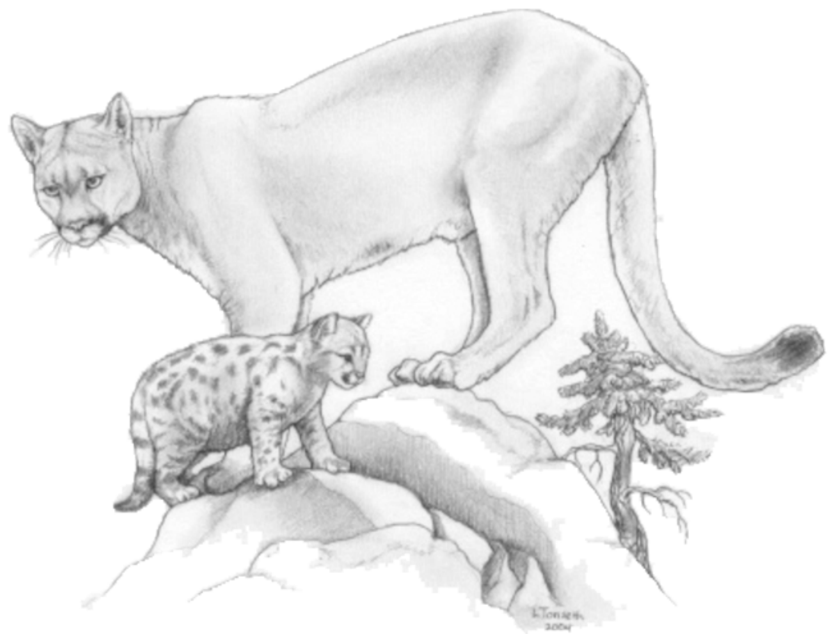
Proceedings of

The 8th Mountain Lion Workshop

Cougars: the controversy of politics, conflict, and conservation



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Proceedings of

The 8th Mountain Lion Workshop

Cougars: the controversy of politics, conflict, and conservation

Editors

Richard A. Beausoleil

Donald A. Martorello

THE COUGAR FUND
Protecting America's Greatest Cat

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Since the first workshop held in Nevada in 1976, which had roughly 46 attendees, interest in the Mountain Lion Workshop (MLW) series has grown considerably. Denver's meeting in 1991 drew well over 200 attendees and since then participation continues to consistently hover around 200 folks. The 8th MLW attracted 187 attendees; participants represented 19 states, 4 provinces, and 3 countries; state and provincial agencies, federal agencies, tribal nations, universities, conservation organizations, politicians, and members of the public added greatly to the diversity of this meeting and the quality of exchange. Thanks to all who participated. The MLW series has proven itself to be an extremely useful opportunity to bring stakeholders together and have quality discussions related to mountain lion management. There is no doubt these workshops further the profession in many ways; including enabling us to: (1) establish and maintain professional contacts; (2) keep up with current and innovative research methodologies; and ultimately, (3) make better decisions as managers and stakeholders.

Many thanks to the state and provincial fish and wildlife agency representatives who contributed to the workshop and provided oral and written status reports. To me, these presentations are at the core of the MLW workshop series and the presenters continued that tradition knowledgeably. The invited speakers did an outstanding job discussing their topics as well; one presentation focused on the role of science in management and the other on the role of public involvement in management. These presentations complemented each other nicely and at times interweaved their philosophy providing valuable discussion on ways to incorporate both strategies into a comprehensive mountain lion management program. The session chairs facilitated the sessions commendably and speakers gave presentations of exceptional quality; the contribution you made to the workshop was much more evident than I could portray in words; each and every one of you should be proud of yourselves and the quality work you are involved in. The poster presentations were also outstanding and seemed to generate quite a bit of discussion and interest. I liked the fact that the posters were hung throughout the main presentation room. I had never seen that at a conference and I believe it contributed to an elevated atmosphere and thought-provoking conversation at breaks and after the sessions. Finally, the panel members tackled difficult social issues related to mountain lion management. This group personified the diversification that would likely be present at any meeting where mountain lion issues would be discussed; they did a great job representing their affiliations and were a shining example of how folks with differing opinions can discuss issues rationally and respectfully.

Although the dates of the various MLW's have been sporadic in nature, it appears the MLW series has now settled into a cycle, roughly every 3 years. Washington's meeting occurred only 2 years after Wyoming; that was by design. The irregular cycle of the workshop series had merged with the 3-year cycle of the Western Black Bear Workshop (WBBW) series in 2000. Since most mountain lion managers are also bear managers, and interest in both species attracts similar groups, travel to 2 meetings within the same year may be difficult for some agencies, organizations, and private individuals to justify since budgets are always being pushed to the limit. So rather than continuing that dilemma, Washington decided to break the cycle and host the 8th MLW in 2 years (rather than the optional 4). Since both workshops appear now to be on separate schedules, and over the past 15 years the WBBW has been cemented in a 3-year cycle, I encourage future MLW hosts to maintain that separation and a consistent 3-year MLW cycle. Recent sanctioning of the MLW by the Western Association of Fish and Wildlife Agencies (WAFWA), and new bylaws developed for these workshops and proceedings should encourage such a schedule. Idaho has graciously agreed to host the 9th MLW in 2008, thus continuing on that course.

The theme of this workshop was certainly a timely one and exemplified the multitude of challenges mountain lion stakeholders encounter when involved in management. It is my hope that this publication will contribute to the existing literature and help folks continue to formulate educated decisions. Keep up the great work and I look forward to seeing you all in Idaho in 2008.

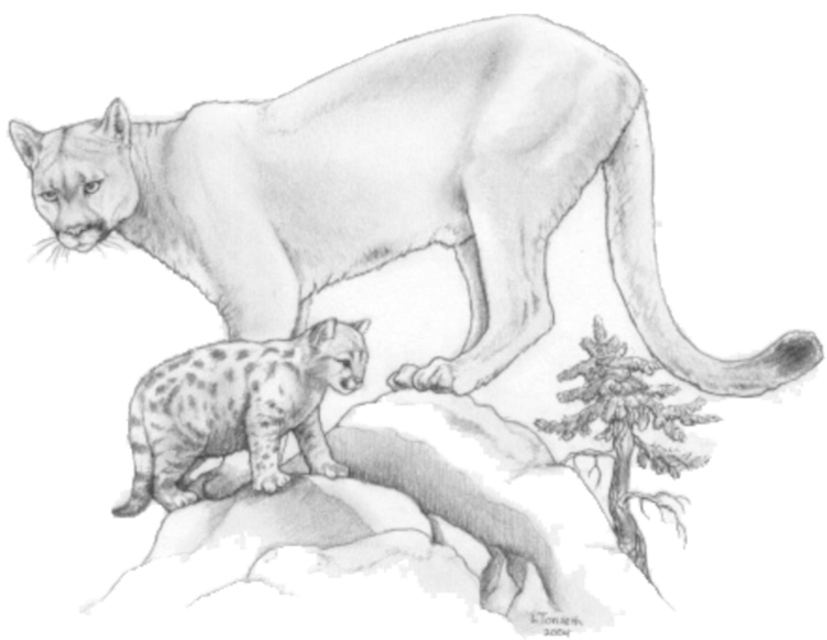
Rich Beausoleil
Steering Committee, Editor

Acknowledgements: Ultimately, the workshop sponsors recognized on the inside cover of this proceedings were responsible for the overall success of the workshop. Their donations were paramount in getting the workshop organized and off the ground. I also want to thank the workshop volunteers for their efforts in helping the steering committee gather donations for door prizes, the hospitality suite, and helping things run smoothly; thanks to Chuck Smith, Bryan Smith, Brian Kertson, and Laura Foreman. Thanks to the many vendors that donated their quality-crafted items to the Workshop and to Stemilt Growers Inc. who provided several varieties of apples that were enjoyed by all throughout the workshop. Finally, thanks to Mike and Lisa Tonseth for their contributions and for helping design the workshop artwork.

Editors Note: Not all of the presenters from the 8th MLW submitted manuscripts for inclusion in this proceedings, some only wanted abstracts published on account of publication elsewhere (current or intended). For others, an 8-week extension for submissions was given after the conference in order to make these proceedings as complete as possible. The steering committee made an effort to record the panel discussion for transcription in these proceedings. Unfortunately, a malfunction of equipment or human error resulted in a blank tape and we were unable to complete that task.

Northwest Mountain Lion

Status Reports



BRITISH COLUMBIA MOUNTAIN LION STATUS REPORT

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Mountain Lion Workshop 8:3

Abstract: Mountain lions are classified as "Big Game" in British Columbia under the provincial *Wildlife Act*. Recently, harvest of any spotted mountain lion or any mountain lion in its company has been restricted. Mountain lions occupy all suitable habitats within BC. The distribution of mountain lions has been expanding northward in recent years due to deer population increases resulting from less severe winters. The current provincial mountain lion population estimate is 4,000-6,000 and the trend is believed to be stable. Mountain lion population declines from a peak in the mid-1990s are related to the severe winter in 1996/97 that reduced deer populations. Mountain lion population estimates are based on the "best guesses" of regional biologists based on anecdotal and harvest/conflict information. Confidence in the population estimate is low but we have greater confidence in the trend estimate. Mountain lion hunting is allowed under General Open Seasons in all but one northern region with a negligible population. There are currently no explicit harvest criteria or objectives aside from quotas for female harvest in a portion of one region. Both harvest and mortalities resulting from conflicts increased from 1985 until 1996 and then declined through 2003. Conservation Officers respond to conflicts with mountain lions through education, translocation or destruction; compensation is not provided for losses. Known mountain lion attacks increased during the 20th Century, peaking in the 1990s. A draft harvest management plan has been prepared that includes the use of refugia to ensure conservation of mountain lion populations, defining the role of mountain lions in ecosystems, setting population objectives that are not based on population estimates, standard harvest prescriptions, allowing liberalized harvest in areas where mountain lions are impacting wildlife populations of concern (while also targeting the primary prey of mountain lions) and establishing pursuit-only seasons such that when combined with normal hunting seasons a minimum period is open to either normal hunting or pursuit-only hunting in all regions (i.e. December 1 – March 31). A draft non-detriment finding as been prepared to defend British Columbia's issuance of export permits for harvested mountain lions under the Convention on the International Trade is Endangered Species of Wild Fauna and Flora. It is speculated that climate change may benefit mountain lions in British Columbia due to milder winters allowing deer populations to increase and reducing mountain lion vulnerability to harvest.

WASHINGTON MOUNTAIN LION STATUS REPORT

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Mountain Lion Workshop 8:4-10

INTRODUCTION

The Washington cougar status report (Beausoleil et al. 2003) and oral presentation manuscript (Martorello and Beausoleil, 2003) submitted at the 7th Mountain Lion Workshop provides detailed background information on cougar management over the past several decades in Washington. Readers interested in knowing more on cougar distribution, hunting, harvest statistics, and conflict information should consult those documents. This status report will focus mainly on recent cougar management, since the 7th workshop.

HUNT SEASONS

Cougar Legislation

There has been much political activity regarding cougars in recent years in Washington (see Kertson, 2005 on page 92 of this proceedings for a more complete legislative account over the past decade). However, most notable was the passing of Substitute Senate Bill 6118 (SSB 6118), which was signed by the 58th Legislature in the 2004 Regular Session. The Bill passed 90 to 5 in the House of Representatives and 34 to 14 in the Senate. The Bill instructed WDFW and County authorities in 5 northeast counties to develop a 3-year pilot program authorizing a cougar pursuit season and a cougar kill season with the aid of dogs; the process was conducted through the Washington Fish and Wildlife Commission's (WFWC) rule-making process (Figure 1).

The Bill also stated that any rule adopted by the WFWC regarding this new season must ensure that all pursuits or hunts are: (a) designed to protect public safety or property; (b) reflective of the most current cougar population data; (c) designed to generate data that is necessary for the department to satisfy the reporting requirements; and (d) consistent with any applicable recommendations emerging from research on cougar population dynamics in a multiprey environment conducted by Washington State University's Department of Natural Resource Sciences that was funded in whole or in part by WDFW.

Creation of a Cougar Quota system

Following SSB 6118, Washington Department and Fish and Wildlife (WDFW) collaborated with County Commissioners from the 5 Counties to develop a draft rule for implementing cougar hunting with the aid of dogs in the 5-County area. As a part of that process, WDFW was tasked with developing cougar harvest levels (quotas) that were consistent with cougar management goals and objectives, current biological information, and public opinion outlined in WDFW' game management plan (Washington Department of Fish and Wildlife, 2003).

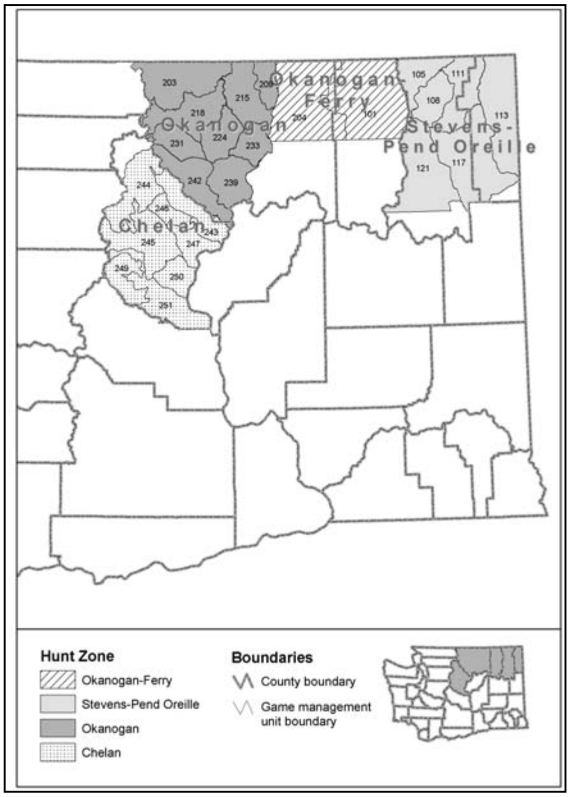

Figure 1. Graphic of the 5-County area in northeast Washington where 4 hunt zones were developed in response to Substitute Senate Bill 6118, Washington Department of Fish and Wildlife, 2005.

To accomplish this task, the Department established a technical team comprised of species specialists, biologists, and scientists within WDFW, as well as cougar scientists from Washington State University. The objective of the technical team was to: 1) review the current state of knowledge on cougar population dynamics, 2) develop a population model to assess the impacts of hunting on cougar populations, 3) develop a series of kill quota options, which include a total quota and female sub-quota, and the corresponding impacts to cougar populations, and 4) provide a relative measure of risk to human safety and population viability for each kill quota option.

After reviewing all current biological information on cougar populations in Washington (obtained from several ongoing search projects), the technical team developed a population model using RAMAS® GIS software (Akcakaya 2002). The model contained the following structure:

1. A meta-population that includes 12 sub-populations, which correspond to 4 hunt zones plus 8 neighboring populations that likely have cougars dispersing into or out of the 4 hunt zones.
2. A Leslie matrix model with age specific fecundity and survival estimates.
3. An error matrix for demographic or environmental variability for fecundity and survival estimates.
4. Population size estimates for each hunt zone.
5. Demographic and population size estimates extrapolated from cougar studies in northeastern and central Washington.

From this baseline model, numerous simulations were done to assess the impacts of various harvest levels on the cougar populations within the 4 hunt zones. In doing so, the technical team was able to estimate the total quota and female sub-quota levels which corresponded to a stable and declining cougar population. The risk to human safety was assumed to be inversely correlated to population size (i.e., increasing cougar population equates to higher risk to human safety). The maximum acceptable level of risk to population viability was set at a 10% probability of <0.85 cougars/100 km2 in 3 years (Lambert et al., in press).

The model indicated that a total quota of 57 cougars, with a sub-quota of 22 females, may lead to a stable cougar population in the 4 hunt zone area. An increase of the female sub-quota above 22 would likely cause populations to decline. The recommended total quota and female sub-quota that reduces populations with an acceptable level of risk to population viability is 102 and 40, respectively (Table 1). These quotas correspond to an estimated 22% decline in cougar populations in the 5-County area over 3 years.

As stated in WDFW's cougar management plan (Washington Department of Fish and Wildlife 2003), the objective for cougar in the 5-County area is to reduce cougar populations to minimize threats to public safety and property. However, the plan also indicates that WDFW's goal is to preserve, protect, perpetuate, and manage cougar to ensure healthy, productive populations. For those reasons, the preferred harvest level for cougars is one that balances these values. The preferred option represented an estimated total quota and female sub-quota levels that result in a population decline to enhance public safety, but at a level where the risk to population viability is acceptable. This option was adopted by the WFWC in August 2004 (Table 2).

Table 1. RAMAS® GIS software results showing cougar harvest levels by county for stable and declining cougar populations in northeast Washington, Washington Department of Fish and Wildlife, 2005.

Option	Hunt Zone	Female Quota	Total Quota
Stable Population	Chelan	3	8
	Okanogan	9	23
	Okanogan / Ferry	5	13
	Stevens / Pend Oreille	5	13
Total for 5-County area		22	57
Declining Population	Chelan	4	10
	Okanogan	11	28
	Okanogan / Ferry	15	38
	Stevens / Pend Oreille	10	26
Total for 5-County area		40	102

New Cougar Hunt Information

Along with the creation of the quota system described above, WDFW also created a special cougar hunt packet for successful draw hunters participating in the new hunt using dogs.

Training program. – Successful applicants were required to complete a training program prior to participating in a permit season with the aid of dogs. The training program was comprised of printed materials on cougar sex identification, species identification and how to avoid chase of non-target species (such as lynx, bobcat, black bear, and grizzly bear), and hunt season rules. Individuals selected for a cougar permit were required to sign and return an affidavit indicating they had read and understood the materials. By signing, each hunter acknowledged that any violation of this permit was justification for immediate termination of the permit by WDFW.

Hunt Logbook. – Hunters were also required to maintain and return to WDFW upon request, a cougar hunting logbook, documenting the days hunted and the number of cougar and cougar tracks encountered. This would allow WDFW to monitor hunt effort and correlate that to he number of cougars killed

Cougar Hotline. – The Department also set up a toll free cougar hotline for hunters to (1) obtain general cougar hunt information, (2) receive cougar quota updates, and (3) report cougar kills. The new rules stated that a kill made in the 5-County area must be reported to WDFW's hotline within 24 hours. Information required on the message included the hunters name and ID number, kill type (i.e. general hunt, 5-County dog season, depredation or landowner kill), the GMU of kill, the sex of the kill, and the date of the kill. The quota was updated daily to ensure the quota system was upheld. Hunters were instructed to call the hotline every 24 hours.

The 5-day mandatory rule on getting the carcass sealed, where WDFW gets information such as sex, age (by pulling a tooth), kill location, and animal condition, remained the same.

Hunt Placard. – All successful draw hunters participating in the cougar season using hounds were given non-transferable hunt placards to place in their vehicle. This identified them as draw hunters. Because hunting cougars with hounds is illegal in all other areas in the state and only draw hunters were allowed to use hounds, the placards were useful for WDFW enforcement personnel enforcing game laws.

RESEARCH

Cougar DNA Project – Northeast WA

A cougar population estimation project using DNA began in November of 2004. The capture technique involves the collection of cougar tissue samples from two periods. During the capture period, approximately 15 hound handlers were deployed each year throughout the project area to tree cougar and obtain a DNA sample via a biopsy dart (no physical handling is required). In 2-45 day capture sessions, over 90 cougar samples have been collected in the sample period and over 200 in the recapture period (see Beausoleil et al. 2005 on page 81 of these proceedings for additional information about this project).

Cougar Population and Survival Project - North-Central WA

WDFW's objective is to reduce cougar populations in north-central Washington. However, cougar population size is largely unknown, so it is uncertain if harvest levels are set too conservatively or too liberal given the objective. In order to better monitor cougar populations and the impacts from harvest, baseline demographic information is needed. A demographic monitoring project began in November of 2004 using 3 volunteer houndsman; after the second capture season (February 2005) project personnel captured 21 individual cougars (14F, 7M). To date, 5 mortalities have been documented (2F, 3M) and all remaining animals are being monitored for

Table 2. 2004-05 cougar hunting season details, Washington Department of Fish and Wildlife, 2005.

Hunt Name	2004-05 Seasons	Area Description	Special Restrictions
General A	Aug. 1, 2004 to Mar. 15, 2005	Statewide, except GMUs or portions of GMUs within Chelan, Okanogan, Ferry, Stevens, or Pend Oreille counties.	Any legal weapon. Cougar may also be hunted with a 22 caliber or larger centerfire rifle.
General B	Aug. 1, 2004 to Nov. 19, 2004	GMUs 101-121, 203, 204, 209-247, 249-251 within Chelan, Okanogan, Ferry, Stevens, or Pend Oreille counties.	Any legal weapon. Cougar may also be hunted with a 22 caliber or larger centerfire rifle.
General C	Nov. 20–30, 2004	GMUs 101-121, 203, 204, 209-247, 249-251 within Chelan, Okanogan, Ferry, Stevens, or Pend Oreille counties.	Archery deer or elk hunters and muzzleloader deer or elk hunters may hunt for cougar during their respective deer or elk seasons and must use equipment consistent with their deer or elk tag.

survival and reproduction.

Project CAT – Central and Western WA

In 2001 WDFW and the Cle Elum-Roslyn School District began a cooperative research and education program known as Project CAT (Cougars and Teaching). The scientific objectives are to investigate changes in cougar travel patterns, habitat use, and predation events as residential and recreational development transform this once rural community. The education objectives are to provide K-12 students with an experiential curriculum, which focuses on the local environment and the changes occurring, with the capstone species being the cougar. Elementary students are involved with incorporating themes about cougar ecology into art and language classes. Middle and high school students participate in captures of cougars and marking them with GPS collars. The students help analyze movements of cougars using GIS and help with necropsies. We have captured and marked 23 cougars (14 male and 10 female). We have obtained more than 16,000 GPS locations from these cougars. In 2004 a second phase of Project CAT began in cooperation with the Tahoma School District of western Washington where we have marked 5 cougars with GPS collars and placed VHF collars on 4 others. Project CAT is planned to proceed for another 4 years to track responses of cougars to development at both study sites. 4M, 5F,

University of Washington –-Central WA

In 2002, WDFW initiated research titled Cougars and Citizen Science (as part of Project CAT) to examine the ability of citizen scientists to collect credible scientific data and information on wildlife and their habitats. Research formally began in September of 2002 with the work being carried out by Brian Kertson, a graduate student with the Washington Cooperative Fish and Wildlife Research Unit at the University of Washington. To date, approximately 200 K-12th grade student volunteers of the Cle Elum/Roslyn School District have actively participated in cougar research activities. Citizen scientists have conducted track transect surveys during the winter to assess wildlife distribution near their homes with a focus on cougars and their primary prey, elk (*Cervus elaphus*) and mule deer (*Odocoileus hemionus*). In the spring, citizen scientists quantify and characterize wildlife habitat within the study area. Beyond the assessment of data quality, the participation of these citizen scientists has the added benefits of generating increased public awareness of cougar management and research. The anticipated completion date is September 2005. A poster presentation abstract can be seen on page 199 of these proceedings.

Washington State University – Northeast WA

Since 1998, students from WSU have studied cougar populations in northeast Washington in collaboration with WDFW. Catherine Lambert (Ph D.) presented findings from her research at the last workshop titled "Cougar population dynamics and viability in the Pacific Northwest". In 2002, Hugh Robinson (Ph D. candidate) began studying prey selection and functional response of cougar. This research focuses on testing the apparent competition hypothesis and the prey-switching hypothesis and how that relates to an increase in white-tailed deer and a decrease in mule deer in northeast Washington. Since 2002, WSU has captured and/or monitored 38 cougars (21 adult females, 2 juvenile females, 7 adult males, 8 juvenile males). From the 38 captures, 17 mortalities have been documented; 16 cougar are still being monitored. In 2004, WDFW initiated a whitetail reduction permit hunt with the hopes of reducing white-tailed deer (primary prey) in a controlled replicated experiment to gauge the population response of mule deer (secondary prey) and cougar (primary predator of both species). Members of the public viewed the hunt negatively and ultimately only 53 of 200 tags issued were filled. Therefore, no change in either population was detectable and that aspect of the project will not be repeated in 2005. Thanks to a recent National Science Foundation grant obtained by WSU, project personnel are replacing all VHF radiocollars deployed on cougars with GPS collars. Hugh plans to complete his research by August 2006. Hilary Cruickshank finished her M.S. research that focused on estimating prey availability using sightability-corrected dynamic ground counts (see her manuscript abstract on page 147 of this proceedings). In fall 2004, she was accepted as a Ph D. candidate and will study the effects of trophy hunting on large carnivore populations and community ecology. Her research focuses on 2 goals; first, to study infanticide in two treatment areas: one heavily hunted area (northeast WA), and one lightly hunted area (central WA); second, to test two competing hypotheses of wildlife management strategies, the "food competition" or "surplus male" hypothesis (which forms the basis for much of modern management) and the "sex competition" hypothesis (an alternative model for effects of male mortality in carnivores). To accomplish this, she will test predictions on 5 responses: male aggregative response (males/unit area), female functional response (kills/unit time/female), female numerical response (offspring/female), female population growth, and predator total response (# kills/unit area/unit time). Her expected date of completion is 2008.

Cougar Education

In 2004, WDFW launched a new cougar awareness campaign. The impetus for this program came about from a series of meetings held throughout the state to receive public input on big game management and regulations. Attendees providing general comment felt WDFW should do more to inform the public about cougars, avoid conflict, and how to contact WDFW should a conflict situation or sighting occur. In response, WDFW developed education materials using many commonsensical media types (Figure 2). These materials include vehicle trash bags, refrigerator magnets (customized by 1 of 6 regions), window stickers, an educational brochure, a wallet card with phone numbers and information on cougar encounters, and kiosk signs warning hikers to be aware they are entering cougar country. Along with general distribution, wildlife officers and biologists responding to cougar sightings are using these materials by placing them into the vehicle trash bag and distributing them to dwellings within sighting areas. The items placed in the bag are convenient for distribution and allow the materials to be placed on doorknobs of households where nobody was present at the time of visitation; a standard letter explaining the cougar sighting is also included in the packet.

In conjunction with the education materials, WDFW is conducting a series of cougar education workshops being held in 6 areas throughout the state. These workshops will be conducted by cougar specialists and are designed to provide information, answer questions on avoiding conflict, and generate media attention on cougar awareness.

LITERATURE CITED

BEAUSOLEIL, R. A., D. A. MARTORELLO AND R. D. SPENCER. 2003. Washington cougar status report. Pages 60-63 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.

LAMBERT, C.M., R. B. WIELGUS, H. S. ROBINSON, D. D. KATNIK, H. S. CRUICKSHANK, R CLARKE, AND J. ALMACK. Cougar population dynamics and viability in the Pacific Northwest. Journal of Wildlife Management: *in press.*

MARTORELLO, D. A., AND R. A. BEAUSOLEIL. 2003. Characteristics of cougar harvest with and without the use of dogs. Pages 129-135 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.

WASHINGTON DEPARTMENT OF FISH AND WILDLIFE. 2003. Game Management Plan, July 2003 –June 2009. Olympia,

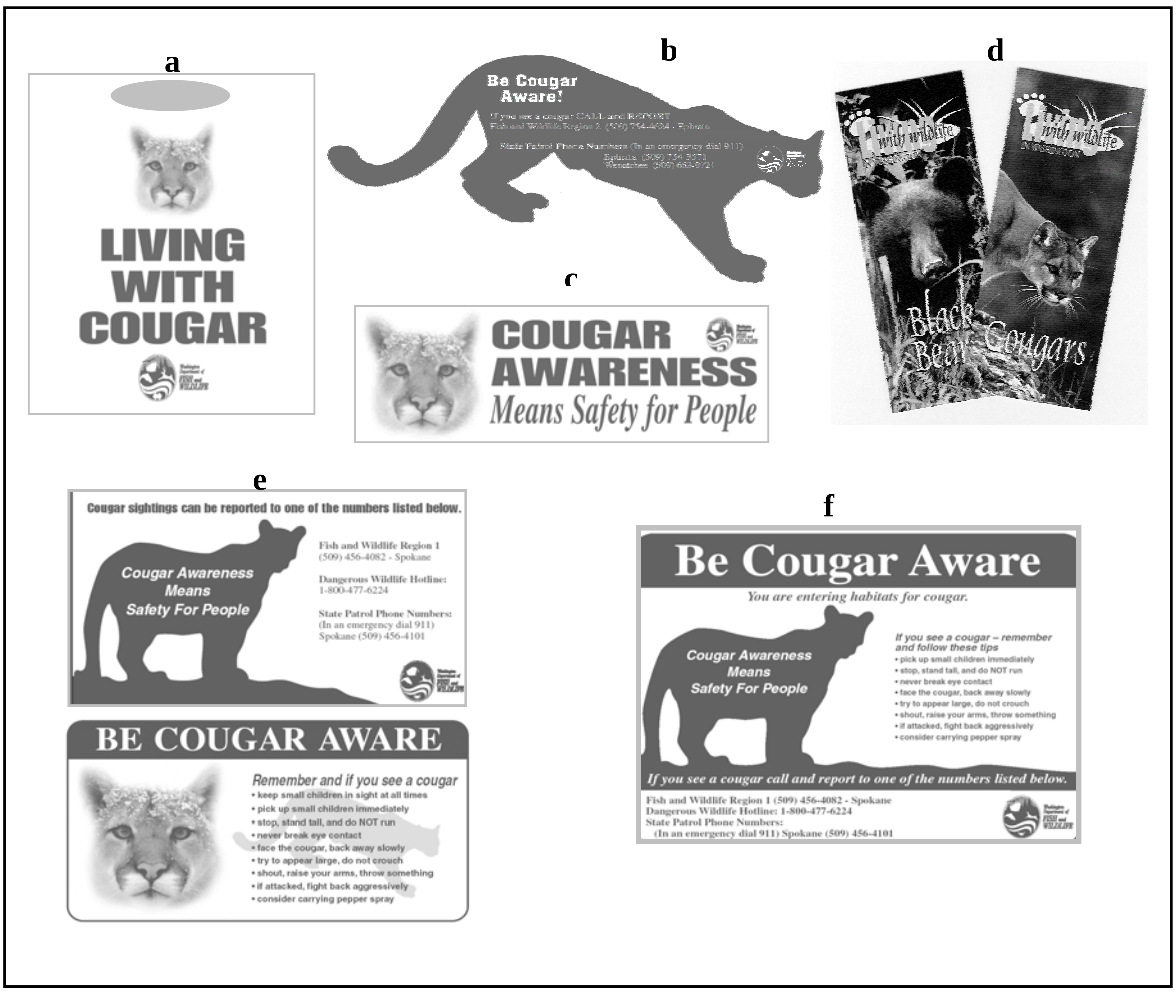

Figure 2. Education materials developed to increase public awareness of cougars in Washington including (a) vehicle trash bag, (b) refrigerator magnet, (c) window sticker, (d) Living with Wildlife pamphlets, (e) wallet card, and (f) kiosk sign, Washington Department of Fish and Wildlife, 2005.

OREGON MOUNTAIN LION STATUS REPORT

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Mountain Lion Workshop 8:11-16

INTRODUCTION

Cougar (*Puma concolor*) occur at varying densities across the majority of the Oregon landscape (Figure 1). Persecuted to near extinction by the mid 1960's, the then Oregon State Game Commission was given management authority by the 1967 Oregon Legislature. Oregon's first Cougar Management Plan was developed in 1987 with revisions in 1993 and 1998. Recent management under the 1993 plan has been directed by three primary goals: 1) Recognize the cougar as an important part of Oregon's wildlife fauna, valued by many Oregonians, 2) Maintain healthy cougar populations within the state into the future, and 3) Conduct a management program that maintains healthy populations of cougar and recognizes the desires of the public and the statutory obligations of the Department. Currently, the Department is in the process of revising Oregon's Cougar Management Plan to guide management for the next five years.

HUNTING SEASONS AND HARVEST TRENDS

Cougar hunting in Oregon has seen a number of dramatic changes in the last decade. From 1970 through 1994, cougar hunting was extremely limited in both number of hunting opportunities and available area for hunting. During this period the use of hounds was a legal method for hunting. However, a citizen ballot initiative (Measure 18) passed in 1994 that made it illegal to use hounds for hunting. Use of hounds by agency personnel was specifically exempted from the prohibition of hounds for cougar hunting. Cougar hunting season subsequently switched from relatively short seasons (about 3months) with a few relatively successful hunters to an expanded (10 months in 2004), general season with unlimited tag sales and much less effective hunters. Harvest quota zones (Figure 1) also were implemented as a measure to help distribute hunting pressure. Further, the Oregon legislature has reduced the price of a cougar tag and included cougar tags as part of an extremely package deal that has increased total tags in the field from 500-600 to over 34,000 (Figure 2). Hunter success rates dropped from 40-50% through 1994 to about 1% in 2004 with <96% of the harvest occurring incidental to deer and elk hunting. Although Oregon did see a dramatic drop in total harvest of cougars immediately following Measure 18, the net effect of increased tag numbers and expansions in season dates and area has been a subsequent increase in harvest to levels slightly greater than observed prior to the initiative (Figure 3). As a result of changes to hunting season structure, Oregon has seen a change in characteristics of harvested cougars. Prior to 1994, hunters tended to be more selective for males (Table 1) and tended to take older animals (Table 2).

Population Status and Trend

Status of cougar populations in Oregon is monitored using a computer model (Keister and Van Dyke 2002), characteristics of the harvest, and trends in

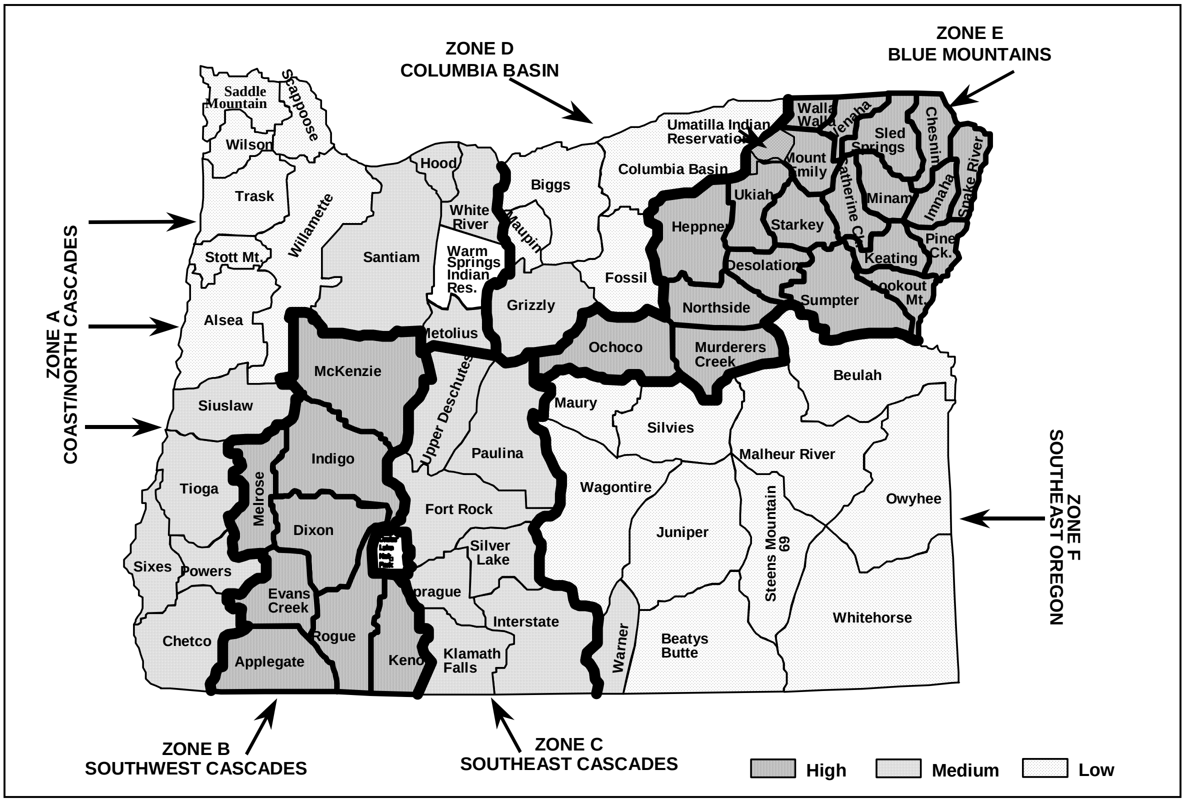

Figure 1. Current distribution and relative density of cougar in Oregon by Big Game Management Unit and Harvest Quota Zone.

non-hunting incidents. Modeled population trend continues to increase (Figure 4). However, as total mortality has increased, growth rate in the modeled population has declined slightly (Figure 5). The existing model is currently being evaluated for application at a regional scale.

HUMAN CONFLICT

Number of incidents of human–cougar conflict continues to increase in Oregon (Figure 6). Human safety concerns (40–60%) and livestock complaints (16–39%) are the dominant form of incident reported. Number of cougars killed as a result of conflict with humans also has increased (Figure 3). However, with recent legal changes limiting reporting capabilities by federal agencies, number of incidents reported in Oregon is likely conservative. Further, recent changes in recording protocols in Oregon also suggest the number of incidents reported as just a cougar sighting is also increasing (from 15% in 2000 to 38% in 2004).

MANAGEMENT CONCLUSIONS

In general, the Department feels cougar populations are increasing throughout the state of Oregon. Concurrent with cougar population changes, level of conflict is increasing. The department is currently revising it Cougar management plan with projected final Commission adoption in December of 2005. The Department’s desire is to have a plan that will establish clear management goals for the species and provide the tools to reach management goal while addressing the issue of human–cougar conflict.

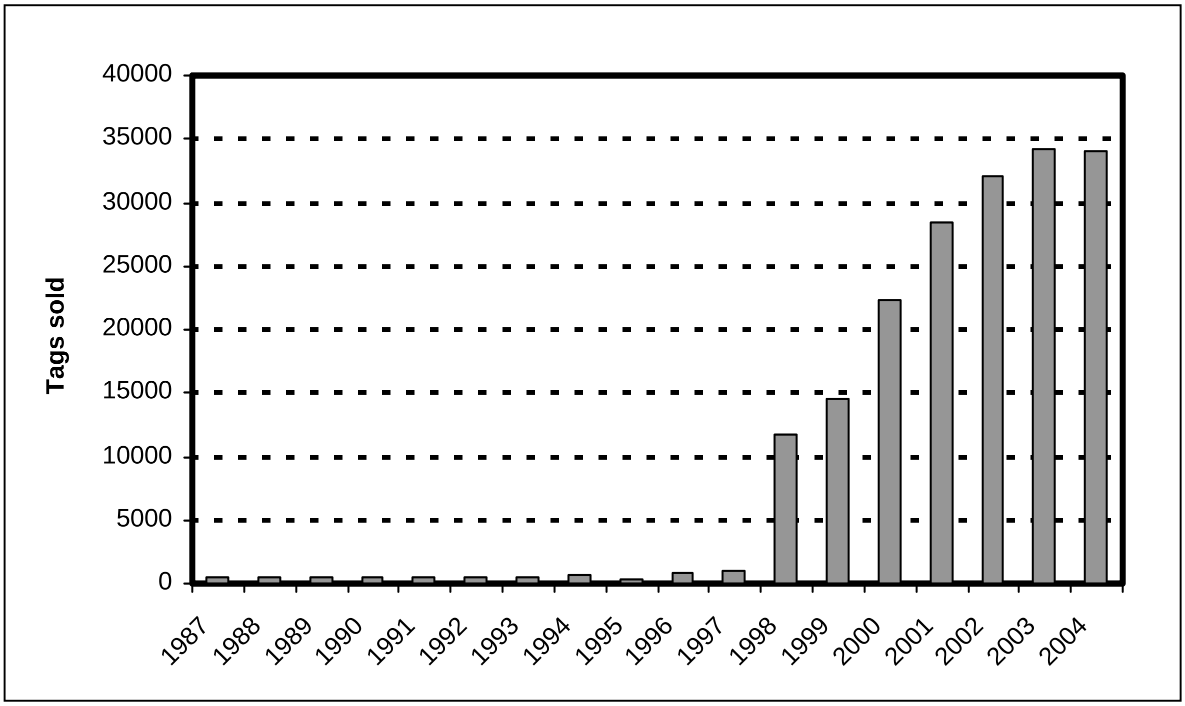

Figure 2. Trend in cougar tag sales for Oregon, 1987–2004.

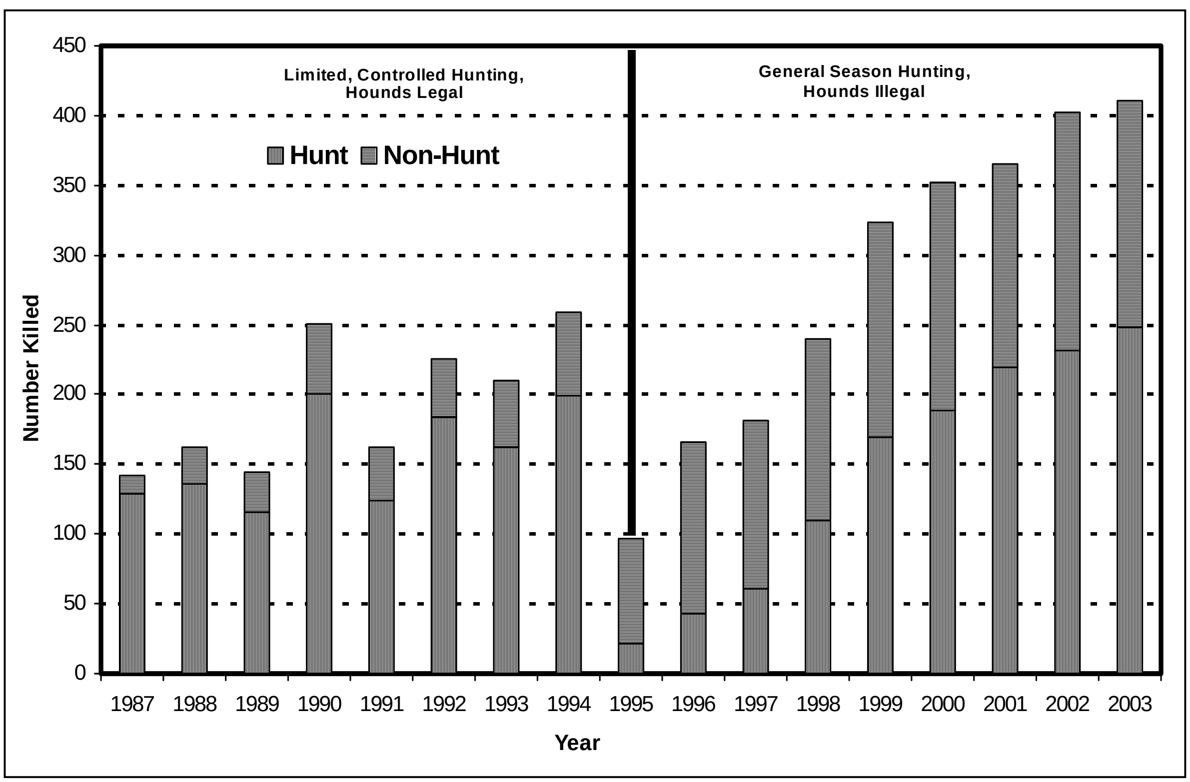

Figure 3. Trend in known cougar mortality in Oregon, 1987–2003.

Table 1. Gender distribution of puma mortality in Oregon before (1987–1994) and after Measure 18 (1995–2003).

		% Male		% Female	
Source	Zone	Pre	Post	Pre	Post
Hunting	A Coast–N Cascades	62.0	54.0	38.0	46.0
	B SW Cascades	61.0	52.0	39.0	48.0
	C SE Cascades	67.0	51.0	33.0	49.0
	D Columbia Basin	100.0	56.0	0.0	44.0
	E Blue Mountains	57.0	46.0	43.0	54.0
	F SE Oregon	60.0	53.0	40.0	47.0
Non-Hunting	A Coast–N Cascades	57.0	56.0	43.0	44.0
	B SW Cascades	57.0	60.0	43.0	40.0
	C SE Cascades	88.0	75.0	13.0	25.0
	D Columbia Basin	100.0	63.0	0.0	38.0
	E Blue Mountains	55.0	53.0	45.0	47.0
	F SE Oregon	67.0	69.0	33.0	31.0
Combined	A Coast–N Cascades	61.0	55.0	39.0	45.0
	B SW Cascades	61.0	56.0	39.0	44.0
	C SE Cascades	73.0	60.0	27.0	40.0
	D Columbia Basin	100.0	59.0	0.0	41.0
	E Blue Mountains	56.0	49.0	44.0	51.0
	F SE Oregon	67.0	58.0	33.0	42.0

Table 2. Measures of location and central tendency (N=sample size, $\bar{x}$ = average age, M=median age) for ages of known cougar mortalities in Oregon by quota zone, 1987-2003.

		Female						Male					
		1987–1994			1995–2003			1987–1994			1995–2003		
Type	Quota Zone	N	$\bar{x}$	M	N	$\bar{x}$	M	N	$\bar{x}$	M	N	$\bar{x}$	M
Hunt	A	38	4.0	4.0	89	2.2	2.0	61	4.3	4.0	104	2.8	2.0
	B	198	3.6	3.0	90	2.9	2.0	319	3.7	3.0	98	3.2	3.0
	C	9	4.9	3.0	38	3.6	2.5	18	5.2	5.0	41	3.7	4.0
	D	0			22	3.3	4.0	3	5.3	5.0	28	3.4	3.0
	E	234	4.3	3.0	262	3.5	3.0	308	4.5	4.0	226	3.8	3.0
	F	2	1.5	1.5	72	3.3	2.0	3	7.3	8.0	81	3.9	3.0
Non-Hunt	A	31	3.0	1.0	148	2.7	2.0	41	3.9	3.0	188	2.4	2.0
	B	46	2.5	2.0	125	1.8	1.0	62	2.8	3.0	184	2.1	2.0
	C	1			12	3.5	2.0	7	3.6	4.0	36	3.6	2.5
	D	0			9	1.8	1.0	2	7.0	7.0	15	3.2	3.0
	E	33	3.3	2.0	135	3.9	3.0	41	4.4	3.0	155	3.2	2.0
	F	2	2.5	2.5	25	3.1	2.0	4	5.3	5.5	55	3.3	3.0
Both	A	69	3.6	3.0	237	2.5	2.0	102	4.1	3.0	292	2.5	2.0
	B	244	3.4	3.0	215	2.3	2.0	381	3.6	3.0	282	2.5	2.0
	C	10	5.2	4.5	50	3.6	2.0	25	4.8	5.0	77	3.7	3.0
	D	0			31	2.9	2.0	5	6.0	6.0	43	3.3	3.0
	E	267	4.2	3.0	397	3.6	3.0	349	4.5	4.0	381	3.5	3.0
	F	4	2.0	1.5	97	3.2	2.0	7	6.1	7.0	136	3.6	3.0

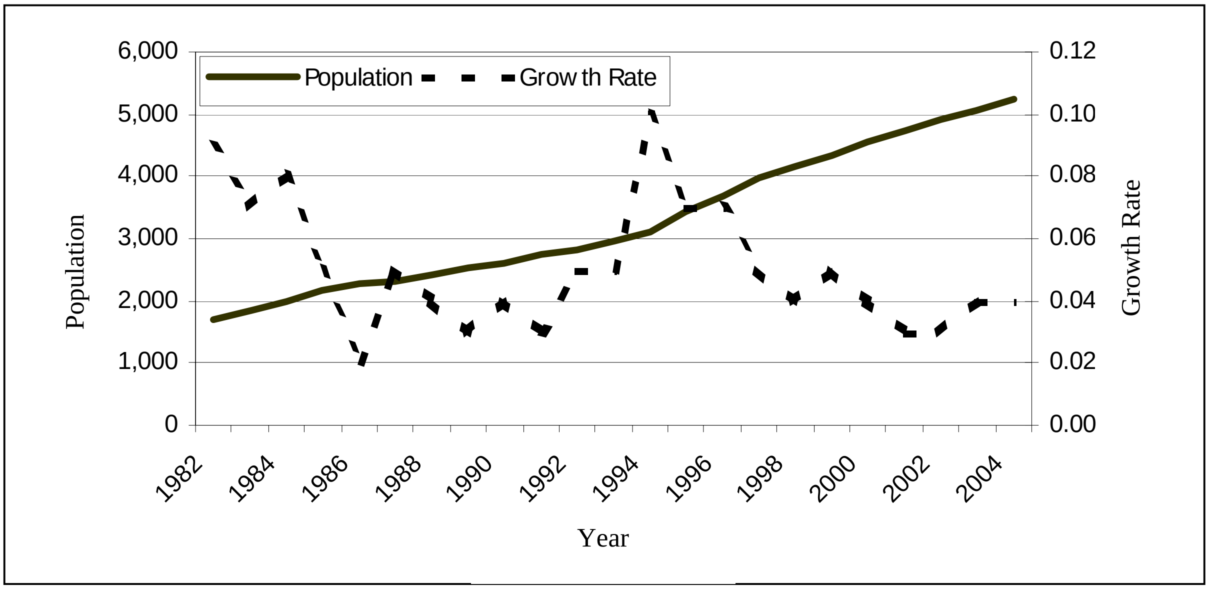

Figure 4. Modeled (Keister and Van Dyke) cougar population growth in Oregon, 1982–2004.

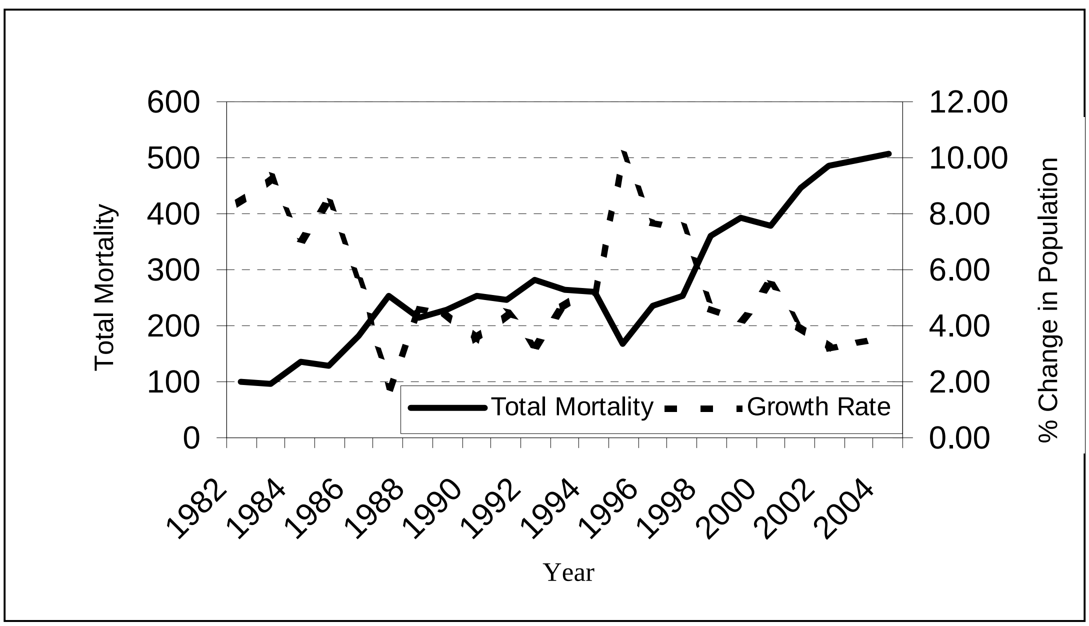

Figure 5. Total harvest and modeled cougar population growth rate in Oregon, 1982–2004.

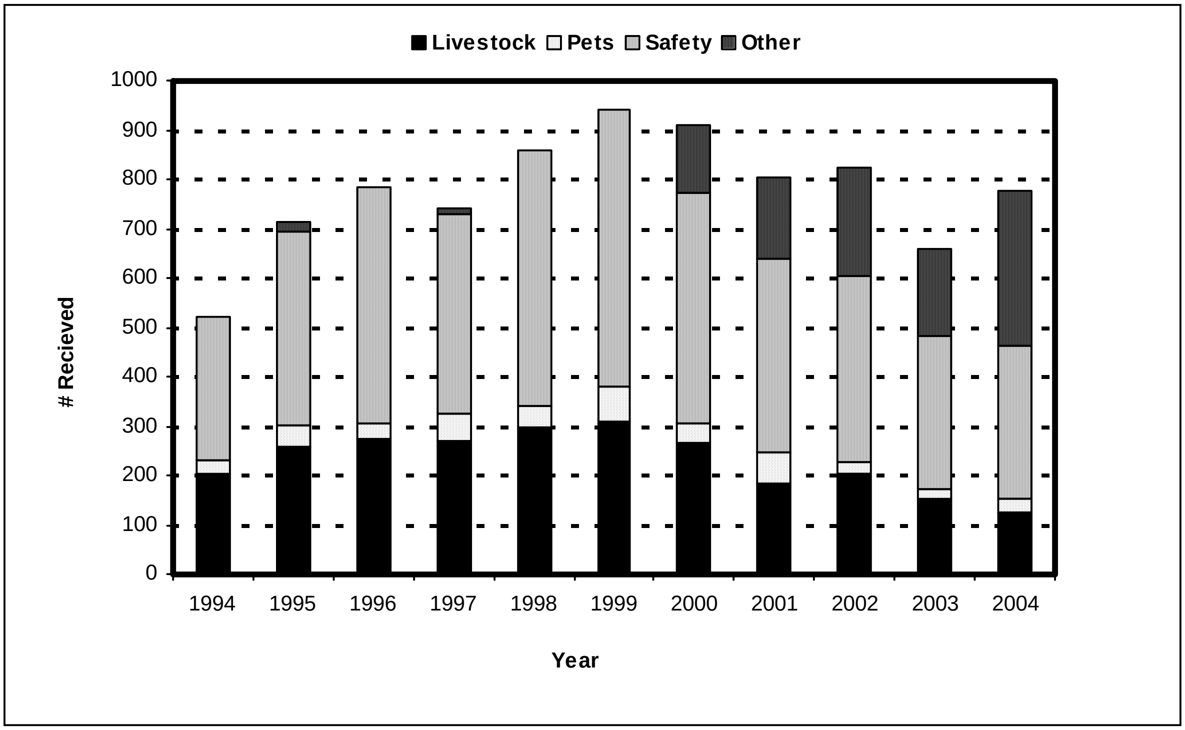

Figure 6. Trend in incidents of human-cougar conflict for Oregon, 1994–2004.

IDAHO MOUNTAIN LION STATUS REPORT

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Mountain Lion Workshop 8:17-21

INTRODUCTION

Lions were classified as big game animals in 1972. The 1990 Mountain Lion Management Plan, called for the reduction in harvest of female lions, and to maintain a harvest of approximately 250 lions statewide. However, lion harvest peaked statewide during the 1997-98 season when 798 lions were harvested. Consequently, a new lion plan was developed to address the changes in the populations and allow more hunting opportunity. Idaho completed the latest Mountain Lion Management Plan in 2002. The lion plan called for maintaining current lion distribution statewide as a goal. However, individual regions could adjust harvest to either increase or decrease populations depending upon the objectives for that area. Seasons were made more lenient, running from August 30 – March 31 in most units. In some areas, 2-lion bag limits were initiated. Hounds were allowed in most units, and non-resident hound hunting was expanded. Female quotas were still used in most of the southern part of the state until 2005 when quotas remained in only 21 of 99 units.

HISTORY

The legal status and public perception of mountain lions in Idaho has changed over time. In the late 1800's and early 1900's, mountain lions and other predators such as wolf, coyote, grizzly and black bears were perceived as significant threats to livestock and human interests and were systematically destroyed. Between 1915 and 1941, hunters employed cooperatively by the State, livestock associations, and the Federal Government killed 251 mountain lions in Idaho; the take by private individuals is not known. During the period 1945-1958, bounties were paid for mountain lions in Idaho with an annual average of 80 mountain lions turned in for payment (Figure 1). The 1953-54 winter yielded the highest recorded bounty harvest of 144 mountain lions (Figure 1). Bounty payments ranged from $50 in the early 1950's to $25 per lion during the last 4 years of payments.

Mountain lion sport harvest became increasingly popular after 1958. Average annual harvest was estimated at 142 lions from 1960 through 1971 (Figure 2). During this period there were no restrictions or regulations on the harvest of mountain lions. An estimated 303 lions were harvested during the 1971-72 season.

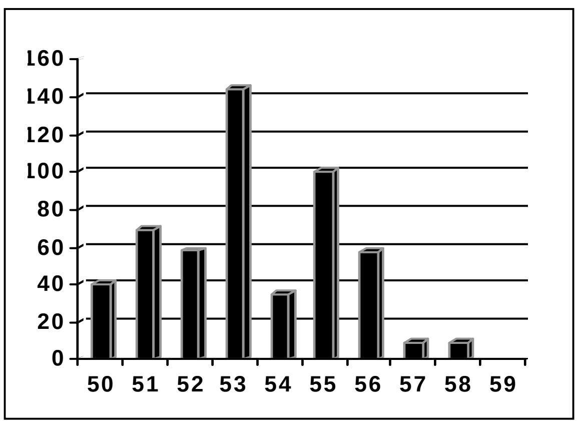

Figure 1. Mountain lion bounty records, 1950 – 1959. From 1950-1954 bounty was $50 per lion; 1955-1959 the bounty was $25 per lion.

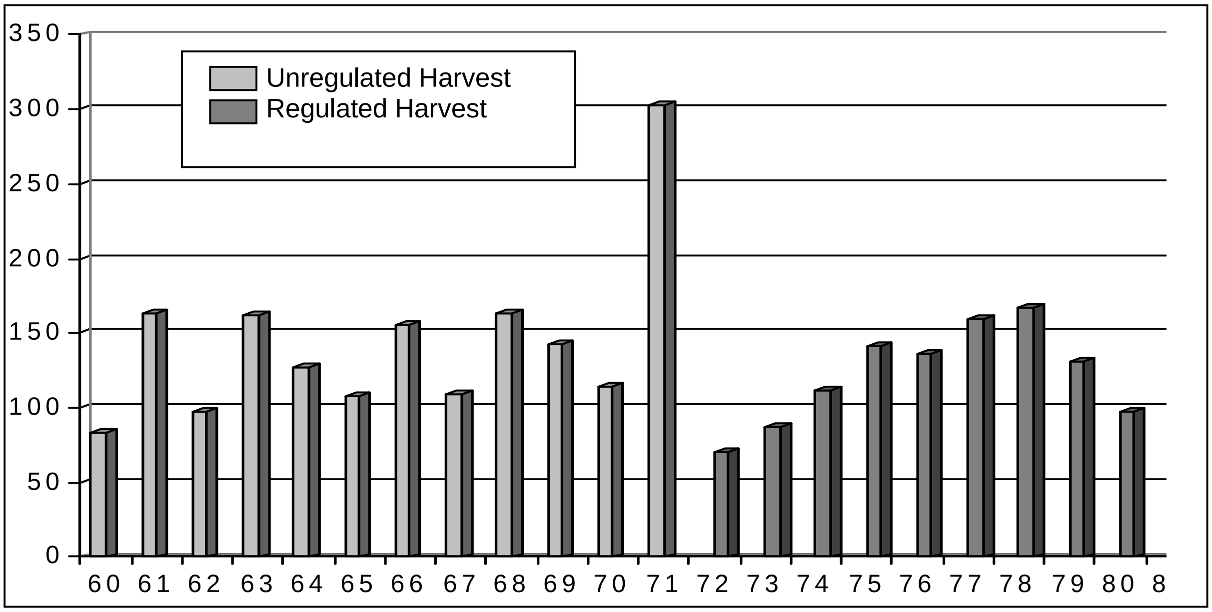

Figure 2. Unregulated mountain lion harvest from 1960-71, and regulated harvest in Idaho from 1972 -1981.

Research conducted by Maurice Hornocker in the Frank Church River of No-Return Wilderness from 1964-1973 added significantly to our knowledge. As a result of the research, the mountain lion was reclassified as a big game animal in 1972. Harvest was then able to be regulated and resulted in some closed units, bag limits, and shortened seasons. Mandatory reporting was started in 1973, and a tag has been required since 1975.

Populations of elk and deer continued to increase across the state during the 1980's and early 1990's, and the resulting mountain lion population did as well. The apparent increase in lion populations allowed the department to increase opportunity for harvest. Harvest continued to increase as a result of liberalized seasons and increased populations and peaked during the 1997-98 season (Figure 3). However, harvest has declined steadily since the peak, and in 2003 and 2004, harvest was about half of the historical high of 1997. Harvest declined despite liberalized seasons, likely a result of declining populations.

DISTRIBUTION AND ABUNDANCE

Lions were distributed across most of the suitable habitat in the state. Management tended to keep lion populations at a low density in developed areas or areas with high road density. However, most of the areas that received high harvest lay adjacent to lightly roaded reservoir areas that seemed to continue to provide dispersing animals. Distribution appeared to be somewhat stable, though overall abundance apparently declined. Mountain lions harvest was reported in most counties across Idaho. As deer and elk winter ranges get developed, residential areas now interface with wildlife habitat. Some conflicts with lions result.

Population estimates have not been made for Idaho in recent years, though some radio collaring mortality information in Idaho indicated a high rate of sustainable harvest in some areas. Given an estimated harvest rate statewide of approximately 20%, we would back calculate and estimate a state population of about 2,500 lions. Research has been ongoing to attempt to develop a population index; however,

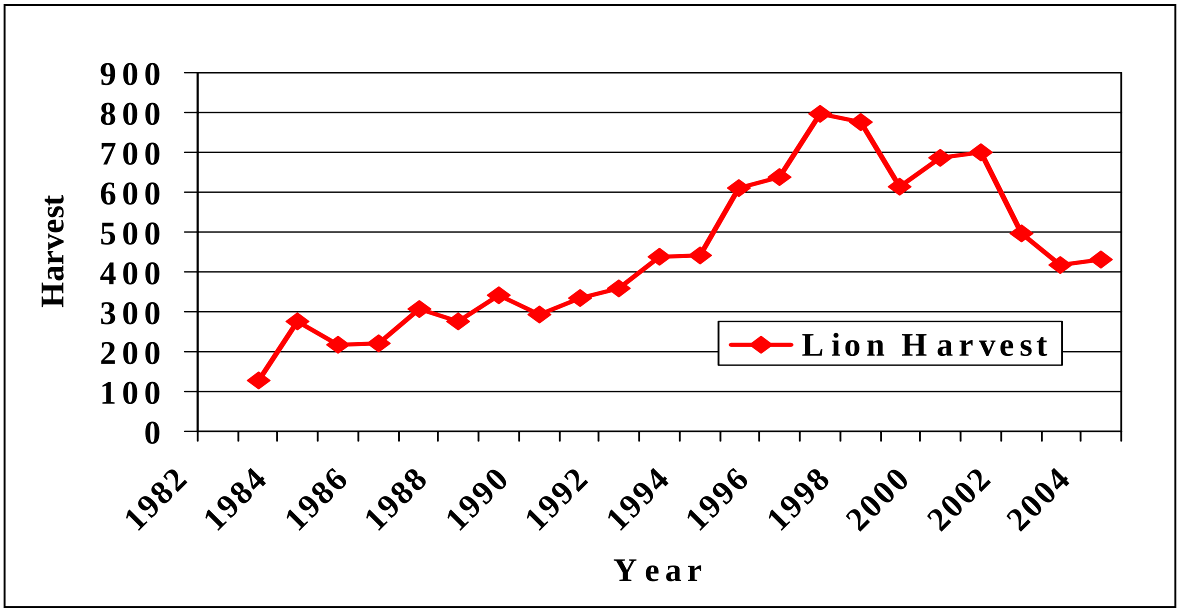

Figure 3. Statewide mountain lion harvest in Idaho.

nothing has been finalized (Zager et al. 2002). All lions legally harvested must be reported. Pelts were tagged and a premolar was removed for aging. Prior to 2000, lion ages were estimated using tooth drop measurements. Based on various tests, tooth sectioning replaced tooth drop as a more reliable estimate of age and has been used since 2000. For data analysis purposes, units were grouped by similar characteristics into Data Analysis Units (DAUs). Age data and harvest rates were used to attempt to identify population trends for a lion by DAU. Populations modeling using these harvest data were used to estimate population demographics and relative abundance.

HARVEST INFORMATION

Lion harvest increased steadily through the 1980's and 1990's and peaked at 798 mountain lions harvested in 1997-98. Lion harvest declined in most areas of the state following the 1997 season despite a liberalized lion hunting season in most of the state (Figure 3).

There were 99 big game management units in Idaho, which were grouped into 18 mountain lion management DAUs. Until 2003, the southern part of the state was predominantly managed under a female quota system, and the northern part of the state was mostly general hunts with most seasons running from August 30 – March 31. Quotas and seasons were set by unit or DAU, usually based on historical harvest rates, big game objectives, depredations, perceived lion population condition, lion hunter success rates and perceptions, public input, and commission desires. Over the last 3 years, general seasons replaced quotas in 33 units, so that in 2005 only 22 units still had female quotas. Many of the quotas were removed in areas where the quotas were seldom reached, or in areas where deer or elk population objectives were not being met. Comparing harvest in units with quotas versus those without indicated that older class lions were more frequently harvested in quota units (Figure 4). Quotas are popular among most hound hunters.

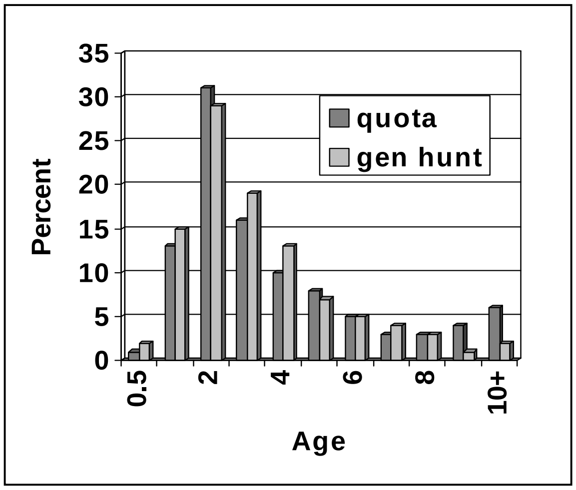

Figure 4. Statewide age structure comparison between quota and general hunt units of lion harvest in Idaho.

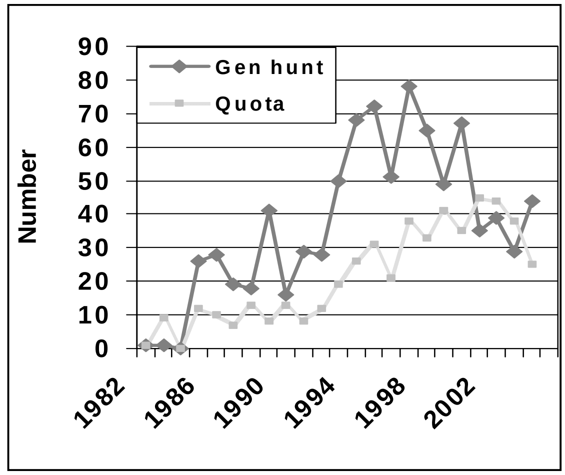

Figure 5. Statewide age structure comparisons between quota and general hunt units of lion harvest in Idaho.

Incidental harvest may be another indicator of population changes through time if tag types, hunters, and seasons are held steady. Incidental harvest by hunters in search of other big game would typically be considered a product of a random encounter. Random encounters increase as populations of lions increase, or if populations of hunters increase. Incidental harvest in north Idaho general hunts peaked during the mid to late 1990's. The incidental harvest in southern Idaho quota hunts peaked a few years later (Figure 5).

Biological objectives for lions were not well established by DAU. Tooth removal for age data was attempted on all lions harvested. Harvest levels reflected in proportions of sex and age were described in Anderson (2003.) This technique was used to monitor and adaptively manage populations by attempting to grow or reduce populations through harvest management, and monitor resultant age/sex structures shifts in the harvest. Regional wildlife managers in the state were given a great deal of flexibility to be able to set objectives for a given DAU.

Hunting with hounds accounted for about 80% of the annual lion harvest in Idaho. The rest of the harvest occurred incidentally to other big game hunting (13%), spot and stalk (5%), or predator calling (1%). The use of electronic calls was allowed in 2 management units where predation was a concern and access was limited. Dogs were prohibited through much of the general deer and elk rifle seasons. Pursuit with dogs was allowed in units with female quotas once the quota was reached. In a few of these units, hunting for males was allowed once the female quota was reached.

Mountain lion tag sales increased 28% from 1998 – 2004, and in 2004 were at an all time high of 21,154 total tags sold (Table 1). Reduced prices, increased nonresident sales of special tags, and liberalized seasons and nonresident hound hunter regulations all added to increased sales. Additionally, in some parts of the state outfitters were engaged to increase harvest of lions to help reduce predation problems on elk and bighorn sheep. Also, non-residents can use their deer tag to kill a bear or mountain lion. In 2004, nearly 3,000 hound permits were

Table 1. Mountain lion tag sales in Idaho from 1998 through 2002.

Year	Resident Tags	Nonresident Tags	Total Tags Sold
1998	16,196	351	16,547
1999	17,072	813	17,885
2000	18,369	961	19,330
2001	18,561	888	19,449
2002	19,757	883	20,640
2003	19,832	725	20,557
2004	20,899	255	21,154

issued to resident and 135 to nonresident hound hunters.

DEPREDATIONS AND HUMAN CONFLICTS

Currently, Idaho law allows for killing lions or bears that are in the act of “molesting” livestock. This law also requires that lions killed in this fashion need to be reported to the Department. Idaho law also allows lions that are perceived as threats to human safety to be killed. Department policy provides that lions that have caused problems or have depredated should be captured and euthanized. Most depredations are reported to U.S. Wildlife Services and they handle the removal. Policy also provides that lions that present a threat due to proximity to residential housing or other area of human habituation or activity should be moved or chased in a preemptive fashion. Depending on the circumstance, if the animal has become habituated or caused problems, the lion can be destroyed. Orphaned kittens are not rehabilitated for release back into the wild.

Idaho averaged 3-4 safety related complaints annually from 1998-2004 and about 50% required capture or removal of a lion. There has been 1-recorded human injury in Idaho caused by lions, and that occurred in 1999 to a 13-year-old boy. However, close encounters and even stalking behavior is regularly recorded but seldom tolerated. Some lions live in or near populous areas, and will kill domestic animals as well as urban wildlife. Once problems arise, lions are usually destroyed. Transplanting of habituated or food conditioned lions is n`ot conducted.

Lion related depredations that required compensation averaged about 1-2 per year. Average annual compensation form 1998-2002 was $4717 for lion depredations on livestock. During that same time, 46 lions were removed due to depredation situations.

RESEARCH

The Department researched techniques for population monitoring in north central Idaho by conducting aerial track surveys (Gratson and Zager 2000), and a mark-recapture technique using rub stations and biopsy darts (Zager et al. 2004). These efforts have not yet been finalized.

LITERATURE CITED

ANDERSON, C. R., JR. 2003. Cougar ecology, management, and population genetics in Wyoming. Dissertation, University of Wyoming, Laramie, Wyoming, USA.

GRATSON, M. W., AND P. ZAGER. 2000. Elk ecology. Study IV. Factors influencing elk calf recruitment. Job No. 2. Calf mortality causes and rates. Federal Aid in Wildlife Restoration, Job Progress Report, W-160-R-26. Idaho Department of Fish and Game, Boise, Idaho, USA.

ZAGER, P., AND C. WHITE. 2004. Elk ecology: Study IV. Factors influencing elk calf recruitment. Progress Report, Project W-160-R-31. Idaho Department of Fish and Game, Boise, Idaho, USA.

MONTANA MOUNTAIN LION STATUS REPORT

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Mountain Lion Workshop 8:22-25

INTRODUCTION

In 1971, mountain lions (*Puma concolor*) in Montana were classified as a big game species. Historically, lions were a bountied animal from 1879 to 1962, an unclassified predator from 1963 to 1966, and a legislatively classified predator from 1966 to 1970 (Mitchell and Greer 1971:207-210).

Overall management direction is provided in the Montana Fish, Wildlife & Parks' (FWP) 1996 Environmental Impact Statement (EIS) – Management of Mountain Lions in Montana. According to the EIS, objectives concerning lion management are "… to maintain mountain lion and prey populations, to maintain mountain lion populations at levels that are compatible with outdoor recreational desires, and to minimize human-lion conflicts and livestock depredation."

DISTRIBUTION

Currently, mountain lions are distributed over approximately 75% of the state. Similar to other western states, Montana has shown a substantial increase in the distribution of mountain lion harvest over the last 30 years (Figure 1). Lions have filled habitats in western and central Montana and are continuing to expand in the eastern part of the state. Wildlife managers monitor lion trends through harvest/mortality data, tooth age information, damage/conflict reports, and information from houndsmen.

HUNTING SEASONS AND HARVEST TRENDS

Mountain lion harvest objectives are guided equally by concerns for human safety and the demand for sport hunting. Montana's 74 lion hunting districts are made up of one or more of the state's 155 deer and elk hunting districts (Figure 2). Harvest is

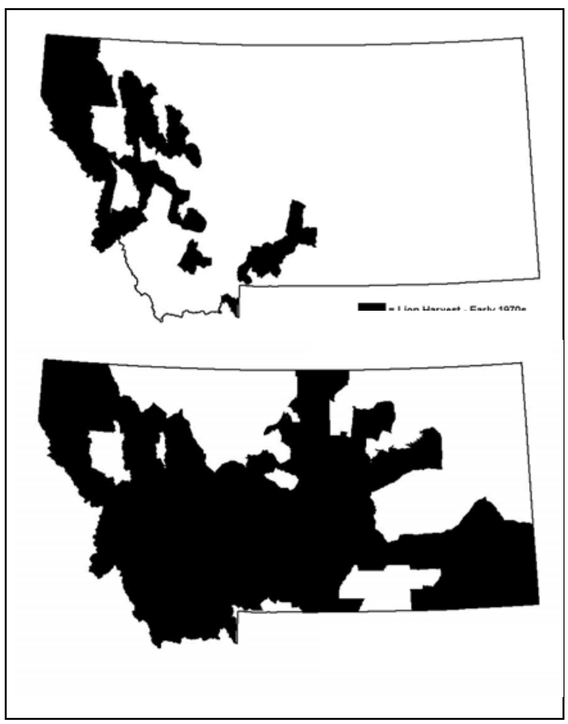


Figure 1. Distribution of mountain lion harvest in Montana, early 1970's vs. early 2000's.

Figure 2. Distribution of mountain lion hunting districts in Montana

regulated through quotas and permits, with hunters permitted to harvest only one lion per year. Quotas include any lion, male and female, and female sub-quotas. In 1999, Montana initiated a statewide fall lion season (last week of Oct. through Nov.) without the use of hounds. During the fall season, a hunting district closes when 20% of the winter season quota has been reached.

During the winter season (12/01 – 04/14), lion hunters may hunt with hounds. Additionally, all mountain lion license holders may pursue and chase lions, even within hunting districts where quotas have been reached. In northwest Montana, since 2001, nonresidents that are not booked with an outfitter must successfully draw a Nonresident Hunter Harvest Permit to harvest a lion while using dogs. Starting in 2003, Montana residents could purchase a $5 hound-training license. Montana Legislatures established this license in a statute, guaranteeing residents the opportunity to chase lions during the winter season.

Increasing interest in mountain lion hunting in Montana has resulted in a record number of license sales in 2004 (Table 1 and Figure 3). In recent years, nonresident hunters have made up less than 5% of the license sales, yet have accounted for 20-30% of the statewide lion harvest. Montana's lion harvest peaked in 1998 and has decreased over the last 6 years. During the same time period, quotas have also been reduced by 56% (Figure 4).

The total number of days hunters have spent lion hunting has ranged from 36,147 in 2002 to 27,153 in 2003. Since 1999, fall season harvests have ranged from ten to twenty lions annually. Overall, fall lion hunting averaged 3.1% of the total annual harvest, while accounting for approximately 25% of the total number of fall and winter lion hunters and lion hunter days.

Table 1. Trend in Montana mountain lion license sales, quotas and harvest

		License Sales			Harvest			
Year	Quota	Resident	Non-Res.	Total	Unk	Male	Female	Total
1994	505	2984	258	3242		348	218	566
1995	544	3056	270	3326		307	228	535
1996	653	3287	301	3588		317	250	567
1997	786	4297	394	4691		367	361	728
1998	868	5422	510	5932	8	351	417	768
1999	773	5886	519	6405		319	335	654
2000	706	5134	493	5627	10	286	288	574
2001	620	5116	421	5537		257	252	509
2002	581	6337	281	6618		219	188	407
2003	540	6130	281	6411		204	142	346
2004	483	6478	313	6791		209	126	335

DEPREDATION AND HUMAN INTERACTIONS / CONFLICTS

When dealing with different types of lion incidents, wildlife managers follow the criteria as stated in FWP's Mountain Lion Depredation and Control Guidelines. Depending on the situation, management actions may include educating the public, relocating the lion, or euthanizing the lion. Montana does not pay for livestock losses attributed to lions. Since 1998, Montana has experienced a substantial decline in incidents and removals (Table 2). These declines could be related to the state's lion harvest declining by over 50% during the same time period, as well as FWP's considerable effort to educate the public on living with lions.

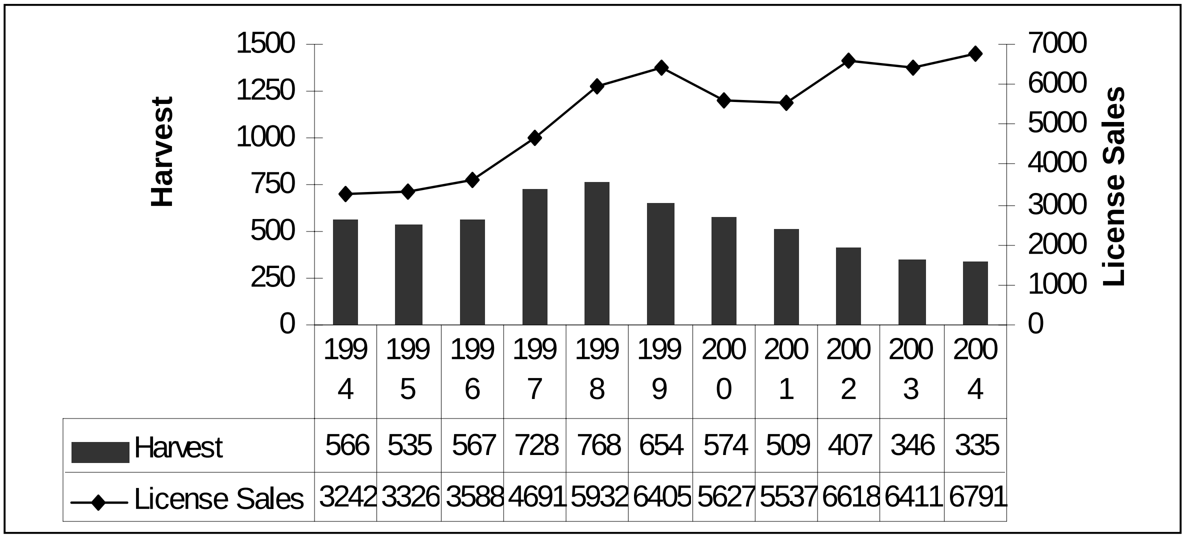
RESEARCH

Currently, FWP research biologists are conducting mountain lion research in the Garnet Mountains (1998 – Present). The goals of the project are to document the influence of hunting on population characteristics, as well as evaluate the ability of various survey techniques to detect trends in lion abundance. An update on this work is being presented at this year's lion workshop.

LITERATURE CITED

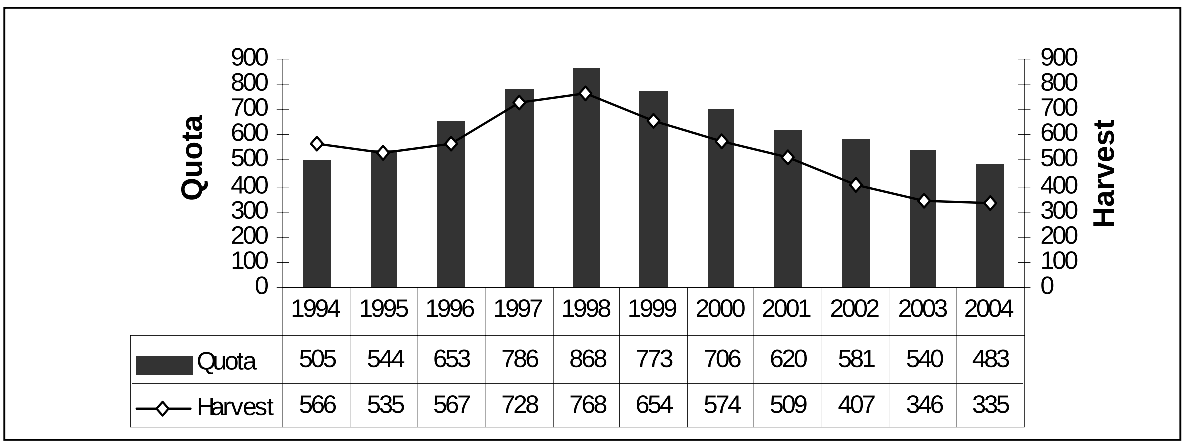
MITCHELL, J.L. AND K.R. GREER. 1971. Predators. Pp. 207-215 *in* T.W. Mussehl and F.W. Howell, editors, Game Management in Montana. Federal Aid Project W-3-C.Montana Fish and Game Department, Helena, Montana, USA.

MONTANA FISH, WILDLIFE & PARKS. 1996. Final Environmental Impact Statement – Management of Mountain Lions in Montana. Helena, Montana, USA.



	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Harvest	566	535	567	728	768	654	574	509	407	346	335
License Sales	3242	3326	3588	4691	5932	6405	5627	5537	6618	6411	6791

Figure 3. Trend in Montana's mountain lion license sales and harvest, 1994-2004.



	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Quota	505	544	653	786	868	773	706	620	581	540	483
Harvest	566	535	567	728	768	654	574	509	407	346	335

Figure 4. Trend in Montana's mountain lion harvest and quotas, 1994-2004.

Table 2. Montana mountain lion incidents and removals, 1998-2004

	1998	1999	2000	2001	2002	2003	2004
Incidents[a]							
Public Safety	41	18	37	30	20	26	20
Depredation[b]	58	44	35	37	29	23	16
Total	99	62	72	67	49	48	36
Removals							
Public Safety	20	2	3	5	2	3	2
Depredation[2]	30	20	20	11	14	7	6
Total	50	22	23	16	16	10	8

[a]Incident: A lion killing a dog or a lion that must be forced to back down.
[b]Depredation: Includes deaths of pets and death and injury of livestock

WYOMING MOUNTAIN LION STATUS REPORT

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Mountain Lion Workshop 8:26-33

INTRODUCTION

Management of mountain lions (*Puma concolor*) has changed markedly since the nineteenth century. In 1882, the Wyoming Territorial government enacted legislation placing a bounty on mountain lions and other predators. This allowed for lion hunting throughout the year and no bag limits were enforced. In 1973, the mountain lion was reclassified as a trophy game animal, which made the Wyoming Game and Fish Department (WGFD) fiscally liable for confirmed livestock losses. The following year, the first hunting season was established that included the entire state as a single hunt area, a bag limit of 1 lion per year was enacted, kittens and females with kittens at side were protected, and hunters were required to present skulls and pelts of harvested lions to the nearest WGFD District Office or local game warden.

In 1997, the WGFD prepared a draft management plan for mountain lions, but the plan has yet to be finalized. However, six main objectives outlined in the draft management plan continue to guide lion management objectives for the state of Wyoming, they are: (1) maintain mountain lion populations within suitable habitat throughout Wyoming; (2) provide mountain lion-related recreational opportunities; (3) minimize female lion harvest in areas where population stability or increase is desirable; 4) minimize mountain lion depredation and lion/human interactions; (5) tailor management objectives to conditions present within each Mountain Lion Management Unit (MLMU) where possible; and 6) implement more specific, quantifiable objectives within each MLMU as information on the state's lion population allows. Using these objectives as guidelines, the WGFD attempts to balance recreational demand and harvest with the biological needs of lion populations throughout the state. A state management plan will be prepared in the winter of 2005/2006.

DISTRIBUTION AND ABUNDANCE

Mountain lions are distributed throughout nearly all habitats in Wyoming although densities are not uniform. Lion densities are thought to be highest in the Bighorn, Owl Creek, and Laramie mountain ranges (Wyoming Game and Fish Department 1997), while some of the lowest densities may be found in the grasslands of northeastern Wyoming. In the Bighorn Mountains, Logan and Irwin (1985) found that mixed conifer and curl leaf mountain mahogany habitats were used most in relation to availability, whereas sagebrush grass habitat types were generally avoided.

In the Snowy Range Mountains of southeastern Wyoming, lions were found at lower elevations during the winter and concentrated their use near the timber/prairie interface (Anderson et al., in preparation).

HARVEST INFORMATION

Data on mountain lions are gathered annually among 29 hunt areas that are grouped into 5 MLMUs (Figure 1), the boundaries of which encompass large areas with contiguous topographic features and are believed to encompass population centers. Each hunt area has a maximum annual mortality quota that varies from 2-25, with 6 areas also having a maximum female mortality quota (Table 1). If either quota is filled, the hunting season in that hunt area automatically closes. Currently, hunting seasons open on September 1 and close on March 31 for all hunt areas except 15, 22, and 27, in which year round seasons exist. Quotas begin at the start of each hunting season and include all legal and illegal hunting mortalities.

Mountain lion data in Wyoming are limited to information obtained annually from harvest or other documented forms of mortality. Since 1974, hunters have been required to present the skull and pelt of harvested lions to a district game warden or biologist at the nearest WGFD regional office within 72 hours after the harvest. Information collected during these inspections include: harvest date, location, sex, lactation status, estimated age, number of days spent hunting, whether or not dogs were used, and number of lions observed while hunting. Skulls and pelts must be presented in an unfrozen condition so teeth can be removed. Evidence of sex must remain naturally attached to the pelt for accurate identification.

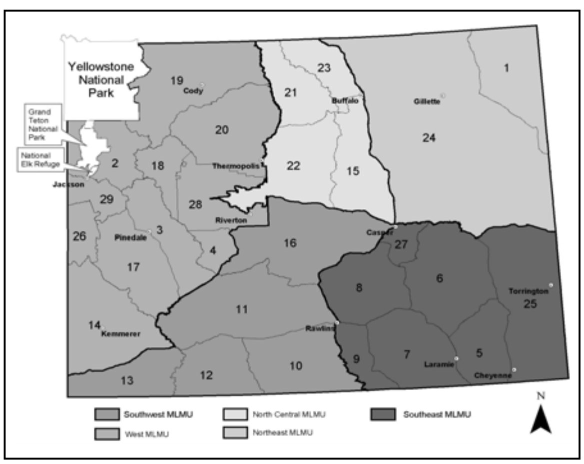

Figure 1. Mountain lion management units and hunt areas in Wyoming, 2005.

Legal shooting hours are from one-half hour before sunrise to one-half hour after sunset. The individual bag limit for lions is 1 lion per hunter per calendar year, except for 1 hunt area in central Wyoming, where 1 additional lion may be taken each calendar year. Kittens (<1 year of age) and females with kittens at side are protected from harvest. Dogs may be used to take mountain lions during open seasons only and non-harvest chase seasons are not allowed. Hunters are responsible for inquiring about season closures by calling a toll free telephone number prior to entering the field. A general hunting license can be purchased over the counter. In 2005, prices were $25.00 and $301.00 for residents and non-residents, respectively. In 2004 the Commission implemented an “additional “ license valid only in Hunt area 27, which allowed both residents and non-residents to purchase two licenses in a calendar year. The cost of the “additional” license is $16.00 for residents and $76.00 for non-residents.

Currently, the WGFD does not attempt to estimate lion populations. Rather, population trends are assessed through sex and age composition of harvest data (Anderson and Lindzey 2005). Management objectives are determined by balancing public demands (i.e., reduce lion-human/livestock conflicts, ensure adequate hunting or viewing opportunity) and biological requirements for sustainable lion

Table 1. Wyoming mountain lion management units, hunt areas, season dates, and quotas for harvest year 2005.

Mountain Lion Management Unit	Hunt Area	Season Dates	Annual Mortality Quota	Annual Female Mortality Quota
Northeast	1	Sept. 1-Mar. 31	12	
	24	Sept. 1-Mar. 31	4	
Southeast	5	Sept. 1-Mar. 31	12	
	6	Sept. 1-Mar. 31	25	
	7	Sept. 1-Mar. 31	15	
	8	Sept. 1-Mar. 31	10	
	9	Sept. 1-Mar. 31	5	
	25	Sept. 1-Mar. 31	3	
	27	Sept. 1-Aug. 31	20	
Southwest	10	Sept. 1-Mar. 31	6	
	11	Sept. 1-Mar. 31	2	
	12	Sept. 1-Mar. 31	6	3
	13	Sept. 1-Mar. 31	3	
	16	Sept. 1-Mar. 31	6	
North-Central	15	Sept. 1-Aug. 31	25	
	21	Sept. 1-Mar. 31	20	
	22	Sept. 1-Aug. 31	15	
	23	Sept. 1-Mar. 31	15	8
	2	Sept. 1-Mar. 31	7	6
West	3	Sept. 1-Mar. 31	8	4
	4	Sept. 1-Mar. 31	8	
	14	Sept. 1-Mar. 31	9	
	17	Sept. 1-Mar. 31	5	
	18	Sept. 1-Mar. 31	12	
	19	Sept. 1-Mar. 31	20	
	20	Sept. 1-Mar. 31	12	
	26	Sept. 1-Mar. 31	12	7
	28	Sept. 1-Mar. 31	3	
	29	Sept. 1-Mar. 31	9	4

populations. The sex and age composition of harvested lions is compiled and analyzed, statewide and for each MLMU, after seasons close. MLMU analysis allows wildlife managers to evaluate harvest within specific hunt areas and the effect of that harvest on the regional population. If observed trends are consistent with objectives set forth for each hunt area, changes in quotas are not recommended. However, if trends deviate from hunt area objectives, quota increases or decreases may be recommended for the following year.

Another technique that was used by the WGFD to cautiously gauge mountain lion population trends was the use of houndsmen surveys, which gave a more accurate measure of hunter effort since successful and unsuccessful hunters were included in the analysis. The survey requested the numbers and locations of lions harvested and released, number of days hunted in each hunt area, ages and sexes of lions harvested and released, numbers of lion tracks passed up, and opinions on perceived lion densities in the areas hunted. Data from these surveys were then compiled into an annual report and distributed to wildlife managers and houndsmen throughout the state. However, the surveys were discontinued in 2000 due to a lack of response from hound handlers.

Anderson and Lindzey (2005) investigated the sex and age composition of harvest as an index of mountain lion population trend. They observed that a reduction in subadult harvest, an initial increase followed by a reduction in adult male harvest, and a steady increase in adult female harvest (exceeding 25% of total harvest) characterized a declining population. Harvest composition was similar at high and low densities when harvest was light, but proportion of harvested subadult males increased at low density as they replaced adult males removed during the period of high harvest. Wildlife managers in Wyoming are presently incorporating this information into mountain lion harvest analyses to better assess mountain lion population trends. This will eventually aid in adjusting population objectives and, thus quotas, to ensure sustainable lion populations statewide.

Harvest increased from 1995 through 2003 and then decreased slightly in 2004 (Figure 2). Since 1995, the average percent of females in the harvest has been 45%, ranging from 41% in 1996 to 51% in 2000 (Figure 3). Over the last ten years, the percent of adults in the female harvest steadily declined from 62% in 1995 to a low of 25% in 2003 (Figure 4). This decline is likely due in part to a change in the criteria used to classify adults and subadults since the 2001 hunting season. Since 1995, hunter effort has ranged from 3.5 to 5.8 days per lion for an average of 4.1 days per lion. Approximately 90% of all successful hunters in Wyoming harvested lions with the aid of dogs from 1995 – 2004.

DEPEDATIONS AND HUMAN-LION INTERACTIONS/CONFLICTS

Currently, Wyoming uses a statewide protocol for managing trophy game depredations and interactions with humans. A depredating lion is defined as a lion that injures or kills livestock or domestic pets. In addition, 4 types of human/mountain lion interactions are defined by the WGFD, they are (1) recurring sighting – repeated sightings of a particular lion; (2) encounter – an unexpected meeting between a human and a lion without incident; (3) incident – an account of abnormal lion behavior that could have more serious results in the future (e.g., a lion attacking a pet, or a lion exhibiting aggressive behavior, without attack, toward humans); and (4) attack – human injury or death resulting from a lion attack. Each incident is handled on a case-by-case basis and is dealt with accordingly based on the location of the incident, the threat to human

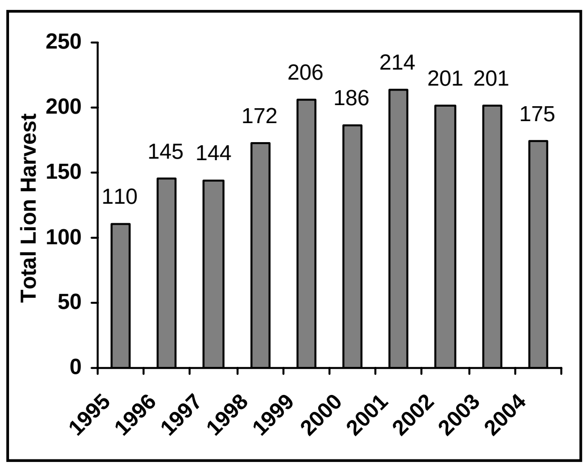

Figure 2. Total Wyoming mountain lion harvest, 1995-2004.

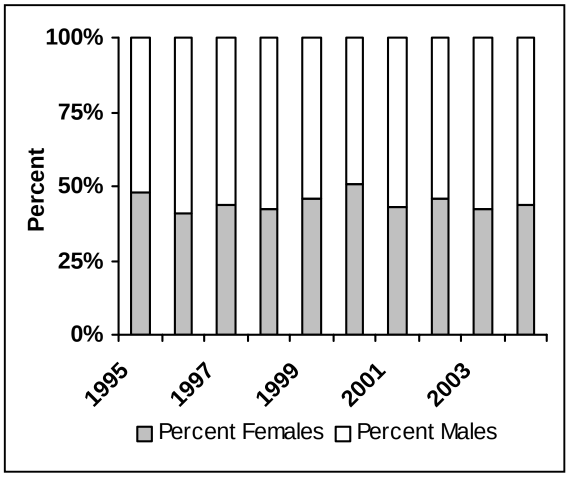

Figure 3. Percent male and female mountain lion harvest in Wyoming, 1995-2004.

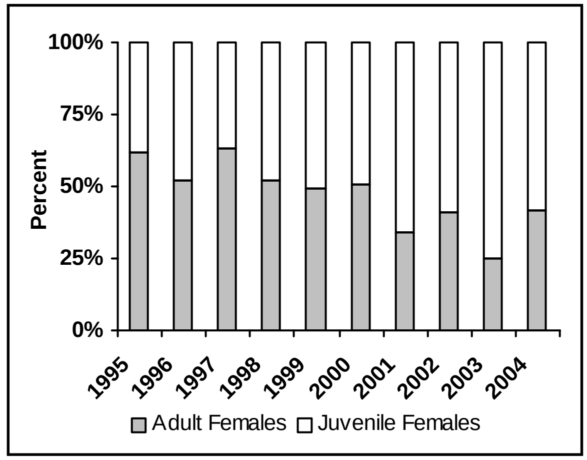

Figure 4. Percent adult and subadult female mountain lion harvest in the total female harvest in Wyoming, 1995-2004.

safety, the severity of the incident, and the number of incidents the animal has been involved in. Every effort is made to prevent unnecessary escalation of incidents through an ascending order of options and responsibilities:

1. No Management Action Taken – Informational packets are provided to the reporting party that describe mountain lion natural history and behavior, damage prevention tips, and what to do in the event of an encounter.
2. Deterrent Methods – Removal or securing of attractant, removal of depredated carcass, removal or protection of livestock.
3. Aversive Conditioning – Use of rubber bullets, use of pepper spray, use of noise making devices or flashing lights. Informational packets provided to the reporting party
4. Trapping and Relocation – If the above efforts do not deter the lion from the area, if public safety is compromised, if it is a first offense, or if it has been a lengthy span of time between offenses, animals may be trapped and relocated. Informational packets are provided to the reporting party
5. Lethal Removal of the Animal by the WGFD – If the above methods do not deter the lion, if public safety is compromised, or if the offending lion has been involved in multiple incidents in a short span of time. Wyoming statute 23-3-115 allows property owners or their employees and lessees to kill mountain lions damaging private property, given that they immediately notify the nearest game warden of the incident. Lions that have been removed from the population will be used for educational purposes. Informational packets provided to the reporting party

Education is a very important aspect of human and mountain lion interaction prevention. Therefore, the WGFD works closely with hunters, outfitters, recreationalists, livestock operators, and homeowners in an attempt to minimize conflicts with trophy game animals. Every spring, the WGFD hosts bear and lion workshops throughout the state to inform the public about bear and lion biology, front and back-country food storage techniques, and what to do in the event of an encounter with a bear or lion. In addition, numerous presentations are given throughout the year to civic, private, and school groups. Media outlets are also used to inform, and in rare incidents warn, the general public about bear and lion safety issues and any recent sightings.

Even with all the educational efforts undertaken by the WGFD and preventive measures taken by the public, conflicts with mountain lions do occur. The number of mountain lion conflicts have ranged from a low of 13 reported incidents in 2002 to a high of 64 reported incidents in 1997. There have been a total of 49 mountain lion/human interactions in Wyoming since 1996 with no major injuries or deaths reported.

Wyoming statute 23-1-901 provides monetary compensation for confirmed livestock damage caused by mountain lions. The number of damage claims for the last 10 years range from 11 in 1995 to 28 in 1998, and payments made to claimants range from a low of $22,627 paid in 1999 to a high of $44,071 paid in 1998 (Table 2). One hundred percent of the mountain lion damage claims paid in 2002 was for sheep depredations. From 1995 to 2003, 86% of reported lion depredations in Wyoming have involved sheep, 4% have involved horses, 6% unknown livestock species, and 4% have involved cattle. An average of 4.6 nuisance lions were removed annually in the last 10 years while an average of 1 lion was translocated annually from 1996 – 2002 (no translocation data available prior to 1996).

PUBLIC ATTITUDES

In 1995, the WGFD contracted with the Survey Research Center at the University of Wyoming to determine attitudes and knowledge of Wyoming residents on mountain lions and mountain lion management (Gasson and Moody 1995). Over 71% of the approximately 500 respondents believed lions were a benefit to Wyoming. Attitudes toward mountain lion hunting were generally supportive, with 49.6% agreeing or strongly agreeing that mountain lion hunting should continue and 29.3% disagreeing or strongly disagreeing. The remaining respondents were either neutral or did not answer. However, most

Table 2. Wyoming ten-year mountain lion damage claim and translocation/removal history (all causes).

Year	# Claims	$ Claimed	$ Paid	Translocations	Removals
1995	11	40,634.67	34,594.67	[a]	4
1996	14	28,540.96	24,947.95	0	6
1997	20	28,935.16	28,761.50	1	10
1998	28	56,171.39	44,070.79	2	5
1999	21	32,307.63	22,627.43	2	6
2000	20	42,352.69	30,773.59	0	5
2001	15	38,322.79	25,592.46	1	6
2002	13	35,870.99	32,075.05	0	2
2003	21	13,688.89	10,130.86	1	1
2004	[a]	[a]	[a]	0	1
Mean	18.1	35,202.80	28,174.92	0.77	4.6

[a] No data available.

(57%) disagreed or strongly disagreed that hunting lions with dogs should continue as a legal method of take. Only 25.3% of respondents agreed or strongly agreed, while the remaining respondents were neutral or did not respond to the question. A large majority of respondents (80.7%) agreed or strongly agreed that mountain lion hunting seasons should be modified to avoid harvesting kittens or running females with kittens. A large majority of respondents (71%) were also opposed to the use of dogs to run and tree lions during non-harvest, chase seasons.

RESEARCH AND PUBLICATIONS

ANDERSON, C.R., JR., AND F.G. LINDZEY. 2000. A photographic guide to estimating mountain lion age classes. Wyoming Cooperative Fish and Wildlife Research Unit, Laramie, Wyoming, USA.

ANDERSON, C.R., JR., AND F.G. LINDZEY. 2003. Estimating cougar predation rates from GPS location clusters. Journal of Wildlife Management 67(2): 307-316.

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 Mammology 85(6):1207-1214.

ANDERSON, C.R., JR., AND F.G. LINDZEY. 2005. Experimental evaluation of population trend and harvest composition in a Wyoming cougar population. Wildlife Society Bulletin 33(1): *in press*

ANDERSON, C.R., JR., F.G. LINDZEY, AND N.P. NIBBELINK. *In preparation.* Estimating cougar abundance using probability sampling: an evaluation of transect versus block design.

ANDERSON, C.R., JR., F.G. LINDZEY, D.D. BJORNLIE, H. SAWYER, R.M. NIELSON, and D.S. MOODY. *In preparation*. Exploring source-sink dynamics of Wyoming cougar populations

BIEK, R., A.G. RODRIGO, D. HOLLEY, A. DRUMMOND, C.R. ANDERSON, JR., H.A. ROSS, and M. POSS. 2003. Epidemiology, genetic diversity, and evolution of endemic Feline Immunodeficiency Virus in a population of wild cougars. Journal of Virology 77:9578-9589.

BIEK, R., T.K. RUTH, K.M. MURPHY, C.R. ANDERSON, JR., M. JOHNSON, R. SIMONE, R. GRAY, C.M. GILLIN, and M. POSS. *In review*. Temporal dynamics and risk factors for microparasitic infections in free-living cougars. Canadian Journal of Zoology.

BIEK, R., T.K. RUTH, K.M. MURPHY, C.R. ANDERSON, JR., and M. POSS. *In review*. Examining effects of persistent retrovirus infection on fitness and pathogen susceptibility in a natural feline host. Journal of Animal Ecology.

GASSON, W., AND D. MOODY. 1995. Attitudes of Wyoming residents on mountain lion management. Planning rep. #40, Wyoming Game and Fish Department, Cheyenne, Wyoming, USA

WYOMING GAME AND FISH DEPARTMENT. 1997. Mountain Lion Management Plan. Wyoming Game and Fish Department, Cheyenne, Wyoming, USA.

WYOMING GAME AND FISH DEPARTMENT. 1999. Protocol for managing aggressive wildlife/human interactions. Trophy Game Section, Lander, Wyoming, USA.

WYOMING GAME AND FISH DEPARTMENT. 2003. Annual mountain lion mortality summary: harvest year 2002. Trophy Game Section, Wyoming, USA.

LITERATURE CITED

ANDERSON, C.R., JR., AND F.G. LINDZEY. 2005. Experimental evaluation of population trend and harvest composition in a Wyoming cougar population. Wildlife Society Bulletin 33(1): *in press*.

ANDERSON, C.R., JR., AND F.G. LINDZEY, D.D. BJORNLIE, H. SAWYER, R.M. NIELSON, and D.S. MOODY. *In preparation*. Exploring source-sink dynamics of Wyoming cougar populations.

GASSON W. AND D. MOODY. 1995. Attitudes of Wyoming residents on mountain lion management. Planning rep. #40, Wyoming Game and Fish Department, Cheyenne, Wyoming, USA.

LOGAN, K.A. AND L.L. IRWIN. 1985. Mountain lion habitats in the Bighorn Mountains, Wyoming. Wildlife Society Bulletin 13: 257-262.

WYOMING GAME AND FISH DEPARTMENT. 1997. Mountain Lion Management Plan. Trophy Game Section, Lander, Wyoming, USA.

SOUTH DAKOTA MOUNTAIN LION STATUS REPORT

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Mountain Lion Workshop 8:34-37

INTRODUCTION

Mountain Lions were recently reclassified from a State Threatened Species in South Dakota to a Big Game animal with no season. It is important to note that while the mountain lion is now off the threatened species list in South Dakota, it actually gained additional protection under law by being defined as a big game animal. Criminal penalties increased from class 2 misdemeanors to class 1 misdemeanors, carrying higher fines, longer jail sentences, and civil penalties.

A misconception existed in that by classifying the mountain lion as a big game animal a hunting season would immediately be implemented. This was absolutely false! The mountain lion continues to be fully protected as a big game animal with a continuously closed season until at some undetermined point when additional management decisions are made.

South Dakota currently has a Mountain Lion Management Plan that runs through the year 2012. This document is in the 2nd working draft stage and can be revised at any time depending on circumstances and need. This document is available to the public and interested parties for review and comment. A copy can be obtained by contacting Dr. Larry Gigliotti at 605-773-4231.

South Dakota has many objectives that are listed in the management plan that concern mountain lion management. They are as follows:

1. Evaluate legal status of the mountain lion in South Dakota by April 1, 2003. (Completed and changes implemented).
2. Evaluate strategies for monitoring & estimating mountain lion populations in SD by 2005.
3. Maintain a statewide database of mountain lion activity including sightings, human interactions, depredation events, and lion mortality.
4. Develop a list of mountain lion research needs. Evaluate and prioritize annually.
5. Develop mountain lion population management methods that are consistent with established goals and objectives.
6. Identify and describe suitable habitat areas and parameters for mountain lions in SD by Sept. 2003. (Completed).
7. Develop a comprehensive Public Education strategy for informing and educating the Staff, citizens and visitors about mountain lions and personal safety while in mountain lion country.
8. Develop a public involvement plan for Implementation during 2003 and 2004 for inclusion in our management planning process.

Over the last 10 years South Dakota has not significantly changed the way we manage mountain lions. During this period of time the only action was to remove the mountain lion from the State's Threatened Species List and very little was done to manage them other than offering them full protection of the law. Our awareness of mountain lions did increase significantly during this time as we observed a steady increase in their numbers. In recent years an Action Plan was developed and is being followed to guide staff in dealing with problem mountain lions and to document and understand mountain lion activity in South Dakota.

DISTRIBUTION AND ABUNDANCE

Mountain lions are currently distributed throughout the Black Hills, which contains the most suitable habitat in South Dakota. Reports of mountain lion activity have been received across most of South Dakota. Verification of reports outside of the Black Hills has proven to be very difficult, especially east of the Missouri River. Most occurrences outside of the Black Hills have been associated with river drainages, which provide marginal habitat.

The mountain lion population in South Dakota appears to be growing at this time. Fecske (2003) reported that the estimated carrying capacity of the Black Hills for mountain lions is approximately 165. There is documented evidence that dispersal is taking place out of the Black Hills. To date we have detected young males and young females dispersing from the Black Hills.

The cougar population in the Black Hills was estimated using program PUMA (Beier 1993), incorporating parameters obtained from radio-collared cougars and habitat quality derived from a habitat-relation model. Fecske (2003) recently finished with a 5-year research study on cougars in the Black Hills. Annual home ranges were generated for 10 adult cougars monitored > 8 months, and spatial distribution of established males was analyzed using a home range overlap index. The area of the Black Hills was estimated at 8,400 km2, comprised of 6,702.9 km2 of high quality and 1,697.1 km2 of lower quality habitat (based on a habitat-relation model developed for the species). Mean annual home range size of established adult male cougars (n = 3) was 809.2 km2, and was significantly larger (P = 0.001) than that of adult females (n = 7 annual ranges), 182.3 km2 (Fecske 2003). Based on sightings of family groups and radio-collared females, we documented up to 5 females occurring in established male ranges. Percent overlap for 3 established cougars averaged 33% (range = 18.0 - 52.0%). Based on 5 population simulations, the total number of cougars in the Black Hills was estimated to be 127 to 149 cougars; 46 to 49 adult females, 12 to 29 adult males; 21 to 24 yearling females and males; and 45 to 48 female and male kittens (Fecske 2003). Updated information will be obtained as the current research project progresses.

HARVEST INFORMATION

South Dakota has not had any form of legalized mountain lion hunting since 1978. The future management of mountain lions in South Dakota will include consideration of a hunting season as a management tool. Concerns about the impacts of hunting to the stability of the population will weigh heavily when those decisions are made.

DEPREDATIONS AND HUMAN INTERACTIONS/CONFLICTS

South Dakota does operate with an “Action Plan For Managing Mountain Lion/Human/Property Interactions.” An Action Plan was first developed in May of 1995 and was revised in 2002. This is an active action plan that may be revised again at any time. This plan is included in the overall Mountain Lion Management Plan, which is in the 2nd working draft. For our agency, addressing “problem” mountain lions is the most difficult aspect of maintaining a population of lions. Public emotions are strong and varied which results in many comments/opinions being expressed directly at the "Action Plan."

South Dakota's Action Plan categorizes Human/Mountain Lion interactions into five types:

1. Sighting - a visual observation of a lion or a report of lion tracks or other sign on unpopulated lands or rural areas within the Black Hills.
2. Encounter - an unexpected direct neutral meeting between a human and a lion without incident (Mountain lion sightings in close proximity to homes, stables or livestock in rural areas and unpopulated lands outside of the Black Hills). A mountain lion is observed for the first time in close proximity or within residential developments and occupied recreational area.
3. Incident - a conflict between a human and lion that may have serious results (e.g. a lion that must be forced to back down). Recurring observations of a lion in close proximity or within residential developments and occupied recreational areas. Livestock is killed in rural areas.
4. Substantial public threat - a mountain lion that is observed within a city near areas where children are regularly congregated, killing wildlife/pets in residential developments or occupied recreational areas or killing livestock.
5. Attack - when a human is bodily injured or killed by contact with a mountain lion.

Each occurrence requires an understanding of all the circumstances and any history involved before an action is decided upon. In general, with every report of a mountain lion a field investigation is highly encouraged by agency personnel. Verification is the key to any response.
SD GFP Personnel are encouraged to take every opportunity to educate the public regarding all aspects of living with mountain lions. Every person that reports a mountain lion receives an agency-produced brochure on mountain lions. Public education is emphasized at this time and every opportunity is taken.

All mountain lion activity is documented in South Dakota on a mountain lion observation form (Table 1). These reports assist SD GFP in assessing the status of mountain lions in South Dakota. South Dakota also attempts to document all mountain lion mortalities on an annual basis. Causes of mortality include vehicle kills, incidental trapping, illegal activity, SDGFP removals, and natural causes. SDGFP removals include depredation situations, and public safety situations.

RESEARCH AND PUBLICATIONS

The Department of Wildlife and Fisheries Sciences at South Dakota State University is currently involved in another 5-year research project on cougars in the Black Hills that was initiated in the fall 2002. The objectives of the research are 1) to estimate survival and document causes of mortality of cougar kittens, 2) Determine longevity of established radio-collared cougars 3) Document dispersal distances, routes, and destinations of subadult cougars, and 4) conduct snow tracking helicopter

Table 1. Mountain lion reports and documented mortalities in South Dakota.

Year	Reports	Mortalities	Removals
1998	52	2	0
1999	54	6	0
2000	66	3	1
2001	144	3	1
2002	198	10	0
2003	171	10	3
2004	394	25	6

population survey to document population trends. Currently, 21 cougars (16 females, 5 males) are being monitored weekly from the ground and fixed wing aircraft using aerial radio-telemetry techniques.

LITERATURE CITED

BEIER, P. 1993. Puma: a population simulator for cougar conservation. Wildlife Society Bulletin 21:356-357

FECSKE, D. M. 2003. Distribution and abundance of American Martens and Cougars in the Black Hills of South Dakota and Wyoming. Dissertation, South Dakota State University, Brookings, South Dakota, USA.

PUBLICATIONS

FECSKE, D. M., J. A. JENKS, AND F. G. LINDZEY. 2004. Mortality of an adult cougar due to a forest fire in the Black Hills. The Prairie Naturalist 36:137-140.

FECSKE, D. M., J. A. JENKS, AND F. G. LINDZEY. 2003. Characteristics of mountain lion mortalities in the Black Hills, South Dakota. Pages 25-29 *in* L.A. Harveson, P.M. Harveson, and R.W. Adams, editors. Proceedings of the Sixth Mountain Lion Workshop. Austin, Texas, USA.

FECSKE, D. M AND J. A. JENKS. 2001. The mountain lion returns to South Dakota. South Dakota Conservation Digest 68(4):3-5.

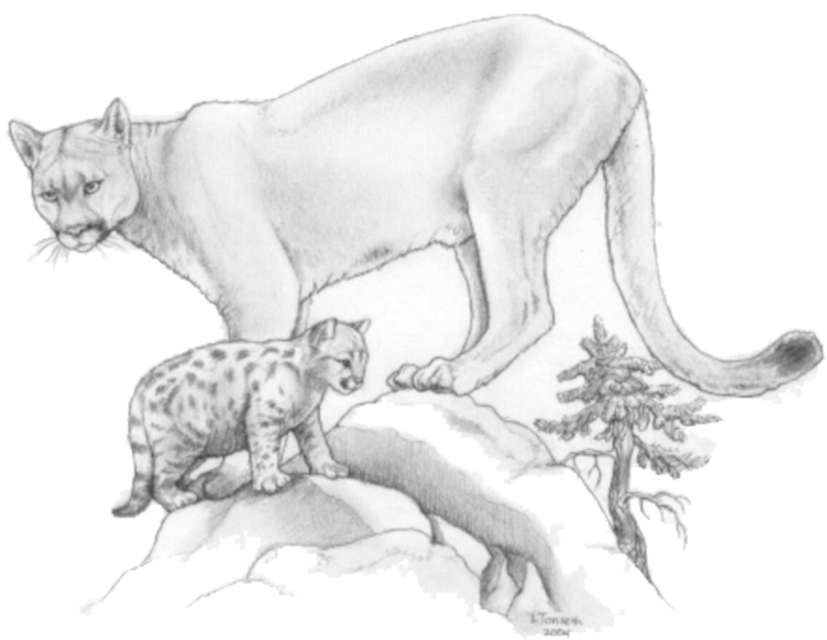
FECSKE, D. M AND J. A. JENKS. 2001. Status report of mountain lions in South Dakota. Pages 22-24 in L.A. Harveson, P.M. Harveson, and R.W. Adams, editors. Proceedings of the Sixth Mountain Lion Workshop. Austin, Texas, USA.

GIGLIOTTI, L. M., D. M. FECSKE, AND J. A. JENKS. 2002. Mountain lions in South Dakota: A public opinion survey. South Dakota Department of Game, Fish, and Parks, Pierre, South Dakota 182 pp.

LONG, E. S., D. M. FECSKE, R. A. SWEITZER, J. A. JENKS, B. M. PIERCE, AND V. C. BLEICH. 2003. Efficacy of photographic scent stations to detect mountain lions. Western North American Naturalist 63:529-532.

THOMPSON, D. J., AND J. A. JENKS. 2005. Long-distance dispersal by a subadult male cougar (Puma concolor) from the Black Hills, South Dakota. Journal of Wildlife Management 69:*In Press*

Southwest & Florida Mountain Lion Status Reports



CALIFORNIA MOUNTAIN LION STATUS REPORT

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Mountain Lion Workshop 8:41-48

INTRODUCTION

California has a statewide mountain lion management plan. In 1990, mountain lions were legally classified as a "specially protected mammal" by the passage of a voter initiative (Proposition 117, June 1990 ballot). Prior to that initiative, lions were classified as "game mammals." Current legislation (Assembly Bill 24, Maze) would overturn some sections of the Fish and Game Code to allow hunters to take two lions per county, where they exist. This would allow about 100 hunting permits annually.

The objectives for mountain lion management in California are to maintain healthy, wild populations of mountain lions for the benefit and enjoyment of the people in the State, to alleviate public safety incidents and reduce damage to private property (pets and livestock) by mountain lions. Mountain lions are not hunted in California, and they may be killed only to preserve public safety, alleviate damage to private property or to protect listed bighorn sheep.

DISTRIBUTION AND ABUNDANCE

Lions are currently distributed throughout all suitable habitats within California. Lion numbers appear to be stable at an estimated 4,000 to 6,000 adults.

The number of lions in California is based upon extrapolating densities determined with the use of radio collars. These studies have been conducted in various locations of the State. The number of lions is determined by multiplying the densities and the area represented by the ecological province. The studies, which provide local lion density data, have been conducted over a period of a couple decades. Consequently, the Department recognizes the estimate has limited application.

The Department issues depredation permits to property owners who have experienced damage from a mountain lion. The following graph represents the number of mountain lion depredation permits issued and the number of lions that have been killed as a result (Table 1).

HARVEST INFORMATION

Mountain lion hunting is prohibited in California. Licensed hunters have taken no lions since 1972. It is also illegal for lions, which have been legally taken in other states to be imported into California.

DEPREDATIONS AND HUMAN INTERACTIONS / CONFLICTS

The Department's Public Safety Guidelines are attached. This policy is intended to guide the actions and decisions of Department personnel who respond to mountain lion incidents.

A summary of the number of human/lion incidents (1997-2004) is provided (Figure 1). We provide educational material to the public to foster an understanding and appreciation of lions. Most of the information, including our brochure, "Living with California Mountain Lions", is available at: http://www.dfg.ca.gov/news /issues/lion.html

Table 1. A summary of the number of human/lion incidents, 1997-2004.

	1997	1998	1999	2000	2001	2002	2003	2004
# of incidents	539	353	697	372	456	379	419	715
# of safety incidents	15	11	16	8	14	13	3	12
Take	11	12	10	7	11	13	2	12
Male	1	6	6	4	8	6	1	6
Female	6	6	3	3	3	5	1	5
Unknown	4	0	1	0	0	2	0	1
# of sightings	340	214	382	174	240	224	237	503

The Department has completed a multiple species program to reduce interactions between wildlife and humans. This is the “Keep Me Wild” program, and the specific recommendations for mountain lions are available at: www.keepmewild.org/ whattodolion.htm

Depredation permits may be issued by the Department subject to the conditions found in Section 402, California Code of Regulations, as follows:

1. The department may issue revocable permits after receiving a report, from any owner or tenant or agent for them, of property being damaged or destroyed by mountain lion. The department shall conduct and complete an investigation within 48 hours of receiving such a report. Any mountain lion that is encountered in the act of inflicting injury to, molesting or killing livestock or domestic animals may be taken immediately if the taking is reported within 72 hours to the department and the carcass is made available to the department. Whenever immediate action will assist in the pursuit of the particular mountain lion believed to be responsible for damage to livestock or domestic animals, the department may orally authorize the pursuit and take of a mountain lion. The department shall investigate such incidents and, upon a finding that the requirements of this regulation have been met, issue a free permit for depredation purposes, and carcass tag to the person taking such mountain lion.
2. Permittee may take mountain lion in the manner specified in the permit, except that no mountain lion shall be taken by means of poison, leg-hold or metal-jawed traps and snares.
3. Both males and females may be taken during the period of the permit irrespective of hours or seasons.
4. The privilege granted in the permit may not be transferred, and only entitles the permittee or the employee or agent of the permittee to take mountain lion. Such person must be 21 years of age or over and eligible to purchase a California hunting license.
5. Any person issued a permit pursuant to this section shall report by telephone within 24 hours the capturing, injuring or killing of any mountain lion to an office of the department or, if telephoning is not practical, in writing within five days after capturing, injuring or killing of the mountain lion. Any mountain lion killed under the permit must be tagged with the special tag furnished with the permit; both tags must be completely filled out and the duplicate mailed to the Department

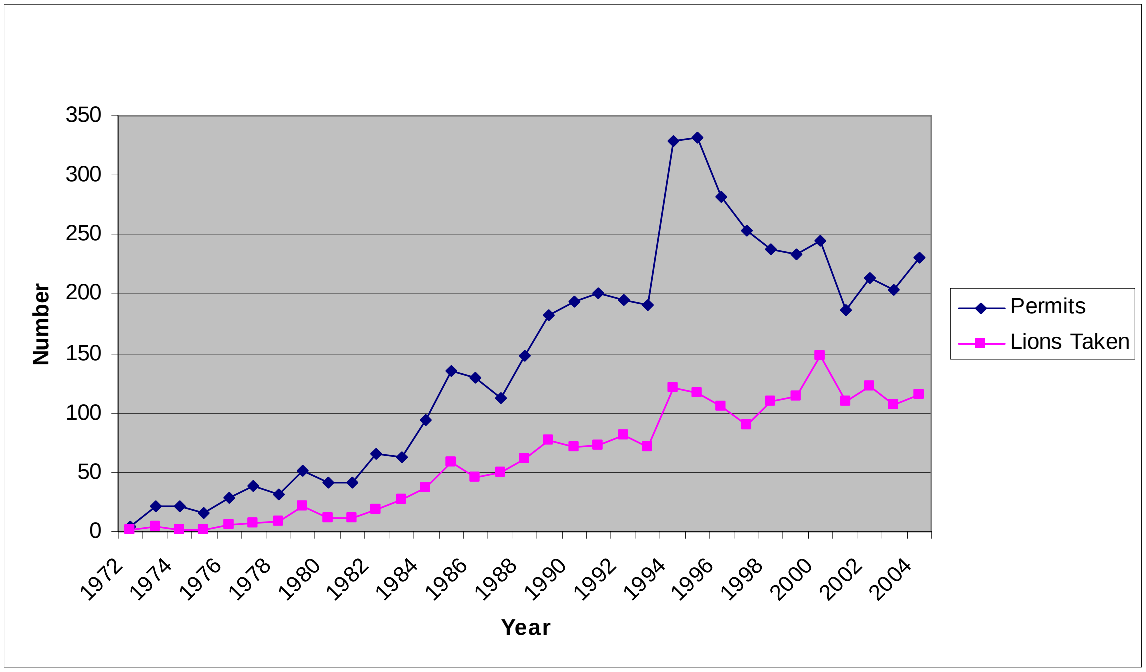

Figure 1. Number of mountain lion depredation permits issued and lions taken, 1972-2004.

of Fish and Game, Sacramento, within 5 days after taking any mountain lion.

6. The entire carcass shall be transported within 5 days to a location agreed upon between the issuing officer and the permittee, but in no case will a permittee be required to deliver a carcass beyond the limits of his property unless he is willing to do so. The carcasses of mountain lions taken pursuant to this regulation shall become the property of the state.
7. Animals shall be taken in a humane manner so as to prevent any undue suffering to the animals.
8. The permittee shall take every reasonable precaution to prevent the carcass from spoiling until disposed of in the manner agreed upon under subsections of these regulations.
9. The permit does not invalidate any city, county, or state firearm regulation.
10. Permits shall be issued for a period of 10 days. Permits may be renewed only after a finding by the department that further damage has occurred or will occur unless such permits are renewed. The permittee may not begin pursuit of a lion more than one mile nor continue pursuit beyond a 10-mile radius from the location of the reported damage.

CURRENT RESEARCH:

1. Population genetics of lions.
2. Lion/deer/bighorn sheep predator prey relationships in Inyo/Mono counties (Los Angeles County and San Diego County).
3. Lion movements and corridors in Los Angeles/Ventura and Orange counties.

4. Impacts of habitat conversions and transportation corridors or lion movements and habitat use on the west slope of the Sierra Nevada Mountains.

PUBLIC SAFETY WILDLIFE GUIDELINES

Consistent with Section 1801 of the Fish and Game Code, these Public Safety Wildlife Guidelines provide procedures to address public safety wildlife problems. Mountain lions, black bears, deer, coyotes, and large exotic carnivores, which have threatened or attacked humans, are wildlife classified as public safety problems. Public safety wildlife incidents are classified into three types:

1. Type Green (sighting) – A report (confirmed or unconfirmed) of an observation that is perceived to be a public safety wildlife problem. The mere presence of the wildlife species does not in itself constitute a threat.
2. Type Yellow (threat) – A report where the presence of the public safety wildlife is confirmed by a field investigation, and the responding person (law enforcement officer or Department employee) perceives the animal to be an imminent threat to public health or safety. Imminent threat means there is a likelihood of human injury based on the totality of the circumstances.
3. Type Red (attack) – An attack by a public safety wildlife species on a human resulting in physical contact, injury, or death.

These guidelines are not intended to address orphaned, injured, or sick wildlife that have not threatened public safety. To achieve the intent of these guidelines, the following procedures shall be used.

Wildlife Incident Report Form

Fill out a Wildlife Incident Report Form (WMD-2) for all reports of public safety wildlife incidents. The nature of the report will determine the response or investigative action to the public safety problem. For those reports that require a follow-up field investigation, the field investigator will complete the Wildlife Incident Report Form. All completed Wildlife Incident Report Forms shall be forwarded through the regional offices to the Chief, WPB.

Response to Public Safety Wildlife Problems

Any reported imminent threats or attacks on humans by wildlife would require a follow-up field investigation (Figure 2). If a public safety wildlife species is outside its natural habitat and in an area where it could become a public safety problem, and if approved by the Deputy Director for the WIFD, it may be captured using restraint techniques approved by the Wildlife Investigations Laboratory (WIL). The disposition of the captured wildlife may be coordinated with WIL.

1. Type Green (sighting) – If the investigator determines that no imminent threat to public safety exists, the incident is considered a Type Green. The appropriate action may include providing wildlife behavior information and mailing public educational materials to the reporting party.
2. Type Yellow (threat) – Once the field investigator finds evidence of the public safety wildlife and perceives the animal to be an imminent threat to public health or safety, the incident is considered a Type Yellow. In the event of threat to public safety, any Department employee responding to a reported public safety incident may take

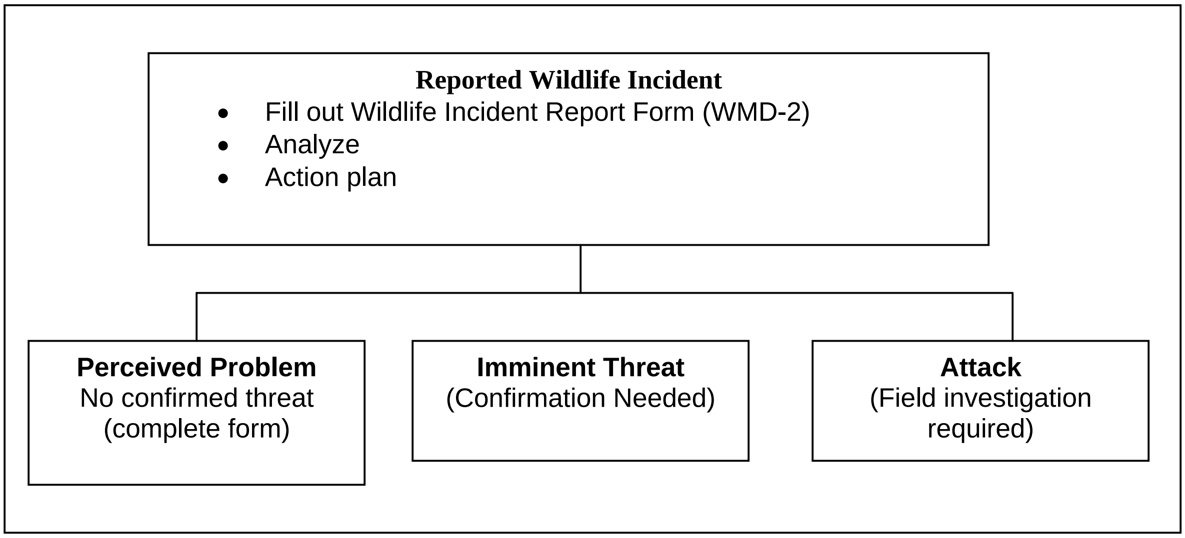

Figure 2. Schematic of the steps taken when responding to a public safety wildlife incident.

whatever action is deemed necessary within the scope of the employee's authority to protect public safety. When evidence shows that a wild animal is an imminent threat to public safety, that wild animal shall be humanely euthanized (shot, killed, dispatched, destroyed, etc.). For Type Yellow incidents the following steps should be taken:

- Initiate the Incident Command System. The Incident Commander (IC) consults with the regional manager or designee to decide on the notification process on a case-by-case basis. Full notification includes: the field investigator's supervisor, the appropriate regional manager, the Deputy Director, WIFD, Chief, Conservation Education and Enforcement Branch (CEEB), Chief, WPB, WIL, Wildlife Forensics Lab (WFL), the designated regional information officer, and the local law enforcement agency.If full notification is appropriate, notify Sacramento Dispatch at(916) 445-0045. Dispatch shall notify the above-mentioned personnel.
- Secure the scene as appropriate. Take all practical steps to preserve potential evidence. The IC holds initial responsibility and authority over the scene, locating the animal, its resultant carcass, and any other physical evidence from the attack. The IC will ensure proper transfer and disposition of all physical evidence.
- In most situations, it is important to locate the offending animal as soon as practical. WIL may be of assistance. The regional manager or designee contacting the local WS District Supervisor can arrange the services of USDA or Wildlife Services (WS). If possible, avoid shooting the animal in the head to preserve evidence.

- If an animal is killed, the IC will decide on the notification process and notify Sacramento Dispatch if appropriate. Use clean protective gloves while handling the carcass. Place the carcass inside a protective durable body bag (avoid dragging the carcass, if possible).

3. Type Red (attack) – In the event of an attack, the responding Department employee may take any action necessary that is within the scope of the employee's authority to protect public safety. When evidence shows that a wild animal has made an unprovoked attack on a human, that wild animal shall be humanely euthanized (shot, killed, dispatched, destroyed, etc.). For Type Red incidents the following steps should be taken:
   - Ensure proper medical aid for the victim. Identify the victim (obtain the following, but not limited to: name, address, phone number).
   - Notify Sacramento Dispatch at (916) 445-0045. Dispatch shall notify the field investigator's supervisor, the appropriate regional manager, the Deputy Director, WIFD, Chief, CEEB, Chief, WPB, WIL, WFL, the designated regional information officer, and the local law enforcement agency.
   - Initiate the Incident Command System. If a human death has occurred, an Enforcement Branch supervisor or specialist will respond to the Incident Command Post and assume the IC responsibilities. The IC holds initial responsibility and authority over the scene, locating the animal, its resultant carcass, and any other physical evidence from the attack. The IC will ensure proper transfer and disposition of all physical evidence.
   - Secure the area as needed. Treat the area as a crime scene. In order to expedite the capture of the offending animal and preserve as much on-scene evidence as possible, the area of the incident must be secured immediately by the initial responding officer. The area should be excluded from public access by use of flagging tape or similar tape (e.g., "Do Not Enter") utilized at crime scenes by local law enforcement agencies. One entry and exit port should be established. Only essential authorized personnel should be permitted in the excluded area. A second area outside the area of the incident should be established as the command post.
   - In cases involving a human death, WFL personnel will direct the gathering of evidence. Secure items such as clothing, tents, sleeping bags, objects used for defense during the attack, objects chewed on by the animal, or any other materials which may possess the attacking animal's saliva, hair, or blood.
   - If the victim is alive, advise the attending medical personnel about the Carnivore Attack-Victim Sampling Kit for collecting possible animal saliva stains or hair that might still be on the victim. If the victim is dead, advise the medical

examiner of this evidence need. This sampling kit may be obtained from the WFL.

- It is essential to locate the offending animal as soon as practical. WIL may be of assistance. The services of WS can be arranged by the regional manager or designee contacting the local WS District Supervisor. If possible, avoid shooting the animal in the head to preserve evidence.
- If an animal is killed, the IC will notify Sacramento Dispatch. Treat the carcass as evidence. Use clean protective gloves and (if possible) a face mask while handling the carcass. Be guided by the need to protect the animal's external body from: loss of bloodstains or other such physical evidence originating from the victim; contamination by the animal's own blood; and contamination by the human handler's hair, sweat, saliva, skin cells, etc. Tape paper bags over the head and paws, then tape plastic bags over the paper bags. Plug wounds with tight gauze to minimize contamination of the animal with its own blood. Place the carcass inside a protective durable body bag (avoid dragging the carcass, if possible).
- WFL will receive from the IC and/or directly obtain all pertinent physical evidence concerning the primary questions of authenticity of the attack and identity of the offending animal. WFL has first access and authority over the carcass after the IC. WFL will immediately contact and coordinate with the county health department the acquisition of appropriate samples for rabies testing. Once WFL has secured the necessary forensic samples, they will then release authority over the carcass to WIL for disease studies.
- An independent diagnostic laboratory approved by WIL will conduct necropsy and disease studies on the carcass. The WIL will retain primary authority over this aspect of the carcass.

Responsibilities of WIL

WIL investigates wildlife disease problems statewide and provides information on the occurrence of both enzootic and epizootic disease in wildlife populations. Specimens involved in suspected disease problems are submitted to WIL for necropsy and disease studies. Most animals killed for public safety reasons will be necropsied to assess the status of health and whether the presence of disease may have caused the aggressive and/or unusual behavior.

Type Yellow public safety animals killed may be necropsied by WIL or an independent diagnostic laboratory approved by WIL. Contact WIL immediately after a public safety animal is killed to determine where it will be necropsied. Arrangements are to be made directly with WIL prior to submission of the carcass to any laboratory.

Type Red public safety animals killed will be necropsied by an independent diagnostic laboratory approved by WIL. Contact WIL prior to submission of the carcass to any laboratory to allow the Department veterinarian to discuss the disease testing requirements with the attending pathologist. A disease testing protocol has been developed for use with Type Red public safety wildlife.

Responsibilities of WFL

WFL has the statewide responsibility to receive, collect, examine and analyze physical evidence, issue reports on evidence findings, and testify in court as to those results. WFL's primary functions in public safety incidents is to verify or refute the authenticity of the purported attack and to corroborate or refute the involvement of the suspected offending animal.

Type Yellow public safety animals killed may be examined by WFL personnel. The examination of the carcass will be coordinated with WIL.

All Type Red public safety animals killed must be examined by WFL personnel or a qualified person approved by WFL supervisor using specific procedures established by WFL.

If a human death occurs, coordination of the autopsy between the proper officials and WFL is important so that WFL personnel can be present during the autopsy for appropriate sampling and examination. In the event of human injury, it is important for WFL to gather any relevant physical evidence that may corroborate the authenticity of a wildlife attack, prior to the treatment of injuries, if practical. If not practical, directions for sampling may be given over the telephone to the emergency room doctor by WFL.

Media Contact

Public safety wildlife incidents attract significant media attention. Issues regarding site access, information dissemination, the public's safety, carcass viewing and requests to survey the scene can be handled by a designated employee. Each region shall designate an employee with necessary ICS training to respond as a regional information officer to public safety wildlife incidents.

Type Yellow public safety wildlife incidents may require the notification of a designated employee previously approved by the regional manager or designee to assist the IC in responding to the media and disseminating information. The IC has the authority to decide if the designated employee should be dispatched to the site.

All Type Red public safety wildlife incidents require that a designated employee, previously approved by the regional manager or designee, to assist the IC in responding to the media and disseminating information, is called to the scene.

The Department will develop and provide training for designated employees to serve as information officers for public safety wildlife incidents.

NEVADA MOUNTAIN LION STATUS REPORT

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Mountain Lion Workshop 8:49-56

HISTORY

Mountain lion (*Puma concolor*) populations in Nevada were scarce prior to the settlement of non-indigenous peoples (Hall 1946, Cahalane 1964, Greenly 1971, Nowak 1974, Nappe 1974). This fact is not surprising considering how limited prey densities were at the time. Bighorn Sheep (*Ovis canadensis*) were likely the most common of the large ungulate species within the state, inhabiting nearly every mountain range of Nevada (Cowan 1940, Hall 1946, Beuchner 1960, McQuivey 1978). Archeological investigations based on osteological records and petroglyphs have shown bighorns to be one of the more numerous and most widely distributed large ungulates throughout historic Nevada (Harrington 1933, Jennings 1957, Gruhn 1976). Although bighorn sheep were seemingly abundant, an understanding of Nevada's habitat, topography and more importantly, minimal water sources, points to the fact that bighorn sheep populations were never dense. Rather, bighorn sheep were sparsely scattered over Nevada's 286,298 square kilometers and 314 mountain ranges. After settlement, bighorn sheep populations dwindled under heavy hunting pressure and competition with non-native ungulates (NDOW 2001). By 1901 hunting laws were enacted by the Nevada State Legislature completely closing bighorn hunting. It would remain closed for the next 51 years.

Mule deer (*Odocoileus hemionus*) were even more limited in range and density within the state. A review of archeological records indicates that in nearly every site, deer remains were conspicuously absent or rare (Harrington 1933, Schroeder 1952, Jennings 1957, Shutler and Shutler 1963, Gruhn 1976). Only two site investigations in Nevada found mule deer to be a significant contributor to archeological middens (Fowler et al. 1973). Both of these locations occur in the northeastern corner of the state in an area that marks the northern limits of desert bighorn sheep and the southern limit of major mule deer populations (McQuivey 1978). Aldous (1945) noted that prior to about 1925, mule deer were not noticeably abundant anywhere in the Intermountain states. During congressional hearings before the special committee on Conservation of Wildlife resources (1934) U.S. Forest Service regional forester R.H. Rutledge estimated deer populations in Nevada forests for the year of 1924 at just over 3,000 animals and noted that those numbers were a marked increase from deer numbers at the turn of the century.

Like bighorn sheep, deer populations were greatly reduced by miners and settlers hunting them for a food source (Hess 1998). Mule deer hunts, like bighorn sheep, were closed by the 1901 state legislature, remaining closed for two years.

While prey density facts all lend credence to the fact that mountain lion numbers would have been very low in the state, federal predator control programs that started in Nevada in 1915 further provide evidence that lion populations were limited. During the years from 1915 through 1949 a total of 115 mountain lions (average 3 per year) were removed by federal and state predator control programs (USDA reports 1915 -1949). During the years 1950 through 1959 the number of lions removed by these programs accounted for the removal of 988 mountain lions (average 99 per year). The hiring of a full time lion hunter in 1950 and eventually 4 lion hunters might explain this increase by the late 1950's. However, during the earlier years of 1915 – 1949, an average of 28 full time trappers a year worked within Nevada. These trappers, though not called "lion hunters" worked full time in an effort to eradicate predatory animals. During the same 34-year period (1915-1949) that it took to remove 115 lions, these full time trappers reportedly removed from the state 195,320 other predatory animals (USDA Reports 1915 -1949). Clearly given the intensity with which predator species were sought during these years, if mountain lions had been common, a greater number would have been taken.

The increase in the 1950s in the number of mountain lions being removed is likely a result of a steadily increasing lion population within the state, rather than an increase in harvest effort alone. This increase can be attributed to mule deer irruptions and the addition of an estimated 4 million sheep grazing in lion habitat throughout the state.

Domestic sheep become a part of the prey base during the later part of the 1800s and early 1900s. Huge numbers of these alternative prey species were being introduced into Nevada providing another viable food source for mountain lions. Nevada tax assessment roles indicate the number of domestic sheep in Nevada rose from 33,000 in 1870 to 259,000 in 1880 (Elliot 1973). During the first thirty years of the 20th century domestic sheep numbers continued to increase, records indicate that the number of sheep in the state reached estimates of between 2 and 4.5 million head (Georgetta 1972, Lane 1974, Meaker 1981, Rowley 1985).

Mule deer irruptions began to occur throughout Nevada beginning in the 1940s (Aldous 1945, Leopold et al. 1947). Leopold et al. (1945) documented mule deer irruptions occurring in several locations in Nevada during this period, and hypothesized that these irruptions were a result of "buck-only" laws, predator control and habitat changes from logging and grazing. Mule deer numbers in Nevada continued to increase, peaking during the mid to late 1950s (Wasley 2004).

Following the mule deer irruptions of the 1940s and 1950s a period of decline occurred, during which time deer numbers dipped but never fell to historic lows. By the late 1970s, deer populations began to increase again state wide (Wasley 2004), with an enormous increase in the Nevada mule deer populations occurring throughout the 1980s. By the time statewide deer populations peaked in the late 1980s, their number had soared to numbers in excess of 200,000 (Wasley 2004).

As prey species begin to increase, so did lion numbers. Populations that had been described as an uncommon denizen (Hall 1946, Cahalane 1964, Stiver 1988) had grown in numbers to over 1,000 strong by the early 1970s (Stiver 1988, NDOW 1995 unpublished data), when deer numbers peaked a decade and a half later, mountain lion numbers in Nevada numbered in excess of 3,500 (NDOW 1995 unpublished data).

Since the extreme high deer densities of the 1980s, various factors including drought, habitat loss, habitat conversion, range fires and a catastrophic mule deer die off in the winter of 1992 – 1993 have caused deer populations to gradually decline throughout the state. However, mountain lion numbers are not following those trends. Even though sheep numbers in Nevada now number below 100,000 and deer numbers are declining, other prey species are on the increase, keeping lion numbers elevated. For example, over the last twenty years, elk (*Cervus elaphus*) numbers in Nevada have risen 650% and now number nearly 8,000 statewide. Likewise, feral horse numbers have been increased since receiving federal protection and now number around 18,000 in Nevada. Reports of both being preyed on by mountain lions are commonplace in the state (NDOW unpublished data).

DISTRIBUTION AND ABUNDANCE

Mountain lions seem well adapted to the wide variety of habitat and environmental conditions that exist in Nevada. They have been observed to live or wander through almost every mountain range from the Mojave Desert in extreme southern Nevada to alpine forests at the highest elevations in the northern part of the state. Distribution appears to be primarily influenced by prey availability, and has remained fairly consistent through time. Mountain lions are known to inhabit every Game Management Unit in the state.

Mountain lions are also known to exist on many of the large land holdings, which are closed to mountain lion hunting in Nevada. These include the complex of the Nellis Air Force Base, the Nevada Test Site and the Desert National Wildlife Range, which exist as one large contiguous land block of over 19,000 km2. Other non-hunted populations exist on The Sheldon National Wildlife Range comprising 2,355 km^2. There are numerous other federally held installations throughout Nevada in the form of National parks, monuments and other military reserves that have non-hunted populations of mountain lions. In all, more than 10% of Nevada's 286,298 km2 is closed to mountain lion hunting.

Mountain lion populations are estimated utilizing a life table model (retrospective harvest/ mortality). The model utilizes known harvest/ mortality rates and recruitment rates (as determined from mark-recapture and telemetry studies) to calculate a retrospective estimate of minimum viable population size needed to sustain known harvest rates over the same time period. Although no defined confidence limit is used during this process, our confidence in this model is relatively high based on the fact that harvest rates over time have not witnessed signs of extirpation, reduced harvest rates, or changes in the average age of harvested lion. Based on our current estimation methods, lion populations within Nevada are estimated to be between 2,500-3,000 animals.

HARVEST INFORMATION

Mountain lions have been classified as a big game species since 1965. They have been hunted annually since that time. Beginning in 1968, mandatory check-in was instituted which has allowed for the collection of sport hunter harvest data. Harvest data reveals that the average age of mountain lions harvested in Nevada has been 4.5 years (± 0.3). Annual harvest of mountain lions has averaged 56.5% (± 5.5) for males and 43.5% (± 5.5) for females (Table 1).

Data also indicates that the annual mountain lion harvest has remained below 10% (avg. 5.6% ± 1.9) of estimated statewide mountain lion numbers.

The 2004-05 mountain lion season resulted in the hunter harvest of 105 lions compared to the previous year's hunter harvest of 192. The 2004-05 harvest is 45% lower than the previous year's hunter harvest and 24% lower than the 20-year average for hunter harvest. Total lion take from the state was 134 lions, down 40% from last year's total of 225 (Table 2). These decreases are most likely a result of weather conditions, which prohibited access to hunting areas. A

Table 1. Mountain lion harvest by harvest type and sex.

	Sport Hunter Harvest			Depredation Take			Total		
Year	Male	Female	Total	Male	Female	Total	Male	Female	Total
1999	77	49	126	8	3	11	85	52	137
2000	104	93	197	8	8	16	112	101	213
2001	96	71	167	10	16	26	106	87	193
2002	77	51	128	7	8	15	84	59	143
2003	97	95	192	16	12	28	113	107	220
2004	65	40	105	9	7	16	74	47	121
Average	86	67	153	10	9	19	96	76	171

Table 2. Mountain lion tag sales, sport hunter harvest, and hunter success by class of hunter.

	Tag Sales			Harvest			Hunter Success		
Year	R[a]	NR[b]	Total	R	NR	Total	R	NR	Total
1999	680	109	789	70	56	126	10%	51%	16%
2000	883	169	1052	108	89	197	12%	53%	19%
2001	838	98	936	104	63	167	12%	64%	18%
2002	1060	131	1191	89	39	128	8%	30%	11%
2003	1133	221	1354	119	73	192	11%	33%	14%
2004	1186	206	1392	62	43	105	5%	21%	7%
Total	5780	934	1392	552	363	915	9%	39%	14%
Average	963	156	1119	92	61	153	9%	39%	14%

[a]Resident
[b]Non-resident

Nevada resident mountain lion tag costs $26.00, and a Nevada nonresident mountain lion tag costs $101.00. The open season for hunting mountain lions in Nevada currently runs year-round (March 1 – last day of February) (Table 3). Any legal weapon may be used to harvest a mountain lion and dogs may be used to hunt a mountain lion under the authority of a current State of Nevada hunting license and mountain lion tag. Because the mountain lion season is year-round no pursuit only season exists. A resident or a non-resident is eligible to obtain two mountain lion tags each year. A person who harvests a mountain lion in Nevada must, within 72 hours after harvesting it, personally present the skull and hide to a representative of the Department for inspection. A seal must be permanently affixed to the hide of a mountain lion before an individual can possess it or removed from the state. It is unlawful to kill a female mountain lion, which is accompanied by a spotted kitten, or to kill or possess a spotted mountain lion kitten. It is also unlawful in Nevada to trap a mountain lion. If a mountain lion is accidentally trapped or killed, the person trapping or killing it shall report the trapping or killing within 48 hours to the

Table 3. Nevada mountain lion units and quotas 2005 – 2007.

Unit Group	2005-2006 Season Dates	2005-2006 Harvest Objectives	2006-2007 Season Dates	2006-2007 Harvest Objectives
011 - 015, 021, 022, 031, 032, 034, 035, 041 - 046, 051, 181 – 184, 192, 194 - 196, 201 - 206, 291	March 1, 2005 – Feb 28, 2006 or earlier if harvest objective met	114	March 1, 2006 – Feb 28, 2007 or earlier if harvest objective met	114
033	Closed	0	Closed	0
061, 062, 064 – 068, 071 - 078, 081, 101 – 108, 111 – 115, 121, 131 – 134, 141 – 145, 151, 152, 154, 155	March 1, 2005 – Feb 28, 2006 or earlier if harvest objective met	163	March 1, 2006 – Feb 28, 2007 or earlier if harvest objective met	163
079	March 1, 2005 – Feb 28, 2006 or earlier if harvest objective met	4	March 1, 2006 – Feb 28, 2007 or earlier if harvest objective met	4
161 - 164, 171 - 173, 211, 212, 221 – 223, 231, 241 – 244, 251 - 253, 261 - 268, 271 - 272	March 1, 2005 – Feb 28, 2006 or earlier if harvest objective met	68	March 1, 2006 – Feb 28, 2007 or earlier if harvest objective met	68
280 - 284	Closed	0	Closed	0

Department. The carcass must be disposed of in accordance with state law.

Mountain lion harvest objectives are calculated for each administrative region on a semi-annual basis using standardized methodology. Harvest objectives are calculated and recommended in order to achieve a specific management action over a short-term period (no more than two years). Management actions may be designed to increase, stabilize and maintain, or decrease mountain lion populations within each of the three administrative regions in Nevada. Calculations of harvest objectives by administrative region incorporate the use of scientific data to determine the current population trend and population density.

Interstate hunt with Utah

Nevada and Utah hunters may hunt within open units in both states (Nevada unit 079, Utah Unit 1c). Nevada hunters hunting in Utah must abide by Utah regulations and season dates on the Utah portion of the hunt area. See Appendix 1 for State of Nevada mountain lion hunt unit reference map.

LITERATURE CITED

ALDOUS, C. M. 1945. A winter study of mule deer in Nevada. Journal of Wildlife Management 9:145-151.

BEUCHNER, H. K. 1960. The bighorn sheep in the U.S.. Its past, present, and future. Wildlife Monographs Number 4.

CAHALANE, V. H. 1964. A preliminary study of distribution and numbers of cougar, grizzly and wolf in North America. New York Zoological Society, New York, New York, USA. 12 pages.

COWAN, I. M. 1940. Distribution and variation of the native sheep of North America. American Midland Naturalist 24:505-580.

ELLIOT. R. R. 1973. History of Nevada. University of Nebraska Press. Lincoln, Nebraska, USA.

FOWLER, D. D., D. B. MADSEN, AND E. M. HATTORI. 1973. Pre-history of southeastern Nevada. Desert Research Institute Publ. In the Social Sciences Number 6.

GEORGETTA, C. 1972. Golden Fleece in Nevada. Venture Publication Company, Reno, Nevada, USA.

GREENLY, J. C. 1971. The status of mountain lion in Nevada. *In* Jorgensen, S. E. and L. D. Mech editors. Proceedings of a symposium on the native cats of North America; their status and management. U.S. Bureau of Sport Fisheries and Wildlife. Twin Cities, Minnesota, USA.

GRUHN, R. 1976. Excavation in Amy's Shelter, Eastern Nevada. Nevada State Museum Anthropological Papers, Number 17, Carson City, Nevada, USA.

HALL, E. R. 1946. Mammals of Nevada. University of Nevada Press, Reno, Nevada, USA.

HARRINGTON, M. R. 1933. Gypsum cave, Nevada. Southwest Museum Papers, Number 8. Los Angeles, California, USA.

HESS, M. 1998. Nevada, the Kaibab, deer and predators. Special report prepared for the Nevada Wildlife Coalition. Nevada Division of Wildlife, Reno, Nevada, USA.

JENNINGS, J. D. 1957. Danger Cave. University of Utah Anthropological Papers Number 27:XIV.

LANE, R. H. 1974. The cultural ecology of sheep nomadism: northeastern Nevada, 1870-1972. Dissertation, Yale University, New Haven, Connecticut, USA. 374 pages.

LEOPOLD, A., L.K. SOWLS, AND D.L. SPENCER. 1947. A survey of over-populated deer ranges in the United

States. Journal of Wildlife Management 11: 162-177.

MEAKER, R. 1981. Nevada desert sheepman. Western Printing and Publishing Company.

MCQUIVEY, R. P. 1978. The Bighorn Sheep of Nevada. Biological Bulletin Number 6, Nevada Department of Wildlife, Reno, Nevada, USA.

NAPPE, L. 1974. On the track of the cat. Wildlife and Natural Areas, Forestry Institute 2:13-16.

NEVADA DIVISION OF WILDLIFE. 2001. Bighorn Sheep Management Plan. Nevada Division of Wildlife. Reno, Nevada, USA.

NOWAK, R.M. 1974. The gray wolf in North America; a preliminary report. Report to New York Zoological Society and U.S. Bureau of Sport Fisheries and Wildlife.

ROWLEY, P. H. 1985. U.S. Forest Service grazing and rangelands, a history. Texas A&M University Press, College Station, Texas, USA.

SCHROEDER, A.H. 1952. The significance of Willow Beach Plateau. University of Utah, Anthropological Papers Volume 25, Number 2. pp 27-29.

SPECIAL COMMITTEE ON CONSERVATION OF WILD LIFE RESOURCES, United States Senate. 1934. Grazing of sheep on the public domain and in the national forests. Hearings before the Seventy-Third Congress, Second Session. United States Government Printing Office. Washington D.C., USA.

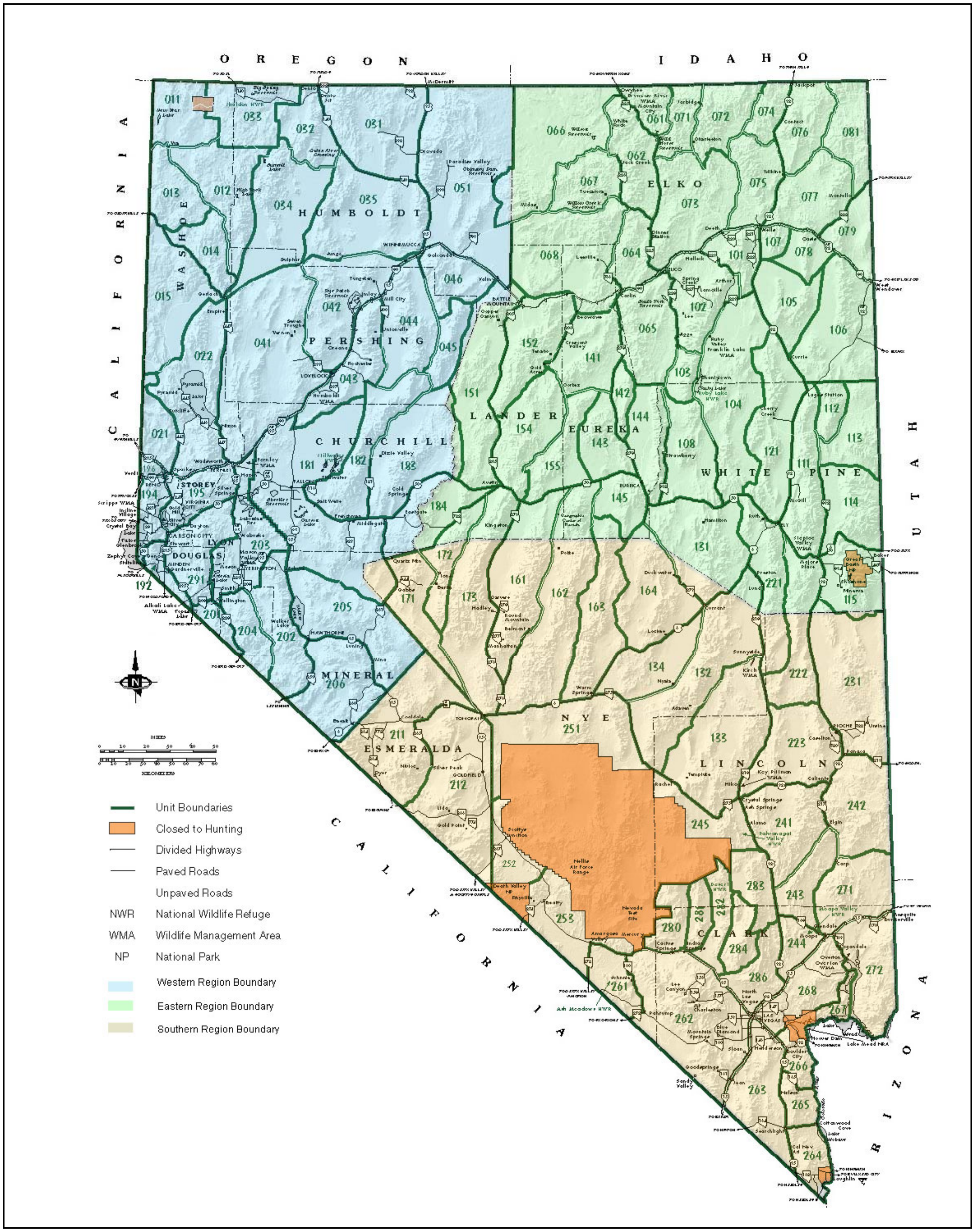
STIVER, S.J. 1988. Status of lions in Nevada. Pages 26-29 *in* R. H. Smith, editor. Proceedings of the third mountain lion workshop. Prescott, Arizona. Arizona Game and Fish Department.

SHUTLER, M.E. AND R. SHUTLER JR. 1963. Deer Creek Cave, Elko County, Nevada. Nevada State Museum, Anthropological Papers Number 11, Carson City, Nevada, USA.

USDA. 1915-1949. Annual Report, Predatory Animal Control, Nevada District (series). United States Department of Agriculture, Bureau of Biological Diversity and Nevada, State Rabies Commission Cooperation, Carson City, Nevada, USA.

WASLEY, T. 2004. Nevada's mule deer; population dynamics: issues and influences. Nevada Department of Wildlife. Biological Bulletin number 14. Reno, Nevada USA.

Appendix A. Nevada mountain lion hunt unit reference map.



COLORADO MOUNTAIN LION STATUS REPORT

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Mountain Lion Workshop 8:57-65

MANAGEMENT BACKGROUND

Mountain lion (*Puma concolor*) received no legal protection and were classified as a predator in Colorado from 1881 until 1965. During this time, bounties and other laws encouraged take of puma at any time and place. The bounty was abolished in 1965, but some provisions for landowner take of a depredating puma remain in Colorado laws to this day. In 1965, puma were reclassified as big game. In 1996 the Colorado Department of Agriculture (CDA) was granted "exclusive jurisdiction over the control of depredating animals that pose a threat to an agricultural product or resource". Thus, CDA has exclusive authority to determine the disposition of an individual puma if it is depredating on livestock, while the Colorado Division of Wildlife (CDOW) retains authority to manage puma populations and all forms of recreational or scientific use.

The state is divided into 19 Data Analysis Units (DAUs) for the purposes of puma management (Figure 1). DAUs are assemblages of Game Management Units (GMUs). Since 1972, Colorado sets harvest limits, which are called quotas for one or more GMUs within DAUs for the purpose of limiting and distributing harvest within a DAU. Hunters are allowed to take one lion per season of either sex. Colorado does not currently use female sub-quotas.

Hunter harvest, non-hunter mortality, game damage conflicts, and puma-human conflicts are monitored annually within DAUs for crude indications of population change. Puma mortality is documented through mandatory checks of hunter kill and mandatory reports for non-hunter mortality and is kept in a database. The database for hunter kill has been kept since 1980, and for non-hunter mortality since 1991. Data on depredation claims since 1979 is also maintained in a database, although the data from 1979 -1987 is somewhat suspect due to inconsistent reporting and record keeping.

Puma quotas increased from 1980 to 1999, leveled out until 2005 when a substantial reduction was enacted (Figure 2). Hunter harvest gradually increased from 1980 to 1997, and has shown since then a slight decline, with variation since 1997 mostly attributed to snow hunting conditions, local public and private land access issues, and in certain GMUs localized exploitation. Currently, Colorado does not survey hunters to determine estimates of the number of hunters that actually participated in a puma hunt nor hunter success. License sales are recorded as an indicator of hunter participation and hunter success is derived by dividing license sales into harvest (Figure 3). The level of quota achievement has been used as a surrogate for hunter success on a localized basis when quotas have remained static or only gradually been adjusted. The utility of this as a surrogate for hunter success, however, becomes suspect if there are significant or frequent changes to the quota.

The 2005 quota reduction stemmed from the analysis that occurred during revision of DAU plans. In some cases quota reductions were intended to produce a slight reduction in puma harvest, whereas in most cases

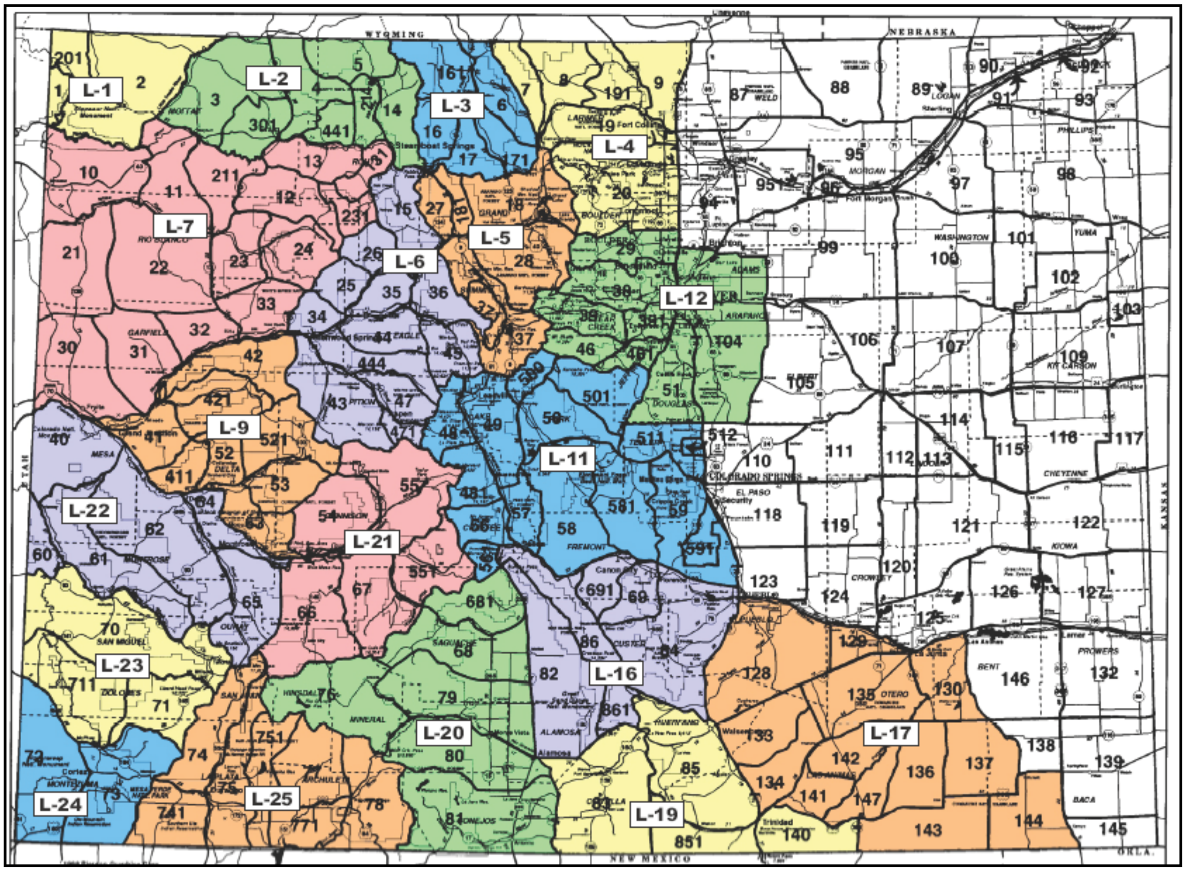

Figure 1. Colorado Data Analysis Units (DAUs) and Game Management Units (GMUs) that comprise them.

reductions were intended to have a negligible harvest affect but realign the quota closer to the harvest objective. In many cases the quota is somewhat higher than the harvest objective. Yet, the quota does represent the upper limit on harvest within a DAU that managers believe we could endure for a one or two year period. The caveat to this being that if mortality did not drop to within harvest and mortality objectives in a two year period, then quota reductions would be the likely response.

NEW EFFORTS SINCE 2003

Since the Colorado status report provided at the May 2003, 7th Mountain Lion Workshop several new management initiatives have begun. Foremost among these efforts are: revision of all DAU management plans, start of a long-term research project, conceptual development of a second research project, and use of geospatial mapping technology for management analysis. Following is a brief discussion of each of these efforts.

DAU Management Plan Revisions

Management plans were developed and approved for each DAU in 2000. These first efforts at developing puma DAU plans provided a history of management, general description, and target quota for the DAU but did not provide specific direction for management. In fact, target quotas contained in plans were misinterpreted to be the desired harvest level. In response, in late 2003 these plans were deemed inadequate and all plans were revised in 2004. Revised management plans describe DAU locations, terrain, related physical and vegetation

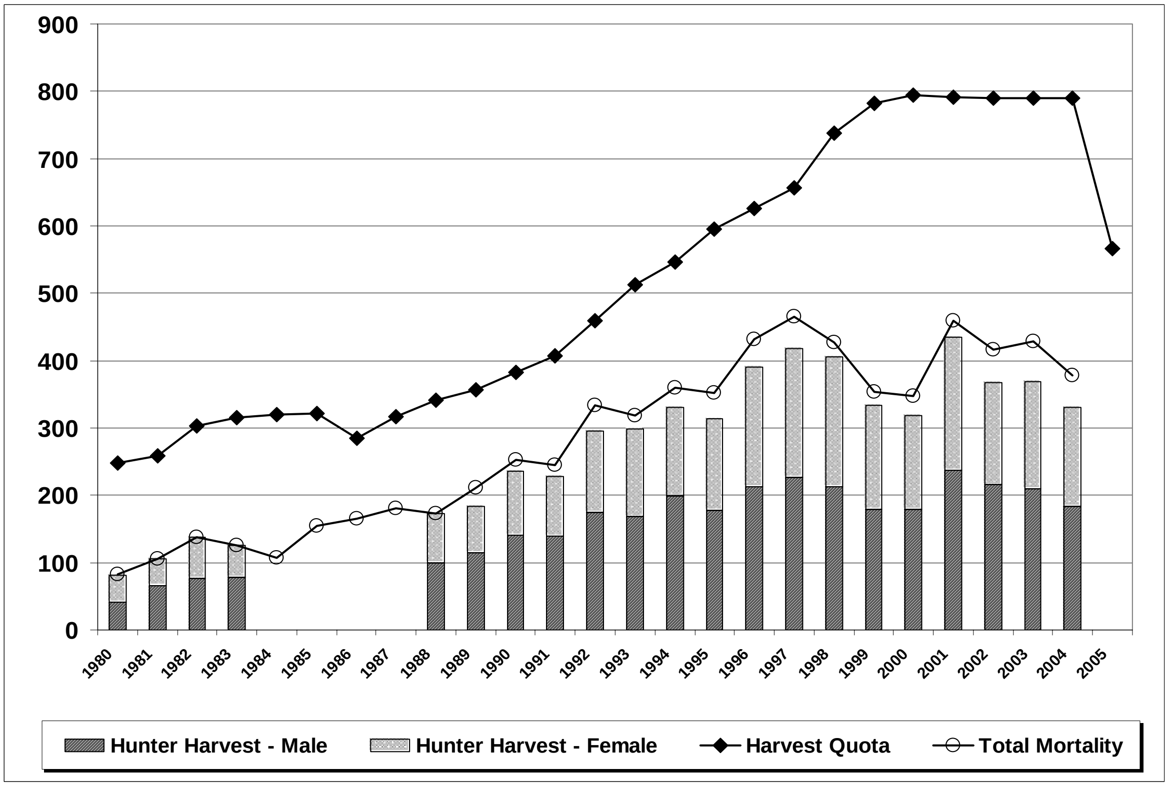

Figure 2. Colorado puma harvest limit quota, harvest, total mortality 1980 – 2005.

attributes, management history, and any unique conditions that may influence management such as persistent game damage conflicts, high levels of human population growth and related development, presence of chronic wasting disease in prey populations, high levels of puma human conflicts, etc.

DAU plans set an overall management strategy for the DAU. Given the coarse nature of information about puma populations and trends the management strategy is set broadly. Managers chose between two approaches; management directed toward suppressing the population, or management directed toward maintaining the current population and/or allowing it to increase. Public meetings, open houses, written comments, and informal discussion groups were used to allow for public input into management plans and overall management strategies.

Each DAU plan projects the puma populations within its area using GIS data layers for vegetation, elevation, relative prey densities, and mortality locations to provide managers information for making judgments about habitat quality. General guidance to managers stipulated that areas above 11,000 feet, agricultural, highway corridors, urbanized areas, and grassland habitat types were not considered puma habitat. In some cases managers reduced the elevational limit to 10,500 – 9,500 feet, and in other cases managers deleted greasewood/salt desert or expanses of sagebrush shrubland from consideration as puma habitat. The general concept is to define winter habitat areas, rank their relative quality, and apply puma population densities within the range of densities reported in literature (Figure 4) to project a possible population for the DAU. From this population projection, usually expressed as a projected population range, a huntable population was generated by

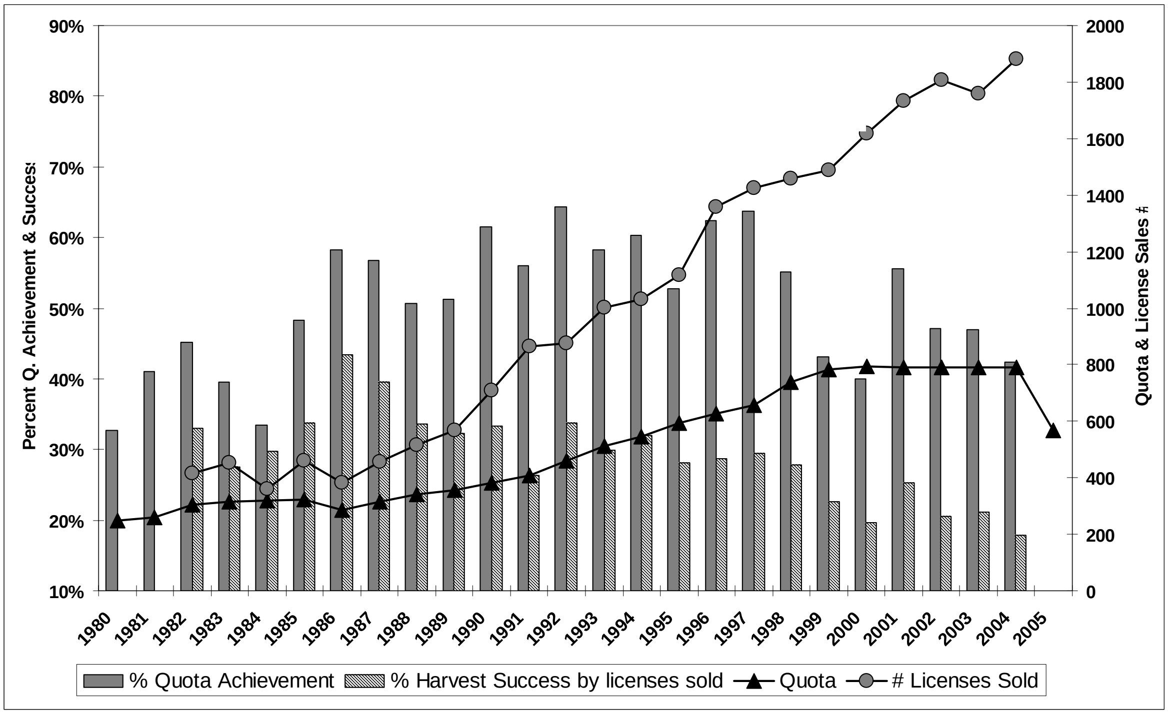

Figure 3. Colorado puma license sales, success, quota achievement 1980 – 2004.

deducting the assumed percentage of the population comprised of kittens. This percentage was derived from the few published studies that reported the percent of kittens evident in exploited populations.

The DAU plans then identify a mortality objective compatible with the overall management strategy. The mortality objective was determined as the allowable mortality as a percentage of the projected huntable population. This follows from the few published studies that showed populations supplemented by immigration/dispersal of subadult males and to a much lesser extent subadult females may have growth rates on the order of 5% - 11%, and following periods of intensive exploitation may have growth rates of nearly 30%. Given very abundant deer, and especially elk as prey base in Colorado, direction to managers stipulated that for management aimed at maintaining or allowing population growth, then the mortality objective should be set at somewhere between 8% - 15% of the huntable population. Conversely, management aimed at suppressing a population should have a mortality objective set at something above 15%, increasing the intensity of suppression effort with higher percentages (Figure 5).

Managers in Colorado are cautious about using density based population extrapolations, and acknowledge that it is a less than optimal approach to management. We nevertheless believe that by using conservative assumptions when defining habitat and selecting densities used in projections, this method provides a tool for guiding management decisions and setting harvest limits.

Uncompahgre Plateau Research

After consideration of several study area locations, an 870-mi^2 area on the southern end of the Uncompahgre Plateau in southwest Colorado was selected for a long-term research project (Figure 6). Hunting is

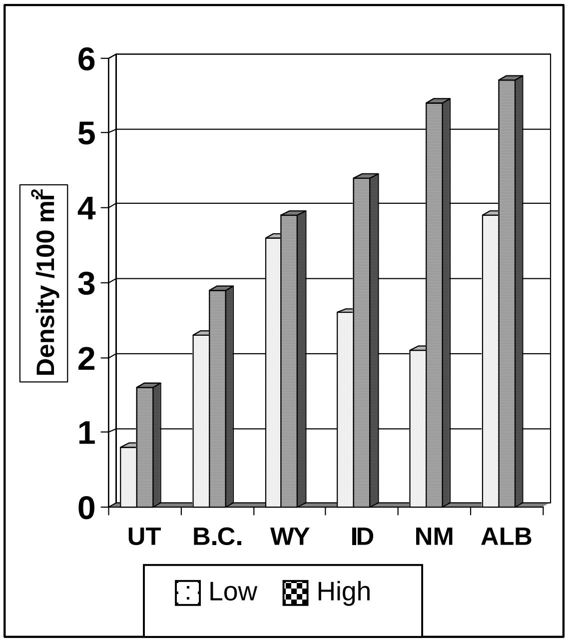

Figure 4. Puma densities reported in literature used in population extrapolation for DAU population projections.

closed in the study area and take of collared animals is prohibited in several adjacent GMUs. We have also worked with the state houndsmen's association to encourage their peers not to take collared animals anywhere they might disperse. Capture efforts began in November 2005.

The desired outcomes from this research include estimation of population parameters and changes during increase and decline phases of the study, identification of habitat preferences and linkages, prey relationships, and testing of management assumptions. The basic research design is an experimental manipulation of the puma population in two 5-year phases, an increase and decrease phase. During the phases various capture-mark-recapture methods are employed and the population is intensively monitored using GPS and radio telemetry. Population indices including catch per unit effort, camera trap, track survey, and DNA genotyping will be monitored throughout the study. As a corollary to the study we are also considering testing the efficacy of genotyping primers using known individuals, related siblings from zoo animals, and samples taken from the individuals in various states of degradation. The desired outcome of this effort, if completed, is to test the reliability of DNA genotyping from a controlled setting in comparison to field settings.

Front-Range Research (Conceptual)

In early 2005 conceptual development of a front-range research project began. The focus of this research effort would be more directly related to puma-human interactions. We intend to structure research jointly funded by the Division of Wildlife and various county and municipal open space and non-government organizations to monitor current perceptions and changes in those perceptions people may have of risk of puma attack and related concerns, as well as public perceptions and changes in those perceptions about differing management strategies before and during application of the different management strategies. Some of the tested strategies may be directed toward puma population manipulation while others may be puma-human conflict incident responses. Assuming sufficient funding is obtained then this will be an intensive long-term study that would monitor human social

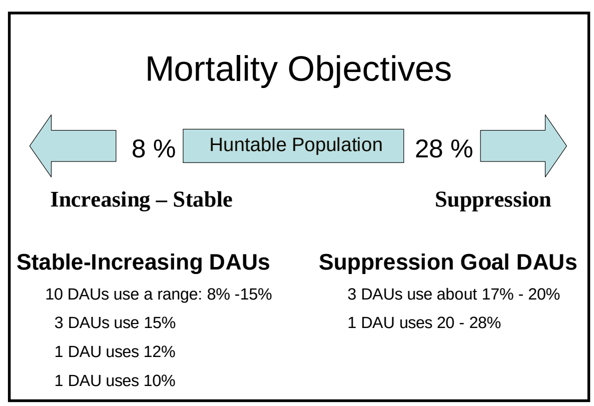

Figure 5. Mortality objectives within a sliding scale depending upon the management strategy for the DAU.

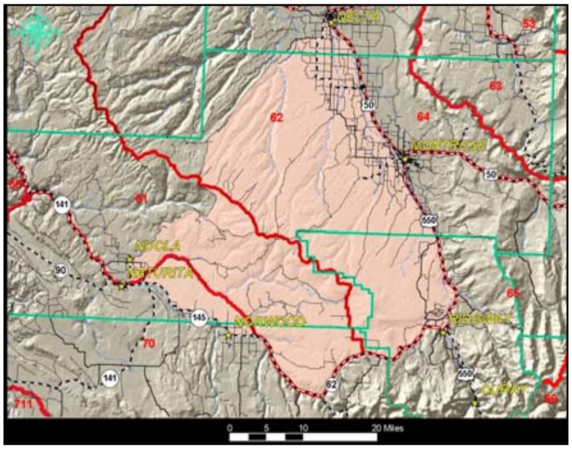

Figure 6. Location of the Uncompahgre Plateau puma research project

metrics as well as puma population metrics during various manipulations.

As an adjunct to the development of this research a statewide survey of public perceptions of risk and safety, different management actions is being implemented. A written, mail return survey instrument was developed and the survey was begun in June 2005. Survey recipients were stratified into three demographic groups primarily based upon human population densities and regions in Colorado. Results of the survey are anticipated in late 2005.

Geospatial Analysis

In late 2003 plotting of the previous 6 years mortality locations buffered with average male and female home area produced a mortality intensity map (Figure 7). When layered with maps of deer, elk, and bighorn sheep winter range, the map was first intended to try to identify potential areas being at least 2 female home areas in size where there was little or no puma mortality. Further investigation about these areas was intended to determine if the area was secure from harvest or other human caused mortality due to land ownership, management, or access and as such may serve as de facto source areas.

With the mortality map as a starting point we began thinking of other applications for geospatial analysis. As of June 2005, the Division of Wildlife and Colorado State University are forming investigations to use geospatial data layers and analysis to produce a habitat model. Both biological/physical metrics and anthropogenic metrics may be included in the model. Biological/physical metrics include prey densities (Figure 8) such as those developed for a coarse scale wolf habitat model, mortality intensity, vegetation (including canopy cover when available), land management status/security, elevation, terrain roughness indices (Figure 9), and snow cover/depth (Figure 10). Anthropogenic metrics such as road densities, human development, game damage and puma-human conflicts may be included. Some of the data layers may be in need of future refinement, for example, current road density maps do not show Forest Service roads nor seasonal road or area closures which may be important. Similarly, snow cover maps are available daily and 8-day composites through MODIS satellite imaging, but snow depth must be inferred over large areas from winter snow moisture content routes (Snotel) measured bi-monthly by the USDA NRCS.

The first part of the modeling effort is simply to produce a ground-truthed model that reasonably predicts areas with sustaining puma populations with little or no human disturbance. As this project develops our hope is that the model may predict with confidence management parameters. If this level of model development is achieved then it could provide a tool to predict population outcomes if management strategies or habitat parameters change.

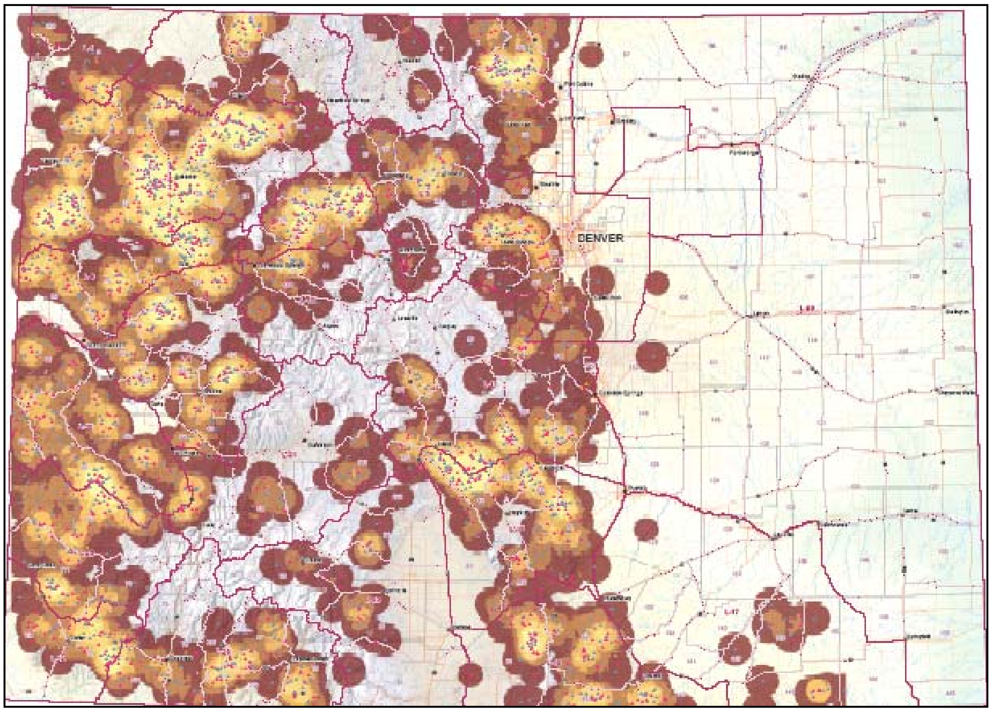

Figure 7. GIS plot of puma mortality locations 1997-2002; male and female mortality is buffered by their average home area. Higher intensity of mortality is lighter in color (brown to yellow).

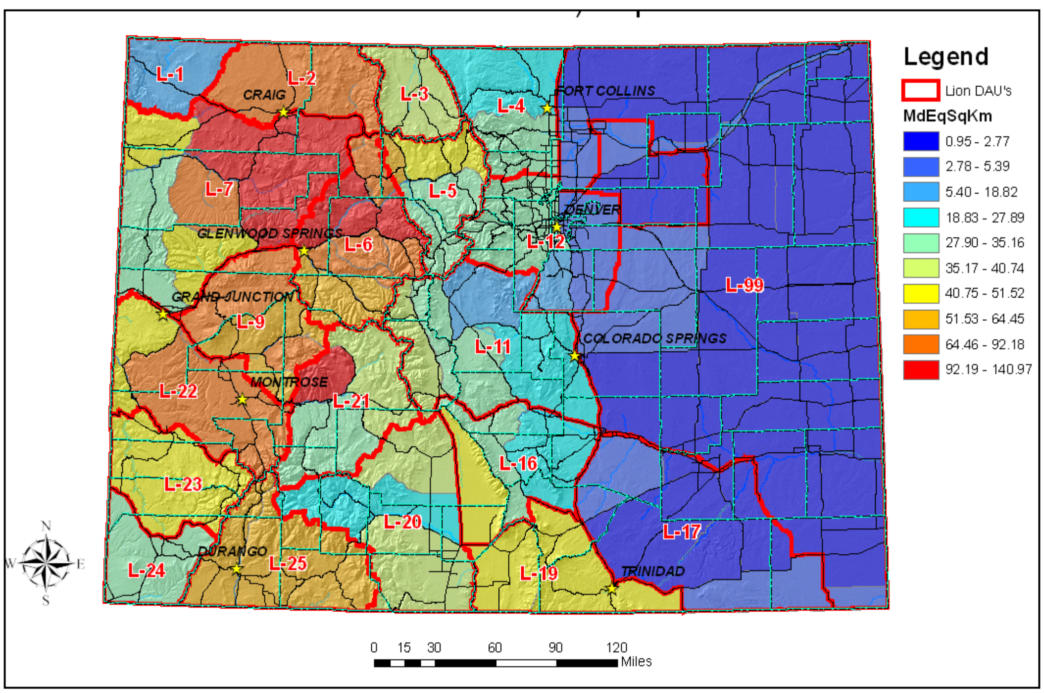

Figure 8. Representative GIS layer of elk and mule deer prey density per km^2. Density layers were developed using similar concepts as represented by this layer but updated with 2000-2004 post-season prey populations.

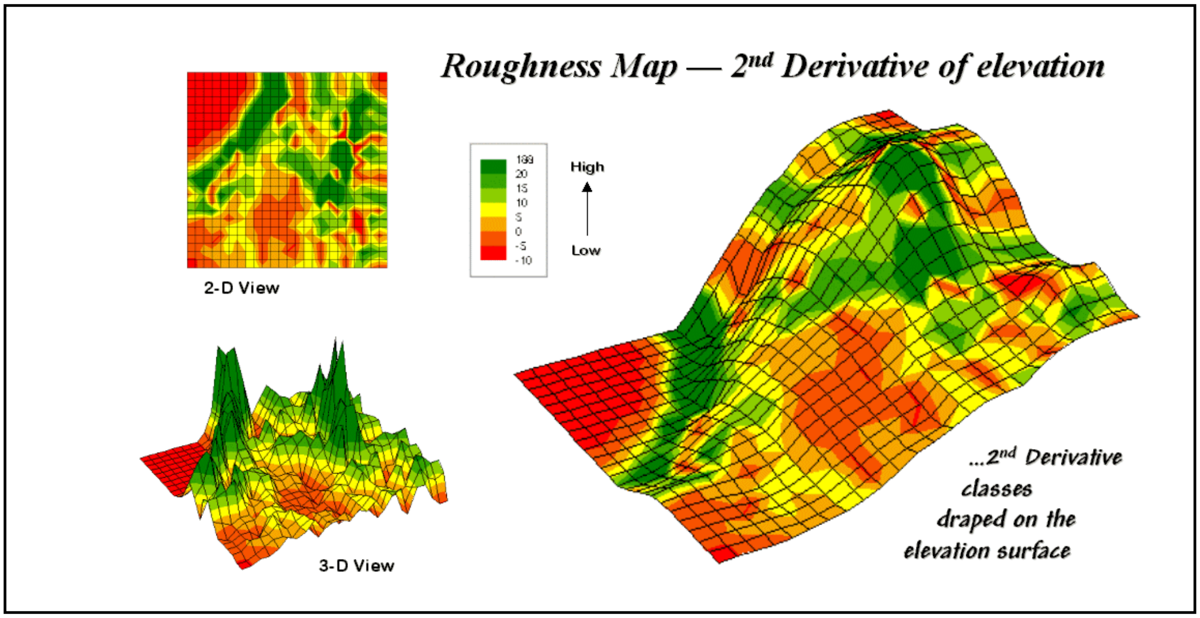

Figure 9. Representative GIS layer depicting how terrain roughness indices are developed at 2nd Derivative classes. Layers can be scaled to DAU, GMU or finer scales depending upon the desired intensity of analysis.

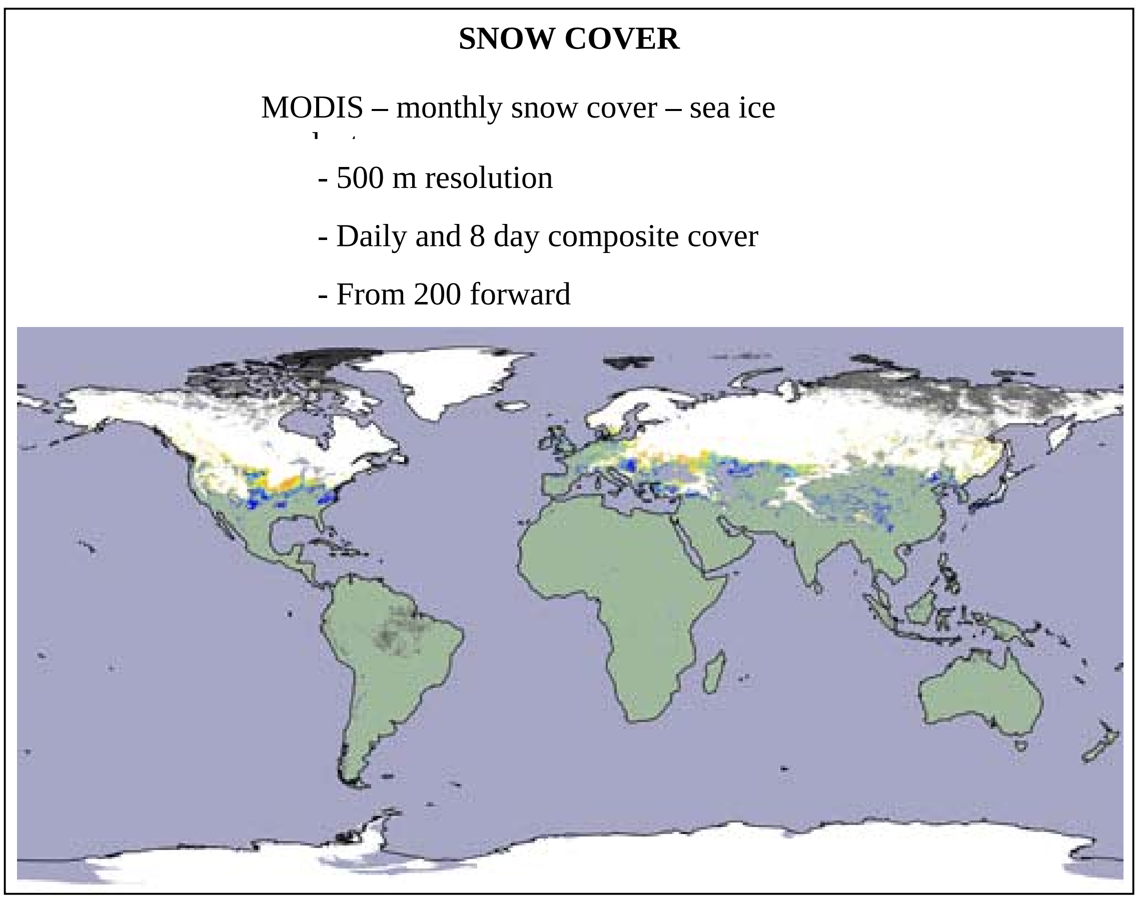

Figure 10. Representative GIS snow cover layer, frequency of imaging, and scale.

ARIZONA MOUNTAIN LION STATUS REPORT

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Mountain Lion Workshop 8:65-69

INTRODUCTION

Arizona maintains a healthy mountain lion population, currently estimated at around 2,500 animals. Mountain lion management in Arizona is guided by the Arizona Game and Fish Department's strategic plan titled "Wildlife 2006." The strategic goal is to "Manage the mountain lion population, its numbers and distribution, as an important part of Arizona's fauna. Provide mountain lion hunting (including with dogs) and other related recreational opportunities." Objectives under the strategic plan are:

1. Maintain annual harvest at 250 to 300 mountain lions (including depredation take).
2. Provide recreational opportunity for 3000 to 6000 hunters per year.
3. Maintain existing occupied habitat and maintain the present range of mountain lions in Arizona.

Species-Specific Strategies are:

1. Maintain a complete database from all harvest sources, through a mandatory checkout system, including age, sex, kill location, etc. to index population trend.
2. Conduct a hunter questionnaire biannually.
3. Evaluate the management implications of population and relative density estimates.
4. Implement hunt structures to increase and direct harvest emphasis toward areas with high lion populations, and where depredation complaints are substantiated, and evaluate the effectiveness of these efforts.
5. Determine population numbers and characteristics on a hunt-area basis.
6. Increase public awareness of mountain lions and their habits, to reduce conflicts with humans.
7. Implement the Department's Predation Management Policy.

The Arizona Game and Fish Department (Department) is currently evaluating several changes to address the biological and social issues associated with managing mountain lions. If the decision is made to pursue any of these changes, they must first go through an internal review and the public process associated with the various rule making and legislative processes before they are finalized.

One change being evaluated is increasing the reporting requirements for hunters. Historically hunters have been required to report by phone within ten days of harvest. In 2004 the requirement to submit a premolar tooth was added to help the Department acquire more accurate age data. The Department is proposing to require a physical checkout of all harvested mountain lions. This will enable the Department to gather more accurate age, sex, and harvest location data.

General mountain lion seasons in Arizona have traditionally listed "any lion" as legal take. In 2004 the Arizona Game and Fish Commission changed the definition of a legal animal from "any lion" to "any lion except spotted kittens or females accompanied by spotted kittens." The Department is also considering changes, either through Commission rule or Commission order, to close the mountain lion season for part of each year. This potential season closure would follow the peak breeding period for mountain lions in Arizona and would be intended to minimize the potential for orphaning dependant kittens if hunters harvest a female.

The Department will also be initiating research in an attempt to develop more reliable methods to index mountain lion population densities and to explore the potential of creating "lion management areas" (LMAs). The LMAs may combine current game management units to manage mountain lion populations based on common prey populations, climate patterns, and other habitat features. The Department will also be implementing a survey of houndsmen to develop a measure of catch per unit effort. All of these efforts are designed to improve the quantity and quality of data used to manage mountain lions.

DISTRIBUTION AND ABUNDANCE

Mountain lions range throughout most parts of Arizona and occupy 72,158 square miles of habitat of which 11,958 are classified as high quality habitat. Arizona Game and Fish Department biologists are playing an active role in Arizona's Missing Linkages workshops that identify habitat continuity. This is a collaborative effort between the Department, the Arizona Department of Transportation (ADOT), Dr. Paul Beier from the Northern Arizona University School of Forestry, and others.

The Missing Linkages workgroup is using Global Information System (GIS) technology to identify core habitat areas throughout the state and the species associated with each core area. The process will prioritize areas in the state and then use the GIS data to analyze linkage areas or corridors between core habitat areas using least-cost-path-corridor analysis. The team will develop strategies to protect existing corridors and to restore some of the lost corridors between areas. ADOT will also use the data in their planning for future road designs. These efforts will help the Department to achieve its strategic objective to maintain the existing occupied mountain lion habitat by ensuring connectivity between habitat areas, allowing for movement and genetic exchange between populations.

HARVEST

Mountain lions are classified as big game in Arizona. The legal limit for mountain lion is one per year, except in those units with a multiple bag limit. Multiple bag limit units are established when prey species are below management guidelines and/or the predation management policy has been implemented. In multiple bag units hunters may take one lion per day until the multiple bag limit is reached at which point the unit reverts to the statewide limit of one lion per year. Multiple bag limits are currently authorized for parts of game management units 13A, 13B, 15B, 21, 22, 28 and 37B and in all of units 15C and 15D. In the southwest part of the state, which includes several game management units, there is a quota of one lion. This part of the state closes to mountain lion hunting if one lion is harvested in any of the units.

The strategic objective in Arizona is to harvest between 250 and 300 mountain lions each year. Harvest has slightly exceeded this objective three of the last five years (Figure 1 and Table 1).

DEPREDATIONS AND HUMAN INTERACTIONS-CONFLICTS

As in many western states, Arizona is enduring a period of rapid development in and around most of our urban areas. The development, coupled with lingering drought conditions, has increased the

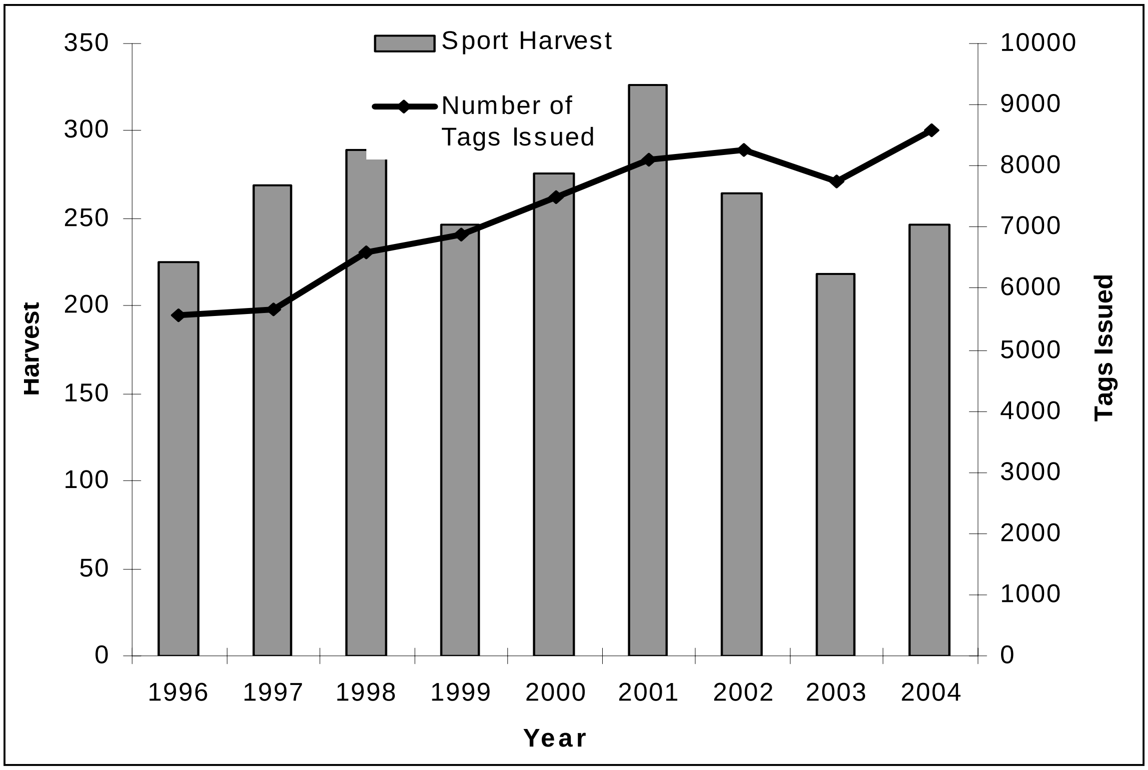

Figure 1: Total mountain lion harvest in Arizona from 1996 to 2004 and the number of mountain lion permits issued over the same time period.

number of encounters between humans and mountain lions in the state, particularly in the urbanized areas in and around Phoenix and Tucson (Figure 2).

The Department is initiating a research project designed to gather data on lions and other wildlife in and around urban areas and the urban interface. The Department is also considering internal policy changes addressing how wildlife conflicts are handled. The potential policy changes would standardize how these conflicts are resolved and would standardize how field personnel collect information about human-wildlife interactions from the public.

These policy changes, in draft form, were reviewed and commented on by an active and diverse section of the public in the fall of 2004. A high profile public safety issue involving multiple mountain lions developed on the north side of Tucson, Arizona during the spring of 2004 that sparked a high level of public interest. This interest enabled the Department to assemble a diverse public group in a facilitated setting. The public included members of activist groups, hunters, as well as members of the general public concerned about public safety and mountain lion welfare.

Mountain lion depredation issues in Arizona are handled differently than nuisance or public safety issues. State statutes allow livestock owners to take mountain lions that depredate on their livestock, but the owner must follow strict reporting requirements once pursuit of a lion is initiated. Depredation take has accounted for an average of 15% of all harvest over the last 10 years (range of 11% to 22%; Figure 3).

ONGOING RESEARCH

The Department has its own Research Branch that is currently finishing one

Table 1. Mountain lion mortality in Arizona, 1995 through 2004.

Year	Sport Harvest	Dep. Harvest	Other [a]	Total
1995	234	31	1	266
1996	225	38	2	265
1997	269	48	3	320
1998	289	52	1	342
1999	247	49	2	298
2000	276	53	0	329
2001	326	58	0	384
2002	264	50	5	319
2003	218	63	12	293
2004	247	31	1	279
Avgs	260	47	2.7	310

[a] "other" kills are road kills, public safety, etc.).

mountain lion study and planning two new mountain lion research projects. The study that is being completed is investigating predator-prey relationships between mountain lions and desert bighorn sheep (*Ovis canadensis mexicana*) in central Arizona. A final report for this study should be available soon.

The first of the new studies will capture and collar up to ten lions in the Tucson area and investigate how lions use the urban areas and the urban interface. The study will use global positioning system (GPS) collars that will allow a large amount of data to be collected. The results of this study will provide information for the Department to use in coordination with municipalities, development interests and land management agencies. The results will also help guide other mountain lion management activities to allow the Department to manage lions in suitable habitat near urban areas and address connectivity issues near urban areas, with minimal public safety risks and conflict.

The second new study will place GPS collars on as many as 30 lions below the Mogollon Rim in central Arizona across a large area of contiguous habitat following the LMA concept. The researchers will study and compare home range use of lions in and around a smaller urban area, and "exurban" lions with home ranges within the same region that do not use urban areas. The study will provide further information about when, how, and potentially why mountain lions venture into and use urban areas. Additionally, the study will look for opportunities to develop reliable methods to index lion populations in a large area. Studying a mountain lion population intensively across a large area will allow the department to begin evaluating the use of LMAs that can be designated based on mountain lion population dynamics, prey populations and habitat availability as opposed to managing them within administratively designed game management units.

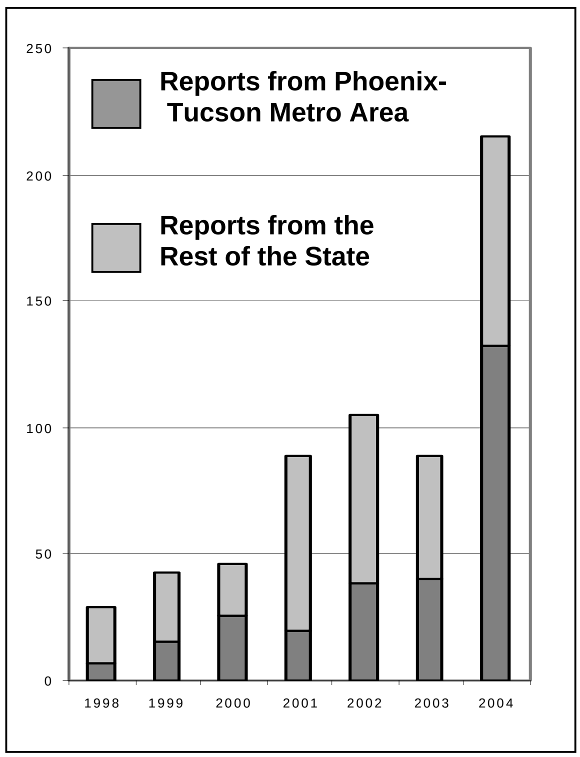

Figure 2: Mountain lion incidents reported in Arizona from 1998 to 2004. This figure demonstrates the increasing number of overall reports and the increasing proportion of calls from urban areas.

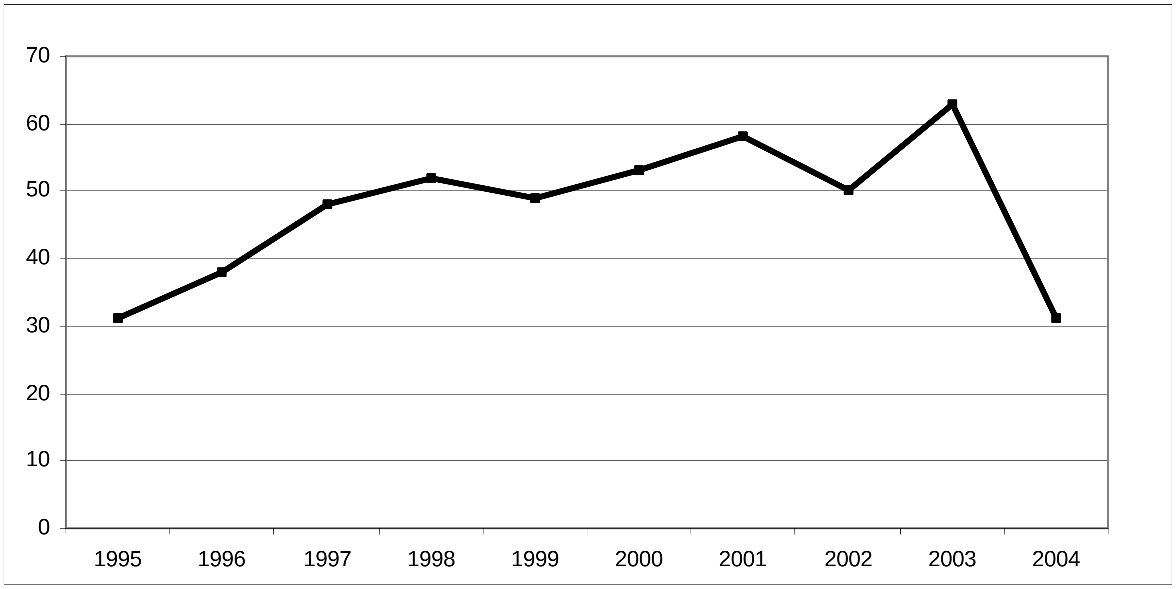

Figure 3: Mountain lions harvested under Arizona's depredation statutes from 1995 to 2004

NEW MEXICO MOUNTAIN LION STATUS REPORT

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Mountain Lion Workshop 8:70-72

DISTRIBUTION AND DENSITY

Rocky, brushy, rugged landscapes (Figure 1). Basically relates to prey distribution, especially mule deer, but including bighorn sheep, javelina, elk and feral or free-range domestic ungulates, equines and swine.

CURRENT SPORT HARVEST MANAGEMENT

New Mexico is divided into management zones based upon lion population management objectives (Figure 2). Each zone is comprised of one or more of the state's Game Management Units (GMUs). Each lion management zone's population objective depends on several factors, but protection of wild ungulate populations (particularly Rocky Mountain bighorn and state listed desert bighorn sheep populations), and depredation on domestic livestock have major influence on much of cougar management. Zones are categorized into 1 of 3 levels of protection:

(1) Population reduction for protection of wild ungulates and domestic livestock.
(2) Population maintenance where wild ungulate populations are stable or increasing and depredation is a small factor.
(3) Population refugia, where harvest is limited by low harvest limits, inaccessibility or protection in refugia.

We had previously considered designating specific management zones as refugia. However, numerous de facto refugia already exist in the form of military bases, tribal lands, state and national parks and refuges, and wilderness areas.

Harvest

Harvest for the past 10 years has ranged from 120 to 283, averaging 194 (Figure 3).

Economic Importance

Two thousand or more lion hunting licenses are sold annually in New Mexico. Resident licenses sell for $33.00 and non-resident licenses sell for $210.00 for a total of approximately, $110,250 annually being paid to NMDGF. Indirect benefits to the state from lion hunting and the outfitting industry on guided lion hunts probably exceeds $450,000. The yearly cost to the state of depredation and lion removal for depredation is approximately $72,000. The cost of lion removal in desert and rocky mountain bighorn sheep ranges has averaged

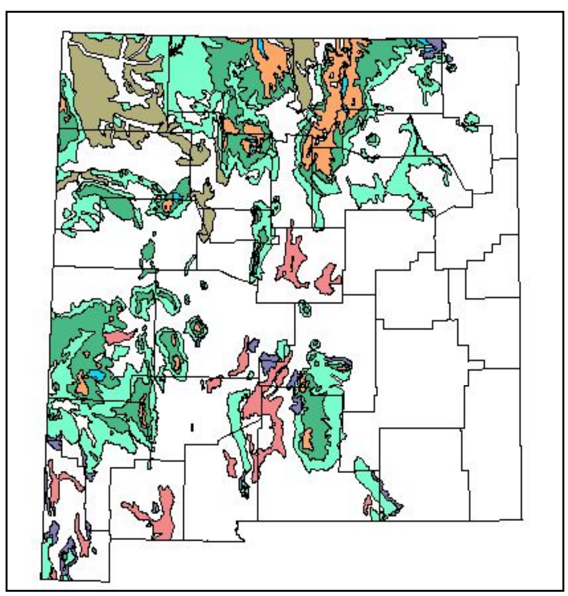

Figure 1. Range of cougars in New Mexico.

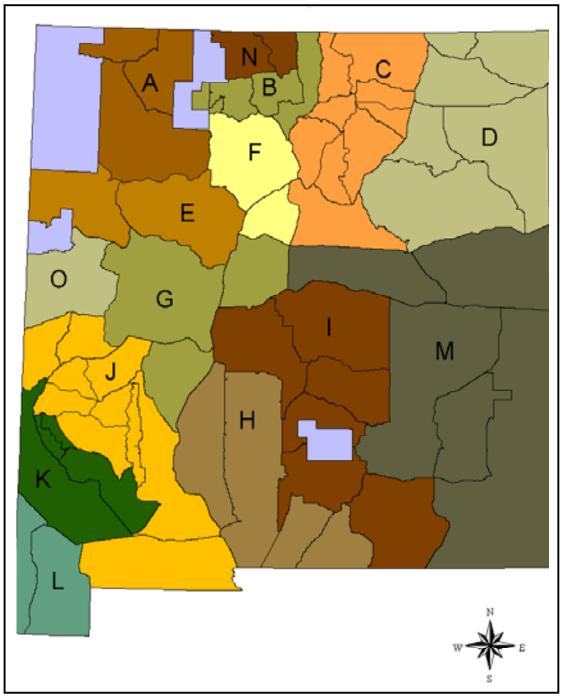

Figure 3. Cougar management zones in New Mexico.

approximately $34,800/yr. over the last four years, or approximately $3,400 per lion removed. Most of this money is spent in desert bighorn sheep ranges and paid to contract snare/houndsmen.

RESEARCH

Two research projects on the state's cougar population are currently underway. The first is focused on the Fra Cristobal Mountain range where one of the desert bighorn sheep herds occurs. The object of this study is to remove female lions from the range and not to allow the establishment of female territories there. Male lions that use the range are captured and GPS/radio collared. Known lion scats are collected for diet analysis. The premise is that if there are no females on the range, male lions will not become residents. This could reduce predation on bighorn.. Preliminary results indicate that male lions do not remain on the range if there is not a female present. This project appears to be working, but the occasional lion kill of a sheep continues to occur and bighorn hair has been present in all scats analyzed.

The second project is to perform diet analysis of cougars involved in depredation. Scat, stomach contents and large intestines of lions are being analyzed for prey remains. The goal of this project is to determine what lions are preying on with particular emphasis being placed on lion use of desert bighorn sheep, deer and domestic ungulates. There is a strong feeling among state biologists that some lion populations are being subsidized by the use of domestic ungulates, particularly cattle, and the quantification of this is a major goal of the project.

MANAGEMENT CONCERNS

Depredation on domestic animals is generally the primary concern for lion management in New Mexico. This is occasionally overridden by fears for human safety when a cat appears or makes kills in residential areas. The next concern is the removal, of lions in desert bighorn sheep ranges. This subject always causes some public comment, particularly from the lion/animal advocacy groups. However,

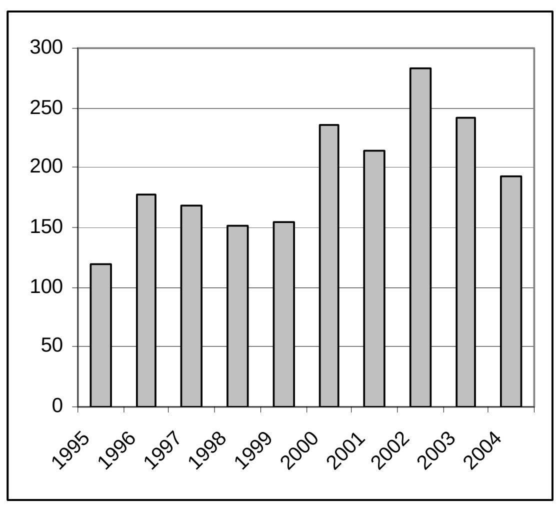

Figure 2. Cougar Harvest in New Mexico, 1995-2004.

Table 2. Sex and age composition of desert bighorn sheep on the Fra Cristobal Mountains, New Mexico, 2003-2005

Year	Ewes	Lambs	Unknown	Class I	Class II	Class III	Class IV	Total
2003s	1	12	2	6	5	3	1	58
2004s	3	16		2	8	4	1	66
2004f		12		2	4	8	1	44
2005s	6	10		4	6	6	3	58

[s]Spring survey
[f]Fall survey

some desert sheep populations probably would have been extirpated without removal of cougars.

Predation on wild ungulates by lions, particularly on our declining mule deer herd is a perennial concern. The question of what a socially acceptable population of mountain lions becomes more of a concern over time, particularly in light of our inability to accurately quantify the actual number of lions we have. Lastly, population sinks in some part of the state and potential sources in others are constant sources of questions and concerns.

LEGISLATION

An attempt was made in the Spring Legislative session to change the status of cougars from game animal to unprotected wildlife. The bill passed two House committees but stalled in a third, and was not considered by the Senate. This could serve as an important gauge of public sentiment on what a "socially acceptable" lion population may be and may have been driven by widespread public sentiment that mountain lions are causing the current mule deer decline.

WHAT'S NEXT?

The State of New Mexico and the NMDGF is currently rethinking management direction for its carnivore populations. We are focusing management in streamlined "action plans" which focus on a few vital instead of all potential challenges. These action plans will be more proactive with measurable steps towards achieving management goals. Our current largest need is developing a cost effective lion population survey technique. We continue to use population modeling based upon density estimates and harvest to determine population and harvest levels. We also are continuing to attempt to determine how mountain lions affect our state endangered desert bighorn sheep populations and how lion removals affect these populations.

FLORIDA MOUNTAIN LION STATUS REPORT

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Mountain Lion Workshop 8:73-77

INTRODUCTION

Florida panthers (*Puma concolor coryi*) once ranged throughout the southeastern United States from the Carolinas to Arkansas but are now restricted to southern Florida. Habitat loss and fragmentation along with unregulated killing over the past two centuries resulted in the panther being classified as endangered by the state of Florida in 1958 and by the federal government in 1967. The Florida Fish and Wildlife Conservation Commission (FWC) and the U. S. Fish and Wildlife Service (USFWS) are involved in all aspects of Florida panther recovery and protection. Other agencies participate in panther recovery efforts including the National Park Service, the Florida Department of Environmental Protection, Florida Division of Forestry, and the South Florida Water Management District. Additionally, several non-government organizations such as White Oak Plantation, Florida Wildlife Federation, National Wildlife Federation, The Nature Conservancy, Florida Audubon Society, and many others are involved with different aspects of panther recovery as well.

The Florida Fish and Wildlife Conservation Commission initiated intensive research efforts in 1981. FWC and many collaborators have published over 200 papers and reports detailing Florida panther life history, habitat use, food habits, mortality, dispersal, home range dynamics, biomedical findings, population modeling and genetics. A population viability analysis was conducted in 1992 which predicted the extinction of the Florida panther within 24-63 years (Seal 1992) and lead to the creation of A Plan for Genetic Restoration and Management of the Florida Panther (Seal 1994). Implemented in 1995, genetic restoration of the Florida panther continues to be the focus of current research and management efforts. Our annual reports summarize data on a fiscal year basis (July 1-June 30).

POPULATION STATUS AND MONITORING

The current population estimate is 70-100 panthers. This number is based on known individuals, tallying observations of uncollared panther sign encountered during yearly field activities, and extrapolating numbers on inaccessible private lands based on home range and habitat requirements. In any given year, approximately one third of the population is monitored with radiocollars. In 1995, 8 female panthers from Texas were released into areas occupied by Florida panthers for genetic restoration purposes. We have documented an increase in population size from 30-50 panthers in the late 1980's to today's 70-100 animals and part of this increase is attributed to genetic restoration efforts. The population appears to occupy all areas with suitable panther habitat and may be close to reaching its capacity.

Transient males continue to disperse north of the Caloosahatchee River, a geographic feature thought to be an obstacle to dispersal; this dredged river flows from Lake Okeechobee to the Gulf of Mexico. Four radiocollared panthers have been documented crossing this river since 1998. The most recent occurrence was in August 2004. Male Florida panther FP130 dispersed approximately 70 miles from his natal range. Previously, in March 2004, an uncollared panther was struck by a vehicle on a road bordering the south end of Highlands Hammock State Park in Highlands County near Sebring. No carcass was discovered but panther hair recovered from the bumper confirmed the animal in question that was struck. This panther may have survived because tracks of an uncollared male were confirmed in Highlands Hammock State Park 3 months later in June 2004. A survey of panther occurrence north of Caloosahatchee River was conducted in 2002-04 and a final report is forthcoming.

Florida panthers are captured using hounds from November through April to change radiocollars and maintain our sample size. Environmental factors—lower temperatures and water levels—make for safer capture conditions during the winter dry season. To date 139 individuals have been radiocollared as part of the study population. During the 2003-2004 and 2004-2005 capture seasons, FWC and BCNP conducted initial captures or recaptures of 26 and 13 panthers respectively. All radiocollared panthers are aerially located 3 days per week (typically Monday, Wednesday, and Friday) by BCNP, Everglades National Park and FWC staff.

Panther kittens are handled at the den when approximately 2-weeks-old and marked with transponders inserted just below the skin between the shoulder blades. Additionally, neonates are weighed, sexed, dewormed, and skin biopsies, feces, hair, and blood samples are collected. Since 1992 a total of 187 kittens have been marked with transponders at den sites. FWC and BCNP handled 9 and 3 kittens in 2003, 14 and 9 kittens in 2004, and 6 and 6 kittens through April 2005 respectively.

Our estimates of annual survival are 0.895 ± 0.13 and 0.787 ± 0.125 for female and male radiocollared panthers respectively (Land et al. 2004). Since 2000, an average of 16 panther mortalities has been documented per year (range 11 -25). Intraspecific aggression accounts for 41% of radiocollared panther mortalities including 4 females in 2003 and 1 in 2004. Thirty-eight panthers have died from intraspecific aggression since 1984; twelve of these deaths were of females, nine of which have occurred since 2001. Six panthers died from collisions with vehicles in 2000 and 11 died in 2004 with an average of 8 panther roadkill deaths per year since 2000.

FELINE LEUKEMIA

Feline leukemia virus (FeLV) is a disease of domestic cats and is very rare in captive or free-ranging non-domestic felids. An outbreak in Florida likely began in 2002 and was apparently restricted to a small area in the northwest portion of the panthers range on Okaloacoochee Slough Sate Forest (OSSF). OSSF is surrounded by private land that we are not permitted to access so the exact extent of this disease is unknown. However, FeLV has not been observed in any panthers further south in their range. Five panthers (2 in 2003 and 3 in 2004) tested positive for FeLV based on ELISA antigen testing. Three of these panthers are believed to have died from the disease. The other 2 died from intraspecific aggression. New vaccine and removal protocols to manage the outbreak have been established. Fortunately no new FeLV positive panthers were discovered during the 2004-2005 capture season. The OSSF will be monitored for future occurrences of FeLV. For more details, refer to Cunningham (2005) on page 127 of these proceedings.

RESEARCH UPDATES

Most of our activities have been focused on following the progress of genetic restoration. Ten years have elapsed since we began panther genetic restoration and we are continuing to track genetics and morphology through successive generations. Preliminary data suggest that there has been an increase in observed heterozygosity and a reduction of deleterious traits such as cryptorchidism and atrial septal defects. We also continue to evaluate the use of GPS radiocollars on Florida panthers and since 2001; FWC researchers have equipped 16 panthers with GPS radiocollars. We have used units from 2 manufacturers all with store-on-board capabilities and some have combinations of remote download on demand or pre-programmed downloads via ARGOS satellites. Two other feasibility studies, extracting DNA from Florida panther scats and using remote cameras to survey Florida panthers, are near completion.

PANTHER-HUMAN INTERACTIONS

Two panthers were removed or relocated in separate incidents. The first involved a family group consisting of a female with 2 kittens. The presence of this family was first brought to our attention through photographs taken by tourists in October 2003 in a fairly isolated portion of BCNP near the tiny community of Pinecrest. The entire family group (mother FP124, male siblings FP125 and FP126) was eventually captured and radiocollared by the BCNP capture team in February 2004. Some local residents and the Miccosukee Tribe of Indians expressed concerns with these cats' behavior and a multi-agency strategy was developed to address these concerns. Part of this strategy was to develop and apply aversive conditioning techniques. For more details, see McBride et al. (2005) on page 126 of these proceedings. One of the dependent kittens (FP126) was relocated in May 2004 in deference to the concerns expressed by the Miccosukee Tribe relative to their annual Green Corn Dance religious ceremony. FP126 was relocated 40 miles from his natal range and was killed 7 months later by an adult male. FP125 dispersed naturally and was apparently struck by a vehicle; the force of the impact severed the breakaway material on the collar but no carcass was ever discovered. His status is unknown. The adult female, FP124, is currently raising another litter in the same area.

The second incident involved a radiocollared 9-year-old male panther, FP60, which was depredating hobby livestock (goats, emus) in a private campground within BCNP in June 2004. The campground owners slowly made improvements in their husbandry practices over the next few weeks but FP60 did not leave the area. Complicating our efforts to resolve this situation, an outside individual convinced the campground owners to allow him to entice FP60 with a tethered goat so that he could videotape a depredation. FWC Law Enforcement officers charged all these individuals with animal cruelty after the tape of the depredation was made public. Once all possible prey items had been secured and no more baiting occurred, FP60 still frequented the area and was eventually captured in a box trap. He was found to be in poor condition and was removed for further evaluation. We discovered that he had a fractured left check bone, atrophied jaw muscles resulting from nerve damage, severe anemia due to a high hookworm load, pneumonia, and a packed cell volume (PCV) of only 13% (35% is normal, 10% is generally considered incompatible with life). We suspect that FP60 survived a vehicle collision. Persistent pneumonia resulted in the removal of a lung lobe in March 2005. Due to the extent of his injuries, particularly his inability to effectively subdue prey because of nerve damage to the jaw muscles, FP60 will remain in captivity. He is currently being maintained at White Oak Plantation (WOP), a private wildlife conservation facility, and is doing well. The individual that tied up the goat was convicted for animal cruelty but received a suspended sentence, a $500.00 fine and incurred $260.00 in court costs.

FLORIDA PANTHER RESPONSE PLAN

In light of the above incidents and in recognition of an increasing panther population, an interagency team was assembled by FWC and charged with developing a Florida Panther Response Plan. Field biologists, law enforcement personnel, and supervisory-level staff from FWC, BCNP and USFWS have been involved in creating this document. The Response Plan covers the spectrum of panther-human interactions including sightings, encounters, depredations, public safety concerns and attacks. The draft plan will eventually go out for public comment before being adopted.

REHABILITATED PANTHERS

Three dependant panthers from two different litters were orphaned when different adult males killed their mothers. A brother and sister, FP113 and FP114 were orphaned at 6-months-of-age in October 2002 and female FP116 was orphaned when 7-months-of-age in January 2003. These kittens were subsequently captured and allowed to grow and hone their hunting skills at WOP. They were all released in August 2003 within their mothers' former home ranges. Both females established home ranges within their mothers' former ranges but male FP114 was killed by an uncollared male 58 days after release. Female FP116 gave birth to 3 kittens in May 2004. One kitten was observed from the air during a routine telemetry monitoring flight when it was 9-months-old. FP113's first attempt at raising kittens was unsuccessful. A live, maggot infested 1-week-old kitten was discovered approximately ¼ mile from the suspected den site in September 2004 and died a short time later. FP113 recently gave birth to 2 kittens in April 2005. She is currently still caring for those kittens at the den site.

FP120 was an adult female panther hit by a vehicle during the late afternoon hours on a stretch of US41 that bisects BCNP on July 11, 2004. FWC wildlife officers were patrolling the panther zone, an area with reduced nighttime speed limits, and witnessed the collision. FP120 survived and swam across a canal adjacent to the highway and moved off about 30 yards. Based on her apparent ability to move and approaching nightfall, we decided to reassess her condition the following morning. She had not moved and did not flee when approached; a broken rear leg was observed. She was subsequently immobilized and taken to the School of Veterinary Medicine at the University of Florida where her right femur was set. After surgery she was transported to WOP for convalescence and further treatment. She developed a bacterial pneumonia secondary to contamination at the fracture site and later underwent a root canal to the lower left canine. With the excellent care provided at WOP, FP120 eventually overcame her complications and just needed time for the bone to heal. Complicating matters was the fact that FP120 was raising 6-month-old kittens at the time of her injury. The day following her removal, a collaborative effort between FWC, BCNP, and Collier County Sheriff's Officers controlled traffic at a greatly reduced speed while dogs searched along the highway for sign of kittens but none was found. Approximately 2 weeks later one of FP120's kittens was killed by a vehicle near where his mother was injured. The status of the remaining female kitten is unknown. FP120 was released near her home range on May 4, 2005 and returned quickly to where she had previously been hit by a vehicle. FP120 was killed after colliding with a vehicle on May 7 near where she was originally injured.

LITERATURE CITED

SEAL, U. S., editor. 1994. A plan for genetic restoration and management of the Florida panther (*Felis concolor coryi*). Conservation Breeding Specialist Group, Apple Valley, Minnesota, USA.

SEAL, U.S. AND WORKSHOP PARTICIPANTS. 1992. Genetic management strategies and population viability of the Florida panther. Yulee, Florida, U.S. Fish and Wildlife Service.

LAND, D., D. SHINDLE, M. CUNNINGHAM, M. LOTZ, B. FERREE. 2004. Florida panther genetic restoration and management. Annual Report 2003-2004. Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida, USA.

Mountain Lion Population Monitoring

USING DNA TO ESTIMATE COUGAR POPULATIONS IN WASHINGTON: A COLLABORATIVE APPROACH

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Mountain Lion Workshop 8:81-82

Abstract: To better understand population dynamics of cougars, wildlife managers need long-term data sets collected using standard methods. Short-term studies, while useful for management, are only "snapshots in time", and provide little information about year-to-year variability and long-term status. Given that it is unlikely WDFW would successfully undertake a statewide census of cougars, it is imperative that an effective sampling regime be developed to estimate population size. The objectives of this project were to acquire a population estimate for cougars in northeast Washington, address management goals for effective cougar management, and to test the efficacy of using DNA techniques to estimate cougar population size. The 5,480-km^2 project area in northeast Washington was chosen because it represents a region that has been designated as a reduction zone (i.e. the public would like to see a reduced cougar population); being able to identify the decrease in the population without reducing it to collapse is imperative. Also, this region is close to another project area where cougars are being captured to estimate population demographics. Therefore, it provides a means of corroborating estimates and, if successful, a valuable link for estimating cougar abundance and demographics in NE Washington. Between 15 November and 31 December 2003 and 2004, approximately 15 hound handlers were deployed throughout the project area to tree cougars using hounds and obtain tissue samples using a biopsy dart fired from a CO_2-powered rifle. Three biopsy dart types were tested during the first year of the project, a 1.5 and 2.0 cm biopsy tip that used barbed broaches to retain the tissue sample, and a 2.0 cm tip- that used a crimped barrel to retain the sample. Within the project area, each hound handler was assigned a specific work area with an identifiable border (i.e. roads or rivers) and required to work a minimum of 20 days. By doing so, we insured that the entire project area was sampled equally and each animal had the same opportunity of capture. There was no physical handling required and once the biopsy sample was retrieved, all research personnel immediately left with area while the cougar was still in the tree (in some instances, the animal jumped and ran off after being sampled). We referred to these initial samples as the "capture-period" samples, and the individuals from whom the samples were taken as "marked" individuals. The "recapture" period (i.e., the general hunting season) immediately followed this "capture" period to ensure a relatively high probability that these "marked" cougars were in the area and available for "recapture". During the hunt season, WDFW personnel collected tissue samples from all known cougar mortalities via a mandatory reporting/sealing system. To confirm that WDFW obtained samples from all "marked" cougars that were killed during

the hunting season (i.e. to account for possible emigration), samples were collected from an area approximately 5-times the size of the initial project area (~25,000 km^2). Upon completion of the hunting season, all cougar DNA samples from both ”capture” and “recapture” sessions were sent to WDFW’s DNA lab for analysis. The tissue samples were analyzed using microsatellite analysis. In this project, the fingerprint analysis consisted of positively identifying 36 alleles (2 alleles x 18 loci) for each tissue sample. Samples that did not produce at least 30 alleles were censored. A comparison was made to determine how many individuals made up each sample and if any individuals were in both samples. In 90 days of “capture” sampling over the two year period, the hound handlers retrieved 96 cougar samples. Of those 96 samples, 69 (72%) samples were uniquely identifiable and 54 individuals were identified. However, the success rate (i.e. efficiency) of identifying the necessary number of alleles increased from 60% success in 2003 to 89% in 2004. This was due to a superior design dart being identified during the first year and used exclusively in the second. Therefore, increased efficiency is likely to continue in subsequent years. During the “recapture” sessions, 182 samples were retrieved, of which 164 (90%) were uniquely identifiable. Thirty-two cougars were killed within the project area over the two-year period and 6 were “marked”. While that supported the use of a closed-population estimator such as Lincoln-Petersen for a within-year estimate, the recapture rate of “marked” individuals was too low to generate a population estimate (i.e. <7 recaptures). Nonetheless, we can say for sure that, within 1 year (before the hunt), there was a minimum of 44 unique individuals occupying the project area equating to a density of .80 cougars/ 100 km^2. No emigration was observed. As many as 28 cougars still remain “marked” on the landscape and will contribute to future within- and across-year population estimates. Continuation of this project can answer important questions including: What is the cougar population size in northeast and north-central Washington? Is this DNA monitoring technique a good technique for cougars? Is the precision of the method consistent with WDFW’s management needs? And, if so, are management objectives being met? The longer the project is conducted, the smaller the confidence intervals will be around the population estimate, thus producing a robust estimate of population size and reduced bias.

UPDATE: EVALUATING MOUNTAIN LION MONITORING TECHNIQUES IN THE GARNET MOUNTAINS OF WEST CENTRAL MONTANA

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Mountain Lion Workshop 8:83-84

Abstract: Mountain lion populations in Montana have created public concern over human safety, depredation of livestock and pets, predation on game animals, over harvesting of lions, and possible restrictions on lion hunting. Montana Fish, Wildlife and Parks (FWP) took a proactive approach to address these concerns and began a long-term mountain lion research project in 1998. Research is being conducted in the Blackfoot Drainage (7908 km^2), specifically, an 858 km^2 portion of the Garnet Mountains designated as the Garnet Study Area (GSA). The goal of this research effort is to improve management of mountain lions by documenting the influence of hunting on population characteristics, as well as evaluating techniques designed to detect trends in lion abundance. Trend indicators being evaluated include: density of lion tracks on established snow-track routes, statewide telephone surveys of houndsmen and deer hunters, and monitoring trends in prey populations. Similar to other lion research projects, it took approximately three years of intensive systematic searching (1998-2000) to capture and mark the resident lion population in the GSA. Furthermore, hunting of mountain lions was restricted within the GSA after the 2000 hunting season to help accomplish population goals. Since then, the number of radio-collared resident adults and subadults has ranged from 11 to 14 individuals. Over 150 miles of routes on established roads and trails are inventoried from January to March of each year to document the number and location of lion tracks. Track surveys are used to determine the relationship between lion track density and the actual density of lions. Since 1998, 93 lions have been fitted with radio-collars and more than 4,700 relocations have been recorded. From 2001 to 2004, the number of radioed adult and subadult lions and the actual number of days radioed lions spent in the study area remained relatively constant. During the same time period, the trend in the average number of lion tracks recorded remained comparatively constant as well. In the Blackfoot Drainage, legal hunting was the cause of 65% of the confirmed deaths of radioed adult and subadult lions. Overall, average annual mortality of the radioed adult and subadults was 49%. The most common cause of death of radioed lion kittens was starvation resulting from the mother being harvested by hunters. The average annual kitten mortality was approximately 40%. Statewide telephone surveys of houndsmen started after the 2000 hunting season with 300-464 houndsmen contacted each year to determine where they hunted lions, the number of days they hunted lions and how many lions they treed. From 2000 to 2002, houndsmen reported that it took more days to tree a lion in the Blackfoot Drainage (+34%) and statewide (+35%). In 2000, FWP's statewide telephone survey of deer hunters included asking hunters if they observed a mountain lion while deer hunting.

From 2000 to 2002, deer hunters reported observing fewer lions in the Blackfoot Drainage (-38%) and statewide (-29%). Trends in both the statewide telephone surveys of houndsmen and deer hunters appear to be consistent with radio-collared lion mortality, pointing to a decline in the lion population in the Blackfoot Drainage. Preliminary data from January 2005 indicates an increase in the radioed-lion population. A continued increase in the lion population over several years will allow an evaluation of the accuracy of lion trend indicators to detect changes in actual lion populations.

POTENTIAL FOR FLORIDA PANTHER RANGE EXPANSION INTO CENTRAL FLORIDA

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Mountain Lion Workshop 8:85

***Abstract**:* Following the success of genetic restoration in 1995, the documented Florida panther (*Puma concolor coryi*) population has tripled. This population is currently located on 8,903 km^2 of public and private land south of the Caloosahatchee River in southern Florida. Whether or not panthers can expand this population north of the Caloosahatchee River into central Florida is of obvious importance for the continuation of panther recovery. The objectives of this study were to determine the occurrence and status of panthers in central Florida and to evaluate the potential for expansion. Field surveys were conducted in 53 areas in 13 counties. Results of the survey concluded that a resident breeding population of panthers does not currently exist in central Florida. Even though some suitable panther habitat remains in central Florida, it is widely scattered and fragmented into small tracts. Dispersing males from the southern Florida population have immigrated into central Florida, but natural recolonization has been frustrated by an absence of females. Major highways and urban or agricultural development isolate the remaining small tracts of suitable habitat, which is rapidly being lost to the same development that threatens southern Florida. The larger segments of remaining panther habitat could possibly support several isolated small populations, but the viability of these populations without periodic translocations are questionable. The certainty of highway mortalities, coupled with an increase in politically sensitive interactions between panthers, humans, and small livestock, may prove insurmountable for population expansion.

COUGAR TRACKING IN THE NORTHEAST: YEARS OF RESEARCH FINALLY REWARDED

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Mountain Lion Workshop 8:86-88

Abstract: Although the last North American eastern cougar was reportedly killed in 1938 near the Quebec-Maine border, cougar sightings in the northeast have never stopped. However, despite a growing number of credible observations, objective evidence of the existence of a wild cougar population is still lacking. The goal of our long-term project is to collect hard data of the cougar presence in the East, and to determine if the origin of these cougars is mainly from western migrants, from escaped animals, or from eastern remnant specimens. Our project combined the use of pheromones to attract cougars to hair poles, and DNA analyses of collected hair samples to confirm animal identification. Recent results have demonstrated that cougars are present in New Brunswick and in at least three regions of Quebec.

Key words: Eastern-Cougar, Puma concolor couguar, Quebec, New Brunswick, pheromone attractant, hair trap, DNA identification.

Despite a growing number of credible observations in Quebec and neighboring provinces (Tardif 1997), evidence of the existence of a wild cougar (*Puma concolor couguar*) population is still lacking in eastern Canada. In fact, the eastern cougar population is currently on the Committee on the Status of Endangered Wildlife in Canada's (COSEWIC) "Data Deficient" list (Van Zyll de Jong and Van Ingen 1978, Scott 1998). This designation means that there is inadequate information to make an assessment of its true status.

Begun in the late 1990's (Gauthier et al. 1999, Gauthier et al. 2000), our project was undertaken to collect evidence of the cougar presence in Quebec and eastern provinces. In the long term, we also would like to determine to what extent the origin of these cougars are from western migrants, escaped animals, or eastern remnant specimens. For this purpose, we have developed a selective lure to attract free-living cougars. These lures were used with scratching posts, which were placed in areas where cougar sightings had been reported. These posts allowed us to obtain hairs from cougars for DNA analyses.

STUDY AREA

From July 2001 to present, about 50 scratching posts have been set up in many areas of Quebec, New-Brunswick and Nova Scotia. Study sites were mainly localized in protected lands, such as the Mont-Tremblant, and Gaspésie Provincial Parks, La Mauricie, Forillon, Kouchibouguac, Fundy National Parks, and the Ruiter Valley ecological Reserve. Most posts were placed in remote and quiet forest areas, relatively unexposed to human disturbances and movement. To maximize the pheromones dispersion, the local topography and the predominant wind direction were also considered when selecting posts sites.

METHODS

Scratching posts were made with 15 cm diameter PVC pipe and covered with a plastic boot mat to collect hairs from animals rubbing on the mat. Each post was also surrounded with two strands of barbed wire, hung about 3 meters from the post. The first wire was placed 45 cm above the ground, and the second strand 30 to 45 cm higher. A pheromone mixture, developed by Envirotel 3000 and the Granby Zoo, was used to attract cougars and bring them to rub on the post or to leave hairs on the barbwires. The pheromone mixture was used as a plaster lure, which was hung inside the post, and a liquid lure which was sprayed on tree bases and other natural structures to make a scent trail leading to the post. Posts were visited once a month to change the plaster lure and check for hair on the mat and surrounding barbed wires. When found, hair samples were placed in paper envelopes and sent for molecular analysis at the Université de Montréal Laboratoire d'écologie moléculaire et évolution. Most posts were followed-up for a period of 3 to 36 months.

Mitochondrial DNA was extracted from 2-10 cm of the hair samples using either the standard phenol/chloroform method proposed by Sambrook et al. (1989) or the protocol of Allen et al. (1998). Species-specific primers were then created to discriminate cougar samples from that of twenty other species of mammals representing seven different families (Felidae, Canidae, Cervidae, Mustelidae, Procyonidae, Ursidae, and Hominidae). When large quantities of DNA were available, sequencing was also performed to directly determine the species identity through comparison with known sequences in GenBank using the Blast search algorithm.

RESULTS

Since August 2001, a few hundred hair samples were collected and 120 of them were analyzed. In all cases, negative controls were used to check for contamination, and positive controls from cat and cougar samples confirmed the amplification. In a number of cases, a single hair was available and we were not able to extract any DNA out of it. However, the species-specific primers allowed the identification of six samples as that of cougar. Three of these samples were sequenced to confirm the identification obtained with the species-specific primers.

DISCUSSION

Our preliminary results show that some cougars are living in Quebec and New Brunswick. They also show that our lures are effective at attracting cougars, and that the genetic identification method is simple and reliable, even for degraded DNA samples. Although the best results were obtained from hairs with follicles, follicles were lacking from most of our samples. Thus, we are currently improving the scratching poles to obtain more hairs with follicles. We are also proceeding with additional DNA analyses, to determine the origin and the subspecies and origins of the identified cougars (Culver 1999). Several new samples must also be analyzed. Such results will be useful to allow the revision of the cougar status in eastern Canada.

ACKNOWLEDGEMENTS

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LITERATURE CITED

ALLEN, M., A-S. ENGSTRÖM, S. MEYERS, O. HANDT, T. SALDEEN, A. VON HAESELER, S. PAABO, AND U. GYLLENSTEN. 1998. Mitochondrial DNA sequencing of shed hairs and saliva on robbery caps: sensitivity and matching probabilities. Journal of Forensic Sciences 43:453-464

CULVER, M. 1999. Molecular genetic variation, population structure, and natural history of free-ranging pumas (Puma concolor). Dissertation, University of Maryland, College Park, Maryland, USA.

GAUTHIER, M., R. BRUNET, AND C. LANTHIER. 1999. Projet de dépistage du couguar dans la vallée du Ruiter. Envirotel 3000 inc., for the Ruiter Valley Land Trust.

GAUTHIER, M., R. BRUNET, C. LANTHIER, AND M. HUOT. 1999. Mise au point d'un outil de dépistage du couguar (Puma concolor) au Québec : Évaluation préliminaire. Envirotel 3000 inc., for the Fondation de la faune du Québec and the Ministère de l'Environnement et de la Faune.

SAMBROOK J., E.F. FRITSCH, AND T. MANIATIS. 1989. Molecular Cloning: A Laboratory Manual, Second Edition Cold Spring Harbor Laboratory Press, New York, New York, USA.

SCOTT, F. 1998. COSEWIC status report on cougar, eastern population, Puma concolor couguar. Committee on the Status of Endangered Wildlife in Canada.

TARDIF, J. 1997. Observations du couguar au Québec, de 1955 à 1995. Ministère de l'Environnement et de la Faune. Direction de la faune et des habitats.

VAN ZYLL DE JONG, C.G. AND E. VAN INGEN. 1978. Status report on the cougar (Eastern population) Felis concolor couguar in Canada. Committee on the Status of Endangered Wildlife in Canada.

Political Influences of Mountain Lion Management

A CAT RACE TALE… OF HOUNDSMEN, BIOLOGISTS, ADMINISTRATORS, COMMITTEES AND LAWMAKERS IN NORTHWEST MONTANA – A HISTORY OF MONTANA HB 142

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Mountain Lion Workshop 8:91

Abstract: Cougar hunting has been part of the fabric of northwest Montana's hunting heritage for over 100 years. From the late 1970's to the mid -1990's cougar populations increased dramatically throughout western Montana. Along with the cougar population increase, the number of houndsmen and cougar hunters coming to northwest Montana from out of state increased as well. Popular press magazines were advertising northwest Montana as a destination cougar hunt for non-resident hunters. The high number of non-resident hunters that subsequently came to northwest Montana, in part, created challenges for FWP's existing cougar management program. Harvest quota management, allocation of the recreational opportunity and quality of the hunting experience were all issues that were raised by both houndsmen and FWP staff. A potential solution presented itself in the form of a new law or Montana statute. This law became known as House Bill 142. The trials and tribulations of implementing a new law and subsequent hunting season regulations were explored in detail for this presentation. Following the implementation of Montana HB 142, hunting season quota over-runs decreased, percent nonresident harvest decreased and the opportunity for resident cougar hunting increased. This was accomplished by people dedicating countless hours at regional and statewide houndsmen, advisory, legislative, FWP Commission and public meetings over a two-year period.

POLITICAL AND SOCIO-ECONOMIC INFLUENCES ON COUGAR MANAGEMENT LEGISLATION IN WASHINGTON STATE: POST INITIATIVE 655

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Abstract: In November of 1996, Washington State voters approved Initiative 655 (I-655) prohibiting the use of dogs to hunt or pursue cougars (*Puma concolor*). I-655 has initiated increased awareness, public safety concerns, and legislative activity surrounding cougars in Washington State and has highlighted differing opinions of cougar management in eastern and western regions of the state. I compared population and economic data for western and eastern Washington counties with the highest reported cougar-human interaction in an attempt to describe and understand the social values and political context of cougar management legislation in Washington after I-655. I searched newspaper and television news archives to characterize how cougars and cougar management are presented to the public and to judge its potential role in the legislative process. Washington's northeastern counties (Chelan, Okanogan, Ferry, Stevens, and Pend Oreille) have significantly lower human population levels, lower household and family incomes, higher unemployment, a greater percentage of families and individuals living in poverty, and a higher percentage of people working in forestry, fisheries, and farming than counties in western Washington (King, Pierce, Snohomish, Thurston, Skagit, and Whatcom). These results suggest Washington's five northeastern counties are rural, resource-based communities with political and social values that differ from those of the more populated, urban counties to the west. Search results of Washington newspaper and television news archives indicated greater coverage of cougar-human interaction (61.6% of media reports) and few reports of cougar science (12.3% of media reports). Since 1996, media coverage of human-cougar interactions and utilitarian views of northeastern county residents and politicians has contributed to eight legislative attempts to overturn all or part of I-655. The most recent attempt, Substitute Senate Bill 6118, has successfully authorized the use of dogs to hunt and pursue cougars in Washington's five northeastern counties. The passage of this bill in light of increasing cougar harvest rates, documented declines in northeastern cougar populations and a decline in cougar complaints relative to pre I-655 levels, suggests that cougar management legislation in Washington may be influenced by political and social factors and may not reflect a scientific understanding of cougar ecology and behavior.

Key words: Cougar, Puma concolor, Washington, State Initiative 655, Substitute Senate Bill 6118, hound-hunting, socio-economic descriptions, public safety, wildlife media coverage

INTRODUCTION

Washington State (172,348 km²) is an ecologically diverse area that is home to 6.1 million people (US Census Bureau 2004) who reside within 39 counties (Figure 1). Washington is also home to an estimated

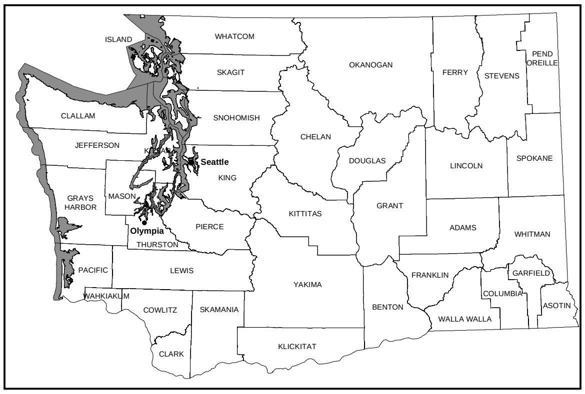

Figure 1: Washington State and its 39 counties.

population of 2,400 - 4,000 cougars (*Puma concolor*) ranging across 88,497 km² of forested habitat. The Washington Department of Fish and Wildlife (WDFW) manages cougars as a game species within nine Cougar Management Units (CMUs, Figure 2) to provide recreational hunting opportunities, ensure public safety, and maintain stable, viable cougar populations (WDFW 2002). However, ensuring public safety and maintaining viable cougar populations within some of Washington's ecological and political boundaries is a source of significant controversy.

The size and central location of the Cascade Mountains in Washington provides a natural divide that separates western and eastern into ecological and socio-economic regions. Differences in the social values, economics, and ecology of these two regions may translate into differences of opinion over the status, management, and ecological significance of cougars; as well as other wildlife species. These differences were demonstrated in November of 1996 when 63% of Washington voters and 31 of 39 counties approved Initiative 655 (I-655) outlawing the use of dogs to hunt and pursue cougars. The Humane Society of the United States and affiliated animal rights organizations backed I-655 with the purpose of eliminating recreational hound hunting of cougars, a practice they viewed as cruel and inhumane (Stiffler 1999, Pacelle 2002). Proponents of I-655 garnered support for the ban primarily from environment groups and suburban/urban voters living in more populated counties of western Washington. Opposition to I-655 stemmed largely from rural communities throughout the state, but opposition to the initiative was greatest from voters east of the Cascade crest (WA Secretary of State, personal communication 2004). Opponents argued that cougar populations would grow unabated and public safety would be threatened as cougars "lost their fear of people" (Stiffler 1999). Many of these individuals viewed hound hunting of cougars as a way of life and strongly opposed what they perceived was increased intervention by government agencies and urbanites into their communities. Specifically, opposition to I-655 existed in four of the five northeastern counties: Okanogan, Ferry, Stevens, and Pend Oreille, (WA Secretary of State, personal communication 2004).

Economics and social values have always played a significant role in the management of North American carnivores (Clark et al. 1996, Kellert et al. 1996, Rasker and Hackman 1996) and cougar management in Washington appears to be no

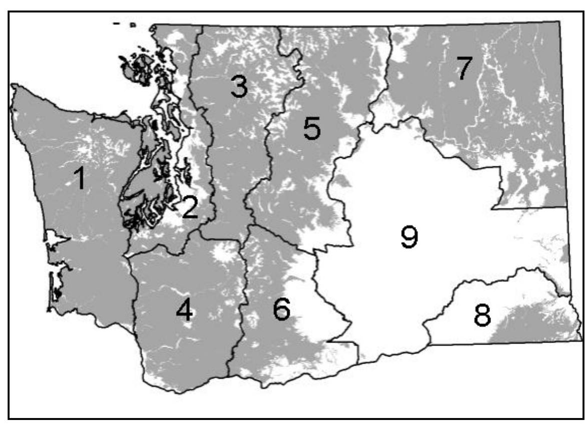

Figure 2: Map of Washington State with Cougar Management Units and distribution of suitable cougar habitat (in gray). Figure courtesy of the Washington Department of Fish and Wildlife, 2004.

exception. In the years following passage of I-655, several unsuccessful attempts were made to overturn all or portions of I-655. Policy and management of wildlife should be based in science (Anderson et al. 2003), but in Washington, non-scientific factors may have influenced cougar management legislation following the passage of I-655. Fueled by concerns over public safety and media reports of cougar-human interactions, a complex network of social values and politics at the state and county level have acted as important factors directing cougar management legislation in Washington.

Objectives

I present and compare information on statewide media coverage of cougars and differences in population levels, economies, and social values for western and eastern Washington counties where the highest levels of cougar-human interaction are reported. This information helps to relate the context of cougar management legislation in Washington State immediately preceding and following the passage of I-655. Particular emphasis is placed on Substitute Senate Bill 6118 (SSB 6118), legislation that authorizes the use of dogs to hunt and pursue cougars as part of a pilot study in Washington's five northeastern counties; Chelan, Okanogan, Ferry, Stevens and Pend Oreille. Additional information on cougar harvest rates, population estimates, and complaint statistics is presented to demonstrate that cougar management legislation may not be based in scientific understanding of cougar ecology, behavior and demographics. The recent legislative history of Washington State highlights the need for managers to understand and communicate with the social and political network in which they operate to ensure effective management conservation of cougar populations within their state or province.

METHODS

Legislative History

The history of cougar management legislation was obtained from a search of Washington State Legislative archives housed in the University of Washington's Suzzalo Library. The search was conducted under the topic of "cougar" and "mountain lion" and limited to Washington State Senate and House of Representative bills from the 1994-1995 legislative session (pre I-655) through the 2003-2004 legislative session. I recorded the number, title, subject, and subsequent fate of each bill. I interpreted bills lacking specific information on House of Representative or Senate floor votes as dying in committee or subcommittee. Election results pertaining to I-655 were obtained from Washington State voting records and personal communication with the office of the Secretary of State.

Washington State Socio-Economic Description

To characterize and compare social values and political context of western and eastern Washington counties where the highest levels of cougar-human interaction were reported, I obtained economic and population data through an online search of the most recent United States Census Bureau databases (2000 for social and economic data and 2003 for population data). I collected information on median annual household and family income, unemployment rates for individuals over 16 years of age, percentage of families and individuals living in poverty, and percentage of workers over 16 years of that work in forestry, fishing, and farming professions (US Census Bureau 2000) for Washington counties within CMU 2, Puget Sound; CMU 5, North Cascades East; and CMU 7, Northeastern. Cougar Management Units 2, 5, and 7 have the highest levels of reported cougar-human interaction and WDFW game management objectives call for reducing cougar populations within these units to ensure public safety and minimize damage to private property (WDFW 2002). Specifically, data was collected for King, Pierce, Snohomish, Thurston, Skagit, and Whatcom counties of western Washington and Chelan, Okanogan, Ferry, Stevens, Pend Oreille, and Spokane counties for eastern Washington. Additional emphasis was placed on the five northeastern counties: Chelan, Okanogan, Stevens, Ferry, and Pend Oreille because of their forthcoming participation in cougar hunts authorized by SSB 6118. Spokane County was included in the socio-economic analysis because of the county's location in CMU 7. Spokane County is eastern Washington's most populated and urban county with the subsequent effect of making eastern Washington counties appear more similar to western counties in the regional comparison.

Cougar Media Context

To quantify and characterize media coverage and publicity surrounding cougars and cougar management in Washington, I queried the internet archives of western and eastern Washington NBC, ABC, CBS, and Fox news affiliates and the state's largest westside and eastside newspapers, The Seattle Times (western Washington) and The Spokesman Review (eastern Washington). Archive searches were performed using the keywords "cougar", "mountain lion", "Initiative 655", and "Senate Bill 6118" while being constrained to the dates: January 1994-September 2004. I classified media reports as scientific (relaying specific information on cougar ecology and/or behavior from cougar research and/or management activities inside or outside of Washington), political/ legislative (conveying information pertaining to cougar management legislation, legal status or hunting regulations), human-cougar interactions (accounts of sightings, encounters, or attacks on livestock, pets or people) or as an editorial (authored by a group or individual conveying their personal view of cougars or cougar management inside or outside of Washington).

RESULTS

Legislative History

From the analysis of Washington State Legislative archives I identified 12 bills directly pertaining to the management and legal status of cougars in Washington in the year leading up to, and the eight years following the passage of I-655 (Table 1). The 1995-1996 legislative session had three bills addressing cougar management. Senate Bill 5153 authorized the killing of a cougar reasonably perceived to be an immediate threat to public safety, SB 5492 made it unlawful to hunt cougars, black bears (*Ursus americanus*), bobcats (*Lynx rufus*) and lynx (*Lynx canadensis*) with dogs, and SB 6262 required the Washington Fish and Wildlife Commission to review cougar management on a regular basis and allowed for a cougar tag to be purchased after the cat was killed. Senate Bill 5153 and SB 5492 each died in subcommittee/committee failing to reach the floor of the Senate. Senate Bill 6262 was passed by both the Senate and House but was vetoed by Governor Mike Lowry. Senate Bill 5492 was the final attempt of The Humane Society of the United States and partnering animal rights advocates to ban the use of dogs to hunt and pursue cougars through traditional lobbying and legislative avenues. In November 1996, Washington State voters approved Initiative 655 by a vote of 1,387,577 (63%) in favor and 815,385 (37%) opposed.

The 1997-1998 legislative session saw the first legislative attempt to override I-655. Senate Bill 5594 authorized the use of dogs to hunt and pursue cougars to protect private

Table 1. Summary of the history of cougar management legislation in Washington State preceding the passage of State Initiative 655 in the 1996 General Election to present. The legislative number, legislative session, subject description, and outcome of each bill is provided.

Legislative Session	Bill Number	Bill Subject Description	Bill Outcome
1995-1996	SB 5153	Authorized killing a cougar or bear reasonably perceived to be an immediate threat to public safety.	Died in committee / subcommittee
1995-1996	SB 5492	Unlawful to hunt cougars, bears, bobcats and lynx with dogs (final legislative attempt to ban hound hunting)	Died in committee / subcommittee
1995-1996	SB 6262	Fish and Wildlife Commission shall review cougar management on a regular basis, allows the purchase of a cougar tag after the animal has been killed	Passage by House and Senate, vetoed by Gov. Mike Lowry
November 1996	I-655	Bans use of dogs to hunt or pursue cougars	Approved by Washington State voters (63% yes votes)
1997-1998	SB 5594	Authorize use of dogs to protect private property and public safety	Died in committee / subcommittee
1999-2000	HB 1012	Authorizes use of dogs to hunt cougars-override I-655	Died in committee / subcommittee
1999-2000	HB 1959	Hunting cougar with dogs authorized-override I-655	Died in committee / subcommittee
1999-2000	SB 5001/ CH 248	Hunting cougar with dogs authorized in specific areas to address public safety concerns-creation of the Public Safety Cougar Removal Hunts	Passage by House and Senate, signed into law by Gov. Gary Locke
1999-2000	SB 5068	Hunting cougar with dogs authorized-override I-655	Died in committee / subcommittee
1999-2000	SB 5120	Hunting cougar with dogs authorized-override I-655	Died in committee / subcommittee
1999-2000	SB 5133	Washington counties may authorize hunting cougar with dogs- override I-655	Died in committee / subcommittee
2001-2002	SSB 6712	Wildlife damage to livestock, permission to trap or kill-cougar included	Died in committee/subcommittee
2003-2004	SSB 6118	Create a 3-year pilot cougar control program through the use of hound hunting in five northeastern counties	Passage by House and Senate, Section 1 and 3 signed into law by Gov. Gary Locke, Section 2 vetoed

property and public safety. Senate Bill 5594 died in committee without a floor vote.

The 1999-2000 legislative session contained six proposed bills authorizing the use of dogs to pursue and hunt cougars in Washington. The proposed bills varied from conditional, cause specific authorization of the use of dogs, to a complete override of I-655. House Bill (HB) 1012, HB 1059, SB 5068, SB 5120, and SB 5133 each unconditionally authorized the use of dogs to hunt and pursue cougars. Each bill failed to make it out of committee/subcommittee. Senate Bill 5133 is of special note because itspecified the right of individual counties, not WDFW or the Fish and Wildlife Commission, to authorize the use dogs to hunt and pursue cougars (similar to initial drafts of 2004's SSB 6118). Senate Bill 5001/CH 248 authorized the hunting of cougars using dogs in specific areas to address public safety concerns. Senate Bill 5001/CH 248 passed through both the Senate and House and was signed into law by Governor Gary Locke in March of 2000. Senate Bill 5001/CH 248 legislated the creation of Public Safety Cougar Removal Hunts (PSCR hunts) with the aid of dogs. WDFW is authorized to issue PSCR hunt permits for any of the 137 Game Management Units (GMUs) based on the number of cougar complaints recorded within a particular GMU the previous year. Substitute Senate Bill 6712 was drafted in the 2001-2002 legislative session and would have granted permission to trap and kill wildlife responsible for killing livestock, including cougars. Substitute Senate Bill 6712 did not specifically address the use of dogs and did not pass out of committee/subcommittee in 2002.

The 2003-2004 legislative session saw the most recent bill to legislate cougar management post I-655. Substitute Senate Bill 6118 creates a three-year pilot program to control cougar populations in Washington's five northeastern counties (Chelan, Okanogan, Stevens, Ferry, and Pend Oreille) with the aid of dogs. Substitute Senate Bill 6118 consisted of three sections. Section 1 created the three-year pilot program authorizing the use of dogs to hunt and pursue cougars to control populations. Section 2 allowed for additional Washington State counties to join the pilot program if they could demonstrate an urgent need to deal with cougar public safety issues. Section 3 of the bill required WDFW to report the findings of the pilot program to the Fish and Wildlife Commission and proper legislative committees and to make recommendations on science-based measures to manage cougar behavior and populations in the future. The bill passed quickly through the Senate and House, garnering little media attention during the legislative session. Prompted by WDFW, Governor Gary Locke vetoed Section 2 of the bill but signed Sections 1 and 3 into law in March of 2004. Substitute Senate Bill 6118 effectively overturned cougar hunting restrictions set forth by I-655 for the five northeastern counties and replaced them with hunting regulations approved by the Washington Fish and Wildlife Commission.

Washington State Socio-Economic Description

U.S. Census Bureau databases for Washington indicate large contrasts for all socio-economic categories between western and eastern counties with the highest levels of reported cougar-human interaction. Western Washington counties averaged higher populations (western: 608,255/county to eastern: 99,764/county) and higher annual median household and family incomes ($46,797 and $55,260) than eastern Washington counties ($33,515 and $40,114; Table 2). Eastern Washington counties averaged higher unemployment rates (eastern: 7.0% to western: 4.0%), a higher percentage of families and individuals living in poverty (eastern: 12.0% and 17% to western: 7.0% and 10%) and a higher percentage of individuals working in forestry, fishing, and agricultural industries (4.0%) than western Washington counties (1%, Table 2).

Cougar Media Context

Searches of western and eastern Washington television news and newspaper archives yielded 138 stories pertaining to cougars. Seventeen reports (12.3%) were classified as science, 85 (61.6%) as cougar-human interaction, 30 (21.8%) as political/legislative, and 6 (4.3%) were classified as editorials (Table 3). Internet-based archives for newspapers contained more stories (82) than the internet-based archives of -local television news affiliates (56). The Seattle Times archive generated 37 articles: 4 science, 20 cougar-human interaction, 8 political/legislative, and 5 editorials. Search of The Spokesman Review archive produced 45 articles: 4 science, 20 cougar-human interaction, 20 political/legislative, and 1 editorial.

Searches of western Washington television news archives produced 52 cougar stories: 8 science, 42 cougar-human interaction, 2 political/legislative, and 0 editorials. Eastern Washington television news archives produced 4 stories: 1 science and 3 addressing cougar-human interaction (Table 3). I obtained no reports from three television news websites (KCPQ-13 Fox Seattle, KHQ-6 NBC Spokane, and KAYU-28 Fox Spokane) because they did not provide access to their archives via their Internet homepages. Searches of all television news archives were limited further by an inability to access stories prior to 2000.

COUGAR MANAGEMENT IMPLICATIONS: 1996-2004

People's attitudes toward wildlife and predators are influenced by their place of residence (urban vs. rural), socio-economic status, and the physical and behavioral characteristics of a species (Kellert et al. 1996, Mankin et al. 1999, Reiter et al. 1999, Deruiter and Donnelly 2002). The socio-economic data for Washington's five northeastern counties indicate they are sparsely populated rural areas with depressed economies based in natural resource and agriculture industries. Political and social views of citizens and politicians towards wildlife and cougars within this cultural setting may be characterized as utilitarian and dominionistic (Kellert et al. 1996). Residents of rural settings often possess strong beliefs of private property rights and may feel marginalized by government agencies and environmental regulations. Land use restrictions may be perceived as a violation of personal rights and residents may express their displeasure with antagonism towards predators (Kellert et al. 1996). The socio-economic description and subsequent attitudes of the northeastern counties towards cougars contrasts the preservationist or ecocentric views of residents and politicians of the more populated, urban counties of western Washington (Kellert et al. 1996, Mankin et al. 1999). Opinions of northeastern Washington residents of cougars may be further influenced by the high percentage of individuals employed in natural resource and agriculture based industries. In surveys of public attitudes of wildlife, farmers and ranchers have expressed the most antagonistic views of cougars and predators (Brown 1986, Kellert et al. 1996). This perspective is contrasted by positive views and values of cougars and predators

Table 2: Population size, annual median household income, annual median family income, unemployment rate, percentage of families and individuals living in poverty, and percentage of individuals working in forestry, fisheries, and farming for eastern and western Washington State counties with the highest levels of reported cougar-human interaction.

County	Population	Median Household Income	Median Family Income	% Unemployed	% Of Families Living In Poverty	% Of Individuals Living In Poverty	% Of Individuals Employed in Forestry, Fisheries, and Farming
Eastern Washington							
Chelan	67,973	$37,316	$46,293	6.6	8.8	12.4	7.4
Okanogan	39,134	$29,726	$35,012	7.0	16.0	21.3	9.5
Ferry	7,417	$30,388	$35,691	10.9	13.3	19.0	3.5
Stevens	40,776	$34,673	$40,250	5.7	11.5	15.9	3.0
Pend Oreille	12,254	$31,677	$36,977	5.1	13.6	18.1	2.5
Spokane	431,027	$37,308	$46,463	5.1	8.3	12.3	0.4
Average	99,764	$33,515	$40,114	7.0	12.0	17.0	4.0
Western Washington							
King	1,761,411	$53,157	$66,035	3.1	5.3	8.4	0.3
Pierce	740,957	$45,204	$52,098	4.1	7.5	10.5	0.5
Snohomish	639,409	$53,060	$60,726	3.5	4.9	6.9	0.5
Thurston	221,950	$46,975	$55,027	3.9	5.8	8.8	1.1
Skagit	109,234	$42,381	$48,347	4.3	7.9	11.1	4.0
Whatcom	176,571	$40,005	$49,325	7.4	7.8	14.2	2.0
Average	608,255	$46,797	$55,260	4.0	7.0	10.0	1.0

expressed by residents working and living in, or near, the diversified economies of urban settings similar to those that exist in western Washington counties (Kellert et al. 1996, Reiter et al. 1999).

As statewide reports of cougar encounters rose from a pre-initiative 255 in 1995, to 495 in 1996, to a peak of 955 in 2000 (Beausoleil et al 2003), the reactions of politicians and residents of western and northeastern counties reflected the two regions' differing social values. Northeastern Washington legislators and county commissioners representing the utilitarian and dominionistic perspectives of ranching, agricultural, and hunting interests worked for legislation aimed at restoring hound hunting to reduce cougar populations and as they believed, "restore fear of people in cougars" (Andrist 2003, Mottrom 2003). Following a 1998 cougar attack that left a 4-year-old Kettle Falls boy severely injured, the position of the area's politicians and residents was bolstered by WDFW proclamations that public safety was its cougar management priority (Koenings 2000, WDFW 2004). Conversely, western Washington residents and politicians did not advocate hound hunting as a solution to increasing cougar-human interaction, deferring instead to WDFW to develop management solutions that were not based in hunting or pursuing. Deferral of predator management by western county residents to the state wildlife management agency is consistent with similar demographics described by Reiter et al. (1999).

Table 3: Summary of cougar media reports obtained from searches of Internet archives for local western and eastern Washington NBC, ABC, CBS, and Fox news affiliates and Washington's largest westside and eastside newspapers, The Seattle Times and The Spokesman Review.

Media News	Source	Science[a]	Political/ Legislative[b]	Cougar / Human Interaction[c]	Editorial[d]
Newspaper	The Seattle Times	4	8	20	5
	The Spokesman Review	4	20	20	1
	Total	8	28	40	6
Television	NBC-Seattle	6	0	6	0
	ABC-Seattle	2	2	26	0
	CBS-Seattle	0	0	10	0
	Fox-Seattle	[e]	[e]	[e]	[e]
	NBC-Spokane	[e]	[e]	[e]	[e]
	ABC-Spokane	0	0	1	0
	CBS-Spokane	1	0	2	0
	Fox-Spokane	[e]	[e]	[e]	[e]
	Total	9	2	45	0

[a] Science: relaying specific information on cougar ecology and/or behavior from cougar research and/or management activities inside or outside of Washington State
[b] Political/legislative: conveying information pertaining to cougar management legislation, legal status or hunting regulations
[c] Cougar-human interaction: accounts of sightings, encounters, or attacks on livestock, pets or people
[d] Editorial: authored by a group or individual conveying their personal view of cougars or cougar management inside or outside of Washington.

During this period of heightened public safety concerns, media coverage of cougars was intensifying and focused on cougar-human interactions. Media has the ability to influence people's value orientations of wildlife (Champ 2002) and people's attitudes towards cougars can be negatively influenced by media coverage of cougar-human interaction (Wolch et al. 1997). Searches of western and eastern Washington newspaper and television news archives show over 60% of stories pertaining to cougars covered human-cougar interaction but only 12.3% of stories dealt with cougar science. These results suggest that Washington residents on both sides of the Cascade Mountains were unlikely to receive information on cougar ecology and behavior in a neutral context of cougar research and management activities. Instead, Washington State residents were more likely to see cougar ecology and behavior framed in an adversarial context of fear stemming from cougar confrontations with, or attacks on, livestock, pets and people. Problems with media coverage of cougars in Washington may be increased further by the tendency of news media to focus on conflict and controversy in their coverage of wildlife issues (Corbett 1992).

Unfortunately, absent from much of the public debate and media coverage of increased cougar-human interaction is informed discussion of the complexity of cougar ecology and behavior, the impacts of human population growth with subsequent expansion of urban sprawl and recreation into historic cougar habitat, and an overall increase in public awareness of cougars over the past decade. Following the passage of I-655, the Washington Fish and Wildlife Commission prompted by WDFW biologists and managers made changes to cougar hunting laws to offset anticipated declines in cougar harvest. These efforts have resulted in steady increases in cougar harvest levels and recent insights gained from harvest statistics and field research suggest cougar populations in areas of high cougar-human conflict are in decline (WDFW 2002, Beausoleil et al. 2003, Lambert et al. 2003, Martorello and Beausoleil 2003). Following a peak of 955 cougar reports in 2000, reports have steadily declined to pre-initiative levels with 255 cougar reports registered in 2003 (R. Beausoleil, personal communication 2004).

With the exception of SB 5001/CH 248, the bill that created the Public Safety Cougar Removal Hunts in 2000, attempts to overturn I-655 in the Washington State Legislature have largely been unsuccessful. These failures may be rooted in continued support of cougars from Washington residents living in or near urban settings and the influence they yield as a result of their large populations, higher income levels and greater political representation.

In early 2003 however, the northeastern county commissioners declared a state of emergency to force the cougar public safety issue with WDFW (Hanron 2003). This move may have offset the political power of western Washington residents and provided the political traction necessary for approval of SSB 6118 in the face of documented increases in cougar harvest levels, declines in cougar complaints, and decreasing northeastern cougar populations. In addition to efforts of northeastern politicians, additional factors may have been operating within political networks to garner support for SSB 6118. These factors may include WDFW lobbying the State Legislature and Washington Fish and Wildlife Commission on behalf of SSB 6118 in an attempt to change cougar hunting laws to gain greater control over cougar harvest characteristics in northeastern Washington. The extent of these efforts remains unclear.

CONCLUSIONS

Social, political, and economic influences on cougar management legislation are not unique to Washington. Across the western United States and Canada, wildlife biologists and managers operate within issue networks that apply various levels of political and social pressure. To a greater extent, cougar management in Washington and throughout much of the West is simply a microcosm of larger social issues surrounding conflicting ideologies over the management of natural resources, private property rights, and the role of government agencies. It is worth noting that more than one proposed hound-hunting bill, SB 5133 and the initial draft of SSB 6118, placed cougar management authority in the hands of county commissioners, not state wildlife biologists and managers. One need look no further than current debates over timber extraction on public land, allocation of water rights, grizzly bear (*Ursus arctos horribilis*) reintroduction efforts, federal designation of wilderness areas, or gray wolf (*Canis lupus*) management to witness the extent of this issue.

There are no quick solutions for addressing the role of politics, social values, and economics in cougar management. Currently, researchers and biologists are engaged in a variety of research and management activities in Washington that utilize a combination of rigorous scientific inquiry and creative education programs. These efforts offer a starting point for the encouragement of future legislative efforts based in knowledge of cougar ecology and behavior to ensure long-term viability of cougar populations inside and outside of Washington.

LITERATURE CITED

ANDERSON, D.A., E.G. COOCH, R.J. GUTIERREZ, C.J. KREBS, M.S. LINDBERG, K.H. POLLOCK, AND C.A. RIBIC. 2003. Rigorous science: suggestions on how to raise the bar. Wildlife Society Bulletin 31: 296-305.

ANDRIST, B. 2003 (July 17). Cougar attacks colt-twentieth attack on Kretz's property. North Cascades Broadcasting, Inc. http://www.komw.net/news/

BEAUSOLEIL, R.A., D.A. MARTORELLO, AND R.D. SPENCER. 2003. Washington cougar status report. Pages 60-63 *in* S.A. Becker, D.D. Bjornlie, F.G. Lindsay, and D.S. Moody, editors. Proceedings of the seventh mountain lion workshop. Lander, Wyoming, USA

BROWN, L.M. 1986. Attitudes, knowledge and behavior towards mountain lions in southcentral Idaho. Yale School of Forestry and Environmental Studies. New Haven, Connecticut, USA

CHAMP, J.C. 2002. A culturalist-qualitative investigation of wildlife media and value orientations. Human Dimensions of Wildlife 7: 273-286.

CLARK, T.W.; A.P. CURLEE; AND R.P. READING. 1996. Crafting effective solutions to the large carnivore conservation problem. Conservation Biology 10: 940-948.

CORBETT, J.B. 1992. Rural and urban newspaper coverage of wildlife: conflict, community and bureaucracy. Journalism Quarterly 69: 929-937.

DERUITER, D.S. AND M.P. DONNELLY. 2002. A qualitative approach to measuring determinants of wildlife value orientations. Human Dimensions of Wildlife 7: 251-271.

HANRON, J. 2003 (February 17). County declares state of emergency-Game agent disputes claim that cougar problem is worsening. Methow Valley News. http://www.methowvalleynews.com

KELLERT, S.R., M. BLACK, C.R. RUSH, AND A.J. BATH. 1996. Human culture and large carnivore conservation.

Conservation Biology 10: 977-990.

KOENINGS, J. 2000 (May 8). Public safety is WDFW's top cougar management priority. Seattle Times. http://www.seattletimes.com

LAMBERT, C., R.B. WIELGUS, H.S. ROBINSON, D.D. KATNIK, H. CRUICKSHANK, AND R. CLARKE. 2003. Dynamics and viability of a cougar population in the Pacific Northwest. Page 139 in S.A. Becker, D.D. Bjornlie, F.G. Lindsay, and D.S. Moody, editors. Proceedings of the seventh mountain lion workshop. Lander, Wyoming, USA

MANKIN, P.C., R.E. WARNER, AND W.L. ANDERSON. 1999. Wildlife and the Illinois public: a benchmark study of attitudes and perceptions. Wildlife Society Bulletin 27: 465-472.

MARTORELLO, D.A. AND R.A. BEAUSOLEIL. 2003. Characteristics of cougar harvest with and without the use of dogs. Pages 129-135 *in* S.A. Becker, D.D. Bjornlie, F.G. Lindsay, and D.S. Moody, editors. Proceedings of the seventh mountain lion workshop. Lander, Wyoming, USA

MOTTROM, B. 2003 (August 6). Cougars a problem. The News Tribune. http://www.tribnet.com/

PACELLE, W. 2002. Adapting to a changing society. Annual Meeting of the Northwest Section and Washington Chapter of the Wildlife Society. Spokane, Washington, USA

RASKER, R. AND A. HACKMAN. 1996. Economic development and the conservation of carnivores. Conservation Biology 10: 991-1002.

REITER, D.K., M.W. BRUNSON, AND R.H. SCHMIDT. 1999. Public attitudes toward wildlife damage management and policy. Wildlife Society Bulletin 27: 746-758.

STIFFER, L. 1999 (April 19). Cougars live; bill seems dead. Seattle Post-Intelligencer. www.seattlepi.com

UNITED STATES CENSUS BUREAU. 2000. Washington Quick Facts. http://quickfacts.census.gov/qfd/states/53000.html

UNITED STATES CENSUS BUREAU. 2004. Annual estimates of the population for counties of Washington. Population Division, U.S. Census Bureau. Washington D.C., USA

WASHINGTON DEPARTMENT OF FISH AND WILDLIFE. 2002. Game Management Plan. Wildlife Management Program, Washington Department of Fish and Wildlife, Olympia, Washington, USA.

WASHINGTON DEPARTMENT OF FISH AND WILDLIFE. 2004 (February 5). Public safety remains top priority for cougar management. News Release. Washington Department of Fish and Wildlife, Olympia, Washington, USA

WOLCH, J.R., A. GULLO, AND U. LASSITER. 1997. Changing attitudes toward California's cougars. Animals and Society 5: 95-116

A CASE STUDY OF MOUNTAIN LION-HUMAN INTERACTION IN SOUTHEASTERN ARIZONA

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Abstract: During March 2004, humans were frequently encountering mountain lions (*Puma concolor*) in Sabino Canyon Recreation Area (Coronado National Forest), a popular recreation area near Tucson Arizona (>1 million visitor days/year). Encounters were also occurring in several nearby neighborhoods and elementary school grounds. As a result of frequent mountain lion encounters, the recreation area was closed to public entry and removal efforts of mountain lions was proposed. The closure and removal plan was based on concerns for public safety that resulted when mountain lions exhibited behavior that has been known to precede attacks on humans, which could have lead to an attack on a human in the vicinity. The closure order was issued by the United States Forest Service out of concern that these encounters could lead to an attack on a human as had occurred recently in southern California. Concurrent with the closure, the Arizona Game and Fish Department and other cooperators attempted to locate and remove mountain lions from urban areas and the most frequently visited portions of Sabino Canyon. USDA Wildlife Services, Department Wildlife Managers, and a Department Research Biologist attempted to track and remove offending animals. Within three days of initiating removal efforts, intense public and political pressure resulted in a temporary pursuit moratorium while public meetings were held with legislators, public, Governor's office representatives, and animal rights groups. Once pursuit resumed, the decision was made to capture lions with non-lethal methods and move them to captivity, if possible. We will outline the controversy surrounding the lion removal and the eventual outcome.

THE ENVIRONMENT

At the beginning of the new millennium, the Arizona Game and Fish Department was managing mountain lions as an important component of the state's big game species. Hunting seasons were established annually with a hunter bag limit in most areas of one lion per year. There also are provisions for livestock operators to take depredating lions. Approximately 250-300 lions are taken in Arizona annually.

For the past 30 years in Arizona, mountain lion management has been controversial. During the 1960's there were bounties on lions and they were managed as predators rather than game animals, without no bag limits. This changed in 1970 when lions were designated as game animals and tags were required with a bag limit of one per year. Subsequently, in 1991, amid controversy over unrestricted depredation take, state depredation laws were changed to provide more detailed procedures and reporting requirements for lions to be taken for depredation reasons.

There have been increasing pressures since the beginning of the 1990's to increase take of predators by some hunter groups and ranchers due to decreased deer populations related to drought. Some members of the public blamed predators for the decline in deer populations and felt increased removal of predators would increase deer populations. These issues were routinely being brought to the attention of the Game and Fish Department, Commission, and Legislature. The pressures were aggravated when Arizona documented four attacks on children in central Arizona by lions. One occurred in 1988 on a hiking trail near Payson Arizona. Three others occurred at recreational lakes in 1989,1994 and 2000. All involved young children.

Additionally, contributing to the challenges faced by the state wildlife agency, Sabino Canyon, the subject of this case study,, is located in the same mountain range where a bear mauling occurred in 1996 in which the Game and Fish Department and U.S. Forest Service were sued. A resulting settlement amounted to millions of dollars, making the agency and Forest Service especially sensitive about protocols for responses to nuisance animals. (4)

All of these historical events provided a fertile environment for controversy at Sabino Canyon concerning mountain lions in 2004. Preservationist groups, working from both outside and inside Arizona, have worked to have lions protected from all sport hunting, as is the case in California. Rumors frequently circulate of a ballot initiative process to stop sport hunting of mountain lions in Arizona.

The Arizona Game and Fish Department's Tucson office is responsible for wildlife management programs in southeastern Arizona. Several environmental groups have established their headquarters in Tucson, finding a favorable atmosphere. This includes Earth First, a radical environmental group recently moved to Arizona. This group, as well as the Center for Biological Diversity, played key roles in the controversy surrounding the bold mountain lions at the edge of Tucson.

The Catalina Mountains lie directly north of Tucson, a city with a population of over 800,000. The mountain is considered part of the identity of Tucson and had experienced huge wildfires in both 2002 and 2003 that altered its habitats with landscape-scale stand replacing fires. Development of high-end subdivisions and custom homes literally stops at the Forest boundary adjacent to Tucson. Along the south boundary of the Forest is a riparian canyon called Sabino Canyon, managed by the U.S. Forest Service, but treated as a local park with over a million human visitors per year riding trams, hiking, and mountain biking the canyon to enjoy the natural environment.

THE INCIDENT

During a period of extreme drought in 2002, the Game and Fish Department began receiving reports of mountain lions around the city of Tucson that were coming into more frequent contact with people and not yielding to the presence of humans. During the summer, a horse was scratched by an encounter with a mountain lion in its corral on the west edge of the city. The owner insisted the Department remove it and was refused because investigations revealed no human threat and it was learned that the cat had visited a corral merely to access water. The horse owner went to the press in an attempt to coerce the Department to act. This brought a great deal of attention to the issue of mountain lions and brought calls from all over the west from people who wanted to insure Game and Fish did act on the complaint.

In mid 2003, the Department started receiving calls about lions on the north edge of the city adjacent to Sabino Canyon. Complaints were that lions were seen during daylight hours, frequently unafraid, and walking down streets in neighborhoods containing large lots interspersed with much unspoiled desert habitat. The same areas were locations where the Department frequently received calls to deal with large herds of javelina, many of which were being fed by nearby residents. Populations of these prey animals were unusually high along the Forest/urban boundary due to feeding by residents and lack of removal by sport hunters. Investigation by officers occasionally resulted in verification of sign indicating the presence of lions. One lion was reported taken by an area resident after the animal killed his goat in a pen at his residence. That animal was an old male with a very debilitating injury.

The State Governor's office was provided information detailing the issue in several monthly briefings during 2003 submitted to communicate Department issues and events.

The Department brought in Department of Agriculture Wildlife Services on three occasions in July and August 2003 to attempt to capture and remove verified lions that appeared to have been frequenting neighborhoods. On all three occasions, by the time those resources could arrive at the location, the lion sign was too old and provided no opportunity to find the offending animal. The reports of lions in the area continued and were investigated as they were reported to the Department. On many occasions officers responded only to locate bobcats that were quite numerous and frequently misidentified by residents as lions. On several occasions, reports were received days after the incident but due to the knowledge or experience of the observers, were felt to be credible. On September 11th, a jogger reported he had been stalked in the Sabino area. The report was received too late to verify the presence of a lion by sign. He reported the cat had followed him for some distance. Due to his experience outdoors, the Department was convinced it was a valid report. Other reports totaling 4 in September, 3 in October, and 11 in November, all caused the Department and Forest Service increasing concern about the situation. A November 8th report of a lion sitting along the road in Sabino Canyon and watching visitors walk by from a distance of 40 feet was of particular concern as was a report of a lion observed leaving a local elementary school grounds in the dark on 17 November 2003.

By November 2003, both the local offices of the Forest Service and Game and Fish decided a cautionary note to the public was warranted. On November 20th a decision was made to issue a joint press release and to erect signage at the Sabino Canyon visitor center and trail head warning the public of increasing lion activity in the area. The Department also provided 1500 brochures titled "Living with Mountain Lions in Arizona" to the Forest Service to distribute at its visitor center to hikers and also worked with the Forest to prepare a lion fact sheet for distribution.

During December 2003, a lull in reports occurred and little was reported to the Department. Beginning in January 2004, reports of lions in neighborhoods near Sabino Canyon again began increasing. On January 7, 2004 a lion at a pool of water along Sabino Creek approached a group of people to within 20 feet. The animal was unobserved by the group it approached, but others saw and reported the incident. Because of the rocky terrain, the report was unable to be verified, but several observers saw the animal and it was felt to be credible. Again on January 13th a lion was reported frequenting a neighborhood near Sabino Canyon. Wildlife Services was called and was able to locate scent but unable to follow the animal due to heavily used human trails in the area. On February 2nd several people reported lions in the same neighborhood acting unafraid of humans. Yet another report February 3rd was received of a lion resting near the Sabino tram that let visitors walk within 10 yards of it without fleeing. Follow up investigation verified the incident by the presence of tracks.

Concurrently, in January 2004, local Tucson newspapers reported a fatality and a near fatality to two mountain bike riders in California from a predatory lion attack.

On February 19th, Wildlife Services again responded to the area to attempt to locate the animal seen February 3rd. Their late response was due to work ongoing in another area of the state. The agent located scent but again was unable to trail the animal due to the amount of human activity in the area. Additional reports continued to be received, totaling 8 in February 2004. The news media followed the events continuously as they unfolded.

On Friday, March 5th, at a meeting attended by Forest Service, Game and Fish Department, Pima County Sheriff's Department, and Pima County Animal Control, a decision was made to close Sabino Canyon for public safety reasons and to allow the Game and Fish Department to work unrestricted by human visitors to remove the habituated lions. An incomplete working draft of a Forest Service list of human/lion encounters and other anecdotal information was circulated. This list was given to media representatives subsequent to the meeting, but before a decision was announced. The decision to close the canyon would not be announced until the Department could determine when Wildlife Services would be able to work the canyon. News media were told and reported to the public that the Forest Service and Department were considering their options and would have a plan to report early the following week.

On Monday March 8th a US Forest Service press release was issued announcing closing of the Canyon to the public effective the following evening to allow the Department to remove threatening human-habituated lions. Immediately the Center For Biological Diversity and preservationist groups publicly questioned the data to support such an effort. They requested a meeting of their groups and the Forest Service to discuss the proposed action. Their request was granted, and at a March 2004 meeting, the Center as well as representatives of the Defenders of Wildlife and other environmental groups demanded that the action be halted and that instead a study of these lions be initiated using radio collars and harassment instead of lethal removal. The Center for Biological Diversity representative threatened that " a blood bath" would result if the action wasn't halted and indicated they would appeal to the Governor to stop the action. Both the Department and the Forest Service replied that this was a public safety issue involving an abundant predator and for human safety reasons their proposal was untenable and the action would proceed.

Amid a plethora of false and misleading information, provided by groups opposed to the Department's action and by media omissions, on March 11th, U. S. Department of Agriculture, Wildlife Services, accompanied by a Game and Fish Department employee, began their efforts to remove habituated lions in the Sabino Canyon area. A call to action utilizing an internet phone tree went out from environmental and preservation groups. Immediately hundreds of calls to the Forest Service and the Game and Fish Department were received necessitating the establishment of a call-answering center in the Sabino Canyon Visitors Center for the Forest Service as well as another in the Game and Fish Department office in Tucson. The Tucson Game and Fish office received 170 calls on March 10th alone, over 60% were calls protesting the action, while others supported it. Many callers were from out of state and used verbiage provided them over an Internet action alert. The Governor's office issued a press release criticizing the Department's action. Two area legislators also inquired directly about what was occurring in response to public complaints. Several direct threats to shoot Arizona Game and Fish officers if they tried to catch lions in the canyon were received among the many calls. Many callers reluctantly agreed the action was necessary and appropriate, once they learned all the information that the news media failed to report.

Meanwhile, reports continued to be received of lion sightings in and around Sabino Canyon. By Sunday March 14th, the Game and Fish Department Director decided to suspend the removal activities until a meeting could be arranged to brief legislators who were interested and to provide the Governor's office a complete report detailing all the incidents that had been reported.

On Tuesday afternoon, March 16th, the Department Tucson Regional Supervisor, Field Operations Assistant Director, and the Deputy Director briefed legislators and provided them with a detailed list of incidents. Legislators were also reminded that the Department had been sued and settled a lawsuit for over $2 million from a bear mauling on the same mountain in 1996. At the conclusion of the meeting, the Department had legislative support, although one Tucson legislator wanted the Department to appear at a forum in Tucson to answer questions about its actions on March 18th. Shortly after the legislative meeting, an agreement was reached with an animal rights representative to place any lions caught into captivity rather than killing them if the animal rights groups could locate a facility where the animal could be kept and it wasn't at the Arizona Game and Fish Department's expense. One facility was located and a new plan was developed to capture any lions alive and move them to captivity.

At the forum on March 18th, a local legislator acted as a moderator and was accompanied by a local state senator and another state representative. During the question and answer session, it was obvious that support for the Department's effort was building, as most questioners were supportive, although a few refused to be swayed by data provided.

After the public forum on the 18th, a report of a lion sighting was received from the 911 operator by the Department on the school grounds of adjacent Canyon View Elementary and Esperero Middle Schools, which are located at the entrance to Sabino Canyon near the visitor's center. The animal was reported by two teachers and a cafeteria worker. Responding officers located lion tracks to verify the animal's presence. The Department immediately reported the incident to the Governor's office and a Department press release was published announcing the occurrence. Department officers worked with the school to identify vegetation-needing removal to lessen the opportunity for lions to remain hidden and to discourage local javelina herds from bedding on school grounds. The next morning, March 19th, four Game and Fish Department officers were present at the school to insure lions weren't present for arriving school children. The schools were closed the following week for spring break, which alleviated the immediate need for that level of vigilance at the school.

Finally, on March 22nd, the effort to catch lions was back on again, but with substantially revised methods. Due to the agreement the Game and Fish Commission had reached with animal rights groups, a helicopter had to be arranged to transport any animal caught in the rough terrain. Additionally, a Department Research Biologist, who had extensive experience with tranquilizing lions (about 100 lion captures), accompanied the Wildlife Service agent. A veterinarian was placed on standby to administer medical attention to any captured lions. Of note, most of the area to be searched is designated wilderness so a waiver had to be acquired by the Department to use a helicopter in the wilderness area. This was achieved from the Albuquerque Regional Forester. Due to flying conditions and extremely rough terrain, a helicopter with great power was needed to effect removal from the wilderness if an animal was captured. Another complication occurred when the Governor's office suggested the Arizona National Guard might be able to accomplish the mission with a black hawk helicopter. The National Guard flew to Tucson March 19th to look at the terrain and agreed they could do the mission but only if the Governor signed a state order activating them to allow funding from other than military sources. By Monday March 22nd, the Governor's office had denied the use of the National Guard's assets, effectively forcing the Department to contract with a local helicopter service for a helicopter to stand by in case an animal was captured in the designated wilderness.

The Department began daily press conferences at its Tucson Office March 22nd to deal with media requests for information and to answer all with one daily event. The Tucson Regional Supervisor conducted these meetings. On Wednesday March 24th, a member of the Center for Biological Diversity was asked to leave the press conference after creating a disruption. When he refused, he was forcibly ejected and later issued local police citations for trespass and disorderly conduct. A subsequent city court trial resulted in guilty findings to trespass and not guilty of disorderly conduct. Later press conferences were restricted to press only, and only one incident occurred where someone not representing a media outlet was asked to leave. Because of threats to officers conducting the removal operation, the Department and US Forest Service officers maintained surveillance of the Sabino Canyon area. A television video provided to local television by Earth First showing members of their group in the canyon attempting to interfere with the effort was aired March 22nd. On the morning of 23rd of March, Game and Fish Department officers observed three individuals on a ridge top in the area closed to public entry who were obviously watching the operation. When they discovered the officers were watching them, the group ran. Officers responded quickly and arrested two individuals in the act of stealing a leghold snare and its associated electronic sensor. One of those arrested was a reporter for *Esquire* magazine and the other a prominent Earth First member who is a convicted arsonist. The third individual escaped, but through investigation was later arrested in Prescott, Arizona. All were charged with State and Federal charges that are still pending at time of the writing of this paper.

Interestingly, the focus of many of the threatening or abusive calls during this incident targeted the spokespersons that were reporting for the Department. The Department used two spokespersons during the two weeks of intense media interest and their names became the focus of abusive calls to the Department.

The removal efforts were unsuccessful in five subsequent days of effort, with ambient temperatures reaching 90 degrees in the area, so the work with lion hounds was finally suspended on March 28th. The effort had revealed several sets of lion tracks but the agent was unable to follow due to their age, dry weather, and hot temperatures.

A joint press conference was held on March 29th with the US Forest Service at Sabino Canyon Visitor Center and the canyon was reopened on March 31st with visitors being warned of possible lion encounters. The Department advised that the capture efforts with hounds stopped because environmental conditions were not optimal and the costs were prohibitive for helicopter support. The Department was clear in stating that the hunt had not ended, just entered a new phase.

Game and Fish officers continued to respond to citizen reports of lions in and around Sabino Canyon. On April 7th, a lion-killed deer was located 400 yards from Esperero Middle School. The Department set a snare on the kill and caught an adult female lion. The animal was sedated and transported to the previously agreed upon facility in Phoenix. Press releases were distributed along with a photograph of the lion. Members of Earth First were critical of the capture as was the Center for Biological Diversity. These groups complained to the press that the Department had claimed they were ceasing all removal activities and that the capture reflected dishonesty on the part of the Department.

Adding to the controversy, a mountain biker in the Santa Rita Mountains, a neighboring mountain range 30 miles south of the Catalina's, shot a lion with a handgun in self-defense on April 16th that chased him on his mountain bike and refused to retreat when the man stopped to scare it away. The animal was recovered by Department and Wildlife Services officers three days later and was identified as an adult female in perfect health other than a dried bullet wound to the abdomen inflicted by the mountain bike rider.

On May 16th, two Game and Fish officers responded to reports of a mountain biker being chased by a lion in the upper reaches of a drainage emptying into Sabino Canyon. When they reached the area, a lion that waited in ambush along the trail stalked the officers. The officers shot the animal with a shotgun and took the animal to the University of Arizona Veterinary Diagnostic Laboratory for necropsy. It was determined to be a healthy 70 pound two year old female lion. Resulting press coverage interviewed the attacked biker and his partner who verified the attack and described having beaten the animal back with rocks after it chased them on their mountain bikes down the trail.

Finally on November 26th, a report was received of a lion in Ventana Canyon (adjacent to Sabino Canyon) that had attempted to attack a young hiker with his father. When an officer responded, he was confronted at 15 feet by a crouched mountain lion. The officer killed the animal and removed it to the University of Arizona Veterinary Diagnostic Lab where it was determined to be a young female (67 lbs.) in otherwise healthy condition. Despite attempts by Earth First to interfere at the press conference the next day, the 8-year-old hiker and his father detailed their harrowing experience. Only two calls were received subsequent to that incident, one in favor of and one opposed to, the killing of the lion.

THE AFTERMATH

The intensity of public interest in this event has been remarkable. The Department created forums for the public to participate in discussions about our lion handling protocols and conducted public input meetings around Arizona. The first was held in Tucson on May 7th 2004, and a facilitator from out of state was retained to conduct the meetings. Several hundred people showed up to offer input including many homeowners and members of environmental groups. Attendees at the meeting seemed to indicate wide support for the effort to remove dangerous animals from the population, but they wanted to have some input into determining at what stages those efforts would be triggered. Subsequent meetings in Flagstaff and Phoenix resulted in the development of a revised draft protocol, which was used to gain more specific public input.

An internal team was assigned to revise the Department's response protocol to mountain lion/human interactions.

The following is an overview of the process the Department followed in its efforts to revise the Protocol:

- Three public workshop meetings were held to solicit input on the draft Protocol (Tucson, Flagstaff, and Phoenix). Approximately 240 people attended the three workshops.
- A summary report was generated for the Tucson workshop and this was posted on the Department's website, where additional public comments were taken for 30 days.
- The results of the Tucson workshop, along with the additional e-mail comments, were reviewed and revisions were made to the Protocol, which then became the basis for the Flagstaff and Phoenix workshops.
- The process was repeated for the Flagstaff and Phoenix workshops, with the exception that a single, combined report was generated for these two workshops. Additional changes were made to the Protocol based on these workshops and the comments.
- On February 19, 2005, the Department hosted a focus group meeting to test the Protocol, with participants from various stakeholder groups presenting scenarios that were reviewed by a Department cross section of members of our Field Operations division consisting of a Regional Supervisor, a Field Supervisor, and a Wildlife Manager Responses to the scenarios were based on the draft Protocol, and participants were invited to provide a critique of each response.
- The draft Protocol was revised one more time based on the input from the focus group meeting, and was presented to the Department's Executive Staff for review and comment.
- Edits based on Executive Staff input were made, and the revised document was sent to the Department Director. The document was recently published for Agency implementation.

An additional point worth noting about the Protocol revision process: At the end of the focus group meeting, the participants were asked if they saw any fatal flaws in the revised document, with the disclaimer that this would essentially be their last chance to comment before it was finalized and sent to the Director for approval. There was unanimous agreement in the room that there were no fatal flaws in the Protocol, and the participants left with a general spirit of consensus that was actually quite remarkable, considering their diverse perspectives.

In the 2004 legislative session, a bill was introduced to limit the State's liability from the acts of wildlife. The bill died when it failed to gain support.

The Game and Fish Department is currently working on an effort to better inform the public of the life history and population status of lions in Arizona. Many people are not aware of how numerous mountain lions are or how resilient they are to the removal of individuals. The Department continues to work to raise public awareness of the problems associated with feeding wildlife and the fact that artificially high populations of prey species supported by feeding activities also carries with it the likelihood of unwanted predators. Legislation introduced in the 2005 legislature to ban feeding of wildlife died in committee for lack of support.

The Department spent $7,365 for the helicopter to participate in the removal effort and another $7,245 for Wildlife Services efforts. Employee time and effort were in the thousands of hours for the incident and is still being accumulated as an indirect result of actions still being taken.

In June of 2004, a pollster who conducts public opinion surveys in Arizona was quoted in the Tucson newspaper as saying the Governor's ratings of job performance had taken a sudden dip particularly in Southern Arizona. In the opinion of the pollster, it was from the Governor's handling of the Sabino lion issue.

The Department, one year later, is aware of a total of 7 mountain lions that have been removed from the Sabino Canyon area. Reported hunter kills, Agency actions, and one carcass discovered from unknown causes accounted for the total. Of these animals, two were males, four were females and one was undetermined. This in itself is remarkable given the area of interest is 100 square miles of habitat, and there are still lions present in apparent abundance. The female lion moved to captivity now has been the subject of an Earth First and animal rights group's slogan, "Free Sabino."

RECOMMENDATIONS

Given the experience the Department has gained in this trying ordeal, we believe there are a great number of things that can be gleaned from our experiences. One of the first things that should be encouraged to anyone interested in the topic is obtain and read a copy of David Baron's book, *Beast in the Garden.* (1) The book details Boulder Colorado's experience with attitudes about wildlife and the challenges that are experienced by everyone in this era of anthropomorphism many of our publics have embraced through fantasy-based television wildlife programs. Baron's thoughts on the subject parallel our recent experiences in Arizona. Other books such as *Cat Attacks* (2) and *Cougar Attacks* (3), illustrate the reality and horrific nature of mountain lion attacks on humans.

Besides these, below are further recommendations:

- Agencies need to develop some sort of tracking mechanism for both bear and lion interactions with humans. In Arizona, a Microsoft Access database is now in place to track these incidents and summarize the occurrences to assist decision makers.
- Critical incident protocols should also be developed proactively to deal with the media and the political repercussions associated with agency actions. The involvement of elected officials in an incident involving wildlife should be expected any time an agency either acts or decides not to act. The media plays a critical role in this interaction.
- Agencies also need to develop a protocol for responding to interactions between humans and large predators, including identifying and separating interactions into sightings, encounters, incidents, and attacks. This will reduce the perception that Agency supervisors are making arbitrary decisions about which animals need removal. It also eliminates protectionist groups from focusing on individual employees rather than Agency actions.
- Any such protocols should also be widely disseminated in draft form to

the public for input well before an action must take place.

- Efforts must be exerted to help the public understand the truth about life history and populations of predators including lions and bears. Many members of the public think they are rare and endangered due to misinformation widely circulated by protectionist groups and used verbatim by the press. Mediums like pamphlets help, but television focused public service announcements and paid television advertisements are more effective at reaching a greater segment of the public.
- Disposition of animals needing removal should also be decided long before such an incident occurs. This would include the need for necropsy and disease testing to determine health and condition of any animals taken.
- States should seek statutes to hold themselves harmless from the acts of wild animals. Some states have such statutes, while others do not. This is now an evolving area of law that some law firms are exploiting. If wildlife managers are to have the ability to manage our wildlife, they must have some protection from the unpredictable and uncontrollable acts of wildlife.
- Managers, administrators, and other decision-makers should be familiar with several important publications regarding mountain lion attacks on humans. Some of these are provided in the literature cited portion of this paper.
- Once a decision is made to remove animals, an accurate and thorough list of reported incidents should accompany any news release of the decision.
- Wildlife Agencies must incorporate training for wildlife managers concerning mountain lion life history, behavior, and verification of sign left at report sites. Most university programs don't incorporate these skills in their programs and these employees' ability to verify reports are critical.

Hopefully, mountain lions and other large predators will always be a part of our landscape in Arizona. Habitat preservation is a continuing challenge as rampant human development continues to reduce the amount of habitat available to lions and other wildlife. At the same time, agencies are experiencing continued liability from enterprising attorneys looking for ways to access the deep pockets of government coffers. All of us in natural resources management will continue to face these challenges in the future. Arizona has learned a great deal in dealing with several critical incidents with lions and bears over the last 10 years. We share our experiences in hopes others with be aided by our perspective.

LITERATURE CITED

BARON, DAVID, 2004. The Beast in the Garden, A Modern Parable of Man and Nature. W. Norton & Company. New York, New York, USA.

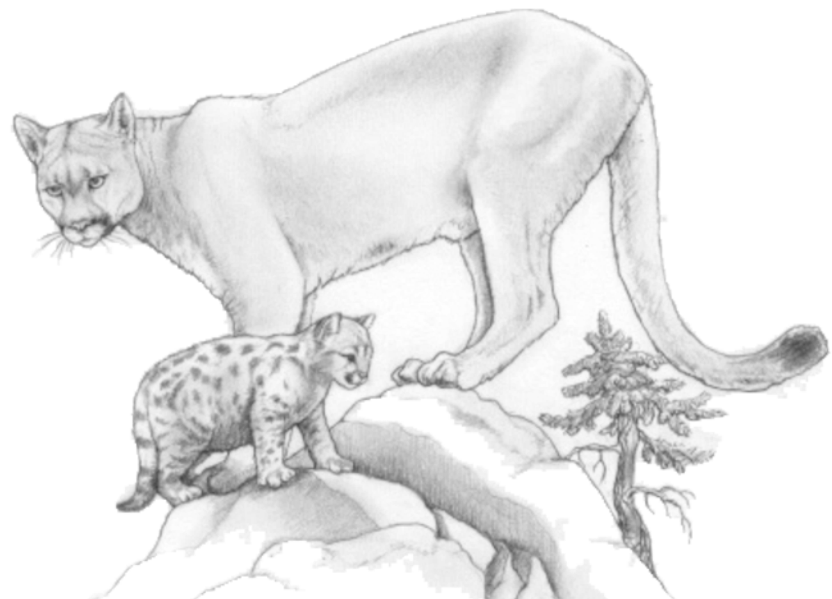
DEURBROUCK, JO, 2001. Cat Attacks, True Stories and Hard Lessons From Cougar Country, Sasquatch Books, Seattle, Washington, USA.

ETLING, KATHY, 2001. Cougar Attacks. The Globe Pequot Press, Guilford, Connecticut, USA

PERRY, G. AND RUSING, M. 2001. The changing dynamics of black bear management: Arizona's experience with litigation from a black bear mauling. Western Black Bear Workshop 7:1-8.

Mountain Lions in

Urban-Suburban Environments



LAND-COVER CHARACTERISTICS OF COUGAR / HUMAN INTERACTIONS IN AND AROUND AN URBAN LANDSCAPE

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Abstract: In the United States, the distribution of reported cougar (*Puma concolor*)-human conflicts suggests they are occurring more frequently in a few specific urban centers, like Denver/Boulder, Missoula, Los Angeles, and San Diego. What, if anything, makes these places so special? For instance, other places have both populations of cougar and humans yet do not suffer large numbers of encounters. Unfortunately, little research exists on the urban cougar phenomena and their distribution. The objective of this research was to investigate how land-cover characteristics, specifically urban, suburban, and exurban residential development in Boulder and Colorado Springs, Colorado, affect these interactions. Cougar-human conflict location analyses, including descriptive statistics, cross-tabulation, and Chi-square reveal significant relationships between land-covers in both cities that can improve management, and the prevention of future conflict in new localities by identifying areas of risk.

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Key words: Colorado, cougar, cougar-human conflict, land-cover use, mountain lion, Puma concolor, urban cougar, western United States, wildlife conflict.

In the past, reports of cougar-human encounters were extremely uncommon. For instance, accounts of cougar attacks on humans date as far back as the 1700s but most were in a wilderness setting, far away from human settlements (Deurbrouck and Miller 2001, Etling 2001). In researching cougar-human attacks, Etling (2001) found records of 29 non-fatal and 19 fatal attacks in North America in roughly 150 years between 1751 and 1899. On average that is about one reported encounter every three years. Between 1900 and 1969 reported attacks increased to 41 non-fatal and 6 fatal, or one reported encounter every one and a quarter years.

Since the 1970s, hazardous cougar-human interactions have sharply increased in western North America (Beier 1991, Deurbrouck and Miller 2001, Etling 2001). During that decade there were a total of 19 non-fatal and 4 fatal cougar attacks on humans, roughly equivalent to 2 attacks a year. In the 1980s attacks escalated to 27 non-fatal and 3 fatal attacks on humans at a rate of 3 encounters a year. Between 1990 and 1999, a record number of 69 non-fatal and 8 fatal attacks occurred (Beier 1991, Deurbrock and Miller 2001, Etling 2001), equaling close to 8 attacks on humans each year. In only 4 years from 2000 to 2004, cougars have attacked humans 17 times in North America with 14 non-fatal and 3 fatal (Danz 1999, Etling 2001, Lewis 2005). If the current trend of attacks continues, we can expect an ever-growing number of dangerous encounters in the coming years, yet little research has been undertaken to determine the factors that have given rise to the increasing number of attacks.

The distribution of cougar-human attacks suggests encounters are occurring more frequently in a few specific localities, near or in populated areas. In the United States, urbanized places like the Denver/Boulder region, Missoula, Los Angeles, San Diego, and Sacramento appear to be hubs of cougar-human interaction. For example, of the seven fatal cougar attacks between 1990 and 2001, five were near major urban centers - three occurred in the Boulder/Denver region, one on the outskirts of San Diego and one near Sacramento (Etling 2001, Beier 1991, Danz 1999). Reports suggest cougars are moving into places where they never were before but little research exists on cougars in habitats other than wilderness.

Research involving cougar habitat has focused on natural landscapes and/or places with very little human modification. For instance, research suggests cougars are spatially specific when choosing home ranges (Beier 1991, Laing 1988), such that habitat choice is influenced by the percentage of habitat diversity and the quantity of forested cover (Riley and Malecki 2001). Laing (1988) found that overall, cougars preferred habitat with low horizontal visibility, high elevations, dense forest, and tall trees. Specifically for the Rocky Mountains, Williams et al. (1995) tested habitat types and discovered cougars used closed conifer, open conifer, aspen and conifer, deciduous tree, and shrubland habitat types most often. Although deer typically use open meadows, grassland, cougars refrained from such habitat (Laing 1988, Williams et al. 1995), but were found to frequent the more densely covered areas on the periphery of open spaces (Williams et al. 1995). This research is inconsistent with the conflict locations as developed areas rarely contain ample amounts of preferred cougar habitat, yet they are entering these spaces and coming in conflict with humans at an increasing rate. In response, this research intended to explore the land-cover types most often found at cougar-human encounter locations in and around urban, suburban, and exurban areas.

One of the reasons that minimal research has been conducted on the cougar-human issue is that most data are in the form of public sighting information or stories. Cougar sighting data are still considered sub-standard or even useless by many wildlife researchers who have experienced cougar sightings that when investigated turned out to be an extra large house cat, a fox, or a golden retriever. In response, I choose to use sighting data that was investigated by a trained wildlife expert in a concerted effort to lend credence to my study results.

For the purposes of this paper, cougar-human encounters/interactions were considered to be any instant a human believed they were in “contact” with a cougar. This included a wide range of interactions from a heard cougar vocalization or witnessed cougar evidence (signs, scrapes, scat, tracks, wildlife kill, domestic animal kill), to visual or physical contact with a cougar.

STUDY AREA

I chose two urban areas as study sites: one with a long history of cougar-human encounters, several non-fatal attacks, and 3 fatal attacks within the region, and another urban area where cougar-human conflict only recently led to a human attack. My two sites were Boulder and Colorado Springs, both in Colorado.

Boulder, Colorado

The city of Boulder is located on the eastern side of the Rocky Mountains in north-central Colorado, approximately 25 miles northwest of Denver, and just south of Rocky Mountain National Park. Boulder, with a population of 100,000 (Census 2000), lies adjacent to the foothills of the Rocky

Mountains, and to dense wilderness. As such, Boulder became a hotspot of cougar-human interactions.

Halfpenny et al. (1991) collected encounter data from Colorado's Front Range from the early 1980s until 1991. During that time, almost 400 incidents (tracks, sightings, and attacks) were reported. Of those 400 reports, close to 90% came from Boulder County, and by the middle of the 1980s, Halfpenny et al. (1991) recognized that a number of cougars had taken up hunting in the city of Boulder at least part-time (Deurbrouck and Miller 2001).

At the beginning of the study, Halfpenny et al. (1991) documented most encounters occurred primarily at night or twilight hours, and at higher altitudes; yet as the study progressed, cougar-human encounters became more frequent during daylight hours, at lower altitudes, and encounters within city limits increased. Halfpenny et al. (1991) suggested cougars in and around Boulder County were becoming habituated to people and more encounters between humans and cougars were inevitable. Additionally, a Colorado Department of Wildlife study noted that the greater Denver/Boulder region had the highest number of reported cougar-human encounters than anywhere else in the state for the years 1997 to 1999 (George 1999).

Colorado Springs, Colorado

The city of Colorado Springs also lies along the Colorado Front Range, just south of Denver. With a population of 320,000 (Census 2000), residents of this growing metropolis also live on the urban-wildland fringe and incur conflicts with wildlife. Calls to the Wildlife Department of Colorado Springs concerning cougars in residential areas increased to an average of two per week in the late 1990s and early 2000 (Seraphin 2002). Luckily there have been no fatalities associated with cougar-human encounters in Colorado Springs, however, the first cougar attack on a human was on January 8th, 2002 as a man tried to protect his dog from a cougar, and was himself attacked (Seraphin 2002).

METHODS

Data Collection

Data for this study were collected during the summer of 2002 and 2003, were obtained from multiple sources, and only available between the years 1985 to 2002 for Boulder, and 1999 to 2002 for Colorado Springs. Data for Boulder were spread across several sources and inspected claims were more difficult to obtain. The Colorado Division of Wildlife provided 35 encounters for Boulder, for years 1999 to 2002 (no reported data could be found for years before 1999), and 191 reports came from the Boulder Open Space and Mountain Parks Department from the 1980s to 2002. In both cases, wildlife officials or rangers in the process of investigating possible cougar-human encounters made the reports. Three hundred ninety-nine reports were obtained from Jim Halfpenny, from the Halfpenny et al. (1991) study of the Colorado Front Range. Each of the data points were given a score of A – F according to the researcher's perceived validity of the encounter after an inspection of the event. David Baron and Lee Fitzhugh provided information on 40 and 10 encounters, respectively. Many of the reports from the various sources where repeats and after cross-referencing all the sighting data, I counted a total of 452 data locations in address, UTM, and Township, Section, and Range (TSR) formats.

Unfortunately, data for Colorado Springs were less available. I obtained 55 reported encounter locations in UTM and address format from the Colorado Division of Wildlife from years 1999 to 2002, as no investigated reports from before 1999 could be found by CDW employees.

Because exact locations of the cougar-human encounters were important, each location needed appropriate information such that I could place it on a map. Unfortunately, much of the encounter data obtained did not specify a location, made reference to a general area, or included an address, UTM, or TSR that was incomplete and could not be identified. Those data were discarded leaving 80 recognizable data locations for Boulder and 38 for Colorado Springs.

Since very little actual cougar habitat exists in urban, suburban, and sometimes exurban areas, cougar habitat data was useless for this study. Instead I obtained land-cover data for both Boulder and Colorado Springs from the USGS seamless.usgs.gov website. The land-cover came from the National Land Cover Dataset (NLCD 1992) in ArcGRID format and at 30-meter resolution. Each 30-meter pixel was classified as one of 21 different land-cover types identified by the USGS.

ESRI's United States Street Database provided a geo-coded road layer. This information was needed to assist in locating specific cougar-human encounters by address.

Data Analyses

Analyses were conducted using two separate software packages. First, land-cover data were entered into ARCINFO 9, Geographic Information System (GIS) by Environmental Systems Research Institute (ESRI). Cougar-human encounter data were then entered in a separate layer; data with addresses were located using the geo-coded ESRI United States Street Database. UTM locations were placed via ARCINFO and TSR sites were derived by using a TSR map. A simple Average Nearest Neighbor analysis was performed on cougar-human encounter locations in both Boulder and Colorado Springs to check for clustering.

Using ARCINFO I created 100-meter buffers around each of the encounter locations to capture the land-cover types in use by cougar. Buffer size was derived from the accuracy of placing encounters with TSR information, as they were the least specific. Next, the USGS land-cover layer was then clipped to the buffers. To be clipped, each land-cover was converted from its original raster ArcGRID layer to a vector layer; this process permitted calculation of each land-cover type in the buffers. Afterward, a new layer was created from the clipped buffers for each of the encounter locations. Finally, total area for each land-cover was calculated for each buffer for future statistical analyses using SPSS.

Second, I ran a series of analyses using the Statistical Package for the Social Sciences 13.0 (SPSS). Descriptive statistics (total, mean, and percentage) were collected for land-covers in individual buffers. Additionally, all buffers in a study site were combined for a total buffered area. I ran frequency, cross-tabulation statistics, and a Chi-square test of independence to determine relationships between variables in both individual and total buffered areas.

RESULTS

Results of the Average Nearest Neighbor analysis revealed encounter locations in both Boulder and Colorado Springs were significantly clustered at the 0.01 significance level, with Z scores of -6 and -5.1 standard deviations, respectively. Also, visual inspection of the clustering illustrated encounter clusters were distributed along the urban-wildland fringe in both urban areas (Figures 1 & 2).

Simple descriptive statistics confirmed that 8 of the 21 land-cover types identified in the NLCD by the USGS stood out in both study sites: Commercial/ Industrial/ Transportation, Deciduous, Evergreen, Grassland/ Herbaceous, High Intensity

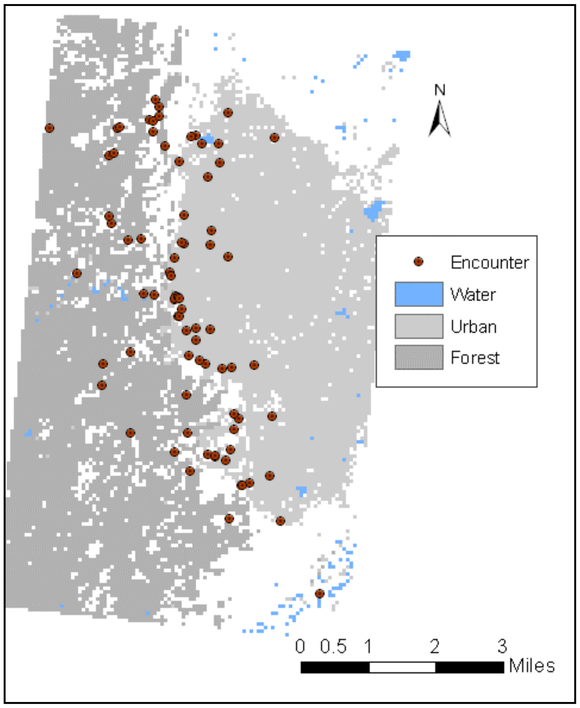

Figure 1. Encounter locations in Boulder, Colorado.

Residential, Low Intensity Residential, Shrubland, Urban/ Recreational Grasses. Commercial/ Transportation/ Industrial (C) land-cover was defined by the USGS as railroads, highways, streets, and all urban areas not classified as residential. Forested areas were separated between Deciduous (D) and Evergreen (E) based on which plant type dominated 75 percent or more of the land-cover. The Grassland/ Herbaceous (G) classification indicated regions where grasses and forbs occurred more frequently than woody vegetation, and included areas used for grazing purposes. High Intensity Residential (HI) had 20 percent or less vegetation, and included apartment complexes and row housing. In contrast, Low Intensity Residential (LI) was defined an area populated by single-family units where between 20-70 percent of the area was vegetated. Shrubland (S) classification was denoted to locales where shrubs exceeded the amount of other plant forms. Lastly, Urban/ Recreational Grasses (UR) included all vicinities maintained for recreation (parks, golf courses, lawns), erosion control, or aesthetic purposes (airport grasses, industrial lawns) where grasses were the dominant plant.

In Boulder, a few land-cover types dominated encounters locations. Encounters occurred most frequently within LI, G, E, and UR land-cover types, with LI standing out as the most common land-cover type found overall (Table 1). Interestingly, Colorado Springs encounters appear more often in G, with LI second, E third, and S next (Table 2). Cross-tabulations and Pearson's correlation coefficient analyses of Boulder and Colorado Springs data showed some strong associations between variables observed at the cougar-human encounter locations. Boulder data displayed relationships between many variables. The strongest associations occurred between E and D with $r = .958$ at $p < .000$, LI and UR with $r = .75$ at $p < .000$, and G and LI with $r = .572$ at $p < .000$ (Table 3). In contrast, Colorado Springs data displayed much

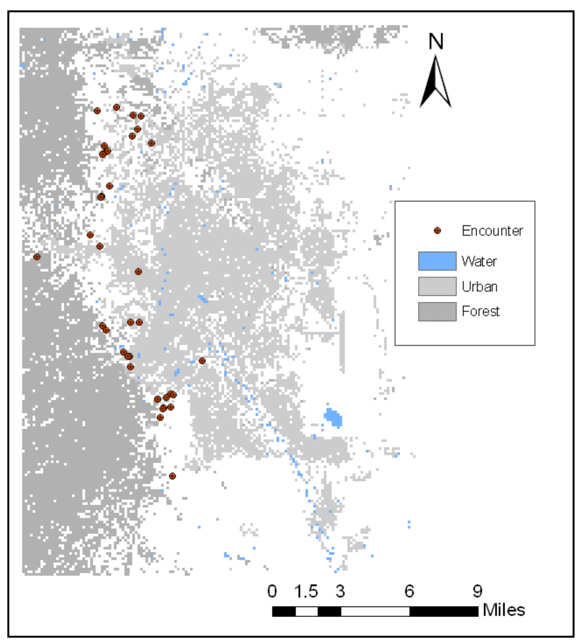

Figure 2. Encounter locations in Colorado Springs, Colorado.

Table 1. Percentage of land covers for total area buffered in Boulder.

Land Cover Type	% of Total
Commercial/Transportation/ Industrial	3
Deciduous	4
Evergreen	18
Grassland	23
High Intensity Residential	3
Low Intensity Residential	34
Shrubland	<1
Urban/Recreational Grasses	14

fewer relationships at a lesser association. The strongest correlation appeared between E and D with r = .456 at p = .004 (Table 4). Correlations were further analyzed using the Chi-square test of independence. Results closely resembled Pearson's r such that variables with a large r also had large Chi-square statistics. Again, Boulder data had many variables that were significantly dependent (Table 5) than Colorado Springs (Table 6).

DISCUSSION

The USGS defines 21 different land-cover types in their NLCD, yet only 8 occurred with any regularity within the buffers and with similarities between the two study sites. With the exception of E and D, the definitions illustrate that the most dominant land-covers in buffered areas are those that previous research suggests cougars avoid. Williams et al. (1995) found that cougars in the Rocky Mountains used E, D, and S most often, yet results from this study indicate LI and G were the most dominant land-cover types. The most common land-cover in Boulder was LI at 34 percent and G second at 23, however Colorado Springs was opposite with G at 43 percent and the most common, and LI at 28 percent. Evergreen was a distant third in both cases showing up in an amount equal to or less than half of the most common land-cover, yet more than other land-covers that were more available in the urban areas. Both D and S appeared far less than E at below 1 percent for S and D at Boulder and Colorado Springs, respectively, yet S bounced up to 9 percent in Colorado Springs, very close to the 13 percent for E. In Boulder, UR showed up at 14 percent, just below the 18 percent for E. The pattern of land-cover used by cougars in the urban areas could have a lot to do with the type of development in each area over the last couple decades.

In the 1970s Americans began an urban-to-rural movement for the first time in U.S. history (Smith and Krannich 2000). Between 1990 and 1993 some rural western counties suffered population growth at rates more than double the national average (Kenworthy 1996 in Smith and Krannich 2000) making the West the fastest growing region in America (Deurbrouck and Miller 2001). The recent migration in Rocky Mountain counties differs from previous settlement patterns (Riebsame et al. 1996, Theobald et al. 1996), such that residential development has moved up valley slopes in more isolated areas with denser vegetation, for access to vistas and an idyllic "countryside" environment (Riebsame et al. 1996). In a study by Theobald et al. (1996) examining the ecological and social landscape of a rapidly changing Colorado mountain county, they found new

Table 2. Percentage of land covers for total area buffered in Colorado Springs.

Land Cover Type	% of Total
Commercial/Transportation/ Industrial	2
Deciduous	<1
Evergreen	13
Grassland	43
High Intensity Residential	1
Low Intensity Residential	28
Shrubland	9
Urban/Recreational Grasses	3

Table 3. Pearson's *r* for Boulder land-cover.

Variable 1	Variable 2	*r*	*p*
Low Intensity Residential	UR[a]	.745	.000
	G[b]	.572	.000
	C[c]	.335	.000
	HI[d]	.335	.000
Grassland/ Herbaceous	LI[e]	.572	.000
	E[f]	.468	.000
	D[g]	.442	.000
	UR	.398	.000
	C	.335	.017
Evergreen	D	.958	.000
	G	.468	.000
	S	.232	.005
	UR	-.263	.001
Urban / Recreational Grasses	LI	.745	.000
	G	.398	.000
	HI	.328	.000
	C	.335	.012
	E	.263	.001
	D	.289	.000

[a]Urban-Recreational Grasses
[b]Grassland/Herbaceous
[c]Commercial/Industrial
[d]High Intensity Residential
[e]Low Intensity Residential
[f]Evergreen
[g]Deciduous

subdivision developments bordered public lands. Deurbrock and Miller (2001, xii) suggest, "Never before have so many cougars lived side by side with so many humans."

It is quite possible then that the recent trend in suburban sprawl, development on valley slopes, and larger lots with dense vegetation near public lands has assisted cougars in providing just enough cover to infiltrate more open urban areas. For instance, the definition of LI includes much of this new suburban growth as it includes areas that have between 20 – 70 percent vegetation, and LI was dominant in Boulder buffers and second in Colorado Springs. Older patterns of residential development like row housing are classified as HI, which shows up in only 3 percent, or less of the total buffered area, and consist of less than 20 percent vegetation.

This suggests LI offered something for cougars that the traditional pattern of residential development did not. Cougars might also be using the increase in recreational and preservation lands.

Both Boulder and Colorado Springs developed citywide plans that increased the amount of vegetation through the creation and preservation of natural areas for recreation and as buffers to development, thereby possibly providing increased cougar habitat in urban areas. Boulder's Greenways Program was first created in the 1980s as a flood mitigation measure to restore wetland and riparian areas throughout the city, but soon became important as a wildlife corridor for many species important to the local people (City of Boulder 2005). Additionally, Boulder is almost completely surrounded by natural lands purchased by the city, beginning in 1898, to limit development but also to provide recreational opportunities and to preserve the natural environment for wildlife and Boulderites alike (City of Boulder 2005). Colorado Springs established the Trails, Open Space, and Parks program (TOPS) in 1997 to develop natural areas for recreation and preservation (City of

Table 4. Pearson's *r* for Colorado Springs land-cover.

Variable 1	Variable 2	*r*	*p*
Grassland	Shrubland	.343	.035
Low Intensity Residential	Commercial / Transportation / Industrial	.335	.018
	Urban / Recreational Grasses	.305	.063
Evergreen	Deciduous	.456	.004
Shrubland	Grassland	.343	.035

Table 5. Chi-square test for statistical independence of Boulder data.

Variable 1	Variable 2	X^2	p
Low Intensity Residential	UR[a]	82.17	.000
	G[b]	48.50	.000
	C[c]	16.64	.000
	HI[d]	16.64	.000
Grassland	LI[e]	48.50	.000
	E[f]	32.44	.000
	D[g]	28.86	.000
	UR	23.42	.000
	C	5.67	.020
Evergreen	D	135.83	.000
	G	32.44	.000
	S	7.97	.040
	UR	10.27	.000
Urban / Recreational Grasses	LI	82.17	.000
	G	23.42	.000
	HI	15.91	.000
	C	6.26	.021
	E	10.27	.001
	D	12.36	.000

[a]Urban-Recreational Grasses
[b]Grassland/Herbaceous
[c]Commercial/Industrial
[d]High Intensity Residential
[e]Low Intensity Residential
[f]Evergreen
[g]Deciduous

Colorado Springs 2005), although the project is not nearly as extensive as Boulder's, and could offer an insight into why UR is 14 percent in Boulder encounter buffers, but only 3 percent in Colorado Springs.

Correlation analyses and Chi-square test of independence shows certain land-covers are more highly connected than others, and may have aided cougars in their movements from wilderness to urban. For example, in Boulder E, D, nor S were correlated with LI, the most common cover, so cougar must have used another land-cover to gain access to LI. Grassland was the second most dominant land-cover and was also significantly correlated with the top four covers (LI, E, UR, D) suggesting it might have been used as a movement corridor between both E and D, to LI and UR. Low Intensity Residential was also highly correlated with UR, however UR was negatively correlated with E and D, and displayed no correlation with S suggesting UR was not used as a corridor to LI.

Land-covers in Colorado Springs showed much fewer associations. Grassland, the most common cover found in buffered areas, displayed moderate correlation to S and no other associations with other land-covers. Evergreen was only correlated with D and showed no connection to S, thus making it difficult to glean movement information for cougars. This dearth of information has much to do with the limited availability of data for Colorado Springs, making the case for cities to maintain an active database of cougar encounters with confirmed reports.

MANAGEMENT IMPLICATIONS

Identifying the relationship between cougar movement and specific land-covers in urban areas can provide a vital window into understanding why conflicts between cougars and humans occur in specific places. Urban spaces can be determined to have a higher or lower risk of cougar use based on the absence or presence of a particular land-cover, or pattern of land-covers. For instance, the Boulder site

Table 6. Chi-square test for statistical independence of Colorado Springs data.

Variable 1	Variable 2	X^2	p
Grassland	Shrubland	4.47	.053
Low Intensity Residential	Commercial / Transportation / Industrial	5.53	.018
	Urban / Recreational Grasses	3.53	.063
Evergreen	Deciduous	7.92	.009
Shrubland	Grassland	4.47	.053

displayed a relationship between natural cougar habitat of E, G, and S, and the urban land-covers of LI, G, and UR. Risky areas can then be managed appropriately to prevent encounters through more intense public education and patrol. However, Le Lay et al. (2001) suggest that trying to control hazards is often impossible, instead we should attempt to decrease the risk within the environment itself. In this sense, it might be more beneficial to manage cougar-human encounters by restricting the development of land-covers or land-cover patterns that produce the most risk. Information like this is essential for protecting the future of cougars and the people who live near them.

ACKNOWLEDGEMENTS

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LITERATURE CITED

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

CITY OF BOULDER. 2005. Boulder's Open Space and Mountain Parks: A history. http://www.ci.boulder.co.us/openspace/about/OSMP-history.htm. Accessed 2005 May 15.

CITY OF COLORADO SPRINGS. 2005. TOPS, planning, design and development homepage. http://www.springsgov.com/units/parksrec/tops.htm. Accessed 2005 May 15.

DANZ, H. 1999. Cougar! Swallow Press/Ohio University Press, Athens, Ohio, USA.

DEURBROUCK, J., AND D. MILLER. 2001. Cat attacks: True stories and hard lessons from cougar country. Sasquatch Books, Seattle, Washington, USA.

ETLING, K. 2001. Cougar attacks: Encounters of the worst kind. The Lyon Press, Guilford, Connecticut, USA.

GEORGE, J. 1999. Mountain lion management guidelines for lion DAU L-12. Colorado Division of Wildlife, Denver, Colorado, USA.

HALFPENNY, J. C., M. R. SANDERS, AND K. A. MCGRATH. 1991. Human-lion interactions in Boulder County, Colorado: Past, present, and future. Pages 10-16 i*n* Mountain lion-human interaction symposium and workshop, edited by C. E. Braun. Colorado Division of Wildlife, Denver, Colorado, USA.

LAING, S. P. 1988. Cougar habitat selection and spatial use patterns in southern Utah. Thesis, University of Wyoming, Laramie, Wyoming, USA.

LE LAY, G., P. CLEARGEAU, AND L. HUBERT-MOY. 2001. Computerized map of risk to manage wildlife species in urban areas. Environmental Management 27, Number 3: 451-61.

LEWIS, LINDA. 2005. List of confirmed cougar attacks in the United States and Canada 2001-now. http://cougarinfo.com/attacks3.htm. Accessed 2005 May 15.

RIEBSAME, W. E., H. GOSNELL, AND D. M. THEOBALD. 1996. Land use and landscape change in the Colorado Mountains I: Theory, scale and pattern. Mountain Research and Development 16, Number 4: 395-405.

RILEY, S. J. AND R. A MALECKI. 2001. A landscape analysis of cougar distribution and abundance in Montana, USA. Environmental Management 28, Number 3: 317-323.

SMITH, M. D., AND R. S. KRANNICH. 2000. "Culture clash" revisited: Newcomer and longer-term residents' attitudes toward land use, development, and environmental issues in rural communities in the Rocky Mountain West. Rural Sociology 65, Number 3: 396-421.

THEOBALD, D. M., H. GOSNELL, AND W. E. RIEBSAME. 1996. Land use and landscape change in the Colorado Mountains II: A case study of the East River Valley. Mountain Research and Development 16, Number 4: 407-418.

WILLIAMS, J. S., J. J. MCCARTHY, AND H. D. PICTON. 1995. Cougar habitat use and food habits on the Montana Rocky Mountain Front. Intermountain Journal of Sciences 1, Number 1: 16-28.

A NEW PARADIGM FOR COUGAR CONSERVATION AND "MANAGEMENT" IN THE 21ST CENTURY

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Mountain Lion Workshop 8:127

Abstract: During the last century we have moved from a society that considered cougars to be vermin and sought their eradication to one that recognizes their invaluable ecological role and seeks to ensure their survival. However, in the end we believe that cougars remain viable through much of the Western U.S. and Canada not because of insightful management over the last three decades, but due more to fact we failed in our mission to eradicate them in the early to mid-1900s. Today, our management of this charismatic carnivore in the west remains based more on unproven assumptions than on hard scientific data. Here we explore two myths that have permeated the literature and we believe affect our management of the species. These are: 1) sport-hunting has been a necessary and effective tool for managing the cougar; and 2) cougars are losing their fear of humans and posing greater risk to us then in previous decades. The pervasiveness of these myths guarantees that the debate surrounding cougars will remain disproportionately focused on the polarization of ideas, thereby complicating efforts to inform public policy and develop long-term conservation strategies for cougars in the West.

MANAGING FEAR: A COMMUNITY-BASED CONFLICT RESOLUTION STRATEGY FOR URBAN AND SUBURBAN COUGAR INCIDENTS

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Mountain Lion Workshop 8:128-135

As most of us eventually learn in our roles as biologists, naturalists, and conservation advocates, wildlife management is often more about managing the human response to animals and their dynamic habitat and population fluctuations, than about species management itself. Many spend their careers studying, researching and monitoring cougar behavior in an attempt to better understand the potential outcomes in species abundance, behavior and distribution from changes in habitat and prey base over vast home ranges. Thus, the most difficult message we have to deliver when dealing with community responses to public safety situations or the perception of a threat is that there is no permanent solution even if the offending animal is taken. It's not like installing lights in a city park to reduce nighttime crime, thus driving criminal activity somewhere else in most cases. Imminent threat from predators may be reduced temporarily if you are certain you took an aggressive animal but the next public safety threat could be tomorrow or not for many years. The unpredictability of nature and the behavior of predators like cougars that must kill every one or two weeks creates a highly charged reality that objective analysis defies. So what if the chance of being attacked by a cougar is statistically less than being struck by lightening or killed in a car accident? It often doesn't matter. When the "perfect storm" of cougar presence heightens fear (Ackerl et al. 2002) within a community with diverse world views (Huitt 2001) media attention can escalate high profile human/cougar sightings and encounters into a public policy controversy that can end up in the Governor's office (Perry 2004). Sometimes the issue of sport hunting is raised as a part of the larger solution to population control in the urban/wildland interface. However, public opinion on hunting and the demographics of those supporting or opposing hunting in the geographic area (Duda et al. 1998) of the public safety lion conflict is a factor to be considered.

Urban and suburban residential communities may respond to wildlife safety threats much like that of a pedophile in their midst. There are many individual opinions with different expectations involving wildlife stakeholder acceptance (Riley and Decker 2000). Most citizens expect the public trust agency and enforcement personnel to identify the public safety cougar or potential threat and keep them safe by: 1) killing it; 2) aversive conditioning combined with education; 3) capturing and relocating 4) deterrent methods (e.g. removal of depredation kills) (State of Colorado Human-Mountain Lion Interactions policy, 2005)

Given these diverse public expectations and agency response options, the "best professional judgment" approach of a wildlife professional or the application of science-based decision making may get lost in the din of the community "fear factor" which can be viewed as individual risk perception theory and (societal) impersonal impact hypothesis. (Trumbo 1999). In California, the department of Fish and Game is responsible for public safety cougar situations. The department has developed a public safety policy and trained for effective incident handling and imminent threat determination. However, due to limited resources, a cohesive educational outreach strategy has not yet evolved. What wildlife professionals may not do for lack of resources, interest, or time, is to develop or apply social science-based community conflict resolution (Paulson and Camberlin 1998) and natural science-based educational strategies (Graham et el. 2000) that enable individuals and community groups to problem-solve situations involving predators in their midst (Messmer 2000).

There are coping—to use a psychological term--strategies for the biologist, game warden, public information officer, or naturalist thrust into the world of high profile urban/suburban public safety cougar conflict situations. A common understanding of the concept of fear and how it relates to predators and human interaction is a starting point for professionals involved in the predator conflict situation:

"Fear can be induced by external objective threats (e.g. predators) as well as by internal, subjective threats, called "free floating anxieties". Free floating anxieties can be generated by conscious or subconscious memories of threatening experiences in the past or…the mere anticipation of a stressful situation" (Ackerl et al. 2002)

Human fear emanates from the most primitive portion of the brain, the brain stem (fight or flight response) and is also associated with the limbic system that governs our emotions such as love, hate, and lust. When humans are afraid, they move away from higher level thinking (associated with the neocortex) and revert to more basic automatic response patterns. Thus, fear of predators can trigger the most basic human instincts of survival, territory and the sense of security arising from the reptilian brain stem. (Miller and Kauffman 2005)

Thus, when a biologist or game warden attempts in a public meeting to rationally downplay the risks of predator threat in their neighborhood to children and adults, they may be rebuffed. There may be a knee-jerk response from community members questioning the credibility or trustworthiness of the wildlife expert despite data, animal behavior, and observations to the contrary. As Miller and Kauffman (2005) note in The Brain and Learning, "When we are afraid, we downshift from higher level reasoning to our most basic automatic, ritualistic, and resistant processes".

If the wildlife professional and/or knowledgeable stakeholder "expert" analyzes the situation (e.g. pattern of sightings, encounters) and determines there is no current public safety threat, the tendency may be for the expert to "tell" the community not to be afraid because in their "best professional judgment" (BPJ) the facts don't warrant a fear response. Unfortunately, the community fear factor, often heightened by rumor, innuendo, and polarized value judgments, may not be mollified by this BPJ intervention strategy (O'Connor 1999). In fact, this BPJ approach may actually escalate an already emotionally charged environment and generate an attack on the credentials or credibility of the expert him or herself (Baron, 2004). Why would this be so? Because many members of the community may respond to their own perception of predator risk based on the "free floating anxieties" discussed earlier and be influenced by what Ajzen and Fishbein (1980) refer to as the Theory of Reasoned

Action (TRA). Under this theory, if attitudes can predict behavior change, then changing attitudes can lead to behavior change.

For example, a person with an animal rights world view may be unlikely to stop feeding the grizzly bear if he/she believes the animal is starving even if that action might lead to a habituated problem bear that a wildlife agency determines must be destroyed. That individual is probably less likely to be influenced by the best professional judgment explanation of the wildlife biologist or the interpretation of the evidence presented by a game warden to justify the management action. However, if this person's attitude about feeding the bear can be changed through a collaborative process such as the town hall meeting model (to be described later), then the individual may accept a management outcome that protects the overall welfare of the bear population even if one animal must be removed from the wild. Now in the case of a mountain lion that has attacked a person it might be expected that the animal rights individual would support removal from the wild but not killing it.

The public safety threat situation is also an approval-laden process governed by wildlife management policy, law, procedural protocols and statewide voter mandates (e.g. Proposition 117 in California), in some cases. However, there is always a subjective element to the warden, biologist, or public safety official's decision to make the public safety judgment call (M. Wade, personal communication).

In the case of mountain lions, most state fish and wildlife agency policies endorse the "take" option of a public safety attack animal to minimize liability and future risk. It should be noted here that "best professional judgment" in public safety situations is a deliberative, evidence-driven process much like response to a human crime scene. In fact, a fatality from a lion attack is treated as a crime scene until law enforcement determines that a murder or accident is not the cause of death.

If there is an actual cougar attack, persistent aggressive behavior, or animals that lose their fear of close human encounters, many communities are more likely to rally behind the imminent threat policy determination of most fish and wildlife agencies or local law enforcement. The animal is identified and removed from the population if conditions for tracking and/or locating are right. Authorities explain their analysis of the evidence leading to the "take" action and the community is satisfied. In California, we have a fairly well defined imminent threat policy. In short, there has to be a verified attack or a "confirmed" threat or potential thereof to do immediate harm (e.g. sightings, encounters near school grounds). But rarely does the observational path and evidence lead to such a clear undisputed outcome unless an actual human attack has occurred.

If the affected community as a whole, does buy the traditional expert testimony or best professional judgment approach where no attack has taken place then the public safety threat incident is resolved with minimal educational outreach or a more time-consuming conflict resolution process (Orange County California human attack 2004).

Whereas, the public safety threat cougar determination by a wildlife agency in a rural community may result in a legal killing with high community acceptance, the same public threat determination in the urban/wildland interface may generate significant controversy with low community acceptance. And the diverse recreational and animal welfare voices in the urban/wildland fringe can be as distinct, strident and politically savvy as the traditional fishing and hunting interests of the Teddy Roosevelt style conservationist of today.

There is a difference between environmental conflicts related to predator fear and those collaborative processes (Crowfoot and Wondolleck 1990) developed to deal with environmental regulatory issues. Regulatory issues related to forest management practices for example, may inflame community debate but are not characterized by the same sense of pending personal risk from attack. If a forest is logged a preservation advocate may feel as bad for a fallen tree as an animal welfare advocate feels for a dead lion. But a TV news report on a logged forest may not have the same impact on the public sentiment as a dead lion shot out of a tree (Palo Alto, 2005).

Recent experience by the California Department of Fish and Game with communities having persistent or chronic wildlife predator presence is telling (San Francisco Bay Area, 1997-2005). Several decades ago, the credibility of resource managers and government officials in general was much higher and the desire for public involvement in natural resource decision-making was less (Chamberlin and Paulson 1998). Today, the conservation and or environmental movement has evolved into many separate special interests and stakeholder groups (e.g mountain bikers, birders, extreme adventurists, ultra-marathoners, sea kayakers, etc.) The traditional fishing and hunting interests may not carry the same weight in influencing fish and wildlife agency policy and actions as they did in the past regarding public safety lion situations, especially in the urban/wildland interface.

In addition, those citizens living adjacent to open space may be most highly affected by predator presence and subject to loss of property such as pets. With property values tending to be higher on the cusp of the urban/wildland interface, these citizens, often characterized by demographers as ex-urbanites, tend to be affluent members of the community with a higher stake in the civic affairs and thus become more engaged in predator conflicts that may affect them. In turn, they are also more likely to demand action from the public trust entities responsible for wildlife management based on experiences in California.

The residential profile of a community with high or repeated cougar presence seems to affect the community fear factor. For example, a polarized populace with strong animal welfare and rancher/farmer hunting interests is more likely to create a more contentious and problematic situation for wildlife agency decision makers seeking an acceptable community resolution to mountain lion presence. Whereas a more homogenous community with either a strong rural or ex-urbanite bent may rally behind an acceptable public safety lion strategy more readily. Future Human Dimensions of Wildlife academic research and community-based attitudinal surveys toward predators are needed in the urban/wildland interface to improve our understanding of how communities are likely to react to various conflict resolution and educational awareness strategies.

In Colorado and California in particular, many cougar threat situations are highly contentious involving numerous stakeholder groups, individual citizens, and public officials. In states with outdoor-oriented citizens living on the urban fringes, there has been a rise in sightings, encounters and even human attacks (California status report, 2005). The public safety risk may especially be increased where residents engage in intensive recreational trail usage at crepuscular times of the day, during the breeding season, or where the prey base (particularly deer) is abundant. This connection between recreationalists and cougar sightings/encounters needs further research to verify to what extent these interactions or close encounters are actually occurring. Where possible, human/predator conflict resolution strategies should be aligned with the public trust mission and management objectives of the state fish and wildlife agency (e.g. Natural Resource Education Messages, California, 2005)

Below is one decision-making process that can be applied to a community with an increasing or high level of cougar presence nearby. The process and subsequent indirect and direct intervention strategies evolved from practical lessons learned from a series of contentious public meetings on coyotes in different communities surrounding San Francisco Bay. The process is grounded in interest-based negotiation principles (Fisher and Ury 1983) and the work of Steve Barber, Navigating the Emerging Paradigm, 2003.

Though coyotes pose a much lower level of actual threat and danger, the nature of the community response, though less intense, appears quite similar to those communities that the California Fish and Game department is beginning to work with regarding cougar presence. Hopefully, the department, working with major stakeholder interests will be able to test these strategies in California communities with cougar "problems" in the very near future. Elements of the town hall meeting and indirect intervention strategies have been applied to these communities in the past but not in a comprehensive social science based "treatment" approach.

While there are many models for facilitating meetings and collaborative decision-making processes, the elements of the following model have evolved and been introduced over a series of three town hall meeting formats in the cities of Walnut Creek, Dublin, and Mill Valley. The aspects of community education prevention strategies and actual incident handling must be clearly delineated since they have distinct characteristics. Prevention is by nature educational, pre-planned and takes place over time. Incident handling is reactive and immediate if a public safety threat is perceived and reported.

The assessment and problem identification process detailed below is appropriate for use before or after an imminent public safety lion threat has been identified.

1. Review or develop a reliable wildlife incident reporting system whereby the wildlife professionals are confident in the pattern of and veracity of the reports over time.
2. Identify key stakeholders in the community and their "world views" (Huitt 2000).
3. Assess the level of polarization, homogeneity, and community activist engagement.
4. Gauge fish and wildlife agency and first responder (local animal control, federal trapper, police, etc.) credibility in cougar management.
5. Apply the interest-based negotiation process (Barber, 2003) to identify community interests and develop options to deal with the predator fear factor.
6. Determine whether an indirect (behind the scenes) or direct (town hall) intervention strategy is appropriate.

There are five steps in the indirect strategy:

1. Interview key players and stakeholders (e.g. residents, key officials and first responders) to get the broad story.
2. Frame the question such as: How can we reduce the community fear factor?

3. Facilitate an interest-based negotiation process to develop educational awareness and empowerment options (e.g. phone alert tree, leaflets, interpretive signage, aversive conditioning techniques, first responder notification network, etc.).
4. Implement a pilot community-based incident response plan (e.g. observation reporting form, neighborhood wildlife alert, first responder notification tree).
5. Debrief with key players and modify as needed.

The direct strategy involves designing and implementing a public venue town hall meeting (Byrd et al. 2000) or a series of targeted neighborhood outreach sessions. The steps include:

1. Obtain skilled facilitator & meeting recorder with no vested interest in the outcome.
2. Select balanced five-person panel of experts representing major stakeholder views (e.g agricultural commissioner, federal or county trapper, outdoor writer, state biologist or naturalist, animal welfare advocate, rancher, hunter, informed elected official, animal control, academic, public/private land manager, licensed wildlife rehabilitation facility representative, etc.) (MSH/UNICEF, Stakeholder Analysis, 2005).
3. Provide brief legal and policy framework for cougar incident handling without judgment.
4. Present incident response handling process (usually fish and wildlife agency biologist/naturalist).
5. Present the cougar presence and community response "story" using the adaptive Content, Process, and Relationship note-taking model (Barber and Walke 2003).
6. Present wildlife agency incident response handling process (usually fish and wildlife agency biologist/naturalist).
7. Solicit audience feedback and record as content (what to do), process (how?), or relationship (who do you trust or not?) issues on flipcharts.
8. Summarize and record final thoughts by using open-ended questions that focus on process---both decision-making and communication---that the community as a whole can live with. Include action items involving mutual expectations for agency and first responders as well as residents.

Above all listen and be flexible in your process. If group is smaller you can use the nominal group technique (Dunham 1998) to collect feedback

There is a community-based advisory process flow chart model developed in the Central Coast Region, California Department of Fish and Game that can be used or adapted to give the community a reference document that clarifies roles and responsibilities for both incident handling and educational/alert system processes that are developed with community input (Figure 1).

In analyzing the statewide effectiveness in responding to cougar public safety situations, these are some "Back at The Ranch" recommendations:

1. Revisit the agencies/organization's response to cougar incidents.
2. Is the community engagement process sound?
3. Is there a partnership opportunity to work with a Human Dimensions of Wildlife type academic program to assist you in the interplay of social science and biological decision-making?

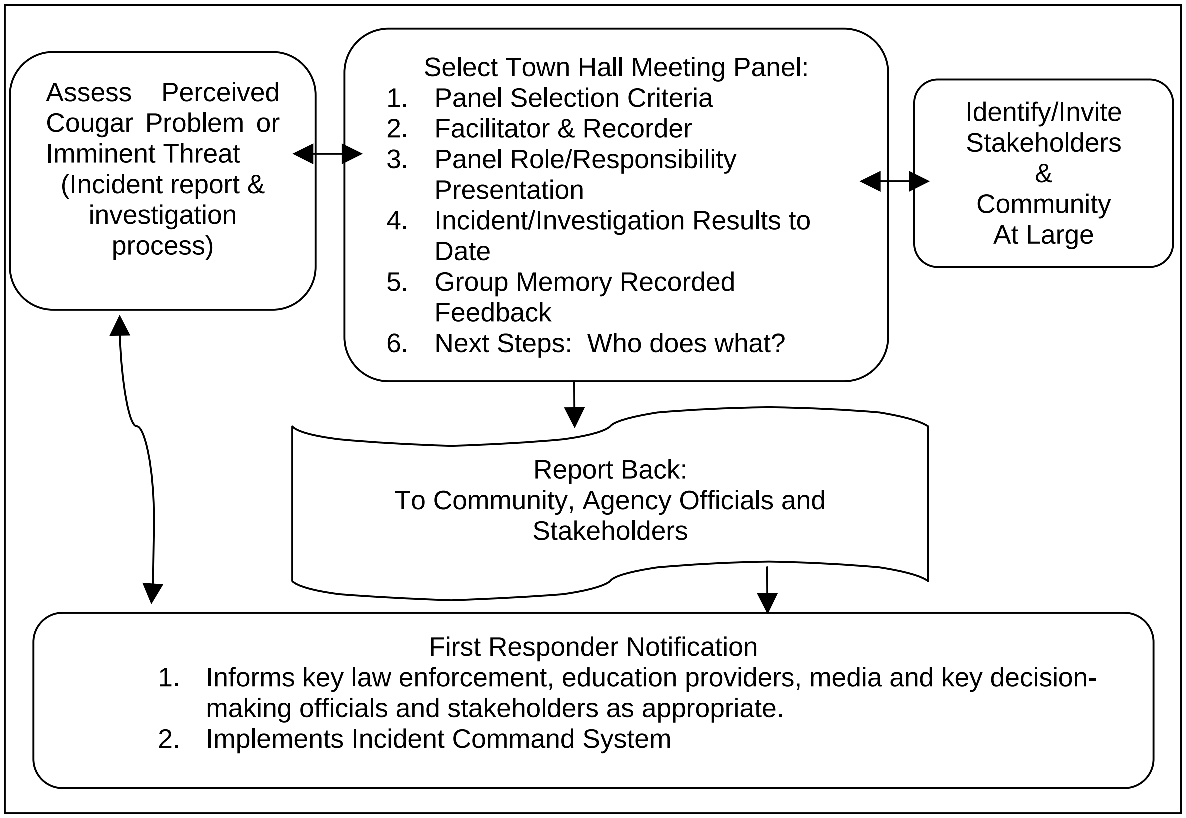

Figure 1. Cougar/Predator Conflict Community-based Advisory Process Central Coast Region, California Department of Fish and Game 2005.

4. If the incident blows up due to media or external political factors, will the decision-making and community involvement strategy be defendable? (e.g. did the best under the circumstances)

The final question to be considered in determining the relative effectiveness of any conflict resolution-based town hall model is: Are the cougar public safety management outcomes acceptable to the majority of the community, elected officials, and principal stakeholders? As human/cougar encounters and conflicts continue to rise throughout the North American continent, it is important that wildlife professionals are equipped with the social science and natural science-based research strategies to effectively protect both cougars and humans from each other.

LITERATURE CITED

ACKERL K., ATZMUELLER, M. AND GRAMMAR, K. 2002. The Scent of Fear, Neuroendocrinology Letters, 2002

ADMINISTRATIVE DIRECTIVE W-20. 2005. Human-Mountain Lion Interactions, Colorado Department of Natural Resources, Division of Wildlife.

AJZEN, I AND M. FISHBEIN. 1980. Understanding attitudes and predicting social behavior. Prentice Hall, Englewood Cliffs, New Jersey, USA.

BARBER, S. 2003. Navigating the Emerging Paradigm, Thriving on Know workbook, Sacramento, California, USA.

BYRD, D. MARTIN, A. AND LEHMAN, D. 2005. How to Facilitate Town Hall Meetings http://66.102.7.104/search?

q=cache:5AmEtfu7mD4J:www.bdcorr.ca.gov/fsod/jjdp_handbooks/jjdp

CROWFOOT, J. AND WONDOLLECK, J. 1990. Environmental Disputes: Community Involvement in Conflict Resolution, Island Press, Washington, D.C., USA.

DUDA, M. BISSELL, S. AND YOUNG, K. 1998. Wildlife and The American Mind, Responsive Management Institute, Harrisonburg, Virginia, USA.

FISHER, R. AND URY, W. 19914. Getting To Yes. Second edition. Penguin Books, East Rutherford, New Jersey, USA.

GRAHAM, J. MAZZOTTI, F. SINCLAIR, J. AND SMITHEM, J. 1999. Scientific approach for developing an education plan for endangered species recovery. University of Florida, Gainseville, Florida, USA. www.crocdoc.ifas.ufl.edu/index.php?croc=education

GRIESE, H, GUYNN, D. AND PEYTON, R. 2005. Review of criteria and procedure and recommendations for tightening regulation-setting in State Wildlife Agencies, International Association of Fish and Wildlife Agencies. www.fw.msu.edu/people/peyton.htm

HUITT, B. 2005. Educational psychology interactive: Paradigms course material. http:// chiron.valdosta.edu/whuitt/col/into/ paradigm.html

MESSMER, T. 2000. The Emergence of human-wildlife conflict management: turning challenges into opportunities. International Biodeterioration and Biodegradation, Volume 45, Number 3.

MILLER S. AND KAUFFMAN, K. 2005. The Brain and learning, course material, Riverside Community College, Riverside, California, USA. www.4faculty.org/includes/109r1.jsp

CALIFORNIA DEPARTMENT OF FISH AND GAME. 2005. Natural resource education messages (draft), Sacramento, California, USA.

OZAWA, C. 1996. Science in environmental conflicts. Sociological Perspectives, Volume 39, Number 2.

PAULSON, D. AND CHAMBERLIN, K. Guidelines and issues to consider in planning a collaborative process. 1998. Report to the Institute for Environment and Natural Resources.

RILEY, P. AND DECKER, W. Wildlife stakeholder acceptance capacity for cougars in Montana. 2000. Wildlife Society Bulletin 28:931-939.

Trumbo. Heuristic-systematic information processing and risk judgement. 1999. Risk Analysis 19:391-400.

UNITED NATIONS CHILDRENS FUND (UNICEF) AND MANAGEMENT SCIENCES FOR HEALTH (MSH). Stakeholder analysis. http://erc.msh.org/quality/ittools/itstkan.cfm

WONDOLLECK, J. The importance of process in resolving environmental dispute. Environmental Impact Assessment Review 5(4) 341-356

UPDIKE, D. 2005. California Mountain Lion Status Report, California Department of Fish and Game, Sacramento, California, USA

AVERSIVE CONDITIONING OF FLORIDA PANTHERS BY COMBINING PAINFUL EXPERIENCES WITH INSTINCTIVELY THREATENING SOUNDS

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Mountain Lion Workshop 8:136

Abstract: Following the groundbreaking genetic restoration program that began in 1995, the documented Florida panther (*Puma concolor coryi*) population has tripled. This increase has escalated the probability for conflicts between panthers and humans. In 2004, 2 such complaints involving public safety were reported. Because the Florida panther is an endangered species, removal of the offending animal was not a preferred option. Therefore, an effective method to aversively condition panthers was needed. To meet this need, we developed a 3-stage aversive conditioning program and tested it in 2004 on 4 Florida panthers involved in the 2 complaints. Stage 1 involved treeing with hounds, tranquilizing, and fitting panthers with radio transmitters. Stage 2 reinforced this initial aggravation by treeing the panthers with hounds when they were in the vicinity of the complaint. The panthers were then provoked into leaving the tree, while restraining the hounds from further pursuit. This allowed the panthers to escape. Stage 3 simulated these previous uncomfortable experiences by approaching the panthers while broadcasting taped recordings of the same hounds. These aversive conditioning techniques resulted in varying responses on the part of the panthers. It appears that some degree of avoidance and fear of humans can be instilled in panthers when combining instinctively threatening sounds such as baying hounds with reinforcement by painful experiences.

FELINE LEUKEMIA VIRUS IN THE FLORIDA PANTHER: INVESTIGATION, MANAGEMENT, AND MONITORING

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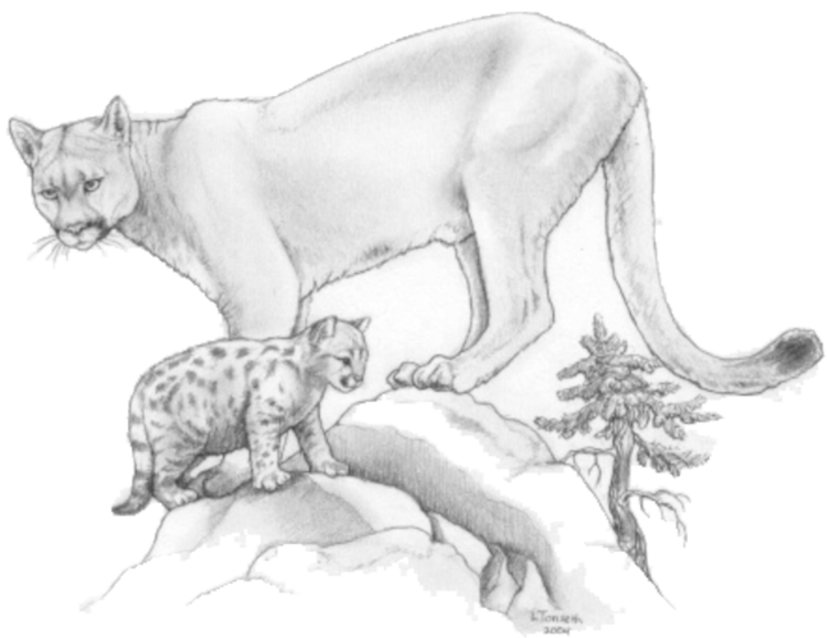
Mountain Lion Workshop 8:137

Abstract: With the growing human-wildlife interface there is increasing exposure of wildlife to domestic animal diseases. Feline leukemia virus (FeLV) is an often fatal infectious disease, common to domestic cats, that is quite rare in non-domestic felids. Routine FeLV antigen testing in Florida panthers (*Puma concolor coryi*) was negative for almost 20 yrs; however, since November 2002, five panthers have tested positive – all in the northern portion of panther range. All infected panthers have died, three due to what were believed to be FeLV-related diseases. Retrospective determination of FeLV antibody titers in archived serum indicated significant exposure beginning in the late 1990's and also concentrated in the northern portion of panther range. Preliminary results for antibody titers and PCR (M. Brown, unpublished data) also suggested that some panthers can be exposed to the virus and recover. The infection in panthers likely originated from an infected domestic cat and testing of cats in panther habitat is currently underway. Vaccination using a killed whole virus vaccine (Fort Dodge Fel-O-Vax® Lv-K) has been the primary management tool to control FeLV in panthers. As of 15 February 2005, 30 free-ranging FeLV-negative panthers have received at least 1 inoculation; 13 of these have been boostered. Test-removal (to captivity) has been added to the management plan. Managers of mountain lion populations can monitor for FeLV by ELISA antigen testing of serum or whole blood collected at capture, or hemolyzed blood and other fluids collected from harvested or necropsied mountain lions. PCR testing of scat may be a suitable non-invasive method of monitoring for FeLV in free-ranging populations.

Mountain Lion-Livestock Conflict and Management



COUGAR IMPACT ON LIVESTOCK RANCHES IN THE SANTA ELENA CANYON, CHIHUAHUA, MEXICO

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Mountain Lion Workshop 8:141-149

Abstract: Few studies try to clarify the different sources of livestock loses. This is a critical knowledge to make a fair evaluation of the effect of a predator involved in human productive activities. The Santa Elena Canyon, a Northern Mexican Protected Area was the ideal study site because of its socioeconomic conditions, associated with several cougar predation claims. Our objectives were to determine the cougar impact on the livestock industry, to identify the factors associated with livestock kills and to generate management recommendations. We identified three groups of cattle loses: by cougars, with 8% of total economic loss, by other animals (25%) and by others factors (67%). We found a positive relationship between cougar cattle predation and the amount of mountain terrain, forest vegetation and relative abundance of cougar in each ranch. Apparently, there is no relationship between livestock husbandry and the kill's frequency, although we discuss the role of other variables. We concluded that current cougar impact on livestock ranches in the Santa Elena Canyon is very low. However, we recognize the need to improve livestock husbandry in the area in order to avoid cattle mortality and further reduce cougar impact on this human activity.

Key words: impact, interviews, Chihuahua, cougar, livestock predation, Puma concolor, Santa Elena Canyon

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Predation is a common event in the ecological system that allows wildlife survival and evolution. However, carnivores cannot distinguish between wild and domestic fauna, as cattle (Linell et al. 1996). This conflict becomes more complex if it occurs in a natural protected area with conservation goals and if it affects a national industry in crisis, such as the livestock in the Santa Elena Canyon, Chihuahua, Mexico.

Cougar (*Puma concolor*) main preys are wild ungulates, especially deer (Anderson 1983), although it also consumes cattle, depending on its abundance, vulnerability and deer availability (Shaw 1977). There are few studies about cougars in Mexico; they include feeding habits (Aranda and Sanchez-

Cordero 1996; Bueno-Cabrera 2001; Núñez et al. 2000), prey selection (Amín et al. 2002; Carrillo and Lopez-Gonzalez 2002), distribution and population status (Hernandez and Laundre 2000) and habitat requirements (Loredo 2003); however cougar cattle predation is still unknown.

In the most extensive cougar study in Mexico, McBride (1976) found high proportions of cattle (2-100%), explained by Mexican agropecuaries policies and land use' features. Avila et al. (2000) in Baja California found 23% of cattle lose to cougar predation and 77% to both robbery and drought; husbandry practices and the high cattle: deer ratio was key variables in this conflict.

The economic impact caused by cougars is variable for each producer, depending on the predation pattern, type and size of the flock, additional incomes, losses to other factors and production costs of each farm (Mazzoli et al. 2002). We believe that a holistic cougar impact assessment on livestock must include social, economic and biological analyses.

Because of the Santa Elena settler's claims about cougar predation, we decided to conduct this study to assess the socioeconomic cougar impact on livestock ranches, to identify the factors associated with the livestock predations and to generate management recommendations to avoid or to reduce this conflict.

We tested the following hypothesis: a) an independent relationship between the negative perception, hostile attitudes and actions and the cougar's evaluated economic damage assessment in each property; b) the cougar kills are related to some ranches features such as bigger area, rugged topography, dense vegetation cover, scarce wild preys, high livestock density and low livestock management practices.

STUDY AREA

We conducted this study from 2003 to 2004 in the Santa Elena Canyon (SEC), a Mexican Natural Protected Area located in Northeast Chihuahua, North Mexico (29°45′N - 104°32′W; Figure 1).

The area belongs to the Chihuahuan Desert and comprises about 277,000 ha. The climate is arid and extreme with mean annual temperature >18°C and rainy summers; total annual precipitation was 36 cm (SMN 2000).

The main native vegetation is desert shrub (70% of the total area), with riparian (13%), grasslands (3%) and forest (2%; INE et al. 2002). The fauna is represented by several birds, reptiles and mammals species such as deer (*Odocoileus virginianus and O. hemionus*), black bear (*Ursus americanus*), coyote (*Canis latrans*) among others (INE 1997).

There are 2,000 settlers, resulting in a very low human density (0.008 persons/ha; INEGI 2000). About 110 properties are divided in two kinds of land use, small properties (35%) and communal lands (60%; ejidatarios). Calves production for export to Texas (USA) is the main economic activity, and 90% of the whole area is dedicated to this industry. Subsistence agriculture is sometimes practiced. Because of the low development in the area, the SEC human population shows low standards of living (INE 1997).

METHODS

We use GIS analyses to make a stratified random choice of 60 properties in three different slope categories: valley, mountainous and mix terrain. A DEM, a land use map and a hillshade map were overlapped in ARC/INFO™ software (Environmental Systems Research Institute, Redlands, California, USA) to make properties selection. The SEC was

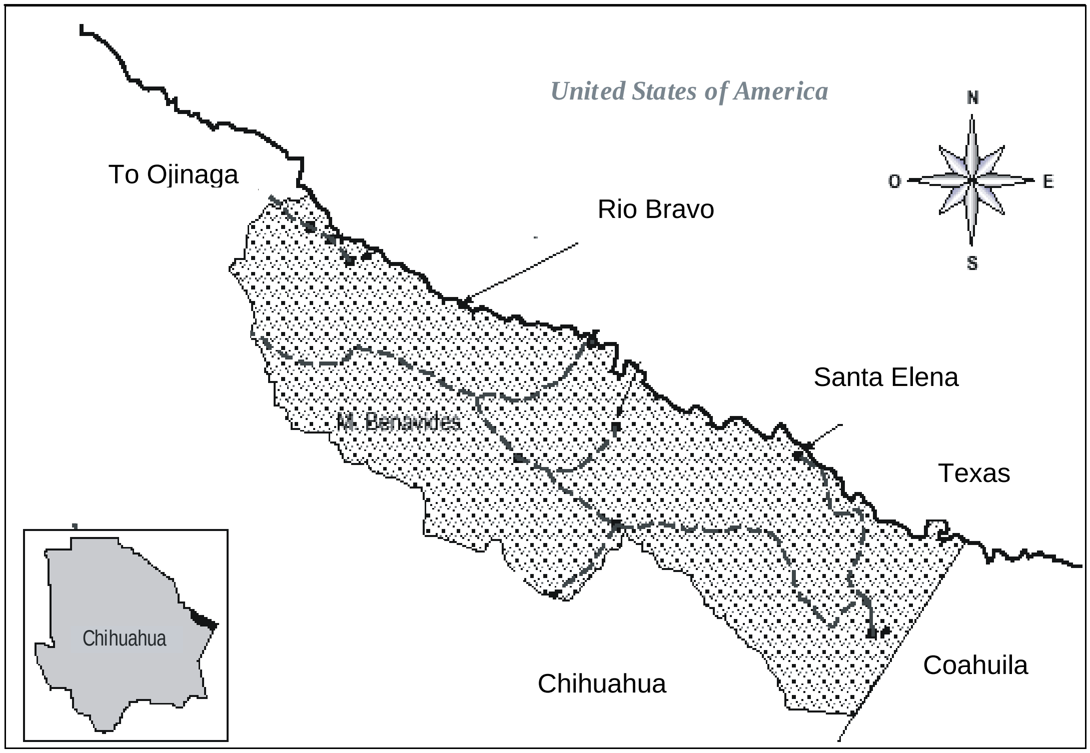

Figure 1. Geographic location of the Santa Elena Canyon, Chihuahua, Mexico.

composed by a 30% of valleys, 60% of mix and 10% on mountainous terrain.

Social analyses

We applied surveys and semi standard interviews to the ranchers in selected properties. Also, we organized two local workshops and participative meetings (Contreras 1999). We employed SPPS for Windows (SPSS Inc.) V.10 to test the social hypothesis with a non-parametric lineal correlation analyses by Spearman ranks (Zar 1999).

Economical analyses

We established three sources of livestock looses in each property: to cougars, to other animals and to other factors, such as drought, robbery and birth complications. A Chi-square analysis by contingency tables subdivision was used to detect differences between ranches and among properties and communal lands. The cougar impact was expressed in 3 different ways: a) the predated proportion of the total flock, b) the proportion of the total looses and c) the economic increase of the incomes without cougars.

Biological analyses

We asked about kill features to know the cougar predation pattern. Also, a livestock census was used to determine any cougar preference throughout a Chi-square goodness of fit test and Bonferroni intervals analyses (Zar 1999; Byers et al. 1984).

We used a PCA (Zar 1999) to identify the key variables and we create three groups to explain the cougar predation events: biotic factors (23 variables), abiotic factors (3 variables) and husbandry practices (22 variables). A standardized index from each variable was created to compare it against a cougar looses index in each ranch. We employed multiple regression and correlation analyses between these two indexes in SPSS and Statistica (StatSoft, Inc.). To detect differences between ranches with and without cougar looses we used t-Student and U-Mann Whitney tests (Zar 1999).

RESULTS

We interviewed 93 ranchers, 71 ejidatarios and 22 small owners in the SEC over 6 months, resulting in 46 sampled ranches (44% of the total area). These properties were located on valley (30%), mix (58%) and mountainous terrain (12%).

Perceptions and attitudes

Most of the Santa Elena Canyon ranchers think cougar as the most harmful animal to the livestock industry, but they feel that coyotes are even worse. However, some positive values are assigned to cougar, for example controlling harmful species, such as coyote. Producers believe to be affected by cougar predation because it diminishes the livestock production, threatens their personal security and limits the game species growth. Until now, no human attack has been registered in the study site. The methods used for cougar combat are diverse, depending on the land use and conditions of each rancher; most of the small owners use lethal measures while the ejidatarios drive away cougars. Only 6% of the producers try to increase their flock's protection.

The hypothesis for the cougar-rancher relationship was fulfilled partially, since only hostile attitudes agreed with the awaited result [n=81; R-Spearman=-0.2; t(n-2)=-1.19; P=0.08] meaning that control cougar actions were independent of the cougar economic impact.

We found that negative perceptions were related to cougar impact [Spearman by Ranks test; n=93; R-S=0.31; t(n-2)=3.13; P=0.002]. Also, we found no differences of perceptions and attitudes between small owners and ejidatarios (Mann-Whitney U test; U=739; P=0.70; U=545).

Cougar economic impact

About 100 livestock heads were reported as predated by cougars during 2000-2002 totalizing $13,700 dollars ($4,566 per year; Figure 2), with no differences between years [Kruskal Wallis test, H (2,N=279) =5.41, P=0.07]. Cougar predation affected 16 ranchers with a mean lose of $285 dollars/year; however, the global economic lose in the SEC was about $49 dollars/ rancher/per year (n=93). Only 26% of total kills were cattle, although it represented the greatest economic lose (63%). Small owners were significant most affected than ejidatarios in monetary terms.

We registered 657 livestock heads predated in the SEC by other animals but the cougar; this account for $38,750 dollars and a mean of $137 dollars/rancher/ per year during 2000-2002 (n=93). Coyote was the most destructive predator with 98% of the total loses, and goats were the most predated livestock (n=574; 87.4%). Both, small owners and ejidatarios suffered very similar livestock loses to other animals in the study period.

We found 771 missing livestock heads in the SEC due to other factors but predation totalizing $105,666 dollars. Drought (38%), robbery (32%) and sickness (16%) explained together most of the total livestock loses. We detected differences between the three livestock loses factors in the SEC, both in numerical and monetary terms.

The several cougar impact expressions showed a minimal effect on the SEC livestock industry: cougar predation reached just 1.9%±0.8% (mean±SE; n=93) of the flock size; the rancher's economic capital was affected in 0.94%±0.45% (0%-24%); loses by cougar predation was 8% of the total livestock loses; the potential economic increase without cougars was 1.3% ($64.8 extra dollars/rancher/year). Ejidatarios were more affected than small owners due cougars.

Factors related with cougar predation

The predation pattern showed that cougars prefer horses and avoid goats ($\chi2$=37.84, 4 d.f., P<0.001). Calves, donkeys and mules were predated according to their availability. Most of the horses and calves attacked ranged from 0 to 6-months-old, while goats ranged from 9 to 12-months-old. We found that 70% of kills were females, although there is no evidence of preference.

We detected a significant and positive relationship between the cougar kills and the abiotic and biotic factors (Adjusted $R2$=0.42, P<0.01), specifically between the relative cougar abundance and the forest percentage (R Spearman=0.48, P=0.049). Also, we noted a close relationship between cougar predations and the amount of mountainous percentage in each property (Adjusted $R2$=0.53, P=0.004). This was also observed with the preference to attack in rugged topography ($\chi2$=55.03, 2 d.f., P<0.05), while predation events on valleys and mix terrains were according to their availability. There was no evidence of relationship between husbandry variables and cougar predation (P=0.56).

DISCUSSION

Santa Elena settler's perception of cougar is highly negative, originated mainly because of livestock predation and in smaller proportion, because of the fear of human attacks. Nevertheless, certain positive values are recognized to cougar, based on the belief of its role as harmful species regulator. Hostile actions towards this species were independent of the evaluated impact, showing that human answer to this conflict is excessive.

Cougars are considered a problem fleeting that will become important according to the season and the producer's particular condition. However, it is not the most serious problem for the local livestock industry. Still, the response of the ranchers is to try to eradicate it, although they are limited by the cougar elusive biology and the economic investment that its combat requires.

The economic analyses showed that cougar predation is not a real cause of concern among the local producers. Mazzolli et al. (2002) found in Brazil that cougar predation represented just 0.27% ($1,890 dollars) of the total size flock, while loses to other causes were 12 times bigger; in our analyses loses but cougar predation were 11 times bigger.

Although we observed a low cougar economic impact in the study site, this could be significant if the damaged resource is the main way of living. In Africa, Mishra (1997) found that carnivores consumed the 18% of the heard, representing the 50% of the rancher's mean annual income. These figures are higher than in the SEC, although we found one producer who suffered up to 67% of his total flock.

Local livestock industry producers earn about $3 dollars/ha/year, while cougar's actions cost only $0.03 dollars/ha/year. This

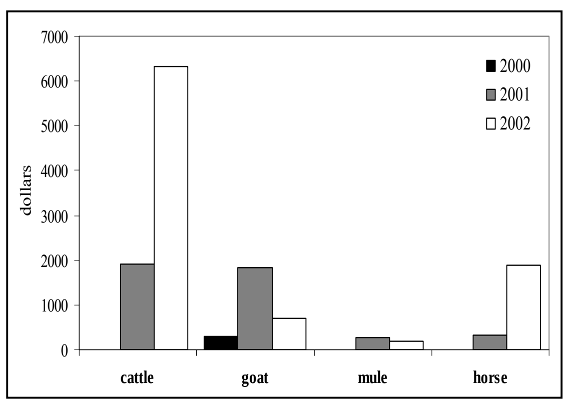

Figure 2. Cougar livestock predation losses during 2000-2002 in the Santa Elena Canyon, Chihuahua, Mexico

low cost is not tolerated, even if it represents 1% “paid to the ecosystem” for livestock practices. Mizutani (2001) observed in Kenya that settler’s were more tolerant to predators actions, paying $1.2 dollars/ha/producer.

The cougar livestock predation pattern in the SEC was similar to other studies (Almanza 2002; Hornocker 1970). According to Shaw (1990) the prey size plays an important role in the attack’s probability, for example cougar attacks to adult horses are rare, but attacks to colts are more frequent because of their vulnerability, pattern also known as “Bambi syndrome” (Linell et al. 1995). Shaw (1981) registered in Arizona that 93% of the cougar cattle predated ranged between 3 and 6 months old, a very similar data with SEC. It is also recognized that cougar searches “deer kind preys” (Shaw 1990), such as the young horses preferred in our study. The physical condition of the attacked animals in the SEC were classified as good, however there is no agreement in this topic; some authors think livestock predated is a reflect of their availability (Anderson 1983; Shaw 1977), whereas there is a strong popular belief that cougar predation improves prey’s population health (Johnson and Gartner 1975).

Relative cougar abundance in each property was related to the predation events in the SEC. Torres et al. (1996) in California showed a strong positive relationship between cattle predation and cougar abundance. However, in the SEC ranches this could be a bias in the sense that an affected producer perceives more cougars than an unaffected one. More over, some authors argue that predation is more a cattle availability function than predator’s density in a zone (Bogges et al. 1978; Clevenger et al. 1994; Landa et al. 1999).

Mountainous terrain was preferred as cougar predation site, result also found in many studies because of its advantages in cougar hunting strategy (Anderson 1983; Cajal and Lopez 1987).

Surprisingly, we had no evidence from a positive relationship between cougar predation and husbandry practices in the SEC. This could be explained due to very similar husbandry practices among producers in the whole area, with and without cougar predation; indeed also could show a lack of deeper social analyses in these productive units. According to Ackerman et al. (1984) and Gurung et al. (1997) the low livestock predation rate is due to good husbandry practices, however high loses is result of the opposite management (Shaw 1977).

MANAGEMENT IMPLICATIONS

It is necessary to reinforce the environmental education programs in the area in order to modify attitudes and perceptions with nonbiased information on cougars. This will be useful to increase the ranchers' tolerance to wildlife and some of its effects (Conover 2002).

Ranchers need to act according to a property diagnosis: those ranchers located on valleys just need to increase their tolerance as they have no cougar livestock predation risk; those located on mix terrain need to avoid the pasture on rugged portions; the highest risk is in ranches on mountainous terrain, where pasture must be on moderated slopes and vigilance should increase. Ranchers also need to avoid pasturing on dense vegetation cover areas, such as forest. Another management strategy is to act according to a livestock type diagnosis: goat flocks have less risk than any other livestock, so ranchers could change their livestock composition; mature cattle and horses do not need protection, however with young horses and calves ranchers should increase vigilance, especially during birth season.

Social techniques, including surveys and interviews were important tools to better understand cougar predation and its effects on the human population in Santa Elena. These methods should continue although they must be seen as complementary to other analyses.

We need to recognize that the biological systems are dynamics, and these recommendations must be modified as other variables, including humans change with the times. Ideally, cougars and some damage levels should be tolerated as part of the livestock industry process (Bruggers and Zaccagnini 1994).

As Logan and Sweanor (2001) point out, the challenge to wildlife managers is to consider all this factors and to balance the local owner's current needs with the cougar's conservation and management.

ACKNOWLEDGMENTS

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LITERATURE CITED

ACKERMAN, B., F. LINDZEY, AND T. HEMKER. 1984. Cougar food habits in Southern Utah. Journal of Wildlife Management 48(1): 147-155

ALMANZA, F. 2002. Depredación de animales domésticos por grandes felinos en zonas rurales de Costa Rica. Programa Regional en Manejo de Vida Silvestre, Universidad Nacional Heredia, Costa Rica.

AMIN, M. G., CEBALLOS AND C. CHAVEZ. 2002. Patrones de alimentación y disponibilidad de presas del jaguar (Panthera onca) y del puma (Puma concolor) en la Reserva de la Biosfera Calakmul, Campeche, México. Memoria de resúmenes. VI Congreso Nacional de Mastozoología, Oaxaca.

ANDERSON, A. 1983. A critical review of literature on Puma (Felis concolor). Special Report Number 54. Colorado Division of Wildlife (Wildlife Research Section). Fort Collins, Colorado, USA.

ARANDA, M. AND V. SANCHEZ-CORDERO. 1996. Prey spectra of jaguar (Panthera onca) and puma (Puma concolor) in tropical forests of Mexico. Stud. Neotrop. Fauna and Environment 31: 1-3

AVILA-VILLEGAS, S., R. MARTINEZ-GALLARDO, A. BUENO-CABRERA, AND J. ALANIZ-GARCIA. 2000. Impact of cougar on livestock in Sierra San Pedro Martir, Baja California, Mexico. Page 77 *in* L. A. Harveson, P. M, Harveson, and R. W. Adams, editors. Proceedings of the Sixth Mountain Lion Workshop, San Antonio, Texas, USA

BOGGESS, E., R. ANDREWS, AND R. BISHOP. 1978. Domestic animal losses to coyotes and dogs in Iowa. Journal of Wildlife Management 42: 362-372

BRUGGERS, R. AND M. ZACCAGNINI. 1994. Vertebrate pest problems related to agricultural production and applied research in Argentina. Vida Silvestre Neotropical 3(2):71-83

BUENO-CABRERA, A. 2001. Hábitos alimentarios del puma (Puma concolor) en la Sierra San Pedro Mártir Baja California, México. Tesis de licenciatura en Biologia. Universidad Autónoma de Puebla.

BYERS, C. R. STEINHORST, AND P. KRAUSMAN. 1984. Clarification of a technique for the analysis of utilization-availability data. Journal of Wildlife Management 48:1050-1053

CAJAL, J. AND N. LOPEZ. 1987. El mayor carnívoro de los Andes: el puma. Revista Chilena de Historia Natural.

Cannell, C. and R. Kahn. 1993. La reunión de datos mediante entrevistas. In Festinger L. and D. Katz. Los métodos de Investigación de las Ciencias Sociales. México.

CARRILLO, S. AND C. LOPEZ-GONZALEZ. 2002. Abundancia, uso de hábitat y patrones de actividad de jaguares (Panthera onca) y pumas (Puma concolor) en la región serrana central de Sonora. VI Congreso Nacional de Mastozoología, Oaxaca.

CLEVENGER, A., M. CAMPOS, AND A. HARTASANCHEZ. 1994. Brown bear Ursus arctos predation on livestock in the Cantabrian Mountains, Spain. Acta Theriologica 39: 267-278

CONOVER, M. 2002. Resolving Human-Wildlife Conflicts: The Science of Wildlife Damage Management. Lewis Publishers, Boca Raton, Louisiana, USA.

CONTRERAS, A. 1999. ¡Dicen los ganaderos!: taller para el cuidado de la Dehesa. Instituto de Sociología, Estudios Campesinos y Sociedad Cooperativa Andaluza Corpedroches. España.

GURUNG, M. K., C. RICHARDS, AND S. ALE. 1997. Livestock depredation in a typical middle mountain village community, in the Annapurna conservation area project. Abstracts of oral and poster papers. 7th International Theriological Congress. Acapulco, México, 6-12 Septiembre.

Hernandez, L. and J. Laundre. 2000. Status of the puma in the Mexican Chihuahuan Desert. Page 60 *in* L. A. Harveson, P. M, Harveson, and R. W. Adams, editors. Proceedings of the Sixth Mountain Lion Workshop, San Antonio, Texas, USA

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

Instituto Nacional de Ecología, SEMARNAT AND UNAM. 2002. Inventario Nacional Forestal 2000. Base de datos geográficos en formato digital.

Instituto Nacional de Ecología. 1997. Programa de Manejo del Área de Protección de Flora y Fauna Cañón de Santa Elena, México. 1ra. Edición.

INSTITUTO NACIONAL DE ESTADÍSTICA, GEOGRAFÍA E INFORMÁTICA. 2000. XII Censo General de Población y Vivienda 2000. Chihuahua: Perfil Sociodemográfico.

JOHNSON, J. AND F.R. GARTNER. 1975. Perspectivas en el manejo de depredadores. Selecciones del Journal of Range Management IV (2): 271-274. Programa Nacional de Mejoramiento de Pastizales. Secretaría de Agricultura y Ganadería, México.

KELLERT, S.R. 1985. Public perceptions of predators, particularly the wolf and coyote. Biological Conservation 31: 167-189

LANDA, A., K. GUDVANGEN, J. SWENSON, AND E. ROSKAFTS. 1999. Factors associated with wolverine (Gulo gulo) predation on domestic sheep. Journal of Applied Ecology (36): 963-973

LINELL, J., M. SMITH, J. ODDEN, P. KACZENSKY, AND J. SWENSON. 1996.

Carnivores and sheep farming in Norway. 4. Strategies for the reduction of carnivore-livestock conflicts: a review. NINA. Oppdragsmelding 443: 1-116

LINNELL, J., R. ANNES, AND R, ANDERSEN. 1995. Who killed bambi? The role of predation in the neonatal mortality of temperate ungulates. Wildlife Biology 1:4, 209-3

LOGAN, K. AND L. SWEANOR. 2001. Desert Puma: Evolutionary Ecology and Conservation of an Enduring Carnivore. Island Press, Washington, D.C., USA.

LOREDO, J. 2003. Evaluación de los componentes de hábitat que afectan la abundancia de pumas en el Desierto Chihuahuense a través de un análisis comparativo. Tesis de maestría en Manejo de Fauna Silvestre. Instituto de Ecología, A.C. Xalapa, México.

MAZZOLI, M., M. GRAIPEL AND N. DUNSTONE. 2002. Mountain lion depredations in Southern Brazil. Biological Conservation 105: 43-51

MCBRIDE R. 1976. The status and ecology of the mountain lions Felis concolor stanleyana of the Texas-Mexico border. Thesis, Sul Ross University, Alpine, Texas, USA.

MISHRA, C. 1997. Livestock depredation by large carnivores in the Indian trans-Himalaya: conflict perceptions and conservation prospects. Environmental Conservation 24(4): 338-43

MIZUTANI, F. 2001. Trends of livestock losses to predators over the last 30 years on the Lolldaiga Hills ranch in Laikipia, Kenya. Scientific program and abstracts. 8th. International Theriological Congress. Sun City, South Africa.

NUNEZ, R., B. MILLER AND F. LINDZEY. 2000. Food habits of jaguars and pumas in Jalisco, Mexico. Journal of Zool. Lond. 252: 373-379. The Zoological Society of London.

SHAW, H.G. 1977. Impact of mountain lion on mule deer and cattle in northern Arizona. Pages 17-52 *in* Phillips R.L and C.J. Jonkel, editors. Proceedings of the 1975 predator symposium. Montana Forestry And Conservation Experiment Station, University of Montana, Missoula, Montana, USA.

SHAW, H.G. 1981. Comparison of mountain lion predation on cattle in two study areas in Arizona. Pages 306-318 *in* Proceedings of Wildlife-Livestock Relationships Symposium, Forestry, Wildlife and Range Experiment Station, University of Idaho, Moscow, Idaho, USA.

SHAW, H.G. 1990. A mountain lion field guide. Arizona Game & Fish Department, Special Report Number 9. 4th. Edition.

SMN. 2000. ERIC II. Base de datos climáticos para la República Mexicana. CLICOM, Instituto Mexicano de Tecnología del Agua. Quintas I. y D. Ramos.

TORRES, S., M. MANSFIELD, J. FOLEY, T. LUPO AND A. BRINKHAUS. 1996. Mountain lion and human activity in California: testing speculations. Wildlife Society Bulletin 24(3): 451-460

ZAR, J. 1999. Biostatistical analysis. Fourth edition. Prentice Hall, New Jersey, USA.

ASSESSING PUMA DEPREDATION RISK IN CALIFORNIA'S WESTERN SIERRA NEVADA

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Mountain Lion Workshop 8:150

Abstract: Puma (*puma concolor*) represent an upper trophic level species whose habitat needs coincide with those of many species, and that commonly experience conflicts with humans as rural landscapes become developed. In California, incidents of puma depredation on domestic animals have increased fairly steadily since 1972. Removal of depredating individuals constitutes the major source of human-induced mortality for California’s puma, which are not hunted. On the western slope of the central Sierra Nevada, residential development is rapidly expanding within puma habitat and the majority of recent depredations were found to occur in urban interface areas. To determine whether factors predicting risk of puma depredation could be identified and potentially minimized, we sampled properties that had experienced a mountain lion depredation during 1999-2004 (n=40), and properties that contained outdoor domestic animals but had not experienced a depredation (n=40). We documented a range of geographic, operational, animal husbandry, and structural features potentially related to depredation. Stepwise logistic regression was used to identify factors and combinations of factors that helped predict occurrence of puma depredation. Results can be used to provide recommendations for minimizing puma depredation risk and to evaluate causes of conflict.

PRACTICAL METHODS FOR REDUCING DEPREDATION BY MOUNTAIN LIONS

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Mountain Lion Workshop 8:151

Abstract: Mountain lion depredation on domestic livestock and pets is of great concern to many individuals and communities. For the last five years, the Mountain Lion Foundation has explored practical community-based methods for reducing mountain lion depredation across a variety of landscapes and human demographics. A review of the scientific literature reveals relatively little hard data regarding the efficacy for various methods of depredation avoidance. Methods such as fencing or enclosure of domestic animals, shed-birthing, lighting, frightening devices, herding, guard animals, corridor redirection, and harassment are detailed. Variables of mountain lion behavior and biology, which may affect the value of these methods, are explored, and the social, economic, and legal challenges to implementation are considered. An outline for research is provided, along with sample forms and a database for detailed mountain lion depredation accounting.

CHANGES IN MOUNTAIN LION (*PUMA CONCOLOR*) DIETS FOLLOWING INCREASED HARVEST OF THE PREDATOR AND REMOVAL OF CATTLE

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Mountain Lion Workshop 8:152

Abstract: We studied mountain lion (*Puma concolor*) diets in association with increased sport harvest of the predator and removal of cattle in the Sonoran Desert of central Arizona from 1999 to 2003. Diets shifted from initially about equal use of biomass of large (cattle, collared peccary [*Pecari tajacu*], deer [*Odocoileus* spp.], desert bighorn sheep [*Ovis canadensis*]) and small prey (rabbits and rodents) to predominantly large wild prey, particularly collared peccary, and diet diversity declined >50%, following increased mountain lion harvest and removal of cattle. Reduced intraspecific interference and higher ratios of large prey per predator ostensibly might explain observed changes in mountain lion diets.

Predator-Prey Interaction

IMPACT OF PUMAS ON THE RECOVERY OF A POPULATION OF MULE DEER IN SOUTHERN IDAHO

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Mountain Lion Workshop 8:155

Abstract: Mule deer (*Odocoileus hemionus*) populations in many western states declined between 40 to 60 % over the winter of 1992-93. To date, over 10 years later, these populations have not recovered significantly in many areas. One of the major factors being blamed for the lack of recovery is predation by pumas (*Puma concolor*). This assumption has driven puma harvest policies in many states to reduce puma numbers to aid deer recovery. We have estimates of puma numbers in our study area for 15 years (1988-2002), which encompassed the deer decline. We also have estimated deer consumption rates for pumas. We coupled these data with data from Idaho Fish and Game reports on deer numbers and other published studies to test if pumas were preventing the recovery of deer in our study area. Puma numbers in our area between 1992 and 2002 ranged from 12 to 21 adult animals. Predation rates of pumas on mule deer varied from 246 to 443 deer/year. These predation levels were approximately 2.0% of the deer population before the decline and 4.0 % after the decline. Our estimation of the impact of pumas on mule deer recovery demonstrated that pumas, even at unusually high densities (. 3 pumas/100 km^2), will only slow recovery by 2-3 years and not suppress deer numbers. We found positive regression relationships of the percentage of winter mortality of fawns ($r^2 = 0.62$, $P < 0.001$) and adult female deer ($r^2 = 0.68$, $P < 0.001$) with December-January snowfall. When incorporated in our calculations, these relationships produced a pattern of deer population change that closely matched estimates from our study area based on field survey data. When we artificially reduced puma numbers by 50%, we found it did not help recovery and deer numbers still declined in years of above average winter snowfall. We concluded that pumas were not contributing to the suppression of deer numbers after the decline of 1992-93. The main causative factor preventing recovery of deer in our area was winter snowfall. The management implications of these results will be discussed.

CASCADING EFFECTS OF SUBSIDIZED MOUNTAIN LION POPULATIONS IN THE CHIHUAHUAN DESERT

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Mountain Lion Workshop 8:156

Abstract: The primary proximate cause of mortality in 4 recently extinct or nearly extinct desert bighorn sheep (*Ovis canadensis mexicana*) populations in New Mexico has been mountain lion (*Puma concolor)* predation. This has occurred in habitats with native ungulate densities hypothesized to be insufficient to maintain resident mountain lion populations. Mountain lions in the Chihuahuan desert ecosystem are a subsidized predator, with domestic livestock the principal subsidy. We hypothesize that the ability to prey switch from native ungulate prey to domestic livestock or exotic wild ungulates may result in an artificially high density of mountain lions. Livestock prey reduces the probability of starvation in mountain lions when native ungulate populations decline to low numbers. This may result in an inversely density dependent mortality rate in desert bighorn populations. The high proportion of cattle in the diets of mountain lions in Arizona (Cunningham et al. 1999) is the basis for this hypothesis. Similar data on the proportion of cattle in mountain lion diets in New Mexico are lacking. However considerable livestock predation is reported and a high percentage of mountain lions harvested in the Chihuahuan desert are pursued from livestock kills. The potential cascading effects of a subsidized predator include population level impacts on alternate prey. In much of the Chihuahuan desert, mule deer (*Odocoileus hemionus*) populations have declined drastically and lion predation has become an additive mortality factor. Another native mammal, porcupine (*Erethizon dorsatum*), was reported to be relatively common less than 30 years ago but appears to have been nearly extirpated from southwestern New Mexico. Empirical data correlates the substantial decline of porcupines with a hypothesized increase in mountain lions in southwestern New Mexico during this time period. Evidence implicating mountain lion predation in the decline of porcupines is lacking in New Mexico. However, the near extirpation of porcupines by mountain lions in a Nevada mountain range (Sweitzer et al. 1997) suggests that this may have occurred in southwestern New Mexico. Numbers of mountain lions harvested, in an effort to protect state endangered desert bighorn sheep, suggest that historical sport harvest in the Chihuahuan desert is an ineffective method for reducing subsidized mountain lion populations.

PREY SELECTION AND FUNCTIONAL RESPONSE OF COUGARS IN NORTHEASTERN WASHINGTON

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Abstract: We investigated prey selection of cougars in northeastern Washington during 2002-2004, where sympatric white-tailed deer and mule deer are the available primary prey. We also tested two competing predation hypotheses, the "prey switching" hypothesis, and the "apparent competition" hypothesis. White-tailed deer comprised the greatest proportion of cougar kills (60%) and prey population (70%) across the study area; however use/availability results in all cases show either selection for mule deer or neutral selection. 2^{nd} and 3^{rd} order selection results indicate that cougars select for mule deer across the entire study area ($p = 0.05$ and $p = 0.07$), however within the study area, selection varies geographically. We detected strong seasonal fluctuations in selection, with cougars strongly selecting for mule deer in summer ($p = 0.02$), but showing neutral selection during winter ($p = 0.49$). Mean annual functional response of cougars was 6.68 days per deer kill. Kill rates did not differ between seasons ($p=0.78$) or deer species ($p = 0.58$), and we found no differences in habitat characteristics between white-tailed deer and mule deer kills. These findings are consistent with the apparent competition hypothesis, suggesting that the mule deer decline, although directly attributed to cougars, is ultimately caused by an abundance of invading primary prey (white-tailed deer).

COUGAR PREDATION IN THE FLAGSTAFF UPLANDS: PRELIMINARY RESULTS FROM JULY 2003-MAY 2005

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Abstract: Predation rates and prey composition are relevant to judging effects of cougars (*Puma concolor*) on ecosystems. Radiocollars that frequently obtain and satellite-transmit GPS locations provide researchers with unprecedented opportunities to collect sustained reliable information on cougar predation. We fitted 7 cougars (3 adult males and 4 adult females) in the Flagstaff uplands of Arizona with Telonics GPS/Argos radiocollars and collected information from 115 kills made by these animals between July 2003 and May 2005. We also obtained a comprehensive record of movements based on 4-hour-interval GPS locations from collars deployed on and dropped by 2 adult males and 2 adult females. Overall, 45% of kills were elk (*Cervus elaphus*), 34% were deer (*Odocoileus* spp.), and 21% were smaller mammals. Elk <1-year-old comprised the largest single category of kills (25%). Compared to adult females, adult male cougars killed more elk (71% versus 38%) and fewer small mammals (3% versus 34%). Two female cougars killed a total of 18 mesocarnivores (28% of all female kills), of which 16 were coyotes (*Canis latrans*). Almost all kills (93%) occurred between 1700 and 1100 hours and were most frequent (69% of kills) between 2100 and 0500 hours. The probability that large prey (adult deer and elk calves or larger) had been killed exceeded 0.50 when a cougar was more-or-less stationary for >39 hours. The probability that no kill had occurred exceeded 0.50 when a cougar was stationary for >4 but <22 hours. Considering only large prey, intervals between kills were 7.8 and 9.9 days for the 2 adult males and 12.1 and 15.6 days for the 2 adult females. Including small prey, intervals for the females were 6.7 and 8.4 days. Mean time spent consuming large prey was 2.4 and 3.4 days for the male cougars and 4.3 days for both female cougars. The females averaged 1.3 and 1.6 days consuming small prey. Our future objectives for this study include collecting more of the types of information summarized here as well as an analysis of habitat features associated with successful predation.

Mountain Lion Workshop 8:158-169

INTRODUCTION

Information on cougar (*Puma concolor*) predation is potentially germane to a number of management issues. Times and locales preferred for hunting are clearly relevant to assessing and managing the risks to humans that are increasingly of concern to managers. Under certain circumstances, cougar predation can limit bighorn sheep (*Ovis canadensis*), have potentially deleterious impacts on vulnerable pronghorn (*Antilocapra americana*), and potentially regulate mule deer (*Odocoileus hemionus*) and other ungulate populations (Ockenfels 1994, Hayes et al. 2000, Logan and Sweanor 2001, Robinson et al. 2002, Rominger et al. 2004). Although not yet tested or demonstrated, these direct effects on populations of herbivores potentially translate into indirect effects on vegetation structure and composition. Indirect effects could also be engendered by cougar predation on mesocarnivores such as coyotes (*Canis latrans*; Boyd and O'Gara 1985). However, despite this multitude of potential effects and the fact that cougars are the most abundant of large predators in the western United States, we know comparatively little about cougar predation and its impacts on ecosystems (Logan and Sweanor 2000). Much of this dearth is attributable to lack of attention and resources, but much is also attributable to the difficulty of studying this cryptic low-density species.

Methods for studying cougar diet and predation have steadily improved since the 1940s. Early studies relied primarily on anecdote, the analysis of opportunistically collected feces, or contents of stomachs from hunter-killed animals (e.g., Robinette et al. 1959, Spalding and Lesowski 1971). Beginning in the 1960s, researchers began using ground-based radiotelemetry, often in combination with snow tracking, to systematically study kills and kill sites (e.g., Hornocker 1970). These methods were pushed to their limits by researchers in southern California, southern New Mexico, Alberta, and the Yellowstone ecosystem (Murphy et al. 1992, Beier et al. 1995, Ross and Jalkotzy 1996, Logan and Sweanor 2001, Ruth 2004). Even so, these more recent intensive and often grueling studies yielded only partial pictures of predation. Kill rates, diel timing of kills, time spent consuming kills, and differences among sex and age classes remained only sparsely sampled, or reliably known from only one or two study areas. The recent incorporation of GPS technology into telemetry collars introduced the potential for comprehensive year-long round-the-clock records of cougar movements which have so far been demonstrated in one study reported from Wyoming (Anderson and Lindzey 2003).

There are a number of issues involving cougars in the Flagstaff Uplands of north-central Arizona, including threats to human safety, impacts of humans and human infrastructure on movements, effects of different management regimes (e.g., National Park versus non-park) on populations, and effects of predation, especially on several small isolated populations of pronghorn. Information on predation is obviously germane to understanding impacts on prey in this region, and also relevant to managing for human safety. Moreover, the natural history of cougar predation is a potentially compelling centerpiece for public outreach designed to educate and raise awareness. We deployed newly developed technology on cougars in the Flagstaff Uplands that coupled satellite delivery of data with GPS-based telemetry, allowing us to document round-the-clock movements and collect detailed information on predation. Our goals for investigation of predation were to determine: (1) diel timing of kills; (2) kill rates, durations of consumption, and prey composition by cougar sex, age, and reproductive class; (3) the likelihood that kills were of small and large prey as a function of durations of localized movements; and (4) selected features of kill sites. In this paper we present a preliminary analysis of predation in our study area using data collected during July 2003-May 2005. A complete analysis will be presented after conclusion of scheduled fieldwork in late 2009.

STUDY AREA AND METHODS

Our 2500 km^2 study area is centered on the city of Flagstaff, Arizona, at 35° 10'N latitude and 111° 35' W longitude, primarily between 1800 and 2150 m elevation. Our study area encompasses the San Francisco Volcanic Field, including the San Francisco Peaks (topping at 3850 m elevation) and numerous cinder cones, as well as extensive plateaus incised by comparatively small steep-sided canyons north of the Mogollon Rim. Vegetation grades from grasslands and saltbrush (*Atriplex* spp.) scrub at lowest elevations, up through pinyon pine (*Pinus edulis*) and juniper (*Juniperus utahensis* and *J. monosperma*) woodlands, through ponderosa pine (Pinus ponderosa) forest, and into mesic mixed forests typified by Douglas-fir (*Psuedotsuga menziseii*), white fir (*Abies concolor*), and white pine (*Pinus strobiformis*) at the highest elevations commonly used by cougars. Roughly 60,000 people lived within Flagstaff city limits, although as many as 100,000 lived within our broader study area. There are no reliable estimates for populations of cougar prey, although our study area supports substantial numbers of mule deer and elk (*Cervus elaphus*), blacktail jackrabbit (*Lepus californicus*) and desert cottontail (*Sylvilagus auduboni*), and coyotes, bobcats (*Lynx rufus*), and badgers (*Taxidea taxus*). Whitetail deer (*O. virginianus*) are rare and javelina (*Pecari angulatus*) present but not abundant. Pronghorn are present and semi-isolated in small patches of grassland scattered throughout the predominantly forested study area.

Field Methods

We pursued and collared cougars within three capture areas located (1) on the north slopes of the San Francisco Peaks, (2) immediately north of Flagstaff between highways 180 (State) and 89A (United States), and (3) on or near Anderson Mesa southeast of Flagstaff and Walnut Canyon National Monument. We used snares and hounds to restrain or bay cougars and either Telazol® or Ketaset-Rompun® (with Yohimbine antagonist) for subsequent sedation and anesthetization. In all but one instance we fitted cougars with 880g-weight Telonics® TGW-3580 collars fitted with a VHF beacon, GPS locational device, and Argos satellite transmitter. We fitted one cougar with a VHF-only collar, and do not include data from this animal in our analysis. Our collars were programmed to attempt a 2–20-m accuracy GPS location once every 4 hours. Collars were also programmed to attempt transmission of the most recent 6 GPS fixes via Argos satellites once daily, for most collars during a 4-hour evening window. Successfully transmitted data were relayed through Argos Inc. to us within 12 hours, embedded in an email message. We converted these data into decimal degree fixes and plotted them on USGS 1:24,000 topographic maps for assistance in field investigations.

We identified all clusters of ≥2 GPS locations <200 m apart as candidate for investigation (Anderson and Lindzey 2003). These clusters represented, at a minimum, 4 hours of cougar activity within a localized area. We attempted to visit clusters within 10 days of when cougars had departed. We were not able to visit all such clusters because data transmission failures did not allow us to identify some in a timely manner and, more commonly, because of lack of time and personnel. Under such circumstances we prioritized visiting clusters of ≥4 locations, representing a minimum of 12 hours of localized activity. We did not visit even some of these longer-duration clusters within 10 days of a focal animal's departure, primarily because of data transmission failures. However, we did visit all such clusters once a collar had been retrieved, the complete collection of data downloaded, and clusters comprehensively identified. Under these circumstances field visits occurred between 1 and 18 months after they had occurred.

We investigated the vicinity of GPS location clusters to document site characteristics, cougar activity, and characteristics of prey, if present. We used a Magellan handheld GPS unit with up to 3 m accuracy to navigate to clusters. Of relevance to this analysis, we determined a kill based on the presence of animal remains, diagnostic physical trauma, and/or evidence of a struggle (e.g., blood, torn ground, broken branches, snagged hair). We determined scavenging in instances where we found animal remains, but together with often substantial sign of especially avian scavengers and no evidence of a struggle. We mapped and measured distances (in m) between activity features, including kill site, burials, latrines, and bed sites. We paced drag trails to estimate total distances and measured length and width of burials (in dm). Where possible, we identified prey to species and, for ungulates, aged animals on the basis of tooth wear and eruption (Anderson 1981, Bubenik 1982). We determined gender on the basis of remaining genitalia and, for ungulates, presence and development of antlers or horns. We could rarely determine species of Leporids, much less age and gender, because remains almost always consisted solely of hair. Remains of animals as large as adult deer also at times consisted of no more than hair and bone chips, even when sites were visited within 24 hours of abandonment by a cougar. Under such circumstances we judged age-class (fawn or yearling versus adult) on the basis of volumes of hair and sizes of burials.

Analysis Methods

We comprehensively documented clusters for individual animals using locational data downloaded from retrieved collars. All clusters of ≥2 points <200 m apart were distinguished, assigned a unique identifier, and ascribed a starting time and duration (in hours). Where field data were available, each cluster was also identified as being with or without a kill, and where a kill was present, identified with the prey type (by species, age class, and gender). Starting time was defined as that of the GPS fix initiating the sequence. Duration was defined as starting with the temporal midpoint between the initiating GPS fix and the fix immediately prior and ending with the temporal midpoint between the terminating GPS fix and the fix immediately following. We excluded long-distance (>400 m) excursions of ≥8 hours duration.

Because we did not visit all clusters to determine presence of a kill and prey type, we were faced with probabilistically assigning this information to unvisited clusters, especially where we were interested in determining kill rates. For purposes of this analysis we differentiated three states: no kill, kill of small-bodied prey, and kill of large-bodied prey. We defined small-bodied prey as being between 2 and 30 kg wet weight, including fawns, porcupines (*Erethizon dorsatum*), and all mesocarnivores. Large prey included all adult ungulates. We used logistic regression to specify relations between the log odds of each state and cluster duration (Anderson and Lindzey 2003). Of relevance to the explanatory power of cluster duration, we found little difference in the duration of time spent on kills of larger prey, including both deer kills (45-80 kg wet weight) and elk kills (100-400 kg; see results). We judged the explanatory and predictive power of our logistic regression models by area under the Receiver Operating Characteristic (ROC) curve (Hosmer and Lemeshow 2000). We determined probabilities (p values) by back-transforming the modeled logits.

We used our logistic regression models and data from visited clusters to assign kill states to unvisited clusters. We differentiated five classes of clusters, defining class boundaries according to durations where p = 0.5 (i.e., 50%) was predicted from models for no kill and kills of small-bodied and large-bodied prey. We calculated proportions of clusters in each state for each duration category from our observations at visited clusters. We then assigned unvisited clusters a state proportional to these results, depending on the corresponding category. Once this was done, we were able to tally total numbers of kills of small versus large prey for each animal. We calculated kill rates (hours per kill) by dividing total number of hours that an animal was monitored by number of kills, differentiating large kills from total kills, which included both large and small prey.

Given apparent differences between male and female cougars in duration of time spent on kills (see results), we pursued a preliminary analysis that considered a larger suite of factors. We developed a preliminary general linear model (GLM) that considered gender (class variable), size of prey (wet weight, considered as a single continuous value for each prey type), and mean ambient maximum and minimum temperatures for the month during which the kill had occurred (continuous value, but expressed as the long-term average for the month). We hypothesized that males would spend less time on a kill compared to females, and that duration would increase with prey mass and decrease with temperature. This last expectation followed from the greater expected wastage to micro-organisms and insects during warmer months (Hornocker 1970), and the greater potential for interference from competing scavengers with greater expected dissemination of scent under warmer conditions. We judged our model by R^2 and P values, but for lack of experimental control, without taking p-values as literally representing the probability of committing type I errors.

RESULTS

We deployed GPS/Argos collars on 7 adult or nearly adult cougars (3 males and 4 females) between July 2003 and December 2004. We collected predation data from these animals during this time, and on through mid-May 2005. We retrieved collars from 4 animals (2 males [C3 and C5] and 2 females [C2 and C4]) by mid-December 2004, obtaining complete records of movements that included location clusters. Durations of records totaled 7056, 3152, 7516, and 2620 hrs for cougars C2, C3, C4, and C5, respectively. We visited 115 clusters from these 4 animals and documented 47 kills of large prey, 17 kills of small prey, and 51 clusters with no kills. For all 7 animals, we documented a total of 115 kills, including 86 kills of large prey and 29 kills of small prey (Table 1).

Documented kills were more-or-less well distributed among mule deer, elk, and smaller mammals (Table 1). Adult mule deer comprised the largest proportion of kills (0.296), followed by elk <1 yr old (calf elk; 0.226), and undifferentiated coyotes (0.139). On a species basis, elk were most commonly killed (proportionally 0.452), followed by mule deer (0.339), followed by coyotes (0.139). Overall, mesocarnivores comprised 15.6% of all kills. In all but one instance the cougars consumed most of the flesh from mesocarnivore kills, the exception being a coyote where only the heart and lungs were eaten. Only 2 of the mesocarnivores were killed near an ungulate carcass. Completing the small prey, we also found 1 porcupine kill and 5 rabbit kills. As of May 2005, none of our collared cougars had killed a pronghorn, although they used areas occupied by this species.

Table 1. Composition of cougar prey (*n* = 115) identified at clusters of GPS locations visited during July 2003–May 2005 in the Flagstaff Uplands of Arizona, differentiating results for 3 male cougars from results for 4 female cougars.

		Male cougars		Female cougars	
Prey type	Mass (kg wet weight)[a]	n	Proportion	n	Proportion
Mule deer		9	0.257	30	0.375
Adult male	74	6	0.171	6	0.075
Adult female	59	1	0.029	7	0.088
Adult	67	2	0.057	12	0.150
Fawn		0	0.000	5	0.063
Elk		25	0.714	27	0.338
Adult male	325	3	0.086	4	0.050
Adult female	238	6	0.171	6	0.075
Adult	282	1	0.029	1	0.013
Calf	120	13	0.371	13	0.162
Scavenged adult	282	2	0.057	3	0.038
Small prey		1	0.029	23	0.338
Coyote	15.5	0	0.000	16	0.200
Badger	8.5	0	0.000	1	0.013
Bobcat	11.2	0	0.000	1	0.013
Porcupine	8.6	0	0.000	1	0.013
Rabbit	1.8	1	0.029	4	0.050

[a]Taken from Burt (1976), Anderson (1981), and Bubenik (1982).

We documented 5 relatively conclusive instances of scavenging involving 4 different cougars (Table 1). In one instance during mid-winter a male cougar scavenged a bull elk that was apparently frozen, accessing the rib cage and eating only the heart. In another instance two different cougars (1 male and 1 female) scavenged the same cow elk during late spring. The remaining two incidents occurred during spring, each involving a cow elk and single female cougars.

Proportional distributions of kills differed between males and females (Table 1). Fisher's Exact Test (P = 0.0000006) suggested it was highly unlikely we would have found this difference in prey composition simply by chance. Kills differed between the genders primarily by females accounting for virtually all of the small prey and by males accounting for proportionally more elk, especially calves and adult females.

Types of activity were strongly related to cluster duration (Figure 1). Area under the ROC curve was >0.9 for all 3 relationships associating activity with duration, suggesting exceedingly good predictive capability. The probability that a cougar had killed large prey exceeded 0.5 when a cluster had lasted approximately 39 hours, whereas the probability that a cougar had killed small prey peaked at 36 hours, after which it declined rapidly. The probability of no kill rapidly approached 0 between 10 and 40 hours duration and was at 0.5 when duration was approximately 22 hours. Applying these results to cougars C2-C5, we found that our sampling approach was biased against documenting small prey, especially for the 2 female cougars. Our corrected sample suggested that 30-60% of the kills by females were of small animals 2-30 kg wet weight. On the other hand, we documented virtually all of the kills of large prey.

Kill rates for large prey and time spent consuming kills differed between the 2 male

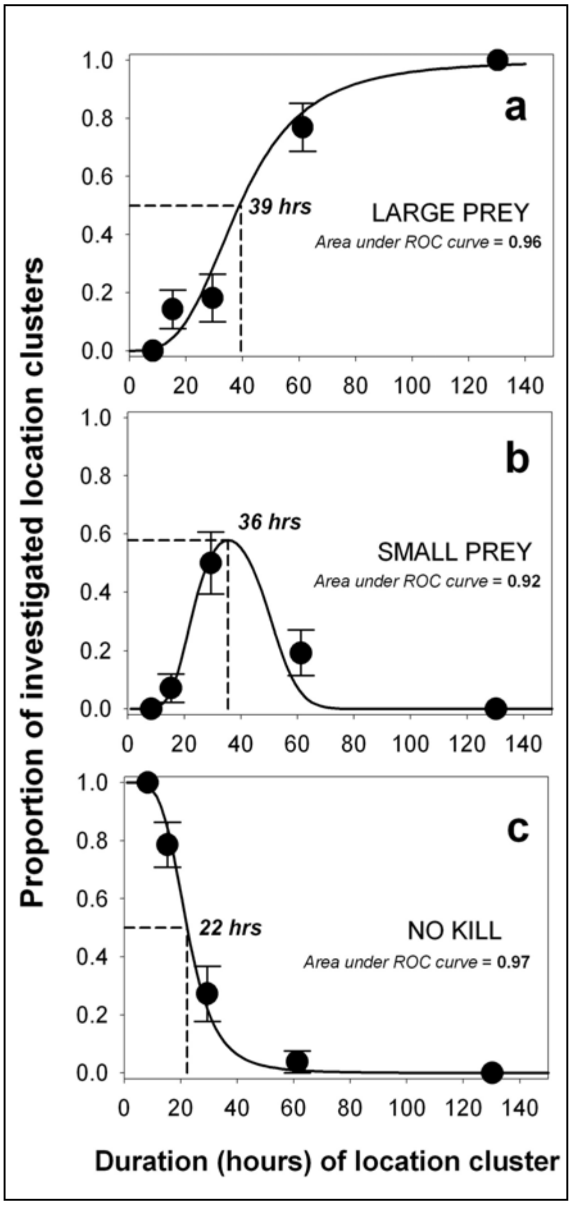

Figure 1. Probability of a location cluster being associated with (a) a kill of large prey, (b) a kill of small prey, or (c) no kill, as a function of cluster duration (in hrs), modeled for data pooled from 2 male and 2 female cougars in the Flagstaff Uplands of Arizona, July 2003–December 2004.

and 2 female cougars (Table 2). On average, compared to the 2 females, the 2 males spent less time consuming a given kill (4.3 days [females] versus 2.4-3.4 days [males] for large prey) and killed more often (once every 12.1-15.6 days [females] versus once every 7.8-9.9 days [males] for large prey). Kill rates were closer to equal between genders when kills of small prey were considered, in the range of once every 7-10 days.

We found no effect of gender when we modeled duration of clusters associated with kills. However, we did find strong effects of prey mass and generalized ambient temperatures (Figure 2). The relation to ambient temperature was as we expected, with duration declining as maximum temperatures increased. The relation to prey mass was unexpectedly hump-shaped, in that maximum duration was associated with an intermediate prey mass of approximately 143 kg, close to the size of an elk yearling (Table 1). In other words, absolute duration *declined* as prey mass increased above about 140 kg.

The initiations of clusters associated with kills and with other periods of relative inactivity were not uniformly distributed with respect to time-of-day (Table 3). The large majority of clusters associated with kills (68.6%) were initiated between the hours of dusk and dawn, peaking around 2100 hours. By contrast, initiation of inactivity *not* associated with kills peaked near mid-day, around 1100 hours.

DISCUSSION

Considering both small and large prey, the kill rates documented so far for cougars in our study area are comparable to kill rates of large prey documented for cougars elsewhere. Murphy et al. (1992) and Ruth (2004) reported kill rates for cougars in the Yellowstone ecosystem mostly in the range of once every 6 to 9 or 11 days, with primary differences evident between maternal females and other cougars. Shaw (1977), Beier et al. (1995), and Anderson and Lindzey (2003) reported similar results from northern Arizona, southern California, and southeastern Wyoming. However, unlike for our marked cougars, small prey were apparently not a significant factor in these other studies, or at not least not overtly considered in calculation of kill rates. Our results are also somewhat unique in showing pronounced differences between the 2 females (longer intervals) and 2 males (shorter intervals). Considering only kills of large prey, our results align remarkable well with kill rates predicted by Ackerman et al. (1986) on the basis of energetics, around once every 8-9 days for adult males and once every 16 days for adult females.

Some of our results pertaining to time spent consuming kills are also consistent with previous work. The roughly 2.5 to 4 days spent by the cougars in our study consuming kills corresponds with the 3-4 days spent consuming especially deer kills observed by Beier et al. (1995), Anderson and Lindzey (2003), and Ruth (2004). However, our results are unique in being the first documentation of time spent consuming small kills, in suggesting a difference between males and females and in also suggesting that time spent on very large kills (i.e., adult elk) was no greater, and perhaps even shorter, than time spent on medium-sized kills, in contrast to results reported by Anderson and Lindzey (2003).

The tendency for duration of consumption to decline with greater prey size and warmer ambient temperatures is consistent with previous ruminations by Hornocker (1970) and Ruth (2004). Hornocker (1970) speculated that warm weather would accelerate decomposition and thereby reduce efficiency of carcass use, whereas Ruth (2004) observed potentially greater competition with scavengers at large kills if for no other reasons than the difficulty of moving a large carcass to a more secure location and adequately burying it. We speculate that warmer temperatures also would enhance dissemination of carcass odors and thereby also increase the likelihood of visitation from scavengers. Cougars may even abandon a large carcass after "high-grading" it simply because they are uncomfortable being near a carcass they have not been able to adequately secure. Whatever the explanation, this result has potentially important implications to understanding prey selection by cougars, which may not be solely a matter of whether they can kill an animal or not.

The composition of cougar kills in our study area was most like that documented in central Idaho, the Montana Rocky Mountain East Front, and northern Yellowstone – other areas with substantial numbers of both

Table 2. Numbers of kills of large and small prey, mean time spent consuming individual kills of large and small prey, and intervals between kills of all type and kills of large prey, for 2 male and 2 female cougars in the Flagstaff Uplands of Arizona, July 2003–December 2004.

	Number of kills		Time spent consuming a kill (hrs)				Interval between kills (hrs)	
			Large prey		Small prey			
Cougar	Large prey	Small prey	Mean	SE	Mean	SE	Large prey	All prey
Males								
C3	16.8	5.4	57.8	9.0	22.0	--	188.2	142.3
C5	10.0	0.0	82.0	14.1	--	--	238.2	238.2
Females								
C2	18.8	25.3	102.7	13.4	30.7	3.7	375.3	160.0
C4	25.7	11.7	104.2	13.2	38.0	4.2	292.4	201.0

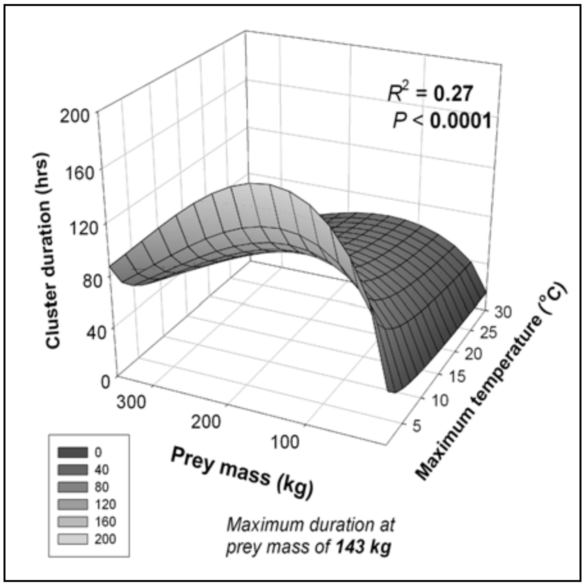

Figure 2. Relationship between cluster duration (in hrs) and modal mass of prey (in kg) and long-term average maximum ambient temperature of the month during which the kill occurred, for data pooled from 2 male and 2 female cougars in the Flagstaff Uplands of Arizona, July 2003–December 2004.

elk and deer (Hornocker 1970, Williams et al. 1995, Husseman et al. 2003, Ruth 2004). Elk comprised 50 to 73% of all kills in these more northern study areas, which was greater than the 45% documented in our study area considering all kills, but overlapped with the 56% calculated considering only kills of large prey. Our finding that elk calves comprised 50% of all elk kills was remarkably consistent with the findings in central Idaho (51%; Husseman et al. 2003) and Yellowstone (50-53%; Ruth 2004), suggesting, in turn, consistency among regions in cougar selection for sizes of elk. This tendency to select for smaller age classes among intrinsically larger-bodied prey is also consistent with the near exclusive focus of cougar predation on moose (*Alces alces*) calves and juveniles observed by Ross and Jolkotzy (1996) in Alberta.

Differences in prey selection between cougar genders have only rarely been documented. Anderson and Lindzey (2003) observed a tendency for adult males to kill more bull elk and for adult females to kill more does, whereas Pierce et al. (2000) observed that, compared to male cougars, female cougars killed more young deer. We found that, compared to females, males killed virtually no small prey and many more elk. This result is consistent with the expectation that larger-bodied cougars of whatever gender would be killing larger-bodied prey, and fits the documented broader pattern of populations of larger-bodied cougars killing, on average, larger-bodied prey (Iriarte et al. 1990). Our results clearly point to the potential importance of smaller (2-30 kg) prey to especially female cougars in our study area, and highlight potential implications of the widespread bias against documenting small prey to our understanding of cougar ecology (Ackerman et al. 1984).

Most of the documented kills of small prey in our study area were mesocarnivores, particularly coyotes. In fact, we have so far documented more kills of mescocarnivores (*n* = 18) than have been documented during other studies regardless of duration, intensity and number of collared animals, including studies with >200 investigated kills (Murphy et al. 1992, Ross and Jalkotzy 1996, Logan and Sweanor 2001, Ruth 2004). In contrast to speculations by Boyd and O'Gara (1985), we found little indication that cougars in our study area were killing coyotes to protect kills of ungulates. All but one of the mesocarnivores was mostly consumed, and only two were associated in time and space with another kill. Our results are more consistent with Logan and Sweanor (2001), who speculated that cougars killed coyotes to protect kittens and more broadly to reduce competition for food. We also speculate that female cougars were killing mesocarnivores simply as an immediate source of energy. If we assume that the proportional composition

Table 3. Distribution of clusters with respect to diel times (military) of initiation, differentiating clusters associated with kills (*n* = 105) from clusters *not* associated with kills (*n* = 251), pooled for 2 male and 2 female cougars in the Flagstaff Uplands of Arizona, July 2003–December 2004.

	Clusters associated with kills			Clusters not associated with kills		
Military time	n	Proportion	SE	n	Proportion	SE
1700	14	0.133	0.033	9	0.036	0.012
2100	34	0.324	0.046	34	0.136	0.022
0100	19	0.181	0.038	36	0.143	0.022
0500	19	0.181	0.038	23	0.092	0.018
1100	12	0.114	0.031	112	0.446	0.031
1300	7	0.067	0.024	37	0.148	0.022

of small prey was constant, and use the corrected number of kills of small prey from Table 2, then two female cougars killed 29 mesocarnivores in a 607-day period, or roughly once every 21 days, which introduces the possibility of indirect ecosystem effects through impacts on populations of mesocarniovores.

We documented 5 instances of scavenging, which lends weight to a growing body of evidence that cougars are not exclusively predators. Logan and Sweanor (2001) and Ross and Jalkotzy (1996) previously recorded 16 and 4 cases of scavenging, respectively, involving primarily mule deer and moose. All of our cases involved adult elk, which were the largest-bodied ungulates in our study area, consistent with the likelihood that, if scavenging were to happen, it would involve a carcass with greater edible biomass (Mattson 1997). This documentation of scavenging raises the possibility that we and others have misclassified incidents of scavenging as predations. Although this may be true, we suspect our error rate has been small primarily because of our often close follow-up on cougar activity and our reliance on confirmatory evidence such as signs of struggle to identify predations.

Our observation that most kills occurred between dusk and dawn is consistent with a long history of anecdotal observations that cougars are primarily nocturnal hunters. Beier et al. (1995) and Anderson and Lindzey (2003) also observed that most kills occurred at night, between 1800 and 0200 hours, using both close ground tracking and GPS locations. This concentration of kills at night contrasts with peak initiation at around 1100 hours of typically 8-12 hours of inactivity, *not* associated with kills. We speculate that these daytime inactive periods corresponded with bedding for rest, security, and thermal regulation and, further, that daytime hours are therefore much safer than nighttime hours for humans to be around cougars.

ACKNOWLEDGMENTS

We thank Sam Dieringer of USDA Wildlife Services for his expert help capturing cougars and especially Mike and Diane Miller, Brandon Holton, Zac and Sky Bischoff-Mattson, and Susan Bischoff for their help visiting GPS clusters to document cougar activity. We also thank Paul Beier of Northern Arizona University, Paul Whitefield of the National Park Service, Rick Miller of Arizona Game and Fish Department, Karen Murray formerly of the Grand Canyon Trust, and Mark Sogge and Denny Fenn of the USGS Southwest Biological Science Center for their enthusiastic support of this project. To date, this project has been funded by the USGS Park Oriented Biological Support Program, the Summerlee Foundation, the NPS

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LITERATURE CITED

ACKERMAN, B.B., F.G. LINDZEY, AND T.P. HEMKER. 1984. Cougar food habits in southern Utah. Journal of Wildlife Management 48: 147-155.

ACKERMAN, B.B., F.G. LINDZEY, AND T.P. HEMKER. 1986. Predictive energetics model for cougar. Pages 333-352 *in* S.D. Miller and D.D. Everett, editors. Cats of the world: biology, conservation and management. National Wildlife Federation, Washington, D.C., USA.

ANDERSON, A.E. 1981. Morphological and physiological characteristics. Pages 27-97 *in* O.C. Wallmo, editor. Mule and black-tailed deer of North America. University of Nebraska Press, Lincoln, Nebraska, USA.

ANDERSON, C.R., JR., AND F.G. LINDZEY. 2003. Estimating cougar predation rates from GPS location clusters, Journal of Wildlife Management 67: 307-316.

BEIER, P., D. CHOATE, AND R.H. BARRETT. 1995. Movement patterns of mountain lions during different behaviors. Journal of Mammalogy 76: 1056-1070.

BOYD, D., AND B. O'GARA. 1985. Cougar predation on coyotes. The Murrelet 66:17.

BUBENIK, A.B. 1982. Physiology. Pages 125-179 *in* J.W. Thomas and D.E. Toweill, editors. Elk of North America: ecology and management. Stackpole Books, Harrisburg, Pennsylvania, USA.

BURT, W.H. 1976. A field guide to the mammals: North America north of Mexico. Third edition. Houghton Mifflin, Boston, Massachusetts, USA.

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.

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

HOSMER, D.W. AND S. LEMESHOW. 2000. Applied logistic regression. Second edition. Wiley and Sons, New York, New York, USA.

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 101: 591-601.

IRIARTE, J.A., W.L. FRANKLIN, W.E. JOHNSON, AND K.H. REDFORD. 1990. Biogeographic variation of food habits and body size of the American puma. Oecologia 85: 185-190.

LOGAN, K.A., AND L.L. SWEANOR. 2000. Puma. Pages 347-377 *in* S. Demaris and P.R. Krausman, editors. Ecology and management of large mammals in North America. Prentice Hall, Upper Saddle River, New Jersey, USA.

LOGAN, K.A., AND L.L. SWEANOR. 2001. Desert puma: evolutionary ecology and conservation of an enduring carnivore. Island Press, Washington, D.C., USA.

MATTSON, D.J. 1997. Use of ungulates by Yellowstone grizzly bears *Ursus arctos*. Biological Conservation 81: 161-177.

MURPHY, K.M., G.S. FELZIEN, AND S.E. RELYEA. 1992. The ecology of the mountain lion (*Felis concolor missoulensis*) in the northern Yellowstone ecosystem. Cumulative Progress Report No. 5. Wildlife Research Institute, Moscow, Idaho, USA.

OCKENFELS, R.A. 1994. Mountain lion predation on pronghorn in central Arizona. Southwestern Naturalist 39: 305-306.

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

ROBINNETTE, W.L., J.S. GASHWILER, AND O.W. MORRIS. 1959. Food habits of the cougar in Utah and Nevada. Journal of Wildlife Management 23: 261-273.

ROBINSON, H.S., R.B. WIELGUS, AND J.C. GWILLIAM. 2002. Cougar predation and population growth of sympatric mule deer and white-tailed deer. Canadian Journal of Zoology 80: 556-568.

ROMINGER, E.M., H.A. WHITLAW, D.L. WEYBRIGHT, W.C. DUNN, AND W.B. BALLARD. 2004. The influence of mountain lion predation on bighorn sheep translocations. Journal of Wildlife Management 68: 412-426.

ROSS, P.I., AND M.G. JALKOTZY. 1996. Cougar predation on moose in southwestern Alberta. Alces 32: 1-8.

RUTH, T.K. 2004. Ghost of the Rockies: the Yellowstone cougar project. Pages 13-24 in R.J. Anderson, editor. Yellowstone Science 12. Yellowstone National Park, Wyoming, USA..

SHAW, H.G. 1977. Impact of mountain lion on mule deer and cattle in northwestern Arizona. Pages 17-32 *in* R.C. Phillips and C. Jonkel, editors. Proceedings of the 1975 predator symposium. Montana Forest and Range Conservation Experiment Station, University of Montana, Missoula, USA.

SPALDING, D.J., AND J. LESOWSKI. 1971. Winter food of the cougar in south-central British Columbia. Journal of Wildlife Management 35: 378-381.

WILLIAMS, J.S., J.J. MCCARTHY, AND H.D. PICTON. 1995. Cougar habitat use and food habits on the Montana Rocky Mountain Front. Intermountain Journal of Sciences 1: 16-28.

MODELING PREY AND COUGAR WITH AN APPROACH FOR MANAGING COUGARS TO MEET PREY POPULATION OBJECTIVES

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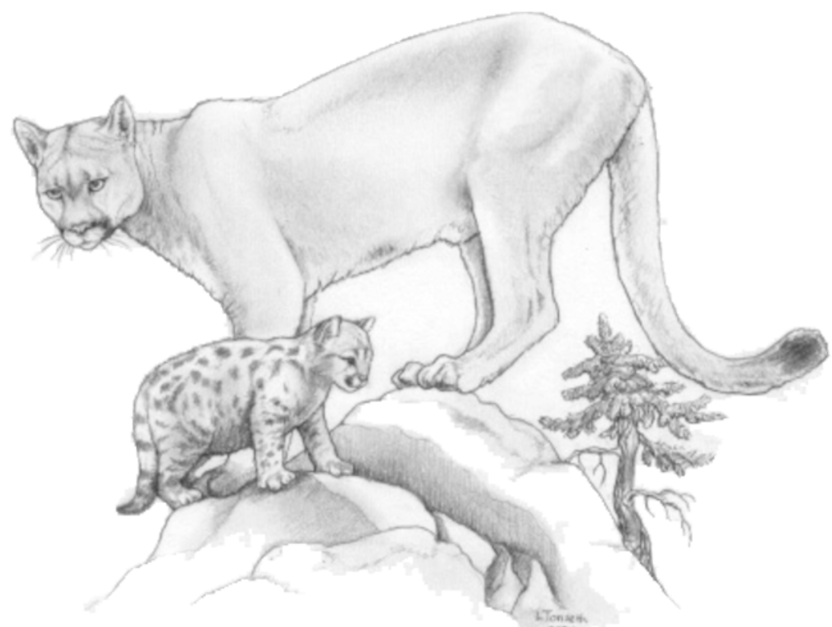
Mountain Lion Workshop 8:170

Abstract: Wildlife population objectives for predator and prey are often developed independent of each other and without rigorous population analyses. I present a modeling and management approach developed by the Muckleshoot Wildlife Program to bring balance between cougar (*Puma concolor*) and their principal prey, elk (*Cervus elaphus*) and black-tailed deer (*Odocoileus hemionus columbianus*) in western Washington. The modeling approach will help managers set population objectives and conduct management actions necessary to reach those objectives. The model is based upon empirical data collected on radio-marked animals over 6 years. Prey population estimates are fundamental inputs to the model. The Tribe's approach is to radio-mark and monitor the predicted core cougar population compatible with prey population objectives. The model is used to predict the allowed increase in cougar numbers as elk and deer numbers increase. The approach is hands on and involves micromanagement, but is necessary to understand and preserve a way of life that tribal members depend on. In this presentation I describe the conflicting management objectives set within the Washington Department of Fish and Wildlife and between the Muckleshoot Tribe and WDFW, data needs for the model approach, predictions, anticipated management actions, and need for a balanced analytical approach toward conserving both predator and prey.

Predator Interaction



PATTERNS OF RESOURCE USE AMONG COUGARS AND WOLVES IN THE NORTHWESTERN MONTANA AND SOUTHEASTERN BRITISH COLUMBIA

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Mountain Lion Workshop 8:173-174

Abstract: As reintroduced wolves expand their range in human–altered landscapes, they may overlap extensively with cougars in areas where prey are available to both species. Understanding the extent to which these two carnivores partition or compete for space, prey, and habitat will enhance management of both species. We used radio-telemetry to examine winter and summer spacing patterns, habitat use of sympatric cougars and wolves in the North Fork of the Flathead River (NFF), Montana and British Columbia between 1993 and 1997. Nine to 15 adult cougars and two to five wolves within each of the 3 wolf packs were radio–collared each year. Cougar and wolf home ranges (95% fixed kernel) were similar in size during winter (139–266 km^2) and summer (194–523 km^2) and overlapped more during winter (43%) than during summer (27%). Cougars and wolves used seasonal overlap areas differently than expected by chance; they did not avoid the overlap area during winter. Simultaneously monitored cougars and wolves that occupied overlapping home ranges were not closer than expected by chance (13 of 21 combinations). Two cougars were closer and 6 cougars were farther away than expected. We used 399 winter and 595 summer relocations of 13 adult cougars and 336 winter and 350 summer relocations of 2 wolf packs to evaluate habitat use. Using compositional analysis we found cougars and wolves did not use habitat compositions in the NFF in proportion to availability at the within home range (3rd–order) level of comparison. Both species preferred coniferous and deciduous cover and habitats 200–500 m from water and >500 m from roads during winter and summer. Study area cougars and wolves used southeast–southwest facing aspects during winter; however, cougars preferred slopes >15% and wolves preferred slopes <5%. We found little evidence that cougars and wolves partitioned habitat compositions at the 2nd-order or 3rd-order scale of selection during winter or summer, with the exception of slope: wolves preferred lower slopes than cougars at both levels of selection. Our daytime locations indicated high overlap in use and a lack of partitioning of habitat compositions by cougars and wolves, particularly during winter. We documented interference competition between cougars and wolves (50 interactions) during winter months, including wolves chasing and treeing cougars, wolves displacing cougars from kills, and wolves killing 2 cougars. In the North Fork, seasonal changes greatly influenced the potential for interference and exploitation competition between cougar and wolves. Greater overlap and greater use of overlap zones by both cougars and wolves during winter was likely influenced by prey distribution, which brought

these two carnivores into close spatial arrangement. Spatial overlap was relaxed during summer months and availability of a greater diversity of prey during this time may enhance cougar and wolf coexistence from year to year. We speculate that the presence of wolves combined with declining prey numbers may have reduced the carrying capacity of cougars and their numbers may stabilize at some level below those that occurred prior to wolf occupation.

INTERACTIONS BETWEEN WOLVES (*CANIS LUPUS*) AND COUGARS (*PUMA CONCOLOR*) IN THE BOW VALLEY, BANFF NATIONAL PARK, ALBERTA

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Mountain Lion Workshop 8:175

Abstract: Interactions between individuals, populations, and species help maintain the structure and function of ecosystems. This is particularly true in the case of predators at the top of the food chain (Soulé et al, 2003). Few places in North America retain their historical large predator community; hence research on interactions among large carnivores is sparse but relevant from the perspective of wildlife management and conservation. In the present study on wolves (*Canis lupus*) and cougars (*Puma concolor*) in Banff National Park, AB, we found indication that direct and indirect interactions between carnivore species helped shape community dynamics. Clearly, prey switching by cougars in response to wolf-induced declines in primary prey, elk, supported the contention that exploitative interactions occurred between the two species with wolves being the dominant competitor. Wolves also appeared to be dominant with respect to interference interactions, including direct predation of cougars and usurpation of prey killed by cougars. Avoidance is a possible response to such interactions and cougar home ranges exhibited limited overlap with areas occupied by wolves. Although dynamic interaction analysis on radioed individuals of both species failed to show non-random distribution of predators across the landscape, we found that cougars temporally avoided areas occupied by wolves. At the finest scale of analysis, at intersections of wolf and cougar tracks, non-random space use was consistent with asymmetrical avoidance behaviour by cougars. The effects of these interactions on prey populations, cougar space use, and cougar population dynamics likely has broader implications to wildlife management and conservation efforts in areas where wolf populations are expanding.

SPATIAL DISTRIBUTION OF COUGARS (*PUMA CONCOLOR*) IN YELLOWSTONE NATIONAL PARK BEFORE AND AFTER WOLF (*CANIS LUPUS*) REINTRODUCTION

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Mountain Lion Workshop 8:176

Abstract: The reintroduction of wolves (*Canis lupus*) into Yellowstone National Park (YNP) has the potential to alter how other native large carnivores use that landscape. We conducted a study of the resident cougar (*Puma concolor*) population on the Northern Range of YNP to assess, in part, cougar spatial distribution before and after wolf reintroduction. Pre-wolf data were collected from 1988 through 1994, and post-wolf data from 1998 through 2004. We based the spatial analysis on adult cougar aerial telemetry locations, split into summer and winter seasons (Pre-wolf summer n = 956; Post-wolf summer n = 1157; Pre-wolf winter n = 756; Post-wolf winter n = 645). The re-location interval averaged 10 days in both time-periods. We assessed changes in spatial distribution with Multi-Response Permutation Procedures (MRPP) and fixed kernel (FK) estimates of 95% and 50% range use areas. The habitat characteristics topographic roughness, distance to high topographic roughness, edge density, and elevation of the 95% and 50% range areas were compared for each season using t-tests. Cover class composition was compared with Chi-square analysis. MRPP showed significant differences between Pre-wolf and Post-wolf cougar spatial distributions for both seasons. The fixed kernel Post-wolf cougar range use areas were consistently smaller than Pre-wolf range areas for both seasons (summer 50% area = 78% smaller; summer 95% area = 52% smaller; winter 50% area = 37% smaller; winter 95% area = 43% smaller). During summer and winter, cougars used areas with greater topographic roughness, greater edge density, lower elevations, and areas closer to high topographic roughness in the 50% FK areas after wolf reintroduction. Cover composition in the 50% FK areas and all habitat characteristic patterns in the 95% FK areas were variable between seasons. We suspect the shifts observed at the 50% FK level are an expression of cougars seeking escape and hiding cover. These patterns are likely not evident in the 95% ranges because the larger areas include a substantial amount of unused habitat. We will continue our habitat analysis with characteristics at point locations. These results suggest the reintroduction of a large carnivore can have noticeable effects on the distribution of existing carnivore populations.

EFFECTS OF WOLF REINTRODUCTION ON A COUGAR POPULATION IN THE CENTRAL IDAHO WILDERNESS

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Abstract: Wolves (*Canis lupus*) were reintroduced in the central Idaho wilderness in 1995 and 1996 and rapidly established packs in areas previously occupied by cougars (*Puma concolor*). We spent four winters studying the relationship between sympatric wolves and cougars in the Idaho wilderness, beginning work the first year the two carnivores coexisted. We examined the potential for competition during winter between resident cougars and a newly established wolf pack for food, space, and habitats through radio telemetry tracking and examination of 192 carcasses. We found that wolf and cougar diets were almost identical. Winter home ranges of wolves and cougars overlapped, although the wolf pack home range size was 2-20 times the size of individual cougar home ranges. We observed wolf utilization of cougar-killed prey and evidence of wolf avoidance by cougars. Although no interspecific killing was documented between wolves and cougars, the effects of competition, a declining prey population, and heavy hunter harvest of cougars were expressed by low recruitment, decreased adults, and disrupted social structure in the cougar population. A large-scale wildfire provided a unique opportunity to compare wolf and cougar responses to catastrophic environmental change. Wolves, with large home ranges, were more adaptable to change than were cougars. For cougars, the combination of decreased prey numbers, low reproductive rate, high hunter harvest, and large-scale habitat alteration from fire appeared to amplify the effects of competition from the recently established wolf pack and increased intraspecific strife. The cougar population experienced a period of instability during this study, as cougars adapted to coexistence with another large carnivore in a dynamically changing environment.

Mountain Lion Workshop 8:177-187

Key Words: Puma concolor, competition, cougar, wolf, Canis lupus, Idaho, predation, carnivore, ungulates, fire.

INTRODUCTION

Prior to 1900, wolves and cougars coexisted in central Idaho, but by the turn of the century settlers had moved into the Big Creek drainage in the rugged Salmon River Mountains to mine for gold, trap, and establish homesteads. Hunting, trapping, and poisoning of carnivores were common practices, and by 1895 sightings or evidence of wolves in the drainage were uncommon (Caswell 1895). Despite the remoteness of the area, ungulate and carnivore numbers varied dramatically over the next 100 years, often in response to human hunting, trapping, and poisoning efforts (Figure 1). The ecology and population dynamics of

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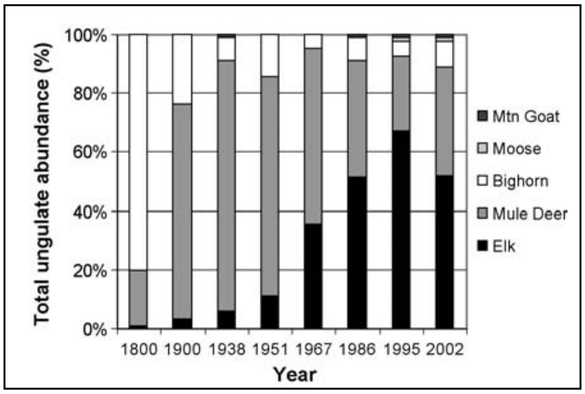

Figure 1. Relative ungulate abundance on Big Creek, from 1800 to 2002. (Unpublished data assimilated from Caswell 1895).

cougars in the Big Creek drainage have been well documented and described over the past 40 year, starting with Hornocker's benchmark cougar population and ecology research from the 1960's (Hornocker 1970). Seidensticker et al. (1973) then elucidated the social organization of cougars and contributed additional information on this cougar population and its food habits. Koehler and Hornocker (1991) compared resource use among cougars, bobcats, and coyotes. Quigley et al. (1989) found that cougar numbers in the Big Creek drainage had increased over a 20-year period in correlation with an increase in elk numbers since the 1960s. In 1995 and 1996 the U. S. Fish & Wildlife Service reintroduced 35 wolves into the central Idaho wilderness, as part of the restoration of wolves to the northern Rocky Mountains. Two of these wolves became the breeding pair of the Chamberlain Pack in 1996 and established a home range that included the Big Creek drainage.

There is strong potential for competition between the recently introduced wolves and resident cougars, because both large carnivores primarily prey on large ungulates and have similar diets when they occur together (Husseman et al. 2003, Kunkel et al. 1999, Ruth 2004b). Competition could be expressed through one species killing the other: as Boyd and Neal (1992) and Ruth (2004b) found with adult cougar mortality in Glacier National Park and Ruth (2004a) documented with cougar kitten mortality in Yellowstone National Park, or cougars could kill wolves. Exploitation competition can occur when these sympatric species share the same food, space, or habitat resources. Interference competition can occur when one species interacts with the other, such as wolf displacement of cougars from their kills. Competition can result in decreased reproductive success or survival of one or both species or lead to resource partitioning to decrease competition (Colwell and Futuyma 1971). Kunkel et al. (1999) found evidence of exploitation and interference competition following wolf recolonization of cougar habitat in northwest Montana, but stated that wolves and cougars had not yet partitioned food resources or space. In assessing the magnitude of the effect of wolf reintroduction on ungulate populations, it is necessary to understand whether wolf predation will be additive to other causes of mortality or be partially offset by changes in predation by other large carnivores such as cougars. Kunkel and Pletscher (2001) determined cougar and wolf predation on white tailed deer (Odocoileus virginianus) in Montana was primarily additive. Cougar numbers and distribution could decline as a result of wolf competition, affecting sport hunting harvest of ungulates as well as cougars. A simultaneous investigation of wolves and cougars provides valuable insights into the influence they have on each other and their combined effect on prey species. Results from this study will guide resource managers in understanding the integrated impact of these sympatric large carnivores on ungulate prey. Furthermore, information from this research is essential for predicting the outcome of wolf recolonization or reintroduction in other areas where cougars occur. The objectives of our study were 1) to assess wolf-cougar-prey dynamics in a wilderness setting, 2) assess competition and resource partitioning of food, space, and habitat between cougars and wolves, and 3) document interspecific interactions and killing between cougars and wolves.

STUDY AREA

Research was conducted from University of Idaho's Taylor Ranch Field Station on Big Creek, in the Frank Church - River of No Return Wilderness (FC-RNRW) in Idaho (Figure 2). The Big Creek study area is in the center of the 9,550 km^2 FC-RNRW, and surrounded by an additional 6,450 km^2 of designated wilderness. The 550-km^2 study area is the Big Creek winter range for elk (*Cervus elaphus*), mule deer (*Odocoileus hemionus*), and bighorn sheep (*Ovis canadensis*). Terrain is steep and dissected by the east flowing Big Creek drainage and its tributaries. Bunchgrass slopes, mountain mahogany (*Cercocarpus ledifolius*) outcrops, and open Douglas fir (*Pseudotsuga menziesii*) forests dominate south aspects; dense Douglas fir forests occur on north aspects, with deciduous vegetation (*Populus trichocarpa*, *Alnus incana*, *Betula occidentalis*) in narrow riparian zones. The winter range is semi-arid; annual precipitation at Taylor Ranch Field Station is 38 cm. Elevations range from 1,200 to 2,200 meters. Native ungulates are migratory and include elk, mule deer, bighorn sheep, moose (*Alces alces*), and mountain goats (*Oreamnos americana*). Over the past century, the Big Creek large carnivore community has consisted primarily of cougars, black bears (*Ursus americanus*), coyotes (*Canis latrans*), and bobcats (*Lynx rufus*), while wolverine (*Gulo gulo*), fisher (*Martes pennanti*), lynx (*Lynx canadensis*), and the occasional grizzly bear (*Ursus arctos*) have also been present. During the same time period, state and federal agency records and historical documents indicated that the numbers and relative abundance of the ungulate species have varied considerably (Figure 1). Bighorn sheep and mule deer were the most common ungulates on Big Creek 100 years ago (Caswell 1895), but elk colonized the area in the 1940s (Coski, Trueblood, and Manis. 1940. USFS unpublished winter range ungulate surveys of Big Creek, 1940, Payette National Forest, McCall, Idaho, USA) and increased in numbers until they peaked in the mid 1990s (Idaho Department of Fish and Game unpublished data, McCall, Idaho, USA). Elk productivity decline to 17 calves per 100 cows in 1995, a few years before the Chamberlain Wolf Pack established a winter home range on Big Creek, reached a low of 7 calves per 100 cows in 1999 and increased to 21 calves per 100 cows in 2003. Since 1986, elk numbers have exceeded mule deer numbers. Elk, mule deer, bighorn sheep, moose, cougars, black bears, and bobcats are hunted species. Mean population estimates for ungulates during 1999-2002 were 1185 elk, 650 mule deer, 150 bighorn sheep, and 30 moose.

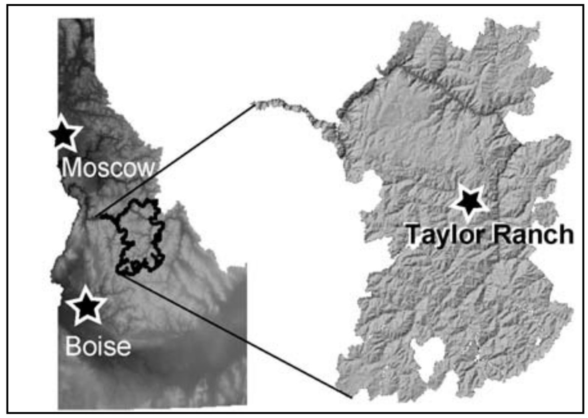

Figure 2. Frank Church River of No Return Wilderness in Idaho and location of Taylor Ranch Field Station on Big Creek.

METHODS

Our study began in the 1998-1999 winter and we monitored wolves and cougars four winters, December through April. The Chamberlain Pack breeding pair were both radio collared in Canada prior to their release in Idaho in 1995. They had their first litter of pups in 1996 and by 1998 there were 7 individuals in the pack. We captured and radio collared 8 cougars from 1999 to 2001 using trailing hounds. Cougars were immobilized with ketamine and xylazine in accordance with the Hornocker protocol (Quigley 2000). Cougar capture and handling was authorized through University of Idaho Animal Care and Use Committee Protocol 1999-23.

We evaluated carnivore competition by comparing food habits. To do this, we intensively searched for kill sites along trail systems, ridgelines, and canyon bottoms within the study area. We travelled up to 30 km daily searching for kill evidence including localized scavenger bird activity, tracking and back-tracking wolf and cougar tracks, and looking for carcasses and blood in the snow. All of our field logistics involved ground travel, either on foot, using snowshoes, or by riding mules, and was supported by aerial telemetry. Once a carcass was located we examined the carcass and surrounding area to determine cause of death and which carnivore made the kill if mortality was due to predation. We collected and dried marrow fat from femurs and calculated percent femur fat using techniques by Neiland (1970). We had an incisor tooth sample from each carcass aged through cementum annuli analysis (Matson's Laboratory, Milltown, MT, USA). We categorized our confidence in identifying the predator as possible, probable, or positive. The latter two categories, indicating higher certainty, were used for comparison following the protocol of Murphy (1998). We also used snow tracking or remote cameras to document scavenging activities.

Winter seasonal home ranges of a Chamberlain Wolf Pack member and 5 cougars were calculated from 95% and 50% fixed kernel home range analyses using the Animal Movement extension (Hooge and Eichenlaub 1997) in ArcView Geographic Information System (GIS, Environmental Systems Research Institute, Redlands, California, USA). A minimum of 30 locations per seasonal home range estimate were obtained through weekly aerial telemetry flights and ground locations at least 2 days apart. We used chi-square analysis to test for differences in sympatric cougar and wolf diets. Chi-square analysis was also used to compare the proportion of calf elk killed by cougars and wolves and the proportion, which occurred on the study area, as well as to compare age distributions. Differences in the two carnivores' intensity of scavenging and preying on animals in poor condition were also evaluated using chi-square analysis.

RESULTS

Reproduction and Mortality

Reproductive success was monitored for both species. The Chamberlain wolf pack size in winter was typically seven to ten wolves. The mean litter size for wolves was 4.8 pups per year. By contrast, the cougar population changed from ten to six resident adults during the study period. Four to six adult cougars were females, producing a total of 1.5 litters per year. Mean litter size was slightly under two kittens per litter. Mortality was monitored over the four-year period with two of five collared wolves dying from illegal human caused mortality. Six of seven radio instrumented cougars died during the study. A total of 20 cougar mortalities were documented in this four-year period, including 14 from hunting, 3 from intraspecific strife, 1 starvation, 1 foot injury/starvation, and 1 killed by wildfire. Hunter harvest represented 44% annual removal of the adult resident cougar population.

Home ranges

The Chamberlain Wolf Pack's winter home range, 1,130 km^2 (95% fixed kernel), was significantly larger than individual cougar winter home ranges and encompassed two ungulate winter ranges. The wolf pack was very mobile, spending time in both the Big Creek and Chamberlain Creek ungulate winter ranges (Figure 3 and 4). In contrast, 3 female cougar winter home ranges were 40.9 km^2, 57.4 km^2, 261 km2, and two male cougar winter home ranges were 618 km^2 and 398 km^2 (95% fixed kernel). Aerial telemetry locations revealed a high degree of winter home range overlap between radio-collared cougars and the Chamberlain wolf pack, with the wolf home range encircling 4 of 5 cougar home ranges in 2000 (Figure 3). The proportion of time the wolf pack spent on the Big Creek winter range varied from 27% prior to the study period to 78% during the study (Figure 4). A large-scale wildfire (700 km^2) burned over 80% of the study area in August of 2000. The fire caused extreme habitat alteration, initially a loss of ungulate winter forage in 2001, then an abundance of nutrient rich grasses, forbs, and shrubs in the following years. In response to the lack of food on the burned winter range, many Big Creek elk migrated to the Chamberlain Creek winter range in the winter following the fire, but returned to the Big Creek the next winter. The wolf pack also avoided Big Creek in 2001; instead it switched its primary use to the Chamberlain winter range (Figure 4). Cougars remained in their Big Creek home ranges in winter 2001 despite the burn and preyed more on alternative food resources such as moose, beaver, coyote, and eagle since fewer elk were available (Figure 5). As a result of the wildfire, there are two winters of pre-fire and two of post-fire data.

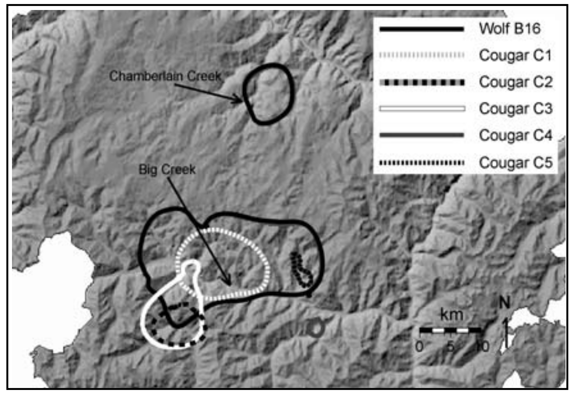

Figure 3. Chamberlain alpha male wolf B16 and 5 cougar winter home ranges (50% fixed kernel home ranges) in the FCRNR Wilderness.

Food Habits

We investigated 192 carcasses during the four winters. Among these carcasses, 84 were cougar kills and 51 were wolf kills. Both cougars and wolves preyed predominantly on elk and mule deer, although cougars had a more diversified diet, particularly after the 2000 fire (Figure 5). In areas where both wolves and cougars occurred, their proportional utilization of elk and deer was the same (c2 p = 0.747; Figure 6). In these areas where home ranges overlapped, neither cougars nor wolves exhibited prey selection between elk and deer; instead, both carnivores killed the two ungulates in the same proportions as the relative abundance of elk and deer within the Big Creek winter range area of overlap (cougar c2 p = 0.645, wolf c2 p = 0.997; Figure 6). Wolves killed a higher proportion of calf elk (48%) than did cougars (24%; c2 p = 0.048) and both species selected for calves when compared to the proportion of calves in the elk population (11%; cougar c2 p = 0.011, wolf c2 p = 0.001). The Big Creek elk population had a high proportion of older aged cows, as suggested by the 9-

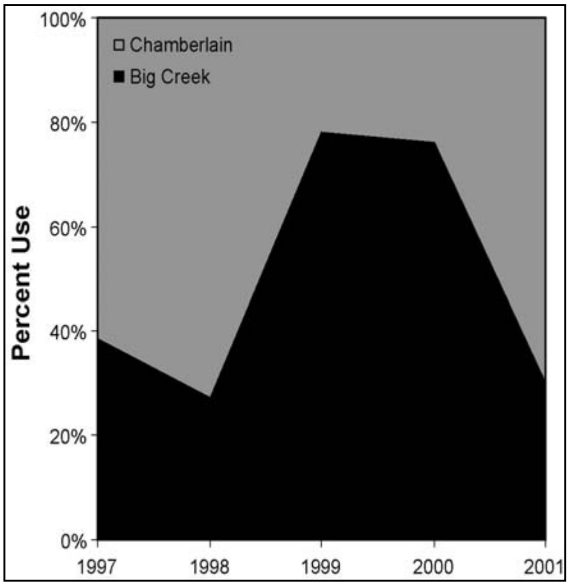

Figure 4. Chamberlain Wolf Pack use of two ungulate winter ranges: Chamberlain Creek and Big Creek.

year-old median age of hunter harvested cow elk during the study period. Cougars and wolves killed many older aged cow elk (cougar median elk age 13, wolf median elk age 11). There was no significant difference in the age distribution of elk killed by cougars and wolves (c2 = 2.91, p = 0.406; Table 1) and neither carnivore killed elk with a different age class distribution than hunters (cougar c2 = 3.13, p = 0.372; wolf c2 = 7.30, p = 0.063; Table 1). We found no difference in the proportion of kills that had severely depleted femur fat between wolf-killed elk (36%) and cougar-killed elk (20%; c2 p = 0.194).

Interactions

We did not document any fatal interspecific interactions between wolves and cougars; however, we did document three cases of mature male cougars killing other male cougars, one occurrence of a female cougar with kittens feeding on one of the dead male cougars, and one incidence of wolves feeding on one of the dead male cougars. Wolves visited or scavenged cougar kills much more often (18%) than cougars visited wolf kills (4%; c2 p = 0.019, n = 84 cougar kills and 51 wolf kills). The proportions of carcasses scavenged by wolves and cougars were nearly identical to the findings of Ruth (2004b) in Glacier National Park. We found evidence that two cougars were treed by wolves at cougar kills (mule deer and bighorn sheep); the cougars abandoned the carcasses and wolves usurped the kills. We documented long distance movements by 2 cougars up to 2 days after wolves arrived in their home range, but were unable to statistically evaluate these movements. The cougar often moved to a distant edge of its home range when wolves were present in its home range, suggesting avoidance behavior (Figure 7).

DISCUSSION

Potential for Competition

We found potential for interspecific competition between the resident cougar population and a reintroduced wolf pack on the Big Creek study area, including home range overlap and shared food resources.

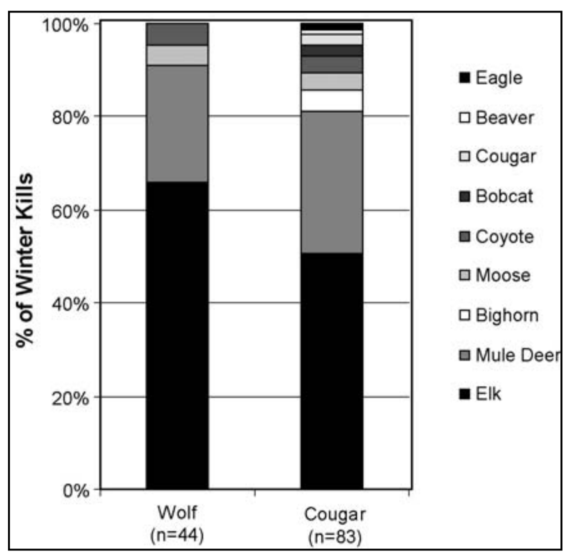

Figure 5. Winter food habits of wolves and cougars in the Big Creek study area, 1999-2002.

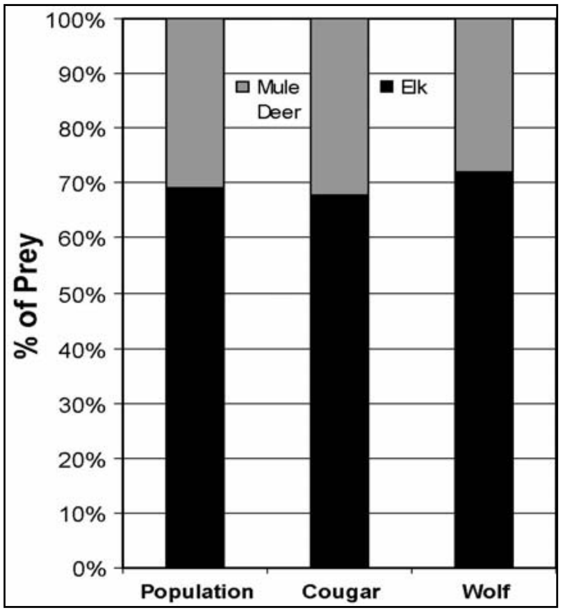

Figure 6. The proportion of elk versus deer killed by sympatric wolves and cougars during winters 1999-2002 and a comparison to the relative abundance of the two ungulates in the Big Creek area of home range overlap.

The 2 large carnivores shared much of the Big Creek ungulate winter range; the wolf pack home range encompassed most of the cougar home ranges on Big Creek except for those in steeper, rockier, and more arid section of the drainage. Sympatric cougars and wolves on Big Creek had similar food habits and shared the same prey populations, thus competing for the same food resources. While Kunkel et al. (1999) found cougars and wolves both selected white-tailed deer over elk, Husseman et al. (2003) found wolves selected elk over deer, and Hornocker (1970) documented that Big Creek cougars selected elk over deer; we did not find any diet selection by wolves or cougars. Like Husseman et al. (2003) we found besides having similar diets, wolves and cougars both selected calf elk over adult elk. The combined predation of cougars and wolves on ungulates could result in decreased prey numbers, further increasing competition. In fact, the Big Creek elk population did decline 20 percent during the study period, and it had declined 15 percent in the 4 years prior to research. The declining elk population, as well as large-scale wildfire, has exacerbated interspecific competition.

Many environmental and temporal factors play into interspecific competition. Koehler and Hornocker (1991) researched competition between mountain lions, bobcats and coyotes in this same study area from 1980-1985. They observed that during winter interspecific competition increased due to both predators and prey congregating at lower elevations. This increased density of food resources resulted in more frequent predator contact. Cougars proved to be the dominant competitor in this drainage 20 years ago, with both bobcats and coyotes incurring fatal consequences, particularly when visiting cougar kill sites.

Expression of Competition

Direct interspecific mortality was not observed between cougars and wolves on Big Creek, however, cougar behavior including treeing from wolves, moving from kills and avoiding wolf contact, and a low incidence of kittens suggested cougars experienced or perceived a threat from encounters with wolves. Interspecific competition can result in decreased reproductive success and increased mortality, leading to population declines. Reproduction and recruitment of subadult cougars on Big Creek was half that documented by Hornocker (1970) from the same study area in the 1960s. For 5 years, we monitored a newly independent resident female cougar that interacted with wolves. During that period, we did not find evidence that she had kittens with her, although we did document her (consorting) with male cougars on several occasions. In both study years post forest fire this cougar exhibited natal localization behavior described by

Table 1. Age distribution of female elk and calves killed by cougars, wolves, and hunters.

Elk Age	Cougar kills	Wolf kills	Hunter harvest
Calf	10	11	2
Yearling	3	0	0
2-8 yrs	8	4	9
9-20 yrs	21	8	14

Seidensticker (1973). However, follow-up monitoring did not verify that she had kittens at heel. Murphy (1998) defined female cougar reproductive success as the ability to raise a litter of kittens to dispersal age. Both Murphy (1998) and Logan (2001) noted that reproductive success of female cougars is highly variable and Robinette et al. (1961) found that one sixth of mature female cougars he sampled had never been pregnant, so we do not dare draw conclusions based on the reproductive success of only one female. However, during the same years post forest fire, we only documented one other female cougar track with a single kitten.

Cougar mortality during 1999-2001 was much greater than that reported for the same study area in 1960s (Hornocker 1970), 1970s (Seidensticker et al. 1973), and 1980s (Quigley et al. 1989), primarily due to high hunter harvest, but also due to intraspecific strife and starvation. High cougar harvest during the study period probably decreased interspecific competition, but wolf competition, coupled with low reproduction and apparent year-long vacancies in 2 female home ranges may slow or inhibit recovery of cougar numbers to previous levels. Logan's (2001) research in New Mexico indicated that when harvest of the adult cougars exceeds 28% a population decline occurs. The 44% annual harvest level on Big Creek exceeded that threshold, and age structure on harvested cougars has changed from primarily mature cougars to mostly subadults (Idaho Department of Fish and Game unpublished data, McCall, Idaho, USA).

Intraspecific strife was not observed during previous cougar research projects in this study area (Hornocker 1970, Seidensticker (1973). Seidensticker (1973) mentioned that male cougars he handled on Big Creek did not have scars from fighting. Hornocker (1970) suggested fighting should be rare in a stable cougar population. In contrast, we documented intraspecific strife among cougars in three cases of mature male cougars killing other males and we observed injuries and scars on males from fighting. Our findings were more similar to those of Logan et al. (1986), Murphy (1998), Ross and Jalkotzy (1992) and Ruth (2004b) and were indicative of a disrupted social structure. Ruth (2004b) suggested that increased intraspecific aggression among cougars might lend further support of exploitation competition between sympatric cougars and wolves in northwestern Montana. It is unclear whether this

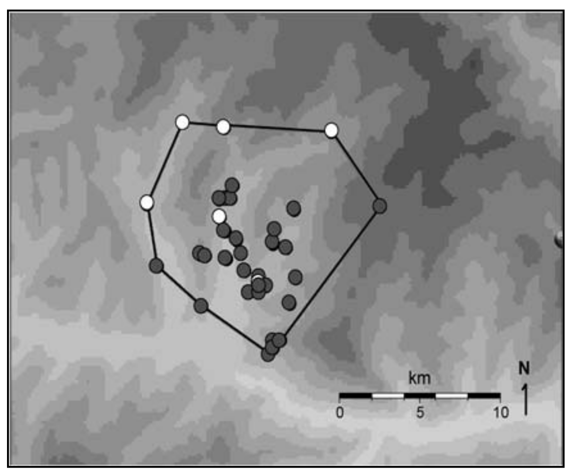

Figure 7. Cougar avoidance of wolves: Female cougar C-5's year 2000 winter home range (100% MCP) and locations. The 6 white circles were cougar locations immediately following the 6 occasions when wolves arrived in the cougar's home range; gray circle cougar locations were when wolves were not in the cougar's winter home range.

breakdown in social structure observed on Big Creek was precipitated by declining elk numbers, wolf arrival in the Big Creek drainage, or other factors, but the strife we observed occurred in the first two years of the study, prior to wildfire and heavy hunting pressure.

Interference competition can be difficult to quantify because it can occur at both individual and population levels (Ruth 2004b). Interference competition occurred on Big Creek when wolves adversely affected cougars when they visited cougar kills, usurped carcasses from cougars, and caused cougars to make long distance movements. These cougar responses could result in decreased food intake or starvation (Ruth 2004b) and increased physical and endocrine stress, and potentially decreased hunting success if cougars leave preferred hunting areas to avoid wolves. These factors could have contributed to the observed lower cougar reproductive success and survival on Big Creek, although Kunkel et al. (1999) believed that it was unlikely that interference competition by wolves resulted in an observed cougar population decline in Montana.

Conclusion

We found biological and social cougar responses that could be explained by interspecific competition with recently established wolves. Unfortunately, with confounding factors which can also affect cougar population dynamics - such as a declining prey population, high hunter harvest, large-scale environmental change from forest fire - it is difficult to assess the relative contributions of each factor in causing the observed decline in the cougar population and its productivity during the 1999-2002 study period. The combination of factors exacerbated the effects of interspecific competition. Wolves were more adaptable to large-scale environmental change than were cougars. Wolves are social animals so the wolf pack shared a very large home range. Therefore, the wolf pack was able to move long distances (35 km) within their home range to areas of higher prey density in another ungulate winter range when elk abandoned the burned Big Creek winter range after the fire. In contrast, cougars were limited by their smaller home range sizes from moving long distances to more suitable areas. When elk left the burned Big Creek winter range the first winter after fire, cougars responded to the lower prey density by diversifying their diets. Branch et al. (1996) observed a similar response by cougars in Argentina following a prey population decline. Wolves benefited more from their association with cougars than cougars did with their association with wolves, since wolves gained food from cougars more often. The timing of this study immediately after wolf reintroduction allowed us to examine cougar and wolf responses to “first encounters” with each other. The characteristics of this initial phase of coexistence may be transient and more overt compared to a future time period when the two large carnivores will act to minimize the effects of interspecific competition by partitioning habitat, food resources, and/or space, or one species’ population will decline as a result of interspecific competition.

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LITERATURE CITED

BRANCH, L.C., M. PESSINO, AND D. VILLARREAL. 1996. Response of pumas to a population decline of the plains vizcacha. Journal of Mammalogy 77:1132-1140.

BOYD, D.K., AND G.K. NEALE. 1992. An adult cougar (Felis concolor) killed by gray wolves (Canis lupus) in Glacier National Park, Montana. Canadian Field-Naturalist 106:524-525.

CASWELL, L.G. 1895. Diaries of L.G. Caswell, Idaho State Historical Library. Boise, Idaho, USA.

COLWELL, R.K. AND D.J. FUTUYMA. 1971. On the measurement of niche breadth and overlap. Ecology 52:567-576.

HOOGE, P.N., AND B. EICHENLAUB. 1997. Animal movement extension to ArcView: version 1.1 Alaska Biological Science Center, U.S. Geological Survey, Anchorage, Alaska, USA.

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

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 101:591-601.

KOEHLER, G.M., AND M.G. HORNOCKER. 1991. Seasonal resource use among mountain lions, bobcats, and coyotes. Journal of Mammalogy 72:391-396.

KUNKEL, K. AND D.H. PLETSCHER. 2001. Winter hunting patterns of wolves in and near Glacier National Park, Montana. Journal of Wildlife Management 65:520-530.

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.

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., AND L.L. SWEANOR. 2001. Desert puma: evolutionary ecology and conservation of an enduring carnivore. Island Press, Washington, D.C., USA

MURPHY, K.M. 1998. The ecology of the cougar (*Puma concolor*) in the northern Yellowstone ecosystem: interactions with prey, bears, and humans. Dissertation, University of Idaho, Moscow, Idaho, USA.

NEILAND, K.A. 1970. Weight of dried marrow as indicator of fat in caribou femurs. Journal of Wildlife Management 34:904-907.

QUIGLEY, H.B., G.M. KOEHLER, AND M.G. HORNOCKER. 1989. Dynamics of a mountain lion population in central Idaho over a 20-year period. Page 54 *in* R. H. Smith, editor. Proceedings of the Third Mountain Lion Workshop, Prescott, Arizona, USA.

QUIGLEY, K. 2000. Hornocker Wildlife Institute immobilization and biological sampling protocols. Hornocker Wildlife Institute, Moscow, Idaho, USA.

ROBINETTE, W.L., J.S. GASHWILER, AND O.W. MORRIS. 1961. Notes on cougar productivity and life history. Journal of Mammalogy 42:209-217.

ROSS, P.I AND M.G. JALKOTZY. 1992. Characteristics of a hunted population of cougars in southwestern Alberta. Journal of Wildlife Management 56:417-426.

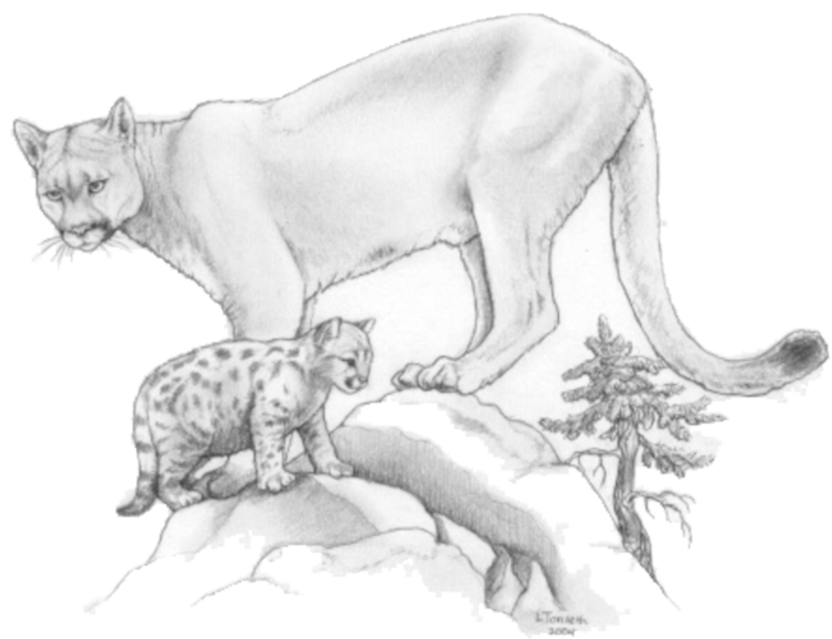
RUTH, T.K. 2004(a). Ghost of the Rockies: the Yellowstone cougar project. Winter 2004, Yellowstone Science 12:13-24.

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

SEIDENSTICKER, J.C. 1973. Mountain lion social organization in the Idaho Primitive Area. Dissertation, Idaho Cooperative Wildlife Research Unit, College of Forestry, Wildlife and Range Sciences, University of Idaho, Moscow, Idaho, USA.

SEIDENSTICKER, J.C., M.G. HORNOCKER, W.V. WILES, AND J.P. MESSICK. 1973. Mountain lion social organization in the Idaho Primitive Area. Wildlife Monographs 35.

Mountain Lions Habitat Use and Movements



USE OF LEAST COST PATHWAYS TO IDENTIFY KEY HIGHWAY SEGMENTS FOR FLORIDA PANTHER CONSERVATION

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Abstract: Highways fragment wildlife habitat and collisions with vehicles are an added source of wildlife mortality. Often, wildlife populations can absorb this unnatural mortality without suffering declines, but for endangered large mammals like the Florida panther (*Puma concolor coryi*), additional fragmentation of remaining habitat or additional sources of mortality (e.g. roadkill) could imperil their existence. A landscape approach is critical to minimize impediments to panther movements caused by highway improvements, changes in traffic volume, or the construction of new roads. Least cost path (LCP) modeling uses landscape features, which have been classified according to their value to panthers, to construct pathways that minimize impediments to panther movements between two areas. We modeled LCP's between six major use areas in southern Florida. We chose these areas because they represent the extents of occupied panther habitat where both male and female panthers live, plus we have also documented panthers traveling between these areas. Seventeen key highway segments were identified where these LCP's intersected improved roadways; these highway segments matched up well with documented panther roadkill locations. We believe that our methodology can be used to better inform panther conservation planning that will be necessary as current road networks are improved or new roads are constructed. We did not attempt to map all possible panther/highway areas but we do recommend this technique for informing conservation planning in other areas as needs arise. We are finalizing a more thorough report on this work and it will be available for download from www.panther.state.fl.us under the Reports section in the near future.

INTRODUCTION

The Florida panther (*Puma concolor coryi*), an endangered sub-species of mountain lion, formerly ranged throughout the southeastern United States (Young and Goldman 1946). Loss and fragmentation of habitat and unregulated killing over the past two centuries have reduced and isolated this southeastern puma to the point where only one population of fewer than 100 animals exists in south Florida (Land et al. 2004).

Human population in the southeastern US has increased 10-fold since 1850, expanding from 4.7 million to over 48 million in 2000 (US Census Bureau); in Florida alone, the population increased from 87,000 to over 16 million. Concomitant with the growth in the human population, new highways have been constructed and existing highways have been improved. Highways fragment wildlife habitat, and collisions with vehicles are an added source of wildlife mortality. The populations of many wildlife species can absorb this unnatural mortality without suffering declines, but for endangered large mammals like the Florida panther, additional fragmentation of remaining habitat or additional sources of mortality could imperil their existence.

Population viability analyses suggest that a panther population of 80-100 would be minimally viable and have a low probability of extinction over 100 years, but genetic diversity would decline and population numbers would also decline if habitat loss continues (Maehr et al. 2002). To achieve panther recovery, the current population needs to be protected and enhanced, and a total of 3 viable populations within the historic range need to be established (USFWS 1995, 1999). New highway construction, expansion of existing highways, or increases in traffic volume may contribute to a loss of prime panther habitat or may impede panther movement within and between the high use habitat blocks throughout the landscape. Further, new or expanded highways may also increase panther mortalities due to collisions, and all of these threats combined would be adverse to panther recovery.

Roads have been identified as a significant cause of panther mortality and habitat fragmentation in Florida. A total of 76 panther/vehicle collisions were documented between 1972 and 2004 of which 67 resulted in panther deaths (Land et al. 2004). Collisions with vehicles were responsible for 19% of all mortalities among radiocollared panthers and were the third most important mortality agent behind intraspecific aggression and unknown causes, respectively. Fifty-one percent (40) of vehicle encounters occurred since 2000, and all but two were fatal to the panther. Fifty-three percent of documented panther roadkills have occurred within the primary zone.

Identifying key highway segments used by panthers traveling between and within major use areas will enable a more prudent use of limited conservation funds to mitigate for these highway impacts. Wildlife crossings and continuous fencing required during the conversion of 2-lane State Road 84 (Alligator Alley) into the 4-lane Interstate 75 between Naples and Ft. Lauderdale allowed panthers to move under I-75. No panther has collided with a vehicle in these protected areas since the highway was completed (Shindle et al. 2003). Additionally, six wildlife crossings and limited fencing were required on State Road 29 in order to approve constructing the SR29/I-75 interchange. Four of these crossings have been completed and again, no panthers have been killed in areas protected by the crossing-fence combination, but some panthers have died just beyond the fencing extents. Wildlife crossings and right-of-way fencing have made highways permeable to panthers and other animals (Foster and Humphrey 1995, Lotz et al. 1997); however, high costs ($350,000 – 500,000 per structure and fencing) make it impractical to fully protect all highways that pass through areas occupied by panthers.

STUDY AREA

Florida panthers occur only on the southern peninsula of Florida, ranging from Everglades National Park in extreme southeastern Florida to a northern limit of Interstate 4 between Tampa and Orlando. From the 1980s to the present, only male panthers have been documented north of the Caloosahatchee River that courses from Lake Okeechobee to Ft. Myers. South of the Caloosahatchee River, panthers utilize a contiguous system of private and public lands, including Big Cypress National Preserve and Corkscrew Regional Ecosystem Watershed in the northwest and western regions, Okaloacoochee Slough State Forest in the north central region and Everglades National Park to the southeast (Figure 1).

Florida's climate is tropical south of Lake Okeechobee and humid subtropical north of the lake (Henry et al. 1994) and is characterized by alternating wet seasons (May through October) and dry seasons (November through April). Upland plant communities include pine flatwoods, hardwood hammocks, and prairies. Wetland communities include mixed swamp hardwoods, cypress swamps, freshwater marshes, and everglades sawgrass marshes (Davis 1943, Duever et al. 1985). There are extensive areas of human-altered habitats including improved pasture, agriculture (row crops, sugarcane, and citrus) and urban/developed land uses.

Our study focused on six major panther use areas: 1) Corkscrew Regional Ecosystem Watershed (CREW), 2) Florida Panther National Wildlife Refuge (FPNWR), 3) Okaloacoochee Slough State Forest (OKSLOUGH), 4) Big Cypress National Preserve north of I-75 (NE BCNP), 5) Big Cypress National Preserve (BCNP) south of I-75, and 6) Everglades National Park (ENP) (Figure 1). Maintaining contiguity among these large, protected habitat blocks is essential for long-term persistence of panthers. In fact, three of the areas, OKSLOUGH, CREW, and ENP are largely dependent upon panther immigration to support the local numbers; ENP and CREW each can support less than 10 panthers and without immigration, local extirpation will occur (Maehr and Bass 1991). Florida panthers have been documented through radio-telemetry observations moving among these habitat blocks, and in doing so, these panthers encounter many miles of roads.

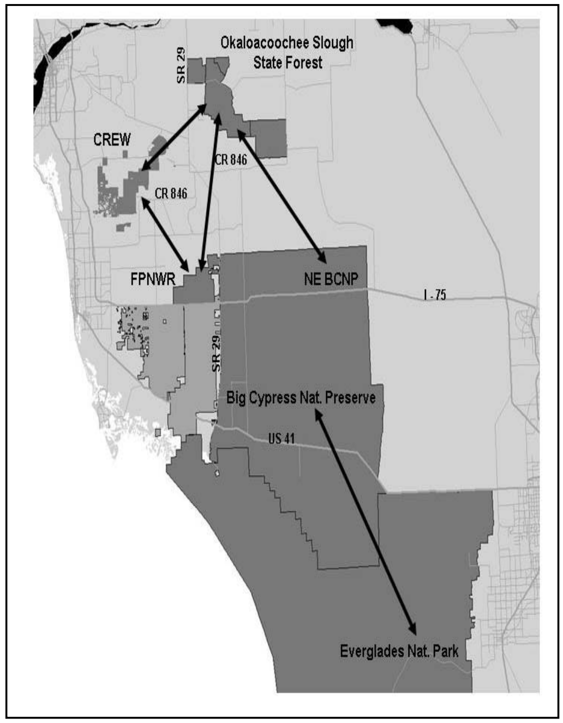

Figure 1. Study area map of southwest Florida showing areas used for least cost pathways analyses.

Major roads and highways course between our six panther use areas; these range from rural 2-lane county roads, 2-lane state highways, a 2 lane US highway and an interstate highway. The more important of these roads include County Roads (CR) 850 (Corkscrew Road), CR 858 (Oil Well Road), CR 846 (Immokalee Road), CR 832, CR 833, State Road (SR) 29, SR 82, US 41 (Tamiami Trail), and Interstate 75 (I-75). Fifty-nine of 73 panther roadkills or injuries prior to July 2004 occurred on these roads (Land et al. 2004).

METHODS

We used a geographic information system (GIS) (ARCINFO version 8.01 (ESRI TM) and the GRID extension) to conduct least cost path (LCP) analyses among our geographic areas of interest. Such a model balances habitat suitability, minimum Euclidean distance, and connectivity between the two endpoints (Walker et al. 1997) by accumulating habitat suitability scores along a predefined cost surface map to find the least cost solution or "pathway" from the destination endpoint back to the original source. We constructed our cost surface map by reclassifying a habitat map based on how easily a panther can travel through each type of habitat and combining the reclassed map with other maps representing impediments to panther movements. Higher costs were associated with road networks or areas of permanent water. Areas adjacent to higher density urban areas or classified as high density urban were removed from the analysis creating holes in our continuous cost surface not allowing a LCP to be developed through heavily populated and surrounding disturbed areas. Pathways were then constructed by finding the easiest travel route (the least cost) between areas of interest.

Wildlife biologists from FWC and the National Park Service monitored radiocollared panthers approximately every other day (M, W, F) from fixed-winged aircraft (Land et al. 2004, Jansen et al. 2004). The aircraft were flown at low altitudes and the target panther was located by homing in on the signal (White and Garrott 1990: page 42-45). Directional antennae were mounted on each wing strut and a switch box allowed the researcher to listen to either or both antennae. Most flights were conducted between 0700-1000 hours. A point estimate of the panther's location was transferred to a 1:24,000 USGS topographical map and the Universal Transverse Mercator coordinates were recorded either from the map or from mapping software (Maptech, Andover, MA). Location accuracy was 115 m ± 29.7 based on differences between aerial locations and actual locations of 36 panther dens or carcasses (Land et al. 2004).

Florida panther radio-telemetry records collected between February 1981 and March 2001 ($n = 55{,}542$) were selected. Of these, 46,685 records were used to determine habitat use and to associate telemetry locations with habitat types. Fixed kernel home ranges (Worton 1989) were calculated with the software program KERNELHR (Seaman et al., 1998) using the least squares cross-validation (LSCV) method for choosing the kernel smoothing parameter. Home ranges were calculated ($n = 81$) for radiocollared panthers >2 years old and for which >50 radio-locations were determined. The age limitation was applied to ensure individuals were independent of their mothers and to reduce the effect of dispersing juveniles on home ranges. The criterion for minimum number of locations follows the recommendation of Seaman et al. (1999) to reduce the effects of small sample sizes on the kernel estimator.

Compositional analysis (Aebischer et al., 1993) was then used to identify the proportions of habitat types within the fixed kernel home ranges that differed from the proportions of habitats within the entire study area. All land cover types within the original data were not represented in each of the home ranges, thus land cover types were combined to 20 categories to reduce the effects of inflated Type I error rates on our results. If the proportions of habitats differed ($p < 0.05$; PROC GLM, SAS Institute Inc., 1999), land cover types were ranked according to the number of positive differences between habitat pairs. Paired t-tests were then used to determine differences ($p < 0.05$) between ranked habitats. The ranking scheme developed through this analysis was applied to the 2003 landcover grid for our study area resulting in the habitat suitability grid (Table 1).

We reclassified the habitat suitability grid to create an initial cost surface map by applying the conversions (Table 2). Ranked

Table 1. Habitat suitability ranks used in the landscape linkage model. Ranks ranged from 0-10 with higher ranks indicating a greater likelihood of use by dispersing panthers. 2003 South Florida Landcover data was generalized into 20 habitats.

Habitat Score[a]	General Habitat suitability reclassification over type	2003 cover type
0	Water	Open Water
1	Coastal strand	Coastal Strand
		Coastal Salt Marsh
		Mangrove Swamp
		Tidal Flat
		Beach
	Tropical hammock	Tropical Hardwood Hammock
	Urban	High impact urban (highly reflective, high density urban, commercial, airports, etc)
		Low impact urban (golf course, low density urban)
3	Exotic plants	Brazilian Pepper
		Australian pine
		Melaleuca
		Exotic Plant Communities
	Extractive	Extractive
4	Crop land	Row/Field crops
		Sugarcane
	Orchards/groves	Citrus
		Other ag (other groves, nurseries and vineyards, specialty farms, aquaculture, fallow crop lands)
5	Shrub and brush	Shrub and Brushland
	Shrub swamp	Shrub Swamp
6	Hardwood-pine forest	Mixed Hardwood-Pine Forest
	Grassland/Pasture	Dry Prairie
7	Grassland/Pasture	Improved pasture
		Unimproved/woodland pasture
		Grassland
8	Barren	Bare Soil/Clearcut
9	Cypress swamp	Cypress Swamp
	Cypress swamp or Hardwood-pine forest	Cypress - Pine- Cabbage palm (transition between moist upland and hydric sites)
	Freshwater marsh	Freshwater Marsh and Wet Prairie
		Freshwater marsh dominated by cattail
		Freshwater marsh dominated by sawgrass
	Hardwood swamp	Hardwood Swamp
		Wetland Forested Mixed (mixture of hardwoods and conifers)
	Pine forest	Pinelands
	Sand pine scrub	Sand pine scrub
10	Hardwood forest	Hardwood-Cabbage Palm Hammock
		Upland Hardwood Hammock
	Xeric Oak Scrub	Xeric Oak Scrub

[a]Score of 2 not used because the habitat type was not represented in our study area. Grassland/Pasture divided into habitat score of 6 and 7 based on cover type.

habitat suitability scores were inverted to create cost scores allowing the most suitable habitat to be the least cost (i.e., habitat suitability score of 1 became a high cost of 10 and habitat suitability score of 10 became a low cost score of 1). However, we separated urban landcover into three different cost values: high impact, low impact and extractive. High impact urban areas are those areas where no appreciable native vegetation remains and are typical of cities and industrial areas. We excluded these high impact areas plus a 300 m buffer around such areas from our cost surface map. Extractive and Low Impact Urban areas were given the cost score of 10. Water and roads were assigned cost values of 15 and 20 respectively, indicating a relatively high accumulating cost for travel along or through either of these features. Wildlife crossings were given a 0 value allowing free passage under the roadways.

We modeled five pathways to connect the three high use panther habitat blocks with the three peripheral areas described above. The five connections are 1) from ENP to southern BCNP, 2) from FPNWR to CREW, 3) from FPNWR to OKSLOUGH, 4) from BCNPNE to OKSLOUGH, and 5) from OKSLOUGH to CREW. We did not model pathways that would connect areas north and south of I-75 because of the existing wildlife crossings and barrier fencing installed along the 40-mile stretch of I-75. We also did not model all possible connections between high use panther habitat blocks within our study area. We designated key highway segments where LCP's and road intersections occurred, buffered by 1 km to each side. Overlapping highway segments were joined to produce a single key segment.

RESULTS AND DISCUSSION

We generated 22 LCPs between the six major panther use areas representing optimal routes for panther movements and identified 17 key highway segments where LCP's intersect highways (Figures 2, 3). LCPs and key highway segments generally agreed with documented panther movement patterns, high-density home range patterns and roadkills (Figure 4). A third of the panther roadkills and injuries fall along the length of key road segments, all but one occurring within the past 7 years.

For many of the paths we modeled, path segments were funneled into single routes

Table 2 Cost values used in the landscape linkage model were derived by inverting the habitat suitability ranks (FWC, 2003). Cost values for ranked habitats ranged from 0-10 with lower scores indicating a greater likelihood of use by dispersing panthers. Water and Roads were valued 15 and 20, respectively, indicating barriers that panthers must navigate but at a much higher cost. High impact urban lands plus lands within a 300 m buffer were excluded from the analysis.

Landcover Type	Cost	Landcover Type	Cost	Landcover Type	Cost
Roads	20	Shrub swamp	6	Hardwood swamp	2
Water	15	Hardwood-Pine forest	5	Cypress swamp/ Hardwood-pine forest	2
Low Impact Urban	10	Grassland/Pasture	4	Freshwater marsh	2
Coastal strand	10	Barren	3	Hardwood forest	1
Tropical hammock	10	Sand Pine Scrub	2	Xeric Oak Scrub	1
Exotic plants	8	Pine forest	2		
Cropland/Orchards/ Groves/Citrus	7	Mixed Hardwood Swamp	2		
Shrub and brush	6	Cypress swamp	2		

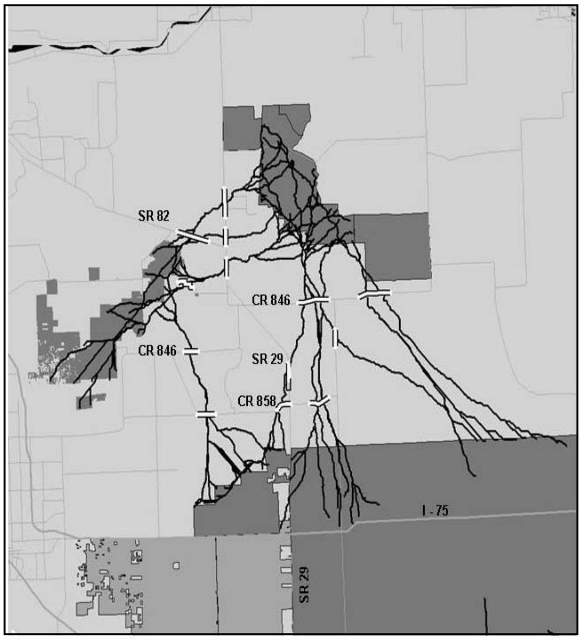

Figure 2. Least cost pathways and key highway segments among Florida Panther NWR, Big Cypress National Preserve, Okaloacoochee Slough State Forest and the Corkscrew Regional Ecosystem Watershed (CREW). Key highway segments are represented as white highlighted areas along highways.

where diverse or fragmented landscapes exist offering few optimal path options. These paths snake along the best single-cell pathway solution balancing favorable habitat, shortest distance, and encountered impediments. In this heterogeneous environment one might expect to see a 'funneling effect'. Multiple paths modeled between same or similar locations come together where favorable habitat exists accumulating the lowest cost between origin and destination. These paths intersect roads at similar locations highlighting key stretches of highway where panthers are likely to come into contact with vehicles. Mapped routes or linkages between high use panther areas, regardless of whether they intersect improved roads, provide regional planning opportunities to protect and/or restore key panther movement routes.

LCP models in a homogeneous landscape composed of favorable habitat and fragmented by relatively few impediments, such as those between BCNP and ENP origins and destinations, returned a less discriminating pathway. In a homogeneous landscape with few impediments, each surrounding cell has a similar 'habitat/connectivity' cost and causes little deviation from the Euclidean distance between origin and destination. South of I-75 the landscape is fairly uniform with respect to supporting panther movements. A single model run where multiple points of departure were selected resulted in numerous 'relatively straight' paths between origins and destinations. Few to no funneling effects were created by the homogeneous habitat characteristics. Although much of the area is conducive to panther travel, management of a large area to minimize panther collisions with vehicle is not practical. Fortunately, this area has also had few documented panther roadkills over the years.

As expected, most LCPs were composed of favorable panther habitat. LCP models select for habitats with the least cost to a panther's health and welfare. However, LCP/road intersections between OKSLOUGH and CREW and OKSLOUGH and BCNPNE shared habitat compositions that consisted of a higher percentage of disturbed lands (i.e., citrus, croplands, rangelands) considered less favorable panther habitat by our cost surface. LCP analysis takes into consideration best routes across the larger landscape. In these instances, the best routes intersected roads at areas that may seem unlikely when viewed at a local scale but their importance becomes apparent with a landscape-level analysis. Given a panther's propensity to maintain large home ranges and travel frequently throughout the extents of these ranges, these results are not surprising.

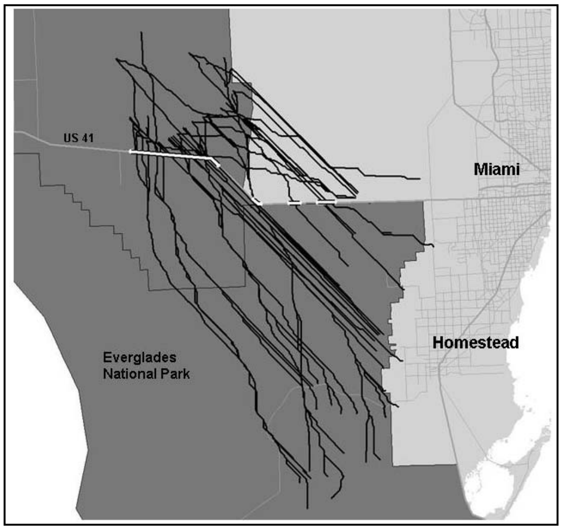

Figure 3. Least cost pathways and key highway segments (highlighted in white) between Everglades National Park and Big Cypress National Preserve.

CONCLUSION

We found that LCP analyses are useful in identifying key landscape linkages between major panther use areas vital to maintaining a viable metapopulation of the Florida panther in southwest Florida. Current population viability analyses suggest that we have a minimally viable panther population today, but with the current trends in habitat loss, the panther's future may become less certain. Panthers require a large landscape, both for individuals and the population, necessitating landscape-level approaches to identify conservation threats. Our LCP approach appears to have utility for aiding such conservation planning. Using the LCP landscape approach, we identified 17 key highway segments including one that explained why a number of roadkills occurred in an area of lower quality panther habitat. Increases in traffic volume, increasing size of highways (lanes), and habitat alterations adjacent to key road segments may jeopardize the panther's ability to cross highways and may ultimately isolate some areas of panther habitat. Mitigation (wildlife crossings, fencing) will be necessary to maintain a connected landscape in areas identified by LCP's when changes to roads or adjacent habitats are proposed.

Agreement among our least cost pathways, groupings of panther/vehicle collision sites, and overlapping fixed kernel home ranges boosts our confidence in employing LCP analysis for identifying key highway segments. Preserving or restoring habitat on either side of a crossing and connecting those lands within a corridor provide a degree of certainty to maintaining routes to and from these high use panther areas. These areas can be prioritized for future conservation and/or mitigation needs.

LCP analyses are useful for "big picture" landscape evaluations but do not necessarily identify all key panther vs. highway conflict areas. Many panther roadkills were not captured by our key highway segments, including a cluster of roadkills on CR 846, west of our key highway segment. These highway segments, identified solely by roadkills, appear to be used by panthers as they travel within their home range, but do not appear to serve as travel pathways as

Figure 4. Key highway segments, least cost pathways, and panther roadkills (1972-2004). Panther roadkills are represented by circles.

panthers move outside of their home range or for dispersal. Panther roadkill data should continue to be collected to augment LCP and other landscape analyses used for future highway projects conservation planning.

We also recommend LCP analyses to examine areas considered for panther reintroductions or for other similar wide-roaming species that exist as metapopulations. Assuming that habitat needs are known well enough to construct a cost surface, LCP analyses can identify how panthers may move through a new landscape, including where those movements may encounter existing highways. We are finalizing a more thorough report on this work and it will be available for download from www.panther.state.fl.us under the Reports section in the near future.

LITERATURE CITED

AEBISCHER, N. J., ROBERTSON, P. A. & KENWARD, R. E. 1993. Compositional analysis of habitat use from animal radio-tracking data. Ecology, 74: 1313-1325.

DAVIS, J.A. 1943. The natural features of southern Florida. Geographic Bulletin No. 25, Florida Geological Survey, Tallahassee, Florida, USA.

DUEVER, M.J., J.E. CARLSON, J.F. MEEDER, L.C. DUEVER, L.H. GUNDERSON, L.A. RIOPELLE, T.R. ALEXANDER, R.L. MYERS, AND D.P. SPANGLER. 1985. The Big Cypress National Preserve.National Audubon Society, New York, New York, USA.

FOSTER, M. L. AND S. R. HUMPHREY. 1995. Use of highway underpasses by Florida panthers and other wildlife. Wildlife Society Bulletin 23(1): 95-100.

HENRY, J.A., K.M. PORTIER, AND J. COYNE. 1994. The climate and weather of Florida. Pineapple Press, Sarasota, Florida, USA.

LAND, E.D., D. SHINDLE, M. CUNNINGHAM, M. LOTZ, B. FEREE. 2004. Florida Panther Genetic Restoration and Management Annual Performance Report 2003-2004. Florida Fish and Wildlife Conservation Commission. Tallahassee, Florida. USA.

LOTZ, M.A., E.D. LAND AND K.G. JOHNSON. 1997. Evaluation and Use of Precast Wildlife Crossings by Florida Wildlife. Proceedings of the Annual Conference of Southeastern Association of Fish and Wildlife Agencies 51:311-318.

MAEHR, D. S., R. C. LACY, E. D. LAND, O. L. BASS JR., AND T. S. HOCTOR. 2002. Evolution of population viability assessments for the Florida panther: a multi-perspective approach. Pages 284-311 *in* Beissinger, S. R., and D. R. McCullough, editors. Population viability analysis. University of Chicago Press, Chicago, Illinois, USA.

MAEHR, D.S. AND O.L. BASS JR. 1991. Do recent panther deaths in Everglades National Park suggest an ephemeral population? National Geographic Research and Exploration 7:427.

SAS INSTITUTE. 1999. SAS/STAT user's guide. SAS Institute, Cary, North Carolina, USA.

SEAMAN, D. E., B. GRIFFITH, AND R. A. POWELL. 1998. KERNELHR: a program for estimating animal home ranges. Wildlife Society Bulletin 26:95-100.

SEAMAN, D. E., J. J. MILLSPAUGH, B. J. KERNOHAN, G. C. BRUNDIGE, K. J. RAEDEKE, AND R. A. GITZEN. 1999. Effects of sample size on kernel home range estimates. Journal of Wildlife Management. 63(2):739-747.

SHINDLE, D., M. CUNNINGHAM, D. LAND, R. MCBRIDE, M. LOTZ, AND B. FERREE. 2003. Florida Panther Genetic

Restoration and Management Annual Report 2002-03. Florida Fish and Wildlife Conservation Commission. Tallahassee, Florida. USA.

WALKER, R., CRAIGHEAD, L. 1997 Least-Cost-Path Corridor Analysis: Analyzing Wildlife Movement Corridors in Montana Using GIS. 1997 ESRI User's conference Proceedings.

WHITE, G.C. AND R.A. GARROTT. 1990. Analysis of wildlife radio-tracking data. Academic Press, San Diego, California, USA.

WORTON, B.J. 1989. Kernel methods for estimating the utilization in home-range studies. Ecology, 70 (1): 164-68.

YOUNG, S. P., AND E. A. GOLDMAN. 1946. The puma - mysterious American cat. Dover Publications Incorporated, New York, New York, USA.

U.S. FISH AND WILDLIFE SERVICE. 1995. Second revision Florida panther recovery plan. Atlanta, Georgia, USA

U.S. FISH AND WILDLIFE SERVICE. 1999. South Florida multi-species recovery plan. Atlanta, Georgia, USA.

GENE FLOW AMONG MOUNTAIN LION POPULATIONS IN THE SOUTHWESTERN USA

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Mountain Lion Workshop 8:201

Abstract: We examined the effects of habitat discontinuities on genetic structuring in mountain lions (*Puma concolor*) across the southwestern USA. Using 16 microsatellite loci, we genotyped 540 mountain lions sampled throughout the states of Utah, Colorado, Arizona, and New Mexico, where a high degree of habitat heterogeneity provides for a wide range of connective habitat configurations between subpopulations. Our analyses revealed genetic structuring at two distinct scales. First, strikingly strong differentiation between northern and southern regions within the study area suggests little migration between them. Second, within each region, gene flow appears to be strongly limited by distance, particularly in the presence of habitat barriers such as open desert and grasslands. Northern mountain lions showed both reduced genetic diversity and greater divergence from a hypothetical ancestral population based on Bayesian clustering analyses, possibly reflecting a post-Pleistocene range expansion. The results presented here build on those of previous studies, and begin to complete a picture of how different habitat types facilitate or impede gene flow among mountain lion populations.

EXPLORING SOURCE-SINK DYNAMICS OF WYOMING COUGAR POPULATIONS

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Mountain Lion Workshop 8:202-203

Abstract: The Cougar Management Guidelines Working Group, consisting of cougar (*Puma concolor*) experts from throughout North America, recently proposed managing cougars in terms of source or sink subpopulations, where areas exhibiting positive growth would be considered a source and those exhibiting negative population growth would be considered a sink. As a first step toward this effort, we developed a cougar habitat use model to delineate suitable cougar habitat and evaluated model predictions using historic harvest locations (1997-2005). We then plotted female harvest locations (1999-2005) relative to suitable cougar habitat predicted by the model to identify unexploited cougar habitat in Wyoming (i.e., defacto refuges or potential source areas). We developed a cougar habitat use model following the resource selection function approach of Manley et al. (2002) using cougar GPS locations (≤6/night) collected in the Snowy Range, southeast Wyoming, from 10 cougars (Nov-May, 1999-2001) representing the range of sex and age (subadult, adult) classes and well distributed throughout the population. We treated individual cougars as the experimental unit and applied stepwise AIC (Venables and Ripely 2002) logistic regression analyses to select model parameters. Variables considered for model development included distance to edge (timber and tall shrub), distance to the forest-grassland interface (defined as ecotone), slope, aspect, elevation, vegetation type, and whether or not the location was within cover or within the ecotone. Ecotone was selected for all 10 models, distance to edge for 8 of 10, slope for 7 of 10, and aspect, elevation, vegetation type, and within ecotone were selected for 5 of the 10 models evaluated, while within cover and interaction terms were rarely or never included. We selected the best global model based on model performance when applied to historic statewide cougar harvest locations and found the model including ecotone, distance to edge, and slope performed as well or better than the more complex models. Thus far, we have evaluated 3 mountain ranges including the Bighorn Mountains and the Snowy and Laramie Ranges in east-central Wyoming and found high-use areas predicted by the model included 85-98% of cougar harvest locations, depending on the area examined. Model predictions of suitable cougar habitat relative to female harvest locations from the past 6 years suggest adequate refuge

areas exist in the Laramie and Snowy Ranges; these areas are inaccessible due to land ownership and limited road access. Some unexploited habitat sufficient to sustain adult females also occurred in the Bighorns, but unexploited habitat was relatively less extensive than other 2 mountain ranges. Efforts will continue to delineate suitable cougar habitat and evaluate refuge areas statewide, but completion will depend upon adequate vegetation layers to provide the necessary resolution (30m x 30m; e.g., Landsat data).

MOVEMENT PATTERNS OF MALE AND FEMALE COUGARS (*PUMA CONCOLOR)*: IMPLICATIONS FOR HARVEST VULNERABILITY

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Mountain Lion Workshop 8:204

Abstract: Prior to 1996 the use of hounds was permitted to hunt cougars in Washington State and since then and the approval of Voter Initiative I-655 the use of hounds was banned for hunting cougars. Harvest data shows a preponderance of male cougars in the harvest prior to 1996 and a preponderance (~60%) of young-aged females in the harvest after hound hunting was made illegal. Conventional understanding is that hound hunters select for males because hunters have the opportunity to assess the sex and trophy quality of cougars that are treed, which allows hound hunters to select for male cougars. Since hound hunting was banned hunters purchased permits along with other big game permits and harvest of cougars has been either incidental to hunting other species or by using predator calls or stalking cougars in snow. This harvest strategy is considered, by some, to provide hunters with little opportunity to select sex and age of cougars harvested. We analyzed movement data from 22 cougars that were marked with GPS collars and have obtained > 16,000 GPS locations in western Kittitas County Washington. Movement data from GPS locations show different travel patterns for male and female cougars. Males, which show greater distance traveled per day and larger home range areas, may be more vulnerable to hound-hunters who drive roads and search large area to search for cougar tracks for hunting. Females, on the other hand, occupy smaller home ranges and use space more intensively and may be more vulnerable to harvest by hunters who search smaller areas more intensively while hunting deer or elk. Differences in home range size and daily movements may account for differences in sex and age of cougars harvested by hunters who use hounds or those who kill cougars incidental to hunting other big game species.

CONSERVATION STRATEGIES FOR COUGARS IN RIVERSIDE COUNTY, CALIFORNIA: FROM MODELS TO MANAGEMENT

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Mountain Lion Workshop 8:205

Abstract: The conservation of wide-ranging carnivores depends critically on planning efforts that consider the habitat requirements of a species at multiple spatial scales. To maximize their utility, these efforts should rely on models constructed and validated using empirical data collected at scales relevant to animal behavior. In southern California, cougar (*Puma concolor*) populations persist in areas increasingly dominated by human influence. Often, habitat features only tenuously connect these populations, and man-made barriers to movement are common. To model suitable habitats, core areas, and landscape connectivity for cougars in this region, we applied data from field studies to a 35,000-km^2 landscape that included all of Riverside County. Results from these studies included information on cougar response to vegetation, topography, and roads at three spatial scales. Although our models identified sizable amounts of suitable habitat, many of these areas provided few key resources, were highly fragmented, and were separated by features that inhibited cougar movement. Circuit-theoretic models of connectivity identified multiple pathways where landscape resistance was minimized by the preservation of important core areas. Our results suggest that regional efforts to conserve and manage cougars should reflect the scale-dependent patterns of selection exhibited by this species. Our hope is that models such as ours will be used by Riverside County in the development of a multi-species habitat conservation plan to preserve areas for cougars and other sensitive species.

MOUNTAIN LIONS IN AN URBAN LANDSCAPE: EFFECTS ON MOVEMENT, GENE FLOW, AND SURVIVAL

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Mountain Lion Workshop 8:206

***Abstract**:* Urbanization results in the widespread loss and fragmentation of natural habitat and can have substantial effects on wildlife, particularly for wide-ranging species such as carnivores. The largest carnivores, such as mountain lions (*Puma concolor*), represent the most difficult challenge for wildlife conservation in urban areas because they have the greatest spatial needs and may also come into conflict with humans. Since 2002, we have been studying the behavior, ecology, and conservation of mountain lions in Santa Monica Mountains National Recreation Area, a national park next to Los Angeles. Roads and development have affected lion movements as lions have learned to reach isolated fragments of habitat and to use underpasses to cross freeways and secondary roads. No monitored lions have yet crossed the largest freeway, although they have been located near it. The barrier effects of development can also lead to long-term population isolation and gene flow reduction. The 5 lions genotyped from this area, when compared with lions genotyped from throughout the state, fall clearly within a genetic group stretching up the coast to the San Francisco Bay Area. They are not closely related to other lions in southern California that are nearer by distance but are across the Los Angeles Basin. In the fall of 2004, two adult lions died from anticoagulant poisoning after spending their last few weeks in the most urban parts of their range. These lions may have acquired the toxins, commonly used as rodenticides worldwide, from preying on coyotes. In the late summer of 2004, four kittens were born in the Santa Monica Mountains. Using implanted transmitters we hope to monitor their survival and dispersal to further understand lion conservation in a challenging urban landscape

POSTER PRESENTATIONS

COUGARS AND CITIZEN SCIENCE: EVALUATING ACCURACY OF DATA COLLECTED BY STUDENT VOLUNTEERS ON COUGAR ECOLOGY-PRELIMINARY FINDINGS

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Mountain Lion Workshop 8:209

Abstract: Field investigations of cougar (*Puma concolor*) often face challenges stemming from budget limitations and staffing shortages. Citizen science is the use of trained volunteers to collect scientific data and information on wildlife and their habitats as a means to meet research and management objectives. If citizen science is to be accepted as a viable resource to assist wildlife biologists in cougar research and management activities, questions of data quality must be addressed. As part of an ongoing investigation of citizen science data quality, we evaluated the ability of 3rd, 5th, and 8th grade student volunteers from the Cle Elum/Roslyn School District to collect accurate scientific data and information on cougar ecology as part of the Washington Department of Fish and Wildlife's Project CAT (Cougars and Teaching). Students were evaluated setting up and completing winter track transect surveys and spring habitat plots. Citizen scientists and researchers conducted 100 meter track transect surveys during the winter from student homes in an attempt to characterize wildlife distribution (focusing on cougar prey species) in different densities of residential development. In the spring, students and researchers quantified and characterized wildlife habitat in the Project CAT study area focusing on attributes of ungulate ecology and winter range. Student citizen scientists received eight hours of training for set up and completion of winter work and 5 hours for spring habitat plots. Training was provided in the classroom and field by teachers with advanced training provided by *NatureMapping* Program partners and project researchers. We used paired t-tests, frequency distributions, and descriptive statistics to compare citizen scientist and researcher datasets. Preliminary results of the Year 1 winter and spring evaluations indicate the ability of student citizen scientists to set up experiments and collect accurate scientific data are variable. Citizen scientist datasets did not differ from researchers for several tasks, but students struggled with portions of setting up experiments, track identification, plant identification, and the concept of scientific bias. Overall, the use of K-12th grade students working as citizen scientists to assist biologists and managers with cougar research and management objectives appears to hold promise. Logistical concerns (volunteer training, coordination, and supervision) may pose a greater challenge to the use of citizen scientists in investigations of cougar than concerns of data quality. Beyond scientific data collection, the greatest benefit of utilizing students as citizen scientists stems from increased community support for, and understanding of, cougar ecology, conservation, and research objectives.

COUGARS IN OREGON: BIOPOLITICS OF A RECENT RESEARCH PROJECT

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Mountain Lion Workshop 8:210

Abstract: In 2001 we initiated research on the potential causes of low elk (*Cervus elaphus*) calf recruitment in portions of northeast and southwest Oregon. We hypothesized elk calf recruitment was being depressed because of poor nutritional condition of cow elk resulting in low pregnancy rates, neonatal calf mortality, and winter starvation versus predation on calves, mostly from cougars (*Puma concolor*). Like many research projects conducted by state wildlife agencies, ours is funded primarily through the U. S. Fish and Wildlife Service (USFWS) via the Pittman Robertson Act. An important aspect of our study was to kill 50% of the cougars in 2 of our 4 study areas if we found that >50% of radiocollared calves died and that cougars killed >30% of these calves. This may have resulted in the death of up to 16 cougars in each of two study areas. We believed it was necessary to manipulate cougar populations to understand whether predation on elk calves was additive or compensatory mortality. Because of the controversial nature of our research the USFWS required us to write an Environmental Assessment (EA). The USFWS analyzed the EA and subsequently released a FONSI (Findings of No Significant Impact) and approved our federal aid contract. Shortly afterwards, 9 animal rights and environmental groups and one individual filed a lawsuit in U.S. District Court to stop our research based primarily on the NEPA process. Judge Dennis Hubel ruled that we could continue our research but could not reduce the cougar population in 2 study areas until we prepared a full Environmental Impact Statement (EIS) that addressed the environmental effects of killing cougars on their population viability. On January 6, 2003 the USFWS filed a notice of intent to appeal the ruling with the U.S. District Court; however, an appeal has not yet been filed. Research is continuing but Oregon Department of Fish and Wildlife decided not to prepare an EIS. From our experience we suggest anyone conducting potentially controversial research using Pittman Robertson funding prepare an EIS rather than an EA. The time commitment is about the same and the outcome for conducting controversial research is more certain.

MANAGING LINKS BETWEEN CARNIVORES, HUMAN BEHAVIOUR, AND LANDUSE

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Mountain Lion Workshop 8:211

Abstract: Past and present forestry activities, increasing tourism and accelerated general human use on the landscape have resulted in an increase in conflicts between carnivores and humans. The park's risk management program has identified a trend of increasing risk to carnivores, visitors and park liability. The park's main challenge is to protect regional biodiversity by conserving wolves and cougars at the landscape level while addressing public safety responsibilities. The long-term viability of carnivores may be at risk. Land use practices appear to be reducing the landscape capacity to support deer, the primary prey of wolves and cougar. Increased human use is contributing to habituation in carnivores. Carnivore-human conflicts lead to the destruction of carnivores due to public safety concerns. Large carnivores such as cougars and wolves are a fundamental ecological component of the greater Pacific Rim coastal ecosystem. The size and shape of PRNPRC is such that the ranges of large terrestrial carnivores extend beyond the park boundaries. The presentation will use Geographical Information System maps, graphs and text to illustrate trend data related to carnivore conservation and public safety issues. Elements of the park's evolving risk management strategy including operational guidelines for carnivore-human conflict management and communications efforts to address the human dimensions will be highlighted. The last component of the presentation will describe a challenging new initiative to engage multiple levels of government, First Nations, the private sector and non-governmental groups in a collaborative effort to address the land use, wildlife and human dimensions of predator-prey management.

EASTERN COUGAR SIGHTINGS: MYTH OR REALITY? REVISITING THE ISSUE

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Mountain Lion Workshop 8:212

Abstract: Committee on the Status of Endangered Wildlife in Canada (COSEWIC) recently classified the cougar (*Puma concolor*) as 'endangered' in all Atlantic Canada. A lack of information prevents us from developing any local conservation strategy to restore or protect large carnivores' suitable habitat. Thus, our objective for now is to verify where cougars remain present in Eastern Canada. We installed scent-lure posts equipped with triggered 35-mm cameras with infrared sensors in strategic locations (i.e., hotspots). We are still collecting sighting reports (and other evidences) all across the Maritimes so that we will soon be able to map cougars' movements within this mosaic landscape (i.e. forestry and agriculture). A better understanding of cougars' use of the habitat could help to define conservation plans to maintain this species in the northeastern part of its range.

Key words: cougars, sighting reports, Atlantic Canada, scent-lure posts, triggered cameras, habitat use

STATE OF PUMAS IN THE WEST: HEADING TOWARDS OVERKILL?

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Mountain Lion Workshop 8:213

Abstract: Extraordinarily asocial, at times fiercely territorial and secretive, mountain lions (*Puma concolor*) are subjected to liberal hunting and trapping regulations in western states—they are afforded few protections in the states were they persist. Yet, little population data exist. Although highly charismatic and important in top-down ecosystem regulation, few governmental or nongovernmental entities expend resources to protect, much less study them because of the expense. Add to that, growth and sprawl and roads contribute to their direct or indirect mortality. States must take steps to protect mountain lions in the near future to avoid their extirpation. Between 1982 and 2003, western states showed a four-fold increase in sport hunter lion kills across the West. The upward trend is particularly noteworthy in Idaho, Colorado, Utah, and Montana for the years 1997 to 2001—although both Colorado and Montana have recently taken steps to curb hunting quotas. The upward trend is particularly noteworthy in Idaho, Colorado, Utah, and Montana for the years 1997 to 2001—although both Colorado and Montana have recently taken steps to curb hunting quotas. In contrast, most other western states (Arizona, Idaho, Nevada, New Mexico, Oregon, Texas, Utah, and Washington) through politically appointed wildlife commissions or through state legislatures, seek higher hunter-induced puma kills. States achieve these results through permissive hunting regulations such as inexpensive hunting tags, increasing the length of the hunting season, and liberalizing the number of cats hunters can take per year. It cannot be overemphasized: pumas are sensitive to overhunting and destruction of their habitat; yet, few states offer safeguards (i.e. science-based hunting quotas, protections for females and their young, and timely reporting of hunter success) to prevent overkill of pumas.

BEAST IN THE GARDEN: A PARABLE IN SUPPORT OF ANACHRONISTIC THINKING REGARDING A PREDATORY ANIMAL

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Mountain Lion Workshop 8:214

Abstract: David Baron's Beast in the Garden: A Modern Parable of Man and Nature uses sloppy methodology, takes leaps in logic, and invents history. Unfortunately Beast has succeeded in unnecessarily frightening the public and generating numerous glowing reviews. Baron argues that Boulder, Colorado's hippy-bred, animal venerating culture led to an "inevitable" mountain lion attack on a young man in Idaho Springs. Wildlife lovers on Boulder's rural-urban interface encouraged deer into their unhunted "gardens". The "increasing" deer population attracted lions (the "beast") closer to human habitants. He maintains humans created habituated cats. In other words, Boulder's culture of animal/nature reverence killed Lancaster. Beast's fundamental underpinnings are easily contested, unsound ethical reasoning further compounds the book's flaws, and Baron makes several unsupported historic claims. While David Baron believes that his book is a "balanced" account, it leaves the discerning reader questioning his intent. Beast in the Garden comes rife with inaccuracies and inventions, an anti-predator bias, and a failure to provide critical information. Beast's anachronistic thinking returns us to the turn-of-the-nineteenth century, the time when the dominant American culture-conservationists included-believed that predators were evil and ravenous and we (and deer) were innocent victims.

COUGAR CAPTURE METHODOLOGIES, DOCUMENTED RESULTS, AND CAPTURE EVENT BEHAVIORAL TRENDS: FROM A TEAM OF HOUND-SCIENCE VOLUNTEERS SUPPORTING KEY PACIFIC NORTHWEST WILDLIFE RESEARCH PROJECTS

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Mountain Lion Workshop 8:215

Abstract: This presentation depicts the Hound-Science team's cougar capture event results during more than 300 man-days of volunteer effort from March 2002 thru December 2004. The team provided hound capture services for state Fish & Wildlife Departments' research projects in southwest Oregon and central Washington. Day to day hunting conditions, depending on season, ranged from dry ground, to periods of light and heavy precipitation, to deep snow. Hounds were deployed using various transportation methods including motor vehicles (pickups), snowmobiles, and on foot handlers. From 51 tracks started, a total of 47 cougar were treed of which 29 were sedated. Thirteen, of those sedated, immediately jumped from the tree after injection (8 female, 5 male). All 13 were located on foot by Hound-Science team members using a single leashed hound. The poster will visualize hound-science capture methods, will correlate capture event results with the level of effort required, and will attempt to show cougar behavioral patterns associated with capture events. The presentation is intended to provide information for enhancing project safety and efficiency by wildlife management personnel either involved in or planning for cougar research. It will also provide general information for others interested in the species.

COUGAR-INFORMED SPATIAL FRAMES AND CONTROL FOR AUTOCORRELATION IN ANALYSES OF HABITAT SELECTION

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Mountain Lion Workshop 8:216

Abstract: Researchers have long struggled with a conceptual basis for specifying spatial frames for analyses of habitat selection. The long-standing issue of control for spatial autocorrelation has also been exacerbated by newly available short-interval GPS animal locations. We developed an approach to specifying spatial frames and controlling for spatial autocorrelation based on measures of performance for models of habitat selection that used all available data. We first determined 50, 67, 75, 90, 95 and 99% quantiles of distances between GPS locations obtained at 4-hour intervals for individual cougars radiocollared in the Flagstaff uplands of Arizona. We buffered each cougar location by radii corresponding to each quantile and randomly located a paired point within each different-sized buffer. Each cougar location and random point was attributed with explanatory variables, including terrain roughness index, elevation, habitat cover type, distance to nearest road and distance to nearest water source. We specified logistic regression models for each variable, a different model each for random points from the different buffer sizes. We used area under the Receiver Operating Characteristic curve (ROC), R^2, and Akaike's Information Criterion (AIC) to determine which model corresponding to which buffer size best discriminated between random points and cougar locations for each variable. By inference, the buffer size associated with the best model represented the spatial scale at which cougars were maximally discriminating for the corresponding variable. This scale varied among cougars, variables, and seasons, suggesting that there was no single best spatial frame for specifying the extent of "available" habitat for cougars, although all best models used random points from quantiles >90%. We controlled for spatial autocorrelation by using values of each variable that were lagged 1-10 time steps prior (i.e., autologistic regression). We only used values from prior steps 1, 4, 7, and 10 (4, 16, 24, and 40 hrs prior) to minimize effects of collinearity among explanatory variables. Correlations among lagged variables dropped below 0.2 within 3 time steps, hence the 3-step interval between lagged variables. Almost all best models included values from at least 1 prior time step.

RECENT COUGAR CONFIRMATIONS IN THE MIDWEST AS DOCUMENTED BY THE COUGAR NETWORK

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Mountain Lion Workshop 8:217

Abstract: Since 2003, the Cougar Network has been consulting with wildlife agencies, universities, and other wildlife biologists to collect definitive evidence of cougar (*Puma concolor*) presence in the Midwest. This poster presentation will showcase the Cougar Network's efforts to document cougars east of their established range and discuss cougar potential in the Midwest. Examination of "hard evidence" such as cougar carcasses, DNA, and pictures, all of which are verified as to origin, has indicated that cougars are now showing up in the Midwest where they have been extirpated for more than a century. The Cougar Network has documented 21 apparently wild (i.e., not former captive) cougar confirmations in 9 Midwestern states and 1 province during August 2003-February 2005. Strict scientific evidence has yet to be presented which indicates that cougars are truly re-colonizing the Midwest. However, several of these and earlier confirmations have been carcasses of younger male cougars that may be dispersers from established western populations. Although suitable dispersal habitat likely exists along major river corridors, it is uncertain whether breeding populations could become established due to higher philopatry and shorter dispersal distances of females. Further, potential habitat quality and spatial requirements of suitable habitat for cougars in the Midwest is entirely unknown. Although prey species such as white-tailed deer (*Odocoileus virginianus*) are plentiful throughout the Midwest, cougars would face several important challenges (e.g., vehicle-caused mortality) to successful re-colonization and establishment. Regardless, we conclude that wildlife agencies and the general public must be prepared for the potential that cougars could eventually return as a component of Midwestern landscapes.

EXAMINING MOUNTAIN LION (*PUMA CONCOLOR*) DISPERSAL IN YELLOWSTONE NATIONAL PARK USING GPS/SATELLITE COLLARS

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Mountain Lion Workshop 8:218-219

Abstract: As habitats become increasingly fragmented dispersal and population connectivity become more pressing to conservation biology. However, information on dispersal behavior and how it is affected by landscape characteristics is needed. This knowledge gap is largely due to the difficulties associated with gathering data on individuals while they are dispersing. When examining large carnivores, such as mountain lions (*Puma concolor*), this problem is particularly acute due to the large spatial scales on which they operate and the unpredictability of their movements. Large-scale movements limit the value of VHF radio-telemetry, which usually provides only a handful of post-dispersal locations, if any. In order to examine mountain lion dispersal movements at finer spatial scales we are deploying store-on-board GPS collars that periodically download their data to Argos satellites, which researchers can then receive remotely. This allows the dispersing mountain lion to be monitored despite the size of its movements or the remoteness of the area which it is in. In Yellowstone National Park we placed two GPS/Satellite collars on two 21–month–old male cougars to examine the feasibility of documenting dispersal behavior. Both collars were set to acquire one GPS location per day and download data to an Argos satellite every 9 days. Since deploying the collars in March 2004, we have downloaded 107 locations covering 674.4 kilometers of movement on one male and 135 locations covering 636.5 kilometers of movements on his brother. Straight-line distance from male M169's most recent location to the center of his natal range was 121.6 kilometers. In that time he traveled through three states: Montana, Wyoming, and Idaho. Straight-line distance from male M177's current location to the center of his natal range is 47.5 kilometers. Clusters of points have led to the discovery of two of M177's kills. While no concerted effort was made to locate kills through this means during the pilot study, this technology shows much promise for that application. Already the data from these collars has supplied a level of detailed movement information far beyond any we have been able to acquire with traditional radio-telemetry. We intend to examine mountain lion dispersal in the Greater Yellowstone Area with the following objectives: 1) document characteristics of dispersal in the Yellowstone cougar population including rate, survivorship, temporal-spatial patterns, and the effects of natural and anthropogenic factors, and 2) incorporate data collected from objective one into a predictive model to identify areas of importance for population connectivity, potential areas of cougar/ human conflicts, and assess the contribution of Yellowstone cougar emigrants to the surrounding meta-population. Using satellite systems to relay location data appears to be an effective way of examining mountain lion dispersal movements, especially in areas such as

the Greater Yellowstone; where fairly large, contiguous wilderness puts relatively less restriction on disperser movements and lower access for researchers.

IDENTIFYING HUMAN-CAUSED MOUNTAIN LION KILL HOTSPOTS IN THE AMERICAN WEST

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Mountain Lion Workshop 8:220

Abstract: Mountain lions (*Puma concolor*) remain the sole large carnivore with viable populations throughout much of the American West, and play an important role in maintaining the integrity and diversity of a variety of ecosystems. Since the management of mountain lions by state wildlife agencies is undertaken primarily through the regulation of mortality, conserving mountain lion populations throughout their range requires a detailed understanding of mortality distribution and trends. In recent decades, growing interest in mountain lions as a trophy game species and increasing conflicts between mountain lions and livestock, pets and humans, have led to a rapid escalation in human-caused mortality of lions. As a result, the number of mountain lions killed by humans in recent years has reached the highest levels reported since 1900 in nearly all the Western U.S. states. We compiled mortality data provided by state wildlife agencies by type (e.g. sport hunting, depredation, public safety, and unspecified) and report on mortality trends in 11 western states, with a focus on the ten-year period from 1992 to 2001. Because state and management units differ markedly in size and amount of suitable mountain lion habitat, to standardize kill rates we utilized available projections of mountain lion habitat and estimated the number of kills per 100 square miles of suitable mountain lion habitat. We then compared these densities of kills to identify which geographic areas within the 11 western states have the greatest concentrations of human-caused mortality. Finally, we provide several recommendations based on our findings.

COMPARISON OF ANNUAL FIXED KERNEL HOME RANGE ESTIMATES OF COLLARED COUGARS (PUMA CONCOLOR) FROM VHF AERIAL TELEMETRY AND GPS COLLAR LOCATIONS

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Mountain Lion Workshop 8:221

Abstract: We compared the annual fixed kernel home range size of collared cougars in Upper Kittitas County from plotting VHF Aerial Telemetry locations and Global Positioning System (GPS) collars programmed to record locations 4 – 6 times/day, 7 days/week. Between 2001-2004 we acquired 362 VHF Aerial Telemetry and over 14,000 GPS locations on 13 cougars. Using ArcView 3.2 (Environmental Systems Research Institute, Inc.) and Animal Movement SA v2.04 beta Extension, we calculated the annual fixed kernel home range size for each cougar from Aerial Telemetry and GPS locations separately. We compared the advantages and disadvantage of conventional Telemetry and GPS collars. From the GPS collar locations we also calculated fixed kernel home ranges to determine seasonal patterns for male and female cougars.

DEVELOPMENT AND TESTING OF NON-INVASIVE GENETIC SAMPLING TECHNIQUES FOR COUGARS IN YELLOWSTONE NATIONAL PARK

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Mountain Lion Workshop 8:222

Abstract: Estimating population size is important to the conservation and management of most carnivore species. Many carnivores, including cougars (*Puma concolor*), are difficult to study due to their low densities and secretive nature. Non-invasive genetic sampling (NGS) has great potential as a tool for population enumeration and monitoring, but to date has not been adequately tested and developed for use on cougars. The Yellowstone Cougar Project provides a unique opportunity to evaluate NGS methods because of the existence of a "known" population of radio-marked cougars and the high percentage of the total number of individuals (estimated 87%) that are collared in the study area. In January 2003, we initiated a study to test and develop NGS methods. Two methods of sample collection were chosen: 1) snow backtracking was used to find hair and scat along tracks and at bed and kill sites, and 2) hair-snagging stations (hair pads) were used to obtain hair. The Cougar DNA Project focuses on three main questions: 1) Which of the two methods is the better method for obtaining DNA samples using non-invasive methods?; 2) How intensive must sampling be in order to collect samples from a sufficient number of individuals to accurately reflect the true population size?; 3) How reliable is the genetic data that is derived from these samples? During the first sampling period, January-March 2003, field crews established and maintained 365 hair-pad stations, conducted track surveys covering over 950 km, and collected a total of 71 hair samples and 16 scat samples. During December-March 2004, field crews established and maintained 40 hair-pad stations, conducted track surveys covering over 1250 km, and collected a total of 129 hair samples and 18 scats. Backtracking successfully yielded hair or scat samples ~80% of the time when tracking conditions were favorable. The results from the Cougar DNA Project could provide managers with reliable protocols for establishing population-monitoring programs.

FEASIBILITY OF EXTRACTING FLORIDA PANTHER DNA FROM SCATS

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Mountain Lion Workshop 8:223

Abstract: The Florida panther (*Puma concolor coryi*) formerly inhabited much of the southeastern United States but today is restricted to the south Florida peninsula and is listed as an endangered species. Early genetic work revealed that Florida panthers had lower numbers of polymorphic alleles and low heterozygosity when compared to western *Puma*. Florida panther genetic restoration was implemented in 1995 as a result of population viability analyses that predicted panther extinction based on continual erosion of genetic variability common to small, isolated populations. Field collection of panther scats is a non-invasive technique that could potentially offer the safest and most cost effective tool for censussing numbers of panthers, measuring population genetic health, and identifying the origins of *Puma* sign found outside of core panther areas. We evaluated the use of panther scats as a source of DNA samples for on-going genetic monitoring. Nine scats were collected in 4 months from 404.8 km of transects, established on existing trails of four different management areas, for an average of 1 scat per 45 km traveled. Conversely, 17 scats were collected opportunistically while performing other field activities, primarily during scheduled panther capture and recollar efforts, during a 6-month period. Sixty percent (21 of 34) of the scats collected yielded viable panther DNA (felid microsatellite PCR product). Existing tissue samples were used to calibrate and verify the utility of extracting and analyzing DNA from scats. Preliminary genetic analyses on these tissue samples have shown the ability to identify Florida panthers, segregate individual panthers into various groupings based on amount of genetic material derived from Texas puma and provide discrete measurements of individual allelic diversity and heterozygosity. DNA extraction from scats may complement or eventually replace handling live panthers if the only need is to assess population genetic characteristics. Because Florida panther scats were infrequently encountered along transects, we suggest opportunistic collection while conducting other field activities may prove more efficient than standard survey routes.

UTILIZING CAPTIVE COUGARS IN CONSERVATION EDUCATION EFFORTS IN SOUTHERN CALIFORNIA

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Mountain Lion Workshop 8:224

Abstract: With the human population in Southern California continually on the rise resulting in loss and fragmentation of natural habitat, the challenges of mountain lion conservation become increasingly magnified. Live animal programs are powerful vehicles for reaching people and can serve research, education and conservation agendas well. As human habitat increases pressure on wildlife habitat public education programs become a valuable platform for dissemination of conservation information. The Nature of Wildworks (NOWW) Wildlife Education Center in Topanga, California houses a variety of non-releasable native birds, mammals and reptiles including four mountain lions. The animals are presented in on-site and outreach public education programs. Our cougar education began with groundbreaking work at the Los Angeles Zoo during the development of the Wild in the City Program, an on-site live animal theater presentation, featuring two cougars, teaching the inner city population ways to live cooperatively with wildlife. This program now continues in outreach fashion for schools and other venues The foundation of our educational activities is the California State Assembly Bill 1548, which mandates that environmental education now be a part of students curriculum. In coalition with the Mountain Lion Foundation and local non-profits, On-The-Edge programs are also presented to adult populations living adjacent to wilderness areas.

PERCEPTIONS AND ATTITUDES ABOUT MOUNTAIN LION AS A LIVESTOCK PREDATOR IN THE "CAÑON DE SANTA ELENA", CHIHUAHUA, MEXICO

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Mountain Lion Workshop 8:225

Abstract: When human activities are harmed by wildlife, a conflict between these two actors arises. This scene becomes more complex when it happens in a protected natural area, where goals of conservation and productive interest, like the livestock industry coexist. Our objectives were: 1) to describe the perceptions and attitudes of the Santa Elena ranchers towards pumas and 2) to determine if these perceptions are related to the puma damage assessed in each studied farm. We used interviews, surveys and local workshops. We found most ranchers have a very strong negative perception about the puma as a livestock predator, independently of its real impact. This perception is originated mainly by the livestock attacks, and in smaller proportion by the attacks to game species, and even to human attacks. Some positive values are recognized for this predator, for example as a regulator of potentially harmful species. Also, it was detected that the rancher perception agreed with the puma damages; nevertheless, the hostile actions towards this species were independent of its real impact evaluated on each flock. Finally, the puma is not seen as a permanent problem, although it can become important according to the season of the year, and also to the social and economic conditions of each producer. Our conclusion is that the social impact of the puma in the Santa Elena is located in an upper-middle scale of importance; nevertheless, it was not detected as the most serious problem for the local livestock industry. The management recommendations to reduce this conflict are centered in environmental education campaigns at different levels, and in the construction of reliable databases about predation events.

MOUNTAIN LION RESEARCH IN NORTHEASTERN COLORADO – TESTING NEW GPS (GLOBAL POSITIONING SYSTEMS) TECHNOLOGY

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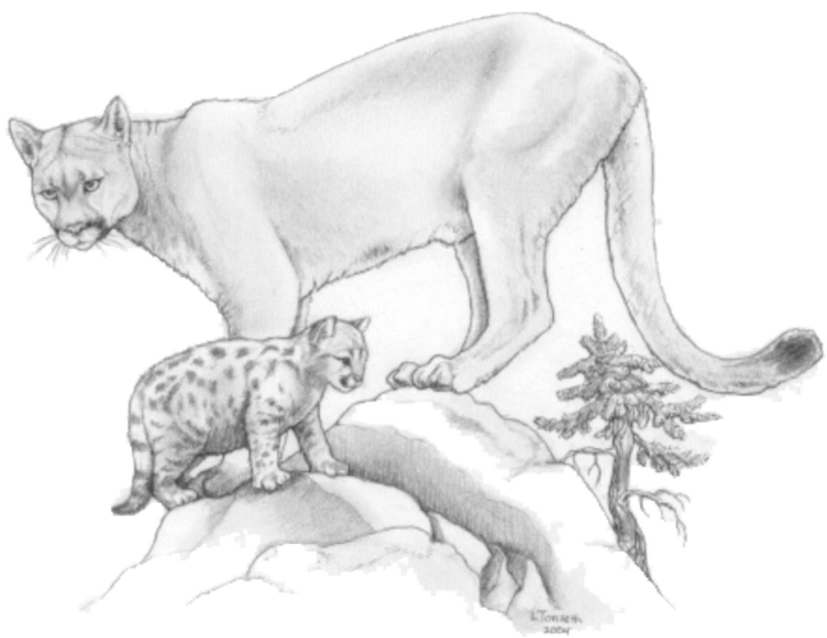
Mountain Lion Workshop 8:226

Abstract: An interagency collaboration has been established in northeastern Colorado to coordinate and integrate ongoing mountain lion (*Puma concolor*) research. Two main areas of study are underway. One focus is on the role of mountain lions in chronic wasting disease (CWD) ecology. Surveys conducted since 1996 have provided data on CWD prevalence in mule deer (*Odocoileus hemionus*) and the potential effects of selective population control on infection rates. Our current study tests the hypothesis that mountain lions prey selectively on mule deer infected with CWD. The other focus of study is on developing techniques for capturing and monitoring mountain lions in national parks. This study aims to learn more about the general ecology of the mountain lion in and around Rocky Mountain National Park. We are conducting research to better understand the value and appropriateness of new tools and techniques for mountain lion capture and monitoring. GPS-collared mountain lions from the prey selection study will aid in assessing the effectiveness of non-invasive techniques. In conjunction with this work, we are evaluating new technology in Global Positioning Systems (GPS) tracking of animals (Lotek Wireless, Newmarket, Ontario and H.A.B.I.T. Research, Victoria, British Columbia) that allows location data to be downloaded remotely without retrieval of collars either from the field or via ARGOS satellite transmission. The time expenditure to field-test new innovations in GPS technology often becomes a trade-off with what is gained by increasing ease in obtaining data. A cost analysis, both with money and field time, allows researchers to see the benefits of testing and evaluating technology as it progresses.

List of Participants



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