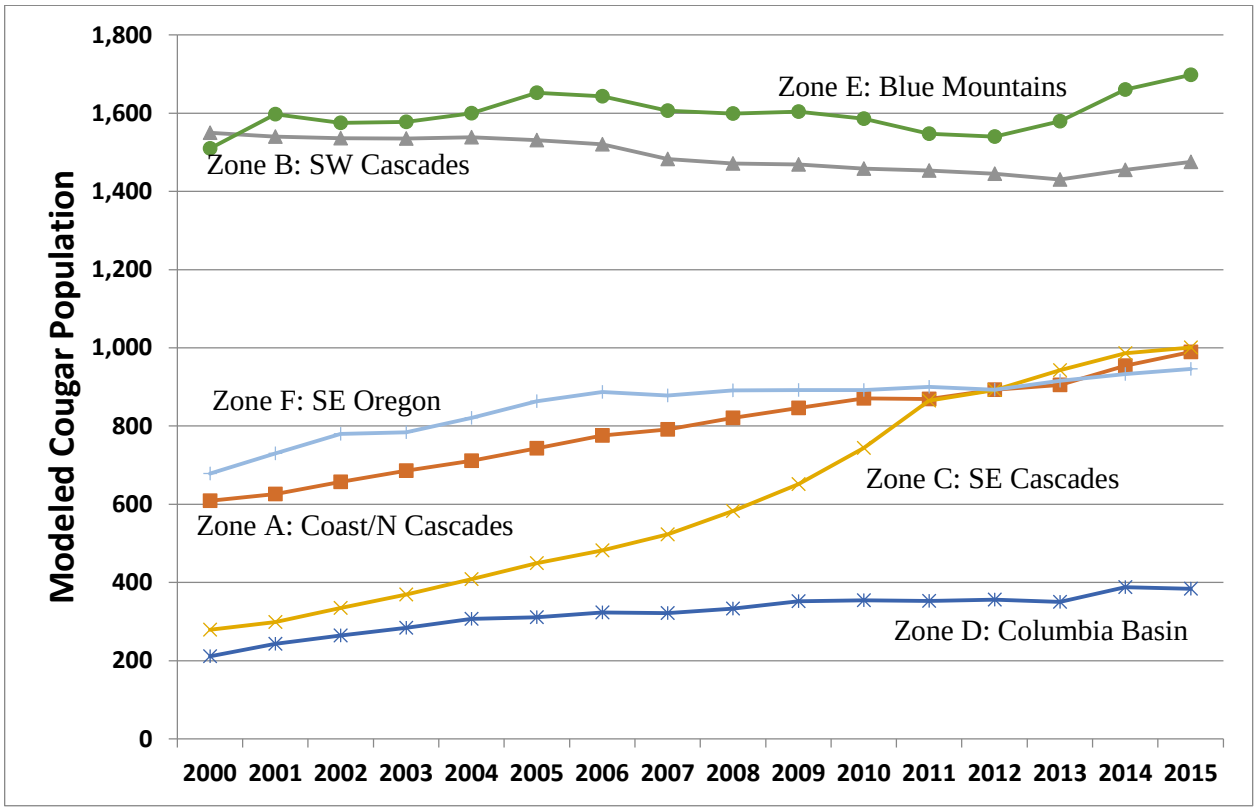


Figure 9. Estimated zone-level population abundance of cougars in Oregon during 2000–2015, based on results from deterministic, density-dependent population model.

CHAPTER III: COUGAR MANAGEMENT OBJECTIVES

In accordance with the Wildlife Policy (ORS 496.012), the purpose of this plan is to maintain cougar populations while managing cougar conflicts with humans, livestock, and other game mammals. In addition to meeting ODFW's statutory obligation, the following objectives 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 the species in Oregon. Objectives 2-4 address major types of cougar conflict. The four objectives are intended to be independent of each other. If objectives 2–4 can be achieved, the cougar population can be any number higher than the minimum objective of 3,000.

Objective 1: ODFW will manage for stable cougar populations that are not fall below 3,000 cougars statewide.

Assumptions and Rationale

Cougars are secretive in nature and occur at low densities, so determining population size, health, and threats is challenging. ODFW data (mortality records, modeling, etc.) indicate Oregon's cougar populations are stable or increasing, and present numbers far exceed levels threatening to population viability. Application of existing Population Viability Analysis (PVA) models (STOCHMVP, INMAT2A, *see* Dennis et al. 1991 and Mills and Smouse 1994) to Oregon cougar data suggests that the previous minimum population threshold of 3,000 cougars (all age classes) and the modeled population estimate of 6,400 in 2015 (model updated April 2017) are much greater than the minimum number of individuals required for genetic and/or demographic viability. Nonetheless, continued efforts to sample and monitor cougar populations (e.g. spatial capture-recapture modeling, GPS telemetry) are desired.

The current habitat and prey populations in Oregon are sufficient to support a cougar population many times greater than the minimums reported above and are key to long-term persistence of the cougar population. Cougars are carnivores and rely on elk and deer in Oregon as primary prey. Thus, maintaining healthy elk and deer populations insures an adequate prey base for sustainable cougar populations. About 50% of Oregon's land base is in public ownership. Much of this area is contiguous elk and deer habitat that also is suitable cougar habitat. Further, scattered throughout Oregon are designated wilderness areas, wild and scenic rivers, and other areas where human access is limited and little cougar mortality occurs. These areas likely function as population sources in a cougar metapopulation, supplementing cougars to population sinks (i.e., areas of high cougar mortality). As human population expansion and habitat loss continues, identifying and ensuring connectivity between habitats, sources, and sinks is essential to cougar management.

The growing presence of wolves in Oregon creates uncertainly when estimating cougar populations and carrying capacity. Multiple techniques have been used to estimate cougar populations and when possible, density estimates derived from nearby cougar studies have been used. Until recently, all those investigations occurred in the absence of wolves. Until it is understood how cougar populations will respond to the establishment of wolves, caution must be taken when estimating future cougar populations, carrying capacity, and determining acceptable minimum and maximum population thresholds.

The Fish and Wildlife Commission's direction in June 1995 was to stabilize the statewide cougar population at the estimated 1994 level of approximately 3,000 cougars of all ages. Attempts to satisfy the directive to stabilize the population were unsuccessful, and the statewide population has since more than doubled. Rather than a population objective, the 3,000 level has instead served

as a biological 'safety net' to ensure cougar population resiliency. Retaining a minimum population threshold is important to cougar management, but acceptable cougar population levels are dependent on individual perspectives. Adjusting that minimum threshold and identifying a maximum has been of interest to stakeholders. While adjusting or creating thresholds has been considered, the uncertainty of cougar population responses to increasing wolf numbers quickly suspends the exercise. Once the relationship between those two apex predators and other factors (changes in climate and habitat) are better understood in Oregon, new thresholds could be evaluated and considered. Until that time, a minimum threshold of 3,000 cougars of all age classes will continue as a statewide population safety net. With adequate control of conflict, the cougar population may be any number higher than the minimum objective of 3,000.

Actions

1.1 Continue to authorize cougar hunting seasons in a manner that meets ODFW's statutory mandates to maintain the species and provide consumptive and non-consumptive recreational opportunities.

1.2 Continue the mandatory check of all harvested cougars.

1.3 Continue using sex, age, and reproductive data collected from all known mortalities to monitor cougar population status.

1.4 Manage cougars to ensure functional metapopulations:

a) by utilizing GIS analyses (Figure 5) to evaluate habitat and connectivity;

b) by identifying potential population sources and sinks;

c) by managing hunting under a compensatory mortality hypothesis where hunting take is compensated by recruitment and immigration.

1.5 Continue to investigate new methods and options to monitor and evaluate cougar populations.

1.6 Survey and monitor cougars in habitats and Zones not previously studied.

1.7 Continue to utilize an adaptive management strategy for managing cougars.

1.8 Continue to study cougar population characteristics as well as the impact of hunting, climate change, and other carnivores (wolves) on cougar populations. Research findings and new information will be used to evaluate, update and/or amend management programs.

1.9 Using information gained from actions 1.2 – 1.8, continue to update and evaluate zone population models.

1.10 Continue using population modeling to monitor cougar population status.

1.11 Maintain protection for spotted kittens and females with spotted kittens as a hunting regulation.

1.12 ODFW will manage for a population of cougars in Zone A that does not decline below an estimated population of 400.

1.13 ODFW will manage for a population of cougars in Zone B that does not decline below an estimated population of 1,200.

1.14 ODFW will manage for a population of cougars in Zone C that does not decline below

an estimated population of 120.

1.15 ODFW will manage for a population of cougars in Zone D that does not decline below an estimated population of 80.

1.16 ODFW will manage for a population of cougars in Zone E that does not decline below an estimated population of 900.

1.17 ODFW will manage for a population of cougars in Zone F that does not decline below an estimated population of 300.

Objective 2: So long as objective 1 is met (statewide cougar population above 3,000 animals) ODFW will proactively manage cougar-human safety/pet conflicts as measured by cougars taken as a result of human safety/pet complaints. ODFW may take management action to reduce the cougar population.

Assumptions and Rationale

Cougar attacks on humans are rare but frequency of occurrence has increased in recent decades (Beier 1991, Fitzhugh et al. 2003, Cougar Management Guidelines Working Group 2005). There has not been a documented, fatal human attack by a cougar in Oregon but numerous fatal and nonfatal attacks have occurred in western US states since the early 1990's. Over the last 20 years (1997-2016) there was an average of 26 (range 18 –46) cougars killed annually in Oregon for threats to human safety/pets (Table 8). Pet losses due to cougars in populated areas are considered a human safety concern because of the close association of pets and humans.

Hundreds of cougar complaint calls are handled by ODFW annually but most do not result in a cougar being taken. Technical information, advice on domestic animal care and husbandry, educational material on cougar behavior, and explanations of current laws regarding addressing cougar threats to human health and safety are commonly provided. ODFW staff categorizes and monitors cougar complaints in the ODFW Wildlife Damage Database. This includes documenting cougar sightings separately from complaints and recording if complaints were verified and by what evidence. Human safety complaints that receive special attention are those where cougars appear accustomed to human activity and development, are frequently observed during daylight hours, and are frequently in close proximity to houses and people.

Oregon statutes permit the public to take a cougar that poses a threat to human safety. ORS 498.166 list criteria used to determine if a cougar is exhibiting a threat to human safety. Criteria include aggressive actions toward humans, loss of wariness for people, attacks on pets or domestic animals (ORS 167.310) or attempts to enter dwellings or buildings. The statute requires a person taking a cougar to notify a person authorized to enforce the wildlife laws immediately. Landowners may kill the individual cougar(s) causing the damage using dogs and/or with the aid of bait (ORS 498.164(3)). ODFW contracts with Wildlife Services (WS) to conduct cougar control work in 22 Oregon counties. Control efforts are closely associated with individual safety complaints, and are designed to take only the animal/s posing a threat to human safety. If that strategy fails to eliminate the threat, then a reduction in cougar numbers may need to be considered in addition to continued use of non-lethals and public education. To standardize damage control statewide, ODFW developed guidelines for responding to cougar sightings and damage complaints (Appendix B) and has a Wildlife Damage Policy (Appendix H).

ODFW has statutory responsibility to address cougar-human conflict. As cougar numbers increased and the human population expanded into rural and suburban areas, the potential for cougar-human/pet conflicts has increased. The topic of human safety is taken very seriously by ODFW and

requires the use of proactive and corrective measures to reduce conflict. ODFW will continue to use non-lethal methods and public education as the primary tool (both proactively and correctively) to address cougar-human/safety conflict. Through implementation of this plan, conflicts will be addressed while maintaining a population of at least 3,000 cougars (Objective 1), which insures continued existence of a healthy cougar population in Oregon.

Actions

2.1 Continue to collect and monitor complaints and non-hunting mortalities resulting from cougar-human safety/pet complaints. Use data fields in the ODFW Wildlife Damage Database to detect and respond to concerning events and trends.

2.2 Encourage minimizing cougar-human conflicts through non-lethal methods where appropriate:

a) by providing the public with advice and educational material for reducing human safety risks associated with residences and property;

b) by providing the public with advice and educational material for reducing human safety risks while recreating in cougar habitat;

c) by providing advice and educational material on cougar behavior that can serve to minimize safety risks.

2.3 Manage for removals of offending individuals or lower cougar densities in areas with recurring cougar-human/pet conflict:

a) by informing citizens of their rights to address human safety situations involving cougars as allowed by Oregon law;

b) by considering additional hunting or control methods in those areas where cougar-human conflicts occur;

c) by targeting areas for more intensive cougar removal by ODFW employees or agents (Administrative Removals) where cougar-human conflicts are the highest.

2.4 Encourage establishment and/or support of active WS Agents in counties without a WS program:

a) by working with County Commissioners to encourage participation in the WS program;

b) by working with other groups to support WS funding.

2.5 Evaluate new information and techniques used to minimize cougar-human interactions:

a) by monitoring research from other states and federal agencies to identify new ways to minimize human safety conflicts;

b) by supporting research to reduce cougar-human conflicts including efforts to model and predict areas of conflict;

c) by adjusting cougar management based on the Adaptive Management findings.

2.6 Manage cougar-human conflicts so that the cougar population and distribution, as indicated by the 3-year average of non-hunting mortalities due to human-safety/pet complaints, does not exceed the 10-year average for that same area.

Objective 3: So long as objective 1 is met (statewide cougar population above 3,000 animals), ODFW will proactively manage cougar-livestock conflicts as measured by non-hunting mortalities of cougars taken as a result of livestock damage complaints. ODFW may take management actions to reduce the cougar population.

Assumptions and Rationale

ODFW will give special attention around areas where cougar-livestock conflicts occur, with the overall objective to minimize current and future conflicts. Ranching and farming are important components of Oregon's economy. Addressing cougar–livestock conflict is an essential part of this management plan.

In areas where cougar populations have increased, human populations have expanded into rural and suburban areas, or both, the potential for cougar-livestock conflicts has increased. Dispersing sub-adult cougars compete with mature and established adults and are frequently forced into areas occupied by people with livestock. Such is the current situation in the northern areas of Zone A where new or growing populations of cougars and human development are coming into conflict as measured by cougars taken on livestock damage. However, in many areas of Oregon with long-established cougar populations, cougar-livestock conflict is present yet appears to be stable or declining.

ODFW receives numerous phone calls from concerned citizens regarding cougar-livestock conflicts. Many complaints are handled by ODFW and do not result in a cougar being taken. Technical information, educational material on cougar behavior, and explanation of current laws regarding livestock protection from cougar depredation is commonly provided. It is possible that these efforts and a greater public understanding of how to avoid or reduce conflict has assisted in reduced or stable occurrences of cougar-livestock conflict across the state. Regardless, ODFW will continue to use non-lethal methods and public education as a primary tool to address cougar-livestock conflict.

Cougars rarely cause damage to land or crops; most damage occurs when cougars take or attempt to take livestock. The Damage Statute (ORS 498.012) allows 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. The statute requires a person taking a cougar to notify a person authorized to enforce the wildlife laws immediately. Landowners may kill the individual cougar(s) causing the damage using dogs and/or with the aid of bait (ORS 498.164(3)). Wildlife Services (WS) is contracted and paid by ODFW to conduct cougar control work in Oregon counties with a WS program. Control efforts are closely associated with individual damage complaints, and are designed to take only the animal creating the damage situation. In Oregon counties where WS is not available, landowners or their agents conduct damage control efforts.

Oregon statute permits the take of offending cougars to resolve conflict, but research using Oregon data determined cougar mortalities associated with livestock conflicts increased with increasing cougar population density and decreased with increasing cougar harvest density (Hiller et al. 2015). Reducing cougar population densities may be considered to address cougar-livestock conflict in an area.

Non-hunting mortalities of cougars represent verified conflict and are not as subjective as complaint or sighting reports. Therefore, cougars taken reactively as a result of livestock complaints will be used as an index to measure conflict for Objective 3. Reported complaints will still serve

useful in monitoring conflict, especially verified complaints that are confirmed with evidence, but Objective 3 will focus on non-hunting mortalities.

Using running averages reduces the impact of rare occurrences and accounts for changes in populations (cougars, humans) and landscape. The use of running averages is also common in monitoring other big game species in Oregon. Therefore, comparing 3-year averages to 10-year averages of non-hunting mortalities provides a dynamic technique to gauge cougar-livestock conflict in a given area.

Actions

3.1 Continue to monitor complaints and non-hunting mortalities resulting from cougar-livestock conflict.

3.2 Encourage minimizing cougar-livestock conflicts through non-lethal methods:

a) by providing education on cougar behavior to minimize vulnerability of livestock.

b) by discussing alternatives in livestock management to reduce the potential for cougar conflicts.

3.3 Manage for removals of offending individuals or lower cougar population densities in areas with cougar-livestock interactions:

a) by informing livestock owners of their rights to address damage as allowed by Oregon law.

b) by considering additional hunting or control options in those areas where cougar-livestock conflicts are high.

c) by targeting areas for more intensive cougar removal by ODFW employees or agents (Administrative Removals) where cougar-livestock conflicts are the highest.

3.4 Encourage establishment and/or support of active WS Agents in counties with cougar- livestock conflicts:

a) by working with County Commissioners to encourage participation in the WS program;

b) by working with WS and other groups to support WS funding.

3.5 Evaluate new information and techniques used to control cougar-livestock interactions:

a) by monitoring research in other states or federal agencies to identify new cougar damage control options;

b) by supporting research on reducing cougar-livestock conflicts including efforts to model and predict areas of conflict;

c) by adjusting cougar management based on the Adaptive Management findings.

3.6 Manage cougar-human conflicts so that the cougar population and distribution, as indicated by the 3-year average of non-hunting mortalities due to livestock damage, does not to exceed the 10-year average for that same area.

Objective 4: So long as objective 1 is met (statewide cougar population above 3,000 animals), ODFW will proactively manage cougar populations in a manner compatible and consistent with management objectives for other game mammals outlined in ODFW management plans.

Assumptions and Rationale

As described under "Interactions with Ungulates" there is evidence that cougar predation can affect ungulate populations in some situations. ORS 496.012 directs the 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. In accordance with this direction, management plans have been established by Oregon Administrative Rule for bighorn sheep and mountain goat (OAR 635- 120), elk (OAR 635-170), and mule deer (OAR 635-190). Most recent versions of the elk and mule deer plans include management objectives (MOs) for winter population levels and male:female ratios for each WMU. These unit specific MOs represent an agreed upon compromise between the landscape's capability to support deer and elk populations, the public's demands for deer and elk hunting and viewing opportunities, and acceptance levels of deer and elk populations by private landowners in the WMU. Deer and elk MOs are the result of an extensive public process culminating in adoption by the ODFW Commission as desired targets for management. Specific MOs have not been adopted for young:100 females because this metric can be highly variable through time and can be affected by many factors including predation, weather, and changing habitat conditions. Nonetheless, annual recruitment is an extremely important metric for monitoring ungulate populations and has a very strong effect on deer and elk populations. As a result the Department regularly monitors young:100 female ratios and considers the minimum levels necessary for maintaining populations given other mortality factors in a population including harvest, predation, and habitat conditions. For bighorn sheep, ODFW seeks to restore viable populations in all historically occupied habitats that contain suitable habitat. Information on ungulate populations (e.g. management objectives, population estimates, herd composition, etc.) are presented at public meetings every spring and at the Big Game regulations Commission meeting in September. Population data also are published annually on the Department's website.

Actions

4.1 Manage for healthy populations of all game mammals.

4.2 Identify game mammal populations that are below adopted objectives where cougar predation may be a significant factor to those populations.

4.3 Increase cougar take to address target populations identified in action #4.2 while maintaining minimum cougar populations for each zone:

a) by providing hunters educational material describing successful cougar hunting strategies and continuing public outreach regarding cougar impacts to other game mammal populations;

b) by managing hunts and hunters to increase cougar harvest in target areas;

c) by utilizing ODFW employees and/or its agents to remove offending individuals or increase cougar take in target areas. Hunting will be used wherever possible. Administrative removal will be used only in those areas where hunting alone has not proved effective at reducing conflict.

4.4 Continue collecting data and conducting surveys for use in identifying and clarifying game mammal population problems identified in action #4.2.

4.5 Use Adaptive Management findings to adjust cougar management for each zone.

CHAPTER IV: ADAPTIVE MANAGEMENT

The 2006 Cougar Management Plan formally included adaptive management in cougar management in Oregon. Adaptive management provides a mechanism to understand problems at scales that are applicable to specific management situations. The process of adaptive management relies on the scientific method that includes synthesis of existing knowledge, proposing hypotheses, implementing treatments, monitoring outcomes of treatments and controls, and adjusting management based on information gained from the experiment. It includes the use of models to predict possible effects of management actions and how they fit with management objectives (Williams et al. 2002). The Cougar Management Guidelines Working Group (2005) summarize adaptive management as a "continual monitoring of indicators that measure progress towards achievement of management goals and objectives, changing of management practices when new information indicates that better alternatives are available, monitoring relevant stakeholder values and interests, and the monitoring of natural environmental changes that may affect cougar management results" (Meffe and Carroll 1997, Williams et al. 2002).

Adaptive Management Plan for Cougar

All management activities will be carried out using an adaptive management approach, as suggested in the Cougar Management Guidelines Working Group (2005) and Managing Cougars in North America (2011), which allows for monitoring, evaluation, and changes in management based on results. Adaptive management will be employed to manage cougar populations by zone, WMU, or target areas to meet management goals and objectives. Each zone, unit, and target area will be managed independently to achieve specific goals and management objectives, but will fall within associated zone and statewide objectives.

Cougar management priorities include addressing conflict while ensuring robust cougar populations. All management activities may occur so long as the population minimums identified in Chapter III: Objective 1 are satisfied. Areas of zero-to-moderate harvest will serve as cougar source populations and should maintain cougar populations at or above that level. Areas within each zone where conflict has exceeded acceptable levels will be identified and managed more intensively to achieve objectives for cougar-human conflicts, cougar-livestock conflicts, and/or elk, deer, bighorn sheep, and mountain goat populations. Intensive management tools and techniques include but are not limited to education, outreach, hunter harvest, habitat management, and population adjustments. Areas around some recent native species transplants, big game winter ranges, and other areas of high game mortality may be targeted for individual removals or intensive cougar harvest if cougar predation is identified as a limiting factor (Oregon Department of Fish and Wildlife 2003a).

Hypotheses to Test in Adaptive Management

Adaptive management has been employed to manage cougar populations at the zone, WMU, and target area levels to meet management goals and objectives. The 2006 Cougar Management Plan identified four hypotheses to test using the adaptive management framework. These hypotheses are still of interest at this time and continued focus is necessary.

Hypothesis 1) Increased cougar mortality near human habitation will reduce cougar-human conflicts to desired levels. Criteria to measure conflict will primarily be non-hunting mortality and secondarily number of complaints received.

Findings

At a larger scale, removals of cougars to reduce human safety/pet concerns was attempted in the Jackson Target Area (2007-2009), but small land holdings and limited access (inherent factors around human habitation) prevented removal objectives from being met (Appendix J). At smaller scales, removal of offending cougars appears to resolve issues. Except for Zone A, non-hunting cougar mortalities due to human safety/pet conflicts have been stable throughout most of the state and complaints are also stable or declining. This hypothesis will continue to be difficult to address at larger scales due to the before mentioned logistical issues, but is of interest at smaller scales, especially as cougars continue to expand into exurban and residential areas.

Hypothesis 2) Increased cougar mortality in focal areas where ungulate population levels are below population MO will increase ungulate recruitment or survival and allow the population to move toward MO. Criteria to trigger cougar management action directed at improving elk populations will be based on spring calf:cow ratios. Based on elk population modeling, observed elk population trends in the absence of larger cougar populations and case histories, ODFW believes 23 calves:100 cows is necessary to maintain an elk herd in the absence of antlerless elk hunting. Evidence indicating that cougar predation is affecting deer populations is necessary to trigger cougar management actions for deer. No single specific metric is useful for triggering cougar management actions for deer, rather examining a combination of metrics and data is most useful. Trend counts or population modeling will determine attainment of ungulate population objectives.

Findings

Cougar removals and modeling efforts have been conducted to address this hypothesis. Five target areas have been implemented to address low ungulate population levels. The Heppner, Ukiah, and Wenaha Target Areas were implemented to improve elk recruitment. The Wenaha Target Area (Appendix K) failed to meet removal objectives due to a challenging landscape (e.g. rough terrain, limited road access). The Heppner (Appendix J) and Ukiah (Appendix K) Target Areas were successful in implementing removals and observed an increase in calf:cow ratios while control units did not. Calf ratios continued to improve for 2-4 years following cougar removals.

Using data collected in the Wenaha and Sled Springs studies, Clark (2014) used stochastic models to simulate elk population responses to cougar removals. The model suggested that at high densities (>4.0 cougars of all age classes/100 km^2), cougars are capable of reducing elk populations. Elk models suggested an elk population increase by 4% annually at mean cougar densities (2.87 cougars of all age classes/100km^2), suggesting that population recovery can occur without lethal removals, but the rate of recovery would be much greater.

An important lesson learned in the Ukiah Target Area was that multiple elk herds, some from outside the target area, congregated on the same winter range in the target area. Herd surveys are conducted on winter range and the mixing of herds can affect the ability to measure the effectiveness of an implemented target area. In that situation, a detectable increase in herd composition was observed but was likely diluted due to the presence of the other herds. A future target area under this hypothesis would need to identify any potential sampling issues during planning and prior to target area implementation.

The Steens and Warner Target Areas were implemented to improve mule deer populations (Appendix K). Those areas were two of five units specifically identified by the Mule Deer Initiative (Oregon Department of Fish and Wildlife 2008), a program to address declining mule deer numbers

in Oregon and develop aggressive strategies to reverse downward trends. For both areas, newly implemented mule deer sampling techniques (quadrats) failed to measure changes in mule deer populations following target area implementation. These results may have been due to numerous issues including biologist inexperience with the new sampling technique, poor technique performance and sensitivity in those landscapes, cougar removals were unsuccessful at improving deer populations, or some other unknown factors. Deer population estimates using standard techniques (POP II models) were used in addition to quadrat sampling. The POP II population models suggested little change in the Warner Target Area and a small increase in the Steens Target Area, but little change occurred following implementation. Although secondary information, harvest statistics (percent success, percent yearling bucks in harvest) suggest removals had a positive impact on mule deer populations.

Improving mule deer populations to meet management objectives will continue to be a high priority for ODFW. Published literature shows that cougar predation on deer is often compensatory but there are clear situations where it is additive (*see* Cougar Interactions with Ungulates). Should cougar removals be considered to improve mule deer populations, emphasis must be placed on the ability to adequately monitor deer populations and measure the impact of a target area effort.

Three target areas (Interstate, Steens, and Warner) are underway at time of writing in Zone F to address mule deer populations that are below management objectives and cougar predation is a significant factor.

Hypothesis 3) Areas with low – medium cougar harvest will act as source populations serving to maintain cougar populations at or above minimum levels. Criteria to measure cougar population status will be based on known cougar mortality (including total mortality, age and sex ratios, average age of adult females), research results, and population modeling.

Findings

Collected data suggests that cougar populations are stable or growing and functional cougar metapopulations consisting of sources and sinks occur throughout Oregon. Areas of suitable cougar habitat that experience no-to-low cougar mortalities are identifiable and likely serve as *de facto* refugia and population sources. Also, most areas do not experience estimated mortality rates that exceed reported intrinsic population growth rates (1.17, Clark 2014), therefore those areas may also serve as population sources.

Various studies have found that once harvest mortality rates exceed 20-40% (Robinson et al. 2014, Stoner et al. 2006) and are sustained for a number of years, population reduction may occur. Smaller areas (especially target areas) may experience harvest and overall mortality rates near those levels and serve as population sinks. However, zone mortality rates (i.e. total known zone mortalities of modeled zone population) are well-below those levels and other indicators (age and sex ratios, average age of adult females, population modeling) indicate stable or growing zone populations.

Data and research findings indicate successful movement between cougar populations is occurring. Examinations of cougar habitat (Musial 2009, this plan) suggest habitat connectivity and continuity is ubiquitous throughout much of the state, likely facilitating cougar movement and dispersal (necessary features of a functional metapopulation). Investigations of landscape genetics of cougars in Oregon (Musial 2009) and surrounding states (Washington-Warren et al. 2016, Idaho-Loxterman 2011, California- Ernest et al. 2003, Nevada- Andreasen et al. 2012) suggest genetic isolation of Oregon populations is not occurring now nor in the foreseeable future.

This hypothesis will continue to be examined as functional metapopulations are vital to population persistence. Many western states and provinces are currently investigating this same hypothesis, therefore new information from those areas could be very insightful.

Hypothesis 4) Increased cougar mortality near areas of livestock concentrations will reduce cougar-livestock conflicts to desired levels. Criteria to measure conflict will primarily be non-hunting mortality and secondarily number of complaints received.

Findings

One effort applicable to this hypothesis was Hiller et al. (2015) who modeled cougar-livestock depredations using Oregon data and found that increasing cougar mortality through hunting has the ability to reduce cougar-livestock conflict. Also applicable are efforts to reduce cougar numbers to reduce conflict in a target area. The Beulah Target Area (2007-2010) was implemented to reduce livestock depredations (Appendix J). A reduction in complaints and non-hunting mortalities was observed during and following cougar removals. The Malheur River Unit served as a control unit and non-hunting mortalities and complaints remained similar over those same years. The duration of the reduction in conflict is inconclusive as complaints and damage/safety non-mortalities rose slightly but fluctuated in the years following removals. Overall, a decline in conflict has been observed since implementation but it is unknown how much of it is due to the target area.

As non-hunting mortalities and complaints are stable or decreasing throughout much of the state, opportunities to address this hypothesis may be limited in the future. However, opportunities to examine this hypothesis further may arise in cougar Zone A (Coast and North Cascades) and Zone B (Southwest Cascades) where the numbers of cougars taken due to livestock conflict have been increasing for the last decade. In these zones, medium-sized livestock (sheep, goats) are the dominant livestock present and cougar populations have been growing and expanding, creating opportunities for conflict. Logistical issues of small landholdings, the primary factor inhibiting implementation of the Jackson Target area, could be a problem with conducting removals and testing the hypothesis.

This topic is being tested at the time of writing in the East Umpqua Target Area (Cougar Zone B) where non-hunting mortalities due to livestock conflict have been increasing for many years.

Objectives for Cougar Management

Cougar management typically occurs at four levels: statewide, zone, target area, and fine scale (Table 16). Fine scale management activities vary greatly in space, time, situation, and solution. For example, these situations include anything from providing advice to a member of the public, directing changes in city ordinances, or selectively removing offending cougars. These more day-to-day management actions are based on policies, rules, and statutes that are, for the most part, independent of this plan. Although adaptive management is applied in these situations, due to the extreme variation at that scale, explicit objectives and actions are not identified in this chapter.

Management objectives and actions for the other three scales of management are defined in this section. The Statewide objective is to decrease cougar conflicts to acceptable levels while maintaining a total population of at least 3,000 cougars. That minimum count serves as a safety net to ensure healthy cougar populations.

ODFW will continue population modeling by zone and will monitor the proportion of adult females in the total known mortality to ensure cougar populations do not drop below zone minimums. Proportion of adult females in the total known mortality indicates whether cougar numbers are

increasing, decreasing, or stable. When the proportion of adult females consistently exceeds 20-42% of total take for consecutive years, research indicates cougar populations may begin to decline (Anderson and Lindzey 2005, Choate et al. 2006, Laundré et al. 2007). Effort will be taken to continue to estimate cougar densities throughout Oregon using proven techniques.

Target Area Management

First presented in the 2006 Oregon Cougar Management Plan, areas with recurring cougar-related conflict (damage, safety, impacts on other wildlife) could be considered for target area management. A target area is defined as a geographical area established by ODFW where cougar numbers will be proactively reduced in response to established criteria with the goal of reducing said conflict. Target areas do not include instances where corrective action results in the lethal removal of one or a few cougars. Although state statute (ORS 496.162) directs the use of regulated harvest as the tool for population reductions, hunting has not been sufficient to reduce cougar numbers and therefore ODFW staff and agents have conducted removals.

Target area management generates a large amount of attention from stakeholders. This tool and its use is taken very seriously by ODFW due to stakeholder interest, fiscal responsibility, impact on staff workloads, and diligence to evaluate all management tools. Therefore, consideration of a target area is a very thorough process and despite conflict thresholds being exceeded, most situations do not result in a target area being implemented. From 2006-2016, zone thresholds for livestock damage and human and pet safety identified in the plan were exceeded 76 times, although only three target areas were implemented (Beulah, Jackson, East Umpqua). Over that same time in eastern Oregon, thresholds for considering a target area to benefit elk and deer populations were exceeded 37 times for elk and 233 times for deer. After careful consideration, only three target areas for elk (Heppner, Ukiah, Wenaha) and five target areas for deer (Interstate, twice for Steens and Warner) have been implemented.

As addressed in the hypothesis section, success in implementing target areas has varied, as has the management tool's ability to meet desired goals. Lessons learned and new scientific information are applied to the consideration and implementation of future target areas (Appendix M). For example, target areas to reduce livestock conflict are guided and supported by published research findings using Oregon data. Hiller et al. (2015) modeled Oregon cougar-livestock conflict and saw that cougars taken on livestock damage increased with increasing cougar densities and decreased with increased hunter harvest. Staff continues to educate the public and livestock producers to reduce damage during target area implementation.

When evidence indicates specific deer, elk, or bighorn sheep populations are negatively impacted by cougars, the area encompassed by that population may be considered a target area. To improve those populations, the target area objective will be to decrease cougar numbers within the area. As addressed in the hypothesis section and Appendix J, previous cougar reductions to improve elk recruitment yielded favorable results without additional efforts to measure herd response. However, the ability to adequately measure a response of deer populations to cougar removals has been difficult and requires efforts beyond routine surveys. Also, the literature suggests that cougar predation on deer is often compensatory unless deer populations are below carrying capacity (*see* Cougar Interactions with Ungulates section). At time of writing, substantial deer data and information is being compiled with hundreds of radio collars currently deployed. These efforts may provide the substantive information necessary to measure the impact of cougars on deer populations and to measure deer response following cougar reductions. The availability and use of such information will be presented as part of the target area proposal process.

Target areas may vary in size from large like a Wildlife Management Unit (WMU, where conflict is generally associated with other game mammals) to small areas encompassing specific areas of livestock damage or human safety/pet conflict. Researchers and managers caution that temporary population reductions conducted in small (<1,000 km^2) areas may be ineffective due to rapid replacement from neighboring populations (Robinson et al. 2008, Cooley et al. 2009a). Oregon target areas range from ~2,000 to 4,000 km2 and are often the size of a WMU.

When target areas are the size of a WMU, cougar removal should be intensive enough to result in an initial increase in adult females in the total mortality (up to 40-45%) followed by a decline in subsequent years as resident adult females are removed (Anderson and Lindzey 2005, Cooley et al. 2009a). Based on findings in Wyoming, as adult female cougar numbers decrease in the target area, the mean age of adult females is expected to decline to 3-4 years (Anderson and Lindzey 2005). If conflict is occurring in areas that are small (often the case with human safety/pet and livestock conflicts), the specific proportion and mean age of adult females in the total mortality has limited application. Therefore, in these areas, cougars will be removed to meet objectives and less emphasis should be placed on the proportion of adult females.

With adequate prey, habitat, and connectivity, cougar populations are resilient to high mortality levels due to reproductive output and immigration. This has been observed in numerous locations: adult cougars in a New Mexico population were reduced by 53% and recovered in 31 months following restricted human take (Logan et al. 1996); a Wyoming cougar population was reduced by 43% and recovered within 3 years of reduced harvest (Anderson and Lindzey 2005); and Utah cougar population was reduced by 60% and recovered in 5 years of reduced harvest (Stoner et al. 2006). Clark (2014) modeled cougar population recovery following a 50% reduction and cougar numbers recovered within 2 years with high immigration to 6 years with no immigration. Assuming target area removal efforts are successful, additional control efforts will have to account for young cougars migrating into the target area to ensure the goals are met. Control activities could consist of continuing removals at a lower annual objective or return to the same intensive levels years after the initial effort has been completed. Due to challenges like agent training, upfront and implementation costs (Appendix L), continuing with reduced take is far more efficient and economical than repeating a target area years later. A reduced level of take could match modeled cougar intrinsic growth rates thereby attempting to maintain lower cougar numbers temporarily.

Proposed Techniques to Reach Adaptive Management Objectives

Techniques ODFW managers have used for cougar population management include:

1) Provide education and outreach
2) Manipulate cougar hunting season structure, i.e. controlled hunting, general seasons;
3) Establish the annual number of cougar tags available;
4) Adjust cougar tag fees;
5) Manipulate hunting bag limits;
6) Manipulate hunting season length;
7) Establish legal methods for cougar hunting;
8) Distribute cougar harvest by zone using a quota system; and
9) Conduct cougar removals in Target Areas

The majority of these techniques revolve around using hunting to address cougar management goals; however, hunting has had a nominal influence on achieving goals focused on cougar reductions. Hunter success rates have been low and interest in cougar hunting has remained steady for many years. Without the use of dogs, efforts to increase hunter harvest in a zone or target area have seen little success. This has resulted in ODFW being unable to control cougar populations or attempt to resolve cougar-human conflicts through hunting alone.

Table 16. Summary of management objectives and actions at different scales in Oregon.

Scale	Objective	Action
Statewide	Cougar population estimate > 3,000.	Adjust harvest to maintain cougar population > 3,000.
	The statewide 3-year average of non-hunting mortalities due to human safety/pet complaints does not exceed the 10-year average.	Use all appropriate tools and techniques to achieve objectives (action items 2.2-2.5 in Chapter III: Objective 2).
	The statewide 3-year average of non-hunting mortalities due to livestock complaints does not exceed the 10-year average.	Use all appropriate tools and techniques to achieve objectives (action items 3.2-3.5 in Chapter III: Objective 3).
	Meet management objectives for other game mammals.	Use all appropriate tools and techniques to achieve objectives (action items 4.2-4.5 in Chapter III: Objective 4).
Zone	Meet specific objectives for each zone (see zone descriptions).	See zone descriptions and Tables 17-22 for objectives and criteria.
	Maintain a three-year average proportion of adult (3+ year old) female cougars in the total mortality at no more than 25-35%.	Adjust cougar harvest to achieve objective.
	Do not exceed total mortality quotas for each zone.	If zone quotas are met, hunting and target area harvest will cease; livestock damage and human safety response will continue.
Target Areas	Resolve conflicts by decreasing cougar numbers. Increase the three-year average proportion of adult (3+ year old) females in the total mortality to 40-45% with a subsequent decline in average age of adult females to 3 - 4 years old.	Apply intensive harvest to target areas to meet objectives (see Tables 17-22). Target area harvest will cease when: 1) objectives are met or 2) zone quotas have been met or 3) it is determined that intensive cougar removal cannot meet objectives.
Fine Scales	Objectives will be determined on a case-by-case basis but the goal will be to reduce conflict.	Proactive and corrective actions guided by policy, rule, and statute will be implemented to reduce conflict.

At every opportunity, ODFW provides education and advice to the public on how to reduce conflict (proactively and correctively) and emphasis is placed on non-lethal practices such as changes in animal ownership and husbandry practices. However, conflict (livestock, human safety/pet) may still occur and almost anywhere in the state. Reduction of cougar numbers in areas of identified conflict, especially when other techniques have failed or are not applicable, may be the best approach to achieve desired objectives.

ODFW can meet proposed management objectives through a combination of public hunting and administrative cougar removal (by agency personnel or agents) in targeted areas with recurring conflict. These actions will occur within the adaptive management process described in this plan. Using experience with past target areas, administrative removals will be designed to be efficient and cost-effective. Consulting management recommendations from Cougar Management Guidelines (Cougar Management Guidelines Working Group 2005) and Managing Cougars in North America

(Jenks et al. 2011) will continue to be a priority for adaptive management implementation. Quotas established under adaptive management will continue to include all known mortality, especially as known annual non-hunting mortalities are similar to hunting totals in some zones (Table 7). Quotas under adaptive management will be evaluated annually and will be set to meet objectives.

Zone A – Coast/North Cascades

Zone Overview

The Coast/North Cascades Cougar Management Zone (Figure 12) is comprised of approximately 21,790 mi^2 (37% public land) of which approximately 19,600 mi^2 is occupied by cougars. This zone includes the Coast Range Mountains, a portion of the Klamath Mountains, the Willamette Valley, and the northern third of the Cascade Mountains. Sixteen WMUs, the Warm Springs Indian Reservation, the White River and Jewell Meadows Wildlife Areas and Dean Creek Elk Viewing Area, major big game winter ranges, are in this zone. Habitats are diverse, ranging from flat agricultural lands in the coastal and Willamette Valleys to alpine habitats at the highest elevations above extensive mixed conifer forests. This zone has the highest human population of any cougar management zone with major human populations around the Portland, Salem, and Eugene metropolitan areas with numerous other smaller communities located in the coast and Willamette Valleys. Primary industries outside the metro areas include ranching, farming, timber, and recreation.

Based on population modeling (updated April 2017), the Zone A population density (all age classes) increased from 4.0 cougars/100 mi^2 (1.5 cougars/100 km^2) of habitat in 2006 to 5.0 cougars/100 mi^2 of habitat in 2015 (1.9 cougars/100 km^2) (Oregon Department of Fish and Wildlife, unpublished data). From 2006 to 2015, the 3-year average proportion of adult (3+) females to total cougar mortalities averaged 14% and over that span, adult females averaged 4.6 years old (Oregon Department of Fish and Wildlife unpublished data).

Cougar-human conflict in Zone A increased substantially since the early 1990's due to increasing cougar numbers and increasing human population. The number of non-hunting mortality in response to livestock and human safety/pet complaints has increased from 15 in 1994 to 26 in 2006 and 70 in 2016. Cougar complaints in Zone A were relatively stable in the decade following the adoption of the 2006 Plan, but in recent years complaints have greatly increased (277 in 2015, 286 in 2016). Most of the increase is observed in northern WMUs of Zone A with expanding cougar populations (Alsea, Santiam, Stott Mountain, Willamette WMUs).

In addition to the increase in the number of complaints and conflict events, the number of areas experiencing conflict have been on the rise. Conflict is occurring in new areas as cougars expand their range northward in the zone but cougars are also coming into conflict with humans and livestock in highly manipulated landscapes (urban areas, livestock pastures with little cover) (Figures 10, 11). As cougars expand their range and venture into urban landscapes, conflict will likely continue to increase and it will take time for the public to learn how to prevent and address cougar conflict. ODFW staff will continue proactively educate the public on living with cougars.

Cougar hunting alone has proven inadequate to control cougar population growth in an attempt to reduce conflict. Although hunt numbers have been increasing, from 2006-2015 hunter harvest has averaged just 46% (range 29-60%) of the zone quota whereas mortalities due to damage and conflict averaged 29% (range 22-40%) of the zone quota. One of the challenges is that much of the conflict occurs on private property and access for hunters is limited. Larger industrial timber owners are implementing gated or fee entry onto much of their previously accessible lands, potentially resulting in less opportunity for hunter harvest as a means of controlling cougar

populations. Much of the hunter harvest in this zone occurs in forested areas well away from high conflict areas.

Landowner options for addressing cougar damage are limited in type and practicality, but they appear to be somewhat effective. Although dogs and trapping can be used to address damage, landowners are limited to their own property for any control efforts, while cougars often leave their property after causing damage. Wildlife Services programs, which provide some options for control on adjacent properties, are not funded or are only partially funded in many counties in this zone, although they have proven effective where employed. This limits options available to landowners to deal with cougar conflicts. Management challenges in Zone A will be to increase the application and effectiveness of non-lethal methods to reduce conflict and to increase lethal cougar control to reduce cougar numbers in areas with high human conflict.

Elk population trends in the last decade have been decreasing in most WMUs in this Zone. These decreasing trends are likely due to several issues including: decreased habitat quality and quantity, predation, disease and harvest. During this period, ODFW decreased controlled hunt tags and eliminated the antlerless elk bag limit from general archery seasons and for hunters with a Disabled Hunting and Fishing Permit in WMUs where elk populations fell below 90% of MO. Additionally, the forage base necessary to support elk populations at current levels appears to be declining in much of the zone as a result of changes in forest management on public and private lands (Oregon State University 2005). On public lands, there has been a reduction of timber harvest as well as a shift from clear- cut logging to thinning and selective cutting. On private timberlands, timber management has become much more intensive including post-harvest site preparation that leaves the landscape void of many important early seral forage species. The result is less forage available on both public and private forestlands. In some WMUs, forage already regulates elk reproduction because lactating Roosevelt cow elk seldom breed in the year following successful reproduction (Trainer 1971). Trainer (1971) suggested elk forage quality in the Coast Range was poor, resulting in lactating cow elk not ovulating. If elk numbers decline enough, increased cougar predation could negatively affect elk population recovery. Although, elk populations in this zone do not appear limited by cougar predation at this time, it is likely that cougar populations play an increasingly important role in elk populations than in the last several decades as cougar populations have increased.

Deer throughout Zone A have shown a declining trend for many years as measured by declining harvest levels, hunter success rates, and observational surveys. As with elk, the forage base necessary to support deer appears to be declining in much of the zone as a result of changes in forest management on public and private lands (Oregon State University 2005). Beginning about 1998, Deer Hair Loss Syndrome (DHLS) became evident in northwest Oregon, and has since spread throughout the lower elevations of this Zone. Adenovirus hemorrhagic disease (AHD) has also been detected in Zone A. However, neither of these diseases appears to be limiting deer populations. While, ODFW does not believe cougar predation is currently the primary factor affecting deer populations, predation likely affects deer populations in WMUs where cougar populations have increased. In the future, increased cougar predation could potentially limit deer population recovery.

Adaptive management will be used to address plan objectives in Zone A. Identified target areas will be managed intensively to achieve objectives for cougar-human conflicts and elk, deer, or bighorn populations. Particular attention will be given to areas around human habitation where cougar-human conflicts have been documented. Conflict will be monitored with established measurement criteria and management will be adjusted based on results. The minimum cougar

population for Zone A identified in this plan is 400 (Chapter III: Objective 1). Based on current population estimates, modeling indicates a total human-caused mortality of 180 cougars/year for 5 years could occur without reducing cougar numbers below the minimum population of 400. Approximately 20% of Zone A is in wilderness areas, roadless areas, state parks, municipal watersheds, or large blocks of private industrial forest lands with limited public access where cougar harvest is low or nonexistent. Intensive cougar harvest in targeted areas, moderate levels of cougar harvest in other areas, and little harvest in roadless areas are expected to meet objectives for cougar conflict while maintaining cougar populations above minimum levels.

Zone Management Summary

If conflict thresholds defined in Table 17 are met, total cougar mortality may be increased in targeted areas in Zone A. Areas of human habitation with elevated or recurring cougar-human conflict may be identified for more intensive cougar management. Currently this applies primarily to the Willamette Valley and adjacent foothill fringe where the highest human population occurs. Desired outcomes include a decrease in cougar-human conflicts measured by non-hunting mortality and cougar complaints. Results will be monitored and hunting or cougar removal programs modified to meet desired outcomes for the zone (Table 17).

Of 16 WMUs in the zone, none currently have elk or deer populations at levels that would trigger intensive cougar control. If data indicate cougar predation is affecting ODFW's ability to meet deer or elk population objectives, some areas may be considered for intensive cougar control (Table 117). In the future ODFW may consider transplanting certain wildlife species within Zone A. Columbia white-tailed deer populations within the zone are federally classified as an endangered species. Recovery efforts could involve establishing new sub-populations in the zone. ODFW is restoring mountain goats to historic habitats throughout the state, and several release sites are identified in the zone. If evidence indicates cougar predation threatens transplant success or viability, release areas may be considered for intensive cougar control.

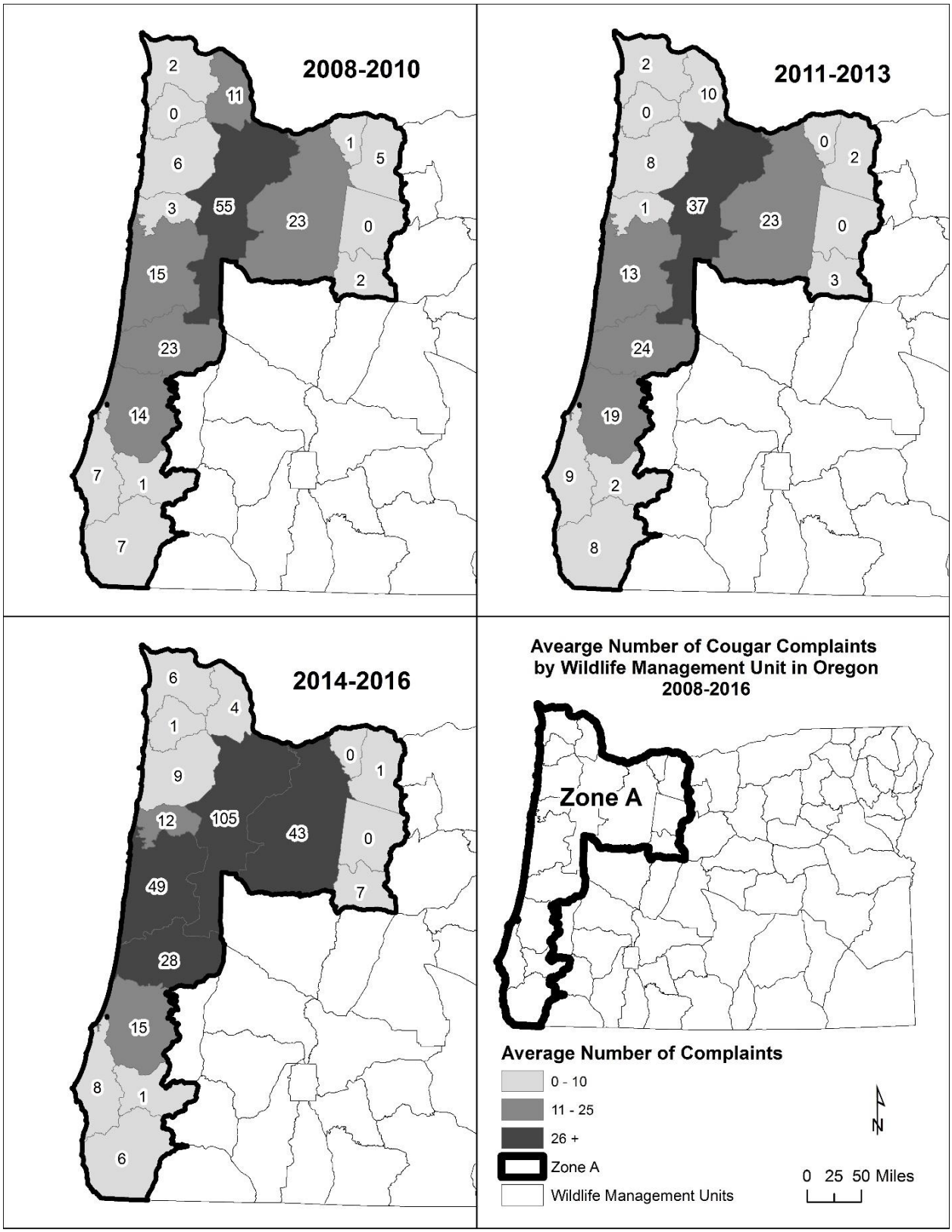


Figure 10. The average annual number of cougar complaints by Wildlife Management Unit (WMU) received by ODFW for cougar Zone A from 2008-2016.

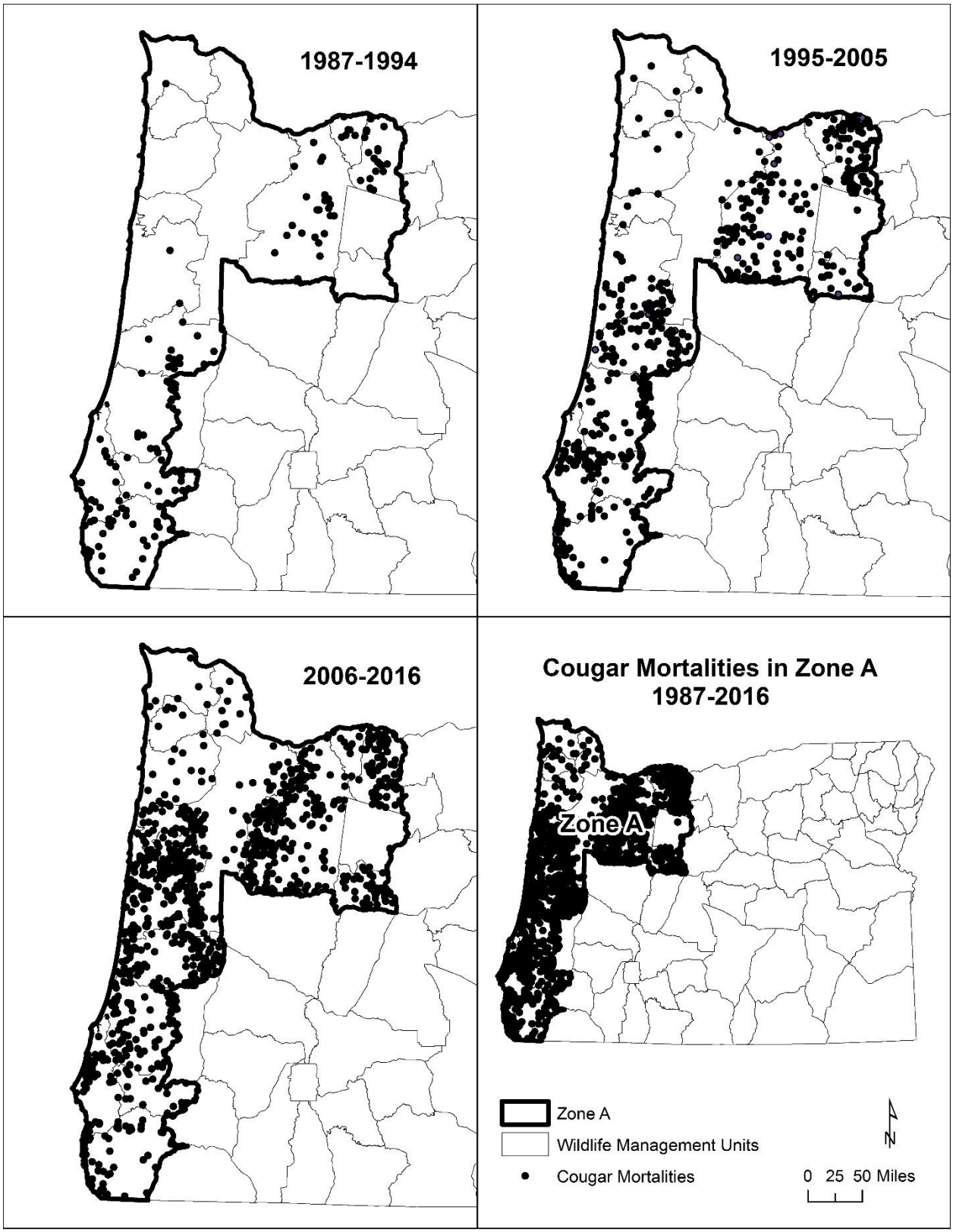


Figure 11. The location of cougar mortalities by Wildlife Management Unit (WMU) received by ODFW for cougar Zone A from 1987-2016. All mortality sources are included.

Table 17. Adaptive management parameters for Cougar Management Zone A: Coast/North Cascades.

Management Concern	Indicator	Objectives	Criteria Triggering Targeted Area Management
Sustain Populations	Cougar population	Cougar population estimate >400 cougars for the zone	Cougar population estimate <400 cougars will result in harvest reductions in the zone.
	Cougar Mortality	Do not exceed total mortality quota	If zone quotas are met, hunting and target area harvest will end. Response to livestock damage and human safety/pet complaints will continue.
Human Interactions	Non-hunting mortality related to human safety/pet	The 3-year average of non-hunting mortalities due to human safety/pet complaints does not exceed the 10-year average	A 3-year average that exceeds the 10-year average could trigger control in areas around human habitation.
	Non-hunting mortality related to livestock	The 3-year average of non-hunting mortalities due to livestock complaints does not exceed the 10-year average	A 3-year average that exceeds the 10-year average could trigger control in areas around livestock operations.
Ungulate Populations	Elk	Maintain 3 year mean calf ratios at approximately 30 - 40 calves/100 cows	Units with < 23 calves/100 cows for 3 years and below population Management Objective for 3 years.
	Deer	Maintain healthy populations with little evidence of disease that support optimum deer populations	Target only when evidence indicates cougar predation is a significant factor to deer populations.
	Ungulate transplants	Insure viable transplants	Target only when evidence indicates cougar predation threatens success or viability of transplant.
	Wildlife Areas (WA)	Satisfy stated purpose and Management Objectives of the Area	Target WA if cougars prevent satisfying WA purpose or achieving WA objectives.

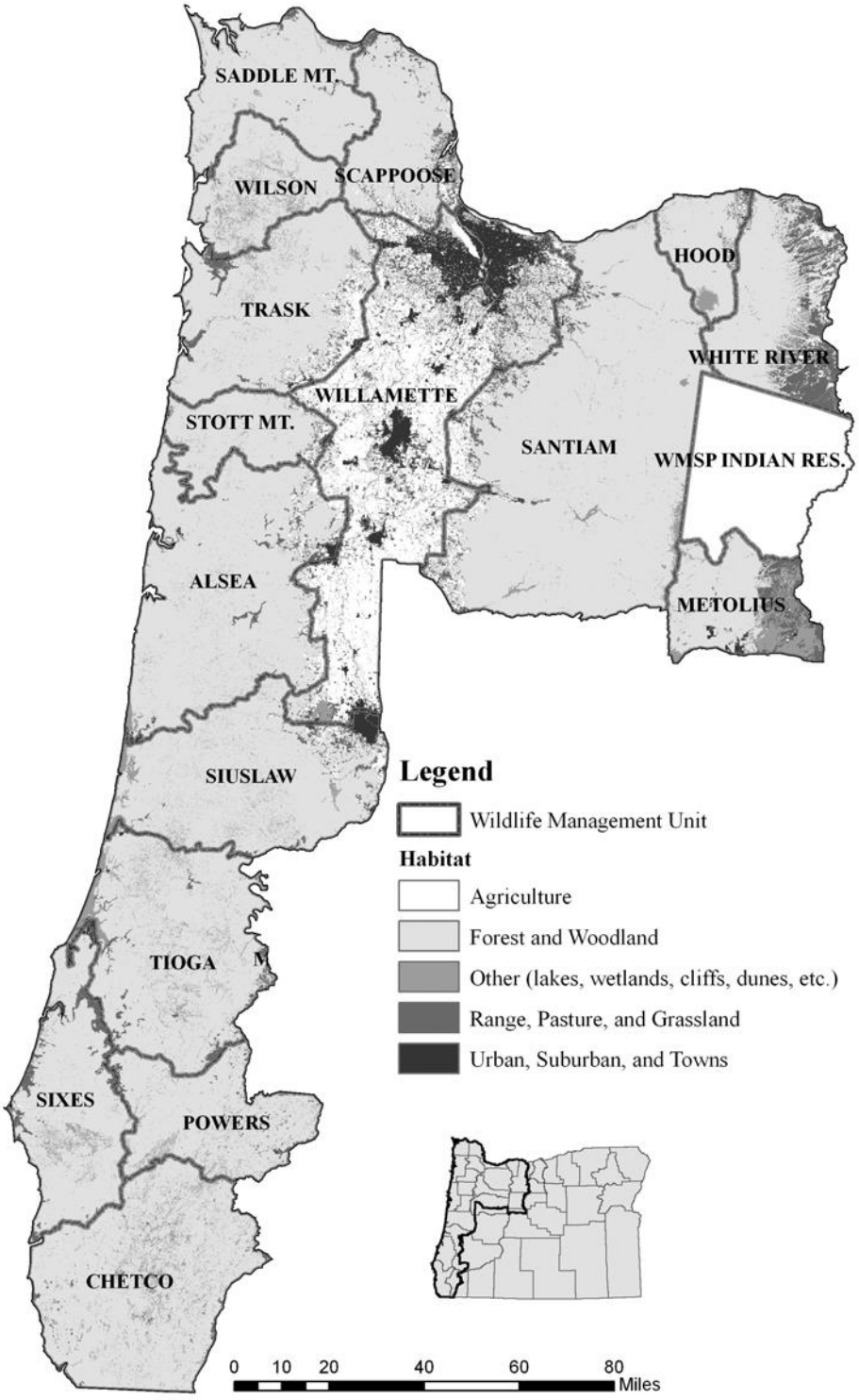


Figure 12. Land cover characteristics of cougar management zone A.

Zone B – Southwest Cascades

Zone Overview

The Southwest Cascades Cougar Management Zone (Figure 13) includes approximately 12,355 mi^2, 56% of which is public land. Zone B includes the southern two-thirds of the west slope Cascade Mountains, 1,030 mi^2 of the southeast portion of the Cascades (Keno WMU), the northern portion of the Siskiyou Mountains in Oregon, the Rogue Valley, Umpqua Valley, and a portion of the Willamette Valley. Eight WMUs make up this zone. Zone B includes three wilderness areas, 2 national wildlife refuges, two national monuments, several municipal watersheds and roadless areas, (2,300 mi^2) and a portion of Crater Lake National Park. Elevations range from approximately 200 feet to the 9,475-foot peak of Mount Mc Loughlin. Habitats are diverse, ranging from flat agricultural lands in valley floors to alpine habitats at high elevations above extensive mixed conifer forests (Figure 13). This zone has the second highest human population of any cougar management zone. Human population centers include Springfield, Roseburg, Grants Pass, Medford, Ashland, and portions of Klamath Falls. There are numerous other smaller communities located primarily in valley floors. Primary industries include construction, ranching, farming, timber, and recreation.

Based on population modeling (updated April 2017), cougar population density (all age classes) in Zone B has been relatively stable from 12.6 cougars/100 mi^2 (4.9 cougars/100 km^2) in 2006 to 12.2 cougars/100 mi^2 (4.7 cougars/100 km^2) in 2015 (Oregon Department of Fish and Wildlife, unpublished data). From 2006 to 2015, the 3-year average proportion of adult (3+) females to total cougar mortalities averaged 15.8% and over that span, adult females (3+) averaged 4.6 years old (Oregon Department of Fish and Wildlife unpublished data).

Cougar-human conflict in Zone B has continued to increase since the early 1990's due to increasing cougar numbers and increasing human population. Non-hunting mortality in response to livestock and human safety/pet complaints increased in the zone from 13 in 1994 to 29 in 2006 and 58 in 2016. Most of these cougars taken fall under livestock damage of sheep and goats (86% annually from 2006-2016). Cougar complaints increased from 153 (69 livestock, 84 human safety/pets) in 1994 to 305 in 2006, but has remained relatively stable since with 186 complaints received in 2016.

Cougar hunting alone has proven inadequate to control cougar population growth in an attempt to reduce conflict. From 2006-2015 hunter harvest was stable and averaged just 26% (range 18-41%) of the zone quota whereas mortalities due to damage and conflict averaged 27% (range 18-38%) of the zone quota. One of the challenges is that much of the conflict occurs on private property and access for hunters is limited. Larger industrial timber owners are implementing gated or fee entry onto much of their previously accessible lands, potentially resulting in less opportunity for hunter harvest as a means of controlling cougar populations. Much of the hunter harvest in this zone occurs in forested areas well away from high conflict areas. However, increased interest in predator hunting and refined techniques in predator calling with electronic calls have allowed for recent increases in hunter harvest.

Landowner options for addressing cougar damage are limited in type and practicality, but they appear to be somewhat effective. Although dogs and trapping can be used to address damage, landowners are limited to their own property for any control efforts, while cougars often leave their property after causing damage. Wildlife Services programs, which provide some control options on adjacent properties, are only partially funded in most of the zone and not funded in Josephine County. This leaves landowners limited options to deal with cougar conflicts. Management

challenges in Zone B will be to increase the application and effectiveness of non-lethal methods to reduce conflict and to increase lethal cougar control to reduce cougar numbers in areas with high human conflict.

Elk populations in Zone B have been stable to increasing on private timber and agricultural lands. Spring calf ratios appear to be stable and have been above the ratio of 23 calves:100 cows necessary to maintain elk herds in the absence of antlerless elk hunting. The forage base necessary to support elk populations at current levels continues to decline in much of the zone as a result of changes in forest management on public and private lands (Oregon State University 2005). On public lands, there has been a reduction of timber harvest as well as a shift from clear- cut logging to selective cutting. On private timberlands, timber management has become more intensive with aerial spray of early successional grasses and shrubs. The result is less forage available on forested lands. Elk populations in Zone B currently have calf ratios above maintenance levels and do not appear limited by cougar predation, although ODFW is aware that cougars prey on elk and elk calves in this zone. Elk populations, particularly on public lands, could decline over the next several decades if the forage base declines because of forest management. If elk numbers decline enough, cougar predation could create a predator pit and limit population recovery.

Declining harvest levels, hunter success rates, and annual spring inventories suggest deer have been declining in Zone B for many years. As with elk, the forage base necessary to support deer appears to be declining as a result of changes in forest management (Oregon State University 2005). On public lands, there has been a reduction of timber harvest as well as a shift from clear-cut logging to selective cutting. On private lands, intensive timber management has resulted in a quick conversion of potential early seral stage habitats into established timber production. The result has been less deer forage available on both public and private forest lands. In the southern portion of this zone, black-tailed deer migrate from higher elevation summer range in the Cascades and Siskiyou Mountains to winter range in the lower elevations of valley sub-floors. This is particularly apparent in Jackson and portions of Josephine and Klamath counties. With increasing urban development, deer winter range is decreasing.

Beginning about 1998, Deer Hair Loss Syndrome (DHLS) became evident in northwestern Oregon and spread south throughout some of the lower elevations of this zone, mostly in Lane, Douglas, and Josephine counties in approximately four years. Adenovirus hemorrhagic disease (AHD) and Epizootic Hemorrhagic Disease (EHD) have also been detected and in some places mortality loss may have been high. If DHLS, AHD, and EHD problems subside, as is typical of most disease concerns, cougar predation could potentially limit deer population recovery if deer numbers decline and a predator pit situation develops.

Adaptive management will be used to address plan objectives in Zone B. Identified target areas will be managed intensively to achieve objectives for cougar-human conflicts and elk, deer, or bighorn populations. Particular attention will be given to areas around human habitation where cougar-human conflicts have been documented. Conflict will be monitored with established measurement criteria and management will be adjusted based on results. The minimum cougar population for Zone B is 1,200 (Chapter III: Objective 1). Based on current population estimates, modeling indicates a total human caused mortality of 165 cougars/year for 5 years could occur without reducing cougar numbers below the minimum population of 1,200. If total human caused mortality reaches 200/yr for 5 years could occur without reducing cougar numbers below the minimum population of 400. Areas with limited public access, which account for approximately 20% of the zone, receive little or no harvest. Intensive cougar harvest in targeted areas, moderate

levels of cougar harvest in other areas, and little harvest in roadless areas are expected to meet objectives for cougar conflict while maintaining cougar populations above minimum levels.

Zone Management Summary

If conflict thresholds defined in Table 17 met, total cougar mortality may be increased in targeted areas throughout Zone B. Areas of human habitation with elevated or recurring cougar–human conflict may be identified for more intensive cougar management. Currently this applies to the foothill fringe and valley floor of the Rogue Valley, Umpqua Valley, and the Southeast portion of the Willamette Valley. Desired outcomes include a decrease in cougar-human conflicts measured by non-hunting mortality and cougar complaints. Results will be monitored and hunting or cougar removal programs modified to meet desired outcomes for the zone (Table 18).

Excluding Applegate WMU, areas with 3-year average elk calf ratios below maintenance level of 23 calves/100 cows may be targeted for intensive cougar harvest. Of eight WMUs in the zone, none currently have elk or deer populations at levels that might trigger intensive cougar control. If data indicate cougar predation is affecting ODFW's ability to meet deer or elk population objectives, some areas may be targeted for intensive cougar control (Table 18).

ODFW may consider transplanting certain wildlife species within Zone B. Columbia white-tailed deer populations within the zone have increased and recently were removed from both the state and federal endangered species lists. Additional recovery efforts could involve establishing new sub-populations within the zone. ODFW is restoring mountain goats to historic habitats throughout the state, and several release sites are identified in the zone. When evidence indicates cougar predation threatens transplant success or viability, release areas may be targeted for intensive cougar control.

Table 18. Adaptive management parameters for Cougar Management Zone B: Southwest Cascades.

Management Concern	Indicator	Objectives	Criteria Triggering Targeted Area Management
Sustain Populations	Cougar population	Cougar population estimate >1,200 cougars for the zone	Cougar population estimate <1,200 cougars will result in harvest reductions in the zone.
	Cougar Mortality	Do not exceed total mortality quota	If zone quotas are met, hunting and target area harvest will end. Response to livestock damage and human safety/pet complaints will continue.
Human Interactions	Non-hunting mortality related to human safety/pet	The 3-year average of non-hunting mortalities due to human safety/pet complaints does not exceed the 10-year average	A 3-year average that exceeds the 10-year average could trigger control in areas around human habitation.
	Non-hunting mortality related to livestock	The 3-year average of non-hunting mortalities due to livestock complaints does not exceed the 10-year average	A 3-year average that exceeds the 10-year average could trigger control in areas around livestock operations.
Ungulate Populations	Elk	Maintain 3 year mean calf ratios at approximately 30 - 40 calves/100 cows	Units with < 23 calves/100 cows for 3 years and below population Management Objective for 3 years.
	Deer	Maintain healthy populations with little evidence of disease that support optimum deer populations	Target only when evidence indicates cougar predation is a significant factor to deer populations.
	Ungulate transplants	Insure viable transplants	Target only when evidence indicates cougar predation threatens success or viability of transplant.
	Wildlife Areas (WA)	Satisfy stated purpose and Management Objectives of the Area	Target WA if cougars prevent satisfying WA purpose or achieving WA objectives.

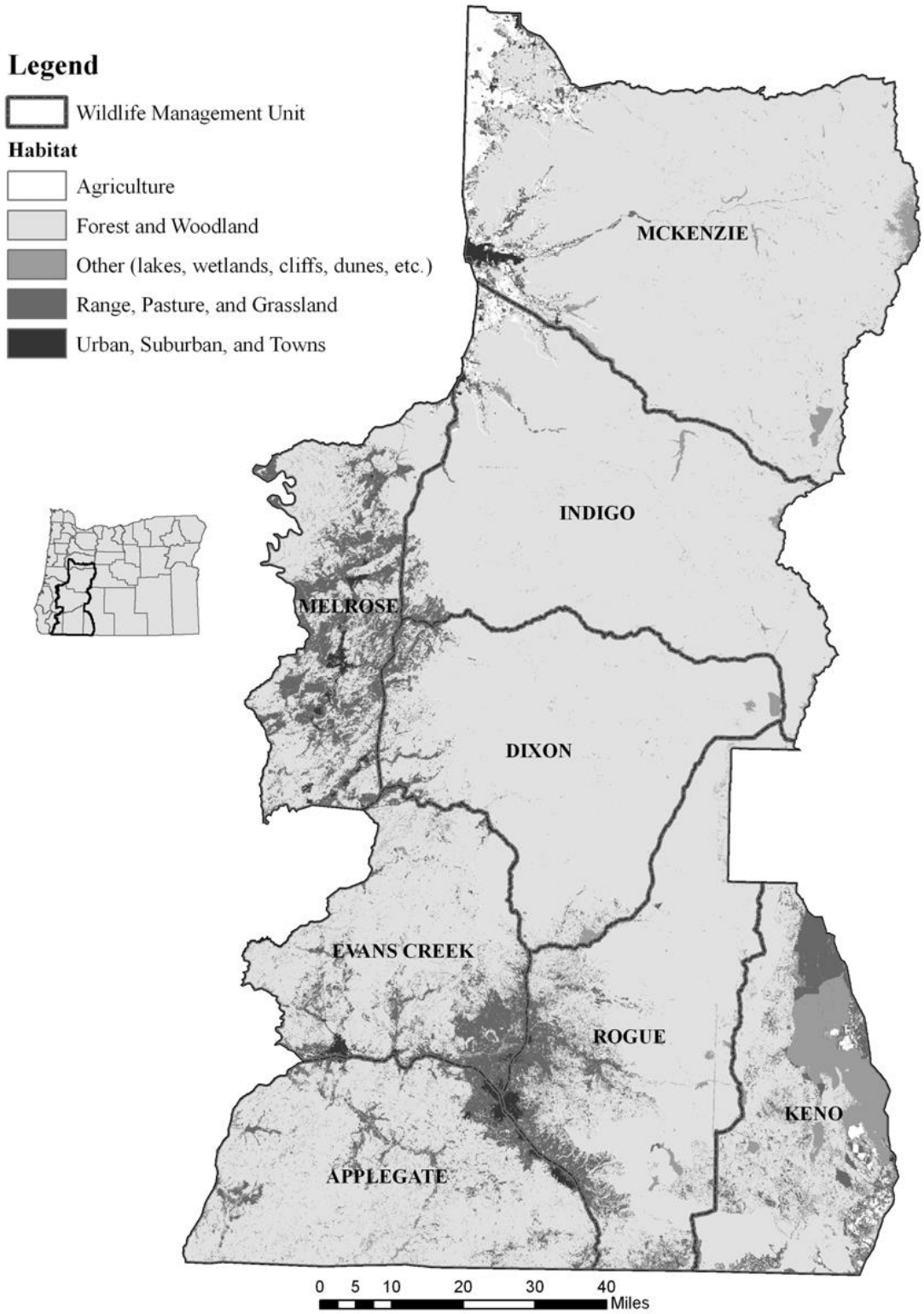


Figure 13. Land cover characteristics of cougar management zone B.

Zone C – Southeast Cascades

Zone Overview

The Southeast Cascade Cougar Management Zone (Figure 14) includes approximately 10,627 mi^2, 66% of which is public land. This zone includes 4 wilderness areas (294 mi^2), 4 roadless areas (221 mi^2), 3 national parks or monuments (212 mi^2), 3 national wildlife refuges (71 mi^2), and 4 large winter road closures designed to protect wintering mule deer from human harassment and poaching (443 mi^2). Seven WMUs make up this zone. Elevations range from approximately 3,000 feet in the vicinity of Bend to over 9,000 feet at the crest of the Cascades. Valleys are high elevation relative to the rest of Oregon. Klamath Basin, Summer Lake Valley, and Warner Valley are approximately 4,200 feet. Goose Lake Valley is approximately 5,000 feet. Habitats are diverse, ranging from sagebrush steppe at drier, lower elevation sites to alpine habitats at highest elevations. The most abundant habitats are typical eastside ponderosa pine forest with white fir and a shrub understory, or lodgepole pine/bitterbrush associated with Mt. Mazama ash soils (Figure 14). The cities of Bend, Redmond, and portions of Klamath Falls are in this zone. There are numerous small towns and other rural communities throughout the zone. Primary industries include ranching, farming, timber, recreation, government (e.g. resource management agencies such as the U.S. Forest Service and Bureau of Land Management), and service businesses associated with the larger cities.

Evaluation of mortality and age data in zone C suggests an increasing cougar population in this Zone over past decades. Based on population modeling, cougar density (all age classes) of Zone C has increased from 4.6 cougars/100 mi^2 (1.8 cougars/100 km^2) in 2006 to 9.6 cougars/100 mi^2 (3.7 cougars/100 km^2) in 2015 (Oregon Department of Fish and Wildlife, unpublished data). From 2006 to 2015, the 3-year average proportion of adult (3+) females to total cougar mortalities averaged 16.3% and over that span, adult females (3+) averaged 4.7 years old.

Cougar-human conflict and hunter harvest in Zone C has been steady for the past decade. From 2007-2016, non-hunting mortalities in response to livestock and human safety/pet complaints have averaged 25 per year (range 15-42). Complaints have decreased from 71 in 2002 to just 20 in 2016. From 2006-2015 hunter harvest has averaged just 27% (range 15-46%) of the zone quota and mortalities due to damage and conflict averaged 5% (range 0-9%) of the zone quota.

Elk densities in Zone C are low relative to other areas in Oregon. Currently there is no indication of cougar predation affecting elk calf recruitment or populations. However, if future information indicates cougar predation is substantially limiting elk numbers in the zone, increased cougar control may be implemented.

Zone C has some of the largest mule deer populations in Oregon. Spring trend surveys suggest populations throughout the zone have been below MO. AHD has affected populations in portions of the Upper Deschutes and Paulina WMU's. Throughout the remainder of Zone C, habitat conditions have stayed relatively constant or have improved. ODFW suspects cougar predation may be limiting fawn recruitment, thus preventing mule deer populations from reaching population MOs. ODFW believes 35 fawns:100 adults in the spring are needed to maintain deer numbers in this zone. Fawn recruitment is substantially affected by winter severity, drought, and coyote predation, as well as cougar predation. Because fawn recruitment is affected by several variables, population trend and abundance is the best indicator of herd health within a WMU. To quantify the effect of cougar predation on deer abundance, it is necessary to measure adult mortality and cause. In July, 2005 ODFW began research on deer that winter in the Silver Lake, Fort Rock, and southern portion of the Paulina WMUs. One objective of this research is to measure amount and cause of adult mule deer

mortality. During the course of the South –central mule deer study, mule deer mortality rates from cougar were found to be 16% of 208 total mortalities (2005-2011). Consequently, this study provides critical information regarding cougar predation on deer that can be used for adaptive management in Zone C.

Hadley Butte and the Devils Garden are the only bighorn herd ranges within the zone. The Hadley Butte herd was established in 1984 when eight California bighorn sheep were re-introduced, and supplemented with 18 in 1995. In 1999, 74 sheep were observed during spring census. By 2004, the herd had declined, and only eight sheep were observed. Based on the number of cougar killed bighorn found and the increase in cougar damage complaints on private land immediately below the sheep range, ODFW believes this decline is due to cougar predation. The Devils Garden herd was established in 1995 with re-introduction of 16 California bighorn sheep. There have been three supplemental releases since then, totaling 40 sheep into two different areas of the range. The 2005 population estimate for this herd was 20 bighorn. The level of cougar predation on this herd is unknown but believed significant. Observational information has documented several adult cougars living in close proximity to these bighorn herds. Necropsies on numerous radio-collared and unmarked carcasses indicated cougar predation as the cause of death. Cougar predation is not the sole cause of decline of this bighorn herd. However, ODFW believes it to be one of the most significant causes of adult bighorn sheep mortality. The zone includes several pronghorn herds. In 1995, these populations were very low following several years of poor recruitment. Since 1995, pronghorn herds have increased substantially. There is no evidence cougar predation on pronghorn is limiting populations.

Adaptive management may be employed to reduce conflict as measured by non-hunting mortality and complaints. The minimum cougar population for Zone C is 120 (Chapter III: Objective 1). Based on current population estimates, modeling indicates that a total human caused mortality of 80 cougars/year for 5 years could occur without reducing cougar numbers below the minimum population of 120. Conflict will be monitored with established measurement criteria and management will be adjusted based on results. Areas with restricted access such as wilderness and roadless areas, national parks and wildlife refuges, and winter road closures will receive little or no harvest. These areas account for approximately 12% of the entire zone or 1,241 mi^2. Other areas will be managed more intensively to achieve objectives for cougar-human conflicts and deer or bighorn populations. Particular attention will be given to areas around human habitation, with elevated or recurring cougar-human conflicts. Some bighorn sheep populations and new ungulate transplants may be targeted for intensive cougar harvest if cougar predation is identified as a possible limiting factor (Oregon Department of Fish and Wildlife 2003a). More intensive cougar harvest in targeted areas, while maintaining moderate levels of cougar harvest throughout most of the zone, and little harvest in areas with restricted human access is expected to meet objectives for cougar conflict, and maintain cougar populations.

Zone Management Summary

Those WMUs in which mule deer herds have declined by 20% over the last 5 years or below 60% of MO for 3 years may be targeted for more intensive cougar harvest (Table 19). Of seven WMUs in the zone, four met these criteria in 2005 (Klamath, Sprague, Upper Deschutes, and Interstate). Starting January 1, 2016, the Interstate Cougar Target area was implemented to address mule deer populations in the Interstate WMU. Managers will remove 50 cougars each year within the target area to raise mule deer populations to MO levels. Areas of human habitation with elevated levels of cougar-human conflict, as defined by cougar non-hunting mortalities, may be targeted for

more intensive cougar harvest (Table 19). To maintain bighorn sheep populations, selective or intensive cougar harvest may be implemented on established bighorn herd ranges if evidence indicates cougar predation is limiting the population. Desired outcomes include a decrease in cougar-human conflicts measured by non-hunter mortality and complaints, maintenance of bighorn herds at desired levels, and an increase in deer populations to MO (Table 19). Outcomes will be monitored and hunting programs modified to meet zone objectives.

Table 19. Adaptive management parameters for Cougar Management Zone C: Southeast Cascades.

Management Concern	Indicator	Objectives	Criteria Triggering Targeted Area Management
Sustain Populations	Cougar population	Cougar population estimate >120 cougars for the zone	Cougar population estimate <120 cougars will result in harvest reductions in the zone.
	Cougar Mortality	Do not exceed total mortality quota	If zone quotas are met, hunting and target area harvest will end. Response to livestock damage and human safety/pet complaints will continue.
Human Interactions	Non-hunting mortality related to human safety/pet	The 3-year average of non-hunting mortalities due to human safety/pet complaints does not exceed the 10-year average	A 3-year average that exceeds the 10-year average could trigger control in areas around human habitation.
	Non-hunting mortality related to livestock	The 3-year average of non-hunting mortalities due to livestock complaints does not exceed the 10-year average	A 3-year average that exceeds the 10-year average could trigger control in areas around livestock operations.
Ungulate Populations	Elk	Maintain 3 year mean calf ratios at 30 - 40 calves/100 cows	Units with < 23 calves/100 cows for 3 years and below population Management Objective for 3 years.
	Deer	Increase populations to MO levels	Units declining by 20% over the last 5 years or below 60% of MO for 3 years.
	Bighorn Sheep	Maintain populations at or near social or habitat capability	Target only when evidence indicates cougar predation is a limiting factor.
	Ungulate transplants	Insure viable transplants	Target only when evidence indicates cougar predation threatens success or viability of transplant.
	Wildlife Areas (WA)	Satisfy stated purpose and Management Objectives of the Area	Target WA if cougars prevent satisfying WA purpose or achieving WA objectives.

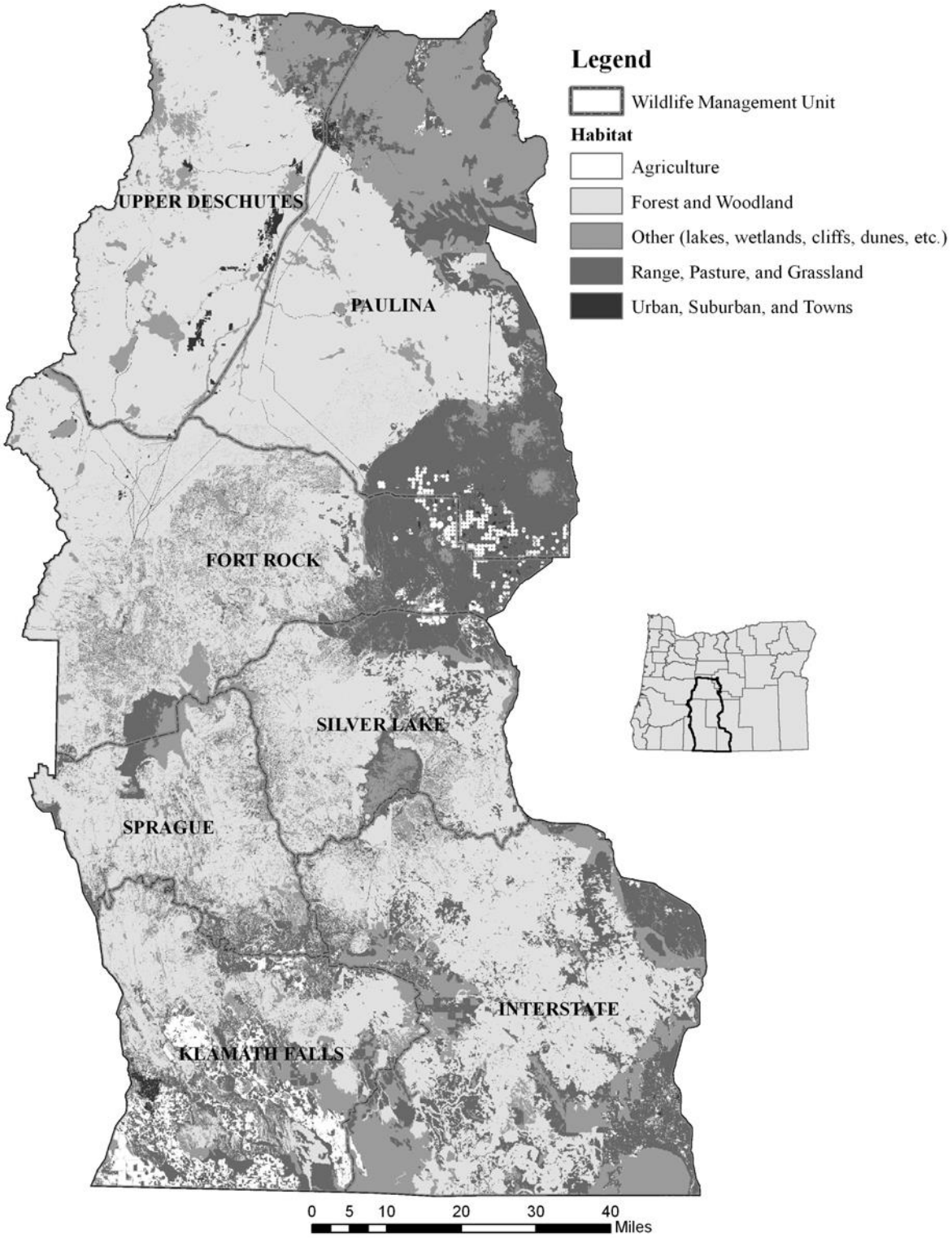


Figure 14. Land cover characteristics of cougar management zone C.

Zone D – Columbia Basin

Zone Overview

Zone D (Figure 15) includes approximately 8,465 mi^2 (13% public land) with one wilderness area and two scenic waterways. Five WMUs make up this zone: Columbia Basin, Biggs, Fossil, Grizzly, and Maupin. Elevation ranges from 72 ft along the Columbia River to 5,800 ft in the mountains. Zone D habitats generally fall into three broad classifications: (1) low elevation shrub-steppe and grasslands heavily dominated by active farming; (2) foothill and canyon shrub-steppe/grassland; and (3) mixed conifer forest in the southernmost portion of the zone (Figure 15). Small rural towns occur throughout the zone but the highest human densities occur in the southwest portion of the zone in Prineville, Redmond, and Madras. However, the majority of the human population lives in rural communities and towns located along Interstate 84 such as The Dalles, Hermiston, and Pendleton. Primary occupations include farming, ranching, timber, and government services. Industry also plays a larger role in the vicinity of the larger cities and ports.

An estimated 60% of this zone (primarily the northern two-thirds) is lower-elevation grass and shrubland with a significant portion converted to agriculture. This portion of the zone is generally considered poor cougar habitat. Based on hunter harvest, recorded cougar-human conflicts, and irregular observations, cougars are believed to occupy this portion of the zone in very low densities with much of this type being devoid of cougars. An estimated 9% of the zone is considered sub-optimal cougar habitat. This type is primarily located within the larger canyon corridors and tributaries of the Deschutes and John Day Rivers, which provides resident habitat and travel corridors for movement and dispersal. The area also includes some foothill shrub- steppe and grasslands. Cougars regularly occupy this type but they occur at an intermediate density. The remaining 31% of the Zone is considered optimal cougar habitat and encompasses much of the Fossil and Grizzly WMUs. The majority of cougars occupying this zone reside within these two WMU's. From 2006 to 2016, 63% of all cougars harvested in Zone D were taken in the Fossil and Grizzly WMUs.

Based on population modeling (updated April 2017), cougar density (all age classes) in Zone D has increased from 3.8 cougars/100 mi^2 (1.5 cougars/100 km^2) in 2006 to 4.7 cougars/100 mi^2 (1.8 cougars/100 km^2) in 2015. Evaluation of mortality and age data in zone D suggests a relatively recent increase in the cougar population in this Zone. From 2006-2015, 25.3% of the cougar mortality was adult (3 yr+) females with an average age of 5.0 years (Oregon Department of Fish and Wildlife, unpublished data). The proportion of 3yr+ adult females in the total mortality is high compared to other zones; however, zone populations appear to be stable or increasing. Due to the large amount of poor cougar habitat, even at maximum cougar densities a large portion of this zone will continue to have few resident cougars.

Cougar-human conflict has increased substantially since the early 1990's. Non-hunting mortality in response to livestock and human safety/pet complaints increased in the zone from 0 in 1994 to an average of 20 from 2006 to 2016 Cougar complaints reported annually to ODFW have increased from 7 in 1994 to an average of just 14 from 2006 to 2016. From 2006-2015 hunter harvest has been stable and averaged just 22% (range 11-29%) of the zone quota whereas mortalities due to damage and conflict averaged 30% (range 21-39%) of the zone quota.

Zone D has not historically had many elk. Elk populations began building in the Grizzly and Fossil WMUs in the 1970's and 1980's. In the 1990's, elk began to occupy lower elevation canyon and farmlands in the northern two-thirds of the zone. Because of this expansion and resulting damage caused by elk in these areas, ODFW initiated a de-emphasis management strategy for elk in the

Columbia Basin, Biggs, and Maupin WMUs. Cougar predation of elk in these three WMU's is not significant for management of either species. In the Fossil WMU, elk calf recruitment has remained relatively low over the past 10 years. From 2006 to 2016, the elk calf ratio has averaged 22 calves: 100 cows. Consistent with recent studies in northeast Oregon, cougar predation is believed to be the primary cause of calf mortality. Continued low calf recruitment and relatively aggressive elk harvest strategies have reduced this elk population significantly. The Fossil WMU continues to be over established elk population MO but is declining. The Grizzly WMU does not appear to be experiencing severe cougar predation on elk as calf ratios have remained relatively high through the 10-year period (average of 38 calves:100 cows from 2006 to 2016). However, as more cougar habitat becomes occupied, it is anticipated that predation on elk will increase similar to neighboring units in northeast Oregon.

Most mule deer occur in vast expanses of habitat with few or no cougars. Fawn ratios across the zone have averaged 36 fawns:100 adults for the period from 2006-2016 with a low of 18 fawns and a high of 49 fawns:100 adults. The fawn ratios have varied greatly during that time frame and within the units. This suggests other factors such as habitat and weather (i.e. drought) may play an important role in the overall decline of mule deer in this zone. In addition, coyotes are ubiquitous across this zone and coyote predation also may affect mule deer fawn survival. With cougar numbers increasing in the zone, cougar predation combined with other factors may substantially affect mule deer population size. Currently, all WMUs within the zone are below established mule deer population management objectives.

Bighorn sheep are found in the lower John Day River and Deschutes River canyons, with a small population along the Columbia River in the Biggs WMU. California bighorn sheep were reintroduced to the Lower John Day River in 1989 and the Lower Deschutes River in 1993 when cougars were rarely found in these areas. Although cougar numbers have increased since bighorn sheep reintroductions, cougars do not appear to be currently impacting bighorn sheep populations in Zone D but as cougar densities continue to increase that may change. Bighorn populations are expanding in range and number in both river canyons and lamb ratios have ranged from 24 – 54 lambs:100 ewes with an average of 37 lambs:100 ewes over the last 10 years. As cougar populations increase, however, they may cause bighorn sheep population declines or cause redistribution of animals away from traditional lambing ranges resulting in lower lamb survival.

Adaptive management will be used to address plan objectives in Zone D. Identified target areas will be managed more intensively to achieve objectives for cougar-human conflicts and elk, deer, or bighorn populations. Particular attention will be given to areas around human habitation, with elevated or recurring cougar-human conflicts. Conflict will be monitored with established measurement criteria and management will be adjusted based on results. Target areas may be identified for some bighorn sheep populations if cougar predation is identified as a possible limiting factor (Oregon Department of Fish and Wildlife 2003a).

The minimum cougar population for Zone D is 80 (Chapter III: Objective 1). Based on current population estimates, modeling indicates that a total human caused mortality of 100 cougars/year for 5 years could occur without reducing cougar numbers below the minimum population of 80. Areas with restricted access such as wilderness and scenic waterways, will receive little or no harvest. These areas account for approximately 1.3% of the entire zone or 108 square miles. Intensive cougar harvest in targeted areas, moderate levels of cougar harvest in other areas, and little harvest in roadless areas are expected to meet objectives for cougar conflict while maintaining cougar populations above minimum levels.

Zone Management Summary

Those WMUs with a 3-year average calf ratio below maintenance level of 23 calves/100 cows and a 3-year average population index below MO may be targeted for more intensive cougar harvest (Table 20). Those WMUs where mule deer herds have declined by 20% over the last 5 years or are 60% below MO for 3 years may be targeted for intensive cougar harvest. Currently none of the WMU's in the zone meets the target criteria for a mule deer orientated cougar target area. Areas of human habitation with elevated levels of cougar-human conflict as defined by cougar non-hunter mortality and complaints greater than the 2000 level may also be targeted for intensive cougar harvest (Table 20). To maintain bighorn sheep populations, selective or intensive cougar harvest may be implemented on established bighorn herd ranges if evidence indicates cougar predation is limiting the population. Desired outcomes include a decrease in cougar-human conflicts, as measured by non-hunting mortalities, an increase in deer populations to MO levels, and an increase in elk calf survival (Table 20). Outcomes will be monitored and hunting programs modified to meet zone objectives.

Table 20. Adaptive management parameters for Cougar Management Zone D: Columbia Basin.

Management Concern	Indicator	Objectives	Criteria Triggering Targeted Area Management
Sustain Populations	Cougar population	Cougar population estimate >80 cougars for the zone	Cougar population estimate <80 cougars will result in harvest reductions in the zone.
	Cougar Mortality	Do not exceed total mortality quota	If zone quotas are met, hunting and target area harvest will end. Response to livestock damage and human safety/pet complaints will continue.
Human Interactions	Non-hunting mortality related to human safety/pet	The 3-year average of non-hunting mortalities due to human safety/pet complaints does not exceed the 10-year average	A 3-year average that exceeds the 10-year average could trigger control in areas around human habitation.
	Non-hunting mortality related to livestock	The 3-year average of non-hunting mortalities due to livestock complaints does not exceed the 10-year average	A 3-year average that exceeds the 10-year average could trigger control in areas around livestock operations.
Ungulate Populations	Elk	Maintain 3 year mean calf ratios at 30 - 40 calves/100 cows	Units with < 23 calves/100 cows for 3 years and below population Management Objective for 3 years.
	Deer	Increase populations to MO levels	Units declining by 20% over the last 5 years or below 60% of MO for 3 years.
	Bighorn Sheep	Maintain populations at or near social or habitat capability	Target only when evidence indicates cougar predation is a limiting factor.
	Ungulate transplants	Insure viable transplants	Target only when evidence indicates cougar predation threatens success or viability of transplant.
	Wildlife Areas (WA)	Satisfy stated purpose and Management Objectives of the Area	Target WA if cougars prevent satisfying WA purpose or achieving WA objectives.

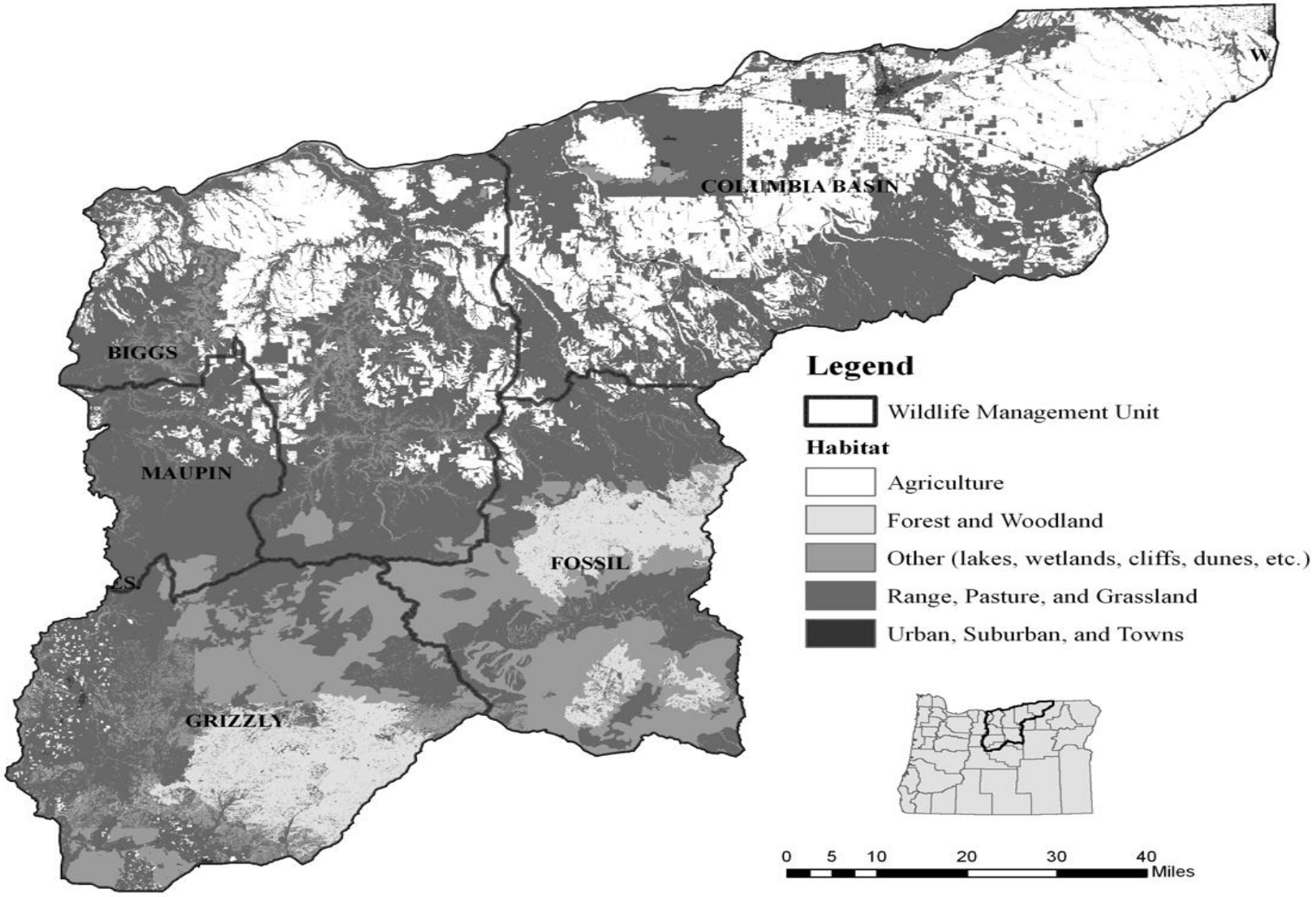


Figure 15. Land cover characteristics of cougar management zone D.

Zone E - Blue Mountains

Zone Overview

Zone E (Figure 16) includes approximately 15,929 mi^2, 49% of which is public land. This zone includes 8 wilderness areas (1,404 mi^2), 81 roadless areas (1,534 mi^2), and 14 wild and scenic areas (97 mi^2). ODFW has four WAs that provide critical winter ranges for big game in this zone (Bridge Creek, Elkhorn, Ladd Marsh, and Wenaha). Twenty WMUs make up this zone. Elevations range from approximately 1,500 ft in the Snake River Canyon to 10,000-foot peaks in the Wallowa, Elkhorn, and Strawberry Mountains. Habitats are diverse, ranging from sagebrush steppe at drier, lower elevation sites to alpine habitats at higher elevations. The most abundant habitat is mixed conifer forests (Figure 16). Major communities include Enterprise, La Grande, Baker City, and John Day. There are numerous other small towns located primarily in the valleys. Primary industries include ranching, farming, timber, support services, and government (resource management agencies such as the U.S. Forest Service and Bureau of Land Management).

Based on population modeling (updated April 2017), cougar population density (all age classes) in Zone E increased from 11.0 cougars/100 mi^2 (4.3 cougars/100 km^2) in 2006 to 11.4 cougars/100 mi^2 (4.4 cougars/100 km^2) in 2015. From 2006 to 2015, the 3-year average proportion of adult (3+) females to total cougar mortalities averaged 24% and over that span, adult females averaged 5.1 years old (Oregon Department of Fish and Wildlife unpublished data).

Cougar-human conflict in Zone E has been on a downward trajectory for many years. Non-hunting mortality in response to livestock and human safety/pet complaints peaked in 1999 with 51 but has averaged just 20 annually over the past 10 years (2007-2016) (Table 3). Complaints have also decreased from 115 in 2005 to just 13 in 2016. From 2006-2015 hunter harvest has been stable and averaged just 40% (range 29-52%) of the zone quota whereas mortalities due to damage and conflict averaged 6% (range 2-11%) of the zone quota.

The Blue Mountains in Zone E have long been known as the premier elk area of Oregon. This status has changed in recent years, as calf recruitment has steadily declined over time. Calf ratio 3 year averages have declined from 43 calves/100 cows in 1983, to 33 calves/100 cows in 1995, to 25 calves/100 cows in 2006, to 21 calves/100 cows in 2016. Based on elk population modeling and case histories, ODFW believes 23 calves/100 cows is necessary to maintain an elk herd in the absence of antlerless elk hunting. Elk population estimates in Zone E have generally been stable to slightly increasing since 2006, due to continued major reductions in antlerless hunting opportunity instituted in many units to reverse declining elk population trends. However, in 2016, 7 of the 20 MMUs in Zone E still remain below population MO.

While other factors affect elk populations, ODFW believes cougar predation is affecting calf survival. In response to declines in observed calf:cow ratios, ODFW initiated a research project in northeast Oregon to evaluate declines in elk calf recruitment. From 2002 – 2008, ODFW captured 204 female adult elk, 460 newborn calves, and 68 cougars and monitored survival of adult and juvenile elk and cougars in study areas within Sled Springs and Wenaha Wildlife Management Units. Nutritional condition (body fat) and pregnancy status of females was measured in spring and fall. Cougar densities varied between 2.25 and 4.29 subadult females and adult cougars per 100 km^2 or 5.8 to 11.1 per l00 mi^2 and does not include kittens or subadult males. Annual survival of radio-collared juveniles varied between 26 – 53%, and cougar predation was the proximate cause of >70% of all mortalities documented. Analysis of survival revealed a strong relationship between juvenile elk survival and cougar density and no relationship between body condition of female elk and

juvenile survival indicating that habitat was sufficient to meet nutritional requirements of females and their calves but that survival of calves was related to cougar density. Additionally a Cougar Target Area was implemented in the Heppner WMU from 2006-2009. Calf ratios in Heppner WMU increased from 17 calves/100 cows in 2005 to 29 calves/100 cows in 2009 and have declined to pretreatment levels following treatment. The Ukiah Cougar Target Area (late 2009-2013) also saw recruitment improvement indicated by an increase from 11 calves/100 cows in 2009 to 23 calves/100 cows in 2014.

A 3-year study in NE Oregon found cougar predation of adult mule deer to be the leading cause of mortality, accounting for 33% of all known mortality (Matthews and Coggins 1997). A study of a wintering mule deer herd in Hells Canyon showed a 25% mortality rate for adult does from 1999-2001 (Edelmann 2003). The primary cause of adult doe mortality was cougar predation. Improvements in adult and fawn survival are necessary to meet established MOs for mule deer. While cougar predation has had a demonstrated effect on mule deer populations, several other factors have also been important. Those factors include other sources of predation (e.g. coyote) and weather, including periodic severe winters and drought. In addition, cougar predation affects adult survival. Therefore, ODFW does not believe fawn ratio is a good indicator of deer population health and greater attention should be placed on total deer population estimates.

ODFW began bighorn recovery in Zone E in the 1970s. Twelve separate Rocky Mountain bighorn herds and three California bighorn herds are now established with a 2016 population estimate of approximately 800 animals. Although total populations have increased, rates of increase have been reduced and some herds have declined. Recent monitoring of radio-collared bighorns in Hells Canyon found the primary causes of mortality to be disease followed by cougar predation (Cassirer 2004). During a 7-year period, 61 of 154 radio-collared sheep died and cougar predation accounted for 27% of all known mortalities. Further, reintroduction efforts in the Minam Unit was likely compromised by cougar predation in 2000.

Adaptive management will be used to address plan objectives in Zone E. Some areas and WMUs will be managed more intensively to achieve objectives for cougar-human conflicts and elk, deer, or bighorn populations. Particular attention will be given to areas around human habitation, with elevated or recurring cougar-human conflicts. Conflict will be monitored with established measurement criteria and management will be adjusted based on results. Some bighorn sheep populations and recent transplants of other native species may be targeted if cougar predation is identified as a limiting factor (Oregon Department of Fish and Wildlife 2003a). The minimum cougar population for Zone E identified in this plan is 900 (Chapter III: Objective 1). Based on current population estimates, modeling quotas include all known mortalities and modeling indicates mortalities of 270 cougars/year for 5 years could occur without reducing cougar numbers below the minimum population of 900. Wilderness, roadless, and wild and scenic areas will have little or no harvest. These areas account for approximately 19% of the entire zone or approximately 3,035 mi^2. Intensive cougar harvest in targeted areas, moderate levels of cougar harvest in other areas, and little harvest in roadless areas are expected to meet objectives for cougar conflict while maintaining cougar populations above minimum levels.

Zone Management Summary

Those WMUs with a 3-year average calf ratio below maintenance level of 23 calves/100 cows and a 3-year average population index below MO may be targeted for more intensive cougar harvest (Table 21). Of 20 WMUs in the zone, four met these criteria in 2016 (Wenaha, Snake River, Walla Walla, and Starkey). WMUs where the deer population has declined >20% over the last 5 years or

is 60% below MO may be targeted for more intensive cougar harvest (Table 21). Areas of human habitation with elevated levels of cougar-human conflict, as defined by 3-year averages of non-hunter mortalities that exceed 10-year averages, may also be targeted for more intensive cougar harvest (Table 21). At this time, no established bighorn sheep herds appear to be limited by cougar predation and intensive cougar management is currently not necessary. However, if a bighorn sheep herd is found to be declining with cougar predation identified as the limiting factor, the herd range may be targeted for more intensive cougar control. In addition, cougars may be targeted in new transplant areas when cougar predation threatens success or viability of the transplant (Oregon Department of Fish and Wildlife 2003a). Desired outcomes include a decrease in cougar-human conflicts, as measured by non-hunting mortalities and an increase in elk calf survival (Table 21). Outcomes will be monitored and hunting programs modified to meet zone objectives.

Table 21. Adaptive management parameters for Cougar Management Zone E: Blue Mountains.

Management Concern	Indicator	Objectives	Criteria Triggering Targeted Area Management
Sustain Populations	Cougar population	Cougar population estimate >900 cougars for the zone	Cougar population estimate <900 cougars will result in harvest reductions in the zone.
	Cougar Mortality	Do not exceed total mortality quota	If zone quotas are met, hunting and target area harvest will end. Response to livestock damage and human safety/pet complaints will continue.
Human Interactions	Non-hunting mortality related to human safety/pet	The 3-year average of non-hunting mortalities due to human safety/pet complaints does not exceed the 10-year average	A 3-year average that exceeds the 10-year average could trigger control in areas around human habitation.
	Non-hunting mortality related to livestock	The 3-year average of non-hunting mortalities due to livestock complaints does not exceed the 10-year average	A 3-year average that exceeds the 10-year average could trigger control in areas around livestock operations.
Ungulate Populations	Elk	Maintain 3 year mean calf ratios at 30 - 40 calves/100 cows	Units with < 23 calves/100 cows for 3 years and below population Management Objective for 3 years.
	Deer	Increase populations to MO levels	Units declining by 20% over the last 5 years or below 60% of MO for 3 years.
	Bighorn Sheep	Maintain populations at or near social or habitat capability	Target only when evidence indicates cougar predation is a limiting factor.
	Ungulate transplants	Insure viable transplants	Target only when evidence indicates cougar predation threatens success or viability of transplant.
	Wildlife Areas (WA)	Satisfy stated purpose and Management Objectives of the Area	Target WA if cougars prevent satisfying WA purpose or achieving WA objectives.

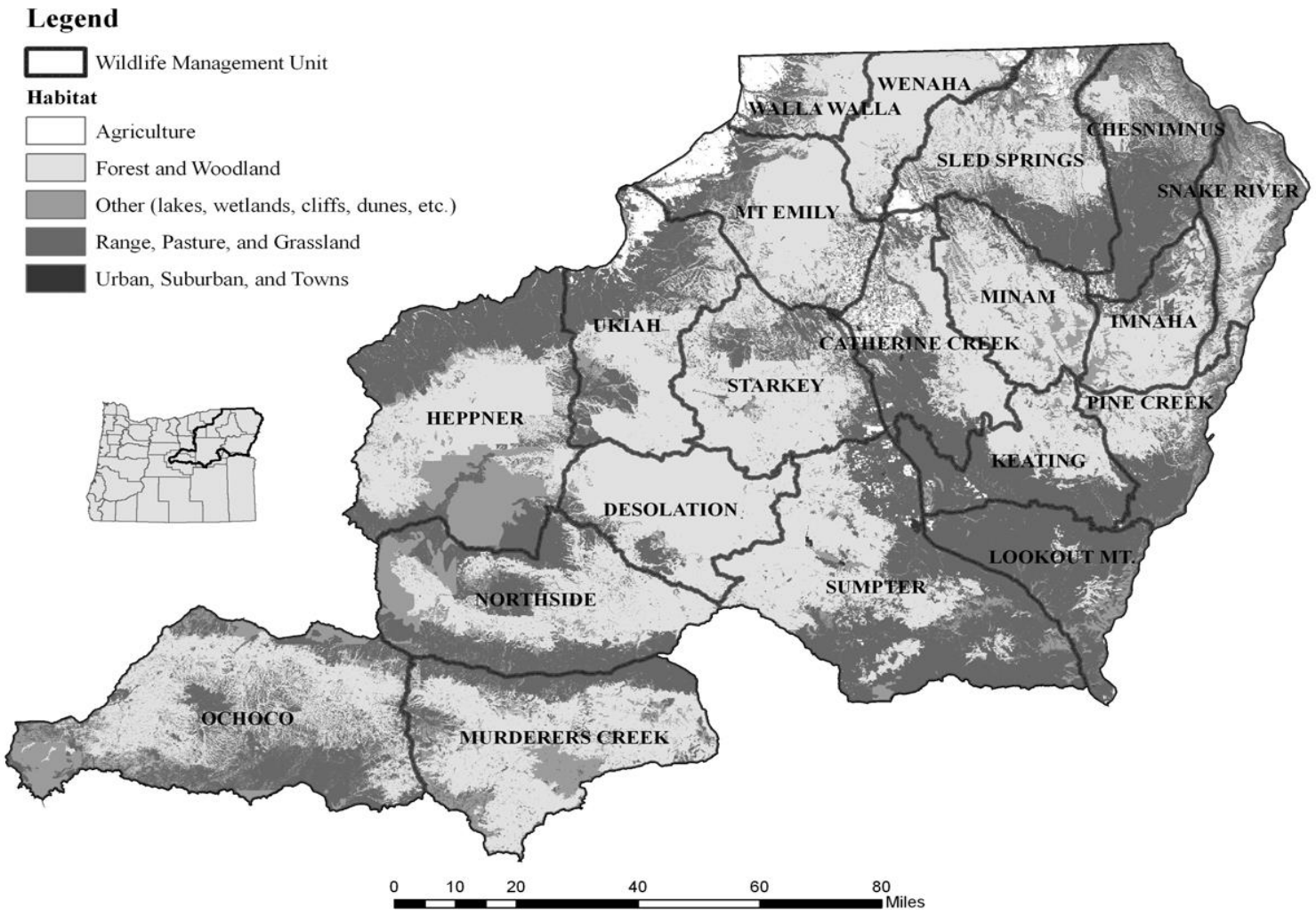


Figure 16. Land cover characteristics of cougar management zone E.

Zone F – Southeast Oregon

Zone Overview

Zone F (Figure 17) includes approximately 28,003 mi^2 and is 64% public land. The zone consists of 11 WMUs (Whitehorse, Owyhee, Malheur River, Steens Mountain, Juniper, Beatys Butte, Warner, Wagontire, Maury, Silvies, and Beulah) and 26,409 mi^2 is considered cougar habitat. Big game habitat in this zone consists primarily of sagebrush habitats (Figure 17), which generally support mule deer, pronghorn, and bighorn sheep as a prey base at relatively low densities compared to mixed conifer habitats in other zones. However, there are areas within these units, which support more diverse habitats and higher densities of prey. Examples include Steens Mountain, Trout Creek Mountains, Mahogany Mountain, Abert Rim, and Hart Mountain. Portions of the Warner, Maury, Silvies, Malheur River, and Beulah WMU's are composed of mixed conifer habitats and subsequently support a more abundant and diverse prey base of deer and elk.

Zone F includes three wild and scenic rivers, two designated wilderness areas, several wilderness study areas, two national wildlife refuges, and one state owned wildlife area managed for big game (Riverside). Elevations range from approximately 2,200 feet at Ontario to 9,670 feet on Steens Mountain. Human population density is low compared to other parts of the state. Local economies are primarily based on agriculture, livestock, timber, and support services. Major towns include Lakeview, Burns/Hines, Jordan Valley, Vale, Nyssa, and Ontario.

Based on population modeling (updated April 2017), cougar population density (all age classes) in Zone F has slightly increased from cougars 3.4/100 mi^2 (1.3 cougars/100 km^2) in 2006 to 3.6 cougars/100 mi^2 (1.4 cougars/100 km^2) in 2015. Evaluation of mortality and age data suggests a stable or slow increase in the cougar population in this Zone for many years. From 2006 to 2015, the 3-year average proportion of adult (3+) females to total cougar mortalities averaged 21% and over that span, adult females (3+) averaged 4.9 years old (Oregon Department of Fish and Wildlife unpublished data).

Cougar-human conflict in Zone E has been low and steady for many years. From 1999 to 2016, non-hunting mortalities in response to livestock and human safety/pet complaints have averaged 14 per year (range 6-27). Complaints have decreased from 27 in 2002 to just seven in 2016. From 2006-2015 hunter harvest has averaged just 24% (range 18-37%) of the zone quota and mortalities due to damage and conflict averaged 11% (range 4-20%) of the zone quota.

Elk numbers have remained somewhat stable over the last 20 years although calf survival and recruitment has gradually declined in WMU's in the northern portion of the zone (Silvies, Malheur River, and Beulah) where most elk in the zone reside. Spring calf ratio 10 year averages have declined from 45-50 calves/100 cows in the mid-90's to 35-40 calves/100 cows in in recent years. At present, elk productivity and survival is sufficient to maintain elk herds at MO and intensive cougar management is not warranted.

Deer populations in Zone F were generally stable to increasing between 2006 and 2016. During this time period drought and catastrophic wildfire had a more prominent impact on habitat conditions than did severe winter conditions. While deer populations have gradually improved in most WMUs within the zone, population estimates still fall below MO in nearly every WMU (except Wagontire), and 5 of 11 WMUs are currently below 60% of MO (Steens Mountain, Whitehorse, Owyhee, Beatys Butte, and Warner).

Fawn recruitment is substantially affected by winter severity, drought, coyote predation, and cougar predation. However, the adult segment of deer populations is also effected by cougar predation. Therefore, fawn ratios are not as reliable an indicator of cougar numbers as calf elk ratios. Spring fawn ratios in most units in this zone have generally been between 30-35 fawns/100 adults since 2006, which means fawn recruitment has been just below herd maintenance level (35 fawns/100 adults). Therefore, if adult mortality is excessive the overall deer population will decline. Two cougar target areas are currently being implemented within Zone F (Steens Mountain, and Warner).

California bighorn sheep were extirpated from Oregon by 1916 (Bailey 1936, Oregon Department of Fish and Wildlife 2003a). ODFW has actively reintroduced bighorn sheep in Zone F since 1954 when the first reintroduction occurred on Hart Mountain. Thirty-six reintroductions have been made to re-establish populations throughout much of their historic range in the zone. Most transplants appeared successful until the severe winter of 1992-93. Since 1993, decreasing population trends have been observed in several herds. Parasites and disease were investigated but not identified as causing these declines and cougar predation was suspected. In 2016, a large scale pneumonia outbreak was detected in the Lower Owyhee herd range, which resulted in an estimated 75% decline in the affected area. Because of that outbreak, an increased sampling and collaring effort has been initiated in the adjacent area. If cougar predation is identified as a limiting factor for sheep restoration, specific herd ranges may be targeted for more intensive cougar management.

Zone F includes many pronghorn herds. Pronghorn populations in Zone F have generally remained stable at a relatively high population level since 2006. There is no evidence cougar predation on pronghorn is having a significant impact on populations.

Adaptive management will be used to address plan objectives in Zone F. Identified target areas will be managed more intensively to achieve objectives for cougar-human conflicts and elk, deer, or bighorn populations. Particular attention will be given to areas around human habitation, with elevated or recurring cougar-human conflicts. Conflict will be monitored with established measurement criteria and management will be adjusted based on results. Target areas may be identified for some bighorn sheep populations if cougar predation is identified as a possible limiting factor (Oregon Department of Fish and Wildlife 2003a).

The minimum cougar population for Zone F identified in this plan is 300 (Chapter III: Objective 1). Based on current population estimates, modeling indicates a total human caused mortality of 120 cougars/year for 5years could occur without reducing cougar numbers below the minimum population of 300. Areas with restricted access such as wilderness, wilderness study areas, and national wildlife refuges will receive little or no harvest. These areas account for 16.4% of the entire zone or 4,603 mi^2. Intensive cougar harvest in targeted areas, moderate levels of cougar harvest in other areas, and little harvest in roadless areas are expected to meet objectives for cougar conflict while maintaining cougar populations above minimum levels.

Zone Management Summary

Those WMUs in which mule deer herds have declined by 20% over the last 5 years or are below 60% of MO for 3 years may be targeted for more intensive cougar (Table 22). Areas of human habitation with elevated levels of cougar-human conflict, as defined by 3-year averages of non-hunter mortalities that exceed 10-year averages, may also be targeted for more intensive cougar harvest (Table 22). To maintain bighorn sheep populations, selective or intensive cougar

harvest may be implemented on established bighorn herd ranges if evidence indicates cougar predation is limiting the population. Desired outcomes include a decrease in cougar-human conflicts as measured by non-hunter mortality and complaints, an increase in deer populations to MO levels, and successful bighorn sheep transplants (Table 22). Outcomes will be monitored and hunting programs modified to meet zone objectives.

Table 22. Adaptive management parameters for Cougar Management Zone F: Southeast Oregon.

Management Concern	Indicator	Objectives	Criteria Triggering Targeted Area Management
Sustain Populations	Cougar population	Cougar population estimate >300 cougars for the zone	Cougar population estimate <300 cougars will result in harvest reductions in the zone.
	Cougar Mortality	Do not exceed total mortality quota	If zone quotas are met, hunting and target area harvest will end. Response to livestock damage and human safety/pet complaints will continue.
Human Interactions	Non-hunting mortality related to human safety/pet	The 3-year average of non-hunting mortalities due to human safety/pet complaints does not exceed the 10-year average	A 3-year average that exceeds the 10-year average could trigger control in areas around human habitation.
	Non-hunting mortality related to livestock	The 3-year average of non-hunting mortalities due to livestock complaints does not exceed the 10-year average	A 3-year average that exceeds the 10-year average could trigger control in areas around livestock operations.
Ungulate Populations	Elk	Maintain 3 year mean calf ratios at 30 - 40 calves/100 cows	Units with < 23 calves/100 cows for 3 years and below population Management Objective for 3 years.
	Deer	Increase populations to MO levels	Units declining by 20% over the last 5 years or below 60% of MO for 3 years.
	Bighorn Sheep	Maintain populations at or near social or habitat capability	Target only when evidence indicates cougar predation is a limiting factor.
	Ungulate transplants	Insure viable transplants	Target only when evidence indicates cougar predation threatens success or viability of transplant.
	Wildlife Areas (WA)	Satisfy stated purpose and Management Objectives of the Area	Target WA if cougars prevent satisfying WA purpose or achieving WA objectives.

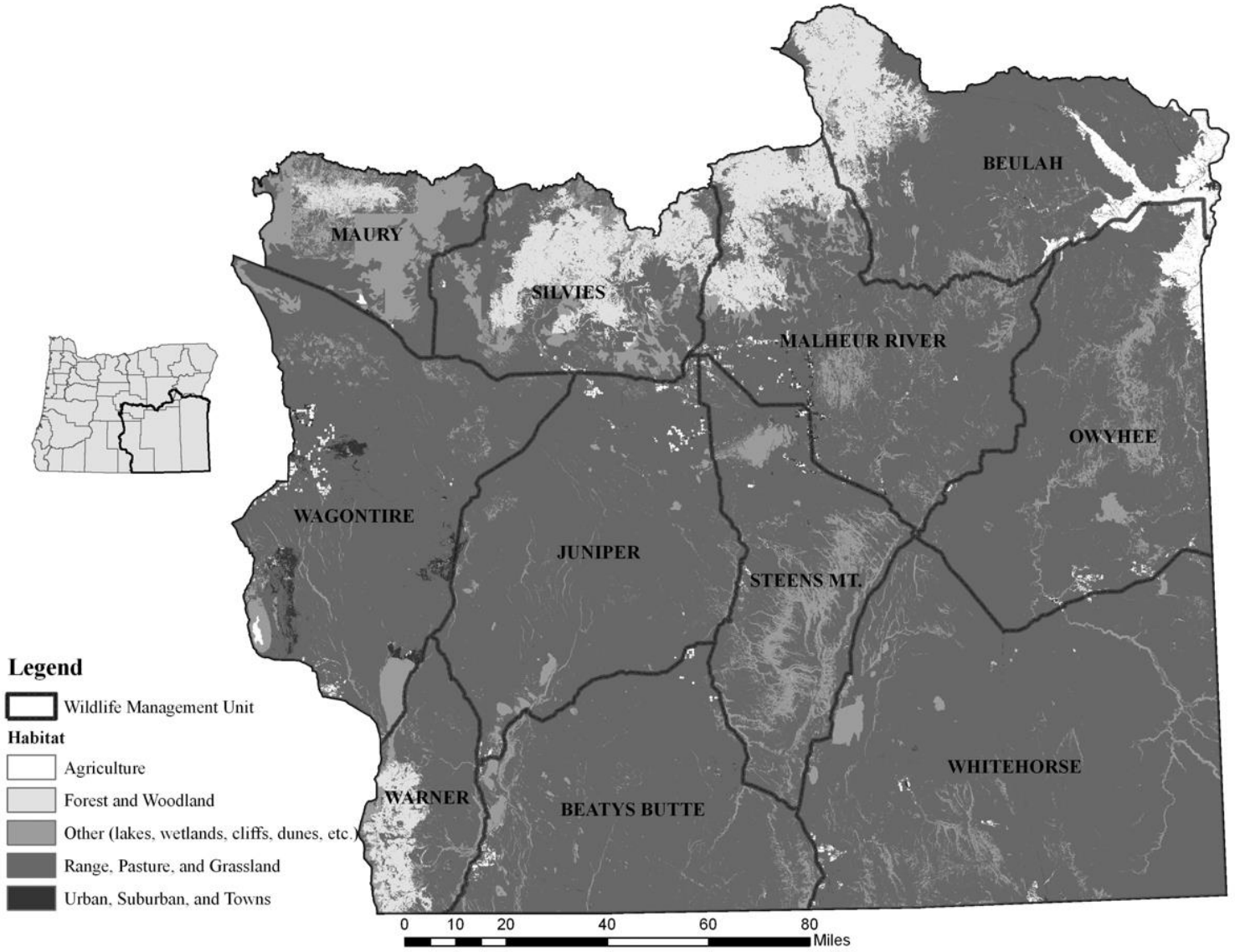


Figure 17. Land cover characteristics of cougar management zone F.

CHAPTER V: LITERATURE CITED

Akenson J. A., M. C. Nowak, M. G. Henjum, and G. W. Witmer. 2003. Characteristics of mountain lion bed, cache and kill sites in northeastern Oregon. pages 111-118 in S. A. Becker, D. D. Bjornlie, F. G. Lindzey, and D. S. Moody editors, Proceedings of the Seventh Mountain Lion Workshop. Lander, Wyoming, USA.

Alexander, S. M., T. B. Logan, and P. C. Paquet. 2006. Spatio-temporal co-occurrence of cougars (*Felis concolor*), wolves (*Canis lupus*) and their prey during winter: a comparison of two analytical methods. Journal of Biogeography 33:2001-2012.

Anderson, C. R., and F. G. Lindzey. 2003. Estimating cougar predation rates from GPS location clusters. Journal of Wildlife Management 67:307-316.

Anderson, C.R., and F.G. Lindzey. 2005. Experimental evaluation of population trend and harvest composition in a Wyoming cougar population. Wildlife Society Bulletin 33(1):179- 188.

Anderson, C. R. Jr., F. G. Lindzey, and D. B. McDonald. 2004. Genetic structure of cougar populations across the Wyoming Basin: Metapopulation or megapopulation. Journal of Mammalogy 85(6):1207–1214.

Andreasen, A. M., K. M. Stewart, W. S. Longland, J. P. Beckmann, and M. L. Forister. 2012. Identification of source-sink dynamics in mountain lions of the Great Basin. Molecular Ecology 21:5689-5701.

Andrew, N. G. 1994. Demography and habitat use of desert-dwelling mountain sheep in the East Chocolate Mountains, Imperial County, California. University of Rhode Island.

Arjo, W. M., and D. H. Pletscher. 1999. Behavioral responses of coyotes to wolf recolonization in northwestern Montana. Canadian Journal of Zoology 77:1919-1927.

Ashman, D., G. C. Christensen, M. L. Hess, G. K. Tsukamoto, and M. S. Wickersham 1983. The mountain lion in Nevada. Nevada Division of Wildlife. Reno, Nevada, USA. 91pp.

Atwood, T. C., E. M. Gese, and K. E. Kunkel. 2007. Comparative patterns of predation by cougars and recolonizing wolves in Montana's Madison Range. Journal of Wildlife Management 71:1098-1106.

Augustine, D. J., and S. J. McNaughton. 1998. Ungulate effects on the functional species composition of plant communities: herbivore selectivity and plant tolerance. Journal of Wildlife Management 62:1165-1183.

Backus, P. 2014. Solving the Bitterrot Elk Mystery. Montana Outdoors November-December:24-29.

Bailey, V. 1936. The mammals and life zones of Oregon. North American Fauna No. 55. United States Department of Agriculture, Bureau of Biological Survey. 416 pp.

Balkenhol N, J. D. Holbrook, D. Onorato, P. Zager, C. White, L. P. Waits. 2014. A multi-method approach for analyzing hierarchical genetic structures: a case study with cougars Puma concolor. Ecography 37:552–563.

Ballard, W. B., D. L. Lutz, T. W. Keegan, L. H. Carpenter, and J. C. deVos, Jr. 2001. Deer-predator relationships: a review of recent North American studies with emphasis on mule and black-tailed deer. Wildlife Society Bulletin 29:99-115.

Beausoleil, R. A., G. M. Koehler, B. T. Maletzke, B. N. Kertson, and R. B. Wielgus. 2013. Research to regulation: cougar social behavior as a guide for management. Wildlife Society Bulletin 37:680-688.

Beausoleil, R. A., J. D. Clark, and B. T. Maletzke. 2016. A long-term evaluation of biopsy darts and DNA to estimate cougar density: an agency-citizen science collaboration. Wildlife Society Bulletin 40:583-592.

Begon, M., J. L. Harper, and C. R. Townsend. 1996. Ecology: individuals, populations, and communities. Blackwell Science, Ltd., Oxford, United Kingdom.

Beier, P. 1991. Cougar attacks on humans in the United States and Canada. Wildlife Society Bulletin 19:403-412.

Beier, P. 1995. Dispersal of juvenile cougars in fragmented habitat. Journal of Wildlife Management 59:228–237.

Beier, P., S. P. D. Riley, and R. M. Sauvajot. 2010. Mountain lions (Puma concolor). Pp. 177–189 in Urban carnivores: ecology, conflict, and conservation *in* S. D. Gehrt, S. P. D. Riley, and B. Cypher, eds. Johns Hopkins University Press, Baltimore, Maryland.

Berger, K. M., and E. M. Gese. 2007. Does interference competition with wolves limit the distrubiton and abundance of coyotes? Journal of Animal Ecology 76:1075-1085.

Berger, K. M., E. M. Gese, and J. Berger. 2008. Indirect effects and traditional trophic cascades: A test involving wolves, coyotes, and pronghorn. Ecology 89:818-828.

Bergman, E. J., P. F. Doherty, G. C. White, and D. J. Freddy. 2015a. Habitat and herbivore density: Response of mule deer to habitat management. The Journal of Wildlife Management 79:60-68.

Bergman, E. J., P. F. Doherty, G. C. White, and A. A. Holland. 2015b. Density dependence in mule deer: a review of evidence. Wildlife Biology 21:18-29.

Bishop, C. J., J. W. Unsworth, and E. O. Garton. 2005. Mule deer survival among adjacent populations in southwest Idaho. Journal of Wildlife Management 69:311-321.

Bishop, C. J., G. C. White, D. J. Freddy, B. E. Watkins, and T. R. Stephenson. 2009. Effect of enhanced nutrition on mule deer population rate of change. Wildlife Monographs:1-28.

Blecha, K. A. 2015. Risk-reward tradeoffs in the foraging strategy of cougar (*Puma concolor*): prey distribution, anthropogenic development, and patch selection. Master's Thesis, Colorado State University, Fort Collins, Colorado, USA. 203 pp.

Boyd, D. K., and G. K. Neale. 1992. An adult cougar, *Felis concolor*, killed by gray wolves, *Canis lupus*, in Glacier National Park. The Canadian Field-Naturalist 106:524-525.

Brodie, J., H. Johnson, M. Mitchell, P. Zager, K. Proffitt, M. Hebblewhite, M. Kauffman, B. Johnson, J. Bissonette, C. Bishop, J. Gude, J. Herbert, K. Hersey, M. Hurley, P. M. Lukacs, S. McCorquodale, E. McIntire, J. Nowak, H. Sawyer, D. Smith, and P. J. White. 2013. Relative influence of human harvest, carnivores, and weather on adult female elk survival

across western North America. Journal of Applied Ecology 50:295-305.

Buotte, P. C., T. K. Ruth, K. M. Murphy, M. G. Hornocker, and H. B. Quigley. 116. Spatial distribution of cougars (*Puma concolor*) in Yellowstone National Park before and after wolf (*Canis lupus*) reintroduction. Washington Department of Fish and Wildlife, 2005.

Burdett, C. L., K. R. Crooks, D. M. Theobald, K. R. Wilson, E. E. Boydston, L. M. Lyren, R. N. Fisher, T. Winston Vickers, S. A. Morrison, and W. M. Boyce. 2010. Interfacing models of wildlife habitat and human development to predict the future distribution of puma habitat. Ecosphere 1: 1-21.

Byers, J. A. 1997. American pronghorn: social adaptations and the ghost of predators past. University of Chicago Press, Chicago, Illinois, USA.

Caughley, G. 1977. Analysis of vertebrate populations. Wiley, New York, New York.

Carter, C.N. 1998. Fiscal effects of voter initiatives to ban certain methods of bear and cougar hunting: Oregon's experience. Human Dimensions of Wildlife 3(2):29-41.

Cassirer, E.F. 2004. The Hells Canyon Initiative. Hells Canyon Bighorn Sheep Restoration Plan. Lewiston, Idaho, USA. 31pp.

Chinitz, A.E. 2002. Laying the groundwork for public participation in cougar management: a case study of southwestern Oregon (*Puma concolor*). M.S. Thesis, Univ. Oregon, Eugene, Oregon, USA. 158 pp.

Choate, D. M., M. L. Wolfe, and D. C. Stoner. 2006. Evaluation of cougar population estimators in Utah. Wildlife Society Bulletin 34:782-799.

Clark, D. A. 2014. Implications of cougar prey selection and demography on population dynamics of elk in northeast Oregon. Dissertation, Oregon State University, Corvallis, Oregon, USA. 297 pp.

Clark, D. A., G. A. Davidson, B. K. Johnson, and R. G. Anthony. 2014. Cougar kill rates and prey selection in a multiple-prey system in northeast Oregon. Journal of Wildlife Management 78:1161-1176.

Clark, D. A., B. K. Johnson, and R. G. Anthony. In Prep. Population growth rates and simulated responses of cougar populations to density reduction under variable immigration and emigration. Wildlife Biology.

Clark, D. A., B. K. Johnson, and R. G. Anthony. In Prep. Response of a large herbivore to top-down and bottom up forcing. Journal of Applied Ecology.

Clark D. A., B. K. Johnson, and D. H. Jackson. 2015. Monthly and annual survival rates of cougar kittens in Oregon. Northwest Science 89:393-400.

Clark, D. A., B. K. Johnson, D. H. Jackson, M. Henjum, S. L. Findholt, J. J. Akenson, and R. G. Anthony. 2014. Survival rates of cougars in Oregon from 1989 to 2011: a retrospective analysis. Journal of Wildlife Management 78:779-790.

Connolly, E. J. 1949. Food habits and life history of the mountain lion. Thesis, University of Utah, Salt Lake City, Utah, USA.

Connolly, G. E. 1978. Predators and predator control. Pages 369 – 394 in J. L. Schmidt and D. L. Gilbert editors, Big Game of North America: Ecology and Management. Stackpole Books, Harrisburg, Pennsylvania, USA.

Conover, M. R. 2002. Resolving human-wildlife conflicts: The science of wildlife damage management. Lewis Publishers, New York, USA. 418 pp.

Cook, R. A., J. G. Cook, D. J. Vales, B. K. Johnson, S. M. McCorquodale, L. A. Shipley, R. A. Riggs, L. L. Irwin, S. L. Murphie, B. L. Murphie, K. A. Schoenecker, F. Geyer, P. Briggs Hall, R. D. Spencer, D. Immell, D. H. Jackson, B. L. Tiller, P. J. Miller, and L. Schmitz. 2013. Regional and seasonal patterns of nutritional condition and reproduction in elk. Wildlife Monographs 184:1-45.

Cooley, H. S., H. S. Robinson, R. B. Wielgus, and C. S. Lambert. 2008. Cougar prey selection in a white-tailed deer and mule deer community. Journal of Wildlife Management 72:99-106.

Cooley, H. S., R. B. Wielgus, G. Koehler, and B. Maletzke. 2009a. Source populations in carnivore management: cougar demography and emigration in a lightly hunted population. Animal Conservation 12:321-328.

Cooley, H. S., R. B. Wielgus, G. M. Koehler, H. S. Robinson, and B. T. Maletzke. 2009b. Does hunting regulate cougar populations? A test of the compensatory mortality hypothesis. Ecology 90:2913-2921.

Cooley, H. S., K. D. Bunnell, D. C. Stoner, and M. L. Wolfe. 2011. Population management: cougar hunting. Pages 111-134 *in* Managing Cougars in North America, J. A. Jenks, editor. Jack H. Berryman Institute, Utah State University, Logan, UT, USA.

Cougar Management Guidelines Working Group. 2005. Cougar Management Guidelines. WildFutures, Bainbridge Island, Washington, USA. 77 pp.

Crabtree, R. L., and J. W. Sheldon. 1999. The ecological role of coyotes on Yellowstone's northern range. Yellowstone Science 7:15-24.

Crête, M. 1999. The distribution of deer biomass in North America supports the hypothesis of exploitation ecosystems. Ecology Letters 2:223-227.

Crooks, K. R., and M. E. Soule. 1999. Mesopredator release and avifaunal extinctions in a fragmented system. Nature 400:563-566.

Culver, M., W. E. Johnson, J. Pecon–Slattery, and S. J. O'Brien. 2000. Genomic ancestry of the American puma. Journal of Heredity. 91(3):186–197.

Cunningham, S. C., W. B. Ballard, and H. A. Whitlaw. 2001. Age structure, survival, and mortality of mountain lions in southeastern Arizona. Southwestern Naturalist 46:76–80.

Cunningham, S. C., L. A. Haynes, C. Gustavson, and D. D. Haywood. 1995. Evaluation of the interaction between mountain lions and cattle in the Aravaipa-Klondyke area of southeast Arizona. Research Branch Technical Report No. 17. Arizona Game and Fish Department, Phoenix, AZ, USA. Davidson, G. A., D. A. Clark, B. K. Johnson, L. P. Waits, J. R. Adams. 2014. Estimating cougar densities in northeast Oregon using conservation detection dogs. Journal of Wildlife Management 76:1104-1114.

Dennis, B., P. L. Munholland, and J. M. Scott. 1991. Estimation of growth and extinction parameters for endangered species. Ecological Monographs 61:115–143.

Donadio, E., and S. W. Buskirk. 2006. Diet, morphology, and interspecific killing in Carnivora. American Naturalist 167:524-536.

Duda, M. D., P. E. DeMichele, M. Jones, W. Testerman, C. Zurawski, J. Dehoff, A. Lanier, S. J. Bissell, P. Wang, and J. B. Herrick. 2002. Washington residents' opinions on and attitudes toward hunting and game species management. Responsive Management, Harrisonburg, Virginia, USA. 167 pp.

Eaton, R. L., and K. A. Velander. 1977. Reproduction in the puma: biology, behavior, and ontogeny. World's Cats 3:45-70.

Ebert, P.W. 1971. The status and management of the felids of Oregon. Pgs. 68-71 *in*: Jorgensen, S.E. and L.D. Mech. Proc. of a Symposium on the native cats of North America, their status and management. U.S. Department of Interior, Fish and Wildlife Service, Twin Cities, Minnesota, USA.

Edelmann, F. B. 2003. Wintering mule deer ecology in the reservoir reach of the Hells Canyon Hydroelectric Complex. Technical Report E 3.2-32. Idaho Power Company, Boise, Idaho, USA. 194 pp.

Elbroch, L., P. Lendrum, J. Newby, H. Quigley, and D. Thompson. 2015. Recolonizing wolves influence the realized niche of resident cougars. Zoological Studies 54:1-11.

Ernest, H. B., W. M. Boyce, V. C. Bleich, B. May, S. J. Stiver, and S. G. Torres. 2003. Genetic structure of mountain lion (*Puma concolor*) populations in California. Conservation Genetics 4:353–366.

Ernest, H. B., E. S. Rubin, and W. M. Boyce. 2002. Fecal DNA Analysis and Risk Assessment of Mountain Lion Predation of Bighorn Sheep. The Journal of Wildlife Management 66:75-85.

Estes, J. A., J. Terborgh, J. S. Brashares, M. E. Power, J. Berger, W. J. Bond, S. R. Carpenter, T. E. Essington, R. D. Holt, J. B. C. Jackson, R. J. Marquis, L. Oksanen, T. Oksanen, R. T. Paine, E. K. Pikitch, W. J. Ripple, S. A. Sandin, M. Scheffer, T. W. Schoener, J. B. Shurin, A. R. E. Sinclair, M. E. Soule, R. Virtanen, and D. A. Wardle. 2011. Trophic downgrading of planet earth. Science 333:301-306.

Evans, S. B., L. D. Mech, P. J. White, and G. A. Sargeant. 2006. Survival of adult female elk in Yellowstone following wolf restoration. Journal of Wildlife Management 70:1372-1378.

Findholt, S. L., and B. K. Johnson. In revision. Estimating cougar population abundance in northeast Oregon: a comparison of two methods. Wildlife Society Bulletin.

Forrester, T. D., and H. U. Wittmer. 2013. A review of the population dynamics of mule deer and black-tailed deer Odocoileus hemionus in North America. Mammal Review 43:292-308.

Fried, B. M., R. M. Adams, R. P. Berrens, and O. Bergland. 1995. Willingness to Pay for a Change in Elk Hunting Quality. Wildlife Society Bulletin (1973-2006) 23:680-686.

Gagliuso, R. A. 1991. Habitat alteration and human disturbance: their impact on cougar habitat utilization in southwest Oregon. MS Thesis, Oregon State University, Corvallis, Oregon, USA. 115 pp.

Geist, V., S. P. Mahoney, and J. F. Organ. 2001. Why hunting has defined the North American model of wildlife conservation. Transactions of the North American Wildlife and Natural Resources Conference. 66:175-185.

Glen, A. S., and C. R. Dickman. 2005. Complex interactions among mammalian carnivores in Australia, and their implications for wildlife management. Biological Review 80:387-401.

Glen, A. S., C. R. Dickman, M. E. Soulé, and B. G. Mackey. 2007. Evaluating the role of the dingo as a trophic regulator in Australian ecosystems. Austral Ecology 32:492-501.

Griffin, K. A. M. Hebblewhite, H. S. Robinson, P. Zager, S. M. Barber-Meyer, D. Christianson, S. Creel, N. C. Harris, M. A. Hurley, D. H. Jackson, B. K. Johnson, W. L. Myers, J. D. Raithel, M. Schlegel, B. L. Smith, C. White, and P. J. White. 2011. Neonatal mortality of elk driven by climate, predator phenology and predatory community composition. Journal of Animal Ecology 80:1246-1257.

Harcombe, D. W. 1976. Oregon cougar study. Oregon Department of Fish and Wildlife, Portland, Oregon, USA. 62 pp.

Harris, N. C., M. J. Kauffman, and L. S. Mills. 2008. Inferences about ungulate population dynamics derived from age ratios. Journal of Wildlife Management 72:1143-1151.

Harrison, A. 1989. Predators and prey--a case of imbalance. Forest Research West. June 1989. 5pp.

Harrison, S. 1990. Cougar predation on bighorn sheep in the Junction Wildlife Management Area, British Columbia. Master's thesis, University of British Columbia, Vancouver, Canada.

Hayes, C. L., E. S. Rubin, M. C. Jorgensen, R. A. Botta, and W. M. Boyce. 2000. Mountain lion predation of bighorn sheep in the Peninsular Ranges, California. Journal of Wildlife Management 64:954-959.

Hiller. T.L. and A.J. Tyre. 2014. Comparison of two age-estimation techniques for cougars. Northwestern Naturalist 65:77-82.

Hiller, T. L., J. E. McFadden-Hiller, S. R. Jenkins, J. L. Belant, and A. J. Tyre. 2015 Demography, Prey Abundance, and Management Affect Number of Cougar Mortalities Associated with Livestock Conflicts. Journal of Wildlife Management 79:978-988.

Hobbs, N. T. 1996. Modification of Ecosystems by Ungulates. The Journal of Wildlife Management 60:695-713.

Hornocker, M. G. 1970. An analysis of mountain lion predation upon mule deer and elk in the Idaho Primitive Area. Wildlife Monographs. 21:1-39.

Hornocker, M. and S. Negri. 2010. Cougar ecology and conservation. University of Chicago Press, Chicago, IL, USA.

Hurley, M. A., J. W. Unsworth, P. Zager, M. Hebblewhite, E. O. Garton, D. M. Montgomery, J. R. Skalski, and C. L. Maycock. 2011. Demographic response of mule deer to experimental reduction of coyotes and mountain lions in southeastern Idaho. Wildlife Monographs:1-33.

Husseman, J. S., D. L. Murray, G. Power, C. Mack, C. R. Wenger, and H. Quigley. 2003. Assessing differential prey selection patterns between two sympatric large carnivores. OIKOS:591-601.

Ingram, R. 1984.Oregon-cougar status report. Pgs. 53-55 *in*: J. Roberson and F. Lindzey (eds.) Proceedings of the Second Mountain Lion Workshop. Utah Division of Wildlife Resources and Utah Cooperative Wildlife Research Unit. Zion National Park, Utah, USA. 271 pp.

Iriarte, J. A., W. Franklin, W. Johnson, and K. Redford. 1990. Biogeographic variation of food habits and body size of the America puma. Oecologia 85:185-190.

Jackson, D. H. In Prep. Dispersal characteristics of juvenile cougars in southwest Oregon. Northwest Science.

Jansen, B. D. and J. A. Jenks. 2012. Birth timing for mountain lions (*Puma conolor*); testing the prey availability hypothesis. PLoS ONE 7: e44625.

Jimenez, M. D., V. J. Asher, C. Bergman, E. E. Bangs, and S. P. Woodruff. 2008. Gray wolves, *Canis lupus*, killed by cougars, *Puma concolor*, and a grizzly bear, *Ursus arctos*, in Montana, Alberta, and Wyoming. The Canadian Field-Naturalist 122:76-78.

Johnson, B. K., P. K. Coe, R. L. Green. 2013. Abiotic, bottom-up, and top-down influences on recruitment of Rocky Mountain elk in Oregon: a retrospective analysis. Journal of Wildlife Management 77:102-116.

Johnson, B. K., D. H. Jackson, R. C. Cook, P. K. Coe, J. G. Cook, S. L. Findholt, S. N. Rearden, D. A. Clark, and J. H. Noyes. *In Review*. Roles of maternal condition and predation on survival of juvenile elk in Oregon. Wildlife Monographs.

Johnson, M. L., and L. K. Couch. 1954. Determination of the abundance of cougar. Journal of Mammalogy 35:255–256.

Kamler, J. F., R. M. Lee, J. C. deVos, W. B. Ballard, and H. A. Whitlaw. 2002. Survival and Cougar Predation of Translocated Bighorn Sheep in Arizona. The Journal of Wildlife Management 66:1267-1272.

Kauffman, M. J., N. Varley, D. W. Smith, D. R. Stahler, D. R. MacNulty, and M. S. Boyce. 2007. Landscape heterogeneity shapes predation in a newly restored predator-prey system. Ecology Letters 10:690-700.

Keister, G. P. Jr. and W. A. Van Dyke. 2002. A predictive population model for cougars in Oregon. Northwest Science. 76(1):15-25.

Kertson, B. N., R. D. Spencer, J. M. Marzluff, J. Hepinstall-Cymerman, and C. E. Grue. 2011. Cougar space use and movements in the wildland–urban landscape of western Washington. Ecological Applications 21:2866–2881.

Kertson, B. N., R. D. Spencer, and C. E. Grue. 2013. Demographic influences on cougar residential use and interactions with people in western Washington. Journal of Mammalogy 94:269-281.

Knopff, K. H. 2010. Cougar predation in a multi-prey system in west-central Alberta. Dissertation, University of Alberta, Edmonton.

Knopff, K. H., A. A. Knopff, A. Kortello, and M. S. Boyce. 2010. Cougar kill rate and prey composition in a multiprey system. Journal of Wildlife Management 74:1435-1447.

Koehler, G. M., and M. G. Hornocker. 1991. Seasonal resource use among mountain lions, bobcats and coyotes. J. Mamm. 72:391.

Kohlmann, S.G. and R. L. Green. 1999. Body size dynamics of cougars (*Felis concolor*) in Oregon. Great Basin Naturalist 59(2): 193-194.

Kunkel, K. E., T. K. Ruth, D. H. Pletscher, and M. G. Hornocker. 1999. Winter prey selection by wolves and cougars in and near Glacier National Park, Montana. Journal of Wildlife Management 63:901-910.

Lambert, C. S., R. B. Wielgus, H. S. Robinson, D. D. Katnik, and H. S. Cruickshank. 2005. Cougar population dynamics and viability in the Pacific Northwest. Journal of Wildlife Management 70:246–254.

Laundré, J., and T. W. Clark. 2003. Managing puma hunting in the western United States: through a metapopulation approach. Anim. Conserv. 6:159–170.

Laundré, J. and L. Hernandez. 2007. Do female pumas (*Puma concolor*) exhibit a birth pulse? Journal of Mammalogy 88:1300-1304.

Levine, C. 1995. Oregon Blue Book. Page 301. Portland, Oregon, USA.

Lewis, J. S., K. A. Logan, M. W. Alldredge, L. L. Bailey, S. VandeWoude, and K. R. Crooks. 2015. The effects of urbanization on population density, occupancy, and detection probability of wild felids. Ecological Applications 25:1880-1895.

Lindzey, F. 1987. Mountain lion. Pages 656–668 *In* M. Novak, J. A. Baker, M. E. Obbard, and B. Mallock (editors), Wild furbearer management and conservation in North America. Ministry of Natural Resources, Ontario, Canada.

Lindzey, F., W. D. Van Sickle, B. B. Ackerman, D. Barnhurst, T. P. Hemker, and S. P. Laing. 1994. Cougar population dynamics in southern Utah. Journal of Wildlife Management 58:619-624.

Lindzey, F. G., B. B. Ackerman, D. Barnhurst, and T. P. Hemker. 1988. Survival rates of mountain lions in southern Utah. Journal of Wildlife Management 52:664-667.

Logan, K.A., L.L. Irwin, and R. Skinner. 1986. Characteristics of a hunted mountain lion population in Wyoming. Journal of Wildlife Management. 50:648-654.

Logan, K. A., L. L. Sweanor, T. K. Ruth, and M. G. Hornocker. 1996. Cougars of the San Andres Mountains, New Mexico. Final Report, Federal Aid in Wildlife Restoration, W– 128–R. New Mexico Department of Game and Fish, Santa Fe, New Mexico, USA. 280 pp.

Logan, K. A., and L. L. Sweanor. 2000. Pages 347–377 in S. Demarais and P. R. Krausman editors. Ecology and management of large mammals in North America. Prentice–Hall, Inc., Upper Saddle River, New Jersey, USA.

Logan, K. A., and L. L. Sweanor. 2001. Desert puma: evolutionary ecology and conservation of and enduring carnivore. Island Press, Washington, D.C., USA.

Lukacs, P. M., M. Hebblewhite, B. K. Johnson, H. Johnson, M. Kauffman, K. M. Proffitt, P. Zager, J. Brodie, K. Hersey, A. A. Holland, M. Hurley, S. McCorquodale, A. Middleton, M.S. Mitchell, M. Nordhagen, J. J. Nowak, D. P. Walsh, and P. J. White. In Review. Declines in juvenile elk recruitment across the western United States are associated with recolonizing predators, habitat, and climate conditions. Journal of Animal Ecology.

Martin, W. E., and R. L. Gum. 1978. Economic Value of Hunting, Fishing, and General Rural Outdoor Recreation. Wildlife Society Bulletin (1973-2006) 6:3-7.

Maser, C., and R. S. Rohweder. 1983. Winter food habits of cougars from northeastern Oregon. Great Basin Naturalist. 43(3):425-428.

Maser, C. and D.E. Toweill. 1984. Bacula of mountain lion (*Felis concolor*), and bobcat (*Felis rufus*). Journal of Mammalogy 65(3):496-497.

Matthews, P. E., V. L. Coggins. 1997. Movements and mortality of mule deer in the Wallowa Mountains. Pages 78-88 *in* J. C. deVos, Jr. ed. Proceedings of the 1997 Deer/Elk Workshop. Rio Rico, Arizona. Arizona Game and Fish Department, Phoenix, Arizona, USA.

McKinney, T. E. D., J. C. Devos, W. B. Ballard, S. R. Boe, and Whittaker. 2006a. Mountain Lion Predation of Translocated Desert Bighorn Sheep in Arizona. Wildlife Society Bulletin 34:1255-1263.

McKinney, T. E. D., T. W. Smith, and J. C. deVos. 2006b. Evaluation of Factors Potentially Influencing a Desert Bighorn Sheep Population. Wildlife Monographs:1-36.

McNay, R. S., and J. M. Voller. 1995. Mortality Causes and Survival Estimates for Adult Female Columbian Black-Tailed Deer. The Journal of Wildlife Management 59:138-146.

Meffe, G. K. and C. R. Carroll, editors. 1997. Principles of conservation biology. 2nd edition. Sinauer Associates, Sunderland, MA, USA.

Melis, C., B. Jędrzejewska, M. Apollonio, K. A. Bartoń, W. Jędrzejewski, J. D. C. Linnell, I. Kojola, J. Kusak, M. Adamic, S. Ciuti, I. Delehan, I. Dykyy, K. Krapinec, L. Mattioli, A. Sagaydak, N. Samchuk, K. Schmidt, M. Shkvyrya, V. E. Sidorovich, B. Zawadzka, and S. Zhyla. 2009. Predation has a greater impact in less productive environments: variation in roe deer, Capreolus capreolus, population density across Europe. Global Ecology and Biogeography 18:724-734.

Middleton, A. 2012. The influence of large carnivore recovery and summer conditions on the migratory elk of Wyoming's Absaroka Mountains. Dissertation, University of Wyoming, Laramie, Wyoming, USA.

Middleton, A. D., M. J. Kauffman, D. E. McWhirter, J. G. Cook, R. C. Cook, A. A. Nelson, M. D. Jimenez, and R. W. Klaver. 2013. Animal migration amid shifting patterns of phenology and predation: lessons from a Yellowstone elk herd. Ecology 94:1245-1256.

Mills, L. S. and P. E. Smouse. 1994. Demographic consequences of inbreeding in remnant populations. American Naturalist 144:412–431.

Monteith, K. L., V. C. Bleich, T. R. Stephenson, B. M. Pierce, M. M. Conner, J. G. Kie, and R. T. Bowyer. 2014. Life-history characteristics of mule deer: Effects of nutrition in a variable environment. Wildlife Monographs 186:1-62.

Moss, W. E., M. W. Alldredge, and J. N. Pauli. 2016. Quantifying risk and resource use for a large carnivore in an expanding urban-wildland interface. Journal of Applied Ecology 53:371-378.

Mulligan, E. M. 2015. Survival Rates and Cause-Specific Mortality of Mule Deer in South-Central Oregon. Oregon State Univeristy, Corvallis, Oregon, USA. 100 pp.

Murphy, K. M., G. S. Felzien, M. G. Hornocker, and T. K. Ruth. 1998. Encounter competition between bears and cougars: some ecological implications. Ursus:55-60.

Musial, T. S. 2009. Evolutionary and landscape genetic structure of *Puma concolor* in Oregon. MS Thesis. Portland State University, Portland, Oregon, USA 70 pp.

Myers, W. L., B. Lyndaker, P. E. Fowler, and W. Moore. 1999. Investigations of calf elk mortalities in southeast Washington: study completion report. Washington Department of Fish and Wildlife, Olympia, Washington.

Newsome, T. M., and W. J. Ripple. 2015. A continental scale trophic cascade from wolves through coyotes to foxes. Journal of Animal Ecology 84:49-59.

Nowak, M. C. 1999a. Predation rates and foraging ecology of adult female mountain lions in northeastern Oregon. M. S. Thesis, Washington State University, Pullman, Washington, USA. 77 pp.

Nowak, M. C., T. E. Taylor, and G. W. Witmer. 2000. Prolonged scavenging by a female mountain lion in northeastern Oregon. Northwest Naturalist 81(2):63-65.

Nowak, R. M. 1999b. Walker's mammals of the world. Sixth Edition, Volume I., John Hopkins Univ. Press. Baltimore, Maryland, USA. 836 pp.

O'Neill, A. 2002. Living with the dingo. Envirobook, Annandale, New South Wales, Australia.

Ockenfels, R. A. 1994. Mountain lion predation on pronghorn in central Arizona. Southwest. Nat. 39:305.

Oregon Department of Fish and Wildlife. 1987. Oregon cougar management plan. Portland, Oregon, USA. 23 pp.

Oregon Department of Fish and Wildlife. 1993. Oregon's cougar management plan 1993-1998. Portland, Oregon, USA. 34 pp.

Oregon Department of Fish and Wildlife. 2006. Oregon's cougar management plan. Salem, Oregon, USA. 135 pp.

Oregon Department of Fish and Wildlife. 2003a. Oregon's bighorn sheep and Rocky Mountain goat management plan. Salem, Oregon, USA. 80 pp.

Oregon State University. 2005. Relationships between forestry, deer, and elk in western Oregon. Corvallis, Oregon, USA.

Pierce, B. M., V. C. Bleich, and R. T. Bowyer. 2000. Social organization in mountain lions: Does a land-tenure system regulate population size? Ecology 81(6):1533–1543.

Pierce, B. M., V. C. Bleich, and R. T. Bowyer. 2000b. Selection of mule deer by mountain lions and coyotes: effects of hunting style, body size, and reproductive status. Journal of Mammalogy 81:462-472.

Polis, G. A., and R. D. Holt. 1992. Intraguild predation: The dynamics of complex trophic interactions. Trends in Ecology & Evolution 7:151-154.

Polis, G. A., C. A. Myers, and R. D. Holt. 1989. The Ecology and Evolution of Intraguild Predation: Potential Competitors That Eat Each Other. Annual Review of Ecology and Systematics 20:297-330.

Profitt, K. M., J. F. Goldberg, M. Hebblewhite, R. Russell, B. S. Jimenez, H. S. Robinson, K. Pilgrim, and M. K. Schwartz. 2015. Integrating resource selection into spatial capture-recapture models for large carnivores. Ecosphere 6(11):239.

Quigley, H., and M. Hornocker. 2010. Cougar population dynamics. Pages 59–75 in M. G. Hornocker, and S. Negri, editors. Cougar ecology and conservation. University of Chicago Press, Chicago, Illinois, USA.Rausch, R.L., C. Maser, and E.P. Hoberg. 1983. Gastrointestinal helminths of the cougar, *Felis concolor* L., in northeastern Oregon. Journal Wildlife Diseases 19(1):14-19.

Raithel, J. D., M. J. Kauffman, and D. H. Pletscher. 2007. Impact of spatial and temporal variation in calf survival on the growth of elk populations. Journal of Wildlife Management 71:795-803.

Rearden, S. N. 2005. Juvenile survival and birth-site selection of Rocky Mountain elk in northeastern Oregon. Thesis. Oregon State University, Corvallis, Oregon, USA. 105 pp.

Rearden, S. N., R. G. Anthony, and B. K. Johnson. 2011. Birth-site selection and predation risk of Rocky Mountain elk. Journal of Mammalogy 92:1118-1126.

Riley, S. P., L. E. Serieys, J. P. Pollinger, J. A. Sikich, L. Dalbeck, R. K. Wayne, and H. B. Ernest. 2014. Individual behaviors dominate the dynamics of an urban mountain lion population isolated by roads. Current Biology 24:1989–1994.

Ripple, W. J., and R. L. Beschta. 2004. Wolves, elk, willows, and trophic cascades in the upper Gallatin Range of Southwestern Montana, USA. Forest Ecology and Management 200:161-181.

Ripple, W. J., R. L. Beschta, and L. E. Painter. 2015. Trophic cascades from wolves to alders in Yellowstone. Forest Ecology and Management 354:254-260.

Ripple, W. J., T. P. Rooney, and R. L. Beschta. 2010. Large predators, deer, and trophic cascades in boreal and temperate ecosystems. Pages 141-162 *in* J. Terborgh, andJ. A. Estes, editors. Trophic cascades: predators, prey, and the changing dynamics of nature. Island Press, Washington D.C.

Ritchie, E. G., and C. N. Johnson. 2009. Predator interactions, mesopredator release and biodiversity conservation. Ecology Letters 12:982-998.

Robinette, W. L., J. S. Gashwiler, and O. W. Morris. 1961. Notes on cougar productivity and life history. Journal of Mammalogy 42:204-217.

Robinson, H.S., R.B. Wielgus, H.S. Cooley, S.W. Cooley. 2008. Sink populations in carnivore management: cougar demography and immigration in a hunted population. Ecol. Appl. 18 (4), 1028–1037.

Robinson, H.S., R. Desimone, C. Hartway, J.A. Gude, M. J. Thompson, M.S. Mitchell, and M. Hebblewhite. 2014. A test of the compensatory mortality hypothesis in mountain lions: a management experiment in West-Central Montana. Journal of Wildlife Management 78:791-807.

Ross, P. I., and M. G. Jalkotzy. 1992. Characteristics of a hunted population of cougars in southwestern Alberta. Journal of Wildlife Management. 56(3):417-426.

Ross, P. I., and M. G. Jalkotzy. 1996. Cougar predation on moose in southwestern Alberta. Alces 32:1-8.

Ross, P. I., M. G. Jalkotzy, and M. Festa-Bianchet. 1997. Cougar predation on bighorn sheep in southwestern Alberta during winter. Canadian Journal of Zoology 75:771-775.

Russell, R. E., J. A. Royle, R. Desimone, M. K. Schwartz, V. L. Edwards, K. P. Pilgrim, and K. S. McKelvey. 2012. Estimating abundance of mountain lions from unstructured spatial sampling. Journal of Wildlife Management 76:1551–1561. Santini,

Ruth, T. K. 2004a. Ghost of the rockies. Yellowstone Science 12:13-24.

Ruth, T. K. 2004b. Patterns of resource use among cougars and wolves in northwestern Montana and southeastern British Columbia. Dissertation, University of Idaho, Moscow, ID, USA.

Ruth, T. K., and P. C. Buotte. 2007. Cougar ecology and cougar-carnivore interactions in Yellowstone National Park. Final technical report. Hornocker Wildlife Institute/Wildlife Conservation Society, Bozeman, Montana, USA.

Ruth, T. K., P. C. Buotte, and M. G. Hornocker. 2017. Yellowstone cougars: ecology before and during wolf reestablishment. University Press of Colorado, Boulder, CO, USA.

Ruth, T. K., M. A. Haroldson, K. M. Murphy, P. C. Buotte, M. G. Hornocker, and H. B. Quigley. 2011. Cougar survival and source-sink structure on Greater Yellowstone's northern range. Journal of Wildlife Management 75:1381-1398.

Ruth, T. K., and K. M. Murphy. 2010a. Competition with other carnivores for prey. Pages 163-172 *in* M. Hornocker, and S. Negri, editors. Cougar ecology and conservation. University of Chicago Press, Chicago, Illinois, USA.

Ruth, T. K., and K. M. Murphy. 2010b. Cougar-prey relationships. Pages 138-162 *in* M. G. Hornocker, andS. Negri, editors. Cougar: ecology and conservation. University of Chicago Press, Chicago, Illinois, USA.

Sarker, R., and Y. Surry. 1998. Economic value of big game hunting: the case of moose hunting in Ontario. Journal of Forest Economics 4:29-60.

Schaefer, R. J., S. G. Torres, and V. C. Bleich. 2000. Survivorship and cause-specific mortality in sympatric populations of mountain sheep and mule deer. California Fish and Game 86:127-135.

Seidensticker, J. D., IV, M. G. Hornocker, W. V. Wiles, and J. P. Messick. 1973. Mountain lion social organization in the Idaho primitive area. Wildlife Monographs 35:1-60.

Sinclair, E. A., E. L. Swenson, M. L. Wolfe, D. C. Chaote, B. Bates, and K. A. Crandall. 2001. Gene flow estimates in Utah's cougar imply management beyond Utah. Animal Conservation 4:257–264.

Singer, F. J., A. Harting, K. K. Symonds, and M. B. Coughenour. 1997. Density dependence, compensation, and environmental effects on elk calf mortality in Yellowstone National Park. Journal of Wildlife Management 61:12-25.

Smith, B. L., and S. H. Anderson. 1998. Juvenile survival and population regulation of the Jackson Elk Herd. Journal of Wildlife Management 62:1036-1045.

Stoner, D. C., M. L. Wolfe, and D. M. Choate. 2006. Cougar exploitation levels in Utah: implications for demographic structure, population recovery, and metapopulations dynamics. Journal of Wildlife Management 70:1588 – 1600.

Stoner, D. C., M. L. Wolfe, C. Mecham, M. B. Mecham, S. L. Durham, and D. M. Choate. 2013. Dispersal behaviour of a polygynous carnivore: do cougars Puma concolor follow source-sink predictions? Wildlife Biology 19:289–301.

Tanner, J. T. 1975. The stability and the intrinsic growth rates of prey and predator populations. Ecology 56:855–867.

Torres, S. G., T. M. Mansfield, J. E. Foley, T. Lupo, and A. Brinkhaus. 1996. Mountain lion and human activity in California: testing speculations. Wildlife Society Bulletin 24:451-460.

Toweill, D.E. 1986. Notes on the development of a cougar kitten. The Murrelet 67:20-23.

Toweill, D. E., and C. Maser. 1985. Food of cougars in the Cascade Range of Oregon. Great Basin Naturalist. 45(1):77-80.

Toweill, D. E., C. Maser, M. L. Johnson, and L. D. Bryant. 1984. Size and reproductive characteristics of western Oregon cougars. Pgs. 176-184 in J. Roberson and F. Lindzey (eds.) Proceedings of the Second Mountain Lion Workshop. Utah Division of Wildlife Resources and Utah Cooperative Wildlife Research Unit. Zion National Park, Utah, USA. 271 pp.

Toweill, D. E., and E. C. Meslow. 1977. Food habits of cougars in Oregon. Journal of Wildlife Management. 41(3):576-578.

Toweill, D. E., C. Maser, L.D. Bryant, and M.L. Johnson. 1988. Reproductive characteristics of eastern Oregon cougars. Northwest Science 62(4):147-150.

Trainer, C. E. 1971. The relationship of physical condition and fertility of female Roosevelt elk (*Cervus Canadensis roosevelti*) in Oregon. M.S. Thesis, Oregon State University, Corvallis, Oregon, USA. 93 pp.

Trainer, C. E., and N. E. Golly. 1992. Cougar age and reproduction. Pitt. Rob. Fed. Aid. Proj. W-87-R, Prog. Rpt, Subproject 281, Job 3. Oregon Department of Fish and Wildlife, Corvallis, Oregon, USA. 14pp.

Trainer, C. E., and G. Matson. 1989. Age determination in cougar from cementum annuli counts of tooth sections (Abstract Only), *in* R. H. Smith, ed. Proceedings of the Third Mountain Lion Workshop. Prescott, Arizona, USA. 88pp.

US Census Bureau. 2017. Oregon Quick Facts census.gov/programs-surveys/popest/data/tables.html Downloaded 7 July 2017.

Unsworth, J. W., D. F. Pac, G. C. White, and R. M. Bartmann. 1999. Mule Deer Survival in Colorado, Idaho, and Montana. The Journal of Wildlife Management 63:315-326.

Van Dyke, W.A. and M. Henjum. 1983. The cougar in northeastern Oregon. Oregon Wildlife 38(3):8-10.

Verts, B. J., and L. N. Carraway. 1998. Land mammals of Oregon. University of California Press, Berkeley, California, USA. 668 pp.

Vucetich, J. A., D. W. Smith, and D. R. Stahler. 2005. Influence of harvest, climate and wolf predation on Yellowstone elk, 1961-2004. Oikos 111:259-270.

Walsh, D. R. 2016. Birth site selection and neonate survival of mule deer in the Blue Mountains of Oregon. Thesis, Univeristy of Nevada Reno, Reno, Nevada, USA.

Warren, M. J., D. O. Wallin, R. A. Beausoleil, and K. I. Warheit. 2016. Forest cover mediates genetic connectivity of northwestern cougars. Conservation Genetics 17:1011-1024.

Weisberg, P. J., and H. Bugmann. 2003. Forest dynamics and ungulate herbivory: from leaf to landscape. Forest Ecology and Management 181:1-12.

White, C. G., P. Zager, and M. W. Gratson. 2010. Influence of predator harvest, biological factors, and landscape on elk calf survival in Idaho. Journal of Wildlife Management 74:355-369.

White, P. J., and R. A. Garrott. 2005. Northern Yellowstone elk after wolf restoration. Wildlife Society Bulletin 33:942-955.

Williams, B. K., J. D. Nichols, and M. J. Conroy. 2002. Analysis and management of animal populations. Academic Press, New York, NY, USA.

Wilmers, C. C., and O. J. Schmitz. 2016. Effects of gray wolf-induced trophic cascades on ecosystem carbon cycling. Ecosphere 7:e01501-n/a.

Winnie Jr, J., and S. Creel. 2016. The many effects of carnivores on their prey and their implications for trophic cascades, and ecosystem structure and function. Food Webs.

Wisdom, M. J., M. Vavra, J. M. Boyd, M. A. Hemstrom, A. A. Ager, and B. K. Johnson. 2006. Understanding Ungulate Herbivory–Episodic Disturbance Effects on Vegetation Dynamics: Knowledge Gaps and Management Needs. Wildlife Society Bulletin 34:283-292.

Wolf, C., and W. J. Ripple. 2016. Prey depletion as a threat to the world's large carnivores. Royal Society Open Science 3.

Wolfe, M. L., E. M. Gese, P. Terletzky, D. C. Stoner, and L. M. Aubry. 2016. Evaluation of harvest indices for monitoring cougar survival and abundance. Journal of Wildlife Management 80:27-36.

Wolfe, M. L., D. N. Koons, D. C. Stoner, P. Terletzky, E. M. Gese, D. M. Choate, and L. M. Aubry. 2015. Is anthropogenic cougar mortality compensated by changes in natural mortality in Utah? Insight from long-term studies. Biological Conservation 182:187-196.

Wright, G. J., R. O. Peterson, D. W. Smith, and T. O. Lemke. 2006. Selection of northern Yellowstone elk by gray wolves and hunters. Journal of Wildlife Management 70:1070-1078.

Yellowstone Center for Resources. 2011. Yellowstone National Park: natural resource vital signs. National Park Service, Mammoth Hot Springs, Wyoming, USA.

Young, S. P., and E. A. Goldman. 1946. The puma, mysterious American cat. Dover Pubs, Inc. New York, USA. 358 pp.

Zager, J. Brodie, K. Hersey, A. A. Holland, M. Hurley, S. McCorquodale, A. Middleton, M.S. Mitchell, M. Nordhagen, J. J. Nowak, D. P. Walsh, and P. J. White. In Review. Declines in juvenile elk recruitment across the western United States are associated with recolonizing predators, habitat, and climate conditions. Journal of Animal Ecology.

Zinn, H. C., and M. J. Manfredo. 1996. Societal Preferences for mountain lion management along Colorado's Front Range. Human Dimensions in Natural Resources Unit, Colorado State University, Fort Collins, Colorado, USA. 22 pp.

Zornes, M. L., S. P. Barber, and B. F. Wakeling. 2006. Harvest methods and hunter selectivity of mountain lions in Arizona. Pages 85-89 *in* J. W. Cain III and P. R. Krausman, editors. Managing wildlife in the southwest. Southwest Section of the Wildlife Society, Tucson, Arizona, USA.

APPENDICES

APPENDIX A: History of Cougar Management in Oregon

Management Stages

The status and management of cougars in Oregon has a long and varied history. This timeline reflects notable changes in cougar management. As management strategies have remained relatively unchanged for previous decades, a detailed overview is not provided here but can be found in Chapter IV: Cougar Management In Oregon in the 2006 Oregon Cougar Management Plan.

1843-1912: First bounty offered by territorial government in 1843. Bounty in 1911 was $10.

1913-1961: Cooperative government hunter program began in 1915. Between 1915 and 1961, federal hunters killed 442 cougar. Bounty increased from $10 to $25 in 1925. The depression forced a reduction to $20 in 1933. Bounty increased to $50 in 1939 and was paid until 1961.

1962-1967: Government hunters took 31 cougar on damage complaints. Hunting became more popular as road construction increased and more efficient snow travel equipment was developed. The 1967 Oregon Legislature granted the Oregon State Game Commission authority to declare cougar a game animal in areas where damage was not expected. Bounties were no longer in effect (ORS 610.205).

1968-1969: Hunting for cougar was closed. A total of 26 cougar were taken on damage complaints.

1970: ODFW authorized controlled season for 25 tags from December 1-31 in parts of Wallowa County. Ten animals were harvested with 8 classified as immature. The price of a cougar tag was $5.

1971-1974: ODFW continued to offer controlled hunts with all or varying portions of the state open to hunting. In 1974, the bag limit was changed from one cougar to "one cougar except kittens and females with spotted kittens are protected."

1974: ODFW developed a draft Strategic Plan for cougar management in Oregon.

1975: The cougar tag fee was increased to $10.

1975-1987: Controlled hunts continued. Varying parts of the state were open.

1987: The first Oregon Cougar Management Plan developed and adopted. The Oregon Legislature approved legislation that increased the price of a cougar tag to $50 (effective 1/1/88).

1987-1992: Controlled hunts continued. Number of hunts and tags increased in response to an expanding cougar population and increasing cougar damage complaints.

1989: ODFW initiated the Catherine Creek Cougar Study.

1992: ODFW initiated the Southwest Oregon Cougar Study.

1993: ODFW and the Fish and Wildlife Commission revised the Cougar Management Plan to guide management through 1998.

1994: Measure 18, a citizen Ballot Initiative, was passed during the November general election making it unlawful for hunters to pursue cougars with dogs (ORS 498.164). Employees of county, state, and federal governments are specifically exempted allowing agencies to use hounds as part of their normal duties.

1995: ODFW changed cougar hunting from a controlled hunt system with a limited number of highly successful hunters with hounds to a statewide, unlimited general season to compensate for the expected dramatic decline in hunter success rates. The season dates also were expanded from 2 ½-4 months to 7 months. ODFW instituted a quota-based system of harvest management.

1996: Measure 34, also a citizen Ballot Initiative, was voted on during the November general election but failed to pass. Measure 34 would have repealed statutes enacted by Measure 18.

1997: The Oregon Legislature dropped the price of a cougar tag to $10.00. Corresponding cougar tag sales increased from 937 in 1997 to 11,761 in 1998. The Oregon Legislature also creates the Sport Pac license for Oregon residents that automatically issues a cougar tag with purchase of the license package.

1998: ODFW institutes year round cougar hunting seasons in four areas of southwest Oregon to help address ongoing levels of high cougar damage.

1999: High interest in the Sport Pac license results in a dramatic increase in number of cougar tags from 14,564 in 1999 to 22,386 in 2000. The Oregon Legislature included a note to ODFW's biennial budget directing ODFW to study the impacts of cougar populations in northeastern Oregon.

2000: Cougar season open only for 5 months in the fall to allow for change into a calendar year framework. ODFW conducts an Environmental Assessment regarding the proposed Elk-Nutrition-Predation study in NE and SW Oregon.

2001: Cougar season changed to a split 10 month season to run January 1 – May 31 and August 1 – December 31. The Oregon Fish and Wildlife Commission adopted changes to the bag limit in Blue Mountain Quota Zone to allow take of second cougar with purchase of an additional tag. The Oregon Legislature adopted legislation formally stating that it is legal for persons to take a cougar posing a threat to human safety without a permit (ORS 498.166). The USFWS found no significant impact for the proposed Elk-Nutrition-Predation study in NE and SW Oregon, approved the study design, and allocated the funding.

2002: Field work began on the Elk-Nutrition-Predation study. Sierra Club et al. filed a temporary restraining order halting the treatment portion of the Elk-Nutrition-Predation study and sued the USFWS in an attempt to halt funding for the project. The 9th Circuit Court of Appeals issued a split decision on the suit against USFWS allowing all of the Elk-Nutrition-Predation study to proceed except for treatment in the form of cougar removals in the study areas.

2003: The Oregon Legislature modified the damage statute (ORS 498.012) to allow take of wildlife including bears and cougars posing a public health risk or that is a public nuisance. The USFWS filed an Intent to Appeal the 2002 court decision.

2006: ODFW and the Fish and Wildlife Commission revised the Cougar Management Plan.

2007: Cougar season mortality quota set at 777 cougars.

2010: Cougar season changed to a statewide, full calendar year structure. Quota remained at 777 cougars.

2015: Cougar season mortality quota set at 970 cougars.

APPENDIX B: Cougar Incident Response Guidelines

Cougar populations occupy the vast majority of their range in Western North America and are expanding into the Midwest. Cougars are found statewide in Oregon and the majority of ideal habitats are currently occupied. As populations continue to grow, cougars are now establishing home ranges in areas of lesser yet suitable habitats such as in and around valley floors, suburbs, and other locations that bring them into close and regular contact with humans. Numerous studies have demonstrated that cougars are capable of using these highly manipulated landscapes of higher human densities, therefore these events are likely to continue. With this trend, contacts between humans and cougars are increasing. While there is a low probability of attack or danger to human beings, events in California, Colorado, and British Columbia where fatal attacks on people have occurred indicate that a careful and cautious approach to cougar management is warranted.

The ODFW Wildlife Damage Policy (2008), Field Staff Response for Cougar Information and Conflict Situations (2015), and numerous applicable Oregon Revised Statutes direct or provide insight on responses to cougar-human interactions. In every situation concerning human health and safety, ODFW will serve as a supporting resource to law enforcement agencies. ODFW will utilize the following guidelines when dealing with cougar/human interactions and damage situations involving cougars:

1) When sightings are reported by the public, without clear evidence of damage or any aggressive behavior (see "Behavior Pattern Criteria" listed in #2 below), ODFW will utilize this contact as an opportunity to educate the public about cougars, their population trends, the fact that people and cougars now occupy more and more of the same habitat, and safety precautions people can take to minimize cougar-human conflicts. *ODFW will not attempt to remove cougars because of incidental sightings*. The public should be referred to the brochure "Living With Mountain Lions" for more information on this topic.

2) When a cougar is discovered in an urban environment and no information or evidence exists to suggest the cougar is causing damage, a nuisance, or a threat to human safety (i.e. wrong place wrong time), under the guidance of local law enforcement, ODFW may attempt to capture and relocate the cougar so long as the act of doing so does not itself compromise human safety. Should equipment be available, relocated cougars may be collared to provide managers with insight on the effectiveness of relocation.

3) When "Behavior Pattern Criteria" as listed below do indicate a concern and it is practical to do so, ODFW, under the guidance of local law enforcement, will attempt to remove offending cougars. *All animals contacted under these circumstances will be humanely euthanized*. Under no circumstances will ODFW or its agents attempt to trap and re-locate cougars, because a chance of human attack and/or continuing damage or human conflict exists.

If one or more of the following criteria are satisfied, the decision to destroy the animal due to concerns over human safety is justified.

Behavior Pattern Criteria:

a) Aggressive actions directed toward a person or persons, including but not limited to charging, false charging, growling, teeth popping and snarling;

b) Breaking into, or attempting to break into, a residence;

c) Attacking a pet or domestic animal as defined in ORS 167.310;

d) Loss of wariness of humans, displayed through repeated sightings of the animal during the day near a permanent structure, permanent corral or mobile dwelling used by humans at an agricultural, timber management, ranching or construction site.

4) Where cougar(s) are causing damage, being a public nuisance, or posing a public health risk, and ODFW personnel or its agents are called to respond, the animal will be humanely euthanized. *Under no circumstances will consideration be given to the re-location of cougars causing damage*.

5) In the case of lethal removal of a lactating female cougar, all reasonable attempts will be made to locate juveniles and capture these animals alive. If successful, juveniles shall first be offered to any bona fide educational facility (member: AZA) for display and/or educational purposes. *If no such permanent home can be found, juvenile(s) shall be humanely euthanized*. Because of potential for future human interactions and danger, no attempt shall be made to rehabilitate and release juvenile cougars in Oregon.

6) Under no circumstance will attempts be made to rehabilitate any cougar for release into Oregon. All animals contacted by ODFW or its' agents as a result of disease, injury, vehicle accident, or other causes, shall be humanely euthanized. Attempts will be made to place captured juveniles as in 4) above. However, if unsuccessful, juveniles will be humanely euthanized.

ODFW staff make every attempt to educate the public on how to reduce conflict with cougars through preventative and corrective methods. While preventative actions are preferred, they may not always be feasible and the appropriate corrective measures will be taken. All opportunities to explain and educate the public about the rationale behind any decision, including lethal removal, shall be utilized. These include not only the potential for future danger, but also cougar welfare and population biology (particularly territoriality and intra-specific competition and mortality), legal liability, and our policy of not moving a potential problem animal to another location where someone else's pets, livestock, or family could be put at risk. All efforts to prepare and respond in a positive manner will be made by all personnel involved in public contacts related to cougar management activities.

APPENDIX C: Captive Cougar Kitten Guidelines, JULY 2017

Young wildlife naively or illegally taken from the wild and brought home by the public each year create many challenges for wildlife managers to produce an acceptable outcome for those animals. Once an animal is removed from the wild prompt action is required including deciding whether the animal can be immediately returned to the wild immediately, and if not, is there an adequate placement facility or alternatives if a placement facility is not available.

ODFW's mission is to "protect and enhance Oregon's fish and wildlife and their habitats for use and enjoyment by present and future generations." Within this mission, ODFW is committed to protecting and managing wild species in the wild habitats and pristine environments they occupy. Through ODFW's Wildlife Health and Population Lab, ODFW's veterinarians are able to temporarily hold wildlife in ODFW and USDA approved caging and enclosures, However, ODFW does not hold wildlife long-term unless held for education (turtles, fish, etc.) nor are animals held by the state for rehabilitation purposes.

Under Oregon Administrative Rule (OAR) 635-044-0440 "wildlife may not be captured from the wild and/or held except as provided by OAR 635-044-450(1)" or with the appropriate permit or license (see Division 044 for list of licenses and permits). Orphaned kittens are not to be rehabilitated for release into the wild due to public safety concerns as defined in Oregon Administrative Rule (635.062.0020).If injured, sick or immature mammals are not capable of survival in the wild if returned, they can be released to an ODFW approved facility.

In almost all cases, cougar kittens of any age will not survive when returned to the wild unless returned to their birth maternal parent animal. Further, returning wild kittens to their parent animal is rarely possible. The current ODFW policy in most cases is to release kittens of appropriate age to a zoo facility or humanely euthanize them when a zoo facility is not available. Where facilities are available, ODFW is interested in only the highest standard of care for those cougar kittens that may become captive.

These guidelines are designed to specifically address issues pertaining to captive cougar kittens. The hope of refining this process is to provide managers a procedure to efficiently and effectively act on situations involving captive cougar kittens.

AZA Accredited Institution

AZA accredited facilities are considered to provide the highest level of care for captive animals. AZA accredited facilities are almost exclusively zoological parks or aquariums that serve as permanent cultural institutions. Under the AZA definition of these institutions, they "own and maintain wildlife, under the direction of a professional staff, provide its collection with appropriate care and exhibit them in an aesthetic manner to the public on a regularly scheduled, predictable basis. They are defined as having as their primary business the exhibition, conservation, and preservation of the earth's fauna in an educational and scientific manner.

Accreditation or certification is good for five years. Standards are subject to continuous review and enhancement, requiring increased levels of professional commitment to achieve and maintain accreditation or certification. Once accredited or certified, an organization is expected to continuously advance its professional operation and constantly maintain, or surpass, all professional standards, policies, guidelines, or resolutions adopted by the American Zoo and Aquarium Association."

Oregon cougar kittens should be sent to an AZA accredited institution, not related or affiliated facilities. The rationale behind this discrimination is that many of the available AZA related facilities, though adequate and inspected by the AZA, are primarily privately owned. If a private facility losses its certification or becomes financially insolvent the animals could theoretically be sold to the highest bidder by the family or corporation. Therefore, one of Oregon's cougars could end up at a roadside zoo in sub-optimal care. AZA accredited facilities are established inspected zoos that often have municipality backing. In the unlikely event that an AZA accredited facility would become financially unable to operate, its animals would likely transfer to another AZA accredited facility. These high facility standards are further supported by a human fatality by captive cougars at an Oregon wildlife sanctuary in 2013.

Cougar Kitten Placement Procedure

When a cougar kitten is brought into captivity because of illegal or unfortunate events, ODFW will 1) determine as soon as possible and usually within 48 hours whether an AZA accredited facility is available for animal placement, or 2) humanely euthanize the animal. The AZA Felid Taxon Advisory Group Puma Population Manager will be contacted for placement. At the time of writing, that contact is Michele Shireman, AZA Felid Taxon Advisory Group Puma Population Manager, Oregon Zoo Hospital & Quarantine Keeper 503-226-1561 x5231.

Available facilities are predetermined via frequent AZA meetings and kept in a record that identifies which AZA accredited facilities are requesting a cougar and when they are able to receive the animal. If a facility is available, the Puma Population Manager will assist ODFW with timely arrangements and transport details concerning the receiving facility. All required permits, and associated costs will be assumed by the receiving institution.

If an AZA accredited facility is not available, ODFW may consider other placement options in other states if the receiving state approves the facility and with concurrent approval by the ODFW Wildlife Administrator or their designee.

Cougar Kitten Handling Procedures

When a cougar kitten comes into the possession of ODFW it will be immediately transported to the ODFW veterinarian at the ODFW Wildlife Health Lab for care and health assessment.

Cougar kittens that come into ODFW control will not be allowed direct contact with ODFW employees or their family members or pets. Photographs should not be taken and employee contact with the animal should be kept to minimum to reduce habituation, stress, and unnecessary emotional attachment. The employee responsible for feeding and cleaning will be the only direct contact until a decision is made on the outcome of the animal's future. All public contact and media attention will be avoided.

Care and Health Assessment

The health status will be assessed as soon as is practical by the ODFW. If the kitten is not healthy, or tests positive to specific diseases of concern for domestic and wild felids in Oregon, it should be euthanized and a necropsy performed with samples taken and sent to the diagnostic lab as directed by the ODFW veterinarian. The carcass can be disposed of routinely by burying, landfill, or incineration.

The animal will be euthanized using standard humane euthanasia methods as prescribed in the "AVMA Guidelines for the Euthanasia of Animals: 2013 Edition."

A necropsy should be performed by the attending veterinarian and resulting findings recorded in the animals record.

Option 1: Animals held for placement in an AZA accredited facility:

1) Weight should be taken daily.
2) The animal can be kept in a large pet carrier with a litter box with shredded newspaper. Old towels and blankets serve as bedding.
3) The animal should be kept out of public view and placed in a vacant room or out building.
4) Latex gloves should be worn at all times. Avoid scratches and bites. Wear animal handling gloves when picking up the animal. The infectious health status is unknown and the kitten should be considered a wild mammal with a potential for rabies, flea- borne diseases (plague, tularemia) and any number of the cat viruses (FIV, FeLv, FIP, panleukopenia, calicivirus, rhinotracheitis, chlamydia, ringworm) that can be spread to pets. Cat scratch disease caused by the pathogen *Bartonella* can cause systemic infections and serious *Pasteurella* infections can be anticipated from a cat bite wound.
5) If an AZA accredited facility is available, a thorough health check should be conducted by a veterinarian and vaccinations (Fel-O-Vax Lv-K IV) and deworming (Pyrantel poamate, fenbedazole, etc.) administered as per the request of the receiving facility.
6) Foods and Feeding for Young Kittens: A wide variety of different formulas are used for feeding young felines (≤ 2 months old). Esbilac canine milk substitute from Bordon is one of the most common formulas, which is available in a liquid and a powder form (both of which need to be mixed with water). It is not recommended unless prepared using an electric blender because it has a tendency to clump and settle at the bottom of the bottle. It has also been known to separate in the kitten's stomach and cause a blockage. The liquid formula is available in 8 and 12 oz cans and although somewhat lower in fat content than natural feline milk, if fed for such a short time, its ease of use makes this formula a good choice. Another suitable formula is Pet-Ag's Zoologic Milk Matrix. Another formula, KMR feline milk substitute by Bordon, is also widely used. Many food products can be found at local pet food markets including Petco or PetSmart, etc. If there are questions about feeding or listed foods are difficult to locate, please contact the ODFW veterinarian or the Oregon Zoo at 503-226-1561x5231.
7) Foods and Feeding for Older Kittens: Older kittens (≥ 2 months) should have solid feline diets added gradually to their formula; recipes include commercial feline preparations made by Zupreem, Spectrum, Dallas Crown and Nebraska, as well as human baby foods such as Gerber's and Beech-nut stage 1 strained chicken and turkey. Commercial feline products should be mixed with formula in a blender and strained as needed to facilitate good flow through the nipple. Because human baby foods lack proper vitamins and calcium, they should be supplemented with additives like Poly-Visol liquid vitamin or Neo-Calglucon liquid calcium supplement. There is some concern that Gerber's brands were recently reformulated and now contain

onion powder. Onion powder is contra-indicated in felines in large doses but because of the short time that kittens are fed this, it is probably not cause for alarm. (Note: I fed 7-8 pound kittens 3-4 freshly killed mice per day acquired from a pet store. Day old chicks can also be used to supplement the kitten diet with more natural food, providing higher levels of protein and calcium – C. Gillin).

8) Volume fed: Infant felids are easily overfed, especially smaller species and their body weight should be monitored daily. Total daily consumption should be limited to no more than 30% of its total body weight.

9) Feeding position: When feeding young felids, they should be placed on their stomach on a flat surface (table). There is a tendency to want to hold the kitten in your arms when feeding which, unfortunately, results in the kitten not being in the correct position. Holding the kitten in your arms usually ends up with it in an upright or head back position, which increases chances of aspiration and death. It is best to immediately start feeding the kitten on a table with the animal in a sternal position (i.e. laying on its stomach). At first the kitten will tend to peddle forward, but in time it will become adjusted to this routine.

10) Elimination: Elimination should occur several times a day for very young (< 6 weeks old) kittens. To accomplish this, the kitten should be held in a sternal position and the region extending from the belly to the anus gently stroked with a warm, moist cloth. Only slight pressure is needed to help guide the fecal material through the digestive tract and out the anal canal. If the kitten is awaiting transfer to an AZA accredited institution, this procedure can be reduced to two times a day after a week. After the young begins eating solid food, this procedure can be reduced to one time per day. Most young will defecate on their own at 8 - 10 weeks, if not sooner.

Option 2: No AZA accredited institution is available to accept the animal(s):

A) ODFW veterinarians may confer with other states or zoological institutions to determine if a non-AZA accredited alternative facility may be available and acceptable by both the receiving state oversight agency and the ODFW Wildlife Administrator. This decision will be made within 48 hours of taking the animal into captivity, however this option will not preclude or preempt option 2 B) if euthanasia is determined to be more appropriate by the ODFW veterinarians, management staff and Administrator or their designee.

B) Animals should be humanely euthanized as quickly as possible if no appropriate facility is available to accept the animal as determined by ODFW veterinarians and management staff. If the animal is not already in the custody of the ODFW veterinarian, the animal can be transported to the ODFW veterinarian for the euthanasia procedure or other arrangements can be made through a cooperating veterinarian.

The events leading to the final outcome of placement or euthanasia will be recorded in daily notes by the keeper of the animal and forwarded to the regional supervisor and Division headquarters (Wildlife Division Administrator, Deputy Administrator, Game Program Manager, and Cougar Program Staff Biologist). The regional ODFW communications coordinator and ODFW veterinarian will field any questions.

APPENDIX D: Current Oregon Statutes Associated with Cougars

Note: Includes only relevant sections to maintain brevity in presentation of related statutes.

496.004 Definitions. As used in the wildlife laws, unless the context requires otherwise:

(9) "Game mammal" means antelope, black bear, cougar, deer, elk, moose, mountain goat, mountain sheep, silver gray squirrel, and gray wolf as a special status mammal defined by commission rule.

(10) "Hunt" means to take or attempt to take any wildlife by means involving the use of a weapon or with the assistance of any mammal or bird.

(11) "Manage" means to protect, preserve, propagate, promote, utilize and control wildlife.

(12) "Optimum level" means wildlife population levels that provide self-sustaining species as well as taking, nonconsumptive and recreational opportunities.

496.012 Wildlife policy. It is the policy of the State of Oregon that wildlife shall be managed to prevent serious depletion of any indigenous species and to provide the optimum recreational and aesthetic benefits for present and future generations of the citizens of this state. In furtherance of this policy, the State Fish and Wildlife Commission shall represent the public interest of the State of Oregon and implement the following coequal goals of wildlife management:

(1) To maintain all species of wildlife at optimum levels.

(2) To develop and manage the lands and waters of this state in a manner that will enhance the production and public enjoyment of wildlife.

(3) To permit an orderly and equitable utilization of available wildlife.

(4) To develop and maintain public access to the lands and waters of the state and the wildlife resources thereon.

(5) To regulate wildlife populations and the public enjoyment of wildlife in a manner that is compatible with primary uses of the lands and waters of the state.

(6) To provide optimum recreational benefits.

(7) To make decisions that affect wildlife resources of the state for the benefit of the wildlife resources and to make decisions that allow for the best social, economic and recreational utilization of wildlife resources by all user groups.

496.162 Establishing seasons, amounts and manner of taking wildlife; rules. (1) After investigation of the supply and condition of wildlife, the State Fish and Wildlife Commission, at appropriate times each year, shall by rule: (a) prescribe the times, places and manner in which wildlife may be taken by angling, hunting, trapping or other method and the amounts of each of those wildlife species that may be taken and possessed. (b) Prescribe such other restrictions or procedures regarding the angling, taking, hunting, trapping or possessing of wildlife as the commission determines will carry out the provisions of wildlife laws. [also subsection 2, 3 and 4].

496.306 Compensation for damage done by bear and cougar not to be paid from State Wildlife Fund. If the State Department of Fish and Wildlife is required to pay compensation for damage activities of bear and cougar to people, real property, livestock, or agricultural or forest products, the compensation, and any attorney fees, shall not be paid from the State Wildlife Fund, but shall be paid from such other moneys as shall be available therefore.

496.705. (1) The State Fish and Wildlife Commission may institute suit for the recovery of damages for the unlawful taking or killing of any of the wildlife referred to in subsection (2) of this section that are the property of the state.

(2)(a) The damages referred to in subsection (1) of this section are as follows:
(A) Each game mammal other than moose, mountain sheep, mountain goat, elk, gray wolf, black bear, cougar or silver gray squirrel, or deer or antelope described in subparagraphs (D) and (E) of this paragraph, $1,000.
(D) Each deer with at least four points on one antler, gray wolf, black bear or cougar, $7,500.
(3) In any such action, the court shall award to the prevailing party, in addition to costs and disbursements, reasonable attorney fees.
(4) Such civil damages shall be in addition to other penalties prescribed by the wildlife laws for the unlawful taking or killing of wildlife.
(5) Any circuit or justice court has jurisdiction to try any case for the recovery of damages for the unlawful taking or killing of any of the wildlife as provided by this section.
(6) Each taking or killing of a single animal referred to in subsection (2) of this section constitutes a separate unlawful taking or killing for purposes of this section.
(7) Subject to ORS 496.690, this section does not apply to the unintentional taking or killing of wildlife incident to an otherwise lawful activity.

496.731 Written notification requiring removal of attractant for potentially habituated wildlife; exceptions. (1) As used in this section:
(a) "Officer" means any person authorized to enforce the wildlife laws pursuant to ORS 496.605, 496.610 or 496.615.
(b) "Potentially habituated wildlife" means bear, cougar, coyote and wolf.
(2) A person who places, deposits, distributes, stores or scatters food, garbage or any other attractant so as to knowingly constitute a lure, attraction or enticement for potentially habituated wildlife may be issued a written notification by an officer requiring the person to remove the food, garbage or other attractant within two days of notification.
(3) A person who receives a written notification under subsection (2) of this section shall remove the food, garbage or other attractant as directed.
(4) This section does not apply to:
(a) Activities related to an agricultural, forestry or ranching operation.
(b) Feeding potentially habituated wildlife with the State Fish and Wildlife Director's authorization. The director may authorize the feeding:
(A) In order to prevent damage to private property;
(B) In order to mitigate the population loss anticipated by a predicted winter mortality; or
(C) As a part of a research or management program.
(c) Waste disposal facilities operating in accordance with applicable federal, state and local laws.
(d) Zoos, wildlife refuges and persons that have a permit to keep wildlife in captivity for rehabilitation or other purposes pursuant to ORS 497.228, 497.298 or 497.308.
(5) Nothing in this section affects any provision of ORS 498.164.

496.992 Penalties. (1) Except as otherwise provided by this section or other law, a violation of any provision of the wildlife laws, or any rule adopted pursuant to the wildlife laws, is a Class A misdemeanor if the offense is committed with a culpable mental state.
(2) Except as otherwise provided by this section or other law, a violation of a provision of the wildlife laws, or a rule adopted pursuant to the wildlife laws, that does not involve the

taking of wildlife is a Class D violation if the offense is committed without a culpable mental state.
(3) A violation of a provision of the wildlife laws, or a rule adopted pursuant to the wildlife laws, that involves the taking of wildlife, other than nongame mammals and game birds, is a Class A violation if the offense is committed without a culpable mental state.
(4) A violation of a provision of the wildlife laws, or a rule adopted pursuant to the wildlife laws, that involves the taking of nongame mammals or game birds is a Class C violation if the offense is committed without a culpable mental state.
(5) A violation of a provision of the wildlife laws, or a rule adopted pursuant to the wildlife laws, that involves the size or quantity limits for salmon, steelhead trout and sturgeon is a Class A violation if the offense is committed without a culpable mental state.
(6) A violation of a provision of the wildlife laws, or a rule adopted pursuant to the wildlife laws, relating to the size or quantity limits for fish or shellfish, other than size and quantity limits for salmon, steelhead trout and sturgeon, is a Class C violation if the offense is committed without a culpable mental state.
(7) A violation of the nonresident licensing provisions of ORS 497.102 (Hunting licenses and permits) or 497.121 (Angling and shellfish licenses and tags) is a Class A violation if the offense is committed without a culpable mental state.
(8) A violation of ORS 496.994 (Obstructing the taking of wildlife prohibited) is a Class A violation if the offense is committed without a culpable mental state.
(9) The second and each subsequent conviction within a 10-year period for the taking of a raptor or the taking of game fish with a total value of $200 or more or the taking of antelope, black bear, cougar, deer, elk, moose, mountain goat or mountain sheep in violation of any provision of the wildlife laws, or any rule adopted pursuant thereto, which occurs more than one hour prior to or more than one hour subsequent to a season established for the lawful taking of such game mammals or game fish is a Class C felony if the offense is committed with a culpable mental state. [also subsection 10, 11 and 12].

497.061 License, tag and permit fee schedule. (1) Except as otherwise provided for by law, the State Fish and Wildlife Commission shall charge the fees listed in the fee schedule under this section for the issuance of the specified licenses, tags and permits.
(2) Fee Schedule:
Cougar Tag Resident Fee $15.50, Nonresident Fee $15.50, Statutory Reference 497.112. Effective January 1, 2018
(2) Fee Schedule:
Cougar Tag Resident Fee $16.00, Nonresident Fee $16.00, Statutory Reference 497.112. Effective January 1, 2020
(2) Fee Schedule:
Cougar Tag Resident Fee $16.50, Nonresident Fee $16.50, Statutory Reference 497.112. Effective January 1, 2027
(2) Fee Schedule:
Cougar Tag Resident Fee $16.50, Nonresident Fee $16.50, Statutory Reference 497.112.

497.112 Hunting tags; fees; restrictions. (1) The State Fish and Wildlife Commission is

authorized to issue, upon application, to persons desiring to hunt wildlife the following general tags and shall charge the applicable fees under the fee schedule in ORS 497.061:
(l) Resident annual cougar tag to hunt cougar.
(m) Nonresident annual cougar tag to hunt cougar.

497.132 Combined licenses for residents; fee. (1) In lieu of issuing to resident persons separate licenses for angling and hunting, the State Fish and Wildlife Commission is authorized to issue resident annual combination angling and hunting licenses, and charge the applicable fee under the fee schedule in ORS 497.061.
(3)(a) In lieu of issuing to resident persons separate licenses and tags for various hunting and angling activities, the commission is authorized to issue resident annual sportspac licenses and shall charge the applicable fee under the fee schedule in ORS 497.061 (License, tag and permit fee schedule). The purchaser of each sportspac license is authorized to engage in those hunting and angling activities for which the following licenses and tags are required:
(C) Cougar tag;
(4)(a) In lieu of issuing to resident persons at least 12 years of age and under 18 years of age separate licenses and tags for hunting and angling, the commission is authorized to issue resident annual youth sportspac licenses for persons at least 12 years of age and under 18 years of age and shall charge the applicable fee under the fee schedule in ORS 497.061. The purchaser of each youth sportspac license is authorized to engage in those hunting and angling activities for which the following licenses and tags are required:
(C) Cougar tag;

497.350 Hunting restriction; generally. (1) No person younger than 12 years of age shall hunt antelope, black bear, cougar, deer, elk, mountain goat, mountain sheep or moose. (2) No person younger than 14 years of age shall hunt with a firearm or bow and arrow unless the person is accompanied by an adult, or is hunting on land owned by the parent or legal guardian of the person.

497.655 Voluntary contributions; county predatory animal control program; State Department of Fish and Wildlife duties. (1) As used in this section:
(a) "Fur-bearing mammal," "hunt" and "wildlife" have the meanings given those terms in ORS 496.004.
(b) "Predatory animals" means those animals listed in ORS 610.002, black bears, cougars, fur-bearing mammals and gray wolves.
(2)(a) Each application for the purchase and issuance of a license, tag or permit to hunt wildlife pursuant to ORS 497.102 or 497.112 must include a separate section under which the applicant may make a voluntary contribution to be used for predatory animal control, to the extent allowable under federal and state law, in the county or counties in which the license, tag or permit allows the person to hunt.
(b) A voluntary contribution made under this section does not convey a privilege to hunt wildlife, and is considered separate from any moneys paid by the applicant for the issuance of a license, tag or permit.
(c) Before developing a predatory animal control program, a county shall consult with the State Department of Fish and Wildlife or the State Department of Agriculture, depending on the predatory animals that are part of the program.
(d) Voluntary contributions received under this section shall be deposited in the Wildlife Conservation Fund established under ORS 497.660.

(3)(a) The State Department of Fish and Wildlife shall keep track of voluntary contributions made under this section. Each quarter the department shall pay to each county in which hunting took place under a license, tag or permit issued under the wildlife laws an amount equal to the total of the voluntary contributions made in association with applications for licenses, tags or permits allowing persons to hunt in the county.

(b) If a license, tag or permit allows the holder to hunt in an area that includes land within more than one county, the department shall designate a proportionate share of any voluntary contribution under this section to each county based on the percentage of the area that is in each county.

498.012 Taking wildlife causing damage, posing public health risk or that is public nuisance. (1) Nothing in the wildlife laws is intended to prevent any person from taking any wildlife that is causing damage, is a public nuisance or poses a public health risk on land that the person owns or lawfully occupies. However, no person shall take, pursuant to this subsection, at a time or under circumstances when such taking is prohibited by the State Fish and Wildlife Commission, any game mammal or game bird, fur-bearing mammal or nongame wildlife species, unless the person first obtains a permit for such taking from the commission.

(2)(a) Nothing in subsection (1) of this section requires a permit for the taking of cougar, bobcat, red fox or bear pursuant to that subsection. However, any person who takes a cougar, bobcat, red fox or bear must have in possession written authority therefor from the landowner or lawful occupant of the land that complies with subsection (4) of this section.

(b) Nothing in subsection (1) of this section requires the commission to issue a permit for the taking of any wildlife species for which a U. S. Fish and Wildlife Service permit is required pursuant to the Migratory Bird Treaty Act (16 U.S.C. 703 to 711), as amended.

(3) Any person who takes, pursuant to subsection (1) of this section, any cougar, bobcat, red fox, bear, game mammal, game bird, fur-bearing mammal or wildlife species whose survival the commission determines is endangered shall immediately report the taking to a person authorized to enforce the wildlife laws, and shall dispose of the wildlife in such manner as the commission directs. In determining procedures for disposal of bear and cougar, the commission shall direct the State Department of Fish and Wildlife to first offer the animal to the landowner incurring the damage.

(4) The written authority from the landowner or lawful occupant of the land required by subsection (2) of this section for the taking of cougar, bobcat, red fox or bear must set forth all of the following:

(a) The date of issuance of the authorization;

(b) The name, address, telephone number and signature of the person granting the authorization;

(c) The name, address and telephone number of the person to whom the authorization is granted;

(d) The wildlife damage control activities to be conducted, whether for bear, cougar, red fox or bobcat; and

(e) The expiration date of the authorization, which shall be not later than one year from the date of issuance of the authorization.

(5) Any regional office of the State Department of Fish and Wildlife ordering the disposal of an animal under subsection (3) of this section shall file a report with the State Fish and Wildlife Director within 30 days after the disposal. The report shall include but need not be limited to the loss incurred, the financial impact and the disposition of the animal. The director shall compile all reports received under this subsection on a bimonthly basis. The reports compiled by the director shall be available to the public upon request.

498.042 Removal of parts of wildlife and waste of wildlife prohibited. (1) No person shall remove from the carcass of any game mammal or game bird, the head, antlers, horns, hide or plumage, and utilize only those parts so removed, except:

(a) When engaged in lawful trapping activities.

(b) When utilizing those game mammals or game birds that the State Fish and Wildlife Commission by rule declares to be inedible.

(2) No person shall waste any edible portion of any game mammal, game bird or game fish or the pelt of any fur-bearing mammal.

498.164 Use of dogs or bait to hunt black bears or cougars; prohibitions; exemptions; penalties; rules. (1) Except as provided in subsections (2) to (4) of this section, a person may not use bait to attract or take black bears or use one or more dogs to hunt or pursue black bears or cougars.

(2) Nothing in subsection (1) of this section prohibits the use of bait or one or more dogs by employees or agents of county, state or federal agencies while acting in their official capacities.

(3)(a) As allowed by subsection (2) of this section, the State Department of Fish and Wildlife is authorized to appoint persons to act as agents for the department for the purpose of using one or more dogs to hunt or pursue black bears or cougars. The hunt or pursuit must be in compliance with any black bear management plan and any cougar management plan adopted by rule by the State Fish and Wildlife Commission. An agent acts on the department's behalf and, subject to the department's direction and control, implements specific management programs of the department. An agent may not engage in any other hunting or pursuit while acting on the department's behalf.

(b) The department shall:

(A) Make the appointment in written form; and

(B) Ensure that the written appointment is available to the public for review at the main office of the department in Salem.

(c) Upon appointment of an agent by the department, the department shall fix the compensation of the agent and prescribe the duties of the agent. The authority of the agent to act is limited to the terms set forth in the written appointment under paragraph (b) of this subsection.

(d) The commission shall adopt by rule a process and criteria for selecting and training persons to act as agents pursuant to paragraph (a) of this subsection. The process and criteria must include, but are not limited to, the qualifications and training for agents and are to cover any guidelines, policies or codes of conduct of the department regarding firearms, first aid, all-terrain vehicles and snowmobiles and the use of alcohol or drugs. The department may also require fingerprints as specified in ORS 496.121 for the purpose of requesting state or nationwide criminal records checks.

(4) Nothing in subsection (1) of this section prohibits the use of bait or dogs by persons for the taking of black bears or cougars in accordance with the provisions of ORS 498.012 relating to taking wildlife that is causing damage.
(5) Any person who violates subsection (1) of this section commits a Class A misdemeanor and, upon conviction, shall in addition to appropriate criminal penalties have his or her privilege to apply for any hunting license suspended for a period of five years for a first offense and permanently suspended for any subsequent offense.
(6) The commission shall report biennially pursuant to ORS 496.128 regarding the department's appointment and use of agents under this section. The report must include information on the use of agents in implementing any black bear management program and any cougar management program of the department and a summary of public input taken by the department regarding use of the agents.
(7) For the purposes of this section, "bait" means any material placed for the purpose of attracting or attempting to attract bears.
Effective January 2, 2019
(1) Except as provided in subsections (2) and (3) of this section, a person may not use bait to attract or take black bears or use one or more dogs to hunt or pursue black bears or cougars.
(2) Nothing in subsection (1) of this section prohibits the use of bait or one or more dogs by employees or agents of county, state or federal agencies while acting in their official capacities.
(3) Nothing in subsection (1) of this section prohibits the use of bait or dogs by persons for the taking of black bears or cougars in accordance with the provisions of ORS 498.012 relating to taking wildlife that is causing damage.
(4) Any person who violates subsection (1) of this section commits a Class A misdemeanor and, upon conviction, shall in addition to appropriate criminal penalties have his or her privilege to apply for any hunting license suspended for a period of five years for a first offense and permanently suspended for any subsequent offense.
(5) For the purposes of this section, "bait" means any material placed for the purpose of attracting or attempting to attract bears.

498.166 Bears or cougars posing threat to human safety. (1) Notwithstanding the licensing and tag requirements of ORS 497.102, 497.112, 497.127 and 497.132, a person may take a cougar or bear that poses a threat to human safety.
(2) Any person who takes a cougar or bear pursuant to subsection (1) of this section shall immediately report the taking to a person authorized to enforce the wildlife laws and shall dispose of the animal in such manner as the State Fish and Wildlife Commission directs.
(3) Any regional office of the State Department of Fish and Wildlife ordering the disposal of an animal under subsection (2) of this section shall file a report with the State Fish and Wildlife Director within 30 days after the disposal. The report shall include but need not be limited to the disposition of the animal, the events leading to the taking of the animal and any injury caused by the animal to humans or domesticated animals. The director shall compile all reports received under this subsection on a bimonthly basis. The reports compiled by the director shall be available to the public upon request.
(4) As used in this section:

(a) “Structure” includes a building being used as a residence, a building located on land actively used for agricultural, timber management, ranching or construction purposes or a building used as part of a business.
(b) “Threat to human safety” means the exhibition by a cougar or bear of one or more of the following behaviors:
(A) Aggressive actions directed toward a person or persons, including but not limited to charging, false charging, growling, teeth popping and snarling.
(B) Breaking into, or attempting to break into, a residence.
(C) Attacking a pet or domestic animal as defined in ORS 167.310.
(D) Loss of wariness of humans, displayed through repeated sightings of the animal during the day near a permanent structure, permanent corral or mobile dwelling used by humans at an agricultural, timber management, ranching or construction site.

APPENDIX E: Mortality Rates of Oregon Cougar Populations.

Table 1. Population estimates, harvest numbers, and total mortalities by cougar zone for Oregon cougars from 2006-2015. Oregon is divided into 6 cougar management zones that were delineated to include similar habitats, human demographics, land use patterns, prey base, and cougar density (Figure 2). Population estimates come from a deterministic model updated in April 2017. Adult cougars include females 2yr and older and males 3yr and older. Data is subject to change pending new information becomes available.

		Total Population Estimate	Mortality Quota	All Mortalities	Total Mortality Rate	Adult Population Estimate	Adult Hunt Mortalities	Adult Hunt Mortality Rate
2006	Statewide	5631	777	453	8%	2869	156	5%
	Zone A	776	120	81	10%	361	27	7%
	Zone B	1,520	165	80	5%	826	16	2%
	Zone C	482	65	34	7%	239	14	6%
	Zone D	323	62	41	13%	156	7	4%
	Zone E	1,643	245	162	10%	837	69	8%
	Zone F	887	120	55	6%	450	23	5%
2007	Statewide	5603	777	537	10%	2853	193	7%
	Zone A	791	120	95	12%	376	25	7%
	Zone B	1,483	165	108	7%	805	30	4%
	Zone C	523	65	35	7%	251	24	10%
	Zone D	322	62	46	14%	152	11	7%
	Zone E	1,606	245	183	11%	825	72	9%
	Zone F	878	120	70	8%	444	31	7%
2008	Statewide	5698	777	492	9%	2908	171	6%
	Zone A	821	120	94	11%	397	30	8%
	Zone B	1,471	165	107	7%	784	24	3%
	Zone C	583	65	25	4%	279	13	5%
	Zone D	333	62	35	11%	166	8	5%
	Zone E	1,599	245	174	11%	826	68	8%
	Zone F	891	120	57	6%	456	28	6%
2009	Statewide	5814	777	473	8%	2934	186	6%
	Zone A	846	120	99	12%	398	40	10%
	Zone B	1,469	165	90	6%	780	20	3%
	Zone C	651	65	25	4%	309	15	5%
	Zone D	352	62	38	11%	168	10	6%
	Zone E	1,604	245	158	10%	817	81	10%
	Zone F	892	120	63	7%	462	20	4%
2010	Statewide	5905	777	482	8%	2939	153	5%
	Zone A	871	120	103	12%	403	40	10%
	Zone B	1,458	165	96	7%	761	22	3%
	Zone C	744	65	20	3%	350	16	5%
	Zone D	354	62	31	9%	167	7	4%
	Zone E	1,586	245	163	10%	801	56	7%
	Zone F	892	120	69	8%	457	12	3%

Table 1 continued

		Total Population Estimate	Mortality Quota	All Mortalities	Total Mortality Rate	Adult Population Estimate	Adult Hunt Mortalities	Adult Hunt Mortality Rate
2011	Statewide	5987	777	453	8%	3011	141	5%
	Zone A	869	120	120	14%	416	36	9%
	Zone B	1,453	165	109	8%	758	19	3%
	Zone C	865	65	15	2%	409	8	2%
	Zone D	353	62	36	10%	174	6	3%
	Zone E	1,547	245	169	11%	788	63	8%
	Zone F	900	120	57	6%	466	9	2%
2012	Statewide	6019	777	530	9%	3069	139	5%
	Zone A	893	120	121	14%	431	33	8%
	Zone B	1,445	165	106	7%	755	20	3%
	Zone C	892	65	24	3%	442	9	2%
	Zone D	356	62	38	11%	178	5	3%
	Zone E	1,540	245	164	11%	799	61	8%
	Zone F	893	120	77	9%	464	11	2%
2013	Statewide	6123	777	531	9%	3145	161	5%
	Zone A	905	120	130	14%	430	31	7%
	Zone B	1,430	165	143	10%	747	37	5%
	Zone C	943	65	21	2%	500	8	2%
	Zone D	350	62	50	14%	181	10	6%
	Zone E	1,579	245	135	9%	817	57	7%
	Zone F	916	120	52	6%	470	18	4%
2014	Statewide	6376	777	385	6%	3233	119	4%
	Zone A	954	120	101	11%	449	27	6%
	Zone B	1,455	165	100	7%	755	14	2%
	Zone C	986	65	17	2%	539	7	1%
	Zone D	388	62	26	7%	186	6	3%
	Zone E	1,660	245	95	6%	828	47	6%
	Zone F	933	120	46	5%	476	18	4%
2015	Statewide	6493	970	427	7%	3291	135	4%
	Zone A	989	180	117	12%	459	31	7%
	Zone B	1,475	200	98	7%	747	23	3%
	Zone C	1,001	80	24	2%	553	10	2%
	Zone D	384	100	41	11%	192	7	4%
	Zone E	1,698	270	106	6%	853	46	5%
	Zone F	946	140	42	4%	487	18	4%

APPENDIX F: Mapping Potential Cougar Habitat in Oregon

Introduction

As part of the Cougar Management Plan update, ODFW staff generated a map of cougar habitat use and distribution in Oregon using mortality locations from hunter killed animals from 1995-2016 and a set of landscape predictor variables believed to be relevant to cougar ecology. These landscape predictor variables and mortality locations, as well as an equal number of randomly generated locations, were used to model habitat use with a resource selection probability function (RSPF) using a used vs. available framework. The resulting model was then used to generate a map of habitat use and a map of potential distribution based on the RSPF score from the model.

Cougar mortalities from hunting were believed to be a good surrogate for habitat use because the cougar hunting season in the state is open year-round (unless the quota is met in a specific zone) and approximately 50,000 cougar tags are issued annually. Most hunters who harvest a cougar are pursuing another big game species (deer, elk, bear) and are therefore well-distributed across the state, assumedly in areas of both good and poor cougar habitat. This essentially provides a statewide sampling of where cougars are located. In addition, using locations from hunter killed animals is less biased than sightings or complaints because hunters are less likely to be in developed areas. Finally, while we gather valuable data about habitat use of cougars from GPS telemetry collars, that collar data is derived from smaller study areas and may be limited when attempting to expand the results to larger scales (e.g., statewide).

Although locations were available from 1987 to present we only used locations from 1995 to 2016. Prior to 1995 cougar hunting seasons were managed as controlled hunts and only took place within the southern Cascades and northeast Oregon. From 1995-2016 cougar hunting has been managed under a quota system and the entire state has been open to hunting. We felt mortalities prior to 1995 would be biased to habitat attributes present in the northeast and southern Cascades. Additionally, we only included hunter-harvested cougar mortalities because other causes of death (including vehicle strikes, response to livestock depredations, safety issues, or found dead due to malnutrition or disease) would result in a habitat map biased towards human development.

Methods

Locations

Locations of cougar mortalities from hunter-harvest animals from 1995-2016 were used to map distribution and habitat use of cougars in the state. Beginning in 1987 ODFW began collecting age, gender, reproductive, and location information from all cougar mortalities. From 1987-2005 all locations were mapped using the Public Land Survey System. Locations from hunter-harvested cougars were given by the hunter, most often by them identifying the section where the animal was harvested on a map. To get a latitude and longitude location the center point of each section was assigned as the mortality location. From 2006-2016 locations were recorded in UTMs but were then converted to latitude and longitude. A subset of these locations

was used for analysis that only included mortalities by hunting from 1995-2016 (n=4463) that had location data associated with them.

Environmental Variables

Landscape predictor variables that have been shown to be important to cougar ecology were chosen to map habitat in the state. They included a mix of topographic, land cover, ungulate distribution, and land ownership. Each variable was converted to 1.0 mi^2 resolution because the location data was accurate to a one square mile section in the Public Land Survey System. Explanations for variable selection are included:

Elevation – A Digital Elevation Model (DEM) was used to model elevation. Cougars may avoid areas of extreme low and high elevations, most notably the beach and high alpine habitats because of lack of cover and available prey.

Slope – We calculated slope, measured in degrees, from the DEM used for elevation. Cougars may use steeper topography to ambush prey species.

Aspect – This layer was created using the DEM layer and converted to the categorical features of flat, north, east, south, and west. Flat aspect was identified as the null, therefore the four other aspects were compared to it. Cougars may be selecting southern facing slopes because ungulates congregate there in winter due to lower snow depths, and during spring green-up. North-facing slopes may be avoided as features are opposite to southern facing slopes.

Vector Ruggedness Measurement (VRM) – This variable measures both the steepness and changes in aspect to measure the overall terrain ruggedness of a landscape (Sappington et al. 2007). Ungulates often use landscapes with this feature because of the potential escape terrain. Whereas cougars may use it because of higher densities of ungulates and the availability of areas to ambush their prey.

Big Game Habitat (BGH) – This habitat variable is a single category variable that shows year-round ungulate presence. The layers were generated by ODFW and includes the combination of eastern Oregon deer winter range, eastern Oregon elk winter range, big-horn sheep range, Columbia white-tailed deer range, and western Oregon big game range (deer and elk). The western Oregon big game range includes the categories year-round major habitat, year-round peripheral habitat, and winter concentration areas. It does not include summer concentration areas because these habitats were not defined for eastern Oregon.

Land Cover – This habitat variable was derived from the National Land Cover Database (NLCD, Jin et al. 2013). These variables were condensed into forest, open water, developed, wetlands, agriculture, meadow (a combination of scrub/shrub and herbaceous land covers), and barren (a combination of barren land and perennial snow/ice).

Ownership – Ownership layers depicting federal and private ownership were generated from publicly available data (Bureau of Land Management 2017). This ownership layer originally contained federal, state, private, tribal, and other ownership but only federal and private were used for the modeling. The area of other land owner types were small compared to federal and private ownership, and thus not included. Ideally, private ownership would be separated into industrial timber company land versus small private or agriculture lands, but this was not possible statewide using the available dataset.

Analysis

To examine cougar habitat use we generated a resource selection probability function with cougar mortality locations (n=4463) and an equal number of randomly generated locations and then compared them with the above environmental variables. Package 'ResourceSelection' (Lele et al. 2017) was used in the statistical package R (R Core Team, 2016) to make the model. A model set was determined *a priori* in order to determine the environmental variables that best explained cougar habitat use across the state. Models were judged based on AIC. Parameter coefficients from the top model were then used in logistic regression equation to generate a map of habitat use in ArcMap 10.3.1.

Results

The top model identified was the full model that include all variables (Table 1), including elevation, slope, aspect, vector ruggedness measurement, land cover, ownership, and big game habitat. The next five top models contained some or all of the land cover variables (Table 1). Additionally, three of the top four models contained the big game habitat layer (Table 1). Based on the variable coefficients, cougars were using areas with steeper slopes and more rugged terrain (Table 2). Ungulate range was a positive predictor of cougar habitat use. There was a stronger selection for private lands versus federal lands (Table 2). When it came to land cover there was a strong selection for forest cover, and an avoidance of developed habitat and agricultural areas (Table 2).

Table 1. Model selection results of Resource Selection Probability Functions used to estimate habitat use of cougars in Oregon from hunter-harvest mortality locations from 1995-2016 and a suite of environmental predictor variables. Candidate models were ranked using Akaike's Information Criterion (AIC) and the number of parameters (K) is reported.

Model	K	AIC
Full Model – all variables included	17	73458.28
Land Cover – forest + meadow + agriculture + developed + wetland + water + elevation + slope + aspect + v.r.m.	14	73576.05
Big Game Habitat and Natural Land Covers – b.g.h. + forest + meadow + wetland + water + elevation + slope + aspect + v.r.m.	13	73581.51
Big Game Habitat and Land Cover – b.g.h. + forest + meadow + agriculture + development + wetland + water + elevation + slope + aspect + v.r.m.	15	73585.61
Land Cover and Ownership – fed. + private + forest + meadow + ag. + develop. + wetland + water + elev. + slope + aspect + v.r.m.	16	73654.89
Natural Land Covers - forest + meadow + wetland + water + elev. + slope + aspect + v.r.m.	12	73807.08
Topographic – elev., slope, aspect, v.r.m.	8	73820.46
Anthropogenic Land Covers + Big Game Habitat - b.g.h. + ag. + develop + private + elev. + slope + aspect + v.r.m.	12	73918.01
Big Game Habitat and Ownership – b.g.h. + federal + private + elev. + slope + aspect + v.r.m.	11	73921.91
Big Game Habitat – b.g.h. + elev. + slope + aspect + v.r.m.	9	73997.23
Anthropogenic Land Covers – ag. + develop. + private + elev. + slope + aspect + v.r.m.	11	74021.28
Ownership – federal + private + elev. + slope + aspect + v.r.m.	10	74077.37

b.g.h – Big Game Habitat
v.r.m. – Vector Ruggedness Measurement

Table 2. Parameter estimates from the Resource Selection Probability Model fitted to cougar mortalities locations from 1995-2016 and environmental predictor variables in Oregon.

Environmental Variable	Beta	SE	z value	P value
(Intercept)	-15.000	0.824	-18.206	< 0.001
Elevation	< 0.001	< 0.001	-4.165	0.000
Slope	0.910	0.082	11.06	< 0.001
VRM	127.769	75.547	1.691	0.091
North	10.917	0.815	13.398	< 0.001
South	11.661	0.803	14.518	< 0.001
West	11.346	0.822	13.805	< 0.001
East	11.756	0.866	13.568	< 0.001
Big Game Habitat	1.739	0.144	12.09	< 0.001
Federal	0.800	0.499	1.601	0.109
Private	2.267	0.483	4.696	< 0.001
Forest	11.523	4.112	2.802	0.005
Meadow	0.363	0.551	0.658	0.510
Agriculture	-0.701	0.560	-1.253	0.210
Developed	-0.403	0.613	-0.657	0.511
Wetland	0.307	0.641	0.478	0.632
Water	1.167	1.043	1.118	0.264

The map of cougar habitat shows a large portion of the state is suitable cougar habitat (Figure 1). On a large scale most of western Oregon, outside of the Portland metro area, the Willamette valley, and the Rogue valley surrounding Medford appears to be good cougar habitat. There are other smaller areas of unsuitable habitat in western Oregon near cities and towns. In eastern Oregon the major block of habitat is found in the Blue Mountains, extending from central Oregon through the northeast corner. Some suitable habiat is also found on the eastern slope of the Cascades and in the forested areas of south-central Oregon. Unsuitable habitat is associated with development or large scale agriculture. Most notably is the Columbia Basin, but also areas surrounding La Grande, Baker City, Bend/Redmond/Madras/Prineville, Ontario/Vale, and Klamath Falls. Relative to the rest of Oregon, the high desert area of southeast Oregon also has less suitable habitat with the exception of some the mountain ranges including the Steens, Pueblos, Trouts Creeks, and Warners and portions of the Owyhee region.

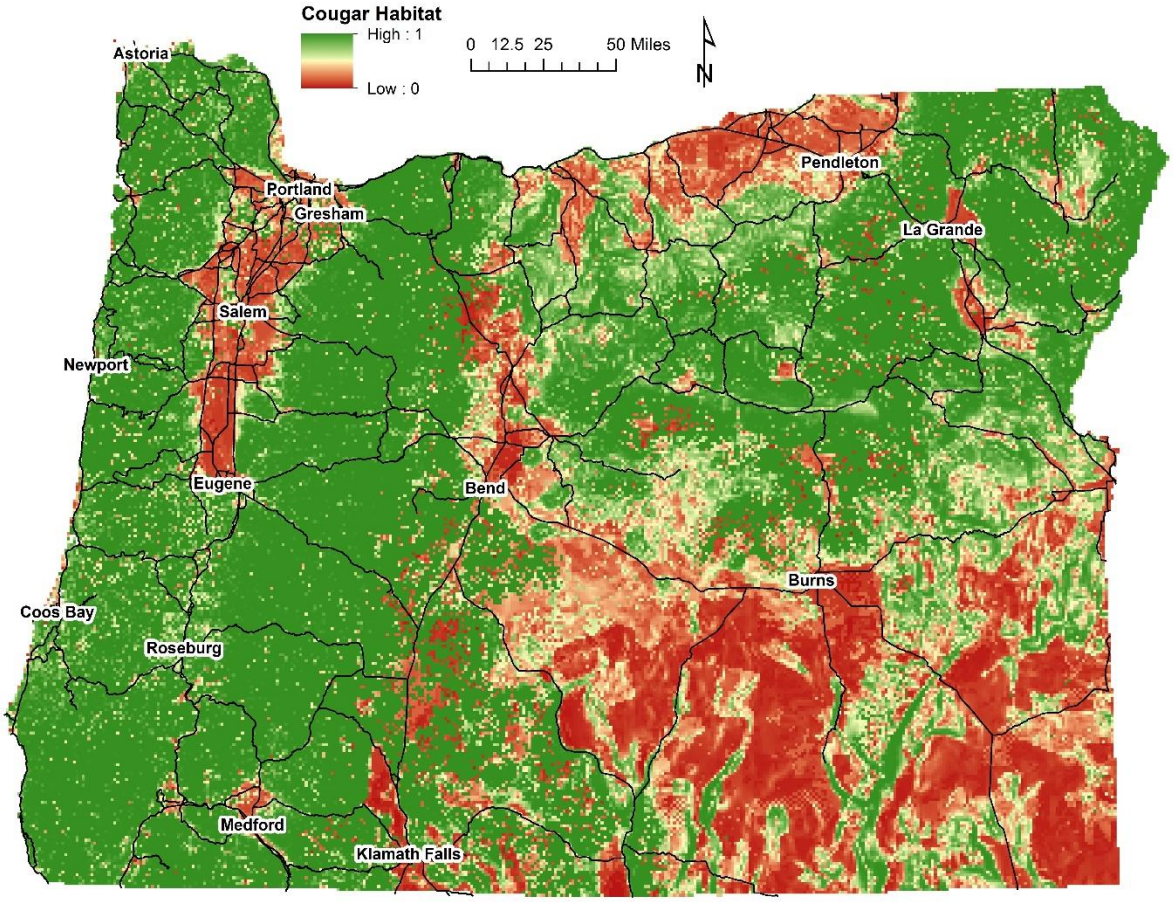


Figure 18. Habitat use of cougars in Oregon based on hunter-harvested mortality locations from 1995-2016. Habitat use was modeled using a Resource Selection Probability function and environmental predictor variables that included land cover, big game habitat, land ownership, elevation, aspect, slope, and terrain ruggedness. Major cities and highways are shown for reference.

Mortality locations displayed on the map show agreement with the habitat model (Figure 2). Most locations are shown in areas of high suitabltiy. There are some locations that fall within poor habiat in the Willamette Valley, Columbia Basin, and certain spots in the south east.

Suitable habiat is widespred throughout Oregon (Figure 3). Using a conservative estimate RSPF score of 0.5 or greater to signify suitable habitat results in approximately two thirds of the state (67.6%, ~65,000 mi^2) being classified as suitable cougar habitat.

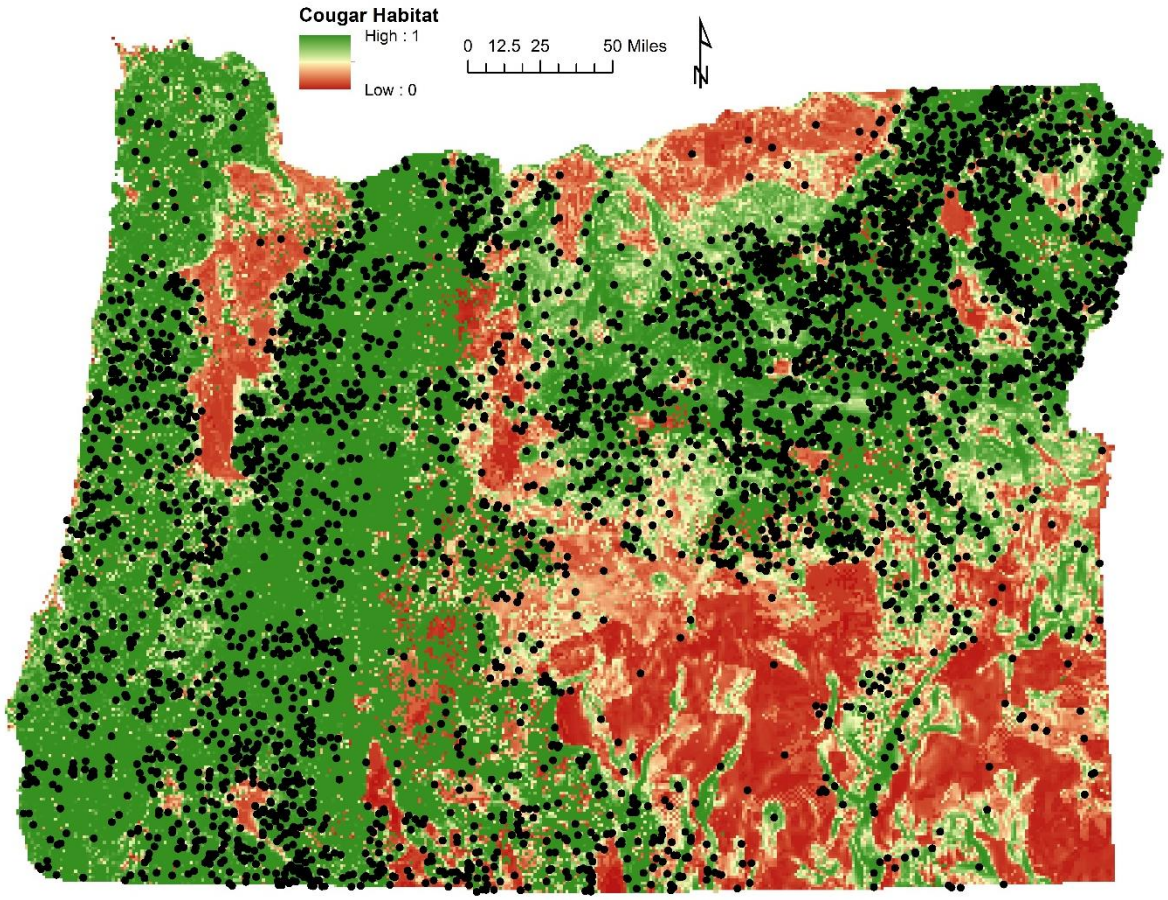


Figure 19. Habitat use of cougars in Oregon based on hunter-harvested mortality locations from 1995-2016. Mortalities are shown (black dots) for reference.

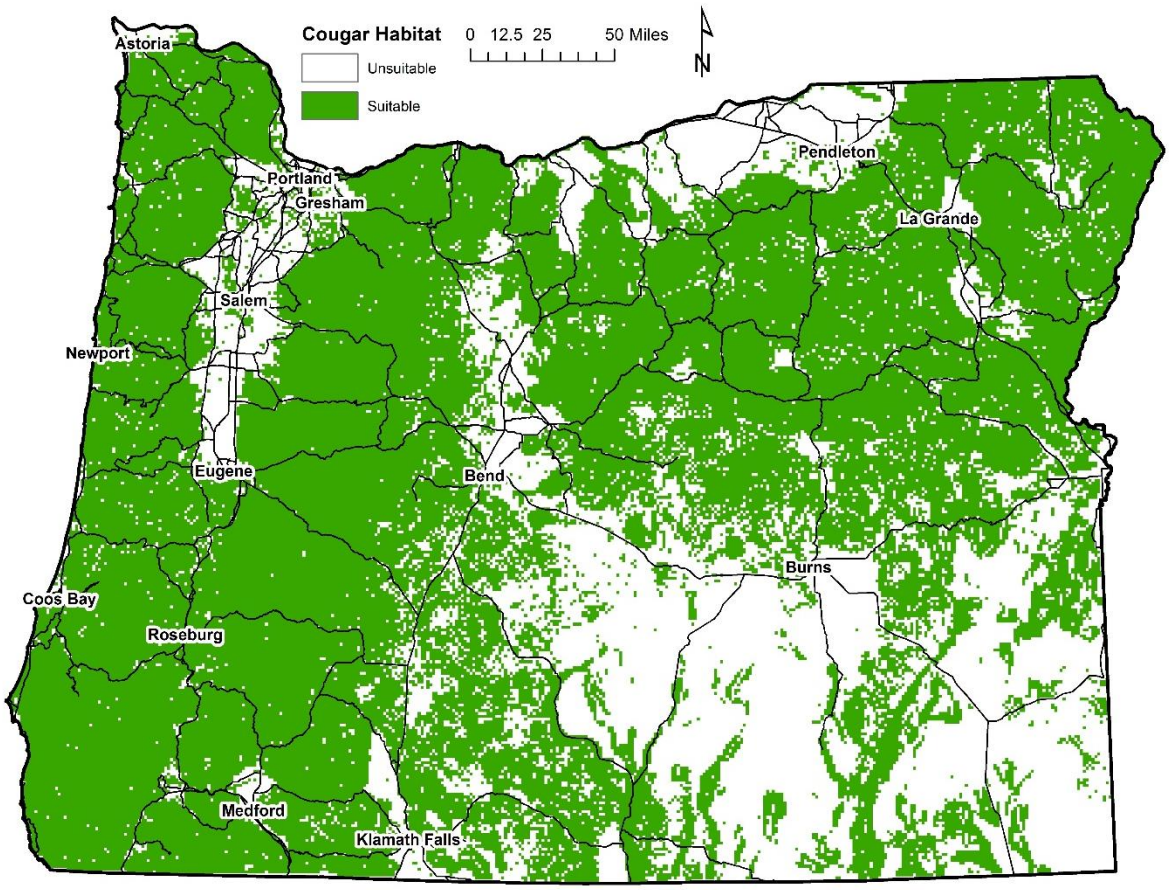


Figure 20. Map of suitable and unsuitable cougar habitat in Oregon. Suitability was defined as a score of 0.5 or higher in the Resource Selection Probability Function.

Discussion

The map of cougar habitat and distribution in Oregon is consistent with what ODFW believes to be good cougar habitat. Cougars are selecting for forested areas that overlap with ungulate distribution and have more rugged topography. They avoid areas of development and heavy agricultural use with little cover. Northeast and southwest Oregon have been considered the primary blocks of habitat for cougars in Oregon and research has documented high cougar densities in these areas. This modeling effort suggests that in addition to these areas, the Cascade Mountains and Coast Range contain large blacks of suitable habitat. There are also portions of quality habitat in southeastern Oregon, mostly confined to the mountain ranges of that area. These areas most likely provide an ungulate prey base, as well as some forest cover or broken topography that allow cougars to successfully hunt ungulate prey species. Outside of these areas, most of the high desert region of southeastern Oregon contains much less suitable habitat.

There appears to be good agreement when the mortality locations are added to the map of habitat suitability (Figure 2). There are some mortality locations that fall within less suitable habitats in the Columbia Basin and southeastern Oregon. This suggests that these area are not ideal cougar habitats, but are also not completely avoided. Cougars taken in those areas could have been following creeks or ridges in between areas of higher habitat quality.

There are also some locations that fall within developed areas of the state. There is increasing evidence that cougars can live in the wildland-urban interface with frequent forays into more developed and human populated areas. While they can live in these areas, they also are at a greater risk of vehicle collisions and are probably more likely to be removed for conflict (damage, safety), making this less suitable habitat.

The absence of mortalities in certain regions may highlight areas of refuge or source populations for cougars, including some of the larger wilderness areas in Oregon, including the Eagle Caps, Hells Canyon, North Fork John Day, Kalmiopsis, and all of the wilderness areas along the Cascade crest. These areas appear to have highly suitable habitat but few mortalities from hunting, most likely due to their remoteness. This makes them valuable as a population source for areas experiencing heavier harvest (population sinks). The north coast of the state also shows relatively few mortalities, but highly suitable habitat. An increase in moralities has been seen in the mid-coast region, potentially due to increased abundance. This could signal that north coast population will increase as well in the future.

The model was validated by examining mortality locations and the expert opinion of ODFW district biologists throughout the state. Most district biologists agreed that the model was representative of what they were seeing in the field. Nonetheless, the model could be improved with additional validation in the form of sub-setting the data and cross-validation, or using existing telemetry data to look at how well the model predicts suitable habitat. There can be difficulties in using fine-scale GPS data to assess a statewide distribution model, but incorporating habitat could increase the resolution data. At this geographical scale the model was limited by the accuracy of hunter's reporting of the mortality location, which was only reasonably accurate to the size of identifiable section (1 mi^2) in the PLSS. By utilizing some fine-scale GPS data, the model could be representative of broad scale cougar distribution, as well as finer scale habitat use.

Additional limitations of the model are the use of hunter-killed mortalities. While these locations are widespread across the state and hunters are present across a range of habitat suitability, it is still not a structured sampling design. Certain areas are more likely to see higher numbers of hunters, and thus an increased chance of harvesting a cougar. We believe this is somewhat offset by the length of time covered by the data used. Locations from over two decades were utilized, so we believe the state was sufficiently 'sampled' by hunters. Additionally, other methods such as using data from GPS collars to model habitat suitability across the state, has its own limitations. Extrapolating models outside the study area can lead to inaccurate measures of suitability. The state is diverse in its different biomes, and habitat relationships that may be true in one area might not be transferable to another. By using cougar mortalities habitat relationships were assessed at a statewide level.

Suitability defined using a conservative RSPF score of 0.5 or greater showed that approximately two thirds of the state was suitable habitat. The majority of this habitat is believed to be currently occupied, but additional information about cougar densities could be obtained to better estimate the potential population of the state. However, using the cutoff of a 0.5 RSPF score is somewhat arbitrary. Validation of the proper RSPF score could improve our knowledge of the available habitat, causing the amount of suitable habitat to either increase or decrease. As we learn more about cougar habitat selection through future studies we can continue to refine our map of suitable cougar habitat.

If this technique and habitat map is determined to be valid, the amount of habitat within each cougar zone, and corresponding estimates of carrying capacity, could be used to update the density-dependent deterministic model (Keister and VanDyke 2002) currently used to estimate Oregon cougar populations. That would be especially desirable in areas where cougar research has not been previously conducted.

Work Cited

Bureau of Land Management. 2017. BLM OR Management Ownership Polygon. *in* OR BLM, Portland, OR, http://www.blm.gov/or/gis/data.php, accessed 4/10/2017.

Jin, S., L. Yang, P. Danielson, C. Homer, J. Fry, and G. Xian. 2013. A comprehensive change detection method for updating the National Land Cover Database to circa 2011. Remote Sensing of Environment 132:159-175.

R Core Team. 2016. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria, https://www.R-project.org/.

Sappington, J.M., K. M. Longshore, and D. B. Thompson. 2007. Quantifying Landscape Ruggedness for Animal Habitat Analysis: A Case Study Using Bighorn Sheep in the Mojave Desert. Journal of Wildlife Management 71:1419-1426.

Lele, S. R., J. L. Keim and P. Solymos. 2017. ResourceSelection: Resource Selection (Probability) Functions for Use-Availability Data. R package version 0.3-2. https://CRAN.R-project.org/package=ResourceSelection

APPENDIX G: Field Staff Response For Cougar Information And Conflict Situations

March 4, 2015.

The following information summarizes how Oregon Department of Fish and Wildlife (ODFW) field staff typically provides public education on cougar in Oregon, and how they respond to cougar conflict reports within the established legal and policy framework. These two topics are generally related as many of the calls to an ODFW office regarding cougar, result in an educational opportunity.

Education

Information and education regarding cougars in Oregon is achieved in a variety of ways including presentations, published literature, and individual interactions.

Published literature includes the *Living with Cougar* pamphlet that is available at ODFW offices and on the ODFW website. ODFW also employs a standardized sign advising local residents and recreational users of cougar sightings in an area when those sightings occur repeatedly over time or are in non-typical cougar habitat. These are typically used at recreation sites such as parks and trails heads.

One on one conversation is the most common education venue employed by district staff. Cougars are a frequent topic raised by the public at meetings and cougar sightings, or damage and human safety issues also generate phone calls to the district office. These situations are the ideal time to provide information on cougars, cougar management and living with cougar. This is how the vast majority of cougar reports and information requests are handled.

Cougar Report Response

Sightings: Initial reports of a cougar sighting actually start with the reporting party believing they have a human safety concern. The ODFW biologist (biologist) or USDA Wildlife Services Agent (WS agent) receiving the report will ask questions on the date time and location of the sighting as well as details on the animal's behavior. To be considered a human safety concern the animal behavior has to meet the definition in ORS 498.166.

In most cases, sightings do not warrant a field response (there is no need to verify a simple sighting as no action will be taken) and the reporting party is provided information on living with cougar. This often includes the facts of cougar behavior that make it a rare event to even see a cougar and that they rarely pose a threat to human safety. Sightings are not considered damage complaints and are not recorded on the damage complaint form, although the biologist or WS agent will likely make notes in their field book to watch for patterns of behavior.

Suspected Human Safety: In some cases a single incident or a series of sightings and/or incidents will indicate a pattern of behavior that is considered a concern for human safety. The most common indicators of a human safety concern are repeated sightings in a populated area, especially in daytime, or cougar behavior that is non-typical including preying on pets and lack of fear toward humans. These complaints are recorded on the damage complaint form and typically warrant a field response by a biologist.

During the field visit the biologist will investigate the area looking for confirmation of the report(s), interview people at the location, and assess any socio-cultural conditions (e.g. feeding of deer) that could be contributing to the problem. Providing advice and information on

living with cougars is standard practice, even if other action such as cougar removal is warranted.

Cougar removal actions vary by county, and location (urban, suburban, rural) and other conditions related to the complaint (see the section on taking cougars below). Reported human safety issues, especially those in urban areas are often coordinated with Oregon State Police and/or local law enforcement agencies.

Suspected Depredations: Details of reported depredations are recorded on the damage complaint form when received by ODFW or WS Agent. If the report is timely they are advised to preserve any evidence at the site and a biologist or agent will respond to investigate. The investigation will determine if a depredation occurred (as opposed to scavenging), and if so, what type of animal was involved in the incident. Wild predators and especially cougars have distinctive kill, caching, and feeding patterns that make positive identification possible in the majority of investigations if reported timely.

The results of the investigation are noted on the complaint form. If the depredation is confirmed as cougar, actions taken will range from providing advice, to initiating a response to remove the offending cougar.

If the incident is a confirmed depredation but other wildlife is involved, the cougar complaint is marked accordingly and a standard wildlife damage complaint with the correct species is started. If the incident was caused by domestic animals the complaint is marked appropriately, closed out and referred to the local animal control officer or law enforcement as appropriate. In both cases the data is recorded in the cougar database as an unconfirmed report – other species.

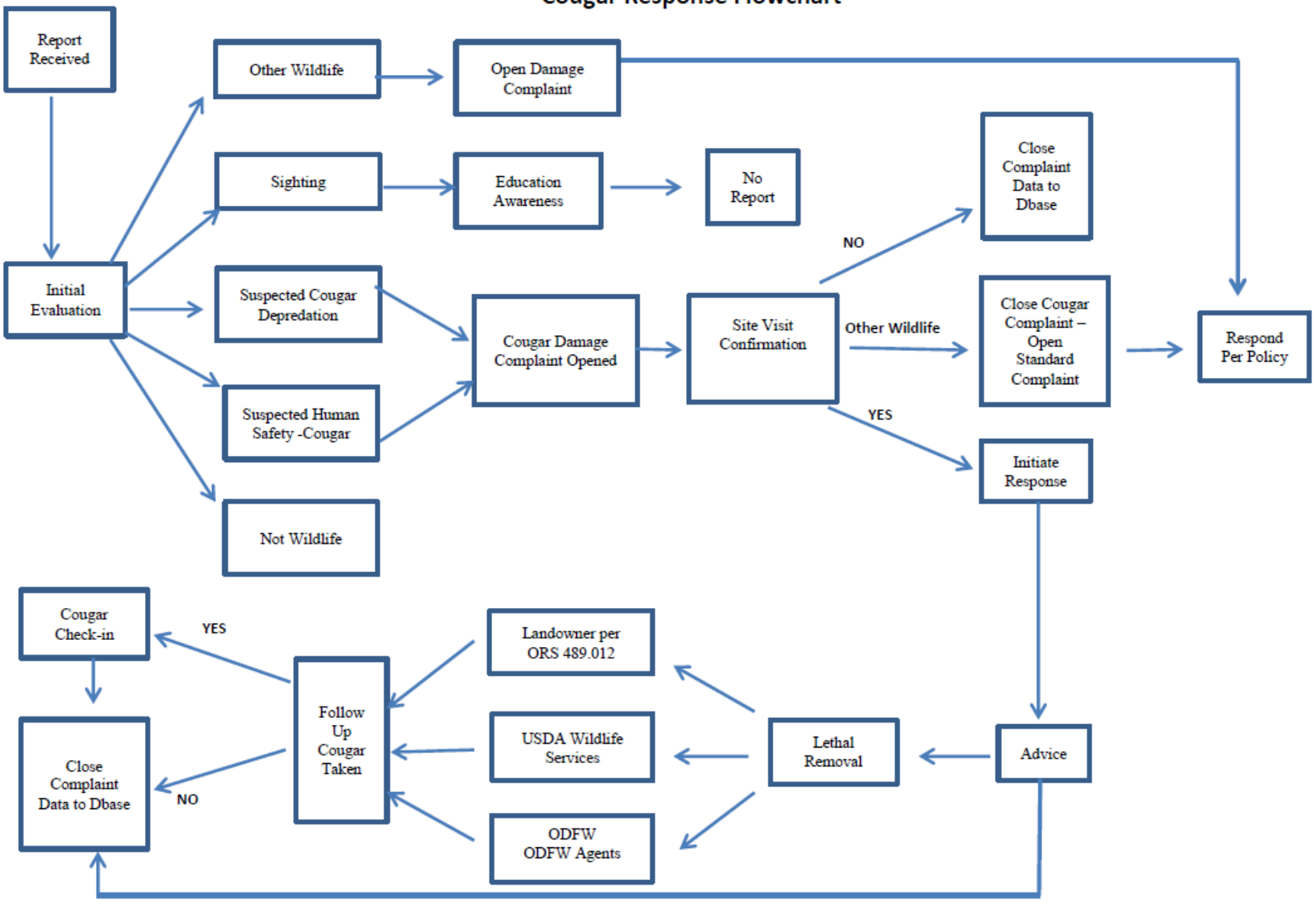
Taking Cougars Involved in Human Safety or Depredations

A confirmed depredation or human safety threat will initiate a response beginning with advice, up to and including removal of the cougar. Response will vary by county and location. In counties with WS agents they will handle the majority of removal efforts using either traps, trained hounds or both. In areas without WS agents ODFW may attempt to remove the cougar with traps and/or agents with trained hounds. In some cases landowners will remove the cougar on their own or with an agent as authorized under ORS 498.012 and 498.166.

However, not all confirmed cougar incidents can be handled with any of these tools. In some locations the human population density, landownership patterns, and uncontrolled domestic pets preclude the use of traps or trained hounds. In these cases advice on protecting people, pets, and livestock and information on ORS 498.012 and 498.166 are provided. With these types of complaints, the landowner often resorts to “guarding” their livestock and shooting the offending animal when it returns.

All cougars captured in response to confirmed depredations or in response to human safety threats are killed.

Cougar Response Flowchart



APPENDIX H: ODFW Wildlife Damage Policy

March 2008

Introduction

The Oregon Department of Fish and Wildlife (Department) has been granted specific authority by the Oregon Legislature to manage wildlife populations. The "Wildlife Policy" is found in Oregon Revised Statute (ORS) 496.012. While directed to manage populations at optimum levels, the department is also directed to manage populations in a manner consistent with the primary uses of the lands and waters of the state. It is the policy of the state that appropriate measures must be taken to assist farmers, ranchers and others in resolving wildlife damage problems and federal, state, county and local governments should cooperate in related efforts involved in wildlife damage control. Wildlife in terms of damage are wild birds, amphibians, reptiles, feral swine as defined by Oregon Department of Agriculture (ODA) rule and other wild mammals (ORS 496.004 (18). Wildlife defined for the purposes of harassment to relieve damage includes game mammals, game birds except migratory birds protected by Federal law, furbearing mammals and wildlife declared protected by the commission (OAR 635-45-0002 (88). Wildlife is further clarified by OAR 635-056-0010 and 0020. The intent of this policy is to address damage associated with all wildlife except fish.

Managing wildlife populations at optimum levels and providing optimum recreational benefits can at times lead to conflicts with some land management uses. Wildlife utilizes all lands, public and private. Private lands are extremely important in supporting and maintaining healthy populations of wildlife. Unfortunately, at times, wildlife can cause damage on private lands by inflicting economic loss to crops, forest products, structures, landscaping and livestock. Wildlife can become accustomed or even dependent on human activities or practices and can generate nuisance type complaints such as raccoons eating dog food or skunks living under a deck. Consequently, the department recognizes that control of damage and nuisance conflicts is an essential part of the department's mission.

As populations of wildlife species increase, the potential for conflicts arise. For example, increases in populations of geese, elk, and cougar have resulted in increased damage complaints. Increasing urban growth and movement out of town onto small acreages has led to an increase in nuisance types of conflicts. In many cases this damage is caused through well meaning landowners feeding wildlife, which can quickly lose fear of humans. Urban landowners especially need to recognize their role in keeping the "wild" in wildlife. Wild animals need to be treated with respect and should not be treated as pets. People should learn how to exist in harmony with wildlife to minimize conflicts.

Proactive outreach and education regarding how people can both prevent and solve damage and public nuisance situations has an important role in preventing and correcting problems, especially some relatively simple urban wildlife public nuisance issues. Department publications such as the "Living with Wildlife" series, "Backgrounders," and websites currently address some damage and public nuisance issues. By providing solutions to common, simple problems through the internet, the department can provide consistent, state-of-the art information in a cost-effective manner and reduce district workload. For urban wildlife public nuisance issues, there is also an opportunity to provide information regarding the benefits of wildlife, such as watchable wildlife opportunities, insect and slug control, rodent control, and seed dispersal.

It is important to note that funding constraints have limited the department's ability to

respond to some damage situations. Changes in land use practices can create damage situations that may not have occurred in the past. Other government agencies may have regulatory authority over specific aspects of wildlife damage control. An example is the Oregon State Fire Marshal's office regulates acquisitions, storage and use of fireworks (hazing or cracker shells). A landowner must acquire an Oregon State Fire Marshal permit before using these types of fireworks.

Damage as described by statute in ORS 498.012, "…means loss of or harm inflicted on land, livestock or agricultural or forest crops". It further describes public nuisance relating to wildlife to mean "…loss of or harm inflicted on gardens, ornamental plants, ornamental trees, pets, vehicles, boats, structures or other personal property". ORS 498.012 allows landowners or lawful occupants to take ". . . any wildlife that is causing damage, is a public nuisance or poses a public health risk . . . ". However, permits are required from the department before taking any game mammal, game bird, furbearing mammal or nongame wildlife species, except cougar, bobcat, red fox or bear. Special consideration has been given to those situations where bears or cougars pose threats to human safety. ORS 498.166 clearly defines the circumstances in which bears or cougars may be taken for human safety concerns. Conflicts between people and wildlife can occur in numerous ways and the Legislative Assembly has declared appropriate measures must be taken to assist people in resolving wildlife damage problems. This direction provides the department authority to address all wildlife conflicts unless they are the specific responsibility of other government agencies. The department provides assistance to people either directly, through other government agencies or through private efforts, to resolve wildlife conflicts.

Managing damage on private lands is dependent on cooperation between the department and private landowners. Both must be willing to recognize the constraints placed upon either the department or on the landowner. Agency budgets or personnel restrictions may impact the department's ability to deal either effectively or in a timely manner with the damage situation, while the landowner may be operating under economic constraints that prevent tolerance and demand immediate attention. In cases where the department is unable to respond, landowners may look to other options, including USDA – Wildlife Services, county control officers, and private contractors.

Wildlife damage control can be classified as either corrective or preventative; corrective actions are used to address existing damage while preventative actions are taken to resolve damage before it occurs. While preventative actions are preferred, they may not always be feasible and the appropriate corrective measures will be taken. Corrective actions may take time to implement and may need to be combined with preventative actions to resolve the problem.

The department will as a matter of policy respond to damage in a timely manner. However, genuine human safety concerns will be the department's highest priority for response. Close coordination with public safety officers will occur when appropriate. The department shall also continue to collect information on population trends, habitat condition and food supplies in an effort to anticipate wildlife damage problems. The most appropriate and effective preventive damage control programs shall, as a long-term goal, be implemented. If an area is not appropriate for a particular wildlife species and continued use will increase conflicts, methods that remove or exclude the animals will be given first priority. It is difficult to anticipate all damage situations, and the department shall utilize the total array of existing or other innovative appropriate corrective methods to alleviate unanticipated damage.

In those cases where joint responsibility for managing wildlife exists, such as management of migratory birds or endangered species, the department shall facilitate cooperative solutions to the problem with the landowners and the other agencies involved. Damage situations that extend over large acreages may require cooperation from multiple landowners and public land managers to develop long-term solutions. However, the department will remain committed to responding promptly to damage situations and may provide short-term assistance to the landowner until the appropriate agency responds.

Procedures for Wildlife Damage Control

Wildlife damage control decisions should be made at the local level. Complaints should be directed to the local department district office for investigation and action, if necessary. If district biologists either fail to respond promptly or are unable to resolve the problem in a manner acceptable to the complainant, the individual should contact the following: Watershed Manager, Regional Manager, then Headquarters and/or the Commission.

The department may deny assistance for control of damage caused by an identified wildlife species under any of the following circumstances.

1. Federal, state, county or local ordinances preclude control measures desired by the landowner; the department doesn't have authority to approve the action.
2. Control would be ineffective or unreasonably expensive due to a lack of cooperation by the landowner.
3. Control would require an unreasonable complete removal of all individuals contrary to management goals.
4. The landowner does not allow sufficient hunting on their base property to reduce game species to numbers that minimize the damage problem.
5. The landowner created the wildlife conflict situation through a categorical change in the use of the land since 1987 in recognized significant wildlife habitat, was aware of pending wildlife damage and neglected taking preventative actions.
6. The landowner is managing the identified wildlife species for personal profit and is excluding public access to that wildlife species.
7. The landowner created an attractive nuisance and refuses to take corrective action for those species causing the conflict.

Damage Control Methods

Each existing or recurring damage complaint will be investigated either in person or by telephone, on an individual basis to determine the specific circumstances, severity of the damage, and the control method most appropriate for the particular situation. The solution must be practical and acceptable to both the complainant and the department. A method of control will be implemented and if necessary revised until the problem has been resolved. When appropriate, the department will provide the complainant with a list of local private contractors or other public agency wildlife control agents who specialize in specific damage situations. The

complainant will be responsible for paying any fees required by private contractors for provided services.

Depending on the situation, the local biologist has broad discretion in dealing with each individual complaint and can use a variety of methods to deal with the problem. Which method works best will be dependent on the particular situation. Generally non lethal methods that are cost effective will be initiated first; more aggressive methods, including lethal removal, will be used as necessary. Some long-term solutions cannot be implemented immediately and are dependent on approval from the Region, Headquarters or Commission. Upon initial receipt of a wildlife damage complaint, the local biologist will record pertinent information on a "wildlife sighting, damage complaint, and permit form". For situations involving cougar or bear, damage complaint information should be recorded on the “Cougar & Bear Damage and Safety Complaint Form”. All damage complaints should be immediately entered into the department’s wildlife complaint database. Upon resolution of the damage, completed forms will be provided monthly to the Wildlife Division.

Due to changes in state and federal regulations and funding constraints, the department will no longer provide repellants; firecrackers, cracker shells, or fence home use gardens. Landowners will be responsible for obtaining these materials themselves. The department will assist by providing required wildlife related permits, vendor lists, and if necessary, directions for securing other permits to obtain and use firecracker devices.

Identifying the specific wildlife species causing the damage is critical to prescribing effective methods of control. Sign, visual observations, history, behaviors, specific characteristics of the damage or victim all can provide clues to which species is responsible. Experience, a detailed investigation or visiting with neighbors can provide information to identify the target species.

For the purposes of this policy, the department has identified categories of species and methods for dealing with damage or nuisance for each category. Species are grouped due to common damage control strategies, federal listings, mixture of groupings created by statutes, statutes specific to species, as well as natural groupings. Determining the group containing the species causing the conflict will enable the reader to review the potential control methods and the statutory restrictions regulating control.

Cougar-specific sections are presented here-on

GAME MAMMALS: This group is defined as antelope, black bear, cougar, deer, elk, moose, mountain goat, mountain sheep and western gray squirrel (ORS 496.004(9)) Moose are historically rare visitors to Oregon but recent information indicates reproduction is now occurring in Oregon and populations may now be established. If moose populations increase to sufficient size and distribution, damage may become an issue in the future. Rocky Mountain goats and mountain sheep generally utilize remote habitats and damage conflicts seldom occur. Western gray squirrels are discussed with small mammals. Specific management plans have been developed for all game mammals except antelope, moose and western gray squirrels. These plans provide goals, guidelines and direction for species management.

Game Mammals are defined by ORS 496.004 (9). The primary preventative control measure to avoid damage is controlled harvest seasons (ORS 496.162(C). The department's goal is to maintain population levels to optimize recreational benefits while maintaining

compatibility with the primary use of the lands and waters of the state. Policies and guidelines have evolved specific to black bear and cougar concerning damage, nuisance; public safety concerns, and carcass disposition will be addressed separately.

Specific herd and population level data are gathered and evaluated yearly to determine season dates, bag limits and harvest levels necessary to maintain optimum population levels. General and management unit harvest seasons address overall population reductions. Seasons specific to subunits or local herds are prescribed to reduce numbers of animals causing damage. These hunts are planned well in advance of occurring and are preventative in nature. Emergency hunts are tailored by the local district biologist at short notice to utilize hunting to alleviate an unanticipated damage problem. These hunts provide a great deal of flexibility in setting dates, hunt area and numbers of hunters. Traditional hunting regulations apply to all of these seasons.

Many complaints received each year can be solved with advice and repellents. The more serious complaints require a combination of methods. The guidelines discussed in this wildlife damage policy describe each type of control method and the type of damage situation to which each method is best suited. Human safety concerns caused by bear and cougars are addressed separately from damage.

1. Advice: In many instances, a prompt response to a damage complaint along with advice on animal behavior and causes of the damage can solve the problem. While most complaints solved in this way are minor, the first priority in responding to any damage complaint is a prompt response and discussion of the problem with the landowner. Frequently, onsite inspection of the damage can verify the severity of the problem and provide innovative solutions. Often the landowner needs to know his problem is recognized and the department wants to help him resolve it. Chronic damage complaints may require a long-term relationship with the landowner to develop hunting seasons or agricultural practices to avoid damage. Advice usually is a corrective action, but it can be considered preventive at times. Advice may include providing the landowner names of hunters with appropriate tags to hunt the offending animals. Consultation or incorporation of WS agents to address bear or cougar depredation of livestock can provide rapid results. However, not all counties have access to WS agents. Simply providing the landowner with a list of reasonable options for him to consider can be the initial response and can begin a dialog for success.

2. Repellents: Information regarding the type of repellents available, sources of repellents, and advice for application of repellents may be obtained from the district biologist and/or the local Oregon State University Extension office. Repellents may be effective in addressing damage complaints on gardens, flowers, ornamental shrubs, berries, and fruit trees for varying lengths of time. However, use of repellents on large commercial crops is expensive and a more permanent solution should be utilized. This action is considered to be corrective.

3. Hazing: Hazing is used to scare wildlife away from the conflict area. Hazing generally provides temporary relief as the animals become accustomed to the noise over time and quit reacting. Hazing is most effective if conducted before the animals become accustomed to using an area and can be an effective method for infrequent, short-term problems. If animals are persistent, other methods should be utilized.

A permit from the department is required to haze game mammals due to the prohibition of chasing or harassing wildlife (ORS 498.006). When appropriate, a district biologist may issue a hazing permit to the landowner or agent, with a copy to the Oregon State Police and appropriate local law enforcement agencies. The permit allows for daytime or night harassment. The department may assist the landowner with hazing or provide supplies such as propane exploders or ammunition. If a landowner wishes to use cracker shells, firecrackers or other fireworks type hazing devices, a permit is required from the Oregon State Fire Marshal prior to using. The department will assist the landowner in obtaining this permit and in supplying vendor contacts for hazing materials. Hazing is considered a corrective action.

4. Barriers: The department's involvement in using barriers to deal with noncommercial damage complaints (e.g. garden fences, hobby farm hay stacks) will be limited to advice on design and availability of supplies. Landowners are responsible for purchase of supplies and construction of the barrier.

In some cases the department may assist commercial operators by providing part or all of the materials, reimburse part or all of the labor costs and provide specifications for design. This assistance is dependant on a variety of factors including, but not limited to, size, cost and biological impact. Maintenance is the responsibility of the landowner.

Barriers include haystack plastic fencing, stackyard fences, permanent fences, and electric fences. Use of barriers will be considered when other damage control methods are ineffective and wildlife use in the general area is temporary, encouraged or inevitable. The use of haystack plastic fencing and some electric fencing is a temporary corrective action, while stackyard and other fences are permanent preventive measures. Due to the expense of haystack plastic fencing, construction of stackyard fences, as a permanent solution to recurring problems is the preferred control measure. Criteria for the use of barriers are as follows:

a. Haystack plastic fencing: when the landowner ceases to need the fencing, it should be returned to the facility that provided the material. The purpose of this fence is to temporarily prevent damage to haystacks by game mammals. The loaning of plastic haystack fencing should be considered an emergency response to wildlife use.

b. Stackyard fences: A permanent stackyard fence where hay is stored annually can provide protection at less cost and manpower to all parties. When stackyard fences are properly constructed and maintained, damage due to game mammals can be eliminated. Adequate planning with the landowner for design must occur to insure the fence will remain effective and meet the landowner's needs. This may include a large enough area to facilitate changes to bigger bales or the equipment used to handle them or future changes to feeding logistics.

c. Permanent large area exclusion fences: when all of the following criteria are met, permanent large area exclusion fences to protect private property from wildlife damage may be constructed:

1. Severe and recurring damage is attributed to requirements of the wildlife policy
2. Fences are cost effective relative to other controls methods
3. Permanent fences will, in all likelihood, solve the problem
4. Wildlife use in the area is encouraged by the department and/or inevitable
5. Other wildlife species will not experience a significant detrimental effect

Construction and maintenance of permanent exclusion fences varies with the number of the affected private properties and the extent to which damage to multiple commercial properties is attributable to implementation of the department's wildlife policy. Permanent fences for protection of commercial property used to produce higher unit value crops in a given area shall be given first priority in the allocation of existing funds.

Cost-share guidelines for permanent commercial fences:
When permanent fences are used to protect privately owned properties, a fencing agreement must be signed by the landowner prior to construction of the fence. These properties must be in commercial use. The department will either (1) provide metal materials for an appropriate fence excluding gates (providing the cost doesn't exceed $28/rod) or (2) compensate the landowner at a rate of $28 per rod for a completed fence approved as meeting department specifications. If materials are provided, the landowner must construct the fence within the time period agreed upon after the delivery of the materials. The option to be utilized will be agreed upon by the landowner and the district biologist as part of the fencing agreement. The landowner is responsible for maintenance and effectiveness (e.g. closed gates) of the fence.

5. Winter Feeding: Winter feeding of game mammals to alleviate damage is different than a program of winter feeding to promote survival. *Winter feeding does not apply to cougars.*

6. Habitat Programs. *Most habitat programs are directed at deer and elk damage and does not generally apply to cougars.*

7. Removal of Wildlife

Large-scale removal is accomplished through controlled harvest seasons. A person is allowed to take any wildlife that is causing damage, is a public nuisance or poses a public health risk on land they own or lawfully occupy [ORS 498.012 (1 - 6)]. However, a permit is required from the department to take any game mammal or game bird, furbearing mammal or nongame wildlife species. Exceptions for a required permit include cougar, bear, bobcat and red fox if written authority from the owner or lawful occupant is attained. There are a variety of mechanisms which can be used to allow the take of deer, elk, and pronghorn causing damage.

When removal of a problem animal or animals may be the only practical solution to a particular damage situation, the department will authorize the removal of animals through hunting seasons including LOP damage conversions, kill permits, live trapping, or immobilization.

Any movement of live animals must be strictly evaluated to determine potential disease transfer, immobilization chemical metabolism, adequate holding facilities and appropriate release sites. Generally, removal of an animal is considered to be a corrective action, but hunting seasons to reduce overall populations in an area are considered preventive.

Hunting Seasons:

Hunting seasons are established by the Commission and implemented under Administrative Rules. A variety of hunting season strategies are used by the department to alleviate damage from game mammals. Traditional hunting regulations apply to all of these hunts.

1. Controlled Hunts are unit-wide tag limited hunts designed to provide general population reductions over a large area and are considered preventive actions.

2. Damage Controlled Hunts can be designed to target groups of animals causing damage. Dates, length, bag limit, number of tags, and boundaries are designed to address specific damage areas. Controlled hunts are corrective actions. The success of damage controlled hunts is greatly influenced by landowner cooperation to provide hunter access.

3. Emergency Hunts are authorized on short notice to address a damage situation which was unforeseen when game mammal regulations were initially adopted. Emergency hunts for game mammals are for antlerless animals only. Any specific hunt requiring less than 50 hunters can be authorized by the Director; a specific hunt requiring more than 50 hunters requires Commission approval. Proposed emergency hunts must be approved by the Regional Manager and the Wildlife Division Administrator with notification to local Oregon State Police Officers. No more than 250 hunters in aggregate per county may be used between August 1 and March 31(OAR Division 078). Emergency hunts are corrective actions.

4. Landowner Preference (LOP) Program is based on ORS 496.146 (4) and Section 2, Chapter 460, Oregon Law, 1995(5) and is implemented according to OAR Division

075. This program includes options to deal with presently occurring damage to the landowner's property very quickly utilizing harvest. Implementation of the damage provisions is somewhat complicated and agreement between the landowner and district biologist that presently occurring damage exists is key (required). Some landowners view this option incorrectly simply as a second hunting opportunity or a chance to have a long, custom hunt. This program is popular with landowners because it enables them to harvest and utilize offending animals when damage is occurring. Many times damage is not occurring when traditional seasons exist. It also allows any deer or elk LOP tag to be converted to two antlerless tags for the removal of offending animals. The district biologists have authority to convert tags immediately after verifying damage and decisive action can begin within hours to alleviate damage. Tag conversion action can occur August 1 through March 31. LOP damage conversion hunts are corrective actions.

Kill Permits

Kill permits may be issued throughout the year but hunting strategies should be used first if practical. From April 1-July 31, a time period when no hunting seasons are authorized, if non lethal actions are deemed infeasible, the department may issue to the landowner or his agent a

permit to kill a specified number of animals doing damage to his property. Kill permits are not hunting and therefore, are not restricted by traditional hunting regulations and can be used day or night, spotlights can be used (ORS 498.142) and the landowner does not keep any of the animals. Frequently, game mammal damage will only occur at night when hunting is illegal. Kill permits can be used to make non lethal hazing more effective by reconditioning animals to fear gunshots or noisemakers. Kill permits will be used as a corrective control measure when there are few animals involved. Kill permits are exercised by the landowner whom process the animals that are salvaged and disposed according to Division 2 (OAR 635-002-005). Generally the meat is donated to charitable organizations.

Trap and Transplant

Removal of live animals by trapping can be effective, however, trapping and transplanting animals is seldom a viable alternative because of cost, labor coordination, disease concerns, and the difficulty of finding acceptable release sites. Relocation can be considered if animals are disease tested and there is a nearby location to humanely hold the animals until results of disease testing are available; and if the herd/population being moved has a disease free history. Relocation is an expensive process. It can require a great deal of coordination and labor and should be considered only if other control methods are ineffective or not practical. Release sites for trapped animals should be preapproved and reasonably free of potential conflicts with present land use.

Immobilization

Immobilization of game mammals to resolve damage complaints generally is not practical. It can be expensive and safety for the user, the animal and potential bystanders must be considered. If this method is used, it should be used only on an individual animal in a confined space or for very special circumstances requiring a great deal of planning and coordination.

Immobilizing drugs should not be used if the animal could potentially be consumed by humans (i.e. open hunting seasons) within 30 days of drug administration. Unique situations may require special ear tags to notify the hunter of the concern.

8. Private Animal Damage Control Services

Some private animal control businesses are available for game mammal damage control or may provide advice on where to obtain and how to use repellants.

Black Bear and Cougar:
Damage, nuisance, human safety response, and carcass disposition

Damage:

Where appropriate, the department will utilize non-lethal methods of managing bear or cougar damage. Advice provided in situations involving damage by black bear or cougar focuses on measures to reduce the potential for attracting bears or cougars. Generally, removal or containment of the attractant, usually food items or prey animals, and containment or protection of livestock and pets can be used to reduce or minimize damage. Electric fencing around beehives or fruit trees can be effective at deterring bears. Information on living with bears or cougars is available from the department ("Living with Wildlife" Series). In situations where a bear or cougar must be removed to solve the damage situation, lethal control is the

recommended option. In larger areas where non-hunting mortality and complaint trends indicate chronic damage problems with cougar, population management will focus on managing the area for lower cougar populations.

Oregon Revised Statute (ORS) 498.012 (1)–(5) allows any person to take (kill) a black bear or cougar causing damage, is a public nuisance, or poses a public health risk on land they own or lawfully occupy. No permit is required; however, persons other than the landowner or lawful occupant must have written authority from the landowner or lawful occupant containing specific information outlined by ORS 498.012 (4). Any bears or cougars taken must be immediately reported to wildlife law enforcement personnel. Pre-treatment of an area in expectation of damage is not allowed. However, the department may proactively manage for lower cougar populations in areas where data indicate chronic damage or human safety conflict exists.

The prohibition on using bait or dogs to take bear or cougars (498.164) is exempted by ORS 498.012 for damage. Bait and dogs can be used by the landowner or lawful occupant to address damage on their land from black bear or cougar. Employees or agents of county, state or federal agencies, while acting in their official capacities, can use bait or dogs to attract, hunt or pursue bears or cougars. The Commission directs carcass disposal. Animals taken on damage are first offered to the landowner incurring the damage (ORS 498.012(3). The department recommends bear carcasses be salvaged for their meat and many are donated to charitable organizations. Disposition of bear or cougar is outlined by OAR 635-002-0009(2, 3).

Nuisance:

Generally, a nuisance complaint doesn't involve a cougar. If a cougar is utilizing an area enough to be considered a nuisance, a public safety concern will exist and appropriate actions should be taken (ORS 498.166 (4) (D)).

Nuisance complaints for bears usually involve an attractant such as pet or livestock feed, garbage, dirty barbecues, abandoned fruit trees, etc.. Generally, advice to landowners to remove, contain or clean up attractants or hazing of the animal will alleviate the nuisance problem.

Nuisance bears that have not caused damage may be trapped and relocated one time if they don't pose a risk to public safety as described by ORS 498.166 (4).

PUBLIC SAFETY:

ORS 498.166 list criteria used to determine if a bear or a cougar is exhibiting a threat to human safety. Criteria include aggressive actions toward humans, loss of wariness for people, attacks on pets or domestic animals (ORS 167.310) or attempts to enter dwellings or buildings. Advice on how to handle these situations are included in “Living With Wildlife” (Black Bear, Mountain Lion), and include remain calm, don’t run, slowly back away or fight back if attacked. Young people need to be closely attended if cougars or bears could be in the area.

ORS 498.166 specifically allows any person to take (kill) a black bear or cougar posing a threat to human safety without a permit. The statute requires that any person taking an animal under these conditions immediately report to department or other personnel authorized to enforce the laws of Oregon, events leading to the taking, any injuries to humans or domestic animals and the disposition of the animal. The Commission directs carcass disposal. Animals taken in human safety situations cannot be offered to the person killing the animal. The department recommends salvaging bear carcasses for their meat to be donated to charitable

organizations following OAR 635-002-009(2, 3). The department will file a report to the Director within 30 days of disposition.

ORS 498.166 does not exempt the public or landowners from the prohibition on using bait or dogs to hunt or pursue bears or cougars to address human safety. However, 498.164, specifically exempts employees or agents of state, county, and federal agencies while acting in their official capacities. Thus state, county or federal employees or agents may use bait or dogs when attempting to address human safety situations involving black bear and cougar. When available, WS agents and human safety (law) officers will lead efforts to resolve bear or cougar human attack incidents. Protocols for such incidents are established and will be followed. Consult Regional contingency plans for appropriate actions.

Lethal control is the only option for bears or cougars causing human safety concerns. Animals causing human safety concerns will not be relocated.

APPENDIX I: Glossary – Definition of Terms

PLEASE NOTE: All terms included in this glossary are only applicable and defined as used in the 2017 Cougar Management Plan.

Adaptive management – a method of managing a wildlife species, applied on a large scale, which uses the current synthesis of knowledge to propose and test hypotheses. Treatments are implemented, outcomes are monitored, and management adjusted to meet objectives.

Administrative Removal – the removal of cougars by ODFW (or agents) to proactively reduce conflict within a target area.

Bag limit – as used for hunting, the specification of the number, gender, and/or age of a wildlife species that may be legally killed with an appropriate license or tag.

Controlled hunt – A season where the number or distribution of hunters is limited through a public drawing or other means. A legal hunting opportunity during a specified time period in a defined geographical area established by ODFW for the purpose of managing wildlife species. Individuals participating in the hunt are required to possess a harvest permit (tag) for the wildlife species being hunted.

Cougar – a large, tawny brown cat (*Puma concolor*) occurring throughout Oregon. Adults may be 7 feet long (nose to tip of tail). Young cougars have spotted pelage. In Oregon, cougars are defined by statue (ORS 496.004 (9)) as game mammals.

Cougar (damage) complaint – a report by the public of a concern regarding cougar(s) recorded by ODFW.

Cougar management zone – six defined geographical areas used for cougar management in Oregon.

Game mammal(s) – are pronghorn antelope, bighorn sheep, black bear, cougar, deer, elk, moose, Rocky Mountain goat, and western grey squirrel (as defined by ORS 496.004 (9)).

Livestock – Livestock is defined as in Oregon state agriculture laws (ORS 609.125) which defines "livestock" to mean: ratites, psittacine, horses, mules, jackasses, cattle, llamas, alpacas, sheep, goats, swine, domesticated fowl and any fur-bearing animal bred and maintained commercially or otherwise, within pens, cages and hutches.

Mortality Quota – the maximum number of known cougar mortalities from all causes in a cougar management zone, during a specified time. Once the mortality quota has been reached, hunting seasons and administrative removal will cease for the year. The only additional cougars allowed to be taken will be in response to specific damage or human safety concerns as specified in ORS 498.012 and ORS 498.166.

Non-hunting mortality – cougars that die from causes unrelated to legal sport-harvest and are reported to ODFW. These causes of death can be varied and include cougars killed by humans because of damage or human-safety concerns, roadkills, and all natural causes.

Tag – a document authorizing the taking (killing) of a wildlife species at a specified time and place.

Target Area - a defined geographical area established by ODFW where cougar numbers will be proactively reduced in response to established criteria (in this plan) for cougar conflicts with humans, livestock, or other game mammals.

Ungulate – any of the group (*Ungulata*) consisting of the hoofed mammals (as pronghorn antelope, bighorn sheep, deer, elk, moose, and Rocky Mountain goat) of which many are herbivorous and many are horned.

Wildlife Management Unit (WMU) – A defined geographical area established by ODFW for management of wildlife species. The boundaries for each wildlife unit are described in "Oregon Big Game Regulations" booklets.

APPENDIX J: 2007-2009 Cougar Target Area Summaries

Oregon Department of Fish and Wildlife Evaluation of cougar removal in Oregon
October 2, 2009

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.

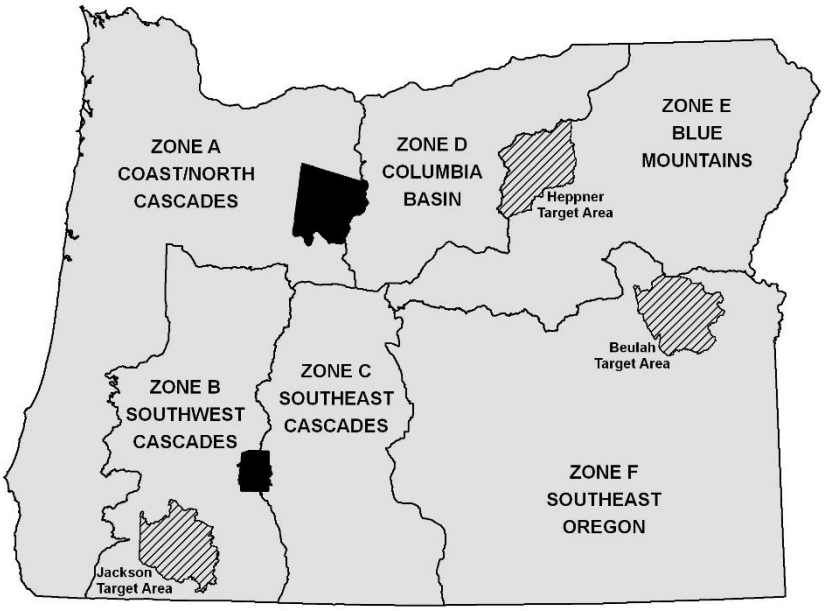

Figure 1. Cougar Management zones and location of cougar target areas in Oregon.

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.

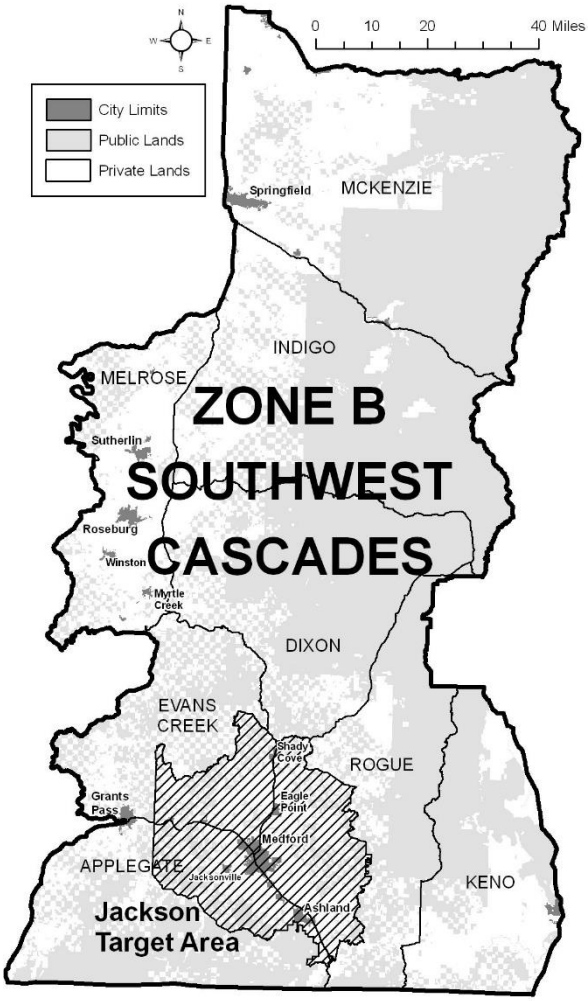

Figure 2. Location and land ownership of Jackson County Cougar Target Area.

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 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.

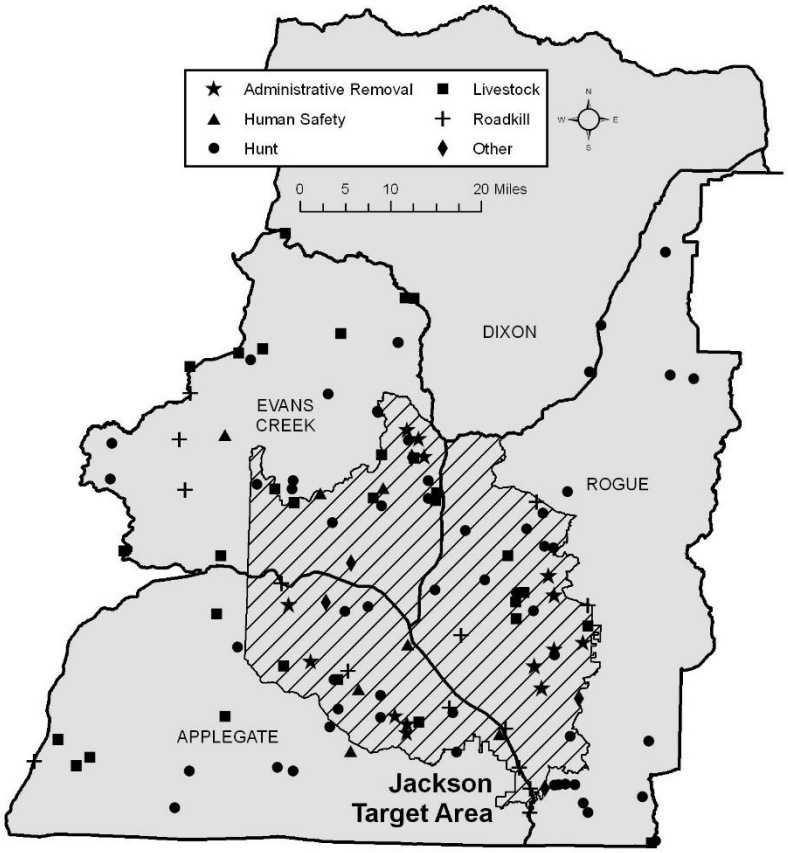

Figure 3. Distribution of known cougar mortalities in the Jackson County Cougar Target Area, Oregon, 2006–2009.

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

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

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.

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).

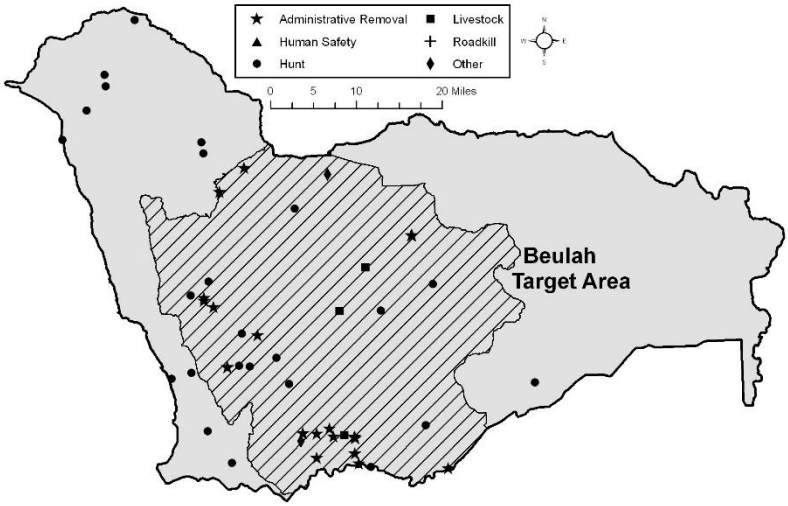

Figure 5. Distribution of known cougar mortalities in the Beulah Unit Cougar Target Area, Oregon, 2006–2009.

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.

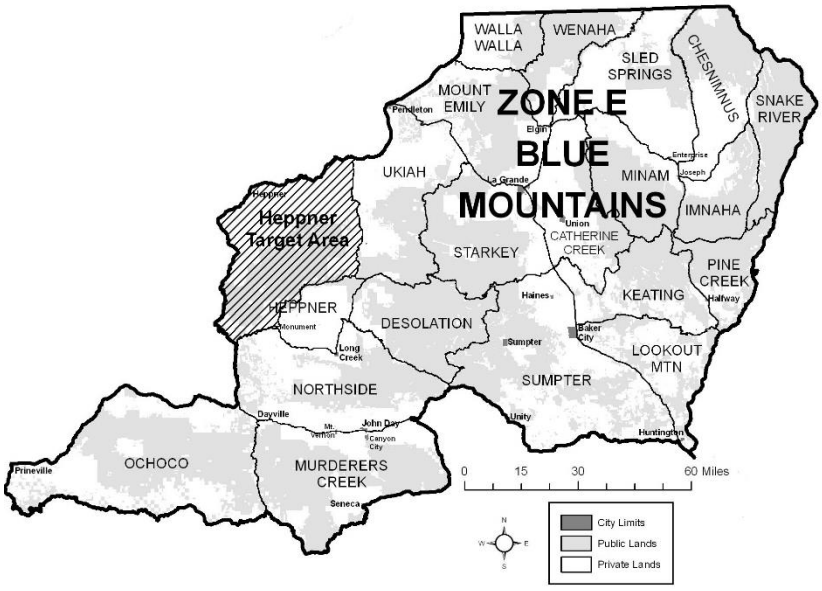

Figure 6. Location and land ownership of Heppner Unit Cougar Target Area.

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

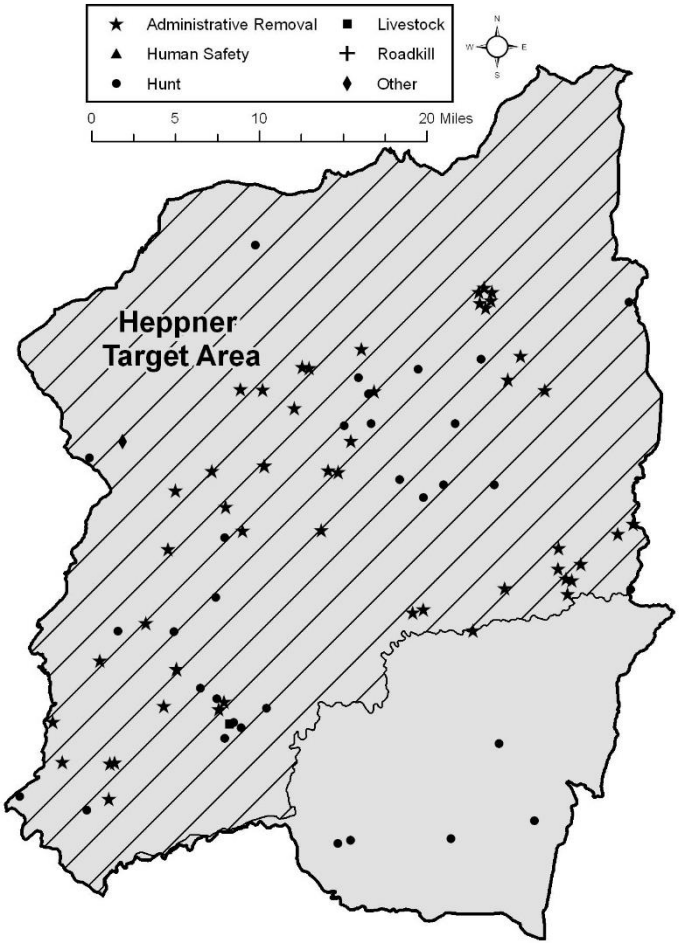

Figure 7. Distribution of known cougar mortalities in the Heppner Unit Cougar Target Area, Oregon, 2006–2009.

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.

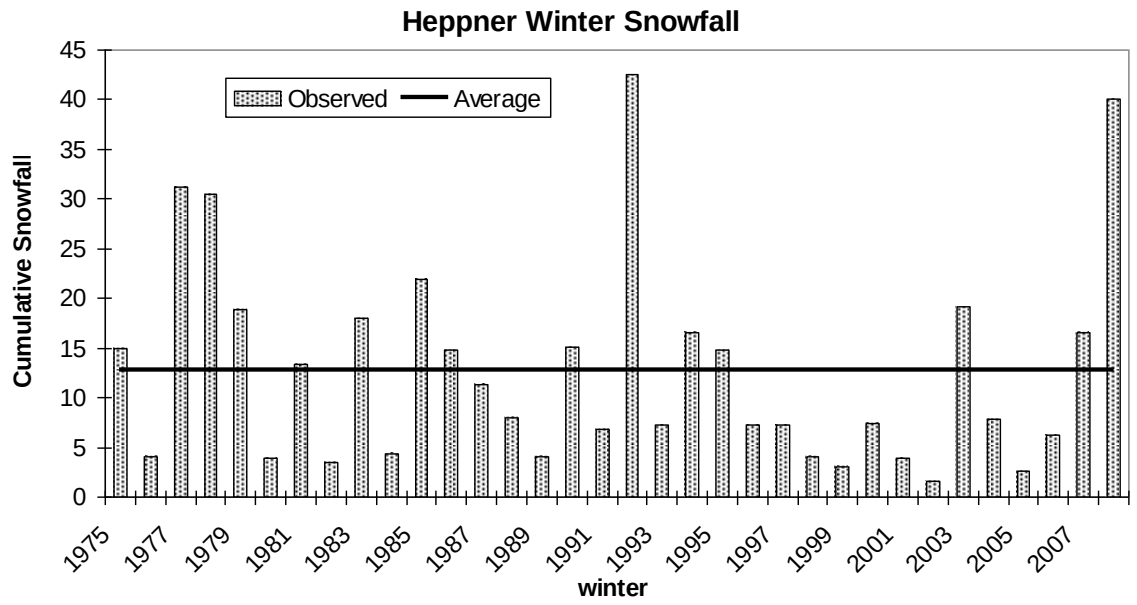

Figure 8. Annual winter snowfall at Heppner, Oregon recording station, 1975–2009.

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.

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			

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.

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.

2017 UPDATE

Jackson Target Area

Following the unsuccessful implementation of the Jackson Target Area, the number of complaints in Jackson County have remained stable while those in Josephine County have been on a slow decline. Cougar mortalities due to damage and human safety/pet conflict have remained relatively stable in both counties.

Table 11. Cougar complaints and mortalities due to damage and human safety/pet conflicts in Jackson and Josephine Counties from 2003-2016. The Jackson Target Area (2007-2009) occurred in Jackson County and was unsuccessful in meeting cougar removal objectives. Josephine County served as a comparison area (control) for assessing impact.

	County	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Complaints	Jackson	116	135	144	138	48	84	67	80	87	62	53	77	60	69
	Josephine	62	96	81	71	53	59	50	61	59	48	26	30	39	23
Damage-Safety Mortalities	Jackson	10	12	9	6	6	7	11	12	5	13	12	14	11	13
	Josephine	1	7	5	2	0	4	3	5	2	3	4	3	1	6

Beulah Target Area

As mentioned in the recommendations section above, the Beulah Target Area continued into 2010 and 10 cougars were taken. Conflict was reduced during the years of target area

implementation, but the duration of reduced conflict following removals in the target area is unclear. Since the implementation of the Beulah Target Area, cougar complaints and conflict mortalities rose two years after removals but then fell to very low numbers (Table 12). The Malheur River Unit served as the control unit for the Beulah Target Area and since the removal effort, complaints have remained low and cougar mortalities due to damage and human safety/pet conflicts have fluctuated. Although complaints and non-hunting mortalities are lower than before target area implementation, to some extent a similar situation occurred in the control unit. Therefore it is difficult to directly attribute the current lack of conflict in the Beulah to the removal effort.

Table 12. Cougar complaints and mortalities due to damage and human safety/pet conflicts in the Beulah and Malheur River Wildlife Management Units (WMU) 2003-2016. The Beulah Target Area (2007-2010) was implemented to address high levels of cougar conflict and was successful in meeting cougar removal objectives. The Malheur River WMU served as a comparison area (control) for assessing impact.

	WMU	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Complaints	Beulah	14	12	6	7	5	2	4	1	2	5	6	4	0	0
	Malheur River	6	1	3	5	6	4	6	1	1	2	0	0	1	1
Damage-Safety Mortalities	Beulah	11	6	5	2	1	0	5	1	2	5	1	3	0	0
	Malheur River	5	0	5	5	2	5	9	0	1	6	1	0	1	4

Heppner Target Area

Following years of decline, the Heppner Target Area saw an immediate increase in elk calf:cow ratios during removals (Table 13). Outside of survey error in 2010, these high ratios continued and remained above the 23 calves: 100 cows threshold for 4 years following target area implementation. Elk calf:cow ratios in recent years appear to now be back to pre target area levels. The Ukiah WMU served as the control unit for this target area and a similar increase in calf:cow ratios was not observed during the years of the Heppner Target Area. A target area was implemented in the Ukiah unit following the Heppner Target Area, so comparisons between the two following removals in Heppner cannot be made.

Table 13. Elk calves per 100 cows ratios for the Heppner and Ukiah Wildlife Management Units (WMU) 2002-2017. The Heppner Target Area (2007-2009) was implemented to improve elk herd recruitment that is due to cougar depredations and was successful in meeting cougar removal objectives. The 2006 Cougar Plan identified 23 calves per 100 cows as a herd minimum threshold before considering cougar removals. The Ukiah WMU served as a comparison area (control) for assessing impact but the WMU experienced a target area treatment from 2009-2013.

WMU	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Heppner	30	27	18	21	17	15	30	29	13	24	29	25	21	22	17	11
Ukiah	30	22	24	19	19	13	16	11	15	13	17	20	23	26	21	19

Summary

The duration of impact following successfully implemented target areas varied. Of those, target area addressing damage (Beulah) saw a small increase in complaints and mortalities followed by

two years of no reported conflicts. Mule deer target areas saw no (Warner) or slow (Steens) improvement in deer populations in the years following implementation. Elk target areas saw the clearest lasting impacts with improvements in calf ratios lasting for 2 (Ukiah) to 4 (Heppner) years following cougar removals.

LITERATURE CITED

Anderson, C.R., and F.G. Lindzey. 2005. Experimental evaluation of population trend and harvest composition in a Wyoming cougar population. Wildlife Society Bulletin 33(1):179-188.

Ashman, D.L.., G.L. Christensen, M.L. Hess, G.K. Tsukamoto, and M.S. Wickersham. 1983. The mountain lion in Nevada. Nevada Dep. Wildl. P-R Proj. W-48-15. 75pp.

Beausoleil, R. A., and D. A. Martorello, editors. 2005. Proceedings of the eighth mountain lion workshop. Washington Department of Fish and Wildlife, Olympia, USA.

Beier, P. 1991. Cougar attacks on humans in the United States and Canada. Wildlife Society Bulletin 19:403–412.

Dawn, D. 2002. Cougar management in the western United States: an analysis of hunting harvest strategies. Thesis, San Jose State University, San Jose, USA.

Edelmann, F. B. 2003. Wintering mule deer ecology in the reservoir reach of the Hells Canyon Hydroelectric Complex. Technical Report E 3.2-32. Idaho Power Company, Boise, Idaho, USA. 194 pp.

Harrison, A. 1989. Predators and prey--a case of imbalance. Forest Research West. June 1989. 5pp.

Hayes, C. L., E. S. Rubin, M. C. Jorgensen, R. A. Botta, and W. M. Boyce. 2000. Mountain lion predation of bighorn sheep in the Peninsular Ranges, California. Journal of Wildlife Management 64:954-959.

Johnson, R. L., and E. Moore. 1992. Oregon elk hunter study. Oregon State University Unpublished Report, Corvallis, Oregon, USA. 53 pp.

Keister, G. P. Jr. and W. A. Van Dyke. 2002. A predictive population model for cougars in Oregon. Northwest Science. 76(1):15-25.

Laundré, J. W., L. Hernandez, D. Streubel, K. Altendorf, and C. L. Gonzalez. 2000. Aging mountain lions using gum line recession. Wildlife Society Bulletin 28(4):963–966.

Lindzey, F.G., W.D. Van Sickle, S. P. Laing, and C.S. Mecham. 1992. Cougar population response to manipulation in southern Utah. Wild. Soc. Bull. 20:224-227.

Mathews, P. E., V. L. Coggins. 1997. Movements and mortality of mule deer in the Wallowa Mountains. Pages 78-88 *in* J. C. deVos, Jr. ed. Proceedings of the 1997 Deer/Elk Workshop. Rio Rico, Arizona. Arizona Game and Fish Department, Phoenix, Arizona,

USA.

Myers, W. L., B. Lyndaker, P. E. Fowler, and W. Moore. 1998. Investigations of calf elk mortalities in southeast Washington: study completion report. Washington Department of Fish and Wildlife, Olympia, Washington, USA.

Oregon Department of Fish and Wildlife. 2003b. Oregon's elk management plan. Salem, Oregon, USA. 58 pp.

Oregon Department of Fish and Wildlife. 2006. Oregon Cougar Management Plan. Salem, Oregon, USA. 135 pp.

Pall, O. 1984. Alberta status report. Pages 1-8 *in* J. Roberson and F. Lindzey, eds. Proc. second mountain lion workshop. Utah Div. Wildl. Resour., Salt Lake City.

Rearden, S. N. 2005. Juvenile survival and birth-site selection of Rocky Mountain elk in northeastern Oregon. Thesis. Oregon State University, Corvallis, Oregon, USA. 105pp.

Runyan, D. 2009. Fishing, Hunting, Wildlife Viewing, and Shell fishing in Oregon, 2008. Dean Runyan Associates, Portland, Oregon, USA. 70 pp.

Shroufe, D. 2006. Western Association of Fish and Wildlife Agencies comment on the Cougar Management Guidelines – first edition. Wildlife Society Bulletin 34:1479.

Trainer, C. E., and G. Matson. 1989. Age determination in cougar from cementum annuli counts of tooth sections (Abstract Only), in R. H. Smith, ed. Proceedings of the Third Mountain Lion Workshop. Prescott, Arizona, USA. 88pp

US Census Bureau. 2005. Oregon Quick Facts. http://quickfacts.census.gov/qfd/states/41000.html. Downloaded 10 May 2005.

US Department of Agriculture. 2007. 2007 Census of agriculture. (http://www.agcensus.usda.gov/Publications/2007/Online_Highlights/County_Profiles/Oregon/cp41045.pdf Downloaded 31 August 2009.

USDA National Agricultural Statistics Service. 2006. Cattle and calf death loss. www.nass.usda.gov/id. Downloaded 31 August 2009.

Wehausen, J. D. 1996. Effects of mountain lion predation on bighorn sheep in the Sierra Nevada and Granite Mountains of California. Wildlife Society Bulletin 24:471-479.

Wilt, D. 1986. Elk herd delineation . Wildlife Research Report Number 16. Oregon Department of Fish and Wildlife. 32 pp.

APPENDIX K: 2009-2013 Cougar Target Area Summaries

STEENS MOUNTAIN TARGET AREA SUMMARY
October 2014

Introduction

The Steens Mountain Cougar Target Area (CTA) was implemented as a result of a recommendation from the Steens Mountain Mule Deer Initiative (MDI) Implementation Team. The Steens deer population has been experiencing a steady decline despite stable fawn recruitment and relatively light buck harvest. The estimated deer population in the Steens decreased from nearly 8,000 in 1990 to less than 4,000 by 2009. The long term (1958-present) average recruitment is 33 fawns per 100 does and the most recent 10 year average is 40 fawns per 100 does. Observed buck ratios have been at or above the management objective (MO) level of 25 buck per 100 does since the mid-1970s. Buck ratios have been maintained above MO primarily though reduction in tag numbers for the controlled rifle season in concert with the declining deer population.

Located in Cougar Management Zone F, Southeast Oregon, the 1,572 mile^2 CTA encompasses the southern portion of the Steens Mountain WMU as well as the southeast corner of the Juniper WMU. The CTA boundary was designed to include the most productive native mule deer habitat in the Steens WMU (Steen Mountain proper) as well as associated high density wintering areas. It is expected that virtually all public mule deer hunting in the Steens Mountain WMU takes place in that portion of the unit encompassed be the target area. The target area is mainly comprised of a mix of public (72%) and private shrub steppe rangelands that range in elevation from 4,000 ft. near the Alvord Desert to over 9,700 ft. near the peak of the mountain. The purpose of the Steens Mountain CTA was to increase mule deer numbers in the unit by increasing adult mule deer survival rates.

Methods

Wildlife Services was contracted to administratively remove up to 20 cougars per year during the 4 year period between 2010 and 2013. One Wildlife Services agent was assigned to the project and cougars were allowed to be taken year round with emphasis between September through May. Hounds were the primary method used to locate cougars, but snares were also used especially in areas where access was limited by terrain or lack of roads.

Variables used to measure deer response included comparison of population estimates between Steens and Trout Creeks using quadrat sampling methodology (Kuefeld, 1980), POP II(Fossil Creek Software) population estimates, deer hunter harvest data, percent adult females cougars taken, and average age of cougars taken.

Results

A total of 60 cougars (34 male, 22 female, 4 Unknown) were administratively removed during the target area implementation (46 on public land and 14 on private). Sport harvest and cougars taken on damage is historically very limited in the Steens. During the period that the CTA was in effect no cougars were taken by either hunters or as the result of damage/human safety (Table 1). Hounds were the primary method for locating cougars with 49 of the 60 being removed with hounds. The other 11 were all taken with snare sets. Trap check requirements, distance to the project area, and high public use all limited use of traps/snares for administrative

removal.

Total cost for Wildlife Services was $65,400.29. This equates to about $1,090 for each of the 60 cougars removed. The cost/cougar remained fairly constant throughout the project, with the highest cost/cougar averaging $1,333 during the final year of the program.
The average age of all cats harvested was 3.23 years. The average age declined for the first 3 years of the project from 3.95 in 2010 to 1.73 in 2012, and then increased to 4.00 in 2013. However, the average age of cougars, not including kittens, was variable and does not appear to indicate a declining age structure (Table 2). The percent of adult females compared to total adults removed was 23% and variable between years, with the highest percent of adult females (30%) taken in the first year of the project (Table 1) .

Hunter success rates have increased and percent yearlings in the harvest have decreased in the Steens WMU since implementation of the CTA (Figure 1). Hunter success rate and percent yearlings harvested in the Trout Creek Mountains has not changed significantly during the past 10 years (Figure 2).

Quadrat sampling was conducted annually during implementation in the Steens Mountain WMU as well as in the Trout Creek portion of the Whitehorse WMU to serve as a control (Table 3). Populations were also monitored with fall composition counts, spring trend and composition surveys and population estimates derived from a POP 2 modeling program (Table 4 and Table 5).

Discussion

The number of cougars removed declined in each of the 4 years of the CTA (20, 18, 15, and 7, respectively 2010-13). Part of the reason for this is that tracking conditions (snow) were favorable for hounds in 2010 and 2011, and snow was very limited during the last two years of the project making hounds less effective. The other reason was cougars seemed to be less abundant. The Wildlife Services Agent reported having more difficulty locating cougars during the final year of the project even when tracking conditions were favorable. This may have also resulted in less effort being put forth in looking for cougars in an effort to spend time/money efficiently.

The quadrat sampling derived population estimate did not show an increasing or decreasing trend in the Steens (Table 3). The technique produced estimates that varied greater that would be expected in the actual population. The primary reasons were the variation in winter conditions that resulted in radically different deer distribution between years and the inherent difficulty in adapting a survey technique to a new area. The most reliable surveys occurred in 2011 and 2012 when deer were concentrated on winter ranges because of good snow pack and fairly well distributed across this winter range, most closely approximating the conditions under which the technique was developed. These two years produced reasonable estimates with the tightest confidence intervals (95% CI +/- 1150 and 979 in 2011 and 2012 respectively). In 2013 conditions were wet and mild so deer were concentrated on green-up which we believe resulted in an over-estimate of the actual population. Also, in 2013 because of changes in protocol, we did not sample any adjacent quadrats. This required us to sample less than 50% of your high strata, which led to a broader confidence interval (95% CI +/- 1669). In 2014 deer were widely scattered and wintering locations extended well onto summer range. We believe this resulted in an under-estimate of the population even though we attempted to expand our strata to allow for the mild conditions.

A multiple data source model was constructed for the Steens Mountain WMU in an effort

to monitor population trends during the CTA. Initial attempts to align the multiple data source model with the quadrat data from the Steens have not been successful. The relatively light buck harvest from the Steens and the observed buck ratio causes the models to produce estimates that are much lower than derived from the quadrat sampling population estimate. Two possible issues are: the deer being sampled during quadrat flights are not representative of the deer being surveyed during fall composition surveys, or adult mortality is much different than what we are using for the model. We intend to place collars on wintering mule deer over the next two winters to ensure deer movements aren't different than expected. Work will continue to try to align the model with the quadrat data.

Current POP II population estimates shown in Tables 4 & 5 indicate that the deer population in the Steens is increasing. The Trout Creeks deer population is also increasing, but at a lower rate. From 2010-2014 the Steens and the Trout Creeks POP II modelled population increased 34% and 20% respectively. The main reasons for the increase, in terms of the model, are the two excellent production years in 2011 and 2012.

Rifle harvest data is probably the clearest indicator that the CTA had a positive impact on the deer population in the Steens Mountain WMU. The number public hunting tags proposed in the Steens (250 tags) and Trout Creeks (50 tags) has remained the same since 2004. Steens hunter success rate from 2004 through 2010 averaged 46%, and the average success rate from 2011-2013 was 53%. In addition, the average percent yearlings in the Steens harvest declined from 37% in 2004-2010 to 25% for 2011-2013 (Figure 1). This indicates that not only are hunters having more success, but they are also killing more mature deer. The Trout Creeks harvest data remained stable during the same time period. Harvest success in the Trout Creeks was 61% from 2004-2010, and 62% from 2011-2013. Yearling bucks in the harvest from 2004-2010 was 14% and 15% from 2011-2013.

Contracting Wildlife Services was the most practical option for implementing the Steens Mountain CTA. There are no qualified Cougar/Bear agents in Harney County and even if there were it would be unreasonable to assume they would be able to spend enough time and effort to have an impact on cougar numbers in the Steens CTA. The average cost of cougars removed ($1,090/cougar) was significant, but less than previous target areas where Wildlife Services was used. ODFW did not assist the Wildlife Services Agent with the removal of cougars so the costs incurred reflect the total actual amount of money to implement the CTA. Distance to the target area (30-120 miles) meant that travel time and mileage accounted for the bulk of the expenses incurred. Because of the distance to the Target Area most work was conducted only when there was an expectation of success in an effort to work efficiently.

The remoteness of the Steens made accessing areas very challenging, especially during winter. Fortunately, Wildlife Services had the equipment, resources, and private landowner contacts to implement the CTA effectively.

Table 1. All cougars taken during implementation of the Steens Mountain Cougar Target Area.

YEAR	Adult* Female n (%)	Adult Male	Sub-adult Female	Sub-adult Male	Kitten	Method of Take			
						Administrative Removal		Sport Harvest	Damage or Other
						Dog	Snare		
2010	6 (30)	10	0	4	0	19	1	0	0
2011	4 (22)	4	3	1	6	11	7	0	0
2012	3 (20)	1	0	4	7	13	2	0	0
2013	1 (14)	4	0	2	0	6	1	0	0
TOTAL	**14 (23)**	**19**	**3**	**11**	**13**	**49**	**11**	**0**	**0**

*Adults are cougars 3 years old and older, sub adults are 1 to 2 years old, kittens are less than 1 year old.

Table 2. Mean age of Cougars taken during implementation of the Steens Mountain Cougar Target Area.

YEAR	All Cougars years (n)	Adults and Sub-adults* years (n)
2010	3.95 (20)	3.95 (20)
2011	3.39 (18)	5.08 (12)
2012	1.73 (15)	3.25 (8)
2013	4.00 (7)	4.00 (7)
Total Average	**3.23**	**4.12**

*Adults are cougars 3 years old and older, sub-adults are 1 to 2 years old, kittens are less than 1 year old.

Table 3. Mule deer population estimates using Quadrat "Sampling for the Steens Mountain WMU (treatment) and Trout Creeks Hunt Area (control) during implementation of the Steens Mountain CTA.

	Steens				Trout Creeks		
YEAR	Population Estimate	95% CI	Standard Deviation		Population Estimate	95% CI	Standard Deviation
2010	6379	2992-9766	1728		818	-136-1772	487
2011	4306	3156-5456	587		997	438-1556	285
2012	4523	3544-5502	500		617	320-914	151
2013	6769	5100-7938	851		901	323-1479	295
2014	4377	3227-5527	586		875	422-1328	231

Table 4. Mule deer buck ratios, fawn ratios, and population estimates for the Steens Mountain WMU.

YEAR	Bucks/100 Does	Spring Fawns/100 AD	POP II Estimate	Quadrat Estimates
2007	47	21	4296	
2008	29	15	3840	
2009	28	24	3728	
2010	37	33	3929	6379
2011	27	43	4375	4306
2012	27	40	4843	4523
2013	35	21	4957	6769
2014	31	29	5257	4377

Table 5. Mule deer buck ratios, fawn ratios, and population estimates for the Trout Creeks WMU.

YEAR	Bucks/100 Does	Spring Fawns/100 AD	POP II Estimate	Quadrat Estimates
2007	24	28	1156	
2008	30	11	996	
2009	15	26	966	
2010	44	31	964	818
2011	37	40	1069	997
2012	55	37	1174	617
2013	51	21	1127	901
2014	57	27	1157	875

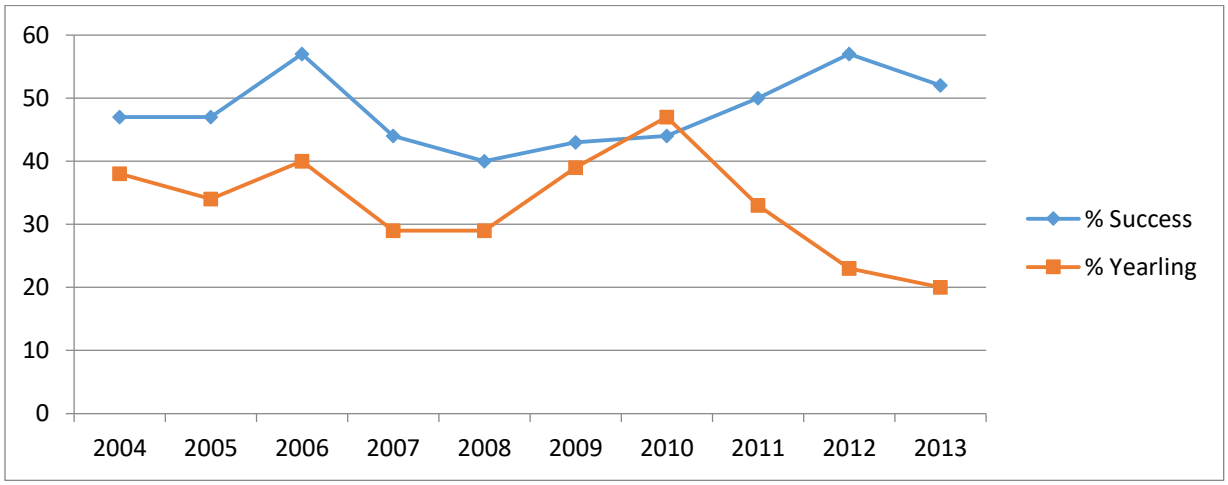

Figure 1. Buck rifle hunter success and percentage yearlings in the harvest in Steens Mountain WMU.

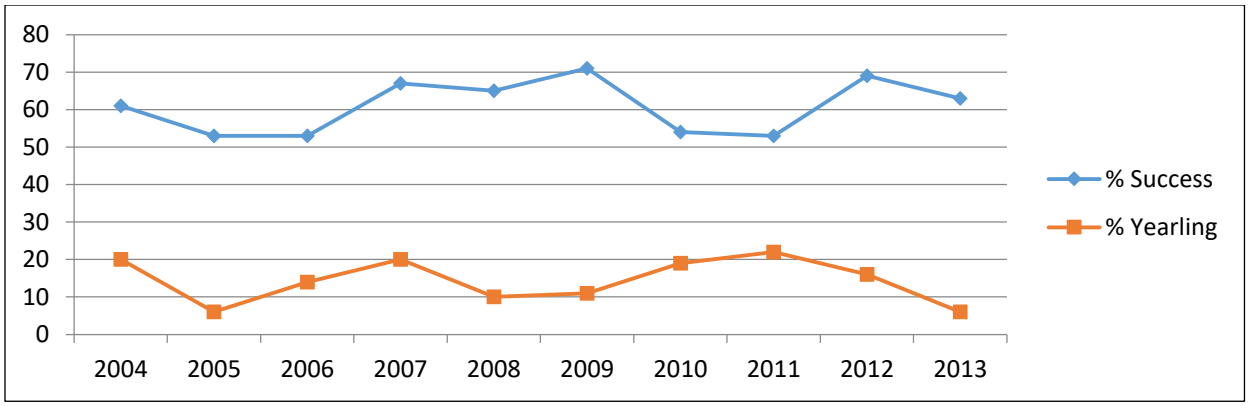

Figure 2. Buck rifle hunter success and percentage yearlings in the harvest in Trout Creeks Hunt Area.

2017 Steens Update

Deer population estimates calculated using POP II models have continued however sampling using quadrat techniques have not. Based on POP II models, deer populations in the Steens Mountain WMU increased during cougar removals but have been relatively stagnant since that time and remain below management objectives (MO in 2017 was 8,000) (Table 6). Deer populations in the Trout Creek Mountains of the Whitehorse WMU have remained stable following target area implementation (2010-2013).

Table 6. Deer population estimates from POPII modeling and Quadrat sampling for the Steens Mt WMU and Trout Creek Mountains. Steens Mt Target Area implementation occurred from 2010-2013 and 2016-present.

	Steens Mountain WMU		Trout Creek Mts	
Year	POPII Population	Quadrat	POPII Population	Quadrat
2007	4296		1156	
2008	3840		996	
2009	3728		966	
2010	3929	6379	964	818
2011	4375	4306	1069	997
2012	4843	4523	1174	617
2013	4957	6769	1127	901
2014	5257	4377	1157	875
2015	5211		1251	
2016	5300		1250	
2017	5200		1250	

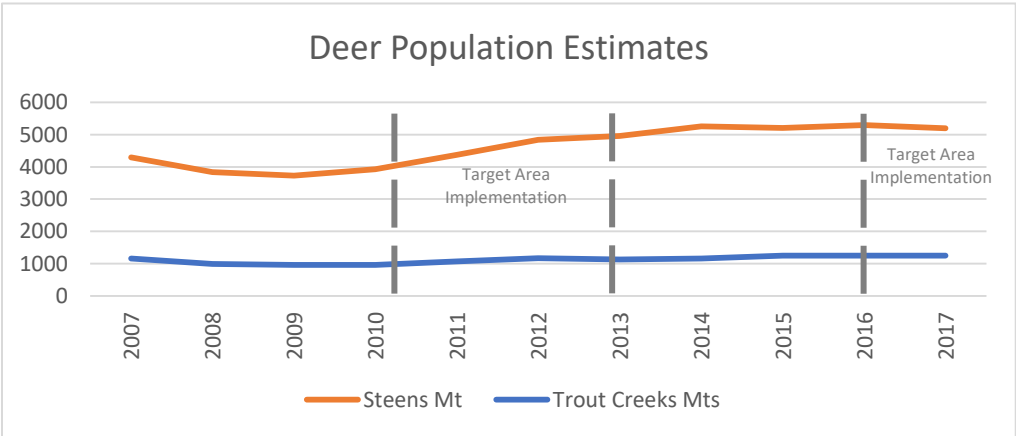

Figure 3. Deer population estimates using POPII models for the Steens Mt WMU and Trout Creek Mts. Steens Mt Target Area implementation occurred from 2010-2013 and 2016-present.

UKIAH TARGET AREA SUMMARY

July 2017

Introduction

The Ukiah Unit Cougar Target Area (Ukiah CTA) was implemented in the fall of 2009 for an improvement in elk calf recruitment. Prior to initiating the Ukiah CTA, the ratio of calves:100 cows had been below 23:100 since 2005 (5 years) and the elk population had been below management objective since 2004 (6 years). Located in Cougar Management Zone E of Northeast Oregon, the 874 mile^2 Ukiah CTA encompassed the entire Ukiah WMU. The Mt Emily WMU will serve as a control area to evaluate the effectiveness of the Ukiah Target Area.

Methods

Wildlife Services (WS), two ODFW Technicians, and three cougar agents were primarily responsible for removing cougars within the Ukiah CTA. In addition to this, public hunters contributed sport harvest of cougars within this area as well. The most successful method of removal was with the use of hounds by both WS and cougar agents when snow cover was sufficient to allow for identifying cougar activity. Also utilized in the removal effort were traps and snares. Traps were typically utilized by ODFW district employees. Traps were useful in certain situations, but were limited due to the need to visually check traps every 48 hours. Traps were typically used at times when they could be checked during other routine ODFW district or target area work duties.

Due to the Ukiah CTA being composed of 65% private property, a "Cooperative Agreement For Cougar Target Area Management On Private Lands" agreement was sent to nearly 350 private landowners. Response rate for allowing Ukiah CTA activities on private land was about 40%. Of particular interest were lands bordering federal and state lands where if hounds started trailing a cougar on public land it was invaluable to have the ability to access private lands to complete target area activities.

Results

Cougar removal occurred for 5 continuous field seasons (field season being defined as June 1-May 31) beginning in the fall of 2009 through the end of 2013. Total administrative removals were 94 cougars (Table 1). During this same time public hunters harvested 32 cougars and WS removed 1 damage cougar within the Ukiah CTA contributing to a total of 127 cougars removed.

The sex of cougars taken in the target area was slightly biased towards males with 54 percent of the cougars being male and 46 percent female. In addition, 1.6 percent of the harvested cougars were of unknown gender (Table 2).

Cost of implementing and conducting cougar removal in the Ukiah CTA administratively for 5 field seasons was $69,909 ($13,982/season). Total price per cougar was $774.

Data showing ratios of spring calves:100cows is probably the clearest indicator that the Ukiah UTA had a positive impact on calf recruitment. Since 1991, calf ratios in the Ukiah BGMU were steadily declining from a high of 46 in 1991 down to 11 in 2009 (Figure 1). In 2012, the third full year of the CTA, calf ratios began to trending in a positive direction, steadily increasing to 26 in 2015. At the same time, the Mt Emily WMU served as a control for comparison and in that unit, calf ratios remained stable (Table 3).

It is likely that the improvement in calf ratios in the Ukiah Target Area was much greater than what was measured. Multiple elk herds, some from outside the target area, congregated on the same winter range in the target area. Herd surveys are conducted on winter range and the mixing of herds can affect the ability to measure the effectiveness of an implemented target area. An increase in calf ratios was observed but was likely diluted due to the presence of the other herds with poor calf ratios.

Summary

- CTA removal work began in the fall of 2009.
- Total cougars removed during implementation was 127.
- Administratively removed 94 cougars (WS 41, ODFW 35, and Agents 18)
- Sport harvest contributed an additional 32 cougars
- WS removed 1 cougar on a damage complaint.
- Three-year average calf ratio prior to the CTA implementation was 16 calves/100 cows and at the conclusion was 23 calves/100 cows.

Table 1. Administrative removals by source.

Field Season	ODFW Employees	Agents	WS	**Total**
2009-10	14	5	4	**23**
2010-11	14	9	17	**40**
2011-12	6	0	6	**12**
2012-13	0	3	8	**11**
2013-14	1	1	6	**8**
Total	**35**	**18**	**41**	**94**

Table 2. Total removals (admin and public) by sex.

Field Season	Male	Female	Unknown	**Total**
2009-10	17	21	2	**40**
2010-11	24	25	0	**49**
2011-12	11	5	0	**16**
2012-13	11	1	0	**12**
2013-14	5	5	0	**10**
Total	**68**	**57**	**2**	**127**

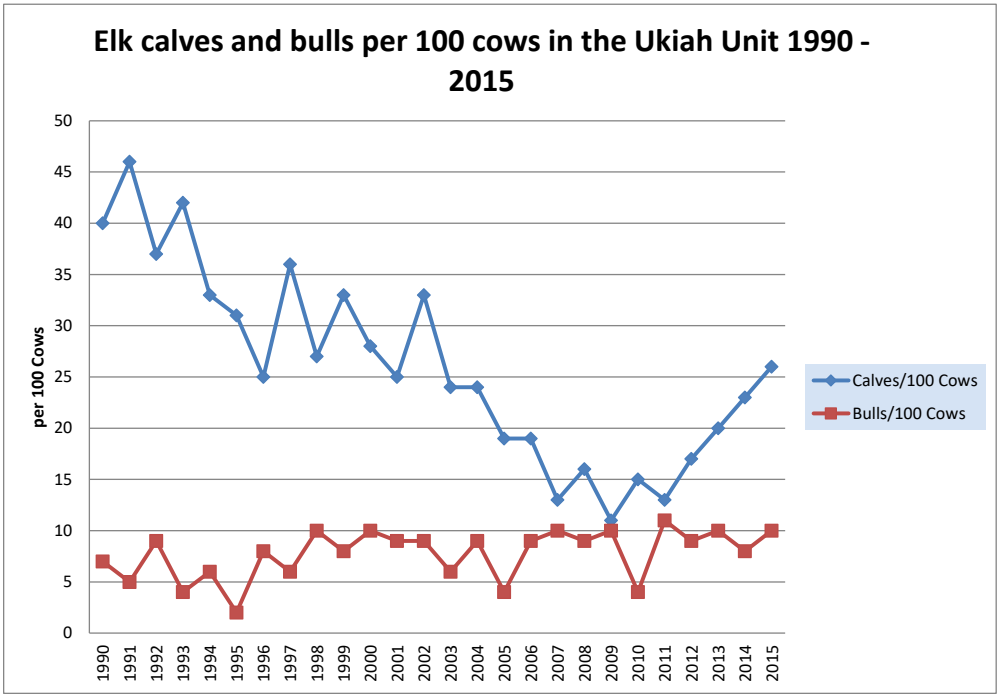

Figure 1. Ukiah BGMU calves/100 cow elk 1990-2015.

2017 Ukiah Update

Following implementation, calf ratios in the Ukiah Target Area (2009-2013) continued to increase for two years (Table 3, Figure 2). In the last two years (2016 and 2017), ratios have been on a decline. The Mt Emily WMU (control area) saw an increase in calf ratios in 2014 but has been on a decline ever since.

Table 3. Elk calves per 100 cows ratios for the Ukiah and Mt Emily Wildlife Management Units (WMU) 2002-2017. The Ukiah Target Area (2009-2013) was implemented to improve elk herd recruitment and was successful in meeting cougar removal objectives. The Mt Emily WMU served as a comparison area (control) for assessing impact.

WMU	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Ukiah	13	16	11	15	13	17	20	23	26	21	19
Mt Emily	15	14	15	10	16	13	13	18	16	15	12

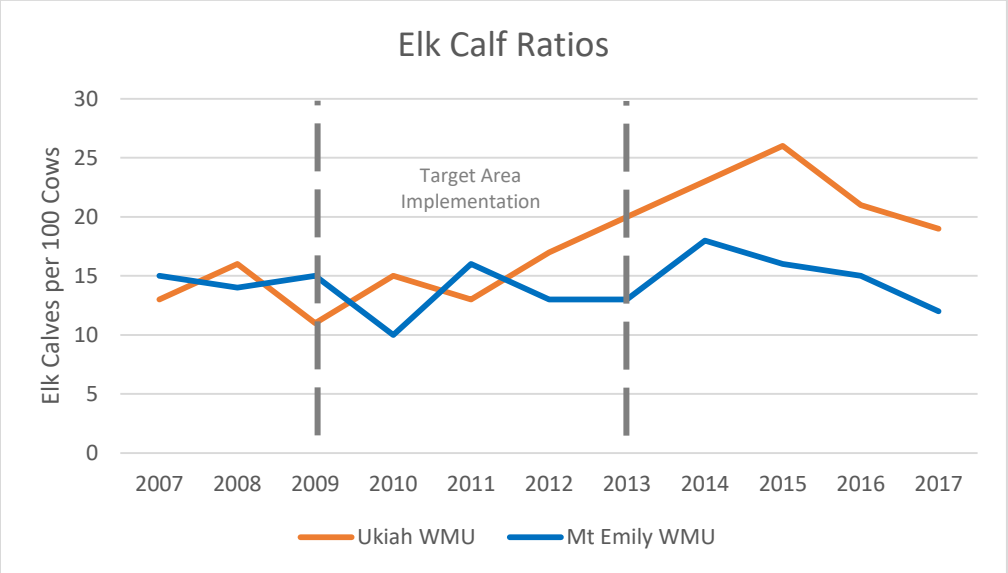

Figure 2. Elk calf ratios for the Ukiah and Mt Emily WMUs. The Ukiah Target Area implementation occurred from 2009-2013.

WARNER COUGAR TARGET AREA SUMMARY
October 2014

Introduction

In 2008, Oregon Department of Fish and Wildlife (Department) started the Oregon Mule Deer Initiative (MDI). The goal of MDI was to implement various methods to increase mule deer populations in Oregon. Five wildlife management units (WMU) were selected and individual implementation teams were set up to review information and identify actions which could be completed to increase mule deer numbers. In general the possible actions included: Habitat Improvement, Predator Control, Modification of Hunting Seasons, and Improved Enforcement.

Cougar target areas were developed in the Oregon Cougar Management Plan (2006) with the goal of reducing livestock damage, reducing human safety conflicts or improving big game populations. Target areas may include one or more WMU's, or be a smaller area within a WMU depending on the conflict being addressed. All target areas have a stated purpose, defined monitoring criteria and are generally in effect for 3 years. The number of cougars to be taken is determined by estimating the number of cougars in the area using the specific Oregon Cougar Management Zone Model, setting a desired population for the area then determining the cougar that need to be taken to meet the desired population.

In September 2009 Warner was selected as an MDI unit and also as one of two units for a cougar target area. Warner is located in Lake County and falls within Cougar Management Zone F. The unit is 923 mi^2, of which approximately 1/3 is forested habitat and 2/3 is shrub steppe (Fig. 1). Approximately half of the shrub steppe habitat is low sagebrush which does not provide habitat for mule deer or cougars.

The purpose of the Warner Cougar Target Area was to increase mule deer numbers in the unit by reducing cougar predation rates and thereby increase adult and fawn survival. Deer populations in the Interstate WMU would serve as a control to compare target area results.

Methods

The target number of cougars to be administratively removed was set at 14 per year for 3 years, and we proposed a maintenance target of 7 cougar per year for 2 additional years. This would be in addition to any sport harvest or take resulting from damage response. This number was determined using the Zone F cougar model to estimate the cougar population in 2008 (~ 862) and the desired level which occurred in the year 2000 (~ 600). Those values were scaled down to the unit level based on the proportion of Zone F that includes Warner, and the estimated cougar density by area within the unit. The 2008 Warner cougar population was estimated to be 58 with a desired population of 44. Accounting for recruitment we calculated that 42 cougars would need to be administratively removed from the unit over the 3 years of target area implementation.

We intended to administratively remove cougars using hounds and traps. Lake County does not have a Wildlife Services program; therefore we proposed using 2 Department appointed Cougar/Bear Agents for implementation of the target area. Agents volunteer their time and dogs, the Department provides traps and trapping supplies. Because of the time and travel required to implement a target area we reimbursed agents for mileage, use of ATV's, increased costs of maintaining dogs and we covered a portion of any veterinarian bills incurred. Department staff assisted the agents when time allowed and completed some of the trapping activities. Staff

expenses were not added into target area costs.

Monitoring criteria for the target area included: Cougar mortalities; Damage and human safety/pet complaints by year; Cougar population trend within the Zone based on model output; Percent adult females in the harvest; average age of harvested cougars; and Mule deer population estimates using quadrat sampling methodology (Kuefeld, 1980).

Results

During target area implementation 28 cougars were removed administratively and 24 by sport hunters or in response to damage (Table 1). At the end of the 3 year operation period Wildlife Division approved one additional year of full operation rather than 2 additional years of maintenance removal.

The assumption that 2 agents would be adequate to implement the target area proved to be incorrect, and by year 4 of implementation we had 5 agents signed up. Only 1 of the 5 was dedicated to running cougars when conditions were best and he caught 21 of the 25 cougars taken using hounds (Table 1). Cougar/Bear agents must meet rigorous requirements and be approved for service by the district biologist. As a result of the requirements all the agents had full time jobs, families and usually other activities which required some of their time. Snow conditions in Warner over the 4 years of implementation were highly variable and the agents we had signed up weren't always available when conditions were best. Part of that was due to the requirements of their full time jobs and family. However, some of the best hound hunting conditions occurred during bobcat season or when coyote fur was prime, and several of the agents were trapping coyotes or hunting bobcats instead of cougars.

Total costs for Warner target area implementation equaled $12,896.00. Of that amount $5098 was paid for by the Josephine County Chapter of OHA. For the 28 cougars administratively removed the costs came to $460.57/cougar.

The Warner unit has not had numerous cougar complaints, but during implementation of the target area complaints declined (Table 2). There was no appreciable change in the Zone F cougar population estimate during the years of implementation. Prior to 2006 the model showed a steadily increasing cougar population, and since 2006 the population has been stable at approximately 800 cougars. Since Warner is less than 4% of the area in Zone F it is not surprising that the number of cougars removed did not affect the zone population estimate. The percent of adult females harvest by all methods equaled 31% and was variable between years (Table 1). Average age of cougars harvested also was variable and did not show a declining trend during years of implementation (Table 3).

Monitoring criteria for mule deer included annual population estimates based on quadrat sampling (Table 4) along with post season buck and spring fawn ratios (Table 5). Prior to Oregon's MDI and the Warner target area mule deer numbers in the unit were monitored with fall composition counts, spring trend and composition counts and development of a population model using the POP II program. Table 6 presents POP 2 model output for the biological years of target area implementation (2009 – 2013).

Discussion

The purpose for the target area was to increase mule deer numbers by increasing adult survival and fawn recruitment. The quadrat based mule deer population estimates did not show an increasing trend in deer numbers (Table 4). Part of this was due to highly variable winter conditions over the 5 years of quadrat sampling. During the first year (2010) we were learning

how to apply the technique and made numerous mistakes in stratifying deer densities across the winter range. The winters of 2013 and 2014 were very mild. In 2013 we had spring green up conditions occur between the time of stratification and sampling, which changed deer distribution and we believe resulted in an over-estimation, and in 2014 a portion of the population was still on summer range during the February sampling period which resulted in an under-estimation. 2011 and 2012 were the only two sampling years with consistent deer distribution and stratification. The fact that fawn ratios were at or below maintenance levels and deer numbers did not decline between those years indicate that cougar removal did affect deer numbers.

POP II data presented in Table 6 indicates that implementation of the cougar target area improved post season buck ratios and at the very least kept the mule deer population stable rather than decreasing. Based on observed fawn ratios and harvest POP II model output shows a declining population and post season buck ratio. Observed post season buck ratios increased during the model years, as did the age of bucks in the harvest. Although population estimates based on quadrat sampling are variable they indicate that the mule deer population in Warner is at the least stable, and not declining as indicated in the POP 2 modelled population estimate.

Rifle harvest data is probably the clearest indicator that the target area had a positive impact on the deer population in the Warner. Hunter numbers in the north and south Warner hunt areas averaged 88 and 249 respectively from 2004 – 2010; and 53 and 200 from 2011 – 2013. Percent hunter success for Warner increased with 51% north and 33% south from 2004 – 2010; and 67% and 49% respectively from 2011 – 2013. Percent yearling bucks in the harvest also declined with 37% north and 63% south from 2004 – 2010; and 18% and 51% respectively from 2011 – 2013. This indicates that not only are hunters having more success, but they are also harvesting more mature bucks. Interstate harvest data did not change substantially during the time period. Average hunter numbers in Interstate was 1351 from 2004 -2010 and 1431 from 2011 – 2013. Average hunter success was 44% and 47% respectively and yearling bucks harvested averaged 54% and 51% respectively.

During the last 2 years of implementation hunters and non-consumptive users of the unit consistently reported seeing more deer than they were used to seeing. In the case of hunters, that included seeing more and bigger bucks. Although these reports are circumstantial most of them came from individuals that have recreated in the unit for years. These reports indicate that all the activities implemented through the Warner MDI have positively affected mule deer in the unit.

Application of quadrat sampling along with some information gathered through the south central mule deer research indicated that the deer wintering within the Warner Unit in the vicinity of Valley Falls may not summer in the unit. This is a substantial amount of the end of winter Warner deer population. If these deer are summering in Interstate it would explain why we haven't been able to increase tag numbers to a level appropriate for a population of ~2500 deer and still meet post season buck MO's. Over the next 2 years we intend to mark a sample of the deer wintering in the vicinity of Valley Falls and determine where they summer.

The use of Cougar/Bear agents was successful and less expensive than contracting with Wildlife Services or hiring temporary employees. Because most agents have full time jobs and families it is unreasonable to assume one or two individuals can take enough cougars to meet a target set for an entire management unit. We would use agents again on another target area, however this method is not without its challenges.

1. Warner has a substantial amount of private land interspersed with public and when we started implementation we were concerned with agents running cougars on land without

permission. For that reason we started with only one agent that had permission throughout the unit and then added one more that also had permission. As we added agents we made it their responsibility to contact landowners and secure permission, and told them that we would cancel their agent status if we received a landowner complaint. We did not receive any landowner complaints, but that requirement affected where some of the agents attempted to find cougars.

2. Our success was definitely impacted by variable snow conditions between winters coupled with some of the agents desire to prioritize bobcats or coyote trapping when we needed them running cougars. If we get the opportunity to do another target area we need to give each agent a small annual quota of cougars in order to get them working at the appropriate time, e.g. each agent has to catch at least 2 cougars every winter or they won't be authorized for the target area next year.

Table 1. All cougars taken during implementation of the Warner Cougar Target Area.

					Method Of Take			
					Administrative	Removal		
YEAR	Adult Female n(%)	Adult Male	Yearling Female	Yearling Male	Dog	Trap	Sport Harvest	Damage or Other
2009	1(11)	5	2	1	1		5	3
2010	3(27)	3	4	1	8		2	1
2011	3(30)	1	2	4	2	2	5	1
2012	8(50)	6	2		12		3	1
2013	1(20)	2	1		2	1	2	
TOTAL	**16(31)**	**17**	**11**	**6**	**25**	**3**	**17**	**7**

Table 2. Cougar complaints in the Warner WMU prior to and during implementation of the Warner Cougar Target Area.

Year	Livestock	Human Safety/Pet	Total
2007	3	3	6
2008	2	1	3
2009	1	3	4
2010	1	2	3
2011	1		1
2012		1	1
2013			0

Table 3. Mean age of cougars taken during implementation of the Warner Cougar Target Area

Year	Admin years(n)	Hunt years(n)	Damage/Other years(n)	**Total years(n)**
2009	2.0(1)	5.0(6)	3.0(2)	**3.8(9)**
2010	3.9(8)	3.5(2)	0.0(1)	**3.5(11)**
2011	3.8(4)	2.4(5)	2.0(1)	**2.9(10)**
2012	4.9(10)	3.7(3)	0(1)	**4.6(14)**
2013	1.7(3)	4.0(2)		**2.6(5)**

Table 4. Mule deer population estimate and Confidence Interval (CI) using Quadrat Sampling for the Warner (treatment) Interstate (control) WMU's during implementation of the Warner Cougar Target Area.

	Warner				Interstate		
YEAR	Population Estimate	95% CI	Standard Deviation		Population Estimate	95% CI	Standard Deviation
2010	3157	2247-4067	464		4718	3190-6247	780
2011	2468	2067-2869	205		4061	3430-4691	321
2012	2464	1774-3155	352		4104	3191	466
2013	3814	2706-4921	565		5538	4405-6670	578
2014	1986	1424-2547	286		3815	2868-4762	483

Table 5. Mule deer buck and fawn ratios Warner WMU prior to and during implementation of the Warner Cougar Target Area.

Year	Bucks/100 Does		Unit Total Spring Fawns/100 Adults
	North	South	
2007	25	18	24
2008	11	18	14
2009	24	13	34
2010	24	24	23
2011	15	40	38
2012	27	29	31
2013	28	21	28
2014	29	26	27

Table 6. POP II model output and observed values for mule deer in the Warner WMU during biological years of cougar target area implementation 2009 – 2013.

Year	Simulated Population	Simulated Post Season Buck Ratios	Observed Post Season Buck Ratios	Simulated and Observed End of Bio Year Fawn Ratios
2009	1574	24	24	23
2010	1459	21	16	38
2011	1488	20	23	33
2012	1337	16	25	28
2013	1246	8	27	27

2017 Warner Update

Deer population estimates calculated using POP II models have continued however sampling using quadrat techniques have not. Based on POP II models, deer populations in the Warner WMU have fluctuated following target area implementation and remain below management objectives (MO in 2017 was 5,500) (Table 7). Deer populations in the Interstate WMU have mirrored the fluctuations observed in the Warner WMU following target area implementation and a target area was implemented in that WMU starting in 2016.

Table 6. Deer population estimates from POPII modeling for the Warner and Interstate WMU. Warner Target Area implementation occurred from 2010-2013 and 2016-present. The Interstate WMU served as a control area for the Warner Target Area but a target area was implemented in the Interstate WMU starting in 2016.

WMU	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Warner	2,270	1,036	2,958	2,389	3,157	2,468	3,814	1,986	2,756	3,997	4,000
Interstate	6,685	5,841	6,100	5,850	5,675	4,061	5,538	3,816	4,472	4,700	6,520

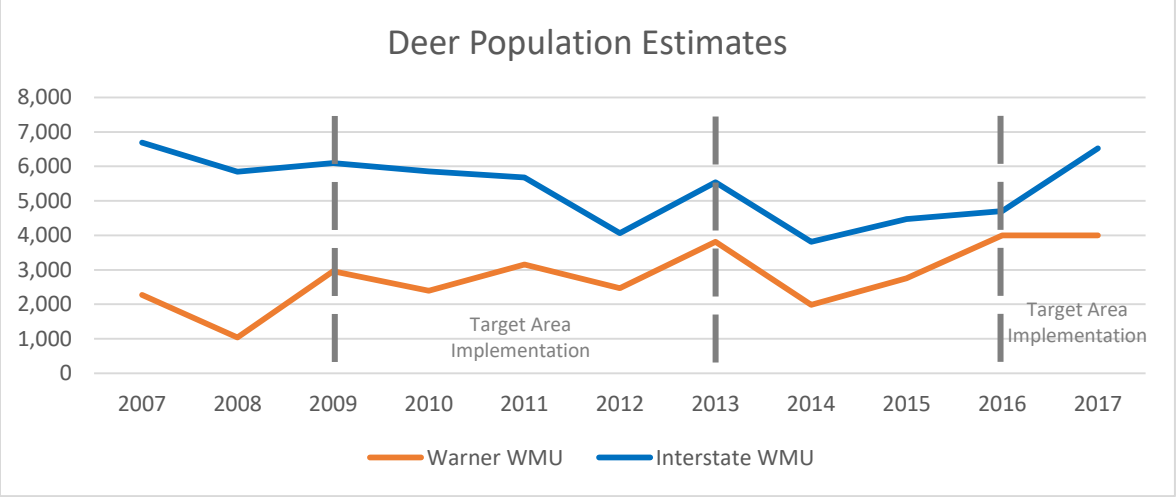

Figure 1. Deer population estimates using POPII models for the Warner and Interstate WMUs. The Warner Target Area implementation occurred from 2009-2013 and 2016-present. The Interstate WMU served as a control area for the Warner Target Area but a target area was implemented in the Interstate WMU starting in 2016.

WENAHA UNIT COUGAR TARGET AREA SUMMARY
October 2014

General Overview

The Wenaha Unit Cougar Target Area encompasses all of the Wenaha Unit south of the Wenaha River, and includes land in Umatilla, Union, and Wallowa counties. The total target area encompasses 420 sq. miles. During the first year of implementation (January 2010 – December 2010) we attempted to remove 20 cougars from the target area and were successful in removing 11. We had only 2 volunteer hound men as agents in 2010, and due to agent work schedules and other logistical issues we were not able to reach our target for cougar removal. During 2011 we again attempted to remove 20 cougars from the target area and we were able to remove 19. We attempted to administratively remove 20 cougars from the target area during 2012 but we were only able to remove 15. Because of the slow start in 2010 we extended the duration of the Target Area through 2013. During 2013 we again attempted to remove 20 cougars from the target area and we were able to remove 11 cougars. From 2011 – 2013 we had 5 volunteer hound men as agents assisting with cougar removal.

Cougar Removal Results

During the first year of implementation of the Target Area (2010), we achieved a removal rate of 2.6 cougars removed per 100 square miles. Eight of the eleven cougars (73%) removed were from the Lookingglass area, two were from Eden Bench, and one was from the area north of Elgin. Eight of the eleven cougars removed were females and three were males (Figure 1).

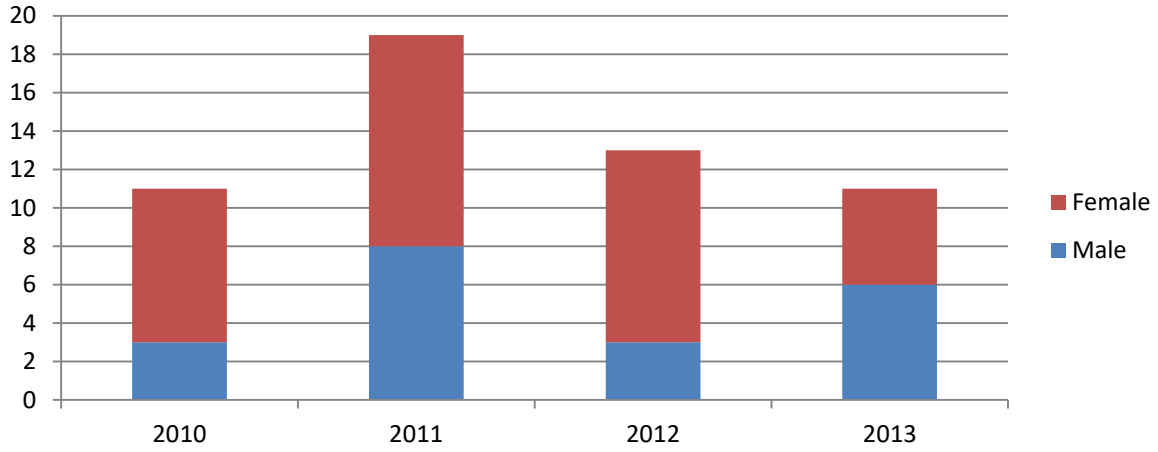

Figure 1. Number of male and female cougars removed from the Wenaha Target Area, 2010-2013.

The ages of the cougars from tooth analysis ranged from 1 to 7 years of age with a mean age of 3.6 years (Figure 2). Three of the cougars were in the 1-2 year old range, 7 ranged from 3-7 years of age, and for one the age was not determined. There were two 3+ year old females that were removed from the target area which corresponded to 18% of the total removal. The mean age of adult females removed was 6.5 years. Two of the cougars were caught in April, one in August, and eight in November or December. During the same time period in 2010, hunters harvested three cougars inside the target area boundary. One of the cougars was a female and two were males. Two of the cougars were 1-3 years of age, one was 4 years of age. None of the

three cougars were 3+ year old females corresponding to 0% of the harvest. The one female harvested was 1 year of age.

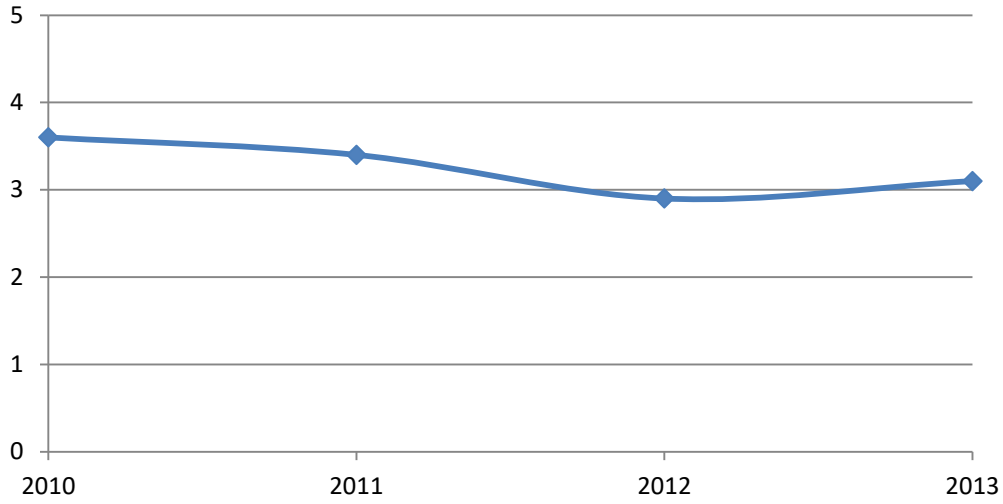

Figure 2. Mean age of cougars removed from the Wenaha Target Area, 2010-2013.

During 2011, we achieved a removal rate of 4.5 cougars removed per 100 square miles. Fifteen of the 19 cougars (79%) removed were from the Lookingglass area, 3 were from Eden Bench, and 1 was from the area north of Elgin. Eleven of the 19 cougars removed were females and 8 were males (Figure 1). Nine of the cougars taken were adults, 6 were sub-adults, and 4 were young of the year. The ages of the cougars from tooth analysis ranged from zero to nine years of age with a mean age of 3.4 years (Figure 2). Nine of the cougars were in the 0-2 year old range, ten ranged from 3-9 years of age. There were six 3+ year old females removed from the target area which corresponds to 32% of the total harvest. The mean age of all adult females removed was 6.5 years of age. Ten cougars were taken on public land and nine were removed from private property. Seven of the cougars removed were caught in January or February, four were caught in April, June, or August, with the remaining seven cougars caught in November or December. During 2011, hunters harvested five cougars inside the target area boundary. Four of those cougars were females and one was a male. All five of the cougars were 1-3 years of age. One of the five cougars was a 3+ year old female corresponding to 20% of the total harvest. The mean age of the eight females harvested was 2 years of age.

During 2012, we achieved a removal rate of 3.6 cougars removed per 100 square miles. Eight of the 15 cougars (53%) removed were from the Lookingglass area, 2 were from Eden Bench, and 5 were from the area north of Elgin. Ten of those cougars were females, 3 were males, and 2 were of unknown sex (Figure 1). Seven of the cougars were adults, 6 of them were sub-adults, and 2 were of unknown age. The ages of the cougars from tooth analysis ranged from zero to nine years of age with a mean age of 2.9 years (Figure 2). Six of the cougars were in the 0-2 year old range, and seven ranged from 3-9 years of age. There were four 3+ year old females removed from the target area which corresponds to 27% of the total harvest. The mean age of all adult females removed was 3.8 years of age. Seven cougars were taken on public land and eight were removed from private property. Four of the cougars removed were caught in January, 4 in March, 1 each in April and May, and 5 were caught in December. During 2012,

hunters harvested six cougars inside the target area boundary. One of those cougars was female and 5 were males. All six of the cougars were 3-6 years of age. One of the six cougars was a 3+ year old female corresponding to 17% of the total harvest. The age of the female harvested was 5 years.

During the fourth year of implementation of the Target Area, we achieved a removal rate of 2.6 cougars removed per 100 square miles. Six of the 11 cougars (54%) removed were from the Lookingglass area, 4 were from Eden Bench, and 1 was from the area north of Elgin. Five of the 11 cougars were females and six were males (Figure 1). Four of the cougars were adults, six of them were sub adults, and one was of unknown age. The ages of the cougars from tooth analysis ranged from one to eight years of age with a mean age of 3.1 years (Figure 2). Six of the cougars were in the 0-2 year old range, and four ranged from 3-8 years of age. There were no 3+ year old females removed from the target area. Five cougars were taken on public land and six were removed from private property. Five of the cougars removed were caught in January or February, one in May, and 5 were caught in November or December. During 2012, hunters harvested three cougars inside the target area boundary. One of those cougars was female and 2 were males. One of the cougars was an adult, and two of the cougars were sub-adults. None of the three cougars was a 3+ year old female.

Ungulate Population Results

After each of the treatment years we surveyed the elk and deer populations in the treated unit as well as a control unit (Mt Emily WMU) to determine if treatment resulted in a positive response in the number of young per 100 adult females as well as an increase in population index. Our objective is to raise the elk calf ratio in the target area to 31-35 calves/100 cows. This was the average calf ratio for the Zone in 1994 and is the objective outlined in the Cougar Management Plan. Our objective for the deer population is to increase the population to our management objective as outlined in the Cougar Management Plan.

The South Wenaha Unit elk population has been below established population management objective (MO) since 1980 and is currently at 51% of MO and was unchanged from before the Target Area treatment began. The South Wenaha elk calf ratio was similar before and after treatment, however an increase in calf ratios during the first 2 years of the experiment was observed (Table 1).

Table 1. Spring Elk Calf Ratios (calves:100cows) for the Wenaha Target Area and Mt Emily WMU

Year	Wenaha Target Area Calf Ratio	Mt Emily WMU Calf Ratio
2007-2009 average	13	15
2010	27	10
2011	21	16
2012	15	13
2013	13	13

There was no apparent relationship between cougar removals and elk calf ratios in the Wenaha Target Area. Similarly, elk populations in the South Wenaha Target Area remained stable or slightly declined during this time. Elk calf ratios in the Mt Emily WMU fluctuated slightly during that time from 10 calves per 100 cows in 2010 to 13 calves per 100 cows in 2013.

The mule deer herd in the South Wenaha Unit remains well below MO and is currently at 69% of our desired population. The population in 2009 was 72% of MO or approximately 2,900 deer. The population in 2013 was approximately 2,750 deer. The spring fawn ratio for the target area was similar before and after treatment (Table 2).

Table 2. Spring mule deer fawn ratios for the Wenaha Target Area

Year	Wenaha Target Area Fawn Ratio
2013	48
2012	51
2011	62
2010	54
2007-2009 average	47

While there was a tendency for mule deer fawn ratios to be higher in years when more cougars were removed from the Wenaha Target Area (Figure 4), the relationship was not significant ($F=3.44$, $P=0.20$, $n=4$) and was primarily driven by the one year when cougar removals approached our desired target number of 20.

Discussion

The administrative removal that was completed does not appear to have had the desired effect on elk in the target area due to inability to remove cougars in focal areas. The objective that is outlined in the cougar plan was to raise the elk calf ratio to 31 -35 calves per 100 cows. While we were initially able to raise our calf ratio to 27 calves per 100 cows, but by the end it was back to 13 calves per 100 cows, thus there was no discernable effect of cougar removals on either elk calf ratios or total population size.

The mule deer in the Wenaha Target Area have not shown a significant response to the cougar removals over the four years of this project. During this time the mule deer population estimates for Wenaha fluctuated at around 70% of our management objective and were not related to the number of cougars removed.

Because we were unable to remove the number of cougars desired in any of the 4 years of the project and only came close to that number in one of the four years, it is possible that we did not reach the threshold of cougar removals needed to affect mule deer and elk populations. However, it is also possible that other ecological factors (e.g. other predators, weather, forage quality and quantity) had a greater impact on mule deer and elk numbers during these years and masked a small effect of cougar removal. Finally, we were limited by the number of agents authorized to catch cougars and those that we did use were located near Elgin and La Grande, thus most of the removals occurred in the southern portions of the Wenaha Target Area while most of the elk winter in the northeastern part of the area. This bias limited the effectiveness of the cougar removals. Indeed, the very slight decline in age of cougars removed suggested that we were not significantly impacting the cougar population.

2017 Wenaha Update

The Wenaha Target Area was unsuccessful in meeting removal objectives, both in number and location. Following implementation, calf ratios in the target area (2010-2013) have fluctuated between 11 and 27 calves per 100 cows (Table 3, Figure 3). No ratios are available for 2014, but

ratios have been on a decline since 2015. The Mt Emily WMU (control area) saw a small increase in calf ratios in 2014 but has been on a decline ever since.

Table 3. Elk calves per 100 cows ratios for the Wenaha and Mt Emily Wildlife Management Units (WMU) 2007-2017. The Wenaha Target Area (2010-2013) was implemented to improve elk herd recruitment and was unsuccessful in meeting cougar removal objectives. The Mt Emily WMU served as a comparison area (control) for assessing impact.

WMU	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Wenaha	13	16	18	26	14	13	17	NA	27	24	11
Mt Emily	15	14	15	10	16	13	13	18	16	15	12

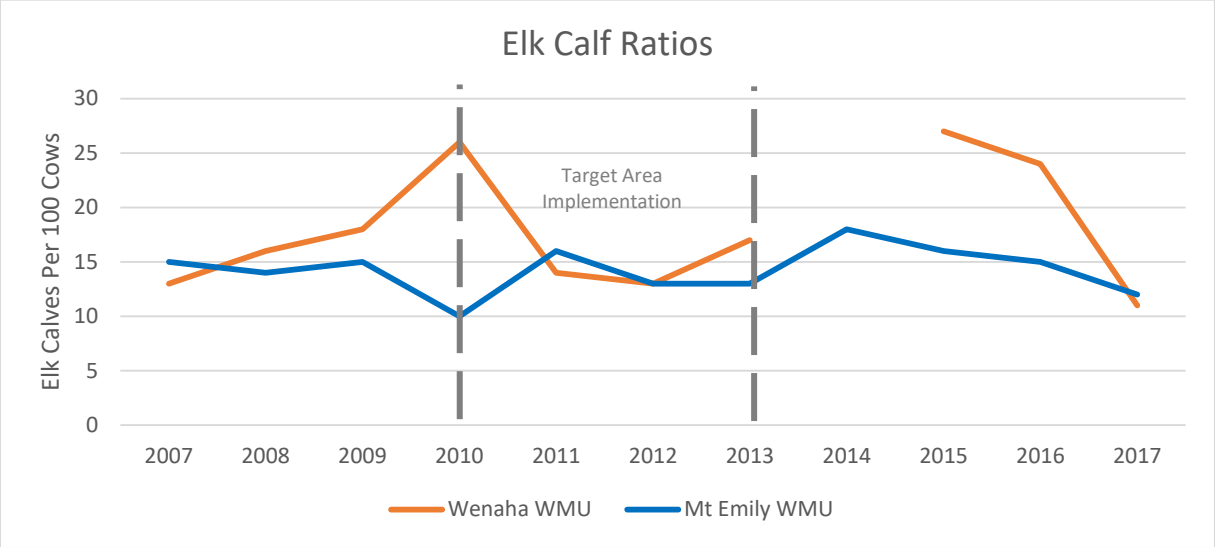

Figure 2. Elk calf ratios for the Wenaha and Mt Emily WMUs. The Wenaha Target Area implementation occurred from 2010-2013.

APPENDIX L: Target Area Expenses

Cost of implementing and conducting cougar removals Cougar Target Areas in Oregon.

Target Area	Expenditure	2006–2007	2007–2008	2008–2009	2009–2010	2010–2011	2011–2012	2012-2013	2013-2014	Total	Cougar Take	Total Price per cougar
Jackson	Existing Employee Salaries	$16,918	$0	$0	-	-	-			$16,918		
	New Employee Salaries	$0	$0	$0	-	-	-			$0		
	Supplies & Services[d]	$4,181	$40,000	$30,000	-	-	-			$74,181		
	Jackson Cnty. Sub-Total	$21,099	$40,000	$30,000	-	-	-			$91,099	24	$3,796
Beulah	Existing Employee Salaries	$4,656	$0	$0	$0	-	-			$4,656		
	New Employee Salaries	$7,200	$0	$0	$0	-	-			$7,200		
	Supplies & Services[d]	$8,010	$18,251	$21,915	$17,207	-	-			$65,383		
	E. Beulah Sub-Total	$19,866	$18,251	$21,915	$17,207	-	-			$77,239	34	$2,272
Heppner	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	53	$3,007
Steens	Existing Employee Salaries	-	-	-	$0	$0	$0	$0	$0	$0		
	New Employee Salaries	-	-	-	$0	$0	$0	$0	$0	$0		
	Supplies & Services	-	-	-	$13,203	$23,572	$11,932	$7,362	$9,331	$65,400		
	Steens Sub-Total	-	-	-	$13,203	$23,572	$11,932	$7,362	$9,331	$65,400	60	$1,090

Continued

Target Area	Expenditure	2006–2007	2007–2008	2008–2009	2009–2010	2010–2011	2011–2012	2012-2013	2013-2014	Total	Cougar Take	Total Price per cougar
Ukiah	Existing Employee Salaries	-	-	-	$0	$0	$0	$0	$0	$0		
	New Employee Salaries	-	-	-	$20,128	$13,213	$13,752	$7,857	$7,500	$62,451		
	Supplies & Services[d]	-	-	-	$1,957	$5,000[d]	$501	$0	$0	$7,458		
	Ukiah Sub-Total	-	-	-	$22,085	$18,213	$14,254	$7,857	$7,500	$69,909	94	$744
Warner	Existing Employee Salaries	-	-	-	$0	$0	$0	$0	$0	$0		
	New Employee Salaries	-	-	-	$0	$0	$0	$0	$0	$0		
	Supplies & Services	-	-	-	$1,908	$4,091	$1,966	$3,945	$986	$12,896		
	Warner Sub-Total	-	-	-	$1,908	$4,091	$1,966	$3,945	$986	$12,896	28	$461
Wenaha	Existing Employee Salaries	-	-	-	$0	$0	$0	$0	$0	$0		
	New Employee Salaries	-	-	-	$0	$0	$0	$0	$0	$0		
	Supplies & Services	-	-	-	$8,142	$8,188	$10,957	$10,834	$3,299	$41,421		
	Wenaha Sub-Total	-	-	-	$8,142	$8,188	$10,957	$10,834	$3,299	$41,421	56	$740
All Completed TAs	Existing Employee Salaries[a]	$65,074	$34,064	$9,841	$0	$0	$0	$0	$0	$108,979		
	New Employee Salaries[b]	$22,700	$18,250	$16,858	$20,128	$13,213	$13,752	$7,857	$7,500	$120,259		
	Supplies & Services[b]	$25,391	$63,513	$54,810	$42,417	$40,850	$25,356	$22,141	$13,616	$288,094		
	Total[c]	$113,165	$115,827	$81,509	$62,545	$54,063	$39,108	$29,998	$21,116	$517,332	349	$1,482

[a] Includes existing employee salaries for all Target Areas combined.

[b] Includes new employee salaries and supplies & services for all Target Areas combined.
[c] Total Expenditure for all target Areas.[d] Contract with USDA Wildlife Services
[d] Contract with USDA Wildlife Services

APPENDIX M: Process for Development and Selection of Cougar Target Areas

Target areas will be developed and/or reviewed annually as part of the big game regulations process. During this process, target areas will be submitted for approval by respective regions (April), Wildlife Division (May), and by the Fish and Wildlife Commission in the same manner as controlled big game hunts. This process will insure target areas will be available for public review and comment.

The process will begin with District Wildlife Biologist review of relevant data (cougar mortalities and ungulate population data) relative to criteria in respective Zone Tables (Tables 17-22, Chapter IV). If a zone trigger has been met, biologists will evaluate the situation and if warranted, they may develop a target area proposal. Proposals will include the area description, control unit/area, timing, duration, relevant data (cougar population estimates, mortalities, complaints, ungulate population data, etc.), personnel needs, estimated costs, monitoring techniques used to assess goal achievement, and any other pertinent information.

The target area approval process would consist of the Region, Wildlife Division, and Commission. The District would first send the proposal to the Region along with big game hunt proposals and tag recommendations for approval and/or prioritization. Then it would pass from the Region to Wildlife Division at hunting season recommendations meetings, followed by Commission during review of the big game regulations.

Following approval, interim updates on target area progress will be presented annually during review of big game regulation process. During implementation, amendments to the proposal may include extending the duration of effort or changing the objectives from cougar population reduction to maintenance (i.e. maintain cougar numbers). Proposed amendments would follow a similar approval process as the original target area proposal.

Following completion, respective biologists would be responsible for composing a report on the target area implementation, results, lessons learned, and provide recommendations on the future use of the tool in cougar management.

APPENDIX N: Appointing Black Bear And/Or Cougar Agents

OREGON ADMINISTRATIVE RULES
Division 079
APPOINTING BLACK BEAR and/or COUGAR AGENTS

635-079-0000
Purpose

These rules implement HB 2971, enacted by the 2007 Legislative Assembly, which authorized appointment of agents, subject to the Department's direction and control, to assist the Department in its official duties by pursuing black bear and/or cougar with dogs. These rules authorize two classes of agents—1) volunteer agents and 2) private contractors hired by the Department on personal services contracts—for responding to specific conflict or management actions consistent with the Oregon cougar and bear management plans and/or to work on specific research projects.

635-079-0005
Selection

(1) Any person applying for appointment as a black bear and/or cougar agent for the Department must submit a completed volunteer application form providing at least the following:
(a) the person's name, contact information and employment history;
(b) a detailed description of the person's experience in pursuing or hunting wildlife with dogs;
(c) a detailed description of the person's experience with firearms, first aid and the use of all-terrain vehicles, four wheel drive pickups, and snowmobiles;
(d) consent to run a criminal records check on the person, including a fingerprint check;
(e) a detailed description of the person's tracking dogs, including their training history, licensing status, canine immunization records, and the locations, timing and species of wildlife the dogs have pursued;
(f) a current certified copy of his or her motor vehicle records; and
(g) a detailed description of available equipment that can be used while pursuing or hunting cougar or bear with dogs.
(2) The Department shall review the person's application materials, run state and national criminal records checks on the person, hold an in-person interview, and determine whether the person meets the following criteria:
(a) is not awaiting prosecution for and has not been convicted of any felony or any violation of the animal cruelty, animal abuse, or domestic abuse laws;
(b) is not awaiting prosecution for and has not been convicted of a wildlife violation involving the illegal take of wildlife;
(c) is not awaiting prosecution for and has not been convicted of aiding in the illegal take of wildlife;
(d) is not awaiting prosecution for and has not been convicted of any wildlife violation involving the use of dogs;
(e) is not awaiting prosecution for and has not been convicted of any violation involving illegal drugs or alcohol abuse;
(f) has not had his or her hunting or fishing license suspended for a wildlife violation;
(g) would be available to respond to assignment by the Department;

(h) is skilled in the safe use of firearms, all terrain vehicles, four wheel drive pickups, and snowmobiles; (i) has a basic understanding of first aid;
(j) understands and respects basic principles of wildlife management; and
(k) currently holds an Oregon driver's license.
(3) The Department will consider the experience level of the person for each of the criteria listed in paragraph (2) and will use that information to select individuals suitable for appointment as an agent. (a) The Department will review any violations on the person's record.
(b) The Department retains discretion to determine how many agents to appoint and which applicants would best represent the state of Oregon.

635-079-0010
Appointment

(1) To appoint a person as an agent under these rules, the Department and the person must enter into a signed agreement which (at minimum):
(a) obligates the person to act on the Department's behalf and subject to the Department's direction and control;
(b) limits the person, when acting on the Department's behalf, to implementing the Department's specific management programs, consistent with the Commission's black bear management plan or Commission's cougar management plan;
(c) prohibits the person from engaging in any other hunting or pursuit while pursuing black bear or cougar on the Department's behalf;
(d) obligates the person to promptly inform his or her Department supervisor of any arrest, citation or conviction since application. The appointment is automatically suspended pending disposition of any arrest or citation;
(e) automatically terminates the appointment if the person is convicted of a felony or any violation of animal cruelty, animal abuse, or domestic abuse laws; the person is convicted of any violation involving illegal drugs or alcohol abuse; the person is convicted of any violation of the wildlife laws; or if the person can no longer legally operate motor vehicles in Oregon;
(f) automatically terminates the appointment if the Department determines that the person is not trustworthy, fails to carefully obey all directions from the Department, or engages in conduct that reflects poorly on the Department;
(g) authorizes the person to pursue black bear and/or cougar with dogs at the direction of the Department and in an official capacity; and
(h) obligates the person to follow all applicable safety and health rules while operating on the Department's behalf.
(2) An agreement with a volunteer agent shall not authorize payment of any compensation or wages to the agent except for the following:
(a) the Department may compensate the agent for vehicle fuel cost incurred while acting for the Department; and
(b) the Department may compensate the agent for dog related expenses incurred while acting for the Department.
(3) An agreement with a person as a private contractor to assist the Department with black bear and/or cougar pursuit using dogs shall provide compensation as per state contracting requirements.
(4) Before pursuing black bear or cougar on the Department's behalf, each agent shall complete an information and training session conducted by the Department. The session shall cover, at a

minimum: (a) requirements for use of pursuit dogs, firearms, all terrain vehicles and snowmobiles;
(b) a code of conduct for volunteers working on the Department's behalf;
(c) information regarding the humane capture and euthanasia of wildlife;
(d) identification of specific areas and boundaries where activities will be conducted; and
(e) identification of specific timing of when activities will be conducted for the Department.
(5) All activities of agents will be reviewed at least annually.
(6) All agreements and contracts with agents will be available for public review at the Department's main office in Salem.
(7) The Department may terminate appointment of any individual as an authorized volunteer or private contractor agent at any time or for any reason if it determines that the appointment no longer is in the best interest of the state of Oregon. Appointment as an agent conveys no rights or privileges other than those specifically outlined in the agreement or contract, all of which rights or privileges terminate immediately upon termination of the appointment of the agent.