OREGON DEPARTMENT OF FISH AND WILDLIFE
BRIEFING RELATIVE TO 2006
COUGAR PLAN

The following is an overview of the 2006 Oregon Cougar Management Plan (Plan) and a summary of actions that have been implemented. This Plan established five objectives that seek to maintain a viable, healthy cougar population, reduce conflicts with cougars, and to manage cougars in a manner compatible with other game mammal species using proactive, adaptive management strategies. To achieve these objectives, the Oregon Department of Fish and Wildlife (Department) implements a zone-based quota system to ensure sustainable harvest levels, estimates population abundance using mortality data, monitors population trends, monitors trends in mortalities, implements target areas, appoints qualified volunteer agents to assist with research and management activities when needed, and develops and implements research projects to assist with management decision-making.

Hunting Season Structure

During 1994, the passage of Measure 18 resulted in the prohibition of the use of dogs to hunt or pursue cougars, with certain exemptions such as for agents appointed by and acting on behalf of the Department to implement management actions, or for landowners to address damage or human safety concerns. Over the next several years, the Department implemented several regulatory changes in an effort to address the expected dramatic decline in hunter success rates. During 1995, the Department changed cougar hunting from a controlled hunt system to a statewide, unlimited general season using a quota-based system (see below) and increased season length from 2½–4 months to 7 months; the season length was increased to 10 months in 2001 and to the current year-long statewide season based on the calendar year (Jan 1–Dec 31) in 2010.

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. During 2010, cougar tags were set at the current $14.50 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.

Successful hunters must present the pelt with skull and proof of sex attached at a Department office within 10 days of harvest. The Department collects harvest data during this mandatory check-in process, including a tooth to age individual cougars, and tags each pelt; the reproductive tract of female cougars is also required for collection of reproductive data. This process is required for cougars taken for any purpose, including damage, human safety, or known road-killed animals.

Zone-based Quota Management

The Department established a zone-management system with mortality quotas starting in 1995 which is used to ensure harvest does not reduce cougar populations below minimum population levels. During 1995–2005, cougars counted towards quotas were only those harvested by hunters. Since adoption of the 2006 Cougar Plan, all known mortalities (e.g., hunter-harvest, damage take, human-safety take, administrative removal, road-killed) count toward zone quotas. Oregon is divided into 6 cougar management zones (Fig. 1). 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. Because hunting seasons for cougar are January 1 to December 31 each year, any closed zone reopens for the next season on January 1 of the year following the closure.

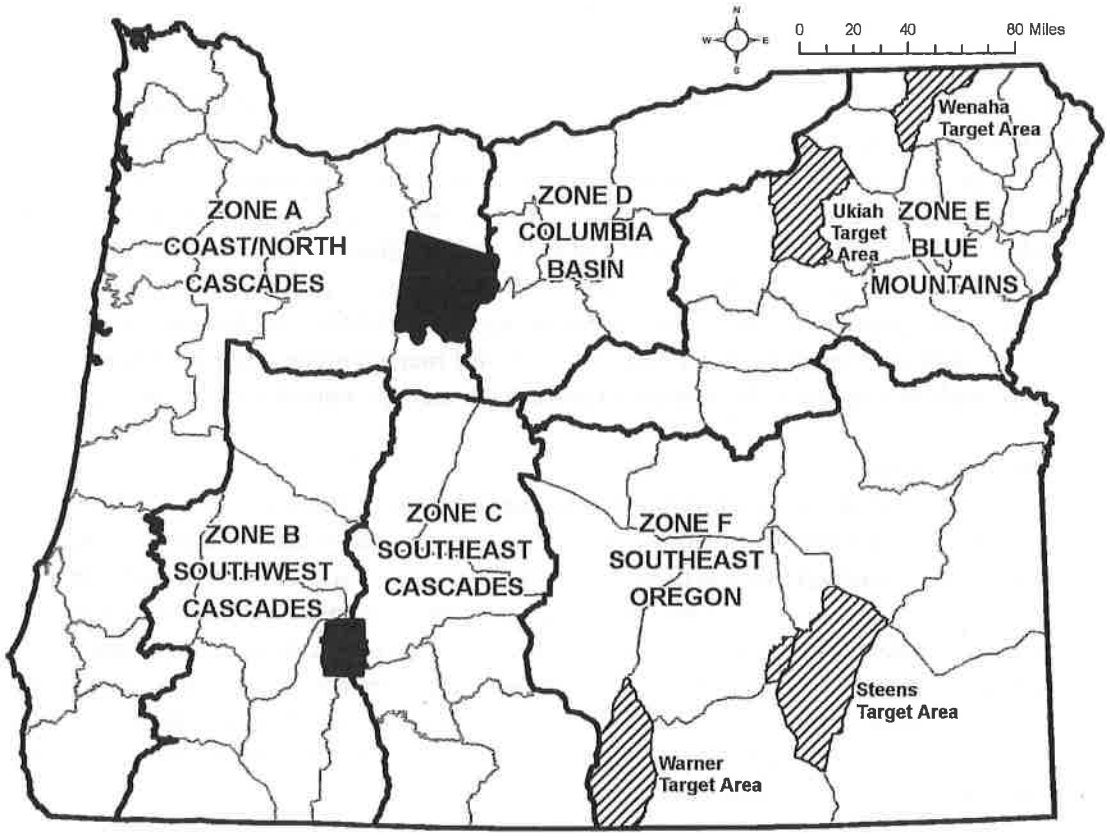

Fig. 1. Cougar management zones and recent target areas in Oregon.

The most recent zone closures occurred in Zone A (Coast/North Cascades) when the quota of 120 cougars was reached and the zone was closed to hunter-harvest of cougars in 2011, 2012, and 2013 (Table 1). This is the sixth time since implementation of the quota system in 1995 that a zone quota has been met. Previous zone where quotas have been met are Zone E: Blue Mountains in 2001 and 2002, Zone D: Columbia Basin in 2002,and Zone A in 2011, 2012, and 2013

Table 1. Cougar mortalities and quotas in Oregon, 2009–2014.

	2009			2010			2011		
	Mortalities			Mortalities			Mortalities		
Hunt Zone	Hunt	Non-Hunt	Zone Quota	Hunt	Non-Hunt	Zone Quota	Hunt	Non-Hunt	Zone Quota
A Coast/N Casc.	61	38	120	55	48	120	60	60	120
B SW Cascades	33	57	165	41	55	165	42	67	165
C SE Cascades	21	4	65	17	3	65	10	5	65
D Col. Basin	16	22	62	14	17	62	14	22	62
E Blue Mtns.	113	45	245	92	71	245	93	76	245
F SE Oregon	30	33	120	21	48	120	22	35	120
Statewide Totals	274	199	777	240	242	777	241	265	777

	2012			2013			2014		
	Mortalities			Mortalities[a]			Mortalities[b]		
Hunt Zone	Hunt	Non-Hunt	Zone Quota	Hunt	Non-Hunt	Zone Quota	Hunt	Non-Hunt	Zone Quota
A Coast/N Casc.	67	54	120	72	58	120	51	50	120
B SW Cascades	37	69	165	67	76	165	30	69	165
C SE Cascades	13	11	65	15	6	65	15	2	65
D Col. Basin	14	24	62	18	32	62	7	19	62
E Blue Mtns.	101	63	245	96	39	245	75	18	245
F SE Oregon	21	56	120	24	28	120	28	18	120
Statewide Totals	253	277	777	292	239	777	206	176	777

Population Monitoring

The Department monitors cougar abundance using two criteria: a deterministic, density-dependent model is used to estimate population abundance at zone and state levels, and the proportion of adult female cougars in the harvest is used at the zone level. For example, given sufficient sample sizes (i.e., annual harvest of >25% of total population), there is scientific evidence that cougar populations do not begin to decline until adult (≥3 yr old) females comprise at least 25% of the harvest (Anderson and Lindzey 2005). At the zone level, the Department has an objective of maintaining a 3-year average proportion of adult females in the total mortality at no more than 25–35% (2006 Cougar Plan, p. 52). No zones currently meet this objective (Table 2.). At the target area level (see below), this value may be monitored to assess effects of administrative removals.

Table 2. Three-year averages of annual proportions of adult (≥3 yr old) females of known ages for all sources of mortality by cougar management zone in Oregon, 1987–2013.

	Zone					
Year	A: Coast/N. Cascades	B: SW Cascades	C: SE Cascades	D: Columbia Basin	E: Blue Mountains	F: SE Oregon
1987–1989	12.8	14.5	-	-	20.0	50.0
1988–1990	5.4	16.2	-	0.0	18.6	0.0
1989–1991	6.1	18.4	-	0.0	23.7	0.0
1990–1992	16.3	20.1	13.3	0.0	28.3	0.0
1991–1993	20.4	20.5	20.0	0.0	27.4	0.0
1992–1994	25.4	24.2	14.4	0.0	27.6	0.0
1993–1995	22.3	18.0	14.4	0.0	27.2	0.0
1994–1996	18.6	14.2	12.5	7.1	26.0	0.0
1995–1997	12.1	8.5	10.3	14.3	24.3	3.7
1996–1998	10.8	12.9	22.4	17.1	22.8	7.2
1997–1999	12.8	15.7	22.0	10.0	24.7	12.8
1998–2000	15.9	15.3	25.4	13.3	24.2	15.2
1999–2001	16.6	14.1	18.8	9.2	25.2	20.4
2000–2002	13.1	14.0	19.4	20.9	26.0	20.5
2001–2003	12.4	13.0	16.6	21.2	22.8	23.2
2002–2004	9.6	12.9	16.2	23.0	20.8	18.8
2003–2005	14.7	12.1	23.7	15.3	17.4	17.8
2004–2006	11.7	15.4	24.5	12.4	18.4	14.4
2005–2007	12.0	15.5	24.1	18.0	19.1	20.6
2006–2008	11.1	16.5	15.6	23.5	20.6	25.9
2007–2009	14.5	18.4	14.1	26.5	22.7	27.8
2008–2010	16.5	18.0	11.0	26.2	25.5	24.1
2009–2011	16.8	17.5	13.7	26.9	27.3	21.2
2010–2012	15.3	13.2	15.3	23.4	23.6	20.3
2011–2013	13.7	13.8	20.3	20.0	21.9	20.1

Deterministic model

The Department uses a deterministic, density-dependent population model (Keister and Van Dyke 2002) to estimate annual cougar abundance in Oregon from 1987 to present at the statewide level and 1994 to present at the zone level. Like most state-level population models for cougars, this model relies on harvest data to develop estimates. The statewide population abundance for 2014 was estimated to be 6,229, an increase of about 170% from 1987 and 92% from 1994 (Fig. 2). The

population has slowly increased since 2006 with an average annual increase of about 1.4% per year. Zone populations also have remained stable except for Zone C (Southeast Cascades) and Zone D (Columbia Basin) (Fig. 3). The estimated population in Zone C has increased 86% between 2006 (487) and 2014 (970). Zone D has increased 23% between 2006 (309) and 2014 (377).

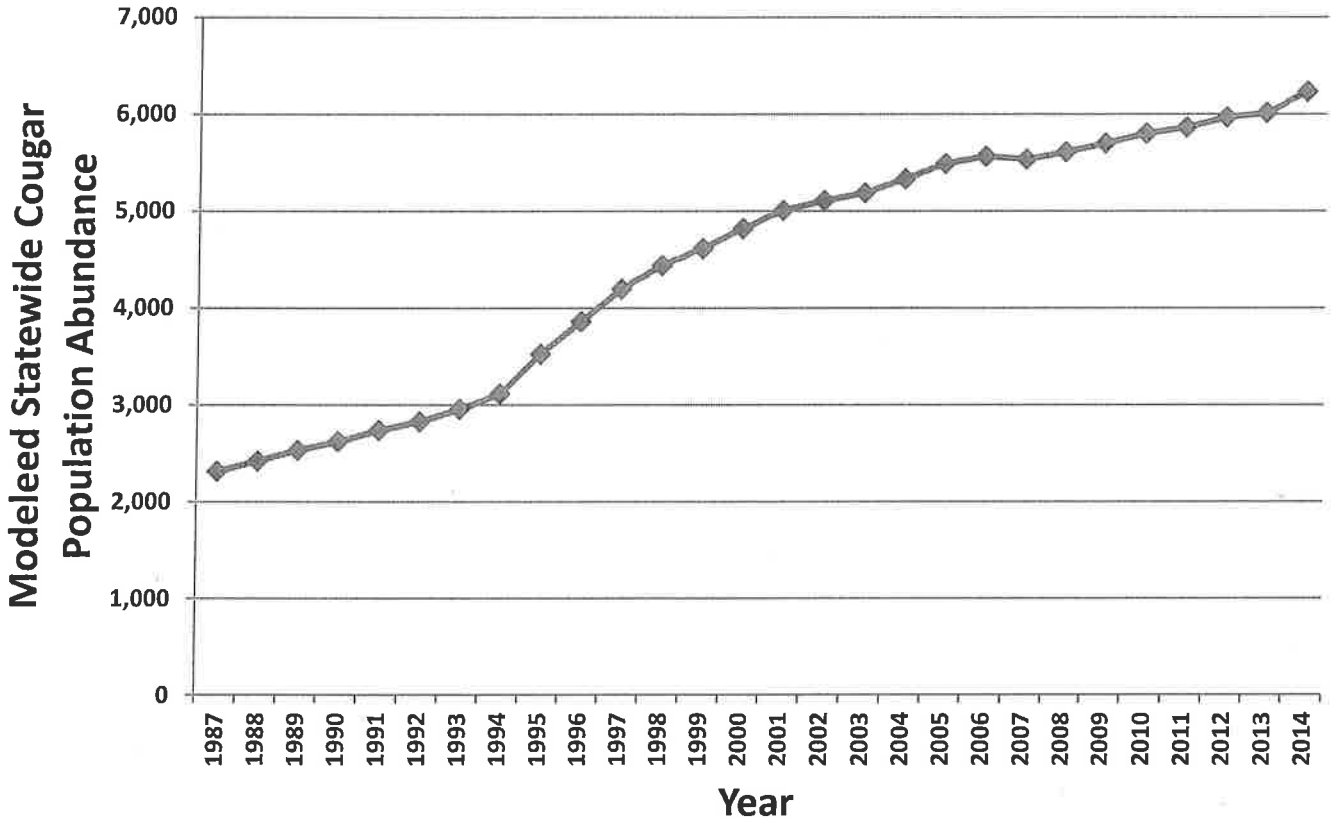

Fig. 2. Modeled statewide population abundance of cougars in Oregon during 1987–2014, based on results from deterministic, density-dependent population model.

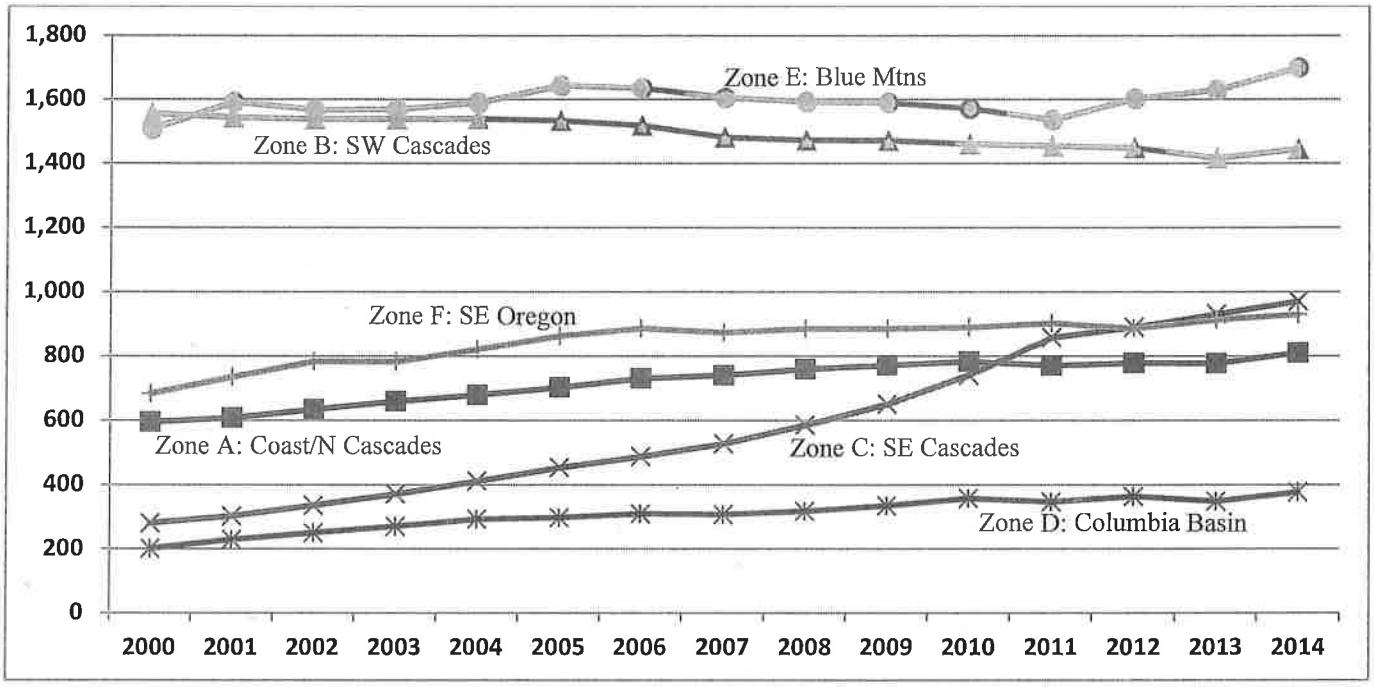

Fig. 3. Estimated zone-level population abundance of cougars in Oregon during 2000–2014, based on results from deterministic, density-dependent population model.

Mortalities

Cougar tag sales continued to increase, up almost 2% to 56,114 in 2014. Harvest dropped from a high of 292 in 2013 to 206 in 2014. (Table 3). Some hunters continue to hunt specifically for cougar outside of the deer and elk seasons when snow conditions allow animals to be tracked or by using a predator call. At the state level, trends in mortalities related to damage management and hunter-harvest were relatively stable.

Table 3. Trends in cougar complaints, damage, harvest, and other mortality in Oregon during 1992–2014. Complaint data entry incomplete and mortality data current through February 12, 2015, based on mandatory check-in of cougars. Numbers may change as late data are added.

			Number of Mortalities by Source					
Year	Number of Complaints[a]	Number of Tags Sold[b]	Hunter-Harvest	Damage[c]	Human Safety[d]	Administrative Removals[e]	Other[f]	Total
1992	184	517	187	17	3	0	22	229
1993	276	560	160	21	6	0	21	208
1994	554	588	144	30	9	0	21	204
1995	742	385	34	41	22	0	12	109
1996	840	779	45	66	32	0	25	168
1997	798	935	61	82	20	0	18	181
1998	954	11,761	153	93	20	0	17	283
1999	1,072	14,564	157	91	39	0	25	312
2000[g]	942	22,386	136	120	25	0	19	300
2001	829	28,447	220	97	25	0	23	365

2002	765	32,126	232	111	23	0	37	403
2003	697	34,135	248	111	28	0	25	412
2004	545	34,071	265	95	28	0	35	423
2005	622	38,079	224	125	28	0	30	407
2006	451	38,719	289	106	26	0	32	453
2007	453	41,813	309	114	21	52	41	537
2008	518	43,211	273	109	23	34	54	492
2009	437	45,375	274	110	31	21	37	473
2010	469	48,776	239	99	25	79	39	481
2011	501	50,889	241	139	23	71	32	506
2012	420	53,698	253	129	46	56	45	529
2013	361	55,072	292	147	25	36	30	530
2014[h]	277	56,114	206	124	27	0	25	382

[a]Number of complaints received during the calendar year. Sightings are not included.
[b]Includes general and additional tags (including Sports Pac licenses).
[c]Number of animals killed as a result of damage during a calendar year.
[d]Animals killed as a result of real or perceived threat to humans or pets.
[e]Adminstrative removals on cougar target areas (2007–present only).
[f]Includes roadkill, accidental, found dead, and illegal kill.
[g]Hunting season changed to calendar year.

Target Areas

The Cougar Plan includes implementation of Target Areas to address recurring cougar-related conflicts in specific areas by decreasing cougar abundance when hunter-harvest of cougars is insufficient. When administrative removals of cougars on a Target Area are at an appropriate level, cougar abundance is expected to decrease, thereby having a positive effect on the specific issue being addressed for a Target Area. Implementation of a Target Area typically occurs for 3–4 years.

Outcomes of management actions on Target Areas may be measured by monitoring pre- and post-conditions within the Target Area and by comparing those values to an adjacent control area. Target Area-specific goals may also be measured through changes in populations of ungulate species such as increased recruitment or population abundance or a change in the level of conflict that lead to the Target Area being implemented, such as fewer cougar/livestock damage complaints. Also, an increase in the 3-year average percent of adult (≥3 yr old) females in the total mortality to 40–45%, with a subsequent decline in average age of adult females to 3–4 years old, may indicate that administrative removals are resulting in the desired decrease in cougar abundance in the Target Area (2006 Cougar Plan, p. 52). However, if conflict is occurring in areas that are relatively small (generally associated with human safety/pet and livestock conflicts), the specific proportion of adult females in the total mortality has limited application. Therefore, in these areas, cougars will be removed until the conflict subsides in the Target Area.

Target Area Criteria

Criteria that may trigger implementation of a Target Area relate to cougar-human interactions and ungulate population characteristics (Plan, p. 15). Most threshold values for these triggers are zone-specific and include:

- Number of non-hunting cougar mortalities related to livestock and human safety/pet concerns
- Number of human safety and pet complaints
- Number of livestock complaints
- Elk calf-to-cow ratios and elk population management objectives
- Predation that threatens viability of deer populations
- Predation that threatens success or viability of transplanted populations of ungulates

On an annual basis, Target Area activities cease if:

- Annual objective for number of administrative removals of cougars is met
- Total mortality quota in the zone is reached
- It is determined that administrative removals cannot meet objectives

Past Target Areas

To assess effects of administrative cougar removal, three Target Areas were chosen to evaluate effects of cougar removal on major categories of conflict: human safety concerns in Jackson County (SW Oregon; 2007–2009), livestock depredation in the Beulah Wildlife Management Unit (WMU; SE Oregon; 2007–2010), and elk predation in the Heppner WMU (NE Oregon; 2007–2009). Administrative cougar removals were designed to supplement removals related to hunter-harvest and complaints.

During 2007–2010, 111 cougars were administratively removed from the three areas (Table 4) at a total cost of $327,708, of which $218,729 were expenses for new ODFW seasonal employees, supplies and services, and contracts with USDA Wildlife Services (Appendix I, Table 7). All funds used for target area implementation were ODFW license dollars; no state general funds, tax dollars, or federal funds were used for implementing cougar removal in Target Areas. ODFW employees took 59% of all administratively removed cougars and 60% 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, but annual removal objectives could not be met due to a complex mixture of private and public lands in this area. Cougar removal in the Beulah Target Area was associated with reduced cougar–livestock conflicts. Cougar removal in the Heppner Target Area was positively related to elk calf survival. The 3-year average percent of adult females in the total mortality was 24% (Beulah), 22% (Heppner), and 21% (Jackson), indicating mortality levels were below the level necessary to achieve adult female mortality of 40-45% in Target Areas.

Table 4. Past Target Areas.

Target Area	Purpose	Annual Objective	Number of Administrative Removals 2007	2008	2009	2010
Beulah	Reduce livestock depredation	12	12	10	2	10
Heppner	Improve ungulate recruitment	30	33	12	8	-
Jackson	Reduce human safety/pet concerns	24	7	12	5	-

Recent Target Areas

Recently, the Department had 4 Target Areas designed to address declining ungulate populations: Steens and Warner Target Areas were designed to positively affect mule deer populations under the Mule Deer Initiative, the Ukiah and Wenaha Target Areas were designed to positively affect elk calf recruitment. Beginning in December 2009, through December 31, 2013, a total of 238 cougars were administratively removed from these 4 Target Areas (Table 5).

Table 5. Recent Target Areas. Data current as of April 7, 2014.

Target Area	Purpose	Annual Objective	Number of Administrative Removals 2009	2010	2011	2012	2013
Steens	Improve mule deer populations	20	0	20	18	15	7
Ukiah	Improve elk recruitment	35	5	30	30	14	15
Warner	Improve mule deer populations	14	1	8	4	12	3
Wenaha	Improve elk recruitment	20	0	11	19	15	11

Cougar-Bear Agents and Costs

The 2007 Oregon Legislative Assembly passed House Bill 2971 authorizing the Department to develop rules necessary to appoint individuals as Department agents for cougar and/or black bear control work and research projects. Subsequently, rules were developed and approved by the Commission in February 2008.

To qualify as an agent of the Department interested individuals must pass a criminal background check, provide a fingerprint record, provide a certified copy of their Motor Vehicles Driving Record for the last five years, and complete a Black Bear and/or Cougar Agent Application. Qualified applicants are interviewed by the respective District Wildlife Biologist to determine suitability for appointment. Those selected are required to meet with the District Biologist and successfully complete required training (Code of Conduct, Use of Firearms, Use of ATVs and Snowmobiles, First Aid/CPR, etc.).

Before being asked to take a control action, the agent and the District Wildlife Biologist will complete a Black Bear and/or Cougar Agent Appointment Agreement that establishes specific work-related duties, equipment requirements etc., for that particular project. As of July 10, 2013, 25 agents are approved and have signed agreements. One agent has been used to capture cougars and black bears for research in northeastern Oregon, and agents are being used in the Ukiah, Warner, and Wenaha Target Areas and to address specific conflicts with cougars.

Expenditures for volunteer agents are related primarily to mileage reimbursements, but other expenditures may occur, especially for agents used during research activities (Table 6). The largest proportion of expenditures related to volunteer agents is for assisting with research on cougars.

Table 6. Expenditures directly related to use of volunteer agents for cougar and bear research and management activities, 2008–2012. Expenditures may have included mileage reimbursement for personal vehicles, veterinary bills for dogs, dog rental fees; for research, also have included per diem and agent use of personal ATV and snowmobile.

	Activity			
Year	Damage/human safety	Cougar Target Areas[a]	Research	Total
2008	$200	$0	$15,026	$15,226
2009	$338	$0	$16,475	$16,813
2010	$0	$7,115	$19,321	$26,436
2011	$700	$13,185	$16,393	$30,278
2012	$0	$10,938	$3,724	$14,662
Total	$1,238	$31,238	$70,939	$103,415

[a]Josephine County OHA covered $5,098 of the 2010–2011 expenditures for Warner Target Area and is included this table.

Research

Since implementation of the 2006 Cougar Plan, the Department has completed three major research projects that included components addressing cougar populations: the North Umpqua project in southwestern Oregon, and the Sled-Springs-Wenaha and Mt. Emily projects, both in northeastern Oregon.

North Umpqua and Sled Springs-Wenaha Project

In Oregon, elk recruitment (calf:cow ratio) has declined from >50 calves per 100 cows to < 20 calves per 100 cows in some management units in northeast Oregon. Concomitantly, elk populations have declined below management objectives in spite of management efforts to increase both recruitment and population numbers. In contrast, in other regions of 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 2 factors, carnivore (black bear, cougar) density and elk nutritional condition may act independently or interact to affect calf recruitment. Elk nutritional condition was used as a surrogate to habitat quality and a measure of the carrying capacity of the landscape. This research approach was conducted in both northeast and southwest Oregon to provide a broad geographic and physiographic contrast.

The cougar component of this research had 2 main 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 radiomarking 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 North Umpqua study areas varied between 0.91 and 2.24 cougars per 100 km^2 (2.4 to 5.8 cougars per 100 mi^2). In the Sled Springs-Wenaha study sites, subadult females and adult male and female cougar densities varied between 1.73 to 4.16 cougars per 100 km^2 (4.5 to 10.8 cougars per 100 mi^2)across 2 study areas from 2001 to 2008. Average density was 2.95 cougars per 100 km^2 (7.6 cougars per 100 mi^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 that translated into changes in cougar density. Survival of radiomarked 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 4 study sites. This 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), and numerous presentations at professional meetings (see detailed list on page 12).

Mt. Emily Project

The most recent cougar research project implemented by the Department is the Mt. Emily project conducted during 2009–2012 in northeast Oregon. This project was developed with 5 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.

The Department captured and radiomarked 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 suggested an effect of season (summer, winter) and demographic classification (age class; females with kittens) on kill rates and prey selection by cougars. While deer comprised about 70% of the prey items, cougars did not show selection for any age or sex class of deer; cougars did show a strong selection for elk calves, but did not show selection for the sex of adult elk. A manuscript describing this objective was submitted to a scientific journal and is in the peer-review process.

A second manuscript has also been submitted to a scientific journal for peer review 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. 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.

A third manuscript is near completion and summarizes survival rates of cougars under different management scenarios (pre- and post-Measure 18). Survival rates varied across 3 study areas (Catherine Creek 1989–1997; Jackson Creek 1993–2001, Wenaha-Sled Springs-Mt Emily 2001–2012). Human-caused mortality was the primary cause of mortality in northeast Oregon (~70%), but disease and natural mortality were the primary causes of mortality of cougars (~70%) in southwest Oregon. Survival rates of radiomarked 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 and in the San Andres Mountains, New Mexico. The high survival rates of cougars in Oregon provide evidence that cougar populations are secure and not threatened by hunting.

Evaluation of data from the Heppner target area indicated that with removal of a sufficient number of cougars, the elk population responded rather quickly (Figure 4). Observed calf ratios increased from the teens to the low 30's. Concommitantly, the elk population increased from about 3,000 to over 5,000.

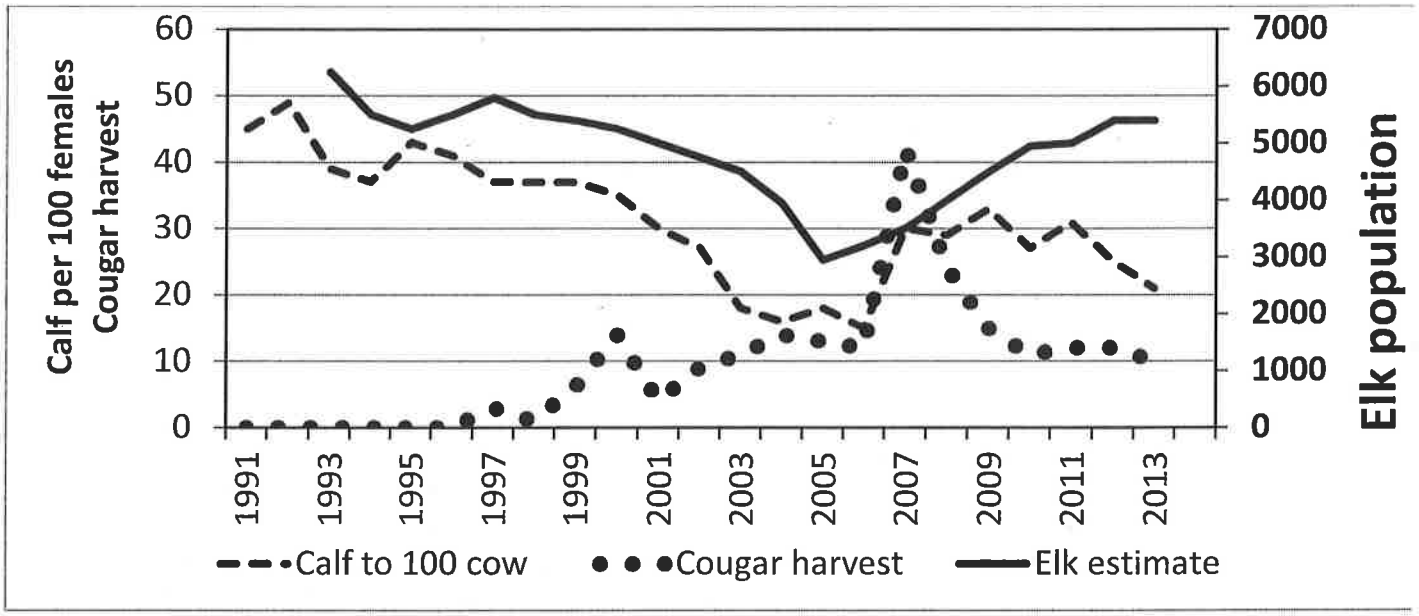

Fig 4. Trend in elk population and cougar harvest for the Heppner Cougar Targert Area.

A fourth analysis estimates cougar population growth rates under a variety of management scenarios and how quickly a cougar population can recover from heavy exploitation such as demonstrated in the Heppner Target area. 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 even low rates of immigration, cougar populations recover within about two 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. Not surprisingly, hunter harvest of cows, and cougar density in the area have a lot of influence on adult female survival and calf survival respectively. Pregnance rates of adult females and other abiotic factors had minimal effects on elk population growth.

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

PUBLICATIONS

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

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

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 predator community composition. Journal of Animal Ecology 80:1246-1257.

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.

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.

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 in press.

Davidson, G. A., D. A. Clark, B. K. Johnson, L. P. Waits, J. R. Adams. In review. Estimating cougar densities in northeast Oregon using conservation detection dogs. Journal of Wildlife Management.

Clark, D. A., G. A. Davidson, B. K. Johnson, R. G. Anthony. In review. Cougar kill rates and prey selection in a multiple prey system in northeast Oregon. Journal of Wildlife Management.

Johnson, B. K., D. H. Jackson, J. G. Cook, R. C. Cook, R. G. Anthony, P. K. Coe, S. L. Findholt, J. H. Noyes, and S. R. Rearden. In prep. Effects of nutritional condition of female elk and carnivore densities on survival of juvenile elk in Oregon. Wildlife Monograph.

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

Clark, D. A., B. K. Johnson, D. R. Jackson, M. Henjum, S. L. Findholt, J. J. Akenson, and R. G. Anthony. In prep. Contrasting survival rates of radiocollared cougars in Oregon under differing hunt regulations from 1989 – 2011. Journal of Wildlife Management.

Findholt, S. L., and B. K. Johnson. In prep. Estimating cougar population abundance in northeast Oregon: a comparison of two methods. Northwest Science.

PRESENTATIONS

Johnson, B. K. 2013. Influences of habitat, nutrition, weather, carnivores, and hunters on elk in Oregon. 10th Biennial Deer and Elk Workshop, May 6 – 9, 2013 Missoula, MT. Abstract only.

Clark, D. A., G. A. Davidson, B. K. Johnson, R. G. Anthony. 2012. Cougar prey composition and predation rates in a multiple prey community in northeast Oregon. 19th Annual Conference of The Wildlife Society, Portland, Oregon, Abstract only.

Clark, D. A., G. A. Davidson, B. K. Johnson, and R. G. Anthony. 2011. Cougar prey composition and predation rates in a multi-prey community in Northeast Oregon – Preliminary results. Page 60 in Williams, J., H. Robinson, and L. Sweanor, editors. Proceedings of the 10th Mountain Lion Workshop. May 2-5, 2011. Bozeman, Montana, USA. Abstract only.

Davidson, G. A., D. A. Clark, and B. K. Johnson. 2011. Pilot study of scat detection dogs for cougar population estimation. Page 122 in Williams, J., H. Robinson, and L. Sweanor, editors. Proceedings of the 10th Mountain Lion Workshop. May 2-5, 2011. Bozeman, Montana, USA. Abstract only.

Johnson, B. K., R. A. Anthony, P. K. Coe, J. G. Cook, R. C. Cook, S. L. Findholt, J. H. Noyes, and S. N. Rearden. 2009. Top-down or bottom-up: what drives calf elk survival in northeastern Oregon? The Wildlife Society 16th Annual Conference, Monterey, CA Sept. 20 – 24, 2009. Abstract only.

Findholt, S. L., and B. K. Johnson. 2009. Estimating cougar abundance in northeastern Oregon. The Wildlife Society 16th Annual Conference, Monterey, CA Sept. 20 – 24, 2009. Abstract only.

Johnson, B. K., P. K. Coe, S. L. Findholt, J. H. Noyes, J. G. Cook, R. C. Cook, R. Anthony, and S. Rearden. 2009. Survival and causes of mortality of calf elk in Sled Springs and Wenaha Wildlife Management Units, northeastern Oregon. 8th Western States and Provinces Deer and Elk Workshop April 27-30, 2009 Spokane, WA. Abstract only.

Findholt, S.L. and B. K. Johnson. 2008. Estimating cougar population abundance in northeast Oregon. Poster presentation given at the 9th Mountain Lion Workshop, Sun Valley, ID May 5 – 8, 2008. Abstract only.

Johnson, B. K. 2007. Factors affecting elk productivity in Oregon. Invited paper and abstract. Western States and Provinces Deer and Elk Workshop. Estes Park, Colorado. May 13 – 16, 2007.

Appendix I

Cost of implementing and conducting cougar removals Cougar Target Areas in Oregon during winter periods.

Target Area	Expenditure	2006–2007	2007–2008	2008–2009	2009–2010	2010–2011	2011–2012	2012-2013	2013-
Jackson County	Existing Employee Salaries	$16,918	$0	$0	-	-	-		
	New Employee Salaries	$0	$0	$0	-	-	-		
	Supplies & Services[d]	$4,181	$40,000	$30,000	-	-	-		
	Jackson Cnty. Sub-Total	$21,099	$40,000	$30,000	-	-	-		
East Beulah	Existing Employee Salaries	$4,656	$0	$0	$0	-	-		
	New Employee Salaries	$7,200	$0	$0	$0	-	-		
	Supplies & Services[d]	$8,010	$18,251	$21,915	$17,207	-	-		
	E. Beulah Sub-Total	$19,866	$18,251	$21,915	$17,207	-	-		
Heppner WMU	Existing Employee Salaries	$43,500	$34,064	$9,841	-	-	-		
	New Employee Salaries	$15,500	$18,250	$16,858	-	-	-		
	Supplies & Services	$13,200	$5,262	$2,895	-	-	-		
	Heppner Sub-Total	$72,200	$57,576	$29,594	-	-	-		
Steens	Existing Employee Salaries	-	-	-	$0	$0	$0	$0	
	New Employee Salaries	-	-	-	$0	$0	$0	$0	
	Supplies & Services	-	-	-	$13,203[d]	$23,572[d]	$11,932[d]	$7,362[d]	$9
	Steens Sub-Total	-	-	-	$13,203	$23,572	$11,932	$7,362	$
Ukiah	Existing Employee Salaries	-	-	-	$0	$0	$0	$0	
	New Employee Salaries	-	-	-	$20,128	$13,213	$13,752	$7,857	$
	Supplies & Services(d)	-	-	-	$1,957	$5,000[d]	$501	$0	
	Ukiah Sub-Total	-	-	-	$22,085	$18,213	$14,254	$7,857	$
Warner	Existing Employee Salaries	-	-	-	$0	$0	$0	$0	
	New Employee Salaries	-	-	-	$0	$0	$0	$0	
	Supplies & Services	-	-	-	$1,908	$4,091	$1,966	$3,945	
	Warner Sub-Total	-	-	-	$1,908	$4,091	$1,966	$3,945	

Wenaha	Existing Employee Salaries	-	-	-	$0	$0	$0	$0	
	New Employee Salaries	-	-	-	$0	$0	$0	$0	
	Supplies & Services	-	-	-	$8,142	$8,188	$10,957	$10,834	$
	Wenaha Sub-Total	-	-	-	$8,142	$8,188	$10,957	$10,834	$
All	Existing Employee Salaries[a]	$65,074	$34,064	$9,841	$0	$0	$0	$0	
	New Employee Salaries[b]	$22,700	$18,250	$16,858	$20,128	$13,213	$13,752	$7,857	$
	Supplies & Services[b]	$25,391	$63,513	$54,810	$42,417	$40,850	$25,356	$22,141	$1
	Total[c]	$113,165	$115,827	$81,509	$62,545	$54,063	$39,108	$29,998	$2

[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