PROCEEDINGS OF THE 13TH MOUNTAIN LION WORKSHOP

April 4-7, 2022

Virtual

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And

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WORKSHOP PARENT ORGANIZATION AND HOST

LOGO DESIGN

Rachel Wheat, Oregon Department of Fish and Wildlife

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EXECUTIVE SUMMARY

The Mountain Lion Workshop is held every three years sanctioned by the Western Association of Fish and Wildlife Agencies (WAFWA). The workshop provides a forum where leading mountain lion managers and researchers share research results, management strategies, and emerging issues in the realms of mountain lion management throughout North America.

The 13th Mt Lion Workshop was hosted virtually April 4-7, 2022 by the Oregon Department of Fish and Wildlife (ODFW). The event was originally scheduled to take place in 2020 in Hood River, Oregon three years after the 12th workshop held in Estes Park, Colorado in 2017. However, the COVID-19 global pandemic resulted in the in-person meeting being first delayed to 2021 and then ultimately held virtually in 2022 to avoid any additional complications with travel and accommodations.

To ensure a quality product and experience, the workshop contracted with Delaney Meeting & Event Management to develop the meeting platform, handle registrations, and coordinate the logistics of the digital meeting. Additional advertising of the event occurred and a group discount was offered in an attempt to ensure a robust turnout for a virtual event that was two-years delayed and occurring during a global pandemic. These efforts were successful in helping increase attendance.

To reduce webinar fatigue, the daily agenda for each of the four days was limited to five hours (six hours the date of the poster session) and start/end times were set to accommodate the numerous time zones of attendees. The daily agenda also had numerous breaks and jurisdiction reports were spread across all four days, producing about four hours of content each day. The workshop included a plenary address by Dr. Dan Edge of Oregon State University, seven oral sessions, three poster sessions, two panel discussions, and state/province jurisdiction reports. The workshop logo was created by Rachel Wheat (ODFW).

Five different registration options were available (early bird, regular, student, daily, and group rate) and the workshop had a total of 225 attendees. About half of the attendees were affiliated with state/province wildlife agencies. There were ten sponsors which included two complimentary registrations among other things. In the business meeting, there was an overview of registrations, budgets, and jurisdiction reports and the New Mexico Fish and Wildlife was nominated to host the 14th workshop (pending agency approval).

SCHEDULE AT A GLANCE

Monday, April 4th	
9:00am - 9:10am	**Welcome and Housekeeping Remarks** *Derek Broman, Oregon Department of Fish and Wildlife*
9:10am - 9:20am	**Opening Remarks** *Curt Melcher, Director, Oregon Department of Fish and Wildlife*
9:20am - 10:00am	**Keynote Presentation** *Dan Edge*
10:00am - 11:25am	**Jurisdiction Reports**
10:00am - 10:10am	Alberta *Paul Frame, Government of Alberta, Environment and Parks*
10:10am - 10:20am	Arizona *April Howard, Arizona Game and Fish Department*
10:20am - 10:30am	British Columbia *Garth Mowat, BC Wildlife and Habitat Branch*
10:30am - 10:45am	BREAK
10:45am - 10:55am	California *Justin Dellinger*
10:55am - 11:05am	Colorado *Mark Viera, Colorado Parks and Wildlife*
11:05am - 11:15am	Idaho *Katie Oelrich, Idaho Fish and Game*
11:15am - 11:25am	Florida *Mark Lotz, Florida Fish and Wildlife Conservation Commission*
11:25am - 12:05pm	**Monitoring/Techniques I**
11:25am - 11:45am	Counting Cougars in a Temperate Rainforest: The Olympic Cougar Project *Cameron Macias, University of Idaho*
11:45am - 12:05pm	The Challenges of Cougar Research in the Temperate Rainforest of Coastal Oregon *Jason Kirchner, Oregon Department of Fish and Wildlife*
12:05pm - 12:40pm	BREAK
12:40pm - 2:00pm	**Competition**
12:40pm - 1:00pm	A Seasonal Pulse of Ungulate Neonates Influences Space Use by Carnivores in a Multi-predator, Multi-prey System. *Joel Ruprecht, Oregon State University*
1:00pm - 1:20pm	Spatial Consequences in Cougar Diel Activity and Habitat Selection Following Wolf Recolonization in Oregon *Elizabeth Orning, Oregon State University*
1:20pm - 1:40pm	Carnivores Coexist Through Fine-scale Avoidance in a Forested Landscape *Tavis Forrester, Oregon Department of Fish and Wildlife*
1:40pm -2:00pm	Attraction, Avoidance, and Death: Cougars Both Suppress and Facilitate Other Carnivores *Joel Ruprecht, Oregon State University*

Tuesday, April 5th	
9:00am - 9:05am	**Announcements** *Derek Broman, Oregon Department of Fish and Wildlife*
9:05am - 9:10am	**Welcome to Day Two** *Zach Lowe, WAFWA Executive Director*
9:00am - 9:50am	**Jurisdiction Reports**
9:10am - 9:20am	Kansas *Matt Peek, Kansas Dept of Wildlife and Parks*
9:20am - 9:30am	Montana *Molly Parks, Montana Fish, Wildlife, and Parks*
9:30am - 9:40am	Nebraska *Sam Wilson, NE Game and Parks Commission*
9:40am - 9:50am	Nevada *Pat Jackson, Nevada Department of Wildlife*
9:50am - 10:30am	**Monitoring/Techniques II**
9:50am - 10:10am	Population Estimates of Mountain lions in California *Justin Dellinger*
10:10am - 10:30am	Cougar Use of Residential Areas and Interactions with People in Periods of Population Stability and Growth *Brian Kertson, Washington Department of Fish and Wildlife*
10:30am - 10:45am	BREAK
10:45am - 12:05pm	**Panel 1: Legal Risk in Managing Human Safety** *Kyle Maynard, State of Utah*
12:05pm - 12:40pm	BREAK
12:40pm - 2:00pm	**Diet**
12:40pm - 1:00pm	The Influence of Man-made Water Sources on Puma Kill Site Locations and Prey Composition *Hunter Prude, Turner Biodiversity*
1:00pm - 1:20pm	Habitat Diversity Influences Puma Diet in the Chihuahuan Desert *Hunter Prude, Turner Biodiversity*
1:20pm - 1:40pm	The Influence of Pyrodiversity on Mountain Lion Behavior in a Human-dominated Landscape *Rachel Blakey, UCLA*
1:40pm - 2:00pm	Cougar Density, Diet, and Kill Site Selection Across the Fire-prone Southern Interior of British Columbia, Canada *Siobhan Darlington, University of British Columbia Okanagan*
2:00pm - 3:00pm	**Poster Session & Ted Craddock Achievement Recognition**
2:00pm – 2:10pm	Ted Craddock Achievement Recognition
	Poster Breakout Room: Monitoring, Modeling, and Data Management
	The Influence of Population Demography, Prey Availability, and Seasonality on Puma Prey Selection Across Six Multiprey Systems
	Cougar Connectivity in Action
	Resource Selection by Mountain Lions at Feeding Sites in relation to Development, Fencing, and Natural Landscape Features
	Comparing and integrating GPS- and stable isotope-based carnivore diet estimation methods
	Poster Breakout Room: Population Interactions & Ecology
	Compositional Changes in Cougar Prey Utilization Following Changes in Availability of Primary Prey: A Preliminary Look
	Predation of cougar kittens (PUMA CONCOLOR) by American black bears (URSUS AMERICANUS)
	Assessing the sustainability of cougar hunting in British Columbia, Canada
	Effects of puma activity, habitat characteristics, and disturbance on coyote activity

	Interactive Effects of Puma Activity and Habitat Characteristics on Mesocarnivore Community Structure
	Poster Breakout Room: Public Interface and Collaboration
	EarthRanger: Cutting-edge technology for mountain lion monitoring on the Olympic Peninsula
	Providing the best care for non-releasable mountain lions
	Interpreting Mt. Lions in the National Park Service

Wednesday, April 6th	
9:00am - 9:10am	**Announcements** *Derek Broman, Oregon Department of Fish and Wildlife*
9:10am - 9:50am	**Jurisdiction Reports**
9:10am - 9:20am	New Mexico *Rick Winslow, New Mexico Department of Game and Fish*
9:20am - 9:30am	North Dakota *Stephanie Tucker, North Dakota Game and Fish Department*
9:30am - 9:40am	Oregon *Derek Broman, Oregon Department of Fish and Wildlife*
9:40am - 9:50am	South Dakota *Andrew Lindbloom, South Dakota Game, Fish, and Parks*
9:50am - 10:30am	**Lion-Bear Interactions**
9:50am - 10:10am	Recolonizing Carnivores: Is Cougar Predation Behaviorally Mediated by Bears? *Jon Beckmann, KDWP*
10:10am - 10:30am	The Effects of Scavenging Black Bears on Cougar Feeding and Vigilance Behaviors *Kristin Engebretsen, Utah State University*
10:30am - 10:45am	BREAK
10:45am - 12:05pm	**Panel 2: Wildlife-Human Attacks, Incident Response, and Wildlife Forensics: Lessons Learned** *Brain Wolfer, Oregon Department of Fish and Wildlife*
12:05pm - 12:40pm	BREAK
12:40pm - 2:00pm	**Policy/Management**
12:40pm - 1:00pm	Navigating Cougar Management Policy in the Era of Wildlife Culture Wars *Kim Thorburn, Washington Fish & Wildlife Commission*
1:00pm - 1:20pm	WAFWA Cougar Book *Terry Messmer, Berryman Institute*
1:20pm - 1:40pm	Montana Mountain Lion Monitoring and Management Strategy *Molly Parks, Montana Fish, Wildlife and Parks*
1:40pm - 2:00pm	Increased Quota Harvest Appears to have Redistributed Human Caused Mortality in Alberta, Canada Paul Frame, Government of Alberta, Environment and Parks

Thursday, April 7th	
9:00am - 9:10am	**Announcements** *Derek Broman, Oregon Department of Fish and Wildlife*
9:10am - 9:50am	**Jurisdiction Reports**
9:10am - 9:20am	Texas *Dana Karelus, Texas Parks and Wildlife*
9:20am - 9:30am	Utah *Darren DeBloois, Utah Division of Wildlife Resources*
9:30am - 9:40am	Washington *Rich Beausoleil, Washington Dept. of Fish & Wildlife*
9:40am - 9:50am	Wyoming *Dan Thompson, Wyoming Game and Fish Department*
9:50am - 11:05am	**Tools**
9:50am - 10:10am	Evaluating and Integrating Spatial Capture–recapture Models with Data of Variable Individual Identifiability *Tavis Forrester, Oregon Department of Fish and Wildlife*
10:10am - 10:30am	Developing a Cougar Habitat Connectivity Model for the Cascades to Coast Ecoregion of Washington State *Glen Kalisz, Washington State Department of Transportation*
10:30am - 10:45am	BREAK
10:45am - 11:05am	Use of Automated Classification Techniques on Camera-trap Videos to Identify Disease (Feline Leukomyelopathy or FLM) in Florida Panthers (Puma concolor coryi) *Sam Kelly, Conservation X Labs*
11:05am - 1:20pm	**Conservation/Outreach**
11:05am - 11:25am	Conservation Challenges for a Small Mountain Lion Population Near Los Angeles: Conflict with Domestic Animals and New Evidence of Inbreeding Depression *Jeff Sikich, National Park Service*
11:25am - 11:45am	Response of Mountain Lions to Increased (massive wildfire) and Reduced (Covid-19 shutdown) Disturbance in a Major Metropolitan Area *Seth Riley, National Park Service*
11:45am - 12:00pm	Statewide Survival and Spatially-Varying Mortality Risk for Mountain Lions in California *John Benson, University of Nebraska-Lincoln*
12:05pm - 12:40pm	BREAK
12:40pm - 1:00pm	Mountain Lion Resource Selection Relative to Mortality Risk at a Multiple Scales *Kyle Dougherty, University of Nebraska Lincoln, California Department of Fish and Wildlife*
1:00pm - 1:20pm	Supporting Communities of California in Coexisting With Cougars *Korinna Domingo, Cougar Conservancy*
1:20pm - 1:25pm	**Closing** *Derek Broman, Oregon Department of Fish and Wildlife*
1:25pm - 2:00pm	**Business Meeting**

HOST WELCOME MESSAGE AND HOUSEKEEPING

Welcome to WAFWA's 13th Mt Lion Workshop. I'm Derek Broman, the Carnivore Furbearer Coordinator for the Oregon Department of Fish and Wildlife and on behalf of the host agency, thank you for joining us.

Our last Mt Lion workshop was May 2017 so we're very excited to reconvene nearly 5 years later! With this workshop to originally take place in early 2020, we very much appreciate everyone's patience with multiple postponements. We joke that maybe had we skipped calling it the 13th and just moved onto 14, perhaps we wouldn't have had two years of delays and a virtual meeting. So, although we still wish this were occurring in-person, we're nonetheless very happy today has finally arrived!

We have an exciting workshop lined up with a wide breadth of topics, speakers, and geographic scope; including hot topic jurisdiction reports from nearly 20 states and provinces, a welcome from the new WAFWA Executive Director, two guest panels, a poster session, nearly 30 oral presentations. An objective of the abstract review committee was to prioritize content with valuable, thought-provoking take-home messages to this diverse audience of biologists, researchers, and enthusiasts, so we're hoping you come away with a lot of vital knowledge to last you for years to come. Thank you very much to everyone who submitted abstracts!

We also want to thank our sponsors: Advanced Telemetry Systems, The Berryman Institute, the Congressional Sportsmen's Foundation, Conservation X Labs, Dallas Safari Club, the Mt Lion Foundation, the OHA, the Oregon Wildlife Foundation, Tomahawk Live Trap, and the ODFW. Everyone please take time to stop by the sponsors booths, especially during breaks for opportunities to see demos and chat with our sponsors' representatives.

KEYNOTE PRESENTATION

Reflections on Mountain Lion Management, Research, and the Fisheries and Wildlife Professions

W. Daniel Edge, Professor Emeritus, Department of Fisheries, Wildlife, and Conservation Sciences, Oregon State University, Corvallis, OR 97331, USA

Biography

Dr. Dan Edge is Professor Emeritus of Wildlife Ecology in the Department of Fisheries, Wildlife, and Conservation Sciences at Oregon State University. He retired last year after a 32-year career with OSU. During his career Dan served as the state's Wildlife Extension Specialist, was the first Bob and Phyllis Mace Professor of Watchable Wildlife and was a national pioneer in distance education. His research focused on habitat and population ecology of mammals in forest and agricultural ecosystems. Dan spent his last 20 years as a university administrator: 13 years as department head of Fisheries and Wildlife Sciences, and seven years as associate dean of the College of Agricultural Sciences. Dan has authored or co-authored over 100 publications, and produced over 40 educational videos, and mentored 26 graduate students most of whom are employed by universities or state or federal agencies. Dan's service activities include serving as President of the Oregon Chapter of The Wildlife Society and Northwest Section Representative to The Wildlife Society Council, President of the National Association of University Fish and Wildlife Programs, Chair of the Association of Public and Land-Grant Universities Board on Natural Resources, Co-Chair of the Oregon Scientific Review Task Force, and President of the OSU Faculty Senate. He is a Certified Wildlife Biologist, Fellow of The Wildlife Society, Distinguished Alumnus of the University of Montana's College of Forestry and Conservation and recipient of numerous national awards. Dan was also on the Oregon Fish and Wildlife Commission and 3 years as Chair, during some of the most contentious years of cougar conservation and management in Oregon.

Abstract

I reflect on changes in mountain lion (Puma concolor) management, science, and policy, and on the changing nature of the fish and wildlife professions that have occurred during my career. Specifically, I (1) provide a context for factors that make predator and specifically mountain lion management challenging; (2) offer observations concerning some of the emerging or continuing issues in mountain lion management; (3) review changes in science related to mountain lions; and (4) discuss the changing face of the fish and wildlife professions. Predator management is controversial, resulting in a high degree of polarization among stakeholders. Polarization is caused by social media and stakeholder reticence to engage in authentic dialogue, rural versus urban attitudes regarding predator management, and the changing nature of mountain lion-human conflicts. This polarization may be reduced by better incorporating human dimensions in the development of policies and management programs. Statutory mandates of fish and wildlife commissions may constrain the decision space around mountain lion management—some options advocated for by certain stakeholders may be outside the sideboards set by state statue. Ballot initiatives are a poor way to resolve stakeholder positions and have resulted in unanticipated consequences. Mountain lion studies over the past 20 years differ substantially from earlier studies with respect to study design, size, scope, and duration. Innovative approaches to data analysis provide wildlife managers

with more flexibility in managing the species and greater certainty regarding the outcomes of management decisions. I discuss the precautionary principle as applied to mountain lion management, the need for density estimates, and the debate around mountain lion impacts on prey populations. The composition and characteristics of students entering fish and wildlife university programs have changed significantly over the past 10 years and so have university curricula. I argue that these changes will result in agency biologists well suited to managing predators.

ORAL SESSION: MONITORING/TECHNIQUES I

Counting Cougars in a Temperate Rainforest: The Olympic Cougar Project

Cameron Macias, University of Idaho

ABSTRACT: As a sovereign nation, the Lower Elwha Klallam Tribe (LEKT) sets annual harvest regulations that differ from those of Washington State. Until now, however, no data had been collected on predator populations in the tribe's historic use area and we lacked information for setting sustainable tribal harvest regulations. To address this data gap, we established the Olympic Cougar Project in 2018 and are using a combination of noninvasive genetic sampling, GPS radio collars, and a camera grid to estimate abundance and observe dispersal patterns of sub-adult cougars (Puma concolor) on the Olympic Peninsula. First, we used scat-detection dogs to locate and collect felid scat samples across our 606 km2 study area. Of the 665 scat samples collected during 2018-2020, we had a 92% success rate for genetic species identification and identified 168 cougar scats and 424 bobcat (Lynx rufus) scats. Of the 168 cougar scats, we had a 49% success rate for genetic individual identification using 11 microsatellite loci and identified a minimum count of 27 individual cougars in our study area across all three years. Second, we equipped 11 adult (6 male and 5 female) and 4 sub-adult (2 male and 2 female) cougars with GPS radio collars in our study area between 2018-2022 to observe movement and dispersal patterns and to estimate a minimum count of cougars using home range overlap estimation. Third, we deployed a 74-camera grid each summer during 2019-2021 to estimate cougar abundance using space-to-event modeling. Statistical analyses are ongoing. This research will provide the first estimates of cougar abundance in the LEKT's historic use area. Moving forward, cameras can provide the tribe with a noninvasive and cost-effective approach for enumerating and monitoring cougars if we can demonstrate that cameras can produce estimates of cougar abundance that are comparable to established enumeration methods.

The Challenges of Cougar Research in the Temperate Rainforest of Coastal Oregon

Jason Kirchner, Oregon Department of Fish and Wildlife

ABSTRACT: We are conducting a cougar population density, home range, and habitat use study on the Oregon coast, initiated in August 2017. Field sampling was completed in July 2021 and data analysis is ongoing. Over the last two decades, increasing cougar harvest, sightings, damage, and human safety complaints have necessitated a need for population density estimates. Cost-effective and noninvasive sampling strategies were a priority. We initially employed data collection methodologies that proved successful in other areas but had not been tested on the Oregon coast. We first utilized a contractor with conservation detection dogs to locate cougar scat for DNA analysis. However, we found that scat samples were difficult to locate due to a lack of distinct travel paths and dense vegetation. We quickly dropped this method due to an insufficient sample size. The Coast Range lacks the

long-exposed ridgelines and the heterogeneous habitat found in eastern Oregon where scat collection has been successful. We suspect the dense coastal vegetation (e.g., blackberry, salmonberry, etc.) limits the mobility of the detection dogs, prevents scat scent from dispersing, and speeds up decomposition rates. We adapted the study design and began using hair snares and bio-darting to collect tissue samples. Two different methods of hair snare setups (barbed wire cubbies and gun brushes) were utilized to capture DNA samples. The study area (2,778 km^2) was divided into 50 grids for random sampling. Ultimately, hair was collected at only 9 grid sites providing an insufficient sample size for analysis. Bio-darting and GPS collaring via volunteer houndsmen was the third and final method attempted. While time and effort-intensive, it proved to be successful, with 71 bio-dart and 25 ear tissue samples collected. Additionally, we genotyped 148 DNA samples from hunter-harvested and road-killed cougars to serve as recaptures. Flexibility and adaptability in sample design were critical to the success of this project. When one method fails, learn from it, and move forward!

ORAL SESSION: COMPETITION

A seasonal pulse of ungulate neonates influences space use by carnivores in a multi-predator, multi-prey system

Joel Ruprecht, Oregon State University

ABSTRACT: Understanding the extent to which predators engage in active search for prey versus incidentally encountering them is important because active search can exert a stabilizing force on prey populations by alleviating predation pressure on low-density prey and increasing it for high-density prey. Parturition of many large herbivores occurs during a short and predictable temporal window in which young are highly vulnerable to predation. Our study aims to determine how a suite of carnivores responds to the seasonal pulse of newborn ungulates using contemporaneous GPS locations of four species of predators and two species of prey. We used step-selection functions to assess whether coyotes, cougars, black bears, and bobcats actively searched for parturient females in a low-density population of mule deer and a high-density population of elk. We then assessed whether searching carnivores shifted their habitat use toward areas exhibiting a high probability of encountering neonates. None of the four carnivore species encountered parturient mule deer more often than expected by chance suggesting that predation of young resulted from incidental encounters. By contrast, we determined that cougar and male bear movements positioned them in proximity of parturient elk more often than expected by chance which is evidence of searching behavior. Although both male bears and cougars searched for neonates, only male bears used elk parturition habitat in a way that dynamically tracked the phenology of the elk birth pulse suggesting that maximizing encounters with juvenile elk was a motivation when selecting resources. Our results support the existence of a stabilizing mechanism to prey populations through active search behavior by predators because carnivores in our study searched for the high-density prey species (elk) but ignored the low-density species (mule deer). We conclude

that prey density must be high enough to warrant active search, and that there is high interspecific and intersexual variability in foraging strategies among large mammalian predators and their prey.

Spatial consequences in cougar diel activity and habitat selection following wolf recolonization in Oregon

Elizabeth Orning, Oregon State University

ABSTRACT: After a 40-year absence from Oregon's landscape, expanding gray wolf (Canis lupus) populations have reestablished elements of interspecific competition with sympatric large carnivores, including cougars (Puma concolor). Interspecific competition can affect the predation patterns, spatial distribution, and population dynamics of a subordinate predator. We evaluated activity patterns and habitat selection for subordinate cougars before recolonization occurred (2009-2012), and for wolves and cougars after wolves recolonized (2014-2018). We compared cougar movement rates (km/hr) and habitat selection based on 43,649 and 54,904 GPS relocations of cougars in pre- and post-wolf periods, respectively. We also compared diel activity of cougars pre- and post-wolf, with patterns generated from 41,124 concurrent wolf GPS relocations. Cougar movement and diel activity differed between time periods. Cougars moved shorter distances per 3-hr time step with wolves on the landscape ($\bar{x}$pre = 0.60 km, 90%CI = 0.49-0.70, $\bar{x}$post = 0.43 km, 90%CI = 0.38-0.47, %P = 0.34). Cougar activity over the diel cycle changed from peak movement rates occurring in the evening followed by night > day > morning, to peak rates of activity occurring in the evening > morning > night > day, with wolves on the landscape. We also found that female cougars selected for less open habitats in winter after wolf recolonization (%P = 0). Our results demonstrated how cougars changed aspects of their activity and provide evidence male and female cougars engaged in different competition mitigation strategies. The patterns we observed reflected an optimal foraging strategy that could balance fitness costs of competition with wolves in areas of sympatry. As wolf populations continue to expand, additional research is needed to clarify behavioral and population responses of shared ungulate prey in the context of dynamic interactions between coexisting carnivore populations.

Evaluating and integrating spatial capture-recapture models with data of variable individual identifiability

Tavis Forrester, Oregon Department of Fish and Wildlife

ABSTRACT: Spatial capture–recapture (SCR) models have become the preferred tool for estimating densities of carnivores. This group of models includes variants requiring identification of all individuals in each encounter (SCR), a subset of individuals only (generalized spatial mark–resight, gSMR), or no individual identification (spatial count or spatial presence–absence). The consistency and relative precision of estimates across methods vary in real-world settings. We tested a suite of models including those only requiring detections of unmarked individuals to others that integrate remote camera, physical capture, genetic, and global positioning system (GPS) data into a hybrid model to estimate population densities of black bears, bobcats, cougars, and coyotes. For each species, we genotyped fecal

DNA collected with detection dogs during a 20-d period. A subset of individuals from each species was affixed with GPS collars bearing unique markings and resighted by remote cameras over 140 d contemporaneous with scat collection. Camera-based gSMR models produced density estimates that differed by <10% from genetic SCR for bears, cougars, and coyotes when controlling for important sources of variation (sex or behavioral status). The cause of the discrepancies in estimates was likely attributable to challenges designing a study compatible for species with disparate home range sizes and the difficulty of collecting sufficient data in a timeframe in which demographic closure could be assumed. Unmarked models estimated densities that varied greatly from SCR, but estimates became more consistent in models wherein more individuals were identifiable. Hybrid models containing all data sources exhibited the most precise estimates for all species. For best results, we further recommend the use of methods requiring at least a subset of the population is marked and that multiple data sets are incorporated when possible.

Attraction, Avoidance, and Death: Cougars Both Suppress and Facilitate Other Carnivores

Joel Ruprecht, Oregon State University

ABSTRACT: Mesopredator release theory suggests that dominant predators such as cougars suppress subordinate carnivores and ultimately shape community dynamics, but the assumption that subordinate species are only negatively affected ignores the possibility of facilitation through scavenging. We examined the interplay within a carnivore community consisting of cougars, coyotes, black bears, and bobcats using contemporaneous Global Positioning System telemetry data from 51 individuals; diet analysis from 972 DNA-metabarcoded scats; and data from 128 physical investigations of cougar kill sites, 28 of which were monitored with remote cameras. Resource provisioning from competitively dominant cougars to coyotes through scavenging was so prolific as to be an overwhelming determinant of coyote behavior, space use, and resource acquisition. This was evident via the strong attraction of coyotes to cougar kill sites, frequent scavenging of cougar-killed prey, and coyote diets that nearly matched cougars in the magnitude of ungulate consumption. Yet coyotes were often killed by cougars and used space to minimize encounters, complicating the fitness benefits gained from scavenging. We estimated that 23% (95% CI: 8 to 55%) of the coyote population in our study area was killed by cougars annually, suggesting that coyote interactions with cougars are a complex behavioral game of risk and reward. In contrast, we found no indication that bobcat space use or diet was influenced by cougars. Black bears avoided cougars, but there was no evidence of attraction to cougar kill sites and much lower levels of ungulate consumption and carcass visitation than for coyotes. Interspecific interactions among carnivores are multifaceted, encompassing both suppression and facilitation.

ORAL SESSION: MONITORING/TECHNIQUES II

Population Estimates of Mountain Lions in California

Justin Dellinger, California Department of Fish and Wildlife

ABSTRACT: Estimating mountain lion population size has historically been achieved by capturing, radio-collaring, and tracking mountain lions in localized areas. This method is very costly, resource intensive, and mathematically difficult to derive associated variance and confidence interval estimates. Advances in non-invasive sampling techniques, and associated genetic and computational methods, are allowing wildlife managers to derive more scientifically robust population estimates of elusive and low-density species like mountain lions across broad spatial scales. We conducted non-invasive fecal DNA collection efforts in 12 areas, averaging 2,700 km2 each, across California and used subsequent genetic results to conduct spatial-capture-recapture analyses. We then used radio-collar data to inform the spatial parameter of the non-invasive approach. This integrated modeling yielded mountain lion density and abundance estimates regionally and statewide. Our statewide model estimated an average density of 1.15 (0.95-1.46) mountain lions per 100 km2 of suitable habitat, for a statewide estimate of 4,738 (3,921-5,997) individuals, with a male to female ratio of 1:1. Regional densities varied slightly with the northwest and eastern Sierra-Nevada having the highest (>1.5/100 km2) and lowest (<1.0/100 km2) densities, respectively. These results demonstrate that current field, genetic, and computational methods can produce scientifically robust estimates and allow for more cost-effective long-term population monitoring of elusive, and relatively low-density large carnivore species across large spatial scales. Our work also shows density can be relatively consistent across a gradient of amount of available habitat (e.g., isolated patches to large contiguous blocks) and that a robust density estimate does not inherently indicate a healthy population (e.g., low heterozygosity from limited habitat and gene flow). We demonstrate that wildlife managers seeking to accurately determine population status of wide-ranging large carnivores like mountain lions must account for demographics, genetics, and habitat simultaneously rather than using demographics alone as an indicator of population status. Additional techniques will likely result in higher estimates and smaller confidence intervals.

Cougar Use of Residential Areas and Interactions with People in Periods of Population Stability and Growth

Brian Kerston, Washington Department of Fish and Wildlife

ABSTRACT: The presence of large carnivores close to people poses unique challenges for wildlife managers working to maintain fully functioning ecosystems while simultaneously minimizing potential risks to public safety and private property. In western North America, cougar (Puma concolor) use of residential areas is relatively commonplace and has contributed to undesirable interactions with people. A common assumption is that cougar population growth translates into greater proximity to people and more interactions, but to our knowledge direct evaluation of this assumption has not occurred. We used GPS telemetry locations and confirmed cougar-human interaction reports to construct single-sex Leslie matrices, utilization distributions and a two-stage hurdle model within a Bayesian framework to investigate the effects of population trajectory on cougar use of residential areas and interactions with people in a wildland-urban system in western Washington. We collected data during two time periods with different expected population growth rates, anticipating greater cougar use of residential areas and more interactions during the period of increased growth. Contrary to our initial expectations, we did not detect meaningful differences in cougar presence in residential areas or the number of interactions between study periods. Instead, we documented consistent space use patterns by all demographic classes that seemed to be governed by different life history strategies. Interactions with humans were largely a function of individual cougar behaviors during both study periods. The consistent presence of abundant, well-connected wildlands coupled with cougar dispersal likely mitigated the potential effects of population trajectory as the increased expected growth rate in Period 2 manifested primarily as subadult emigration via wildlands. Cougar management in wildland-urban environments would benefit from the application of strategies that address the complex interplay of biological and anthropogenic factors that contribute to cougar presence in residential areas and their likelihood of interacting with people.

ORAL SESSION: DIET

The Influence of Man-made Water Sources on Puma Kill Site Locations and Prey Composition

Hunter Prude, Turner Biodiversity

ABSTRACT: Man-made water sources have been developed for wildlife in arid regions since the mid 1900's. Although wildlife are generally considered to benefit from water development, there is very little known about how the provision of man-made water influences predator-prey dynamics. It is possible that the increased abundance of prey and or the habitat features surrounding man-made water sources increase predation risk by puma (Puma concolor). To examine this, puma diet data was compiled from seven study areas in the Chihuahuan and Sonoran deserts to determine the influence of man-made water sources on puma habitat use and kill site locations. The proximities of ungulate kill sites to man-made water sources were compared with areas generally available within puma home ranges. Mixed effects logistic regression was used to determine if the probability of a site being a kill location was related to the proximity to water sources and or other habitat characteristics. While pumas did not appear to be exploiting the predictable prey visitation of man-made water sources, they were capitalizing on the restricted distribution of prey within 5 km of water sources. At the home range scale, puma use areas proximate to water sources that likely have increased prey abundance and higher probabilities of encountering prey for hunting. Within the home range, pumas select fine scale habitat features, such as woody cover, that enhance their ability to stalk, ambush, and effectively kill prey.

Habitat Diversity Influences Puma Diet in the Chihuahuan Desert

Hunter Prude, Turner Biodiversity

ABSTRACT: Several studies report on puma diets in the arid regions of the southwestern United States within homogenously xeric locations, overlooking landscape diversity generated by riparian forests. Such habitat heterogeneity and corresponding prey diversity could influence puma habitat use, prey availability and diet composition. Therefore, we examined puma diet in New Mexico, at sites representing riparian areas adjacent to the Rio Grande and xeric Chihuahuan Desert uplands. We determined seasonal prey composition and described differences in prey composition between pumas occupying distinct cover typeshabitats. We collected prey composition data from 686 kill sites made by GPS-collared pumas on the Armendaris Ranch and Sevilleta National Wildlife Refuge from 2014 to 2018. Diet composition included 32 different avian, aquatic, small mammal and ungulate prey species. Prey composition varied, with more ungulate prey being consumed by pumas inhabiting the upland desert areas and more aquatic prey consumed in the riparian bosque. Prey composition differed between seasons, as ungulate prey decreased and aquatic prey increased during the hot-dry season. Diet varied between puma sex and habitat with females in the desert uplands consuming more small mammals than either males or females in riparian areas. Game

managers remove puma primarily for livestock depredation and management of game species (e.g., bighorn sheep). We found, however, that pumas have generalist diets, strongly influenced by the habitat and corresponding prey community their home range encompass. Puma management can improve by accounting for puma habitat locations and their diet availability.

Cougar Density, Diet, and Kill Site Selection Across the Fire-Prone Southern Interior of British Columbia, Canada

Siobhan Darlington, University of British Columbia Okanagan

ABSTRACT: In the southern interior of British Columbia, cougars (Puma concolor) are the main proximate source of mortality for declining mule deer (Odocoileus hemionus) and bighorn sheep (Ovis canadensis) populations. Habitat disturbance from forestry, roads, agriculture, and wildfire are cumulatively changing the landscape for predators and their prey annually. The role of these disturbance types in mediating cougar predation is not well understood. The objectives of this study are to measure seasonal differences in cougar diet, habitat use, and movement in response to landscape change. To do this, we deployed 40 GPS collars on adult cougars across three study areas along the international boundary in southern BC; these include the West Okanagan (5,800 km2) eastward to the Boundary (5,200 km2), and the Kootenays (3,800 km2). Each area varies in predator and prey communities, habitat disturbance, and hunting pressure on cougars. We identified cougar kills by visiting cluster sites, groups of GPS points that indicate an area used by a cougar for at least 12 hours. To date we have investigated 925 cougar cluster sites, identifying 612 kills from 35 individuals. Mule deer were the largest proportion of prey killed in the West Okanagan but kills shift gradually towards white-tailed deer (Odocoileus virginianus) and elk (Cervus elaphus) in more easterly locations. The next steps on the project include modeling seasonal habitat and kill site selection of GPS-collared cougars. We are also collecting population data including density, survival, reproduction, dispersal, and harvest rates for cougars. Collectively, these data will be used to inform provincial wildlife managers on the effects of human and natural disturbance types on cougar populations, and their predation pressure on ungulates in southern British Columbia.

ORAL SESSION: LION-BEAR INTERACTIONS

Recolonizing Carnivores: Is Cougar Predation Behaviorally Mediated by Bears?

Jon Beckman, Kansas Department of Wildlife and Parks

ABSTRACT: Conservation and management efforts have resulted in population increases and range expansions for some apex predators, potentially changing trophic cascades and foraging behavior. Changes in sympatric carnivore and dominant scavenger populations provide opportunities to assess how carnivores affect one another. Cougars (Puma concolor) were the apex predator in the Great Basin of Nevada, USA, for over 80 years. Black bears (Ursus americanus) have recently recolonized the area and are known to heavily scavenge on cougar kills. To evaluate the impacts of sympatric, recolonizing bears on cougar foraging behavior in the Great Basin, we investigated kill sites of 31 cougars between 2009 and 2017 across a range of bear densities. We modeled the variation in feeding bout duration (number of nights spent feeding on a prey item) and the proportion of primary prey, mule deer (Odocoileus hemionus), in cougar diets using mixed- effects models. We found that feeding bout duration was driven primarily by the size of the prey item being consumed, local bear density, and the presence of dependent kittens. The proportion of mule deer in cougar diet across all study areas declined over time, was lower for male cougars, increased with the presence of dependent kittens, and increased with higher bear densities. In sites with feral horses (Equus ferus), a novel large prey, cougar consumption of feral horses increased over time. Our results suggest that higher bear densities over time may reduce cougar feeding bout durations and influence the prey selection trade- off for cougars when alternative, but more dangerous, large prey are available. Shifts in foraging behavior in multicarnivore systems can have cascading effects on prey selection. This study highlights the importance of measuring the impacts of sympatric apex predators and dominant scavengers on a shared resource base, providing a foundation for monitoring dynamic multipredator/scavenger systems.

The Effects of Scavenging Black Bears on Cougar Feeding and Vigilance Behaviors

Kristin Engebretsen, Utah State University

ABSTRACT: Managing the complexities of multi-predator and multi-prey communities is a frequent challenge for wildlife agencies. As predator populations grow, decline, or shift in range, subsequent changes in intraguild competition may occur and have cascading effects, including impacts to highly valued prey species. Cougars (Puma concolor) are the apex predator in parts of their widespread range. Cougars hunt solitarily and cache large kills for feeding over multiple days. However, they can be displaced from their cached kills by dominant black bears (Ursus americanus). Previous studies have offered conflicting evidence

regarding the potential effects of cougar displacement from their kills on cougar predation rate. In order to better understand the influence that black bears have on cougar predation rate and feeding behavior, we investigated kill sites from GPS-collared mountain lions across a range of black bear densities in Utah. We collected data on feeding behavior and scavenger sign at the cache site and placed trail cameras at active kill sites where prey biomass remained to evaluate cache-site behavior. Specifically, we quantified the time that individuals spent vigilant at a kill compared to their time spent feeding. At sites with higher densities of black bears, we expect to see increased vigilance and reduced feeding efficiency of foraging mountain lions due to higher perceived risk of kleptoparasitism. This vigilance data will be combined with our models on cougar handling time at kill sites to clarify the influence that scavenging bears have on mountain lions within these complex systems.

ORAL SESSION: POLICY/MANAGEMENT

Navigating Cougar Management Policy in the Era of Wildlife Culture Wars

Kim Thorburn, Washington Fish & Wildlife Commission

ABSTRACT: Wildlife policymakers make decisions that incorporate diverse cultural perspectives. Nowhere is the challenge more fraught than policy to guide cougar and other large carnivore management. Some communities express strong opposition to cougar hunting and lethal removals for other management needs, such as human-cougar conflict and imperiled species protection. At the same time, most western states and provinces find cougar populations healthy enough to be classified as game species and provide regulated sport opportunities as well as apply harvest to other management objectives. The cultural clash between groups that don't want cougars killed by humans and those who like to hunt them tends to come before policymakers as arguments about science. Hunting opponents reject extant population monitoring metrics and argue resource-intensive studies, such as density measures, to determine population estimates should be carried out when there is hunting. Such studies provide important biologic information but have limited value in game population monitoring. Policymakers can be best served by a clear understanding of population monitoring methods and their application to regulated hunting, season setting, and other game management. The conflict over lethal removals as a management tool for human-cougar conflict is even more challenging. Opponents limit the concern to statistical risk analysis when, in fact, social and cultural values should predominate in policy decisions about human-cougar and other cougar conflict. The emerging field of human dimensions in wildlife science encompasses long-standing social science methodology. Management studies about human-cougar conflict that consider community values with community-engaged research methods will support policymakers in navigating diverse cultural perspectives. Decision making about cougar management policy informed by community-engaged research can be more equitable, just, and inclusive.

Montana Mountain Lion Monitoring and Management Strategy

Molly Parks, Montana Fish, Wildlife and Parks

ABSTRACT: In 2019, Montana Fish and Wildlife Commission adopted the Mountain Lion Monitoring and Management Strategy, which commits Montana to a more rigorous approach to monitoring and managing lion populations in the state. The strategy uses a Resource Selection Function habitat model to divide the state into 4 biologically meaningful lion ecoregions as the spatial scale of management. Routine field monitoring will occur in the western 3 ecoregions, with 2 successive years of field data collection in each, after which field monitoring efforts rotate to the next ecoregion. FWP uses genetically based spatial capture-recapture (SCR) methods to estimate lion abundance and density in local areas, then extrapolates these estimates to the ecoregion based on the estimated relationship between habitat quality and density. These ecoregional population estimates, along with lion demographic rates from previous research in Montana and age-at-harvest population reconstruction, are incorporated into an integrated population model (IPM) to predict the impact of past and future harvest prescriptions on density in the ecoregion. This analysis process is utilized in an adaptive harvest management process where ecoregional committees composed of diverse stakeholders vested in Montana lion management develop recommendations for measurable population objectives. Ecoregional committee recommendations are forwarded to the Commission to set harvest levels that will meet those objectives. Continued monitoring will estimate the extent to which those population objectives are met and will help to reduce uncertainty represented in the modeling and prediction process, hopefully improving future management decisions. Montana is just completing the first citizen committee process for the Northwest Ecoregion. This presentation will cover their process and recommendations, including field-based monitoring and IPM prediction results.

Increased Quota Harvest Appears to have Redistributed Human Caused Mortality in Alberta, Canada

Paul Frame, Government of Alberta, Environment and Parks

ABSTRACT: In spring of 2016, Alberta Environment and Parks initiated a cougar (Puma concolor) adaptive management project to inform our lion harvest program with Alberta specific data. Alberta's wildlife regulation requires that all human-caused cougar mortality be registered. During the 5-years prior to the project, licensed hunting accounted for 49% of documented cougar mortality. During that time, legal landowner take (19.9%), incidental capture in wolf snares (16.5%), and agency removal (6.3%) were the primary sources of unlicensed cougar mortality provincially.

At the 2017 WAFWA Mountain Lion Workshop, I presented a component of our project designed to test the idea that unlicensed cougar mortalities were lost recreational harvest opportunities such that, if we increase the quota in a given cougar management area, new harvest would be compensatory and we would see reductions in unlicensed sources of mortality. The alternative is that increased quota harvest is additive and total human caused mortality would increase.

To test this, we increased quotas in cougar management area (CMA) 21 for two winter lion seasons (2018, 2019) and compared cause specific mortality to the prior 7 years (2011-2017). Before the treatment, annual male quotas were 3 while the female quota was 2 for 2011-2015 and 3 for 2016-2017 seasons. Our treatment increased the male quota to 12 and the female quota to 6; approximately 46.5% of the estimated adult population in the CMA.

The average annual human-caused cougar mortality the 7 years proceeding our experimental treatment was 22.4 and during the 2 years of our treatment was 23.5. Average quota harvest in the pre-treatment period was 7.7 cats and 14.5 during treatment. The annual average unlicensed mortality pre-treatment was 13.1 lions and 8.0 during treatment. These results suggest we were able to redistribute human caused mortality from unlicensed sources to licensed hunting.

ORAL SESSION: TOOLS

Evaluating and Integrating Spatial Capture–Recapture Models with Data of Variable Individual Identifiability

Tavis Forrester, Oregon Department of Fish and Wildlife

ABSTRACT Spatial capture–recapture (SCR) models have become the preferred tool for estimating densities of carnivores. This group of models includes variants requiring identification of all individuals in each encounter (SCR), a subset of individuals only (generalized spatial mark–resight, gSMR), or no individual identification (spatial count or spatial presence–absence). The consistency and relative precision of estimates across methods vary in real-world settings. We tested a suite of models including those only requiring detections of unmarked individuals to others that integrate remote camera, physical capture, genetic, and global positioning system (GPS) data into a hybrid model to estimate population densities of black bears, bobcats, cougars, and coyotes. For each species, we genotyped fecal DNA collected with detection dogs during a 20-d period. A subset of individuals from each species was affixed with GPS collars bearing unique markings and resighted by remote cameras over 140 d contemporaneous with scat collection. Camera-based gSMR models produced density estimates that differed by <10% from genetic SCR for bears, cougars, and coyotes when controlling for important sources of variation (sex or behavioral status). The cause of the discrepancies in estimates was likely attributable to challenges designing a study

compatible for species with disparate home range sizes and the difficulty of collecting sufficient data in a timeframe in which demographic closure could be assumed. Unmarked models estimated densities that varied greatly from SCR, but estimates became more consistent in models wherein more individuals were identifiable. Hybrid models containing all data sources exhibited the most precise estimates for all species. For best results, we further recommend the use of methods requiring at least a subset of the population is marked and that multiple data sets are incorporated when possible.

Developing a Cougar Habitat Connectivity Model for the Cascades to Coast ecoregion of Washington State

Glen Kalisz, Washington State Department of Transportation

ABSTRACT The Washington Wildlife Habitat Connectivity Working Group (WHCWG) is a science-based collaboration designed to produce tools and analyses that identify opportunities and priorities to provide habitat connectivity in Washington and surrounding landscapes. The WHCWG is co-led by the Washington State Department of Transportation (WSDOT) and the Washington Department of Fish and Wildlife (WDFW) and is composed of members representing land and natural resource management agencies, conservation organizations, tribes, and universities. In 2019, the WHCWG began on the Washington State Cascades to Coast ecoregion habitat connectivity model for five focal species, including cougar (Puma concolor). This model seeks to identify key linkage areas for cougar in western Washington by characterizing landscape resistance and habitat concentration areas (HCAs) to create cost-weighted distance and least-cost corridor maps using Linkage Mapper. Identifying cougar corridors, and crucially, where they cross highways, will be invaluable to WSDOT staff when identifying locations for wildlife connectivity infrastructure, as cougar connectivity needs are often encompassing of the larger wildlife community's needs. The highly collaborative process of model development involved assembling a group of cougar experts to parameterize and refine the model, culminating in a partnership and validation effort with the Olympic Cougar Project. This talk will be dedicated to describing the collaborative process of model development and potential contributions to habitat connectivity planning. Preliminary maps identifying select cougar linkages crossing Interstate 5 will be included and discussed.

Use Of Automated Classification Techniques on Camera-Trap Videos to Identify Disease (Feline Leukomyelopathy or FLM) in Florida Panthers (Puma concolor coryi)

Sam Kelly, Conservation X Labs

ABSTRACT Wildlife agencies are increasingly presented with new management challenges, including the resurgence and emergence of diseases. These will have increased importance particularly as expanding mountain lion populations continue to push into more urbanized

habitats. In recent years, several individuals of the Florida panther population have been afflicted by the neurological disorder feline leukomyelopathy (FLM), which directly affects motor nerves in the spinal cord. How the disease spreads and how individuals contract it in the first place is poorly understood. Recent advances in computer vision and deep learning technologies present unique opportunities to assist wildlife managers in addressing these important challenges. Automated classification or categorization of animal behavior is one such tool. Here we developed a software pipeline using camera trap videos of Florida Panthers collected over three years. The pipeline is based on convolutional neural networks and can automatically differentiate animal species, track them over subsequent video frames, and then classify their behavior. We found that our behavioral classification algorithm can reliably distinguish healthy from afflicted animals based on differences in the dynamics of their individual movements. We note that our pipeline is successful even when more than one animal is present (e.g., family groups), and even on animals displaying more subtle or milder symptoms. Finally, we highlight the potential use of similar disease detection models that can readily be integrated within existing studies to accelerate data processing or with the Sentinel, a camera trap companion device, to detect disease in real-time.

ORAL SESSION: CONSERVATION/OUTREACH

Conservation Challenges for a Small Mountain Lion Population Near Los Angeles: Conflict with Domestic Animals and New Evidence of Inbreeding Depression.

Jeff Sikich, National Park Service

ABSTRACT In urban southern California, habitat loss and fragmentation threaten the conservation of wildlife populations, particularly for large carnivores such as mountain lions because of their extensive spatial requirements, low population density, and potential for conflicts with humans. Since 2002, we have been studying the ecology, behavior, and conservation of mountain lions in and around Santa Monica Mountains National Recreation Area. One challenge for mountain lion conservation in the park is conflicts with people resulting from predation on pets and livestock. One-third (20 of 60) of all GPS-collared mountain lions predated on domestic animals. We documented 131 incidents at 71 properties, resulting in the loss of 323 domestic animals. Most depredations occurred where animals were insufficiently protected, while confining animals in a full enclosure at night or using properly trained guard dogs greatly reduced livestock losses. Other deterrent devices and hazing techniques have shown mixed results. Another threat to this small population is the lack of connectivity to other lion populations nearby, and we have documented very low genetic diversity and repeated instances of close (father-daughter) inbreeding. In 2020, a new

challenge for this population became evident- we documented the first evidence of inbreeding depression in this population: four lions with kinked tails, one unilaterally cryptorchid male, one male with testes that differed significantly in size, and three males that showed evidence of severe teratospermia, all traits seen in highly inbred Florida panthers before genetic rescue. There are several conservation actions planned or currently underway that could improve the long-term prospects for the population, including changes to depredation policy for mountain lions, the potential listing of the species as threatened in parts of the state, and a planned wildlife overpass over the 101 Freeway, the major barrier separating the Santa Monica Mountains from other populations.

Response of Mountain Lions to Increased (Massive Wildfire) and Reduced (Covid-19 shutdown) Disturbance in a Major Metropolitan Area

Seth Riley, National Park Service

ABSTRACT Mountain lions face many challenges in fragmented urban landscapes such as Los Angeles, including isolation by freeways and development and anthropogenic mortality resulting from vehicles, toxicants, and human-wildlife conflicts. Significant modifications of the landscape or of human activity may in turn modify these challenges. We have been conducting a long-term study of the ecology, behavior, and conservation of mountains lions at Santa Monica Mountains National Recreation since 2002, allowing us to evaluate the effects of singular events. In 2018, the Woolsey Fire burned more than half of the natural area in the park, 2.5× larger than the previous largest fire to affect the Santa Monica Mountains. Mountain lions largely avoided the burned area for more than a year, and they engaged in behaviors that increased their risk of negative encounters with humans and conspecifics. In particular, they crossed roads more often and increased their daytime activity, both of which could increase risk associated with people. And they used more space, travelled farther, and exhibited increased overlap with conspecifics, especially in the unburned eastern half of the mountains. In the Spring of 2020, human activity, including driving and use of parks, was greatly reduced as a result of the COVID-19 pandemic. We compared mountain lion behavior before and after the shutdown and found that contrary to popular expectation and proclamation, mountain lions used less space and moved shorter distances when people were less active and showed no evidence of increased road-crossing. We hypothesize that the reduction in human activity allowed wildlife to use the landscape more efficiently when freed, to an extent, from avoiding humans. Indeed, mountain lions relaxed their avoidance of trails and development during the shutdown. Overall, the contrasting responses of mountain lions to these two major changes to their environment demonstrate the varied and complex ways that large carnivores may be affected by ecological disturbance and human activity.

Statewide Survival and Spatially-Varying Mortality Risk for Mountain Lions in California

John Benson, University of Nebraska-Lincoln

ABSTRACT Quantifying factors influencing mortality risk for large carnivores is essential given the importance of survival to individual fitness and population growth. Most studies estimate survival of wildlife within single populations; however, management is often conducted at larger scales (regional or statewide). For instance, mountain lions in California are being considered for listing as 'threatened' in southern California and central coast populations, partly because of concern regarding interregional connectivity. We estimated survival, cause-specific mortality, and factors influencing mortality risk of >500 individually tracked mountain lions (>240 mortality events) with collaborative research across their distribution in California. Annual survival was 0.80 (95% CI: 0.77, 0.84) for females and 0.68 (0.64, 0.73) for males. The annual human-caused mortality rate (0.13, [0.11, 0.15]; primarily depredation management mortality and vehicle collisions) was greater than natural mortality (0.06 [0.05, 0.08]) despite mountain lions being a specially protected species that cannot be legally hunted in the state. Importantly, human-caused mortality appeared to be additive to natural mortality as a) overall survival decreased as a function of increasing human-caused mortality rate, and b) natural mortality did not decrease as a function of increased human-caused mortality rate across study areas with sufficient data. Mortality risk decreased for mountain lions farther from low-intensity development (hazard ratio = 0.32, 95% CI [0.17, 0.60]) and in areas with higher proportions of citizens voting to support pro-environmental statewide ballot initiatives (hazard ratio = 0.51 [0.33-0.86]). Our results highlight that human-caused mortality can influence mountain lion survival, even in areas where they are protected from hunting. Highway crossing structures with exclusionary fencing to help funnel wildlife to appropriate crossing points would mitigate vehicular mortality for mountain lions. Reducing conflict over livestock depredation and promoting tolerance of mountain lions and other large carnivores are important goals for effective conservation in California and around the world.

Mountain Lion Resource Selection Relative to Mortality Risk at a Multiple Scales

Kyle Dougherty, University of Nebraska-Lincoln

ABSTRACT Developing a more comprehensive understanding of the behavioral mechanisms underlying human-wildlife conflict is a critical component of the effective management and conservation of large carnivores like mountain lions (Puma concolor). Despite their status as a specially protected mammal in California, mortality resulting from the issuance of depredation permits is the leading known cause of death for mountain lions throughout the state. Using records from the California Department of Fish and Wildlife (CDFW) wildlife incidence reporting system, as well as telemetry data from a subset of radiocollared mountain lions, we quantified risk of mountain lions being killed on depredation permits and found proximity to areas of low-intensity development and specific anthropogenic features, including roads and buildings, increased risk while increasing slope and proximity to cover

reduced risk. We then evaluated mountain lion selection of natural landscape features and depredation risk at two spatial scales. Mountain lions avoided areas that increased their risk of being taken on depredation permits and selected shrub and forest cover, both when selecting home ranges from the landscape and making fine-scale selection decisions along movement paths. Our results suggest that most mountain lions adequately perceive risks associated with intermediate levels of anthropogenic presence and exhibit behaviors to minimize mortality risk. However, individual mountain lions may employ different strategies to navigate trade-offs between prey availability and depredation risk, some of which may be more effective than others. Our evaluation of mountain lion habitat selection relative to depredation risk at multiple scales is timely given CDFW's review of a proposal to list populations in Southern California and along the central coast under the California Endangered Species Act (CESA). Our results should contribute to the development and implementation of more effective mitigation measures to reduce livestock depredation and mountain lion mortality following depredation in these and other populations throughout the state.

Supporting Communities of California in Coexisting with Cougars

Korinna Domingo, Cougar Conservancy

ABSTRACT The Cougar Conservancy (CC) is a non-profit organization with a mission to reduce human-wildlife conflict and conserve cougar populations through science-based management and conservation. Through its various initiatives, CC has demonstrated its commitment to both human and cougar communities by providing needed resources on human-cougar coexistence. Our focus area includes the state of California, with emphasis on Southern and Central Coast cougar populations, which are currently a candidate species under the California Endangered Species Act. With over 80% of depredation permits in California being a result of the loss of domestic animals in non-commercial settings, we have targeted our limited resources towards this demographic as opposed to cougar-livestock interactions occurring on large scale ranching operations. Targeting hobby farmers offers an opportunity to engage and build relationships with these critical stakeholders that may act as future stewards of responsible livestock husbandry within their own communities and networks. We collaborate with state and federal agencies by serving as a supplemental/ complimentary resource to support communities living and recreating in cougar country through our Conflict Task Force activities, the development of educational resources, community outreach, and public programming. CC's partnership with #SaveLACougars, which is a campaign to building the world's largest wildlife crossing in order to prevent the extinction of an at-risk population of cougars in Southern California—the Wallis Annenberg Wildlife Crossing—targets communities living and recreating around the future land bridge through outreach and education designed to prevent human-cougar conflicts before they occur and provide direct assistance to individuals experiencing conflicts, both perceived and actual. Our Pen Building Assistance and Carcass Disposal Assistance Programs off-set costs associated with domestic animal protection and the proper disposal of depredated animals. In addition, a vital component of CC's programming involves increasing our reach with California's diverse communities. This work is done through culturally sensitive community engagement strategies

that emphasize genuine connections, support, and investment. Therefore, a community centered approach to conflict resolution or outreach is always utilized. For example, CC supports our 68 volunteers who live within over 42 California communities to disseminate scientifically accurate and regionally-specific information—as they are the most poised to do so (i.e. trust). Increasing social tolerance is crucial in order for our programs to not only have a wide-ranging effect, but also establish a healthy and thriving space for community members to engage with and feel support. Cougar habitat spans multicultural spaces in California and therefore is relevant to a variety of communities. We need to broaden the scope of our outreach beyond that of the "normal players" and include other communities such as those living on the urban-wildland gradient, and Spanish speaking communities who may live and work in cougar country. By involving communities usually left out by the conservation field and providing them with the knowledge and resources they need to coexist with cougars and other wildlife, we ensure that the scope of work goes beyond the hubs of "usual suspects" and instead creates an interactive network that reflects California/ Southern California. Government distrust is prevalent in some communities; as a non-profit entity, we often work with community members who are unwilling to have government agencies on their property. This is especially relevant as it pertains to people growing marijuana throughout the state but may be experiencing issues with wildlife. By acting as a "bridge" or liaison between agencies, scientists, and the general public, we can make sure that various members of the public have access to the resources they need to #CoexistWithCougars and other wildlife with minimal apprehension, allowing us to more effectively prevent, reduce, and mitigate conflict between human and cougar communities. In this presentation, we will share information regarding our programs and highlight lessons learned.

POSTER SESSION: MONITORING, MODELING, AND DATA MANAGEMENT

Session Moderator: Justin Dion, Oregon Department of Fish and Wildlife

The Influence of Population Demography, Prey Availability, and Seasonality on Puma Prey Selection Across Six Multiprey Systems

Logan Bates-Mundell, Albert Ludwigs Universiatat Frediburg

ABSTRACT: Puma foraging strategies are influenced by a complex network of interacting components including population demography, seasonality, prey availability, and individual specialization or prey selection. While many puma habitats overlap with rare or at-risk ungulate prey species, associated management regimes attempt to protect these rare ungulates with predator controls, assuming fewer carnivores will allow populations of ungulates to propagate. As more and more research supports the existence of complex predator prey interactions which go unaccounted for within these simplistic models, the efficacy of these predator controls comes into question. This study examines multiple puma populations across six study sites in North and South America, with the intention of furthering

understanding as to the varying levels of influence held by the different factors which inform prey selection. In terms of influence on prey weights, seasonality and maximum size of available prey were the most important factors in prey selection. While puma age did exhibit significance across these populations, the influence was marginal when compared to maximum available prey size and seasonality effects on prey weight selection patterns.

Cougar Connectivity in Action

Sarah Croston, Washington Department of Transportation

ABSTRACT: The Washington State Department of Transportation's Habitat Connectivity Program monitors the relationship of animals and highways through a number of different measures. One way in which we observe animal activity near roads is through camera monitoring. WSDOT's habitat connectivity camera monitoring program dates back more than a decade, and during this time a plethora of cameras have been deployed across Washington State's diverse ecosystems. The Habitat Connectivity Program monitors infrastructure specifically built for wildlife such as underpasses, overpasses, and jumpouts, as well as structures that were not built specifically for wildlife, but which still often provide benefits to them. WSDOT also selects camera monitoring sites near roads with no structures currently in place to support future habitat connectivity planning and scientific research. Through a series of trail camera footage, I will cover the diverse range of structures, from cattle culverts to rainforest-spanning viaducts to jumpouts, that cougars in Washington have been documented using to safely coexist with our highways. This presentation is intended to be an informational session highlighting cougars we have caught on trail cameras and will display novel information about the elusive species and how they interact with highways in Washington State.

Resource Selection by Mountain Lions at Feeding Sites in Relation to Development, Fencing, and Natural Landscape Features

Jacob Harvey, University of Nebraska-Lincoln

ABSTRACT: Understanding resource selection patterns underlying mountain lion (Puma concolor) predation and feeding ecology in human-dominated landscapes is paramount to their conservation. Accordingly, we investigated interactions between mountain lions and black-tailed deer (Odocoileus hemionus columbianus), their main prey and the only wild cervid native to our study area in the North Bay of San Francisco, California. Specifically, we investigated 112 foraging sites identified with GPS telemetry where mountain lions consumed deer within a landscape of predominately private lands ranging from urban to natural areas. We used these data to conduct a resource selection function by comparing natural and anthropogenic landscape features at foraging sites to those available across their home ranges. We predicted that mountain lions select areas with fencing and stalking cover to aid in prey capture and potentially increase hunting success. Additionally, we predicted that mountain lions would avoid public lands as they have high concentrations of human recreation

and disturbance as compared to private lands. Our preliminary results showed a trend of selection of property boundaries that likely reflects selection for fences and cover used for stalking prey. In a system where most mountain lion home ranges encompass over 10,000 private land parcels, understanding landscape features influencing predator-prey interactions relative to development and fragmentation is essential. Likewise, understanding the role of natural and anthropocentric landscape features will improve management strategies for mountain lions occupying human-dominated landscapes.

Comparing And Integrating GPS- and Stable Isotope-Based Carnivore Diet Estimation Methods

Veronica Yovovich, Panthera

ABSTRACT: Quantifying large carnivore prey selection and predation rates are critical to understanding community ecology dynamics, but these data are often difficult, time-consuming, invasive, and expensive to collect. Stable isotope analyses are a powerful tool that allow researchers to non-invasively estimate the relative contributions of prey species to carnivore diets. However, these methods have not been compared to conventional GPS cluster investigations or evaluated for their potential to accurately estimate carnivore diet. We reconstructed puma (Puma concolor) diets using stable isotope analyses and GPS cluster analyses and compared these two methods at both the population and individual level. Stable isotope analyses and GPS cluster methods showed similar prey use at the population level but differed significantly at the individual level. Regardless of estimation method, large ungulates (e.g., deer and pigs) consistently comprised >90% of prey biomass in puma diet. In decreasing order of importance, the remaining <10% of prey biomass was composed of raccoons, opossums, and domestic cats. At the population level, GPS data consistently recovered a significantly higher proportion of larger prey items (GPS=97.35%, SIA=94.93%, $p=0.04$) in puma diet, while SIA indicated relatively greater contributions from smaller prey items (GPS=2.65%, SIA=5.07%, $p<0.01$). On an individual level, reconstructed diets using SIA suggested higher small prey use than were detected in GPS cluster data. The GPS data estimated that small prey comprised 0.0 to 12.7% of puma diets, while SIA estimated small prey use was 12.0 to 32.0%. Our results suggest that SIA provide a reliable complement and/or alternative to GPS cluster investigations for studying carnivore diet composition, and may be especially suitable at the individual level or for detecting small prey consumption. These results could help inform conservation efforts, particularly those utilizing hair snares or other non-invasive techniques.

POSTER SESSION: POPULATION INTERACTIONS & ECOLOGY

Session Moderator: Darren Clark, Oregon Department of Fish and Wildlife

Compositional Changes in Cougar Prey Utilization Following Changes in Availability of Primary Prey: A Preliminary Look

Marcus Bianco, Oregon Department of Fish and Wildlife

ABSTRACT: Much work has been done to show cougars (Puma concolor) are optimal foragers, suggesting they should utilize areas with aggregated, easy to acquire prey to optimize energetic gains. What is less clear, however, is how cougars respond to reductions of an aggregated prey base. We conducted an experiment in northeast Oregon in an area with a high density of elk. Between 2018 and 2020, the most abundant prey of cougars, elk (Cervus canadensis), were reduced by roughly 80% to alleviate competition with mule deer (Odocoileus hemionus) which have declined in recent decades. We examined data from 6 GPS collared cougars to document potential changes in their space use and prey selection as the elk population was reduced. Over the past 3 years we visited over 800 potential feeding sites and documented over 200 prey items. We hypothesized that: 1) cougars would increase the utilization of secondary prey with fewer elk to encounter; and 2) cougars would decrease the use of the area as the number of prey available decreased. Preliminary results show a decrease in proportion of elk killed by cougars coincident with the reduction in the elk population. Concurrently, the proportion of cougars' 2nd and 3rd most selected prey, deer and coyotes (Canis latrans) respectively, increased during the elk reduction. We did not observe a significant decrease in seasonal use by individual cougars as elk availability decreased. Observing this initial change in cougar diet is a first step to answering questions of apparent competition, functional, and numerical responses. The continued level of use by cougars and impacts on the food web can have significant short-term effects on remaining prey populations.

Predation of Cougar Kittens (Puma concolor) by American Black Bears (Ursus americanus)

Marcus Bianco, Oregon Department of Fish and Wildlife

ABSTRACT: The prevalence, intensity, or outcome of interference competition and interspecific killing between predominantly solitary species operating on large spatial scales is challenging to document or test. Here we present a detailed account of inter- and intra-specific interactions from contemporaneous GPS location data and in field investigation. In June 2018, a GPS collared female cougar (Puma concolor) maintained strong site fidelity for a period of 19 days prior to the arrival of three GPS collared black bears (Ursus americanus),

which elicited the female cougar to abandon the site. The result was the predation of cougar kittens by one or more bears. The evidence provides support for ecological theory that body size, mass, or group number is an important predictor of outcome. Our observation provides an example of bears potentially making risk-reward tradeoffs by eliminating a potential competitor that at the same time provisions carrion as critical food resources. These real-time inter- and intra-species competitive interactions as documented using GPS collars allow for greater insight into individual fitness and community level effects.

Assessing the Sustainability of Cougar Hunting in British Columbia, Canada

Garth Mowat, BC Wildlife and Habitat Branch

ABSTRACT: Cougar, wolf, and grizzly bear populations in British Columbia have largely recovered from a long period of intense human persecution. Interior cougar populations increased and now appear to cycle in abundance following changes in deer numbers. On Vancouver Island, cougar populations declined during a period of wolf recovery and deer population decline and have not recovered. Hunter harvest increased during cougar population recovery and young average age of hunter killed cougars and local knowledge suggested harvest rates were high. We estimated cougar population density in two areas of British Columbia to calculate harvest rates. We used hounds to tree cougars and sampled them with biopsy darts and also collected samples opportunistically. We used spatial capture-recapture to estimate density. Preliminary cougar density averaged 0.66/100 km2 (90% credible interval 0.49-0.79) on Vancouver Island and 1.8 per 100 km2 (CI 1.2-2.5) in southeast British Columbia. Harvest rates averaged 29-41% on Vancouver Island during 3 consecutive winters of sampling and 27-30% in southeast BC based on two winters of sampling two adjacent areas. We suspect that cougar hunting was not sustainable on our Vancouver Island study area during the 3 years of our study. The harvest rate in southeast BC likely exceeded local reproduction but may have been sustained by immigration.

Effects of Puma Activity, Habitat Characteristics, and Disturbance on Coyote Activity

Travis Perry, Furman University

ABSTRACT: We investigated the relationship between puma and coyote activity and whether this relationship was altered by habitat characteristics or landscape level disturbances. Our study area is located in the eastern foothills of the Black Range, bordering the eastern edge of the Aldo Leopold Wilderness, in Sierra County, New Mexico. Photo data were collected, uninterrupted, from 2008 to 2019, from twenty-five remote cameras distributed over 100 km^2 at a density of 1 camera per 4 Km. Camera locations remained constant over the study period. Puma and coyote activity was measured by photo rate. Habitat characteristics associated with remote camera sites were obtained from raster files in ArcGIS. In 2013, over

100,000 acres of the Aldo Leopold Wilderness burned in the Silver Fire and provides the landscape level disturbance in our study. We used quantile regression analysis in R using package qgam and qu set to 0.9 as well as GLM analysis in the R base package. We predicted that coyotes would avoid areas with high puma activity and that this relationship would be more extreme in low visibility habitats. Before the fire, we found that coyote activity decreased significantly with puma activity ($p=0.00352$) and topographic ruggedness ($p=0.00652$), but that there was no significant interactive effect of these predictors. However, after the fire we did find a significant interactive effect of puma activity and topographic ruggedness on coyote activity ($p=0.00169$). The negative relationship between coyote activity and puma activity was increased by topographic ruggedness after the fire. We hypothesized that the fire, adjacent to our study area, created more open habitat for coyotes, allowing them to shun high puma-low visibility habitats with greater frequency. Our study suggests that the relationships between apex predators and individual mesocarnivore species is habitat specific and that disturbance may plan a pivotal role in these relationships.

Interactive Effects of Puma Activity and Habitat Characteristics on Mesocarnivore Community Structure

Travis Perry, Furman University

ABSTRACT: We investigated the relationship between puma (Puma concolor) activity and mesocarnivore community structure, as determined by principal components analysis, and whether or not habitat characteristics modify this relationship. The study area was located in the eastern foothills of the Black Range, bordering the eastern edge of the Aldo Leopold Wilderness, in Sierra County, New Mexico. Photo data were collected, uninterrupted, from 2009 to 2019, from twenty-five remote cameras distributed over 100 km^2 at a density of 1 camera per 4 km^2. Camera locations remained constant over the study period. Puma activity was measured by photo rate, as was the structure of the mesocarnivore community, which was then characterized using principal component analyses. Habitat characteristics associated with remote camera sites were obtained from raster fi les in ArcGIS. We used quantile regression analysis in R using package qgam and qu set to 0.9. Mesocarnivores recorded in the study area included coyote (Canis latrans), bobcat (Lynx rufus), gray fox (Urocyon cinereoargenteus), ringtail (Bassariscus astutus), and badger (Taxidea taxus). Puma activity may be a significant driver of change in the mesocarnivore community structure($p<0.004$). However, this relationship is significantly modified, reversed actually, in riparian habitats ($p<0.004$). Puma activity is associated with the structure of the mesocarnivore community perhaps by suppressing coyote and bobcat activity while being positively associated with ringtail activity. There was no significant relationship between puma activity and gray fox activity. It seems that the relationship between puma activity and the mesocarnivore community is different in riparian corridors because coyotes particularly avoid that habitat type in our study area.

POSTER SESSION: PUBLIC INTERFACE AND COLLABORATION

Session Moderator: Derek Broman, Oregon Department of Fish and Wildlife

EarthRanger: Cutting-Edge Technology for Mountain Lion Monitoring on the Olympic Peninsula

Read Barbee, Panthera

ABSTRACT: Work flow, data management, and data archiving are constant challenges for wildlife managers, researchers, and conservation practitioners, especially with the advent of new technologies like GPS collars and digital cameras that allow for large amounts of data to be collected over short time frames. These problems are particularly acute for collaborative efforts with multiple stakeholders sharing work activities, such as day-to-day research needs. EarthRanger is a free, web-based, data management and visualization software designed to aid protected area managers, ecologists, and wildlife biologists in making more informed operational decisions for wildlife management and conservation. Originally developed to help counter elephant poaching in Africa, it is now used by over 180 conservation programs in 42 countries across Africa, North America, Europe, and Asia on a wide variety of species including mountain lions. The Olympic Cougar Project, a collaborative effort between Panthera, the Lower Elwha Klallam Tribe, and five other Native American Tribes on the Olympic Peninsula, is using EarthRanger to visualize data from collared animals, generate clusters, collect and manage data, and collaborate with partners in real time. This talk will provide a broad overview of the capabilities of the EarthRanger platform and outline the custom system and workflow we have built with the EarthRanger team. For example, in EarthRanger, you can view all of your collared animals, GPS units, handheld radios, vehicles and cameras on one map in real time. EarthRanger alerts you instantly whenever an animal crosses an important boundary, or approaches another marked animal or other geographic feature, or even if an abnormality in their data suggests they may be in trouble. We will also discuss how to decide if EarthRanger may be a good fit for your project and how to get started with the platform if you're interested.

Providing the Best Care for Non-releasable Mountain Lions

Alicia Powers, Conservation Society of CA, Oakland Zoo

ABSTRACT: Conservation Society of California's Oakland Zoo manages three non-releasable mountain lions. There are many facets to providing for these individuals. The zookeeper team focuses on providing optimal diet, effective enrichment, and relevant training. The entire organization has a mission to advocate for the species by interpreting to the public and collaborating with researchers and conservation groups. This poster breaks down the key elements of each of these facets and where we have had our successes and challenges.

Interpreting Mtn. Lions in the National Park Service

Lori Rome, National Park Service

ABSTRACT: The National Park Service preserves and protects natural and cultural resources on 85 million acres at 423 sites across the United States. The agency informs and educates the public about the values inherent in these resources and shares diverse stories. 327,516,619 people visited national parks last year. Mountain lions occur in many of the national park units. Interpreting and educating about mountain lion biology, science, safety, and legend can demystify fears, pique curiosity, and generate stewardship of mountain lions and their habitats. A group of park rangers from across the nation formed in 2019 with the goal of promoting mountain lion interpretation in the National Park Service. This Mountain Lion Interpretation Team has since created a service wide online learning platform that focuses on all topics related to mountain lions in order to encourage interpretive rangers to seek out sound scientific information to share with the public. The group used an internal grant process to request funding to attend this workshop, with the goal of sharing information from this workshop on the online learning platform and with rangers across the nation. The poster presentation will share visitation trends in national parks, educational efforts being made in the agency, and highlight the "mountain lion interpretation (MLI)" online learning platform. Researchers, land managers, and educators can use this poster to understand how mountain lions are currently being interpreted to the public in parks and identify any gaps in the current interpretive approach. This poster presents an opportunity for researchers to collaborate with science communicators in mountain lion education and outreach efforts. NPS employees can access the MLI online platform through the mylearning.nps.gov, outside entities are encouraged to join. Contact Lori_Rome@nps.gov to request an invitation.

PANEL 1 DISCUSSION- LEGAL RISK IN MANAGING HUMAN SAFETY

Moderator: Kevin Blakely, Oregon Department of Fish and Wildlife

Panelists:
Kyle Maynard, Assistant Attorney General, State of Utah
Steve Sanders, Oregon Department of Justice (retired)
Mick Rusing, Rusing, Lopez & Lizardi, P.L.L.C.
Bob Webber, Black, Chapman, Petersen, & Stevens

Topic: Wildlife management and decision-making for agencies is incredibly complex and influenced by a large list of factors. One of the most complicated areas of influence include legal responsibility and navigating risk, especially in situations surrounding human safety. This panel of attorneys discussed actions to consider reducing risk, unique court rulings, and new challenges.

PANEL 2 – WILDLIFE-HUMAN ATTACKS, INCIDENT RESPONSE, AND WILDLIFE FORENSICS: LESSONS LEARNED

Moderator: Brian Wolfer, Oregon Department of Fish and Wildlife

Panelists:
Jillian Adkins, California Department of Fish and Wildlife
Mark Vargas, Oregon Department of Fish and Wildlife
Tasha Bauman, Rusing, Wyoming Game & Fish, Wildlife Forensics & Fish Health Laboratory
Tabitha Viner, National Fish and Wildlife Forensics Laboratory

Topic: Panelists shared their experiences and advice regarding the do's and don'ts when responding to possible wildlife-human attacks. Items discussed included policies and procedures for agencies responsible for investigating and managing these tense and stressful situations. Panelists unanimously advised that agencies take a proactive approach to prepare for these events that are likely to continue to increase in occurrence.

TED CRADDOCK LIFETIME ACHIEVEMENT AWARD

By Jim Akenson, Mark Henjum, Bruce Johnson – ODFW retired

Over the past 5 decades, Ted Craddock has made significant contributions to the conservation and management of carnivore species in Oregon. Through his extraordinary efforts as a volunteer houndsman, he has supported Oregon Department of Fish and Wildlife (ODFW) in research and management of mountain lions, black bear, and bobcats. In the late 1970's, he was contacted by ODFW for his advice in locating a study area to conduct a project on the status of a bobcat population in northeastern Oregon. His extensive knowledge of local bobcat populations and his expertise and skills with hounds were instrumental in moving the project forward. He volunteered his dogs, 4-wheel drive vehicle, and snowmobiles, to assist biologists in surveying 3 different study areas. He treed bobcats in all 3 areas and assisted in capturing, ear tagging and radio-collaring. Ted was an integral team member with capture efforts on the Catherine Creek Cougar Study, from 1988 to 1993. This project was the first of its kind in Oregon, and with Teds' help 60 lions were captured and radio-collared. This work, and the capture methods applied, led to the Starkey Black Bear Study which ran from 1993 to 2000. To get this project off the ground, Ted committed to donating his time as a match for federal funding which resulted in $140,000 for the project at no cost to the State. The Starkey Black Bear Study stands as the first major bear research effort using dogs as a primary capture method in the western U.S. Ted went on to do capture on cougar population and predation studies in the Wenaha and Mount Emily Units over the next 15 years. His most recent capture efforts have focused on a multiple carnivore project on the Starkey Experimental Forest. Besides his skills and abilities putting animals in trees, Ted has provided ecological insights to assist biologists in the field, including his observations of bears using large diameter white fir and western larch trees for denning – with both top and bottom entry approaches. His natural history observations greatly influenced research objectives on many studies and spin-off investigations. For several decades US Forest Service and ODFW biologists have provided Ted with "wildlife tree" signs that he posted on hundreds of large diameter trees that are a host to a wide range of wildlife. Since the 1950s Ted has maintained a capture diary. Last year he eclipsed 4,000 black bears put into trees since he began as a houndsman – dating back to when Elvis Presley first hit stardom on the rock & roll circuit! By all accounts Ted is considered Oregon's premier houndsman. Based on his track record, he is a devoted sportsman and conservationist. Over the years he has had great personal satisfaction in helping capture cougars and other carnivores to gain a better understanding of their existence and role in the natural world.

Award was presented by ODFW and the Oregon Hunters Association as part of the workshop.

STATE AND PROVINCE MOUNTAIN LION STATUS REPORTS

Alberta Mountain Lion Status Report

Paula Framer, Provincial Carnivore Specialist, Government of Alberta, Environment and Parks

The first Management Plan for Cougars in Alberta (GoA 1992) was implemented in 1992. The plan outlined a quota system to sustainably manage cougar hunting. That plan was updated in 2012 (GoA 2012) incorporating new research and allowing management to be more adaptive to changing conditions on the landscape. Building on the adaptive framework in the 2012 plan, the management strategy was refined further in 2019 (GoA 2019) with a reduction of quota allocation to stabilize the population at an older age structure (Cooley et al. 2009, Beausoleil et al. 2013).

The framework cougars are managed by in Alberta has four main points:

1. Maintain sustainable populations.
2. Provide consumptive and non-consumptive recreational opportunities for Alberta residents as well as non-residents.
3. Minimize property damage and other hazards to humans.
4. Learn about the cougar population in Alberta and communicate those learnings to the public.

Recent research (Robinson et al. 2008, Cooley et al. 2009, Beausoleil et al. 2013, Meletske et al. 2014, Teichman et al. 2016, Logan 2019) suggests that managing for a stable and older age structure in the cougar population will help us meet these objectives.

NOTEWORTHY MANAGEMENT TOPICS

A few noteworthy changes made to the management strategy in Alberta since the 2017 Mountain Lion Workshop are an update of our provincial cougar population estimate (GoA 2019). The area of occupancy was refined using resource selection of cats from agency research projects and applied provincially. Additionally, the proportion of the population that are adults was estimated and used to guide our quota allocations (GoA 2019).

Since the 2019 winter season (Dec. 1, 2019 – Feb. 28, 2020), Alberta is managing cougars for an older age structure in the population by aiming for a quota allocation of about 14% of the estimated adult population in each cougar management area (CMA). Fourteen percent was selected because it is a reliable population growth rate reported by Beausoleil et al. (2013). In most CMAs this meant a reduction in quota, which brought mixed response from hunters, however publishing a report online that outlined the rational and supporting science behind the changes (GoA 2019) generally satisfied cat hunters.

Another change implemented in Alberta for the 2019 winter cougar season was voluntary weekend and holiday harvest reporting. In Alberta, all cat hunters must register their harvest with agency staff within one business day of the kill. The cat must be physically examined at

a Government of Alberta office to confirm sex after which the animal is subtracted from the quota for the CMA it came from. Government offices are closed on weekends and for a period over the Christmas holiday each year. This can lead to over quota harvest, for example, if a cat that would close the season in a CMA is taken on Friday afternoon, but it is not registered until Monday morning, the CMA has been legally open for three additional days, which could lead to it going over quota.

To attempt to resolve this issue, starting with the 2019 season, we implemented a voluntary email or text in harvest reporting program such that if a quota is met on Saturday, the hunter can report his harvest and the season in the CMA will be closed that day. The 3-year average number of cougars over quota provincially prior to this change was 11. In the 3-years since implementing the voluntary harvest reporting program, it has only been five. That is about a 55% reduction in over quota harvest annually.

RESEARCH UPDATE

Alberta Environment and Parks initiated a Cougar Adaptive Management Project (CAMP) in spring of 2016. All fieldwork and data collection for the project is complete as of March 31, 2022. The primary objective of the CAMP is to learn if it is possible to reduce problem wildlife kills and incidental trapping mortality by increasing licensed quota harvest. Preliminary results were presented at the 13th WAFWA Mountain Lion Workshop and are included below.

INCREASED QUOTA HARVEST APPEARS TO HAVE REDISTRIBUTED HUMAN CAUSED COUGAR MORTALITY

BACKGROUND

At the 12th WAFWA Mountain Lion Workshop in Colorado, the Alberta Environment and Parks, Provincial Carnivore Specialist gave a presentation titled, "Can Increased Quota Harvest Redistribute Human Caused Cougar Mortality in Alberta?" The presentation was an introduction and discussion of a project initiated to try to answer that question. We now have a preliminary answer, so it seemed fitting to present it at the 13th WAFWA Mountain Lion Workshop. If all goes to plan, we will have results to present at the 14th Mountain Lion Workshop.

In Alberta's early history, cougars were managed for depopulation. They were viewed as a threat to personal property and safety as well as competition with settlers for protein in the form of elk, deer, and moose. The end of an intensive government sponsored rabies control program that operated in the early 1950s (Ballantyne 1956) and ending the bounty on cougars in 1964, along with rebounding big game populations in the 1960s, allowed cougar distribution to expand in the province (Knopff et al. 2014).

Cougars were classified as a big game species in 1971 and offered protections through a limited hunting season, which further supported expansion of the population (Knopff et al. 2014). Harvest limits in the form of quotas were introduced in 1990 and the first management plan for cougars was implemented in 1992 with an objective to sustainably manage the species (GoA 1992). The management plan was updated in 2012, incorporating new research and allowing management to be more adaptive to changing conditions on the landscape. Management strategies were further clarified in 2019, aiming for an older age structure in the population by reducing hunting mortality and thus allowing older animals to persist in the population (Maletske et al. 2014).

MANAGEMENT CONTEXT LEADING TO CAMP STUDY

The 2012 cougar management plan describes a method for adjusting quotas that uses the sex-ratio of the harvest and the average age of harvested males to guide any changes. When the method described in the plan was first applied to harvest data after the 2014 winter season, it provided no meaningful guidance for adjusting quotas. Issues we identified were that Alberta uses sex specific quotas so the sex-ratio of the harvest is predetermined and voluntary tooth submissions for age data were so sparse in some units that adding a single cat could change the average age by several years.

Environment and Parks held an internal meeting to discuss how best to move forward given the issues identified with the quota adjustment system. Some of what was discussed at the meeting was an increase in human caused mortality (HCM) over the past ten years while the proportion of HCM attributed to licensed hunting was decreasing. This led us to ask if we were missing harvest opportunities. Common sense might suggest that an increase in quota harvest will reduce unlicensed take such as conflict kills and incidental trapping mortality. However, before using this information to guide quota changes, we needed to learn if increasing licensed harvest will add to, or compensate for, other sources of human caused mortality. This was the management context that led to the initiating of the cougar adaptive management project (CAMP).

Although the primary management question for the CAMP is "can increased quota harvest redistribute human caused cougar mortality?", during the project we have learned, and continue to learn, a lot about the cougars in Alberta, which has led to a shift in our harvest management direction away from a hunt opportunity focus to a focus on hunt quality. However, there is still management value in presenting this portion of our project now and seeing it through to completion.

METHODS

The CAMP is using a before, after, control, impact study design over six cougar seasons: 2-years of pre-treatment monitoring (2016 & 2017 seasons), 2-years with an increased quota (treatment, 2018 & 2019 seasons), and 2-years post treatment monitoring (2020 & 2021 seasons). In Alberta the winter hound pursuit season starts on December 1 and ends March 31 of the following year.

The project was conducted in cougar management area (CMA) 21, which consists of 3 wildlife management units (WMU) and is 7,270 km^2 total area, of which 5,525 km^2 of that is good cougar habitat (GoA 2019, Smereka et al. 2020). The landscape transitions from forestry and oil and gas activity to agriculture and more human dominated habitats from west to east. During the pre-treatment period, quotas in CMA 21 were three males and three females for a total of six cats. For the treatment period, the male quota was increase by 300% to 12 and females were doubled to six. We then monitored human caused mortality (HCM) to see if the increase in harvest was additive or compensatory to other sources of HCM.

RESULTS

Because the post treatment period ended a few days before the Mountain Lion Workshop, preliminary and descriptive results with a very simple comparison of HCM sources for the pre and during treatment periods are all that is presented (Table 1). Although the study design is 2-years pre-treatment, 2-years of treatment, and 2-years post-treatment, here I consider the

seven cougar seasons between 2011 and 2018 as the pre-treatment period as that coincides with the implementation of the 2012 cougar management plan (GoA 2012).

Type	Pre	During	Change	% Change
Quota	7.7	14.5	6.8	88.3
Spec Lic.	1.6	1.0	-0.6	-8.8
Removal	7.3	4.0	-3.3	-45.2
Inc. Trap	3.9	3.0	-0.9	-23.1
Other	1.8	1.0	-0.8	-44.4
Total HCM	22.3	23.5	1.2	5.0
% Tot. Pop.	27	28	1	

Table 1. Sources of human caused mortality and results for the pre (2016 & 2017 seasons) and during (2018 & 2019 seasons) treatments periods of a harvest manipulation study in cougar management area 21, Alberta, Canada. Quota = licensed resident harvest, Spec Lic. = non-resident harvest, Removal = problem wildlife removals, Inc. Trap = incidental trapping mortality, Other = roadkill, treaty harvest, etc. Change and % Change is the difference between pre and during treatment.

Although these results do not include our post-treatment monitoring period and have had no analysis done to them, it is interesting that with an increase in harvest of this magnitude, the number of conflict removals went down 45%, which is contrary to what Teichman et al. (2016) found in their study. However, caution is warranted in interpreting this result until the complete analysis is done, because emerging theory suggests that infill by younger cats after periods of high harvest removal can lead to increased conflict (Cooley et al. 2009, Beausoleil et al. 2013, Teichman et al. 2016).

DISCUSSION/CONCLUSION

This project initially asked the question “can increased harvest redistribute HCM?” Based on our preliminary results, it appears that it can, but until a robust analysis is done on the complete 6-year data set, which accounts for other factors such as prey availability and vulnerability, the safe answer is, maybe. It appears that our increased harvest was compensatory to other sources of HCM, which may have local short term management application, but at this time there is uncertainty if unintended consequences that would be counter to management objectives may develop, as emerging theory suggests (Cooley et al. 2009, Beausoleil et al. 2013, Maletske et al. 2014, Teichman et al. 2016).

OTHER RESEARCH

Over six capture seasons 99 individual cougars were GPS radio-collared 128 times. Alberta Environment and Parks is collaborating with the Royal Alberta Museum and the University of Alberta to use these data and study various aspects of cougar ecology and management that may inform future policy decisions. So far one graduate student has completed their project studying space and habitat use patterns and managed to publish two peer-reviewed papers.

Smereka, C. A., Frame, P. F., Edwards, M. A., Frame, D. D., Slater, O. M., and A. E. Derocher. 2020. Seasonal habitat selection of cougars *Puma concolor* by sex and reproductive state in west-central Alberta, Canada. Wildlife Biology 2020(4): 1-14. Accessed on 2022-07-05, https://doi.org/10.2981/wlb.00735

Abstract
Resource selection studies are commonly used to assess the landscape features that animals select or avoid in their environment. Selection for certain landscape features and landcover types may vary by sex and reproductive status of an individual, and habitat selection studies should incorporate these factors. Cougars *Puma concolor* are a wide-ranging species that live in a diversity of habitats with varying levels of human disturbance. Geographic positioning satellite telemetry collars were deployed on 55 males, single females, and females with kittens. We used a two-stage resource selection function to assess the seasonal habitat characteristics used by adult cougars in west-central, Alberta, Canada, near the northern extent of the species range, from 2016 to 2018. A latent selection difference function was used to compare differences in habitat selection between groups. All groups selected for similar habitat types including edge habitat, proximity to water, sloped terrain, forested habitat, and avoided roads. During the summer, proximity to water and wetland land cover were among the most selected features for all groups. Forest and edge habitats also were important for single females and males. During the winter, forested habitat was one of the most important covariates for all groups along with proximity to water, edge habitat and slope for single females and males. Selection for slope and avoidance of open agricultural land were among the most important for females with kittens. Our results provide insights into those landscape variables that are important for cougars at the northern extent of their geographical range.

Smereka, C. A., Frame, P. F., Edwards, M. A., Slater, O. M., Frame, D. D., and A. E. Derocher. 2021. Space use of cougars at the northern edge of their range. Journal of Mammalogy 102(4); 1042-1053. Accessed on 2022-07-05, https://doi.org/10.1093/jmammal/gyab070

Abstract
The space use strategies animals use to acquire resources needed for survival and reproduction reflect life history traits and individual behaviors. For large solitary carnivores, such as cougars (*Puma concolor*), prey, mates, and safe habitat in which to raise offspring, are resources that influence space use. Most animal home range studies investigate differences between sexes but fail to explore the space use patterns among individuals. We first used 95% minimum convex polygon (MCP), kernel density estimate (KDE), and Brownian bridge estimator (BB), to estimate the home range of 43 cougars' satellite-collared in west-central Alberta, Canada, in 2016–2018. We found that adult males (MCP = 498 km^2; KDE = 623 km^2; BB = 547 km^2) had home ranges that were more than twice the size of those of adult females (MCP = 181 km^2; KDE = 273 km^2; BB = 217 km^2). We then used net squared displacement, path segmentation analysis, and multi-response permutation procedure, to examine the space use patterns of 27 female and 16 male cougars. We constructed a decision tree and found that 23% of cougars were dispersers (12% of females and 44% of males), 47%

were residents (58% of females and 31% of males), 9% were seasonal home range shifters (12% of females and 6% of males), and 19% shifted to a new area during the study period (19% of females and 19% of males). We learned that dispersers all were subadults, whereas all residents, seasonal shifters, and shifters, were adults, except for one subadult male. Our study provides insights on animal home ranges with methods to categorize different space use strategies which could be used to help assess the dynamics of a population.
There are four additional graduates and one undergraduate student working on other aspects of the project. Their topics are population genetics of cougars in Alberta, behavior of cougars with overlapping ranges, landscape and anthropogenic factors that influence survival, cougar predation patterns, and scavenger dynamics at kill sites. The hope is that several of these students will have results to present at the 14th WAFWA Mountain Lion Workshop.

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British Columbia Mountain Lion Status Report

Garth Mowat, BC Wildlife and Habitat Branch

The 2017 closure of the grizzly bear hunt in BC has brought new focus on the cougar hunt from animal welfare groups. Most hunters in BC use hounds and several regions had pursuit-only seasons to allow hunters to train their dogs after their season had closed due to dates or the filling of a regional quota. These seasons have now all been closed. The mainland cougar population has gone through 2 cycles of abundance in the last 4 decades. Hunter and conflict kill correlate roughly with trends in abundance based on an independent analysis of trend using age-at-harvest data from hunted cougars. A few other updates from BC include:

- We are working on an IPM that will estimate cougar population dynamics using statistical population reconstruction of the age-at-harvest data. Next, we hope to incorporate spatial density estimates to better predict abundance in space and across time.
- We are assessing hunter harvest rates in several areas using DNA-based inventories. Preliminary results suggest high harvest rates.
- An intensive study of cougar behavior and population dynamics in the Okanagan Valley southern BC is in its third year with results expected in the next 2 years. This study is a partnership between university-based and government-based biologists.
- A radiotelemetry-based study of cougar diet and kill rates began during winter 2021/22 in the central interior of the province where feral horses are abundant and overlapping the range of a declining caribou herd.

Colorado Mountain Lion Status Report

Mark Viera, Colorado Parks, and Wildlife

History of Legal Classification

Mountain lions (Puma concolor) were classified as a predator and received no legal protection in Colorado from 1881 until 1965. During these years the take of mountain lions 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 lions 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 Colorado Parks and Wildlife (CPW) 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 8 Data Analysis Units (DAUs) for the purpose of lion management (Figure 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 use female harvest limit sub-quotas.

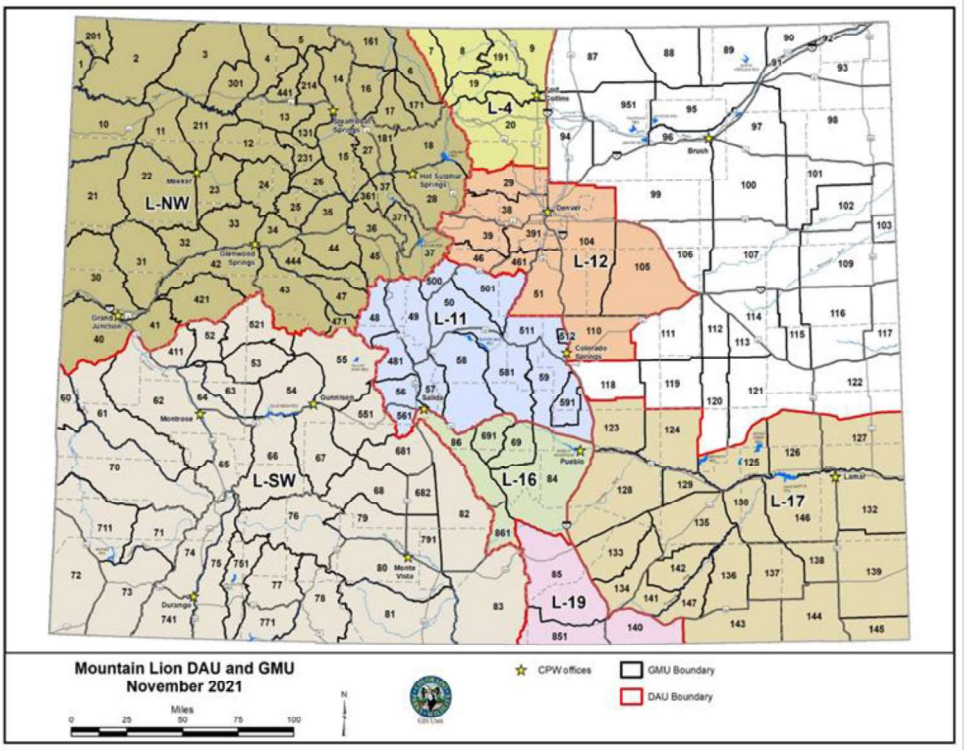

Figure 1. 2021 Colorado mountain lion Data Analysis Units (DAUs).

Colorado does not have a statewide management plan for lion. However, in 2020, a new management plan was adopted and covers the entire Western Slope (NW and SW DAUs, Figure 1) of the state. This "West Slope Plan" focuses lion management at a much larger spatial scale by the consolidation of DAUs, which is better aligned to lion use and movement across the landscape. The plan's objectives for both West Slope DAUs are for stable lion population levels. Two complementary mortality thresholds are evaluated during annual data analysis to ensure that objective is met. The first is that the proportion of adult female lions in harvest will not exceed 22% in any year at the DAU scale. Secondly, the total annual proportion of human-caused mortality will not exceed 17% of the projected population size. Human-caused mortality is largely comprised of harvest, but also includes control mortalities and lions killed by cars. The West Slope management plan also included a small group of GMUs near Glenwood Springs that were carved out from the DAU, with their own objectives and thresholds related to reducing human-lion conflict. The implementation of this plan resulted in a reduction in the harvest limit for lions on the West Slope beginning in the fall of 2020.

Remaining plans east of the Continental Divide each have their own management targets and specific management approaches that may vary but remain within the constraints of over-arching management guidelines. Currently, these lion management plans analyze data on 3-year running averages and examine the composition of all females in hunter harvest and total mortality in comparison to certain thresholds, overall harvest and total mortality and amounts of game damage in the DAU. DAU objectives are based on not exceeding certain harvest and total mortality amounts that are set in each plan.

As part of the development of the West Slope plan for DAUs NW and SW, CPW committed to measure lion density in multiple study areas in each of the two units over the next 10 years. Study areas are approximately 2,000 km2 in size and employ a mark-resight study design utilizing remote trail cameras to estimate density. Lions are marked with ear tags and GPS collars, which provide visible marks on camera, helps inform closure assumptions and provides a density correction factor for animals that move on and off the study area. CPW expects to have numerous measures of independent lion density across the West Slope in the coming years, which can help inform density assumptions used in resource selection function modeling in the West Slope plan. Lion densities have also recently been measured on the Front Range (see Research Efforts) and in the Upper Arkansas River drainage.

Harvest and Total Mortality

Lion mortality is documented through mandatory checks of hunter kill and mandatory reports for non-hunter mortality. Historic statewide lion harvest limits are shown in Figure 2. Hunter harvest has gradually increased over the last 40 years with current statewide harvest around 500 animals. The harvest reduction evident in 2005-2007 (Figure 2) stemmed from analysis that occurred during revision of DAU plans in 2004 and educational efforts to reduce the take of females. In some cases, harvest limit reductions were intended to produce a slight reduction in lion harvest, but in most cases, reductions were implemented to realign the harvest limit quota closer to the harvest objective. In most DAUs the harvest limit was somewhat higher than the harvest objective due to a DAU history in which the objective is rarely or never achieved. For

east slope DAUs, harvest limits represent the upper ceiling on harvest that managers believe could be endured for a one- or two-year period.

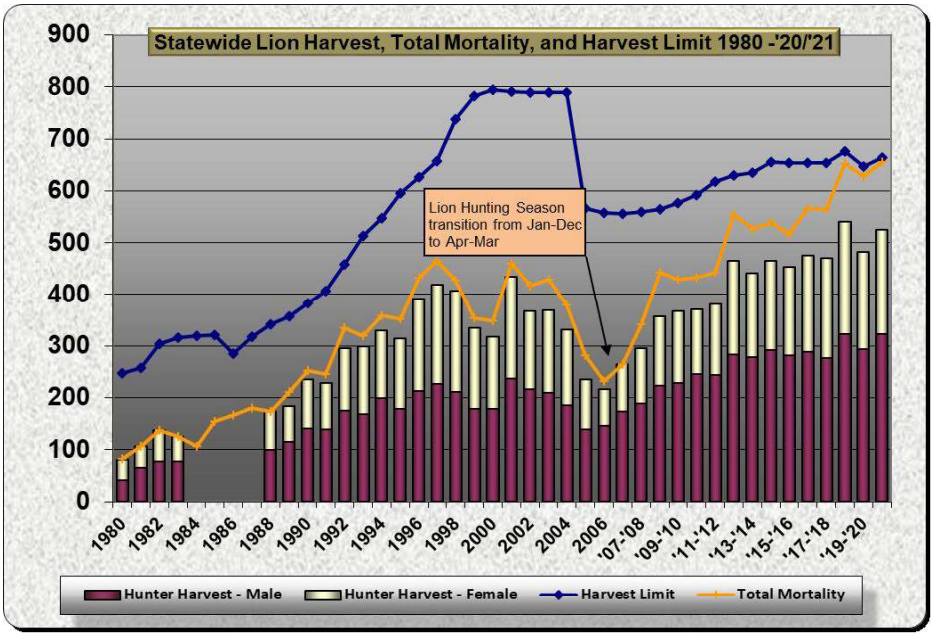

Figure 2. Colorado lion harvest limit quota, harvest, and total mortality 1979/1980 – 2020/2021.

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 required could constitute a significant wildlife law violation. 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 regulation 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.

About 15 years ago, CPW collaborated with a State Hounds men's Association to conduct training workshops about the biology and life history of mountain lion as well as the importance of females to sustaining populations. Regulation brochures also provided similar written information. Beginning in 2007, 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 to demonstrate their ability to identify lion gender characteristics. Subsequently, female composition of harvest has declined from about 42% to the most recent 10-year average of ~38% since these efforts were implemented. Incorporation of an adult female harvest threshold on the West Slope is expected to maintain or even further reduce this lower proportion of females in harvest.

In 2013, CPW implemented an extended April season in locations that were persistently under harvest objectives. Lion DAUs are evaluated annually as part of the regulation process to determine which units are eligible for an April season. Annual statewide April harvest is around

1% of what is taken during the November-March portion of the season. As part of the West Slope plan in 2020, the agency also legalized electronic calls for the harvest of lions in two small areas of the West Slope.

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. Data on mountain lion depredation claims on livestock since 1980 is maintained in a database. Since the mid-2000s the number of claims paid annually has fluctuated between about 20-70 and the indexed cost of those claims is typically between about $25,000 and $100,000 annually. The long-term trend over the last 15 years is a slight decline in both numbers of claims and dollars paid. Sheep and other stock claims and costs (mostly hobby stock like llamas, alpacas, goats, or pigs) are the most common in Colorado.

Improvements have been made in the recording and searching of human-lion incident records. Historically, incidents reported to CPW involving lions were recorded on a paper form, which had to be manually entered into a database, created significant lag times in data queries and was prone to errors. Beginning in 2019, CPW adopted the use of an application (app) available to staff on computers and mobile devices to record all reported human-lion incidents. This Incident App has improved data collection, location mapping, searching for records and helps relate multiple incidents or observations involving the same lion. Over the past 3 years, CPW also started using apps for data collection on lion mandatory mortality reporting as well as recording drug and capture information.

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.

Legislation

During the 2022 Colorado legislative session, a draft bill was presented to ban the hunting of bobcats, mountain lions and Canada lynx. The bill received significant interest from stakeholders and citizens and was postponed indefinitely, but the implications to management of lions without the tool of hunting would have had significant implications to CPW.

In November of 2020, Colorado voters passed Proposition 114, which requires CPW to develop a management plan to reintroduce gray wolves to the western part of the state by December 2023. While this state statute doesn't directly involve mountain lions, questions of if or how wolves may impact other species, including lions, is a matter managers will need to consider.

Research Efforts

CPW staff published the results of the 10-year Uncompahgre lion research project as a Wildlife Monograph in 2021 (Logan and Runge, 2021) as well as in a technical agency publication. Additionally, research on lions from Colorado's Front Range was published in several peer-reviewed journals since the last workshop. Recent publications include:

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Idaho Mountain Lion Status Report

Katie Oelrich, Wildlife Staff Biologist, Idaho Department of Fish and Game

Current Management: Idaho currently implements the 2002–2010 Mountain Lion Management plan. Management goals for mountain lions are to: ensure long-term viability of the population, provide a diversity of harvest opportunity, and to be responsive to human conflicts, livestock depredations and underperforming ungulate populations. We are working on the 2022-2028 mountain lion plan and expect a draft this summer. The goals from the 2002 plan are still appropriate for the new plan, but we need update where we are and incorporate information that'd become available within the last 20 years.

Hunting and Harvest Characteristics: Idaho's mountain lion season generally runs September through March. Currently there are no areas with quotas. Idaho allows the use of electronic calls and offers a second lion tag and expanded seasons to increase harvest opportunity in units with underperforming deer or elk populations, which are difficult to access backcountry units often in wilderness. All harvested and salvaged lions require check-in to collect biological data used to evaluate population status statewide and in 18 Data Analysis Units. In addition to using harvest data, sightings/conflicts, depredations, hunter effort and prey metrics also guide local management strategies.

The current plan, 2002, states that initial harvest goals will be based on maintaining harvest levels on a 3-year running average. We use a running 3-year average to compensate for yearly variability. Harvest criteria will be used to indicate need for management changes to increase or decrease harvest, including total harvest, % total females in harvest and % adult females' ≥3 years old in harvest (Anderson and Lindzey 2005).

- Mountain lion harvest has increased an average of 4.4% annually during the past 10 harvest seasons. Harvest increased to ~725 lion per year, because of second tags in backcountry areas, increasing quota limits or removing quotas, and just having more hunters out in the hills.
- During Harvest Seasons 2017-2019 the percentage of females in the harvest averaged 43%, and adult female harvest averaged 16% (harvest season July 1- June 30). Neither of the 3-year average for adult female harvest or overall female harvest indicate that females are overharvested.
- The primary method of take is hounds. Making up about 65% of the total documented mortality. Which over the last 10 years has decreased, and the proportion of incidental harvest increased, compared to the prior 10 years.
- About 30,000 tags and 4,000 hound hunting permits are sold annually. Tag are purchased individually or included in the Sportsman package (which bundles other tags for a discounted price). The sales of mountain lion tags and hound hunting permits are slightly increasing by an average of 3.6% annually. We do not know how many people are actively hunting for mountain lions.

Typically, harvest is higher in areas closer to accessible roads, which makes it easier for a sportsman to run hounds, and it overlaps much of our heavier hunted deer and elk populations. Where there is more dense cover and more prey available, we see denser predator populations. Wolf, black bear, and mountain lion harvest is more pronounced in the northern half of the state. Wolf presence in these areas has some influence on hound hunting.

Some hound hunters moved to other areas with lower wolf densities to avoid the risk of losing dogs. Significant harvest south of the Snake River Plain is relatively new. Game management units have of sufficient sources of prey for sustaining mountain lion population; but of because access difficulty (wilderness) and/or inefficiency of hound hunting, harvest is low. These areas provide a source of animals for dispersal into adjacent populations.

Management Direction: A goal of the new management plan looks to expand and strengthen Idaho's ability to prescribe harvest strategies that meet desired objectives by developing additional monitoring tools utilizing resources we already have. As a result, the new plan is pursuing additional population monitoring tools to supplement harvest data. Including information collected from camera-based monitoring methods.

Important knowledge has been gained to improve camera-based mountain lion monitoring based on recent camera projects to develop methods to estimate mountain lion abundance or population trajectory.

1. During winters 2016-2017 and 2017-2018, IDFG Research and University of Montana conducted a graduate study in the Sawtooth and Bear River areas to test the effectiveness of using remote cameras to monitor mountain lion populations and abundance estimate. Genetic sampling of mountain lions was also conducted in the study area (biopsy darting and backtracking to collect scat and hair samples) used for comparison with the trail camera results. Results are published in the Journal of Wildlife Management (Loonam et al. 2020): See Link: https://wildlife.onlinelibrary.wiley.com/doi/epdf/10.1002/jwmg.21950
2. Over the 2019/2020 winter, IDFG and houndsmen collared mountain lions in the Bear River area. Also, during this period, staff deployed a remote camera grid to estimate mountain lion density. We used a space-to-event analysis to estimate the number of mountain lions in the study area. Unfortunately, cameras collected too few mountain lion photos for this analysis to generate a stable estimate; numbers were highly variable depending on study dates or other parameter selections. We are extending this work by adding information from collared animals and employing spatially explicit capture-recapture methods. Initial work complete to incorporate camera-based estimation with movements and detections of collared lions to improve estimation.
3. Building off those results, planned additional work from the North ID camera arrays (units 1, 6, and 10A) to produce estimates for summer and winter range estimates, continue to investigate space-to-event model assumptions relative to species-specific behavior, and investigate use of other models with camera data. This study area also includes ongoing research to examining how predator management influences prey and other predator populations using trial cameras.

Some of more complex issues with ML Management are the substantial differences that exist in public desires and subsequent trustee goals for mountain lion management. Communication across these scales are crucial for meeting this challenge.

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Florida Mountain Lion Status Report

Mark Lotz, Florida Fish and Wildlife Conservation Commission

Feline Leukomyelopathy

Feline Leukomyelopathy (FLM) is a neuromuscular disorder that presents as hind limb incoordination and weakness. It was first detected in Florida panthers (Puma concolor coryi) in 2017, and in bobcats (Lynx rufus) a few years later. It has not been detected in any other species, including domestic cats. The Florida Fish and Wildlife Conservation Commission (FWC), in cooperation with multiple scientists and institutions, are working to determine the cause. So far, any direct cause has remained elusive. FLM causes severe degeneration of axons (nerve fibers) and myelin (nerve fiber insulation) in the spinal cord. It can only be verified by examining the spinal cord at necropsy. Probable cases are determined by video evidence. As of April 2022, we have documented 58 cases (14 confirmed, 44 probable) of FLM in panthers and bobcats. There have been 24 cases (4 confirmed, 20 probable) in panthers and 34 cases (10 confirmed, 24 probable) in bobcats. Most cases are in southwest Florida, where the bulk of the panther population lives. However, cases of FLM in bobcats have been verified in central and north Florida, indicating FLM is present state-wide. The leading hypothesis is that FLM is caused by some sort of toxin that is rapidly metabolized. Further, it must be common and broadly distributed. There is a higher incidence in panther kittens, first appearing when 4-5 months old, and some speculation that exposure may occur in utero or during lactation. After an acute onset, it does not appear to progress or improve. FLM is not infectious or congenital nor is it caused by myriad agents such as tick paralysis, bufo toxin, or cyanobacteria. FWC has increased monitoring efforts by expanding camera grids to assess the distribution and prevalence of FLM. We also capture and test acutely affected felids and collect spinal samples for testing on all road-killed individuals. We have also increased monitoring efforts of panther kittens, with similar plans for bobcats, to document onset with the hope of learning a cause. Fewer cases of FLM have been observed in 2021 compared to previous years.

Panthers in Central Florida

In 2016, a female panther was documented north of the Caloosahatchee River, a feature that historically defined the extent of the breeding population, for the first time since 1973. In March 2019, FWC expanded camera monitoring efforts based on known habitat utilization by male panthers in central Florida. Our assessment of the distribution of Florida Panthers north of the Caloosahatchee River was completed in March 2021 (Kelly and Onorato, 2021). From 1 March 2019 to 1 March 2021, cameras were deployed for >100 days at each of 138 Central Florida locations, yielding a monitoring effort of 47,400 camera trap-days. A total of 419,236 images were cataloged, including 3,066 panther images representing 619 independent detections. When presence of females was confirmed or suspected, we used an adaptive monitoring approach by increasing the density of cameras in the vicinity to improve the probability of timely detection of breeding activity and documentation of kittens. The pattern of detections at camera sites across Central Florida indicates panthers are distributed unevenly with some localities having higher abundances. Detection rates are a more accurate reflection

of panther activity than panther abundance. Three female panthers were detected as well as several males.

Population Status and Distribution

Annual counts of Florida panther sign provided insight into panther abundance. Counts conducted primarily on public lands, south of Lake Okeechobee, 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 (McBride and McBride, 2015). The upper bound of 230 is calculated using annual count data from core 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. We have also utilized roadkill information for a motor vehicle mortality model as another means to derive a population estimate. While the model is imprecise, due partly to the poor sample size of radio collared animals in recent years, the lower confidence intervals tracked closely with our minimum counts. Results from this model, in addition to the number of roadkill's collected and declining depredation complaints (Florida Fish and Wildlife Conservation Commission, 2021) all indicate that the panther population is no longer increasing. Male panthers are routinely documented in central Florida, primarily south of the I-4 corridor, albeit at low densities (Fig. 1). Three female panthers were detected north of the Caloosahatchee River after a 43-year absence.

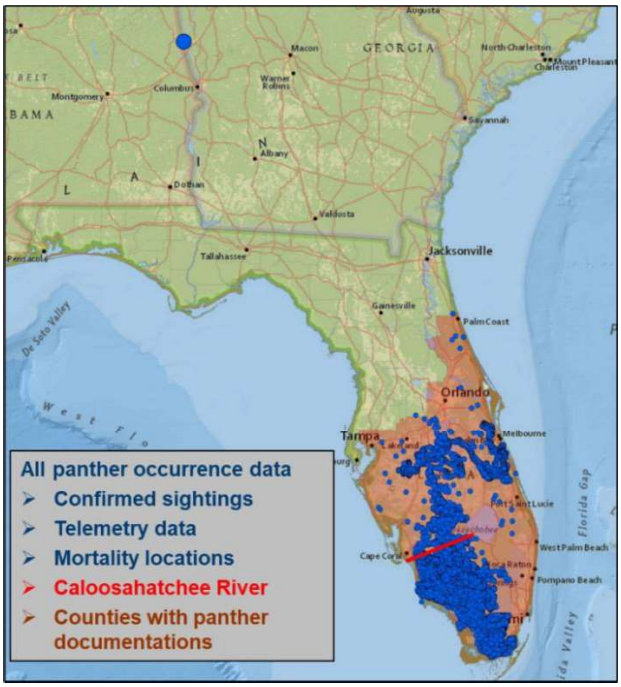

Figure 1. Florida panther occurrence data, 1981-2022. Shaded counties indicate verified presence of a minimum of one panther.

Species Status Assessment

The Species Status Assessment (SSA) for the Florida Panther (USFWS, 2020) was completed in September 2020 after an exhaustive 3-year process. Members of the FWC panther research and management program provided significant contributions towards completion of the SSA. The purpose of an SSA is to document a species life history and ecological relationships to provide the foundation for the assessment, describe and hypothesize causes for the species current condition, and forecast the species future condition. The SSA does not result in a decision directly, but it provides the best available scientific information to guide Endangered Species Act (ESA) decisions. The SSA will be used to inform the next 5-Year Review, required of the U. S. Fish and Wildlife Service for any species listed as threatened or endangered under the ESA.

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Kansas Mountain Lion Status Report

Matt Peek, Kansas Department of Fish and Wildlife

Mountain lions are classified as "nongame" wildlife in Kansas with no open harvest season. State law allows wildlife including mountain lions to be taken by landowners or licensed Wildlife Control Operators for damage or being in or near buildings, but so far none have been.

The first confirmation of a mountain lion in Kansas in modern times occurred in 2007, ending a 100-plus year absence of documented wild mountain lions in the state. Since 2007, 41 confirmations have been made (figure 1). These confirmations are not all the result of unique individuals. In several cases, a single lion is believed to be responsible for 5 or more confirmations. The number of annual confirmations is trending slightly upward due partially to the high number of confirmations in 2020, which was the result of at least three different lions being in the state during the winter, one of which was apparently documented multiple times over several months in southcentral Kansas. However, this lion has apparently moved on, and there is currently no evidence of resident mountain lions in Kansas.

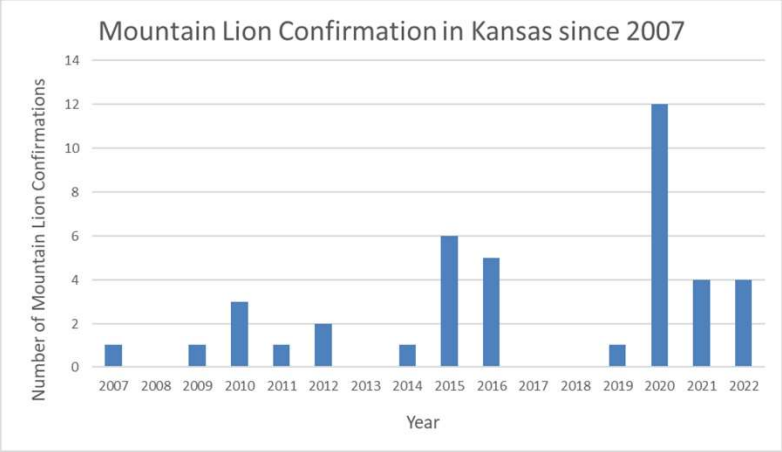

Figure 1. Annual mountain lion confirmations in Kansas since 2007.

The source of most of Kansas' lions in unknown, but tissue samples sent to the Rocky Mountain Research Station lab indicated that a lion that apparently starved to death in Ford County was genetically most similar with lions from Wyoming (66.6%) and another that was shot in Rooks County was most similar with those from Nebraska & South Dakota (99.8%). A third lion was collared in Colorado and known to have passed through western Kansas on its way to New Mexico. The general movement of several other lions was apparently from the north/northwest to the southeast/east.

A model of mountain lion habitat in Kansas based on slope, landcover and hydrography indicates Kansas has little high value habitat (Figure 2). However, mountain lions did occur in Kansas historically, Kansas does have more abundant prey than many of the areas, especially the arid areas, in which they currently exist, and they have proven increasingly capable of living near people. As a result, the potential for resident mountain lions in Kansas should not

be totally discounted, though the likelihood of more than a very small number in Kansas anytime into the foreseeable future appears very low.

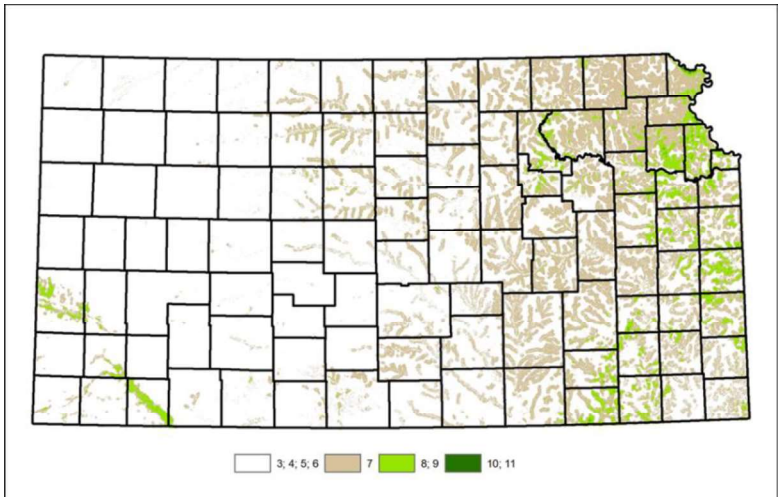

Figure 2. Habitat model of mountain lions in Kansas based on slope (1-4 pts), landcover (1-4 pts) and hydrography (1-3 pts).

The Kansas Department of Wildlife and Parks (KDWP) established a response plan for mountain lions and other large carnivores in 2004, in anticipation of their future dispersal into Kansas. The primary purpose of the plan was to guide KDWP's response to these species when they show up in the state under different circumstances. This plan was updated in 2021 to describe a more current status of these species in the state and to affirm KDWP's anticipated response given entirely new administrators on the response team since the original document.

In conclusion, Kansas is a testament to the successful management of mountain lions in the West. Following over 100 years of no documentation in Kansas, a surplus of lions is now being produced in other states such that mountain lions now occur nearly annually in Kansas. These dispersers represent an opportunity for potentially suitable habitat in Kansas and elsewhere in the Midwest to become occupied – even if by just by a few individuals - that would not exist if not for the effective conservation of mountain lions occurring in states with resident populations.

Montana Mountain Lion Status Report

Molly Parks, Montana Fish, Wildlife and Parks

In 2019, Montana Fish, Wildlife and Parks (FWP) began implementing the Mountain Lion Monitoring and Management Strategy (FWP 2019), which outlines the state's new approach to conserving, monitoring, and managing mountain lions within an adaptive management framework. The strategy uses a Resource Selection Function habitat model to divide the state into four ecoregions (Figure 1), which delineate the spatial boundaries and scale of all monitoring and management moving forward. Population abundance is estimated in each ecoregion using an integrated population model (IPM) which combines data from mandatory reporting of mountain lion harvest, vital rates estimated from past studies of radiomarked animals, and a field-based spatial capture-recapture (SCR) method for estimating population density relative to habitat quality using mountain lion DNA. The IPM is also used to develop projections of future population change under alternative harvest scenarios that will inform management decisions.

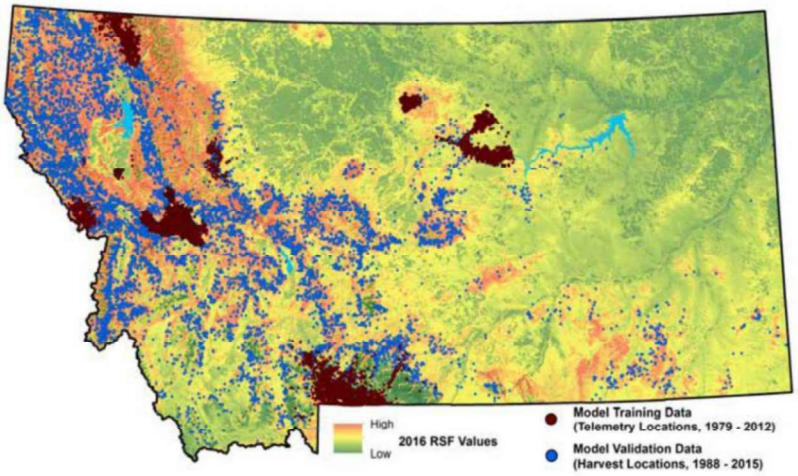

Figure 1. The 2016 Montana Mountain Lion Resource Selection Function map with 22,595 mountain lion telemetry model training points (1979–2012) and 10,503 harvest location validation points (1988–2015).

Montana recently completed field monitoring in the Northwest ecoregion (Figure 2). Based on spatial capture-recapture population estimates and mountain lion density-habitat quality relationships estimated in the 2019–2020 trend monitoring area and the 2020–2021 supplemental monitoring area, the estimated population of the Northwest Ecoregion is 3.7 independent aged mountain lions/100 km2 (90% credible interval: 3.3–7.9) or 1,376 individuals (90% credible interval: 650–2547).

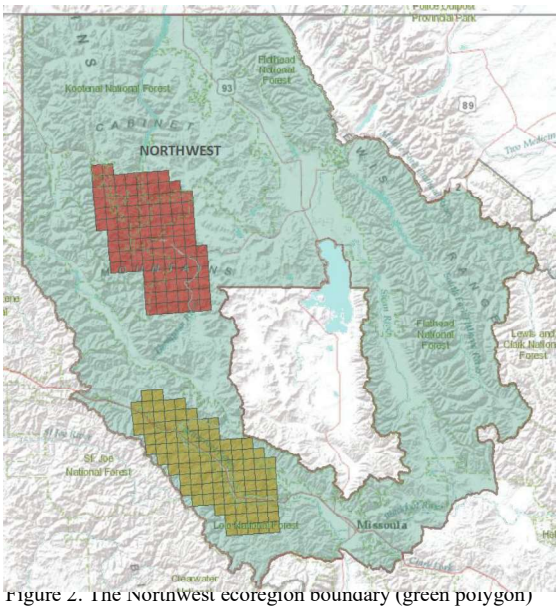

Figure 2. The Northwest ecoregion boundary (green polygon) and Northwest (red polygon) and Middle Clark Fork (yellow polygon) trend monitoring areas sampled during the winters of 2019–2020 and 2020–2021, respectively.

Upon completion of population monitoring in the Northwest ecoregion, the Northwest Lion Ecoregional Population Objective Committee (LEPOC) was developed to directly engage the public in the management decision-making process. The LEPOC comprised 10 members of the public who reside within or close to the Northwest ecoregion, and as a committee, represented a broad spectrum of mountain lion stakeholder viewpoints. The objective of the LEPOC was to work with FWP to provide a recommendation to the Montana Fish and Wildlife Commission (Commission) regarding 1) target population trend over a 6-year period, 2) degree of ecoregional population size change (% up or % down), and 3) Lion Management Unit (LMU) emphases (e.g., older-age class harvest, conflict reduction, aid ungulate populations, more opportunity.). After working through a Structured Decision Making (SDM) process spanning two sessions in early 2022, the LEPOC presented FWP a final recommendation of a 12.5% decrease in the Northwest Ecoregion Mountain lion population by 2027, with focal areas of higher harvest in specific LMUs (i.e., LMUs100,121,122,123, and124). Pending approval by the Commission, the harvest prescriptions to meet this population objective will be implemented beginning in the 2022–2023 season (Figure 3).

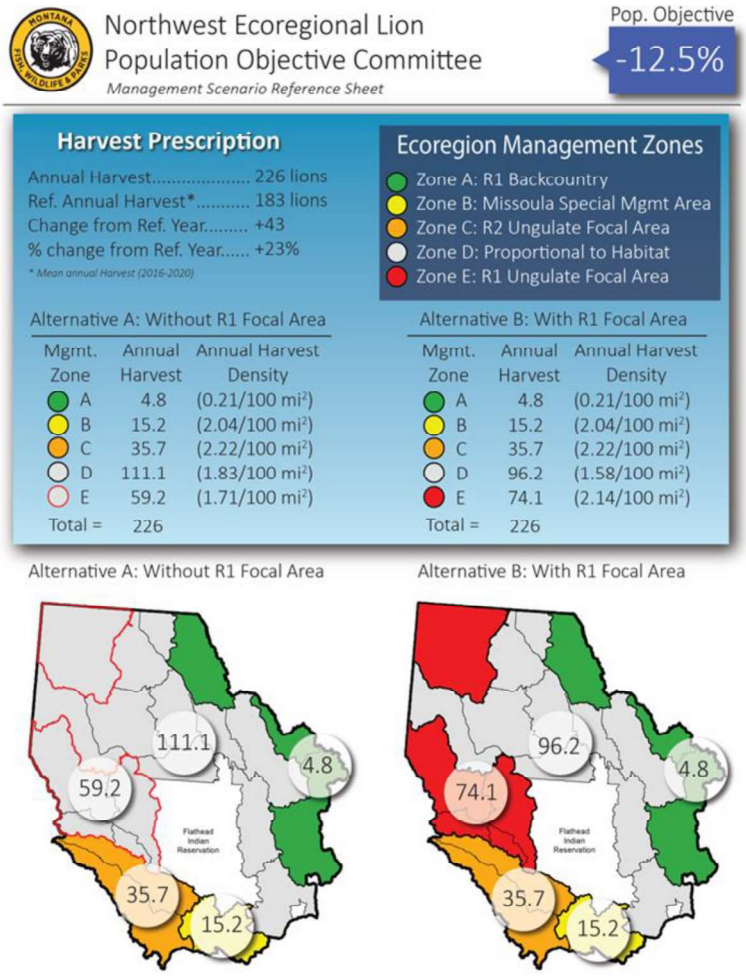

Figure 3. Northwest Lion Ecoregional Population Committee Informational Sheet illustrating LEPOC final recommendation. Maps show spatial alternatives where numbers within the circles indicate annual harvest prescription for the management (colored) zones for which they overlap.

Currently, the Commission process for setting mountain lion season structure and quotas is underway, with some recently adopted changes to allocation of mountain lion hunter opportunity. In alignment with Commission direction, FWP has developed a single, statewide season structure. Winter hunting seasons that allow the use of hounds will now allocate harvest between limited special limited mountain lion licenses obtained through a drawing (10- 30% of the quota for any LMU) and regional unlimited special mountain licenses that are governed by quotas or sex-specific subquotas. Proposed mountain lion quotas will be adopted at the June 2022 Commission meeting. FWP's modification to mountain lion season structure is one facet of a new Regulation Simplification process initiated in 2021 to improve public understanding of harvest seasons and regulations. To date, this process has included consolidation of hunting districts and simplification of license structures for several of Montana's game species.

Aside from Montana's direction to streamline harvest regulations and improve public understanding of seasons, other updates include a variety of recent publications. The following is a list of research papers and agency reports either published or in press since the 2017 WAFWA Mountain Lion Workshop.

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Nebraska Mountain Lion Status Report

Sam Wilson, Nebraska Game and Parks Commission

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. The first regulated harvest season for mountain lions in Nebraska was held in 2014.

Current Status and Management

The Nebraska Game and Parks Commission approved a mountain lion management plan in 2017. The Commission's management goal is to maintain resilient, healthy, and socially acceptable mountain lion populations that are in balance with available habitat and other wildlife species over the long term.

The Nebraska Game and Parks Commission does not create statewide population estimates. Genetic surveys conducted between 2010 and 2021 indicate that the population in the Pine Ridge area has been relatively stable, with estimates ranging from 22 – 59 total animals. The most recent estimate (2021) for the population in the Pine Ridge unit is 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 there are no estimates for those populations. We have also documented one instance of reproduction along the Missouri River bluffs in northeast Nebraska. A few dispersing animals typically wander elsewhere in the state.

Historical and Current Mountain Lion Harvest

The first regulated harvest season for mountain lions in Nebraska was held in 2014. Five mountain lions were harvested. There have been four consecutive mountain lion harvest seasons beginning in 2019 (2019, 2020, 2021, and 2022) in the Pine Ridge unit. Harvest totals for those seasons range from four to seven. These seasons consist of an initial season that does not allow hounds and a possible auxiliary season that may take place if the limit is not met during the initial season. Hounds are allowed if an auxiliary season is held. The seasons have an overall harvest limit and a female sublimit. No harvest season has been held outside the Pine Ridge since 2014.

Mountain Lion Depredation

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.

Human Safety

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.

Current Research

The Nebraska and the Game and Parks Commission has been investigating observations of mountain lion presence by the public for more than 30 years. This effort has been important in helping document expanding populations since this species began recolonizing the state in 1991.

The Commission is conducting a multi-year research project to model habitat, determining population sizes, distribution, movements, habitat use, and impacts on big game prey species. Most of this information is determined through global positioning system collars. The Commission also estimates population sizes using scat-based genetic surveys, which have been conducted since 2010. Trail camera grid surveys are also used to assess changes in distribution.

Nevada Mountain Lion Status Report

Pat Jackson, Nevada Department of Wildlife

Predator Management Program

Nevada Department of Wildlife (NDOW) develops a Predator Management Plan annually. The current plan for fiscal year 2022 outlines five projects pertaining to mountain lions; Project 22-01: Mountain Lion Removal to Protect California Bighorn Sheep, Project 22-074: Monitor Rocky Mountain Bighorn Sheep for Mountain Lion Predation, Project 37: Big Game Protection-Mountain Lions, Project 40: Coyote and Mountain Lion Removal to Complement Multi-faceted Management in Eureka County, Project 42: Assessing Mountain Lion Harvest in Nevada, and Project 44: Lethal Removal and Monitoring of Mountain Lions in Area 24. More information can be found in the Annual Predator Plan at www.ndow.org (Nevada Department of Wildlife 2022*a*).

Population Model

NDOW collaborated with the University of Nebraska, Lincoln to build an integrated population model, based of existing harvest and GPS data. The population was found to be stable, with 3,200-3,400 mountain lions in Nevada (fig 1). Lambda was 0.994 (fig 2). More information can be found in the Annual Predator Report at (www.ndow.org; Nevada Department of Wildlife 2022*b*).

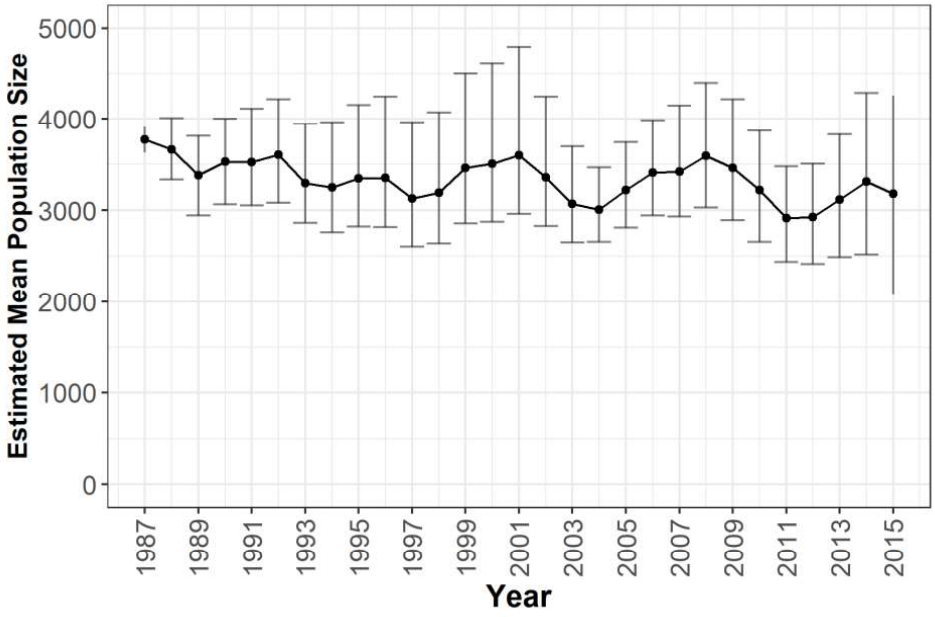

Figure 1. Predicted mountain lion population size from 1987 through 2015 across the state of Nevada, credit Benson and Mahoney.

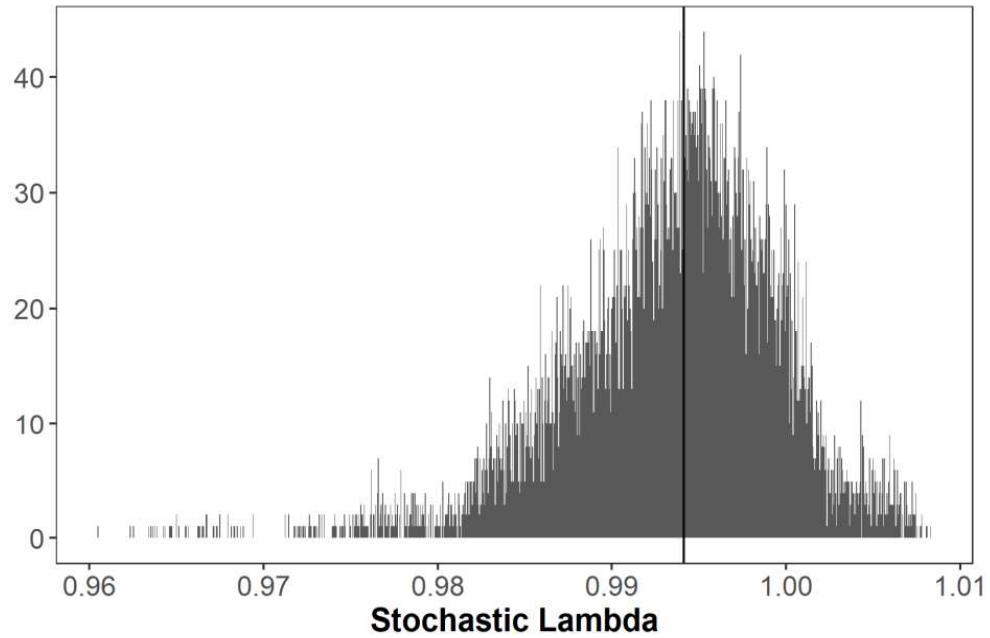

Figure 2. Stochastic population growth for mountain lions in Nevada from 1987 through 2015. Median growth (0.994) depicted as a vertical black line credit, Benson, and Mahoney.

Mountain Lion and Feral Horse Interactions

Project 44 within the Annual Predator Plan (Nevada Department of Wildlife 2022*a*) has involved GPS marking mountain lions and visiting kill sites. Some preliminary findings: the majority of marked mountain lions consumed feral horse (fig. 3), both male and female mountain lions consumed feral horse (fig. 4), mountain lions have consumed feral horse year round (fig. 5) and foals are the age class most focused on (fig. 6).

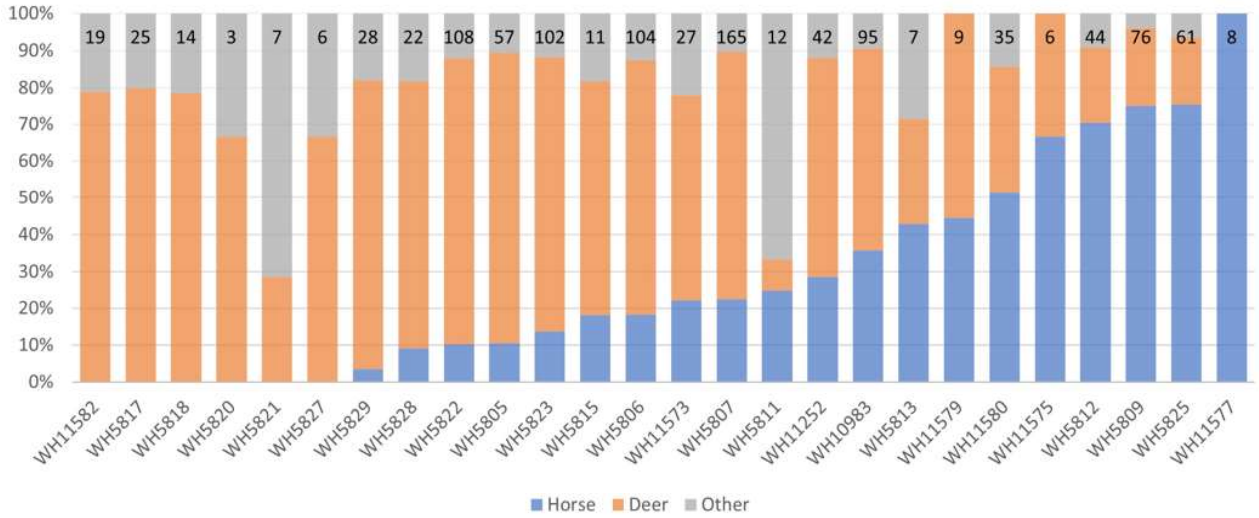

Figure 3. Proportion of horses and deer in each Delamar mountain lion's diet, 2018-2021, credit P. Iacono.

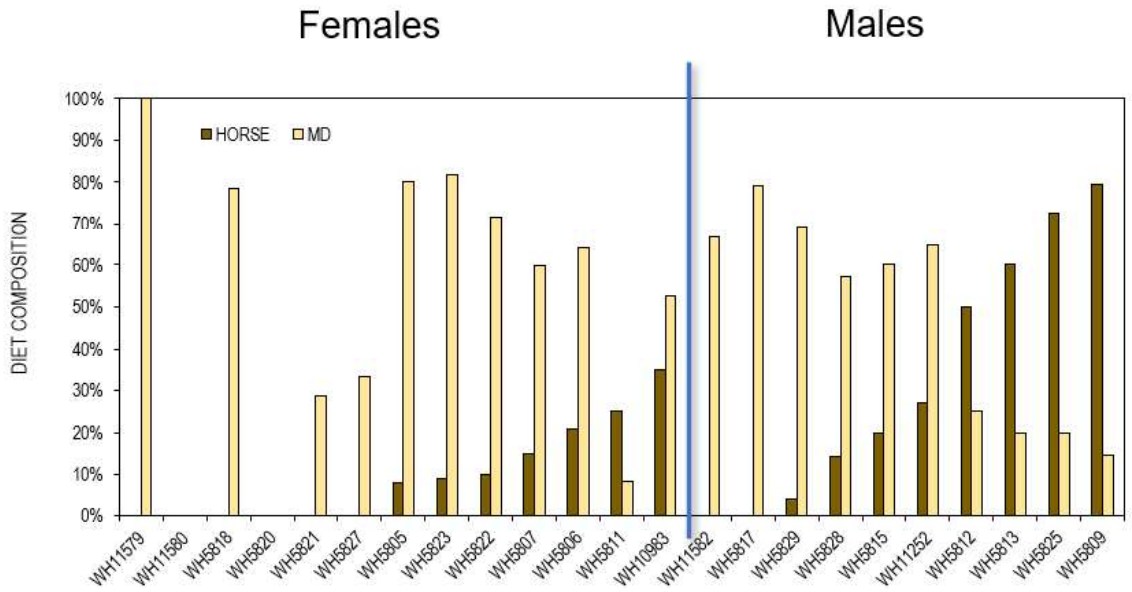

Figure 4. Proportion of deer and horses in diet of Delamar mountain lions, by sex, 2018-2021, credit P. Iacono.

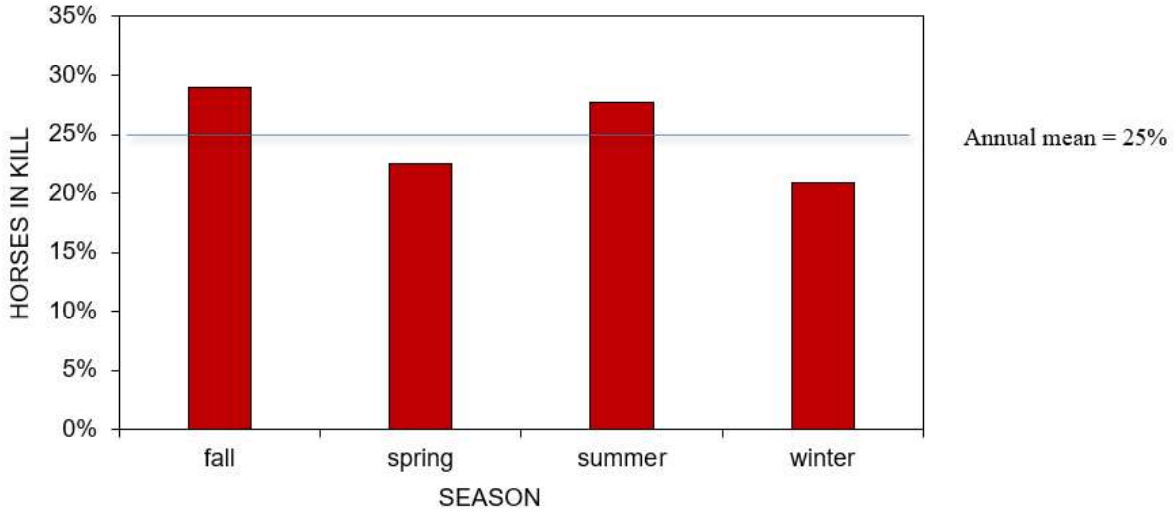

Figure 5. Seasonality of mountain lion predation on horses, Delamar Mountains, 2018-2021, credit P. Iacono.

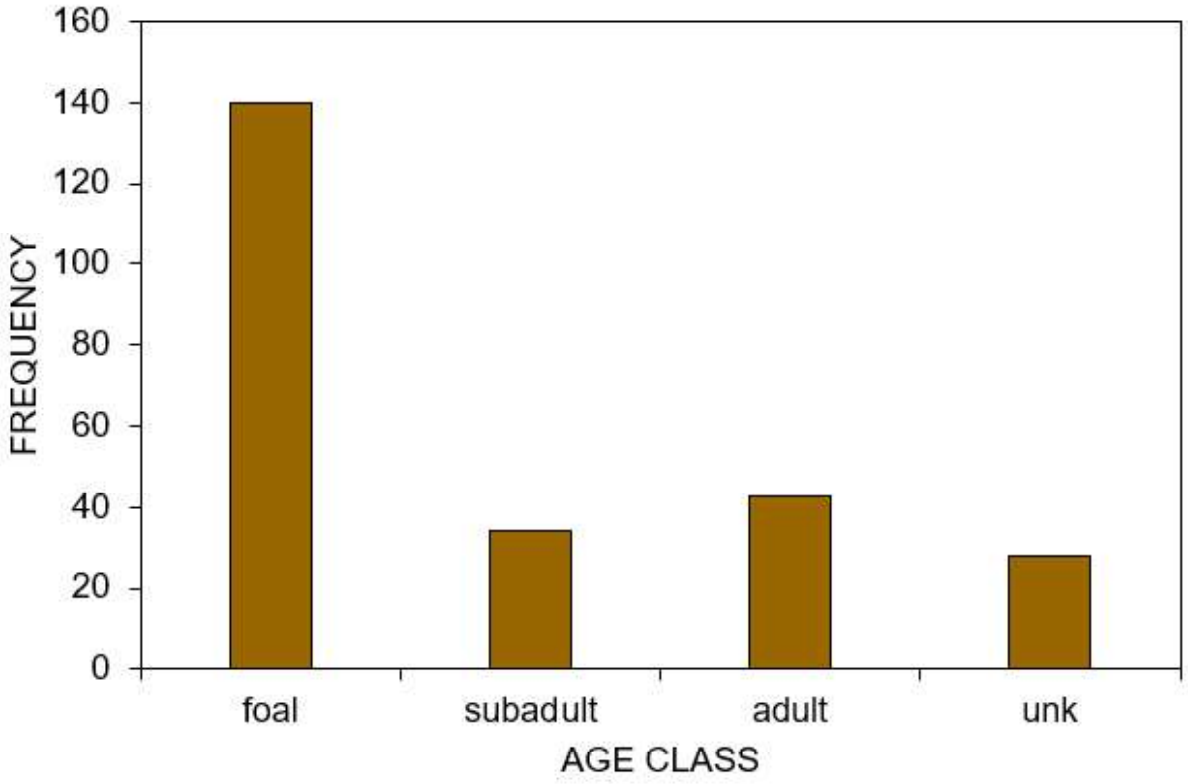

Figure 6. Age classes of horses killed by mountain lions, Delamar Mountains, 2018-2021, credit P. Iacono.

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New Mexico Mountain Lion Status Report

Rick Winslow, New Mexico Department of Fish and Wildlife

ABSTRACT:

Harvest statistics: 5-year average sport harvest, 279; 5-year average non-sport mortality, 56 (Table 1). New Mexico manages by Cougar Management Zones (Figure 1), composed of multiple game management units; and estimates independent-aged population by zone based on NM specific habitat map and densities from NM studies and the literature. Harvest limits are set for each zone, with a total limit and a female sub-limit, either of which will close a zone. The harvest is monitored through mandatory pelt tagging (within 5 days of harvest) by the Department. Harvest and management are reviewed and modified on a 4-year rule setting cycle.

Current research: We are using spatially explicit capture-recapture (SECR) to estimate cougar densities, one zone at a time, which will continue into the foreseeable future. We utilize a Spatial Mark-Resight (SMR) approach combining trail cameras and GPS collars to get robust, defensible density estimates.

The study design is 9 sites/grid (3x3), with sites spaced ~5 km apart, and grids spaced 15 km apart, with flexibility on the inter-camera and inter-grid spacing. Typically, we have 15-20 grids to cover a 15-20,000 sq-km study area. Ideal sample size is to catch and collar 15-20%+ of the population. Camera sites are set up with two cameras ~10 m apart with same focal area. We use a lure to attract felines, check cameras, re-lure and change batteries and SD cards regularly. There is a minimum analysis period of 16 weeks, after which we analyze photos, build capture histories from photo data GPS collar data, and feed the data into an integrated SMR.

In 2017 and 2018 we used this approach in the Jemez-Southern San Juan/CMZs B, F, and N: ~150 camera trap sites, ~20 collared cougars, ~70 camera detections. Initial model runs have produced robust estimates. From 2019 to 2021 we deployed cameras and collars in the Sacramento-Guadalupe Mountains/CMZ Q: ~200 camera trap sites, ~30 collared (15%), and we are still analyzing photos. General study take-aways: very windy, lots of extraneous photos; irregular visitation due to weather and challenges with access due to conditions. In 2021 we began another iteration in the Gila Region/CMZs J and K: ~80 camera trap sites on initial study area in northern part of Gila; ~15 cougars collared (goal of 40-50 collars deployed). Overall takeaways from using this approach: check camera sites often; high-grade sites to maximize cougar detections and make sure staff deploying cameras are knowledgeable about where those spots would be; people steal and/or vandalize cameras; wind is bad; rain is a mixed blessing.

Where we're headed: The current SMR model structure is a starting point to update density estimates for zones. We have an opportunity to update the cougar habitat map statewide with additional NM specific data and create an Integrated Population Model (IPM) based on all the available data sources, including GPS location and mortality data, trail cameras, and harvest statistics. Ideally, we would like to repeat the SECR studies every 5-10 years for a

given area and update the IPM in the interim years with harvest and other data to monitor the population.

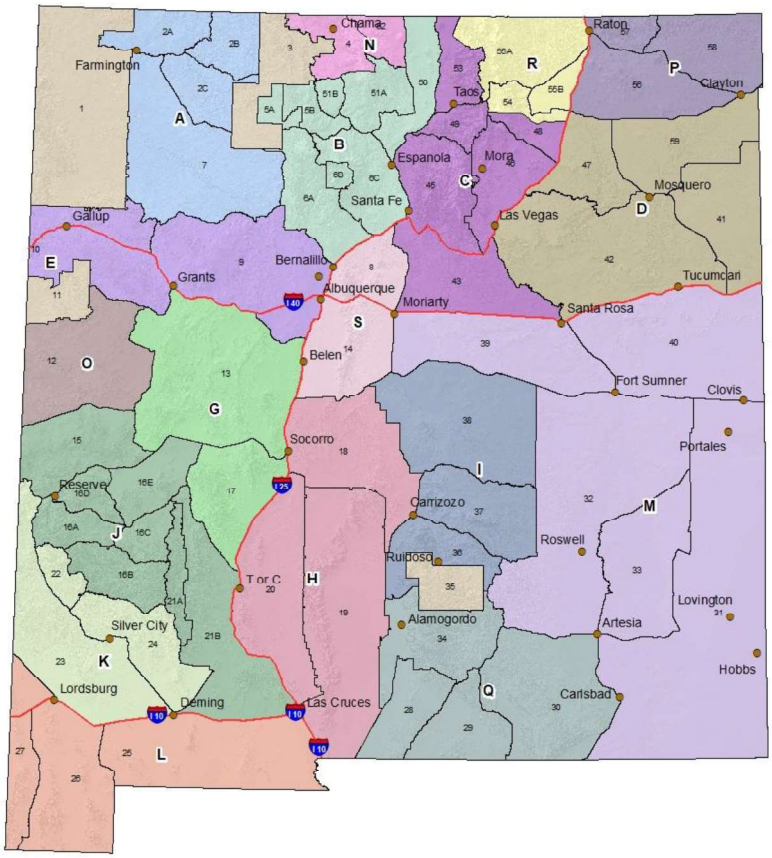

Figure 1. New Mexico state cougar management zones and game management units.

Table 1. Annual Cougar Mortality Statistics 2001-2020, New Mexico Department of Game and Fish

	Sport Harvest			Depredation Kill			Bighorn Sheep Protection			Other (road kill, accident, etc.)				
License Ye	Fem	Male	Unk.*	Fem	Male	Unk.	Fem	Male	Unk.	Fem	Male	Unk.	**Total**	**% Female**
2001-02	76	110	0	3	3	1	5	6	0	3	0	2	209	41.20%
2002-03	82	120	1	14	13	1	14	11	0	6	3	2	267	43.40%
2003-04	84	114	0	17	5	0	5	12	0	3	2	0	242	45.00%
2004-05	72	89	0	16	16	1	3	8	0	4	0	0	209	46.30%
2005-06	34	72	0	5	5	0	6	8	0	1	3	0	134	34.80%
2006-07	82	95	0	11	13	1	8	10	0	3	1	0	224	46.70%
2007-08	59	104	0	13	13	0	3	8	0	1	1	0	202	37.60%
2008-09	50	72	0	5	11	0	4	11	0	4	1	0	158	39.90%
2009-10	55	103	0	7	11	0	8	7	0	1	5	0	197	36.00%
2010-11	57	110	1	1	3	0	8	6	0	5	5	0	196	36.20%
2011-12	75	123	0	14	7	0	4	8	0	5	7	0	243	40.20%
2012-13	87	170	0	14	6	0	7	23	0	4	5	1	317	35.30%
2013-14	85	117	1	12	12	0	5	12	0	5	4	0	253	42.40%
2014-15	102	130	0	12	10	1	8	10	0	4	7	0	284	44.80%
2015-16	88	151	0	14	9	0	6	5	1	7	13	0	294	39.10%
2016-17	89	154	1	15	6	0	5	12	0	7	9	2	300	38.70%
2017-18	94	143	1	10	10	0	9	10	0	5	9	1	292	40.40%
2018-19	122	236	0	14	11	0	6	22	0	5	6	2	424	34.70%
2019-20	112	170	0	3	5	0	7	19	0	4	3	0	323	39.00%
2020-21	122	150	0	10	7	0	9	17	0	11	4	1	331	45.92%

*Unk. - Unknown, sometimes the sex is impossible to determine due to decomposition or physical damage.

North Dakota Mountain Lion Status Report

Stephanie Tucker, New Mexico Department of Fish and Wildlife

Abstract:

Historically, mountain lions (*Puma concolor*) once ranged over most of North Dakota, although they were considered scarce except in the Little Missouri Badlands region (Bailey 1926). Records indicate mountain lions disappeared from North Dakota in the early-1900s (Bailey et al. [1914] *in* Young and Goldman [1946]) with the last confirmed record of a mountain lion being harvested in 1902 along the Missouri River south of Williston (Bailey 1926). There has never been a bounty on mountain lions in North Dakota (McKenna et al. 2004). In 1961, Adams advised that mountain lions have the potential to show up in North Dakota, particularly the Little Missouri Badlands region. According to Seabloom et al. (1980), there were 10 reports of mountain lions in southwestern North Dakota between 1958 and 1980 and they felt the species should be considered extant in the state. In 1991, after a young female mountain lion was shot near Golva, mountain lions were classified as a "furbearer" in the state (North Dakota Century Code 20.1-01). Provisions were made to allow removal of individual mountain lions for protection of property and human safety concerns (North Dakota Century Code 20.1-07-04). Prior to this time, mountain lions were unprotected and could be killed legally (McKenna et al. 2004). By the early-2000s, the number of reports of mountain lion occurrences documented by the North Dakota Game and Fish Department (hereafter, NDGF) had increased such that it became apparent there was a continued presence of mountain lions in western North Dakota (NDGFD 2006).

Currently, there is a relatively small population of mountain lions occurring in western North Dakota. Occasionally, individual mountain lions are documented in other parts of the state (McKenna et al. 2004, NDGF 2006, NDGF 2007, Johnson 2017). Estimates of habitat suitability indicated that the Badlands, Missouri River Breaks, and Killdeer Mountains regions (comprising 3.6% of total state area) provide suitable habitat for mountain lions (Johnson 2017).

The first regulated hunting season for mountain lions in North Dakota occurred in 2005-2006 with a harvest limit of 5. This first hunting season was considered experimental with the goal being to acquire biological and distributional information about the population of mountain lions occurring in the state (NDGF 2006). The second regulated hunting season (2006-2007) was modified to prohibit the harvest of kittens (i.e., mountain lions with visible spots) or females accompanied by kittens. Additionally, hunters were not allowed to use dogs to pursue mountain lions until 4 months later in the season. Changes to the 2007-2008 regulations included dividing the state into 2 management zones (Zone 1 had a harvest limit of 5, Zone 2 had no harvest limit), no longer counting incidental or depredation removals towards the harvest limit, and Fort Berthold Reservation (hereafter, Reservation) having a separate harvest limit. During the 2008-2009 hunting season, the harvest limit for mountain lions in Zone 1 was increased to 8 while the harvest limit within the Reservation was 5. The harvest limit in Zone 1 was again increased to 10 in the 2010-2011, 14 in 2011-2012, and 21 in 2012-2013 harvest seasons. In 2015-2016, the harvest limit within the Reservation was increased to 10. In 2016-2017, the harvest limit in Zone 1 was lowered to 15.

Reports of mountain lion occurrence (e.g. sightings, tracks, etc.) could have been submitted to NDGF by calling or emailing agency personnel or by filling out an online form https://gf.nd.gov/hunting/furbearers/furbearer-observation. Reports were classified as

a. Verified – Evidence available, including a carcass or live-captured mountain lion, photograph or video, DNA analysis results, or tracks, scat, kill or attack confirmed as being that of a mountain lion by a qualified wildlife professional.
b. Probable Unverified – No evidence available, but report, animal description, and/or location are plausible.
c. Improbable Unverified – No evidence available and report, animal description, and/or location are not plausible.
d. Unfounded – Evidence available which disproves the claim that it is a mountain lion, including carcass or live-captured animal, photograph or video, DNA analysis results, or tracks, scat, kill or attack disproved as being that of a mountain lion by a qualified wildlife professional.

We required hunters to turn in the entire, intact carcasses of all harvested mountain lions after they removed the pelts. Additionally, we collected data from mountain lions killed on the Reservation, when feasible. From the mountain lion carcasses, we estimated age (Anderson and Lindzey 2000, NDGFD 2018), examined reproductive tracts and stomach contents, and collected tissue samples. We examined reproductive tracts for placental scars to determine pregnancy rates and litter sizes. We extracted an upper premolar and sent them to Matson's Laboratory (Manhattan, Montana, USA) to confirm age via counts of cementum annuli.

To estimate trends in abundance of mountain lion in North Dakota, we analyzed age-at-harvest and radio-collar data using statistical population reconstruction (SPR; Johnson 2017, Johnson et al. 2019). We updated the SPR model to include age-at-harvest data from the 2020-2021 season.

Our SPR model assumes that known age mountain lions included in the data set were produced from our breeding population in the Badlands region. However, we felt we may be violating this assumption by including individuals in the model from Zone 2, as these mountain lions are generally dispersing subadults. Therefore, we sent tissue samples from all mountain lion mortalities having occurred in Zone 2 to the National Genomic Center for Wildlife and Fish Conservation at the USFS Rocky Mountain Research Station (Missoula, Montana, USA) to conduct genetic population assignments. Population assignments are reported as a probability that a mountain lion is from a particular population based the available genetic database (Ortloff et al. 2019). Those mountain lions that had a high probability (≥60%) assigned to a population other than North Dakota were subsequently removed from our SPR model analysis.

From 1 July 2020-30 June 2021, we recorded 39 reports of mountain lions (Figure 1). Of those, 14 reports (36%) were classified as Verified. This was a lower number of reports of mountain lions compared to the previous year. The Verified reports consisted of 79% carcasses (i.e., mountain lions harvested during the regulated hunting season, dispatched for protection of property, or killed by automobiles), 14% photographs or videos, and 7% mountain lion signs (i.e., tracks, scat, kills, or scrapes). Like past years, the distribution of

Verified Mountain lion reports occurred primarily in western North Dakota, particularly the northern Badlands region.

The hunting season for mountain lions opened on 4 September 2020. Zone 1 had a harvest limit, whereas Zone 2 had no harvest limit and remained open for hunting until 31 March 2021. In Zone 1, the harvest limit was split between consecutive early- (4 September 2020-22 November 2020) and late-seasons (23 November 2020-31 March 2021). Zone 1 early-season harvest limit was 8 and the late-season harvest limit was 7 total or 3 females, whichever came first, for a combined harvest limit of 15 in Zone 1. Hunters could use dogs to pursue mountain lions only in the late season. The harvest limit for the early-season was not reached prior to 22 November 2020, therefore 5 days after the late-season harvest limit was reached, a conditional season opened in Zone 1 to allow additional mountain lion harvest until the early-season harvest limit was reached or 31 March 2021, whichever came first. Use of dogs to pursue mountain lions was prohibited during the conditional season.

The early season in Zone 1 closed on the last day of the season with 2 mountain lions (1 F, 1 M) being harvested (Figure 2). The late season in Zone 1 closed on 18 January 2021 after the harvest limit of females was met, with a total of 4 mountain lions being harvested (3 F, 1 M). A conditional season opened on 24 January 2021, and 2 more mountain lions (1 M, 1 Unknown) were taken before closing on 31 March 2021. Additionally, 1 female mountain lion was legally harvested in Zone 2. Therefore, the total legal harvest consisted of 5 females, 3 males, and 1 unknown.

We had genetic analysis conducted on tissue samples from 1 female mountain lion from Zone 2, to calculate population assignments (Ortloff et al. 2019). Results indicated the mountain lion was assigned to the North Dakota population. Probability of assignment was high, 100%. Subsequently, this individual was included in our SPR analysis.

Trends in annual abundance from our SPR model resulted in estimated mountain lion numbers ranging from a low of 30 total mountain lions in 2005-2006 to a high of 179 in 2011-2012 (Figure 3). The average total abundance was estimated at 73 mountain lions over the course of 15 years.

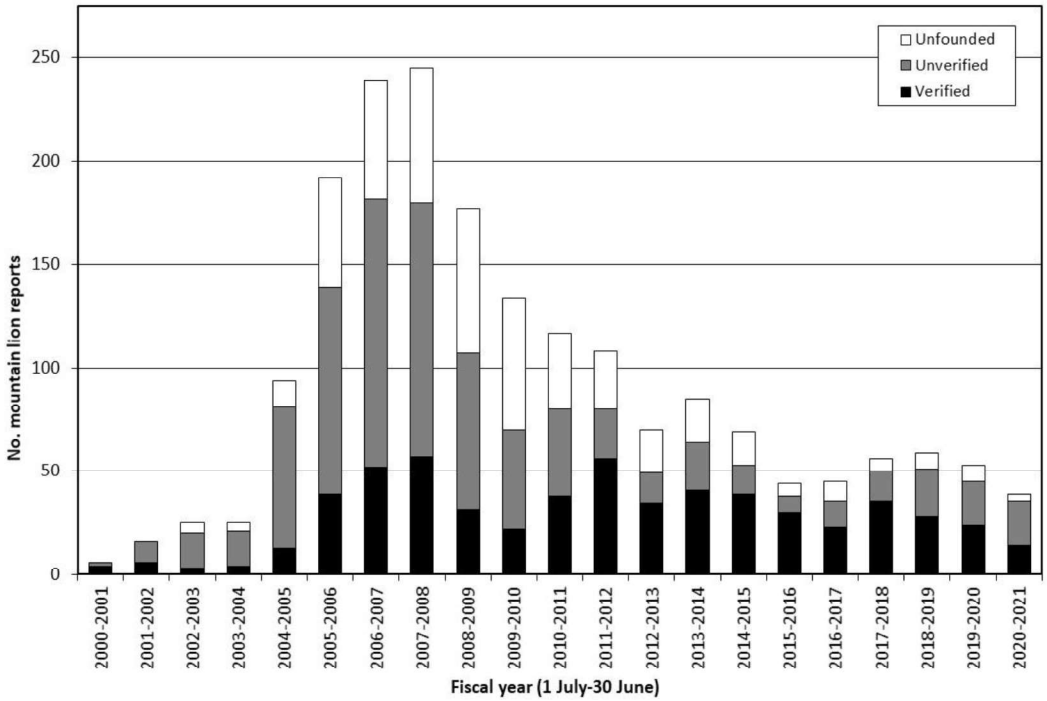

Figure 1. Reports of mountain lion occurrence in North Dakota from 1 July 2000 to 30 June 2021.

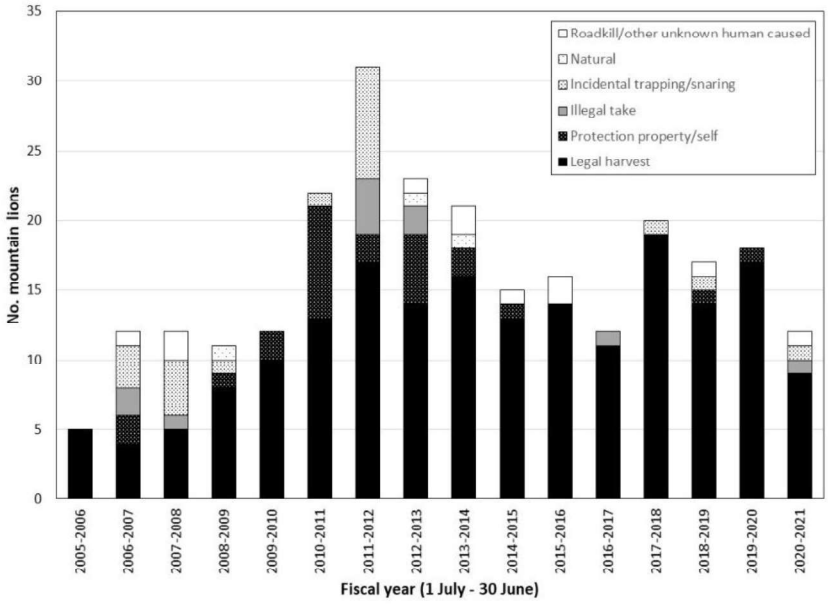

Figure 2. Number of documented mountain lion mortalities due to legal and illegal harvest, protection of property or self, incidental trapping or snaring, other or unknown human causes (automobile collisions, suspected poaching, etc.), and natural causes (predators, disease, etc.) in North Dakota, fiscal years (1 July-30 June) 2005-2006 through 2020-2021.

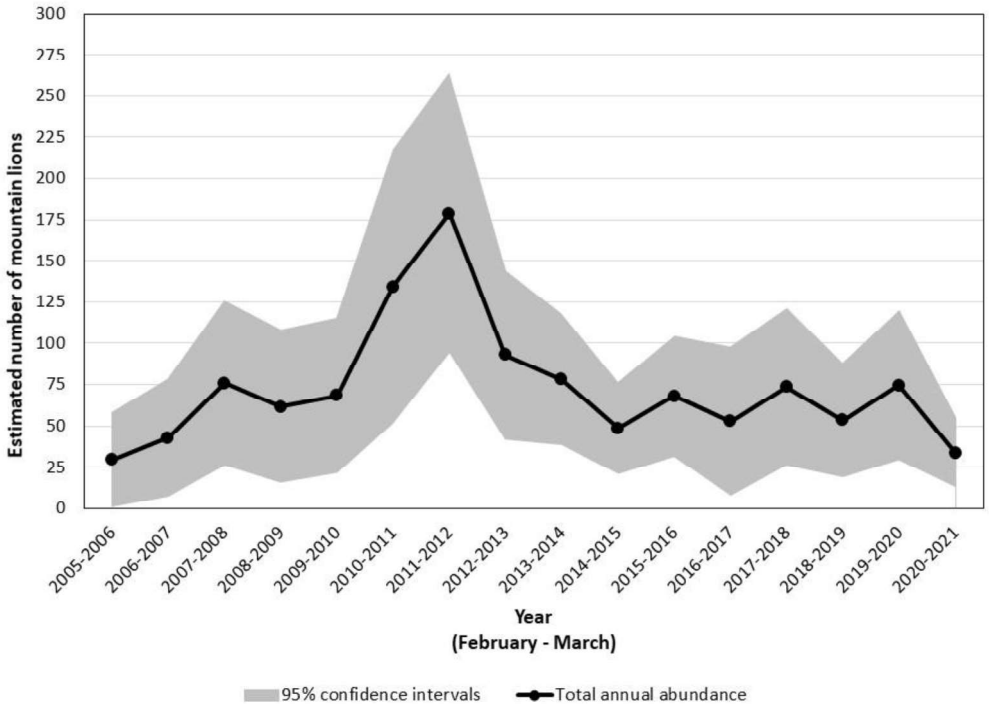

Figure 3. Annual estimates of mountain lion population abundance and associated 95% confidence interval in North Dakota, from 2005-2021, calculated using age-at-harvest data and statistical population reconstruction (Johnson et al. 2019).

Oregon Mountain Lion Status Report

Derek Broman, Oregon Department of Fish and Wildlife

Abstract:

Since the 12th WAFWA Mt Lion Workshop, the third revision of the Oregon Cougar Management Plan was finalized in late 2017 (original plan adopted in 1987). The updated plan, which continues to manage at the zone-scale, contains objectives regarding population health, addressing conflict, and managing cougars in concert with other native wildlife. Regarding monitoring population health, the department uses a deterministic, density-dependent population model to estimate annual cougar abundance in Oregon from 1987 to present at the statewide level, and 1994 to present at the zone level. Like most state-level population models for cougars, this model relies on mortality data (harvest and non-harvest) to develop estimates. The statewide population across all age classes for 2021 was estimated to be 6,987 and has been increasing slowly since 2006. As many cougar zones are nearing estimated carrying capacity, this growth will continue to remain low and/or slow with current observed mortality rates. Only one cougar zones reached their respective mortality caps in the last five years (Zone A in 2018) suggesting further continued population growth statewide when not at carrying capacity. Also included in the 2017 Cougar Management Plan, when the average proportion of 3+ year old female cougars in the total mortality exceeds 35% in a zone, the department considers a zone cougar population to be exceeding mortality levels. In the past decade, no cougar zone has exceeded these criteria. Cougar tags have continued to increase each year since 2017 with 72,740 in 2021 with total cougars taken by hunters varying between 250 and 290 over that time frame. Cougar tags sold as part of a Sports Pac continue to comprise the majority of cougar tags issued. The total number of statewide damage complaints saw high values in 2018 and 2019, possibly spurred by increased public concern following a human fatality in 2018. Areas of the state with growing human and cougar populations are the primary sources of complaints and new challenges have arised such as conflict experienced by those with hobby farms and/or free-range pets and livestock. The majority of the state has lived and coexisted with cougars for many decades and complaints are relatively low and stable in those areas. Otherwise, statewide, complaints, the number of cougars taken for human safety and for damage has remained relatively constant over recent years. The department initiated a cougar study in the Alsea basin of the Oregon coast range in 2017. In order to learn more about cougars in this wet, densely-vegetated deciduous rainforest, staff collared cougars to estimate home ranges, density, and habitat selection. Other monitoring tools including scat dogs and bio-darts were tested to assess their use and value in this unique landscape. Field work concluded in 2021 and data analysis is ongoing. A wildlife monograph (see below) was published in 2019 highlighting substantial work studying elk in Oregon, including predator-prey relationships with cougars.

Johnson, B.K., D.H. Jackson, R.C. Cook, D.A. Clark, P.K. Coe, J.G. Cook, S.N.Rearden, S.L. Findholt, and J.H. Noyes. 2019. Roles of maternal condition and predation in survival of juvenile Elk in Oregon. Wildlife Monographs 201:3-60.

South Dakota Mountain Lion Status Report

Andrew Lindbloom, South Dakota Game, Fish, and Parks

Abstract:

Mountain lions (*Puma concolor*) are native to South Dakota and were historically considered numerous in the Black Hills. After near extirpation in the early 1900s due to unregulated harvest and bounties on mountain lions and unregulated harvest on their prey species, mountain lions were listed as a state threatened species in 1978. Mountain lion populations rebounded in the late 1900s and the species was reclassified as a big game animal in 2003. The first regulated hunting season was established in 2005.

The South Dakota Mountain Lion Management Plan was revised in 2019 and provides a foundation for science-based management decisions, thus ensuring a healthy, self-sustaining population of mountain lions in the Black Hills of South Dakota. Population and management objectives for mountain lions vary by geographic area within South Dakota. In the Black Hills, South Dakota Game, Fish and Parks (SDGFP) manages for an objective of 200- 300 total mountain lions, and hunting opportunities are maximized by only allowing boot hunting methods. In Custer State Park, mountain lions are managed to primarily provide hunting opportunities using dogs. For the remainder of the state, no population objective has been established, with minimizing potential human/wildlife conflicts and providing unlimited resident hunting opportunity being the main objectives. The current hunting season in the Black Hills and Custer State Park begins December 26 and ends April 30 or when the harvest limit of 60 total or 40 females is reached. A year-round season with no limit exists in the remainder of the state. All harvested mountain lions must be presented to a SDGFP representative within 24 hours of harvest for inspection and sampling.

The SDGFP conducts several surveys and assessments to better understand mountain lion population abundance and trends in the Black Hills. SDGFP is also collaborating on 2 research projects with the University of Montana to develop an Integrated Population Model and evaluate the use of trail cameras to estimate abundance and composition of several game species. The primary surveys and data used to assess trends include hunting season evaluations, documented mortalities, DNA mark/recapture survey, and observation reports. Data from hunting seasons and hunter surveys are evaluated annually, such as harvest, harvest sex and age composition, female proportions in the harvest, and harvest per unit effort. Other mountain lion data, including non-harvest mortalities, removals and total mortality densities are also assessed for any apparent trends. In addition, DNA biopsy-darting surveys are conducted annually prior to each hunting season to provide mark/recapture population estimates and evaluations of catch per unit effort. Furthermore, all observation reports from the public are evaluated.

Although not all trend indices assessed by the SDGFP are in agreement, several surveys and population projections suggest mountain lions increased following several years of low harvest rates through 2018/19. The past 2 years (2019/20 and 2020/21) of increased harvest and other documented mortalities, however, should reduce growth rates and maintain the population within the objective range.

Texas Mountain Lion Status Report

Dana Karelus, Texas Parks, and Wildlife

Abstract:

Mountain lions (*Puma concolor*) have been designated as a non-game species in Texas since the 1970's. Although legislation would be required to change their status to a game species as they are in most other states, Texas Parks, and Wildlife Department (TPWD) has authority to manage mountain lions as they see fit with the approval of the Commission. Currently, people with a valid hunting license may hunt mountain lions at any time of the year and without limit on public land where and when hunting is allowed. Texas is comprised of approximately 95% private land (Smith et al. 2019) and hunting or trapping of mountain lions on private land is allowed at the discretion of the landowner. Voluntary reporting of harvest is encouraged, but not required. Mountain lions are also taken by agencies. U.S. Department of Agriculture's Wildlife Services performs predator control activities for mountain lions and other predators in the state. Additionally, TPWD has strategically taken mountain lions in focused seasons and locations when necessary for bighorn sheep (*Ovis canadensis*) reintroduction and population management.

TPWD collects reports of mountain lions in the state and confirmed cases (carcass, confirmed photo, tracks, or other unmistakable sign) are made available to the public on a map by county https://storymaps.arcgis.com/collections/685a0ee58ca140c9a8e1a1939f725f94?item=1; Figure 1). Mountain lion confirmations have occurred throughout the state (Figure 1); however, the majority of reports have come from the areas where the two main populations occur, one in West Texas and one in South Texas (Walker et al. 2000, Holbrook et al. 2012a). Confirmations outside the two areas have occurred sporadically and are likely dispersing individuals (Holbrook et al. 2012a). There is no obvious trend (either an increase or decrease) in the reports from outside the two populations, especially considering some reports may be from the same dispersing individual and that not all individuals get sighted and reported. Furthermore, the confirmed cases cannot be used to evaluate changes in occupied range or population changes within the two main populations as motivation by the public to report cases varies over time.

The South Texas mountain lion population exhibits less genetic diversity and is smaller than the West Texas population and the two populations are genetically different from each other (Walker et al. 2000, Holbrook et al. 2012a). The density in the South Texas population is also lower than in the West Texas population (Harveson et al. 2012). In the past, the two populations were more genetically similar (Holbrook et al. 2012b), indicating that the South Texas population has declined in size and has become genetically isolated from the West Texas population. The main sources of mortality also differed between the two populations, with hunter harvest being the main source of mortality in South Texas and trapping being the main source of mortality in West Texas (Harveson et al. 2012).

As mountain lions are a non-game species and funds for their research are therefore in competition with all other non-game species in the state, including threatened and endangered species, TPWD has not funded mountain lion research in the last several years. Recent mountain lion research in the state has been limited to work in West Texas by

Borderlands Research Institute. Dennison et al. (2016) evaluated habitat use by mountain lions and prey species from camera trap photos. Karelus et al. (2021) estimated mountain lion movement speeds and home range sizes and found that mountain lions did not shift their ranges seasonally. More peer-reviewed publications from the mountain lion studies at Borderlands Research Institute are forthcoming. The only other mountain lion research performed recently in the state has been an attitudes survey regarding mountain lions by Texas A&M; this work is currently in-progress.

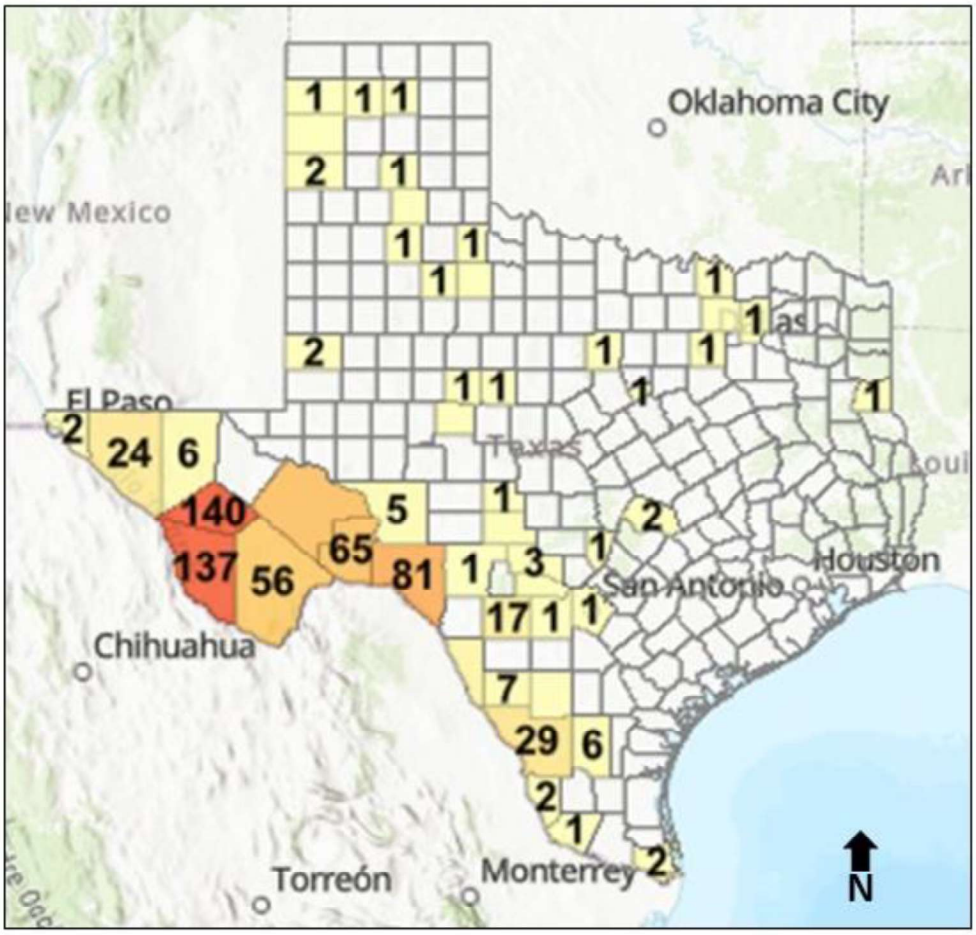

Figure 1. Map of confirmed mountain lion reports in Texas in the last 10 years (2012-2022) by county. The numbers inside the county indicate the number of reports and darker colors indicate more reports.

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Smith, L.A., R.R. Lopez, A.A. Lund, B.N. Wegner, J.A. Cathey, A. Lopez, R.E. Anderson, G.W. Powers, K.L. Skow, and M.A. Crawford, 2019. Status update and trends of Texas working lands. College Station, TX, USA.

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Utah Mountain Lion Status Report

Darren DeBloois, Game Mammals Program Coordinator, Utah Division of Wildlife Resources

Abstract:

Utah manages cougars according to the Utah Cougar Management Plan 2015-25 (https://wildlife.utah.gov/pdf/cougars/cmgtplan.pdf). Management objective are apply by cougar management unit throughout the state. Objective are 3 year average females in the harvest < 40%, and 3 year average adult ages ≥ 5 years between 15% and 20% of harvest. Utah implements different harvest strategies on different units, some units have limited entry seasons followed by harvest objectives equal to remaining unfilled permits, other units are only harvest objective units. Utah also offers pursuit only seasons and spot-and-stalk hunting during fall big game seasons.

Recent legislation require the Division Director to take immediate action to reduce mountain lion densities when mule deer population fall below management plan objectives, and cougars could be contributing to either the decline in numbers or are preventing or slowing mule deer population recovery. The Division of Wildlife implements this requirement through policy. We review mule deer herd status twice a year, once prior to winter following body condition assessment in December (we use IFBF as a metric of mule deer body condition). We also evaluate if the mule deer population is significantly below K, or is at risk of drastic declines based on body condition and forecast winter severity or drought conditions. The second assessment is conducted post winter based on mule deer survival and status relative to population objectives. We also have good data throughout the state on cause specific mortality of adult female mule deer. We use these data to evaluate the roll cougar predation may be playing in mule deer population status. If our local biologists and regional managers determine the cougars are hindering mule deer population growth based on these assessments, they draft a predator management plan for cougars on that unit. Units with predator management plans are opened for year-round unlimited harvest. We assess these plans each year, but to be most effective we plan to run them for at least three years. Our goal is to see female harvest increase under the plan. We are currently two years into these plans and will assess effectiveness after next year (summer 2023).

Utah has two lion related studies underway now. Utah State University is working with us to help develop a mountain lion population model for Utah. They are looking at kitten survival as part of this effort. Along with this goal, they are also looking at cougar diets and handling time of different prey species and impact of kleptoparasitism by black bears. Brigham Young University is collaborating with us on a study looking at scavenging behavior of lions in central Utah. In addition to these studies, our big game program has been conducting a long-term study on mule deer part of which is giving us insights into predator-prey dynamics of cougars and mule deer in the state.

For more information on Utah cougars, we post annual harvest reports that are available on our website here: https://wildlife.utah.gov/hunting/main-hunting-page/cougars.html

Washington Mountain Lion Status Report

Rich Beausileil, Washington Department of Fish and Wildlife

Abstract:
Washington Department of Fish and Wildlife (WDFW) is currently in the process of revising its management plan for all big game species, including cougar, which expired in 2021. Public surveys were recently conducted on a variety of topics and a final report was completed in March 2022 by an independent contractor; hunter surveys are currently underway. In addition to managing for maximum recreational opportunity, understanding prey relationships, minimizing conflict with people, and preserving, protecting, and perpetuating cougar populations, Washington has identified additional strategies and objectives. These include managing recreational harvest opportunity at a 12-16% annual harvest rate, which is the documented growth rate of the population, managing for stable populations at the Population Management Unit (PMU) level using harvest guidelines, preserving an older age structure and social stability, and managing for a variety of recreational and ecological benefits. Washington's cougar management program has been founded on 24 consecutive years of cougar research (1998-2022) conducted in 9 research areas. More than 30 manuscripts have been published in scientific journals reporting on a variety of topics including density, abundance, growth rate, social organization, habitat and space use, resource selection, predator-prey interactions, source-sink dynamics, cougar-human interactions, genetic structure, gene flow, and connectivity. In 2021, 24 standardized annual cougar density calculations were generated from 5 study areas resulting in average independent-aged densities ranging from 1.6 - 2.8 cougars /100km^2 (Beausoleil et al 2021). These estimates are in addition to 8 existing total annual estimates generated using DNA (biopsy darts) and spatially explicit capture-recapture (Beausoleil et al 2016), and 5 adult and total density estimates (Lambert et al. 2006), providing WDFW with a total of 37 annual densities for cougar in numerous locales statewide. Beausoleil et al (2021) also reported on a novel way to establish cougar harvest guidelines using a Bayesian-based harvest risk analysis. This process assumes density is unknown at any given time and incorporates all variability observed in density estimates over time and across study areas. Further explanation is provided in Beausoleil et al. (2022). This technique has the benefit of extending the utility of past density research findings and minimizes risk when projections are made to unstudied areas. Staff also assisted in a publication that reviewed all published cougar density estimates in the scientific literature and reported on sources of bias and the need for standardization (Murphy et al. 2022). In 2020, WDFW's Wildlife Commission adopted changes to Washingtons' cougar management including the use of presumed densities in 19/45 PMUs to increase harvest guidelines and reduce hunting closures and ruled that harvest guidelines would only apply towards adults rather than all independent-aged animals Future challenges include: (1) understanding how these recent changes affect cougar populations; (2) understanding the effects of annual mortality being comprised of 53% females; (3) undocumented tribal harvest in WDFW managed areas and the impacts it may have on management objectives; and (4) creating a habitat map that that classifies habitat quality into low, medium, and high quality. Recent advancements since the last workshop include: (1) an electronic mortality reporting system resulting in real-time tracking of harvest (via a mandatory sealing requirement) and improved data quality; (2) the development of a guide for small livestock owners to reduce conflict; (3) high quality signage for kiosks and trailheads advising visitors they are entering wildlife habitat and how to avoid a surprise encounter with all species (including a QR code for multiple languages); and various other new educational brochures and pocket guides.

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Wyoming Mountain Lion Status Report

Dan Thompson, Wyoming Game and Fish Department

Abstract:

Justin G. Clapp, Large Carnivore Section, Wyoming Game and Fish Department
260 Buena Vista Drive, Lander, WY 82520 USA justin.clapp@wyo.gov

Wyoming's mountain lion management plan (WGFD 2006) was implemented in 2007, an adaptive management strategy which incorporated suggestions put forth in the cougar management guidelines by the Cougar Management Guidelines Working Group (CMGWG 2005). The plan utilizes regional input and biological aspects associated with habitat of hunt areas within mountain lion management units (MLMUs, Fig.1). Wyoming's management of mountain lions relies on source/sink dynamics estimated via harvest densities and sex/age population structure, incorporating the need to address human/lion conflicts, livestock depredation, habitat quality, and prey availability. Wyoming's plan is aimed at sustaining mountain lion populations throughout suitable habitat at varying densities depending on management objectives to provide for recreational/hunting opportunity, and to minimize mountain lion depredation and the potential for human injury throughout the state.

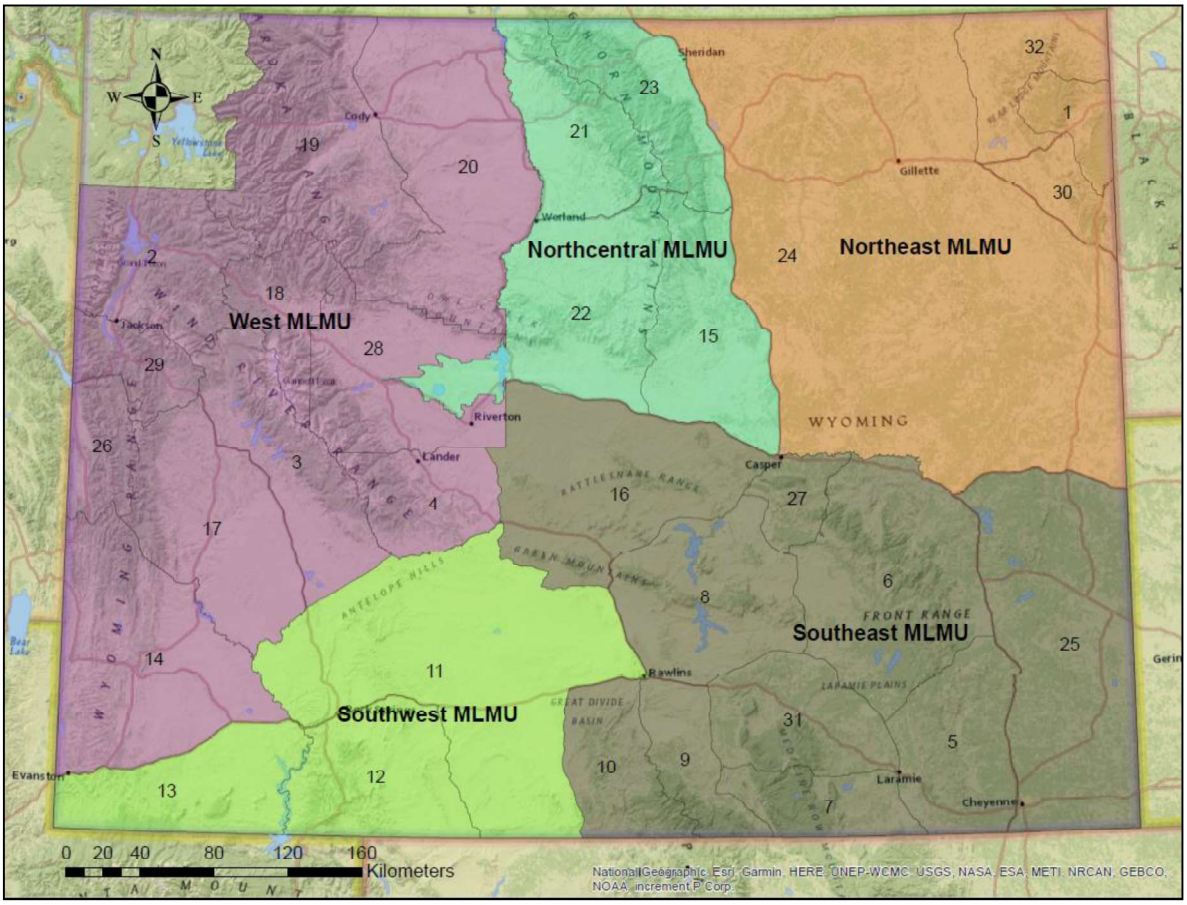
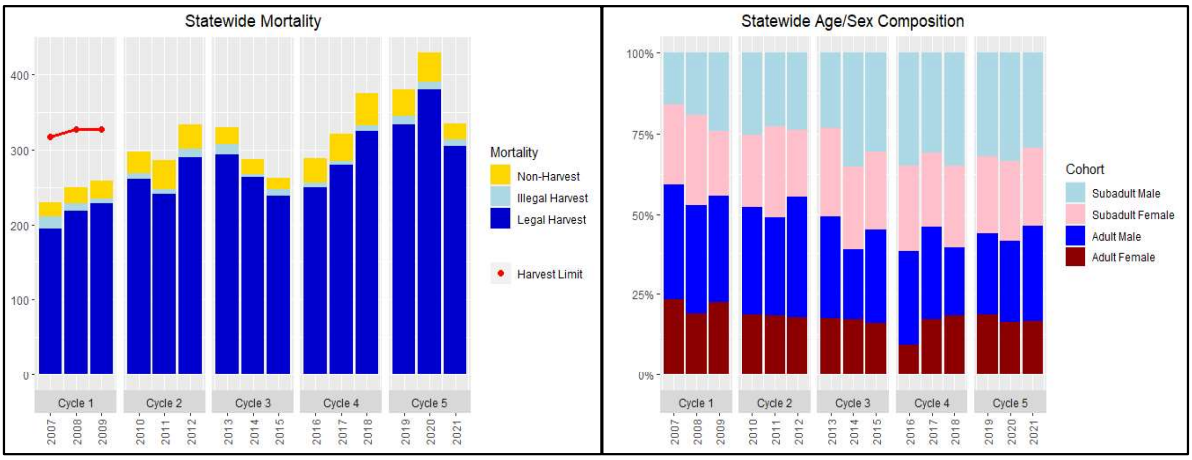


Fig.1 Wyoming mountain lion hunt areas and associated management units, 2022.

HARVEST

Statewide harvest has generally increased, with the 2020-2021 harvest year reporting the highest harvest of mountain lions in Wyoming to date. These general increases correlate with a shift in age structure, resulting in an increase of sub-adult mountain lions represented in statewide harvest (Fig.2). These shifts are attributed to specific areas with increasing harvest pressure, particularly those in the southern Bighorn Mountains as well as in the Black Hills in northeast Wyoming.

Fig. 2 Wyoming mountain lion mortality and associated age/sex structure, 2007 - 2022.



Challenges associated with the assessment of source/sink dynamics include limited samples sizes in some hunt areas that make deriving the proportion and average age of adult females difficult. In addition, changes in mountain lion densities over time can influence the accuracy of how mortality density estimates align with source/stable/sink classifications. Finally, maintaining a balance of these classifications within hunt area objectives across the state can be challenging with respect to various public opinions and tolerance of large carnivores on the landscape.

MONITORING

From 2016 – 2019, the WGFD radio collared and monitored mountain lions in southwest Wyoming. Spatial data was used to validate habitat suitability estimates, and infrared detection of mountain lions at night were tested. We also developed an R package (GPSeqClus; Clapp et al. 2021) that streamlined clustering of potential kill sites using GPS data, and we applied predictive models to inform investigations to estimate diet composition in the study area. Highlights from this effort included a relatively high proportion of pronghorn found within mountain lion diets, as well as a high proportion of coyote predations by mountain lions in this system. Finally, we continue to collaborate with the University of Wyoming via data sharing to support and supplement ongoing research projects in southwest Wyoming.

In 2019 we shifted monitoring efforts to central Wyoming with primary objectives aimed at the interplay between predation and Chronic Wasting Disease (CWD). Using the clustering procedure from our previous monitoring efforts, we are investigating mountain lion kill sites

and collecting biological data from prey items to quantify selection of CWD-infected ungulates by mountain lions. This monitoring effort is also in collaboration with the University of Wyoming and is ongoing at this time.

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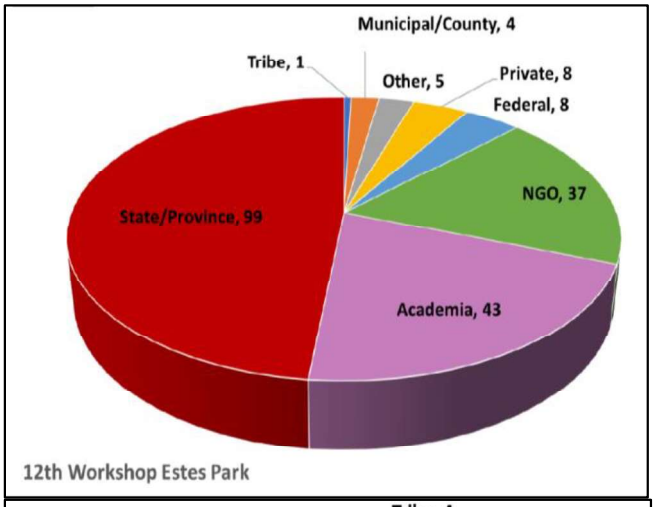
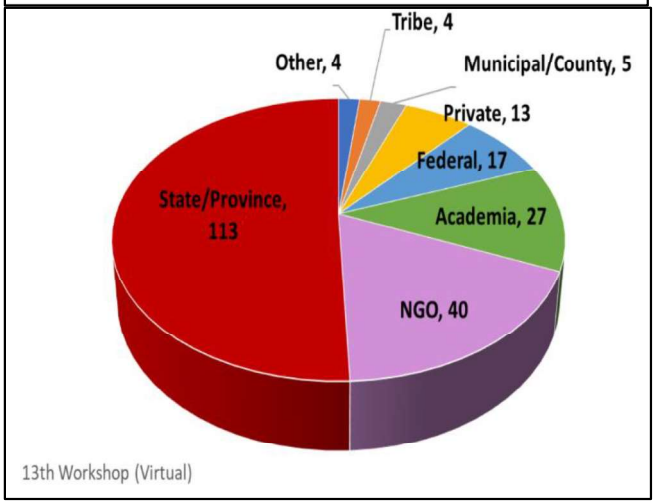
BUSINESS MEETING

During the business meeting, the workshop registration totals were broken down and tentative budgets presented, including the full list of sponsors. Of the attendees, 44% of attendees registered using the Early Bird Group rate, followed by 24% Early Bird Single rate, 11% Regular Single rate and the remaining 21% was a mix of other categories however, there were no 1-Day attendees. Many lessons were learned hosting the workshop online and the event went smoothly. However, attendee preference is still an in-person event. Income from registrations and sponsorships totaled $30,625 and expenses (contractor, advertising, etc.) totaled $30,230.34. The net profit has been added to the workshop account and now totals $19,445.81 for use for the next workshop. Agency representatives were reminded that jurisdiction reports were due May 7th, 2022 but were welcome to submit a succinct abstract rather than a massive report. Finally, the attendees discussed the host of the next (14th) WAFWA Mt Lion Workshop. A table showing participating state/province agencies and previous hosts was presented and the group suggested New Mexico serve as the next host. Rick Winslow was going to communicate with administrators at the New Mexico Department of Fish and Wildlife to see if they could host.





State/Province	Hosted Workshop	
Alberta		
Arizona	3rd	
British Columbia		
California	5th	
Colorado	4th	12th
Idaho	9th	
Kansas		
Montana	10th	
Nebraska		
Nevada	1st	
New Mexico		
North Dakota		
Oregon	13th	
South Dakota		
Texas	6th	
Utah	2nd	11th
Washington	8th	
Wyoming	7th	

Captions

Left- Figures of affiliations of Mt Lion Workshop attendees for the 12th and 13th workshops.

Above- Previous workshop hosts.

April 4-7, 2022