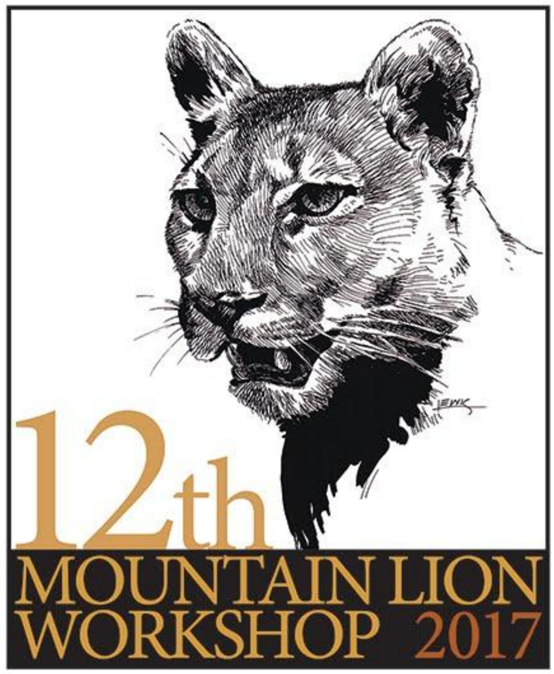
PROCEEDINGS OF THE 12TH MOUNTAIN LION WORKSHOP

A Synthesis of Management and Research Findings



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PREFACE

Chronology of Mountain Lion Workshops:

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11th Mountain Lion Workshop – Cedar City, Utah
12th Mountain Lion Workshop - Estes Park, Colorado

The 12th Mountain Lion Workshop was held in Estes Park, Colorado from May 15-18, 2017. The workshop theme was: A Synthesis of Management and Research Findings.

This meeting was structured to ensure that managers from WAFWA's member agencies and beyond had opportunity to share relevant information and gain additional perspective and knowledge to strengthen their ability to monitor and manage this incredible wild felid. Workshop attendees were treated to presentations on population monitoring, genetics, mountain lion-human relationships, harvest management, biology and ecology. To stimulate thoughts about the current state of mountain lion management across the continent, a presentation that provided a synopsis of a questionnaire on agency programs was presented early the first day of meetings.
Two panel discussions challenged the audience to think broadly, including one on stakeholder perspectives about lions and their management, and a second that focused on interactions with lions and management of conflict and depredation. An evening session on May 16th featured posters, a meet and greet with vendors, and a social hour. This gathering exceeded expectations for attendance, with 22 posters and 3 vendors present; the room was overflowing with attendees and was a smashing success!

Jerry Apker, Colorado Parks and Wildlife Carnivore and Furbearer Program Manager, delivered the keynote address. Jerry's presentation was introspective and insightful, and based on decades of work as an agency manager; he challenged the audience to work collaboratively toward a common goal of managing lions in the future. Jerry's observations on agency workings, political aspects of mountain lion management and advocacy, and the relevancy of lion management to greater society were thought provoking. Although Jerry retired on June 30, 2017, his seasoned perspective on living with and managing mountain lions will continue to serve the professional community.

The organizing committee met multiple times in the year leading up to the workshop, selecting session topics, generating the agenda and contacting participants to ensure a successful meeting. We are indebted to the following individuals for chairing sessions: Mathew Alldredge, Jerry Apker, Kristin Cannon, Loren Chase, Stephanie Durno, Mark Elbroch, Holly Ernest, Brian Kertson, and Jay Kolbe. Matt Eckert and Elizabeth Dowling provided additional assistance during the meeting. Gwen Jordan and Danielle Williams supplied administrative support.

The YMCA of the Rockies provided our workshop venue, which treated attendees to a spectacular view of the Rocky Mountains on a campus where meeting, lodging, and dining facilities were conveniently co-located. We thank the YMCA staff that provided technical assistance when needed and was responsive to all of our logistical needs.

There were 206 registered workshop participants, representing entities from across North America, Latin America, and the British Isles. We received $27,840 in registration fees (many of them late registrations), contributions, sponsorships, and vendor fees. We expended $21,374.26, which left us with $6,465.74 that was applied to the conference wrap-up and the balance sent to WAFWA. The current balance in the Mountain Lion Workshop account ($16,780.72) is available as start-up money to assist with costs of hosting the next workshop. The 13th mountain lion workshop will be hosted by Oregon Department of Fish and Wildlife. Dates and location of that workshop are still to be determined.

12th Mountain Lion Workshop:
A Synthesis of Management and Research Findings
Hosted by Colorado Parks and Wildlife

May 15–18, 2017
Estes Park, Colorado

Agenda

Mon. May 15	
4:00 p.m.+	Arrival, registration, East Portal & Bible Point rooms, Emerald Mountain Lodge
6:00–8:00	Meet & Greet, East Portal & Bible Point rooms, Emerald Mountain Lodge, Dinner 5–7 p.m. in Aspen or Walnut dining halls
Tues. May 16	
8:00 a.m.+	Registration
8:00–8:10	Welcome: Craig McLaughlin, Chairman, the *12th Mountain Lion Workshop*, Colorado Parks & Wildlife
8:10–8:45	Keynote address: *Managing Lions: Fandom– Irony– Anachronism* Jerry Apker, Carnivore and Furbearer Manager, Colorado Parks & Wildlife
	Session 1: **MOUNTAIN LION/FELID POPULATION MONITORING** Moderator: Jay Kolbe, Montana Fish, Wildlife & Parks
8:45–9:05	*Evaluating noninvasive survey methods for cougars in northwest Wyoming* by Peter Alexander, Eric Gese, Dan Thompson, Mark Elbroch, and Howard Quigley
9:05–9:25	*Screaming in the woods: Noninvasive techniques for estimating cougar densities* by Mathew Alldredge and Tasha Blecha
9:25–9:45	*A long-term evaluation of biopsy darts and DNA to estimate cougar density: An agency–citizen science collaboration* by Richard Beausoleil, Joseph Clark, and Benjamin Maletzke
9:45–10:05	*A multi-method approach to estimating jaguar & puma density: Integration of home range data into a noninvasive genetic sampling approach* by Anthony Giordano
10:05–10:20	**Break**
10:20–10:40	*Integrating population monitoring and modeling methods to enable an adaptive harvest management strategy for mountain lions in Montana* by Jay Kolbe, Kelly Proffitt, Josh Nowak, and Hugh Robinson
10:40–11:00	*Estimating mountain lion abundance in Arizona 2004–2015* by Frances Peck, April Howard, and Matthew Clement
11:00–11:20	*Estimating puma densities from camera trap data using generalized spatial partial identity models* by Christopher Rowe, Ben Augustine, and Marcella Kelly

11:20–11:40 *Mule deer abundance, cougar home range size, and predator–prey density across a climatic gradient in the Intermountain West* by David Stoner, Joseph Sexton, Heather Bernales, David Choate, Jyothy Nagol, Kirsten Ironside, Kathleen Longshore, and Thomas Edwards

11:40–12:00 *Standarization of cougar population metrics* by Richard Beausoleil

12:00–1:00 **Lunch**– Aspen or Walnut dining rooms

1:00–1:40 **Session 2**: **JURISDICTIONAL MOUNTAIN LION MANAGEMENT SURVEY** by Jerry Apker, Colorado Parks & Wildlife

Session 3: **MOUNTAIN LION GENETICS & GENOMICS**

Moderator: Holly Ernest, University of Wyoming

1:40–2:00 *Interactions between demography, genetics, and landscape connectivity increase extinction for a small mountain lion population in a major metropolitan area* by John Benson, Peter Mahoney, Jeff Sikich, Laurel Serieys, John Pollinger, Holly Ernest, and Seth Riley

2:00–2:20 *Genomic assessment of mountain lions within an urbanized landscape* by Roderick Gagne, Patricia Solerno, Daryl Trumbo, Walter Boyce, Winston Vickers, Seth Riley, Sue VandeWoude, Chris Funk, and Holly Ernest

2:20–2:40 *Statewide genetic analyses identify mountain lion populations and barriers to gene flow in California and Nevada* by Kyle Gustafson, Walter Boyce, Winston Vickers, Becky Pierce, Vernon Bleich, Marc Kenyon, Seth Riley, Chris Wilmers, Tracy Drezenovich, Roderick Gagne, and Holly Ernest

2:40–3:00 *Quality control measures reveal substantial effects of genotyping errors on DNA-based mark–recapture results* by Michael Sawaya, Colby Anton, Mirjam Barrueto, Anthony Clevenger, Howard Quigley, Toni Ruth, Daniel Stahler, and Chris Wilmers

3:00–3:20 *Landscape genomics of mountain lions on the rural Western Slope and urban Front Range of Colorado* by Daryl Trumbo, Patricia Solerno, Ken Logan, Mathew Alldredge, Kevin Crooks, Sue VandeWoude, and Chris Funk

3:20–3:35 **Break**

3:35–4:50 **Panel Discussion**: **STAKEHOLDER PERSPECTIVES**

Moderator: Loren Chase, Arizona Game & Fish

Panelists: Bill Canterbury (Cougar hunter & houndsman, Colorado), Patt Dorsey (State Wildlife Agency, Colorado Parks & Wildlife), Patrick Knackendoffel (Ungulate hunter, Colorado), Penelope Maldonado (The Cougar Fund), Delia Malone (Sierra Club), Steve Wooten (Rancher, Colorado)

4:50–6:00 Dinner 5–7 p.m. in Aspen or Walnut dining rooms

6:30–8:30	**Session 4**: **Posters, Vendors, Social** in Aspen Glen room, Emerald Mountain Lodge Organizer: Stephanie Durno, Colorado Parks & Wildlife

Wed. May 17

8:00 a.m.+	Registration
8:00–8:10	Announcements: Craig McLaughlin, Workshop Chairman
	Session 5: **Mountain lion–Human Relationships** Moderator: Mathew Alldredge, Colorado Parks & Wildlife
8:10–8:30	*Community management of jaguars and pumas: multi-stakeholder processes and methods* by Ronit Amit
8:30–8:50	*Puma-human interactions in Brazil: A review of depredation causes and management practices* by Fernando Cesar Cascalli de Azevedo
8:50–9:10	*Spatio–temporal and demographic drivers of cougar predation behaviors in an urban–rural gradient* by Kevin Blecha and Mathew Alldredge
9:10–9:30	*Conducting research and conservation efforts for jaguars and mountain lions on ranchlands in the southwestern U.S.: A model for communication and coordination with the ranching community* by Lisa Haynes, Melanie Culver, Susan Malusa, Kirk Emerson, Aaron Lien, George Ruyle, Laura Lopez Hoffman, Howard Quigley, Rafael Hoogesteijn, and Harley Shaw
9:30–9:50	*Gaps of knowledge in recovery actions for jaguars (Panthera onca) in Mexico* by Mircea Hidalgo Mihart, Octavio Rosas-Rosas, Rodrigo Nunez Perez, Carlos Lopez Gonzalez, and Diana Friedeberg
9:50–10:10	*Social acceptance and Florida panther management– Is there a sweet spot?* by Darrell Land, Kipp Frohlich, and Carol Knox
10:10–10:25	**Break**
10:25–10:45	*Landscape and habitat use for a large carnivore in the city: Use and selection for mountain lions around Los Angeles* by Seth Riley, John Benson, and Jeff Sikich
10:45–11:05	*Evaluating potential for human and mountain lion conflict in Big Bend National Park* by Price Rumbelow, Patricia Moody Harveson, Louis Harveson, Bert Geary, Catherine Dennison, and Raymond Skiles
11:05–11:25	*Conserving mountain lions in southern California: Addressing fragmentation, conflict, and excess human-related mortality in comprehensive and collaborative ways* by Winston Vickers, Kathy Zeller, Trish Smith, Brian Cohen, Holly Earnest, Kyle Gustafson, Patrick Huber, Doug Geremenga, Valarie McFall, Niamh Quinn, Lynn Cullens, Jessica Sanchez, and Walter Boyce
11:25–12:25	Lunch– Aspen or Walnut dining rooms

12:25–1:40	**Panel Discussion**: **HUMAN–LION INTERACTIONS AND CONFLICT & DEPREDATION MANAGEMENT** Moderator: Kristin Cannon, (District Wildlife Manager, Colorado Parks & Wildlife) Panelists: Mathew Alldredge (Wildlife-Human Interactions Scientist, Colorado Parks & Wildlife), Loren Chase (Social Scientist, Arizona Game & Fish), Martin Lowney (Wildlife Conflict Manager, A.P.H.I.S., Wildlife Services, Colorado), Valerie Matheson (Urban City Manager, Colorado), Jerrie McKee (Urban District Wildlife Manager, Colorado Parks & Wildlife), Fernando de Azevedo, Latin American Representative, Brazil)
	Session 6: **MOUNTAIN LION HARVEST MANAGEMENT** Moderator: Brian Kertson, Washington Department of Fish & Wildlife
1:40–2:00	*Impacts on survival of cougars caught as non-targets in foothold traps* by Alyson Andreasen, Carl Lackey, Jon Beckmann
2:00–2:20	*Can increased quota harvest redistribute human caused cougar mortality in Alberta?* by Paul Frame
2:20–2:40	*Anthropogenic mortality levels shape the characteristics of a lightly hunted cougar population in western Washington* by Brian Kertson
2:40–2:55	**Break**
2:55–3:15	*Effects of hunting on a mountain lion population on the Uncompahgre Plateau, Colorado* by Kenneth Logan
3:15–3:35	*Mountain lion management in western North America: >100 year retrospective* by Steven Torres, Heather Keough, Justin Dellinger, and Marc Kenyon
3:35–3:55	*Evolving mountain lion management in the West: Applying science with human values* by Kenneth Logan
	Session 7: **MOUNTAIN LION BIOLOGY & ECOLOGY** Moderator: Mark Elbroch, Panthera
3:55–4:15	*The role of native prey restoration in reducing livestock depredation by puma (Puma concolor) and jaguar (Panthera onca) in Sonora, Mexico* by Ivonne Cassaigne and Rodrigo Medellin
4:15–4:35	*New insight into utilizing bone marrow to assess the health of mountain lion prey* by Jacob Kay and James Cain III
4:35–4:55	*Re-colonization of bears in the Great Basin and resulting species interactions: Effects on cougar predation behavior and implications for prey* by Jon Beckmann, Carl Lackey, Pat Jackson, and Alyson Andreasen
6:00–8:00	BBQ in the Assembly Hall

Thurs. May 18

8:00–8:10	Announcements: Craig McLaughlin, Workshop Chairman
	Session 7 continued: **MOUNTAIN LION BIOLOGY & ECOLOGY**
	Moderator: Mark Elbroch, Panthera
8:10–8:30	*Scaredy cats and the big bad wolf: How intraguild competition influences home range selection in a subordinate predator* by Anna Kusler, Mark Elbroch, Howard Quigley, and Melissa Grigione
8:30–8:50	*Preliminary predation patterns of cougars and wolves in an area of sympatry* by Elizabeth Orning, Katie Dugger, and Darren Clark
8:50–9:10	*Foraging behavior of coyotes under intraguild predation risk by cougars: An experimental approach* by Julie Young and Peter Mahoney
9:10–9:30	*Spatial ecology and survival of mountain lions on private lands in west Texas* by Catherine Dennison, Patricia Moody Harveson, Bert Geary, and Louis Harveson
9:30–9:45	**Break**
9:45–10:05	*Mountain lion social organization* by Mark Elbroch, Michael Levy, Mark Lubell, Howard Quigley, and Anthony Caragiulo
10:05–10:25	*Spatial and temporal shifts in cougar presence in the Midwest in response to changing management regimes* by Michelle LaRue, Brent Pease, and Clay Nielsen
10:25–10:45	*Retroviral infections among North American mountain lions (Puma concolor)* by Jennifer Malmberg, Simona Kraberger, Elliott Chiu, Justin Lee, Ryan Troyer, Melody Roelke, Mark Cunningham, Winston Vickers, Walter Boyce, Erin Boydston, Laurel Serieys, Seth Riley, Ken Logan, Mathew Alldredge, Chris Funk, Kevin Crooks, and Sue VandeWoude
10:45–11:05	*Vertebrate diversity benefitting from carrion provided by mountain lions* by Michelle Peziol, Mark Elbroch, Connor O'Malley, and Howard Quigley
11:05–11:15	**Final remarks**: Craig McLaughlin, Workshop Chairman
11:15–11:30	**Business meeting**: Craig McLaughlin, Workshop Chairman Choose host for the *13th Mountain Lion Workshop* in year 2020.
11:30	**Adjourn**

KEYNOTE ADDRESS – Jerry Apker, Colorado Parks and Wildlife

Managing Lions: Fandom – Irony – Anachronism

I like to watch TED talks and I often wish I could deliver a presentation as smooth and effective as do those folks. Sadly, this isn't a TED stage and I will be speaking from my notes. In my talk this morning it is my hope to encourage you to absorb what others have learned and experienced, to think large and creatively about how we manage and research lions, and I hope to challenge some of our conventional thinking about lion management and research.

Let's begin with some definitions of the terms used in the title of my talk. I start here because too often when we speak, we are well along in the conversation before we learn that there is no communicating going on at all; absent a common language we are just talking past one another.

Fandom. The fans of a particular person, thing, team, fictional series, etc., regarded collectively as a community or subculture. (Here in Colorado we often collectively refer to Bronco Land or Bronco Mania. Either way – you get the point.) When we talk about mountain lion management we know that we must deal with the diversity of interest groups, and that most have strong feelings about lions. That is a big problem with fandoms; they can easily morph into fanaticism, and fanaticism can be dangerously electric.

Some view lions with high esteem and assign elevated status to lions above other wildlife species. Some folks feel emotional or spiritual value with lions. In my career I have at times referred to these folks as environmentalists, which is grossly inaccurate. Or, I might use the more tortured but specifically accurate phrasing of species advocacy constituents or the easier: species NGOs. But, if I am in a particularly sour mood I just call them puma groupies.

In order to get the electricity of lion management flowing we know that there must exist two poles; and indeed there is. The other pole as relates here are the interest groups that perceive large carnivores of all types more negatively. The agricultural sub-genre is the livestock producers. A related fandom with similar negative perceptions we refer to as big game hunters, which is a misnomer because in many jurisdictions lions are big game, what we are really talking about is the rising fandom of deer hunters. To be completely fair, since I revealed my downer label for lion supporters, the derogatory term I've used for those that hold negative views of lions are rednecks or, considering this much more scientific than average audience, I've also called them felinophobes a time or two.

As you know, the list goes on to include houndsmen, predator callers, other agencies, local governments, and so on. It is tempting to think of these folks as less fanatical for their respective interests, but I know some houndsmen and predator callers that nearly live for the chase or the opportunity to hunt and they are no less vigorous in asserting those interests as those previously named.

We know that as managers we ought to apply and address Stephen Kellert's typology of human attitudes as relates to lions and that the failure to do so often results in increased controversy and the marginalizing or disenfranchising of one group or another. Utilitarian and moralistic perspectives clash over the proper use of animals while negativistic and humanistic perspectives clash over caring for animals.
All that is just a fancy way of saying that wildlife managers stand between the poles of these clashes and seek a way through. If you know anything about the conduction of electricity you know that being grounded when you touch the wire is going to get you a shock.

I cannot speak to how events transpired in California, Oregon, or Washington that resulted in prohibiting or restricting the manner in which lions can be hunted. Here, in Colorado we have some vivid examples of just how badly you can get shocked – with ballot initiatives and lawsuits.

First, a 1992 citizen-initiated ballot measure passed with 70% voting in favor to eliminate spring and summer bear seasons and prohibited hunting bear with bait or dogs. Bounce forward a few years and citizens passed by a narrower margin a 1996 ballot measure about trapping methods. Both of these events had roots in various fandoms feeling disenfranchised and/or intransigent by some or all of the parties.
I would like to circle back around to this concept of fandom in a moment, but for now let's move on before I stretch the electrical metaphor too far.

Irony. There are two definitions here that I believe are applicable in lion management. First: Irony is the incongruity between the actual result of a sequence of events and the normal or expected result.

I don't think I'm the only manager that has been struck by the increasing evidence that a stable, comparatively older lion population structure may result in fewer human-lion interactions, fewer game damage conflicts, and even, perhaps, fewer events of ungulate predation. More simply stated, contrary to expectation, lower lion harvest might equal fewer conflicts with lions.

Many of us, myself included, remain suspicious of the theory, partly because evidence for it is correlative not causative, but I also struggle to break the bonds of my belief that fewer lions must equate to fewer conflicts. I might concede that on the journey of getting from say 4,000 lions to 2,000 lions, perhaps conflicts would increase as we caused social disruption and reduced the age structure of the population. But, in the end, using my hyperbolic example, logic suggests that 50% fewer lions would yield a considerable reduction in human-lion conflicts. The question of should we do this and why would we is a separate matter I will touch on later.

But, my current rationalization goes like this: how can we possibly sustain the same number of lions in the face of 4 million more people living here in the next 20 years. The expected human population growth in Colorado and all the related development that comes with it, cannot possibly allow us to maintain current lion abundance without continually increasing amounts of lion conflicts. Increasing lion conflicts will reduce human tolerance for lions and result in political backlash. Therefore, certainly we should increase public education efforts aimed toward avoiding or mitigating conflicts, but we should also kill lions and reduce populations, thereby avoiding the inevitable backlash and consequences for the agency and for lions.

There are two competing ironies here: the stable lion social structure theory and the kill more lions in order to maintain lions theory. One is predicated on some evidence and the other is predicated, for sure on some beliefs, but also on 30+ years of pragmatic experiences. Some of you may dismiss those political consequences but I have personal experience that they are very real and can be very painful for an agency that wants to maintain its ability to manage wildlife. And, those consequences may very well result in fewer lions than an approach that seeks to better manage social tolerance.

I suggest that one other irony of lion management is found in the difficulty of studying and learning more about lions. As a species, their survival relies in being really good at being really hard to observe and because they live at low densities research projects are plagued by small sample sizes and many have been designed as observational studies in which correlation not causation is the conclusion. Add to this the interventions and pressures applied by the various fandoms… it is damned hard to craft truly experimental cross over studies that are adequately scaled in space and time. The irony here is that to learn more we need to actually experiment with wild lion populations. Yes, that means killing some individuals while we experimentally manipulate a population. It is ironic to me that some, including our own higher education institutions have opposed such research, and other outside pressures either refuse or combat permissions, by various means. Or, they want quick and easy answers which largely confirm the preconceived notions of the protectionist or the utilitarian; each group is complicit in wanting confirmation of their opinions.

Circling back to the matter of small sample sizes, the danger of small sample sizes and poor study design has been increasingly exposed in medical studies. I recently read Richard Harris' book, *Rigor Mortis: How Sloppy Science Creates Worthless Cures, Crushes Hope, and Wastes Billions*.

Some examples he reports on:

Over the course of four years, 270 researchers attempted to reproduce the results of 100 experiments that had been published in three prestigious psychology journals. It turned out to be awfully hard. They ultimately concluded that they had succeeded just 39 times. The main culprits in descending order were small sample sizes, poor study design, poor data analysis, and contaminated samples.

Independently, a scientist from Amgen attempted to replicate the published findings on 53 studies thought to be highly promising in the development of some new cancer treatment medications. Out of those 53 studies the scientist could only replicate 6 even when the original researchers were involved in the replication. Here the problems were related to small sample sizes and contaminated samples.

Our temptation, as humans first and scientists second is to explain it away: "Well, that's biomedical research not field wildlife science." Or, to redirect: "You don't understand, that the scientific method is an iterative process, meant to disprove unsupported conclusions. Of course results will change over time."
There is an important lesson here; our best efforts might not be good enough, or the sample sizes are simply too small to be meaningful, or the data analysis was weak, or maybe our foolish pride is at work?

There is a second definition of irony that is relevant to our profession: Irony is a literary technique in which the full significance (or insignificance) of a character's words or actions is clear to the audience or reader although unknown to the characters.

I have felt this way quite often in my career, that somehow or other the joke is on me. While I am hurrying about the very important business of lion management, feeling like I am engaged in some herculean battle to explain some new concept or approach, to persuade top staff, or field managers, or houndsmen, or you good folks… that somehow, some greater audience is watching and laughing at my antics and sense of self-importance. And, as I think about it I begin to realize that I am the butt of the joke.

Here is why, and there are a couple reasons.

First, wildlife management just isn't that important to most people. Don't get me wrong it is a wonderful and noble endeavor. But, as I've said to several of you over the years, wildlife management is a luxury of an affluent society. Tolerated by society as a quaint activity for "those people", but not mainstream. Most people in society are just trying to get through the day, make the car or house payment and maybe have some free time with the family. Only the emotional wildlife stuff taps them on the shoulder now and then… the evening news story of bear troubles, cute shots of a gangly giraffe calf standing for the first time, a goose and her goslings crossing the busy highway, and so on.

Second, lions are neither the saints nor the demons that they are made out to be. Genus puma is, quite simply, the most successful large felid in the world. Excepting one subspecies, they are not threatened or endangered by a long shot. They don't live at high densities and thus they are not as abundant as, say deer, but they are just about as common. Extending from Patagonia to Alberta, they are certainly more widespread across the western hemisphere than mule deer.

Anachronism. When I hear this word I think of things that are about as useful as a Renaissance Festival. A person, thing, idea, or custom that seems to belong to a different time in history, or which seems to be no longer useful or applicable.
To put it bluntly, our profession and lion management in particular is increasingly an anachronism. My preceding 15 minutes or so is testimony to this. The term fandom was chosen deliberately. Each group seems to parse themselves into ever smaller sub-genres, kingdoms intent upon their own purposes but meaningfully lost to the larger picture. The real world goes about its business with bare notice of our raging debates about whether electronic calls or crossbows should be allowed. Or, whether killing a literal handful of lions in one unit or another should or should not happen. Or, whether or not a research project should be allowed to use traps or snares, or allowed to proceed at all? The rest of society barely notices us wasting time with this stuff. It barely notices the finger pointing; deer hunters blaming predators for the lack of their

preferred quarry, or rednecks railing about the loss of tiny handfuls of livestock to lions, or puma groupies using lion hunting mainly as a convenient foil for NGO fund raising activities.

This anachronism is not a recent event; it has been building within agencies, the profession, and the lion "community" for at least the past 2 decades. There are three social-political changes that could help make wildlife management more relevant and responsive to society.

1. Effectively fund agencies from all citizens of the State/Province, not just licensees.
   The current funding mechanism makes wildlife agencies primarily beholden to license buyers. Speaking from personal experience, in my 38 years with CPW I have always paid more attention, given more credence and time to hunters, trappers, and anglers than any other group. In my agency this results in tensions between resident and non-resident license buyers; but the focus remains on license buyers and because ungulate licenses generate the abundance of agency funding we have an ungulate-centric management.

2. Take concrete actions to change the agriculture commodity philosophy of wildlife management.
   For too long agencies have approached wildlife management as merely growing a harvestable surplus of crops. This approach devalues the individual animal to the level of a product to be extracted. It has proven to be especially problematic with lions when there is little or no evidence of compensation in lion mortality. Corollary to this second action is for agencies to hire and promote staff from more diverse wildlife management backgrounds. Stated bluntly, agencies need fewer good old boys (like me) in positions of policy, administration, and leadership.

   3. Agency governance could be more accountable to the actual demographics of society – not just select sub-genres.
   Wildlife related legislation should not go through Committees that are commodity centric. Eg. Agriculture, Energy, Water, or Resource Extraction. This may mean creation of new legislative oversight bodies.
   Wildlife Commission structures could better reflect the demographics of society rather than emphasizing select commodity sub-genres.

Making these things happen would be a long process, won't be easy, and would best be accomplished with close collaboration of all the fandoms. It is also Pollyanna naiveté to think that any of the above, if accomplished would somehow magically make wildlife management apolitical. Wildlife management is and always will be political because it involves issues related to managing a publicly owned resource. But, we could have governing bodies that represent a wider breadth of social interests and agency staff and leaders from more diverse wildlife backgrounds than the hook, bullet, and trap backgrounds like mine.

Lest you think my critique ends with agencies, there are also 3 ways in which each of you here in this audience today could help lion conservation succeed and be more relevant to society. None of these is any easier than the foregoing – so work hard, expect miracles, but understand; it is a process.

1. Be more transparent about our motivations and what we know and what we don't know.
   I think we tend to overstate how much we know about managing lions; we understate how much hunting can alter lion demographics. We overstate the purported "need" for managing lion abundance; and understate the ecological role that lions can and should be allowed to play in the more wild spaces of our jurisdictions. Species NGOs overstate how sensitive and essential individual lions are to the ecosystem; they understate the degree to which they are motivated by fundraising. I know this by some of my conversations with board members of these groups. Species NGOs overstate and overplay the emotional appeals about lions, and vastly overstate the impacts of hunting on species survival. And, they understate or never mention that hound hunting and trapping lions is the most selective of hunting methods, which can be used to reduce hunting impacts on females and thus on population performance. Facing facts: using the Humane Society of the United States own 2017 data on lion population extrapolations and hunter harvests, nationwide there has been average 6% harvest rate over the past 30 years. All the while, lions have begun expanding their range and presence east and northward. Not a compelling case that lion hunting is the greatest threat to the survival of the species.

2. Be open to collaborative decision making, openly sharing research and management results, and having direct conversations with each other, rednecks, science nerds, cowboys and shepherds, puma groupies, the houndsmen, and predator callers.

My caution is that all must come to the table being willing to compromise. None of you would welcome a fox in your henhouse. So, why would a rational wildlife agency welcome to the decision making table, any of the various NGOs whose mission statements indicate that they intend to eliminate lion hunting? Regulated hunting is about as dangerous to lion population survival as a Renaissance Festival is to broader American culture. So, if you wish to be at the decision making table I suggest lion hunting itself is off limits. Conversely, to the lion hunters and agencies, if wasting lion meat is legal your jurisdiction then it really is just trophy hunting. And, the NGO warfare on lion hunting may be warranted.

3. Lion ecology shows us we must think BIG; spatially and temporally.
This species transcends game management units, State, and even Federal boundaries. Our political and administrative boundaries mean nothing to the species. We should think big about management scale. We can no longer tolerate research in which as few as 8 or even 15 lions make the basis for conclusions; large enough sample sizes may mean large scale multi-agency research and management collaborations that experimentally explore some of our big questions. We must also think big about the duration of management and research experiments, 5 years seems a minimum temporal investment.

I challenge each of you here this week, and beyond, to think big about lions and together let's take some big steps forward and make a more encompassing and relevant fandom for mountain lion management.

SESSION 1: MOUNTAIN LION/FELID POPULATION MONITORING

Moderator: Jay Kolbe, Montana Fish, Wildlife & Parks

Evaluating noninvasive survey methods for cougars in northwest Wyoming

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ABSTRACT
Cougars are difficult to census due to their large home ranges, low densities, and cryptic nature. The conventional "gold-standard" method for estimating cougar abundance entails the capture, radio-tagging and enumeration of individuals in an area to produce a minimum count. While believed to be accurate, this method is logistically challenging, expensive, and usually infeasible at large spatial scales. Noninvasive survey techniques may offer the ability to both accurately and inexpensively monitor cougar populations, but remain questionable as to their accuracy and comparative cost effectiveness. We estimated the density of a cougar population in Northwest Wyoming using direct enumeration, and used that estimate as a reference with which to evaluate the accuracy and cost-effectiveness of three types of noninvasive surveys: 1) remote camera trapping, 2) winter hair-collection, and 3) scat detection dogs. We captured and GPS-tracked 13 adult cougars (males = 5, females = 8) over 3 annual periods (Sep 2010 – Sep 2013). We used proportional home range overlap to determine a mean density of 0.82 cougars/100 km^2 (± 0.10 SD; n = 3 years) in the 1,570 km^2 study area. Using spatially explicit capture recapture (SECR) models, we estimated a multi-year densities of 0.6 adult cougars/100 km^2 (95% CI = 0.3 – 1.1) from camera trapping, and 4.2 cougars/100 km^2 (CI = 2.8 – 6.7) from the scat dogs. The winter transects failed to produce a sample large enough for a density estimate. Additional analysis indicated that individual identification of cougars in photographs may not be reliable, challenging the validity of photo-based abundance estimates. Scat detection dogs were the most

cost effective method (cost-per-detection: scat detection dogs = $341; remote cameras = $3,241; winter transects = $7,627). Our results indicated that, using our methods, scat detection dogs are the most cost effective and least biased method for noninvasively monitoring cougar populations.

Screaming in the woods: Noninvasive techniques for estimating cougar densities

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Tasha Blecha, Mammals Research Section, Colorado Parks and Wildlife, Fort Collins, CO 80526; tasha.blecha@state.co.us

ABSTRACT

Estimating cougar density is a difficult, expensive and error prone task. Many estimates of cougar density come from mark-recapture studies at limited spatial scales (1,000 km^2 or less) and many represent assumed complete counts. Non-invasive genetic mark-recapture techniques present an intriguing option to estimate cougar numbers over broader spatial scales at significantly reduced expenses. However, attempts to sample cougar populations with such techniques have met with limited success, primarily because luring cougars to specific sites is unreliable at best. We developed techniques to sample cougars to specific locations using auditory calls as lures and hair snags and cameras as sampling devices. Results of this study indicate the auditory calls are effective lures to attract cougars to specific locations with detection probabilities exceeding 60% based on camera trap data. However, obtaining hair snags from cougars was less successful (<25%) and uniquely identifying cougars based on genotypes from hair samples was minimally successful (<10%). Based on these data, we were not able to estimate population density using non-invasive mark-recapture techniques. However, this sampling approach does present a unique ability to estimate cougar densities using mark-resight models and may also offer the ability to use spatially explicit approaches. This approach will provide statistically defensible estimates of cougar density, which is an improvement over count data and provides a logistically feasible alternative to intensive mark-recapture approaches.

A long-term evaluation of biopsy darts and DNA to estimate cougar density: an agency - citizen science collaboration

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Joseph D. Clark, United States Geological Survey, Southern Appalachian Field Branch, University of Tennessee, Knoxville, TN 37902

Benjamin T. Maletzke, Washington Department of Fish & Wildlife, PO Box 238, South Cle Elum, WA 98943; benjamin.maletzke@dfw.wa.gov

ABSTRACT

Accurately estimating cougar (*Puma concolor*) density is usually based on long-term research consisting of intensive capture and Global Positioning System collaring efforts and may cost hundreds of thousands of dollars annually. Because wildlife agency budgets rarely accommodate this approach, most infer cougar density from published literature, rely on short-term studies, or use hunter harvest data as a surrogate in their jurisdictions; all of which may limit accuracy and increase risk of management actions. In an effort to develop a more cost-effective long-term strategy, we evaluated a research approach using citizen scientists with trained hounds to tree cougars and collect tissue samples with biopsy darts. We then used the DNA to individually identify cougars and employed spatially explicit capture–recapture models to estimate cougar densities. Overall, 240 tissue samples were collected in northeastern Washington, USA, producing 166 genotypes (including recaptures and excluding dependent kittens) of 133 different cougars (8–25/yr) from 2003 to 2011. Mark–recapture analyses revealed a mean density of 2.2 cougars/100 km^2 (95% CI = 1.1–4.3) and stable to decreasing population trends (β = 0.048, 95% CI = 0.106–0.011) over the 9 years of study, with an average annual harvest rate of 14% (range = 7–21%). The average annual cost per year for field sampling and genotyping was US$11,265 ($422.24/sample or $610.73/successfully genotyped sample). Our results demonstrated that long-term biopsy sampling using citizen scientists can increase capture success and provide reliable cougar-density information at a reasonable cost.

A multi-method approach to estimating jaguar & puma density: integration of home range data into a noninvasive genetic sampling framework

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ABSTRACT

There are number of established techniques for estimating the population density of territorial wildlife species. Not all approaches are optimally suited for all species however, and there are advantages and disadvantages to each. Capture-recapture (CR) models have long represented a gold standard for estimating population abundance; however, how best to define an effective sampling area (ESA) has frequently been a matter of debate. More recently, whereas spatial capture-recapture (SCR) techniques have logically addressed this problem, for many species their use still presents logistical or other practical challenges. The capture and recapture of large carnivores over an adequate area for example is often cost-prohibitive, and the physical effort required to accomplish this is generally infeasible for closure models. Moreover, whereas camera-trapping techniques work effectively for animals that can be individually identified, absent this criterion estimates of density are frequently relative, or derived from occupancy parameters. Jaguars and pumas represent both sides of this equation, respectively. Here I demonstrate the use of a multi-technique approach to estimate the density of either species, and any other territorial solitary carnivore. I describe a case study involving a jaguar population of unknown size sampled over a large geographical region. I systematically collected jaguar scats on multiple occasions with the purpose of identifying individuals and estimate the local abundance of jaguar population in Paraguay’s largest protected area. I then integrated circle-transformed GPS-collar home range data for six individual jaguars into a single-session CR sampling framework to buffer my sampling transects and calculate my effective sampling area. I conclude that whereas this approach worked very well for jaguars, which are often equally-suited to individual identification via camera-trapping, it might be most promising for use in management and monitoring of pumas and other large territorial carnivores, for which individual identification using other remote or more labor-intensive means might not be possible.

Integrating population monitoring and modeling methods to enable an adaptive harvest management strategy for mountain lions in Montana

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ABSTRACT

Managing harvested mountain lion populations was historically confounded by the lack of methods to affordably, accurately, and repeatedly estimate a population's size, make rigorous predictions about the effect of future harvest prescriptions, and monitor population trends over time. Managers were unable to fully implement an adaptive mountain lion harvest management program because they lacked the necessary monitoring and modeling information. Disagreement about past, and potential, effects of management decisions led to conflict among stakeholders and disagreement about management decisions. Montana Fish, Wildlife & Parks (FWP) recently developed a mountain lion management strategy that directs the agency to actively monitor statewide mountain lion populations using genetic spatial capture-recapture field techniques. These local monitoring data will be extrapolated across discrete mountain lion ecoregions using a resource selection function (developed using local research and validation data) in order to estimate populations at a meaningful scale. Managers will then input these population estimates, along with local lion demographic parameters and harvest information, into a web-based integrated population model to predict the likely effect of future harvest prescriptions on managed lion populations across the State. These new monitoring and modeling methods will enable FWP to fully implement an adaptive harvest management program through which population objectives are set, management alternatives are objectively evaluated, a preferred harvest prescription is applied, the effect of that harvest is directly monitored over time, and management is adjusted based on new information and changing objectives. FWP believes that this strategy will help reduce contention among stakeholders, optimize mountain lion harvest and pursuit opportunities, reduce stakeholder conflicts, and ensure that robust lion populations are conserved through time across their Montana habitats.

Estimating mountain lion abundance in Arizona 2004-2015

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Matthew Clement, Arizona Game and Fish Department, 5000 West Carefree Highway, Phoenix, AZ 85086; mclement@azgfd.gov

ABSTRACT

Hunting harvest of mountain lions (*Puma concolor*) is the primary mechanism for population level management in Arizona. In hunted populations, there is a need for reliable and affordable techniques to monitor population trends for large-scale species management. Population survey techniques, such as track counts and mark-recapture have been used to estimate local abundance in small study areas in Arizona, but there are limitations to extrapolating these estimates to the statewide population. In this paper, we use cementum annuli tooth age data from premolar teeth removed during physical inspection to calculate age at harvest. By applying virtual population analysis, an age-structured population model, age-at-harvest data are used to reconstruct cohort abundance over time and summed across cohorts age class 0 through age class 14 to estimate minimum abundance from 2004-2015. The methods of Gulland were then applied to incorporate natural mortality and harvest of mountain lions with unknown ages into estimates of statewide mountain lion abundance. Virtual population analysis provides a tool for estimating and monitoring mountain lion populations temporally and spatially where survey or mark and recapture methods are unattainable. Hunter harvest data are relatively low cost, easy to collect, and can provide crucial information on survival, productivity, age composition, and abundance. However, uncertainly about natural mortality rates reduces the precision of abundance estimates. These estimates will be useful in developing management recommendations for mountain lions in Arizona.

Estimating puma densities from camera trap data using generalized spatial partial identity models

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Ben Augustine, Virginia Tech, 310 W. Campus Dr., 100 Cheatham Hall, Blacksburg, VA 24061; baugusti@vt.edu

Marcella J. Kelly, Virginia Tech, 310 W. Campus Dr., 146 Cheatham Hall, Blacksburg, VA 24061; makelly2@vt.edu

ABSTRACT
Using camera trap surveys to estimate population densities has become increasingly popular over the last 20 years. While the natural markings of some species have allowed analysis in a mark-recapture framework, this has not been possible for species like pumas that lack sufficiently distinctive pelage patterns to allow for individual identification. Mark-resight models have attempted to address this problem by combining data from both marked and unmarked individuals. In such an analysis, a subset of pumas would be "marked" by identifying subtle markings like scars, tail kinks, or parasites. In this study, we developed a generalized spatial partial identity model that allowed us to use natural marks to link together sets of capture events that can be determined to be the same individual and also exclude the possibility that others are the same individual. These identity connections and exclusions reduce the uncertainty stemming from the unknown individual identities in many photographs and thus increase the precision of the density estimates. In mark-resight models, two marked individuals could be two sides of the same individual. Generalized spatial partial identity models avoid this error and also allow us to make identity exclusions for unmarked individuals based on sex or other features. We used a generalized spatial partial identity model to estimate the population densities of pumas at six sites in Belize from existing camera trap data. Using generalized spatial partial identity models will allow managers to assess puma population densities from camera trap data with more precision.

Mule deer abundance, cougar home range size, and predator-prey density across a climatic gradient in the Intermountain West

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David M. Choate, School of Life Sciences, University of Nevada, Las Vegas, 4505 S. Maryland Pkwy, Las Vegas, NV, 89154; choate.davidm@gmail.com

Jyothy Nagol, Global Landcover Facility, Dept. of Geographical Sciences, University of Maryland, Hartwick Building, College Park, MD, 20740; jyothy.nagol@gmail.com

Kirsten E. Ironside, U.S. Geological Survey Southwest Biological Science Center, 2255 Gemini Drive, Flagstaff, AZ, 86001; kironside@usgs.gov

Kathleen M. Longshore, U.S. Geological Survey Western Ecological Research Center, Las Vegas Field Station, 160 N. Stephanie Street, Henderson, NV, 89074; longshore@usgs.gov

Thomas C. Edwards, Jr., U.S. Geological Survey, Utah Cooperative Fish and Wildlife Research Unit, Quinney College of Natural Resources, Dept. of Wildland Resources, Utah State University, 5230 Old Main Hill, Logan, UT, 84322-5230; t.edwards@usu.edu

ABSTRACT

Mule deer (*Odocoileus hemionus*) and cougars (*Puma concolor*) are habitat generalists distributed throughout western ecosystems. Local densities vary widely as a function of limatic/environmental conditions. Consequently, natural resource managers require a means of estimating species abundance across the range of conditions found within their jurisdictions. Ecological theory states that energy transfer diminishes predictably across trophic levels, suggesting that measures of primary productivity can be used to estimate consumer abundance. We evaluated this hypothesis by estimating spatial variation in density of mule deer and cougars across a climatic gradient in the Southwest. We measured growing-season primary productivity on mule deer fawning

ranges with the Normalized Difference Vegetation Index (NDVI), which was used to predict variation in mule deer abundance among wildlife management units in Utah. We used cougar GPS data sampled from the Great Basin, Colorado Plateau, and Mojave Desert ecoregions to measure variation in home range size with respect to changes in primary production. We then used the reciprocal of home range area as an index of cougar density (adults/100 km^2) to estimate predator-prey ratios as a function of peak-of-season NDVI. Deer and cougar density varied positively and significantly with primary productivity, but the predator-prey ratio remained constant across climatic zones. Cougar density estimates approximated those derived from intensive mark-recapture techniques. We discuss the utility of integrating satellite imagery with *in situ* data to inform large scale assessments of big game abundance in the Intermountain West.

Standardization of cougar population metrics

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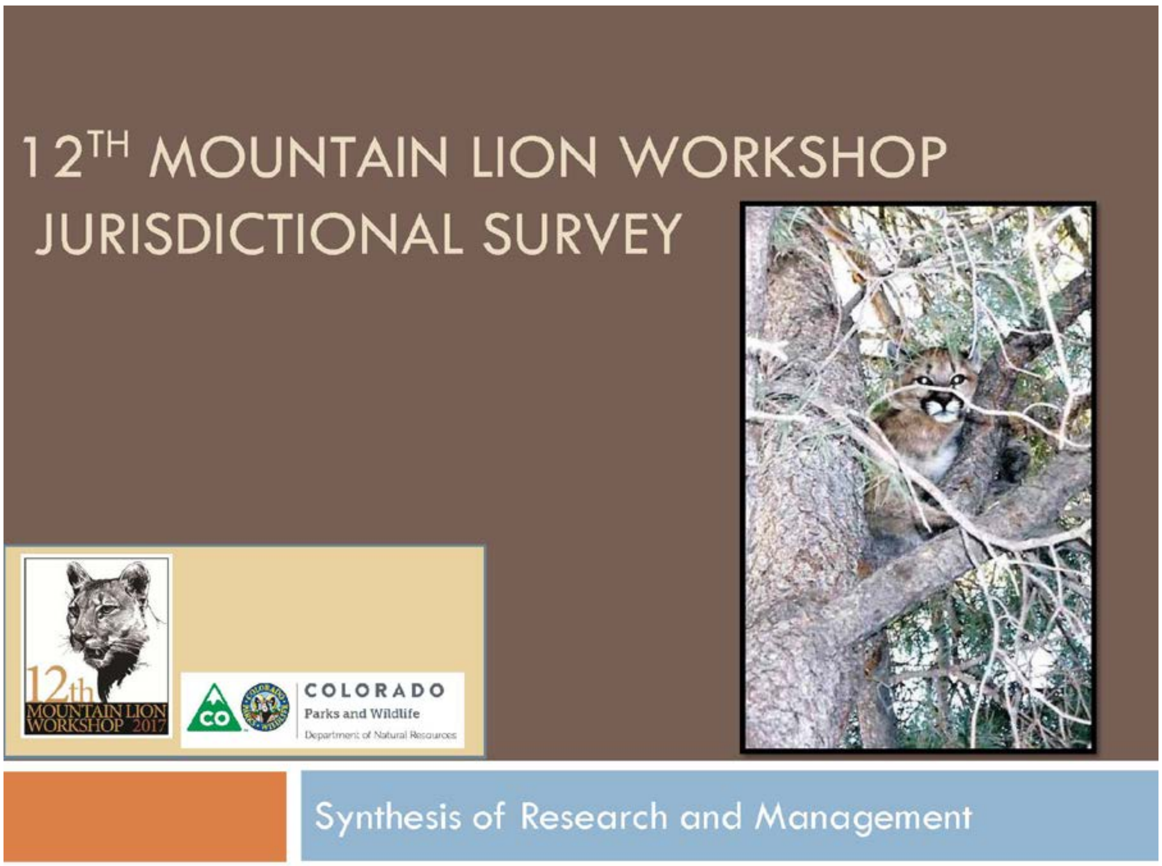
ABSTRACT

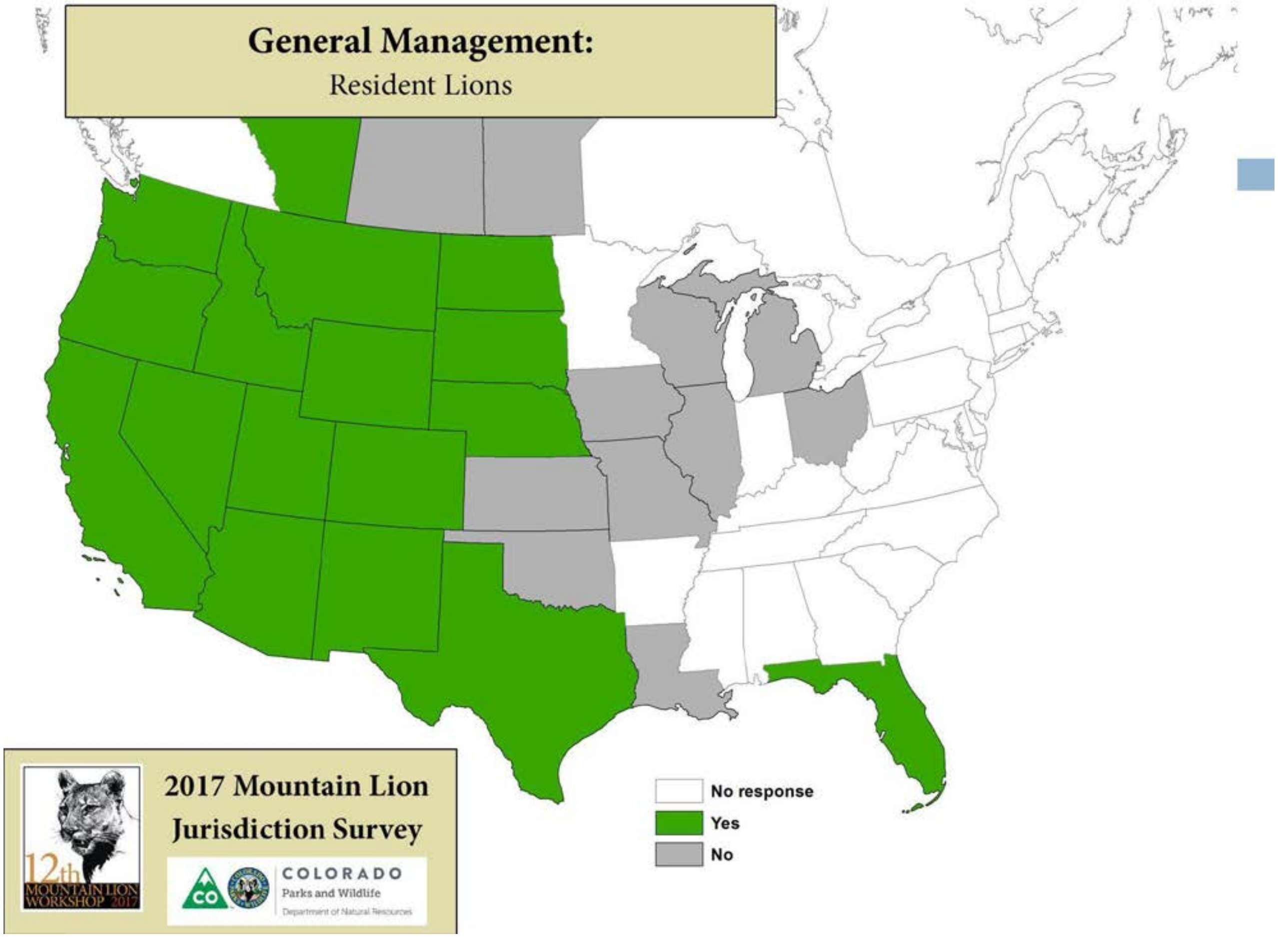
Long term research, replication, and rigorous analytical methods are the hallmark and guiding scientific principles for a systematic management strategy. However, even where long-term research is conducted and published, findings are often not presented in a consistent and standardized format which may result in inconsistent and ambiguous results. For many wildlife species and disciplines, this lack of standardization has complicated both the scientific and management processes. For example, cougar (*Puma concolor*) metrics including population size, density, harvest rate, and population growth rates have been reported incongruously, and sometimes erroneously, resulting in conflicting application which then manifests into debate amongst researchers, state wildlife agencies, wildlife commissions, and ultimately stakeholders. Without explicit explanation and consistent application the result may be biological uncertainty and stakeholder criticism. These inconsistencies will be discussed as will a recommended standardized approach to reporting cougar population metrics in the future.

SESSION 2: JURISDICTIONAL MOUNTAIN LION MANAGEMENT SURVEY

Moderator: Jerry Apker, Colorado Parks & Wildlife

The following graphics represent all slides that summarize Jerry Apker's survey results. They are followed by individual written jurisdictional reports submitted to Jerry prior to the workshop.

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2017 Mountain Lion
Jurisdiction Survey
12th
MOUNTAIN LION
WORKSHOP 2017
COLORADO
Parks and Wildlife
Department of Natural Resources
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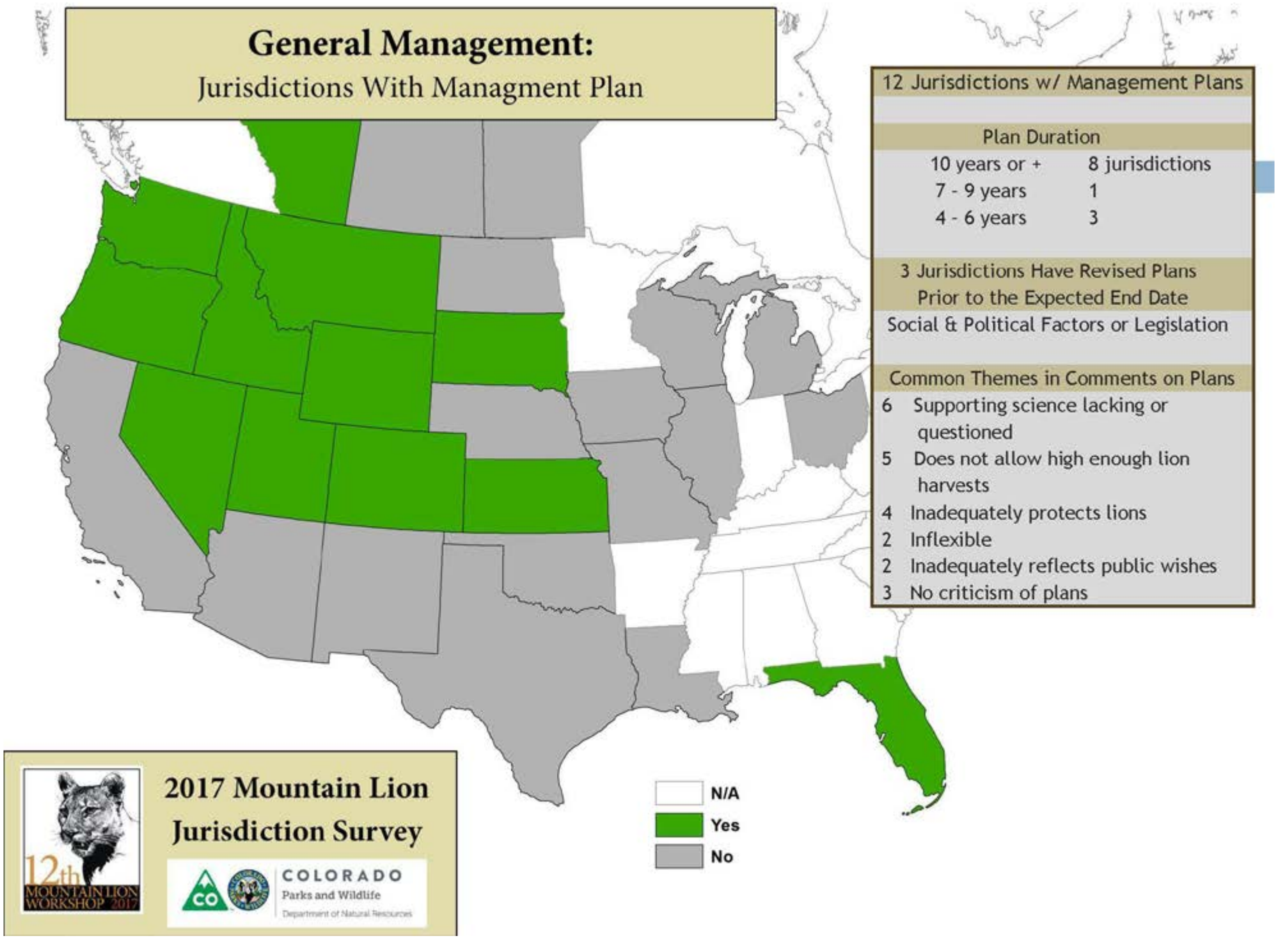
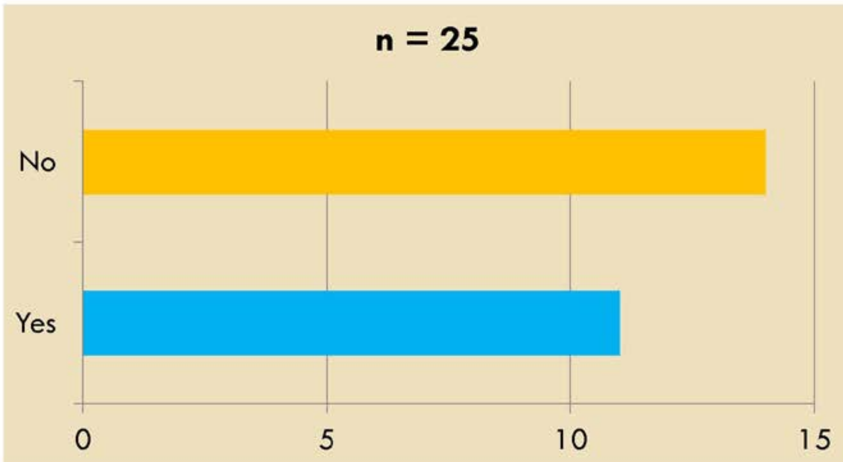
Yes
No

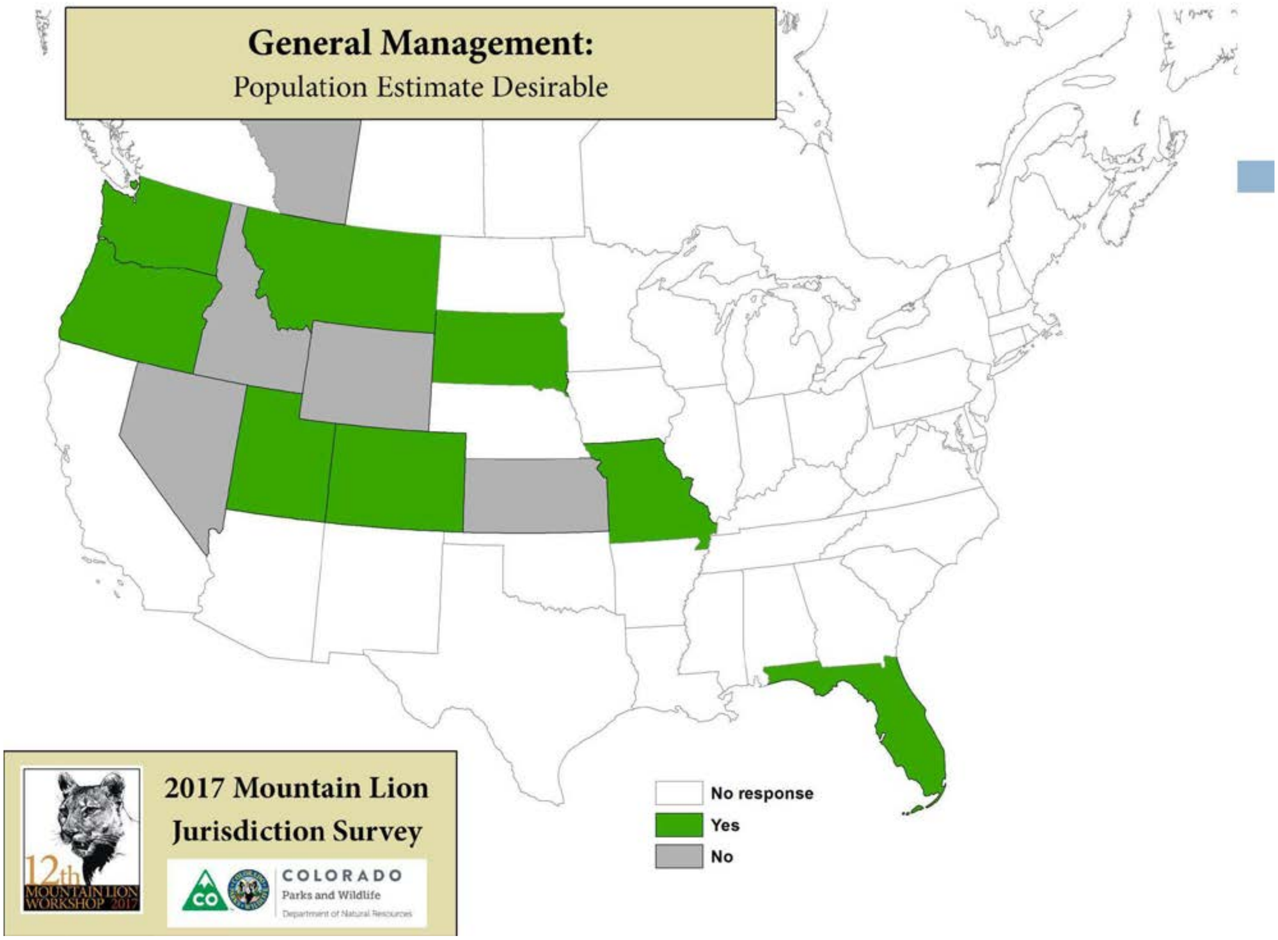

General Management:
Jurisdictions With Managment Plan
12 Jurisdictions w/ Management Plans
Plan Duration
10 years or + 8 jurisdictions
7 - 9 years 1
4 - 6 years 3
3 Jurisdictions Have Revised Plans
Prior to the Expected End Date
Social & Political Factors or Legislation
Common Themes in Comments on Plans
6 Supporting science lacking or questioned
5 Does not allow high enough lion harvests
4 Inadequately protects lions
2 Inflexible
2 Inadequately reflects public wishes
3 No criticism of plans
N/A
Yes
No
2017 Mountain Lion
Jurisdiction Survey
12th
MOUNTAIN LION
WORKSHOP 2017
CO
COLORADO
Parks and Wildlife

Mountain lion management objectives: statewide or smaller scales?



Jurisdictions with Management Objectives:

~ 2/3 conduct both subjective and quantitative monitoring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Jurisdiction Survey
12th
MOUNTAIN LION
WORKSHOP 2017
COLORADO
Parks and Wildlife
Department of Natural Resources
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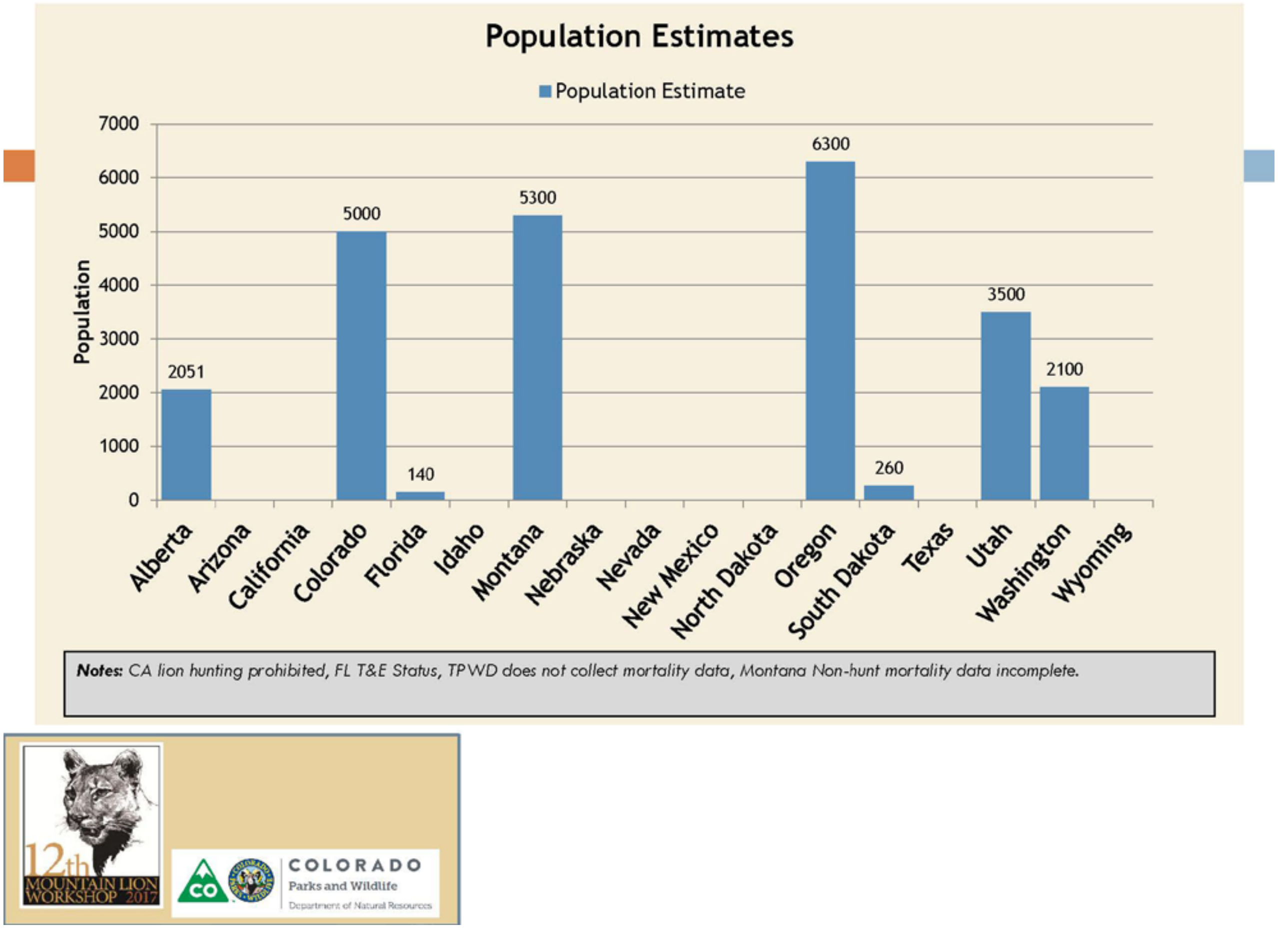
No


Population Estimates
Population Estimate
Population
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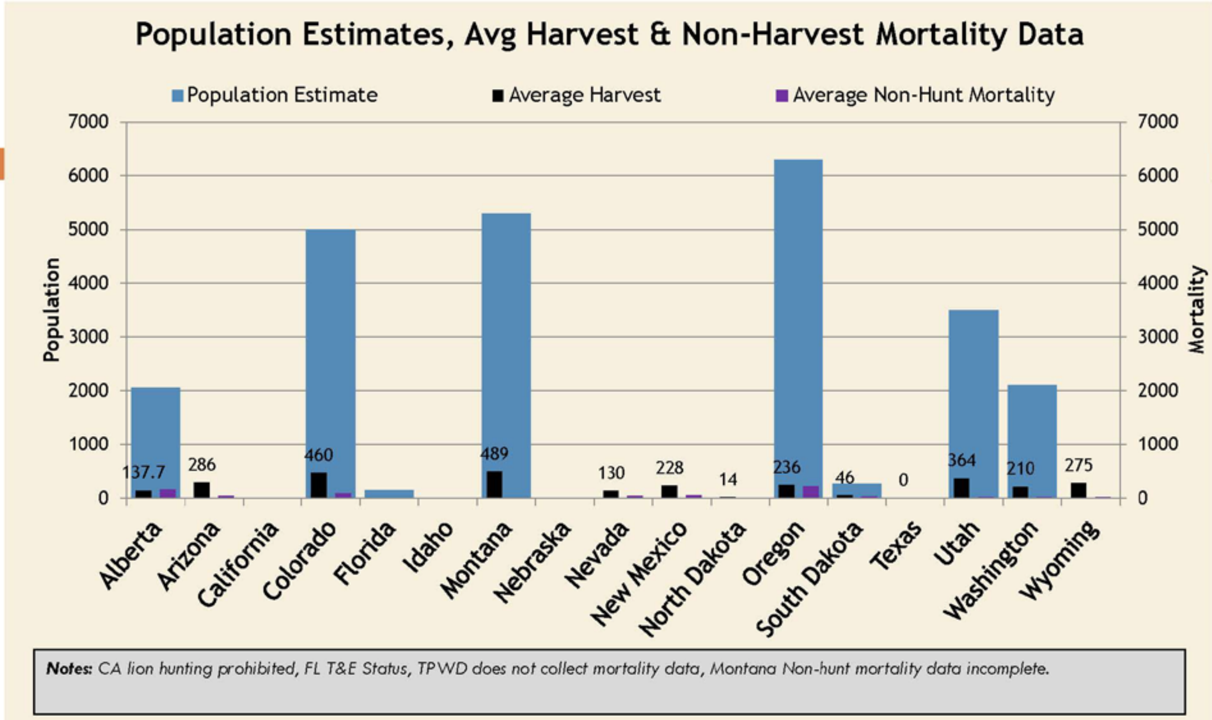
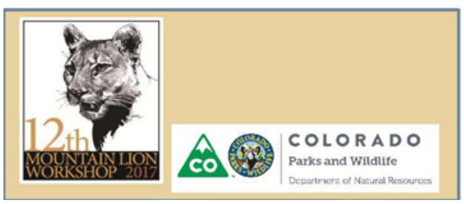
6000
5000
4000
3000
2000
1000
0
2051
5000
140
5300
6300
260
3500
2100
Alberta
Arizona
California
Colorado
Florida
Idaho
Montana
Nebraska
Nevada
New Mexico
North Dakota
Oregon
South Dakota
Texas
Utah
Washington
Wyoming
Notes: CA lion hunting prohibited, FL T&E Status, TPWD does not collect mortality data, Montana Non-hunt mortality data incomplete.
12th MOUNTAIN LION WORKSHOP 2017
COLORADO
Parks and Wildlife
Department of Natural Resources


Population Estimates, Avg Harvest & Non-Harvest Mortality Data
Population Estimate
Average Harvest
Average Non-Hunt Mortality
Population
Mortality
7000
6000
5000
4000
3000
2000
1000
0
137.7
286
460
489
130
228
14
236
46
0
364
210
275
Alberta
Arizona
California
Colorado
Florida
Idaho
Montana
Nebraska
Nevada
New Mexico
North Dakota
Oregon
South Dakota
Texas
Utah
Washington
Wyoming
Notes: CA lion hunting prohibited, FL T&E Status, TPWD does not collect mortality data, Montana Non-hunt mortality data incomplete.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COLORADO
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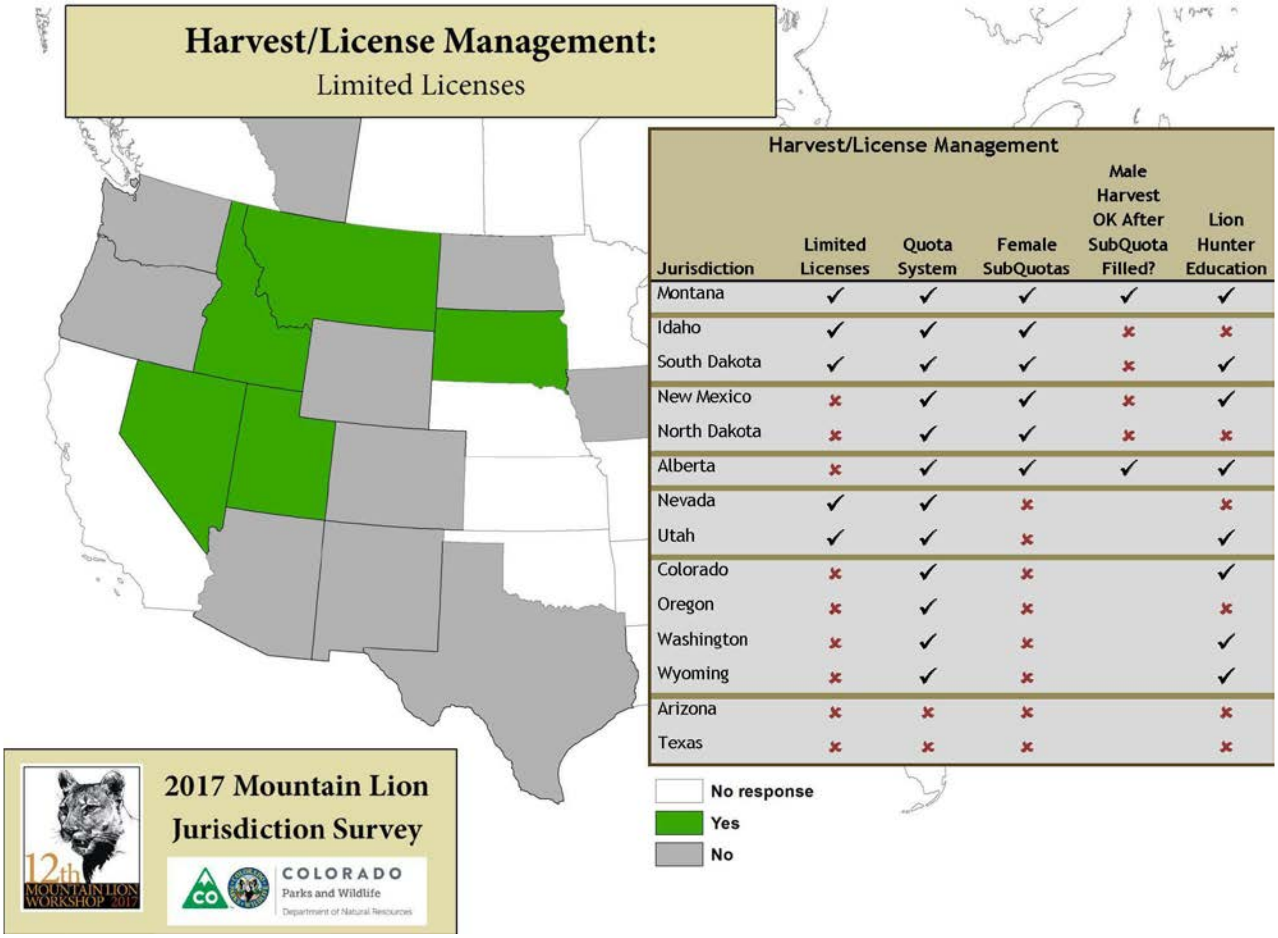
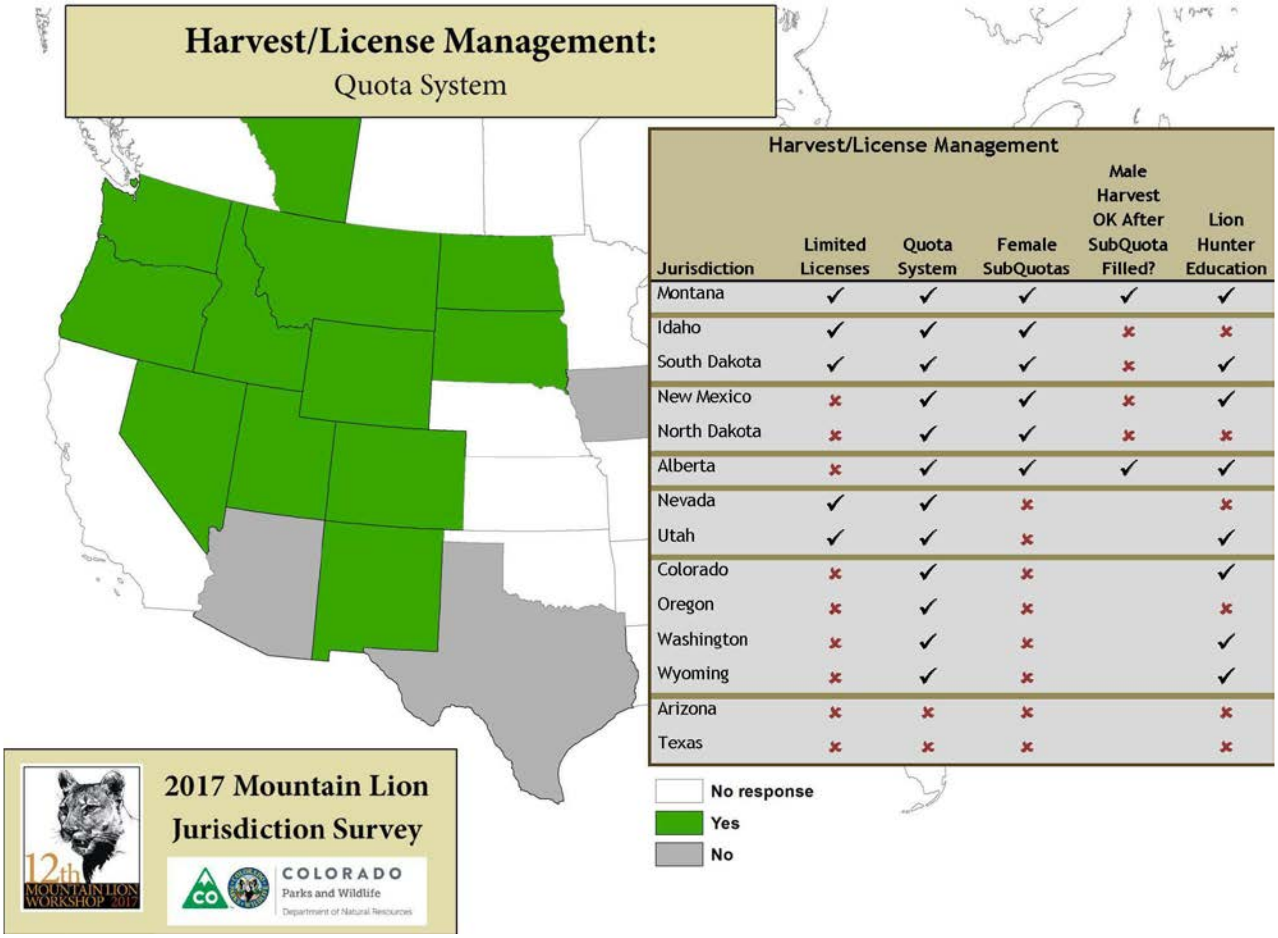
Department of Natural Resources

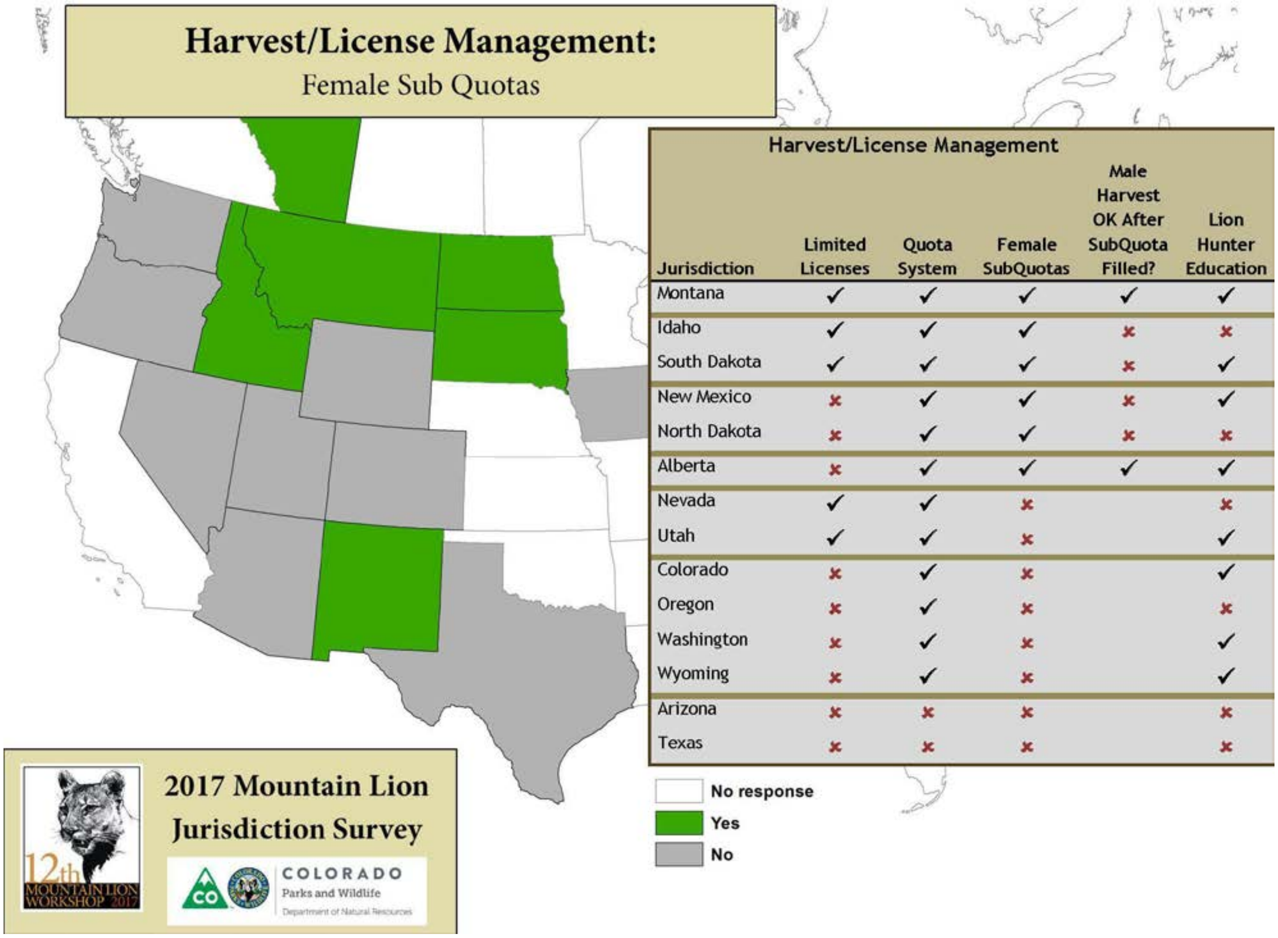


Harvest/License Management

Jurisdiction	Limited Licenses	Quota System	Female SubQuotas	Male Harvest OK After SubQuota Filled?	Lion Hunter Education
Montana	✓	✓	✓	✓	✓
Idaho	✓	✓	✓	✗	✗
South Dakota	✓	✓	✓	✗	✓
New Mexico	✗	✓	✓	✗	✓
North Dakota	✗	✓	✓	✗	✗
Alberta	✗	✓	✓	✓	✓
Nevada	✓	✓	✗		✗
Utah	✓	✓	✗		✓
Colorado	✗	✓	✗		✓
Oregon	✗	✓	✗		✗
Washington	✗	✓	✗		✓
Wyoming	✗	✓	✗		✓
Arizona	✗	✗	✗		✗
Texas	✗	✗	✗		✗



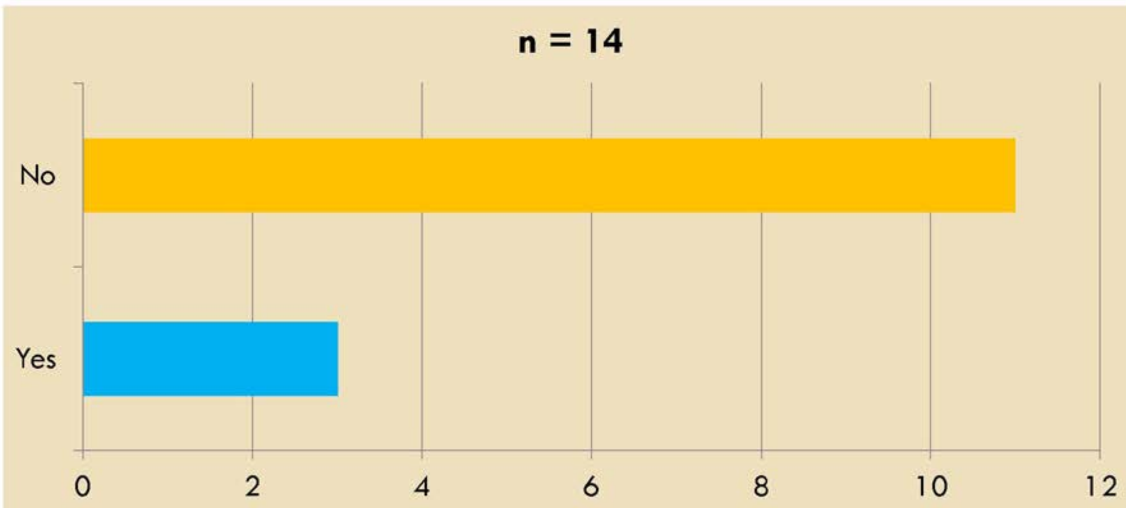
Harvest/License Management					
Jurisdiction	Limited Licenses	Quota System	Female SubQuotas	Male Harvest OK After SubQuota Filled?	Lion Hunter Education
Montana	✓	✓	✓	✓	✓
Idaho	✓	✓	✓	✗	✗
South Dakota	✓	✓	✓	✗	✓
New Mexico	✗	✓	✓	✗	✓
North Dakota	✗	✓	✓	✗	✗
Alberta	✗	✓	✓	✓	✓
Nevada	✓	✓	✗		✗
Utah	✓	✓	✗		✓
Colorado	✗	✓	✗		✓
Oregon	✗	✓	✗		✗
Washington	✗	✓	✗		✓
Wyoming	✗	✓	✗		✓
Arizona	✗	✗	✗		✗
Texas	✗	✗	✗		✗

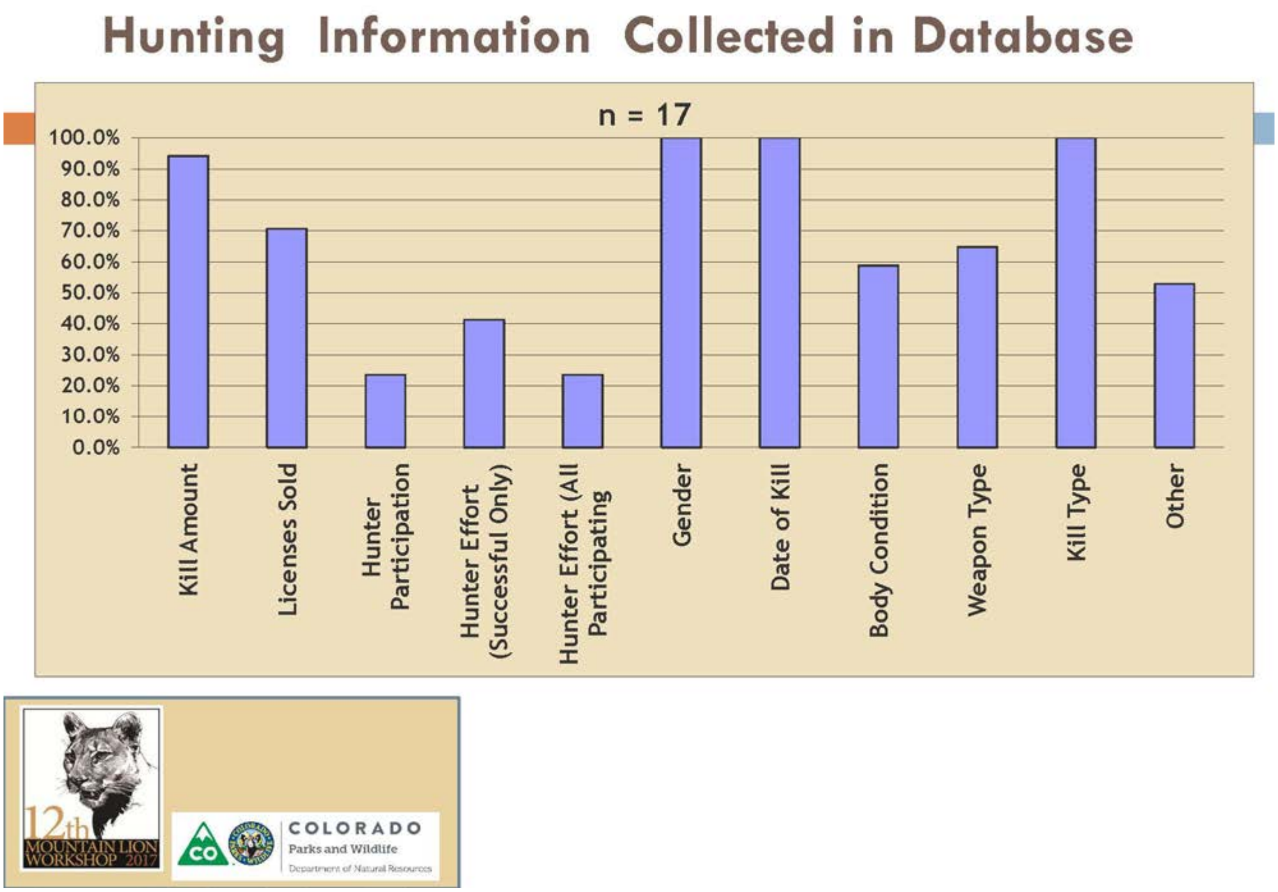


Harvest/License Management

Jurisdiction	Limited Licenses	Quota System	Female SubQuotas	Male Harvest OK After SubQuota Filled?	Lion Hunter Education
Montana	✓	✓	✓	✓	✓
Idaho	✓	✓	✓	✗	✗
South Dakota	✓	✓	✓	✗	✓
New Mexico	✗	✓	✓	✗	✓
North Dakota	✗	✓	✓	✗	✗
Alberta	✗	✓	✓	✓	✓
Nevada	✓	✓	✗		✗
Utah	✓	✓	✗		✓
Colorado	✗	✓	✗		✓
Oregon	✗	✓	✗		✗
Washington	✗	✓	✗		✓
Wyoming	✗	✓	✗		✓
Arizona	✗	✗	✗		✗
Texas	✗	✗	✗		✗

Does Your Jurisdiction Require Hunters Bring Lion Meat Out for Human Consumption?




Hunting Information Collected in Database
n = 17
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
Kill Amount
Licenses Sold
Hunter Participation
Hunter Effort (Successful Only)
Hunter Effort (All Participating
Gender
Date of Kill
Body Condition
Weapon Type
Kill Type
Other
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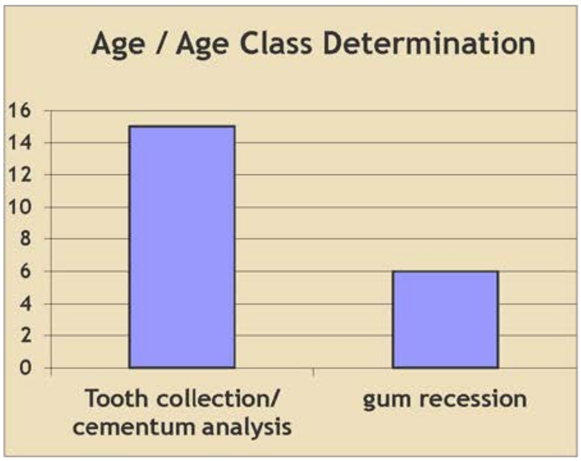
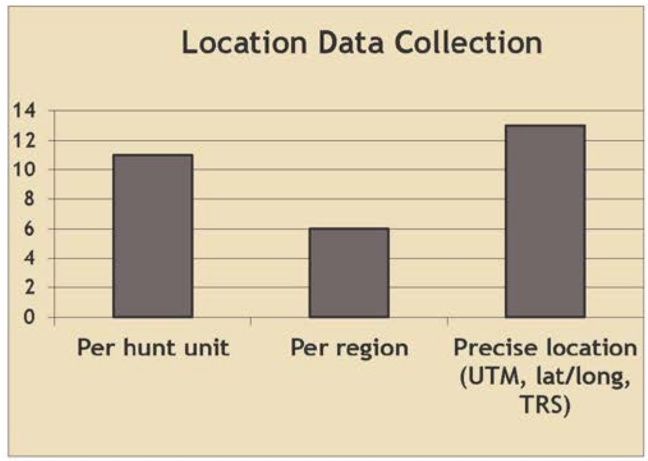
Age & Location Data Collection






Lion Hunting Questions:
Lions Hunted
No response
Yes
No
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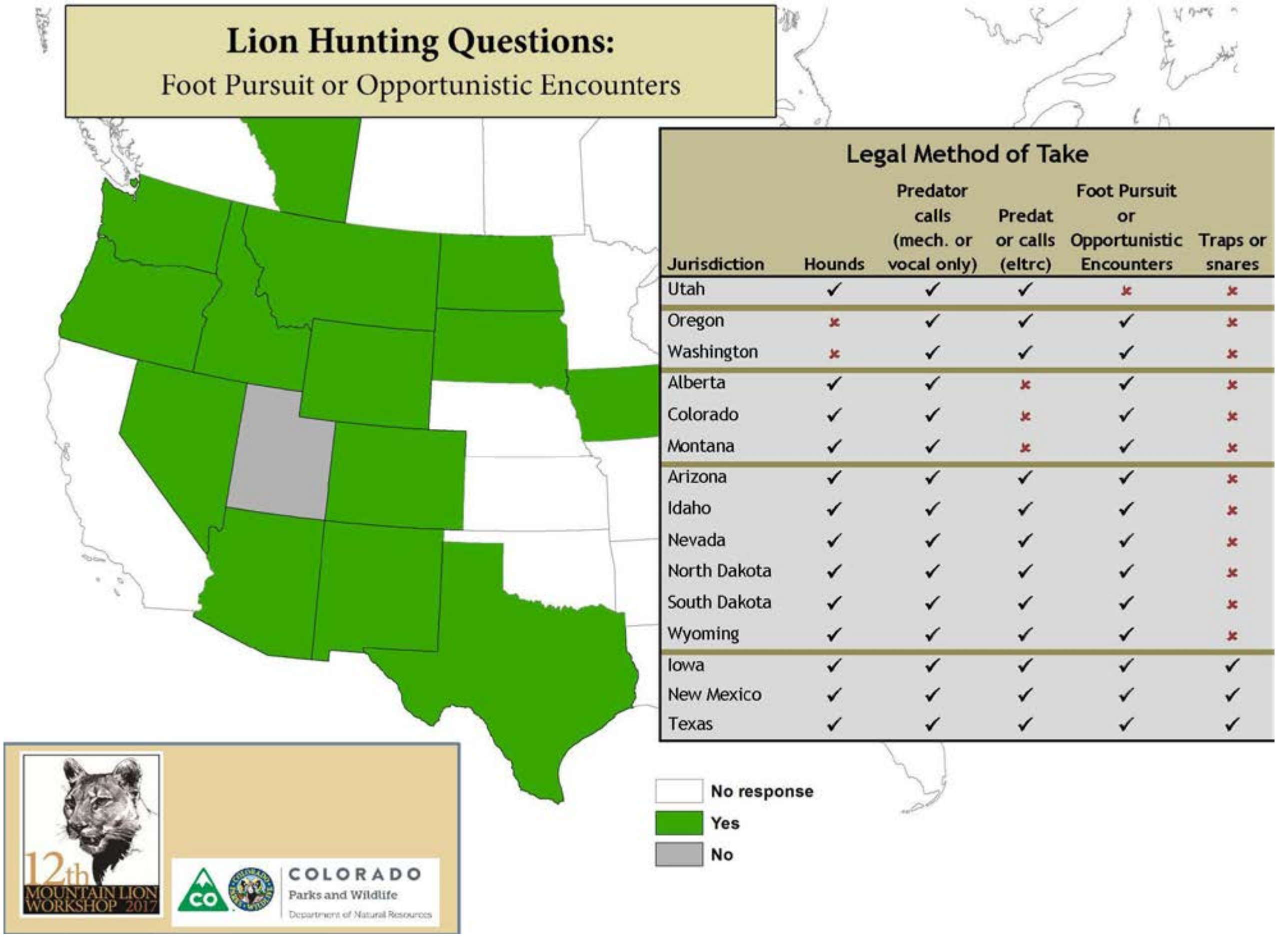
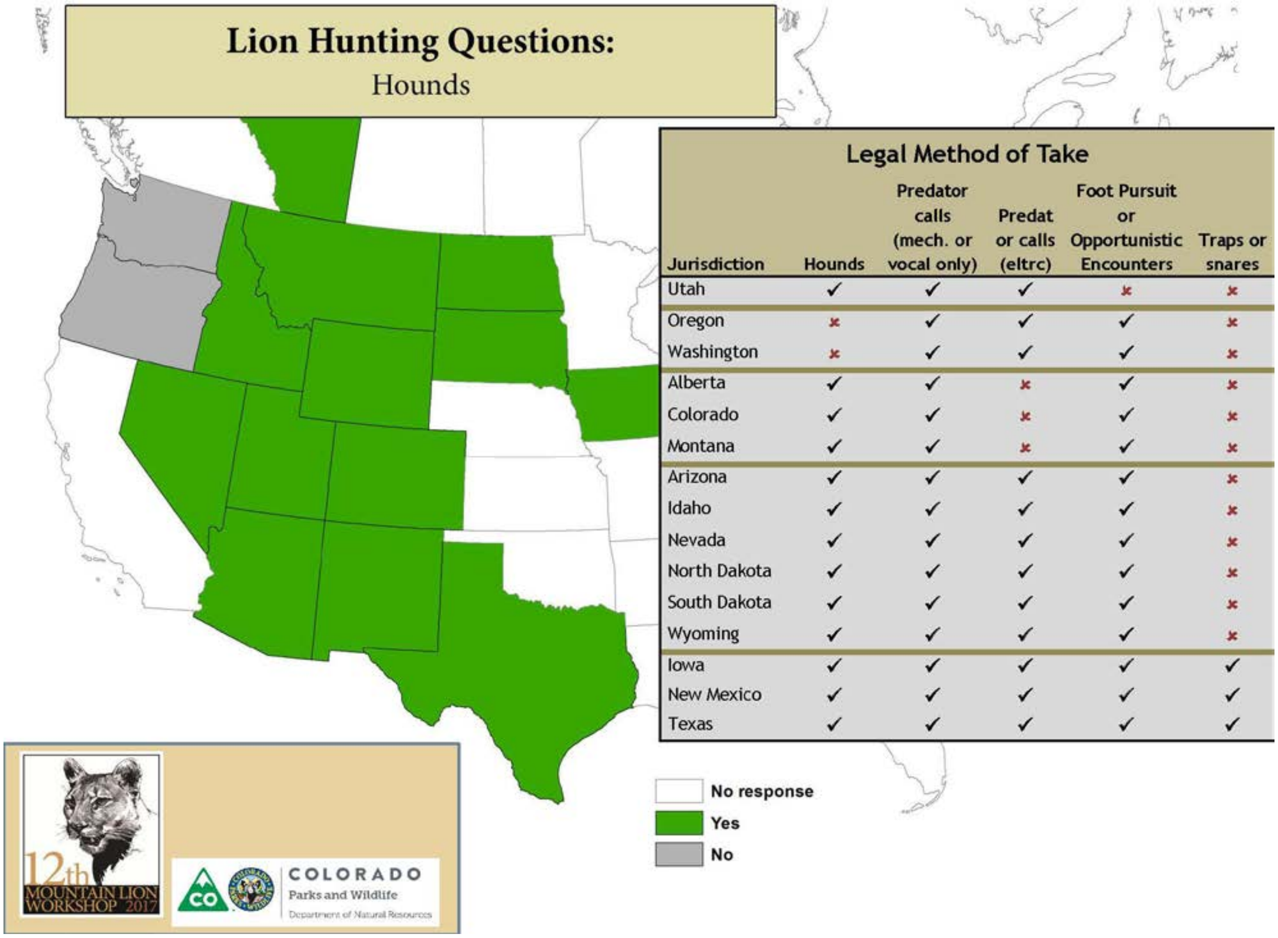


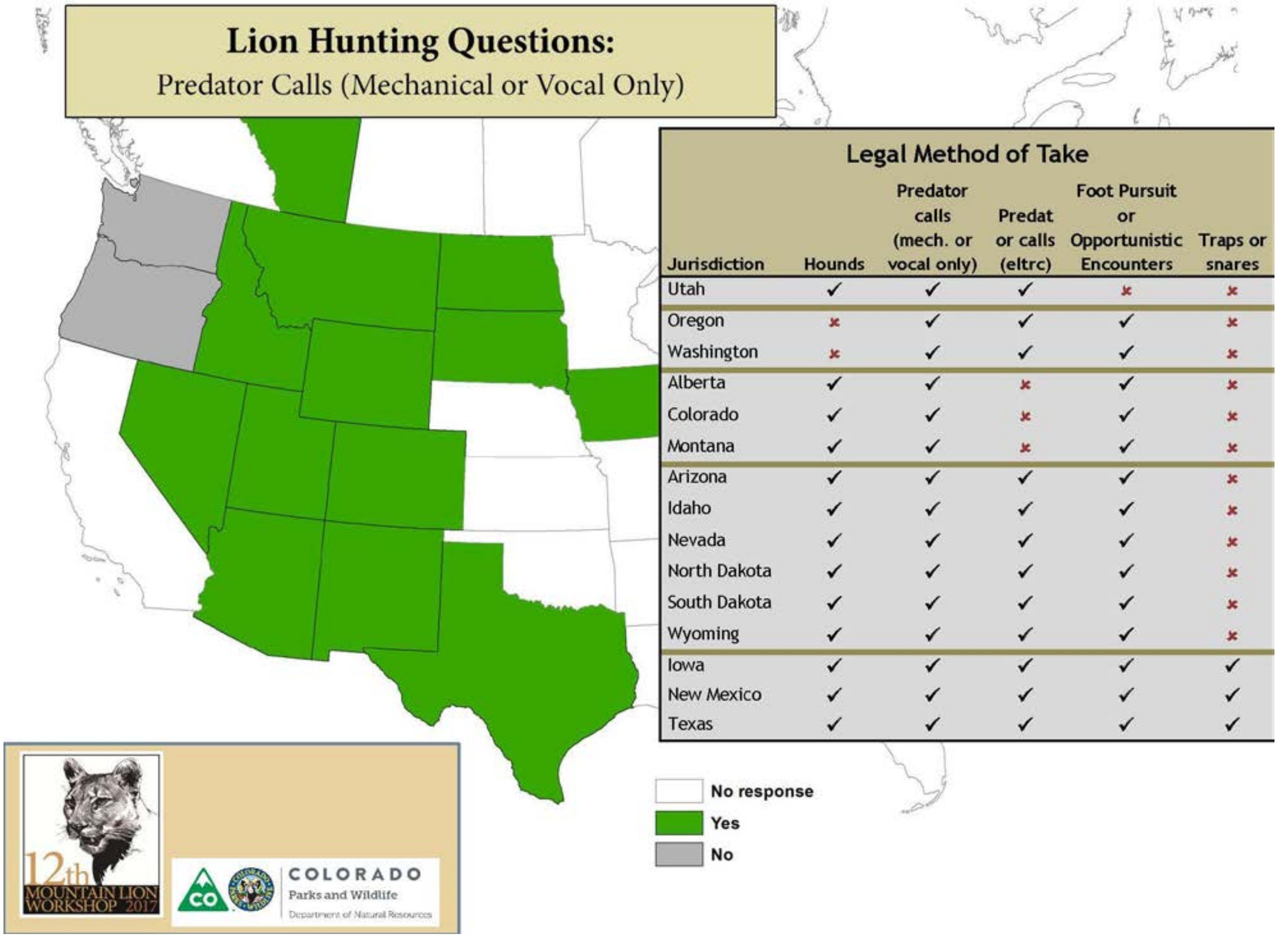
Legal Method of Take

Jurisdiction	Hounds	Predator calls (mech. or vocal only)	Predat or calls (eltrc)	Foot Pursuit or Opportunistic Encounters	Traps or snares
Utah	✓	✓	✓	✗	✗
Oregon	✗	✓	✓	✓	✗
Washington	✗	✓	✓	✓	✗
Alberta	✓	✓	✗	✓	✗
Colorado	✓	✓	✗	✓	✗
Montana	✓	✓	✗	✓	✗
Arizona	✓	✓	✓	✓	✗
Idaho	✓	✓	✓	✓	✗
Nevada	✓	✓	✓	✓	✗
North Dakota	✓	✓	✓	✓	✗
South Dakota	✓	✓	✓	✓	✗
Wyoming	✓	✓	✓	✓	✗
Iowa	✓	✓	✓	✓	✓
New Mexico	✓	✓	✓	✓	✓
Texas	✓	✓	✓	✓	✓



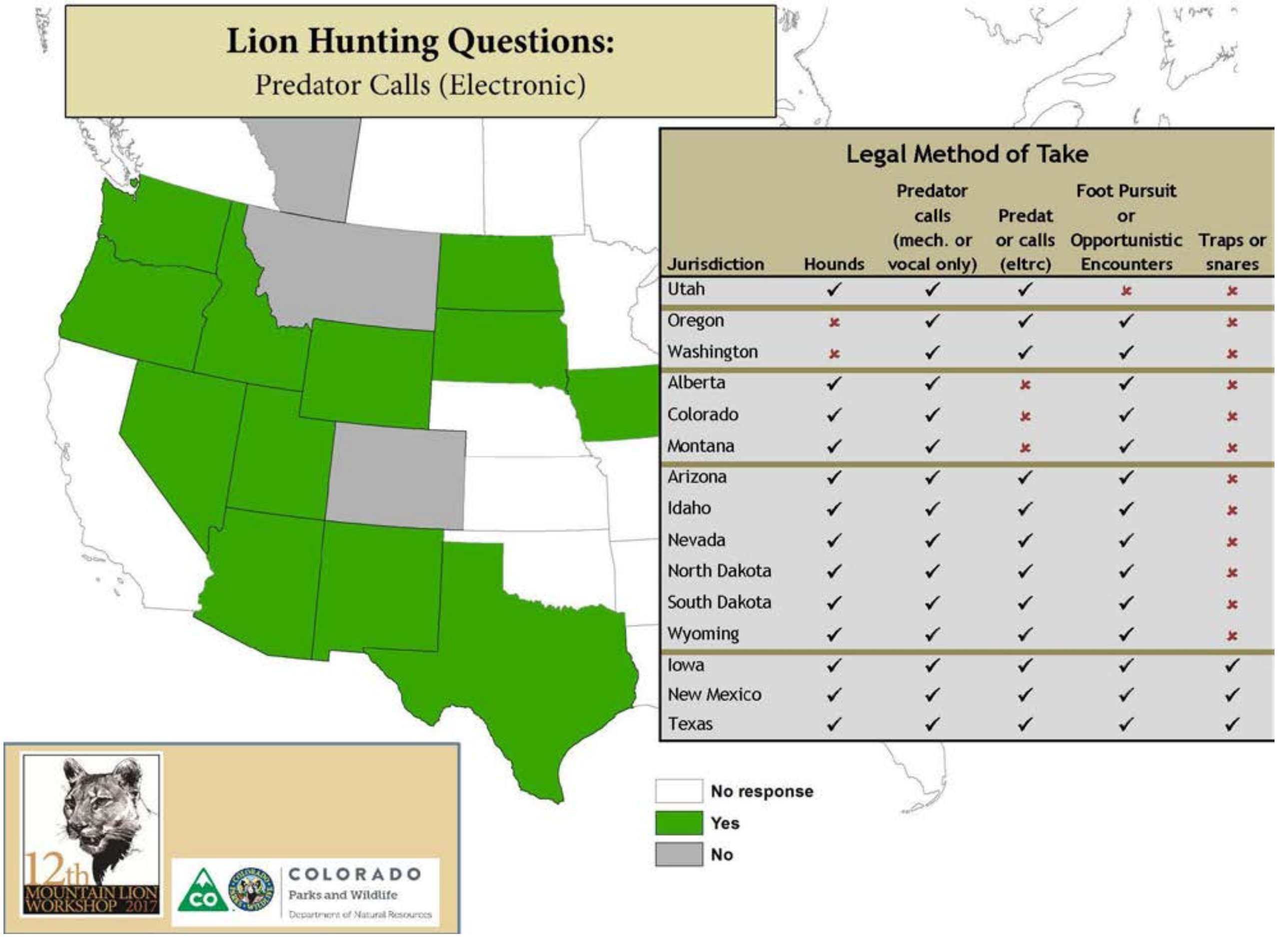
Legal Method of Take

Jurisdiction	Hounds	Predator calls (mech. or vocal only)	Predat or calls (eltrc)	Foot Pursuit or Opportunistic Encounters	Traps or snares
Utah	✓	✓	✓	✗	✗
Oregon	✗	✓	✓	✓	✗
Washington	✗	✓	✓	✓	✗
Alberta	✓	✓	✗	✓	✗
Colorado	✓	✓	✗	✓	✗
Montana	✓	✓	✗	✓	✗
Arizona	✓	✓	✓	✓	✗
Idaho	✓	✓	✓	✓	✗
Nevada	✓	✓	✓	✓	✗
North Dakota	✓	✓	✓	✓	✗
South Dakota	✓	✓	✓	✓	✗
Wyoming	✓	✓	✓	✓	✗
Iowa	✓	✓	✓	✓	✓
New Mexico	✓	✓	✓	✓	✓
Texas	✓	✓	✓	✓	✓



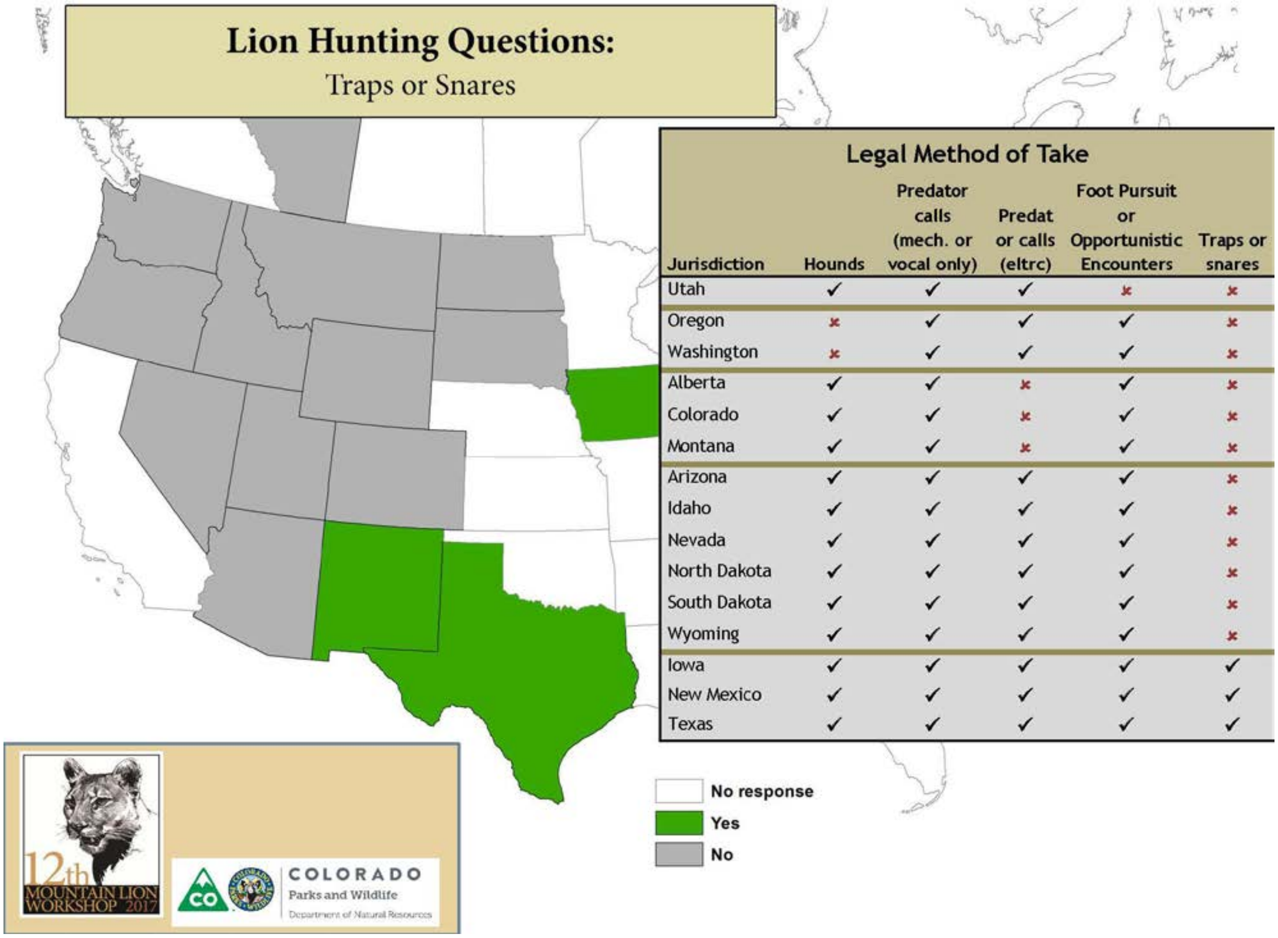
Legal Method of Take

Jurisdiction	Hounds	Predator calls (mech. or vocal only)	Predator calls (eltrc)	Foot Pursuit or Opportunistic Encounters	Traps or snares
Utah	✓	✓	✓	✗	✗
Oregon	✗	✓	✓	✓	✗
Washington	✗	✓	✓	✓	✗
Alberta	✓	✓	✗	✓	✗
Colorado	✓	✓	✗	✓	✗
Montana	✓	✓	✗	✓	✗
Arizona	✓	✓	✓	✓	✗
Idaho	✓	✓	✓	✓	✗
Nevada	✓	✓	✓	✓	✗
North Dakota	✓	✓	✓	✓	✗
South Dakota	✓	✓	✓	✓	✗
Wyoming	✓	✓	✓	✓	✗
Iowa	✓	✓	✓	✓	✓
New Mexico	✓	✓	✓	✓	✓
Texas	✓	✓	✓	✓	✓



Legal Method of Take

Jurisdiction	Hounds	Predator calls (mech. or vocal only)	Predator calls (eltrc)	Foot Pursuit or Opportunistic Encounters	Traps or snares
Utah	✓	✓	✓	✗	✗
Oregon	✗	✓	✓	✓	✗
Washington	✗	✓	✓	✓	✗
Alberta	✓	✓	✗	✓	✗
Colorado	✓	✓	✗	✓	✗
Montana	✓	✓	✗	✓	✗
Arizona	✓	✓	✓	✓	✗
Idaho	✓	✓	✓	✓	✗
Nevada	✓	✓	✓	✓	✗
North Dakota	✓	✓	✓	✓	✗
South Dakota	✓	✓	✓	✓	✗
Wyoming	✓	✓	✓	✓	✗
Iowa	✓	✓	✓	✓	✓
New Mexico	✓	✓	✓	✓	✓
Texas	✓	✓	✓	✓	✓



Legal Method of Take

Jurisdiction	Hounds	Predator calls (mech. or vocal only)	Predat or calls (eltrc)	Foot Pursuit or Opportunistic Encounters	Traps or snares
Utah	✓	✓	✓	✗	✗
Oregon	✗	✓	✓	✓	✗
Washington	✗	✓	✓	✓	✗
Alberta	✓	✓	✗	✓	✗
Colorado	✓	✓	✗	✓	✗
Montana	✓	✓	✗	✓	✗
Arizona	✓	✓	✓	✓	✗
Idaho	✓	✓	✓	✓	✗
Nevada	✓	✓	✓	✓	✗
North Dakota	✓	✓	✓	✓	✗
South Dakota	✓	✓	✓	✓	✗
Wyoming	✓	✓	✓	✓	✗
Iowa	✓	✓	✓	✓	✓
New Mexico	✓	✓	✓	✓	✓
Texas	✓	✓	✓	✓	✓

Human-Lion Conflicts

- Damage/Depredation
- Public Safety

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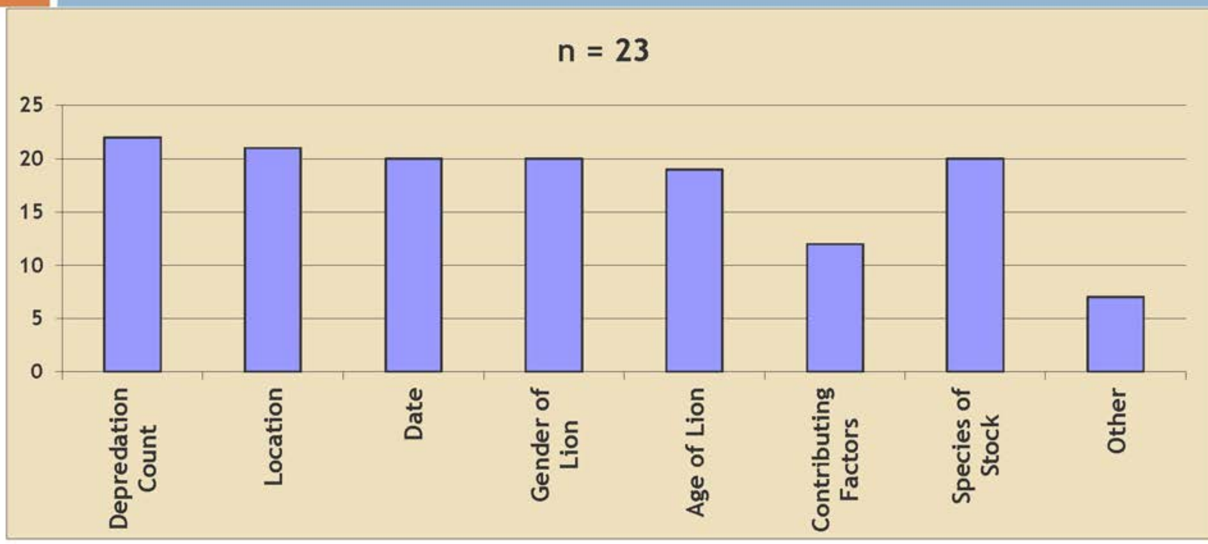
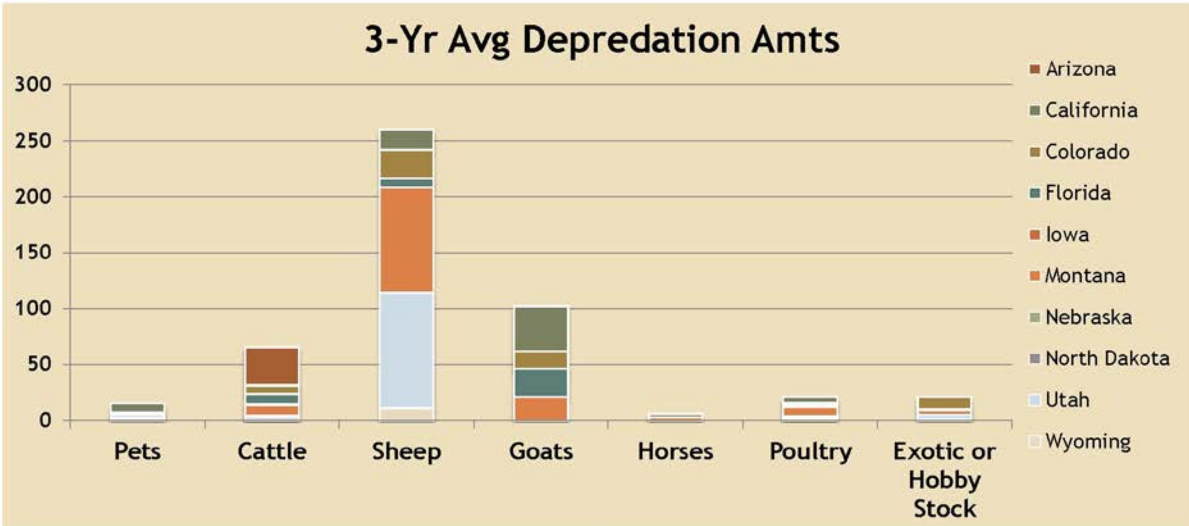
Depredation Information Data Collection



Depredation Amounts



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Human Lion Conflicts/Management:
Depredation Response Protocols
No response
Y
N
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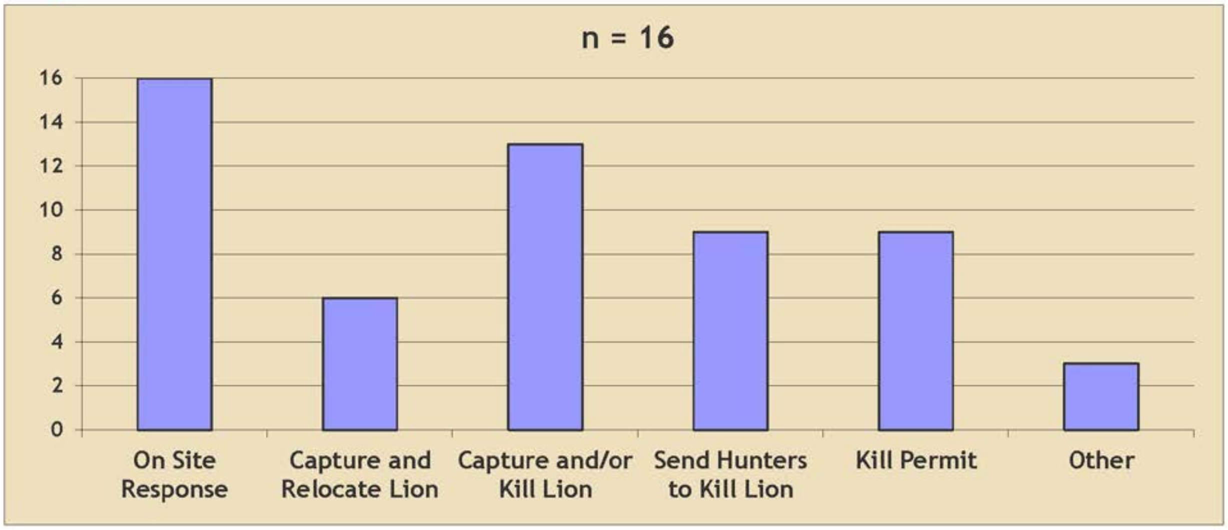
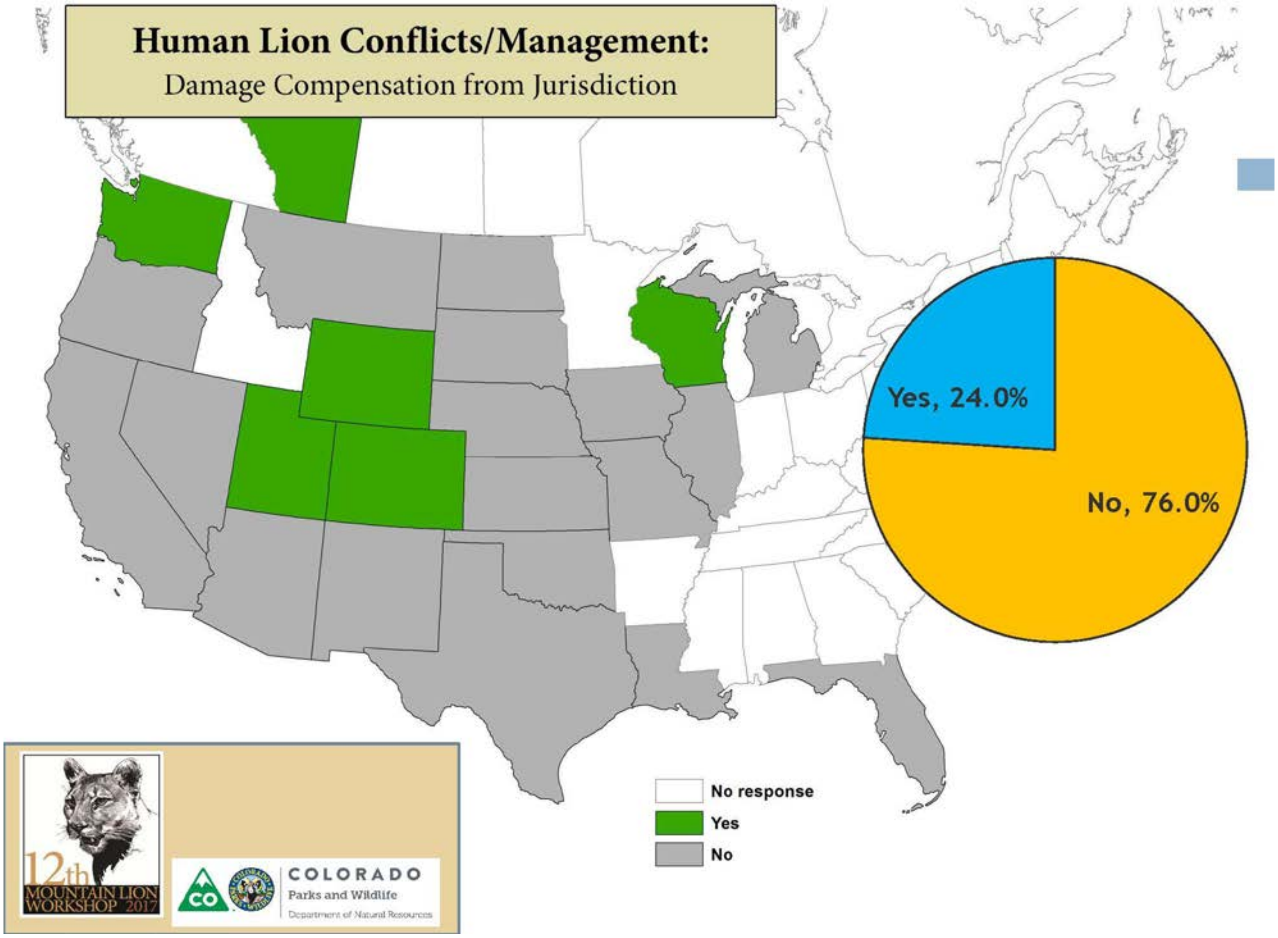
Agency Investigation Response Protocols - Depredations




Human Lion Conflicts/Management:
Damage Compensation from Jurisdiction
Yes, 24.0%
No, 76.0%
No response
Yes
No
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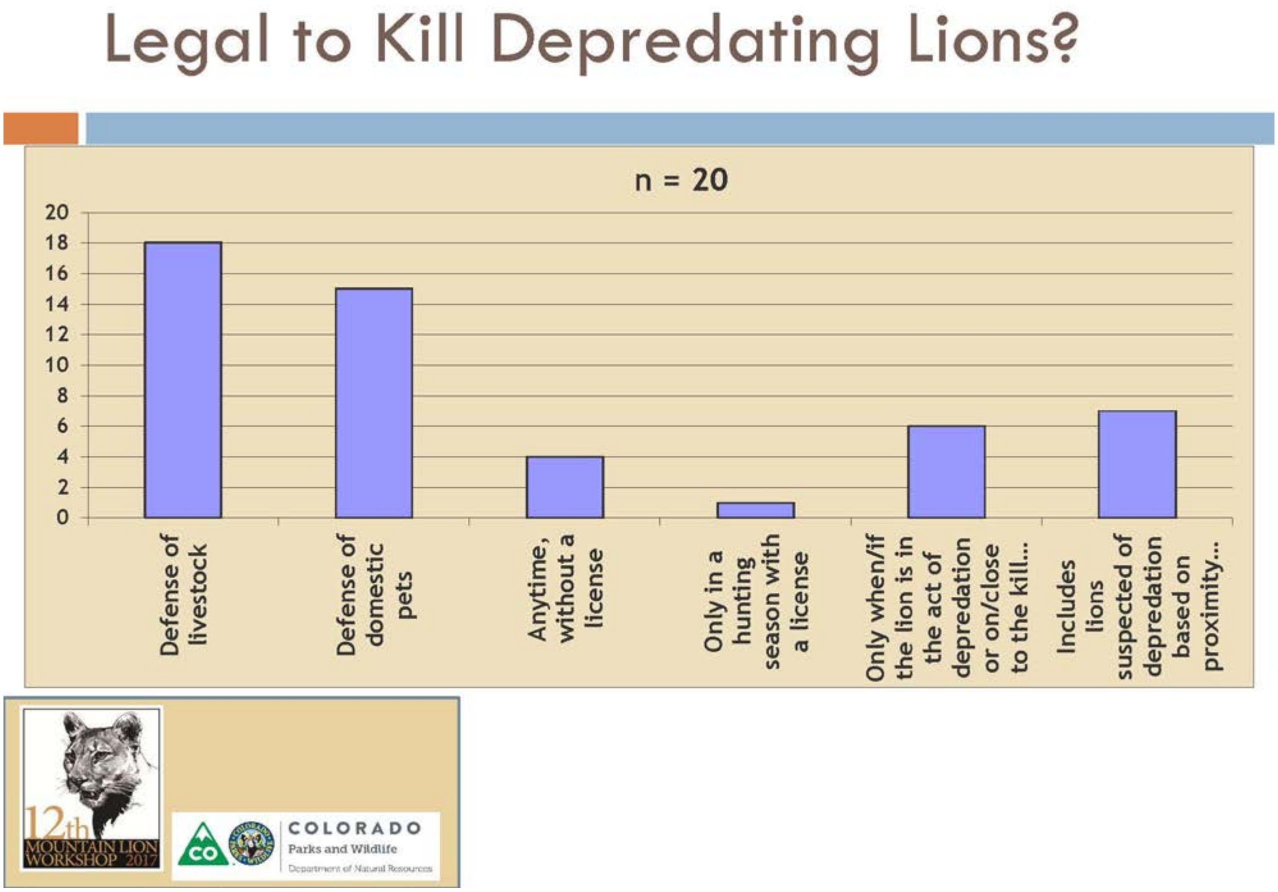
Legal to Kill Depredating Lions?
n = 20
20
18
16
14
12
10
8
6
4
2
0
Defense of livestock
Defense of domestic pets
Anytime, without a license
Only in a hunting season with a license
Only when/if the lion is in the act of depredation or on/close to the kill...
Includes lions suspected of depredation based on proximity...
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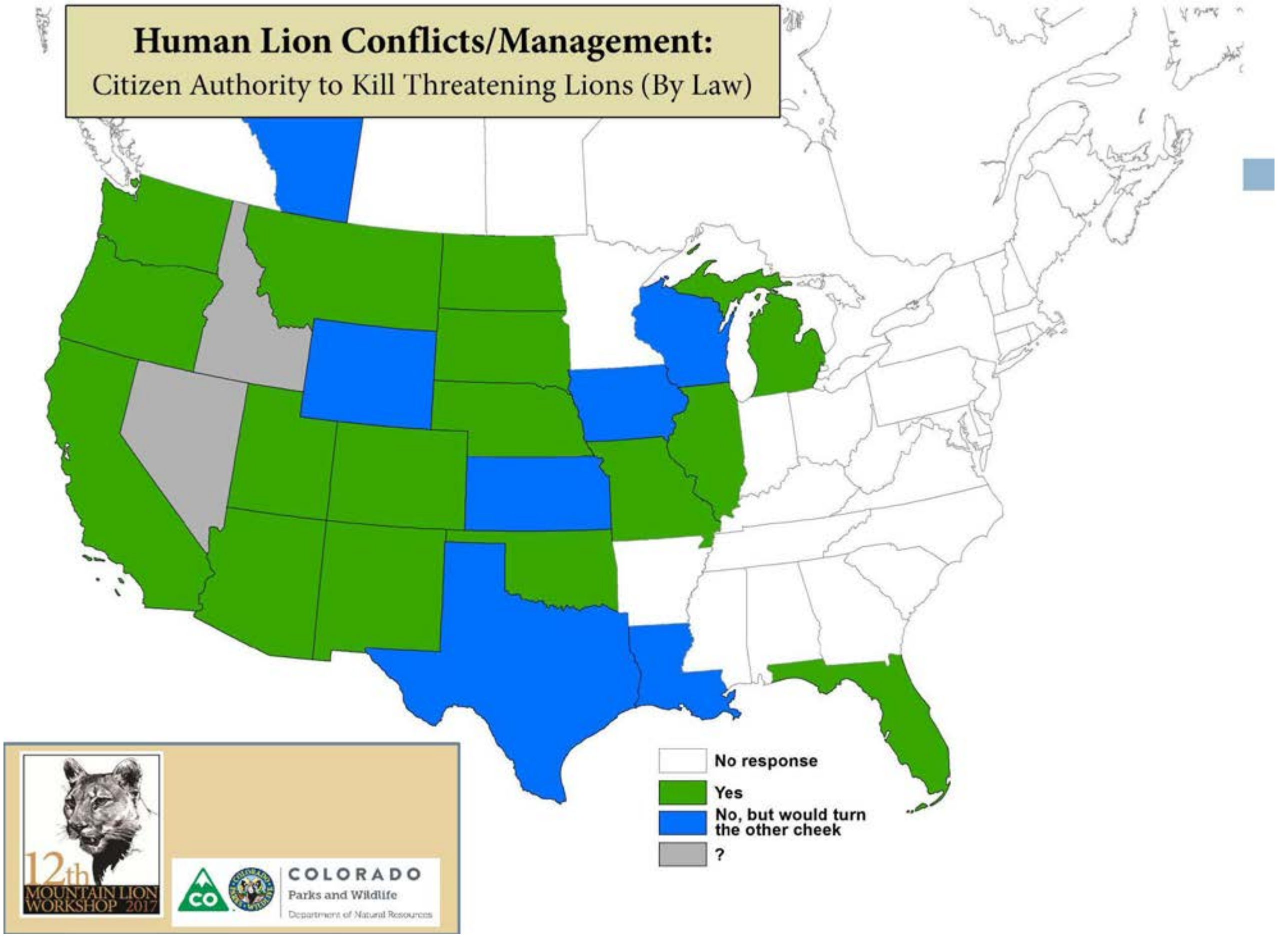
Human Lion Conflicts/Management:
Citizen Authority to Kill Threatening Lions (By Law)
No response
Yes
No, but would turn the other cheek
?
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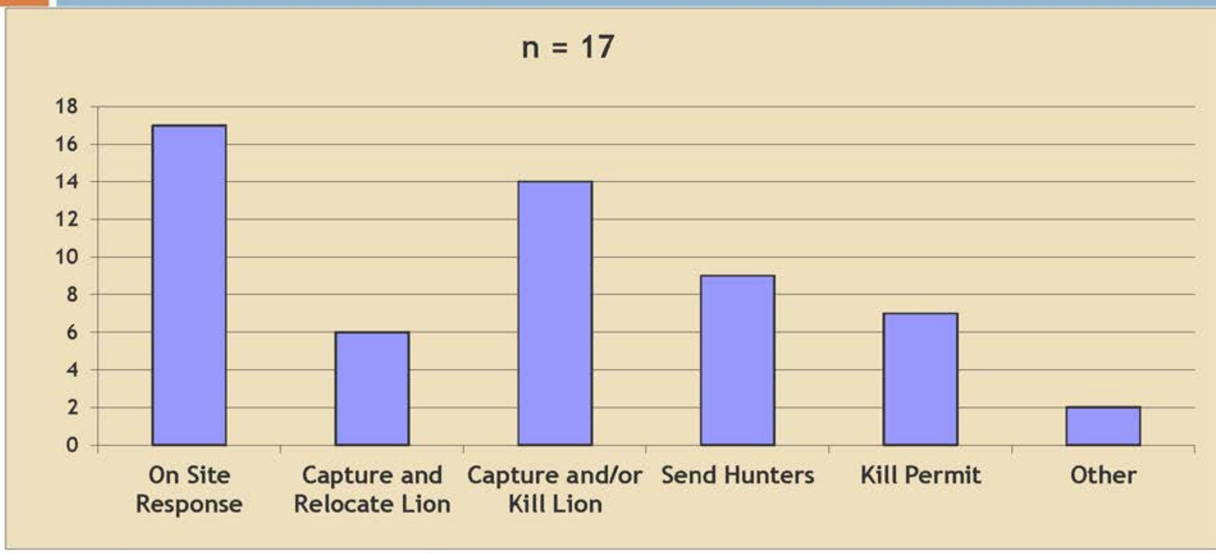
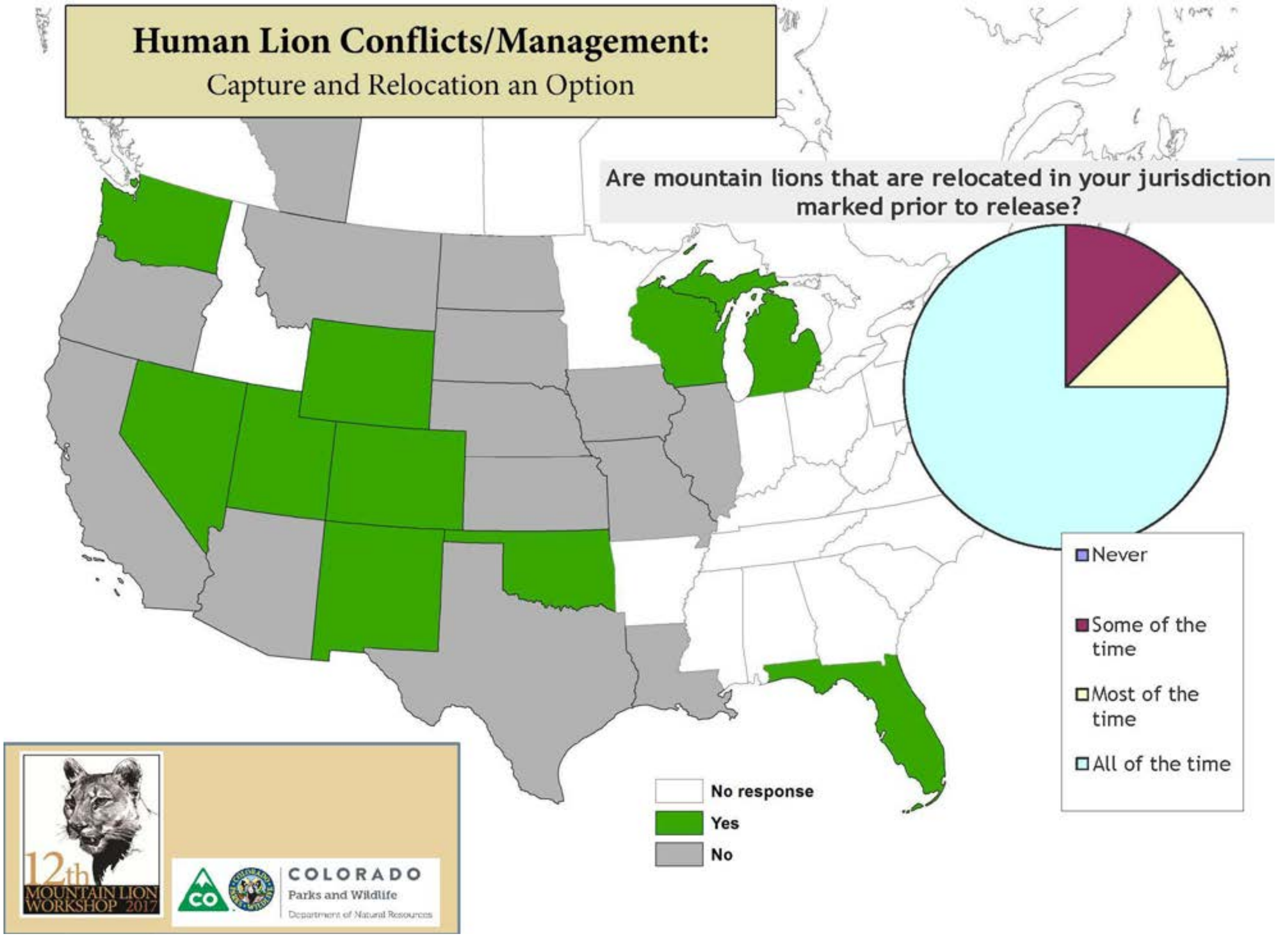
Public Safety

Agency Investigation Response Protocols – Public Safety




Human Lion Conflicts/Management:
Capture and Relocation an Option
Are mountain lions that are relocated in your jurisdiction marked prior to release?
Never
Some of the time
Most of the time
All of the time
No response
Yes
No
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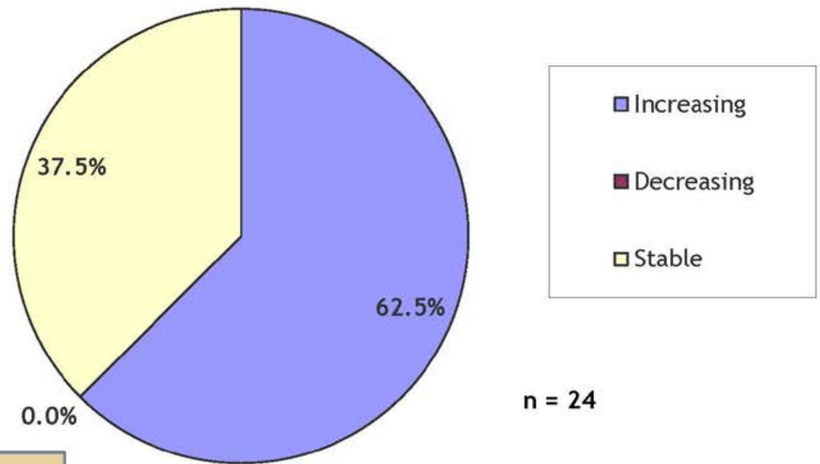
Public Education - Information

Is the need for public education regarding mountain lions?



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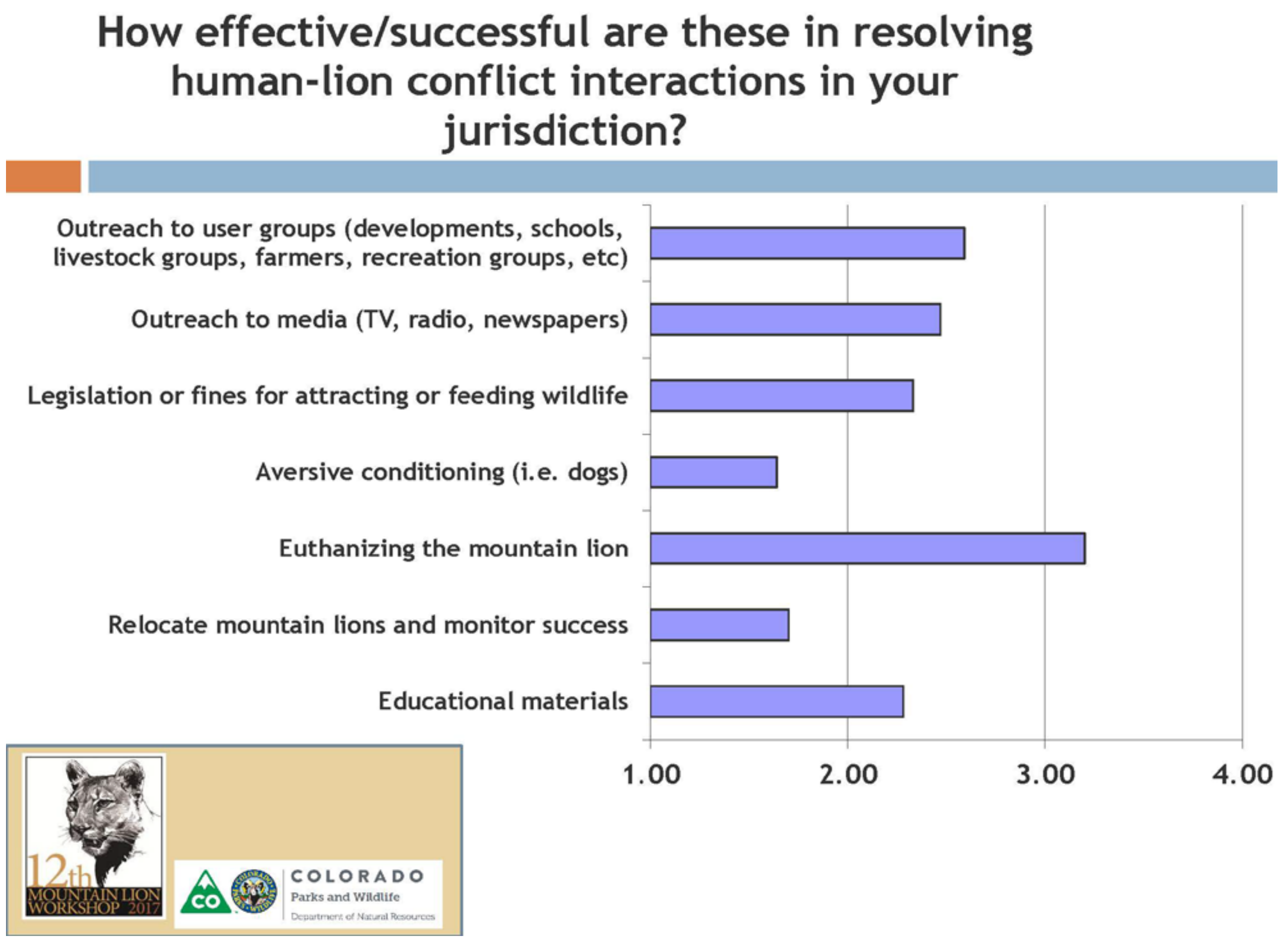
How effective/successful are these in resolving human-lion conflict interactions in your jurisdiction?
Outreach to user groups (developments, schools, livestock groups, farmers, recreation groups, etc)
Outreach to media (TV, radio, newspapers)
Legislation or fines for attracting or feeding wildlife
Aversive conditioning (i.e. dogs)
Euthanizing the mountain lion
Relocate mountain lions and monitor success
Educational materials
1.00
2.00
3.00
4.00
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Acknowledgments

- Paul Frame. Alberta Environment and Parks
- April Howard. Arizona Game and Fish Department
- Marc Kenyon. California Department of Fish and Wildlife
- Jerry Apker. Colorado Parks and Wildlife
- Mark Lotz. Florida Fish & Wildlife Conservation Commission
- Jim Hayden. Idaho Fish and Game
- Doug Dufford. Illinois Department of Natural Resources
- Vince Evelsizer. Iowa Dept of Natural Resources
- Matt Peek. Kansas Dept of Wildlife, Parks and Tourism
- Maria Davidson. Louisiana Dept of Wildlife and Fisheries
- William Watkins. Manitoba Wildlife and Fisheries Branch
- Kevin C. Swanson. Michigan Department of Natural Resources, Wildlife Division
- Laura Conlee. Missouri Department of Conservation
- Jay Kolbe. Montana Dept. of Fish, Wildlife & Parks
- Sam Wilson. Nebraska Game and Parks Commission
- Pat Jackson. Nevada Department of Wildlife
- Frederic Winslow. New Mexico Dept. of Game and Fish
- Stephanie Tucker. North Dakota Game and Fish Department
- Suzie Prange. Ohio Division of Wildlife
- Jerrod L. Davis. Oklahoma Department of Wildlife Conservation
- Derek Broman. Oregon Department of Fish and Wildlife
- Mike Gollop. Saskatchewan Ministry of Environment
- Andrew Lindbloom. South Dakota Game, Fish, and Parks
- Jonah Evans. Texas Parks and Wildlife
- Leslie McFarlane. Utah Division of Wildlife Resources
- Rich Beausoleil. Washington Dept. Fish & Wildlife
- David MacFarland. Wisconsin Department of Natural Resources
- Justin Clapp. Wyoming Game and Fish Department

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Adios, mi amigos...

Arizona Mountain Lion Status Report

Report provided by: April L. Howard, Arizona Game and Fish Department, 5000 West Carefree Highway, Phoenix, AZ 85086; ahoward@azgfd.gov

History of Legal Classification:

Dates for major status changes, e.g., non-regulated killing, bounties, regulated management, protection, use of dogs.

Mountain lions were classified as a "predatory animal" by the territorial legislature and were subject to a statewide bounty of $50.00 in 1919. This status continued until 1970 when the mountain lion was classified as a big game animal and a tag was required to take one, even though livestock operators and their agents could still take a depredating mountain lion. A mandatory checkout procedure and other reporting requirements were instituted in 1982. The hunting season in Arizona does not restrict the number of tags sold but allows for an annual bag limit of one mountain lion per hunter in most units throughout the state. Since 1999, multiple bag limits have been used in limited areas for the purpose of management or research. In 2004, AZGFD required successful mountain lion hunters to provide a premolar tooth which increases accuracy in aging data. As of 2006, mountain lion hunters are required to present their mountain lion to the Department for inspection, DNA collection, and tooth extraction. In 2007, the hunt season was shortened from yearlong to being closed from June through August but, in 2012, the hunt season was again extended to yearlong. It is legal to use hounds to hunt mountain lions. AZGFD is currently evaluating its mountain lion management strategies and will likely propose substantial changes to its Commission in September 2017.

Current status & management:

Presence/ absence of a formal management plan. AZGFD is in the process of drafting a mountain lion management plan.

- Statements of lion management policy, goal and objectives.

The Department's Lion Management Goal is to manage the mountain lion population, its numbers and distribution, as an important part of Arizona's fauna while providing mountain lion hunting and other recreational opportunities. Management Objective: Maintain lion population at levels that provide diverse recreational opportunities, while minimizing negative impacts to the lion population due to hunting or big game prey species due to predation.

Lion management structure and strategies, including dates, methods, use of special quotas, limited entry areas, closed areas, bans. We are evaluating our current mountain lion management strategies and have proposed changes to hunt guidelines which will be presented to the Arizona Game and Fish Commission in September 2017. If approved, they will be implemented in the 2018 season. Zone Description: A grouping of units where the presence of lions is desired at levels that provide maximum lion hunting and other recreational opportunities.

Harvest Guidelines: The Department currently uses a zone approach to evaluate and manage adult (≥ 3 years) female harvest. Trends are managed to keep adult female harvest <35% of the total take. Should the 2-year mean adult female harvest comprise >35% of the harvest for the zone, female harvest limits may be established to reduce the overall female harvest in that zone. Zones with established female harvest limits may close to mountain lion take for the season or a portion of the season if the female harvest limit is met. The proportion of acceptable adult female harvest would decrease under the proposed changes.

Management zones will be used in which different season prescriptions will be instituted and strategies will be determined by the desired levels of mountain lion presence within each zone. Proposed changes would divide the state into smaller Mountain Lion Management Zones to better manage regional mountain lion populations and harvest thresholds would be established by management zone. The current season is year-round but we propose to close the season for about 3 months during the summer. This was also done in 2007 but in 2012 the season was extended to yearlong again.

Currently, the Standard Mountain Lion Management Zone is implemented in areas where the goal is to maintain current mountain lion population levels while providing maximum hunting and recreational opportunities. The annual bag limit in the standard zone is typically 1 mountain lion per person per year.

Minimal Occurrence Zones were used in some areas of the state where the goal was to reduce conflicts with other public, private, or wildlife resources by maintaining extremely low population densities as deemed appropriate. In this zone, the bag limit was 3 mountain lions/person/year with daylong shooting hours. The Minimal Occurrence Zone was removed in July 2017. The entire state is now managed under the Standard Mountain Lion Management Zone with only daylight shooting hours.

In either zone, a multiple bag limit season structure in hunt units, or a portion of a hunt unit, may be implemented to increase mountain lion harvest where prey populations are below management objectives and mountain lion predation is implicated as a contributing factor, where a translocation is being limited by mountain lion predation, or when mountain lion predation is identified as a limiting factor in a management focus area (MFA) plan or other management plan. Restricted season structures may also be used to meet management objectives and to address specific needs within predation management plans. In both zones it is illegal to harvest mountain lion spotted kittens or females accompanied by spotted kittens. The season is year-round. Proposed changes would remove multiple bag limits.

- Use of mandatory checks or sampling numbers, sex, age data, hunter effort.

Hunters are responsible for reporting mountain lion harvest within 48 hours of harvest. All hunter-harvested mountain lions must be physically checked out at a Department office, or with authorized Department personnel, within 10 days of harvest. The hunter will present the head and complete hide, with evidence of sex attached, for inspection. Data collected will include: age, sex, reproductive status, hunting method, harvest date, harvest location, biological condition of animal, evidence of disease, hunter effort, and other pertinent data as determined. One premolar tooth and DNA will be collected.

- State-wide lion number and population trend.

- How lion population numbers/densities are derived, e.g., extrapolated assumptions, use of study results, biological judgments, population reconstruction.

In the past, mountain lion populations in Arizona were estimated by determining the amount of suitable habitat in each game management unit and assigning a density estimate per square mile. More recently, the Department used virtual population analysis (VPA) as an additional tool to estimate the statewide mountain lion population using age-at-harvest data. AZGFD continues to refine this model and evaluate other statistical population reconstruction models.

Colorado Mountain Lion Status Report

Jerry A. Apker, (retired), Colorado Parks and Wildlife

Mark Vieira, Colorado Parks and Wildlife, 317 W. Prospect Rd., Fort Collins, CO 80526; mark.vieira@state.co.us

History of Legal Classification:

Mountain lion (*Puma concolor*) received no legal protection and were classified as a predator in Colorado from 1881 until 1965. During these years the take of mountain lion at any time, any place was encouraged by bounties and other laws. The bounty was abolished in 1965, but some provision for landowner take of a depredating lion remains in Colorado laws to this day. In 1965, mountain lion 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 lion if it is depredating on livestock, while the Colorado Division of Wildlife (CDOW) retains authority to manage lion populations, all forms of recreational or scientific use, and resolution of human-lion conflicts.

Management Background:

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

Colorado does not have a statewide management plan for lion. Instead, Colorado applies a decentralized approach to planning. Local biologists, in collaboration with local managers and with public input, formulate plans associated with each lion DAU. The plans each have their own management targets and specific management approaches may vary but must remain within the constraints of over-arching management guidelines that are developed by developed by the agency carnivore programs leader. Currently, most DAU plans analyze data on 5 year running averages and examine the composition of all females in hunter harvest and total mortality in comparison to certain thresholds, the amounts of game damage and human conflicts within the DAUs. DAU objectives are based on not exceeding certain harvest and total mortality amounts and also not exceeding the composition of females in harvest and total mortality. A statewide lion management plan was drafted in 2015-2016 and is under consideration for advancement and possible future approval, but as yet remains in draft form.

Hunting of mountain lions is legal in nearly all locations in Colorado. However, legal access on the land may not be allowed and thus some jurisdictional rules may restrict actual hunting activities. For example, access to National Park Service lands typically prohibits hunting and some USFWS lands also may not allow lion hunting per se or may have seasonal closures which constrain lion hunting. Likewise, some county and city open space lands and State Park lands may not allow access for lion hunting. The State does not have specific DAUs in which lion hunting is prohibited or greatly reduced in order to provide so called refugia.

Colorado has conducted population extrapolations based on a habitat suitability model that considered prey densities, vegetation types, terrain roughness, deer, elk, and bighorn sheep winter range and historic mortality locations. Densities of independent lions utilized in these extrapolations ranged from 1.5 lion/100 km^2 to 4.5 lion/100km^2 depending upon the rated quality of the habitat. These extrapolations and how they are derived are described in each of the present DAU plans. Notably, per statewide direction each DAU plan also deducted from the extrapolation about 35% in order to account for kittens in the density estimates. This erroneously reduces the end result because kittens were never or only very rarely included in density estimates reporting in literature which formed the basis for densities used in our extrapolations. With this error in mind, then the summation of the DAU extrapolations is likely a conservative representation of possible population size in Colorado; 3,500 – 4,500. If the deduction for kittens is eliminated in the DAU extrapolations then the possible population of independent lions in Colorado is probably nearer 4,500 – 5,500 lions.

Harvest and Total Mortality:

Lion 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. Lion harvest limit quotas increased from 1980 to 1999, leveled out until 2005 when a substantial reduction was enacted. Since 2005 the harvest limit quota gradually increased to the current level of about 650 (Fig. 2). Hunter harvest gradually increased from 1980 to 1997 with increasing quotas and showed some variability from 1998 through 2004. During this same time hunter success rates relative to licenses sold declined (Fig. 3). From 2005 through 2015 hunter harvest and total mortality have increased and hunter success rates rebounded from 2005; stabilizing at about 20% to 24% over the past 8 years (Fig. 2). Reduced harvest levels in 2005-2007 are attributed mainly to efforts to reduce the take of females but are also aligned with the reduction to harvest limit quotas. License sales are recorded as an indicator of hunter participation and hunter success is derived by dividing license sales into harvest (Fig. 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 have 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 harvest limit quota reduction stemmed from analysis which occurred during revision of DAU plans in 2004. In some cases harvest limit quota reductions were intended to produce a slight reduction in lion harvest, but in most cases reductions were intended to have a negligible harvest affect but realign the harvest limit quota closer to the harvest objective. In most DAUs the harvest limit quota is somewhat higher than the harvest objective due to a DAU history in which the objective is rarely or never achieved. Yet in these DAUs, harvest limit quota represents the upper limit on harvest that managers believe could be endured for a one or two year period. The caveat being that if mortality did not drop to within harvest and mortality objectives in a two year period, then harvest limit quota reductions would be the likely response. The effectiveness of this approach depends upon management corrections are effectively applied on a consistent basis. That assumption is open to debate.

There are no restrictions in Colorado on the use of GPS and tip-up collars which may indicate that a dog is baying a lion. There are also no restrictions on the use of snowmobiles or tracked ATVs to access lion hunting areas. The private landowners or land management agencies control when and how access is allowed. CPW also does not have regulatory authority over guides and outfitters. That authority rests first with the Colorado Department of Regulatory Agencies, Outfitters Board. Federal land management agencies have authority to control which outfitters may be licensed to operate within specific geographic areas. This authority does not extend to independent houndsmen who are not operating a business relationship with a hunter. Thus, so called privateer houndsmen may hunt in a given Federal area that has limits or restrictions on licensed outfitters that are guiding paid hunters. This exception for privateers can and in some places, frequently results in illegal outfitting in which payment is made “off the books” or in trade for services and so on.

Colorado regulations for the care of lion meat are the same as are required for all other big game; meat must be removed from the field and cared for in order to make it fit for human consumption. Failure to remove meat from the field or care for it as require could constitute misdemeanor waste of wildlife or one of Colorado’s few felony wildlife violations, willful destruction of wildlife. Colorado also requires that hunters that take a lion must be present at the time dogs are released on a track and must continuously participate in the hunt until it ends. This law is intended to prohibit guides/outfitters from pursuing and holding a lion at bay and then calling/notifying a hunter to come from a remote location just to finish the hunt.

From 2005-2007 CPW, in collaboration with a State Houndsmen's Association conducted training workshops about the biology and life history of mountain lion as well as the importance of females to sustaining populations. Regulation brochures/proclamations also provided similar written information. In 2007/2008 lion seasons, at the direction of our Wildlife Commission, CPW implemented a mandatory mountain lion hunter education requirement. The course provides training information to hunters about mountain lion ecology and hunters must pass an exam demonstrating ability to identify lion gender characteristics. Subsequently, female composition of harvest and total mortality has declined from about 42% to about 36% since these efforts were implemented (Fig. 4).

During 2005 through 2007 seasons hunter harvest declined, apparently as an unintended consequence of hunter efforts to reduce female harvest (Fig 2). Hunters that passed on taking a female lion likely did not have a subsequent opportunity to kill a lion during the time they had available for hunting. CPW made efforts to communicate with lion hunters, informing them of opportunity for female was abundant and that often there was ample quota available for increased harvest on both genders of lions. In 2013 CPW implemented an extended April season in locations that were persistently under our harvest objectives.

Depredation and Human Safety Conflict Management:

Management of human-lion conflicts is governed by agency policies and administrative directives that focus management efforts on the offending lion. Colorado policies require that depredating lions be killed if caught or bayed. Policies do allow that non-depredating lions may be translocated if the conflict is due to the lion being in a dangerous location but not exhibiting dangerous behaviors towards humans (eg. a lion caught in an urban/suburban area but not displaying any dangerous behaviors). Generally, however, lions in caught in conflicts with humans are humanely euthanized. Hunter harvest, non-hunter mortality, game damage conflicts, and human-lion conflicts are monitored annually within DAUs for crude indications of population change.

Data on depredation claims since 1980 is also maintained in a database, although the data from 1980-1987 is suspect due to inconsistent reporting and record keeping. Excluding data prior to 1988, from 1988 until 2000 lion claims had increased from about 10-20 per year to about 70-80 per year (Fig. 5). In this same time indexed costs had increased from about $25,000 per year to about $150,000 to $200,000 per year, excluding a single year event in 200 in which some expensive hobby stock were claimed

(Fig. 5). There was a period from about 2000 through 2006 in which claims and costs returned nearly to pre 1995 levels, mostly due to a large reduction in sheep losses. Reasons for this lull are unknown but may relate to sheep/wool market conditions. Since about 2007 the number of claims paid annually has fluctuated between about 50-70 and the indexed cost of those claims is typically between about $50,000 and $100,000 annually. Sheep and other stock claims and costs (mostly hobby stock like llamas, alpacas, goats, or pigs) are the most common in Colorado (Fig. 5).

Information and Education Programs:

Agency staff and volunteers conduct information and education programs and efforts particularly on the Front Range and West Slope urban/suburban areas. Efforts peak during times when human-lion conflicts have increased (such as increased sightings, losses of pets, or after lion-human attacks). Such efforts include the use of radio, television, social media, trail signage, distribution of informational brochures, community meetings, and may include meetings with elected government officials at State and local levels. Citizens and communities are also usually provided with stock and pet pen designs that will prevent a lion from gaining entry.

No recent human dimensions efforts have been conducted.

Research Efforts:

Uncompahgre Plateau Research (K.Logan): An 870 mi^2 area on the southern end of the Uncompahgre Plateau in southwest Colorado was selected for a long-term research project. The basic research design is an experimental manipulation of the lion population in two 5-year phases. Desired outcomes from this research include: estimation of population parameters and changes during a reference phase (no hunting to influence population dynamics) and a treatment phase (hunting manipulation of the population); identification of habitat preferences and linkages; lion-prey relationships; and testing current CPW lion management assumptions. Plans are underway to develop and test methods to estimate lion abundance primarily using mark-recapture. Indices to lion abundance under consideration include change in harvest sex and age structure and aerial track surveys. This research has been concluded and the results and conclusions are being written now. Federal Aid reports are available on request. A preliminary report of results was provided by Ken Logan during the workshop (see proceedings abstracts).

Front Range Research (M. Alldredge): Pilot research began in 2007 with the following research objectives: capture and mark independent age cougars and cubs to collect data to examine demographic rates for the urban cougar population, assessment of aversive conditioning techniques on cougars within urban/exurban areas, assess relocation of cougars as a practical management tool, assess cougar predation rates and diet composition based on GPS cluster data, assess kill site dynamics and prey selection of cougar kills, field work completed—data analysis and publication in progress, model movement data of cougars to understand how cougars are responding to environmental variables (see Blecha and Alldredge in proceedings abstracts) and to develop non-invasive mark-recapture techniques to estimate cougar population size (see Alldredge and Blecha in proceedings abstracts). This work is largely complete and parts are in publication; Federal Aid reports are available on request.

Telomere Aging (M. Alldredge): We obtained blood and hair samples from known-age cougars on the Front Range and extracted DNA to measure relative telomere length. In numerous mammals, telomeres shorten as an individual ages, and thus shorter telomeres indicate an older individual. This relationship has not been characterized in cougars; therefore it was not known whether such a correlation exists. Utilizing quantitative PCR to estimate telomere length to age non-invasively obtained hair samples was not shown to be a successful technique in this project.

Stable Isotopes (M. Alldredge/K. Logan): Beginning in 2012, we collected hair samples from both cougar and potential prey species, and have analyzed the isotopic signature in $\delta^{13}C$ and $\delta^{15}N$. Using stable isotope mixing models, we estimated the relative importance of different classes of prey to cougar diets. We found that cougars in the Front Range obtained 67-76% of their diet from native herbivores, mostly elk and deer, whereas in the Uncompagre Plateau, nearly all of the diet (98-100%) came from native herbivores. Individuals in the Front Range population were much more heterogeneous in diet, and these differences appeared to be driven mostly by habitat use. Individuals who foraged in areas of higher housing density relied more heavily on smaller-bodied prey, like synanthropic wildlife and domestic species. Males were also more likely to use non-ungulate prey than females.

Currently, Colorado is conducting lion-mule deer predation experiments in two locations in Colorado. More detailed description of these predator management experiments can be found on the CPW web page: Predator Management Experiments Overview.

Figures

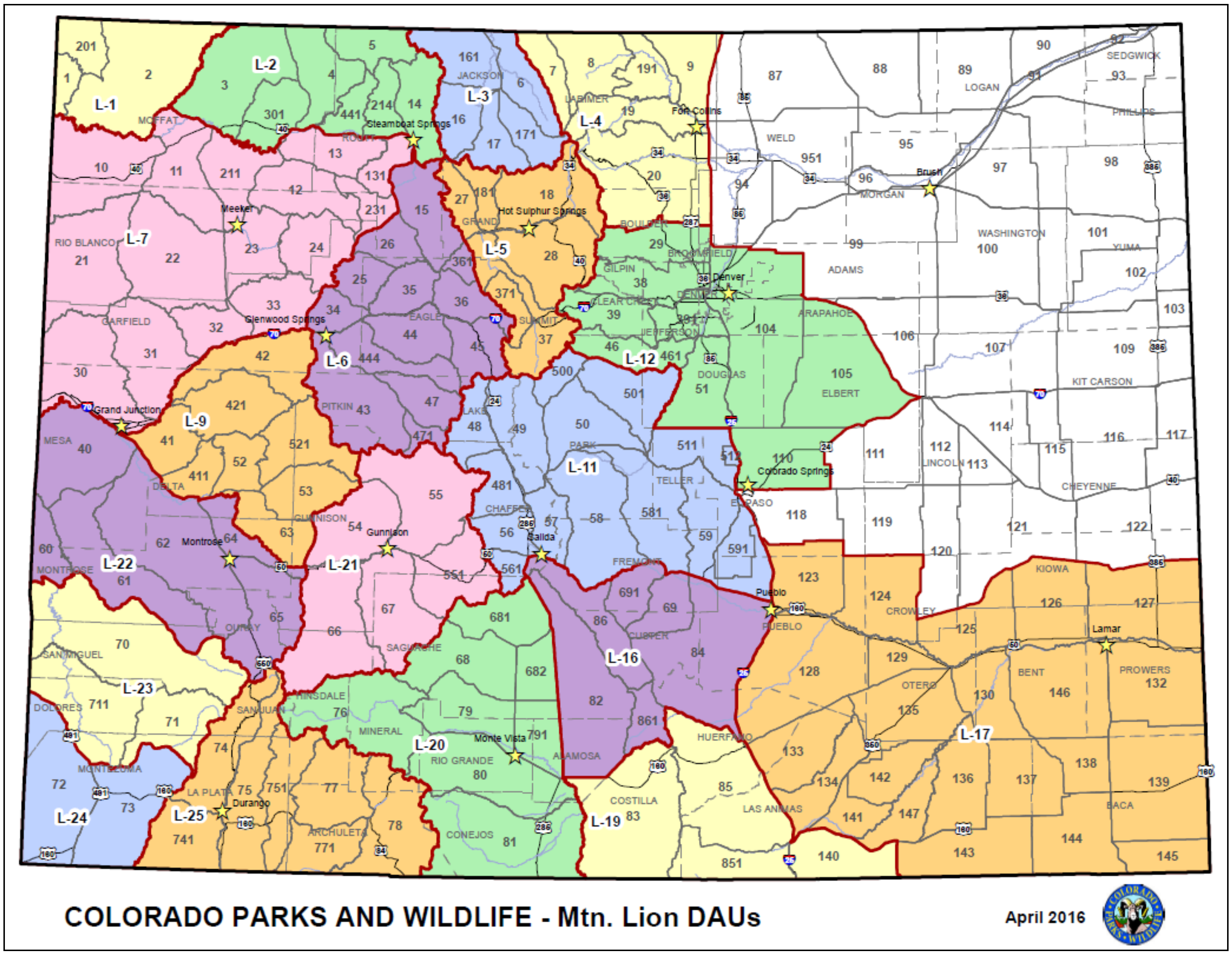


Figure 1. Colorado mountain lion Data Analysis Units (DAUs).

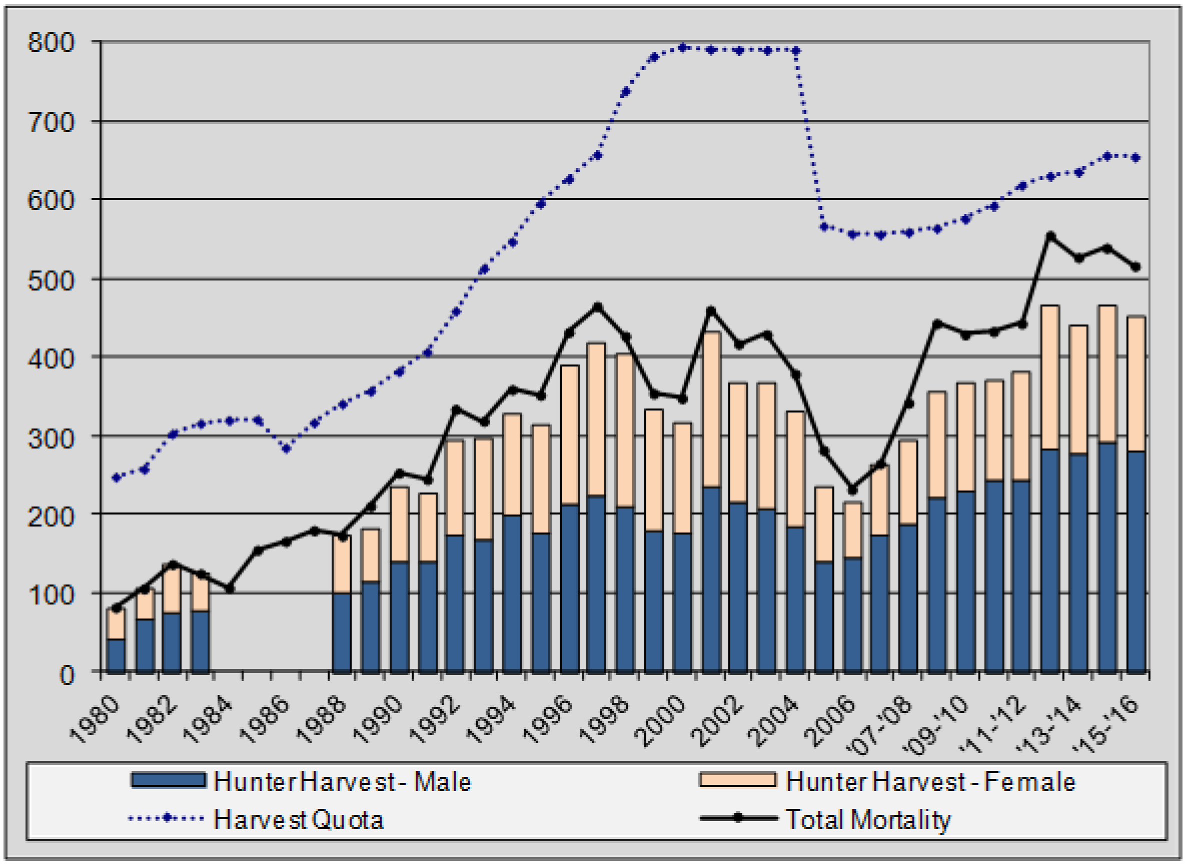


Figure 2. Colorado mountain lion harvest limit quota, harvest, and total mortality 1979/1980 – 2015/2016.

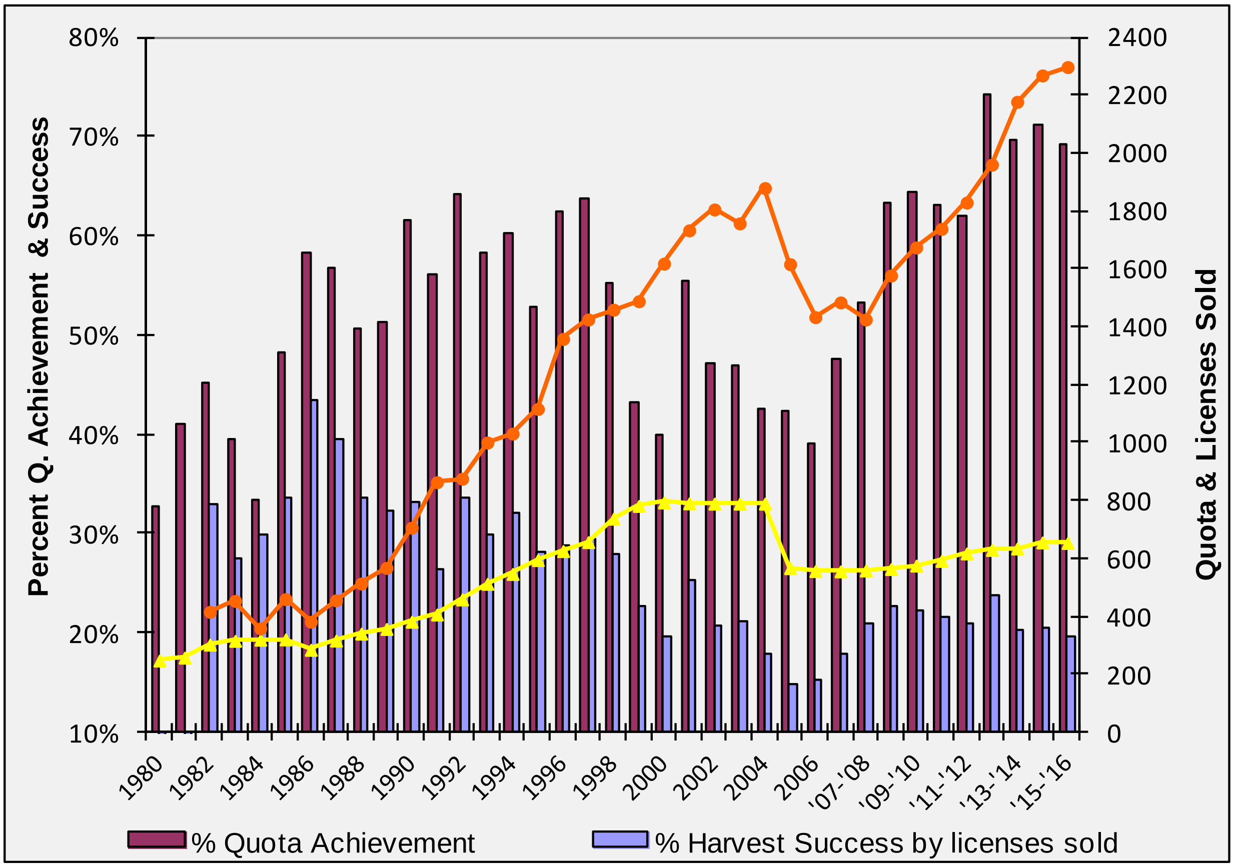


Figure 3. Colorado mountain lion license sales, success (by licenses sold), quota achievement 1979/1980 – 2015/2016.

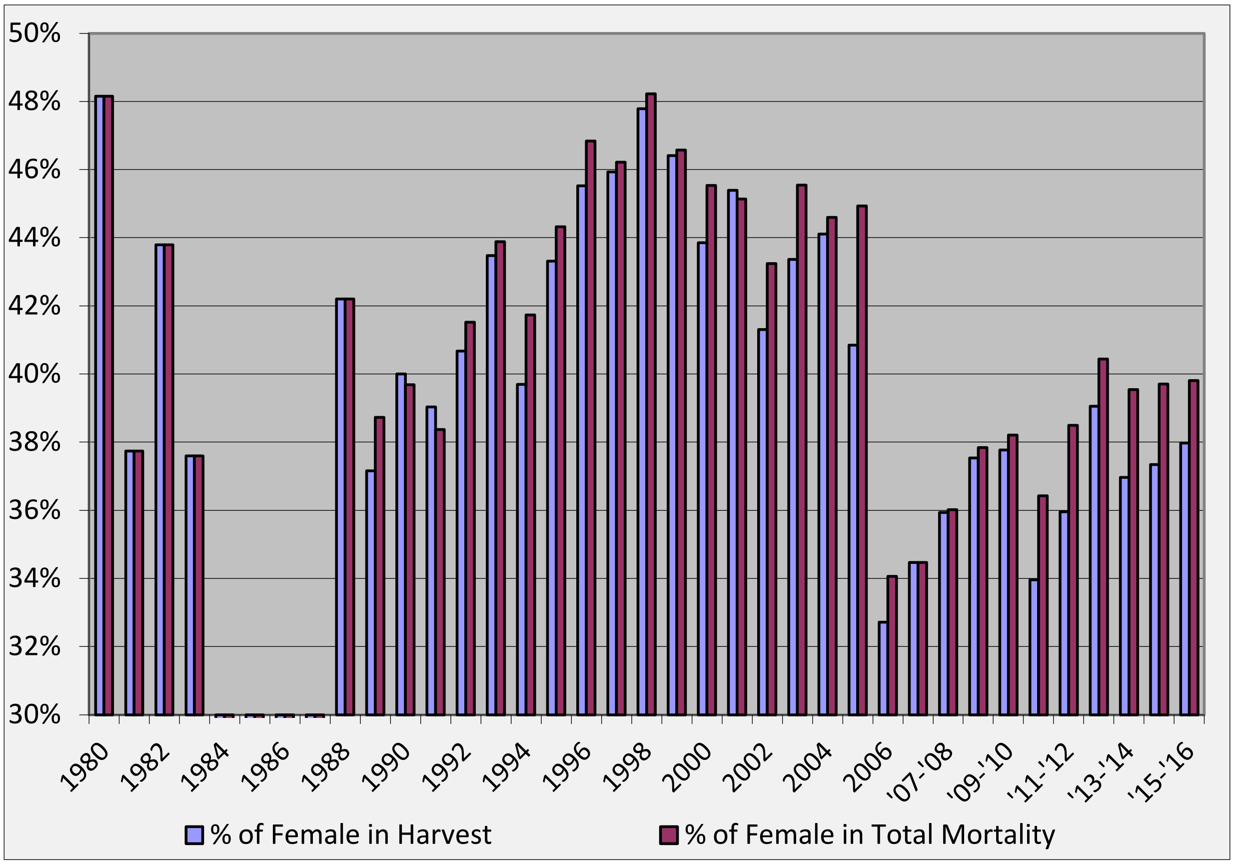
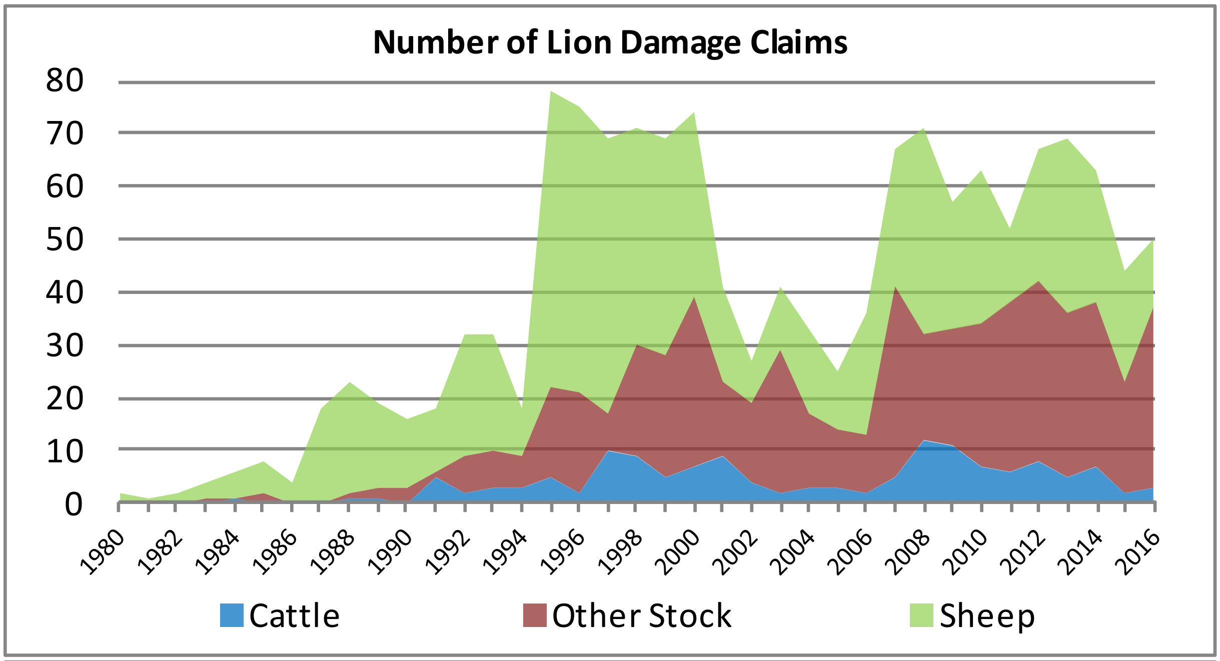


Figure 4. Percentage of females in hunter harvest and total mortality 1979/1980 – 2015/2016.



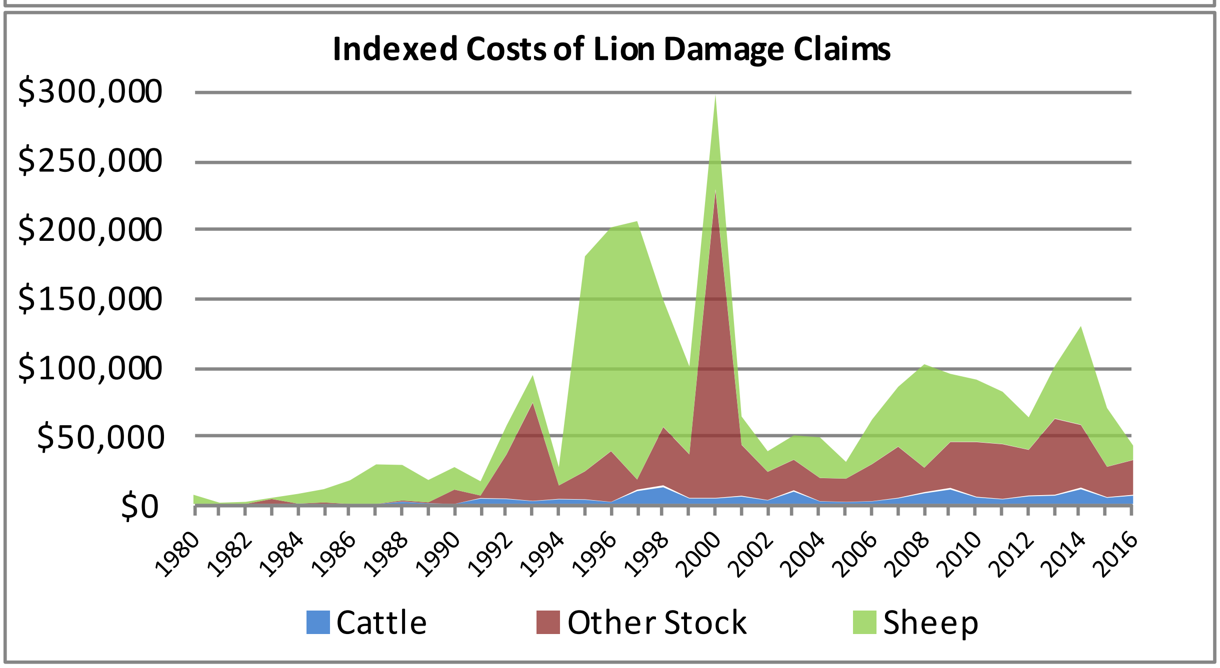


Figure 5. Charts display the number of lion damage claims paid and the indexed cost of those claims for cattle, sheep, and other stock in Colorado from 1980-2016.

(costs are indexed to 2015 dollars)

Florida Mountain Lion Status Report

Mark Lotz, Florida Fish & Wildlife Conservation Commission, 298 Sabal Palm Rd., Naples, FL 34114-6352; Mark.Lotz@myfwc.com

History of Legal Classification:

The Florida panther (*Puma concolor coryi*) declined in numbers as the south-eastern United States was settled through the early 1800s. Bounties were paid by the courts beginning in 1832, 13 years before Florida became a state. In 1887, the state of Florida was offering $5.00 for panther scalps. By the late 1800s panthers were so scarce that they were regarded as mythical by many hunters. In 1950 panthers were given partial protection by being classified as a game animal that could only be taken during deer season. Special permits were issued for nuisance panthers depredating livestock and could hunted at any time. In 1958, Florida panthers were given complete legal protection by the Florida Fish and Wildlife Conservation Commission (FWC). Following the passing of the Endangered Species Preservation Act, the U.S. Department of the Interior listed the Florida panther as endangered in March 1967. Florida panthers have been listed as endangered since passing of the Endangered Species Act in 1973.

Current Status and Management:

The FWC does not have a formal management plan for federally listed species but works cooperatively with the U.S. Fish and Wildlife Service (USFWS) to implement recovery goals outlined in the Florida Panther Recovery Plan (USFWSa, 2008). Full recovery and delisting of the Florida panther under the current recovery plan would require establishment of additional breeding populations outside of south Florida and possibly into other southeastern states. Recognizing this, FWC has focused its limited resources on management efforts to maintain the existing panther population and address challenges associated with human-panther coexistence.

The FWC initiated radiocollaring studies in 1981. While specific objectives have changed each year, this long-term research continues today. Inbreeding depression was detected early on in the small and isolated Florida panther population. Genetic restoration (Seal 1994) was implemented in 1995 with the release of 8 female pumas from Texas to mimic historic gene flow. This was arguably one of the most beneficial management actions affecting Florida panthers and resulted in increased genetic variation, reduced inbreeding correlates, and improved reproductive output. The ensuing population growth resulted in recolonization of prior habitats. As the Florida panther population increased alongside an ever-increasing human population in south Florida, the FWC faced new management challenges. Dealing with conflict resolution led to the creation of an Interagency Florida Panther Response Plan (USFWSb, 2008) by the three managing agencies (USWFS, National Park Service [NPS], and FWC) responsible for panther recovery. The plan guides the agencies actions when dealing with human-panther interactions and depredations.

Florida panthers are largely restricted to the lower third of peninsular Florida, generally south of Lake Okeechobee (Fig.1). Although a limited number of males have ventured into central Florida and beyond, females were absent from 1973-2015. Reproduction outside of south Florida was verified in early 2017 when two kittens were captured in camera trap photos (FWC, unpublished data).

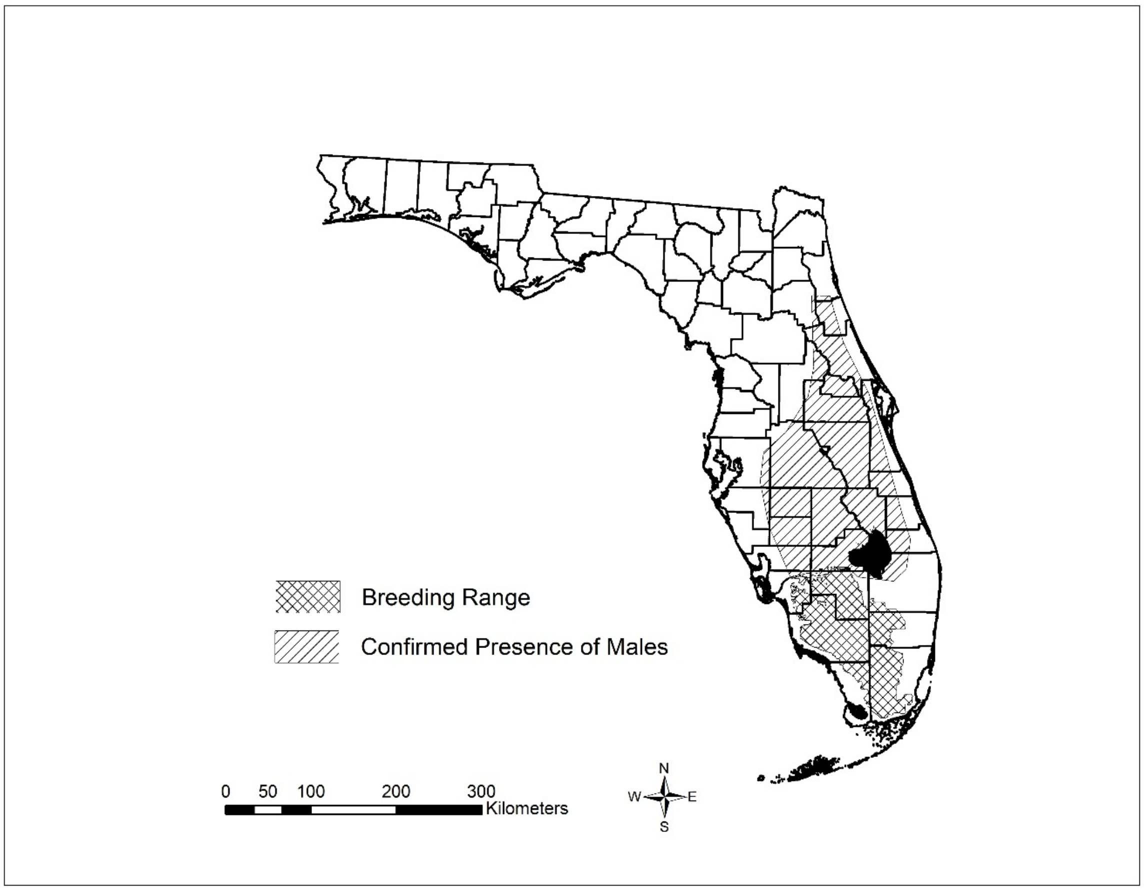


Figure 1. Current distribution of Florida panthers in Florida.

Annual counts of panther sign (photos, tracks, captures, mortalities, and radiocollar locations) provide insight into abundance (McBride, 2008). Counts conducted primarily on public lands were informative in reaching the conclusion that the panther population is likely between 120 and 230. The lower bound is based on the number of adults and subadults documented during the most recent annual minimum count. The upper bound of 230 is calculated using annual count data from core (very good) panther habitat to derive a density of panthers for that area. The density value is then multiplied by the total number of acres of habitat in the primary zone as identified by Kautz et al. (2006) to come up with an upper range of 230. Because this method does not account for sampling effort, imperfect detection of animals, or provide a margin of error, it can't be categorized as a scientific population estimate. Even with these shortcomings, this methodology has provided the agency with a reliable means of monitoring the population with the best data currently available.

Depredation and Human Safety Conflict Management:

An Interagency Florida Panther Response Team (Response Team), comprised of biologists, law enforcement personnel, and public information staff, was established by the FWC, FWS, and NPS in 2004 to respond to human-panther interactions. The Response Team developed the Interagency Florida Panther Response Plan (Response Plan) to provide guidelines for responding to human-panther interactions and conflicts that promotes public safety while assuring the conservation of the panther. Also included in the plan is an outreach strategy that provides goals and objectives for educating the public. The Response Plan has been the guiding document for the Response Team since February 2005. The Response Plan identifies five human-panther interaction classifications: Sighting(s), Encounter, Incident, Threat, and Attack. Panther depredation (preying on domestic animals) is addressed separately because it does not involve direct interaction with a human.

Depredation: Panther depredations have been trending upward (Fig. 2) but deciphering the significance of yearly variations is confounded by our outreach efforts. More depredations may have been reported as word got out about who to call but at the same time improved husbandry practices outlined in our outreach materials may be practiced which reduces depredations.

The vast majority of depredations occur in a 68,000 acre exurban subdivision on the outskirts of the city of Naples in southwest Florida known as Golden Gate Estates. Golden Gate Estates is nestled among conservation lands with resident panthers to its north, east, and south (Fig. 3). Average lot size is 2.37 acres and often the rear half of properties are left in native vegetation providing cover and corridors for wildlife. Many people enjoy maintaining a variety of hobby livestock. Goats and sheep account for most depredations but panthers have been documented preying on an array of animals. Depredations also occur on commercial cattle ranches although a recent study documented that <3% of radio-tagged calves were killed by panthers (Jacobs and Main, 2015).

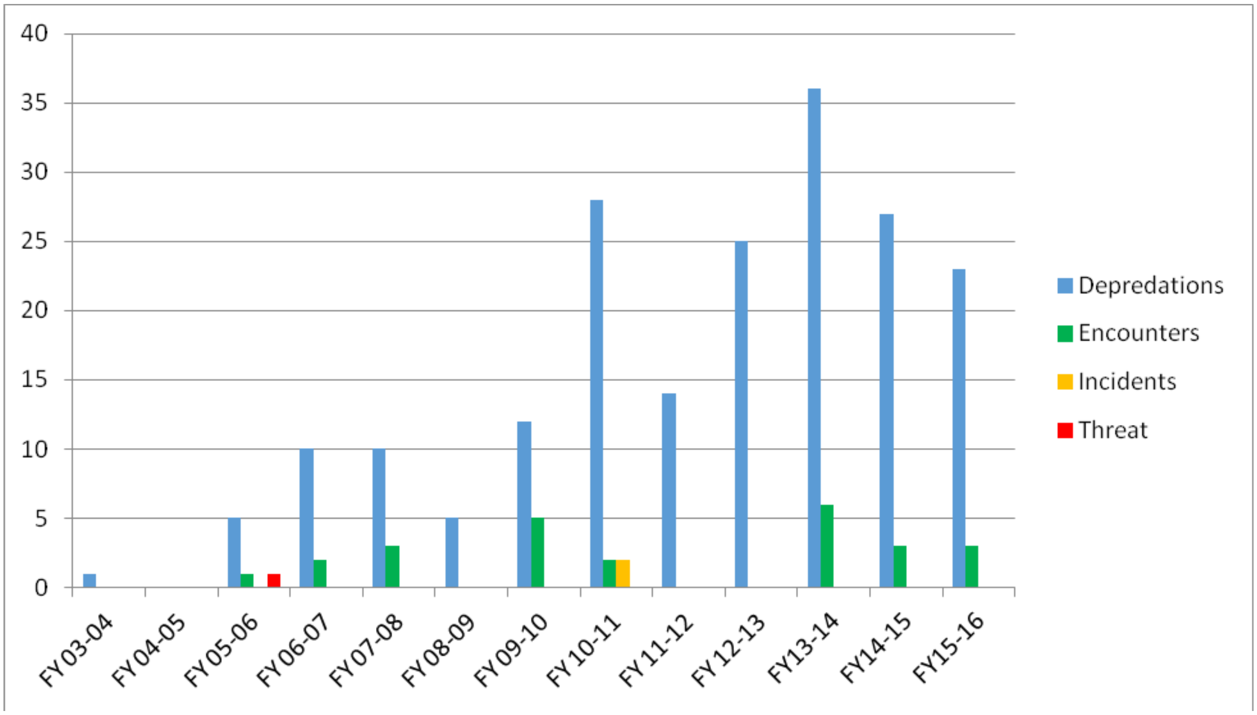


Figure 2. Number of verified human-panther conflicts in Florida per fiscal year (1 July-30 June).

Panthers killing animals, whether wild or domestic is viewed as a natural behavior and not a human safety issue. FWC advises residents on proper husbandry practices to protect their pets and, through cooperation with two local non-government organizations (NGO's), aids with acquiring and constructing predator resistant enclosures. This approach has been successful and no human safety issues have resulted by not removing panthers from close proximity to residences. Additionally, there is no evidence that panthers that occasionally prey on domestic animals switch to solely preying on domestics nor that it leads to attacks on humans. The two NGO's, The Conservancy of Southwest Florida and the Defenders of Wildlife, each offer cost-share assistance programs to help hobby livestock owners offset the cost of acquiring a predator resistant enclosure. Qualifying criteria is slightly different for each program but they work in tandem whenever possible to further reduce the cost to individual owners. During the most recent fiscal reporting period (FY2015-16) these organizations contributed a combined $6,041.00 to construct 6 predator resistant enclosures (FWC et.al., 2016).

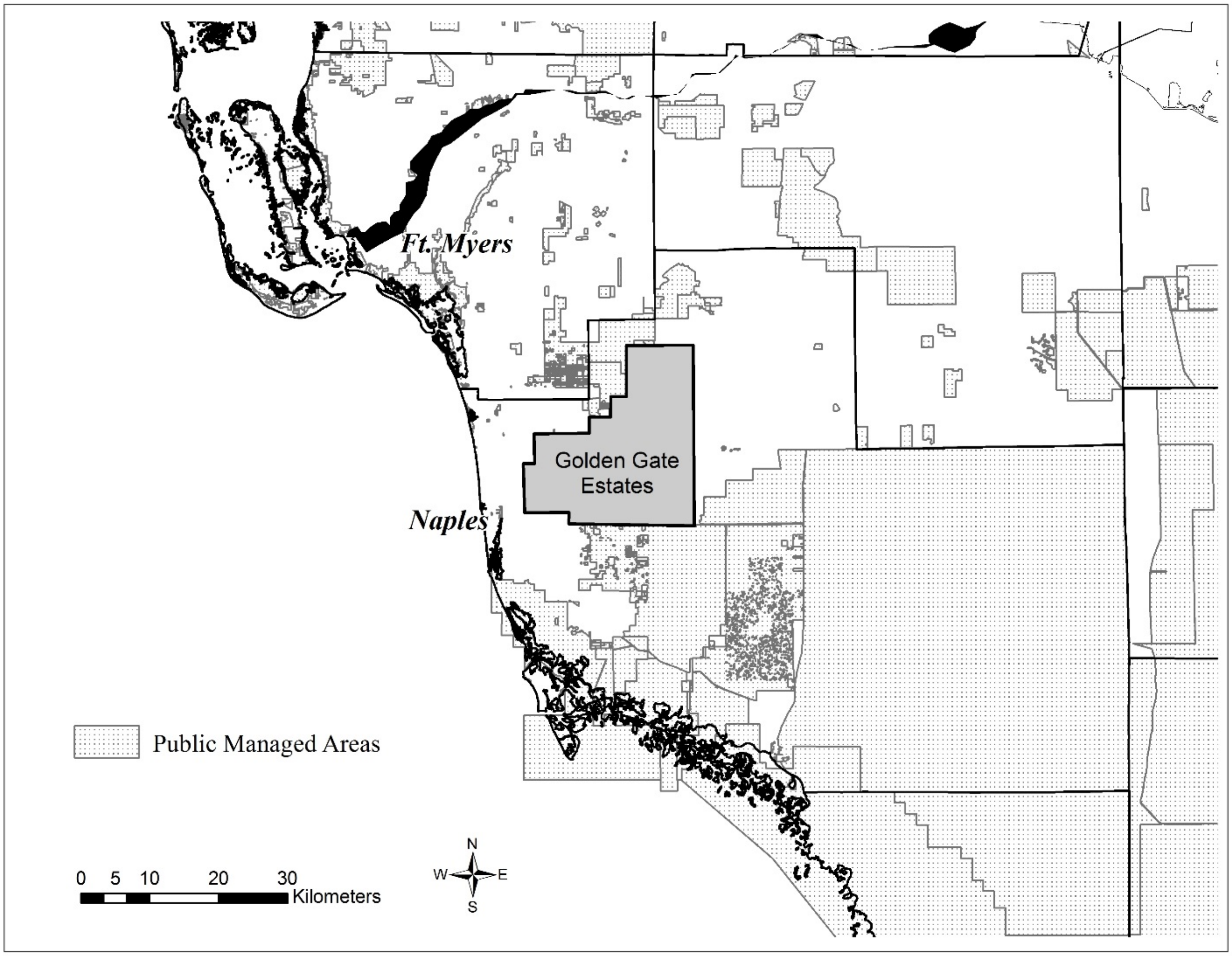


Figure 3. Proximity of Golden Gate Estates subdivision in southwest Florida to surrounding public lands containing resident panthers.

Florida does not have an established compensation program for loss of livestock but the Livestock Indemnity Program (LIP) authorized through the Agricultural Act of 2014 (2014 Farm Bill) provides benefits to commercial livestock producers. LIP covers attacks by animals reintroduced into the wild by the federal government or protected by federal law. However, few individuals have taken advantage of this program and so far, only one rancher has filed and was compensated $6,130.00 for 15 calves attributed to Florida panther depredation. The Conservancy of Southwest Florida offers a free-ranging cattle compensation program designed to assist smaller, private operations with 300 head of cattle or fewer. Four owners were compensated for 4 calves during the FY2015-16 reporting period totaling $2,396.00

Human Safety:Provisions within the Endangered Species Act allow for the lethal removal of a Florida panther posing a demonstrable threat to human safety. However, the Interagency Florida Panther Response Plan has been valuable in providing other options to conflict resolution. Sightings and encounters, which pose low-moderate risk, are not uncommon while incidents and threats, which have escalated risk factors, are far more rare (Fig. 1). Wayward panthers in highly urbanized settings have been captured and relocated to more suitable habitat for their own safety. Only rarely has a panther been relocated due to conflict concerns. While no humans were directly threatened in any cases, the panthers behavior in each case had departed from that which is expected and, after conferring with the Response Team, those panthers were captured, radiocollared and relocated. Most recently, a young male was observed on multiple occasions over a 4-month period within a small community and preyed on pets and feral cats in the area. This panther was relocated over 50 miles away. Within 2 months he returned to a similar setting in a different community and displayed similar lingering and prey selection behaviors. Due to the apparent inability to alter this panther's behavior he was removed and placed in captive management (FWC, et. al., 2016).

Information and Education Programs:

During depredation and interaction investigations, biologists share information about living with panthers and offer advice specific to the resident's situation to prevent future conflict issues. After a depredation, "A-frame" style information signs, stocked with *A Guide to Living with Florida Panthers* brochures, are placed at the end of the street advising residents of recent activity. Additionally, information packets containing our panther brochure and information on pen building programs are delivered door-to-door in a 1-mile radius of an event. FWC recently added a part-time panther outreach specialist position whose primary focus is to educate the local community about panther awareness issues. Spreading our living with panthers initiatives is accomplished through an annual Florida Panther Festival as well as focused talks to school groups, homeowners associations, and at other special meetings.

Research Efforts:

Genetic health and disease monitoring of the Florida panther population is monitored through capture and radiocollaring efforts, handling neonates at den sites, and recovery of deceased specimens from the field and along roadways. Additionally, radiocollared panthers are aerially located 3 times per week from a fixed-wing aircraft to monitor movement and habitat use and to detect timely mortality and denning events.

The FWC is currently involved in several collaborative research projects focusing on issues related to Florida panther conservation and management. Among these are a population viability analysis that involves individual-based models, testing novel methods of estimating home ranges using GPS data, assessing genetic restoration using whole genome sequencing, evaluating the presence and significance of various parasites and environmental contaminants in panthers, determining mortality factors, assessing the efficacy of panther rehabilitation, and evaluating the diet of panthers from scat and stomach contents.

The FWC continues to assess innovative techniques that could potentially provide statistically robust estimates of the panther population size, a task that is notoriously difficult for cryptic, wide-ranging, and endangered large carnivores. A methodology that relies on a combination of trail camera surveys and marked panthers was initiated in the spring of 2014. Preliminary analyses indicate that this method may have utility for estimating a range-wide panther population size with reasonable levels of precision. Additional work on improving the statistical model by incorporating relevant covariates is expected to be completed within the next year.

Details of FWC's research and management activities are summarized each year (Florida Fish and Wildlife Conservation Commission. 2016).

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Illinois Mountain Lion Status Report

Doug Dufford, Wildlife Disease and Invasive Wildlife Program Manager, Illinois Department of Natural Resources, One Natrual Resources Way, Springfield, IL 62702; doug.dufford@illinois.gov

History of Legal Classification:

Dates for major status changes, e.g., non-regulated killing, bounties, regulated management, protection, use of dogs. *Mountain lions were thought to be extirpated from Illinois before 1870 and had no formal protection prior to January 2015 when mountain lions, black bears, and gray wolves were added to the list of protected species in Illinois.*

Current Status & Management:

Presence/absence of a formal management plan. *A response plan for large carnivores (including cougar, bear and wolf) has been drafted and awaiting agency review and approval.*

Statements of lion management policy, goal and objectives. *A formal policy statement pertaining to cougar, bear, and wolf has been drafted and awaiting agency review and approval.*

Lion management structure and strategies, including dates, methods, use of special quotas, limited entry areas, closed areas, bans. *Lion populations are currently limited to the occasional transient sub-adult male in Illinois. There are no plans for active population establishment, though natural population establishment will not be impeded.*

Use of mandatory checks or sampling numbers, sex, age data, hunter effort. *N/A*

State-wide lion number and population trend. *Due to low population levels, there have been no formal attempts to determine population numbers. Confirmed lions in Illinois have all been sub-adult males believed to be transients from the western mid-west (Nebraska, South Dakota). A total of four lion carcasses (all sub-adult males from South Dakota) and 6 trail camera pictures (suggesting two additional animals) have been confirmed in Illinois since 2002. Population trend information is not currently available.*

How lion population numbers/densities are derived, e.g., extrapolated assumptions, use of study results, biological judgments, population reconstruction. *N/A*

How lion harvest objectives and numbers are derived. *N/A*

Use of management experiments and adaptive management to guide decisions. *N/A*

Special considerations and concerns. *None*
Legislation, ballot initiatives. *None*
What works? What doesn't work?

Historical & Current Lion Harvest (with tables & graphs): *N/A*
Historical lion harvest. *None*
Categorize by sex and age (stage) if available. *N/A*
Number of lion hunting licenses sold annually. *N/A*
Number of hunters actively hunting annually if available. *N/A*
Number of lion hunting outfitters annually if available. *N/A*
Hunter effort, e.g., days hunting, days to kill. *N/A*
Hunter success annual y if available. *N/A*
Issues of use of technology in lion hunting. *N/A*
What is informative? What is not?

Depredation and Human Conflict Management:

There have been no confirmed cases of lion depredation in Illinois. A response plan has been drafted and under agency review that will provide guidelines regarding the handling of lion depredation. Illinois law allows for the take of lions that pose an imminent threat to person and property, and authorizes the IDNR to issue nuisance animal removal permits for other threats.
Policy and protocols for handling lion depredation. *A response plan has been drafted and is currently under agency review.*
Number and type of losses annually. *None have been confirmed.*
Number of lions killed, captured and translocated. *N/A*
Financial costs (SUS) if available, reimbursement program (if applied) *N/A*
Control efforts, e.g., broad-scale, focused, offending animal. *N/A*
Methods &. results of monitoring effectiveness of management actions. *N/A*

Information and Education Programs:

IDNR has contracted with USDA WS to develop educational materials and programs as needs develop related to large carnivore depredation.

What works? What doesn't?
Human safety (with tables and graphs): *There have been no attacks on humans in Illinois in modern history.*
Policy and protocols for handling human safety. *A response plan for large carnivores (including lions, bears, and wolves) which addresses human safety issues has been developed and under agency review.*
Number and type of incidences, e.g.,lion attacks, dangerous behavior, translocations, lions killed. *None confirmed in modern history.*
Information and Education Programs:

IDNR has contracted with USDA WS to develop educational materials and programs as needs develop related to large carnivores and human safety issues.
What works? What doesn't?
Other Information and education programs- summary of approaches with results if applicable. *N/A*
Current research programs- summary with approaches, goals and objectives for each. *None currently.*
Human dimensions surveys- summary. *Illinois Natural History Survey is currently summarizing results from a survey of human attitudes toward large carnivores (including mountain lion, black bear, and gray wolf). Results are expected in 2017.*

Missouri Mountain Lion Status Report

Report provided by: Laura Conlee, Missouri Department of Conservation, 3500 East Gans Road, Columbia, MO 65201; laura.conlee@mdc.mo.gov

History of Legal Classification:

The mountain lion (*Puma concolor*) was state-listed as "endangered" in Missouri until 2006 when the Conservation Commission changed the status of mountain lions to "extirpated". The Conservation Commission also issued a policy statement in 2006 which said: "It is not desirable to encourage the re-establishment of a mountain lion population in Missouri. The Department has not and has no plans to stock mountain lions in Missouri." The Commission does not condone indiscriminate killing of mountain lions just because they may occasionally wander into Missouri, but allows landowners to protect themselves and their property, as seen in the Wildlife Code (effective March 1, 2000).

Code book wording states that:

(6) Mountain lions may be killed without prior permission if they are attacking or killing livestock or domestic animals, or if they are threatening human safety. Any mountain lion killed under this rule must be reported immediately to an agent of the department and the intact mountain lion carcass, including pelt, must be surrendered to the agent within twenty-four (24) hours.

Current Status & Management:

Although the Missouri Department of Conservation (MDC) annually receives hundreds of mountain lion sighting reports, the Mountain Lion Response Team (MLRT) has confirmed only 69 mountain lion reports since 1994. Between 1994 and 2010 there were only 12 confirmations of mountain lions in Missouri, but confirmations have increased dramatically in the last 7 years with an additional 56 confirmations (Figure 2). To date, the Department has not documented any evidence of breeding within the state, and thus, all mountain lion confirmations are likely of dispersing animals from nearby populations, the majority of which are likely males. Female DNA was detected on an elk carcass in February of 2016 and this is the first time a female has been confirmed in the state since 1994. It is not known whether this female remained in Missouri or continued dispersing. Of the 69 confirmations, 72% of confirmations are the result of photographic or video evidence and 12% were of lion carcasses (roadkill or shot)(Figure 3). Confirmations are highest between September and January. Genetic analyses to assess where mountain lions originated have been conducted on 10 samples and have determined the probable populations of origin to be the Black Hills Region (n = 5), Wyoming (n = 1), Colorado (n = 1), Montana (n = 1), and North America (n = 2; these analyses were conducted to determine whether the lion was likely captive (South American origin) vs. wild (North American origin)). Forty-nine percent of sightings have come from a 6-county region in the Ozarks of southern Missouri: Shannon (n = 11), Texas (n = 2), Oregon (n = 4), Carter (n = 8), Ripley (n = 1) and Reynolds (n = 7) counties.

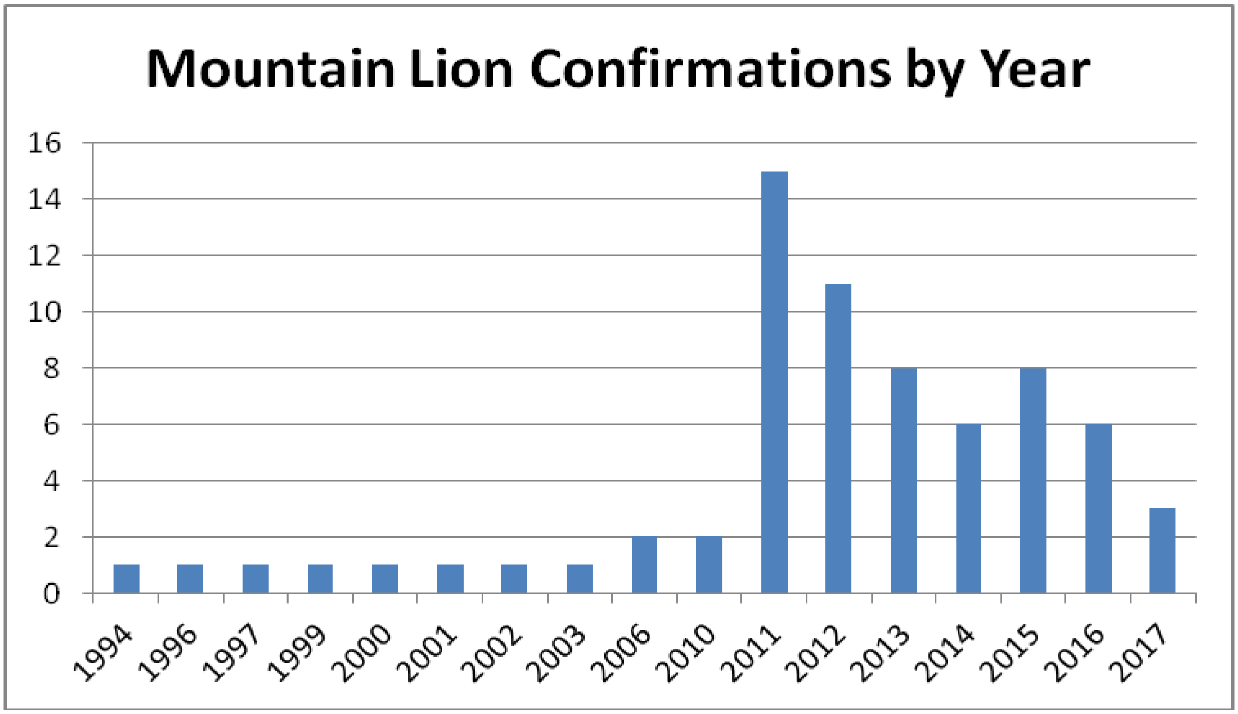


Figure 2. Total number of mountain lion confirmations per year between 1994 and January 2017.

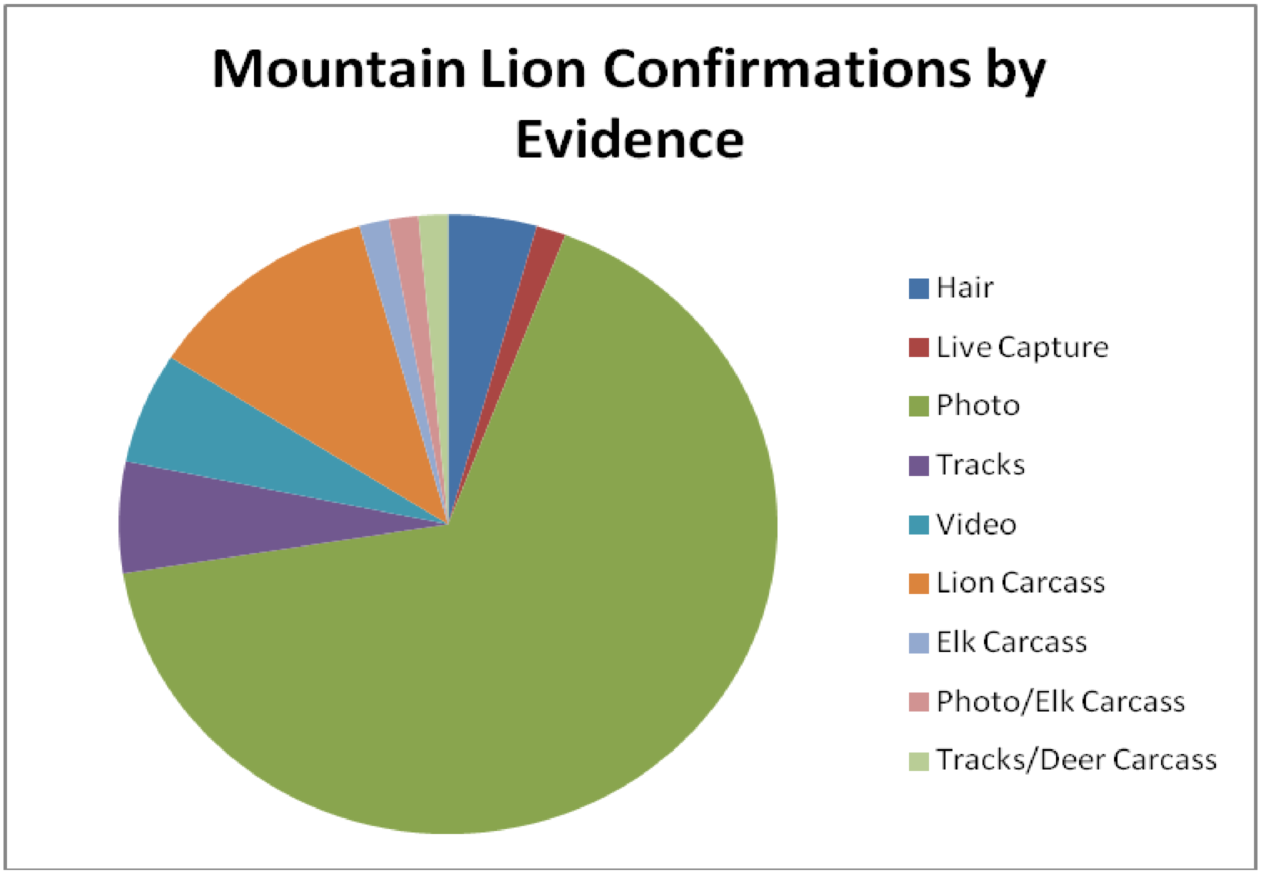


Figure 3. Evidence used for 69 mountain lion confirmations in Missouri between 1994 – January 2017.

Research Efforts:

The MLRT collects genetic evidence from mountain lion reports when it is available. Genetic evidence has been collected through hair samples, swabs containing saliva from animals that had been fed on by a mountain lion, tissue samples from road-kill, and scat identified by a scat-detecting dog. Genetic samples help confirm that a mountain lion is a wild animal versus one that likely had captive origins. Genetic samples also provide insight into the sex (from hair, saliva, or scat) and probable population of origin of a mountain lion. These genetic samples also identify individual lions and determine if they have ever been detected before. When looking at lion confirmations in an area, it is difficult to determine if we have one lion that has been confirmed 5 times, or 5 different lions that were confirmed once. Of the genetic samples that have been identified to individual (n = 9), we have not detected the same individual more than once; supporting assumptions that mountain lions in Missouri are transient. The MLRT will continue to collect genetic samples when possible to identify sex, population of origin, and individual.

Montana Mountain Lion Status Report

Report provided by: Jay Kolbe, Montana Department of Fish, Wildlife and Parks, White Sulphur Springs, Montana 59645; jkolbe.fw@gmail.com

History of Legal Classification:

Mountain lions were bountied in Montana from 1879 to 1962 and were then managed as predators from 1963 until 1971, when the Montana legislature reclassified the species as a game animal. Montana is in the final stages of developing a Mountain Lion Management Strategy that describes the use of the best available scientific population monitoring and modeling techniques to inform harvest management decisions. In general, mountain lions in Montana are managed to provide sustainably harvested populations while mitigating present or potential human-lion conflicts.

Mountain lions in Montana began recovering in the 1950s and peaked in the late 1990's before falling in the 2000's following high female harvest and prey declines. Field research data, conflict rates, public observations and other indices suggested that populations had rebounded to 1990s levels by the 2010's. Lions have now re-occupied all suitable habitats in the state and have been legally harvested in 49 of its 56 counties. Recent genetically-based estimates of lion density in several areas of the state were some of the highest reported in the literature.

Montana currently offers a series of hunting seasons including a fall Archery-only season, a Fall Season without Dogs (that runs coincident with general deer/elk seasons), a Winter Season (12/1 – 4/14) that allows the use of dogs, and a Resident Hound Training Season (12/2 – 4/14). The state is divided into 48 Lion Management Units (LMUs) which include all lands under MT Dept. of Fish, Wildlife & Parks' jurisdiction; access to lions in the remaining 11% of the state is managed by the National Park Service or Native American nations.

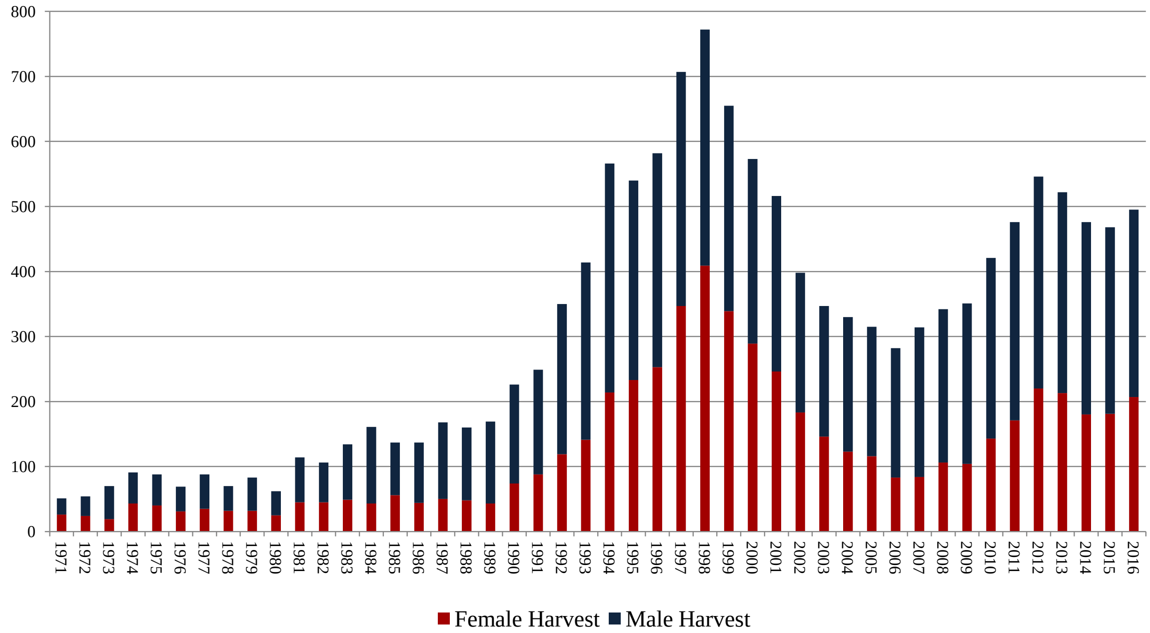
Current Status & Management:

Hunting is allowed in nearly all statewide LMUs and harvest is generally constrained by either sex-specific LMU quotas or limited Special Licenses. Montana does not use a source-sink management approach. Instead, most LMUs are managed to maintain sustainable lion populations, although there are several "control zone" LMUs (surrounding urban centers) where lion quotas are high or unlimited.

Harvest & Total Mortality:

Montana requires that any harvested lion be reported within 12 hours and physically presented for inspection by a FWP official within 10 days at which time the lion's sex, the location of harvest, hunter effort, and other data can be recorded and a tooth is collected for aging.

Montana statewide mountain lion harvest, 1971 – 2016.

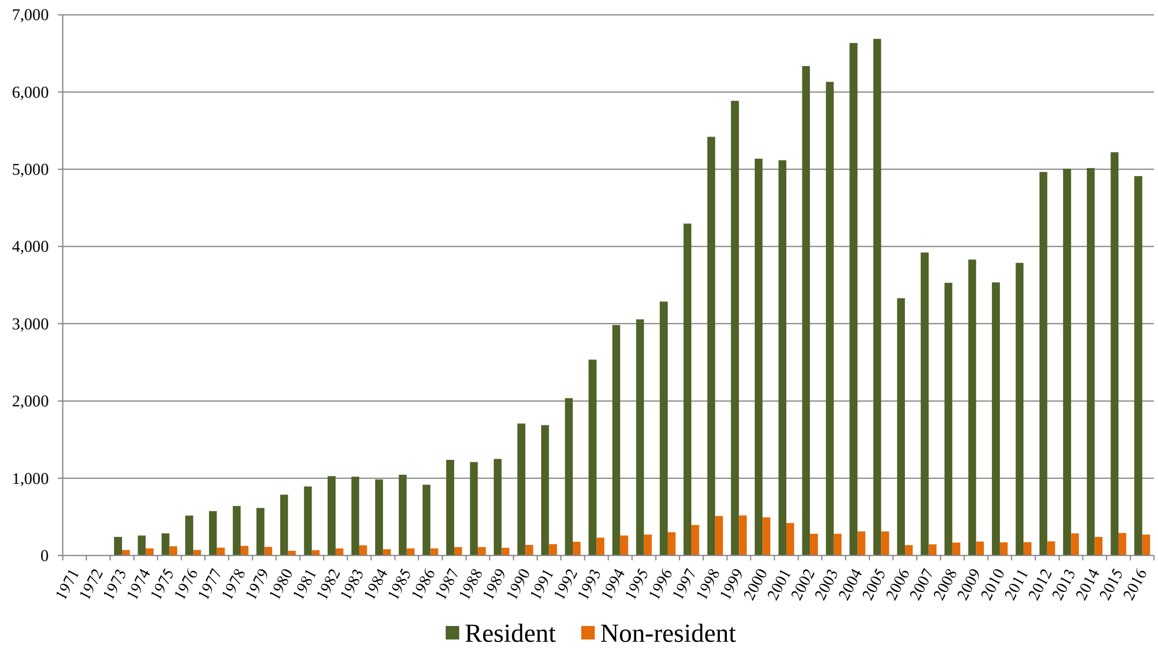


Montana law restricts non-residents to no more than 10% of licenses that are offered in limited numbers to resident hunters. Non-resident harvest is not limited where that harvest is managed using un-restricted resident General Licenses. Certain Montana LMUs, therefore, have limited non-resident hunter-harvest while others do not. Montana currently sells approximately 5,000 mountain lion hunting licenses per year.

Montana FWP and partners have invested in extensive primary research into mountain lion ecology, the effects of harvest, population monitoring techniques, and population modeling tools. The resulting information, and that from other areas, forms the basis of the state's draft Mountain Lion Management Strategy.

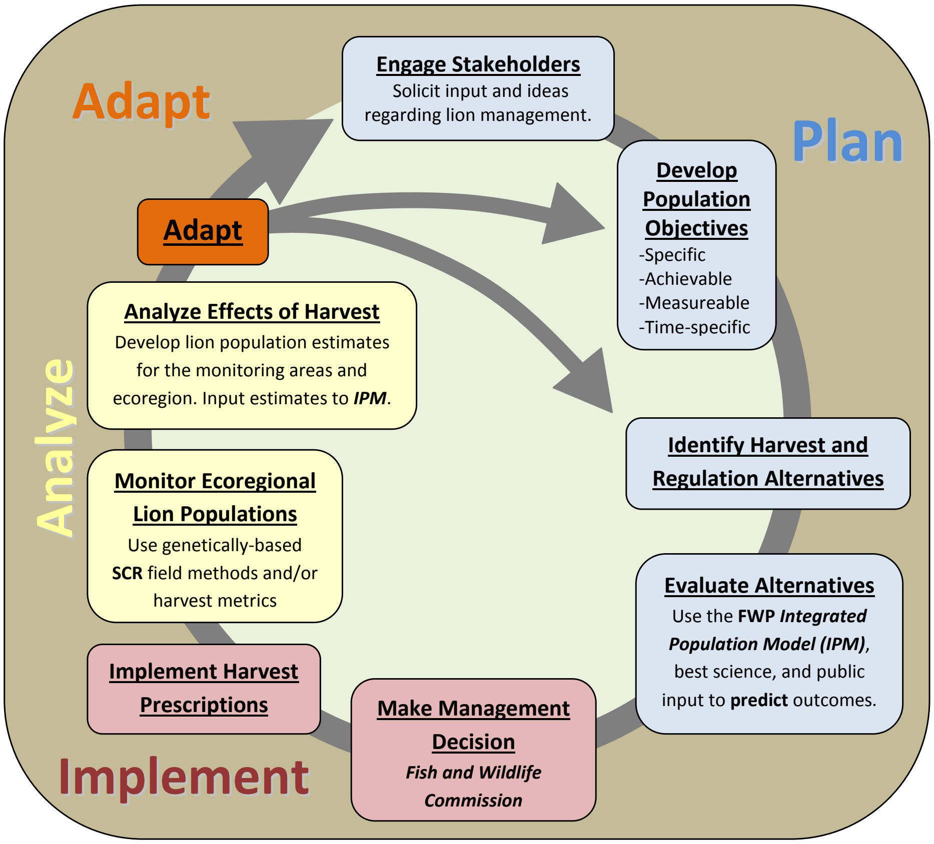
Montana is proposing to use field-based spatial capture-recapture sampling and a statewide resource selection function surface to periodically develop estimates of lion densities both within specific trend monitoring areas and several large mountain lion ecoregions. Montana has also built an integrated population model (which uses all available research and harvest data) to describe past and future population numbers and trends for those ecoregions. Using the integrated population model, FWP estimates there are approximately 5,000 independent-aged (harvestable) mountain lions in the state.

Montana mountain lion hunting license sales, 1971 – 2016.



Montana's Management Strategy emphasizes that lions are best monitored and managed at a large spatial scale. Biologist and the public will work collaboratively to determine population and harvest objectives for each of Montana's 4 mountain lion ecoregions. The ecoregional harvest objective will then be allocated across ecoregional LMUs to meet local social and biological needs.

FWP will explicitly employ an adaptive management framework to guide management decision making. Stakeholders will develop specific population objectives, identify regulatory alternatives that may help achieve those objectives, evaluate the alternatives using models, implement the favored management action, monitor the effects of management using genetically-based field sampling, and adjust management as needed based on those results.



Depredation and Human Safety Conflict Management:

Montana follows explicit Mountain Lion Depredation and Control Guidelines when responding to human-lion conflicts, including incidents of livestock depredation. Montana law provides citizens broad discretion to haze or kill a mountain lion that is threatening people, property, or livestock. The state annually contracts USDA Wildlife Services to respond to incidents of depredation of commercial livestock while FWP personnel lead responses to other human-lion conflicts. FWP staff follows guidance in the Guidelines when deciding whether to monitor a conflict situation, haze nuisance lions, or lethally remove offending individual animals.

One person has been killed by a mountain lion in Montana in recorded history. Attacks and dangerous incidents are rare, but regularly occur. The state mitigates the risk of human-lion conflict using a combination of education, hunter harvest, and incrementally more aggressive responses to individual habituated or aggressive lions. The Guidelines direct FWP staff (or its agents) to lethally remove aggressive or depredating individual lions in most cases—conflict mountain lions are not translocated under any circumstances.

Montana non-harvest mountain lion mortality, 1989 – 2015.

Year [2]	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
FWP, Private Party, & Other Removals [1,3]	**10**	**14**	**17**	**20**	**23**	**15**	**9**	**23**	**53**	**19**	**21**		**3**			**5**		**8**	**22**	**32**	**24**	**23**	**39**	**27**	**35**	**21**	**16**
Public Safety																			4	10	9	9	15	9	10	6	1
Depredation or Protection of Pets			1	2						3	2								5	4	5	2	6	5	2	6	5
Depredation or Protection of Livestock	1			1						6	1								5	8	4	6	15	6	14	8	4
Self Defense																			4	10	4	2	2	3	7	1	5
Other/Unknown	9	14	16	17	23	15	9	23	53	10	18		3			5		8	4		2	4	1	4	2	0	1
% Female (of those known)																			50%	50%	55%	41%	47%	36%	64%	42%	44%
Livestock Depredation USDAWS/APHIS [4]	2	**3**	**3**	**4**	**7**	**3**	**9**	**8**	**13**	**21**	**16**	**18**	**9**	**12**	**7**	**3**	**7**	**5**	**8**	**13**	**12**	**14**	**17**	**19**	**15**	**12**	**12**
Illegal	2	**2**	**2**	**4**	**9**	**5**	**11**	**6**	**18**	**7**	**5**	**0**	**2**	**0**	**1**	**0**	**0**	**2**	**4**	**2**	**5**	**6**	**7**	**5**	**9**	**7**	**3**
Incidental Trapping [5]	**2**	**2**	**2**	**4**	**5**	**9**	**7**	**4**	**6**	**4**	**2**	**0**	**1**	**3**	**3**	**1**	**1**	**1**	**10**	**9**	**9**	**8**	**8**	**16**	**16**	**12**	**13**
Snare																			7	2	7	4	6	7	2	6	8
Foothold																			2	7	2	4	2	9	13	2	5
Conibear																									1		
Unknown	**2**	**2**	**2**	**4**	**5**	**9**	**7**	**4**	**6**	**4**	**2**	**0**	**1**	**3**	**3**	**1**	**1**	**1**									
% Female (of those known)																			60%	78%	63%	50%	88%	75%	50%	89%	73%
Total	**16**	**21**	**24**	**32**	**44**	**32**	**36**	**41**	**90**	**51**	**44**	**18**	**15**	**15**	**11**	**9**	**8**	**16**	**44**	**56**	**50**	**51**	**71**	**67**	**75**	**56**	**40**

[1] Roadkill incidents are inconsistently reported in MT and are not included in this table
[2] FWP License Year, 8/1 - 7-31, unless otherwise noted
[3] Data from License Year 2000 to 2006 are incomplete and should be considered minimums
[4] Source: USDAWS/APHIS. Data recorded by Federal Fiscal Year, 10/1 - 9/30
[5] Data prior to 2007 are incomplete and should be considered minimums

Nebraska Mountain Lion Status Report

Sam Wilson, Nebraska Game and Parks Commission, 2200 N 33rd Street, Lincoln, NE 68503; Phone: (402) 471-5174; E-mail: sam.wilson@nebraska.gov

History of Legal Classification:

Mountain lions had no legal status and could be killed year-round until 1995 when they were listed as game animals in statute. In 2010 statute was created that allows mountain lions to be killed for the protection of people and livestock under specific circumstances. In 2012 statute was created that allows the Nebraska Game and Parks Commission to hold regulated harvest seasons. Regulations allowing a harvest season were approved by the Commission for 2014. No harvest season has been held since then.

Current Status & Management:

The Nebraska Game and Parks Commission is presently working on a mountain lion management plan. The Commission's management goal is to maintain stable, healthy, and socially acceptable mountain lion populations that are in balance with available habitat and other game species over the long term.

The Nebraska Game and Parks Commission does not create statewide population estimates. Genetic surveys conducted between 2010 and 2015 indicate that the population in the Pine Ridge area has been relatively stable, with estimates ranging from 22 – 33 total animals. In addition to the population in the Pine Ridge, there are also resident populations in the Niobrara River Valley and Wildcat Hills; however, due to their recent establishment in these areas there are no estimates for these populations at this time. A few more animals typically wander elsewhere in the state as well.

Harvest & Total Mortality:

The first regulated harvest season for mountain lions in Nebraska was held in 2014. Five mountain lions were harvested in total (three males and two females). Four units were created, two with a harvest allowed (the Pine Ridge and Prairie units) and two with no harvest allowed (the Keya Paha and Upper Platte units). In the Pine Ridge Unit two separate seasons were held. The first season allowed two hunters and the use of hounds. The second season allowed 100 hunters but hounds were not permitted. Both seasons had a harvest limit of two with a female sub-limit of one. The Prairie Unit consisted of the majority of the state where no evidence of mountain lion populations existed. All harvested mountain lions were required to be checked and tagged by the

Commission. 2,663 licenses/applications were sold in 2014. The two units closed to harvest were areas with recent evidence of mountain lion recolonization but with no population estimates to create harvest recommendations. No harvest season has been held since 2014.

Depredation and Human Safety Conflict Management:

Depredating mountain lions may be killed if they are in the process of stalking, killing or consuming livestock. If the Commission confirms a mountain lion has killed livestock they may issue a 30-day permit to the landowner that allows them to kill the offending mountain lion or the Commission may remove the offending animal. Two instances of mountain lion depredation on calves have been documented in Nebraska. In the most recent case the mountain lion was removed by Commission staff. This is the only instance of lethal removal of a mountain lion for depredating livestock.

Mountain lions may be killed without a permit if they stalk, attack, or show unprovoked aggression toward a person. It is the policy of the Nebraska Game and Parks Commission to kill mountain lions found in municipalities. Over the last five years an average of two mountain lions per year have been killed due to concerns for human safety.

Research Efforts:

The Nebraska and the Game and Parks Commission has been investigating observations of mountain lion presence by the public for more than 25 years. This effort has been important in helping document expanding populations since this species began recolonizing the state.

The Commission recently initiated a multi-year research project aimed at determining population sizes, changes in distribution, movements, habitat use, and impacts on big game prey species. The majority of this information will be determined through capturing mountain lions and fitting them with global positioning system collars. The Commission will continue to estimate population sizes using scat-based genetic surveys, which have been conducted since 2010. The third part of this research is to use systematically placed trail cameras to document expansion or contraction of populations in areas such as the Niobrara River Valley and Wildcat Hills where little information is presently available.

Nevada Mountain Lion Status Report

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ABSTRACT
Mountain lions (*Puma concolor*) have been classified as a protected big game mammal in Nevada since 1965. Mountain lions may be harvested through hunting yearlong at any time of day with a state issued tag. Currently, the Nevada Department of Wildlife (NDOW) manages mountain lions with 3 separate harvest limits for the eastern, western, and southern administrative regions. NDOW recently drafted Harvest Management Guidelines for Nevada, and the mountain lion segment guideline recommends using 6 unique genetic subpopulations identified by Andreasen et al. (2012) to manage mountain lion harvest by evaluating harvest demographics and establishing harvest limits as needed. State legislation mandates NDOW collect a $3 predator fee on big game and turkey application to manage predatory wildlife; that statute also requires that 80% of revenues must be spent on lethal management of predatory wildlife. This fee generates about $550,000 annually. For fiscal year 2017, 3 lethal projects and 2 non-lethal mountain lion management projects are funded by the $3 predator fee in Nevada. To date, NDOW has no evidence that mountain lion harvests are overexploiting statewide populations.

<u>History of Legal Classification:</u>
As with most western states, Nevada's history of mountain lion (*puma concolor*) management has progressed to provide greater regulation over time. Nevada state legislature changed the classification of mountain lion from unprotected (predator) to protected (game animal) in 1965. Since that date, mountain lion management has changed substantially. The change in classification resulted in the requirement of a valid hunting license to hunt mountain lion, along with restrictions in the method of take. This provision precluded the taking of mountain lions at any time other than from sunrise to sunset and defined legal methods of take as shotgun, rifle, or bow and arrow.

The season was defined as yearlong without a bag limit and no tag was required; either sex was lawful for harvest.

In 1968, a tag requirement was instituted, although no bag limits were established. The tagging requirement made it possible for the Nevada Department of Wildlife (NDOW) to begin monitoring hunter harvest. In 1970 a bag limit of 1 mountain lion/person/year and a 6-month season were established. During that year, the requirement that each harvested mountain lion had to be physically inspected within 5 days of the harvest was instituted. This regulation afforded ndow the ability to collect biological data from harvested mountain lions in addition to enumerating take.

In 1976, 26 mountain lion management areas were defined statewide, and a harvest limit established for each to regulate hunter harvest. Harvest limits were used to close hunting seasons when the harvest limit was reached. In 1979, this approach was modified using 6 management areas, each with a harvest limit. In 1981, this harvest limit approach was applied statewide. Initially, this system required a hunter to obtain a free hunting permit (in addition to the tag) to hunt in a single management area. In 1994, hunters were allowed to obtain a free hunting permit that authorized the hunter to hunt in 2 management areas until the established harvest limit was reached. Both of these permit systems allowed hunters to change management areas at will as long as the harvest limit had not been reached in a specific management area.

In 1995, the hunting permit approach was modified to eliminate the physical issuance of a permit in favor of establishing a 1-800 telephone number that informed hunters if harvest limits had been reached within a specific area. Hunters could continue to hunt in any management area where the harvest limit had not been reached. In 1997, changes were made to mountain lion regulations to increase mountain lion harvest, while maintaining the integrity of the harvest limit system. Those changes included the reduction of tag fees, over-the-counter tag sales, allowing hunters to obtain 2 tags/year, increasing bag limits from 1mountain lion/hunter/year to 2 mountain lions/hunter/year, and consolidating some harvest unit groups.

In 1998, Nevada's southern region was modified to provide for a yearlong hunting season. The yearlong season was adopted for the entire state in 2001. In 2003, harvest limits from 24 unit groups throughout the state were consolidated into 3 statewide regions corresponding with NDOW administrative regions. The mountain lion season dates were changed to march 1 through end of february each year, or until harvest limit was reached, corresponding with the valid dates of a Nevada hunting license (table 1). To date no harvest limit for any of the regions have been reached.

Current status & Management:

NDOW completed its comprehensive mountain lion management plan in January 1995 (add citation here), and the nevada board of wildlife commissioners approved the plan in october 1995. The goals and objectives of the mountain lion plan are to maintain lion distribution in reasonable densities throughout nevada, to control mountain lions creating a public safety hazard or causing property damage, and to provide recreational, educational and scientific use of the mountain lion resource. Additional goals include maintaining a balance between mountain lions and their prey and managing mountain lions as a genetic metapopulation.

The approach used by NDOW in predator management as stated in the Nevada Predation Management Plan Fiscal Year 2017 was, "NDOW maintains a philosophy that predator management is a tool to be applied deliberately and strategically. Predator management may include lethal removal of predators or corvids, nonlethal management of predator or corvid populations, habitat management to promote more robust prey populations which are better able to sustain predation, monitoring and modeling select predator populations, managing for healthy predator populations, and public education, although not all of these aspects are currently eligible for funding through predator fee dollars. NDOW intends to use predator management on a case-by-case basis, with clear goals, and based on an objective scientific analysis of available data. To be effective, predator management should be applied with proper intensity and at a focused scale. Equally important, when possible projects should be monitored to determine whether desired results are achieved. This approach is supported by the scientific literature on predation management. NDOW is committed to using all available tools and the most up-to-date science, including strategic use of predator management, to preserve our wildlife heritage for the long term" (Nevada Department of Wildlife 2017)

In 2001, the Nevada Legislature adopted Nevada Revised Statute (NRS) 502.253. This action created a $3 fee added to all big game and turkey tag applications, which currently generates about $550,000 annually. In 2015, Assembly Bill 78 was signed into law amending NRS 502.253 to include, "[The Department] Shall not adopt any program for the management and control of predatory wildlife developed pursuant to this section that provides for the expenditure of less than 80 percent of the amount of money collected pursuant to subsection 1 in the most recent fiscal year for which the Department has complete information for the purposes of lethal management and control of predatory wildlife." NDOW must spend about $440,000 annually on lethal predator management.

Beginning in 2017, NDOW adjusted hunt unit groupings to address genetic subpopulations and harvest limits more effectively from a biological standpoint. Following the genetic subpopulations identified by Andreasen et al. (2012), NDOW aligned hunt unit groups to closely mirror these genetic subpopulations. NDOW also identified an additional transient zone (Figure 1) that was not classified by Andreasen et al. (2012). The management approach will be to use the following guidelines:

1. The number of total and adult female mountain lions removed from each unit will be monitored annually. A premolar will be removed from each harvested mountain lion during the mandatory check procedures. Premolars will be sectioned and age will be determined using cementum aging techniques. If the 3-year mean percentage of adult (≥3 year old) female in the regulated hunting seasons within any specific management zone exceeds 35%, the Department will establish a separate harvest objective for that zone to limit harvest.
2. Female mountain lions should comprise <50% of the overall take within a specific management zone. If the 3-year mean percentage of female in the regulated hunting seasons within any specific manage zone exceeds 50%, the Department will establish a separate harvest objective for that zone to limit harvest.
3. Harvest objectives within a specific management zone may be increased or combined with the statewide harvest objective following 2 consecutive seasons in which the 3-year mean of adult females in the harvest is ≤35% of the total harvest and the 3-year mean of total females in the harvest is <50%.

Neither the 3-year average for adult female harvest or overall female harvest indicate overharvest in the south, central, east, north, and west subpopulations (Figure 2). The available habitat within the transient delineated area does not support robust prey populations and the habitat is considered low quality; NDOW does not believe a viable population of mountain lions will ever be established in the transient subpopulation area. The only other area to have 2 consecutive 3-year mean valued to exceed thresholds is the southern population during 2005–2007 and 2006–2008. Because of the small sample size (9 of 17 during 2005–2007 and 13 of 23 in 2006–2008) and adult female harvest being well below the 35% cutoff, NDOW does not believe this subpopulation was overharvested.

Harvest & Total Mortality:

In Nevada, a resident mountain lion tag costs $25.00 usd and a nonresident mountain lion tag costs $100.00 usd. Generally, nonresident hunters account for about 10% of tag sales, yet harvest a greater proportion of mountain lions than do resident hunters (table 2). Total hunter harvest has averaged 130 mountain lions per year for the last 3 years (table 2). The open season for hunting mountain lions in Nevada currently runs yearlong (March 1–last day of February), unless a harvest limit is reached. To date, harvest limits have not closed any season. Dogs may be used to hunt a mountain lion, yet no pursuit-only season exists because the season is yearlong. A resident or nonresident is eligible to obtain 2 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 NDOW. NDOW will affix a mountain lion seal permanently to the hide, and this seal is needed for possession or transport from the state. It is unlawful to harvest a female mountain lion that is accompanied by a spotted kitten, or to harvest or possess a spotted mountain lion kitten. It is also unlawful in Nevada to trap a mountain lion. However, if a mountain lion is accidentally trapped or harvested, the person trapping or harvesting it shall report the incident to NDOW within 48 hours. NDOW will assist in the release or disposal of any mountain lions inadvertently captured with a trap.

Depredation and Human Safety Conflict Management:

NDOW develops a Predator Management Plan annually. The current plan for fiscal year 2017 outlines five projects pertaining to mountain lions; (1) Mountain Lion Removal to Protect California Bighorn Sheep, (2) Monitor Rocky Mountain Bighorn Sheep for Mountain Lion Predation, (3) Mountain Lion, Black Bear, and Mule Deer Interactions, (4)Big Game Protection-Mountain Lions, and (5) Assessing Mountain Lion Harvest in Nevada.

Mountain Lion Removal to Protect California Bighorn Sheep.—California bighorn sheep (Ovis canadensis californiana) populations have been reintroduced in northwestern Nevada, but mountain lion predation can be a significant source of mortality that may threaten the population's viability. Area 01 is in close proximity to the Sheldon National Wildlife Refuge, California, and Oregon; all 3 may act as a source for mountain lions. Mountain lions will be removed proactively by USDA Wildlife Services until the local bighorn sheep population reaches the population objective.

Monitor Rocky Mountain Bighorn Sheep for Mountain Lion Predation.—Rocky Mountain bighorn sheep (O. c. canadensis) populations have been established in portions of Nevada, but mountain lion predation can be a significant source for mortality that may threaten the population's viability. No collared bighorn sheep have been killed by mountain lions in over a year, it is the area biologists belief mountain lion predation is not a current threat to the local bighorn sheep population.

Mountain Lion, Black Bear, and Mule Deer Interactions.—Black bears (Ursus americanus) are expanding numerically and geographically, and in so doing they are recolonizing historical ranges in Nevada. It is imperative to understand to what extent this increasing distribution is affected by their interactions with mountain lions. Black bear interactions with mountain lions at kill sites could potentially have effects on mule deer (Odocoileus hemionus) populations, and possible implications on livestock husbandry practices.

Big Game Protection-Mountain Lions.—Predation issues frequently arise in a very short timeframe. These issues often occur within a fiscal year. By the time a project can be drafted, approved, and implemented, it may be too late to prevent or mitigate the predation issue. Removing mountain lions that prey on sensitive game populations quickly is a required tool to manage big game populations statewide.

Assessing Mountain Lion Harvest in Nevada.—The Department has a yearlong mountain lion hunting season with harvest limits, although mountain lion are also lethally removed for livestock depredation and to limit predation on specific wildlife populations. Statewide annual adult female harvest is ≤25%, which indicates that statewide harvests are unlikely to be reducing statewide mountain lion population abundance (Anderson and Lindzey 2005). Nevertheless, regional area harvests may be greater and can be more difficult to assess the effects due to small sample sizes. Conversely, current NDOW mountain lion removal projects may not be sufficiently intensive to reduce local mountain lion populations to attain reduced predation on prey populations. Improved understanding of mountain lion population dynamics in Nevada would allow for better informed management. The proposed approach to population monitoring will involve Integrated Population Modeling (IPM) which brings together different sources of data to model wildlife population dynamics (Abadi et al. 2010, Fieberg et al. 2010). Age-at-harvest data can be used in combination with other data, such as telemetry, mark-recapture, food availability, and home range size to allow for improved modeling of abundance and population dynamics relative to using harvest data alone (Fieberg et al. 2010). Depending on available data, we will build a count-based or structured demographic model (Morris and Doak 2002) for mountain lions in Nevada. The model (s) will provide estimates of population growth, age and sex structure, and population abundance relative to different levels of harvest. Additionally, we will critically evaluate the model, as well as uncertainty in model outputs, to identify key gaps in existing data that limit the realism and utility of the model as a management tool. Based on this evaluation, we will make recommendations on the most cost-effective ways to address these data gaps and limitations to allow the model to be improved in the future.

An additional project is being undertaken to determine the extent of injuries and survival, habits, and diet of mountain lions incidentally captured in bobcat traps and released by NDOW personnel. All mountain lions released will have age, weight, and level of injury recorded, and have a Global Positioning System radiocollar applied. All mountain lions will be examined by a veterinarian.

Conclusion:

Although mountain lion management is frequently criticized in public forums, progressive game management actions are ensuring that mountain lions remain a vital component within our wildlife communities. Human behavior is often more challenging to manage than wildlife interactions. Just as managing forage and ungulates remains integral to this process, so does management and research on predators.

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TABLE 1. NEVADA MOUNTAIN LION UNITS AND HARVEST LIMITS.

Unit Groups	Harvest Limits
011-015,021,022,031,032,034,035,041-046,051,181-184,192,194-196,201-208,291	83
061,062,064-068,071-079,081,101-109,111-115,121,131-134,141-145,151-156	111
091	2
161-164,171-173,211-213,221-223,231,241-245,251-254,261-268,271-272	49
033, 269, 280-284, 286	Closed Units

TABLE 2. MOUNTAIN LION DEPREDATIONS, TAG SALES, HUNTER HARVEST, AND HUNTER SUCCESS IN NEVADA,1975-2016.

	Depredations			Tag Sales		Hunter Harvest		Hunter Success	
Year	Males	Females	Unknown	Resident	Nonresident	Resident	Nonresident	Resident	Nonresident
1975–1976	14	5	0	-	-	-	-	-	-
1976–1977	10	7	1	-	-	-	-	-	-
1977–1978	17	7	0	129	16	15	6	12%	38%
1978–1979	16	8	0	146	38	18	8	12%	21%
1979–1980	12	11	0	235	46	30	17	13%	37%
1980–1981	19	3	0	313	61	24	14	8%	23%
1981–1982	20	17	0	527	62	36	24	7%	39%
1982–1983	11	10	0	519	61	41	20	8%	33%
1983–1984	13	12	0	329	50	57	21	17%	42%
1984–1985	12	16	0	352	107	60	46	17%	43%
1985–1986	16	9	0	394	96	54	29	14%	30%
1986–1987	22	15	0	345	114	51	36	15%	32%
1987–1988	21	20	0	416	91	41	37	10%	41%
1988–1989	26	23	0	383	124	65	53	17%	43%
1989–1990	23	24	0	439	184	75	77	17%	42%
1990–1991	37	20	0	318	112	55	33	17%	29%
1991–1992	27	22	0	507	112	78	47	15%	42%
1992–1993	32	17	0	348	149	75	75	22%	50%
1993–1994	21	15	0	405	139	99	74	24%	53%
1994–1995	16	8	0	403	151	89	72	22%	48%
1995–1996	13	10	0	432	186	73	61	17%	33%
1996–1997	11	9	0	480	137	80	63	17%	46%
1997–1998	12	10	0	870	137	122	88	14%	64%
1998–1999	8	3	0	643	124	73	67	11%	54%
1999–2000	8	8	0	680	109	71	55	10%	50%
2000–2001	5	10	0	883	169	104	90	12%	53%

2001–2002	8	11	0	838	98	104	63	12%	64%
2002–2003	7	6	0	1,060	131	89	39	8%	30%
2003–2004	16	12	0	1,133	221	119	73	11%	33%
2004–2005	9	7	0	1,186	206	62	43	5%	21%
2005–2006	15	4	0	1,021	162	70	46	7%	28%
2006–2007	10	9	0	1,366	121	95	39	7%	32%
2007–2008	18	19	0	1,521	200	94	51	6%	26%
2008–2009	10	16	0	3,484	284	83	34	2%	12%
2009–2010	16	15	0	3,873	302	80	51	2%	19%
2010–2011	13	17	2	3,942	275	96	50	2%	18%
2011–2012	12	17	1	4,067	297	72	31	2%	10%
2012–2013	8	12	1	4,735	354	122	60	3%	17%
2013–2014	9	10	1	4,968	358	85	33	2%	9%
2014–2015	8	9	1	5,325	384	73	26	1%	7%
2015–2016	22	12	0	5,332	392	113	60	2%	15%

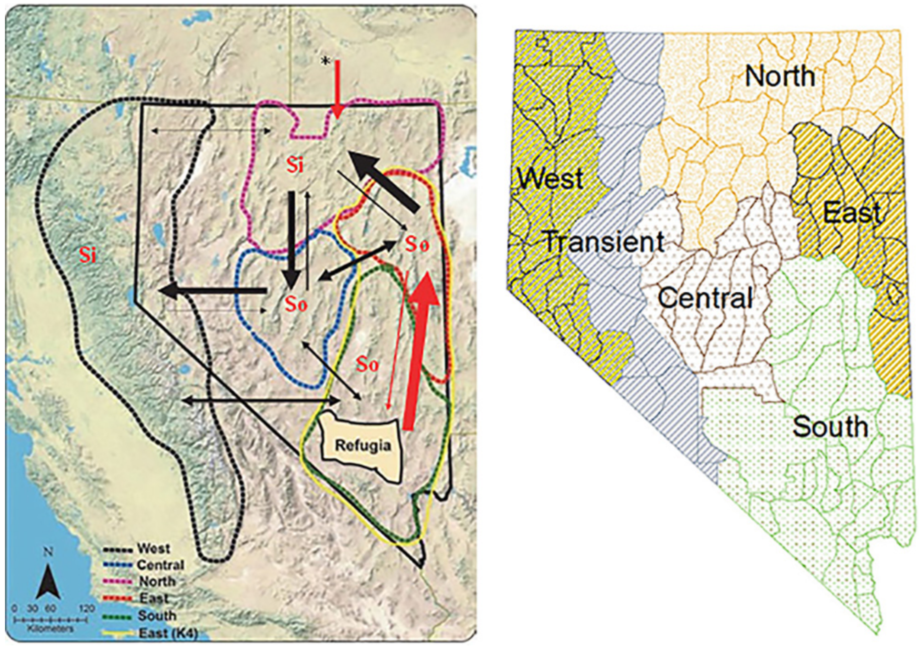


Figure 1. Genetic populations and migration rates map from Andreasen et al. (2012) and NDOW's interpretation for mountain lion management.

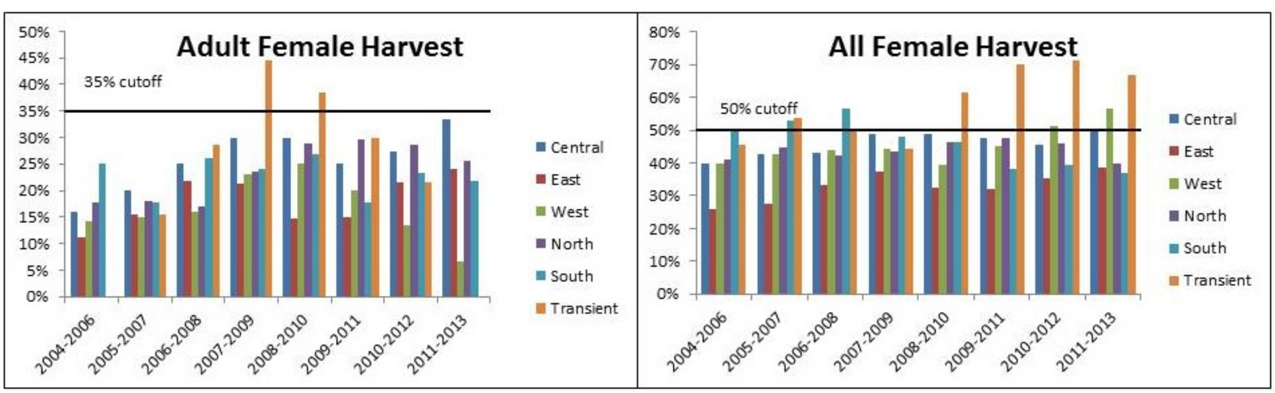


Figure 2. Three year averages for adult female mountain lion harvest, and all female harvest, Nevada.

New Mexico Mountain Lion Status Report

Report provided by: Frederick Winslow, New Mexico Department of Game and Fish

History of Legal Classification:

Dates for major status changes, e.g., non-regulated killing, bounties, regulated management, protection, use of dogs.

1867: $5.00 bounty
1923-70: Bounty suspended, cougar unprotected
1971: Protected, hunting in SW corner of state only, bag limit 1
1972-1978: Seasons increasingly liberal
1979-83: 11 month season, bag limit 2
1984: 3 month season, bag limit 1
1985-99: 4 month season, bag limit 1
2000-02: Zone Management begins; 6 month season, year around in bighorn sheep areas, bag limit 1
2002-07: Year around in BHS areas, bag limit 2, year around season on private property
2007-11: Dual harvest limit, sport and total sustainable mortality, population model driven
2011-15: Sustainable mortality limit and female sub-limit, population model and management driven
2016-20: Year around seasons statewide, total and female harvest limits, traps/foot snares legal on private and state trust lands.
General regulations: Hounds generally allowed, females with kittens and spotted kittens protected.

Current Status & Management:

No formal management plan per se; instead a Cougar Population and Harvest Management Matrix (2016-17 through 2019-20) is used as an "action plan" (Table 1).

Habitat quantity and quality for the state was derived from a model designed by G&F and T. Perry (Clemson Univ.). The habitat classes are Excellent, Good, Moderate, and Fair; Excellent has a density of 3.0-4.0/100km^2, Good has a density of 1.2-1.7/100km^2, Moderate has a density of 0.6-0.9/100km^2 and Fair has a density of 0.4-0.5/100km^2 adult cougars. Densities were extrapolated from the Logan and Sweanor (2001) study conducted in New Mexico and from published estimates in other parts of the western U.S. 64% of the state is considered cougar habitat, whereas 5% is tribal jurisdiction and not considered in management.

The point estimate of total cougar population is used; thus, management objectives and removal/harvest level calculations may not reflect the true value for the population. The population estimated is that of independent cougars, ≥18 months of age.

Stable = harvest ≤ 17% of total estimated population w/max of 30% of that 17% being female; Stable to decrease = harvest ≤ 25% of total estimated population with ≤ 50% of that 25% being female.

90% of Total mortality limit and/or female sub-limit will close harvest in any zone, whichever occurs first.

Lion management structure and strategies, including dates, methods, use of special quotas, limited entry areas, closed areas, bans. See Table 1.

Table 1

10-24-16 – New Mexico Cougar Population and Harvest Management Matrix (2016-17 through 2019-20).

Zone	Game Management Units	Estimated Cougar Habitat (km^2)[a]	Cougar Population Point Estimate[b]	Cougar Population Management Objectives 2016-2020[c]	2016-20 Total Mortality Limit [d]	2016-20 Female Sub-Limit
A	2, 7	13,728	207-285	Manage for stable cougar populations	42	13
B	5, 50, 51	6,526	142-192		28	8
C	43,45,46, 48, 49, 53	11,482	289-387		85	43
E	9, 10	13,674	251-341		50	15
I	36-38	7,138	121-165		24	7
J	15, 16, 21, 25	22,714	445-603		89	27
M	31-33, 39, 40	21,394	146-215		31	9
N	4, 52	2,801	76-102		15	5
O	12	6,663	103-141		21	6
Q	28, 29, 30, 34	11,752	170-235		35	11
R	54, 55	4,557	131-175		26	8
D	41, 42, 47, 59	6,468	76-106	Manage for decreasing cougar populations	23	12
F	6	6,659	156-209		46	23
G	13, 17	14,422	247-338		73	37
H	18-20	11,878	140-197		42	21
K	22-24	11,299	225-305		66	33
L	26, 27	6,456	64-91		19	10
P	56-58	2,700	49-66		14	7
S	8, 14	4,661	85-116		25	13
Totals:		**186,972**	**3,123-4,269**		749	303

[a]The quantity of the habitat was derived from a model designed by G&F and T. Perry, PhD. The habitat is classed as Excellent, Good, Moderate, and Fair; Excellent has a density of 3.0-4.0/100km2, Good has a density of 1.2-1.7/100km2, Moderate has a density of 0.6-0.9/100km2 and Fair has a density of 0.4-0.5/100km2 adult cougars. Densities derived from studies conducted in New Mexico. 64% of the state is considered cougar habitat, 5% is tribal jurisdiction.
[b]The point estimate total cougar population is used, management objectives and removal/harvest level calculations and may not reflect the true value for the population. The population estimated is that of independent cougars, ≥18 months of age.
[c] Stable = harvest ≤ 17% of total estimated population w/max of 30% female; Stable to decrease = harvest ≤ 25% of total estimated population with ≤ 50% females.
[d] 90% of Total mortality limit and/or female sub-limit will close harvest in any zone, whichever occurs first.

Use of mandatory checks or sampling numbers, sex, age data, hunter effort. All harvested and/or killed cougars must be pelt tagged by a department official within 5 days of kill. Tooth and tissue samples are taken and sex, method of kill, location of kill, effort, etc. are recorded at the time of pelt tagging.

State-wide lion number and population trend. 3,123-4,269 is the currently estimated population of cougars ≥18 months of age and the population trend is stable or increasing.

How lion population numbers/densities are derived, e.g., extrapolated assumptions, use of study results, biological judgments, population reconstruction. Cougar habitat quantity and quality was modeled based on VHF and GPS collar data, mortality information over multiple years, study results from marked animals, and biological judgements. The population was estimated by assigning a range of densities to modeled habitat based on habitat quality.

How lion harvest objectives and numbers are derived. Harvest objectives are generally based on maintaining a sustainable harvest. Some portions of the state, particularly bighorn sheep management areas, urban areas, or areas of other “special” circumstances are managed to reduce cougar populations. Harvest limits are infrequently met in most parts of the state and the annual average mortality is ~40% of maximum estimated sustainable mortality statewide. Some individual game management units (GMUs) sustain higher annual harvest and a few are closed due to harvest limits reached annually.

Use of management experiments and adaptive management to guide decisions. Multiple different harvest prescriptions have been attempted over the years since zone management was instituted. Management used has been an attempt at adaptively managing for harvest, bighorn sheep, depredation/human safety, and other ungulate-related concerns at differing levels, regionally over the last 17 years.

Special considerations and concerns. The inclusion of mortality other than sport harvest in harvest limit calculations has changed over the years, and non-harvest mortality is currently not considered in harvest limit calculations. Total mortality may be included in harvest limits eventually.

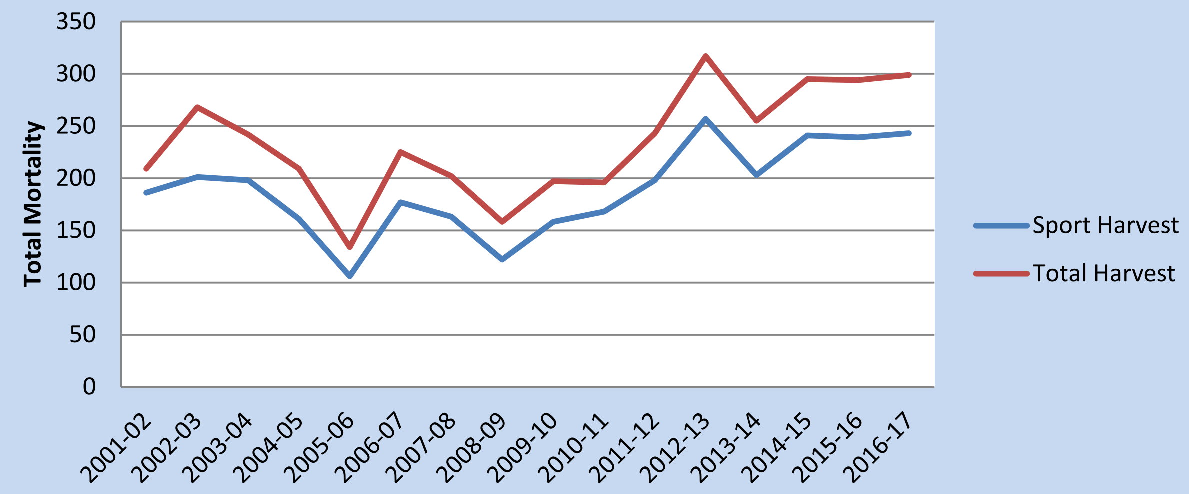
Legislation, ballot initiatives. There have been repeated attempts to legislatively remove cougars from protected species status which have been unsuccessful to this point. We are currently in litigation over the recent change to allow trapping/snaring of cougars as a legal harvest method.

What works? What doesn't work? Current management strategies seem to be successfully maintaining viable cougar populations statewide. Desert bighorn sheep related cougar removals continue to occur and protect those herds, and at this time there is no plan to discontinue removals; however, we may in the future if sheep populations reach specific numerical thresholds.

Harvest & Total Mortality:

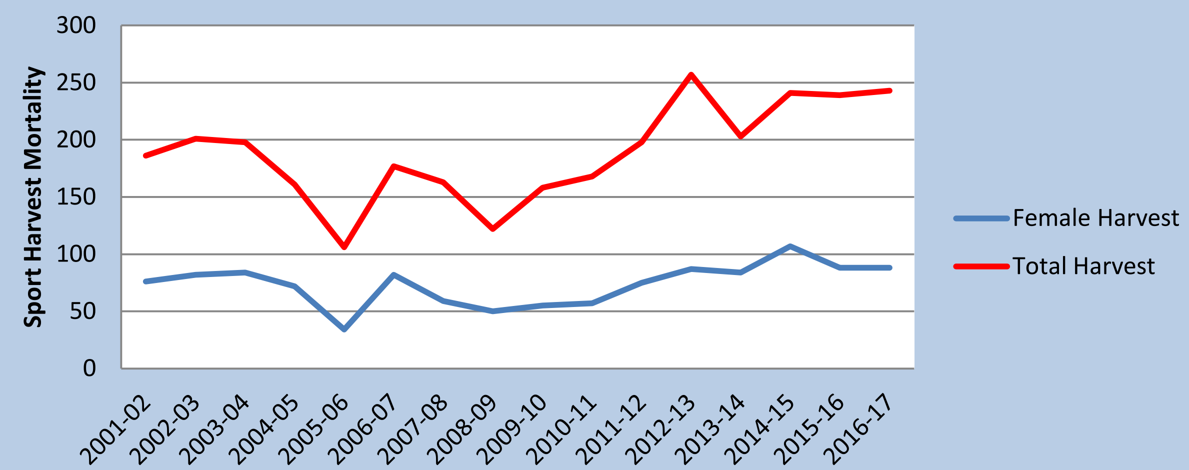
Historical lion harvest.

Figure 1. Total Mortality and Sport Harvest of Cougars in New Mexico, 2001-2016



Categorize by sex and age (stage) if available.

Figure 2. Total and female harvest of Cougars in New Mexico, 2001-2016



Number of lion hunting licenses sold annually.

Table 2. Total cougar license sales by year from 2001-2016/17.

License Year	Total Cougar License Sales
2001-02	1832
2002-03	2158
2003-04	2026

2004-05	2158
2005-06	2080
2006-07	1899
2007-08	1991
2008-09	1947
2009-10	2084
2010-11	2008
2011-12	2008
2012-13	2013
2013-14	2223
2014-15	2203
2015-16	2345

Number of hunters actively hunting annually if available. *N/A*
Number of lion hunting outfitters annually if available. *N/A*
Hunter effort, e.g., days hunting, days to kill.

Table 3. For successful cougar hunters: License year, % hunters guided, % non-resident hunters, % hunters using hounds, average days hunted, catch per unit effort and hunter success from 2001-2016/17.

License Year	% Guided	% Non Resident	% used hounds	Average Days Hunted	CPUE	Hunter Success
2001-02	49.5%	38.2%	91.9%	3.35	0.317	10.2%
2002-03	44.8%	37.4%	86.2%	4.04	0.285	9.3%
2003-04	43.4%	46.5%	86.9%	3.63	0.244	9.8%
2004-05	40.4%	39.1%	83.9%	3.84	0.245	7.5%
2005-06	37.7%	32.1%	81.1%	3.82	0.244	5.1%
2006-07	41.0%	35.4%	80.3%	3.40	0.335	9.3%
2007-08	39.9%	40.5%	81.6%	3.36	0.307	8.2%
2008-09	32.0%	28.7%	78.7%	4.96	0.199	6.3%
2009-10	48.1%	45.6%	83.5%	3.28	0.362	7.6%
2010-11	43.5%	38.1%	81.5%	3.57	0.278	8.4%
2011-12	49.5%	41.4%	90.9%	3.39	0.298	9.9%
2012-13	51.8%	53.7%	91.1%	3.77	0.279	12.8%
2013-14	36.3%	41.2%	79.4%	4.57	0.215	9.1%
2014-15	47.9%	47.5%	92.2%	3.60	0.276	10.9%
2015-16	47.7%	49.8%	90.8%	4.11	0.243	10.2%

Hunter success annually if available. See Table 3.

Issues of use of technology in lion hunting. There are no current issues; however, the use of GPS collars on dogs, telemetered trail cameras, and similar devices does raise questions from NMDGF law enforcement.

What is informative? What is not? Most of the metrics gathered can be informative if somewhat anecdotal. They are useful measures of hunter metrics and provide harvest trend information.

Depredation and Human Safety Conflict Management:

Policy and protocols for handling lion depredation. Cougar depredation is generally handled on a case-by-case basis. There are general guidelines that are summed up in the following: Cougars displaying aggressive or unacceptable behavior shall be killed. Practicality, safety and the on-site situation will determine whether the cougar is killed on or off-site. Cougar behavior and the potential for conflicts with humans remain the guiding principles for

Department action. Department staff may implement aggressive aversive conditioning where aggressive or unacceptable behaviors have not been observed. The Department may actively attempt to control cougars at high densities near residential areas. More general guidelines are attached as Table 4.

Table 4. Guidelines for interpreting bear and/or cougar behavior.

1. Aggressive Behavior:
    a. An animal is known or suspected to have caused a human injury;
    b. An animal aggressively approaches humans forcing the human to give ground;
    c. Any overt action by an animal that would cause a reasonable person to fear for their or someone else's safety (i.e. entering an inhabited residence regardless of attractant); or
    d. An animal displays predatory behaviors towards humans (stalking behavior, moves to intercept, etc.).
2. Unacceptable behavior:
    a. Intentionally approaching close to a human after the animal knows the human has seen it, even if the human did not have did not have to take evasive or aggressive action to drive the animal off;

   b. An animal that is not cornered, knows humans area aware of its presence, and fails to retreat given appropriate stimulus (after a human takes action, such as yelling, waving arms, throwing objects at it or uses some other methods of hazing);

   c. The animal continues to disturb, raid, or investigate humans or frequents high human-use areas (e.g. fails to respond to aversive conditioning or has been previously tagged);

   d. The animal causes property damage or causes multiple “nusinace” reports;

   e. An animal is staying or lingering in the vicinity of a school or other area where children are congregated, especially during hours when children are present; or

   f. An animal remaining in a residential area (neighborhoods yards) and is eating pet food or pets (including chickens or goats).

3. Acceptable behavior:

   a. The animal retreats at the sight of human;

   b. The animal stays put while humans show no aggression;

   c. The animal shows signs of curiosity while humans show no aggression;

   d. The animal is present in open space areas or natural travel corridors an shows no behaviors outlined in number 1 above; or

   e. A cougar that crouches twitches its tail and stares directly into the person’s eyes, immediately followed by retreating or showing no further aggression.

Number and type of losses annually.

Table 4. Depredation, Road or accidental kills and bighorn sheep kills by license year for 2001-2016/17.

License Year	Depredation				Road Kill				BHS Kills			
	Fem.	Male	Unk.	Tot.	Fem.	Male	Unk.	Tot.	Fem.	Male	Unk.	Tot.
2001-02	3	3	1	7	3	0	2	5	5	6	0	11
2002-03	14	14	1	29	6	5	2	13	14	11	0	25
2003-04	17	5	0	22	3	2	0	5	5	12	0	17
2004-05	16	16	1	33	4	0	0	4	3	8	0	11
2005-06	5	5	0	10	1	3	0	4	6	8	0	14
2006-07	12	13	1	26	3	1	0	4	8	10	0	18
2007-08	13	13	0	26	1	1	0	2	3	8	0	11
2008-09	5	11	0	16	4	1	0	5	4	11	0	15
2009-10	7	11	0	18	1	5	0	6	8	7	0	15
2010-11	1	3	0	4	5	5	0	10	8	6	0	14
2011-12	14	7	0	21	5	7	0	12	4	8	0	12
2012-13	14	6	0	20	4	5	1	10	7	23	0	30
2013-14	12	12	0	24	5	4	0	9	5	12	0	17
2014-15	13	11	1	25	4	7	0	11	8	10	0	18
2015-16	14	9	0	23	6	5	1	12	7	13	0	20
2016-17	15	6	0	21	7	9	2	18	5	12	0	17

Number of lions killed, captured and translocated. See Table 4. Very few cougars are captured and translocated, as few as one or none annually. Since most if not all cougar habitat in the state is already occupied, NMDGF does not believe that it is appropriate to translocate offending animals and they are generally euthanized.

Financial costs (SUS) if available, reimbursement program (if applied). New Mexico does not have a reimbursement program. Financial costs of staff dealing with an individual cougar problem/incident can vary but at a minimum approach ~$250.00/incident (minimum time 4 hour @ $125.0 + vehicle, immobilization drugs and equipment use).

Control efforts, e.g., broad-scale, focused, offending animal. Most control efforts are related to desert (and some Rocky Mountain) bighorn sheep population protection (i.e., preventative control removals). These efforts are generally broad scale and include any and all cougar habitat in proximity to bighorn sheep herds and habitat. On case by cases and generally in or near human population centers or as a result of depredation incidents, we will use offending animal removal if possible.

Methods & results of monitoring effectiveness of management actions. There is little or no monitoring of results of management actions to this date. We are currently in the process of estimating cougar populations on a GMU basis in one section of the state, and there are broader based efforts underway, no results are currently available.

Information and Education Programs:
In the case of incident response, information about living with cougars is provided to complainants/communities. On a broader level, department staff provide living with cougars/carnivores at request, and periodically meet with community groups to provide information and give presentations.
What works? What doesn't?

Human safety (with tables and graphs):

Policy and protocols for handling human safety. See Table 4 (above).

Number and type of incidences, e.g.,lion attacks, dangerous behavior, translocations, lions killed. Included in general depredation (Table 4) statistics. Human safety incidents are not tracked separately and are lumped in with general depredation. As a general rule, cougars in "town" are considered human safety incidents and the offending animal is generally euthanized. In rare cases cougars caught in urban areas may be translocated to nearby cougar habitat without large communities and/or ungulate issues present.

Information and education programs. As detailed in Table 4 (above).
What works? What doesn't?

Other Information and education programs- summary of approaches with results if applicable.

Research Efforts:
Summary with approaches, goals and objectives for each. Cougar Management Zone F (GMU 6 – Jemez Mountains) spatial capture- recapture study to estimate management-scale (> 3,000 km^2) cougar density using marked (GPS-collared animals) and un-marked animals, spatially clustered camera-trapping, and generalized spatial mark-resight models. Cougars were live-captured and outfitted with GPS collars during winter and spring 2017, and spatial resight camera trapping will occur summer 2017. This is an intramural Department study.

Statewide survey of cougar population using scat detection dogs to collect cougar scats in delineated cougar habitat of varying qualities for genetic identification and population estimation. This project is ongoing through the Co-Op unit at New Mexico State University. Completion date unknown. Human dimensions surveys- summary. None planned at this time.

Oregon Mountain Lion Status Report

Report provided by: Derek Broman, Oregon Department of Fish and Wildlife

History of Legal Classification:

1967 Cougar was classified as a game mammal.
1994 Ballot Initiative (Measure 18) banned, among other things, the use of dogs for cougar harvest.

Current Status & Management:

Presence/absence of a formal management plan. *Yes (1987, with updates in 1993, 2006, and planning on late 2017).*

Statements of lion management policy, goal and objectives. *No one statement exists, but the cougar plan identifies objectives that together seek to maintain a viable, healthy cougar population, reduce conflicts with cougars, and manage cougars in a manner compatibale with other game mammal species using proactive, adaptive management strategies.*

Lion management structure and strategies, including dates, methods, use of special quotas, limited entry areas, closed areas, bans. *State is divided into 6 Cougar Zones. A quota occurs for each zone that serves as a mortality cap. Should the quota be reached, harvest is closed in the zone for the remainder of the calendar year, cougar removals for damage and human safety are still permitted. Dogs are not allowed for hunting cougars, nor are traps. Harvest structure is a general season that runs the full calendar year. Hunters can harvest up to 2 cougars per year.*

Use of mandatory checks or sampling numbers, sex, age data, hunter effort. *All cougars regardless the mortality source are required to be checked in at an ODFW office. Gum measurements, tooth samples, and female reproductive tracts are taken at check in. All big game hunters, regardless of success, are required to report. This provides information on hunt unit, effort, and success.*

State-wide lion number and population trend. *6,400 cougars across all age classes in 2017. Statewide number is slowly increasing, but many cougar zones may be near carrying capacity.*

How lion population numbers/densities are derived, e.g., extrapolated assumptions, use of study results, biological judgments, population reconstruction. *A deterministic population (reconstruction) model for each zone is updated annually. Study and carcass data is used to update model components (e.g. age class survival, litter size, density, etc.). Numerous research projects have cal*

How lion harvest objectives and numbers are derived. *Cougar Plan Objectives require numbers to not fall under 3,000 cougars (across all age classes) statewide. As such, mortality quotas are established in each zone so that populations do not fall below that objective. Without the use of hounds, hunter harvest is not a threat to cougar populations (based on the literature) and harvest quotas (functionally a cap) are rarely met.*

Use of management experiments and adaptive management to guide decisions. *Adaptive management is used to test hypotheses and address conflict as identified in the Oregon Cougar Plan. Since 2006, seven efforts to reduce cougar numbers in a specific area (called target areas) have been implemented to address conflict (damage, safety, or impacts to other game mammals).*

Special considerations and concerns.

Legislation, ballot initiatives. *Besides 1994 initiative (Measure 18) that banned use of dogs (and baiting black bear), nothing big to report. Bills are regularly proposed that would allow counties to vote to repeal ban, but none make it out of session.*

What works? What doesn't work?

Harvest & Total Mortality:

Historical lion harvest.

Categorize by sex and age (stage) if available.

Count of age class of hunter harvested male cougars, Oregon 1987-2016.																				
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**Unk**	**Pending**	**Grand Total**
1987		8	22	12	8	4	4	2	1	2	1							9		73
1988	4	12	24	15	13	2	3	2	1	1	2							10		89
1989	1	12	26	9	3	6	4	4	3	2	1			1				1		73
1990	7	8	22	28	14	16	10	3	5	1	1	2			1			7		125
1991	1	6	12	11	11	10	13	3	3	3				1				1		75
1992	4	3	13	18	18	14	13	9	7	2		5	3	1	1					111
1993	2	3	16	15	12	9	13	8	5	5	4	1	1					2		96
1994	1	14	14	10	14	11	12	6	4	5	3	1	2	3				4		104
1995		1	3	2	2	4				1										13
1996	1	4	4	4	4	3	1	2	2	1		1								27
1997	2	1	4	4	6		4	5	2	1	1							2		32
1998	5	11	14	6	6	6	3	1	1	1	1									55
1999	5	10	16	9	10	7	4	3	2	1	1							3		71
2000	3	15	26	17	11	9	7	3	2	2	4	1						3		103
2001	5	19	26	14	11	13	9	8	3	2	3							3		116
2002	2	24	20	17	13	8	9	5	3				1					2		104
2003	5	25	29	14	15	9	9	4	7	1	1	2						6		127
2004	10	25	31	24	15	13	5	8	2	2	3							7		145
2005	4	22	28	19	13	7	10	1	2	1	3	2	1		1			2		116
2006	5	31	43	32	9	7	9	7	3		1							7		154
2007	7	29	36	22	16	18	9	8	6	2	1	1				1				156
2008	12	15	32	31	10	10	12	4	3	2	3							2		136
2009	7	11	27	28	17	13	11	6	6	3	3							1		133
2010	6	19	22	23	18	10	12	6	1	3	2	1						1		124
2011	6	19	30	23	8	10	3	1	2	2	1	1						3		109
2012	10	20	37	32	10	13	7	4	1	1			1					3		139
2013	6	21	40	20	13	17	7	6	3	3								2		138
2014	7	22	28	18	13	14	12	3										1		118
2015	3	29	27	17	16	11	9	6	2	7	3	1					1	4		136
2016	9	17	19	20	11	7	4		1	1								3	32	124

Count of age class of hunter harvested cougars with unknown sex, Oregon 1987-2015									
		0	1	2	4	5	7	Unk	Total
1987			1						1
1994								1	1
1999								1	1
2001			1						1
2004		1	1						2
2009			2						2
2010				1			1		2
2011		1		1	1				3
2012			1						1
2013				2					2
2015						1			1

Count of age class of hunter harvested female cougars, Oregon 1987-2016.

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	Unk	pend	Total
1987	3	5	12	7	6	7	4	2	1	1	1	1									5		55
1988	2	11	14	10	5	2	3																47
1989	1	5	15	7	3	4	3		1	1		2									1		43
1990	2	8	18	14	13	5	2	1	2		3	1	2				1				4		76
1991		4	11	5	6	9	1	4	3	2			1		1			1			1		49
1992	2	2	16	7	9	13	8	4	3	3	1	2	1								2		73
1993	4	5	16	6	5	5	7	2	5	3	1		1								6		66
1994	3	9	18	17	8	7	10	4	4	2	6		1	1	1						3		94
1995	1	2		3	1			1													1		9
1996	1	6	2	1			1	1			1	1									2		16
1997		8	9		4	2		1			1	1							1		2		29
1998	5	10	12	7	7	5	3		2	1	1	1									2		56
1999	8	21	28	12	8	8	5	1	1	1	1	1				1					1		97
2000	3	19	16	16	5	6	2	7	4	2	2					1					2		85
2001	5	20	22	12	13	14	6	1	1			1				1	1				6		103
2002	10	25	25	17	14	8	6	5	3	3	1		1			1					9		128
2003	8	28	36	17	10	4	3	4	5	3			1								2		121
2004	11	34	35	8	6	5	4	3	2	2	2	1	1								4		118
2005	9	29	25	13	8	4	6	4		1	1		1	2							5		108
2006	5	39	42	13	5	11	5	3	2	2	1	1			2	1					3		135
2007	11	26	41	31	16	6	5		5	2	2	1									7		153
2008	8	27	33	28	8	7	8	3	3	2	3							1			5		136
2009	14	24	35	20	21	8	3	4	2	4			2								2		139
2010	7	28	23	16	6	7	9	4	4	4	1		2	1							2		114
2011	8	25	26	30	11	9	2	1	6		3		1		1						6		129
2012	7	35	28	17	13	3	5	1	3												1		113
2013	12	47	38	16	14	5	6	3	4	2	1	1	1		1						1		152
2014	6	24	19	11	9	11	4	2		2			1								2		91
2015	7	21	24	11	8	5	3	4	3		2		2								6		96
2016	7	33	18	22	12	6	2	3	1											1	3	35	143

Number of lion hunting licenses sold annually.

Number of hunters actively hunting annually if available.

Hunter success annually if available.

Oregon Hunter success, 1987-2016

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

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

Number of lion hunting outfitters annually if available. NA
Hunter effort, e.g., days hunting, days to kill. Not of value as most take is opportunistic.
Issues of use of technology in lion hunting. None.
What is informative? What is not? Most take is opportunistic while hunting other big game; therefore most traditional hunt metrics (CPUE, etc.) are not applicable.

Depredation and Human Safety Conflict Management:
Policy and protocols for handling lion depredation. *ODFW has a wildlife damage policy and that policy as well as the Plan direct staff to focus on education and the use of non-lethal approaches. When appropriate, an attempt is made to remove offending animals.*

Number and type of losses annually.

Number of lions killed, captured and translocated. *TABLE*

Financial costs (SUS) if available, reimbursement program (if applied) *Valuation of loss is not always available and there is no reimbursement program.*

Control efforts, e.g., broad-scale, focused, offending animal. *Oregon Statutes permit the taking of cougar without a permit if the animal is causing damage or poses a threat to human safety. Agency involvement typically consists of attempts to remove the offending animal, but in almost all cases, the public is educated on how to reduce current and future* *conflict. One target area effort has been completed and one is currently underway to reduce cougar numbers in areas experiencing high damage and conflict. Removals are conducted by staff, public cougar agents, and Wildlife Services.*

Methods &. results of monitoring effectiveness of management actions. *Hiller et al. (2015) used Oregon data to model cougar conflict and suggested that conflict (measured by cougars taken on damage) decreased with increasing hunter-harvest or at worst remained constant at low to average cougar densities.*

Policy and protocols for handling human safety*. Oregon Statutes permit the taking of cougar without a permit if the animal is causing or poses a threat to human safety. Agency involvement typically consists of attempts to remove the offending animals, but in almost all cases, the public is educated on how to reduce current and future conflict. One target area effort has been completed and one is currently underway to reduce cougar numbers in areas experiencing high damage and conflict. Removals are conducted by staff, public cougar agents, and Wildlife Services.*

Number and type of incidences, e.g.,lion attacks, dangerous behavior, translocations, lions killed.

All known Oregon cougar mortalities recorded 1987-2016.

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

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

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

Information and Education Programs:

A considerable amount of information is provided by ODFW Biologists when interacting with the public either whether over the phone or in person. ODFW website and brochure entitled 'Oregon is Cougar Country' are excellent tools that are regularly used by staff, the public, and the media.

http://www.dfw.state.or.us/wildlife/living_with/cougars.asp

http://www.dfw.state.or.us/wildlife/living_with/docs/CougarBroch.pdf

What works? What doesn't? **Damage and complaints are stable or declining throughout much of the state. Public education and corrective actions appear to satisfy issues of cougar damage and conflict.**

Other Information and education programs- summary of approaches with results if applicable.
Current research programs- summary with approaches, goals and objectives for each.

Research Efforts:

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

- An effort to quantify cougar density in portions of the Dixon, Evans Creek, Indigo, and Melrose WMUs of southwest Oregon is currently underway. This study uses DNA collected from treed cougars using biopsy darts that collect a tissue sample without killing the cougar. Those samples and samples collected from cougar mortalities are used in a mark-recapture analysis.
- A cougar study will begin in the fall of 2017 in the Alsea WMU which is located in the mid-coast range west of Corvallis. The objectives of this research are to: 1) identify cougar densities through telemetry and scat dog analysis, 2) identify home range size of adult cougars, and 3) identify diet through scat analysis.

Human dimensions surveys- summary. None.

Saskatchewan Mountain Lion Status Report

Report provided by: Mike Gallop, Saskatchewan Ministry of Environment

History of Legal Classification:

No recent changes – fully protected except that a landowner protecting his property may kill a cougar and a trapper who incidentally traps a cougar can sell the pelt

Current Status & Management:

No management plan. One in draft but without a firm release date.

Policy speaks to the removal of cougar where there are issues of public safety or livestock predation.

Currently all cougar management pertains to the removal of problem animals.

Mandatory reporting of all cougar taken by landowners or trappers. Developing a protocol for the collection of biological samples for DNA profiling.

Number unknown – likely less than 400 but increasing.

Use of study results with collared animals were used to derive densities for the Cypress Hills. Elsewhere there is no formal method for estimating population. Confirmed sightings are generally reported but these data have been used mainly to track distribution.

Provincial regulations extend full protection to all species unless specified as a game, fur or pest species. To date mountain lion are fully protected.

Harvest & Total Mortality:

Incidental harvest only. Averaging 10 animals/year.

Depredation and Human Safety Conflict Management:

Handled by Saskatchewan Crop Insurance Corporation a wing of our Agriculture ministry.
2011 – 2015 Alpaca 4; Bison 2; Goats 3; Llama 1; Horse 21; Sheep 61; Cattle 151
At least 3 cougar killed in association with livestock predation. An additional 15 by ranchers where cats encroached on yard or corral sites.
2011 – 2015 - $169,000 on 243 claims.
Control efforts focus on offending animal.
Only monitoring of effectiveness is whether incidents continue.
Increased efforts to update website information on cougars and to educate key stakeholder

groups on the ecology of the species and how best to avoid conflicts.
Still learning what works. Certainly helps maintain landowner tolerance that we offer 100% compensation on livestock kills.

Ministry staff utilizer a matrix to determine appropriate actions (attached). In general, animals in a yard-site or town are removed wherever possible.

No dangerous incidents to date but increasing cases of encroachment into yards and towns. At least 15 cats killed to date for this reason.

I+E as previously stated.

So far the suite of options available (compensation for livestock losses; services of predator control specialists to assist with removing problems animals, relaxed regulations for landowners) is keeping the lid on but we anticipate pressure for more options as populations increase. *Only as previously mentioned. No current research underway.*

No HD surveys underway.

South Dakota Mountain Lion Status Report

Report provided by: Andrew Lindbloom, South Dakota Game, Fish and Parks

History of Legal Classification:

Mountain lions (*Puma concolor*) have historically occurred througout South Dakota and were considered numerous in the Black Hills. The lion population declined in the early 1900's due to unregulated harvest and bounties placed on mountain lions until 1966. In 1978, mountain lions were listed as a state threatened species. With a breeding population established in the Black Hills and a better understanding of population dynamics within the Black Hills, the mountain lion was removed from the state threatened species list and classified as a big game animal in 2003 with protection under a year-round closed season. The first hunting season was established in 2005 as an "experimental season" and a season continues to be implemented as a tool to manage mountain lion populations at a desired level. There is currently an established season and harvest limits for the Black Hills Fire Protection District of South Dakota, and a year-round season in the remainder of the state.

Current Status & Management:

Management Plan

The South Dakota Mountain Lion Management Plan 2010-2015 is located at: http://gfp.sd.gov/wildlife/critters/mammals/docs/2010mtlion-managementplan.pdf. The South Dakota Department of Game, Fish, and Parks (SDGFP) will begin the process of updating and revising the current management plan this year, with completion expected mid- to late-2018. Obtaining public input on the plan revision will be an important part of the process, but actual strategies to gather public input have not been selected at this point. Current goals and management strategies will be re-evaluated and modified as needed.

Hunting Seasons

The 2016/17 lion season for the Black Hills Fire Protection District had season dates of December 26, 2016 – March 31, 2017. Regulations were in place to end the season immediately if the harvest limit of 60 mountain lions, or 40 females, was met at an earlier date. Within the Black Hills, the use of dogs to hunt mountain lions is prohibited except during specified hunting intervals in Custer State Park. Outside of the Black Hills Fire Protection District, the season is year-round and the use of dogs is allowed on private land. The 2016/17 lion season in the Black Hills ended on March 31 with a total of 30 lions harvested.

All harvested mountain lions must be presented to a SDGFP representative within 24 hours of harvest for inspection and DNA sampling. Location of harvest, estimated age, sex, and weight are all recorded for each harvested lion. In addition, a harvest survey is sent to all licensed hunters to compile additional lion season information.

Population Assessments
The majority of the lion population in South Dakota occurs within the Black Hills in the south-western portion of the state. There is no known established breeding population outside of the Black Hills and thus no population assessments are conducted for the remainder of the state. Mountain lions are occasionally observed outside of the Black Hills area, but most are likely transient lions with the majority being young males.

The lion population in the Black Hills appears to be stable but not all trend estimates are in agreement. The primary surveys and data used to assess trends include the following: 1) DNA sampling (catch per unit effort, population mark/recapture estimate), 2) hunter harvest surveys (harvest, harvest per unit effort, female harvest proportions), 3) documented mortalities (harvest, non-harvest, densities), and 4) observation reports.

Mountain lion population estimates are derived using the Lincoln-Petersen mark-recapture method, with the Chapman modification to account for small sample sizes. Beginning in 2013, SDGFP began using biopsy-darting as the primary method to mark lions immediately prior to the season; radio-collared lions from previous research are also utilized to assess availability. In December of 2016, SDGFP used 3 houndsmen teams (SDGFP, Wyoming Game and Fish, private contractor) to collect 63 samples. After DNA analyses were conducted by the USFS National Genomics Center for Wildlife and Fish Conservation and data were further reviewed, there were DNA samples from 50 individual adult and sub-adult mountain lions that were considered available for harvest leading up to the first day of the 2016/17 hunting season. The 96-day hunting season is considered the recapture event, and during that time 26 adult and sub-adult lions were harvested; 5 were either previously DNA sampled or had a functioning radio collar. The inputs for the 2016/2017 Lincoln-Petersen mark-recapture estimate are as follows; M = 50, C = 26, R = 5.

Lincoln-Petersen mark-recapture Chapman estimates are derived using:

$$N = \frac{(\mathrm{M}+1)(\mathrm{C}+1)}{\mathrm{R}+1} - 1$$

N = Estimate of adult/sub-adult population size
M = Total number of adults captured and marked on the first visit
C = Total number of adults captured on the second visit
R = Number of adults captured on the first visit that are then recaptured on the second visit

95% confidence intervals are then formulated using the variance estimator below:

$$var\ (N) = \frac{(M+1)(C+1)(M-R)(C-R)}{(R+1)(R+1)(R+2)}$$

Vital rates from radio-collared individuals and recruitment data from previous research studies in the Black Hills were used as input variables to calculate the total lion population. Age and sex composition of starting populations was based on the 3-year average of harvested mountain lions. The 2016/17 preseason population estimate for the Black Hills was approximately 300 total lions (95% CI: 119-466), of which 230 are adults/subadults. Population estimates have low precision, but appear to be slightly above management objective the past few years (Figure 1). Catch per unit effort data are also recorded during DNA collection efforts, and are evaluated annually (Table 1).

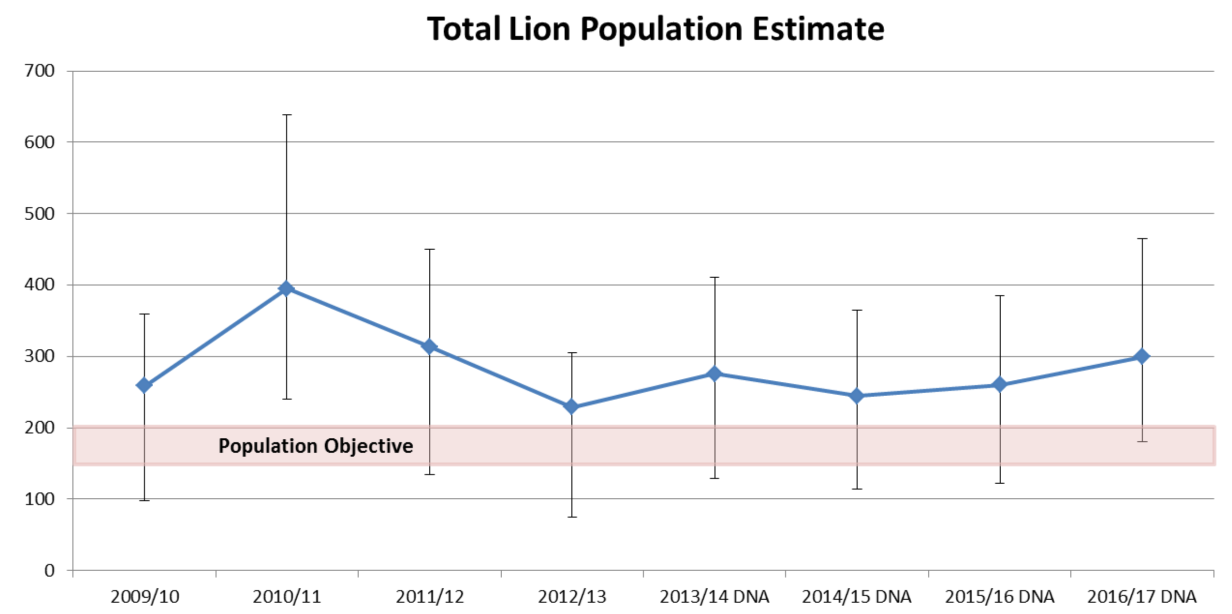


Figure 1. Mark/recapture estimates of the mountain lion population in the Black Hills of South Dakota, 2009/10-2016/17.

Table 1. Catch per unit effort data collected during annual biopsy surveys of mountain lions in the Black Hills of South Dakota, 2013-16.

Year	hours	lions	hrs/lion	catch/100 hrs
2013	319	26.0	12.3	8.2
2014	615	31	19.8	5.0
2015	508	56	9.1	11.0
2016	578	63	9.2	10.9

All mountain lion observations reported by the public are also documented and evaluated for trend assessments along with other lion population data. Observation reports have been on a decreasing trend since they peaked in 2005 at approximately 371 total reports (Figure 2). Because SDGFP encourages the public to report any observations of lions and documents all such observations, it is important to report these data. Interpretation of observational data is challenging, however, because reporting rates from the public are unknown and this may impact data trends. Therefore SDGFP uses these data as supplementary to other survey data.

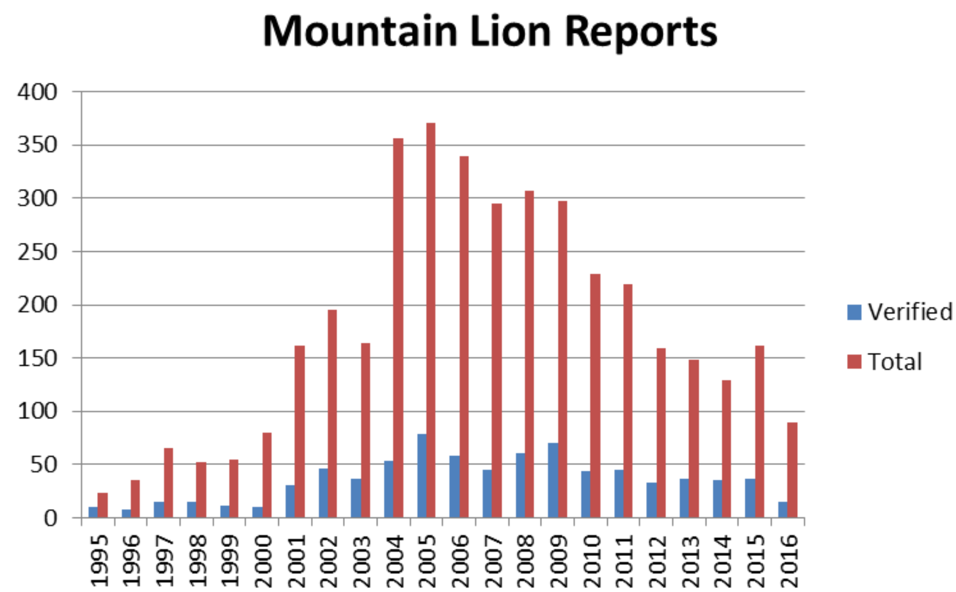


Figure 2. Mountain lion observation reports in South Dakota, including total numbers of reports and those verified by SDGFP, 1995-2016.

All known lion mortalities are also recorded and later evaluated for population trend assessments. Harvest mortalities can be influenced by hunting seasons and regulations, but have been decreasing the past 5 years (Figure 3); the harvest limit in the Black Hills has not been reached in the past 5 hunting seasons. Non-harvest mortalities peaked at 51 lions in 2009/10, and have declined to 10 in 2016/17 (Figure 3). Total mortality densities are also evaluated in relation to thresholds defined for Wyoming lion populations. Mortality densities over the past 2 years would suggest a stable lion population (Figure 4).

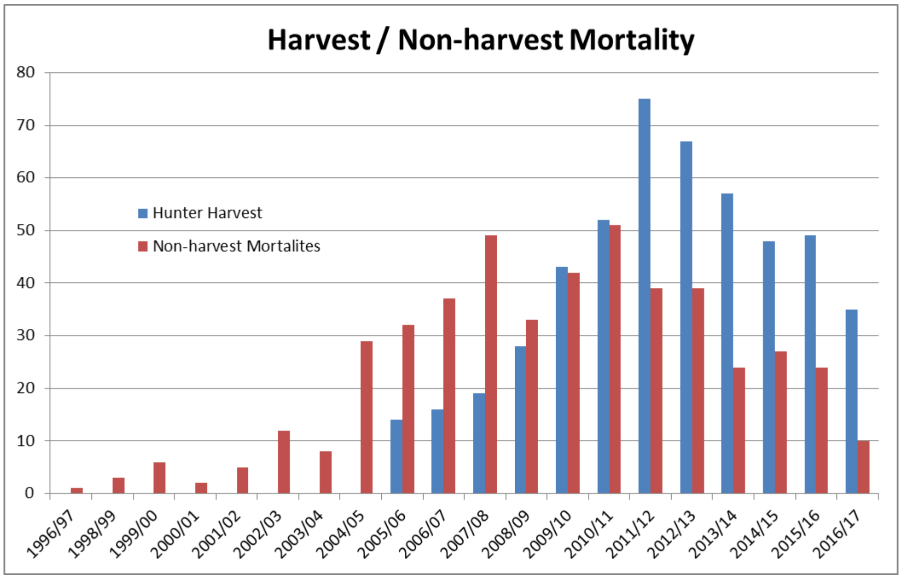


Figure 3. Harvest and non-harvest mortalities documented in South Dakota, 1996/97 – 2016/17.

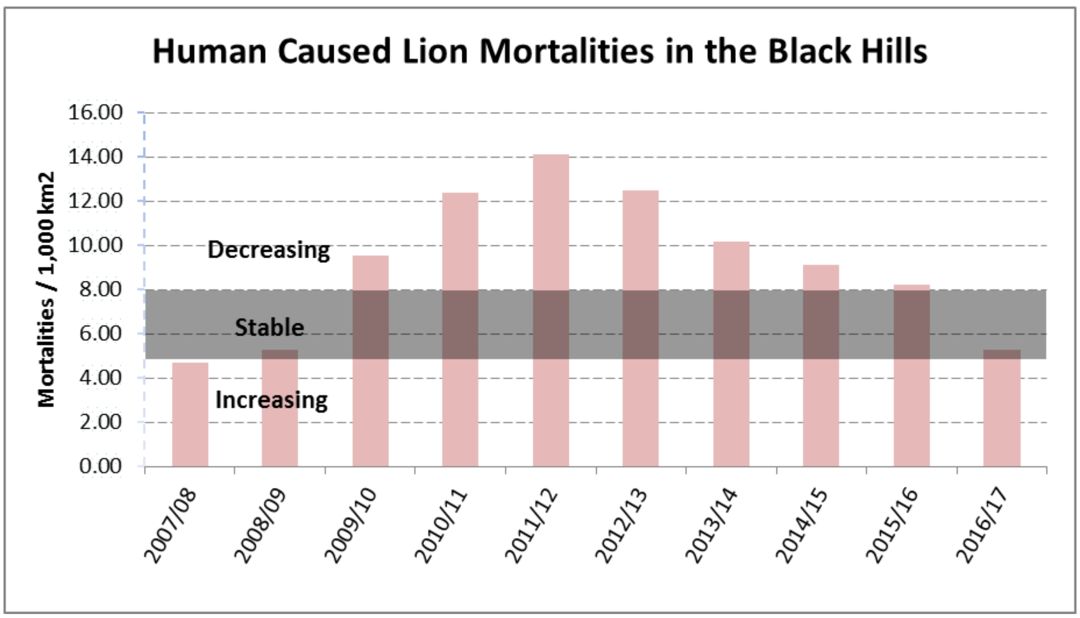


Figure 4. Human-caused mountain lion mortality densities in the Black Hills of South Dakota, 2007/08 – 2016/17.

Harvest & Total Mortality:

Hunting seasons for mountain lions in South Dakota began in 2005. Historical lion harvest, season dates, and associated season data are depicted in Table 2 and Figure 5. Lion harvest peaked in 2011/12 at 73 total lions and is currently trending downward. Harvest limits are established to ensure harvest levels do not exceed management objectives, but limits have not been reached since the 2011/12 season.

Table 2. Mountain lion hunting season data for South Dakota, 2005/06 – 2016/17.

Year	Licenses Sold	Season Dates	BLACK HILLS HARVEST Males	Females	Total	PRAIRIE	Harvest Limit	Quota Reached	Season Length(days)
2005/06	2,589	Oct.1 - Dec. 15	6	7	13	1	25 or 5 breeding age females	Female	24
2006/07	3,297	Nov. 1 - Dec. 31	7	8	15	1	25 or 8 females	Female	19
2007/08	4,067	Nov. 1 - Dec. 31	2	15	17	2	35 or 15 females	Female	23
2008/09	2,678	Jan.1 - Mar. 31	11	15	26	0	35 or 15 females	Female	45
2009/10	2,356	Jan.1 - Mar. 31	16	24	40	0	40 or 25 females	Total	41
2010/11	2,560	Jan.1 - Mar. 31	20	27	47	2	45 or 30 females*	Total	52
2011/12	3,786	Jan.1 - Mar. 31	27	46	73	0	70 or 50 females	Total	61
2012/13	4,344	Dec.26-Mar. 31	26	35	61	3	100 or 70 females	Date	96
2013/14	3,293	Dec.26-Mar. 31	22	31	53	4	75 or 50 females	Date	96
2014/15	3,210	Dec.26-Mar. 31	21	22	43	5	75 or 50 females	Date	96
2015/16	3,102	Dec.26-Mar. 31	16	25	41	8	60 or 40 females	Date	97
2016/17	2,561	Dec.26-Mar. 31	14	16	30	5	60 or 40 females	Date	96

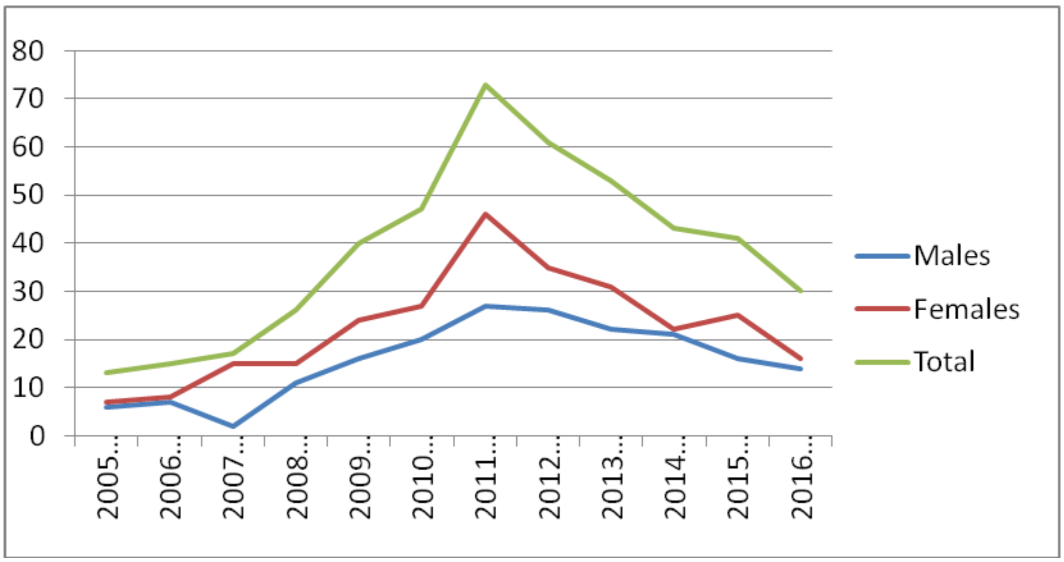


Figure 5. Mountain lion harvest in the Black Hills of South Dakota, 2005/06 to 2016/17.

The majority of harvest in South Dakota occurs without the use of hounds (hounds are only legal outside the Black Hills and in Custer State Park). Age and sex harvest proportions are evaluated annually (Figure 6). Overall, since the first regulated hunting season in 2005, 60% of all adult/subadult lions harvested in South Dakota have been females (35% adult, 25% subadult), whereas 40% have been males (19% adult, 21% subadult). Approximately 46% of all lions harvested have been subadults.

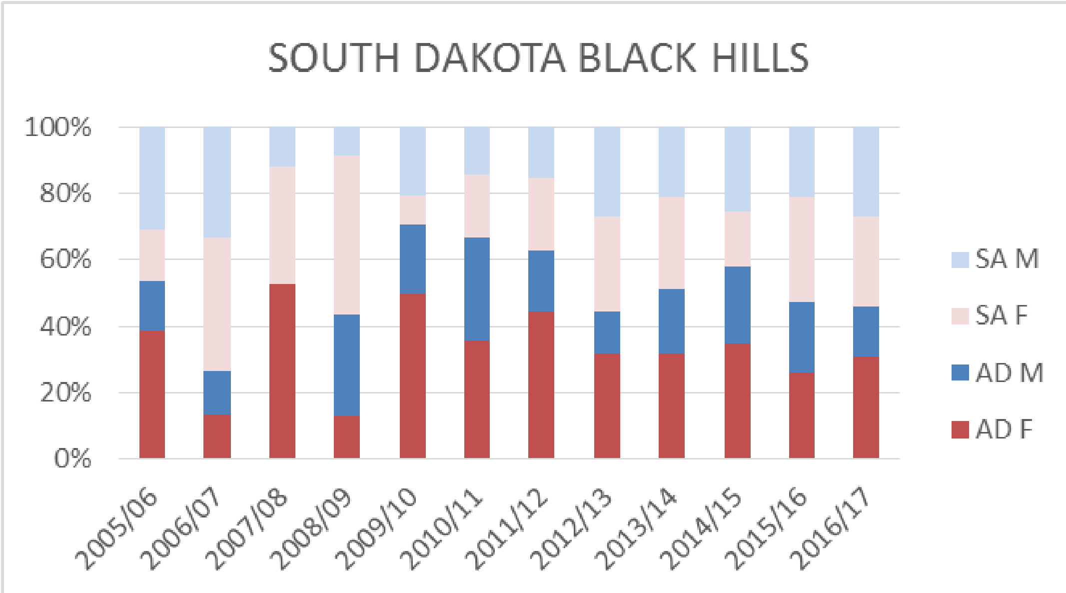


Figure 6. Sex and age harvest proportions of lion harvest in the Black Hills of South Dakota, 2005/06 – 2016/17.

Because lion hunting in South Dakota is primarily conducted through a boot hunt, harvest success rates are low compared with other big game hunting seasons. Overall, hunting success for all licensed hunters in the Black Hills from 2005/06 to 2016/17 averaged 1.2%. Hunting licenses for mountain lions in South Dakota are relatively inexpensive ($28), and each year hunter surveys conducted by SDGFP reveal that some hunters purchase licenses but do not actually hunt; in the 2015/16 season only about 49% of licensed hunters spent time hunting lions (Table 3). Hunter surveys also collect hunter effort (# days hunted), which is used with active hunting participants to estimate harvest per unit effort. Data and reports are not currently available for the most recent 2016/17 lion season hunter survey results, but hunters in 2015/16 harvested lions at an approximate 3.2 lions per 1,000 hunted days and has trended somewhat downward since the 2009/10 season (Figure 7).

Table 3. Harvest per unit effort for Black Hills lion hunting seasons, 2008/09 – 2015/16.

Year	Season Length (Days)	Lions Harvested	Licenses	Active Hunters	Average # Days	Man-Days Hunted	Harvest Per 1,000 Man-Days	% Change from Previous Yr
2009	45	26	2,428	1,646 (1,594, 1,698)	6.5	10,698 (10,003, 11,404)	2.43 (2.28, 2.60)	-
2010	41	40	2,082	1,468 (1,423, 1,513)	6.2	9,100 (8,535, 9,678)	4.40 (4.13, 4.69)	81%
2011	52	47	2,325	1,790 (1,749, 1,831)	6.6	11,814 (11,128, 12,508)	3.98 (3.76, 4.22)	-9%
2012	61	69	3,482	2,646 (2,591, 2,701)	7.1	18,787 (17,831, 19,749)	3.67 (3.49, 3.87)	-8%
2013	96	54	4,351	2,872 (2,804, 2,940)	7.3	20,966 (19,799, 22,143)	2.58 (2.44, 2.73)	-30%
2014	96	44	3,293	1,861 (1,796, 1,925)	6.9	12,841 (11,920, 13,775)	3.43 (3.19, 3.69)	33%
2015	96	38	3,210	1,689 (1,620, 1,758)	7.1	11,992 (11,053, 12,953)	3.17 (2.93, 3.44)	-8%
2016	97	35	3,102	1,529 (1,462, 1,596)	7.1	10,856 (9,972, 11,759)	3.22 (2.98, 3.51)	2%

* Numbers in parentheses represent 95% confidence intervals; calculations do not include lions harvested or days hunted in CSP.

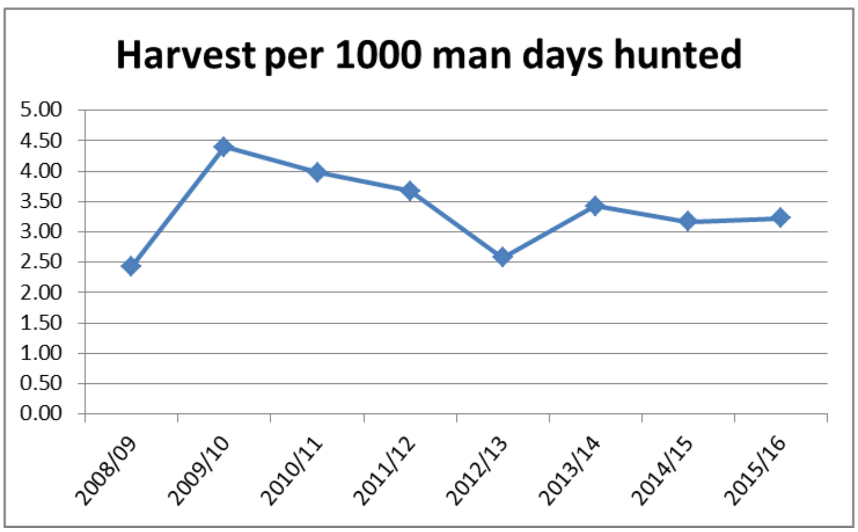


Figure 7. Harvest of lions per active lion hunter, 2008/09 – 2015/16.

Depredation and Human Safety Conflict Management:

In South Dakota, mountain lions will not be removed by SDGFP unless they attack a human, attack livestock, or if they are judged to be a substantial threat to public safety. The most lions annually removed by the Department was 19 in 2009/10, and the number of removals has decreased to zero in 2016/17 (Figure 8). Under South Dakota codified law 46-6-29.2, killing of a mountain lion is permitted if reasonably necessary to protect the life of a person or if a lion is posing an imminent threat to a person's livestock or pets. If a person kills a mountain lion pursuant to state law, they must contact SDGFP within twenty-four hours of killing the mountain lion. SDGFP encourages problem prevention when dealing with mountain lion incidents. SDGFP will remove a mountain lion for attacking domestic animals (i.e., pets), but may not remove a lion for attacking or killing pets that are free-roaming or that provoke a mountain lion. Feeding of prey species in urban areas or near rural homes will be discouraged as it can lead to an increased presence of mountain lion.

Relocating problem lions is not a viable solution in South Dakota. The Department has attempted to relocate lions within the Black Hills in the past with no success. The relocated lions returned to the capture site, moved to a different site and became a problem, or were killed by other lions.

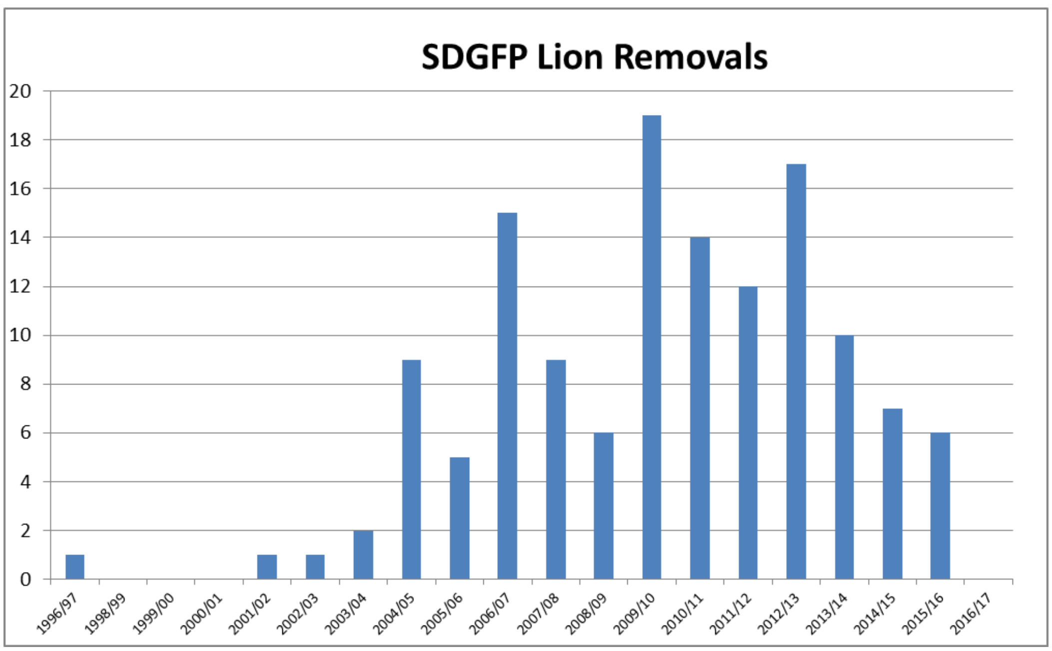


Figure 8. Mountain lion removals by SDGFP, 1996/97 – 2016/17.

Human Safety Incidences:

The following section is a copy of the "South Dakota Mountain Lion Response Protocol".

…In 1995, SDGFP developed and adopted response goals for dealing with mountain lion/human encounters. Over the years, this response protocol has been revised to include experience and techniques learned from previous responses and results from research. All reports of mountain lions will be documented by Department personnel.

PROTOCOL PURPOSE

• To guide Department personnel in responding to a report of a mountain lion-human interaction in a consistent fashion, while minimizing, to the extent possible, public safety risks and the need to eliminate specific mountain lions.

• To aid Department personnel in maintaining a central mountain lion–human interaction database using reporting forms to ensure consistency in the collection of data.

• To assure the public that the Department will work seriously and cooperatively to respond to mountain lion–human interactions.

DEFINITIONS

1. Sighting - a visual observation of a lion or a report of lion tracks or other sign.
2. Encounter - an unexpected direct neutral meeting between a human and a lion without incident.
3. Incident - a conflict between a human and lion in which the human must take action to make the lion back away or leave the immediate area, without injury to the human. Recurring observations of a lion in close proximity to human developed areas. A pet or livestock is killed by a lion.
4. Attack - when a human is bodily injured or killed by contact with a mountain lion.

RECEIVING, COMPILING AND CLASSIFYING MOUNTAIN LION REPORTS

Department personnel receiving a report of mountain lion will complete a mountain lion observation report form (appendix A) and enter the report into the wildlife incident database. Every report must be entered into the database in case repeat sightings or unacceptable behavior of an individual mountain lion develops. Reports shall only be accepted from the observer. Second or third hand reporters shall be advised to inform the actual observer to make the report. Department staff receiving a report will determine the extent of actual response that may be required. The observer should be asked about the existence of evidence that may be used to verify mountain lion presence (e.g. photographs, video, tracks, kill, etc…). When reports of mountain lion occur within known mountain lion range, the need for an actual investigation will be determined by the level of perceived threat to humans, pets or livestock. An investigation will only be conducted if a report is recent enough to allow a reasonable chance of confirmation. Reports will be classified into the following categories:

- Unfounded – evidence exists that proves the report was not a mountain lion
- Unverified – There is no evidence to support or reject the report of mountain lion
- Verified – Evidence exists that proves the report was a mountain lion

DEPARTMENT PERSONNEL RESPONSE

1. Sightings

- *Field response is recommended to verify the presence of a mountain lion. Personal contact is encouraged in all situations.*
- *Provide brochure Living with Mountain Lions to reporting party and make an effort to educate reporting party about mountain lions and their behaviors.*
- *Complete mountain lion observation report form (Appendix Figure 9) and submit the report for entry into the wildlife incident database.*

2. Encounter

- *Field response is required to verify presence of a mountain lion.*
- *Provide brochure Living with Mountain Lions to reporting party and make an effort to educate reporting party about mountain lions and their behaviors. Information will be provided to reporting party if humans, pets or livestock are at risk.*
- *Complete mountain lion observation report form (Appendix Figure 9) and submit the report for entry into the wildlife incident database.*
- *Contact the appropriate Regional Supervisor and/or Regional Wildlife Manager and local Department staff.*

3. Incident

- *Prompt field response is required in all cases to verify the presence of a mountain lion. Where a lion is judged to be a substantial threat to property or public safety it may be removed. The decision to remove a mountain lion will be made by the Regional Supervisor and/or the Regional Wildlife Manager. However, if Department personnel observe a conflict between a human and a lion, a lion attacking a pet or livestock or a lion in a heavily populated area (e.g. downtown Rapid City) it may be removed immediately.*
- *If presence of a mountain lion is verified IMMEDIATELY NOTIFY – Regional Supervisor and/or Regional Wildlife Manager. Local staff should be notified as soon as possible.*
- *Provide brochure Living with Mountain Lions to reporting party and make an effort to educate reporting party about mountain lions and their behaviors. In the case of an attack on pets or livestock, Department personnel will encourage and emphasize problem prevention.*

• Complete mountain lion observation report form (Appendix Figure 9) and submit the report for entry into the wildlife incident database.
• The entire carcass including all parts of a mountain lion that is removed will be taken to the respective Regional Office. The Regional Supervisor or the Regional Wildlife Manager will report the lion removal to the Secretary of the Department.

4. Attack

• Immediate field response is required in all cases.
• Department personnel on scene will secure the scene and treat it as a crime scene.
• IMMEDIATELY NOTIFY - Regional Supervisor and/or Regional Wildlife Manager. Regional Supervisor will notify the Division Director, the Assistant Director of Operations, the Chief of Terrestrial Resources and the Public Information Officer. The Regional Supervisor and/or the Regional Wildlife Manager will institute the Emergency Action Plan for a Lion Attack. Local staff should be notified as soon as possible.

Information and Education Programs:

Education will be an ongoing effort to increase the public's knowledge about mountain lions and to create an awareness of how to reduce the potential of mountain lion-human conflicts. A brochure, titled "Living with Mountain Lions", has been developed and is available from the Department. Education efforts will be intensified when lion sightings increase in an area.

In addition, an informative handout titled "Mountain lion identification and methods of determining sex and age", has been developed for hunters to aid the identification of sex and age on lions.

Research Efforts:

There are no current research projects being conducted in South Dakota.

Utah Mountain Lion Status Report

Report provided by: Leslie McFarlane, Utah Division of Wildlife Resources

History of Legal Classification:

1888 - $5 bounty
1967 – Received protected status
1990 – Limited entry system established
1996 – Predator management plans to address decline in mule deer numbers, increased cougar harvest
1997 – Harvest Objective system implemented
1999 – Cougar Management Plan adopted by Utah Wildlife Board

Current Status & Management:

- Formal Management Plan in Place.
- Current management parameters - <40% females in harvest over three years, 15% - 20% older than five years in the harvest over three years.
  - Three season types:
  - Limited entry – November through May
  - Split – LE November through February, Harvest Objective March through May
  - Harvest Objective – November through November (year round).
  - Pursuit Season – November through May
- Mandatory Check in of all harvested lions required within 48 hours of harvest
  - Tooth collected for ageing
  - Sex of animal
  - Lions treed per day
- Population calculation not required by plan, but we calculate and look at trends as part of our management considerations.
- Lion population numbers/densities are derived by population reconstruction.
- Harvest objectives are derived base on management targets in management plan. Units outside of management plan parameters will either reduce permits (if numbers are below objective), or increase (if numbers are above objective). Additionally status of mule deer populations, big horn sheep populations and depredation concerns are factored in and permits/quotas may be adjusted accordingly.
- We are currently exploring a research project that looks at predator/prey dynamics with mule deer, bear/cougar dynamics and livestock depredation impacts.
- No current Legislation or ballot initiatives, but continued concerns from Governor's office over livestock depredation and active Humane Society (and similar groups) concerns about take.
- Overall our management objectives seem to be working and most units in the State

are within parameters. Statewide population probably growing about 3% annually.

Harvest & Total Mortality:

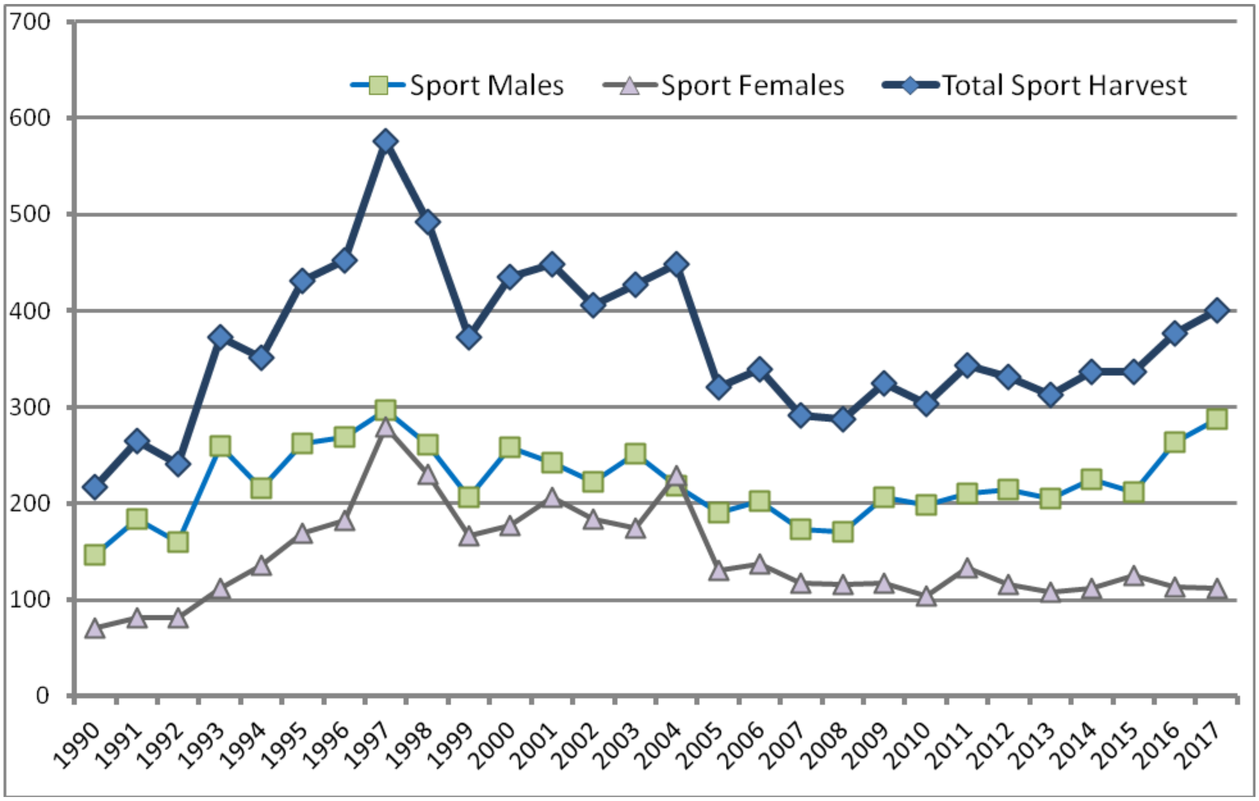


Figure 1: Historical Lion Harvest of Utah

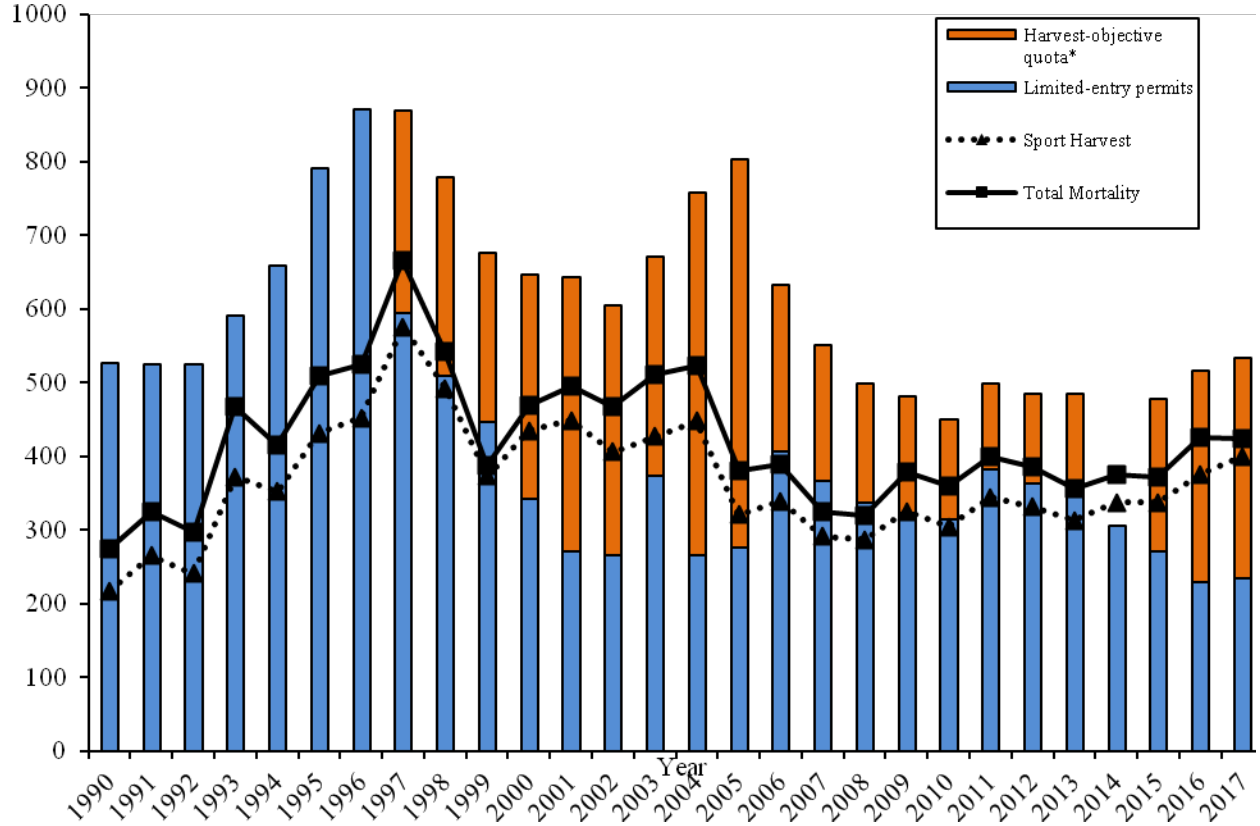


Figure 2: Historical Permits and Total Mortality

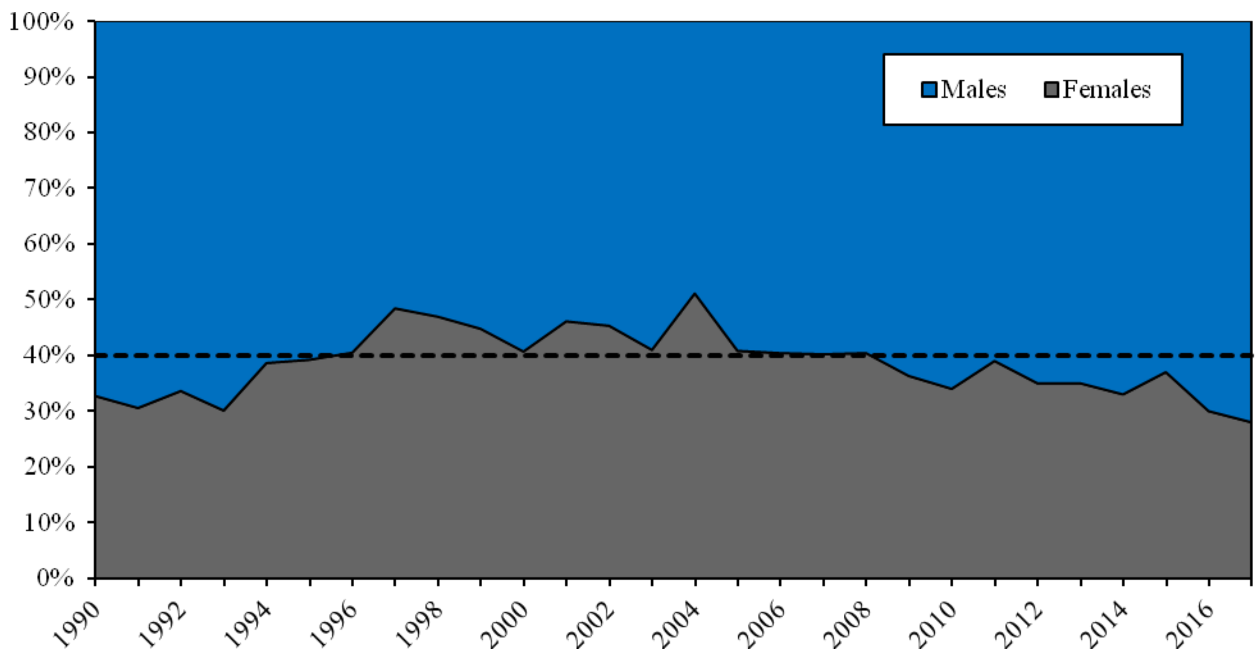


Figure 3: Proportion of Sex in Harvest

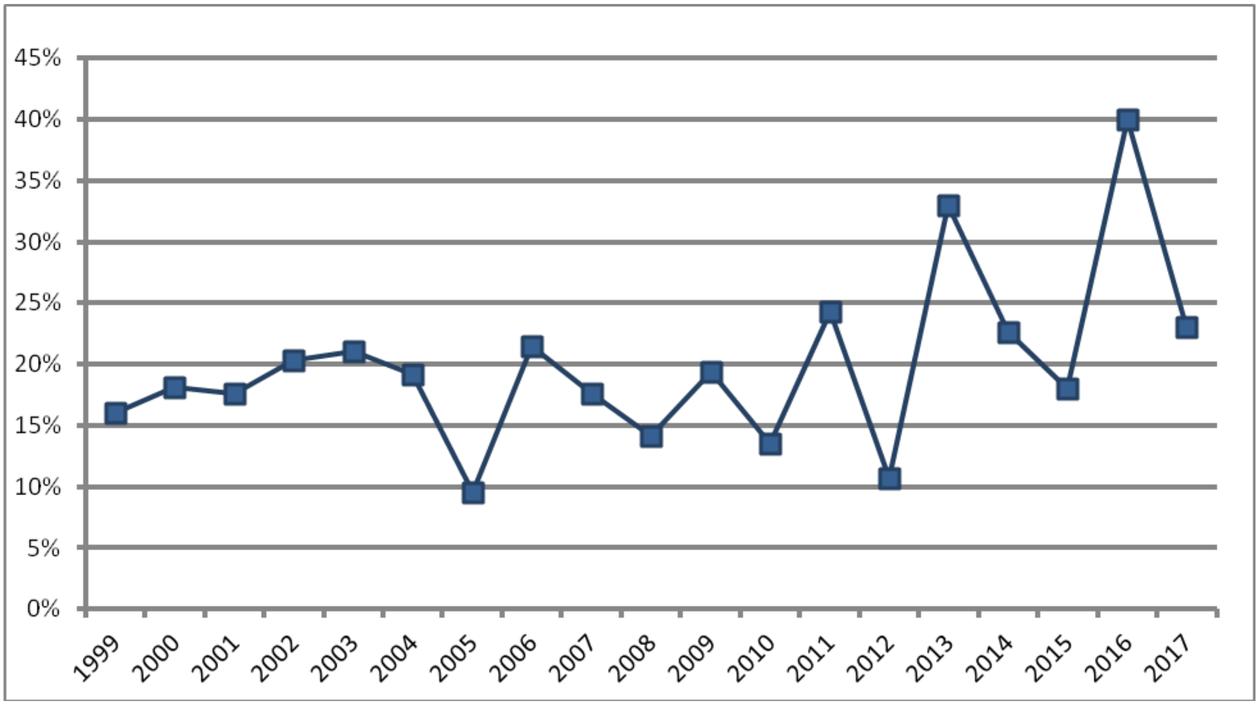


Figure 4: Proportion 5 years and older in the harvest

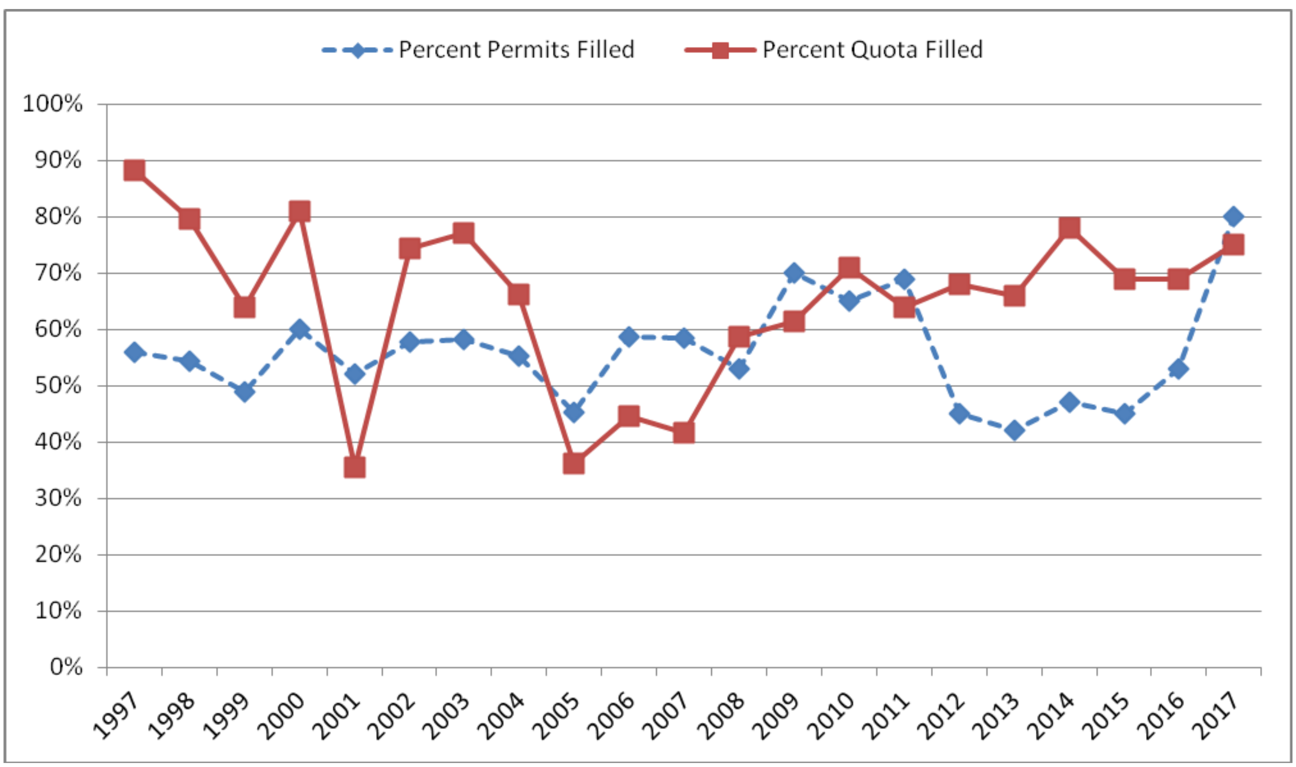


Figure 5: Percent Success for Limited Entry and Harvest Objective Units

Utah cougar harvest summary statewide, 1990 through 2017.

Year	Hunters Afield	Limited Entry Permits*	Harvest Objective Quota**	Average Permits	Sport Males	Sport Females	Total Sport Harvest	Average Sport Harvest	Average Age	Percent Permits Filled	Percent Quota Filled	Percent Females	Percent Adult Females	Percent ≥6 Yrs Old	Percent ≥5 Yrs Old	Cougar Treed per Day	Wildlife Services Harvest	Other Mortality	TOTAL HARVEST + MORTALITY	Average Total Mortality	Non-hunt Males	Non-hunt Females	Total % Females	Adult Survival
1990	478	527		602	146	71	217	366		41%		33%				0.41	48	10	275	420				
1991	480	525		602	184	81	265	366		50%		31%				0.49	38	22	325	420				
1992	485	525		602	160	81	241	366		46%		34%				0.45	34	22	297	420				
1993	598	591		602	260	112	372	366		63%		30%				0.49	53	42	467	420				
1994	575	659		602	216	136	352	366		53%		39%				0.57	53	10	415	420				
1995	656	791		602	262	169	431	366		54%		39%					54	24	509	420				
1996	787	872		602	269	183	452	366	3.5	52%		40%		17%		0.48	33	39	524	420				67%
1997	1376	595	275	602	297	279	576	366	3.8	56%	88%	48%		20%		0.33	40	50	666	420				67%
1998	1370	509	270	602	261	231	492	366	3.2	54%	80%	47%		15%		0.36	27	23	542	420				63%
1999	1201	446	230	602	206	167	373	366	3.1	49%	64%	45%		10%	16%	0.3	13	1	387	420				62%
2000	817	343	304	602	258	177	435	366	2.9	60%	81%	41%		10%	18%	0.28	25	9	469	420				60%
2001	1351	272	371	602	242	207	449	366	3.3	52%	35%	46%		13%	18%	0.3	27	20	496	420				63%
2002	1114	266	339	602	222	184	406	366	3.1	58%	74%	45%		12%	20%	0.21	45	17	468	420	24	29	46%	61%
2003	994	374	297	602	251	175	427	366	3.6	58%	77%	41%		13%	21%	0.29	53	30	510	420	31	49	44%	63%
2004	926	266	492	602	219	229	448	366	3.4	55%	66%	51%		14%	19%	0.23	47	28	523	420	29	38	51%	61%
2005	1265	276	527	602	190	131	321	366	2.5	45%	36%	41%		7%	10%	0.17	38	21	380	420	22	25	41%	54%
2006		406	227	602	202	137	339	366	3.2	59%	45%	40%		9%	22%	0.19	35	15	389	420	17	26	42%	62%
2007		366	185	602	173	117	291	366	2.9	59%	42%	40%		11%	18%	0.22	9	25	325	420	12	16	41%	
2008		337	162	602	171	116	287	366	3	53%	59%	40%		7%	14%	0.27	15	18	320	420	19	13	40%	56%
2009		323	158	602	207	118	325	366	3.3	70%	61%	36%		10%	19%	0.26	22	32	379	420	22	29	39%	61%

2010		314	136	602	199	104	304	366	3.2	65%	71%	34%		7%	13%	0.24	21	35	360	420	22	31	37%	58%
2011		383	116	602	210	134	344	366	3.6	69%	64%	39%	30%	12%	24%	0.25	19	36	399	420	24	27	40%	
2012		364	121	602	215	116	331	366	2.9	45%	68%	35%	23%	6%	11%	0.24	33	21	385	420	22	30	38%	
2013		365	120	602	205	108	313	366	3.9	42%	66%	35%	25%	22%	33%	0.27	12	23	356	420	18	17	36%	
2014		306		602	225	112	337	366	3.4	47%	78%	33%	22%	13%	23%	0.23	18	21	376	420	13	26	37%	
2015		272	207	602	212	125	337	366	3	45%	69%	37%	18%	10%	18%	0.25	11	24	372	420	11	24	40%	
2016		230	287	602	263	113	376	366	4.2	53%	69%	30%	17%	24%	40%	0.29	27	23	426	420	22	24	32%	
2017		234	299	602	288	112	400	366	3.3	80%	75%	28%	14%	10%	23%	0.3	5	19	424	420	10	12	30%	
Total	**14473**	**11737**	**5123**	**16860**	**6213**	**4025**	**10241**										**855**	**660**	**11764**		**318**	**416**		
Average	**905**	**419**	**256**	**602**	**222**	**144**	**366**	**366**	**3.3**	**55%**	**65%**	**39%**	**21%**	**12%**	**20%**	**0.31**	**31**	**24**	**420**		**20**	**26**	**40%**	**61%**

Depredation and Human Safety Conflict Management:

- Depredation verified by Wildlife Services.
- Pay up to $180,000 annually for verified claims. If total cost exceeds budget, prorated payments.
- Control efforts both focused and general on particular units depending on the scale of the problem.

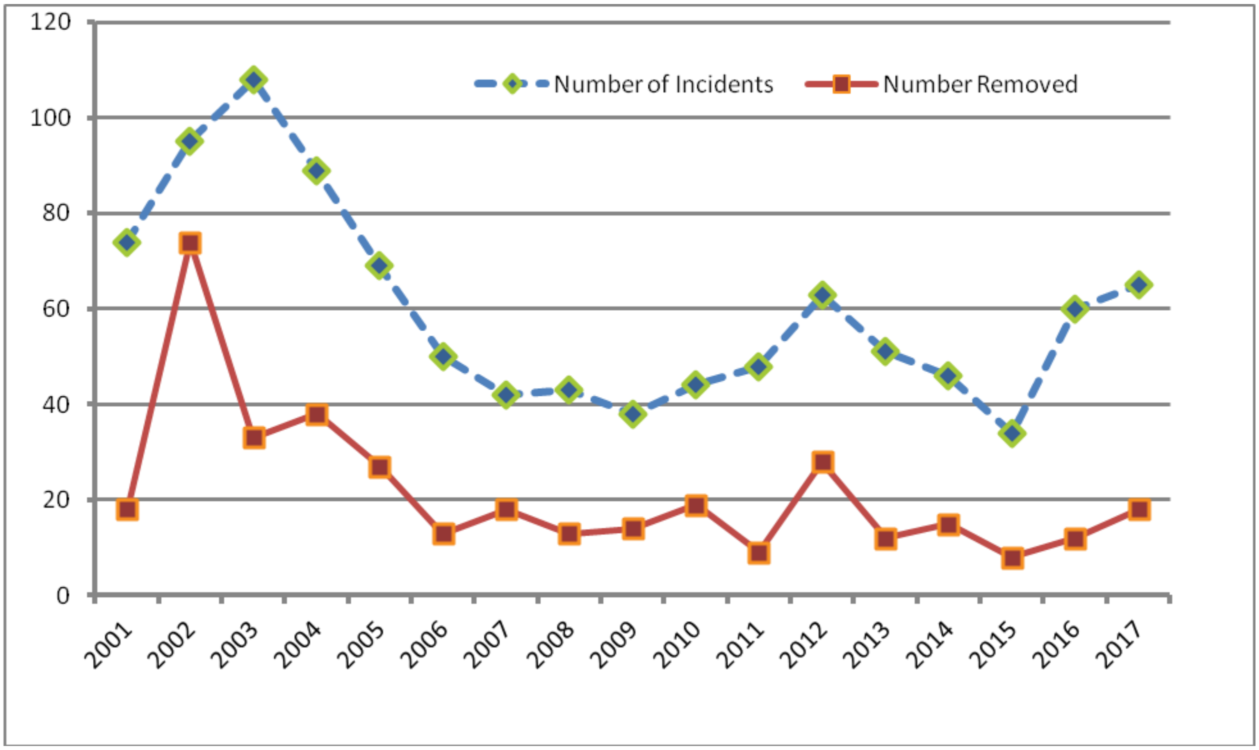


Figure 6: Number of Depredation Incidences and Lions Removed

Table 2. Confirmed livestock losses due to COUGAR depredation in Utah

Fiscal Year	Number of Incidents	Confirmed Losses: Ewes	Lambs	Bucks	Calves	Goat	Other	Total Confirmed Losses	Total Value Losses	Cougar taken by WS
2001	74	136	361	12	3	1		513	$61,395.00	18
2002	95	167	453	18	11	2	1	652	$70,351.34	74
2003	108	204	778	8	4	22	3	1019	$81,067.00	33
2004	89	222	533	7	9	5	0	776	$108,917.25	38
2005	69	99	362	2	1	19	0	483	$64,911.61	27
2006	50	56	228	0	32	26	0	342	$77,415.00	13
2007	42	46	265	0	0	7	0	318	$43,082.50	18
2008	43	79	215	34	3	0	0	331	$56,364.00	13
2009	38	66	117	10	3	2	0	198	$34,509.50	14
2010	44	98	205	0	0	0	0	303	$50,190.00	19
2011	48	64	165	0	21	0	1	251	$65,580.00	9
2012	63	84	219	1	4	0	0	308	$74,077.50	28
2013	51	97	286	0	2	0	0	385	$51,439.00	12
2014	46	111	232	5	2	0	0	350	$68,038.00	15
2015	34	62	178	0	1	0	0	241	$44,749.00	8
2016	60	64	269	7	4	7	14	365	$68,550.00	12
2017	**65**	**112**	**287**	**2**	**2**	**4**	**9**	**416**	**$91,143.00**	**18**
TOTAL	**954**	**1655**	**4866**	**104**	**100**	**91**	**19**	**6835**	**$1,020,636.70**	**351**

- Policy for handling human safety concerns. Classifies lions based on behaviors and suggest responses based on those behaviors. Responses vary from no response, to documentation, to lethal removal
- Probably three incidences of people being attacked in some way by a lion in the last 20 years. Usually lions in town are the most common complaint that we respond to.
- We provide information on safety in lion country at the following sites.
  https://wildlife.utah.gov/learn-more/living-with-cougars.html
  http://www.wildawareutah.org/utah-wildlife-information/cougars/

Working with Utah State University to develop a cougar/deer/black bear related study looking at population calculation, cougar/deer dynamics, cougar/bear dynamics and impacts to livestock producers.
The last human dimensions study was conducted in 1997.

Washington Mountain Lion Status Report

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ABSTRACT

Since 2013, Washington's cougar management program has been founded on cougar behavior and social organization designed to maintain an older cougar age structure and promote population stability (Beausoleil et al. 2013). To achieve these cougar management objectives as outlined in the agency's Game Management Plan (WDFW 2015), the hunt structure is currently administered within 50 management units, each of which is approximately 1,000 km^2 in size. A harvest guideline of 12-16% of the population within each unit allows an equitable distribution of harvest across the jurisdiction. The 12-16% incorporates the margin of error surrounding a documented 14% growth rate (Wielgus et al 2013) but the sliding scale also allows district biologists throughout the jurisdiction to adjust harvest levels accordingly based on total mortality (i.e. non-hunt losses). This cougar management structure allows the agency to address concerns of various constituencies. For hunters, it provides older aged animals on the landscape thus a better quality hunt, it allows harvest to be equitable across the entire jurisdiction, and when closures do occur, it does not impact a large-scale landscape forcing hunters to travel long distances. For non-consumptive users, it recognizes their values by maintaining population stability, social structure, and ecosystem integrity. For managers, it's based in science thus defensible and insures credibility, it's simple for multiple user groups to understand, it's inexpensive to implement, and it satisfies multi-stakeholder interests. Where we continue to face challenges is with undocumented tribal harvest and the risks and effects it may have on objectives, and the lag time associated with the closure process which may result in overages. Since the last Mountain Lion Workshop in Utah in 2014, several more manuscripts have been published from long-term scientific research in Washington including Beausoleil and Warheit (2015), Beausoleil et al. (2016), Warren et al. (2016), and Maletzke et al. (2017).

Beausoleil R. A., J. D. Clark, and B. Maletzke. 2016. A long-term evaluation of biopsy darts and DNA to estimate cougar density: an agency/citizen science collaboration. Wildlife Society Bulletin 40(3): 583–592

Beausoleil, R. A. and K. A. Warheit. 2015. Using DNA to evaluate field identification of cougar sex by agency staff and dog hunters. Wildlife Society Bulletin 39(1) 203- 209.

Maletzke, B. T., B. N. Kertson, M. E. Swanson, G. M. Koehler, R. A. Beausoleil, H. S. Cooley, and R. B. Wielgus. 2017. Cougar response to a gradient of human development. Ecosphere 8(7):e01828

Warren, M, J., D. O. Wallin, R A. Beausoleil, and K. I. Warheit. 2016. Forest cover mediates genetic connectivity of northwestern cougars. Conservation Genetics 17 (5) 1011–1024.

Washington Department of Fish and Wildlife. 2015. 2015-2021 Game Management Plan, Olympia, WA, USA.

Wielgus, R. B., D. E. Morrison, H. S. Cooley, and B. Maletzke. 2014. Effects of male trophy hunting on female carnivore population growth and persistence. Biological Conservation 167 (2013) 69–75

Wyoming Mountain Lion Status Report

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History of Legal Classification:

From territorial days to 1973, mountain lions (*Puma concolor*) received no legal protection in Wyoming. The earliest statutory reference to mountain lions was in 1882 when the Council and House of Representatives of the Territory of Wyoming enacted Chapter 108, Section 1. This legislation authorized county commissioners to encourage the destruction of wolves (*Canis lupus*), wild cats (i.e., bobcats; *Lynx rufus*), lynx (*Lynx canadensis*), bears (*Ursus* spp.), and mountain lions by offering bounty payments. Although property owners, employees, and lessees are still allowed to kill any mountain lion causing damage to private property, bounty payments are no longer authorized. In 1973, the mountain lion was reclassified from a predator to a trophy game animal. Since then, regulations governing the take of mountain lions have become more restrictive with the establishment of shorter seasons and mortality limits.

As in other western states, mountain lion management in Wyoming became increasingly conservative during the mid 1970s, primarily to control the number and sex of lions harvested. Emphasis was placed on controlling the take of females until sufficient information was available to warrant increased harvest. Although population estimates have traditionally been lacking, evidence based on professional experience and opinion (i.e., local wildlife biologists, game wardens), increasing mountain lion harvest levels, hunter observations, sightings, and nonharvest-human caused mortalities indicated mountain lion populations increased in Wyoming. In response to perceived increases in mountain lion numbers, harvest limits were increased annually during the mid to late 1990s. Approaches to how we manage mountain lion populations have changed gradually since 1974 when regulated hunting was first established in Wyoming, including establishment of fall-winter hunting seasons, developing management units and hunt areas to address local management issues, requiring mandatory inspection of harvested mountain lions for annual data collection, and developing and adapting mortality limits to address hunt area management objectives. Traditionally, mountain lion harvest quotas were set based on perceived densities and the history of or potential for human conflicts (e.g., mountain lion-human interactions, depredation incidents, potential impacts to big game species) and adjusted based on mountain population trends relative to annual harvest data, and how quickly limits were filled each year loosely reflecting hunter effort. Although mountain lion populations in Wyoming increased under this management scheme, this general approach to mountain lion management provided managers with limited ability to determine whether or not management objectives were achieved. The Draft Wyoming Mountain Lion Management Plan (1997) identified the lack of data necessary to identify whether or not management objectives have been met and supported research investigating potential methods to adequately monitor mountain lion population responses to varying management prescriptions. Subsequently, mountain lion research was conducted from 1997-2003 to investigate potential approaches for evaluating mountain lion management.

Mountain lion hunting in Wyoming is accomplished using various hunting methods including opportunistic harvest (spot and stalk) during big game (e.g., elk and deer) seasons, calling mountain lions using predator calls, and tracking and baying mountain lions using trained hunting dogs (i.e., hunting with hounds). The majority of mountain lions harvested annually in Wyoming are taken by hunting with hounds (typically >90%).

Current Status & Management:

In 2007, Wyoming began managing mountain lion populations under an adaptive management plan, with harvest limits set to achieve stable, source, or sink population objectives (CMWG 2005) within five mountain lion management units (MLMUs) across the state. The objectives and classifications could be viewed as a continuum between “Sink/Reduction” through “Source/Increase”. Primary monitoring criteria were established via empirically tested research (Anderson and Lindzey 2005), which provided insight to general trends in mountain lion populations under various conditions and hunting pressures. Telemetry data were collected from a sample of various cohorts of mountain lions throughout test and reference areas within the state, and population estimates were established through mark-recapture techniques. Location data from these samples were also used in a resource selection function analysis to estimate and map suitable mountain lion habitat. Hunting pressure was applied to test areas to increase mountain lion mortality and to estimate a mortality density that resulted in decreasing population estimates. When hunting pressure was restricted, mortality densities were again estimated to determine the level at which population estimates rebounded. Age and sex composition of mortality data were also gathered throughout this process. Generally, as relative mortality increased (number of mortalities/unit area of suitable habitat), a higher proportion of adult females were harvested, and the average age of those females decreased. The opposite was true of these trends as relative mountain lion mortality decreased across the landscape.

These findings were used as a framework for the adaptive state management plan (WGFD 2006), where primary monitoring criteria can be derived through mountain lion mortality data including: (a) human-caused mountain lion mortality density/1,000km^2 suitable winter habitat, (b) proportion of adult females harvested, (c) mean age of adult females harvested (female age status is determined by lactation). These criteria are assessed at the hunt area level to determine a status of source, stable, or sink trends or variations thereof.

Primary hunt area management objective criteria include:

1. Sink management: reduce mountain lion densities

    a) Maintain density of human-caused mortality >8 mountain lions/1,000 km^2 (386 mi^2).
    b) Achieve adult female harvest >25% of total harvest for 2 seasons.
    c) Progression in mean age of harvested adult females should decline to <5 years old.

2. Source management: maintain human-caused mortality levels that allow mountain lion population growth or maintain relatively high mountain lion densities that provide a source to other populations.

    a) Maintain density of human-caused mortality <5 mountain lions/1,000 km^2 (386 mi^2)
    b) Maintain adult female harvest <20% of total harvest.
    c) Maintain older-age adult females in the population (>5 years old).

3. Stable management: maximize long-term hunting opportunity and population viability.

    a) Maintain human-caused mortality density between 5-8 mountain lions/1,000 km^2 (386 mi^2)
    b) Adult female harvest should not exceed 25% of total harvest for more than 1 season.
    c) Maintain intermediate aged adult females (mean ≅ 4-6 years old) in the harvest.

In addition to the hunt area criteria, other factors (e.g., total age/sex composition trends, hunter effort, and hunter selectivity) are also evaluated when assessing hunt area and/or MLMU population trends. Overall, Wyoming utilizes these monitoring criteria to estimate local population trends, but does not use specific population numbers or calculate annual density estimates to manage mountain lions.

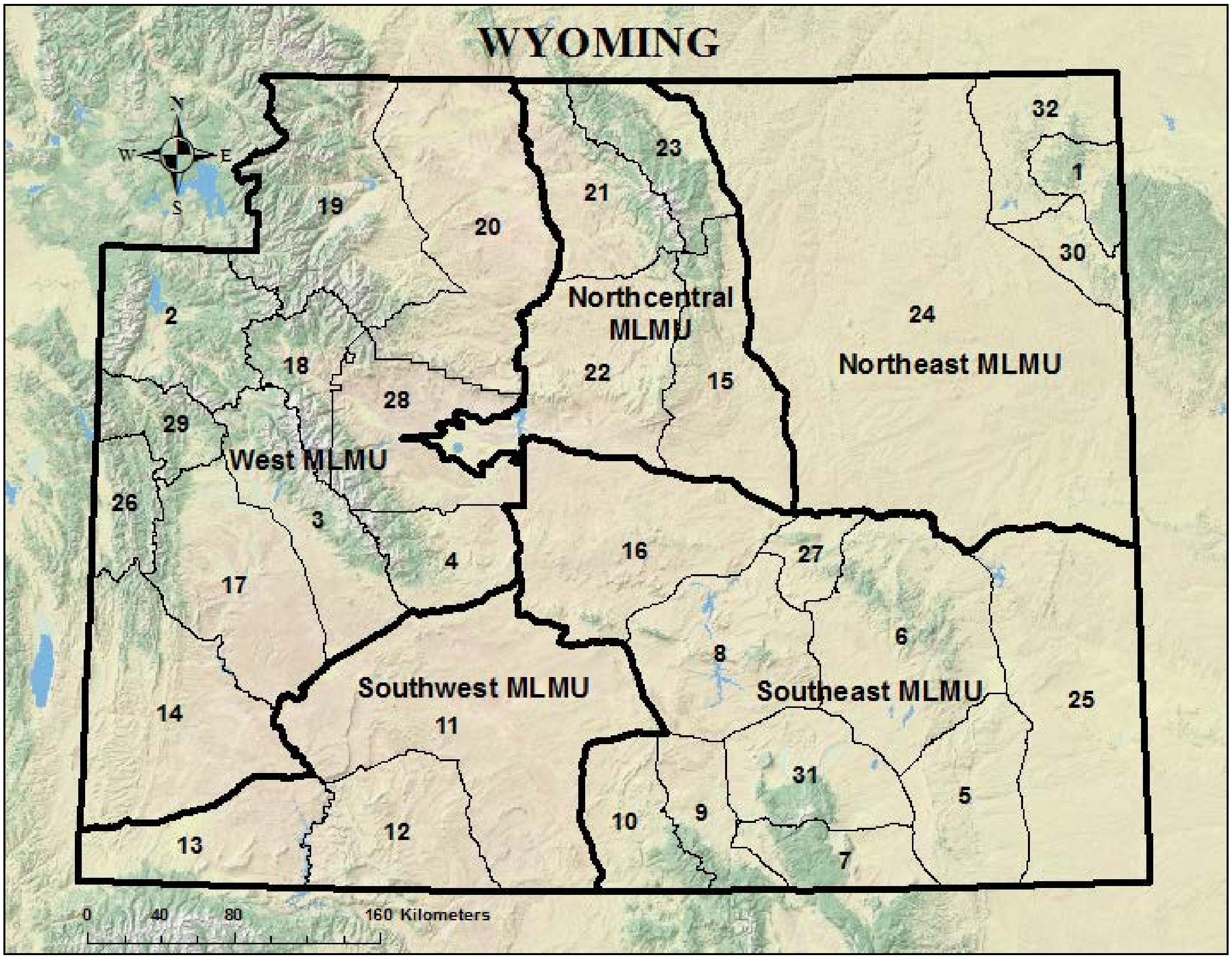

Figure 1: Mountain lion Hunt Area and Management Unit boundaries for Wyoming, USA in 2016.

Figure 1 shows current mountain lion hunt areas and MLMUs across Wyoming. Additionally, the west MLMU is partitioned into Data Analysis Units (DAUs) due to the expanse of contiguous suitable habitat identified throughout the western portion of the state. These DAUs include Absaroka (hunt areas 19 and 20), Wind River (hunt areas 3, 4, 18, and 28) and Wyoming Range (hunt areas 2, 14, 17, 26, and 29).

Mountain lion management in Wyoming uses the described criteria to assess trends on a 3-year management cycle, where alterations to objectives, harvest limits, seasons, and boundaries are minimized during a management cycle to provide necessary data to delineate trend and avoid reactionary management decisions based on variation within any given harvest year. The 3-year management cycle also bolsters the evaluation and classification of sink, stable, or source for hunt areas given previous direction in trends. Managing for a combination of source, stable, and sink mountain lion subpopulations within MLMUs (i.e., at the hunt area level) provides flexibility to address local management concerns (e.g. livestock depredation, proximity to residential areas) while maintaining overall population viability on a landscape level as well as long-term harvest and recreational opportunities (WGFD 2006). The goal of mountain lion management in Wyoming is to sustain mountain lion populations throughout core habitat at varying densities depending on management objectives to provide for recreational/hunting opportunity, maintain ungulate populations at established objectives or in line with current habitat conditions, and minimize mountain lion depredation to pets and livestock and reduce the potential for human injury.

Data analyses and reporting are typically conducted under a biological or harvest year framework (1 Sept. – 31 Aug.). Harvest year [HY] 2015 marked the end of the third 3-year cycle under the current management plan, which provided complete harvest data in Wyoming necessary to assess the effectiveness of the mountain lion management strategy across three complete management cycles.

Harvest & Total Mortality:

With the increases in mountain lion density and distribution across Wyoming, mortality limits were likely commensurate with population changes, showing a general increase in the number of animals harvested (Figure 2). The decade after the implementation of the current WGFD management plan (2007), harvest levels again increased in an effort to reduce mountain lion densities in specific areas of the state. Much of the recent increases in harvest were in response to the reestablishment of mountain lion populations in the Black Hills region in northeast Wyoming, where by the late 2000's some of the highest mountain lion densities reported to date (Jenks 2011) came from this shared ecosystem between Wyoming and South Dakota.

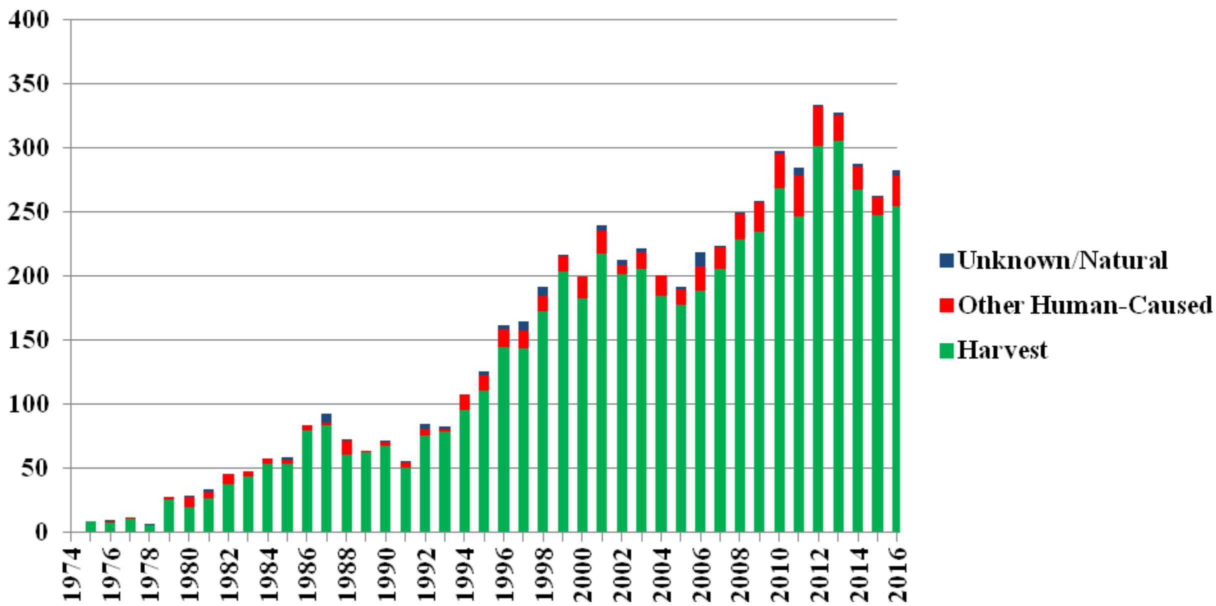

Figure 2. Documented mountain lion mortality for Wyoming, USA.

Therefore, mortality limits were increased in an effort to reduce mountain lion densities in this region, and harvest within the NE MLMU comprised approximately 20% of overall statewide harvest. Therefore, the last management cycle (HY2013 – HY2015) has shown local reduction efforts to be effective, likely stabilizing statewide populations following targeted reductions. Statewide age/sex composition of harvest matches this trend showing a general increase in the number of sub-adult mountain lions in the harvest (Figure 3), and overall harvest numbers have fallen after a peak harvest reported in 2013.

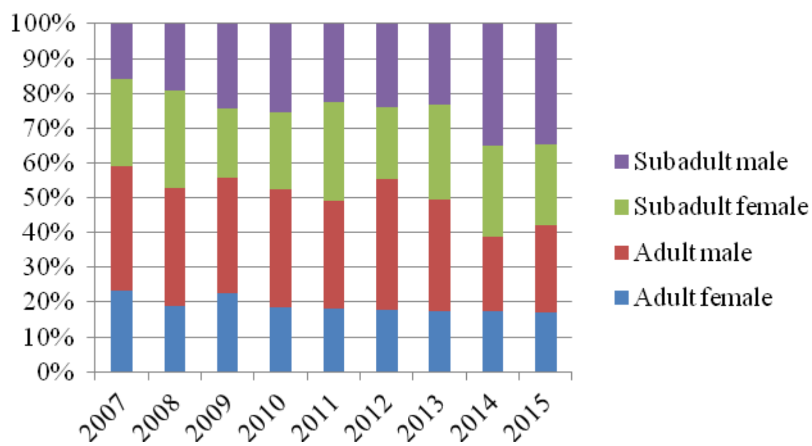

Figure 3. Statewide age and sex composition of mountain lions harvested in Wyoming, HYs 2007-2015.

License sales and harvest generally matched trends during increased harvest through the peak harvest in 2013, but during the last management cycle as harvest began to decline license sales proportionally exceed mountain lion harvest rates (Figure 4), resulting in a reduction in hunter success as a measure of licenses purchased/annual harvest (Figure 5). Although not all licensees actively engage in specifically targeting mountain lions, this measure of success has slightly declined to around 10% success in HY 2015.

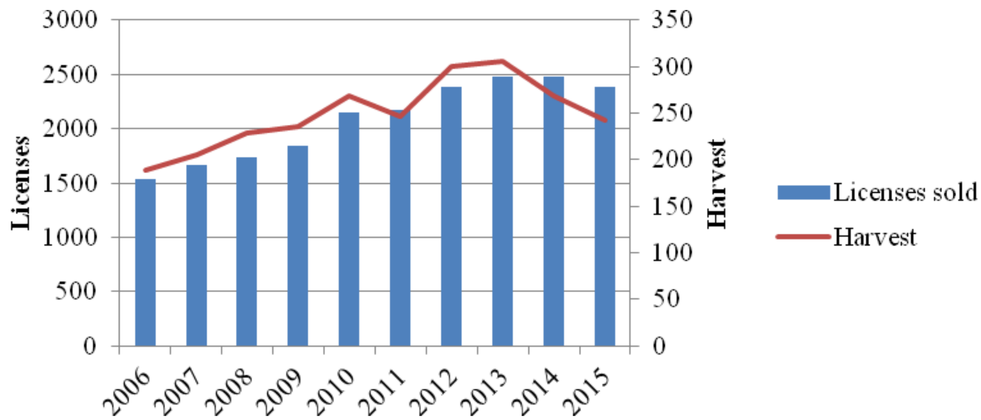

Figure 4: Mountain lion license sales and annual harvest in Wyoming, 2006-2015.

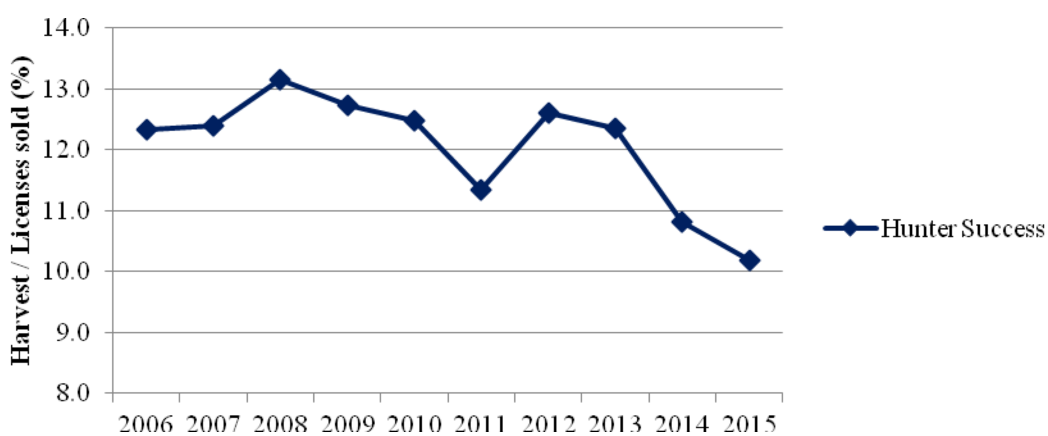

Figure 5: Mountain lion hunter success in Wyoming, 2006-2015.

Overall statewide assessments for the last management cycle (HY 2013-2015) indicate a stabilized population occurring after local population reductions, while maintaining stable and source function in other hunt areas across the state (Figure 6).

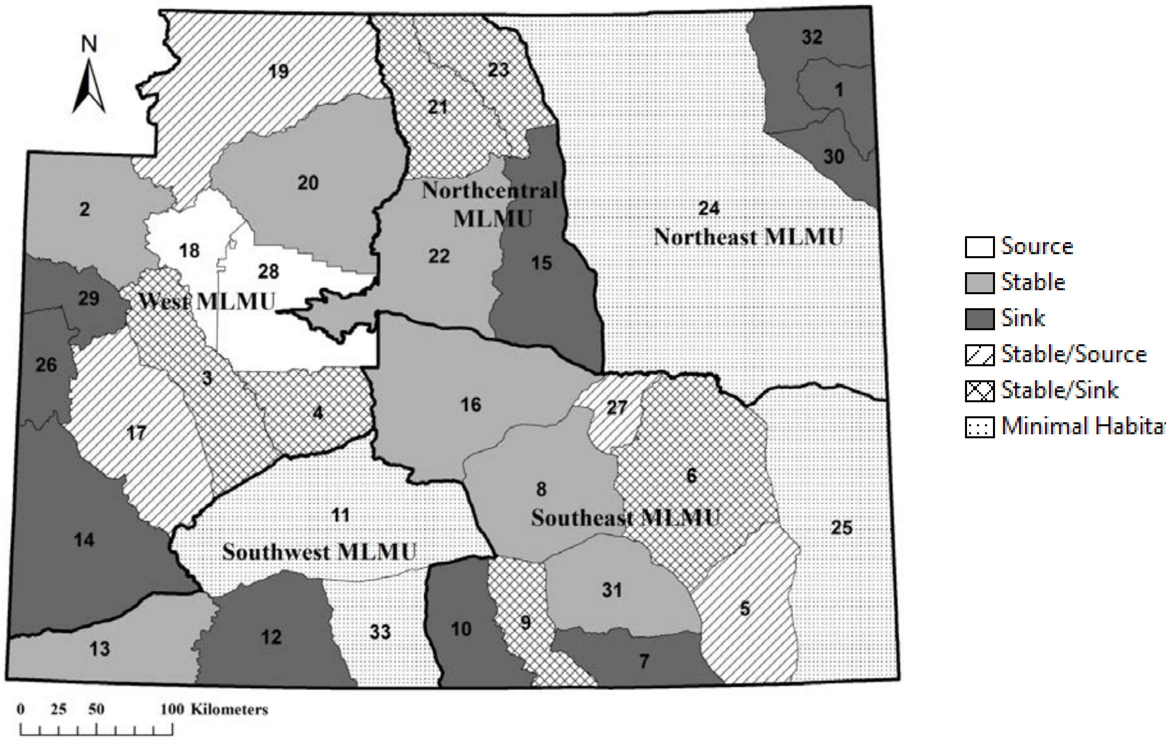

Figure 6: Map of estimated population function for mountain lion hunt areas in Wyoming during the third management cycle (HYs 2013-2015).

Depredation and Human Safety Conflict Management:

Documented mountain lion conflicts in Wyoming have declined since 2010, with a 10-yr average of approximately 40 reported conflicts annually. Conflicts include depredation-related events toward domestic livestock and pets, which make up the largest portion of mountain lion conflicts annually (average ~ 62%, 2007-2016). Mountain lion encounters at private residences or within city limits are also quantified, however circumstantial sightings in and around residences or by people recreating are not considered conflicts. Nevertheless, conflicts do occasionally include mountain lions exhibiting aggressive behavior toward humans (Figure 7).

Mountain lion depredations in Wyoming are dominated by predation on domestic sheep, comprising over 78% of all depredation events. However, this proportion underestimates sheep depredation due to the common occurrence of multiple stock animals lost during a single reported event. Pet depredation comprises around 12% of losses, while the remaining 10% corresponds to other domestic livestock, mostly poultry and hobby stock. The WGFD offers reimbursements for depredation by all animals classified as trophy game in Wyoming.

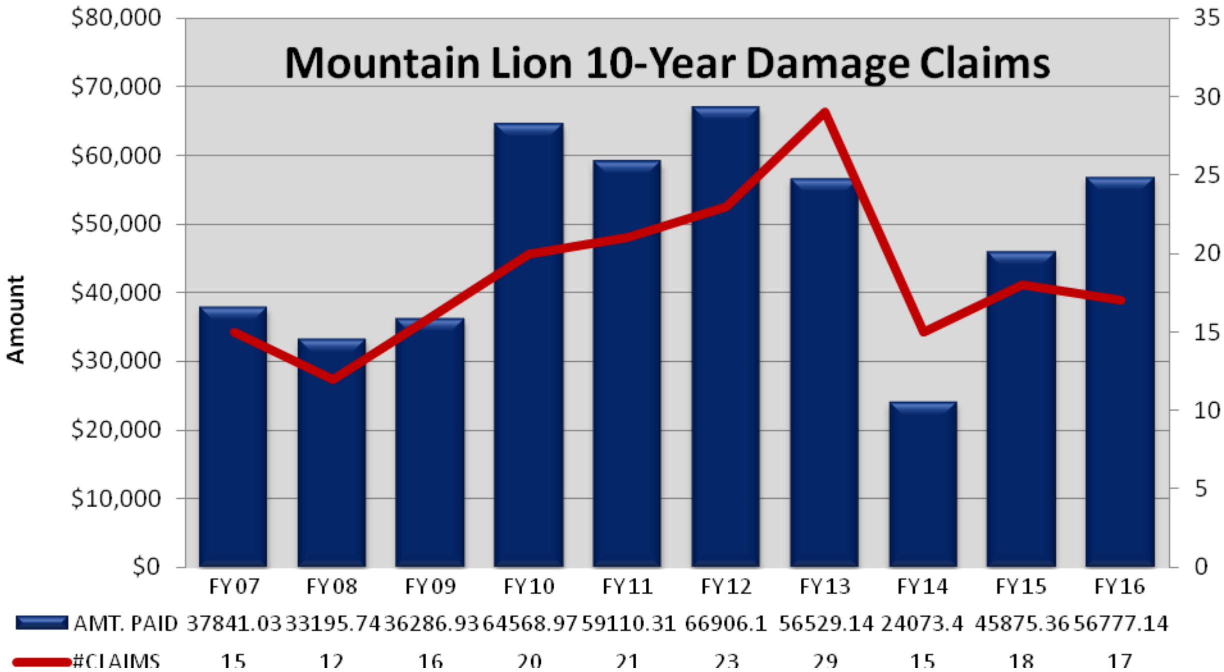

Figure 7: Documented mountain lion conflicts in Wyoming, 2007-2016.

Because domestic sheep are the primary source of mountain lion depredation in Wyoming, estimated costs correspond to not only the number of reported depredation events, but with the actual number and value of livestock killed. Therefore, the cost of losses primarily fluctuates around total sheep losses due to mountain lions, and has averaged around $48,000 annually (Figure 8).

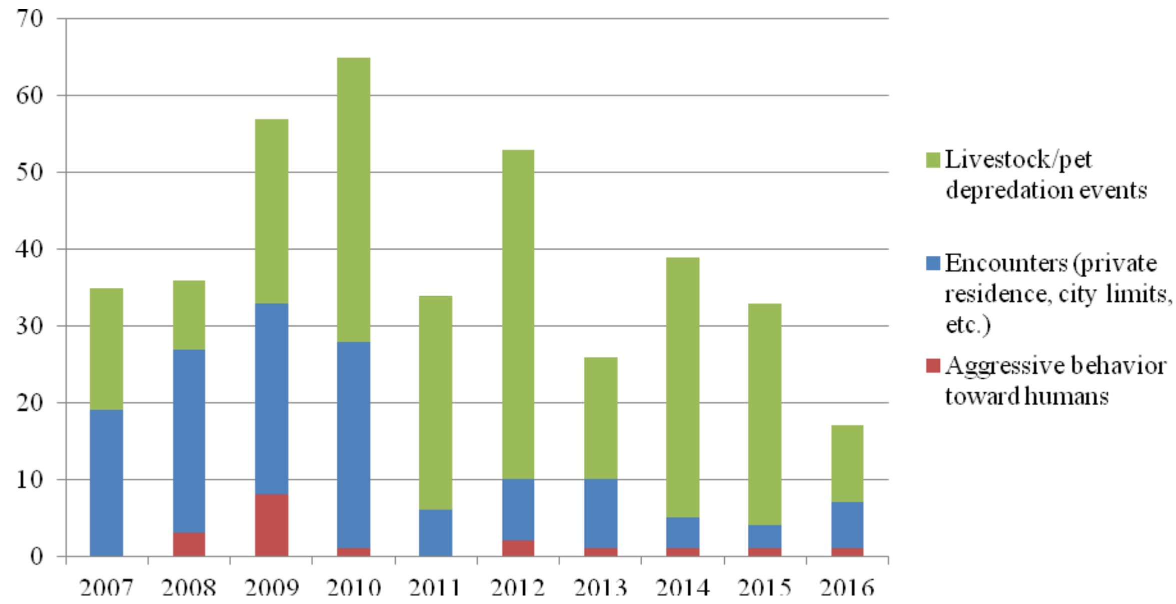

Figure 8. Financial cost for mountain lion conflicts in Wyoming, 2007-2016.

The current WGFD mountain lion management plan includes objectives to use hunter harvest to minimize mountain lion conflicts while maintaining sustainable populations in applicable situations. Certain areas with high likelihood for conflict generally have higher mortality limits, with instances where targeted harvest can be successfully used to reduce situation specific conflicts. The primary and most effective action employed by the Department, specifically in regard to livestock depredation and human safety issues, is the targeted removal of offending individuals by agency personnel. In addition, WGFD conducts captures and relocate mountain lions on situation specific basis, generally when a conflict is not associated with depredation or the animal does not appear to be an immediate threat to public safety (Figure 9).

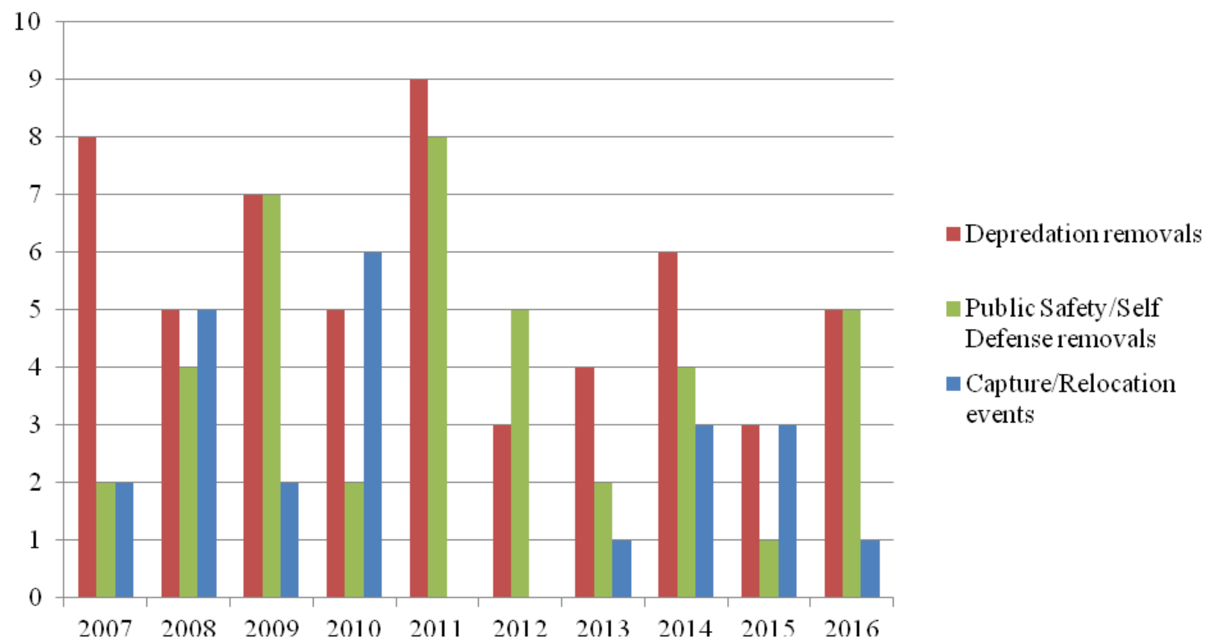

Figure 9. Mountain lion removals and relocations in Wyoming, 2007-2016.

The WGFD conducts annual large carnivore safety workshops throughout every region of the state on an annual basis. These workshops promote public education and awareness for residents and visitors about large carnivores including their overall ecology, proactive efforts the public can take to minimize conflict risk around homes or in the field, and how to react in the event of an encounter with a carnivore. Active training in the proper use of bear spray is also conducted at these workshops. The Department also provides several news releases as reminders for recreationists in the state to be aware of large carnivores on the landscape, provides brochures and handouts, and makes available additional information on the WGFD website that includes information for educating hunters on determining sex of mountain lions in the field. Much of the information provided to the public emphasizes securing food attractants, not artificially feeding/concentrating prey species, and promoting outdoor lighting and landscaping with reduced cover that may encourage mountain lion activity near domiciles.

Research Efforts:

While the aforementioned monitoring criteria are primarily used to estimate mountain lion population trends and inform management strategies, the Wyoming Game and Fish Department continues to conduct additional monitoring of all trophy game animals across Wyoming. Mountain lion monitoring occurs on a rotational basis across

WGFD regions, primarily where questions arise as to the effectiveness of management strategies or to gain information to address ecological processes with regard to mountain lions. Current efforts include 1) monitoring distribution of marked mountain lions to improve seasonal habitat models, determine home range size and dispersal rates in non-mountainous habitats, and monitoring post-relocation movements and fidelity, 2) evaluating mountain lion demographics as part of a larger ongoing multi-ungulate interaction research project with the University of Wyoming, and 3) testing various aerial detection methodologies for future use in monitoring population level abundance to inform management.

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SESSION 3: MOUNTAIN LION GENETICS & GENOMICS

Moderator: Holly Ernest, University of Wyoming

Interactions between demography, genetics, and landscape connectivity increase extinction probability for a small mountain lion population in a major metropolitan area

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ABSTRACT
The extinction vortex is a theoretical model describing the process by which extinction risk is elevated in small, isolated populations due to interactions between environmental, demographic, and genetic factors. However, empirical demonstrations of these interactions have been elusive. We modeled dynamics of a small mountain lion population isolated by anthropogenic barriers in greater Los Angeles, California using 13 years of field and genetic data to evaluate the influence of demographic, genetic, and landscape factors on extinction probability. Our model was an individual-based population viability model in which we assigned empirical, multi-locus genotypes to all mountain lions in the starting population. We projected the model forward and assigned genotypes to offspring simulated in the model using principles of

Mendelian genetics. The population exhibited strong survival and reproduction, and the model predicted stable median population growth and a 15% probability of extinction over 50 years in the absence of inbreeding. However, our model also predicted the population will lose 40-57% of its heterozygosity in 50 years. When we reduced demographic parameters proportional to reductions documented in another wild population of mountain lions that experienced inbreeding depression (Florida panthers), extinction probability rose to 99.7%. Simulating greater landscape connectivity by increasing immigration to ≥1 migrant per generation appears sufficient to largely maintain genetic diversity and reduce extinction probability. We provide empirical support for the central tenet of the extinction vortex as interactions between genetics and demography greatly increased extinction probability relative to the risk from demographic and environmental stochasticity alone. Our modeling approach realistically integrates demographic and genetic data to provide a comprehensive assessment of factors threatening small, isolated wildlife populations.

Genomic assessment of mountain lions within an urbanized landscape

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ABSTRACT

Mountain lions, *Puma concolor,* in southern California are living in an increasingly fragmented habitat due to intensifying urbanization. These populations have low survival rates and humans are responsible for the majority of lion fatalities, with vehicle strikes being the single largest source of mortality. Tracking of collared lions as well as microsatellite DNA analysis reveals that lions rarely cross major highways and at least one population has a high probability to go extinct due to continued loss of genetic diversity. Genomic techniques provide an increase by orders of magnitude in the number of genetic markers (tens of thousands or more as opposed to less than 100 for microsatellites). This higher genetic resolution can refine identification of barriers to gene flow and further assess genetic diversity, allowing state and local managers to identify at risk populations and target key connectivity corridors. In addition, the genomic approach is permitting us to identify loci likely under selection

and this will assist in managers attempting to restore functional genetic diversity to genetically degraded populations. Here, we used double digest restriction site associated DNA (ddRAD) to assess genetic structure and diversity of southern California mountain lions. We recovered over 15,000 SNPs which revealed that genetic structure reflects roads as well as major urban development and that gene flow is restricted in several populations. As a result, genetic diversity is troublingly low in two populations within California coastal mountain ranges, which raises concerns of inbreeding depression and the long term viability of these population. This work shows the utility of ddRAD in determining impediments to gene flow of large carnivores and allowed for direct comparison with microsatellite analyses, providing state and local agencies with information on the cost/benefits of genomic data to informing mountain lion management strategies.

Statewide genetic analyses identify mountain lion populations and barriers to gene flow in California and Nevada

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ABSTRACT

Populations are the main level at which demographic and evolutionary processes occur. Thus, to conserve and manage species, it is of fundamental importance to understand population structure and how geographic and anthropogenic landscape

components dictate that structure. We used statewide genetic data from mountain lions (*Puma concolor*) sampled across California and Nevada to identify and characterize populations. Given that mountain lion habitat in the state of California is highly structured among several mountain ranges and possibly fragmented by a dense human population, we also assessed landscape barriers to gene flow. From 992 individuals genotyped at 42 microsatellite loci, we detected 10 mountain lion populations. Some populations are small and inbred whereas some are large and genetically-diverse. The primary factors acting as barriers to gene flow were roads, specifically interstate highways, and geographic distance. Our results identify populations of conservation priority and critical areas for population connectivity. Although our results have large-scale conservation implications for mountain lions, it is also considered an umbrella species. Thus, the strong effect of interstate highways on mountain lion population genetic structure may indicate a large-scale ecological problem for other wildlife species and communities in one of North America's most biodiverse and rapidly-urbanizing regions.

Quality control measures reveal substantial effects of genotyping errors on DNA-based mark-recapture results

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ABSTRACT
Carnivore management depends on robust population monitoring programs to provide reliable metrics for success. Wildlife managers have increasingly been turning to DNA-based mark-recapture methods to estimate population parameters of interest as methods have been developed for the collection of DNA samples (e.g., scat, hair, tissue) and the analysis of mark-recapture data. Despite the rapidly growing popularity of these approaches, few studies have examined the reliability of individual identifications from DNA collected in the field. We used a series of quality control measures to assess the prevalence of genotyping errors in two multi-year mark-recapture datasets, cougars (*Puma concolor*) and wolverines (*Gulo gulo*), generated from microsatellite analysis of DNA samples. We compared spatial and temporal information from sample collection with genotypes to identify likely genotyping errors (i.e. dropout, false alleles) that were confirmed through re-

analysis. Quality control revealed errors led to large proportions of mis-identified individuals for both species. Our total two-year minimum count of cougars decreased from 36 to 20 (44%) and our total three-year minimum count for wolverines decreased from 64 to 49 (23%). Genetic datasets that exhibit the following pattern, similar to ours, should be given extra scrutiny: 1) unexpectedly high number of individuals detected, 2) unexpectedly low recapture rates, and 3) many individuals detected only once during sampling. To minimize future problems such as these, we recommend researchers take more accountability of genetic data by performing quality control measures with field data and then working closely with laboratories to ensure data integrity. We additionally recommend that it become standard practice to include microsatellite genotypes in all publications using DNA-based mark-recapture results; studies that omit these data cannot be evaluated objectively. Our results demonstrate that genotyping errors continue to undermine the reliability of mark-recapture data, leading to overestimates of abundance; however, quality control can help to alleviate these problems.

Landscape genomics of mountain lions on the rural Western Slope and urban Front Range of Colorado

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ABSTRACT

Accurate population sizes and movement estimates for mountain lions, critical for informed management, are difficult to achieve given their reclusive nature. Thus, estimates of genetic connectivity (gene flow), genetic diversity, and effective population sizes are useful compliments to labor-intensive, field-based studies. The advent of next-generation sequencing (NGS) now allows for cost-effective generation of tens of thousands of genetic markers spread throughout the genome, providing high power for accurate estimates of connectivity and genetic diversity. Landscape genomics is an emerging field that investigates how demographic and habitat factors interact to shape neutral and adaptive genomic variation, taking advantage of recent advances in NGS and Geographic Information Systems (GIS) technologies. We genotyped mountain lions from the rural Western Slope and rapidly-urbanizing Front Range of Colorado at approximately 28,000 single nucleotide polymorphism (SNP) loci.

We then used landscape genomic techniques to determine how connectivity and genetic diversity vary in response to environmental factors related to human development and habitat quality. Preliminary results suggest Front Range mountain lions may have smaller effective population sizes and more restricted movement relative to the Western Slope, as expected in a more fragmented, urbanized landscape. On the Western Slope, mountain lion connectivity is strongly associated with forested habitats containing high tree canopy cover, particularly along steep slopes and canyons; whereas connectivity was not significantly associated with low temperatures, low precipitation, roads, streams, or overall vegetation density. Moreover, preliminary results revealed approximately 450 SNP loci that may be associated with genes under selection based on F_{ST} outlier tests and genotype-environment association analyses. Ongoing work includes an assessment of Colorado mountain lion source-sink dynamics from hunter-collected tooth samples across the state, disease dynamics of Colorado mountain lions, and genomic effects of an experimental hunting study conducted on the Western Slope, with collaborators from Colorado Parks and Wildlife and other universities.

Panel Discussion: Stakeholder Perspectives

Moderator: Loren Chase, Arizona Game & Fish

Panelists: Bill Canterbury (Cougar hunter & houndsman, Colorado), Patt Dorsey (State Wildlife Agency, Colorado Parks & Wildlife), Patrick Knackendoffel (Ungulate hunter, Colorado), Penelope Maldonado (The Cougar Fund), Delia Malone (Sierra Club), Steve Wooten (Rancher, Colorado)

NOTE: *This well-conducted and informative discussion was not recorded.*

SESSION 4: POSTERS, VENDORS, SOCIAL

Organizer: Stephanie Durno, Colorado Parks & Wildlife

Attitudes and perceptions of mountain lions (*Puma concolor)* across 5 Bay Area communities

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ABSTRACT

Inadequate public awareness and misinformation are often among the greatest hurdles to large carnivore conservation. These phenomena can lead to irrational fear, and cultivate conditions for increased conflicts, resulting in negative responses to sightings or encounters. Moreover, the lack of knowledge and support for large carnivores undermines community capacity to support much needed conservation methods, such as the protection of critical habitat and the identification and protection of critical movement corridors and road crossings. It is for this reason that we developed a survey to assess the state of public awareness and attitudes across the Bay Area, which we distributed to residents of 5 distinct communities ranging from suburban to rural. Survey results reflect several gaps in knowledge where wildlife conservation organizations, and land/game management agencies are best served to direct their community outreach and education efforts. Community tolerance for large carnivores can be dramatically improved using data from the completed surveys to target outreach and education, thereby reducing conflicts, and promoting conservation of this reclusive, keystone species.

Facial recognition in cougars: Initial tests of novel field and analysis methods

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ABSTRACT
Several studies have estimated cougar (*Puma concolor*) abundance using camera trapping in conjunction with capture-mark-recapture (CMR) analyses. However, photo-based CMR requires that animals are individually recognisable. For many felids, this is achieved using naturally occurring marks (e.g., stripes or spots) that are unique to the individual. Cougars, however, are uniformly pelaged, and conventional photo-based CMR may not be appropriate due to uncertainty in identification. One possible solution is to identify cougars by facial features instead of pelage markings. We are exploring this possibility through three novel systems: 1) a camera trap design that uses motion triggered sound and light to prompt cougars to face towards a camera trap, thereby generating facial images, 2) a haar-cascade classifier trained to detect cougar faces in images, and 3) the use of facial identification metrics, such as eigenface or local binary pattern analysis, to differentiate individual cougars based on facial features. Initial field tests indicate that cougars will respond positively to this camera design, with facial images being generated from 77% of cougar visits (n = 13) in northwest Wyoming. Our haar-casacade classifer was successful in identifying 70% of cougar faces in a test set of naïve images (n=30), with one false positive. This may allow for the automation of the tedious process of cataloguing and cropping camera trap images, which can then be used in various facial recognition analyses.

Estimating cougar (*Puma concolor*) population density and abundance using noninvasive genetic sampling and spatial capture recapture models

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ABSTRACT
Yellowstone National Park (YNP) has a rich history of wildlife research and provides a unique natural laboratory for predator-prey studies. Two prior studies have documented the cougar's (*Puma concolor*) ecological niche and the immediate impacts of wolf (*Canis lupus*) recovery in northern YNP. This third phase of cougar research seeks to understand how the cougar population persists on this landscape under changing carnivore and ungulate dynamics. Ongoing projects have focused on determining predator-prey dynamics and the factors affecting the northern range elk (*Cervus elephus*). It is critical to estimate density and abundance for all extant predators in order to disentangle the cumulative effects of predation on prey population dynamics. Monitoring large carnivores can be difficult due to low densities, their secretive nature, and intensive methods involving radio-marked animals. Noninvasive genetic sampling methods, coupled with new models for analyzing DNA-based spatial capture-recapture data hold much promise for estimating demographic and genetic parameters for elusive species like the cougar. During the winters of 2014 and 2015, we searched over 3,300km of cougar habitat for tracks and collected 377 genetic samples, including hair, scat, and blood. Our cougar track encounter rate on surveys was 0.54 and 0.59 in 2014 and 2015, respectively. In addition, we collected at least one DNA sample on half of the 238 track surveys. Through laboratory analyses,

100 samples yielded sufficient DNA that identified 13 female and 7 male cougars on YNP's Northern Range. Preliminary results show similar cougar density and abundance values compared to those obtained ten years ago during a previous phase of cougar research in YNP. Our findings provide valuable insight to the benefits of noninvasive genetic sampling methods for studying wide-ranging large carnivores.

Carrion on the landscape: mountain lions support biodiversity through predation

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ABSTRACT
Carnivore ecology is a broad field, inclusive of novel hypotheses and new research aimed at describing the ecological niche of large carnivores and their keystone roles in natural environments. While numerous gaps have been addressed in this field, many remain open to speculation. Here, we present research on an iconic species that, through predation, provides significant amounts of carrion to diverse scavengers in natural systems.

We conducted weekly sampling of invertebrate scavengers at 24 carcasses of ungulate prey killed by mountain lions in the Greater Yellowstone Ecosystem for on average 9.45 +/- 7.08 weeks (mean and SD) each, and collected approximately 23,000 adult beetles total. Beetles were identified to species level at the Marsh lab at Montana State University, and we calculated Shannon's diversity metrics for each week and over the course of each carcass. We documented >300 species of beetles, of which three-fourths were carrion-dependent, emphasizing the keystone function mountain lions have in supporting invertebrate biodiversity. Beetle richness and evenness increased overtime; northern carrion beetles (*Thanatophilus lapponicus*) dominated carcasses initially, and then other species began to arrive as northern carrion beetles peaked and subsided.

In closing, our results offer wildlife managers novel data demonstrating the keystone function large carnivores have in supporting biodiversity. This is the first study to connect any large carnivore with invertebrate diversity, across multiple habitats and seasons. The results of this research could have important consequences for species conservation, and could be applied broadly to numerous carnivore species across diverse habitats and time.

Hunger mediates cougar's risk avoidance response in wildland-urban interface.

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ABSTRACT
Conflicts between large predators and humans in the wildland-urban interface present a challenge to wildlife conservation efforts by influencing attitudes and policies of humans toward predator species. Generalities portrayed in many empirical studies depicting large carnivore avoidance of residential development do not explain the carnivore's occasional utilization of a potentially risky habitat type. Carnivores, like cougar (*Puma concolor*) may perceive the utilization of residential development as a behavioral risk-reward tradeoff. We examine cougar's risk-reward tradeoff in the wildland-urban interface and whether cougar's risk avoidance behavior is state dependent. Continuous tracking of GPS location data on a sample of cougars were characterized as hunting and feeding locations to assess landscape variables governing hunting success (via modeling feeding versus hunting site attributes) and hunting site selection (via step-selection function modeling). Hunting site selection behavior was then analyzed conditional on indicators of hunger state. Higher housing densities carried a higher energetic reward value; cougar hunts were more successful as housing density increased. Despite the relatively higher energetic reward value associated with housing density, step-selection function data indicated that cougars avoided patches of higher housing density, a landscape carrying higher mortality risks. However, when cougar experienced periods of extended hunger, risk avoidance behavior toward housing declined. This study demonstrates that cougars do face a trade-off between acquiring energetic rewards and avoiding risks associated with human housing. Hunger, a basic physiological process experienced by many organisms, helped describe cougar's occasional utilization of residentially developed landscapes. Explaining cougar behavior with state-dependent risk sensitive foraging theory provides a more unified approach than a risk-avoidance or energy acquisition explanation does alone.

How should we measure human tolerance of mountain lions?

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ABSTRACT

Mountain lions are returning to their historic range east of the continental divide. This recolonization event has spurred conversations about how to approach the reappearance of a species that has been largely absent from the region for nearly a century. Eastern wildlife agencies are at a critical juncture, and must decide if and how nascent mountain lion populations will be managed. Human dimensions studies have shown that residents of eastern states are ambivalent about the prospect of mountain lions returning, but once attitudes toward mountain lions are solidified, they will be nearly impossible to change. Therefore, any new management plans should include policy and educational interventions carefully designed to minimize factors that lead to intolerance of mountain lions. However, there are a few barriers preventing the implementation of such management plans. One is that there currently exists no consistent method of measuring tolerance of mountain lions, or indeed of any wildlife; another is that few studies have examined the downstream impacts of mountain lion policy on human tolerance. I developed and distributed a social survey to ~3300 members of the general public in rural communities in Montana, Washington, and California, three states with varying mountain lion policy. The survey included several metrics of wildlife tolerance that have been used more or less interchangeably in the literature, including attitudes, behavioral intentions, and acceptability of management actions. I also tested a version of a sociological tolerance metric known as the “least-liked” method that has not yet been applied to the human dimensions of wildlife. Here I will present the results of the tolerance metric comparison, identify antecedents of tolerance through path analysis, develop a typology of those who are truly “tolerant,” and examine whether mountain lion policy has a top-down effect on public tolerance by comparing results between states.

A retrospective look at mountain lion (Puma concolor) populations in California (1906-2016)

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ABSTRACT
Mountain lion population management in California has varied widely within the last 100 years, ranging from a bounty system (circa 1906-1963) to a fully-protected status (circa 1971-2013). We estimated population abundance of mountain lions in California by combining official bounty and depredation statistics with knowledge of annual intrinsic growth and mortality rates of the species derived from literature review. We used an annual backwards population projection method to estimate status and trajectory of mountain lion populations in California, starting with systematically adjusted population sizes in 2016 based on current amount and quality of habitat. Using these derived values we projected populations back to 1906. These back-calculations, in conjunction with linear modeling, demonstrate that mountain lion populations experienced a decline during the bounty period and a subsequent increase following the bounty period. These analyses provide context for understanding historic aspects of mountain lion populations in California and demonstrate the need for developing accurate population estimation techniques to monitor mountain lion populations in California into the future.

Development of baseline occupancy rates for long-term monitoring of mountain lions in the Mojave Desert of California

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ABSTRACT

We collected and analyzed a five year remote game camera dataset from the Mojave National Preserve for determining baseline occupancy and detection rates for mountain lions in the Mojave Desert. Mountain lions were detected in 25 of 172 sampling intervals at 34 sites monitored by remote game cameras. Occupancy and detection rates decreased with increasing distance to shrub cover, with occupancy decreasing more rapidly than detection. Our analyses represent the first occupancy and detection estimates for mountain lions in the Mojave Desert and can serve as a baseline for tracking populations over time. Lastly, our analyses can lead to further understanding of mountain lion spatial ecology and community level interactions in the Mojave Desert ecosystem.

How mountain lions support migratory eagles

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ABSTRACT

Migratory birds are particularly vulnerable to disturbance along corridors and rely heavily upon specific stopovers that provide the resources needed to recover and prepare for further travel. Some populations of bald (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*) migrate from Alaska and northern Canada down the Rocky Mountains to southern wintering areas. We caught, tagged and monitored eagles in Jackson, WY, as well as caught, tagged and followed local mountain lions. We also deployed motion-triggered video cameras at 229 mountain lion kills to document vertebrate scavengers benefiting from carrion. We documented eagles at 81 kills, which disproportionately fed from mountain lion kills in winter (50% of kills with cameras) versus summer (14% of kills with cameras). We found that most bald eagles used Jackson at a stopover to refuel and prepare for the last leg of their southern migration—eagles resided in Jackson primarily during the Fall human hunt for elk before departing south. Bald eagles were most frequently detected on mountain lion kills immediately following human hunting in the Fall, and then again in spring as eagles migrated north, when human hunters were not active. Our results for Golden eagles were different, as many goldens wintered in the mountains around Jackson rather than continuing south along the Rocky Mountains. Our detection of golden eagles at mountain lion kills increased following the human hunt season and continued to increase through the winter. Some kills supported as many as 6 individual golden eagles feeding at the same time. One strategy for building tolerance for controversial carnivores is gathering the data necessary to show everyday people the positive roles they play in natural systems. Here we show the importance of mountain lion kills in subsidizing two charismatic, sensitive species that migrate along the Rocky Mountain corridor.

Mountain lion resource selection in the North Dakota Badlands and statewide habitat suitability

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ABSTRACT
Understanding resource use and selection of an animal is fundamental to sound wildlife science and management. Due to the relatively recent recolonization by mountain lions (*Puma concolor*) of the Little Missouri Badlands Region of western North Dakota, detailed data regarding resource selection in the region has been lacking. Therefore, we studied mountain lions occupying the Badlands Region to improve our understanding of mountain lion resource selection and occurrence. Specifically, our objectives were to: 1) develop a population-level resource selection function for mountain lions across the Badlands, 2) investigate individual variation in habitat selection of mountain lions, and 3) create a statewide habitat suitability map for the species. Between 2011 and 2016, we captured and placed GPS collars on 13 resident, adult mountain lions (6 M, 7F) across the Badlands, collecting 19,995 locations. We then developed digital layers of 8 landscape variables deemed potentially important to mountain lion resource selection. We used them to develop a resource selection function (RSF) that yielded values proportional to probability of use by comparing habitat attributes at used locations to attributes of randomly generated “available” points within the individual’s home range. By estimating resource selection of individuals within their home range (Design III), we were able to evaluate variation among individuals, and then average coefficients across individuals to approximate population-level resource selection (Design II). Mountain lions showed some seasonal variation in resource selection, as well as differences between individuals. Mountain lions showed strong positive selection for ruggedness, edge habitat, and forest, while displaying negative responses to disturbance. Finally, we used the population-level RSF to create a habitat suitability map for the state of North Dakota. The map indicated a total of 6,547 km^2 of habitat deemed excellent or good quality, equating to approximately 3.57% of the total land area in the state; the remainder of the state was considered moderate-low quality or unsuitable.

Documentation of mountain lion occurrence and reproduction in the Sacramento Valley of California

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ABSTRACT

We documented mountain lion activity in relic riparian habitat in California's Sacramento Valley. There is little documentation showing mountain lions historically (within the last 112 years) occurred in this area. Using game cameras we documented regular occurrence of mountain lions in addition to multiple reproductive events. The prevalence of human activity in the area is significant and, combined with lack historic documentation, makes the occurrence of mountain lions in this area all the more unique. Overall, we demonstrate that mountain lions are very much habitat generalists. We suggest that mountain lions are occupying and reproducing within the Sacramento Valley, an area heavily impacted by humans. Such information should be carefully considered when designating suitable habitat for mountain lions in California.

Texas native cats: raising awareness about mountain lions through education and outreach in Texas

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Problem Statement: Texas has two distinct mountain lion populations, yet most people in the state know little about them or their significance to ecosystems. To paraphrase Cougar Ecology and Conservation, scientific knowledge alone is insufficient for the challenges these cats face when it is uncoupled from public values. Without knowledge, public values may be based on incomplete or biased information.

Purpose: The purpose of Texas Native Cats is to expand education about mountain lions and other wild Texas felids, to increase outreach throughout the state, and, ultimately, to improve conditions for these important but often misunderstood predators. In general, people are unaware of the mountain lion's habitat, physical characteristics, threats to its existence, and the importance it plays in maintaining Nature's health and diversity.

Methods: Various sources have been used to compile presentations made to audiences. Significant sources of information include Cougar Ecology and Conservation, Panthera, Borderlands Research Institute at Sul Ross University, and websites, studies, and articles. Conversations, email correspondence, and meetings with various mountain lion researchers and other experts also provided insight into the unique situation facing Texas mountain lions. Additionally, personal experience with captive cougars was a factor in creating presentations as the author has 15+ years of experience working with these cats in rescue centers in Texas.

PowerPoint presentations made to master naturalists, zoo keepers, and schools have been the method of communication as well as participation in community outreach events. Plans are underway to expand these talks not only to the groups cited here but also to others, primarily in the state's population centers.

Conclusions: Audiences have been interested and engaged in learning about these cats. Audience sizes have ranged from 25 to more than 100. Owing to the fact these are a non-game species in Texas, audiences gain an understanding that mountain lions are a controversial and complex topic and that in order for there to be any positive change for these cats, compromise will be required and the process of change will likely require time and perseverance.

Too much commotion here for a secretive big cat? Puma don't care

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ABSTRACT

Human-puma conflict in the western U.S. is a growing management concern as development and recreational activities increase human activity in and around wildlands. Using three years of photo data taken from 48 remote cameras which were distributed among three study sites across New Mexico, we addressed the following question: What is the fine scale spatial relationship between human and puma activity? The results of a negative binomial regression indicate that puma are not displaced, at least spatially, by human activity. Our study confirms similar, earlier findings from California. To mitigate potential conflict, we suggest a pro-active approach to educate the public regarding puma distribution and the big cat's apparent indifference to areas of high human activity.

Demographics of mule deer puma prey in south-central New Mexico

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ABSTRACT

Population effects of puma predation on mule deer are a topic of broad and current interest to western wildlife managers and hunters. We used mule deer population parameters from a previous mule deer study in New Mexico together with our own data on mule deer prey of 21 GPS collared puma to answer the following questions: (1) Is puma predation variable across mule deer sex and age classes?; (2) What is the relationship between mule deer prey demographics and reproductive value. We were able to age 88 and determine the sex of 91 mule deer prey. We found: (1) puma kill fawns (i.e. less than 1 year old) and mid to late age classes disproportionately to their availability and (2) puma take mule deer of the greatest reproductive value, 2 year old does, less frequently than would be expected based on availability (X-squared = 62.745; df = 10; p-value = 1.092e-09 for both). Our data suggest that differential puma predation across mule deer age classes produces less of a population control effect than might be expected based on prey numbers alone.

Human and large carnivore encounters in Big Bend National Park

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ABSTRACT
Encounters with large carnivores can be positive and/or negative for park visitors. An encounter is any interaction with wildlife experienced by a person (track, auditory, sighting, and physical contact); an incident is an encounter involving contact with human property, aggressive behavior, or attack on a person. Better understanding of human-carnivore encounters will allow park managers to mediate between positive encounters and negative incidents. The goal of this study was to consolidate historical reports of human and carnivore interaction in Big Bend National Park. When a mountain lion (*Puma concolor*) or black bear (*Ursus americana*) encounter occurs, visitors are asked to fill out a natural history field observation card. Encounters were grouped and summed by year, month, day of the week, and hour. Each encounter and incident was mapped in ArcGIS. There was a total of 3,862 mountain lion encounters and 6,871 black bear encounters recorded from 1950-2015. Most mountain lion encounters occurred in the evening, while most black bear encounters occurred during the morning. There was an increase in mountain lion and black bear encounters during winter months. Eight of the top 10 management zones for mountain lion encounters and all of the top 10 management zones for black bear encounters were Chisos Mountain zones, which are high human use areas. Carnivores play an important role in ecosystem function and are identified by many as symbols of wilderness. Visitor observational data that tracks large carnivore encounters provide park managers with needed information to continue to conserve these species and address human safety issues.

The influence of anthropogenic water on puma habitat use and prey selection in arid ecosystems

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ABSTRACT

Water is an essential resource for wildlife and is often the primary limiting factor in desert ecosystems. For decades, wildlife agencies have developed anthropogenic water sources in arid regions to benefit game species. Little is known about how, or if, water development effects predator-prey dynamics. Our objectives are to determine the influence of anthropogenic water sources (i.e., wildlife water catchments, livestock drinkers) on puma (*Puma concolor*) habitat and prey selection by: 1) analyzing spatial and diet data collected from from satellite collared puma on the Armendaris Ranch and Sevilleta NWR; 2.) disentangle the reasons for puma use of anthropogenic water sources (i.e., prey or water) by placing trail cameras at two resources that concentrate large ungulates: water sources and salt sites; 3.) quantify the relationship between the distribution of puma kill sites and their proximity to water sources to determine if puma are using man-made water sources to ambush prey. Research is ongoing, however data has currently been collected from 13 collared puma on the Armendaris (8 male, 5 female) and 5 collared puma on the Sevilleta (1 male, 4 female). Approximately 35,000 GPS locations have been accumulated from these animals to date. Diet data has been collected from more than 364 kill sites, with 404 total prey items. Diet composition is diverse, with more than 25 different prey species being utilized ranging from carp (*Cyprinus carpio,* n =36) to gemsbok (*Oryx gazella*, n = 5). Approximately 45% of the combined puma diet is comprised of small prey items (less than 15kg), however mule deer (*Odocoileus hemionus,* n = 102) are the most selected prey species at 25% of the combined diet.

Spatial density estimations of *Puma concolor* by remote cameras and a novel hair sampling method

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ABSTRACT
Effective species management rests on a foundation of reliable monitoring of populations, yet monitoring puma (*Puma concolor*) populations remains logistically complex, expensive, time consuming, and invasive. Our study has two objectives: 1) to determine the efficacy of a novel, cost-effective, and minimally invasive genetic sampling method – a modified Belisle foothold trap – for obtaining hair to generate mark-recapture population estimates, and 2) to test habitat suitability and population density parameters in the model currently used by New Mexico State Department of Game & Fish for puma management. Hair traps will be used in parallel with a remote camera survey of a partially marked puma population to compare our Belisle hair trap results with a mark-resight population estimate. Data from each survey technique will be applied to Bayesian spatial capture-recapture or mark-resight models to yield two separate density estimations of the local population for comparison. As this study is in progress, the poster will focus on the methods and data collected through April 2017.

Where do mountain lions kill deer along the urban-wildland interface?

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ABSTRACT

Understanding population and individual-level behavioral responses of large carnivores to human disturbance is important for conserving top predators in fragmented landscapes. However, previous research has not investigated resource selection at predation sites of mountain lions in highly urbanized areas. We quantified selection of natural and anthropogenic landscape features by mountain lions at sites where they consumed their primary prey, mule deer (Odocoileus hemionus), in and adjacent to urban, suburban, and rural areas in greater Los Angeles. We documented intersexual and individual-level variation in the environmental conditions present at mule deer feeding sites relative to their availability across home ranges. Males selected riparian woodlands and areas closer to water more than females, whereas females selected developed areas marginally more than males. Females fed on mule deer closer to developed areas and farther from riparian woodlands than expected based on the availability of these features across their home ranges. We suggest that mortality risk for females and their offspring associated with encounters with males may have influenced the different resource selection patterns between sexes. Males appeared to select mule deer feeding sites mainly in response to natural landscape features, while females may have made kills closer to developed areas in part because these are alternative sites where deer are abundant. Individual mountain lions of both sexes selected developed areas more strongly within home ranges where development occurred less frequently. Thus, areas near development may represent a trade-off for mountain lions such that they may benefit from foraging near development because of abundant prey, but as the landscape becomes highly urbanized these benefits may be outweighed by human disturbance.

State of the mountain lion: a call to end trophy hunting of America's lion

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ABSTRACT
The Humane Society of the United States has recently released a new report titled, *State of the Mountain Lion: A Call to End Trophy Hunting of America's Lion.* The report details the current plight of mountain lions across the United States. The report stands out as an exceptionally valuable resource to support the long term protection and conservation of mountain lions with never-before amalgamated materials, including:

- Geographic information system (GIS) maps that identify potential suitable habitat and optimal population sizes for mountain lions, by state;
- A detailed legal review of mountain lion regulations in every U.S. state; and,
- An overview of necessary actions to protect mountain lions for the long-term.

The report highlights major threats to the species, including rampant trophy hunting which kills thousands of mountain lions each year in the U.S., and reports on the tens of thousands legally killed over the past three decades.

The HSUS's State of the Mountain Lion delves into mountain lion biology, current state-management efforts and the majority public's highly positive perceptions of this iconic species. The report dispels commonly held myths and provides valuable coexistence strategies for residents, recreationists and livestock growers.

Mountain lions, once the most common mammal in North and South America, are restricted to breeding populations in only 16 states. The report details how they are managed in those jurisdictions, which includes the West, parts of the midwest and Florida. The State of the Mountain Lion provides important policy recommendations for decision makers to better protect mountain lions and conserve the species for future generations.

Estimating mountain lion populations for improved management

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ABSTRACT

Reliable data detailing the size and trends of mountain lion populations is significantly lacking where mountain lions reside. Understanding the size of a state's mountain lion population is essential to properly conserve the species and prevent overexploitation. Trophy hunting, where the primary motivation is to obtain animal parts for display or bragging rights, is the most pervasive threat mountain lions face. Trophy hunters killed more than 78,000 mountain lions in the U.S. from 1984-2014.

The Humane Society of the United States, with the aid of Bird's Eye GIS, identified potential lion habitat and the potential abundance of adult mountain lions if they existed at their most suitable density for all 16 states in which breeding populations of mountain lions exist. Based upon Beausoleil et al. (2013), we used a density estimate of 1.7 adult mountain lions per 100km^2. While not every area will have the same density, this estimate can be used as an average (for purposes of gross estimation) for all habitats in which adult mountain lions occupy a home range. A deductive model was created using these habitat determinants: available prey, terrain ruggedness index and human footprint.

The results suggest that, in current states with breeding mountain lion populations, there is sufficient home and resources for over 43,000 adult mountain lions. If restored to the prairie states, eastern cougar conservation could also be achieved. Additionally, habitat across Florida could support over 470 adult panthers.

Our estimates for adult mountain lion population potentials in each state is generally much higher than current estimates from state agencies, suggesting that mountain lions face too-high levels of suppression mostly from trophy hunting. State wildlife agencies can use this information to better manage mountain lion populations and determine the extent to which further study is necessary in order to prevent overexploitation.

Cascading fear: plant architecture reflects human-carnivore-herbivore relationships

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ABSTRACT

Fear of predation elicits strong behavioral responses from prey, with impacts that trigger cascades through food chains. The ecology of fear responses to natural predators is becoming better understood, but little is known about how humans - the world's most ubiquitous super-predator - influence subsequent trophic levels, through changes in carnivore habitat use and behavior. We combined GPS puma tracking data and field experiments to demonstrate a trophic cascade precipitated by anthropogenic development. Starting with the top of the chain, we examined the spatial patterns in puma feeding sites, and found that pumas select hunting areas away from human disturbance. Puma aversion to disturbed areas created predator refugia for deer. We determined that deer take advantage of this aversion by increasing their activity near human development. Our data revealed greater browse pressure in sites near humans, and that browsed woody plants develop a greater number of branches that are within reach of browsing deer. The impact on plant architecture is likely to create a feedback in which increased browse pressure cultivates more abundant deer forage in areas avoided by pumas. Our study is the first to link a human-initiated trophic cascade to changes in plant physical structure. We expect that higher browse pressure in low predation risk sites near humans may cause a shift in plant species composition over time. However, our study area is a landscape in which puma recovery and human development is fairly recent on the timescale of tree life histories. Therefore, the full extent of the relationship is likely not yet expressed in a way that we can detect.

Bridging the gap: increasing access with a new online reference tool for *Puma concolor* in the U.S.

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ABSTRACT

The Mountain Lion Foundation has established a centralized online database, bibliography, and library of documents pertaining to mountain lions (*Puma concolor*) in each of the 15 states in which mountain lions can be found. The bibliography will be available to prospective or current researchers, policy makers, agencies, students, non-profits, and any other members of the public. The project is continuing, and will include references for all 49 states, as well as map the locations of accomplished

research. To date, the project has compiled more than 1,700 research papers, reports, news articles, legal documents, theses, dissertations, etc. These documents span a diverse array of topics, such as: biology, behavior, habitat, connectivity, genetics, and research methods. Though research papers are often indexed online, other documents, such as grey literature, legal documents, news articles, etc., are often ephemeral and/or difficult to access. This database will house all of this information in one searchable master database, providing easy access to researchers and enabling people outside of academic institutions access to these critically important resources.

SESSION 5: MOUNTAIN LION–HUMAN RELATIONSHIPS

Moderator: Mathew Alldredge, Colorado Parks & Wildlife

Community management of jaguars and pumas: multi-stakeholder processes and methods

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ABSTRACT
Empowering and supporting rural communities in solving conflicts with wildlife is a necessary step to confront the environmental challenges facing society today. In 2015, we advanced in this effort bringing together more than 158 participants in a participatory structured communication process. The goal was to design incentives for enhancing coexistence among jaguars, pumas and humans in Costa Rica at communities that suffer predation on livestock by big cats. The final product integrated 823 ideas into six types of incentives: organization of communities, mechanisms for dialogue, technical assistance based on citizen science, a green marketing label, a payment for production of biodiversity, and an assessment of financial alternatives. This plan encompassed a diversity of tools, beyond finances, that target benefits for affected ranchers and other community members, and provides opportunities for local development while resolving conflicts with wildlife. Current follow up consists on a pilot test of incentives under a quasi-experimental research design combining social and ecological indicators. All activities include community members in an active role to build on social learning processes, this is a collaborative effort with input from institutions and multidisciplinary experts. Participatory methods and techniques we adapted for our research include focus groups, varied workshop and survey modes, the Policy Delphi, the Nominal Group Technique, the Logic Framework approach, and Problem-Solution trees. We will address the assessment of legitimacy of participatory processes, i.e. their validity, through measurements of consensus, support, satisfaction, engagement and representativeness. By focusing in our methods, we expect to offer a template for reducing human-wildlife conflicts with multi-stakeholder processes.

Puma-human interactions in Brazil: a review of depredation causes and management practices

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ABSTRACT

Considered the carnivore species with the widest distribution in the Americas, pumas are present in all Brazilian biomes. Currently classified as vulnerable in Brazil, pumas face several threats, such as habitat destruction and fragmentation, illegal hunting, retaliatory killing, and road mortality. Despite its wide distribution in Brazil, the number of scientific studies of this species is low. From 2000 to 2016, only ten peer-reviewed publications presented data on puma-human relationships in Brazil, by observation or through interviews. Here I present a review of the main causes of attacks and husbandry practices implemented to reduce livestock depredation by pumas in Brazil. Attacks on humans were very rare. In general, attacks were concentrated on sheep, goats, calves, horses and pigs. Proximity to forested areas, poor husbandry practices and lack of wild prey seemed to be the most important causes of depredation on domestic stock. Attempts to reduce depredation focused on confinement of herds to corrals at night (sheep, goat, adult horses) or permanently (juvenile horses), and establishment of grazing areas away from forest fragments (cattle). In addition, the killing of predators supposedly involved in depredation events was a common practice. The lack of scientific studies dealing with human-puma interactions in Brazil may be explained by the presence of the jaguar in sympatry with pumas for most regions of the country. Jaguars are preferred as a scientific subject because they cause more livestock depredation than pumas and are internationally recognized as threatened species. Moreover, difficulties for financing long-term studies with large cats in Brazil hinder efforts to investigate concurrently both species and to test husbandry practices aimed to minimize losses due to predation on domestic stock. The presence of pumas near rural and urban areas is currently increasing and may become a serious risk for domestic stock and humans in the foreseeable future.

Spatio-temporal and demographic drivers of cougar predation behaviors in an urban-rural gradient

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ABSTRACT
Understanding wildlife community responses to the conversion of undeveloped to residential lands is a challenge that wildlife managers and conservationists are facing more often. Despite conflicts between cougar (Puma concolor) and humans in the urban-wildland interface, cougar appear to persist in some residentially developed landscapes. We test the influence of spatial (i.e., housing density), seasonality, and puma biological covariates on predation parameters (per-capita kill rate, prey composition, handling time) for GPS collared cougar subjects in the Colorado Front Range. A sample of cougar kill sites was used as input for a series of statistical and deterministic models to derive annual and monthly per-capita kill rates for five prey classes: non-ungulates, adult mule deer, fawn mule deer, adult elk, and calf elk. Alternative prey, such as non-ungulate (i.e., meso-carnivore, pets) and elk comprised a mean proportion of 0.23 and 0.13 respectively of items killed. Despite mule deer (fawn and adult) kill rates decreasing as a function of increased alternative prey utilization and increased housing density, the annual per-capita kill rates on mule deer were high relative to past studies. Collinear with increased utilization of higher housing densities, younger cougar killed a higher proportion of non-ungulate than did older cougar, while female cougar killed higher proportion of non-ungulates than did male cougar. Low to moderate housing densities found in the exurban developments appear to be utilized not only for preying upon abundant deer, but also when preying upon alternative non-ungulate prey. Areas of suburban-urban development appear to be used primarily when preying upon non-ungulates. Handling time of adult ungulates varied by season, but not by any spatial or demographic variable. Cougars are likely trading off a higher risk of anthropogenic related mortalities found in the higher housing development for greater availability of prey resources relative to less developed habitat. Managers focused on reducing back-yard residential conflicts in this system may consider managing for a cougar population with an older age structure, reducing synanthropic prey species, discouraging exurban developments from occurring, and discouraging mule deer utilization of current exurban developments.

Conducting research and conservation efforts for jaguars and mountain lions on ranchlands in the Southwestern US: a model for communication and coordination with the ranching community

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ABSTRACT
From 2012 to 2015 the University of Arizona, funded by US Fish and Wildlife Service (from Department of Homeland Security mitigation funds), conducted a landscape-scale project to survey for jaguars across 16 mountain ranges in southern Arizona and southwestern New Mexico. Using primarily wildlife cameras we detected and

monitored one jaguar and three ocelots, plus a variety of other wildlife, over the course of the study. Other than one military reservation and a couple of small US Park Service sites, all of our activities took place on ranchlands, either as leased public lands or private lands. We took a proactive approach, and in conjunction with the ranching community, developed a communication and coordination protocol that we followed while conducting the project. In a second component of the USFWS-funded program, we organized a depredation workshop for ranchers to provide information and facilitate discussions relative to potential depredation incidents. Since there was only one jaguar (with no known depredation problems), and since jaguars only occur in the US infrequently, we opened the forum to include mountain lions, for which there are depredation conflicts in the region. Finally, in a third component, the university embarked on examining the potential for a payment-for-ecosystem-services model on ranchlands to keep working wildlands intact and functioning for jaguars and other wildlife across the region. In summary, these approaches generally resulted in interest and cooperation from the ranching community, which serve as a model for conducting research, management, and conservation efforts for large felids and other carnivores on Western ranchlands.

Gaps of knowledge in recovery actions for jaguars (*Panthera onca*) in Mexico

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ABSTRACT
Endangered species such as jaguars, require a suit of actions to recover, maintain and possibly increment their populations, both at national and regional levels. The Mexican government has implemented a series of recovery actions for the stabilization of jaguar populations initially characterized in the program actions for the conservation of species (PACE). This group of actions has been implemented in different degrees at the State level. Our objective was to identify priority actions that need attention to continue the recovery of the species. We analyzed priority conservation programs implemented by the Mexican government in the past decade and identified gaps of knowledge for the species as well as which conservation actions require more attention. We assessed 21 topics and their implementation both inside and outside protected areas, they included corridors, habitat assessment and restoration, food habits and prey restoration, camera trap and radio-telemetry studies, environmental education, capacity building, depredation and livestock workshops, community surveillance, genetic and disease studies, and feral wildlife. We concluded that gaps in knowledge (ranging from 60 to100% absence of actions) requiring further attention are food habits, radio-telemetry, genetic and diseases, impact of feral wildlife, and habitat restoration. We suggest this analysis provides direction to funding alternative opportunities, as well as collaborations with Academia, communities and Government.

Social acceptance and Florida panther management – is there a sweet spot?

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ABSTRACT

Large carnivore conservation is a challenge across the globe as growing human populations continue to encroach upon those remaining wild places where these carnivores have persisted. Exacerbating the issue is the fact that some carnivore populations have increased in size in recent decades as the result of directed conservation efforts and legal protections. In Florida, we have an endangered subspecies of puma whose current range is surrounded by the majority of Florida's 20 million residents. Protected by the State in 1958, the panther has enjoyed strong public support in Florida. It was designated by the U.S. Fish and Wildlife Service as an Endangered Species in 1967 and was voted the official state animal in 1982. Panther specialty license plates are the fifth most popular plate with over 47,700 owned, raising over $1.1 million dollars annually for panther research and conservation. Many Floridians applaud the rise in panther numbers and are pressuring to keep its population growing. However, as panther numbers have grown over the past 20 years, so too have human-panther conflicts. Depredations on pets and livestock, increases in human-panther interactions, panthers living in ex-urban areas and concerns that certain prey species have declined are issues requiring significant management resources. Groups and individuals that are concerned with the direction of panther conservation in Florida are regularly present at Commission meetings and have an expanding presence on social media. In this presentation, we will provide an overview of panther issues, describe our complex and diverse group of stakeholders and summarize our current research and management efforts that are directed at these social acceptance issues. Human values are the ultimate driver in wildlife management decisions so stakeholders' involvement, both positive and negative towards an expanding panther population, will strongly influence whether panthers will be managed at numbers supported by available resources or as rarities on the landscape. Although we hope that western puma populations are secure for the long-term, Florida panther management may be a harbinger of the challenges that puma managers in North America are or will be facing in the upcoming decades.

Landscape and habitat use for a large carnivore in the city: use and selection for mountain lions around Los Angeles

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ABSTRACT

Although some species of wildlife can adapt to and even thrive in urbanized areas, many species are rare or absent there. Large carnivores have some of the largest spatial requirements of any animal, and they have generally been thought to be incompatible with cities. However, in and around Los Angeles, the second largest metropolitan area in the U.S., mountain lions (*Puma concolor*) still persist despite the significant challenges. At Santa Monica Mountains National Recreation Area, we have been studying the behavior, ecology, and conservation of mountain lions since 2002. Here we analyze mountain lion landscape use and selection across the complex urban landscape of southern California using more than 125,000 GPS locations from 30 collared animals over 14 years. In general, mountain lions were rarely in developed areas, as their home ranges consisted on average of just 3% urban and 10% unnatural areas (urban plus "altered open" areas such as golf courses, low density residential areas, landscaped parks, etc.). However, there was significant variation between age and sex classes, and between individuals. Adult females had the smallest percentage of urbanized areas, at 0.8%, whereas subadult males had the highest, at 3.6%. Two adult males, P22 and P41, lived in highly circumscribed parklands, and they had some of the smallest adult male home ranges (24 and 54 km^2) ever documented, and in our study by far the greatest use of urban areas, at 17.4%, and unnatural areas, at 26.4%. Interestingly, patterns of resource selection were different, in that all age-sex classes strongly selected areas near urbanization, with the exception of adult males, which strongly selected chaparral and riparian woodland areas. Subadults and females may be taking advantage of deer presence near developed areas while avoiding adult males. These results have important implications for mountain lion conservation and management in urban landscapes.

Evaluating potential for human and mountain lion conflict in Big Bend National Park

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ABSTRACT
Big Bend National Park (BIBE) provides the largest area of protection for mountain lions (*Puma concolor*) in the state of Texas and yet BIBE's annual visitation exceeds 300,000. The goal of this study was to evaluate the potential for conflict between humans and mountain lions in BIBE. My objectives were to: 1) evaluate mountain lion occurrence relative to areas of human use (i.e., trails, roads, facilities); 2) examine the temporal and spatial use of park trails by humans, using active infrared trail monitors; 3) evaluate the effects of seasonality on daily activity patterns of mountain lions and humans; and 4) identify areas of overlap between the temporal and spatial use of the park by humans and mountain lions. A total of 3,654 GPS locations from 4 mountain lions (2 M, 2 F) suggests that mountain lions avoided areas of high human use in BIBE. The majority of visitor use in BIBE was diurnal in all seasons and for all trail categories. While my study did show decreased diurnal mountain lion activity, female diurnal activity was less diminished, with 64% of female diurnal movements being active. Based on my analyses of human and mountain lion activity, the likelihood of an encounter was increased during winter crepuscular (morning and evening) periods. In the face of increasing outdoor recreation, using modern technologies such as GPS collars to understand and reduce the potential for human and mountain lion conflict will help to insure the long-term conservation of mountain lions in Texas and across the United States.

Conserving mountain lions in southern California: Addressing fragmentation, conflict, and excess human-related mortality in comprehensive and collaborative ways

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ABSTRACT

Our UC Davis team and collaborators have been studying pumas *(Puma concolor)* in Orange, Riverside, and San Diego Counties in southern California since 2001, and have

identified numerous threats to their long term survival. The study area is highly biodiverse, with landscapes as varied as coastal Mediterranean to high mountain and desert, and contains ~9 million people. Conserved lands vary from national forests to small peri-urban "wilderness" parks. Conserved lands are often separated by development and roads (including interstate highways) that create risks and barriers for pumas, and protected corridors between them are often inadequate. Because male puma home ranges average 375km^2, and females half that, circulation and dispersal often require crossing extensive areas of unprotected lands and encounters with busy highways. These factors have resulted in low annual survival (mean 56%) and genetic isolation. Long term survival of mountain lions in this landscape will be dependent on reversing isolation and mortality trends that currently exist, or will require active population manipulation in the future. To address the isolation and mortality issues, our team has engaged and collaborated with a wide array of stakeholders to provide comprehensive information and leadership. These include collaborations that have or are currently: 1) Using GPS data, cameras, and genetics to model highest priority parcels for conservation, especially for corridors; 2) Defining high-risk highway crossing points and identifying solutions; 3) Designing highway crossings, fencing, jumpouts, etc, and providing construction oversight; 4) Advising planners, NGO's, and wildlife agencies on connectivity challenges and solutions; 6) Improving domestic animal protection measures through education, outreach, and testing of predator deterrence methods, as well as sequentially surveying residents to assess the effects of these measures; 7) Developing best practices through expert workshops and other means for modification or creation of highway crossings, and long term monitoring of the population.

Panel Discussion: HUMAN–LION INTERACTIONS AND CONFLICT & DEPREDATION MANAGEMENT

Moderator: Kristin Cannon, (District Wildlife Manager, Colorado Parks & Wildlife)

Panelists: Mat Alldredge (Wildlife-Human Interactions Scientist, Colorado Parks & Wildlife), Loren Chase (Social Scientist, Arizona Game & Fish), Martin Lowney (Wildlife Conflict Manager, A.P.H.I.S., Wildlife Services, Colorado), Valerie Matheson (Urban City Manager, Colorado), Jerrie McKee (Urban District Wildlife Manager, Colorado Parks & Wildlife), Fernando de Azevedo, Latin American Representative, Brazil)

NOTE: *This well-conducted and informative discussion was not recorded.*

SESSION 6: MOUNTAIN LION HARVEST MANAGEMENT

Moderator: Brian Kertson, Washington Department of Fish & Wildlife

Impacts on survival of cougars caught as non-targets in foothold traps

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ABSTRACT

We captured 48 cougars (*Puma concolor*) between 2009-2013 in western Nevada and followed 33 individuals until death (through 2016). During the course of our research, it became apparent that anthropogenic sources of mortality for cougars was high (87%) and that non-target capture of cougars caught in foothold traps and snares set legally by trappers for bobcats (*Lynx rufus*) was likely impacting annual adult survival of cougars. Trapping of cougars is not a legal method of harvest in Nevada and trappers are required to report incidental capture of cougars to the Nevada Department of Wildlife within 48 hours, even if the cougar is released by the trapper. We found mortality associated with non-target capture of cougars is often unaccounted for however because cougars often die several weeks later from associated injuries. We examined cause specific mortality rates of radio-collared cougars and assessed the impacts of non-target capture of cougars in bobcat traps on estimated adult survival in our study area. Using a known fate model with staggered entry in Program MARK we estimated overall annual survival rates for adult cougars (n = 29) examining the impacts of incidental trap history, mountain range, and body condition. Our results indicate that the capture of cougars as non-targets in bobcat foothold traps does impart a negative effect on cougar survival. Given that this source of mortality is unaccounted for in both harvest objectives and harvest data, managers responsible for cougars in all areas should consider the potential for incidental cougar mortalities when setting harvest limits for cougars where snares or foothold traps are used. In addition, these results suggest it may be necessary to make adjustments to current trapping regulations to minimize mortality of cougars associated with non-target trapping in regions with concurrent trapping of bobcats.

Can increased quota harvest redistribute human caused cougar mortality in Alberta

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ABSTRACT

Cougar mangers in Alberta have initiated an Adaptive Management Project with the objective of improving our lion management program. Provincially, during the past 5 years, 49% of documented cougar mortalities resulted from licenced hunting. Over that period the primary unlicensed causes of cougar mortality were legal landowner kills (19.9%, range 44-73), incidental capture in wolf snares (16.5%, range 14-92), and agency removal (6.3%, range 5-29).

To wildlife managers at Alberta Environment and Parks, this non-hunting mortality represents lost recreational harvest opportunities. However, before using this information to adjust lion quotas across the Province, we need to learn if these are in fact lost opportunities or if increased take by licenced hunters will be additive to the less desirable sources of human caused mortality. We also want to know what effects, if any, increased cougar harvest could have on local and regional population dynamics and space use patterns.

To answer these questions, we are deploying 50 GPS telemetry collars on cougars in a 15,580 km^2 area of west central Alberta. This area consists of three cougar management areas (CMA) of similar mortality statistics. CMA 21 (7557 $km^{2)}$ will be our treatment area and CMAs 11/12 combined (8023 km^2) will be our control. We will measure demographic parameters, space use patterns, and mortality causes for 2-years prior to implementing a quota increase equal to the 5-year average removal rate in CMA 21 (25 individuals).

This paper is a discussion of the management related factors leading to the project and our methods, with the intent of gaining insights from other jurisdictional managers during and after the workshop.

Anthropogenic mortality levels shape the characteristics and source-sink dynamics of a lightly hunted cougar population in western Washington

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ABSTRACT

Human activities and landscape conversion shape ecosystems and disproportionally impact large carnivores. For cougars, populations occupying landscapes with a substantial human presence are exposed to a greater variety of anthropogenic mortality sources - frequently at levels that translate into population declines and a breakdown of social stability. Consequently, wildland-urban environments are often assumed to be population sinks for cougars. However, levels of anthropogenic mortality can vary considerably in both time and space, contributing to an increase in survival, stabilization of the social structure, and a population that functions as a source for neighboring populations. To demonstrate this phenomenon and its implications for cougar conservation and management, I provide information on survival rates, age structure, and social dynamics from a wildland-urban population in western Washington studied during periods with different levels of anthropogenic mortality. Between 2004 and 2008, my study population experienced limited levels of hunting mortality (≤ 3 individuals/year), but conflict removals, tribal predator control, collisions with motor vehicles, and an outbreak of feline leukemia virus resulted in an average annual survival rate of 55% for individuals > 1 year of age, a mean age of 4.2 years for adults, frequent observations of transients, and a likely decline in the population. Conversely, between 2012 and 2016, an observed reduction in the number of conflict removals and motor vehicle collision combined with the absence of feline leukemia virus and tribal predator control activities translated into an average annual survival rate of 86% for individuals > 1 year of age, a mean age of 7.1 years for adults, robust levels of emigration, and a positive growth rate for the population. These observations reinforce the dynamic nature of human-dominated systems and suggest that some wildland-urban cougar populations have the potential to function as both a significant sink and source for the broader landscape. Accordingly, anthropogenic mortality levels may directly and indirectly shape cougar impacts on ungulate prey, interactions with people, and population viability. Wildlife managers and conservationists would be wise to acknowledge and account for the complex role humans play in cougar ecology and behavior while also developing a better understanding of all sources of mortality acting upon a population when crafting strategies to achieve desired outcomes.

Effects of hunting on a mountain lion population on the Uncompahgre Plateau, Colorado

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ABSTRACT

We conducted a 10-year (2004–2014) study on effects of sport-hunting on a mountain lion *(Puma concolor)* population. Our design had a *reference* period (years 1–5) without lion hunting, and a *treatment* period (years 6–10) with lion hunting. Lion abundance was estimated during the Colorado lion hunting season. In the *reference* and *treatment* periods, 109 and 115 individual lions were captured and marked, respectively, during 440 total capture events. Those animals produced known-fate data for 75 adults, 75 subadults, and 118 cubs. Lion population responses to hunting and other causes of mortality were based on changes in: 1) abundance of independent lions, 2) survival of adults, subadults, and cubs, 3) reproduction rates, and 4) age structure of independent lions. The *reference* period population of independent lions increased by at least 70% and exhibited high survival. Hunting clearly affected the lion population in the *treatment* period. Hunting was the major cause of death to independent lions and added to other human and natural forms of mortality. Abundance of independent lions declined 25% after the first 3 hunting seasons with a 15% design harvest of independent lions. Actual harvests ranged from 15.4–16.7% of independent lions and total independent lion mortality ranged from 16.1–20.8%. The harvest was reduced to 11–12% of independent lions in the final two years of the *treatment* period with total independent lion mortality ranging 13.6–14.3% in which the population decline ceased. By the fifth year of the *treatment* period, abundance of independent lions had declined by 21%, and adult females and males had declined by 23.3% and 50%, respectively. Survival modeling in MARK indicated that hunting was associated with statistically significant lower adult and subadult male, but not independent female, survival rates. But the decline in adult females by 23.3% in the *treatment* period exhibited the biological significance of lower survival. The age structure for independent males declined in the *treatment* period. Cub survival was most affected by natural causes and in association with fates of the dams. Reproduction rates were not statistically different in the two periods. In the *treatment* period there was no compensatory reproduction and inadequate immigration to offset losses in independent lions. These results can be used to guide mountain lion hunting management in Colorado.

Mountain lion management in western North America: > 100 year retrospective

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ABSTRACT

Mountain Lion (Puma concolor) populations have had a diverse and long history of management in western North America. For the greatest part of the last century mountain lions were a bountied predator, and a transition to game mammal status was reached by the early 1970’s. Most states and Canadian provinces have reported increased mountain lion activity since the bounty period through the end of the 20th century, and the year 1999 ended with highest recorded removals. Simultaneously this was a period of dramatic human population increases and land conversion. In the 21st century (last 15 years), this upward trend of removals has changed.

We will present an updated summary of documented mountain lion harvest and changes in policy and management over the last 115 years in western North America. We will also overlay the political and biological factors influencing mountain populations to provide perspective on the potential effects of past and current management practices as they may relate to harvest, hypothesized population increases, and the more recent decreases in removals.

This presentation will chronicle the challenges and changing philosophy of predator management.

Evolving mountain lion management in the West: Applying science with human values

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ABSTRACT

Mountain lion *(Puma concolor)* management in the western U.S. evolved from unregulated killing and government-sanctioned eradication during the early 1900s to regulated sport-hunting and control actions in most western states during the mid-1960s to the 1970s. Changes resulted from shifts in peoples' attitudes toward nature, including big carnivores. More protective attitudes toward lions in the 1980s to 1990s resulted in ballot initiatives and litigation that restricted options to lion management. Together, regulated lion hunting and conservation of ungulate prey populations enabled lions to recover from a historical low point to a wide-spread resilient population by the 1990s. Today, regulated lion sport-hunting provides primarily for lion conservation and sustainable use. In other regions heavy lion hunting pressure is used with intent to reduce lion abundance to lower predation on livestock and big game ungulates and to calm human safety concerns. Lion control is also sometimes applied in efforts to restore endangered or threatened ungulates. Research on lions has more recently progressed to a point of enabling managers to learn how to use hunting and control as a management tool and for scientists to test hypotheses. Meanwhile, wildlife management has met with financial and political challenges due to structural changes in society and peoples' attitudes toward hunting. Thus, further evolution of lion management is inevitable. An adaptive lion management structure to consider is called *Zone Management*, one based on current science and theory on lion natural history and population dynamics and that considers the diversity of human values toward nature. Zones delineating lion population segments are specifically managed as high management zones, hunting zones, and reference/source zones. This structure creates a working and teaching landscape, which provides for: a) a broad range of lion management options, b) variation in lion population states for the conduct of reliable management experiments and science to further inform managers and the public's, and c) society's varied values toward nature that is transparent and inclusive to improve collaboration, governance and trust.

SESSION 7: MOUNTAIN LION BIOLOGY & ECOLOGY

Moderator: Mark Elbroch, Panthera

The role of native prey restoration in reducing livestock depredation by puma (*Puma concolor*) and jaguar (*Panthera onca*) in Sonora, Mexico

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ABSTRACT
Livestock depredation by pumas and jaguars often results in their illegal killing in retaliation by ranchers. Through augmentation of peccaries (*Pecari* tajacu) and white-tailed deer (*Odocoileus virginianus*) on a 7,000 ha ranch we tested the hypothesis of prey switching by both predators, when native prey species became more available. During an 8-month initial control period, we identified the diets of both pumas (*Puma concolor*) and jaguars (*Panthera onca*) in the study area. We estimated the relative abundances of white-tailed deer, peccary and cattle (*Bos tarus)* with camera traps. We collected scat for molecular identification of both prey and the depositing predator species, identified prey consumed at kill sites using GPS kill site clusters and estimated predator diet preference. During a subsequent second 8-month period, we translocated peccaries and increased deer density through artificial feeding during fawning season. Using similar molecular analyses of scat and GPS kill site investigations we detected a 73% and 65% decrease in livestock as prey, respectively. Since completing our study we have added 5 more ranches to a program that includes restoration of peccaries, protection of native prey and improvement of cattle management through synchronized breeding. Actions like killing predators to protect prey species have proven to be unseccesful in the long term and detrimental to the environment. The conservation of prey and predators in ranching operations should be achieved by actions that consider all species interaction and good livestock management practices.

New insight into utilizing bone marrow to assess the health of mountain lion prey

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ABSTRACT
Bone marrow fat content has commonly been utilized as a metric to assess the health of mountain lion (*Puma concolor*) prey species. Evaluating body condition of individuals provides important insight to wildlife managers that allows them to better understand predator-prey interactions and sustainably manage both mountain lions and their prey. Studies have compared different methods of measuring bone marrow fat content as well as identified which bones are most representative of an individual's health. However, no previous research has examined how the amount of time from death to sample collection affects bone marrow fat measurements of ungulates in natural conditions. It is not always feasible to collect marrow samples from an individual at the time of mortality, which could potentially bias fat estimates from bone marrow samples. We examined how bone marrow fat content is affected by time post mortem and other factors by collecting multiple bones from individual elk (*Cervus elaphus*) and deer (*Odocoileus hemionius*) at different time intervals in central New Mexico. We found that marrow fat content can change significantly over time. Our top model that explained this change included time between samples, initial fat content and sex of the species. Future research efforts that utilize bone marrow fat content should attempt to retrieve bone samples immediately after death. Failure to do so can lead to false conclusions regarding the nutritional state of individual animals and subsequent mismanagement of both mountain lion and ungulate populations.

Re-colonization of bears in the Great Basin and resulting species interactions: effects on cougar predation behavior and implications for prey

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ABSTRACT
Black bears were extirpated in the Great Basin through targeted removals due to conflicts with humans, along with changes in land use patterns beginning in the mid-1800s. While post-settlement disturbances, including the introduction of domestic livestock, had a negative effect on bighorn sheep and pronghorn, mule deer responded favorably and populations increased, followed by increased numbers of cougars in the Great Basin. As a result of habitat recovery beginning in the early 1900s, bears have begun to re-colonize historic ranges in the region. Cougars have been the apex predator for the past 80+ years, yet our data indicate that cougars and bears now have frequent interactions at cougar kill sites where bears take over and scavenge prey carcasses. Data from >800 kills by collared cougars in Nevada suggest that, on average during months when bears are active,~ 50 percent of cougar-killed deer are scavenged by bears when bears are present at moderate to high densities. We are using GPS cluster analyses, camera traps, and visits to cougar kill sites combined with Vectronic-Aerospace proximity GPS collars (set to record synchronous data every second when lions and bears are within 200 meters of each other) to address the following questions: 1) increase understanding of bear-cougar interactions, especially in areas where bears are expanding into historic habitat; 2) determine if cougar kill rates and composition differ in areas occupied by bears at differing densities (low, medium and high bear density study areas) and if these change over time with bear expansion into historical ranges; 3) determine if human-cougar conflicts increase where bears are newly present; and 4) examine if food subsidies gained by the dominant carnivore (black bears) usurped from subordinate species ultimately aide in population expansion. Here we present preliminary results from the first two years of study from >20 collared bears and 11 collared cougars.

Scaredy cats and the big bad wolf: how intraguild competition influences home range selection in a subordinate predator

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ABSTRACT

In systems with multiple carnivores, dominant competitors exclude or limit subordinate competitors; as such, subordinate predators must balance energy expenditures to collect critical resources with the costs associated with interactions with more dominant competitors. Cougars are the most widely distributed carnivore in the western hemisphere, but in the Greater Yellowstone Ecosystem they are subordinate to wolves and bears. Our research examined the role that competition refugia may play in cougar home range selection. We used confirmed cougar kill sites to measure hunt opportunity (prey availability), and a novel method to measure competition refugia based upon cougar bed sites. We quantified the attributes of cougar home ranges to test if they were different from attributes of the overall study area to examine if 1) cougars select home ranges based on the availability of hunt opportunity, refugia, or some combination of the two, 2) if there are differences between cougar sexes and seasons, and 3) if cougar home range size is better predicted by refugia, hunt opportunity, or some combination of the two. Our findings demonstrated that cougars selected for both refugia and hunt opportunity when choosing home ranges. Selection for both resources was strongest at the 50% core area, though there was some minor variation across sexes and season. Across both sexes and seasons, refugia was the attribute that best explained home range size. Our results suggested that cougars—a subordinate predator—selected bed sites that facilitated anti-predator and thermoregulatory functions, and that visiting and measuring bed sites may provide a novel method to measure the use of refugia in subordinate predators. Refugia may be a critical resource for cougars, especially as wolves expand in the lower 48 states, and managers and scientists may need to account for this requirement when preparing habitat suitability analyses or proposing management actions.

Preliminary predation patterns of cougars and wolves in an area of sympatry

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ABSTRACT
Expanding gray wolf (*Canis lupus*) populations and interspecific competition with sympatric cougars (*Puma concolor*) presents new challenges for management of multiple carnivore effects on ungulate populations (e.g., elk, *Cervus elephus*; mule deer, *Odocoileus hemionus*) in the western United States. We examined wolf and cougar predation patterns before (2009-2012) and after (2014-2016) wolves recolonized the Mt. Emily Wildlife Management Unit in northeast Oregon. We identified 1,213 and 541 prey items utilized by cougars in the pre- and post-wolf periods, respectively. We also identified 158 prey items utilized by wolves. Cougar diet was similar between the pre- and post-wolf time periods. Cougar preyed predominantly on deer (mule deer and white-tailed deer, *O. virginianus*; 58% and 53% of all ungulate kills pre- and post-wolf, respectively) and primarily killed fawns (53% and 44% of all deer kills, pre- and post-wolf, respectively). When cougar preyed on elk, they primarily preyed on calves pre – (77%) and post-wolf (71%) recolonization. Wolves preyed predominantly on elk (61%) and primarily killed the calf age class of elk in summer (83%) and winter (49%), but used adult elk nearly as often as calves in winter (46%). Strong selective predation on elk calves coupled with high density cougar populations explained the low recruitment and reduced population growth rates of elk in Oregon before wolves recolonized the state. The continued selection of elk calves by cougars coupled with wolf predation may intensify the effects of carnivores on elk populations. Conversely, wolves may ultimately decrease cougar densities such that effects on elk populations remain relatively unchanged in this multi-predator system. As wolf populations continue to expand, additional research is needed to clarify the combined effect of wolves and cougars on elk population dynamics.

Foraging behavior of coyotes under intraguild predation risk by cougars: an experimental approach

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ABSTRACT

When mesopredators encounter carcasses belonging to a dominant apex predator, they must balance the degrees of risk associated with detection against the loss of fitness-enhancing benefits from kleptoparasitism. Subordinate predators may behaviorally mediate risk by restricting activity to low-risk times of day, increasing latency to consume caches to reduce encounter risk, or increasing vigilance behavior while at cached items. Alternatively, subordinate predators may spatially avoid risk altogether but also lose access to the resource. We tested whether a subordinate predator modified behavior or avoided risk when encountering large, cached prey items of a dominant predator by experimentally placing carcasses with and without cougar (*Puma concolor*) scat and urine and measured coyote (*Canis latrans*) use and behavior via camera traps. In our study system, cougars killed coyotes both as prey and in defense of cached prey, providing in excellent system to evaluate the influence of risks and rewards on foraging behavior of a subordinate predator. We found no effect of cougar scent on the latency to detection (Odds Ratio = 0.85, $p = 0.70$) nor time from first discovery to contact/feeding (Odds Ratio = 0.86, $p = 0.85$) on the carcasses. Coyotes spent 143% ($p < 0.001$) more time exhibiting vigilance behavior and 46% ($p = 0.18$) less time feeding when in the presence of cougar treatments once a carcass was located. Coyotes also spent 10% ($p = 0.02$) less time in a vigilance state in the cover of darkness. Yet, we found no support for an increase in the frequency of specific vigilance behaviors between treatments. Our results strongly indicate that coyotes are willing to capitalize on risky subsidies in the form of cougar caches and balance risk by increasing the duration and not the frequency of vigilant behavior. These findings improve our understanding of how subordinate predators co-occur with dominant predators.

Spatial ecology and survival of mountain lions on private lands in west Texas

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ABSTRACT

Not much is known about the ecology of mountain lions on private lands in Texas. In recent years, west Texas has seen significant changes in landownership patterns and land management strategies on private lands, exacerbating the need for research to understand the behavior and spatial requirements of mountain lions in this area. We used data collected from GPS collars to evaluate the movements, home range, habitat use, and survival of 20 mountain lions on private lands in west Texas. Survival estimates were calculated in program MARK using a known-fate analysis. To estimate home range size, we calculated 100% Minimum Convex Polygons (MCPs), and also used the program T-LoCoH to estimate 95% and 50% utilization distributions (UDs). Nine monitored mountain lions are known to have died over the course of the study, 7 due to predator control. The annual survival rate was 0.536 (95% CI = 0.311–0.728). The average daily movement rate for all mountain lions was 3.74 km/day (SE = 0.38, n = 20), and ranged between 1.07 km/day and 7.53 km/day for individuals. Mountain lions selected for the highest elevations and most rugged terrain within the Davis Mountains, and within the mountains avoided ecological sites dominated by grass species. We observed long range or dispersal movements for 7 individual mountain lions, 2 of which successfully left the Davis Mountains. Adult MCPs ranged from 24–1036 km^2, and averaged 392 km^2. In general, the MCP home ranges we observed were larger than have been recorded in previous studies of west Texas mountain lions. In the Davis Mountains, MCP's covered on average at least 25 properties (SE = 3, n = 19). Our results indicate the large area and multiple land owners that one mountain lion can impact, and be impacted by, and accentuate the need for a landscape level approach to management of Texas' mountain lions.

Mountain lion social organization

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ABSTRACT
As mountain lion management continues to evolve, there is increasing interest from managers and advocates alike to adapt management to better match the social organization of mountain lions. Intuitively, researchers, managers, and hunters recognize the importance of territorial males in influencing population density and other social structures, but research supporting this intuition is limited. We documented mountain lion social interactions with remote cameras and GPS data. We employed Conditional Uniform Graph (CUG) tests and exponential random graph models (ERGMs) to test assumptions that social interactions in solitary animals are explained by spatial overlap or kinship, as current literature suggests, or more complex social systems associated with social species such as reciprocity. Our results revealed an unexpectedly sophisticated mountain lion social organization. Every mountain lion participated in the network, which was divided into smaller communities explained by the spatial boundaries of territorial males. Overall, conspecific tolerance between mountain lions was best explained by direct reciprocity, establishing a clear benefit to individuals that participated in social behaviors, and hierarchical (transitivity) reciprocity ruled by territorial males. Our work contributes landmark evidence of complex social organization in a solitary carnivore, and an empirical framework for testing hypotheses about the drivers of social behavior in solitary species. Further it provides quantitative evidence of the importance of territorial males in structuring mountain lion populations and smaller societies, useful to managers looking to advance harvest strategies to better support

not just mountain lion population stability, but also the stability of social structures central to the makeup of the species.

Spatial and temporal shifts in cougar presence in the Midwest in response to changing management regimes

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ABSTRACT

In response to increasing activity of mountain lions outside of established ranges in recent decades, the Cougar Network has built a network comprised of the public, state agencies, and researchers to compile physical evidence of mountain lions in the Midwest dating back to 1990. It has long been thought that the Black Hills, SD represents the primary source location for dispersing animals in the North American interior. Using Cougar Network confirmation data, we wished to learn if harvest implementation in the Black Hills, SD in 2005 affected midwestern recolonization, specifically the number of confirmed carcasses in our 13-state study region. We analyzed 117 known-sex carcass confirmations to determine differences in spatial and demographic trends comparing two time frames: before 2005 and after 2005. Compared to before 2005, we found nearly four times the number of carcasses along with a significant clustering pattern, a greater proportion of females, and a 460 km northward shift in the directional distribution of carcass locations in the Midwest region after 2005. Concurrently, we also found that states farther to the west (i.e., Montana, Wyoming, and Colorado) implemented regulations that could result in increased females in their respective populations. These results suggest the Black Hills, SD may not be the most important source of dispersing individuals. Further, our results suggest regional-scale metapopulation connectivity and provide insight for management and public education about the return of this apex predator.

Retroviral infections among North American mountain lions (*Puma concolor*)

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ABSTRACT

North American mountain lions (*Puma concolor*) are known to be infected by a range of pathogens including at least three retroviruses: lentivirus (feline immunodeficiency virus, FIV), spumavirus (feline foamy virus, FFV), and gammaretrovirus (feline leukemia virus, FeLV). In order to investigate the dynamics of these three viruses in the mountain lion host we undertook large scale molecular analyses. Our results highlight differing evolutionary histories, origins and transmission modes for each of these infectious agents. Our findings show that one subtype of FIV found in mountain lions originated from a cross-species transmission from infected bobcats, while another subtype was likely co-introduced to the Florida panther (*Puma concolor coryi*) during Texas puma translocations aimed at genetic rescue. Florida panthers have also been afflicted by multiple outbreaks of FeLV, a pathogen that poses a threat to the single small remaining population of this subspecies. Our findings implicate domestic cats as a source of panther FeLV infections with the circulation of three documented strains and an additional uncommon fatal FeLV subtype. Similarly, genetic analysis of FFV in North American mountain lions supports likely recent introduction(s) from domestic cats. Collectively, these findings show that mountain lions are frequently exposed to retroviral infections from sympatric mesopredators, likely through predation. These interspecific viral transmissions emphasize the important role of domestic animals in dispersal of infectious diseases to wildlife and thereby the importance of monitoring both domestic and wild felids to aid the implementation of management practices and translocation of individuals. Our analysis lends insights into the emergence of pathogenic agents in mountain lion populations exposed to domestic cats, and can inform management actions that may impact mountain lion space use and interactions with domestic animals.

Vertebrate diversity benefiting from carrion provided by mountain lions

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ABSTRACT
Key strategies for building tolerance for controversial carnivores that compete with humans for resources, or threaten (both real and perceived) human safety, include gathering the data necessary to show everyday people the positive roles carnivores play in natural systems. One such contribution is providing carrion, which ecologists are increasingly recognizing as essential in maintaining biodiversity and supporting ecosystem stability. Evidence suggests that mid-trophic felids have evolved to absorb the costs of kleptoparatism by scavengers, and thus, they likely contribute more carrion to ecological communities than other top predators. We employed motion-triggered cameras and GPS technology to monitor vertebrate scavengers at mountain lion kills. We divided scavengers detected at puma kills into four categories based upon two seasons and pre- or post-departure by the mountain lion (Winter PreCat, Winter PostCat, Summer PreCat, Summer PostCat); then we compared Shannon's Index (*H*) across categories to see whether they supported different levels of biodiversity. We also ranked species detected scavenging at kills, and calculated Kendall's tau coefficients and abundance-based Sorensen's indices to test whether each category supported the same or different scavenger species. We documented 38 species of birds and mammals that benefited from mountain lion kills—more than any other scavenger study in the world and triple the diversity documented on wolf kills in Yellowstone NP. Diversity metrics did not differ across our four categories, but rank did, emphasizing that each season and pre versus post cat departure supported different scavenger assemblages. In conclusion, mountain lion evolution and behaviors make them disproportionately important producers of carrion for their respective ecological communities. Mountain lions play an important and positive role through predation—stabilizing food webs through scavenger vectors—and this information should be used to help promote stable mountain lion populations and to address negativity in areas where mountain lions are recolonizing former range.

Business Meeting

A brief, 10-minute meeting of agency representatives was held immediately following the final workshop session. The only item of discussion was determination of the host for the next mountain lion workshop. Oregon Department of Fish and Wildlife offered to serve as the host, and was selected by unanimous vote.