Nadeau, S. 2008. Idaho Mountain Lion Status Report. Pages 10-17 in Toweill, D. E., S. Nadeau and D. Smith, editors. Proceedings of the Ninth Mountain Lion Workshop, May 5-8, 2008, Sun Valley, Idaho, USA.

Abstract

Lions were classified as big game animals in 1972. The 1990 Mountain Lion Management Plan, called for the reduction in harvest of female lions, and to maintain a harvest of approximately 250 lions statewide. However, lion harvest peaked statewide in 1998 when 798 lions were harvested. Consequently, a new lion plan was developed to address the increases in the populations and allow more hunting opportunity. Idaho completed the latest Mountain Lion Management Plan in 2002. The lion plan called for maintaining current lion distribution statewide as a goal and to not allow harvest and populations to drop below the 2002 levels. However, individual regions could adjust harvest to either increase or decrease populations depending upon the objectives for that area. Seasons were made more lenient, running from 30 August to 31 March in most units, and until 30 June in two desert canyon units. In some areas, two-lion bag limits were initiated. Hounds were allowed in most units, and non-resident hound hunting was expanded. Female quotas were used in most of the southern part of the state until recent population expansions, and by 2008, quotas remain in only 20 of 99 units.

Naggiar, M. 1982. The Florida Panther. Florida Wildlife 36 (Sept/Oct.):17-20.

The Florida panther is a medium sized, relatively dark panther with short and rather stiff pelage. In comparison to other subspecies, it has noticeably long legs and small feet. The tail has a right angle bend in the last vertebra, giving it a distinctive kink at the end. In addition, a whorl of hair- a "cowlick"- exists in the middle of the back and there is irregular white flecking on the head, neck and shoulders. A mature male Florida panther weighs from 100 to 130 pounds and measures nearly 7 feet from nose to tip of the tail. The female weighs from 60 to 80 pounds and measures about 6 feet from tip to tip. Their mating season is January and February and males and females travel together only at this time. A panther requires some 40-150 square miles of territory with females occupying smaller areas than males. It was estimated that there are only about 20 Florida panthers remaining in the state. Deterioration of the quality of remaining habitat is the major threat to the continued existence of the Florida panther. Road kills are also a serious threat and in a recent 18-month period, three panthers were killed by motor vehicles.

Neal, D.L. 1984. The Effect of Mountain Lion Predation on the North Kings Deer Herd in California. Pgs. 138-140 In: J. Roberson and F. Lindzey (eds.), Proc. of the Second Mountain Lion Workshop. Utah Div. Wildl. Res. and Utah Coop. Wildl. Research Unit. Zion National Park. 271pp.

The declining North Kings deer herd was experiencing a low recruitment rate into the adult population for inconclusive reasons. Thirty-nine fawns were radio-tagged with mortality sensors from June, 1978 through June, 1983. Of 33 fawn deaths, 64% were killed by predators and 62% of these predator kills were made by mountain lions. Computer modeling indicated that this loss of fawns was large enough to prevent the herd from increasing from the present number. A study in the early 1970's estimated four lions within the 800 square mile North Kings range while this study estimated 30 mountain lions on the North Kings range. Home range sizes averaged 75 square miles for females and 190 square miles for males with considerable overlap among females and little among males. The summer and winter home ranges for individual lions overlapped between 30 and 50%. While generally accepted estimates of deer and mountain lion populations give a ratio between 700-900 deer per lion in the late 1940's and early 1950's, current estimates on the North Kings herd indicates a ratio of only 75 deer per lion. It appeared that an increase of 2.5 times will be required to allow the herd to meet recruitment needs and that a temporary reduction in mountain lion numbers will be necessary.

Neal, D.L., G.N. Steger, and R.C. Bertram. 1987. Mountain Lions: Preliminary Findings on Home-range Use and Density in the Central Sierra Nevada. Res. Note PSW-392. Berkeley, Ca: Pacific Southwest Forest and Range Experiment Station, Forest Service, U.S. Dept. Agriculture. 6pp.

SUMMARY

Between August 1983 and December 1985, 19 mountain lions were captured, radio equipped, and monitored daily within a portion of the North Kings deer herd range on the west slope of the central Sierra Nevada in California. The density of adult mountain lions was estimated to be one per 33.3 km^2; that of adults and kittens together was estimated to be one per 20.9 km^2. Home-ranges averaged 265 km^2 for adult females and 350 km^2 for adult males. Home range overlap was high among females, among males, and between males and females. Some mountain lions migrated elevationally with the deer, but others remained at low elevations throughout the year. The preliminary results of this study suggest that mountain lions could be limiting the North Kings deer herd.

Neal, D.L. 1988. Mountain Lion Density and Movement in the Central Sierra Nevada. Pg. 72 In: R.H. Smith (ed.), Proc. of the Third Mountain Lion Workshop. Arizona Chapter, The Wildlife Society and Arizona Game and Fish Department, Prescott, Arizona. 88pp.

Mountain lion predation has been identified as a factor limiting the North Kings deer herd in the central Sierra Nevada. Twenty-four mountain lions were monitored within a 215 square mile portion of the 800 square mile deer herd range. Fourteen of these lions were still being monitored during most of 1985 and 1986. Using only these 14 radio equipped mountain lions, it was calculated that there were 6.3 adult mountain lions per 100 square miles (39.8 km^2/adult) using the area which represented a minimum density of 2.9 adults per 100 mi^2 (89.3 km^2/adult). The total of known adults using the study area was 29 at a density of 6.1 adults per 100 mi^2 (45.2 km^2/adult). Approximately l9.5 kittens inhabited the study area at a density of 4.5 kittens per 100 mi^2 (57.6 km^2/kitten). Combining adult and kitten densities gives a total mountain lion density of 10.6 per 100 mi^2 (24.4 km^2/mountain lion). Home ranges averaged 285 square miles; 340 for males, and 244 for females, using the minimum convex polygon method. There was extensive home range overlap between females, males, and males and females.

Neal, D.L. 1990. The Effect of Predation on Deer in the Central Sierra Nevada. Page 53 In: Predator Management in North Coastal Ca.: Proceedings of a Workshop Held in Ukiah and Hopland, Ca., March 10-11, 1990 (G.A. Giusti, R.M. Timm, and R.H. Schmidt, eds.). Univ. of Ca., Hopland Field Station Public. 101.

Two studies, one to determine the direct causes of fawn losses in the North Kings deer herd, and the other to examine mountain lion behavior as it relates to deer, are described. Predation was the largest cause of fawn loss, resulting in the death of 50.6% of all fawns during the first 12 months of life. Mountain lions were the principle predator, and were responsible for 49% of the fawn kills. Coyotes, bears, and bobcats took 27%, 22%, and 3% respectively. Mountain lion density was estimated at 1 per 8 square miles (12.4/100 mi^2). Home ranges averaged 102 square miles for adult females and 135 square miles for adult males. Home range overlap was extensive. Most mountain lions migrated seasonally with the deer but some remained at low elevation throughout the year on foothill ranches and in the vicinity of rural communities.

Negrões, N., P.Sarmento, J. Cruz, C. Eira, E. Revilla, C. Fonseca, R. Sollmann, N.M. Tôrres, M. M. Furtado, A.T.A. Jácomo and L.Silveira. 2010. Use of Camera-Trapping to Estimate Puma Density and Influencing Factors in Central Brazil. J. Wildl. Manage. 74(6):1195-1203.

Abstract

We used remotely triggered cameras to collect data on Puma (Puma concolor) abundance and occupancy in an area of tropical forest in Brazil where the species' status is poorly known. To evaluate factors influencing puma occupancy we used data from 5 sampling campaigns in 3 consecutive years (2005 to 2007) and 2 seasons (wet and dry), at a state park and a private forest reserve. We estimated puma numbers and density for the 2007 sampling data by developing a standardized individual identification method. We based individual identification on 1) time-stable parameters (SP; physical features that do not change over time), and 2) time-variable parameters (VP; marks that could change over time such as scars and botfly marks). Following individual identification we established a capture–recapture history and analyzed it using closed population capture–mark–recapture models. Puma capture probability was influenced by camera placement (roads vs. trails), sampling year, and prey richness. Puma occupancy was positively associated with species richness and there was a correlation between relative puma and jaguar (Panthera onca) abundance. Identifications enabled us to generate 8 VP histories for each photographed flank, corresponding to 8 individuals. We estimated the sampled population at 9 pumas (SE = 1.03, 95% CI = 8–10 individuals) translating to

a density of 3.40 pumas/100 km^2. Information collected using camera-traps can effectively be used to assess puma population size in tropical forests. As habitat progressively disappears and South American felines become more vulnerable, our results support the critical importance of private forest reserves for conservation.

Neighbor, D.S., T.K. Ruth, J.R. Skiles, Jr., and B.P. McKinney Jr. 1991. Live Trapping Mountain Lion. Pg. 25 In: Mountain Lion-Human Interaction Symposium, C.E. Braun (ed.), Col. Div. Wildl., Denver. 114pp.

The predominate technique for capturing mountain lions (Felis concolor) in North America is hunting with trained hounds. As an alternative technique, Big Bend National Park personnel used a live trap to reduce the costs and risks of capturing mountain lions with trained hounds. The live trap is a simple box with a guillotine-style trap door and six removable panels for easier transportation. A radio collar is attached to the trap door to alert field personnel when the trap has been triggered. The live trap was used for 280 trap-nights. We estimated that 33.9 h and $81.00 were spent per capture. In comparison, since 1987, 58.8 h and $561.00 were spent per capture with trained hounds. The live trap can minimize safety concerns such as injuries to kittens, injuries from falls, and injuries during immobilization. However, injuries such as facial lacerations and a broken canine tooth occurred during trapping. Other factors to consider before initiating live trapping include habitat type, ease of trapping a mountain lion, and desired concentration of trap effort. In 1989, the total cost of material and construction labor for the live trap was $400.00. We believe the live trap can be an inexpensive tool with which land managers can capture mountain lions.

Nelson, E.W., and E.A. Goldman. 1929. List of the Pumas, with Three Described as New. J. Mammal. 10:345-350.

Nineteen recognizable subspecies of Felis concolor, with type localities are described. Three of these subspecies were described as new and were as follows: Felis c. incarum, the Inca puma from Peru; Felis c. osgoodi, the Bolivian puma; and Felis c. mayensis, the Guatemalan puma.

Nelson, E.W., and E.A. Goldman. 1931. Three New Pumas. J. Wash. Acad. Sci. 21(10):209-212.

Three new geographic races of Felis concolor Linne are described. Felis concolor kaibabensis, the Kaibab mountain lion of the Kaibab plateau north of the Grand Canyon of the Colorado River in northwestern Arizona, southwestern Utah, and central and eastern Nevada is closely allied to F. c. hippolestes which has an extended range from north to south in the Rocky Mountain region. Felis concolor anthonyi, the Venezuelan puma from the Monte Duida region, near the upper Orinoco River, may range into much of the upper Amazon Valley. Felis concolor greeni, the East Brazilian puma from extreme eastern South America requires no very close comparison with any known form and is readily distinguished by small size and remarkably small teeth. The canines are especially short and weak.

Nelson, E.W., and E.A. Goldman. 1932. A New Mountain Lion from Vancouver Island. Proc. Biol. Soc. Wash. 45:105-108.

A new geographic race of the mountain lion, Felis concolor vancouverensis, from Campbell Lake, Vancouver Island, British Columbia is described.

Nelson, E.W., and E.A. Goldman. 1933. A New Puma from Brazil. J. Wash. Acad. Sci. 23(11):523-525.

A new geographic race of Felis concolor Linne is described from the great lowland area in the Amazon River drainage, northern Brazil. This subspecies, Felis concolor borbensis, the Amazon puma, is more nearly related to Felis c. concolor than to any other known form.

Nero, R.W. 1974. Cougars in Manitoba. Blue Jay 32(l):55-56.

From 1879 to 1950 there are only 16 reports of cougars from Manitoba. However, from 1951 to 1960 there are 21 reports and from 1961 to 1970 there are 38 reports. There were more than 30 reports from 1971 to the time of this writing. These reports include 86 sightings, eight observations of cougar tracks or deer kills attributed to cougars, and five animals that were shot. A cougar was shot and killed on December 25, 1973 about 35 miles northeast of

Winnipeg. Cougars seemed to have increased in number since 1960 and this could be related to increased white-tailed deer populations in Manitoba.

Nero, R .W. and R.E. Wrigley. 1977. Status and Habits of the Cougar in Manitoba. Can. Field Nat. 91:28-40.

A cougar (Felis concolor missoulensis), collected at Stead, Manitoba in 1973, and 281 well documented sightings establish the species as resident in the province for the first time. Though there are cougar sightings from 1879 to 1975, the majority are recent (40 in 1974). Prior to 1940, the cougar was restricted to the grassland and aspen-oak transition of extreme southwestern Manitoba within the ranges of mule deer and American Elk. After 1940, these two prey species became rare and localized, and white-tailed deer became the dominant big game animal, spreading far north into the boreal forest. Recent cougar distribution is closely associated with that of the white-tailed deer, an apparent doubling of the cougars range. A rough estimate of the cougar population in Manitoba is 50, and it seems likely that some individuals have been observed in adjacent Saskatchewan, North Dakota, Minnesota, and Ontario.

Nero, R., and R. Wrigley. 1978. A Little Home on the Prairie. Animal Kingdom. April/May.

An account of the taking of the first authenticated specimen of cougar in Manitoba, Canada on December 25, 1973 is presented. The 2 year old male measured one inch short of 7 feet from nose to tip of tail and weighed about 100 pounds. The species became legally protected in Manitoba on January 7, 1974. Information showed that lions exist as a resident breeding population in Manitoba. There are only about 2 dozen records of cougars in Manitoba from 1897 to 1939, with at least ten of the cats supposedly killed in those years. More than 100 cougar reports are available for the period of 1940 to 1969. There had been over 200 reports of cougar sightings in Manitoba for the brief period of 1970-1976, with 12-40 recorded annually.

Newby, J., T.K. Ruth and P. Buotte. 2005. Examining Mountain Lion (*Puma concolor*) Dispersal in Yellowstone National Park Using GPS/Satellite Collars. Pages 218-219 *in* R.A. Beausoleil and D.A. Martorello, editors. Proceedings of the Eighth Mountain Lion Workshop, Olympia, Washington, USA.

Abstract

As habitats become increasingly fragmented dispersal and population connectivity become more pressing to conservation biology. However, information on dispersal behavior and how it is affected by landscape characteristics is needed. This knowledge gap is largely due to the difficulties associated with gathering data on individuals while they are dispersing. When examining large carnivores, such as mountain lions *(Puma concolor),* this problem is particularly acute due to the large spatial scales on which they operate and the unpredictability of their movements. Large-scale movements limit the value of VHF radio- telemetry, which usually provides only a handful of post-dispersal locations, if any. In order to examine mountain lion dispersal movements at finer spatial scales we are deploying store-on-board GPS collars that periodically download their data to Argos satellites, which researchers can then receive remotely. This allows the dispersing mountain lion to be monitored despite the size of its movements or the remoteness of the area which it is in. In Yellowstone National Park we placed two GPS/Satellite collars on two 21-month-old male cougars to examine the feasibility of documenting dispersal behavior. Both collars were set to acquire one GPS location per day and download data to an Argos satellite every 9 days. Since deploying the collars in March 2004, we have downloaded 107 locations covering 674.4 kilometers of movement on one male and 135 locations covering 636.5 kilometers of movements on his brother. Straight-line distance from male M169's most recent location to the center of his natal range was 121.6 kilometers. In that time he traveled through three states: Montana, Wyoming, and Idaho. Straight-line distance from male M177's current location to the center of his natal range is 47.5 kilometers. Clusters of points have led to the discovery of two of M177's kills. While no concerted effort was made to locate kills through this means during the pilot study, this technology shows much promise for that application. Already the data from these collars has supplied a level of detailed movement information far beyond any we have been able to acquire with traditional radio-telemetry. We intend to examine mountain lion dispersal in the Greater Yellowstone Area with the following objectives: 1) document characteristics of dispersal in the Yellowstone cougar population including rate,

survivorship, temporal-spatial patterns, and the effects of natural and anthropogenic factors, and 2) incorporate data collected from objective one into a predictive model to identify areas of importance for population connectivity, potential areas of cougar/ human conflicts, and assess the contribution of Yellowstone cougar emigrants to the surrounding meta-population. Using satellite systems to relay location data appears to be an effective way of examining mountain lion dispersal movements, especially in areas such as the Greater Yellowstone; where fairly large, contiguous wilderness puts relatively less restriction on disperser movements and lower access for researchers.

Newell, D. 1935. Panther. Sat. Eve. Post. July 13:10.

The author was asked by district game wardens to investigate the existence of panthers in the Big Cypress Swamp. Three panthers were killed in the first 2 days within four miles of their camp which was located about 9 miles east of the Tamiami Trail on the edge of the Big Cypress. Two of the panthers were skinned and one was skeletonized and prepared for shipment to the Academy of Natural Sciences of Philadelphia. Panthers eat at least 60 deer per year, and one panther, living to an average age, will kill close to 1000 deer. The author said that all of the deer that he had examined which had been killed by panthers were bucks. A total of eight panthers were killed on this hunting trip.

Newman, J., E. Zillioux, E. Rich, L. Liang and C. Newman. 2005. Historical and Other Patterns of Monomethyl and Inorganic Mercury in the Florida Panther (Puma concolor coryi). Arch. Environ. Contam. Toxicol. 48(1):75-80.

Abstract

Since the late 1980s, elevated levels of mercury have been reported in the tissues of the Florida panther (*Puma concolor coryi*) from the Florida Everglades. The extent, degree, and length of time of mercury contamination in the Florida panther are unknown. The objective of this study was to determine the historical and other patterns of monomethyl and inorganic mercury in the Florida panther by analysis of mercury in panther hair from museum collections. In addition, this study evaluated the effects of preservation of skins on mercury concentrations in hair and the representativeness of museum collections for evaluating historical trends of contamination in the Florida panther. Hair from 42 Florida panther specimens collected from 1896 to 1995 was analyzed for both monomethyl and inorganic mercury. Monomethyl mercury (MMHg) and inorganic mercury (IHg) were found in all specimens. Monomethyl mercury in hair from untanned skins was significantly higher than MMHg in hair from tanned skins. For untanned specimens, the mean MMHg concentration in hair was 1.62 +/- 1.87 mug/g (range 0.11 to 6.68 mug/g, n = 16). Monomethyl mercury accounted for 88% of the total mercury in untanned Florida panther hair. No sexual or geographical differences were found. Although MMHg is generally stable in hair, the tanning process appears to reduce the amount of MMHg in hair. In addition, exogenous IHg contamination of the panther hair was found in museum specimens, especially in older specimens. The implication of these and other factors in interpreting results of museum studies is discussed. The presence of MMHg in panther hair since the 1890s indicates long-term and widespread exposure of the Florida panther to mercury. Levels of MMHg are significantly greater in the 1990s than the 1890s. When combined with field studies of mercury in the Florida panther, considerable individual variability is observed, reflecting short-term changes in exposure of individual panthers to mercury. Although museum specimens showed a significant increase in MMHg over the last 100 years, they did not show the magnitude of increase that field populations of Florida panthers did. A number of Florida panthers appeared to be at risk from mercury over their lifetimes, especially individuals from the early 1990s.

Nielsen, C.K., M. Dowling, K. Miller and B. Wilson. 2005. Recent Cougar Confirmations in the Midwest as Documented by the Cougar Network. Page 217 *in* R.A. Beausoleil and D.A. Martorello, editors. Proceedings of the Eighth Mountain Lion Workshop, Olympia, Washington, USA.

Abstract

Since 2003, the Cougar Network has been consulting with wildlife agencies, universities, and other wildlife biologists to collect definitive evidence of cougar *(Puma concolor*) presence in the Midwest. This poster presentation will showcase the Cougar Network's efforts to document cougars east of their established range and discuss cougar potential in the Midwest. Examination of "hard evidence" such as cougar carcasses, DNA, and pictures, all of which are verified as to

origin, has indicated that cougars are now showing up in the Midwest where they have been extirpated for more than a century. The Cougar Network has documented 21 apparently wild (i.e., not former captive) cougar confirmations in 9 Midwestern states and 1 province during August 2003-February 2005. Strict scientific evidence has yet to be presented which indicates that cougars are truly re- colonizing the Midwest. However, several of these and earlier confirmations have been carcasses of younger male cougars that may be dispersers from established western populations. Although suitable dispersal habitat likely exists along major river corridors, it is uncertain whether breeding populations could become established due to higher philopatry and shorter dispersal distances of females. Further, potential habitat quality and spatial requirements of suitable habitat for cougars in the Midwest is entirely unknown. Although prey species such as white-tailed deer *(Odocoileus virginianus*) are plentiful throughout the Midwest, cougars would face several important challenges (e.g., vehicle-caused mortality) to successful re-colonization and establishment. Regardless, we conclude that wildlife agencies and the general public must be prepared for the potential that cougars could eventually return as a component of Midwestern landscapes.

Nielsen, C.K. 2006. Using the Bobcat as a Surrogate Species to Preliminarily Assess Cougar Recovery Potential in Illinois. Pages 87-93 in H.J. McGinnis, J.W. Tischendorf and S.J. Ropski editors. Proceedings of the Eastern Cougar Conference 2004, Morgantown, West Virginia, USA.

Abstract

Illinois is far from the nearest known established western populations of cougars (Puma oncolor). However, local interest peaked in July 2000 when an adult male was found dead from a train collision in southern Illinois. Herein, I speculate if cougars could recover in Illinois if they naturally dispersed from the West using insight from a recent 5-year study of bobcats (Lynx rufus) in Illinois. I assessed cougar habitat potential using a simple 2-level screening process within a geographic information system. First-level screening assessed a statewide bobcat habitat suitability map; areas with bobcat habitat suitability of P>0.50 were considered to be potential cougar habitat. Second-level screening evaluated patch area of potential cougar habitat; patches were retained if the area was more than 1,000 km2 (i.e., easily able to support more than 10 individuals). Using these guidelines, potential cougar habitat in Illinois is located in the extreme southern portion of the state dominated by the Shawnee National Forest, an area with ample prey populations. However, cougars would face several challenges in successfully re-colonizing southern Illinois. After several decades of low abundance and 25 years of harvest protection, bobcat populations in southern Illinois were growing 10% annually by the late 1990s. If cougars were to re-colonize southern Illinois, their population growth might not follow that of the bobcat. Nonetheless, cougar re-colonization remains a possibility that wildlife biologists and the public in Illinois and other midwestern states should consider.

Nielsen, C.K., M. Dowling, K. Miller, and B. Wilson. 2006. The Cougar Network: Using Science to Assess the Status of Cougars in Eastern North America. Pages 82-86 in H.J. McGinnis, J.W. Tischendorf and S.J. Ropski editors. Proceedings of the Eastern Cougar Conference 2004, Morgantown, West Virginia, USA.

Abstract

The status of cougars (Puma concolor) in the eastern half of North America (outside of Florida) has not been documented by scientific standards. Cougars were likely extirpated from the East by 1920. However, beginning around 1990, hard evidence of cougars in the East began to surface. In response, the Cougar Network (CN), a nonprofit research organization, was formed in August 2002. CN is dedicated to the study of cougar distribution and habitat by documenting the current range of the species and determining its potential for natural re-colonization. CN concentrates exclusively on the collection of “hard evidence,” and gives little credence to sighting reports. The establishment of solid working relationships with independent researchers as well as federal, state, and provincial natural resource agencies has facilitated data collection. Since its inception, CN has documented dozens of legitimate cases of cougar presence in the eastern half of North America. The results of this research to date are compelling, and suggest that cougars are expanding their range eastward. Strict scientific evidence has yet to be presented which indicates that cougars are truly re-colonizing former habitats in the Midwest. However, the frequency of verified cougar activity in these areas is accelerating, as evidenced by 9 apparently wild cougars

documented in 6 Midwestern states during August-December 2003. We hypothesize that this potential re-colonization is being driven by the recovery of western cougar populations. CN's future research will continue to focus on the potential for cougar recovery via ambitious habitat and field research projects.

Nielsen, C.K. and M. A. LaRue. 2008. Potential Habitat and Dispersal Corridors for Cougars in the Midwest. Page 122 in Toweill, D. E., S. Nadeau and D. Smith, editors. Proceedings of the Ninth Mountain Lion Workshop, May 5-8, 2008, Sun Valley, Idaho, USA.

Abstract

Increasing cougar (*Puma concolor*) presence in the Midwest represents a growing management concern for wildlife biologists. However, with the exception of ongoing research in the Black Hills, no studies have been conducted regarding potential cougar habitat and dispersal corridors in the Midwest. Our objectives were to model potential habitat and dispersal corridors for cougars using an expert-opinion survey, geospatial data, and a GIS. Five geospatial data layers were used in the model: land cover, digital elevation models, roads, streams, and human density. Based on matrices of pair-wise comparisons involving these data layers, 11 expert biologists were surveyed to rank combinations of habitat factors in order of importance to potential cougar habitat in the Midwest. We evaluated surveys using the Analytical Hierarchy Process and used a GIS to analyze data and create a map of potential cougar habitat in a 9-state portion of the Midwest just east of established cougar range. About 8% of the study region contained highly favorable habitat (≥75% favorability) for cougars; Arkansas (19%) and Missouri (16%) had the most potentially favorable habitat. We identified 6 large, contiguous areas of highly favorable habitat for cougars (≥2,500 km^2 in size with ≥75% habitat favorability). Based on this habitat model, we used least-cost pathway methods to create corridors for cougars from established western populations into the interior Midwest. The most-likely least-cost pathways started in western Texas and went to areas of suitable habitat in the Ouachita and Ozark National Forests. Additionally, we created least-cost pathways to 30 locations of known cougar occurrence in North Dakota, Nebraska, and Missouri. Our models represent the first large-scale assessment of cougar habitat and dispersal potential in the Midwest and serve as a baseline for conservation and management efforts.

Nielsen, C.K., M.J. Dowling, C.K. Miller, R.D. Wilson, H.G. Shaw, C.R. Anderson Jr. and S.R. Wilson. 2008. Research Efforts by the Cougar Network. Page 250 in Toweill, D. E., S. Nadeau and D. Smith, editors. Proceedings of the Ninth I Workshop, May 5-8, 2008, Sun Valley, Idaho, USA.

Abstract

The goal of this poster is to showcase the non-profit Cougar Network's efforts to document cougar presence east of their established range, conduct research on cougar ecology and human dimensions, and provide wildlife biologists and the general public with training and information. Since 2003, the Cougar Network has consulted with its board of scientific advisors, wildlife agencies, universities, and other wildlife biologists to collect definitive evidence (e.g., carcasses, photographs) of cougar (*Puma concolor*) presence east of their established range. This database represents the foremost repository of information regarding cougar confirmations in the Midwest, and is highly valued by wildlife biologists and the public alike. Scientific research efforts conducted thus far by the Cougar Network, in conjunction with Southern Illinois University of Carbondale, include: (1) prediction of suitable cougar habitat and dispersal corridors in 9 midwestern states, (2) a survey of human attitudes towards cougars in 2 midwestern states, and (3) a study of jaguar (*Panthera onca*) and cougar occupancy in relation to livestock operations in Sonora, Mexico. The Cougar Network is also active in training wildlife biologists (especially those from the Midwest and East with little cougar experience) by conducting cougar field workshops. The Cougar Network has also printed the latest Puma Field Guide and publishes Wild Cat News, an acclaimed newsletter that summarizes a variety of felid research and management projects conducted worldwide. These efforts have contributed to our understanding of cougars and other Felidae, especially in the Midwest, and will help wildlife biologists face present and future management challenges.

Noble, R .E. 1971. A Recent Record of the Puma (Felis concolor) in Arkansas. Southwest. Nat. 16:209.

A male puma was killed in southeastern Arkansas about 6 miles east of Hamburg, Ashley County, on December 8, 1969. The animal weighed 152 pounds and measured 6 feet 11 inches from tip of nose to tip of tail. Selected skull measurements in millimeters were: total length, 212.7; zygomatic breadth, 144.4; height of sagittal crest, 9.5; length of

right mandible, 140.0; length of right upper canine, 29.39; weight, 508.0 grams. The skeleton resides in the collection of the Department of Biological Sciences, Northwestern State College of Louisiana, Natchitoches.

Norelius, S.E., and M. Bruscino. 1988. Domestic Sheep Depredation from Mountain Lions in the Southern Bighorn Mountains: A Field Study and Literature Review. Wyoming Game and Fish Dept. 42pp.

Ground searches by Department personnel in potential or historic areas of lion depredation located 75 sheep carcasses (20 ewes and 55 lambs). Lion depredation accounted for 30% of the ewe losses and 27% of the lamb losses, or 28% of the 75 sheep. Wool-growers in Mountain Lion Hunt Areas 15 and 22 reported 254 sheep carcasses as possible lion kills (109 ewes and 145 lambs). Lion depredation accounted for 64% of these ewes and 55% of the lambs, or 59% of the 254 sheep. Other predators accounted for 8% of the carcasses located by Department personnel and 10% of the documented wool-grower finds. Department personnel documented 3 sheep deaths due to poisonous plants; wool-growers did not report any poison plant related death loss. Unknown causes accounted for 70 total sheep carcasses, and 50 rumen samples from these sheep remain at the CSU Range Analysis Laboratory.

Norris-Elye, L.T.S. 1951. The Cougar in Manitoba. Can. Field Nat. 65:119.

Although no definite record had previously been verified, the author reported that during the previous 30 years there had been about six sight records within the Province, including a specimen found in the Regina Museum which was killed near Yorktown.

North Dakota Game and Fish Department. 2006. Status of Mountain Lions (*Puma concolor*) in North Dakota. A Report to the Legislative Council. Bismarck, North Dakota, USA.

Executive Summary

Section 2 of House Bill 1102, enacted by the 2005 legislature, directed the North Dakota Game and Fish Department (Department), in cooperation with Tribal authorities, to assess the status of mountain lions (*Puma concolor*) in North Dakota and report its findings to the legislative council before July 1, 2006. In the past year, the Department: 1) reviewed reported sightings of lions from the recent past (2001-2005), 2) surveyed North Dakota hunters for additional sighting information, 3) mapped suitable lion habitat throughout the state, and 4) initiated an experimental mountain lion season with a quota of five animals. Although most of North Dakota is unsuitable for mountain lions, the habitat suitability map identified the North Dakota Badlands (Badlands) and associated Missouri River (MR) Breaklands as having a sufficient amount of suitable habitat to support a small resident population. Data from verified reports of sightings and the experimental season indicated mountain lions either have recolonized or are in the process of recolonizing a portion of their former range in the Badlands. Not only did the majority of verified sightings occur in the Badlands and vicinity, but also, all animals harvested during the state-wide season were taken from this area. The relatively small lion population in the Badlands likely will be vulnerable to human-caused mortality due to its geographic isolation from breeding lion populations in adjacent states, therefore, close monitoring of management prescriptions carried out on the population will be necessary if a reproductively viable population is to be maintained. Based on an initial analysis of habitat quality, approximately 2% of North Dakota (suitable habitat in the Badlands and MR Breaklands) could support an average of 45 to 74 resident adult animals under a management scenario with no harvest mortality. This is not an estimate of the current population size, but rather an estimate of habitat potential for the area. Plans for 2006-07 are to: 1) continue to record and verify reported sightings of lions, 2) survey hunters for lion sighting information, 3) test the habitat suitability map, 4) conduct field surveys to monitor the population, 5) coordinate with Tribal authorities and adjacent state agencies on lion management issues, 6) continue with education efforts and 7) conduct a second experimental season.

North Dakota Game and Fish Department. 2007. Status of Mountain Lion Management in North Dakota 2007. A Report to the Legislative Council. Bismarck, North Dakota, USA.

Executive Summary

This report summarizes information collected on mountain lions (*Puma concolor*) in North Dakota by the North Dakota Game and Fish Department (Department) for the period beginning 1 January 2006 and ending 31 July 2007. Lion sightings were recorded by Department personnel, and included reports by the general public, deer hunters, fur hunters and trappers, and Department, U.S.D.A Wildlife Services, Theodore Roosevelt National Park (TRNP) and Three Affiliated Tribe (TAT) employees. The Department proposed a second lion season in the Governor's 2006-2007 Small Game and Furbearer Hunting Proclamation, which was approved. Similar to the first season, an agreement was made with TAT to include lions taken from Fort Berthold Reservation (Reservation) in the five lion quota. A mandatory check-in of intact carcasses was required, and information from lions killed on the Reservation outside of the hunting season also was shared with the Department. Following the season, a snow track survey for lions in the North Dakota Badlands (Badlands) was conducted in cooperation with U.S.D.A. Wildlife Services and TRNP. Efforts to educate North Dakota residents about lions continued and Department biologists gave 52 presentations on lions to a variety of audiences. The Department also met with TRNP and South Dakota State University researchers to discuss potential cooperative research opportunities. Although no formal research project was initiated, on 26 November 2006, an incidentally trapped subadult male lion that was reported to the Department was released after fitting it with a radio-collar. This was the first lion radio-collared in the state by the Department. The animal has remained in the Badlands, traveling over an area of about 140 square miles. In 2006, 218 reports of mountain lions were recorded by the Department and from 1 January through 31 July 2007, the Department received 103 reports. Of the 52 reports classified as "Verified", 41 (82%) were either non-threatening observations of the animal (n = 8) or its sign (n = 35). Other verified sightings included seven lions (n = 4 males, n = 3 females) that died from causes other than legal hunting mortality. Of these, two subadult lions were legally shot for protection of property purposes involving outdoor domestic pets, two kittens were illegally shot, three lions (2 kittens, one adult) were captured incidentally in cable devices and/or traps set for bobcats, and one subadult lion was found dead in Lake Sakakawea. Similar to the past few years, the distribution of verified lion sightings occurred predominantly in western North Dakota, in the Badlands and vicinity, and to a lesser extent in other regions of the state. However, the lion population appears to be expanding into portions of the northern Missouri River (MR) Breaks based on a greater number of verified sightings in the region. Unlike the first experimental mountain lion season in 2005-2006, when all five lions were taken from the Badlands and vicinity, only one lion during the 2006-2007 season (illegally harvested female kitten) was taken from the region. The remaining four animals (2 males, 2 females) were harvested in prairie-dominated landscapes in Kidder, Bottineau, and Morton counties, and along the Missouri River in McLean County, respectively. The fact that two of the four animals taken outside of the Badlands were 3-4-year-old females was interesting because females typically are philopatric. Similar to the first season, harvested lions were in good physical condition and good to fair nutritional condition. The preliminary genetic relatedness results provided evidence that indicates multiple breeding aged female mountain lions have occurred in the Badlands for at least the past decade, and verified sightings in 2007 indicate continued expansion of the species in North Dakota. Based on the age and sex composition of the animals taken in the Badlands, the lion population appears not to have been negatively impacted by the first two experimental seasons with the additional human-caused mortality. However, until more information is known about population size and distribution, the number, age, and sex of lions killed in the Badlands, including those outside of season dates, and especially adult females, should be closely monitored.

Novack, A.J., M.B. Main, M.E. Sunquist and R.F. Labisky. 2005. Foraging Ecology of Jaguar (*Panthera onca*) and Puma (*Puma concolor*) in Hunted and Non-Hunted Sites Within the Maya Biosphere Reserve, Guatemala. Journal of Zoology 267(2):167-178.

Abstract

Subsistence hunting and commercial exploitation directly influence wildlife populations in many regions of Central and South America. Where prey populations are exploited, the foraging ecology of top-level predators can be effected negatively. This study assessed the food habits and prey selection of jaguar *Panthera onca* and puma *Puma concolor* within hunted and non-hunted segments of the Maya Biosphere Reserve (MBR), Guatemala. Food habits were determined from analysis of 76 jaguar and 145 puma scats collected within hunted and non-hunted areas of the MBR from February 2000 to August 2001. Diets of jaguar and puma were compared (1) within species between areas with and without hunting to evaluate effects of subsistence hunting, and (2) between species to evaluate resource partitioning between these sympatric carnivores. Origin of predator scats was determined from mitochondrial DNA, diets were determined from prey remnants found within scats, and frequency of prey in scats was compared to expected values based on prey density estimates to test the hypothesis that diets of jaguar and puma were selective.

Densities of major prey species were estimated using line-transect sampling. White-lipped peccary *Tayassu pecari*, collared peccary *Tayassu tajacu* and brocket deer *Mazama* sp. were less abundant, and coatis *Nasua nasua* more abundant, in the hunted area than in the non-hunted area. Jaguar and puma in both hunted and non-hunted sites obtained similar dietary contributions from large prey to their respective diets despite differences in the abundance of these prey species. Diets of jaguar and puma, as measured by percentage biomass occurrence of prey species, did not differ between hunted and non-hunted areas. Jaguar diets were dominated by medium-sized prey, particularly armadillos *Dasypus novemcinctus* and coatis, in both hunted and non-hunted areas. Medium-sized mammals also were prominent in puma diets, but large mammals constituted approximately 50% of prey biomass in both hunted and non-hunted areas. Deer *Odocoileus virginianus* and *Mazama* sp. and large rodents *Agouti paca* and *Dasyprocta punctata* were the most important prey of puma. Dietary overlap between jaguar and puma in both hunted and non-hunted areas was low.

Nowak, M.C., T.E. Taylor and G.W. Witmer. 2000. Prolonged Scavenging by a Female Mountain Lion in Northeastern Oregon. Northwestern Naturalist 81(2):63-65.

Scavenging reports by mountain lions (*Puma concolor*) are uncommon and the authors cite several studies where scavenging was indicated but were usually limited to single, isolated incidents where one carcass was utilized. This study documented a prolonged period of carrion feeding by an adult female in northeastern Oregon during a 2-year study in the western Wallowa Mountains. An adult female in apparent good health that had recently dispersed 3 kittens and had been a successful predator of mule deer (*Odocoileus hemionus*) made no kills for 22 days but instead fed upon 4 different sources of carrion. The circumstances around these carrion feedings are detailed and it was speculated that the use of carrion may reduce their rate of predation on ungulates by the provision of the temporary food sources even though they may be seasonal, primarily provided by humans, and in the absence of other possible consumers such as bears (*Ursus americanus*).

Nowak, M.C. and G.W. Witmer. 2003. Predation Rates of Female Mountain Lions in Northeast Oregon. Page 73 *in* L. A. Harveson, P. M. Harveson, and R.W.Adams, eds. Proceedings of the Sixth Mountain Lion Workshop. Austin. Texas.

Abstract

Wildlife managers are increasingly expected to balance populations of mountain lions (Puma concolor) and their prey, often with little data about their interactions. We investigated the foraging ecology of mountain lions in the Catherine Creek Wildlife Management Unit in northeast Oregon from June 1996 through June 1998. We present predation rate data from this investigation. We located individual lions by ground radio telemetry each day during 25-day predation sequences and subsequently searched those sites for kills. Kill date was estimated based on location data, degree of consumption, and general condition of the kill when located. Interkill interval was calculated and recorded as the number of days between consecutive ungulate kills made by a single lion. We documented 75 ungulate kills and 40 interkill intervals from 5 adult female mountain lions. The mean annual interkill interval was 7.7 days with a shorter interval in summer-fall than winter-spring.

Nowak, M.C. and G.W. Witmer. 2003. Prey Selection of Female Mountain Lions in Northeast Oregon. Page 73 *in* L. A. Harveson, P. M. Harveson, and R.W.Adams, eds. Proceedings of the Sixth Mountain Lion Workshop. Austin. Texas.

Abstract

Wildlife managers are increasingly expected to balance populations of mountain lions (Puma concolor) and their prey, often with little data about their interactions. We investigated the foraging ecology of mountain lions in the Catherine Creek Wildlife Management Unit in northeast Oregon from June 1996 through June 1998. We present prey selection data from this investigation. We located individual lions by ground radio telemetry each day during 25-day predation sequences and subsequently searched those sites for kills. Species, sex, and relative age of the prey were recorded and an incisor collected for aging of animals older than 1 year. We documented 75 ungulate kills from 5 adult female mountain lions. Of the documented kills, 65% were mule deer (Odocoileus hemionus); 35% were elk (Cervus elaphus). Mountain lions selected for fawns and older adult females from among the mule deer and calves from

among the elk. Mountain lion use of ungulate species, age, and sex classes did not differ seasonally.

Nowak, R.M. 1973. Status Survey of the Southeastern Puma. World Wildl. Fund Yearbook, 1972-73:197-198. Project 973.

The feasibility of a more comprehensive ecological study of the S.E. puma (Felis concolor coryi) was the main objective of this project. Perhaps 100 animals inhabit southern Florida. Roy McBride, professional puma hunter from Texas, shall assist the author in the study. Specially trained puma hunting dogs will track the pumas in the Big Cypress Swamp area to determine whether live capture and intensive ecological study would be practical.

Nowak, R.M., and R. McBride. 1973. Feasibility of a Study on the Florida Panther. Report to World Wildlife Fund. 13pp.

Except for the sign of one panther that was captured, no sign was found in areas of southern Florida that seemed likely to harbor panthers. The authors learned of three cases of apparently authentic reports in the previous year in which a panther had actually been killed or captured. Two young adult panthers were released at the east side of Everglades National Park on 8 February 1973 and another two had been released in the same area in 1969. Other panthers had previously been released into the park, but no detailed records were available. It was estimated that the population from the Lake Okeechobee area southward was about 20 or 30 individuals and probably far fewer in all the rest of Florida and adjoining states combined. The Florida panther was clearly in imminent danger of extinction. Recommendations were to provide better publicity for the endangered status of the panther and enforce existing laws protecting panthers and establish definite and meaningful penalties for violators. The proposed federal purchase of the Big Cypress Swamp was encouraged and restrictions on hunting and other activities was recommended. Increased state governmental interest in the panther was needed as well as insuring the maintenance of adequate facilities and records for Florida panthers now in captivity. A detailed study of the status and ecological requirements of the Florida panther was needed.

Nowak, R.M., and R. McBride. 1974. Status Survey of the Florida Panther. World Wildl. Fund Yearbook, 1973-74:237-242. Project 973.

One 9-10 year-old panther in poor physical condition was located and live-captured by McBride in the area of the Lykes Brothers Ranch west of Lake Okeechobee. No sign was found except for the sign of this panther. The authors learned of 3 cases in the previous year in which a panther had been killed or captured that was believed to be authentic. Two young adult panthers which were descendants of native Florida panthers in captivity at the Everglades Wonder Gardens were released by the Park Service in the east side of the Everglades National Park on 8 February 1973. An additional two had been released in the same area in 1969 and other releases are said to have occurred, but records were not available. The greater part of Everglades Park, the Big Cypress, and adjoining areas to the north should be considered for investigation at various times. The authors estimated the regular population from the Lake Okeechobee area southward to be about 20 or 30 individuals with probably far fewer in all the rest of Florida and adjoining states combined. Recommendations were made to protect the Florida panther which was clearly in imminent danger of extinction.

Nowak, R.M. 1976. The Cougar in the United States and Canada. U.S. Dept. Interior, Fish and Wildlife Service, Washington D.C. and York Zoological Society, New York. 190 pp.

SUMMARY

Populations of cougars still inhabit 14 states and provinces of western Canada and the United States. In each of these political units, except Texas and California, the cougar is legally classified as a regular game animal and is subject to regulated hunting. Current open seasons vary considerably, from only one month in Oregon to year-round in Arizona and Wyoming. The limit is one cougar per year, except in certain parts of British Columbia where it is two per year. The regulations of most states make provision for property owners to kill depredating cougars, and some governments issue long-standing permits for such purposes. In California the cougar is classified as "big game", but currently there is a moratorium on sport hunting. In Texas the cougar is classified as a predator and receives no protection. The legal

history of the cougar seems to have followed a general pattern throughout the west. In Alberta, British Columbia, and most states of the U.S., the species was bountied for many years. From 1958 to 1970, the bounty was phased out in each state and province, but all except Colorado subsequently went through a period in which the cougar still was unprotected. Game status was granted by each government except Texas, in the period from 1965 to 1973. Most political units have steadily increased the restrictiveness of their hunting regulations covering the cougar.

DISTRIBUTION-- The cougar formerly occurred in areas of suitable habitat throughout the United States and southern Canada. At present, substantial populations still inhabit most of their original range to the west of the Great Plains. The species, however, has become rare or has disappeared from certain areas such as central Texas, parts of Wyoming, and the lower Colorado River Valley. To the east, very small groups of cougars exist in southern and central Florida, and probably in south-central Canada, the Appalachian Mountains, southeastern Canada, and the Ozark region and adjoining forests of Arkansas, southern Missouri, eastern Oklahoma, and northern Louisiana.

NUMERICAL ESTIMATES-- Approximate, average estimates (in most cases guesses), based on information given in the previous pages, are as follows: British Columbia- 4,000; Alberta- 700; Wyoming- 200; Idaho- 800; Washington- 1500; Oregon- 500; California- 2,200; Nevada- 1,200; Utah- 1,500; Colorado- 800; Arizona- 1,500; New Mexico- 400; Texas- 100. No estimates are available for Montana, but considering area occupied and recorded take, 500 seems a reasonable guess. Taking 100 as the number in all other states and provinces, the total estimate for the United States and Canada is 16,000.

POPULATION HISTORY-- Cougars were eliminated in most areas to the east of the Rockies by about 1900. At that time a significant population still was present in southern Florida, but it apparently declined steadily until the present. There is evidence that certain other populations also survived or became re-established in the central and eastern parts of the continent, and that there may have been moderate increases since the 1940's. Population trends are difficult to assess in western North America, mainly because of the few data available, and the probability that major natural fluctuations have occurred in addition to the effects of human activity. Natural cyclic processes seem especially pronounced in British Columbia which apparently has the largest cougar population of any political unit. The present trend in that province seems to be slightly downward in the sections most subject to man's influence. In neighboring Alberta there also has been a moderate drop in cougar numbers in recent years, along with a decline in deer numbers. In the northwestern United States the general picture is of a slow drop in numbers over much of the century, followed by an accelerated decline in the 1950's and 1960's as human access and activity increased in the cougar's range. The species may have been nearly exterminated in both Wyoming and Oregon. Increases now are reported in nearly all northwestern states following the establishment of game status and regulated hunting. In California the cougar may have undergone a numerical reduction between the turn of the century and 1960. With the end of the state hunting program and the bounty system, and the establishment of total protection, the species seems to have increased considerably in California. Available information suggests that cougars may have increased since the early 1900's in both Nevada and Utah, coincident with a rise in deer populations. With a recent decline in the deer herds, and an intensification of hunting pressure in some localities, the trend in these two states may be slightly downward. Colorado probably has fewer cougars now than earlier in the century, but present controlled hunting seasons may be contributing to an increase. Arizona apparently long has had a large cougar population and there is no conclusive evidence of any overall decline in recent years, though there is concern about the heavy take in some areas. New Mexico seems to have a comparatively smaller population, but there are no data to show that it has been reduced in many years. In Texas, cougars are certainly much less common than they were in 1900, and the trend continues to be downward, at least in the southern part of the state. In recent years, however, the small population west of the Pecos River may have increased, coincident with a decline in the sheep industry.

DEPREDATIONS-- Attacks by cougars on domestic stock have been reported from all parts of the range of the species, and were the most direct cause of the cougar's extirpation to the east of the Rocky Mountains. In the west, the attacks may have been significant in some areas, especially on sheep in the southwest, and were the cause of intensive control programs. Depredations are reportedly less severe in Colorado, Utah, and Nevada, and are surprisingly few in California and the northwest. There seems to have been a general lessening of the depredation problem in recent years.

OTHER PROBLEMS-- Six persons are known to have been killed by cougars in this century in the United States and

Canada, and concern for human safety is a factor that must be considered in some areas. Nonetheless, the cougar normally is so harmless that this problem could never become a serious threat to the welfare of the species. Regular hunting for sport now probably accounts for the greatest amount of pressure on cougar populations in most parts of the west. In some localities such hunting is thought to have been excessive, but officials generally think that regulatory mechanisms are adequate to prevent serious reductions. More important long-term threats involve disturbance and usurpation of habitat by man. Such problems include the loss of key winter range of prey species to housing projects, and the potential development of the oil shale industry.

STUDIES-- A major field study of the ecology and behavior of the cougar has been completed in Idaho. Other field work is underway in British Columbia, Washington, California, Nevada, Arizona, and Texas.

Nowak, R. 2007. Eastern Carnivores--A Legal and Taxonomic Legacy. Pages 7-8 in Abstracts of Presentations of the 3rd Midwestern-Eastern Puma Conference, Trent University, Peterborough, Ontario.

Abstract

In the 1950s, the large carnivores of North America stood at low ebb, especially in the eastern two-thirds of the United States. Gray wolves had vanished even from the West, only a couple hundred holding out in northern Minnesota. A few packs of red wolves made their last stand in remote swamps and coastal prairies of Louisiana and Texas. Pumas apparently were gone everywhere east of the Rockies and Rio Grande Valley, except for a tiny, almost mythical group of "panthers" in the wilds of southern Florida. The black bear hung on in the Appalachians and northern Great Lakes region, but otherwise survived only in a few fragments of bottomland forest. It seemed likely the historical trends of human fear and hatred would soon eliminate most remnant carnivore populations. Around 1960, these trends began to change through a series of careful scientific studies of large carnivores in the wild, the Leopold Report on predator control, and growing public awareness of the environment and endangered species. Progress, however, was sporadic and came with a curious conjunction of sometimes coordinated but often conflicting elements of law and taxonomy. Lengthy field and laboratory investigation, starting in the 1960s, was needed to show that the red wolf was not common but on the verge of extinction. After being legally recognized as endangered, and a recovery program was initiated, the red wolf became subject to repeated claims that it was not a valid species but merely a modern or historical hybrid. Demonstration that the Florida panther existed, and that study and conservation was feasible, came in the 1970s. The panther's popularity then soared, it being designated "state mammal" and its name being adopted by a local hockey team. Yet controversy continued to embroil its taxonomic distinction, as well as that of the even more ephemeral "eastern cougar" to the north; legal battles would be fought over conservation measures, especially as to whether interbreeding with introduced western pumas should be encouraged. In the 1980s, the federal government was petitioned to add the Louisiana black bear to the List of Endangered and Threatened Wildlife. Trying to avoid the responsibility, the government argued at various points that the bear was too common to list, that it already was extinct through hybridization with introduced bears from another region, and that it had never been taxonomically valid. As in so many cases of government reticence, a lawsuit was needed to bring proper classification. A federal effort to curtail protection of the gray wolf in Michigan in the 1980s was defeated by the courts and the species consequently multiplied in numbers and re-established viable populations in Wisconsin and Minnesota. Hence, all four of the East's large carnivores still survive. Whether they can persist in the face of legal and scientific imbroglio, and likely new political and socioeconomic challenge, will depend on future generations.

Nunez, R., B. Miller and F. Lindzey. 2000. Food Habits of Jaguars and Pumas in Jalisco, Mexico. J. Zoology 252(3):373-379.

Abstract

Jaguars (*Panthera onca*) and pumas (*Puma concolor*) are sympatric over much of their geographic range in Mexico and South and Central America. We investigated diets of these felids in and around the Chamela-Cuixmala Biosphere Reserve in western Jalisco, Mexico. Diets were determined from scat analyses and documentation of prey cadavers. Relative biomass of each prey species consumed by pumas and jaguars was estimated from analysing 65 puma and 50 jaguar scats collected from 1995 to 1998. Both jaguars and pumas fed mainly on mammals, with white-tailed deer (*Odocoileus virginianus*) dominating the biomass of the diet of each species (54% and 66% respectively). There was a

high degree of overlap between jaguar and puma diets, but pumas had a broader food niche than jaguars, and their ability to exploit smaller prey may give them an advantage over jaguars when faced with human-induced habitat changes.

Obaugh, W. 1971. Panther Stories. Virginia Wildlife 32(7):16-18.

A 7-month-old mountain lion of unknown origin was shot and killed by John D. Gallant in Venago Township, Crawford County, Pennsylvania on October 28, 1967 and it was reported that a larger one got away. It had been a century since a wild lion was known there. A few accounts of attacks on humans are described, as are a few opinions on the voice of the puma. The recent possible sighting of panthers near the Peaks of Otter and the fact that Virginia and her neighbor states have enough wild wooded country and an established elk herd placed the probable local existence of the big cats on a fairly firm base.

O'Brien, S.J., M.E. Roelke, N. Yuhki, K.W. Richards, W.E. Johnson, W.L. Franklin, A.E. Anderson, O.L. Bass Jr., R.C. Belden, and J.S. Martenson. 1990. Genetic Introgression Within the Florida Panther Felis concolor coryi. National Geographic Research 6(4):485- 494.

Summary

The Florida panther (Felis concolor coryi) is a severely threatened relict population of puma or mountain lion whose historic range has included much of the southeastern United States. The population now consists of 30 to 50 animals living in the Big Cypress Swamp-Everglades ecosystems in southern Florida. Field observations indicated the presence of two distinct morphological phenotypes that are stratified between the two adjacent areas despite the occurrence of periodic migration between them. A comprehensive molecular genetic analysis using mitochondrial DNA and nuclear markers indicates the existence of two distinct genetic stocks concordant with the morphological phenotypes. One stock confined to Big Cypress is derived from the ancestors of F. c. coryi. A second stock, found largely in the Everglades, is descended primarily from pumas that evolved in South or Central America, but were introduced (probably by man) in the Florida habitat very recently. The precarious genetic disposition of the few remaining authentic Florida panthers may be benefitting from the introgression of genetic materials into the wild population.

O'Brien, S.J. and E. Mayr. 1991. Bureaucratic Mischief: Recognizing Endangered Species and Subspecies. Science 251:1187-1188.

A recent allozyme and mitochondrial DNA (mtDNA) analysis of the population revealed that two very distinct genetic stocks were living in Florida; one that resembled other North American pumas and another that was more closely related to a puma subspecies that had evolved in South America. This latter stock was apparently due to the release of seven animals from captive stock into the Everglades between 1957 and 1967. This infusion of additional genetic material into the Florida panther population should have proven to be beneficial except for a later ruling that set the precedent that hybrids between endangered species, subspecies, or populations cannot be protected under the United States Endangered Species Act of 1973. This policy concluded that the protection of hybrids would not recover listed species and would instead jeopardize their continued existence. The current status of the Florida panther as endangered could be challenged or even revoked under such a strict interpretation of this policy. It was recommended that this policy should not imperil the listing or protection of species with sympatric hybrid zones as long as the existence of the zones does not disintegrate the genetic organization of the species in contact. For subspecies and threatened populations, the policy should be dropped. The easement of this policy would offer the Florida panther continued protection since it clearly qualifies as a subspecies.

O'Brien, S., M. Culver, W. Johnson and J. Pecon-Slattery. 2000. Genomic Ancestry of the American Puma (*Puma concolor*). Journal of Heredity 91(3):186-197.

Abstract

Puma concolor, a large American cat species, occupies the most extensive range of any New World terrestrial mammal, spanning 100 degrees of latitude from the Canadian Yukon to the Straits of Magellan. Until the recent Holocene, pumas co-existed with a diverse array of carnivores including the American lion (*Panthera atrox*), the North American cheetah (*Miracynonyx trumani*), and the saber toothed tiger (*Smilodon fatalis*). Genomic DNA specimens from 315 pumas of specified geographic origin (261 contemporary and 54 museum specimens) were collected for molecular genetic and phylogenetic analyses of three mitochondrial gene sequences (16S rRNA, ATPase-8, and NADH-5) plus composite microsatellite genotypes (10 feline loci). Six phylogeographic groupings or subspecies were resolved, and the entire North American population (186 individuals from 15 previously named sub-species) was genetically homogeneous in overall variation relative to central and South American populations. The marked uniformity of mtDNA and a reduction in microsatellite allele size expansion indicates that North American pumas derive from a recent (late Pleistocene circa 10,000 years ago) replacement and recolonization by a small number of founders who themselves originated from a centrum of puma genetic diversity in eastern South America 200,000-300,000 years ago. The recolonization of North American pumas was coincident with a massive late Pleistocene extinction event that eliminated 80% of large vertebrates in North America and may have extirpated pumas from that continent as well.

Ockenfels, R.A. 1994. Mountain Lion Predation on Pronghorn in Central Arizona. S.W. Naturalist 39(3):305-306.

Mountain lion predation on adult pronghorn was documented in central Arizona (34^{E}20'N, 112^{E}07'W) from October 1989 to October 1993. Forty-seven pronghorn (29 females, 18 males) were captured and collared with motion-sensing (mortality) transmitters. Mountain lions were identified as the cause of death for 11 of 29 mortalities (9 females, 2 males). Three additional mortalities (1 female, 2 males) were suspected to be killed by lions, but conclusive evidence was lacking. Most of the kills were within 100 meters of rugged terrain and no kills occurred in the large undulating flats typical of most pronghorn habitat. In addition, all kill sites were located in semidesert grassland or juniper woodland rather than in short-grass prairie. Most kill sites showed extensive drag marks (n = 6), and most remains were buried (n = 9). Substantial mountain lion predation on adult pronghorn likely occurs wherever their distributions overlap in rugged, heavily-vegetated terrain in Arizona.

O'Gara, B.W. and R.B. Harris. 1988. Age and Condition of Deer Killed by Predators and Automobiles. J. Wildl. Manage. 52(2):316-320.

We evaluated the condition of mule deer (Odocoileus hemionus) and white-tailed deer (O. virginianus) killed by mountain lions (Felis concolor), coyotes (Canis latrans), and automobiles from December through March, 1969-81 in western Montana. Predators killed prime-aged animals and automobiles killed ($G = 41.4$, $P < 0.001$) more fawns and old-aged animals. Fifty-three deer (90%) killed by automobiles were in poor condition, but only 2 (7%) deer killed by predators were in poor condition. Predator selectivity could not be inferred from the sample of deer killed by automobiles.

Onorato, D., C. White, P. Zager and L.P. Waits. 2006. Detection of Predator Presence at Elk Mortality Sites Using mtDNA Analysis of Hair and Scat Samples. Wildl. Soc. Bull. 34(3):815-820.

Abstract

The identification of carnivores responsible for preying on wild or domestic ungulates often is of interest to wildlife managers. Typically, field personnel collect a variety of data at mortality sites including scat or hair samples that may have been deposited by the predator. We compared mitochondrial DNA (mtDNA) analysis of hair and scat samples (n = 122) collected at elk (Cervus elaphus) mortality sites between 1997 and 2004 in north-central Idaho, USA, with field identification of carnivore presence. We amplified mtDNA from samples via a 2-step process involving an initial screening for American black bears (Ursus americanus), brown bears (Ursus arctos), and gray wolves (Canis lupus) using a length variation in the 5′ hypervariable section of the control region. Samples that failed the first screening subsequently were analyzed using conserved mtDNA primers that amplify a wide array of vertebrates. Species identification success rate was high (88.5%) and established the presence of 3 predators at elk mortality sites including black bears (55.7%), cougars (Puma concolor; 27.9%), and coyotes (Canis latrans; 6.6%). Attempts at hair and scat identification by field personnel were correct for 58% of hair samples and 79% of fecal samples. Results from these analyses demonstrate the merits of combining field mortality assessments with mtDNA species identification to aid

wildlife managers in more accurately pinpointing predators involved in either predation or depredation events.

Onorato, D., W. Johnson, M. Roelke, M. Cunningham, D. Land, M. Lotz, R. McBride, D. Shindle, D. Jansen, O. Bass and S.J. O'Brien. 2008. A Preliminary Retrospective on the Implementation of Genetic Introgression in the Florida Panther. Pages 165-166 in Toweill, D. E., S. Nadeau and D. Smith, editors. Proceedings of the Ninth Mountain Lion Workshop, May 5-8, 2008, Sun Valley, Idaho, USA.

Abstract

The decline of populations of large carnivores is typically an unfortunate result of varied anthropogenic factors that ultimately expedite endangerment and extinction. The Florida panther (*Puma concolor coryi*) is a perfect example of the plight faced by many populations of large carnivores in the 20th century. Extirpation of panthers throughout most of their range resulted in a small (< 50) remnant population isolated in southern Florida by the 1980's. Early research revealed that portions of the population appeared to be impacted by several correlates of inbreeding. Amending detrimental influences of inbreeding depression often associated with endangered populations should theoretically be possible via the introduction of novel genetic variation from conspecifics. Herein, we report the historical decline of the Florida panther, the subsequent initiation of a genetic introgression program in 1995 via the release of Texas cougars (*Puma concolor stanleyana*), and findings derived in the ensuing decade of research. We incorporated field observations, biomedical records, and genotypic data from 21 microsatellite loci for panthers sampled between 1970 and 2007 to assess changes in genetic variation, population structuring, and kinship in pre- and post-introgression periods. We also delineated temporal trends regarding observations of congenital defects and reproductive abnormalities in the panther population. Heterozygosity, average number of alleles, and measures of genetic structuring and distance have all increased in cohorts of panthers born since the initiation of the introgression project. Conversely, cases of atrial septal defects and cryptorchidism have decreased in generations since the introduction of Texas cougars. A slow and steady expansion of the Florida panther population (90-100 animals) has ensued in the decade following genetic introgression. While inbreeding and genetic variation remain issues of concern, recovery of panthers continues to hinge largely on the preservation of usable space and improving prospects for recolonization of former range in other regions in Florida and the southeastern U.S.

Onorato, D.P., M. Criffield, M. Lotz, M. Cunningham, R. McBride, E.H. Leone, O.L. Bass, and E. Hellgren. 2011. Habitat Selection by Critically Endangered Florida Panthers Across the Diel Period: Implications for Land Management and Conservation**.** Animal Conservation 14(2):196-205.

Abstract

Decisions regarding landscape management, restoration and land acquisition typically depend on land managers' interpretation of how wildlife selects habitat. Such assessments are particularly important for umbrella species like the endangered Florida panther *Puma concolor coryi*, whose survival requires vast wildlands. Some interpretations of habitat selection by panthers have been criticized for using only morning locations in defining habitat use. We assessed habitat selection using a Euclidean distance analysis and location data collected throughout the diel period from GPS collars deployed on 20 independent Florida panthers. We corroborated aspects of earlier analyses by demonstrating the selection of forested habitats by panthers. We also confirmed the selection of open habitats (i.e. marsh-shrub-swamps, prairie grasslands), a novel result. Habitat selection did not vary by sex or season but varied by time of day. Panthers were located closer to wetland forests in the daytime and used prairie grasslands more at night. Our assessment of the effect of patch size on selection of forest habitat revealed that panthers were not solely reliant on large patches (>500 ha) but utilized patches of all sizes (≤1, >5-10, >1000 ha, etc.). Our results emphasize the importance of collecting panther location data throughout the diel period when assessing habitat selection. Conservation strategies for panthers should consider a mosaic of habitats, a methodology that will protect other sensitive flora and fauna in South Florida.

Orlando, A.M. and M. Demment. 2005. Assessing Puma Depredation Risk in California's Western Sierra Nevada. Page 150 *in* R.A. Beausoleil and D.A. Martorello, editors. Proceedings of the Eighth Mountain Lion Workshop, Olympia, Washington, USA.

Abstract

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

Osgood, W.H. 1920. Attacked by a Cougar? J. Mammal. 1:240-241.

An encounter with a cougar in the foothills of the Sierra de Perija near the Rio Cogollo, eighty miles southwest of the city of Maracaibo is recounted. A large cougar came from behind some low bushes 50-60 feet ahead on a deer trail and started toward the author growling savagely, apparently with intent to attack. The author promptly fired a load of buckshot full into its face. In spite of being dropped instantly and rolling behind some bushes, the cougar rose and disappeared into the thicket while the gun was being reloaded.

Owings, M. 1981. The Lion in Monterey County. Pacific Discovery 34(4).

The crest of the Santa Lucia coast range, stretching from the Carmel Valley south through San Luis Obispo County, has been described as a lion traffic route. But today these lions, which play a critical role in carrying new genes between widely-separated resident lion populations, must cross two wide highways and a divided freeway in western San Luis Obispo County. Fifty-six years of bounty subsidies had amounted to $27,500 paid by the State until it was eliminated in the summer of 1963. During the bounty period (1907-1963), 630 lions were taken in Monterey County alone and the total kill in the State numbered 12,461. The California Department of Fish and Game estimated 2,400 lions in the State which occupied a summer range of 70,000 square miles. Dr. Carl Koford, a research biologist at the University of California at Berkeley, estimated an average of only 1000 year-round residents in a total area of 15,000 square miles.

Owston, M.A., C.C. Wu and J.A. Ramos-Vara. 2006. Hepatic Yersiniosis in a Cougar. J. Vet. Diagn. Invest. 18(5):511-513.

Abstract

A cougar (*Felis concolor*) was diagnosed with hepatic yersiniosis by bacterial culture and histopathology. The animal had a 2-week history of anorexia and jaundice before its death. Grossly, the liver exhibited caseo-necrotic foci. Histopathologically, there was necrotizing and suppurative hepatitis, with large numbers of intralesional gram-negative coccobacilli. Additional hepatic lesions included central vein thrombosis, lymphoplasmacytic portal hepatitis, and capsulitis. Yersinia pseudotuberculosis coccobacilli were isolated in pure culture from the hepatic lesions. Because the hepatic lesions in this animal resemble those of other zoonotic diseases, such as plague and tularemia, veterinarians and laboratory personnel who handle samples should take adequate safety precautions. This report is the first to describe the pathology associated with hepatic yersiniosis in a cougar.

Padley, W.D. 1990. Home Range and Social Interactions of Mountain Lions (Felis concolor) in the Santa Ana Mountains, California. M.S. Thesis, California State Polytechnic Univ., Pomona.

Female mountain lions (Felis concolor) in the southern Santa Ana Mountains were monitored from 1986 to 1989, and home ranges were determined using the modified minimum area and minimum convex polygon methods. Mean total home range size in the southern Santa Ana Mountains was 111.2 km^2 and was similar to other coastal California mountain ranges. Mountain lion home ranges in coastal California mountain ranges were similar probably because those populations had relatively constant annual climates and resident prey populations. Total home range size in this study were smaller than those of populations in the Sierra Nevada, Nevada, Utah, and Idaho, where climate was seasonally variable, and prey populations migrated. Winter home ranges of mountain lions in the Santa Ana Mountains were similar to those in most other areas, but smaller than those of mountain lions in Utah. Summer home ranges of females were smaller than those for female mountain lions reported for Utah and Idaho. Mountain lion social interactions were monitored between 1987 and 1989. Twenty-two interactions involving at least 10 different individuals were documented. Female-female interactions were most common and appeared to be related to the estrus cycles of the individuals. Females with overlapping home ranges may have had synchronous estrus cycles.

Padley, W.D. 1991. Mountain Lion Ecology in the Southern Santa Ana Mountains, California. Final Contract Report, California State Polytechnic Univ., Pomona.

Mountain lion home ranges of 7 adult females in southern Santa Ana Mountains were similar in size. All of the radio-collared mountain lions were resident and non-migratory and used the foothills of the Santa Ana and Santa Margarita Mountains. Most locations obtained were in coastal sage scrub, oak woodland, or riparian habitats which support good populations of mule deer, their principal prey. The mountain lion population in the Santa Ana Mountains at the beginning of the study had at least 2 adult males and probably more. The sex ratio of kittens born in 1989 was skewed in favor of males (six of seven kittens sexed were males). It was believed that the 20 and 22 day periodicity of female-female interactions reflects the periodicity of estrus cycles, and that females tended to interact during their periods of sexual receptivity (estrus). Because these interactions and vocalizations involved different combinations of female mountain lions at specific time intervals, the author believed the estrus cycles of female mountain lions with overlapping home ranges were synchronous. A mutual avoidance system was apparently not operative during most of the study. Two of three yearling kittens were probably killed by an uncollared mountain lion. The apparent lack of an adult male and, consequently, the lack of kittens for over a year led to a break down of the mutual avoidance system. The mutual avoidance system was reestablished during the summer of 1989 after kittens were born to several mountain lions. Although deer were found in half of all prey identified, several other species were found and indicates that mountain lions may be opportunistic predators. Beavers may be an important prey species for those mountain lions along the Santa Margarita River, Las Flores Creek, and Aliso Creek.

Padley, W.D. 1997. Female Mountain Lion (*Puma concolor*) Home Ranges in the Southern Santa Ana Mountains, California. Page 89 in W.D. Padley, ed., Proc. Fifth Mountain Lion Workshop: 27 February- 1 March 1996; San Diego, California.

Eight female mountain lions were radio-collared and monitored between October 1986 and December 1989. Individual mountain lions were monitored for periods from 9 to 38 months. Total home ranges for this period varied from 56.5 km^2 to 237.7 km^2 (mean=111.2, SD=58.4, n=8). Annual home ranges for five mountain lions for the 1988-89 period varied from 81.7 km^2 to 226.3 km^2 (mean=111.3, SD=64.9, n=5). The 1988 dry season (April 1-October 31) home ranges (mean=64.1 km^2, SD=35.4, n=6) and 1988-89 wet season (November 1-March 31) home ranges (mean=68.4, SD=37.2, n=7) were similar in size (t=0.213, 10 df, P=0.83). The 1989 dry season home ranges (mean=31.6, SD=9.1, n=6) were smaller than either of the 1988 dry season or 1988-89 wet season home ranges (t=2.375, 11 df, P=0.037: and t=2.558, 11 df, (P=0.025). The smaller 1985 dry season home ranges were the result of all 6 female mountain lions producing litters during that season and confining their movements to areas near natal dens, whereas in 1988 only 1 female was accompanied by kittens. A core area analysis of total home ranges indicated the female mountain lions did not use distinct core areas during this study. In general home ranges remained stable from year to year; however, urban development may have decreased habitat availability for two mountain lions. The stability of the home ranges may be attributed to the abundance of the resident deer population, and the relatively mild climate.

Padley, W.D. 1997. Mountain Lion (*Puma concolor*) Vocalizations in the Santa Ana Mountains, California. Page 89 in W.D. Padley, ed., Proc. Fifth Mountain Lion Workshop: 27 February- 1 March 1996; San Diego, California.

Vocalizations of wild and free ranging mountain lions in the Santa Ana Mountains were heard during a five year study of mountain lion ecology. The vocalizations were classified as one of three types: screams and yowls; "ouch" calls; and clicks, whistles and buzzes. Calls in each of these three categories are indicative of a different type of behavior. Screams and yowls were associated with female estrus cycles and may be considered advertisement calls. "Ouch" calls were heard following unsuccessful hunts and may indicate frustration. Clicks, whistles, and buzzes were given by adult females and their juvenile kittens and are considered contact calls.

Padley, W.D. 1997. Social Encounters Among Mountain Lions (*Puma concolor*) in the Santa Ana Mountains, California. Pages 89-90 in W.D. Padley, ed., Proc. Fifth Mountain Lion Workshop: 27 February- 1 March 1996; San Diego, California.

The intraspecific encounters of eight female and two male mountain lions were monitored over a three year period. Five male-female and 18 female-female encounters were observed. Encounters lasted from one to six days and involved two to three mountain lions. Yowls and screams were heard during several of these encounters. The encounters of adult females occurred at intervals of 20-22 days and the timing is consistent with the length of estrus cycles in mountain lions. Sixteen of the eighteen encounters among females were females without kittens. Two encounters involving an adult female with kittens were brief and one resulted in a fight. No males were observed on the study area from February 1988 through February 1989. Following the appearance of a male mountain lion in February 1989 all female mountain lions were bred and produced litters during the spring and summer of 1989. No encounters were observed following the production of litters. The absence of male mountain lions and the subsequent reproductive failure led to a partial breakdown of the mutual avoidance reaction. The mutual avoidance reaction may be a means by which adult female mountain lions protect their young kittens.

Pall, O., H. Carr and A. Lukey. 1982. The 1980-81 Cougar Hunt in Alberta. Energy and Natural Resources, Fish and Wildl. Div., Calgary, Alberta, Canada.

The results of the 1980-81 cougar (Felis concolor) hunt and harvest in Alberta were summarized by compiling and analyzing the information on the compulsory hunter registration forms. Cougar skulls and carcasses submitted by hunters were examined. Sales of cougar hunting licenses climbed steadily from 1971 to 1979, but fell by 33% to 116 in 1980-81 because of the poor snow conditions. Most cougar hunters in 1980-81 were residents (97%) and there was no restriction on the number of licenses sold or where the licensees hunted. Cougar hunting was permitted for 68 days during the fall season (dogs not permitted) and for 62 days during the winter season (dogs permitted) on a Provincial basis. In Big Game Zone 11, the winter season was restricted to 27 days. Twenty cougars were killed in the Province (18 by residents and 2 by non-resident aliens), a 47% reduction from the previous year. This decrease was attributed primarily to very poor snow conditions for hunting and a major decrease in license sales. During the bounty years (1937 to 1964), the annual cougar kill averaged 40. From 1973-74 to 1980-81, the average annual harvest was 30. The kill was dispersed over 12 Wildlife Management Units with F304 having the highest recorded kill as it did in most previous years. Over a third of the cougar harvest occurred in the fall season, but this was an unusually high percentage due mainly to the low winter kill. As usual, January was the peak month of harvest. Although 60% of the cougar harvest was comprised of females, the actual number of females killed was substantially lower than for any of the three preceding years. Until more is known about the cougar population through intensive field studies, a conservative hunting strategy is in order. One of the 16 skulls examined qualified for the Boone and Crockett trophy status. As determined from analysis of seven cougar stomachs, deer was the most common prey species. At least seven species of parasites infect cougars in Alberta. One, Trichinella sp, is dangerous to humans.

Pall, O., M. Jalkotzy and H.D. Carr. 1983. The Population Status of Cougars Near Sheep River, Alberta, 1982-83. Energy and Natural Resources, Fish and Wildl. Div., Calgary, Alberta, Canada. Progress Report.

In an attempt to compile baseline population data for cougars (Felis concolor) in southwestern Alberta, a capture and radio tracking study commenced in March, 1982. The 1300 km^2 study area was located southwest of Calgary in the Sheep River vicinity. By 30 April, 1983, 20 cougars had been captured 24 times and radio collared. Field effort approximated 3.6 capture-attempt days and 162 km travelled per cougar caught. The mean weight for 6 adult females was 48 kg. For 4 adult males, it was 72. Males were larger for all physical characteristics measured. Four cougar family groups were encountered. Two kittens were present in each of 2 litters. The other 2 litters consisted of 3 kittens

each. Kittens were born in February, March, April/May and September. Two collared kittens became independent when 16 months old and dispersed over 50 km from their maternal home range at 20 months of age. Several instances of non-hunting mortality were documented for adults, subadults and kittens. Between 1973 and 1982, 28 cougar kills (10% of the provincial hunting harvest) occurred in the study area and immediate vicinity. The average annual harvest for this area was about 3. Four hundred thirty-five ground and air telemetry fixes were recorded for 20 collared cougars. An adult female was the only cougar whose home range (310 km^2) was adequately defined. Of 25 cougar prey kills identified, 9 (36%) were moose, 5 (20%) were elk, 4 (16%) were porcupines, and 3 (12%) were mule deer. In addition, 1 (4%) white-tailed deer, 1 (4%) bighorn sheep, 1 (4%) cougar, and 1 (4%) snowshoe hare were identified.

Pall, O. 1984. Alberta-Cougar Status Report. Pgs. 1-8 In: J. Roberson and F. Lindzey (eds.), Proc. of the Second Mountain Lion Workshop. Utah Div. Wildl. Res. and Utah Coop. Wildl. Research Unit. Zion National Park. 271pp.

A bounty was paid for each cougar killed from 1937 to 1964. In 1971, the cougar was classified as a Big Game animal and hunting licenses were introduced and it became mandatory for hunters to register each cougar killed. Cougars inhabit the foothills and mountains of the southwestern section of the Province and have been sighted along river courses to the east. The estimated population in Alberta was 1000 cougars. Bag limits were one cougar per hunter per year with females accompanied by kittens and spotted kittens protected. Licensed hunter harvests averaged 30 per year from 1973 to 1983, which compared with an average of 40 cougars per year during bounty years 1937 to 1964. Existing and possible future management activities are described.

Pall, 0. 1984. The Population Status of Cougars Near Sheep River, Alberta. Pgs. 116-118 In: J. Roberson and F. Lindzey (eds.), Proc. of the Second Mountain Lion Workshop. Utah Div. Wildl. Res. and Utah Coop. Wildl. Research Unit. Zion National Park. 271pp.

The Alberta Fish and Wildlife Division initiated a capture and radio tracking study in March, 1982 to compile population data for cougars in southwestern Alberta. Data collected will be used to help formulate a provincial cougar management plan. The 750 km^2 core study area of alpine, sub-alpine, montane and parkland habitats is located 40 km southwest of Calgary in the Sheep and Highwood drainages. By 30 April 1984, 28 cougars had been captured 41 times and radio collared despite very poor searching conditions and unseasonably mild winters. Of the 28, 6 were males, 8 were females and 14 were kittens (11 females and 3 males). The mean weight for 7 adult females captured was 46 kg. For 5 adult males, it was 70 kg. Adult males were larger for all physical characteristics measured. Seven cougar family groups have been documented with litters averaging 2.3 kittens each. Kittens were born in February, April, August, September, and October. Seven collared kittens became independent at ages of 12 to 16 months and 2 dispersed at least 100 km from their maternal home ranges. Over 900 ground and air telemetry fixes have been recorded. The average size of the areas travelled for at least one complete year by 8 resident female cougars was 259 km^2. For the single adult male radio tracked for more than 1 year, the size was 454 km^2. Field work has not progressed to the point that confident population densities can be determined. As of November 1, 1984, 16 of the original 28 collared cougars were still being monitored. The fate of the other 12 was as follows: 3 dead of natural causes; 1 poached; 3 shot legally; 1 transmitter malfunction; 1 battery life termination; and 3 dispersed out of area. Legal hunting accounted for all three collared cougar mortalities documented during the winter of 1983-84. Approximately 10% of the provincial cougar harvest from 1973 to 1984 has occurred in the study area and immediate vicinity. Of 37 cougar prey kills identified, 12 (32%) were moose, 8 (22%) were mule deer, 7 (19%) were elk, and 5 (14%) were porcupines. In addition 1 (3%) white-tailed deer, 1 (3%) bighorn sheep, 1 (3%) cougar, 1 (3%) snowshoe hare and 1 (3%) spruce grouse were identified.

Pall, O., M. Jalkotzy and I. Ross. 1988. The Cougar in Alberta. Arc Associated Resource Consultants Ltd., Calgary, Alberta.

EXECUTIVE SUMMARY

Alberta Forestry, Lands and Wildlife, Fish and Wildlife Division personnel including the authors conducted an intensive capture and radio tracking program to obtain information regarding densities, reproduction, dispersal, home ranges, movements, and winter food habits of cougars in the southwestern foothills and mountains of the Province between

1981 and 1986. Forty-four cougars were captured 79 times in and around the 780 km^2 study area. All cougars captured were placed into 1 of 4 age classes based on dentition and body size: kittens (0-6 months), juveniles (7-18 months), subadults (19-30 months), and adults (>30 months). These age classes appeared to best fit the behavioral phases of a cougar's life in the study area. Body measurements were collected from 36 known age females and 13 known age males. Annual home ranges of 14 adult females, irrespective of their reproductive status, averaged 158 km^2. Average home range size of females travelling with kittens was significantly smaller than that of lone females. Conversely, the average home range size of females travelling with juveniles was significantly larger than that of lone females. When they showed an affinity for an area, subadult females used areas which were significantly larger. Adult male home ranges were extremely variable in size, ranging from 232.3 km^2 to 1031.4 km^2. Shifts in home range boundaries between winter and summer did not occur in most cases. Overlap between neighboring female home ranges was variable and at times extensive, while neighboring male home ranges tended to overlap less. Eleven radio collared females produced 16 litters between 1981 and 1986. Average litter size between 4 and 6 months after birth was 2.2 and the sex ratio favored females 3:1. Although kittens were born during all seasons, most births occurred during spring and summer. Ten litters became independent during the course of the study; the average age of juveniles at independence was 14 months. They became independent throughout the year. Eleven of 22 kittens dispersed from their maternal home ranges, although dispersal did not necessarily occur immediately after independence. Mean dispersal age was 16 months. Eight subadult cougars appeared to be establishing residency in areas contiguous with their maternal home ranges at the end of the study. The annual recruitment rate for a female cougar in the study area was approximately 1.0 to 1.2 kittens per year. Humans were the primary source of mortality of radio collared cougars. Of the 16 cougars that died, 7 were legally shot, 1 was shot illegally, 3 were killed by other cougars, 1 died from an infection, 1 died accidentally while attacking a mule deer, and 3 died of unknown causes. Known annual mortality in and around the study area was approximately 12%, 3%, and 10% in 1984, 1985, and 1986, respectively. The total cougar population in the study area was estimated to be about 30 to 32 individuals in 1985 and 1986. Females always outnumbered males, although the ratios were usually not significantly different from equality. Resident adults comprised 43-61% of the population. Dependent kittens and juveniles accounted for between 22-38%. Density estimates of cougars in the study area varied from 24.6 to 37.1 km^2/cougar. An average of 30 cougars were legally shot each year in Alberta between 1972-73 and 1986-87. Residents were responsible for the majority of the harvest. Variability in the annual harvest was caused in large part by differences in snow conditions during each hunting season. The largest cougar harvest came from Wildlife Management Units (WMU's) south of the Bow River. Within this southern area, the harvest was very patchy; a few WMU's provided the majority of the harvest, while others appeared to be hunted much less. Harvests within WMU's also fluctuated annually. In many cases, 1 or 2 years of relatively high harvests were followed by reduced harvests for at least 1 year. Between 1977-78 and 1986-87, 54% of all cougar kills were males. The adult male sex-age group and independent juvenile and subadult male sex-age group comprised 31% and 16% of the aged harvest sample across the Province, while in the Sheep River study area population, these same 2 sex-age groups represented about 20% and 10% of the population. The sex ratio of the harvest in WMU's 302, 304/305, and 400 appeared to be different from the provincial ratio. Subadult males were shot most frequently in these WMU's; whereas, adult females were the most often harvested sex-age group in the whole of the Province. More cougars were shot from WMU's 302, 304/305, and 400 than any other WMU's in the Province between 1981-82 and 1986-87. Cervids accounted for 72.7% of all prey occurrences found in scats, cougar stomachs, and at kills. Deer were most frequently taken, followed by moose and elk. Bighorn sheep, although abundant in the study area, were not preyed on frequently. Porcupines and beavers were the only other prey items to appear regularly. Male cougars killed moose much more frequently than did female cougars. Most moose killed were calves in poor condition. Cougar kills were discovered most often on steep slopes in spruce and pine dominated forests. Between 1974 and 1983, the effects of cougar depredation on Alberta livestock was minimal in comparison to the effects of wolves, coyotes, and bears. An average of between 4 and 5 claims were awarded annually during that period. Cougars are an important wildlife resource to many Albertans. The intangible aspects of cougars were the most important benefits the public gained. Just knowing that the cougar still roamed the foothills and mountains of Alberta was deemed very important, even though the opportunity to see one was very small.

Palmeira, F.B.L., P.G. Crawshaw Jr., C.M. Haddad, K.M.P.M.B. Ferraz and L.M. Verdade. 2008. Cattle Depredation by Puma (*Puma concolor*) and Jaguar (*Panthera onca*) in Central-Western Brazil. Biological Conservation 141(1):118-125.

Abstract

In this study, data on cattle depredation by puma (*Puma concolor*) and jaguar (*Panthera onca*) were recorded for six years (1998–2003) in a cattle ranch in central-western Brazil. Depredation represented 18.9% of the overall cattle mortality, being predominant on calves. In biomass, kills represented 0.4% (63.8 kg/km^2) of the ranch's annual stock. In economic loss, kills represented 0.3% of the cattle stock value. Depredation was mainly associated with cattle's age class and location along with the time of birth of calves. The proportion of pastures next to forest with depredation (n = 33, 48.5%) was not distinguished to the proportion of pastures not bordering forest with depredation (n = 35, 51.5%). However, the proportion of pastures next to forest with depredation represented 54% (n = 33) of the 61 total pastures that were at least partially surrounded by forest patches or riparian forests that comprised eight continuum blocks of forest fragments of different sizes in the ranch and adjacent areas. No kills occurred in the central portion (main house) of the farm, close to the headquarters where the pastures not bordering forest. The distances of the kills in relation to areas of native forest was 1317.48 ± 941.03 m. In order to reduce depredation, calves should be kept as far as possible from forest areas and concentrated cattle breeding and calving seasons should be encouraged.

Palmer, M.J. 1986. Cougars on the Run in California. Pacific Discovery 39(1):16.

On January 1 1986, legislation that had shielded the lions from hunting for the previous 13 years was allowed to expire. Through the 1970's and 1980's the state legislature repeatedly extended this legislation. Governor Deukmejian vetoed the bill stating "I believe it is unnecessary to statutorily treat the mountain lion differently from other game animals."

Papouchis, C.M., and L.M. Cullens. 2003. Improving Our Understanding of Mountain Lion Management Trends: the Value of Consistent Multi-State Record Keeping. Page 88 *in* S.A. Becker, D.D. Bjornlie, F.G. Lindzey, and D.S. Moody, eds. Proceedings of the Seventh Mountain Lion Workshop. Lander, Wyoming.

Abstract

The sound management and conservation of mountain lions relies on comprehensive scientific data. Yet the cost of mountain lion research can be prohibitive and the results are often difficult if not impossible to extrapolate. Wildlife managers, field researchers, and conservation organizations would benefit from more complete and consistent records of validated mountain lion sightings, hunting mortalities, depredation incidents, and road kills. Scientists who have mined such data in the past have isolated important variables, generated important hypotheses, and targeted future research. But their work is usually limited by funding, academic or agency agendas. Further, there is no long-term multi-state repository for mountain lion data. The task of data collection is made more difficult because there is no multi-state standard, and therefore states collect and store data inconsistently. This presentation explores the potential for developing a multi-state database, and examines the existing state data sets in order to identify the essential variables that might be included.

Papouchis, C.M. and J.D. Wehausen. 2003. Mountain Lions and Bighorn Sheep: Facing the Challenges. Page 150 *in* S.A. Becker, D.D. Bjornlie, F.G. Lindzey, and D.S. Moody, eds. Proceedings of the Seventh Mountain Lion Workshop. Lander, Wyoming.

Abstract

Mountain lions (*Puma concolor*) and bighorn sheep (*Ovis canadensis*) have coevolved as predator and prey. Bighorn sheep populations have declined over the past several centuries across their range due to a variety of anthropogenic causes, and have been the subject of extensive translocation efforts in recent years in an effort to reestablish populations in historic habitat. In the past several decades mountain lion predation has also been implicated in the decline of several populations of endangered bighorn sheep, including the federally listed Peninsular (*O. c. cremnobates*) and Sierra Nevada populations in California and state listed desert bighorn sheep (*O.c. mexicana*) populations in New Mexico. We hypothesize that this recent phenomenon has resulted from land and wildlife management practices that have affected both species. Restoring the natural relationship between mountain lions and bighorn sheep presents both biological and ethical challenges. We discuss the current status of management efforts, review several hypothesis of why predation has become a limiting factor for bighorn sheep recovery, and discuss current and potential management options.

Papouchis, C., R.A. Hopkins and D. Dawn. 2005. A New Paradigm for Cougar Conservation and "Management" in the 21st Century. Page 127 *in* R.A. Beausoleil and D.A. Martorello, editors. Proceedings of the Eighth Mountain Lion Workshop, Olympia, Washington, USA.

Abstract

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

Papouchis, C. and T. Dunbar. 2005. Identifying Human-Caused Mountain Lion Kill Hotspots in the American West. Page 220 *in* R.A. Beausoleil and D.A. Martorello, editors. Proceedings of the Eighth Mountain Lion Workshop, Olympia, Washington, USA.

Abstract

Mountain lions *(puma concolor*) remain the sole large carnivore with viable populations throughout much of the American West, and play an important role in maintaining the integrity and diversity of a variety of ecosystems. Since the management of mountain lions by state wildlife agencies is undertaken primarily through the regulation of mortality, conserving mountain lion populations throughout their range requires a detailed understanding of mortality distribution and trends. In recent decades, growing interest in mountain lions as a trophy game species and increasing conflicts between mountain lions and livestock, pets and humans, have led to a rapid escalation in human-caused mortality of lions. As a result, the number of mountain lions killed by humans in recent years has reached the highest levels reported since 1900 in nearly all the Western U.S. states. We compiled mortality data provided by state wildlife agencies by type (e.g. sport hunting, depredation, public safety, and unspecified) and report on mortality trends in 11 western states, with a focus on the ten-year period from 1992 to 2001. Because state and management units differ markedly in size and amount of suitable mountain lion habitat, to standardize kill rates we utilized available projections of mountain lion habitat and estimated the number of kills per 100 square miles of suitable mountain lion habitat. We then compared these densities of kills to identify which geographic areas within the 11 western states have the greatest concentrations of human-caused mortality. Finally, we provide several recommendations based on our findings.

Paradiso, J.L. 1972. Status Report on Cats (Felidae) of the World, 1971. U.S. Dept. Int., Fish and Wildl. Service, Bureau of Sport Fisheries and Wildlife Special Scientific Report, Wildlife #157. 43pp.

The puma (Felis concolor) is found from western Canada to Patagonia. This species is widespread in distribution, and, in some places common. Although it has been extirpated in much of the settled portions of North America, it still persists in the wilder regions of much of the New World. The subspecies from the southeastern United States, F. c. coryi, however, is endangered and is on the Bureau's list of species endangered within this country. The eastern subspecies, F. c. couguar, has been listed as extinct. However, there have been several recent reports of pumas within the range of this form and it is possible that it survives in the wilder regions of the eastern United States.

Parfit, M. 1985. Its Days as a Varmint Are Over, but the Cougar is Still on the Run. Smithsonian 16(6):68-79.

The work of Allen Anderson, Research Biologist with the Colorado Division of Wildlife, is described. Over the first 3 years of the 15-year study of lion ecology, Anderson spent 323-days searching for pumas in which 23 were treed, tranquilized, and radiocollared. Puma predation on livestock and sport hunting is discussed.

Pathak, S. and D.H. Wurster-Hill. 1977. Distribution of Constitutive Heterochromatin in Carnivores. Cytogenet. Cell Genet. 18:245-254.

Felis concolor (2n=38). The karyotype fails to show an appreciable amount of heterochromatin. At least 4 pairs of chromosomes (two of the A group, one of the E group, and the acrocentric) show small paracentromeric C-bands. In some cells, there is an indication of terminal C-bands in a number of chromosomes, but these C-bands are small and weakly stained. One pair of medium-sized submetacentric chromosomes shows a broad interstitial C-band.

Paul-Murphy, J., T. Work, D. Hunter, E. McFie and D. Fjelline. 1994. Serologic Survey and Serum Biochemical Reference Ranges of the Free-Ranging Mountain Lion (Felis concolor) in California. J. Wildl. Dis. 30(2):205-215.

Serum samples from 58 mountain lions (Felis concolor) in California (USA) were collected between April 1987 and February 1990. Nineteen serum samples were used for serum biochemistry determinations; the ranges were similar to reference values in domestic cats, captive exotic felidae and free-ranging mountain lions. A serological survey was conducted to determine whether antibodies were present against selected infectious agents. Fifty-four (93%) of 58 sera had antibodies against feline panleukopenia virus. Fifteen (68%) of 22, 16 (28%) of 58, 11 (19%) of 58, and 10 (17%) of 58 had serum antibodies against feline reovirus, feline coronavirus, feline herpes virus, and feline calicivirus, respectively. Twenty-three (40%) of 58 and 21 (58%) of 36 had serum antibodies against Yersinia pestis and Toxoplasma gondii, respectively. Only one of 22 sera had antibodies against the somatic antigen of Dirofilaria immitis. Feline leukemia virus and feline immunodeficiency virus antigens were not detected in any mountain lion's sera. All 58 sera samples were negative for antibodies to feline immunodeficiency virus and Chlamydia psittaci.

Paviolo, A., Y.E. Di Blanco, C.D. De Angelo, and M.S. Di Bitetti. 2009. Protection Affects the Abundance and Activity Patterns of Pumas in the Atlantic Forest. J. Mammal. 90(4):926-934.

Abstract

Knowing the factors that affect the abundance and activity patterns of pumas (*Puma concolor*) in South American forests may help in their conservation. Using camera traps, we conducted 4 surveys in 3 areas with different levels of protection against poaching and logging within the biggest continuous fragment of the Upper Parana Atlantic Forest. We used capture–mark–recapture population models to estimate the density of pumas for each area. The core area of Iguazú National Park, with low poaching pressure and no logging for >60 years, had the highest density of pumas (between 1.55 and 2.89 individuals/100 km^2). Yabotí Biosphere Reserve, an area with the highest poaching and logging pressure, showed the lowest density (between 0.3 and 0.74 individuals/100 km^2). Areas with intermediate levels of poaching and logging pressure had densities between 0.66 and 2.19 individuals/100 km^2. Puma activity peaked during the 1st hours of morning in the most protected area, but became more crepuscular and nocturnal in areas with less protection. The lower abundance of pumas in the more degraded areas may be related to lower prey abundance. Differences in activity patterns of pumas among areas with different poaching pressures may be a direct response to poaching or to changes in the availability and activity patterns of primary prey. Conservation efforts should focus on decreasing poaching and logging pressures within protected areas to benefit pumas and other endangered species in the Atlantic Forest.

Peirce, M.F. and J.L. Cashman. 1997. Movements and Diets of Mountain Lions in Southwestern Arizona. Page 90 in W.D. Padley, ed., Proc. Fifth Mountain Lion Workshop: 27 February- 1 March 1996; San Diego, California.

Much of Arizona supports a healthy, viable mountain lion (*Puma concolor*) population. However, movements and diets of mountain lions in the desert portions of southwestern Arizona have not been described in detail. The Arizona Game

and Fish Department has conducted lion track surveys in the Lower Colorado River Valley Subdivision of the Sonoran Desert habitat (Shaw et al. 1988). Lion tracks were not observed during 22 routes totaling 346 kilometers (215 miles). Mountain lions have been documented (sport, road, and depredation kills) within the Arizona Upland Subdivision of the Sonoran Desert. This subdivision forms a curving border along the northeastern edge of the Sonoran Desert. We studied mountain lion occurrence, movements, and food habits within a 2,575 square kilometer (1,000 mi^2) study area centered 129 kilometers (80 miles) northwest of Phoenix, Arizona. The Sonoran Desert in southwestern Arizona is located within the Basin and Range Geographic Province. This area is characterized by small (often <259 km^2), insular mountain ranges separated by broad valley basins. Five mountain lions were telemetered and monitored between February 1989 and October 1995. Home ranges for 3 of these mountain lions were determined to be 787, 412, and 241 km^2. These home ranges included intermountain movements between 5 isolated mountain ranges within the study area. While monitoring these radio-collared mountain lions we collected scats to determine the diet of lions inhabiting this portion of the Sonoran Desert. We identified greater than or equal to vertebrate items in 159 mountain lion scats. Desert mule deer (*Odocoileus hemionus crooki*) (36%), was the primary food item, followed by collared peccary (*Tayassu tajacu*) (21%), cattle (10%), desert bighorn sheep (*Ovis canadenis mexicana*) (7%), small rodents (6%), lagomorphs (6%), badger (*Taxidea taxus*) (5%), and skunk (*Spilogale* sp. or *Mephitis* sp.) (3%). Our results suggest that mountain lions in the Sonoran Desert may be dependent upon alternative prey which compensates for low ungulate densities. In small populations of bighorn sheep (<100) the level of lion predation we observed may be significant. Though this was not an intensive study we did invest sufficient effort to question the apparent absence of female mountain lions. We seldom encountered sign from lions other than those we had radio-collared. This is not to say that other lions could pass through without detection but that we question the long term presence of other lions. This study was conducted as part of the Arizona Game and Fish Department's policy of allowing Wildlife Managers the opportunity to conduct Special Investigations. These studies are performed in addition to normal duties and responsibilities. The success of this effort was not possible without the assistance of many people both inside the Department and volunteers from the public and University of Arizona.

Pemble, D.W. 1991. Cougars in Residential Areas and Evasive Tactics to Prevent Injury. Pg. 38 In: Mountain Lion-Human Interaction Symposium, C.E. Braun (ed.), Col. Div. Wildl., Denver. 114pp.

SYNOPSIS

Most, if not all attacks by cougars on humans in British Columbia occurred while the victim was either unaware of the animal's presence, or running away from it. This observation leads me to believe that a cougar is most likely to attack when it believes its prey is not aware of its presence, taking advantage of a surprise; or if the prey does not indicate it will fight back, such as someone running away. Only five of several attacks by cougars on humans were fatal in British Columbia. Most attacks and all fatalities were children. Investigations of these attacks and kills revealed that most victims were unaware of the cougar. Even with children, cougars seemed to depend on the element of surprise. This paper presents details of the most recent serious attacks by cougars in British Columbia.

Pence, D.B., R.J. Warren, D. Waid, and M.J. Davin. 1988. Aspects of the Ecology of Mountain Lions (Felis concolor) in Big Bend National Park. Final Report to USDI, National Park Service, Santa Fe, New Mexico. 81pp.

Eleven lions were captured and radiocollared during the 2 years of field research within the 2685 km^2 (1106 mi^2) area of Big Bend National Park. Eight lions were radiocollared in 41 days of tracking between December 22 and February 11, 1984. Emigration and natural and man-induced mortality reduced the eleven to three collared lions alive in the park at the end of the field work. It was possible to obtain a minimum of 10 months of movement data on seven of the lions. One case of captive-related mortality occurred in the eleven captures and three recaptures due to the contents of the dart entering a portion of the lumen of the bone of one of the front legs and causing the death of the marrow. Information from lion captures and track sign resulted in a conservative estimate of 21 adult lions using the inspected areas of the park during 1984, and 15 lions in 1985. However, it was thought that as many as 30 lions of independent age used the park in 1984 as opposed to 20-25 animals in 1985, including transients. It appeared that young animals accounted for less than 25% of the resident lion population (23% in 1984, 17% in 1985). Ground and aerial radio tracking resulted in 1,796 locations for 7 of the 11 collared lions. A total of 815 aerial telemetry locations were recorded for these 7 lions and their movements are detailed. The average home ranges of the five resident females, (without regard to age, reproductive status, or vegetative formations) was 142.9 km^2 (55.6 mi^2). During the study, 548

scats were collected. Deer and javelina comprised the bulk of the diet in both years, with deer having a slightly higher frequency of occurrence. Skunk was the third most important species the first year with lagomorphs replacing skunk as the third most important species the second year of the study. It appeared that mature does were more prone to predation than mature bucks, and that lions are not preferential regarding physiological condition of the prey they kill. Forty-six mountain lion viscera were examined with a total of 11 helminth species (9 nematodes, 2 cestodes) collected and identified. Six of the helminth species recovered represented the first reported records for their occurrence in mountain lions in North America. There were 1 cestode; Taenia multiceps, and 5 nematodes, Vogeloides felineus, Ancylostoma tubaeforme, Physaloptera rara, Cylicospirura subequalis, and Gnathostoma procyonis. The occurrence of G. procyonis was the first record of this nematode in mountain lions. Management recommendations are presented which address lion/lion interactions, response to lion attacks on park visitors, and lion depredation on livestock on private lands surrounding the park.

Pendleton, R.C., R.D. Lloyd, C.W. Mays and B.W. Church. 1964. Trophic Level Effect on the Accumulation of Caesium-137 in Cougars Feeding on Mule Deer. Nature 204:708-709.

Abstract

In aquatic ecosystems, cæsium-137 levels in predators exceed those of herbivores under conditions of equal contamination of the environment. Examples of the step-wise increase in contamination-levels of cæsium-137 in four species of fish representing three trophic levels, and an explanation of the reason for the increase, will be published soon. To our knowledge, no example of trophic level increase has been demonstrated in terrestrial wildlife, although an approximate 2- to 3-fold increase in cæsium-137 in man over his integrated food has been reported by several workers, and similar results were obtained by feeding cæsium-137 to animals.

Perry, G.L. and J.C. Devos Jr. 2005. A Case Study of Mountain Lion-Human Interaction in Southeastern Arizona. Pages 104-113 *in* R.A. Beausoleil and D.A. Martorello, editors. Proceedings of the Eighth Mountain Lion Workshop, Olympia, Washington, USA.

Abstract

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

Peterson, S. 1952. Puma Attacks Child and Man. Idaho Wildlife Review 4(3):15.

An unusual incident in which a cougar picked up a 2 year old girl approximately 35 miles southeast of Wallace, Idaho is recounted by the child's father. The mother and two boys, aged 8 and 9, were in the house and the 2 year old daughter was playing in the yard when they heard the little girl cry out. They all ran out of the house as the cougar was

making off with the child. Hearing the girl's cries, they ran screaming at the cougar down the trail. The cougar then dropped the girl and she was picked up and taken back to the house. The back of the girl's sweater was drawn out of shape showing teeth marks. The child received only a scratch over one eye.

Pettan, K.C.B., D.A. Jessup, L.J. Lowenstine, and N.C. Pedersen. 1992. Feline Leukemia Virus Infection in a Free-Ranging Cougar (Felis concolor). Annu. Proc. AAZV/AAWW Joint Conf., R.E. Junge (ed.), Oakland, Ca., Pgs. 136-138.

There were few reports of feline leukemia virus in exotic felids and none reported in free-ranging cougar (Felis concolor). A young free-ranging male cougar sighted on the campus of California State University in the center of the greater Sacramento urban area led to this report. After immobilization, clinical examination revealed that the animal weighed 102 pounds, appeared thin, had external evidence of diarrhea, but otherwise appeared normal. Over the next 5 days the animal appeared to be anoretic and alternatively agitated and lethargic. The animal was euthanized after laboratory results revealed acute renal disease, anemia, dehydration, and lymphopenia; repeated ELISA tests were FeLV positive and FIV negative. Post mortem examination revealed: focal ulcerative pododermatitis and glossitis (traumatic); generalized lymphoproliferative disease characterized by lymphofollicular hyperplasia in lymph nodes, spleen and lymphoid nodules in bone marrow, thymus and testis; evidence of septicemia (hemolytic E. coli from heart blood culture); mild intestinal parasitism (Taenia hydatigena and Toxocara cati); and severe, subacute to chronic, suppurative, plasmacytic and neutrophilic tubulointerstitial nephritis. Filamentous silver positive microorganisms with morphology compatible with Leptospira spp. were demonstrated by Warthin-Starry staining. Immunoperoxidase staining of bone marrow and lymph node smears for FeLV was positive. FeLV was isolated from peripheral blood mononuclear cells. A recent serosurvey of wild cougars in California revealed no evidence of exposure to FeLV in populations from remote areas or suburban environments (Jessup, unpublished).

Pettan-Brewer, K.C.B., L.J. Lowenstine, R. McMannamon, D. Naydan and M.E. Fowler. 1993. Biliary Cysts and Hepatic Proliferative Lesions in Captive Wild Felids. Annu. Proc. Am. Assoc. Zoo Vet.:214-219.

A retrospective study was conducted to determine the significance, prevalence, etiopathogenesis and external factors associated with intrahepatic cysts of suspected biliary origin in felids and to differentiate these cysts from cystic hyperplasia of biliary epithelium, proliferative hepatocellular lesions, and primary and metastatic hepatic neoplasia in captive wild felids. To date, necropsy information on 740 animals had been received from 14 collections in response to questionnaires. Thirty-three large cats (18 males, 15 females) were diagnosed with hepatic cysts or neoplasms with ages ranging from 4 months to 26 years (average 16 years). The pathogenesis of these cysts remains uncertain with no clear association with contraceptive steroids or other liver diseases. Animals with biliary cysts from this study were asymptomatic.

Phelps, J.S. 1988. Status of Mountain Lions in Arizona. Pgs. 7-9 In: R.H. Smith (ed.), Proc. of the Third Mountain Lion Workshop. Arizona Chapter, The Wildlife Society and Arizona Game and Fish Department, Prescott, Arizona. 88pp.

The mountain lion was unprotected in Arizona prior to 1947 and at least 2,400 lions were killed between 1918 and 1947. A state-paid bounty was established in 1947, but was only funded until 1968, even though the regulation continues to exist. Over 5,400 lions were killed between 1947 and 1969. The mountain lion was classified as a big game species in 1970 with a tag required and a limit of one lion per hunter per year was established. The Arizona mountain lion population was established at between 1500 and 2500 individuals. A mandatory checkout of lions was began in 1981 and for one year the lower jaw was to be submitted for aging but was discontinued for lack of a reliable method for aging wild mountain lions. Since 1970, over 6,400 lions have been killed, mostly by sport hunters. Research studies initiated from l971-76 on Spider and Cross U Ranches near Prescott indicated an estimated population of 10 resident adults on 175 square miles and 18-20 lions total including transients and kittens. The majority of prey (65%) represented mule deer and 30% represented cattle (mostly calves). Territories of 100-150 square miles for males and females covered 20-50 square miles. Both ranches were closed to lion hunting during the 5-year study and when reopened, an average of 10 lions/year were taken off the two ranches in the subsequent five years. In 1977, a three-year study was initiated on the North Kaibab in conjunction with mule deer research. The lion population declined drastically during this study due to lack of replacement by young, natural mortality, hunting, and a

previous decline in mule deer numbers. The deer herd began to increase immediately after the lion population crashed. Rancher returned questionnaires indicated that a significant number of lions killed under depredation permits were not reported to the Department due to fear of unfavorable publicity and increased regulation. Track counts indicated that lion densities are directly related to mule deer densities in most areas. Cattle losses were highest in areas where lion densities were highest and were also the areas where year long cow-calf operations occurred.

Phelps, J. 2003. Status Report on Mountain Lions in Arizona. Pages 8-10 *in* L. A. Harveson, P. M. Harveson, and R.W.Adams, eds. Proceedings of the Sixth Mountain Lion Workshop. Austin. Texas.

Details of Arizona mountain lion harvest trends and techniques employed from 1951 through 1999 is presented. This information includes tags issued, sport, depredation, other and total harvest. In addition, Arizona lion harvest by method is provided for years 1995-2000.

Phillips, J.C. 1912. A New Puma from Lower California. Proc. Biol. Soc. Wash. 25:85-86.

A new species of puma, Felis improcera, from Calmalli, Lower California is described.

Pierce, B.M., V.C. Bleich, C.L.B. Chetkiewicz and J.D. Wehausen. 1998. Timing of Feeding Bouts of Mountain Lions. J. Mammal. 79(1):222-226.

Onset of feeding by mountain lions (Puma concolor) on individual prey was studied with an automatic camera near mule deer (Odocoileus hemionus) that had been killed and cached by mountain lions. We categorized mountain lions as adult males, adult females, females with juveniles, and females with kittens. After sunset, females with kittens returned to kills significantly earlier than males, females, or females with juveniles. Early feeding by females with kittens might reflect avoidance of conspecifics, which are known to kill kittens. Alternatively, mothers with young kittens may remain closer to caches of prey than lone males, females, or mothers with juveniles. Increased energetic needs of lactating mothers also may dictate earlier feeding.

Pierce, B.M., V.C. Bleich, J.D. Wehausen and R. T. Bowyer. 1999. Migratory Patterns of Mountain Lions: Implications for Social Regulation and Conservation. J. Mammal. 80(3):986-992.

We studied movements of mountain lions (*Puma concolor*) in the southern Sierra Nevada of California from 1992-1997. We observed two distinct patterns, which likely represent strategies of mountain lions for coping with variability in abundance of their primary prey, mule deer (*Odocoileus hemionus*). Some mountain lions migrated together, often slowly, following movements of mule deer from winter range toward the summer range of their prey. Those mountain lions remained together on the eastern scarp of the Sierra Nevada and overlapped in distribution throughout the year. Other mountain lions exhibited rapid movements to disjunct summer ranges, on the western side of the Sierra Nevada, shared with mountain lions that did not occur on their winter range. Mountain lions that moved more slowly and overlapped in distribution had large annual home ranges (95% adaptive kernel; mean = 817 km squared), whereas mountain lions with distinct summer (mean = 425 km squared) and winter (mean = 476 km squared) distributions had smaller home ranges. Such disparate patterns of movement may lead to difficulties in sampling population size for mountain lions. Moreover, maintaining corridors that would allow for both patterns of movement may be critical for the conservation of these large felids. Finally, extensive overlap in the distribution of mountain lions, especially the association of one group of individuals on winter range and another on summer range for mountain lions with disjunct distributions, indicates a more flexible social system than previously described.

Pierce, B.M., V.C. Bleich and R.T. Bowyer. 2000. Selection of Mule Deer by Mountain Lions and Coyotes: Effects of Hunting Style, Body Size, and Reproductive Status. J. Mammal. 81(2):462-472.

Predation on mule deer (*Odocoileus hemionus*) by mountain lions (*Puma concolor*) and coyotes (*Canis latrans*) was examined to test effects of hunting style and body size, and for mountain lions reproductive status, on selection of prey. Mountain lions, which hunt by stalking, selected less than or equal to 1-year-old mule deer as prey. Body condition of mule deer did not affect prey selection by coyotes or mountain lions, and both predators preyed upon females and older adult deer more often than expected based on the percentage of these groups in the population.

Female mountain lions selected female deer, but male mountain lions did not. Female mountain lions without offspring, however, did not differ from male mountain lions in prey selection. Coyotes did not select for young deer. Female mountain lions with kittens were selective for young deer in late summer.

Pierce, B.M., R.T. Bowyer and V.C. Bleich. 2004. Habitat Selection by Mule Deer: Forage Benefits or Risk of Predation? J. Wildl. Manage. 68(3):533-541.

Abstract

Risk of predation may affect individuals in prey populations by limiting their use of high-quality habitat. Predation risk, however, cannot be implicated as a factor in habitat selection by prey without data comparing quality of selected and avoided habitats, along with the predation risk associated with those habitats. If forage benefits and predation risk are not positively correlated among habitat types, then predation risk may have little influence on the habitat selected by prey. We evaluated habitat selection by mountain lions (*Puma concolor*) and mule deer (*Odocoileus hemionus*) in the eastern Sierra Nevada, California, USA, from 1994 to 1997, to determine how forage benefit or risk of predation by mountain lions affects habitat selection by mule deer. Mountain lions were the primary predator of mule deer in our study area. Stands of bitterbrush (*Purshia tridentata*) in the Great Basin provided more cover for mule deer than surrounding patches of rabbitbrush (*Chrysothamnus nauseosum*) or desert peach (*Prunus andersonii*). Bitterbrush also was important forage for mule deer during winter. We hypothesized that mountain lions would be more successful at stalking and killing mule deer in habitats with more concealment cover than in habitats with less cover, and therefore mule deer would choose between foraging on bitterbush and avoiding predation by mountain lions. We collected data on habitat characteristics in 3 types of locations: random locations (n = 180), deer foraging locations (n = 179), and locations where mountain lions killed deer (n = 41). Mule deer selected habitat at greater elevations ($P < 0.001$) with more bitterbrush ($P < 0.001$) and less rabbitbrush ($P = 0.033$) when compared with random locations. Logistic regression indicated that mountain lions killed deer in relatively open areas with more desert peach ($P < 0.001$) than at locations in which deer foraged. Therefore, deer were not confronted with a trade-off when selecting habitat on winter range, and they minimized the ratio of predation risk to forage benefit by selecting habitat with more bitterbrush. Changes in diet among seasons, which occur for herds of migratory deer, lead to individuals experiencing changing predation risk to forage benefit ratios throughout the year. Hence, migratory populations of mule deer likely adopt different strategies of habitat selection among seasons.

Pike, J.R., J.H. Shaw and D.M. Leslie Jr. 1997. The Mountain Lion in Oklahoma and Surrounding States. Proc. Oklahoma Acad. Sci. 77:39-42.

Abstract

We investigated the historic distribution of the mountain lion in Oklahoma and surrounding areas on the basis of previous publications. Historically, the mountain lion occurred throughout Oklahoma, but was most abundant in the western and southwestern regions of the state. Mountain lion population trends in Oklahoma and surrounding areas indicate that mountain lions may be attempting to reinhabit Oklahoma.

Pike, J.R., J.H. Shaw, D.M. Leslie Jr. and M.G. Shaw. 1999. A Geographic Analysis of the Status of Mountain Lions in Oklahoma. Wildl. Soc. Bull. 27(1):4-11.

The geographic distribution of sightings and sign of mountain lions (*Puma concolor*) in Oklahoma was investigated. Mail survey questionnaires were sent to natural resource professionals throughout Oklahoma to gather temporal and spatial information on sightings of mountain lions from 1985 to 1995. We used a geographic information system (GIS) to compare locations of sightings and sign in the state with ecoregions, deer harvest, human population densities, locations of licensed owners and breeders of mountain lions, and generalized topography. Sightings and sign of mountain lions occurred significantly more often in the Central Rolling Red Plains than elsewhere in the state. Sightings of mountain lions increased with total deer harvest statewide (R squared = 0.828, P less than 0.001). Numbers of sightings of mountain lions were correlated negatively with density of the human population (R squared = 0.885, P = 0.017). Surveys are a valuable method to assess the status of rare wildlife species when other methods are

not available and when those receiving the survey are qualified.

Pimm, S.L., L. Dollar and O. L. Bass Jr. 2006. The Genetic Rescue of the Florida Panther. Animal Conservation 9(2):115–122.

Abstract

We examine the consequences of panthers introduced from Texas into south Florida, an area housing a small, isolated, inbred and distinct subspecies (*Puma concolor coryi*). Once part of a continuous, widespread population, panthers became isolated in south Florida more than a century ago. Numbers declined and the occurrence of genetic defects increased. Hoping to reverse the genetic damage, managers introduced eight female panthers from Texas into south Florida in the mid-1990s. This action was highly controversial and we explain the arguments for and against the intervention. We synthesized data systematically collected on the Florida panthers from before, during and after this management intervention. These data include information on movements, breeding, mortality, survivorship and range. There is no evidence that purebred Florida females produce fewer kittens at a later age or less often than do hybrid cats (i.e. those with a Texas ancestor). Hybrid kittens have about a three times higher chance of becoming adults as do purebred ones. Hybrid adult females survive better than purebred females; there is no obvious difference between the males. Males die younger than females, are more often killed by other males and are more likely to disperse longer distances into habitats that are dangerous to them. Hybrids are expanding the known range of habitats panthers occupy and use.

Pittman, M.T., B.P. McKinney and G. Guzman. 1995. Ecology of the Mountain Lion on Big Bend Ranch State Park in Trans-Pecos Texas. Proc. Annu. Conf. Southeast Assoc. Fish and Wildl. Agencies 49:552-559.

Reproduction, mortality rates, dispersal, and survival of young lions are among the most basic factors affecting lion populations. The Texas Parks and Wildlife Department (TPWD) initiated a research study to investigate home ranges, population dynamics, genetic variability, and diets. We captured 19 mountain lions (Felis concolor) on Big Bend Ranch State Park (BBRSP) 22 January 1993 through 9 March 1995, using trained hounds or leg-hold snares. All captured lions were examined, aged and sexed, and a series of body measurements were recorded. Two lions- 1 adult female and 1 subadult male- died during capture. A subadult male orphaned as a kitten and sent to a wildlife rehabilitor was returned to the study area, but was later killed off the study area. Fifteen lions- 5 adult females, 1 subadult female, 7 adult males and 2 subadult males- were fitted with radio transmitters. Three of the collared lions- 1 adult female and 2 adult males, were killed north of the study area. Collared lions were monitored from the ground and fixed-wing aircraft. We recorded 506 locations and delineated home ranges for 10 collared lions. Home ranges of males varied from 316-597 km^2, while those for females ranged from 167 to 505 km^2. Fecal analysis indicated collared peccary (Tayassu tajacu), mule deer (Odocoileus hemionus), and lagomorphs (Lepus spp.) were the most important prey species in descending order of frequency of occurrence. Data will continue to be collected for another 2 years.

Pittman, M.T., G.J. Guzman and B. P. McKinney. 2000. Ecology of the Mountain Lion on Big Bend Ranch State Park in the Trans-Pecos Region of Texas. Final Report, Wildl. Div. Res. Study Proj. No. 86, Texas Parks and Wildl.,Austin, TX.

Twenty-one mountain lions (Puma concolor) were captured on Big Bend Ranch State Park (BBRSP), 18 December 1992 - 31 August 1997, using leghold snares or trained hounds. Captured lions were examined, aged, and a series of morphological measurements were recorded. Sixteen lions were fitted with radio transmitters operating on individual frequencies. Collared lions were monitored from the ground and fixed-wing aircraft. A total of 711 locations were recorded for 10 male and 5 female mountain lions. Home ranges were delineated for 6 male and 5 female lions. Average annual ranges (100% minimum convex polygon) for adult male lions (348.6 square kilometers) were larger ($P < 0.05$) than for adult female mountain lions (205.9 square kilometers). Average percent overlap (100% minimum convex polygon) of annual female-female, male-male, and female-male lion ranges were 26.1, 22.9, and 28.9, respectively. Annual shifts were apparent ($P < 0.05$) for female lions and for the cumulative male mountain lion ranges. Analysis of fecal samples (n=135) indicated collared peccary (Tayassu tajacu) and mule deer (Odocoileus hemionus) were preferred prey and were consumed almost equally. Genetic analysis, as compared to South Texas lions, defined two distinct groups of mountain lions with evidence of reduced gene flow between the groups and

indicated the effective number of breeding individuals in the West Texas population may be greater than for South Texas. Mountain lion density (#/100 square kilometers) ranged from 0.26-0.59. Observed and deduced lion litters (n=13) indicated minimum mean litter size was 1.54. A total of 19 mountain lions was killed, 17 during and 2 after the study, on or near BBRSP as a result of predator control practices on private lands (n=15), capture activities (n=3), and shooting (n=1). The mountain lion population on BBRSP was limited by high mortality rates of female and male mountain lions.

Pittman, M.T., G.J. Guzman and B.P. McKinney. 2003. Ecology of the Mountain Lion on Big Bend Ranch State Park in the Trans-Pecos Region of Texas. Page 74 *in* L. A. Harveson, P. M. Harveson, and R.W.Adams, eds. Proceedings of the Sixth Mountain Lion Workshop. Austin. Texas.

Abstract

Twenty-one mountain lions (Puma concolor) were captured on Big Bend Ranch State Park (BBRSP), 18 December 1992 -31 August 1997, using leghold snares or trained hounds. Captured lions were examined, aged, and a series of morphological measurements were recorded. Sixteen lions were fitted with radio transmitters operating on individual frequencies. Collared lions were monitored from the ground and fixed-wing aircraft. A total of 711 locations were recorded for 10 male and 5 female mountain lions. Home ranges were delineated for 6 male and 5 female lions. Average annual ranges (100% minimum convex polygon) for adult male lions (348.6 km^2) were larger ($P < 0.05$) than for adult female mountain lions (205.9 km^2). Average percent overlap (100% minimum convex polygon) of annual female-female, male-male, and female-male lion ranges were 26.1, 22.9, and 28.9, respectively. Annual shifts were apparent ($P < 0.05$) for female lions and for the cumulative male mountain lion ranges. Analysis of fecal samples (n=135) indicated collared peccary (Tayassu tajacu) and mule deer (Odocoileus hemionus) were preferred prey and were consumed almost equally. Genetic analysis, as compared to South Texas lions, defined two distinct groups of mountain lions with evidence of reduced gene flow between the groups and indicated the effective number of breeding individuals in the West Texas population may be greater than for South Texas. Mountain lion density (#/l00 km^2) ranged from 0.26-0.59. Observed and deduced lion litters (n = 13) indicated minimum mean litter size was 1.54. A total of 19 mountain lions was killed, 17 during and 2 after the study, on or near BBRSP as a result of predator control practices on private lands (n = 15), capture activities (n = 3), and shooting (n = 1). The mountain lion population on BBRSP was limited by high mortality rates of female and male mountain lions.

Pocock, R.I. 1940. Description of a New Race of Puma (Puma concolor), with a Note on an Abnormal Tooth in the Genus. Annals and Mag. of Nat. History, Series 11, 6(33):307-313.

A new race of puma, Puma concolor cabrerae is described from the northern Argentine, just north of 30 degrees south latitude. In addition, the presence of a distinct, though small, cusp was detected on the lower carnassial (M_1) in the skull of a specimen of Puma concolor osgoodi. This cusp was presumably the homologue of the ancestral metaconid, even though it occupied an abnormally forward position on a level with the notch between the two main blades instead of behind on the inner side of the posterior cusp.

Poelker, R. 1976. The Status and Management of the Cougar in Washington. The World's Cats 3(I):23-28.

The puma was a bountied animal in Washington until 1961. A bounty of $25 was offered until 1937 when a bounty of $50 was established. The bounty was again raised to $75 in 1949 and remained at that amount until discontinued in 1961 with the puma being reclassified as a predator. No season, bag limits, or hunting license requirements were established until 1966 when the puma was reclassified as a game animal. From this time a license was required to hunt puma and a limit of one puma was set. In 1973, a mandatory reporting procedure was established with each hunter having to report the killing of any puma to the Game Department within 7 days. From 1936 to 1970, the puma harvest varied until 1951 when a steady decline began which lasted until the bounty was removed in 1960. The highest direct harvest was 275 pumas in 1946. A low of 39 was recorded the last year the bounty was in effect. Since 1970, the harvest has been between 200 and 300 pumas per year. Early population estimates ranged from a low of 500 in 1940 to 1000 in 1948. The population was estimated to be 1,100 in 1970 and in 1974 was estimated at approximately 1,500. In 1973, some 2,900 hunters killed 200 pumas in Washington. Fifty-four percent of the harvest was males. Thirty-six percent of the harvest was taken by hunters actually hunting pumas while 32% were taken by

hunters pursuing bobcat, black bear, and coyotes. Twenty-three percent of the harvest was taken by persons who were not hunting. Sixty percent of the harvest was taken with hounds.

Polisar, J. 2003. Jaguars, Pumas, Their Prey Base, and Cattle Ranching: Ecological Perspectives of a Management Issue. Ph.D. Thesis. University of Florida.

Abstract

Jaguar and puma depredation on livestock may be influenced by 1) innate and learned behavior; 2) health and status of individual cats; 3) division of space and resources among jaguar and puma; 4) cattle husbandry practices; 5) abundance and distribution of natural prey. Our study in Los Llanos Altos of Venezuela aimed to establish how all these inter-related elements were related to cattle being lost to cat depredation. Linear foot transects, vehicle transects, point counts, incidental observations, camera trapping, net, hoop trap, funnel trap, haul seine, box trap, and noose captures, and detailed vegetation sampling and mapping were employed to understand the patterns of prey distribution by species and available biomass. Prey distribution was influenced by forest composition, topographical characteristics, and degree of habitat interspersion. Climate, topography, and soils interact to define variation in primary productivity, dictating prey distributions, and large cats use space accordingly. The few preferred prey species were both large and productive. Large reptiles were used less than their high biomass would suggest, presumably a result of access and risk. The biomass of natural prey in the study area was adequate to support the resident large cats without a subsidy of domestic livestock. Selective rather than opportunistic hunting by the cats reinforced that conclusion. However, the distribution of natural prey was far from uniform. Puma were responsible for more attacks on livestock than jaguar, frequently in maternity pastures set in upland areas of relatively low prey availability. The mammalian biomass in the study area rivaled that of the most productive savanna/forest mosaics of the Old World. Up to 97% of that high biomass was represented by grazers introduced from the Old World, the majority being bovid livestock apparently occupying niches left vacant since the megafauna extinctions of the Pleistocene. The closing discussion of management recommendations focuses on Los Llanos Altos of Venezuela, but contains elements applicable to all the savanna/forest mosaics of South America where similar issues may arise.

Polisar, J., I. Maxit, D. Scognamillo, L. Farrell, M.E. Sunquist and J.F. Eisenberg. 2003. Jaguars, Pumas, Their Prey Base, and Cattle Ranching: Ecological Interpretations of a Management Problem. Biological Cons. 109(2):297-310.

Abstract

Jaguar and puma depredation on livestock may be influenced by (1) innate and learned behavior; (2) health and status of individual cats; (3) division of space and resources among jaguar and puma; (4) cattle husbandry practices; and (5) abundance and distribution of natural prey. Our study in Los Llanos of Venezuela aimed to establish how all these elements related to cattle being lost to cat depredation. Prey distribution was influenced by forest composition, topographical characteristics, and degree of habitat interspersion. The biomass of natural prey in the study area was adequate to support the resident large cats without a subsidy of livestock. Selective rather than opportunistic hunting by the cats reinforced that conclusion. Puma were responsible for more attacks on livestock than jaguar, frequently in maternity pastures in upland areas of relatively low prey availability. Management recommendations are discussed that may be relevant to other savanna/forest mosaics of South America.

Poss, M., H.A. Ross, S.L. Painter, D.C. Holley, J.A. Terwee, S. Vandewoude and A. Rodrigo. 2006. Feline Lentivirus Evolution in Cross-Species Infection Reveals Extensive G-to-A Mutation and Selection on Key Residues in the Viral Polymerase. J. Virol. 80(6):2728-2737.

Abstract

Factors that restrict a virus from establishing productive infection in a new host species are important to understand because cross-species transmission events are often associated with emergent viral diseases. To determine the evolutionary pressures on viruses in new host species, we evaluated the molecular evolution of a feline immunodeficiency virus derived from a wild cougar, *Puma concolor*, during infection of domestic cats. Analyses were based on the coding portion of genome sequences recovered at intervals over 37 weeks of infection of six cats

inoculated by either intravenous or oral-nasal routes. All cats inoculated intravenously, but only one inoculated orally-nasally, became persistently viremic. There were notable accumulations of lethal errors and predominance of G-to-A alterations throughout the genome, which were marked in the viral polymerase gene, pol. Viral structural (env and gag) and accessory (vif and orfA) genes evolved neutrally or were under purifying selection. However, sites under positive selection were identified in reverse transcriptase that involved residues in the nucleotide binding pocket or those contacting the RNA-DNA duplex. The findings of extensive G-to-A alterations in this cross-species infection are consistent with the recently described editing of host cytidine deaminase on lentivirus genomes. Additionally, we demonstrate that the primary site of hypermutation is the viral pol gene and the dominant selective force acting on this feline immunodeficiency virus as it replicates in a new host species is on key residues of the virus polymerase.

Poss, M., H. Ross, A. Rodrigo, J. Terwee, S. VandeWoude and R. Biek. 2008. The Molecular Biology and Evolution of Feline Immunodeficiency Viruses of Cougars. Veterinary Immunology and Immunopathology 123(1-2):154-158.

Abstract

Feline immunodeficiency virus (FIV) is a lentivirus that has been identified in many members of the family Felidae but domestic cats are the only FIV host in which infection results in disease. We studied FIVpco infection of cougars (*Puma concolor*) as a model for asymptomatic lentivirus infections to understand the mechanisms of host–virus coexistence. Several natural cougar populations were evaluated to determine if there are any consequences of FIVpco infection on cougar fecundity, survival, or susceptibility to other infections. We have sequenced full-length viral genomes and conducted a detailed analysis of viral molecular evolution on these sequences and on genome fragments of serially sampled animals to determine the evolutionary forces experienced by this virus in cougars. In addition, we have evaluated the molecular genetics of FIVpco in a new host, domestic cats, to determine the evolutionary consequences to a host-adapted virus associated with cross-species infection. Our results indicate that there are no significant differences in survival, fecundity or susceptibility to other infections between FIVpco-infected and uninfected cougars. The molecular evolution of FIVpco is characterized by a slower evolutionary rate and an absence of positive selection, but also by proviral and plasma viral loads comparable to those of epidemic lentiviruses such as HIV-1 or FIVfca. Evolutionary and recombination rates and selection profiles change significantly when FIVpco replicates in a new host.

Powell, J.L. 1971. Problems Posed to the Livestock Industry by Felids. Pgs. 127-131 In: Jorgensen, S.E. and L.D. Mech. 1971. Proc. of a Symposium on the Native Cats of North America., Their Status and Management. U.S. Dept. Int., Fish and Wildlife Service, Twin Cities, Minnesota.

The author, a livestock grower, expresses his thoughts and attitudes toward the mountain lion. Mountain lions are not a serious problem to domestic livestock in the Western rangelands, and livestock predation losses which do occur can usually be handled on an individual basis. However, losses can be and are a serious problem to some individual ranchers and predators in general cause many millions of dollars in lost revenue. The bounty system was not the answer. Professional lion hunters and help from Federal and State Fish and Wildlife Departments can help if quick action is taken to stop the offending animal and care is taken to not kill the wrong animal.

Power, G.D. and T. Hemker. 1985. Mountain Lion Management Plan 1986-1990. Idaho Dept. Fish and Game, Boise. 16pp.

Mountain Lions have been classified as both predators and game animals in Idaho. During the bounty years (1945-1958) an average of 80 mountain lions per year were turned in for payment. Average annual sport harvest was an estimated 142 mountain lions annually from 1959 through 1971 when there were no restrictions or regulations on the harvest. Legislation reclassified the mountain lion as a game animal on July 1, 1972. It became mandatory to check harvested mountain lions in 1973 and tags were required since 1975. The 1973-76 average of 80 mountain lions harvested annually increased to an average of 145 per year. Since 1982-83, an average of 207 lions have been taken annually in Idaho. Economic values for mountain lions have increased dramatically since the bounty years when, in 1953-54, the state paid a high of $8,500 for 144 mountain lions harvested. Presently, many sportsmen are willing to pay $2,500 for outfitter fees, plus additional expenses (license, tag and transportation) for the opportunity to harvest a mountain lion. Nearly $400,000 was spent by 756 hunters to hunt mountain lions in Idaho in 1983. Statewide

management direction, goals, issues and strategies for designated Areas in Idaho are presented.

Pratt, D.W. 1990. Electric Fences for Predator Control. Pg. 75 In: Predator Management in North Coastal Ca.: Proceedings of a Workshop Held in Ukiah and Hopland, Ca., March 10-11, 1990 (G.A. Giusti, R.M. Timm, and R.H. Schmidt, eds.). Univ. of Ca., Hopland Field Station Public. 101.

Three basic types of electric fences are discussed: 1) temporary, portable electric fences; 2) retrofitted fences which consist of electric wires attached to offset insulators mounted on existing fences; and 3) hi-tensile electric fences. The effectiveness of each type for predator control varies depending on the type of predator and predation pressure, terrain, soil moisture, fence design (i.e. post spacing, number of wires, offset spacing, fence height, etc.) and fence maintenance. Temporary, portable electric fences are used primarily to improve grazing management but have limited value for predator control. Retrofitted fences can provide inexpensive, effective protection for sheep against dogs and coyotes. Hi-tensile electric fences can provide protection from predation by dogs, coyotes, mountain lions, and bears.

Preble, E.A. 1945. The American Cougar. Nature 38(3):137.

The cougar persisted in the Adirondacks until about 1890 and was extirpated in New England even earlier. The author felt that without some protection, the cougar would be eliminated in the United States within a few years.

Pritchard, P.C.H. 1976. Florida Panther. Florida Nat. 49:15-22.

The puma is described and records of possible sightings in several states are provided. The panther was first noticed in Florida by Hernando de Soto. As early as 1832 a law was enacted in Florida to permit financial rewards to people who killed panthers. Despite becoming scarce by 1874, a new law authorized a bounty system in 1887 of $5 for each panther scalp turned in. The panther was recognized as an endangered species in 1950, but could still be hunted during deer season or if killing livestock. The panther was given complete legal protection in 1958 in Florida. Roy McBride was recruited by the U.S. Department of the Interior and the World Wildlife Fund to undertake a population estimate in 1974 and found evidence of panther only in the Fakahatchee Strand in Collier County. Other areas of the state where panthers have been sighted are presented. It appeared essential to establish a captive breeding population of Florida panthers.

Pritchard, P.C.H. 1981. Captive Breeding. The Florida Naturalist 54(l):8.

A Florida panther was born on January 15, 1980 at Robert Baudy's Rare Feline Breeding Compound in Sumter County, Florida. The parents had been in captivity for many years at the Everglades Wonder Gardens near Bonita Springs. Baudy obtained the initial stock for his captive breeding program from the Piper Brothers Everglades Wonder Gardens on long-term loan in 1978. He took four of the Pipers' eight animals (2 males, 2 females) and these were elderly and were not prime breeding animals. However, one pair produced the kitten born on January 15, 1980 and later produced three more (two survived). The author presents the most common objections to captive breeding programs and answers these objections.

Puckette, W.L. 1975. An Occurrence of the Puma, Felis concolor, from Svendsen Cave, Marion County, Arkansas. Proc. Arkansas Acad. Sci. 29:52-53.

A partial skeleton including fragmental skull and mandibles of the puma, Felis concolor, was recovered from Svendsen Cave, Marion County, Arkansas. The remains are thought to be of Late Pleistocene (Wisconsin) or Sub-recent age. Fossil records of the puma are rare and only one other Pleistocene or Sub-recent site in Arkansas, Conard Fissure, has yielded remains which could be assigned to this large felid.

Quadros R.M., C. Pilati, S.M.T. Marques, M. Mazzolli and R.C. Benedet. 2009. Capillaria Hepatica in Puma concolor: First Report in Brazil. J. Zoo and Wildlife Medicine 40(3):586-587.

Abstract

Capillaria hepatica was detected by histopathologic diagnosis in two cougars that were shot in April 2008 in Painel, Santa Catarina, Brazil. Macroscopic analysis of their livers revealed the presence of diffuse granulomas, and the histopathologic analysis indicated the presence of C. hepatica eggs, surrounded by mononuclear inflammatory cell infiltrate, small foci of necrosis, and mild-to-moderate fibrosis. This is the first report of C. hepatica in cougars (Puma concolor) in Brazil.

Quigley, H.B., G.M. Koehler, and M.G. Hornocker. 1988. Dynamics of a Mountain Lion Population in Central Idaho Over a 20-Year Period. Pg. 54 In: R.H. Smith (ed.), Proc. of the Third Mountain Lion Workshop. Arizona Chapter, The Wildlife Society and Arizona Game and Fish Department, Prescott, Arizona. 88pp.

From the mid-l960's through the early 1970's research was conducted on the mountain lion population in the Big Creek drainage of the Frank Church/River of No Return Wilderness Area of central Idaho. Over a 4-winter period, from winter 1983-1984 through winter 1986-1987, mountain lions were captured and radio-collared in the same area. Information was sought on the numbers and composition of adult mountain lions in the drainage for comparison to the earlier research. This earlier research found a maximum resident population of 9 individuals, 3 males and 4-6 females. During the 4-winter period ending winter 1986-1987, 29 captures were made on 19 individuals. A total of 13 individuals was defined as resident, 3 males and 10 females. We hypothesize this increase in mountain lions is a numerical response to an approximate one-third increase in the number of elk on the area. A reduction in female home range size appears to have facilitated in the increase. We discuss the apparent higher level of responsiveness of the female segment of the population over that of males in terms of fitness and population stability. The importance of long-term research is emphasized.

Quigley, H.B. 1994. Encounters with a Silent Predator. Natural History 103(12):57.

There are now an estimated 5,000 cougars in California; 2,000 in Idaho; 2,500 in British Columbia; and 700 in Alberta. Cougars are fully protected in California and numbers are increasing in the Rockies. More people are using wilderness areas for recreation and human-animal encounters are on the rise. Two runners will killed by lions in the past five years, one in California and one in Colorado. Are lions changing their shy ways and becoming more aggressive or are these young, inexperienced lions testing new marginal habitats? Field studies can answer some of these questions, but a renewed fear of cougars seems unwarranted. During the past century, there have been fewer than sixty documented attacks by cougars on people.

Rabb, G.B. 1959. Reproductive and Vocal Behavior in Captive Pumas. J. Mammal. 40:616-617.

A puma at the Chicago Zoological Park first came into heat at the age of two years and five months of age. Estrus was marked by persistent yowling or caterwauling much like the domestic cat only amplified and harsher. The cries were frequently given from a crouching position, especially during the middle of her periods. Nonvocal estrus behavior included rubbing the perineal area against the ground, brushing frequently against the sides of the cage, more amiable responses to human attentions such as scratching and reduced feeding. The vulva was noticeably moist at these times, but no vaginal discharge was seen. As measured by the vocalizations, of nine periods to date, the longest was 11 days and the shortest and the mode was 8 days. From February 13 to June 17, 1957, there were six rather regular periods. An average of 14.4 days elapsed from the end of one to the beginning of the next, and an average of 22.8 days from the beginning of one to the start of the next. Sixty-three days passed from the end of estrus activity in June to August 19, when she began a 10-day period. During the last 8 days of this period a male was introduced and cubs were born on November 19. Gestation was not less than 82 nor more than 90 days. Seventeen days later she was in heat for 8 days and mated again. The subsequent gestation of 88 to 92 days resulted in 3 cubs born on March 10, 1958. Copulation was brief and was less than one minute in the instances observed.

Radinsky, L.B. 1969. Outlines of Canid and Felid Brain Evolution. Ann. N.Y. Acad. Sci. 167:277-288.

Brains of modern felids are advanced beyond the stage represented by a Pseudaelurus, (a specimen about 15 million years old) and a genus probably near the ancestry of modern felids. The neocortex is expanded ventrally in the temporal lobe (which extends below the level of the pyriform lobe) and, most strikingly, enlarged in the region of the

anterior and posterior sigmoid gyri, with ansate and cruciate sulci developed in relation to the latter expansion. The anterior sigmoid gyrus is continuous rostrally with a slightly enlarged prorean gyrus, the beginnings of which were seen in Pseudaelurus.

Rau, J.R. and J.E. Jimenez. 2002. Diet of Puma (*Puma concolor*, Carnivora: Felidae) in Coastal and Andean Ranges of Southern Chile. Studies on Neotropical Fauna and Environment 37(3):201-205.

Abstract

Between 1985 and 1999 we collected a total of 62 puma (*Puma concolor*) feces in two reserves located on the coastal range and on three national parks located in the Andean range, all in the Lake Region of southern Chile. The identification of 79 prey items showed that the puma diet in the southern rainforests was made up mainly of European hares (*Lepus europaeus*; an exotic species), ungulates (chiefly the pudu deer; *Pudu puda*), rodents, birds and marsupials, in that order of importance. Except for the lowland site San Martin, the trophic ecology of pumas did not differ substantially among sites. At San Martin, in addition to hares, pumas hunted Black-necked swans (*Cygnus melancoryphus*) and coypu (*Myocastor coypus*). Although pumas preyed upon the largest prey available, the mean prey weight was of only 7.7 kg, much smaller than on other previous studies. European hares due to their high abundance, have replaced pudus as the main prey of pumas in the forests of the Lake Region. In order to maintain viable populations of pumas in the biologically most interesting coastal forests, it will be necessary to protect larger native forests that provide enough food and habitat for pumas.

Rausch, R.L., C. Maser, and E.P. Hoberg. 1983. Gastrointestinal Helminths of the Cougar, (Felis concolor L.) in Northeastern Oregon. J. Wildl. Dis. 19(I):14-19.

Helminths of nine species were identified from 39 cougars obtained in northeastern Oregon (Wallowa, Baker, and Union Counties), viz., Taenia omissa Luhe, 1910 (100%); T. ovis krabbei Moniez, 1879 (61%); T. hydatigena Pallas, 1776 (10%); Mesocestoides lineatus Goeze, 1782 (5%); Toxascaris leonina von Linstow, 1902 (69%); Toxocara cati Schrank, 1788 (15%); Physaloptera praeputialis von Linstow, 1889 (13%); Pterygodermatites affinis Jagerskiold, 1904 (ca. 2%); and Trichinella sp. (larvae) (ca. 2%). In addition, undeveloped cestodes of the genus Taenia in 26 animals had lost rostellar hooks and could not be identified. Host records, prevalence, and biological characteristics of some of the helminths are discussed.

Reed, D., T. Bartnick, M. Cuthill, D. McCarthy, H. Quigley and D. Craighead. 2008. Cougar Home Range Shifts and Apparent Decrease in Cougar Abundance in the Southern Greater Yellowstone Ecosystem. Page 153 in Toweill, D. E., S. Nadeau and D. Smith, editors. Proceedings of the Ninth Mountain Lion Workshop, May 5-8, 2008, Sun Valley, Idaho, USA.

Abstract

The stability of large mammalian populations is considered relatively constant over short periods of time (< 5 yrs) unless strong human influences are active or disease plays a role. Dramatic fluctuations in numbers and distribution are rarely documented except as they relate to human-influenced populations. This also appears to be the case in cougar populations. Beginning in 2001 and continuing through 2005, six adult radiocollared cougars (5 Females, 1 Male) were tracked intensively to document cougar home ranges, movements, and predation within the Buffalo Fork River drainage northeast of Jackson, Wyoming. Cougar locations were obtained through ground-based telemetry, GPS collars, aerial telemetry, and capture locations. We used LOAS 4.0 triangulation software to derive the ground-based telemetry locations; all other methods produced a single UTM location. We documented the death and non-replacement of three adult female resident cougars in the focal area. These deaths presented no evidence of human cause or influence. In addition, two adult female residents shifted their home ranges, one of which partially overlapped her previous area and the other seemingly abandoned her previous area. Both of these females were raising kittens of less than one year old at the time of their home-range shifts. The cause of these population changes are difficult to identify. No disease was documented; however, these changes were correlated with concurrent increases in wolves, decreases in prey abundance, and shifts in prey distribution.

Reed, S., C.M. Papouchis and L.M. Cullens. 2003. Depredation Trend in California. Page 166 *in* S.A. Becker, D.D. Bjornlie, F.G. Lindzey, and D.S. Moody, eds. Proceedings of the Seventh Mountain Lion Workshop. Lander, Wyoming.

Abstract

Since 1972 more than 1,600 California mountain lions have been killed under depredation permits. The number of lions killed annually has increased, with a peak of 149 lions killed in 2000. Although some permits are issued for losses incurred by traditional, economically viable, open range livestock operations, incidents on ranchettes and "hobby farms" are increasing. We evaluate trends in depredation permitting, including analysis of depredation events geographically, by parcel size and size of herd, and relative to human population and development trends. We conclude with new approaches to mountain lion conservation that stress science to establish a factual basis for dialogue, community involvement, and developing partnerships with diverse stakeholders.

Reichling, W.L. 2006. Puma Research in Ohio. Pages 21-23 in H.J. McGinnis, J.W. Tischendorf and S.J. Ropski editors. Proceedings of the Eastern Cougar Conference 2004, Morgantown, West Virginia, USA.

Abstract

Organized, long-term research in Ohio on cougar existence had never been undertaken prior to 1988. The longest publicly-funded investigation into Ohio cougar presence was done in 1956 by Hamilton County Sheriff Dan Tehan and Officer Robert Spraul. It was initiated due to citizen complaints about livestock attacks and numerous sighting reports. The investigation was terminated due to Republican complaints about the Democratic Sheriff's waste of taxpayers' money on a silly cougar hunt. It became a political liability in an election year. A second inquiry into Ohio cougar existence began with a cougar sighting that my son Steve and I experienced in 1988. The initial curiosity sparked by that sighting has evolved into a 16 year, privately funded study and is now known as R&R Animal Trackers' Puma Research Project. Seventeen volunteer trackers from R&R Animal Trackers aid in finding and collecting cougar evidence from 8 transects. Tracks, deer kills, scat, and tree scrapes indicate at least occasional puma presence in Ohio. This cougar sign has been documented by slides taken in the field. Repeated discoveries of this evidence on 3 transects suggest that a sub-population may have been overlooked and may be now extending into past territories.

Reilly, E.M. Jr. 1964. New York's Spooky Big Cat. The Conservationist. Feb./Mar.

The eastern panther roamed New York until about 1890, about the same time that deer became scarce in the region. Since 1871, the state of New York had paid bounties on 99 cougars. The last bounty was paid in 1894, for a puma killed in Hekimer County. A conflicting report states that 107 bounties were paid between 1871 and 1897. The only "recent" evidence of cougar in the northeast was authenticated by a photograph and was shot near Mundeville, Kent County, New Brunswick in March of 1932. Natural history information is provided on the cougar and a few reported sightings are described.

Rember, J. 1990. Cougar-The All-American Predator. Wildlife Conservation. March/April: 60-79.

The author interviewed several people whose lives pivot around the cougar. Differing outlooks are presented by a wildlife filmaker, hunting guide, and staff biologists. Hunting guide, Stan Meholchick, takes only the big toms and the older, non-reproducing females. If a track spans more than 39 inches between paw prints on one side, the guide could be 90 per cent certain that it is a mature male. This guide rotates his hunting areas, usually on a three-year cycle. Maurice Hornocker, research biologist and nationally acclaimed expert on cougars, said that the cougar population had increased in the last 30 years, and may be on the order of 20-40 per cent in the American West. The biggest limitation on cougar populations is habitat loss. Cougars can be successfully reintroduced to the wild and breed well in captivity. After a 50-year absence, cougars are back in Yellowstone Park. There were at least 20 cougars in Yellowstone in the summer of 1989, many migrating from adjacent national forests. Hornocker believes that the cougar population can be maintained at its present level if Idaho institutes a statewide quota system that severely limits the number of females harvested. Jim Dutcher, wildlife filmaker, is making a film about the cougar which had been tentatively titled "Cougar: The Ghost of the Rockies". Hornocker is the film's technical expert and was scheduled to be completed in time for a

Fall 1990 showing on the ABC network.

Rensberger, J. and X. Wang. 2005. Microstructural Reinforcement in the Canine Enamel of the Hyaenid *Crocuta crocuta*, the Felid *Puma concolor* and the Late Miocene Canid *Borophagus secundus*. J. Mammalian Evolution 12(3-4):379-403.

Abstract

In bone-eating carnivores such as the hyena *Crocuta crocuta*, the tooth enamel contains a secondary vertical prism decussation phyletically derived from the wavelike horizontal decussation of primitive carnivores. The structure resists fracture under vertical, oblique, and horizontal tensile stresses, owing to the following modifications of the primitive structure. Positions of wave crests and of wave troughs are synchronized in the vertically successive layers of decussating prisms. Prisms in each successive layer run in a common direction at the crests and in a common but reversed direction at the troughs. Between the crests and troughs, prisms in obliquely slanting layers often retain their primitively reversed prism directions. Near the enamel–dentine junction (EDJ), irregular horizontal decussation is retained. In the upper canine of *C. crocuta*, a consumer of large bones, secondary vertical decussation is largely confined to the labial and anterior sides of the crown toward the tip where modeling of the static stresses predicts the tensile stresses to be highest and aligned vertically. In *Puma concolor*, which does not consume large bones, secondary vertical decussation is absent, indicating stress magnitude to be a critical factor in the selection for secondary vertical decussation. The canine enamel in *Borophagus secundus*, an extinct canid with derived aspects of skull and dental shape like those in hyenas, has dental structures similar to those in *C. crocuta* but which differ in several ways. The wavelike shapes of the decussation planes are better developed in transverse sections in *B. secundus* than in *C. crocuta*, suggesting either the folds are less modified or they dip at a steeper angle. Secondary vertical decussation in *B. secundus* is more extensive around the circumference of the canine than in *C. crocuta*, related to a difference in cross-sectional shape of the tooth. Vertical prism decussation may have been more frequently attained in carnivorous mammals than in ungulates because of the more random orientation of dental stresses which creates a selective advantage for wavy decussation planes—a structural transition to vertical decussation.

Rettig, T. 1981. Hypocalcemic Tetany Induced by Piperazine Citrate in a Mountain Lion. Vet. Med./Small Animal Clinician. 76:1632-1634.

A convulsing 5 year-old intact female mountain lion was presented to the Atlanta Animal Hospital. The lion had been fed only beef livers and kidneys and, occasionally chicken necks for more than a year. The lion weighed 33 kg and had appeared healthy until shortly after deworming with about 1300 mg of piperazine citrate. Treatment and therapy are discussed in detail.

Rickard, L.G. and W.J. Foreyt. 1992. Gastrointestinal Parasites of Cougars (Felis concolor) in Washington and the First Report of Ollulanus tricuspis in a Sylvatic Felid from North America. J. Wildl. Diseases 28(1):130-133.

Gastrointestinal helminths including two species of cestodes (Taenia omissa and T. ovis krabbei) and three species of nematodes (Toxocara cati, Cylicospirura subequalis and Ollulanus tricuspis) are reported from two free-ranging cougars (Felis concolor) in Washington (USA). Ollulanus tricuspis is reported for the first time from cougars and represents the first occurrence of this parasite in a sylvatic felid from North America.

Rieck, J.M. 1988. Status of the Cougar in Washington. Pgs. 33-37 In: R.H. Smith (ed.), Proc. of the Third Mountain Lion Workshop. Arizona Chapter, The Wildlife Society and Arizona Game and Fish Department, Prescott, Arizona. 88pp.

A bounty was placed on the cougar in 1935 until removed and reclassified as a predator in 1961. The cougar achieved game animal status in 1966 and became a trophy class game animal with controlled-permit only hunting seasons in 1987. Cougars are found throughout the state except for dry, open steppe and shrub-steppe areas east of the Cascade Mountains. The population was estimated at 1500 animals statewide. Pursuit only seasons are available for hunters and during these seasons no cougars may be killed. Cougars may only be killed during special permit

seasons by permit holders. All permit holders must complete and return a questionnaire after the season or are ineligible to receive a permit the following season. A valid hunting license is required to hunt or pursue a cougar and a hound stamp is required if dogs are used. The pelt must be presented to a State Wildlife Agent or a Department office for sealing within 10 days of the kill. The bag limit is one cougar and it is illegal to kill or possess spotted kittens or an adult accompanied by spotted kittens. Attacks by cougars on domestic animals is not common in Washington and constitutes a minor management concern. High road density and timber harvest are the major habitat concerns for cougar management. An ongoing study has raised concerns about the level of poaching with 44% of the cougars collared since the early 1970's being killed illegally. Washington State does not license or promote guiding.

Riley, S.J. and K.E. Aune. 1997. Mountain Lion-Human and Mountain Lion-Livestock Incidents in Montana. Page 91 in W.D. Padley, ed., Proc. Fifth Mountain Lion Workshop: 27 February- 1 March 1996; San Diego, California.

We present data on 245 mountain lion incidents reported in Montana between July 1989 and July 1995. Incidents were defined as an interaction between mountain lions and humans or livestock, initiated by the mountain lion, that were perceived serious enough to warrant attention by wildlife agencies. Combined incidents increased from 23/yr to 48/yr throughout the period. There were 123 (50.2%) incidents involving livestock and 122 involving humans. The number of livestock incidents increased regularly from 8 in 1989-90 to 35 in 1994-95. Sheep (67%) were most frequently preyed upon by mountain lions followed in rank by horses, goats, cattle, poultry, llamas and rabbits. Human incidents were highest in 1991-92 (n=27) and declined steadily to 14 in 1994-95. The peak time period for both livestock and human incidents was between June and November. Age and physical condition of mountain lions killed in control actions is characterized as young (1-4 yr; 61% less than or equal to 2 yr) and in good condition. There is no difference in either age structure or condition class of lions involved in livestock vs. human incidents. Male mountain lions were involved in significantly more livestock incidents than females, but sex ratios of lions involved in human incidents were not significantly different from 50:50. Livestock incidents occurred in central Montana where sheep production is greatest and in western valleys where there is a greater proportion of hobby ranchers. Human incidents mostly occurred near western intermountain valley communities. A record of the frequency of calls to agencies by people involved in incidents inflates the reporting of actual incidents. We discuss biological, socioeconomic, and policy factors affecting rates of both livestock and human incidents.

Riley, S.J. and R.A. Malecki. 1997. Developing an Adaptive Management Program for Mountain Lion (*Puma concolor*) in Montana. Page 91 in W.D. Padley, ed., Proc. Fifth Mountain Lion Workshop: 27 February- 1 March 1996; San Diego, California.

We describe research initiated in Montana during 1995 to help reduce the uncertainty associated with decisions concerning mountain lion management in a rapidly changing environment. The American West is experiencing the most massive redistribution of humans since the early land-rush days. Of the 10 US states with the fastest growing human populations, seven are in the West. At the same time, mountain lion populations are reported to be reaching historically high levels in many of these areas. Human-mountain lion interactions are also reported to be increasing and creating difficult choices for people living and working in the region, as well as for agencies responsible for mountain lion management. We use a risk assessment approach that identifies real or objective risks associated with mountain lions and perceived or subjective risks. Both risks have associated benefits and costs to society or management that we are measuring with economic methodology. Socio-economic literature suggests a bimodal distribution of beliefs about such risks, skewed to both over and under estimation of the objective risk. The discrepancy between what the public perceives and those risks that experts believe is scientifically founded creates significant policy dilemmas. Over-estimation of the risk increases management costs. Underestimation may initially lower costs, but creates a potentially volatile whiplash of negative sentiment in the event of low probability-high consequence mountain lion-human interactions. To understand and manage the objective risk, we are comparing distribution and abundance data for mountain lions with variables pertaining to habitat, prey, land-use, humans, policy governing mountain lions, and the historical influence of wolves. For the subjective risk, we are using mail and telephone surveys to gain insights into the knowledge, beliefs, attitudes and underlying assumptions of both the public and wildlife professionals about mountain lions. We are also using an economic method of "expressed preference" to estimate the public's acceptance of risk associated with mountain lions. Results will be formulated into conceptual models as well as an objective feedback management function based upon historical data but designed for systematic

updating.

Riley, S.J. 1998. Integration of Environmental, Biological, and Human Dimensions for Management of Mountain Lions (Puma concolor) in Montana. Ph.D. Dissertation, Cornell University, Ithaca, New York. 158pp.

Abstract

Recent increases in mountain lion (*Puma concolor*) populations throughout western North America challenge wildlife managers who attempt to achieve a balance between the beneficial and detrimental aspects of a large carnivore in human dominated environments. A lack of understanding of the environmental, biological, and human dimensions that affect mountain lions and the interrelationships of these dimensions has been an impediment to effective lion management. I used a combination of ecological and social science methods to determine: (1) factors that influence the distribution and abundance of mountain lions; (2) vital rates that most affect lion population growth; and, (3) factors that determine stakeholder preferences for lion populations. Records of 4,057 mountain lion deaths from 1971-1994 were used to develop a total mortality index (TMI) as an indirect index of mountain lion abundance. A 2-factor model that included quantitative measures of lion habitat and white-tailed deer (Odocoileus virginianus) abundance was the most parsimonious model (r^2 = 0.78) for prediction of TMI on a state-wide basis. Within specific ecoregions, there was a strong linear relationship (r^2 = 0.89) between white-tailed deer abundance and TMI in the Montane Ecoregion west of the continental divide. A similar strong linear relationship (r^2 = 0.74) existed between elk (Cervus elaphus) abundance and TMI in the Intermountain Ecoregion of southwest and central Montana. Sensitivity analyses of a stochastic population simulation model indicated adult survival was the most important vital rate in affecting the intrinsic rate of increase in lion populations. A mail questionnaire was used to determine factors that affect stakeholder preferences for mountain lion populations. A 3-factor model that included measures of respondent's perceptions about the direction of current mountain lion population trends, attitudes towards lions, and beliefs about risks to humans from lions, correctly predicted the desired trend of 73.8% of respondents who wanted a smaller lion population and 90.8% who wanted a larger population or no change. Recommendations to influence the environmental, biological, and human dimensions of mountain lions are presented within integrated management matrices. Implications of the temporal and spatial scales and the interrelationship of the 3 management dimensions are discussed.

Riley, S.J. and D.J. Decker. 2000. Wildlife Stakeholder Acceptance Capacity for Cougars in Montana. Wildl. Soc. Bull. 28(4):931–939.

Abstract

Management of wildlife stakeholder acceptance capacity (WSAC) for cougars (Puma concolor) presents a formidable challenge for wildlife managers concerned with coexistence of this species with humans, although considerations of WSAC may provide supplemental or even alternative approaches to direct manipulation of cougars and their habitat. We used personal interviews (n=34) and a mail-back questionnaire (n=805) from a stratified random sample of households to measure WSAC for cougars in Montana and identify factors that affect WSAC. A 3-variable model that included stakeholder perception of cougar population levels, attitudes toward cougars, and risk beliefs about cougars correctly predicted respondents' WSAC 85% of the time. Compared to persons desiring stable or increased populations, respondents who desired a decrease in cougar numbers were more likely to perceive that populations of cougars were increasing, have negative attitudes toward cougars, have risk beliefs that implied dread toward cougars, and perceive an inequity between people who benefitted from cougars and people who were exposed to potential risks. Demographic variables such as location and tenure of residency, gender, and level of formal education gained by respondents did not significantly affect WSAC. Our study suggests that WSAC for cougars may be modified most effectively through communication and management actions that affect stakeholder attitudes and beliefs about cougars and their population levels and affect perceptions of risks to humans from cougars.

Riley, S.J. and R.A. Malecki. 2001. A Landscape Analysis of Cougar Distribution and Abundance in Montana, USA. Environ. Manage. 28(3):317-323.

Abstract

Recent growth in the distribution and abundance of cougars (*Puma concolor*) throughout western North America has created opportunities, challenges, and problems for wildlife managers and raises questions about what factors affect cougar populations. We present an analysis of factors thought to affect cougar distribution and abundance across the broad geographical scales on which most population management decisions are made. Our objectives were to: (1) identify and evaluate landscape parameters that can be used to predict the capability of habitats to support cougars, and (2) evaluate factors that may account for the recent expansion in cougar numbers. Habitat values based on terrain ruggedness and forested cover explained 73% of the variation in a cougar abundance index. Indices of cougar abundance also were spatially and temporally correlated with ungulate abundance. An increase in the number and total biomass of ungulate prey species is hypothesized to account for recent increases in cougars. Cougar populations in Montana are coping with land development by humans when other components of habitat and prey populations are sufficient. Our analysis provides a better understanding of what may have influenced recent growth in cougar distribution and abundance in Montana and, when combined with insights about stakeholder acceptance capacity, offers a basis for cougar management at broad scales. Long-term conservation of cougars necessitates a better understanding of ecosystem functions that affect prey distribution and abundance, more accurate estimates of cougar populations, and management abilities to integrate these components with human values.

Riley, S.J., G.M. Nesslage and B.A. Maurer. 2004. Dynamics of Early Wolf and Cougar Eradication Efforts in Montana: Implications for Conservation. Biological Conservation 119(4):575-579.

Abstract

Bounty records from Montana (1902–1930) were used to better understand spatial and temporal response of wolves (*Canis lupus*) and cougars (*Puma concolor*) to an eradication program. Number of payments for wolves declined from a high of 4116 in 1903 to 0 by 1928. Numbers of cougar pelts fluctuated, but generally declined from 177 in 1908 to 2 in 1930. An inverse spatial relationship existed between density of payments for wolves and cougars. Payments for wolves were greatest in the Prairie ecoregion, while payments for cougars were greatest in the Montane. The ratio of pup to adult wolves also was greatest in the Prairie ecoregion and least in the montane. If distribution and frequency of bounty payments were a reflection of the distribution and abundance of wolves, populations were highest and most productive in areas where they currently do not occur.

Riley, S.P.D., R.M. Sauvajot and E.C. York. 2003. Mountain Lion Movements and Persistence in a Fragmented, Urban Landscape in Southern California. Page 106 *in* S.A. Becker, D.D. Bjornlie, F.G. Lindzey, and D.S. Moody, eds. Proceedings of the Seventh Mountain Lion Workshop. Lander, Wyoming.

Abstract

As natural habitat is increasingly eliminated and fragmented by human land uses the long-term prospects for conservation of carnivore populations become correspondingly worse. This is especially true for larger carnivores such as mountain lions, which require significant amounts of both space and prey. In rapidly urbanizing southern California, conservation of carnivores in general, and of mountain lions in particular, is particularly challenging. In the Santa Monica Mountains and surrounding areas, we have begun a project using GPS collars to determine mountain lion movement and space use in a fragmented landscape. Our goal is to determine whether lions are successfully traversing freeways and other human-made barriers between large areas of natural habitat. Ultimately, we hope to determine whether enough natural habitat can be preserved, and enough connectivity maintained between core habitat areas, to maintain lion populations in such a landscape. We have collared lions already in the Santa Monica Mountains, and determined that one large male is using the entire mountain range (home range of 394 km^2), from a major freeway to the east to a developed agricultural valley to the west, and from the Pacific Ocean to the south to a major freeway to the north. Given the small number of lions likely persisting in the Santa Monica Mountains, connectivity is as important, if not more important, than we anticipated. We continue to collar other lions in the study region to evaluate whether any exchange occurs across barriers created by freeways and urban development. While both the male and the female in the Mountains have approached the freeway to the north, neither one has crossed it in the 9-12 months that we have been following them. We are also investigating kill sites to determine kill rates, species of kills, and whether lions are preying on any domestic animals. So far in the Santa Monica Mountains our data indicate that lions are killing 3-4 deer/month of all different age/sex classes, and an occasional coyote or raccoon. The collared animals are almost never seen by anyone, including the researchers tracking them, even though they cross

numerous roads and trails and sometimes venture close to residential areas.

Riley, S.P.D., E.C. York, J.A. Sikich and R.M. Sauvajot. 2005. Mountain Lions in an Urban Landscape: Effects on Movement, Gene Flow, and Survival. Page 206 *in* R.A. Beausoleil and D.A. Martorello, editors. Proceedings of the Eighth Mountain Lion Workshop, Olympia, Washington, USA.

Abstract

Urbanization results in the widespread loss and fragmentation of natural habitat and can have substantial effects on wildlife, particularly for wide-ranging species such as carnivores. The largest carnivores, such as mountain lions *(Puma concolor);* represent the most difficult challenge for wildlife conservation in urban areas because they have the greatest spatial needs and may also come into conflict with humans. Since 2002, we have been studying the behavior, ecology, and conservation of mountain lions in Santa Monica Mountains National Recreation Area, a national park next to Los Angeles. Roads and development have affected lion movements as lions have learned to reach isolated fragments of habitat and to use underpasses to cross freeways and secondary roads. No monitored lions have yet crossed the largest freeway, although they have been located near it. The barrier effects of development can also lead to long-term population isolation and gene flow reduction. The 5 lions genotyped from this area, when compared with lions genotyped from throughout the state, fall clearly within a genetic group stretching up the coast to the San Francisco Bay Area. They are not closely related to other lions in southern California that are nearer by distance but are across the Los Angeles Basin. In the fall of 2004, two adult lions died from anticoagulant poisoning after spending their last few weeks in the most urban parts of their range. These lions may have acquired the toxins, commonly used as rodenticides worldwide, from preying on coyotes. In the late summer of 2004, four kittens were born in the Santa Monica Mountains. Using implanted transmitters we hope to monitor their survival and dispersal to further understand lion conservation in a challenging urban landscape.

Riley, S.P.D., C. Bromley, R.H. Poppenga, F.A. Uzal, L. Whited and R.M. Sauvajot. 2007. Anticoagulant Exposure and Notoedric Mange in Bobcats and Mountain Lions in Urban Southern California. J. Wildl. Manage. 71(6):1874-1884.

Abstract

Humans introduce many toxicants into the environment, the long-term and indirect effects of which are generally unknown. We investigated exposure to anticoagulant rodenticides and evaluated the association between notoedric mange, an ectoparasitic disease, and anticoagulant exposure in bobcats (*Lynx rufus*) and mountain lions (*Puma concolor*) in a fragmented urban landscape in southern California, USA. Beginning in 2002, an epizootic of notoedric mange, a disease previously reported only as isolated cases in wild felids, in 2 years reduced the annual survival rate of bobcats from 0.77 (5-yr average) to 0.28. Anticoagulants were present in 35 of 39 (90%) bobcats we tested, multiple compounds were present in 27 of these 35 (77%), and total toxicant load was positively associated with the use of developed areas by radiocollared animals. Mange-associated mortality in bobcats showed a strong association with anticoagulant exposure, as 19 of 19 (100%) bobcats that died with severe mange were also exposed to the toxicants, and for bobcats with anticoagulant residues >0.05 ppm, the association with mange was highly significant (X^2 = 10.36, P = 0.001). We speculate that concomitant elevated levels of rodenticide exposure may have increased the susceptibility of bobcats to advanced mange disease. Bobcats were locally extirpated from some isolated habitat patches and have been slow to recover. In 2004, 2 adult mountain lions died directly from anticoagulant toxicity, and both animals also had infestations of notoedric mange, although not as advanced as in the emaciated bobcats that died with severe disease. Two other mountain lions that died in intraspecific fights also exhibited exposure to 2–4 different anticoagulants. These results show that the effects of secondary poisoning on predators can be widespread, reach even the highest-level carnivores, and have both direct and possibly indirect effects on mortality. Further research is needed to investigate the lethal and sub-lethal effects of anticoagulants and other toxicants on wildlife in terrestrial environments.

Riley, S.P.D., J.A. Sikich, E.C. York and R.M. Sauvajot. 2008. Prospects for Mountain Lion Persistence in a Complex Urban Landscape in Southern California. Page 117 in Toweill, D. E., S. Nadeau and D. Smith, editors. Proceedings of the Ninth Mountain Lion Workshop, May 5-8, 2008, Sun Valley, Idaho, USA.

Abstract

Because of their extreme spatial requirements, large carnivores such as mountain lions represent a significant challenge for conservation, especially in urban areas where habitat loss and fragmentation are particularly severe. Since 2002, we have been studying the behavior and ecology of mountain lions in the urban landscape of Santa Monica Mountains National Recreation Area (SMMNRA) north of Los Angeles, CA. From the beginning of the study, we assumed that none of the remaining blocks of habitat were sufficient for a functioning population of mountain lions, and therefore that successful movement across freeways and other barriers was critical for long-term persistence. Although two individuals successfully crossed one freeway, none of the 9 radiocollared lions have crossed highway 101, the largest barrier that separates the Santa Monica Mountains from likely source populations to the north. The first mountain lion in the study has survived and even thrived for 5+ years, but 9 of the 11 lions documented in the study so far have died: Two from anticoagulant rodenticide poisoning, two from vehicle collisions, and five, including two females, from fights with adult males. We were able to radio-track one litter of 4 kittens from 4 weeks old through their first two years, and although all four survived the death of their mother at one year, only one survived past 25 months. The two male kittens appeared to be attempting to disperse from the territory of an adult male, but they were thwarted by roads and development. Anthropogenic barriers to movement and dispersal may increase the frequency of intraspecific strife. In this area, we also found widespread exposure of mountain lions to anticoagulant rodenticides, as 7 of 8 animals tested were positive for 2-4 different compounds. Despite these threats and the lack of known freeway crossings, mountain lions persist across the landscape, and we continue to document new animals using remote cameras. Through working to maintain and enhance connectivity, preserving remaining habitat, and educating local communities about mountain lion behavior and ecology, we hope to continue to fulfill the National Park Service mandate of preserving all species in the parks, even mountain lions in an urban park like SMMNRA.

Riome, S.D. 1973. Evidence of Cougars Near Nipawin, Saskatchewan. Blue Jay 31:100-102.

Accounts of 13 sightings and reports of cougars in the Nipawin area of Saskatchewan from 1934 to 1973 are provided. Two of these reports were those of tracks seen; ten were actual sightings or cougars; and 1 was an assumption of the presence of cougar due to livestock reaction.

Ripple, W.J. and R.L. Beschta. 2006. Linking a Cougar Decline, Trophic Cascade, and Catastrophic Regime Shift in Zion National Park. Biological Conservation 133(4):397-408.

Abstract

The strength of top-down forces in terrestrial food webs is highly debated as there are few examples illustrating the role of large mammalian carnivores in structuring biotic and abiotic systems. Based on the results of this study we hypothesize that an increase in human visitation within Zion Canyon of Zion National Park ultimately resulted in a catastrophic regime shift through pathways involving trophic cascades and abiotic environmental changes. Increases in human visitors in Zion Canyon apparently reduced cougar (*Puma concolor*) densities, which subsequently led to higher mule deer (*Odocoileus hemionus*) densities, higher browsing intensities and reduced recruitment of riparian cottonwood trees (*Populus fremontii*), increased bank erosion, and reductions in both terrestrial and aquatic species abundance. These results may have broad implications with regard to our understanding of alternative ecosystem states where large carnivores have been removed or are being recovered.

Ripple, W.J. and R.L. Beschta. 2008. Trophic Cascades Involving Cougar, Mule Deer, and Black Oaks in Yosemite

National Park. Biological Conservation 141(5):1249-1256.

Abstract

Using a historical reconstruction, we discovered a potential trophic cascade involving cougar (*Puma concolor*), mule deer (*Odocoileus hemionus*), and California black oak (*Quercus kelloggii*) in the Yosemite Valley of Yosemite National Park in California. Our objective was to determine whether large deer populations in the absence of a top-level carnivore were suppressing tree regeneration. As human visitation increased in the early 1900s and cougar became increasingly scarce, the mule deer population irrupted in the 1920s. In August 2006, we undertook a retrospective study of black oak recruitment (i.e., growth of seedling/sprouts into tall saplings and trees) by inventorying all black oaks in stands accessible to deer and greater than 0.5 ha in size (18 stands, 2921 trees). We similarly inventoried oaks within sites representing refugia from deer browsing (4 stands, 481 trees). While significantly diminished oak recruitment has occurred since the 1920s in stands accessible to deer ($p < 0.01$), continuous recruitment of oaks was found in refugia sites. We also found less oak recruitment in areas of high human activity near the park's visitor center ($p < 0.01$), possibly due to behaviorally-mediated effects of lower cougar and higher deer densities. Overall our results are consistent with trophic cascade theory involving large predators, herbivores, and plants. The long-term lack of oak recruitment is also an indicator of a probable loss of biodiversity.

Robb, D. 1955. Cougar in Missouri. Missouri Conservationist 16(7):14.

The last recorded kill of a cougar in Missouri was in the Mississippi Lowlands in 1927. However, many reported sightings coupled with increased deer numbers indicated that the cougar was present in the state. A member of the Fish and Game Commission's staff spotted a cougar on the Floyd Tower Road north of Shirley in Washington County on May 13, 1955.

Roberson, C.J., N.M. Riblett, B.T. Maletzke and G.M. Koehler. 2005. Comparison of Annual Fixed Kernel Home Range Estimates of Collared Cougars (*Puma concolor*) from VHF Aerial Telemetry and GPS Collar Locations. Page 221 *in* R.A. Beausoleil and D.A. Martorello, editors. Proceedings of the Eighth Mountain Lion Workshop, Olympia, Washington, USA.

Abstract

We compared the annual fixed kernel home range size of collared cougars in Upper Kittitas County from plotting VHF Aerial Telemetry locations and Global Positioning System (GPS) collars programmed to record locations 4 - 6 times/day, 7 days/week. Between 2001-2004 we acquired 362 VHF Aerial Telemetry and over 14,000 GPS locations on 13 cougars. Using ArcView 3.2 (Environmental Systems Research Institute, Inc.) and Animal Movement SA v2.04 beta Extension, we calculated the annual fixed kernel home range size for each cougar from Aerial Telemetry and GPS locations separately. We compared the advantages and disadvantage of conventional Telemetry and GPS collars. From the GPS collar locations we also calculated fixed kernel home ranges to determine seasonal patterns for male and female cougars.

Roberson, J. 1984. Utah-Cougar Status Report. Pgs. 60-79 In: J. Roberson and F. Lindzey (eds.), Proc. of the Second Mountain Lion Workshop. Utah Div. Wildl. Res. and Utah Coop. Wildl. Research Unit. Zion National Park. 271pp.

A bounty was paid for cougars as early as 1886 and continued until 1959. Until 1967, the mountain lion was unprotected with no restrictions on methods, numbers, or season of take. The history of predator control in Utah is provided and guide and harvest regulations are discussed. Depredation control is one of the biggest management problems concerning the cougar in Utah. Trapping of mountain lions was authorized in Utah until 1971. Results of research indicate that although mountain lions breed year-round, 10 of 16 litters were born from October through December and these kittens were vulnerable to mauling by dogs until several months old. These kittens were likely to be orphaned since they only occasionally accompany the adult female, and therefore, hunters would not know that the

female had kittens. Juveniles dispersed at 16 to 19 months of age or late the second winter or spring.

Roberson, J. 1984. Pursuit Seasons. Pgs. 191-203 In: J. Roberson and F. Lindzey (eds.), Proc. of the Second Mountain Lion Workshop. Utah Div. Wildl. Res. and Utah Coop. Wildl. Research Unit. Zion National Park. 271pp.

Pursuit permits were for those who did not wish to harvest an animal but who enjoyed pursuing cougars with dogs. Five of 15 states and provincial wildlife agencies presently allowed mountain lion pursuit. The advantages and disadvantages of pursuit seasons are explored and a panel discussion is provided at the end of the paper.

Robertson, L.K., D.E. Jones and D.H. Jackson. 2003. Dispersal Characteristics of Juvenile Mountain Lions in Southwest Oregon. Pages 74-75 *in* L. A. Harveson, P. M. Harveson, and R.W.Adams, eds. Proceedings of the Sixth Mountain Lion Workshop. Austin. Texas.

Abstract

Limited long-term data are available documenting dispersal movements of juvenile mountain lions (Puma concolor) in the Pacific northwest. During January 1994 - August 2000 we investigated the movements of 29 mountain lions (10 M, 19 F) that were radio-collared as dependent kittens from a 518km^2 study area in the southern Cascade Mountains of Oregon. The average age young lions became independent (separated from their mother) was 16 months of age (range 9-23 months). Male offspring delayed an average of 18 days prior to leaving the natal home range while females averaged an additional 47 days in their mother's home range prior to leaving. After leaving the natal home range, at an average age of 18 months, the mean movement distance from the natal home range center to the farthest documented location was greater for males than females (82 km for males, 36 km for females, $t = 3.67$, $P = 0.002$). Dispersal direction from the home range center was random ($z = 0.609$, $P > 0.5$). Twenty-six dispersing young survived sufficient time to established an independent home range (IHR). Dispersing females required an average of 55 days to establish an IHR compared to 103 days for males. All the males established an IHR that was not adjacent to the natal home range while 78% of the females' IHRs were adjacent to or overlapped the natal home range. No dispersing juvenile male survived >2 years after becoming independent, compared to 75% of the females surviving >2 years past independence. An interstate located 37 km from the study area appeared to restrict juvenile movement to the west and may be a potential barrier to dispersal movement.

Robertson, M., and M. Bell. 1988. Status of the Mountain Lion in New Mexico. Pgs. 24-25 In: R.H. Smith (ed.), Proc. of the Third Mountain Lion Workshop. Arizona Chapter, The Wildlife Society and Arizona Game and Fish Department, Prescott, Arizona. 88pp.

The mountain lion was classified as a predator with no protection prior to 1971 when it achieved protected status. The number of mountain lions in the state was estimated at approximately 2000. Harvest information is collected by means of a pelt tag report. The bag limit was one cougar and the killing of a female followed by kittens is illegal.

Robertson, P. and C.D. Altman Jr. 2003. Texas Mountain Lion Status Report. Page 75 *in* L. A. Harveson, P. M. Harveson, and R.W.Adams, eds. Proceedings of the Sixth Mountain Lion Workshop. Austin. Texas.

Abstract

A statewide survey of mountain lion (Puma concolor) mortalities and sightings has been conducted. Data through 1999 were combined with previous data beginning in 1983 for a 17-year summary of lion mortalities and sightings. Data were recorded by county, date, number and age of the lion, and location for each mortality or sighting. A total of 2,273 lion mortalities was reported in 67 of 254 Texas counties from 1983-1999. The Trans-Pecos Ecological Region ranked first in total mortalities (73%) and had the highest total for each survey year. A total of 87 lion mortalities was reported in 18 counties during 1999. The Trans-Pecos Ecological Region ranked first with 69% of the mortalities. Edwards Plateau Region was second with 16%. Lion mortalities also occurred in South Texas (11%) and in the Gulf Prairies and Marshes (3%). A total of 2,374 lion sightings was reported in 218 Texas counties from 1983-1999. A total of 178 sightings were reported in 1999. The Pineywoods and Post Oak Ecological regions were the highest ranked with 28 and 27 verified sightings respectively. This is the first year two eastern ecological regions recorded the most

verified sightings. Although sightings have decreased to 178 in 1999 from a high of 363 in 1994, five additional counties with sightings were added to the statewide county totals during this report period. Texas has a widely distributed mountain lion population. The number of Texas lion sightings appears stable, but more research is needed to confirm population status in each region. Research on population levels, recruitment, survival, age structure and reproduction rate is being conducted in West, Central and South Texas. This information should be integrated with mortality and sighting data to address the future management needs of this species.

Robertson, W.B. Jr., O.L. Bass Jr., and R. McBride. 1985. Review of Existing Information on the Population of the Florida Panther in the Everglades National Park, Big Cypress National Preserve and Environs with Suggestions for Needed Research. Everglades National Park. 13pp.

Information is reviewed concerning the Florida panther population in and near the Everglades National Park (EVER) and Big Cypress National Preserve (BICY). Florida Game and Fresh Water Fish Commission research since 1981 involved the capture and radio-collaring of nine panthers (5 females, 4 males). Three panthers had active collars at the time of this writing. National Park Service research supported a hands-off survey in 1984-85 of EVER and BICY for signs of Florida panthers. The size of the surviving adult population continued to be about 30 panthers. From 1981-1985, 12 adults were known to have been removed from the population (11 killed, 1 injured) and recruitment of young into the population appeared to have failed to replace these adults (8 young recorded). Although sex ratios are approximately 1:1, the population is strongly skewed toward old animals, reflecting inadequate recruitment. Most adults have an extensive history of exposure to feline distemper (panleukopenia) virus, which may be killing kittens and may be responsible for this low recruitment. White-tailed deer and feral hogs are the principal prey species as determined by scat analysis. There is strong indication that Florida panthers have decreased markedly since the early 1980's in the Fakahatchee Strand, in BICY south of Alligator Alley and in EVER, west of Shark River Slough, an area comprising more than 75 percent of the known range. Possible future research parameters are presented.

Robinette, W.L., J.S. Gashwiler, and O.W. Morris. 1959. Food Habits of the Cougar in Utah and Nevada. J. Wildl. Manage. 23:261-273.

A food habits study of the cougar was conducted in Utah and eastern Nevada from 1946 to 1958. A total of 227 intestinal tracts and scats and 401 stomachs were collected, but only 275 stomachs contained food. Deer (Odocoileus hemionus) was the all important food species. Next in importance were the porcupine and domestic sheep, followed by a number of lesser important species such as beaver, cottontail, hare, marmot, packrat, skunk, horse, domestic cow, dog, goat, bobcat, unidentified bird, ground squirrel, coyote, pocket mouse, elk, and grasses. Deer constituted 77% by weight of the cougar's winter diet and 64% of the summer diet by frequency of occurrence. Of 186 cougar-killed deer examined, a higher proportion of bucks to does were taken during the winter. Two possible explanations were that bucks were less wary during the rutting season of November and December, and that following the rut, many bucks prefer ledgy, broken terrain, which is also the preferred habitat of the cougar. Fifteen recorded distances over which cougars were noted to drag deer averaged 305 feet, with a range of 16 to 1,100 feet. The first feeding is commonly from the liver, heart, and lungs through an opening sheared in the ribs. The porcupine made up 8.8% by weight of the cougar's winter diet and 19% by frequency of occurrence from scat and intestinal samples for both winter and summer. A cougar kills a deer every 4-10 days and averages one deer per week in the cool winter months. It is possible that the kill could be greater in the summer months due to the increased likelihood of tainted or spoiled meat. A number of observations on the hunting habits of cougars are presented.

Robinette, W.L., J.S. Gashwiler, and O.W. Morris. 1961. Notes on Cougar Productivity and Life History. J. Mammal. 42(2):204-217.

Records collected principally from 1946 through 1958 in Utah and Nevada have shown that the cougar may have young any month of the year. However, birth months, as determined by reference of juvenile weights from 145 litters to a growth rate curve, indicated that about 60% of the litters were probably born from June through September with a peak in July. The highest incidence of pregnancy for 199 mature females was in June and July. Forty percent of 299 females had young at the time of capture. Evidence is presented that some females apparently have young as often as 12-15 months, but a 2-year interval appeared the rule. Most young apparently remain with their mothers for at least a year. The average size of 258 postnatal litters was 2.9 (range, 1-5) and of 66 prenatal litters was 3.4 (range, 1-6).

Females 80 pounds and over were considered mature. The average weight of 50 females was 94 pounds (range, 80-132). Males 125 pounds and over were considered mature. The average weight of 34 males was 156 pounds (range, 125-192). The two largest weights of males on record were 204 and 265 pounds with the intestines removed.

Robinson, H.S., R.B. Wielgus and J.C. Gwilliam. 2002. Cougar Predation and Population Growth of Sympatric Mule Deer and White-Tailed Deer. Can J. Zool. 80(3):556-568.

Abstract

Mule deer (*Odocoileus hemionus*) populations throughout the west appear to be declining, whereas white-tailed deer (*Odocoileus virginianus*) populations are increasing. We compared abundance, number of fetuses per female (maternity rate), recruitment, and cause-specific adult (≥1 year old) mortality rate for sympatric mule deer and white-tailed deer in south-central British Columbia to assess population growth for each species. White-tailed deer were three times more abundant (908 ± 152) than mule deer (336 ± 122) (mean ± 1 SE). Fetal rates of white-tailed deer (1.83) were similar to those of mule deer (1.78). There was no statistically significant difference in recruitment of white-tailed deer (56 fawns : 100 does) and mule deer (38 fawns : 100 does). The annual survival rate for adult white-tailed deer (S_{WT} = 0.81) was significantly higher than that for mule deer (S_{MD} = 0.72). The main cause of mortality in both populations was cougar predation. The lower mule deer survival rate could be directly linked to a higher predation rate (0.17) than for white-tailed deer (0.09). The finite growth rate (l) was 0.88 for mule deer and 1.02 for white-tailed deer. The disparate survival and predation rates are consistent with the apparent-competition hypothesis.

Robinson, H., R. Wielgus, H. Cruickshank and C. Lambert. 2003. Cougar Total Predation Response to Differing Prey Densities: A Proposed Experiment to Test the Apparent Competition Hypothesis. Page 128 *in* S.A. Becker, D.D. Bjornlie, F.G. Lindzey, and D.S. Moody, eds. Proceedings of the Seventh Mountain Lion Workshop. Lander, Wyoming.

Abstract

Mule deer populations throughout the west are declining whereas white-tailed deer populations are increasing. We compared abundance, fetal rate, recruitment rate, and cause-specific adult (≥1 yr. old) mortality rates of sympatric mule and white-tailed deer in south-central British Columbia to assess the population growth of each species. White-tailed deer were three times as abundant (908±152) as mule deer (336±122) (± 1SE). Fetal rates of white-tailed deer (1.83) were similar to mule deer (1.78) (t = 0.15, df = 13, P = 0.44) as was recruitment of white-tailed deer (56 fawns: 100 does) and mule deer (38 fawns:100 does) (χ^2 = 0.91, df = 1, P=0.34). Annual adult white-tailed deer survival (S_{WT} = 0.81) was significantly higher (z = 1.32, df = 1, P= 0.09) than mule deer survival (S_{MD} = 0.72). The main source of mortality in both populations was cougar predation. The lower survival rate of mule deer could be directly linked to a higher predation rate (0.17) compared to white-tailed deer (0.09) (z = 1.57, df = 1, P = 0.06). The finite growth rate (λ) of mule deer was 0.88 and 1.02 for white-tailed deer. We suggest that the disparate survival and predation rates are caused by apparent competition between the two deer species, facilitated through a shared predator; cougar. The apparent competition hypothesis predicts that as alternate prey (white-tailed deer) densities increase, so do densities of predators, resulting in increased incidental predation on sympatric native prey (mule deer). Apparent competition can result in population declines and even extirpation of native prey in some cases. Such a phenomenon may account for declines of mule deer throughout the arid and semi-arid West where irrigation agriculture is practiced. We are in year two of a proposed five-year study. We will test the apparent competition hypothesis by conducting a controlled, replicated "press" experiment in 2 treatment and 2 control areas in North-eastern Washington by reducing densities of white-tailed deer and observing any changes in cougar predation on mule deer. Washington
Fish and Wildlife personnel using annual aerial surveys and/or other trend indices will monitor deer densities. Predation rates and population growth rates of deer will be determined using radio telemetry. Changes in cougar functional (kills/unit time), aggregative (cougars/unit area), numerical (offspring/cougar), and total (predation rate) responses on deer will also be monitored using radio telemetry. Results will be used to determine the effect of increased white-tailed densities on cougar predation of mule deer.

Robinson, H.S., R.B. Wielgus, H.S. Cooley and S.W. Cooley. 2008. Implications of Sink Populations in Large Carnivore Management: Cougar Demography and Immigration in a Hunted Population. Ecological Applications 18:1028-1037.

Abstract

Carnivores are widely hunted for both sport and population control, especially where they conflict with human interests. It is widely believed that sport hunting can be effective in reducing carnivore populations and related human/carnivore conflicts whilst maintaining viable populations. However, how carnivore populations respond to harvest can vary greatly depending on their social structure, reproductive strategies, and dispersal patterns. For example, hunted cougar populations have shown a great degree of resiliency. Although hunting cougars on a broad geographic scale (>2000 km^2) has reduced densities, hunting of smaller areas (i.e., Game Management Units <1000 km^2), could conceivably fail because of increased immigration from adjacent source areas. We monitored a heavily hunted population from 2001 to 2006 to test for the effects of heavy hunting at a small scale (<1000 km^2) and to gauge whether population control was achieved ($\lambda \leq 1.0$) or if hunting losses were negated by increased immigration allowing the population to remain stable or increase ($\lambda \geq 1.0$). The observed growth rate of 1.00 was significantly higher than our predicted survival/fecundity growth rates of 0.89 (deterministic) and 0.84 (stochastic), with the difference representing an 11- 16% annual immigration rate. We observed more juveniles in the population than predicted by the stable age distribution, no decline in the total or adult population density, and a significant decrease in the average age of independent males. We found that the male component of the population was increasing ($\lambda_{OM} = 1.09$), masking a decrease in the female component ($\lambda_{OF} = 0.91$). Our data support the compensatory immigration sink hypothesis; cougar removal in small game management areas (<1000 km^2) increased immigration and recruitment of younger animals from adjacent areas, resulting in little or no reduction in cougar densities and a shift in population structure toward younger animals. Hunting in high quality habitats may create an attractive sink, leading to misinterpretation of population trends and masking population declines in the sink and surrounding source areas.

Robinson, H.S., R.B. Wielgus, H.S. Cooley and S.W. Cooley. 2008. Implications of Sink Populations in Large Carnivore Management: Cougar Demography and Immigration in a Hunted Population. Page 202 in Toweill, D. E., S. Nadeau and D. Smith, editors. Proceedings of the Ninth Mountain Lion Workshop, May 5-8, 2008, Sun Valley, Idaho, USA.

Abstract

Carnivores are widely hunted for both sport and population control especially where they conflict with human interests. How carnivore populations respond to harvest can vary greatly depending on their social structure, reproductive strategies, and dispersal patterns. If carnivore management plans (both sport harvest and population control) do not take into account the specific response of individual species to harvest, the plans may be detrimental to the greater population, or ineffective for local population control. Hunted cougar populations have shown a great degree of resiliency, due to high immigration and recruitment, and have sustained annual harvest levels of 15-30 % of resident adults. Although hunting cougars on a broad geographic scale (>2,000 km^2) can reduce cougar densities, hunting of small areas (i.e., Game Management Units <1000 km^2) as currently prescribed by many game management agencies, may lead to the establishment of metapopulation source/sink dynamics. We tested the effects of heavy hunting at a small scale (<1,000 km^2) to gauge whether population control was achieved ($\lambda \leq 1.0$) or if hunting losses were negated by increased immigration allowing the population to remain stable ($\lambda = 1.0$) or increase ($\lambda \geq 1.0$). The real growth rate of 1.00 was significantly higher than modeled growth rates (deterministic 0.89 and stochastic 0.84), with the difference representing an 11-16% annual immigration rate. We observed more juveniles in the population than predicted by the stable age distribution, no decline in the total or adult population density, and a significant decrease in the average age of independent males. Our data support the compensatory immigration sink hypothesis: cougar removal in small game management areas (<1,000 km^2) will increase immigration and recruitment of younger animals from adjacent areas, resulting in little or no reduction in cougar densities and a shift in population structure toward younger animals. Metapopulation source/sink dynamics between areas with disparate harvest levels can complicate management objectives by maintaining populations in heavily hunted sink areas through immigration, while possibly masking declines in source populations. We suggest that broad-scale population reductions of predators or local prey reductions may be necessary for local population control of cougars and other carnivores.

Robinson, R. 1976. Cytogenetics of the Felidae. The World's Cats 3:15-28.

The published material on the chromosome morphology of felid species is reviewed. In relationship to the puma, the karyological data is reported as: haploid number-19; metacentric and submetacentric chromosomes-18; acrocentric

and submetacentric chromosomes-0; number of chromosome arms-37. Five distinctive karyotypes are recognizable in the Felidae.

Robinson, R. 1976. Homologous Genetic Variation in the Felidae. Genetica 46:1-31.

The puma has a haploid chromosome number of 19, with 18 meta- and submetacentric chromosomes and one acro- and subacrocentric chromosome, with a total of 37 chromosome arms. Three mutant genes are listed as probable and are defined in the text.

Roboski, J.C. 1985. Panther Population Monitoring. Perf. Rep., Study No. E-1-09 II-E-4. Florida Game and Fresh Water Fish Commission, Tallahassee. 5pp.

Known panther (Felis concolor coryi) populations in Collier, Hendry, Glades and Palm Beach Counties were monitored. Techniques involving the simultaneous survey of all parts of an area by a team consisting of at least one person to evaluate sign found and others who can consistently recognize panther sign when it is present were evaluated. Habitat used by panthers was monitored and input provided on proposed land use changes and on proposed land acquisition.

Rochat, M.C., and E. Settles. 1993. Persistent Right Aortic Arch in a Cougar (Felis concolor). J. Zoo and Wildl. Medicine 24(4):534-538.

An 8-month-old intact female Western cougar (Felis concolor) was examined for vomiting, periodic regurgitation, and failure to thrive. Physical examination revealed a thin but otherwise normal animal. Survey radiographs revealed a large, saccular dilatation of the esophagus in the cranial thorax. Nonselective angiography identified a vascular ring anomaly constricting the esophagus at the heart base compatible with persistent right aortic arch (PRAA). The ligamentum arteriosum was ligated and divided through a left fourth intercostal thorocotomy. Recovery was uneventful. Two months after surgery the cougar had gained 9kg and had experienced no further episodes of regurgitation. Persistent right aortic arch is the most common vascular ring anomaly reported in domestic cats; however, PRAA has not been reported in nondomestic felids. The presentation of the disorder in this cougar and its management were identical to that reported for domestic dogs and cats.

Roelke, M.E., E.R. Jacobson, G.V. Kollias, and D.J. Forrester. 1985. Medical Management and Biomedical Findings on the Florida Panther, Felis concolor coryi, July 1, 1983 to June 30, 1985. Perf. Rep., Study No. E-I-09. Florida Game and Fresh Water Fish Commission. 113pp.

During January to March of 1984 and 1985, four Florida panthers (Felis concolor coryi) were immobilized in the Fakahatchee Strand for the purposes of radiocollaring and collection of biomedical information. During immobilization, each panther's physical and reproductive condition were evaluated and samples of blood, feces, urine, ectoparasites, and skin biopsies were collected and subsequently processed. The most relevant findings were: 1) moderate to poor physical condition and anemia in females; 2) depressed serum iron levels; 3) gastrointestinal infection with nematodes, cestodes, and trematodes; 4) acariasis; 5) microfilaremia; 6) hyperproteinemia, and the prevalence of antibody titers to parvovirus and calicivirus. Forensic studies were conducted on six dead panthers. Three were hit by cars, two were illegally killed by gun shot, and one was presumed killed by another panther. Aging studies of panthers based on radiographs of cadavers and skeletal elements also were initiated. Accumulative panther mortality was examined for causes, frequency and seasonality. Seroepidemiologic studies of small carnivores were initiated. One-hundred road-killed and hunter taken specimens of bobcats, raccoons, otters, everglades mink, feral cats and grey foxes were collected and frozen for future analysis. Serum from wildlife serum banks and a limited number of carcasses indicated that bobcats, raccoons, and otters are potential reservoir hosts for parvovirus. Biomedical studies were conducted on a captive Florida panther which survived fractures incurred from a traffic accident. Successful orthopedic surgery and follow up medical support was provided by staff members of the Veterinary Medical Teaching Hospital, University of Florida. The areas of additional study included: a) hematologic and clinical chemistry determinations; b) evaluation of immune response to killed feline viral vaccine; c) evaluation of the chemotherapeutic treatment for parasites; d) development of techniques for ejaculation and cryopreservation of panther semen; and e) collection of samples for

future genetic evaluation.

Roelke, M.E. 1986. Florida Panther Health and Reproduction (July 1, 1985- June 30, 1986). Annual Performance Report. Study No. E-I-10, Florida Game and Fresh Water Fish Commission. 65pp.

Between January and May, 1986, seven individual Florida panthers were successfully immobilized or treed ten different times for the purposes of radiocollaring and collection of biomedical information. Several significant reproductive events were documented this year. A 5-7 month old panther kitten, born to #09 female was captured. A newly captured female (#11) conceived a pregnancy only three weeks after radio-collaring. She was impregnated by a male who had also been immobilized only one week prior and is now rearing the second documented litter in the Bear Island area. The older Fakahatchee female (#08) was in poor physical condition, anemic, and has failed to produce any documented surviving offspring in the past three years despite periodic association with males, indicating cyclical reproductive activity. Semen from four male panthers examined all exhibit a very high percentage of abnormal spermatozoa, 94%. The significance of these male seminal traits with respect to reproductive success or genetic "health" is yet to be examined. The physical condition, body weight, and blood and serum indicies (hematology and serum iron) all indicate that the three newly captured panthers utilizing Bear Island and the private lands north and west are in better health than the previously studied Southern Fakahatchee Strand (SFS) panthers. This appears to be highly associated with the type of prey taken in the respective areas as indicated by scat analysis. The panthers living primarily north of Alligator Alley in the Fakahatchee Strand, Bear Island Unit of BCNP, and private ranches to the North are deriving 83% of their diet from large prey species. Conversely, those panthers living in the SFS derive only 18% of their diet from these species and are instead feeding primarily on raccoon (45%), armadillo (16%), and panther (11%). Sero-epidemiologic studies of Florida panthers have revealed that 89% of 18 animals were positive for feline panleukopenia virus antibodies (FPL) and 50% were positive for feline calicivirus antibodies (FCV). In 58 south Florida bobcats, 48% were positive for FPL and 27% were positive for FCV. Additionally raccoons (43%), otters (13%), and grey fox (8%) indicate that they may all be involved with the circulation of parvovirus in the wild carnivore populations.

Roelke, M. 1986. Medical Management, Biomedical Findings and Research Techniques for the Florida Panther. Pgs. 7-14 In: Survival of the Florida Panther; A Discussion of Issues and Accomplishments. W.V. Branan (ed.), Florida Defenders of the Environment. 67pp.

Biomedical investigations have revealed an array of extremely serious problems facing the Florida panther Felis concolor coryi. Diseases such as feline panleukopenia and calcivirus, as well as hookworm have been documented. An inadequate prey base, resulting in malnutrition in some panthers, may be acting in combination with diseases and parasites to the detriment of the panther population. The effects of inbreeding may be having a negative impact; this is most evident in potential reproductive problems in males. In addition, known highway mortalities, at least partly as a result of continuously increasing traffic, seem to be claiming a disproportionate number of young animals.

Roelke, M.E., E.R. Jacobson, G.V. Kollias, and D.J. Forrester. 1986. Florida Panther Health and Reproduction, July 1, 1985 to June 30, 1986. Perf. Rep., Study No. E-I-10. Florida Game and Fresh Water Fish Commission. 65pp.

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Roelke, M.E. 1987. Florida Panther Biomedical Investigation. Perf. Rep., Study No. E-I-11 7506. Florida Game and Fresh Water Fish Commission. 39pp.

Between November 1986 and June 1987, twelve individual Florida panthers (Felis concolor coryi) were successfully immobilized twenty different times for the purposes of radio-collaring and collection of biomedical information. One hundred fifty-two field days resulted in radio-collaring 6 new panthers in the Everglades National Park (ENP) and 3 new adults on private ranches (PR) north of the Bear Island Unit, Big Cypress National Preserve (BI/BCNP). The physical condition, body weight, and blood and serum indices all indicate that the panthers utilizing the PR's were in excellent health and considerably heavier than those previously studied in the Fakahatchee Strand State Preserve (FSSP): PR male weight x=141.5, s.d. = 0.7; FSSP males weight x=115, s.d. = 6.0. This north/south "health cline" continues to be highly associated with the type and abundance of prey taken in the respective areas as indicated by scat analysis. The ENP panthers were in moderate physical condition with hematology values in the low normal range for cougars. Four wild panthers were taken into captivity and successfully rehabilitated: #08F FSSP was anemic and in poor physical condition (66 lbs.); #09 female had a gun shot wound with osteomyelitis in her hind foot; #20 male was hit by a car; and #23 was orphaned and anorectic for 10 days. Morphological examination of semen from two new male panthers were strikingly similar to the four previously tested, all males exhibit a very high percentage of abnormal spermatozoa, x=92.9%, s.d. = 2.2. The significance of these male seminal traits with respect to reproductive success and genetic "health" is yet to be determined. Florida panthers are exposed to feline panleukopenia virus (FPL) (22 of 28 = 85%) and feline calicivirus (14 of 28 = 50%). However, the prevalence and intensity of exposure to FPL is considerably less on the PR's and almost nonexistent in the ENP compared to the FSSP/BI. A cougar population genetics study was initiated utilizing isozyme electrophoretic techniques. Preliminary data indicate that the species has abundant genetic diversity (minimum of 9 polymorphic loci) but F. c. coryi has less diversity than other wild subspecies examined. However, further research needs to be conducted before a definitive conclusion can be made.

Roelke, M.E. 1988. Florida Panther Biomedical Investigation. Perf. Rep., Study No. E-I-12 7506. Florida Game and Fresh Water Fish Commission. 47pp.

Fourteen individual Florida panthers (Felis concolor coryi) were successfully immobilized for the purposes of radio-collaring and collection of biomedical information and/or for removal from the wild for rehabilitation. One hundred and five field days resulted in radio-collaring four new panthers. The physical condition, body weight, reproductive status, and blood and serum values all indicate that the panthers utilizing the private lands adjacent to the Bear Island Unit, Big Cypress National Preserve were in excellent health and in better condition than those previously studied in the Fakahatchee Strand State Preserve (FSSP). This north/south "health cline" continues to be associated with the type and abundance of prey taken. Seven panthers have died since December 1987 and human activity is responsible for the majority of all documented panther deaths (road killed 52%, illegally killed 15%). Seventy-five percent of all Florida panthers were exposed to feline panleukopenia virus, however, the prevalence was significantly higher in the FSSP/Big Cypress Swamp ecosystem than in the Everglades National Park ($p<0.05$). Panthers were also exposed to feline calicivirus (56%) but there was no significant difference in prevalence by location ($p>0.05$). In addition to the above two viruses, bobcats have antibodies to feline rhinotracheitis virus, which has not been reported in wild Florida felids before. In vitro fertilization experiments produced 141 oocytes (eggs) from seven female cougars. Following insemination, ten cleaved embryos resulted, including one sired by a captive Florida panther, which were transferred to two recipient females. Preliminary data from the panther/cougar population genetics study reveal that the species has abundant genetic diversity (minimum of 11 polymorphic loci), but F. c. coryi has fewer polymorphic loci than other wild subspecies examined. The results of the genetic study coupled with an increase in abnormal male reproductive traits (>90% abnormal spermatozoa and 33% cryptorchidism) raise serious concern for the reproductive potential and genetic health of this subspecies.

Roelke, M.E., S.J. O'Brien, L. Johnson, D. Wildt, J. Howard, and A.M. Miller. 1988. Demographic, Genetic and Reproductive Peril of the Endangered Florida Panther (Felis concolor coryi). Pg. 55 In: R.H. Smith (ed.), Proc. of the Third Mountain Lion Workshop. Arizona Chapter, The Wildlife Society and Arizona Game and Fish Department, Prescott, Arizona. 88pp.

The endangered Florida panther (Felis concolor coryi), declared the state mammal of Florida in 1982, is estimated to number less than fifty individuals and currently is protected under both state and federal endangered species statutes. This remnant population of the subspecies that once occupied the entire southeastern United States is now isolated in the remote cypress swamps and hardwood hammocks of southern Florida, primarily in the Big Cypress Swamp and Everglades ecosystems. Human population growth in southern Florida with the concomitant loss of suitable panther habitat is the major threat to the continued survival of this rare mammal. Further, direct human contact is responsible for the majority of documented panther deaths. Road kill and illegal kill account for 67% of 35 known panther deaths since 1973. The existing population of panthers is extremely vulnerable to demographic catastrophes such as diseases or natural disasters that could drive the subspecies to extinction. Further, with the current small population size, loss of genetic diversity is inevitable. Before informed management decisions can be made with regard to the maintenance of existing heterozygosity or perhaps enhancement through the introduction of new genetic material from another cougar population, we need to determine existing levels of diversity in the Florida panther compared to several other out-bred, healthy populations of free-ranging cougars. A population genetics study of Felis concolor was initiated in January of 1984 and thus far 115 individuals, representing eight different subspecies, plus zoo stock of unknown origin, have been analyzed using starch and acrylimide protein gel electrophoesis. Preliminary data reveal that the species has abundant genetic diversity, 22% polymorphism (40 loci examined thus far), but F.c. coryi has fewer polymorphic loci (7.5%) and the lowest heterozygosity of all other wild subspecies examined. The results of the genetic study coupled with an increase in abnormal male reproductive traits (90% abnormal spermatozoa and 33% cryptorchidism) raise serious concern for the reproductive potential and genetic health of this subspecies. In vitro fertilization experiments were initiated in the spring 1988 and produced 141 oocytes (eggs) from seven female cougars. Following insemination, ten cleaved embryos resulted, including one sired by a captive Florida panther, which were transferred to two recipient females. No live young were produced. However, this technique shows distinct promise as a tool to augment the captive breeding efforts with this subspecies by utilizing non-endangered surrogate females to carry Florida panther young.

Roelke, M.E. 1989. Florida Panther Biomedical Investigation. Perf. Rep., Study No. E-I-13 II-E-6. Florida Game and Fresh Water Fish Commission. 36pp.

Eighteen individual Florida panthers (Felis concolor coryi) were captured 26 times and 15 were immobilized for the purposes of radio-collaring and collection of biomedical information and/or for removal from the wild for rehabilitation. One hundred and twenty-eight field days resulted in radio-collaring 6 new panthers. Two panthers were hit by cars and survived, one of which was rehabilitated and released to the wild and the other is still receiving treatment in captivity. One additional panther was successfully released back into the Everglades National Park after 11 months in captivity. Five panthers have died since July, 1988; human activity is responsible for the majority of all documented panther deaths (road killed 54%, illegally killed 14%). Florida panthers were exposed to feline panleukopenia virus (FPV) (65%) and feline calicivirus (FCV) (43%); the prevalence of FPV was significantly higher in the Fakahatchee Strand/Big Cypress Swamp ecosystem than in the Everglades National Park ($p<0.05$). However, there was no significant difference in prevalence of FCV by location ($p>-0.05$). Antibodies to 2 new potentially pathogenic viral agents were identified this year-- feline immunodeficiency virus and corona virus. The significance of these viruses in free-ranging panthers is yet to be determined. Preliminary data from the panther/cougar population genetics study reveal that F. concolor has abundant genetic diversity (minimum of 11 polymorphic loci), but F. c. coryi has fewer polymorphic loci than other wild subspecies examined. The results of the genetic study coupled with an increase in abnormal male reproductive traits (>90% abnormal spermatozoa and 47% cryptorchidism) raise serious concern for the reproductive potential and genetic health of this subspecies.

Roelke, M.E. 1990. Florida Panther Biomedical Investigation (July 1, 1986- June 30, 1990). Final Performance Report. Study No. 7506, Federal No. E-1 II-E-6. Florida Game and Fresh Water Fish Commission. 175pp.

Veterinary medical management has improved the safety of Florida panther (Felis concolor coryi) immobilizations.

Since veterinary involvement began in January of 1983, 89 immobilizations involving 40 individuals have been accomplished with one possible capture mortality. The veterinary medical team has been involved in all Florida panther captures by the 2 agencies conducting panther research, the Florida Game and Fresh Water Fish Commission (GFC) and the National Park Service. The physical condition, body weight, reproductive status, and hematologic and serum values all indicate that the panthers utilizing land north of State Road 84, particularly the private ranches east of Immokalee, the Florida Panther National Wildlife Refuge, Bear Island Unit of the Big Cypress National Preserve (BCNP), and adjacent ranches were in excellent health and in better condition than those in the Everglades National Park (ENP) or Fakahatchee Strand State Preserve (FSSP). The north/south "health cline" in southwestern Florida appears to be associated with the type and abundance of prey taken. Nine panthers have been rescued and removed from the wild due to injuries or illness; 4 were successfully rehabilitated and released back to the wild, 3 did not survive because of the severity of their injuries or illness, and 2 are still receiving treatment in captivity or are permanent residents. Twenty panther deaths have been documented since 1 July 1986, and human activity continues to be responsible for the majority of all documented panther deaths (road killed, 46.5%; illegally killed, 16.3%). Other important causes of mortality are intraspecific aggression (11.6%) and disease (9.2%). Serologic evidence from 51 different Florida panthers indicates that they were exposed to or are infected with several potentially pathogenic agents: feline panleukopenia virus (FPV) (65%), feline calicivirus (FCV) (43%), feline enteric corona virus/feline infectious peritonitis virus (23%), feline immunodeficiency virus (25.6%), rabies virus (26%), feline syncytia-forming virus (FeSFV) (33.3%), Toxoplasma gondii (8.0%) and Brucella sp. (2.4%). All were negative for pseudorabies virus (PRV), feline leukemia virus, and feline viral rhinotracheitis virus (FVRV). The prevalence of FPV was significantly higher in the FS/Big Cypress Swamp (BCS) ecosystem than in the ENP ($p < 0.05$). However, there was no significant difference in prevalence of FCV by location ($p > 0.05$). The significance of many of these agents in free-ranging panthers is yet to be determined, but an unvaccinated panther died of a raccoon rabies virus. We believe that this is the first documented case of rabies in a wild cougar. A serosurvey of bobcats (n=113) indicated that they have been exposed to FPV (44.2%), FCU (33%), FVRV (9.3%), and Toxoplasma gondii (7.1%). One hundred fifty-five other carnivores were tested for FPV antibodies, positive animals included otter (13.2%), raccoon (43.0%), and grey fox (8.3%). One hundred sixty-six non-panther carnivore sera were screened for PRV, and only raccoon (3 of 57) and black bear (2 of 20) were positive. Cytauxzoon felis was documented in both free-ranging Florida panthers and bobcats. Mercury was identified as a significant contaminant in free-ranging panthers, particularly those living on the ENP and the FSSP. Mercury was strongly implicated in the death of one female panther in the ENP with a liver mercury level of 110 ppm (wet weight). In vitro fertilization experiments produced 141 oocytes (eggs) from seven female cougars. Following insemination, ten cleaved embryos resulted, including one sired by a captive Florida panther. Transfer of the embryos to two recipient females did not result in any live births. Results from a population genetics study of Felis concolor reveal that the species has abundant genetic diversity (minimum of 11 of 41 loci are polymorphic (P), allozyme analysis, but F. c. coryi has fewer polymorphic loci (7.5%) and lower heterozygosity (0.019) than other wild subspecies examined. The results of the genetic study coupled with an increase in abnormal male reproductive traits (>90% abnormal spermatozoa and 44.4% cryptorchidism) raise serious concern for the reproductive potential and genetic health of the subspecies. Mitochondrial DNA (mtDNA) analysis of 8 North American (NA) and 3 South American (SA) subspecies of puma indicates that two groups, or clades, can be discriminated; a NA clade and a SA clade. Further, the mtDNA study has revealed a partitioning of the Florida panther into two populations with differing maternal evolutionary histories; the BCS population is largely descended from NA, historic F. c coryi animals and the mtDNA of the ENP population is derived from Central American (CA) or SA cougars. It is possible that this introduction of foreign genetic material is the result of non-coryi cougar releases which occurred in the ENP between 1957-1967. The Florida panther may have benefitted from this introgression of SA or CA genes in that the incidence of cryptorchidism is zero in males with ENP mtDNA as compared to 63% of the males with BCS mtDNA.

Roelke, M.E., D.P. Schultz, C.F. Facemire and S.F. Sundlof. 1991. Mercury Contamination in the Free-Ranging Endangered Florida Panther (Felis concolor coryi). Proc. AAZV 1991. pp. 273-283.

Due to mercury (Hg) contamination, the entire Everglades watershed in southern Florida has been closed to the hunting of alligators (Alligator mississippiensis), and health advisories have been issued to curtail consumption of largemouth bass (Micropterus salmoides). Other species of fish in Florida, and more recently, shark flesh, have also been determined to be contaminated at levels above those recommended by consumption by the Florida Department of Health and Rehabilitative Services (0.5-1.5 ppm wet wt., consumption no more than once per week by healthy nonpregnant adults; >1.5 ppm, no human consumption). As a result of the death of an apparently healthy, radio-collared female Florida panther (Felis concolor coryi) in Everglades National Park (ENP) in summer 1989, we began to

investigate contaminant impacts on this endangered species. Examination of the dead female revealed relatively high Hg concentration (110 wet wt.) in the liver. This was comparable with levels (37-145 ppm) found to be lethal to feral cats in Minimata, Japan. Analysis of hair and blood from the dead panther revealed Hg concentrations of 130 and 21 ppm, respectively, in these tissues. The panther, a top mammalian carnivore in southern Florida, primarily preys on white-tailed deer (Odocoileus virginianus) and feral hogs (Sus scrofa). However, in some areas they also consume various small mammals, including raccoons (Procyon lotor), armadillos (Dasypus novemcinctus), and rabbits (Sylvilagus sp.) as a significant part of their diet. Therefore, we believed it was necessary not only to study Hg contamination of panthers, but of alternate prey species (raccoons) as well. Tissue samples from 52 free-ranging panthers, primarily those living in the Big Cypress Swamp and Everglades ecosystems, were collected opportunistically between 1978 and 1991. Whole blood and hair were routinely collected from living animals (n=43); liver, hair and blood were collected from dead animals at necropsy (n=21; 12 of those also sampled when alive). Six raccoons were also collected from each of 7 different sites within representative panther habitat. Muscle (caudal thigh) tissue from each of these animals was analyzed for Hg content. The majority of reports for Hg in wildlife usually present organ data only, rarely including antemortem samples such as hair and whole blood. The total Hg values for liver samples for dead panthers are presented by location. When these data are examined by location and age, striking differences are noted. The mean liver Hg level for the younger group of panthers (less than 8 years old) living in southeastern Florida was significantly higher ($p=0.024$; geometric mean (GM)(east)=25.8 ppm, GM (west)=0.304 ppm, 5df) than panther samples in southwestern Florida. If only the western group is considered, older animals had significantly higher liver Hg levels than did younger ones ($p=0.029$; GM(old)=14.6 ppm, GM(young)=0.304 ppm, 5df). The Hg burden was much higher among older animals living in the Fakahatchee Strand State Preserve (FS; 19-20 ppm) than the single animal living north of Alligator Alley (NA; 7.8 ppm). It should be noted that we have not sampled any older panthers in the eastern portion of the range due either to random chance or possibly to an absence of older animals there. The pattern of distribution by location for hair (H) and whole blood (WB) was similar to liver. Average levels of Hg in WB and H were greatest in panthers from the eastern portion of the range, particularly from the Shark River Slough (SS) area (WB=l.986 ppm, H=55.532 ppm). Lowest values were noted in panthers from western Florida (NA; mean=0.089 and 1.77 ppm, respectively; $p< 0.001$). Panthers from Pine Island (PI) in ENP, FS, and Raccoon Point (RP) in eastern Big Cypress National Preserve all had H and WB levels significantly higher ($p<0.01$) than those in NA. Reproductive success in female panthers appeared to be adversely affected by elevated Hg levels. There was a significant reduction ($p<0.01$) in the number of surviving kittens for females with WB Hg values >0.5 ppm (mean= 0.167 kittens/female yr) compared to those females with 0.00-0.25 ppm WB Hg values (mean 1.46 kittens/female yr). Mercury passes through the placenta and is concentrated at higher levels in the fetus than occurs in the mother. Disruption of normal fetal development by Hg has been documented to cause abortions, stillbirths, congenital anomalies and behavioral changes resulting in early neonatal death. The most probable source of Hg contamination in panthers is via the food chain. The panthers in NA had the lowest levels of blood, hair and liver Hg and feed primarily on the white-tailed deer and feral hog that occur at high densities on these largely private and protected lands. Although nothing is known about tissue Hg levels in the hog, Hg has been found to be less than 1.0 ppm in liver samples from approximately 100 southern Florida deer. Panthers with the highest levels of tissue Hg were those which regularly consumed nonungulates--primarily raccoons, armadillos, rabbits, and for a couple of adult male panthers, alligators. The index panther case fed only on small prey during the 17 months that she was monitored. Of 12 kills recovered, all were raccoons. Mercury in the muscle of raccoons varied markedly between the different watersheds and habitats across the panther's range in southern Florida. Relative Hg levels in raccoon muscle were very similar to those observed for blood from panthers from the same locations. The above scenario suggests that the raccoon can be used as an indicator species for Hg contamination of the environment. Further, it predicts that if the preferred prey base for the panther is not abundant and the substitute food source is polluted (such as with Hg in the raccoon or alligator), then the panther can be expected to bioaccumulate Hg. The subsequent problem(s) for the panther will be commensurate with the magnitude of Hg in the prey of any given location and with the extent to which the panther must rely on that prey to complement its diet. This paper presents the magnitude and distribution of Hg levels in free-ranging Florida panthers sampled over the past 13 years. The data suggest that the consumption of nonungulate prey, principally raccoons and alligators, is the significant inverse relationship between the levels of Hg found in whole blood and the reproductive success of female panthers. Chronic exposure to Hg is probably responsible for lower than expected population densities of panthers in large portions of their range due to frank mortality and lowered reproductive success, and thus is contributing to the extinction of this endangered mammal.

Roelke, M.E., D.J. Forrester, E.R. Jacobson, and G.V. Kollias. 1991. Rationale for Surveillance and Prevention of Infectious and Parasitic Disease Transmission Among Free-Ranging and Captive Florida Panthers (Felis concolor

coryi). Proc. AAZV. Pgs. 185-190.

Samples were collected from live-captured and necropsied panthers. Several agents were determined to be present in the population: feline panleukopenia virus (FPLV), feline calicivirus (FCV), and feline peritonitis virus/feline enteric corona virus (FIP/FECV) (low titers only), T. gondii, and Dirofilaria microfilaria (probably D. striata). Serologic data indicated that the majority of panthers had been exposed to FPLV (64% with positive titers of 1:50, or greater), and many had very high antibody titers (up to, or >1:10,000). Several other important infectious disease agents have been identified. Rabies virus caused the death of one panther in 1989 and retrospective analysis of banked serum revealed that nearly 30% of the population had previously encountered rabies virus and survived (titers greater than or equal to 0.6 IU/ml). Feline immunodeficiency virus (FIV) was found in 25% of the population and feline syncytia-forming virus was also discovered. Other agents were discovered during routine histopathologic (Sarcocystis sp.), parasitologic (Toxocara sp., Giardia sp.) or microbiologic (fecal pathogen: Campylobacter sp., Salmonella sp.) examinations. Four disease agents were identified that met criteria of pathogenicity and ease of control: rabies virus, panleukopenia virus, calicivirus, and the hookworm Ancylostoma pleuridentatum. Three important, non-treatable, infectious disease agents in the wild were identified which have the potential to cause morbidity and/or mortality in captive felids; FIP/FECV, Cytauxzoon felis, and FIV. The FIP/FECV titers documented were exceedingly low (generally 1:25) and are not thought to be of serious concern. To manage C. felis, all ticks are removed during the initial immobilization and blood smears are examined for infection with the protozoan. The significance of FIV to the wild panther population and the potential impact on other captive felids is unknown at this time. All kittens selected for the captive breeding program are tested for FIV in the field so that no FIV positive animal is brought into captivity.

Roelke, M.E. and C.M. Glass. 1992. Strategies for the Management of the Endangered Florida Panther (Felis concolor coryi) in an Ever Shrinking Habitat. Proc. Joint Conf. AAZV/AAWV. Pgs. 38-43.

Habitat loss continues to be the greatest threat to extinction for the Florida panther. The core breeding population now occupies an area of approximately 2.2 million acres and only 55% of this area is protected in state and federal ownership. Acreage devoted to citrus production in prime panther habitat has increased by approximately 400% in Collier and Hendry counties during the last 20 years. Human population in Collier County continues to be the fastest growing area in the nation. Daily traffic counts on Interstate 75, running through the center of panther habitat, have increased by 220% in the past 10 years. The entire Everglades National Park is currently inhabited by only one adult male panther. The most significant causes of mortality in panthers from 1972-1990 were; automobile trauma (46.6%), illegal kills/injury (16.3%), and intraspecific aggression (11.6%). An attempt is being made to manage a minimum habitat size and maintain a maximum population density of Florida panthers. Computer modeling is underway to define the minimum threshold needed to support Florida panthers. Negotiations for additional land acquisition continue at an increasing rate. Research on developing technology for assisted reproductive techniques appears promising. Captive breeding facilities have been established and the transfer of wild born animals to these facilities is underway. Efforts to identify unoccupied historic range sites for future reintroduction are in progress. Even as the situation appears to be worsening, some hope for the future still perseveres.

Roelke, M.E. 1992. Status of the Florida Panther. Pgs. 40-42 In: Felid Action Plan, 1991 and 1992 (D.E. Wildt, J.D. Mellen and U.S. Seal, eds.); AAZPA Felid Taxon Advisory Group and IUCN Captive Breeding Specialist Group.

SUMMARY

The endangered Florida panther (Felis concolor coryi), declared the state mammal of Florida in 1982, is estimated to number fewer than 50 individuals and currently is protected under both state and federal endangered species statutes. This remnant population of the subspecies once occupied the entire southeastern United States. Now it is isolated in the remote cypress swamps and hardwood hammocks of southern Florida, primarily in the Big Cypress Swamp and Everglades ecosystems. Human population growth in southern Florida with the concomitant loss of suitable panther habitat is the major threat to the continued survival of this rare mammal. The core breeding population lives largely on privately-owned ranches, the northern portion of the Big Cypress National Preserve (BCNP) and the Florida Panther National Wildlife Refuge. The privately-owned land presently is unprotected and is particularly vulnerable to development. The population of panthers in this area is at carrying capacity with little opportunity for animals to disperse into suitable buffer zones. Consequently, intraspecific aggression appears to be increasing and now

constitutes the major cause of mortality. The breeding population of panthers in the Everglades National Park (ENP; n=7 in 1988) now is functionally extinct. The one surviving male resides primarily in the BCNP and makes only periodic forays into the ENP. There currently are only 3 known panthers in the BCNP. Intensive hunting and tract surveys on these publicly-owned lands (> 120,000 acres) have not identified any additional animals in the area. Presently there are 3 ongoing radio-telemetry studies of the panther, one under the direction of the Florida Game and Fresh Water Fish Commission (n=19 panthers) and 2 with the National Park Service (n=4). The primary thrust of the field work is to understand the natural history, food habits, social structure and critical habitat requirements of the subspecies. As an integral part of the field work, veterinary protocols have been established for handling and anesthesia of free-ranging panthers to minimize capture-related injury and mortality. Additionally, biomedical studies are being conducted in the areas of health, clinical pathology, infectious disease, reproduction, genetics and environmental contaminants. A summary of major findings is as follows. Serological evidence from 51 individual Florida panthers indicated that this subspecies has been exposed to, or is infected with, several potentially pathogenic agents including feline panleukopenia virus (65%), feline calicivirus (FCV; 43%), feline enteric corona virus/feline infectious peritonitis virus (23%), feline immunodeficiency virus (FIV; 25.6%), rabies virus (26%), feline syncytia-forming virus (FSFV; 33.3%), Toxoplasma gondii (8.0%) and Brucella sp. (2.4%). All panthers have been negative for pseudorabies virus, feline leukemia virus and feline viral rhinotracheitis virus. Rabies virus (raccoon strain) was isolated from an unvaccinated panther that died of rabies (Rupretch, unpublished data). This probably is the first documented case of rabies in a wild cougar. A puma lentivirus (FIV) has been isolated successfully (Olmsted, unpublished data). Mercury has been identified as a significant contaminant in free-ranging panthers and raccoons. Those animals with particularly high concentrations were found in the Shark River Slough of the Everglades National Park and adjacent wetlands. Panthers with elevated concentrations of mercury occur where non-ungulate prey is consumed as part or all of the diet (raccoon is probably the primary source of mercury). Mercury levels in panthers living in the Fakahatchee Strand State Preserve have decreased ($P<0.01$) since the fall of 1987 when land management actions were initiated to enhance deer density. Females with elevated mercury had poorer reproductive success than those with low mercury concentrations. Analysis of panther electroejaculates revealed semen samples of lower volume and sperm concentration (compared to other puma subspecies) with poor sperm motility and >90% abnormal sperm forms. Seventy-five percent (9 of 12) of free-living males that were examined were unilaterally cryptorchid. These unusual male reproductive traits very likely are due to inbreeding. The occurrence of heart defects (atrial septal defects, n=2; tricuspid valve dysplasia, n=l) also support the notion that a general loss in genetic diversity is influencing the physiological health of the subspecies. Mitochondrial DNA (mtDNA) analysis of 8 North American and 3 South American subspecies of puma indicates that 2 groups, or clades, can be discriminated, one in North America and another in South America. Further, the mtDNA study has revealed a partitioning of the Florida panther into 2 populations with differing maternal evolutionary histories. The Big Cypress population largely is descended from historic F.c. coryi animals (North America), and the mtDNA of the ENP population is derived from non-North American cougars. It is possible that this introduction of foreign genetic material is the result of non-coryi puma releases that occurred in the ENP between 1957 and 1967. The Florida panther may have benefitted from this introgression in that the incidence of cryptorchidism is zero in males with ENP mtDNA as compared to 63% of the males with historic mtDNA. A captive breeding program was initiated in February 1991 with the capture of 6 juvenile animals (6 to 8 months old). Thus far in 1992 one 10 month old kitten has been added to the captive population. Twenty-seven founders were identified as potential contributors to the captive breeding program. Between 1989 and 1991, 13(48%) of these founders died, only 2 of which have offspring in captivity. Six of the remaining living founders now are represented in captivity by 3 kittens. There are several crucial and immediate actions that could help alleviate the above problems before the Florida panther suffers further loss and potential extinction. 1. Secure vulnerable habitat, especially on private lands in Collier and Hendry Counties; 2. Proceed with the captive breeding program as planned; 3. Maximize preservation of gametes to help preserve current genetic diversity; 4. Pursue assisted reproductive technologies that will contribute to points 2 and 3; 5. Thoroughly study the incidence of mercury in the ENP, east Everglades and southern BCNP and continue to study the dynamics of mercury in the ecosystem; 6. Support the possibility of introducing surrogate, nonendangered pumas, into the ENP to determine the effects of mercury on puma physiology.

Roelke, M.E, D.J. Forrester, E.R. Jacobson, G.V. Kollias, F.W. Scott, M.C. Barr, J.F. Evermann, and E.C. Pirtle. 1993. Seroprevalence of Infectious Disease Agents in Free-Ranging Florida Panthers (Felis concolor coryi). J. Wildl. Diseases 29(1):36-49.

Serum samples obtained from 38 free-ranging Florida panthers (Felis concolor coryi) in southern Florida, March 1978

through February 1991, were tested for antibodies against eight bacterial, parasitic, and viral disease agents. Sera were positive for antibodies against feline panleukopenia virus (FPV) (78%), feline calicivirus (56%), feline immunodeficiency virus/puma lentivirus (37%), feline enteric coronavirus/feline infectious peritonitis virus (19%), and Toxoplasma gondii (9%). All samples were seronegative for Brucella spp., feline rhinotracheitis virus, and pseudorabies virus. In addition, all the animals tested were negative for feline leukemia virus p27 antigen as determined by enzyme-linked immunosorbent assay. Feline panleukopenia virus was considered to be a potentially significant disease agent; FPV antibodies occurred in the highest prevalences in older age classes (P = 0.096). Because <50 animals remain in this relict population and the probable resultant depression of genetic diversity and lowered disease resistance, FPV or other disease agents could contribute to the extinction of this endangered subspecies.

Roelke, M.E., J.S. Martenson and S.J. O'Brien. 1993. The Consequences of Demographic Reduction and Genetic Depletion in the Endangered Florida Panther. Current Biology 3(6):340-350.

Abstract

The Florida panther has recently suffered severe range and demographic contraction, leaving a remarkably low level of genetic diversity. This exerts a severe fitness cost, manifested by spermatozoal defects, cryptorchidism, cardiac abnormalities and infectious diseases that threaten the survival of the subspecies.

Roelke, M.E., J. Pecon-Slattery, S. Taylor, S. Citino, E. Brown, C. Packer, S. Vandewoude and S.J. O'Brien. 2006. T-Lymphocyte Profiles in FIV-Infected Wild Lions and Pumas Reveal CD4 Depletion. J. Wildl. Dis. 42(2):234-248.

Abstract

Feline immunodeficiency virus (FIV) is a lentivirus related to human immunodeficiency virus (HIV) that causes feline AIDS in the domestic cat (*Felis catus*). Serological surveys indicate that at least 25 other species of cat possess antibodies that cross-react with domestic cat FIV. Most infected nondomestic cat species are without major symptoms of disease. Long-term studies of FIV genome variation and pathogenesis reveal patterns consistent with coadaptation of virus and host in free-ranging FIV-Ple-infected African lions (*Panthera leo*) and FIV-Pco-infected pumas (*Puma concolor*) populations. This report examined correlates of immunodeficiency in wild and captive lions and pumas by quantifying CD5(+), CD4(+), and CD8(+) T-cell subsets. Free-ranging FIV-Ple-infected lions had immunofluorescence flow cytometry (IFC) profiles marked by a dramatic decline in CD4(+) subsets, a reduction of the CD4(+)/CD8(+) ratio, reduction of CD8(+)beta(high) cells, and expansion of the CD8(+)beta(low) subset relative to uninfected lions. An overall significant depletion in CD5(+) T-cells in seropositive lions was linked with a compensatory increase in total CD5(-) lymphocytes. The IFC profiles were altered significantly in 50% of the seropositive individuals examined. The FIV-Pco-infected pumas had a more generalized response of lymphopenia expressed as a significant decline in total lymphocytes, CD5(+) T-cells, and CD5(-) lymphocytes as well as a significant reduction in CD4(+) T-cells. Like lions, seropositive pumas had a significant decline in CD8(+)beta(high) cells but differed by not having compensatory expansion of CD8(+)beta(low) cells relative to controls. Results from FIV-infected lions and pumas parallel human and Asian monkey CD4(+) diminution in HIV and SIV infection, respectively, and suggest there may be unrecognized immunological consequences of FIV infection in these two species of large cats.

Rokosky, E.J. 1963. Hand-rearing Techniques for Pumas. Int. Zoo Ybk. 4:317.

Information on the weights of two female pumas at 4 days and 11 days which were neglected by the mother are furnished as well as formula used (Esbilac) and amounts given.

Rollins, C.E., and D.E. Spencer. 1995. A Fatality and the American Mountain Lion: Bite Mark Analysis and Profile of the Offending Lion. Journal of Forensic Science 40:486-489.

Abstract

Attacks on humans by mountain lions have been infrequent in the history of the United States. Of the 64 authenticated

attacks since 1890 in North America, there have been 13 fatalities. This paper reports a case of an adult mountain lion which attacked and killed a female jogger during the spring of 1994 in California. The lion left an imprint of its teeth on the victim's chin. The authors used this bite mark to aid authorities in profiling the approximate age and gender of the attacking animal. The authors subsequently utilized bite mark analysis to establish that the lion actually responsible for the attack had been removed from the area.

Rome, L., M. Quinn and E. York. 2008. Science and Education Working Together to Promote Lion Awareness at Grand Canyon. Page 191 in Toweill, D. E., S. Nadeau and D. Smith, editors. Proceedings of the Ninth Mountain Lion Workshop, May 5-8, 2008, Sun Valley, Idaho, USA.

Abstract

The theme of the workshop is Cougars: Past, Present and Future Challenges. Future challenges at Grand Canyon National Park include rapid human development and visitation, continued reduction of lion habitat and a growing chance for adverse human-lion interactions. There is a nationwide need for education and awareness about lion behavior, ecology and management. Teaching the general public how and why lions are important can create support for research and science-based lion management. Scientists gather the information, while educators disseminate it. Eric York, late Grand Canyon biologist, believed that the research and education occurring at Grand Canyon was different than most lion research projects in that research conducted here could be disseminated immediately to a very large audience and that the Park environment offered many unique educational avenues. A successful team has been created between science and education at Grand Canyon NP with the result that the public has received balanced and accurate mountain lion information. Methodologies used to disseminate mountain lion information have included ranger presentations, articles in Nature Notes, web-based videos, special programs to Elderhostel and conservation groups and the creation of site bulletins. Over 10,000 visitors have attended evening ranger programs on current mountain lion research. Our mountain lion web sites have had approximately 13,000 hits since May of 2007 and over 60 Park personnel have been trained by Science Center and Interpretive staff in mountain lion issues. Public support for the program has led the Park Science Center and Interpretive Staff, in conjunction with the Grand Canyon Association, to launch an “Adopt-A-Lion” program which is expected to bring in a significant amount of new funding to support mountain lion research at Grand Canyon National Park.

Rominger, E.M., H.A. Whitlaw, D.L. Weybright, W.C. Dunn and W.B. Ballard. 2004. The Influence of Mountain Lion Predation on Bighorn Sheep Translocations. J. Wildl. Manage. 68(4):993-999.

Abstract

We studied the effects of mountain lion (*Puma concolor*) predation on 2 translocated populations of bighorn sheep (*Ovis canadensis*) in New Mexico, USA. During 1993, 32 Rocky Mountain bighorn sheep (*O. c. canadensis*) were translocated to Wheeler Peak Wilderness Area in northern New Mexico, and during 1992–1993, 31 desert bighorn sheep (*O. c. mexicana*) were translocated to Sierra Ladron in central New Mexico. We monitored both populations from release through 2000 using fixed-wing aircraft and ground and/or helicopter surveys. We determined cause of mortality for radiomarked individuals (n = 26) and calculated survival rates, cause-specific mortality rates, exponential growth rates, and lamb:ewe ratios. The post-lambing population estimates in 2000 were 180 in Wheeler Peak and 21 in Sierra Ladron. Annual adult survival was higher ($P < 0.005$) in the Wheeler Peak population (0.955) than in the Sierra Ladron population (0.784). Annual lamb:ewe ratios also were higher ($P < 0.001$) in the Wheeler Peak population (66.7 vs. 29.8). Mean annual exponential growth rate (r) in the Wheeler Peak population was 0.25 compared to −0.01 for the Sierra Ladron population. Predation by mountain lions was the primary proximate cause (75%) of 16 known-cause mortalities of radiomarked bighorn sheep in the Sierra Ladron population, while we did not document any predation in Wheeler Peak. The annual cause-specific mortality rates due to mountain lion predation in Sierra Ladron were 0.13 for males, 0.09 for females, and 0.11 for all adult bighorn sheep. Mountain lion predation may have limited the Sierra Ladron bighorn sheep population and could be imposing a destabilizing inverse density-dependent mortality. Mountain lions preyed on domestic cattle in the Sierra Ladron area and throughout desert bighorn sheep habitat in New Mexico; we therefore hypothesize that cattle “subsidized” the diets of mountain lions (i.e., reduced or eliminated natural starvation). The ultimate cause of mortality for these desert bighorn sheep may be related to subsidized mountain lion populations that do not appear to decline following native ungulate population decreases. In addition, the encroachment of woody vegetation may increase the hunting success of ambush predators

like mountain lions. High mountain lion predation may require mitigation for the successful restoration of bighorn sheep.

Rominger, E.M., F.S. Winslow, E.J. Goldstein, D.W. Weybright and W.C. Dunn. 2005. Cascading Effects of Subsidized Mountain Lion Populations in the Chihuahuan Desert. Page 156 *in* R.A. Beausoleil and D.A. Martorello, editors. Proceedings of the Eighth Mountain Lion Workshop, Olympia, Washington, USA.

Abstract

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

Rominger, E.M. and E.J. Goldstein. 2006. Synopsis of a 5 Year Mountain Lion Control Management Action on Endangered Desert Bighorn Sheep Recovery. New Mexico Department of Game and Fish, Santa Fe, NM 87504.

Abstract

Desert bighorn sheep (*Ovis canadensis mexicana*), are a state-listed endangered species in New Mexico (NMDGF 2003). The total population estimate declined to <170 (~140 adults) in 2001, despite the release of 151 adult desert bighorn sheep from Red Rock between 1992 and 1999. Between 1996-2002, the number of extant wild populations declined from 7 to 4 following the extinction of the Alamo Hueco, Animas, and San Andres desert bighorn sheep populations. In October 1999, after determining that the principle proximate cause of mortality on adult desert bighorn sheep was mountain lion (*Puma concolor*) predation, a management action to mitigate this high level of mortality was initiated (Rominger and Dunn). Mountain lions are subsidized predators in the Chihuahuan desert and it is hypothesized that as a result mountain lions are able to exert an unnatural level of predation on native ungulates (Rominger et al. 2004). New Mexico Department of Game and Fish (NMDGF) using contract hunters and trappers attempted to reduce mountain lion numbers in 4 desert bighorn sheep ranges. Lion control, measured by number of lions removed, did not occur in any range during the first 2 years of the management action. Between years 3 and 5 partial mountain lion control was attained in 3 of 4 ranges (Peloncillo, Sierra Ladron, and San Andres). However, this has allowed for just 1-2 years of data collection following some level of mountain lion control. Preliminary results are reported for individual desert bighorn sheep populations in a case-study format due to variable conditions among

populations. A total of 51 adult mountain lions were culled using contractors during the 5 years. However, only 4 mountain lions were culled the first 2 years. Sport hunters harvested an additional 9 mountain lions during this period and there were 2 known roadkills. The number of adult ewes in these 4 populations was estimated to have declined to fewer than 35 prior to attaining some level of mountain lion control, and therefore a population level response is not detectable because of the short timescale. We have assessed mortality of adult radiomarked bighorn sheep attributed to mountain lion predation and lamb:ewe ratios in each of the populations. In ranges with partial treatment, percent mortality of adult desert bighorn sheep declined each year following partial mountain lion control. No mortality, attributed to mountain lion predation, has occurred on radiomarked bighorn sheep (n=58) in the last 14 months in any of the 3 partially treated ranges. However, in the Hatchet Mountains where treatment was not achieved, mortality of radiomarked adults increased from 15% the first 2 years to 22% during the last 3 years. In 2 ranges with pretreatment data (Peloncillo and Sierra Ladron), spring lamb:ewe ratios increased from 36:100 and 28:100 to 67:100 and 52:100 respectively, following partial mountain lion control. In the Hatchet Mountains the lamb:ewe ratio was 40:100 and 42:100 during the same periods. In the San Andres Mountains where 19 mountain lions were culled prior to and following translocation of 51 desert bighorn sheep, the spring lamb:ewe ratios have been 79:100 the 2 years since translocation. The recruitment ratio has been 49:100 both years since the translocation. Although mountain lion numbers were reduced in all ranges, mountain lion sign was found each year, in all ranges, during annual mountain lion sign surveys (Rominger et al. 2002, Goldstein and Rominger). Expenditures for the 5-year lion control program were approximately $173,900US (~$34,780US/year). In 2004, the New Mexico State Game Commission increased the length of time for the lion control management until September 30, 2007 to allow for the collection of 5 years of data as was originally designed. A final report, to be completed by March 2008, will include cause specific mortality rates calculated using Program Mark (G. White, Colorado State University).

Rominger, E.M. and E.J. Goldstein. 2008. Evaluation of an 8-Year Mountain Lion Removal Management Action on Endangered Desert Bighorn Sheep Recovery. New Mexico Department of Game and Fish, Santa Fe, NM 87504.

Executive Summary

Desert bighorn sheep (*Ovis canadensis*) (bighorn) have been a state-listed endangered species in New Mexico since 1980 (NMDGF 2003). The Plan for the Recovery of Desert Bighorn Sheep in New Mexico was produced in 2003 to guide the management of this endangered species (NMDGF 2003). In 2001, the state-wide population estimate declined to <170 (~60 ewes), despite the release of 151 bighorn from Red Rock Wildlife Area between 1992 and 1999. Between 1996 and 2002, the number of wild populations declined from 7 to 4 following the extinction of the Alamo Hueco, Animas, and San Andres populations. The principle proximate cause of mortality on adult bighorn during this period was determined to be mountain lion (*Puma concolor*) (lion) predation. In October 1999, a management action to mitigate this high level of mortality was initiated in 3 bighorn ranges (Rominger and Dunn 2000). A fourth population in the San Andres Mountains was added to the management action when it was reestablished in 2002. Due to the small number of populations and imminent risk of extinction, the lion control effort is a management action rather than a research project. Lions are subsidized predators in much of the Chihuahuan desert ecosystem and it is hypothesized that the ability to prey-switch onto domestic livestock may explain why some small populations of bighorn become extinct without lion populations diminishing (Rominger et al. 2004). New Mexico Department of Game and Fish (NMDGF), using contract hunters and trappers attempted to reduce lion numbers in 4 bighorn ranges. This management action occurred in <1% of the estimated state wide lion habitat and removal was within the objectives of a sustainable lion population as specified in the harvest management matrix (NMDGF 2006b). Lion control, measured by lion predation rates on bighorn and the number of lions removed, did not occur in any range during the first 3 years of the management action and no response was measured until the end of the fourth year (2003). During the 8 years, a total of 82 were killed using contractors and an additional 16 lions were killed by other causes. We assessed bighorn mortality rates using program MARK (White and Burnham 1999). Average annual mortality rates from lion predation decreased from 0.17 during periods of minimum protection to 0.04 during periods of maximum protection. The statewide bighorn population increased to >400 in 2007 from a combination of increased survival and translocation. Although lion numbers were reduced in all 4 ranges, lion sign was found each year in all ranges during this

management action (Rominger et al. 2002, Goldstein and Rominger 2004, Goldstein and Rominger 2007). An example of the high value of desert bighorn sheep is reflected in the $187,500 paid for the 2006 New Mexico auction permit. Expenditures for the 8-year lion control program were approximately $293,450 (~$36,681/year), which averaged <8% of the total annual bighorn sheep budget.

Roof, J.C., and D.S. Maehr. 1988. Sign Surveys For Florida Panthers on Peripheral Areas of their Known Range. Florida Field Naturalist 16:81-85.

Surveys for Florida panther (Felis concolor coryi) sign were conducted between April 1984 and March 1987 at Fisheating Creek, Glades County, and Corkscrew Swamp, Collier County. Sign was encountered regularly at Fisheating Creek and sporadically at Corkscrew Swamp. A search method involving weekly surveys from an all-terrain cycle was preferred over pick-up truck surveys.

Roop, L. 1971. The Wyoming Lion Situation. Wyoming Wildlife 35(12):16-21.

The mountain lion was relatively abundant in Wyoming around 1900. From 1894-1914, a total of 111 lions were taken in Yellowstone National Park for predator control purposes. This predator control program continued until 1934 but no kill figures were available. It was estimated that at least a dozen lions still exist in Yellowstone, mostly confined in the northern portion of the park. The author cites examples of mountain lion sightings and killings reported primarily by game wardens in Wyoming.

Rosas-Rosas, O.C., R. Valdez, L.C. Bender and D. Daniel. 2003. Food Habits of Pumas in Northwestern Sonora, Mexico. Wildl. Soc. Bull. 31(2):528-535.

Abstract

It is questionable whether food-habits studies of pumas conducted in the southwestern United States can be extrapolated to northwestern Mexico, because of differences in management, distribution, and abundance of wildlife. We determined food habits of pumas (Puma concolor) in the Sonoran Desert of northwestern Sonora, Mexico. Based on studies in the western United States, we hypothesized that desert mule deer (Odocoileus hemionus) were the major food source of pumas in Sonoran Desert habitats of Mexico. The study area supports populations of desert mule deer, white-tailed deer (Odocoileus virginianus), lagomorphs (Lepus spp. and Sylvilagus audubonii), collared peccary (Pecari tajacu), and the largest population (~300 individuals) of desert bighorn sheep (Ovis canadensis) in Sonora. Based on pugmark characteristics, we recorded 3 different adult resident pumas in approximately 90 km^2. We analyzed 60 puma fecal samples collected September 1996-November 1998. Primary prey items based on frequency of occurrence and estimated biomass consumed were desert bighorn sheep (40% and 45%, respectively), lagomorphs (33%, 19%), deer (17%, 17%), and collared peccary (15%, 11%). The high percentage of desert bighorn sheep in puma diets may be due to high abundance relative to mule deer, which declined in number during our study. No differences were found in puma diets between seasons ($X2/2$ = 2.4526, P=0.2934). Fluctuations in mule deer populations in northwestern Sonora may influence prey selection by pumas.

Ross, I., O. Pall and H.D. Carr. 1986. The 1984-85 Cougar Hunt in Alberta. Energy and Natural Resources, Fish and Wildl. Div., Calgary, Alberta, Canada.

The results of the 1984-85 cougar hunt and harvest in Alberta were summarized from compulsory registration forms. Cougar skulls submitted were aged and measured. Cougar license sales in 1984-85 (150) increased from 1983-84. Cougar hunting was permitted in parts of the Province for 67 days in the fall season (no dogs allowed) and 27 days in the winter season (dogs allowed). Thirty-nine cougars (19 females and 20 males) were legally harvested in the entire season with residents accounting for 87% of the kills. This represented a 39% increase in the cougar harvest from 1983-84 and was 30% greater than the 11 year average of 30 kills per year from 1973 to 1984. Forty-six percent of the cougar harvest was taken from W.M.U.'s south of the Bow River, an area that has accounted for 61% of the kill since 1971. The 1984 fall cougar harvest accounted for 18% of the annual kill compared to the average fall harvest of 16% from 1973 to 1984. Age data from skulls submitted indicated that 11%, 33% and 56% of the cougars harvested

were subadult, young adult, and mature adult, respectively. Only 1 of 34 skulls submitted for measurement was of trophy status as defined by the Boone and Crockett Club.

Ross, I. and M. Jalkotzy. 1989. The Sheep River Cougar Project-Phase II. Final Report 1987-1989. Arc Associated Resource Consultants Ltd., Calgary, Alberta.

EXECUTIVE SUMMARY

Arc Associated Resource Consultants Ltd. conducted an intensive radio telemetry study of cougars in the Sheep River area of southwestern Alberta between 1987 and 1989. The work, dubbed the Sheep River Project - Phase II, was a continuation of a study conducted by the Fish and Wildlife Division, Alberta Forestry, Lands and Wildlife between 1981 and 1986. Forty-nine cougars were captured during Phase II, 27 of them for the first time. Between 1981 and 1989, 71 cougars were captured 127 times in and around the Sheep River study area. Over 1,000 radio locations were logged during Phase II, bringing the total number of radio telemetry locations to over 3,400. The total cougar population in the vicinity of the study area on 31 March 1988 and 1989 was estimated at 35 to 37 and 33, respectively. The resident adult population was the same both years at 4 males and 12 females. Density estimates in and around the study area between 1984 and 1989 varied between 2.0 and 4.2 cougars/100 km^2. Between 1981 and 1989, the mean annual home range size for adult females was 140 km^2, while for males it was 334 km^2. The home ranges of neighboring male residents tended not to overlap, while those of female residents overlapped considerably at times. Summer and winter home ranges of individual males and females were contiguous; large shifts in seasonal home ranges did not occur. Females with kittens less than 6 months old had smaller home ranges than those traveling alone or with older kittens. Twenty-nine litters were born to radio collared females between 1981 and 1989. Births were recorded in all seasons of the year, although there was a marked peak in August. Average litter size of 27 litters was 2.2 and the sex ratio in 20 litters was 1 male:1.2 females. Average birth interval was 19 months and recruitment to independence was 1.8 to 1.9 kittens/female/year. Marked male kittens were never recaptured as adults in the vicinity of their maternal home ranges, but some female kittens born in the study area established residency there after independence. The deaths of 27 marked cougars were recorded between 1981 and 1989. Sport hunting accounted for 63% of those deaths. Recorded deaths in and around the study area between 1985 and 1989 annually accounted for between 3 and 14% of the estimated population. One hundred fifteen cougar kills were examined between 1981 and 1989. Mule deer, elk, and moose accounted for 77% of all kills. Moose calves and female elk were the most preyed on components of their populations, whereas mule deer from all classes were taken regularly. Moose calves contributed 85% of all biomass consumed by male cougars, while deer and elk combined nearly equally for 79% of females' diets.

Ross, I. and M. Jalkotzy. 1990. The Sheep River Cougar Project-Phase III. Cougar Prey Relationships, Progress Report 1989-1990. Arc Associated Resource Consultants Ltd., Calgary, Alberta.

EXECUTIVE SUMMARY

Phase III of the Sheep River Cougar Project was initiated in 1990 to investigate the relationship between cougars and their prey in the Sheep River study area. This report details progress on the project after the first of three years scheduled. In 1989-90, 163 man-days were spent in the field. Fourteen cougars were captured, bringing to 141 the total number of captures since the project started in 1981. Snow conditions were generally very poor throughout the winter. Although aerial telemetry flights were flown only 4 times during the year, intensive ground radio tracking allowed us to collect an average of 17 radio locations per collared cougar between October 1989 and May 1990. Cougars continued to be found throughout the study area and home ranges of cougars collared for more than a year remained very consistent in size and location. Pronounced seasonal shifts in home ranges did not occur. The Sheep River cougar population numbered 45 to 46 cougars on 31 March 1990, the highest estimate for the area since the project's inception. Independent cougars accounted for 22 individuals and at least 24 dependent kittens and juveniles were traveling with 9 adult females in the study area. Eight new litters comprised of at least 22 kittens were documented during 1989-90. Two litters of 4 kittens each were documented for the first time; until this winter litter sizes had never exceeded 3. Since 1981, 37 litters have been recorded. Most litters continued to be born in late summer. Dispersal patterns seen in previous years remained; 1 female born in the study area is now an adult with a home range immediately adjacent to her mother's, while the long range dispersal of 2 young males was documented.

Seven mortalities of study area cougars were recorded including 4 deaths during the January hunting season. Forty-seven kills made by cougars were recorded and included 35 mule deer, 6 moose, 3 elk, 2 bighorn sheep, and 1 snowshoe hare. Predation sequences were collected on 10 occasions and included 24 kills. As expected, adult females traveling with large juveniles consumed prey fastest, often finishing an adult mule deer in 2 days, while subadult females traveling alone remained on kills for much longer periods. Field work during 1991 and 1992 will continue to emphasize the collection of predation rate data. Sex and age classification counts of ungulates started in 1990 will be continued. If the budget permits, aerial surveys for elk will be flown. In addition, systematic cougar track surveys will be conducted when conditions are appropriate.

Ross, P.I. and M.G. Jalkotzy. 1992. Characteristics of a Hunted Population of Cougars in Southwestern Alberta. J. Wildl. Manage. 56(3):417-426.

We studied characteristics of a hunted cougar (Felis concolor) population in southwestern Alberta between 1981 and 1989 to support development of a species management plan. Although most cougars did not maintain separate summer and winter home ranges, the size of these ranges varied. Mean summer and winter home ranges for female residents were 87 ± 8.5 (SE) and 97 ± 8.2 km^2, respectively. Male home ranges were larger ($P<0.0001$); summer and winter home ranges averaged 314 ± 62.9 and 204 ± 34.0 km^2, respectively. Females with kittens used smaller ($P = 0.001$) home ranges than did lone females or females with juveniles ($P = 0.0003$); whereas home-range sizes of lone females and those with juveniles did not differ ($P = 0.37$). Population estimates increased from 21-26 in 1984 to 35-37 in 1988, primarily resulting from an increase in adult females and their dependent young. Densities varied from 2.7-3.3 cougars/100 km^2 to 4.5-4.7 cougars/100 km^2. Mean size of 27 litters was 2.2 ± 0.1 kittens. Litters were born throughout the year but with a pronounced late summer peak. Six females gave birth to their first litters at a mean age of 30.0 ± 1.8 months, and the average interval between successive litters (n=12) for all females was 19.7 ± 1.9 months. Mean age of independence was 15.2 ± 0.5 months. Most cougars dispersed after independence, but 7 females established home ranges contiguous with their mothers' ranges. Annual mortality varied between 3 and 14% of the total population, with legal hunting being the most important cause. Non-dispersal of young females and fairly rapid population growth suggest that this cougar population rebounded quickly from depressed levels with a reduction in hunting pressure.

Ross, I. 1994. Lions in Winter. Natural History 103(12):52-59.

The author details his 13-year investigation of cougar ecology conducted near the Sheep River in southwestern Alberta. Cougar litters were documented in every month of the year with one quarter of the litters born in the winter, between October and March. Most litters were found in surface nests screened by vegetation which probably functions mainly to hide kittens from predators. At Sheep River, males feed primarily on young moose which may last three weeks. A female cougar's estrus lasts about seven days and a male that stayed near the carcass until he finished eating it would risk missing the reproductive peak of one of his neighborhood females. Because estrus in cougars can occur at any time of the year, resident males must constantly be on the lookout for receptive females and be ready to drive off trespassing upstart males. Rather than risk being tied down to a kill site, males frequently gorge themselves for a day or two, then cover the carcass and leave it for up to two weeks. During that time they patrol their home ranges to hunt and possibly encounter receptive females. A violent struggle with large prey is second to human hunters as the chief causes of cougar deaths in the study area.

Ross, P.I., M.G. Jalkotzy and P.Y. Daoust. 1995. Fatal Trauma Sustained by Cougars, *Felis concolor*, While Attacking Prey in Southern Alberta. Can. Field Nat. 109(2):261-263.

Three radio-collared cougars (*Felis concolor*) in Alberta died from injuries sustained while attacking prey, and a fourth may have died protractedly from such an injury. Injuries included a fractured vertebral column, punctured abdominal cavity, severe cranial trauma, and bacterial infection of the thoracic cavity.

Ross, P.I. and M.G. Jalkotzy. 1995. Fates of Translocated Cougars, Felis concolor, in Alberta. Can. Field Nat. 109(4):475-476.

Three cougars in Alberta were translocated in response to problem-wildlife complaints. One, an adult female, died

within a few weeks. The other two, subadult males, survived at least 10 months and did not return to their natal areas.

Ross, P.I. and M.G. Jalkotzy. 1996. Cougar Predation on Moose in Southwestern Alberta. Alces 32:1-8.

Prey selection, and kill and consumption rates by cougars (*Puma concolor*) were studied in the Sheep River area of southwestern Alberta during winter from 1981 to 1994. We investigated 368 kills made by cougars. All 5 ungulate species available within the study area were taken by cougars. Ungulates provided >99% of the biomass consumed by both male and female cougars between November and April each year. Female cougars killed mostly mule deer (*Odocoileus hemionus*) and elk (*Cervus elaphus*), but all males we studied specialized in moose (*Alces alces*). Of 54 moose fed upon by cougars, 4 were adults who had been found dead and scavenged. Forty-four calves (7-12 months) and 6 yearlings (13-20 months) were killed by cougars: 14 by females, 34 by males, and 2 by cougars of unknown sex. Moose comprised an estimated 12% of the biomass consumed in winter by female cougars, and 92% of that for males. A model derived from observed kill rates and estimated cougar-population structure predicted that cougars in the 515 km^2 study area would kill 18 moose calves and 3 yearlings each winter between December and March. This represented 16-30% of the estimated early winter calf crop.

Ross, P.I., M.G. Jalkotzy, and J.R. Gunson. 1996. The Quota System of Cougar Harvest Management in Alberta. Wildl. Soc. Bull. 24:490-494.

Cougar harvest in Alberta prior to 1990-91 was regulated primarily by a short season length, with unlimited hunter numbers and harvest. This resulted in unpredictable size, distribution, and sex structure of the cougar harvest depending on local snowfall, and restrictive hunting opportunities. Specific concerns were disproportionately high harvest from areas south of the Bow River, occasional local overharvest, and overharvest of females in some areas. Beginning in the 1990-91 season, a harvest quota system was implemented. Total quotas were established at 10% of the estimated population for each of 11 Cougar Management Areas (CMA), with a female subquota set at one-half of the total. With control over harvest levels in place, hunting season length was expanded from 1 month to 3, beginning 1 December, but the season for any CMA is closed when either of its quotas is reached. Since implementation of these changes, mean total provincial harvest increased ($p=0.001$) from 33.0 to 51.6. Average annual harvest from areas north of the Bow River increased ($p=0.005$) from 9.8 to 19.4, while mean harvest south of the Bow increased ($p=0.017$) from 23.0 to 32.2. The percentage of the harvest taken north of the Bow River increased slightly from 29.5% to 37.6%. Province-wide, the proportion of the females in the harvest declined from .43 to .29. Persistent problems in cougar management include the establishment of reliable population estimates within individual CMAs, and exceeding quotas due to the lag period between compulsory registrations of kills and informing hunters of CMA closures.

Ross, P.I., M.G. Jalkotzy, and M. Festa-Bianchet. 1997. Cougar Predation on Bighorn Sheep in Southwestern Alberta During Winter. Can. J. Zool. 74:771-775.

Predation by cougars (*Puma concolor*) upon bighorn sheep (*Ovis canadensis*) was studied in southwestern Alberta during winters from 1985-86 to 1993-94. We examined 320 kills and found that ungulates provided >99% of the biomass consumed by cougars in November-April. All ungulate species found within the study area were taken by cougars. Predation on bighorn sheep varied greatly from year to year; cougars were known to kill 0-13% of the November sheep population, and 0-57% of overwinter sheep mortality was due to known cougar kills. Of 29 bighorns killed by cougars, 13 were lambs. The remainder ranged in age from 1-17 years, and included 9 ewes and 7 rams. Cougar predation on bighorn sheep appears to be largely an individual, learned behavior; most cougars rarely killed sheep, but some preyed heavily upon them. One female killed 9% of the population and 26% of the lambs over a single winter. For mountain-dwelling ungulates that occur in small groups, the presence of 1 or a few individual specialist predators may strongly and unpredictably influence demography and behavior.

Rotstein, D.S., S. Taylor, J. Harvey, and J. Bean. 1999. Hematologic effects of Cytauxzoonosis in Florida Panthers and Texas Cougars in Florida. J. Wildl. Dis. 35(3):613-617.

Abstract

Cytauxzoon felis is a long-recognized hemoparasite of free-ranging Florida panthers (*Puma concolor coryi*), but its

prevalence and effect on the population has not been assessed. Red blood cell indices and white blood cell counts were compared between infected and noninfected Florida panthers and Texas cougars (*Puma concolor stanleyana*) from 1983-1997 in Florida (USA). The prevalence of *cytauxzoonosis* for both populations was 39% (11/28) for Texas cougars, 35% for Florida panthers (22/63) and 36% overall. Thirteen hematologic parameters were compared between *C. felis* positive and negative panthers and cougars. Florida panthers had significantly lower mean cell hemoglobin count (MCHC) and higher white blood cell (WBC), neutrophil, monocyte and eosinophil counts ($P < or = 0.05$) than Texas cougars. Infected Florida panthers had significantly lower mean cell hemoglobin (MCH) and monocyte counts and higher neutrophil and eosinophil counts than infected Texas cougars. Although statistically significant differences were measured for hematologic parameters in *C. felis* positive panthers and cougars, biologically significant differences were not likely because values were generally within expected reference ranges for healthy animals. *Cytauxzoonosis* does not appear to have a negative effect on the hematologic parameters of chronically infected panthers and cougars. Potential transient changes during initial infection were not evaluated.

Rotstein, D.S., R. Thomas, K. Helmick, S.B. Citino, S.K. Taylor and M.R. Dunbar. 1999. Dermatophyte Infections in Free-Ranging Florida Panthers (*Felis concolor coryi*). Journal of Zoo and Wildlife Medicine 30(2):281-284.

Three free-ranging Florida panthers (*Felis concolor coryi*) were diagnosed with clinical dermatophytosis; two were infected with *Trichophyton mentagrophytes*, and one was infected with *Mycrosporum gypseum*. Two of these panthers were juvenile males that were diagnosed with focal to focally coalescing dermatophytosis; one caused by *M. gypseum* and the other by *T. mentagrophytes*. These animals were not treated, and clinical signs resolved spontaneously over 6 months. The third panther, an adult male from southern Florida, presented with a diffuse dermatophytosis due to *T. mentagrophytes* infection. Initially, the panther had alopecia, excoriations, ulcerations, and multifocal pyoderma of the head, ears, neck, rear limbs, and abdominal region that progressed to lichenification of the skin and loss of nails from two digits. When topical therapy applied in the field at 45-day intervals was ineffective in clearing the infection, the animal was placed in captivity for intensive oral therapy to prevent further development of dermal mycosis, loss of additional nails, and spread of infection to other panthers. The panther was treated orally with itraconazole (9.5 mg/kg) in the food s.i.d. for 6 weeks. After treatment, nail regrowth occurred but the multifocal areas of alopecia remained. The panther was released back into the wild after two skin biopsy cultures were negative for fungal growth. Temporary removal of a free-ranging animal of an endangered species from its habitat for systemic treatment of dermatophytosis requires consideration of factors such as age, reproductive potential, holding facilities, treatment regimen, and the potential for successful reintroduction of the animal.

Rotstein, D.S., S.K. Taylor, J. Bradley, and E.B. Breitschwerdt. 2000. Prevalence of Bartonella henselae Antibody in Florida Panthers. J. Wildl. Dis. 36(1):157-160.

Abstract

Serum samples from 28 free-ranging Florida panthers (*Puma concolor coryi*) and seven mountain lions from Texas (*P. concolor stanleyana*) living in south Florida (USA) between 1997 to 1998 were tested for antibodies to *Bartonella henselae*. Twenty percent (7/35) of the samples were reactive to *B. henselae* antisera with a subspecies prevalence of 18% (5/ 28) for Florida panthers and 28% (2/7) for cougars from Texas (USA). There was not a significant sex related difference in infection rates among the Florida panthers. Antibody prevalence was higher in panthers <2-yr of age (40%) compared to panthers >2-yr (13%). Compared to studies of antibody prevalence in mountain lions (*P. concolor*) from California (USA), overall seroprevalence was lower as was prevalence in panthers >2-yr-old. However, the seroprevalence in animals <2-yr from southern Florida was similar to prevalences reported in mountain lions or domestic felids in California.

Rotstein, D.S., S.K. Taylor, G.D. Bossart and D. Miller. 2000. Dissecting Thoracoabdominal Aortic Aneurysm in a Free-ranging Florida Panther (*Felis concolor coryi*). J. Zoo and Wildlife Medicine 31:208–210.

Abstract

A 12-yr-old female free-ranging Florida panther (*Felis concolor coryi*) was found dead in good flesh. The panther had a ruptured thoracoabdominal aneurysm and 0.5 L of unclotted blood in its thorax. Intimal plaques 6.0 X 3.0 X 3.0 cm and 4.0 X 3.0 X 1.0 cm were present in the thoracic and abdominal aorta extending below the bifurcation of the

renal arteries. Histologic examination revealed necrohemorrhagic aortitis with a mixed inflammatory infiltrate of lymphocytes, macrophages, and neutrophils. Death was almost certainly due to exsanguination and hypovolemic shock secondary to the ruptured aneurysm, and the aortitis with the resultant aneurysm may have been secondary to an infectious or a toxic process. This is the first reported death of a free-ranging mammal from a ruptured aortic aneurysm.

Rotstein, D.S., S.K. Taylor, A.Birkenhauer, M. Roelke-Parker and B.L. Homer. 2002. Retrospective Study of Proliferative Papillary Vulvitis in Florida Panthers. J. Wildl. Dis. 38(1):115-123.

Abstract

Proliferative, papillary vulvitis was identified in 16 of 34 (47%) free-ranging and captive female Florida panthers (*Puma concolor coryi*) monitored over a period from 1983-98. Gross lesions were characterized by extensive papilliferous proliferation in the mucosa of the vestibulum vaginae. Within lesions, the mean length and width of vestibular papillae were 1.07 +/- 0.39 mm (CV = 36%) and 0.55 +/- 0.11 mm (CV = 20%) respectively. Histologically, three to 12 layers of non-cornified stratified squamous epithelium with various degrees of basal cell spongiosis and rete ridge formation covered fibrous papillae. Mixed leukocytic mucosal inflammation also was observed. Infectious organisms were not observed, and immunohistochemical testing for the presence of papillomavirus antigens in specimens from seven panthers was negative. Lesions in nearly all of the panthers were first observed during a six-year period (1986-92), with one each in 1983, 1996 and 1998. There were no significant differences between the number of females having litters, the number of litters between age-matched and interval-matched females, and the interval between litters among lesions positive and lesion negative females over the 15 yr period. The severity of lesions did not appear to differ between parous and nulliparous free-ranging lesion-positive females. The cause of proliferative vulvitis remains unknown. However, the lesion did not appear to have a significant effect on reproduction.

Rubin, E., W. Boyce, C. Hayes, S. Torres, and M. Jorgensen. 1997. Mountain Lion Predation on Bighorn Sheep in the Peninsular Ranges of California. Page 92 in W.D. Padley, ed., Proc. Fifth Mountain Lion Workshop: 27 February- 1 March 1996; San Diego, California.

An investigation of cause-specific mortality among 91 radio collared bighorn sheep was conducted from November 1992 through January 1996 in the Peninsular Ranges of southern California. Mountain lion predation was the most significant cause of mortality and accounted for 63% (27/43) of all mortalities in the 6 sheep populations included in the study. Lions accounted for 0-100% of all mortalities within these populations, and 0-27% of the radio collared sheep within any given population were killed by lions annually. The age at capture of the sheep varied significantly among populations, and the age distribution of sheep killed by lions did not appear to differ from this pattern. Sheep of both sexes were preyed upon by lions but a statistical comparison between sexes was not possible because only a small number of rams were radio collared. Predation occurred during all times of the year except for the months of June, July, and August. Sixty-seven percent (18/27) of the predation events occurred between December and March. It appears that lion predation has been a significant limiting factor during the past three years, and sustained high levels of predation by lions may adversely affect the long-term viability of this threatened metapopulation of bighorn sheep.

Russ, W.B. 1988. Status of the Mountain Lion in Texas. Pgs. 30-31 In: R.H. Smith (ed.), Proc. of the Third Mountain Lion Workshop. Arizona Chapter, The Wildlife Society and Arizona Game and Fish Department, Prescott, Arizona. 88pp.

The mountain lion is classified a nongame mammal and is not subject to any specific protective regulations in Texas. Lion numbers were considered to be increasing statewide due to changing land use and the public's perception toward predators. Data was not sufficient to make a reliable statewide estimate of lion numbers. Lion sightings had been documented throughout the state except for the northern portion of the Panhandle.

Russ, W.B. 1995. The Status of Mountain Lions in Texas. Proc. Annu. Conf. Southeast Assoc. Fish and Wildl. Agencies 49:545-551.

The mountain lion (Felis concolor) is legally classified as a nongame mammal in Texas within the broad scope of

wildlife regulatory authority delegated to the Texas Parks and Wildlife Department. Lions are not subject to any specific protective regulations; however, mountain lions are recognized as an important part of the native fauna of Texas. The Department is currently collecting mortality and sighting data by ecological region to determine current distribution and population status of Texas lions. Sighting data are reported by county with the date, number and estimated age of lions, and location. Mortality data includes the above information plus weight, length, and reason for death. Over 1,500 mortalities and 1,400 sightings were reported from 1983 to 1994. Sightings were recorded in all ten ecological regions and mortalities in all ecological regions except the Blackland Prairies and Post Oak Savannah. Most sightings and mortalities have occurred in the Trans-Pecos Ecological Region. Texas mountain lion management addresses a wide spectrum of issues including their impact on domestic livestock, wildlife, and encounters with human beings; while filling an ecological role as one of the largest predators in Texas and providing sport hunting opportunities.

Russell, D.N. 1971. History and Status of the Felids of Texas. Pgs. 53-58 In: Jorgensen, S.E. and L.D. Mech. Proc. of a Symposium on the Native Cats of North America, Their Status and Management. U.S. Dept. Int., Fish and Wildlife Service, Twin Cities, Minnesota.

Mountain lions once ranged throughout the southern two-thirds of the state, but is now confined to rugged parts of the Trans-Pecos and South Texas with scattered animals along the Balcones Escarpment and Edwards Plateau. Lions were found in the densely forested swamps of eastern Texas before the turn of the century (possibly Felis c. coryi). It was estimated that only 65-135 lions reside in the entire state, with the Trans-Pecos region probably containing the highest densities. However, many of these animals are transients from the mountains of Mexico. Other populations probably exist in other mountainous areas, but all are confined and not allowed to expand into the lower lands due to heavy trapping and hunting pressures. The South Texas Brush Country probably contains the largest remaining populations within the state, and is estimated to contain no more than 50 animals and is by no means stable or secure. A small breeding population of 5-10 animals may still exist in the Possum Kingdom section west of Fort Worth near Possum Kingdom Lake. Without a doubt, predatory animal control efforts have contributed to the decline of mountain lions within the state. Trappers have pursued the mountain lion over half a century, with major efforts being confined largely to protecting sheep and goats. Lions were bountied in two counties at $15 and $50.

Russell, K.R. 1978. Mountain Lion. Pgs. 207-225 In: J.L. Schmidt and D.L. Gilbert (eds.), Big Game of North America: Ecology and Management. Stackpole Co., Harrisburg, Pa. 494pp.

The mountain lion is described and many previous authors are cited. Mountain lion ecology, distribution, habitat, food habits, movement, reproduction, mortality, diseases, parasites, behavior, natural competitors, density, abundance, and management options are discussed.

Russo, J.P., and J.N. Carr. 1970. Status of the Lion in Arizona and Its Future. Annual Proc. Western Assoc. of State Game and Fish Commissioners 50:387-403.

The history of the cougar in Arizona is provided. From 1948 through 1969, bounties totaling $350,685 were paid on 4957 lions. In addition, 237 lions were reported taken on the Fort Apache Indian Reservation and 233 from other areas in the state by the Division of Wildlife Services, Bureau of Sport Fisheries and Wildlife. Total removal for the period of 22 years was 5454 mountain lions. Maximum number removed in any one year was 330 in 1964. The largest number of lions bountied in one year was 286 in 1965, and the smallest number was 181 in 1951. The average take from 1948 through 1969 is 247 lions per year. The bounty system was established in 1947 with the Livestock Sanitary Board paying a reward of $50 for each mountain lion. Payment varied up to $100 in the following years.

Rusz, P.J. 2006. Evidence of Cougars in Michigan: An Historical Summary. Pages 59-65 in H.J. McGinnis, J.W. Tischendorf and S.J. Ropski editors. Proceedings of the Eastern Cougar Conference 2004, Morgantown, West Virginia, USA.

Abstract

The cougar was thought by wildlife officials to have been extirpated from Michigan by the early 1900s. However, a

recent study confirmed the presence of cougars in multiple areas with long histories of cougar sighting reports. The purpose of this paper is to review the milestones in the history of cougar evidence in Michigan. Physical evidence and events that seemed to influence public policy and/or led to hypotheses about the animal's status are emphasized. The r media, law enforcement agencies, and professional biologists in collecting and synthesizing information are discussed.

Rusz, P.J. 2006. Methods For Detecting Cougars In The Great Lakes Region. Pages 119-123 in H.J. McGinnis, J.W. Tischendorf and S.J. Ropski editors. Proceedings of the Eastern Cougar Conference 2004, Morgantown, West Virginia, USA.

Abstract

A relatively modest search for cougars during the warm weather periods of 2001 resulted in the discovery of physical evidence of at least 9 cougars on both the Upper and Lower Peninsulas of Michigan. Since then, cougars have been detected at many other sites. The author's team first familiarized themselves with sign of cougars in captivity. Then they searched a 33-mile stretch of beach and dunes near Seul Choix Point in the Upper Peninsula's Schoolcraft and Mackinac counties. This area was selected for the first search because suitable tracking surfaces are scarce in Michigan. After successfully finding tracks, scat and deer kills here, many other areas were searched. Areas in which cougars have been sighted should be selected for searches rather than remote areas picked at random. Walking transects is a very poor way to search for cougar sign because cougars have predictable travel routes. The best time to search for scats is in the spring because scats that had been buried in snow rapidly deteriorate after they thaw out. Observations of tracks of captive cougars showed that the appearance of tracks varies markedly on various substrates. The scats of wolves and cougars are compared. Cougar scats have a strong "cat" smell. Remote cameras and scent posts are much less effective than searching for sign.

Ruth, T.K., J.M. Packard, and J.R. Skiles. 1991. Mountain Lion Use of an Area of High Recreational Development in Big Bend National Park, Texas. Pg. 20 In: Mountain Lion-Human Interaction Symposium, C.E. Braun (ed.). Col. Div. Wildl., Denver. 114pp.

Although mountain lions are ecologically important in national parks and can enhance recreational values for visitors, close association of mountain lions with humans can also cause conflict. Spatial data collected on 12 adult and 10 young (kitten to subadult) mountain lions on Big Bend National Park (1984-1990) indicate that adult mountain lions used human recreational areas with little or no interaction with people. Subadult mountain lions were the age group most likely to come into contact with humans. Movements of a reproductive female (Basin female) and her subadult daughter were monitored through monthly 72-h radio-tracking sessions. Mountain lion movements in recreational development areas were analyzed by season, subadult dispersal, and day versus night use. The Basin female spent most of her time in areas of low recreational development. She moved into the area of highest recreational development in the Chisos Basin during the cold dry period when her offspring were in transition from dependency to dispersal (14-16 months old). In contrast to her mother, the subadult female did not avoid the area of highest recreational development early in her dispersal. Incidents of mountain lion-human interactions occurred in the Chisos Basin campground and backcountry, and on the Basin Loop trail. Forty-eight alternative management actions were identified and evaluated. Proactive management with education of park residents and visitors and continued monitoring of mountain lions in the Chisos Mountains were recommended.

Ruth, T.K., K.A. Logan, L.L. Sweanor, J.F. Smith, and L.J. Temple. 1993. Evaluating Mountain Lion Translocation. Final Report. USFWS Grant Agreement No. 14-16-0009-91-1216. 49pp.

Thirteen mountain lions with a known social and behavioral history were translocated an average of 477 km from the San Andres Mountains in south-central New Mexico to 8 release sites in northeastern New Mexico. The mountain lions were captured, transported and released at separate times over a 7 month period (9 December 1990 through 22 June 1991) and radio-monitored through 7 January 1993. The average number of days that the mountain lions remained near (less than or equal to 7 km) their release site was 8 days for females and 4 days for males. Initial movement directions away from release sites ranged from 22 degrees to 313 degrees and were uniformly distributed about a 360 degree circle (P>0.50). Eight (4F:4M) mountain lions had an endpoint >40 km from their release site and had endpoint directions that were almost exclusively south, southwest, or southeast (X = 181 degrees, range = 116 degrees to 237 degrees). Endpoint directions were not uniformly distributed about a 360 degree circle

(0.002<P<0.0005). Two males returned to their original home ranges in the San Andres Mountains. Distances moved from release sites to endpoints ranged from 3-285 km (X = 133.8 km) for females and 11-494 km (X = 254.0 km) for males. Three of 13 (23.0%) translocated lions (all females) established home ranges within 9 km, 19 km, and 84 km of their release sites. Five of 13 (38.5%) established home ranges at distances 176 km to 285 km from their release sites. Two female mountain lions that established home ranges near their release sites had litters of kittens. Mortality was 69.2% during the 2 year study. Establishment success near release sites was most successful for lions that were less than or equal to 2 years old (60.0%). Translocation of "problem" mountain lions to acceptable areas away from livestock and human-use areas may be successful as a large percentage of lions involved in interactions with humans were in the less than or equal to 2 year-old age class. Translocation of mountain lions for reintroduction purposes will require a high cost per effort for establishment success. The high, predominately natural mortality of the mountain lions we translocated will probably be compounded by human induced mortality associated with states, such as eastern states, that have high human densities. Several translocation/release attempts over a long period of time may provide the greatest chance of establishment success for reintroduction and/or population augmentation purposes. The maintenance of existing areas of habitat and large connective corridors for travel should be considered as part of a long-term management program for mountain lions as habitat conservation will ultimately be easier to achieve and less costly than trying to maintain populations through translocations.

Ruth, T.K., K.A. Logan, L.L. Sweanor, M.G. Hornocker, and L.J. Temple. 1997. Orientation, Movements, and Survival of Translocated Cougars in New Mexico. Pages 92-93 in W.D. Padley, ed., Proc. Fifth Mountain Lion Workshop: 27 February- 1 March 1996; San Diego, California.

We conducted a 2-year study of wild-caught translocated cougars to evaluate translocation as a management tool to: 1) re-establish cougar populations in historic ranges, 2) relieve the threat of inbreeding in isolated populations, and 3) manage nuisance cougars. Our objectives were to document orientation, movements, establishment, and survival of translocated cougars and to make comparisons with similar parameters for cougars in a reference population. Thirteen cougars were translocated an average of 477 km from the San Andres Mountains (SAM) study area in south-central New Mexico to 9 release sites in northeastern New Mexico and were monitored from 9 December 1990 through 7 January 1993. A fourteenth cougar was translocated 338 km from the SAM to northwestern New Mexico on 8 April 1989 and monitored to 29 May 1990. Initial orientation of cougars away from release sites ranged from 22 degrees-313 degrees and was uniformly distributed about a 360 degree circle. Eight (4M:4F) of 14 cougars had endpoints > 80 km from their release sites and endpoint directions that were almost exclusively south, southwest or southeast (x=181 degrees), suggesting the cougars homed toward the source population. Two males returned to their original home ranges in the SAM. Distances moved from release sites to endpoints ranged from 3-285 km for 8 females and 11-494 km for 6 males. Nine of 14 translocated cougars died during the study. Annual survival rates for translocated cougars averaged 0.55 for females and 0.44 for males and were lower for both sexes during the second year of the study. Translocation was most successful with cougars that were 12-27 months of age. For management or conservation programs, we suggest that 12-27 month-old cougars are the best candidates for translocation.

Ruth, T.K. and M.G. Hornocker. 1997. Interaction Between Cougars and Wolves (and a Bear or Two) in the North Fork of the Flathead River, Montana. Page 93 in W.D. Padley, ed., Proc. Fifth Mountain Lion Workshop: 27 February-1 March 1996; San Diego, California.

Cougar (*Puma concolor*) populations exist in all areas of the west where wolf (*Canis lupus*) recovery is proposed or currently underway. As wolf recovery efforts continue, agencies responsible for the management of predator species will need information on how predators such as cougars and wolves interact with one another and the combined effect of predation on ungulate species. Since January 1993 we have radio-marked and monitored a total of 39 cougars in and near areas used by 2 established wolf packs. Cougar winter home ranges overlapped to a high degree with wolf winter use areas and ungulate winter ranges. During winter months, we have documented instances of wolves and bears (*Ursus arctos*) tracking and treeing cougars and displacing cougars from ungulate kills. Three cougars have been killed by wolves or bears during the past 3 years of our study. This paper will present preliminary findings of spatial-temporal relations of cougars and wolves, predation on ungulates, and discuss reproductive success and survival of cougars in the North Fork valley.

Ruth, T.K., K.A. Logan, L.L. Sweanor, M.G. Hornocker, and L.J. Temple. 1998. Evaluating Cougar Translocation in

New Mexico. J. Wildl. Manage. 62(4):1264-1275.

Abstract

We translocated wild cougars (*Puma concolor*) with known social and behavioral histories to evaluate the feasibility of translocation as a management tool to reestablish populations, relieve the threat of inbreeding in isolated populations, and manage problem individuals. Eight female and 5 male cougars 16-108 months old were translocated a mean distance of 477 km from the San Andres Mountains (SAM) study area in southcentral New Mexico to 9 release sites in northeastern New Mexico (NENM) from December 1990 through June 1991 and then radiomonitored through January 1993. Another male cougar was translocated 338 km from the SAM to northwestern New Mexico in April 1989 and monitored until May 1990. Initial movement directions away from release sites were uniformly distributed about a 360° circle. Eight (4 F, 4 M) of 14 cougars had movement end points >80 km from their release sites, and end point directions were generally south, suggesting they homed toward the source population; 2 male cougars returned to their original home ranges. Dispersing cougars from a SAM reference population showed no southerly tendencies. Distances moved from release sites to end points ranged from 3 to 494 km; 4 cougars (3 F, 1 M) established home ranges '84 km from release sites. Mean pretranslocation home ranges were generally smaller than mean posttranslocation use areas. Nine of 14 translocated cougars died during the study. Annual survival rates of translocated cougars did not differ by sex and were lower in 1992 than survival rates of cougars from the reference area. We concluded that translocation was most successful with cougars 12-27 months old.

Ruth, T.K., P.C. Buotte, H.B. Quigley and M.G. Hornocker. 2003. Cougar Ecology and Cougar-Wolf Interactions in Yellowstone National Park: A Guild Approach to Large Carnivore Conservation. Page 122 *in* S.A. Becker, D.D. Bjornlie, F.G. Lindzey, and D.S. Moody, eds. Proceedings of the Seventh Mountain Lion Workshop. Lander, Wyoming.

Abstract

Successful restoration of large carnivores in the Northern Rockies and the concomitant increase in carnivore abundance and distribution will challenge humans as human development increases throughout the West. Presently, there is little understanding of how reintroduction/reestablishment of endangered large carnivores (wolves and grizzly bears) may affect the population characteristics, distribution, and behavior of other large carnivore populations, such as cougars. If restored wolves limit cougar populations in number or distribution, this limitation may have synergistic effects with current relaxation of cougar hunting regulations and rapid development. An added stress such as low prey availability (e.g. caused by hard winter or disease) could further impact populations. Understanding competitive relationships between large carnivores and the role that habitat and prey availability play is paramount to predicting and preparing for changes in the Greater Yellowstone region. In order to assess population-level effects of wolf (*Canis lupus)* reestablishment on cougars (*Puma concolor*) in and near Yellowstone National Park (YNP), we initiated a Phase II study of YNP cougars in 1998. The study is designed to examine the characteristics of the cougar population including: sex and age structure, density, reproductive and survival rates, dispersal and recruitment events, rate of predation on prey, and spatial and temporal movements. These parameters will be compared with analogous estimates made prior to the wolf restoration event in 1995 (Phase I data, Murphy 1998) and similar parameters documented for the wolf population to assess competition and resource partitioning between the two species. During 1998-2002, 56 cougars were captured in and adjacent to areas used by 35-88 wolves within 3-5 wolf packs on the Northern Yellowstone Study Area, Montana and Wyoming. A sample of 3 to 10 radio-collared wolves was maintained within each wolf pack by the Yellowstone Wolf Restoration program. In this paper we summarize current research findings relative to cougar population changes pre- and post-wolf reintroduction, species interactions, and discuss future study direction.

Ruth, T.K., P.C. Buotte, K.M. Murphy and M.G. Hornocker. 2003. Cougar Predation on Prey in Yellowstone National Park: A Preliminary Comparison Pre- and Post-Wolf Reestablishment. Page 126 *in* S.A. Becker, D.D. Bjornlie, F.G. Lindzey, and D.S. Moody, eds. Proceedings of the Seventh Mountain Lion Workshop. Lander, Wyoming.

Abstract

On Yellowstone National Park's Northern Range cougars and wolves rely on economically important prey species, particularly elk. Understanding how these large carnivores partition prey resources and their combined affect on prey

is important for management and conservation of cougars, wolves, and ungulate species. As part of a cougar-wolf interactions study, we quantified predation rates and prey selection by cougars on Yellowstone's northern range prior to (Phase I) and post wolf (Phase II) reestablishment. During Phase II, cougars spent an average of 3.7 days at kills and 4.4 days between each kill. The mean annual rate of cougar predation in Phase I was 9.4 (SD = 4.0; 95% CI = 7.8 to 11.0) days per ungulate kill, and 10.9 (SD = 8.5; 95% CI = 6.7 to 15.1) days per ungulate kill in Phase II. Rate of predation varied by cougar social class. When converted to biomass killed per day, cougars averaged 12.2 kg per day during Phase I and 12.9 kg per day during Phase II. We documented a total of 306 and 256 positive and probable cougar kills during Phase I and Phase II, respectively. During Phase II, 70% (n = 179) of cougar kills were elk, 17% (n = 43) were mule deer and 13% (n = 34) were other prey. During both Phase I and II more than 50% of cougar kills were elk calves, with cow elk making up the next largest category. During Phase I, cougar predation was neither a major source of mortality nor a significant factor limiting the numbers or growth rates of elk and mule deer populations in northern Yellowstone. Cougars present on the study area killed 2-3% of the elk and 3-5% of the mule deer estimated to be available during 5 years spanning the Phase I study. Simultaneous to our Phase II study, the Yellowstone Wolf Project quantifies wolf predation rates and prey selection. Cougars killed proportionally more elk calves and fewer bull elk than wolves between 1998 and 2002. We are continuing our data collection and analyses and plan to: 1) compare cougar and wolf per capita rate of predation, 2) contrast femur marrow fat content of cougar and wolf kills, by season killed and prey age, and 3) compare yearly off-take of elk and mule deer by cougars and wolves. Cougar per capita predation rate averaged across social classes was 0.06 kills/cougar/day. When kittens were included with maternal females, that group had the lowest predation rate of 0.01. Without including kittens, maternal females averaged 0.15. Subadult males had an equally high rate of 0.15. Wolf predation ranged from 0.03 to 0.078 kills per wolf per day (Smith et al., In Press).

Ruth, T.K., K.M. Murphy and P.C. Buotte. 2003. Presence and Movements of Lactating and Maternal Female Cougars: Implications for State Hunting Regulations. Page 144 *in* S.A. Becker, D.D. Bjornlie, F.G. Lindzey, and D.S. Moody, eds. Proceedings of the Seventh Mountain Lion Workshop. Lander, Wyoming.

Abstract

Established in the early 1970's, the regulation of cougar harvest through hunting seasons and quotas contributed to increases in cougar abundance and distribution in most western states during the past 30 years. Today, 10 of 12 western U.S. states regulate cougar harvest through hunting seasons and quotas, which vary by state, year, and in season length and quota numbers. California prohibits cougar hunting and Texas allows unlimited hunting and therefore lacks regulations. Three of 11 states that allow cougar hunting regulate the harvest of female lions through subquotas. Two states that do not regulate female harvest do not allow the use of hounds for hunting cougars. Hunting regulations in 9 of 11 states prohibit killing spotted kittens and females with spotted kittens. Only one state, Montana, requires hunters to backtrack lactating females that have been killed in order to locate dependent young. While regulations prohibiting the take of maternal females and affording protection to nonmaternal females through subquotas should remain in place, little information has been provided to hunters, guides and outfitters, or state managers on the proportion and movements of lactating and maternal females which may be encountered during hunting seasons. We examined reproductive data for a moderately hunted cougar population (1988-1992) and a primarily non-hunted population (1998-2002) on the Northern Range of Yellowstone National Park. Proportion of females with dependent (pre-dispersal) offspring was calculated across winters. We summarized breeding, denning, and lactation chronology for maternal females from both study periods. Peak breeding occurred in March through May and denning followed approximately 3 months later, peaking in June through August. Given a 4-month lactation period, proportion of lactating females (n = 19 known date births or births estimated to <1 month) was at a peak in July and declined to zero by January each year. During all winter hunting months combined (September through April, 1999-2002) the proportion of females with dependent young < 18 months of age was 56% (range = 45 – 70%); females with kittens <1 year was 40% (range = 18 to 60%) and the proportion of solitary females was 44% (range = 30 to 56%). Our data suggest that female cougars are solitary (without dependent young) for 18 to 35% (95% CI) of their reproductive life, and with dependent young for 65 to 82% (95% CI) of their reproductive life (calculations based on a 10.5 year reproductive life assuming survival to 13 years of age). Although female cougars may care for young for 44-82% of their reproductive life, detection of kitten tracks with the mother is low. Kittens traveled with their mother proportionally less during their first year of life than during their second year of life and detection of kittens is often possible only through extensive backtracking. Although estimates likely differ for hunted cougar populations, we suggest this type of information for various geographic regions should be provided to hunters and state game

managers and that conservative approaches in setting sport hunting regulations should be considered.

Ruth, T.K., M.G. Hornocker, K.E. Kunkel and D.H. Pletscher. 2005. Patterns of Resource Use Among Cougars and Wolves in Northwestern Montana and Southeastern British Columbia. Pages 173-174 *in* R.A. Beausoleil and D.A. Martorello, editors. Proceedings of the Eighth Mountain Lion Workshop, Olympia, Washington, USA.

Abstract

As reintroduced wolves expand their range in human-altered landscapes, they may overlap extensively with cougars in areas where prey are available to both species. Understanding the extent to which these two carnivores partition or compete for space, prey, and habitat will enhance management of both species. We used radio-telemetry to examine winter and summer spacing patterns, habitat use of sympatric cougars and wolves in the North Fork of the Flathead River (NFF), Montana and British Columbia between 1993 and 1997. Nine to 15 adult cougars and two to five wolves within each of the 3 wolf packs were radio-collared each year. Cougar and wolf home ranges (95% fixed kernel) were similar in size during winter (139-266 km^2 and summer (194-523 km^2) and overlapped more during winter (43%) than during summer (27%). Cougars and wolves used seasonal overlap areas differently than expected by chance; they did not avoid the overlap area during winter. Simultaneously monitored cougars and wolves that occupied overlapping home ranges were not closer than expected by chance (13 of21 combinations). Two cougars were closer and 6 cougars were farther away than expected. We used 399 winter and 595 summer relocations of 13 adult cougars and 336 winter and 350 summer relocations of 2 wolf packs to evaluate habitat use. Using compositional analysis we found cougars and wolves did not use habitat compositions in the NFF in proportion to availability at the within home range (3^{rd} -order) level of comparison. Both species preferred coniferous and deciduous cover and habitats 200-500 m from water and >500 m from roads during winter and summer. Study area cougars and wolves used southeast-southwest facing aspects during winter; however, cougars preferred slopes >15% and wolves preferred slopes <5%. We found little evidence that cougars and wolves partitioned habitat compositions at the 2^{nd}-order or 3^{rd}-order scale of selection during winter or summer, with the exception of slope: wolves preferred lower slopes than cougars at both levels of selection. Our daytime locations indicated high overlap in use and a lack of partitioning of habitat compositions by cougars and wolves, particularly during winter. We documented interference competition between cougars and wolves (50 interactions) during winter months, including wolves chasing and treeing cougars, wolves displacing cougars from kills, and wolves killing 2 cougars. In the North Fork, seasonal changes greatly influenced the potential for interference and exploitation competition between cougar and wolves. Greater overlap and greater use of overlap zones by both cougars and wolves during winter was likely influenced by prey distribution, which brought these two carnivores into close spatial arrangement. Spatial overlap was relaxed during summer months and availability of a greater diversity of prey during this time may enhance cougar and wolf coexistence from year to year. We speculate that the presence of wolves combined with declining prey numbers may have reduced the carrying capacity of cougars and their numbers may stabilize at some level below those that occurred prior to wolf occupation.

Ruth, T.K., P.C. Buotte, M.A. Haroldson, K.M. Murphy, M.G. Hornocker and H.B. Quigley. 2008. Cougar Reproduction and Survival Pre– and Post–Wolf Reintroduction in Yellowstone National Park. Pages 150-151 in Toweill, D. E., S. Nadeau and D. Smith, editors. Proceedings of the Ninth Mountain Lion Workshop, May 5-8, 2008, Sun Valley, Idaho, USA.

Abstract

Wolves interact with a variety of carnivore species and their reestablishment may affect population dynamics of other carnivores, as well as alter carnivore community structure. Information regarding how wolf reestablishment influences reproductive and survival rates of sympatric cougars has not been documented, yet is relevant to cougar management and conservation in many western states. We assessed changes in reproductive parameters, survival rates, and factors affecting survival of cougars prior to (1987–1994) and after (1998–2005) wolf reintroduction in Yellowstone National Park. We radio-marked 80 cougars including 55 kittens in 24 litters in the pre-wolf (PW) study and 83 cougars

including 52 kittens in 24 litters during wolf presence (WP). Size of nursing litters (<9 weeks old; mean ± SD) was similar between PW (2.8 ± 0.7, n = 16 litters) and WP (2.9 ± 0.8, n = 14 litters) studies. Sex ratio of 15 nursing litters (<8 weeks of age) was female-biased (21 females:15 males) during the PW study and was male-biased (15 females:21 males) in 13 nursing litters in the WP study, but were not significantly different (Chi-square test, P = 0.157). Kittens reached independence and dispersed from their mothers at approximately 5-months older (Mann-Whitney test, P = 0.000) during the WP phase: age at independence averaged 12.8 ± 3.2 months (n = 27) during the PW study and 17.1 ± 3.2 months (n = 29) after wolf reintroduction. Age at dispersal also differed between the two phases (Mann-Whitney test, P = 0.000) and averaged 13.2 ± 2.6 months (n = 22) during the pre-wolf study and 18.2 ± 3.4 months (n = 25) after wolf reintroduction. Female cougars whose offspring survived to dispersal age had a longer mean interval between litters (Wilcoxon test, P = 0.013) during wolf presence (21.7 ± 7.5 months, n = 6 intervals for 4 females) than before wolf presence (12.7 ± 2.1 months, n = 8 intervals for 6 females). We used program MARK to estimate survival rates and multi-model inference to assess a number of predictive models of survival relative to explanatory covariates for cougar demography (birth pulse, age class, dependent young), cougar and wolf density, ungulate biomass, winter severity, rainfall, total homes, road density, escape cover, wolf use, and land management area. Although there were some differences in survival rates for adults, subadults, and kittens, the study phase and wolf use and density were not important predictors of survival in our models. Model results indicate that survival of adult and independent, pre-dispersal cougars was influenced by (1) sex – females had higher survival rates than males; (2) age – females between 1 and 10 years of age had survival >0.80, males 3–8 yrs. old had survival of 0.7–0.8; (3) road density during the cougar hunting season – survival declined with an increasing density of km of road/km^2 during the cougar hunting season (Dec–Feb); and (4) elevation – cougars had highest survival at higher elevations. For kittens, results indicate that survival was influenced by (1) age – survival increased rapidly and asymptotes around 0.90 between 0.6 to 0.7 years of age; (2) season – survival was lower during winter; (3) elk calf biomass – survival increased with increasing minimum estimates of calf biomass; and (4) adult male density – kitten survival increased with adult male density (an index of male stability in our studies). Many of the differences in reproduction and survival between the two study phases are consistent with density-dependent influences. Although wolf use and wolf density were not important predictors of survival, cougars responded to wolf presence through spatial shifts which may influence intraspecific strife, reproduction, and possibly survival when examined on a longer time frame than our study.

Ruth, T.K., P.C. Buotte and H.B. Quigley. 2010. Comparing Ground Telemetry and Global Positioning System Methods to Determine Cougar Kill Rates. J. Wildl. Manage. 74(5):1122-1133.

Abstract

We assessed whether use of 2 methods, intensive very high frequency (VHF) radiotelemetry and Global Positioning System (GPS) cluster sampling, yielded similar estimates of cougar (Puma concolor) kill rates in Yellowstone National Park, 1998–2005. We additionally determined biases (underestimation or overestimation of rates) resulting from each method. We used modeling to evaluate what characteristics of clusters best predicted a kill versus no kill and further evaluated which predictor(s) minimized effort and the number of missed kills. We conducted 16 VHF ground predation sequences resulting in 37 kill intervals (KIs) and 21 GPS sequences resulting in 84 KIs on 6 solitary adult females, 4 maternal females, and 5 adult males. Kill rates (days/kill and biomass [kg] killed/day) did not differ between VHF and GPS predation sampling methods for maternal females, solitary adult females, and adult males. Sixteen of 142 (11.3%) kills detected via GPS clusters were missed through VHF ground-based sampling, and the kill rate was underestimated by an average of 5.2 (95% CI = 3.8–6.6) days/kill over all cougar social classes. Five of 142 (3.5%) kills identified by GPS cluster sampling were incorrectly identified as the focal individual's kill from scavenging, and the kill rate was overestimated within the adult male social class by an average of 5.8 (95% CI = 3.0–8.5) days/ungulate kill. The number of nights (locations between 2000 hours and 0500 hours) a cougar spent at a cluster was the most efficient variable at predicting predation, minimizing the missed kills, and minimizing number of extra clusters that needed to be searched. In Yellowstone National Park, where competing carnivores displaced cougars from their kills, it was necessary to search extra sites where a kill may not have been present to ensure we did not miss small, ungulate prey kills or kills with displacement. Using predictions from models to assign unvisited clusters as no kill, small prey kill, or large prey kill can bias downward the number of kills a cougar made and bias upward kills made by competitors that displace cougars or scavenge cougar kills. Our findings emphasize that field visitation is crucial in

determining displacement and scavenging events that can result in biases when using GPS cluster methods in multicarnivore systems.

Sadleir, R.M.F.S. l966. Notes on Reproduction in the Larger Felidae. Int. Zoo Ybk. 6:184-187.

The following information is entirely based on data collected by keepers in the Lion House of the Zoological Society of London, Regents Park. Females were considered to be in heat on days in which they permitted mounting and copulation by the male. Heat was usually accompanied by increased activity, willingness to be stroked by their keepers, increased rubbing on bars and walls of the cage, and repeated rolling over on their backs. The duration of estrus was taken as the total number of days on which the above behavior was recorded. The interval between the mid-points of consecutive estrus periods is referred to as inter-estrus. The day of conception was regarded as having occurred on the second day of estrus for the purpose of estimating the gestation period since the actual time of conception was not known for species of larger Felidae. A total of eight estrus periods for three female pumas had an average length of 6.6 days (range 4-9). No inter-estrus periods could be calculated because of repeated conceptions. The average length of gestation was 93.3 days.

Salazar, J.L., L. Hernandez and J.W. Laundre. 2003. Evaluation of Habitat Factors that Affect the Abundance of Pumas in the Chihuahuan Desert. Page 123 *in* S.A. Becker, D.D. Bjornlie, F.G. Lindzey, and D.S. Moody, eds. Proceedings of the Seventh Mountain Lion Workshop. Lander, Wyoming.

Abstract

Pumas originally occupied all of Mexico but their current status is not well known. This is especially true in the Chihuahuan desert of Northern Mexico. To manage this species in this area, it is important to have some estimation of their status. To evaluate the status of pumas in this area we need to first identify factors that may contribute to their rarity or abundance. Such factors can be placed into three separate but related groups: habitat quality, prey abundance, and human impacts. To evaluate these various factors, we selected two mountain ranges in the northern Chihuahuan desert where previous work indicated differences in the relative abundance of pumas. The area of low puma abundance was El Cuervo near Aldama, Chihuahua and the area of high abundance was Sierra Rica in the Canyon de Santa Elena protected area. In the field we estimated habitat quality by measuring shrub density, cover, and height. We also estimated prey (wild and domestic) abundance by counting fecal groups along random transects. With the use of GIS technology we assessed human impacts by determining the number of roads, number and size of towns, and overall density of humans in a 20 km radius around each range. Our results indicate that habitat quality was similar between the two areas. However, wild and domestic prey was higher in Santa Elena and all measurements of human impact were higher in El Cuervo. We concluded that habitat quality was not a factor contributing to relative puma abundance. However, the increased presence of and access by humans in El Cuervo is the main contributing factor via illegal hunting of pumas and their prey. Future work will test this hypothesis in other areas of the Chihuahuan desert. If this hypothesis is supported, it indicates that conservation efforts of pumas in Northern Mexico need center on environmental education rather than habitat protection/restoration.

Sanborn, C.C. 1954. Weights, Measurements, and Color of the Chilean Forest Puma. J. Mammal. 35:126-128.

Stuffed skin specimens of four adult female, three immature, and one spotted juvenile Chilean forest puma (F. c. araucanus) were sent to the Chicago Natural History Museum. The specimens are described and information on when the animals were taken is provided.

Sanders, M.R. and J.C. Halfpenny. 1991. Human-Lion Interactions in Boulder County, Colorado: Behavioral Patterns. Pg. 17 In: Mountain Lion-Human Interaction Symposium, C.E. Braun (ed.). Col. Div. Wildl., Denver. 114pp.

SYNOPSIS

Documentation of human-mountain lion interactions, especially in urban settings, is rare. We surveyed Boulder County residents to obtain information about behavioral characteristics of mountain lions in interactions. Starting in January

1985, information was solicited by radio, television, newspapers, and posters. In addition to being questioned about time and locality, respondents were queried about the behavior of mountain lions before and during interactions. Behavioral profiles showed mountain lion activities around humans, the roles of pets and ungulates, and details of human-mountain lion interactions. Mountain lions dominated humans 9% of the time. Interactions were in close proximity to human dwellings, and pets had a role in interactions. Of the 261 records of behavior of mountain lions before the interaction, 31% were near houses. Fifteen percent of the interactions were in urban communities, and 8%, in rural communities. Mountain lions may be more interested in populated areas with pets. Of 71 interactions with pets, mountain lions attacked 61% of the time and killed pets 39% of the time. Only 11% of the times were pets dominant over mountain lions. Human behavior may have altered the responses by the mountain lions. Aggressive actions by humans seemed to control mountain lions. Throwing objects or yelling averted 43% of near-attacks. Mountain lions displayed many behavioral traits in interactions with humans, but no single behavioral characteristic signaled an imminent attack. Vocalization was a warning and not necessarily a signal of attack. More research is necessary to confirm behavioral patterns of mountain lions in interactions with humans.

Sandfort, W.W. and R.J. Tully. 1971. The Status and Management of the Mountain Lion and Bobcat in Colorado. In: Jorgensen, S.E. and L.D. Mech, Proc. of a Symposium on the Native Cats of North America, Their Status and Management. U.S. Dept. Int., Fish and Wildlife Service, Twin Cities, Minnesota.

Mountain lion habitat was best characterized by rocky ledges and pinyon-juniper, ponderosa pine, oakbrush, and other brushland vegetation types. A relatively stable population of mountain lions existed in Colorado and was estimated at a minimum of 613 to a maximum of 726. The annual take had also been relatively stable for many years and averaged 58 animals per year from 1960-1969.

Santos, A.L.Q., S.F.M.de Carvalho and F.M. de Moraes. 2004. Myocardial Bridges in Mountain Lion (Puma concolor, Jardine-1834) (Felidae): A Case Report. Braz. J. Morphol. Sci. 21(4):221-223.

Abstract

In the present study, the myocardial bridges of an adult, female, mountain lion that died of natural causes at the "Parque do Sabiá" Zoo, Uberlândia, Minas Gerais, Brazil were examined. The heart was fixed in a 10% formalin solution and the coronary arteries were injected with neoprene latex 450®. The myocardial bridge is a superficial muscular band that crosses a short segment of the coronary arteries on the epicardium at various locations in the heart. Twelve bridges were seen in this heart. Three crossed the first branch, five crossed the second branch and four crossed the fifth branch of the paraconal interventricular branch of the left coronary artery. The average length of the myocardial bridges was 2.08 mm (range 0.80-3.95 mm), the length of the left ventricle was 58.3 mm. Of the bridges examined 58.3% were in the medial third of the ventricle, 33.3% were in the apical third and 8.3% were in the basal third.

Sass, H.R. 1954. The Panther Prowls the East Again. Sat. Eve. Post. March 13:31.

Several accounts of panther sightings are presented as evidence by the author that the panther has made a comeback in South Carolina and other eastern states.

Sawaya, M.A., T.K. Ruth, S. Creel and S. Kalinowski. 2005. Development and Testing of Non-Invasive Genetic Sampling Techniques for Cougars in Yellowstone National Park. Page 222 *in* R.A. Beausoleil and D.A. Martorello, editors. Proceedings of the Eighth Mountain Lion Workshop, Olympia, Washington, USA.

Abstract

Estimating population size is important to the conservation and management of most carnivore species. Many carnivores, including cougars *(Puma concolor),* are difficult to study due to their low densities and secretive nature. Non-invasive genetic sampling (NGS) has great potential as a tool for population enumeration and monitoring, but to date has not been adequately tested and developed for use on cougars. The Yellowstone Cougar Project provides a

unique opportunity to evaluate NGS methods because of the existence of a "known" population of radio-marked cougars and the high percentage of the total number of individuals (estimated 87%) that are collared in the study area. In January 2003, we initiated a study to test and develop NGS methods. Two methods of sample collection were chosen: 1) snow backtracking was used to find hair and scat along tracks and at bed and kill sites, and 2) hair-snagging stations (hair pads) were used to obtain hair. The Cougar DNA Project focuses on three main questions: 1) Which of the two methods is the better method for obtaining DNA samples using non-invasive methods?; 2) How intensive must sampling be in order to collect samples from a sufficient number of individuals to accurately reflect the true population size?; 3) How reliable is the genetic data that is derived from these samples? During the first sampling period, January-March 2003, field crews established and maintained 365 hair-pad stations, conducted track surveys covering over 950 km, and collected a total of 71 hair samples and 16 scat samples. During December-March 2004, field crews established and maintained 40 hair-pad stations, conducted track surveys covering over 1250 km, and collected a total of 129 hair samples and 18 scats. Backtracking successfully yielded hair or scat samples ~80% of the time when tracking conditions were favorable. The results from the Cougar DNA Project could provide managers with reliable protocols for establishing population-monitoring programs.

Sawaya, M.A., T.K. Ruth and S.T. Kalinowski. 2008. Evaluation of Noninvasive Genetic Sampling Methods for Cougars Using a Radio-Collared Population in Yellowstone National Park. Page 164 in Toweill, D. E., S. Nadeau and D. Smith, editors. Proceedings of the Ninth Mountain Lion Workshop, May 5-8, 2008, Sun Valley, Idaho, USA.

Abstract

Reliable information on populations is essential for the successful conservation and management of many carnivore species. Carnivores such as cougars (*Puma concolor*) are particularly difficult to study due to their large home-range sizes, low densities and secretive nature. The conventional method for monitoring cougar populations involves capture, tagging and radio-collaring, but this method is time-consuming, expensive and logistically difficult. For difficult-to-study species such as cougars, noninvasive genetic monitoring may be a useful alternative. DNA extracted from hair or scat can be used to identify individuals, determine genders and relationships, examine patterns of gene flow and estimate population size. The ability to identify individuals from samples collected though noninvasive sampling methods provides many opportunities for developing population-monitoring tools, but the utility of these survey methods is dependent upon the collection of samples and the accurate genotyping of those samples. In January 2003, we initiated a 3-year study to evaluate the merits of noninvasive genetic sampling methods for monitoring cougar populations in Yellowstone National Park (YNP), USA. The goals of this study were to develop a noninvasive hair sampling method for cougars and to examine the reliability of the genetic data derived from those hair samples. This study was conducted in conjunction with the Yellowstone Cougar Project, a long-term research project on cougars in YNP. We used 2 noninvasive sampling methods concurrently, hair snares and snow tracking, to obtain hair samples from free-ranging cougars in the Northern Range of YNP. We compared the effectiveness of the 2 collection methods to obtain hair samples and produce accurate individual identifications and genders. We also evaluated the accuracy of the noninvasive genotypes by comparing them to genotypes from blood and tissue samples collected during cougar capture. The results from this study show that snow tracking is a better method than hair snaring for collecting hair samples in YNP. The genetic data generated from these samples produced accurate individual identifications and genders.

Scheminitz, S.D. 1972. Distribution and Abundance of Alligator, Bear, Deer, and Panther in the Everglades Region of Florida, Florida Game and Fresh Water Fish Commission. 21pp.

Estimates for the black bear and panther populations in the Everglades were 145 and 92, respectively, based on questionnaires. Higher numbers were recorded for both species in Collier County. The panther had been fully protected in Florida from hunting since 1958. The U.S. Fish and Wildlife Service estimated the statewide population to be 100-300 in 1966. In 1969, there were 125 panthers (one per 10 square miles) in the Big Cypress as estimated by the U.S. Department of Interior. One of the interesting aspects of this study was the frequent reports of black panthers.

Schireman, M.R. 2003. Managing the Captive Mountain Lion Population in North American Zoos. Pages 40-42 *in* L. A. Harveson, P. M. Harveson, and R.W.Adams, eds. Proceedings of the Sixth Mountain Lion Workshop. Austin. Texas.

Abstract

The Studbook Keeper for Cougar in the U.S. and Canadian zoos keeps all of the records for puma that have been held in our member institutions since the first cat entered the Philadelphia Zoo in 1874. This includes causes of death, transfers, Dams and Sires, and places of capture or release where applicable. Subspecies are included when known and all of the Florida Panther that have passed through our institutions. As this species of animal breeds easily in captivity, the Felid Taxon Advisory Group has mandated a temporary breeding moratorium on this population until we can get a handle on their genetic make up. As a result, no litters have been born at our institutions since 1995. An unfortunate result of this moratorium is that attrition is taking hold of our population. As individuals die and exhibits are left empty zoos are asking for help in locating cubs to fill these spaces. While some conservationists would like to see these exhibits filled with other endangered species, the public demands to see predators and the zoogeographic layouts of our zoos demand that they remain North American species. This is where careful genetic pairing of captive animals and placement of wild orphans will save this population. Our goal is to maintain 90% genetic variation in this population for the next 100 years.

Schmidt, J.E. 1986. Mountain Lion Attacks on Humans. Unpubl. Rep., Wildlife Ext., Univ. Ca., Davis. 17pp.

The majority of puma attacks were in tree/wooded areas or thick brush areas. The high number of houses, cabins and people present during many attacks questions the "normal" mountain lion behavior because most cougars are rarely seen and are presumed to avoid civilization. Research indicates that children and adults are not differentially attacked. In this study, only 7 out of 69 attacks were known to be provoked and none of the seven provoked attacks involved children. Data, although incomplete, indicated that 83% of the mountain lions were starved, wounded, or sick. The research in this study was confounded by incomplete information and conclusions were difficult to reach with sparse data that has questionable validity.

Schorger, A.W. 1938. A Wisconsin Specimen of the Cougar. J. Mammal. 19(2):252.

A cougar was killed on November 22, 1857, 2 miles northeast of Appleton, Wisconsin, which measured 7 feet 2 inches in length. The specimen (at Lawrence College) was mounted and measured 27 inches in height at the shoulders and 85 inches in length from the end of the nose to the tip of the tail. Despite conflicting information on the card attached, it appeared that the specimen was the cougar shot in 1857 and insofar as was known was the only Wisconsin specimen of Felis concolor couguar extant.

Schorger, A.W. 1942. Extinct and Endangered Animals of the Upper Great Lakes Region. Trans. Wisc. Acad. Sci., Arts, and Letters 34:23-34.

The cougar (F. c. couguar Kerr) was rare in the Upper Peninsula of Michigan and was last observed about 1850. There were many records from Wisconsin, especially from the Lake Winnebago district and from the valleys of the Chippewa and St. Croix Rivers. The only specimen extant for the entire region was killed in 1857 and was mounted and is located in the museum of Lawrence College at Appleton. The last acceptable record for Wisconsin was a cougar killed near Butternut, Ashland County, in 1884.

Schortemeyer, J.L. 1994. Habitat Management for Panthers in South Florida--An Overview. In: Dennis Jordan, ed., Proc. of the Florida Panther Conf., USFWS. 4pp.

This report examines the important features of panther habitat in south Florida. Panther habitat requirements, pre-Columbian and recent distributions, food habits in relation to panther health and distribution, and habitat management practices which can improve conditions for the panther in the future are discussed.

Schortemeyer, J.L., D.S. Maehr, J.W. McCown, E.D. Land and P.D. Manor. 1991. Prey Management for the Florida Panther: A Unique Role for Wildlife Managers. Trans. 56th N.A. Wildl. and Nat. Res. Conf. 56:512-526.

CONCLUSIONS

Many of the important prey management actions occurred before the welfare of the Florida panther was a concern. Two important prey species are exotics which became established as a result of actions unrelated to Florida panthers. Both wild hogs and armadillos are well established in most currently occupied panther range. Efforts to control or eliminate either species from currently occupied range could have adverse impacts on the panther. In addition, stocking, especially wild hogs, could enhance game abundance, especially in areas where low prey density has been identified as a problem for the panther. The most important action to date has been the protection of over 1,000,000 ha of contiguous landscape in the Everglades/Big Cypress areas. Most of this land is not prime habitat for the panther or its prey (Maehr 1990), and many areas are marginal at best. Nevertheless, there is little question that this large protected area greatly enhances the prospect for successful panther management. Conversely, the loss of habitat due to urban and agricultural development has been widespread. As these losses continue, new management strategies and incentives must be developed to insure that private lands will continue to provide important habitat for panther and their prey. Without effective conservation programs on private lands in southern Florida, the less productive lands in public ownership will be forced to provide a greater proportion of the panther's range. Data-based prey management actions were initiated in southern Florida only in the last decade. Initially, management was regulatory and aimed at minimizing perceived adverse impacts of recreational hunting on both prey and predator. These actions combined with the existing conservative bucks-only harvest strategy have been successful in minimizing the potential adverse impacts of overharvesting deer and hog. Examination of deer herd parameters indicated that productivity and populations are within desirable limits considering the quality of habitat. Higher prey densities may be achieved by improving habitat conditions. Increasing forage quantity and quality is the management option which has the greatest potential in the Big Cypress area. The use of prescribed fire is currently being utilized by most land management agencies primarily to prevent catastrophic wildfires by reducing fuel levels. Only recently have managers of these public lands recognized the potential for improving habitat conditions for wildlife via prescribed fire. In order to provide maximum benefits for deer and other important prey species, burning programs should be designed for these specific purposes. Burns should be conducted on fire tolerant areas on a two- to five-year rotation, depending upon fuel type and site conditions. Burn compartments should be less than 2,500 ha and annual partial compartment burns or rotating burns should be employed when possible to increase habitat heterogeneity. Other habitat management actions may also provide significant benefits for deer and/or hogs. Food plots, clearings and feeders have been effective management tools in local situations. Disturbed sites, particularly those invaded by willows, have produced good forage for deer. Establishment of mast producing species, including oak and palms, on disturbed sites can significantly increase mast production in selected areas. While the present conservative harvest strategy has been effective in maximizing deer numbers, wildlife managers need to retain flexibility in meeting tomorrow's challenges. Changing environmental conditions may lead to excessive fluctuations in prey populations. Increased harvest, including either sex hunts or conversely more conservative strategies, may be needed to provide sustained maximum benefits for panthers and their prey. Current information shows that recreational hunting does not adversely impact deer behavior or deer numbers. However, telemetry data indicates that panthers may be altering use patterns in response to human activity relating to hunting seasons. Recent regulation changes including designated trails, reduced quotas and shortened seasons may reduce these impacts. However, because the cause and effect relationships between panther and human behaviors have not been established, additional research concerning predator, prey and human interactions would be valuable.

Schulenberg, B. 1984. California-Cougar Status Report. Pgs. 23-26 In: J. Roberson and F. Lindzey (eds.), Proc. of the Second Mountain Lion Workshop. Utah Div. Wildl. Res. and Utah Coop. Wildl. Research Unit. Zion National Park. 271pp.

The mountain lion was classified as a bountied predator in 1907. In 1963 it was classified as a nonprotected mammal until 1969 when it changed to game mammal status. In 1972, the Legislature placed a moratorium on the sport take of lions and they could only be taken by depredation permit until January 1, 1986. The lion was distributed over approximately 74,000 square miles (75%) of California and is void only in the Central Valley and Mojave Desert. It was estimated that 2,400 lions occupied California in 1973 with an estimated annual growth rate of 8% per year. The population was approximately 4,800 animals with a range of 4,100 to 5,700 in 1984.

Schulman, F.Y., A.E. Kraft, T. Janczewski, I. Mikaelian, J. Irwin and K. Hassinger. 2003. Cutaneous Fibropapilloma in a Mountain Lion (*Felis concolor*). J. of Zoo and Wildlife Medicine 34(2):179-183.

Abstract

A 12-yr-old mountain lion (*Felis concolor*) developed a 0.5-cm^3 raised nonpigmented and nonulcerated mass between the lip and the nasal planum. The tumor was surgically removed and diagnosed histologically as a fibropapilloma. The tumor recurred 1 yr later, at which time it was again excised, and the diagnosis was reconfirmed by biopsy. Frozen tissue from the second excision was submitted for polymerase chain reaction testing for papillomavirus. The 176–base pair polymerase chain reaction product recovered from the tumor was cloned and sequenced. The papillomavirus had 96% homology with a papillomavirus previously retrieved from a fibropapilloma in a domestic cat and is the next most closely related to bovine papillomavirus type 1. This is the first report of a virus-associated fibropapilloma in a mountain lion.

Scognamillo, D., I.E. Maxit, M. Sunquist and J. Polisar. 2003. Coexistence of Jaguar (*Panthera onca*) and Puma (*Puma concolor*) in a Mosaic Landscape in the Venezuelan Llanos. Journal of Zoology 259(3):269-279.

Abstract

Jaguar *Panthera onca* and puma *Puma concolor* are sympatric throughout the jaguar's distribution. Although several studies have focused on the interactions between these two predators, the ecological and behavioural factors that promote their coexistence remain unclear. The goal of this study was to identify those factors that facilitate the coexistence of these cats in a mosaic landscape in the Venezuelan llanos. The study was conducted from January 1996 until November 1998. Five jaguars and six pumas were captured and radio-collared. A high degree of spatial overlap was observed between jaguars and pumas, which may be related to the abundance and distribution of prey species. At a fine scale, there was little overlap of puma locations with jaguar locations. Both species were more active at night than during daytime, but seasonal differences were detected in the activity levels of these predators. Major segregation was found in food habits. Jaguars selected for large prey and pumas for medium-sized prey. Jaguars selected for capybara *Hydrochaeris hydrochaeris* and collared peccary *Tayassu tajacu* and consumed caiman *Caiman crocodilus* and white-tailed deer *Odocoileus virginianus* less than expected. Pumas selected just for collared peccary and also killed caiman less than expected. It is suggested that the abundance of medium-sized prey is an ecological factor that is facilitating the coexistence of jaguar and puma in the study area. Habitat heterogeneity may be another influential factor leading to the coexistence. Seasonal differences in activity levels probably reflect differences in the size and species of prey taken by these cats.

Scott, W.E. 1939. Cougar or Mountain Lion. Wisconsin Conservation Bulletin 4(10): 25.

Cougars were still in Wisconsin in 1882, with the most recent record being two cougars spotted in Marinette County on January 2, 1909. The most recent record of one being killed was in Douglas County in 1908. The only known specimen of a Wisconsin cougar is mounted in the Lawrence Museum at Appleton and was killed in December, 1857, near Appleton. Nine records of cougars killed or seen in Wisconsin between 1859 and 1878 are cited.

Scrivner, J.H., W.E. Howard, A.H. Murphy and J.R. Hays. 1985. Sheep Losses to Predators on a California Range, 1973-1983. J. Range Manage. 38(5):418-421.

Predation at the University of California Hopland Field Station was evaluated for an 11-year period beginning in 1973. Of those lambs placed on range, averages of 2.7% were killed each year by predators. Averages of 1.5% of the ewes were killed. When the number of missing animals which were killed was estimated, the average annual predation rate for lambs and ewes killed was 10.4 and 3.8%, respectively. For all known ewe and lamb deaths, respectively, 45% and 26% were caused by predators, 14% and 28% died from causes other than predation, and 41% and 46% died from unknown causes. Of those sheep killed by predators, 89% were killed by coyotes (Canis latrans), 8% by dogs, and 1% each by black bear (Ursus americanus), mountain lion (Felis concolor), and golden eagle (Aquila chrysaetos). More sheep were killed by coyotes from October to March than from April to September and the annual number of sheep killed by coyotes and dogs has increased since the beginning of the study. Not including the value of missing animals which were killed, the present value of livestock killed by predators was estimated to be $62,364.

Seagears, C. 1956. Feline Flying Saucer. New York State Conservationist 10(3):48-49.

Apparently the last panther was killed in the 1890's in the Adirondack's. However, numerous reports of recent panther sightings had gained alot of publicity. The author states that panther tracks average 4½ inches or more wide. The distance between tracks when walking would be about 17 inches.

Seal, U.S. and R.C. Lacy, Captive Breeding Specialist Group (SSC/IUCN). 1989. Florida Panther (Felis concolor coryi) Viability Analysis and Species Survival Plan. CBSG, Apple Valley, MN. 264pp.

EXECUTIVE SUMMARY

The objective of this plan is to prevent the certain extinction of the Florida panther and to provide for it's recovery in the wild through the establishment of 130 breeding animals in a combination of wild and captive populations by the year 2000 and increasing to 500 breeding age panthers by the year 2010. Implementations of the captive population recommendations in this plan are contingent upon the continuation and, in some cases expansion, of the existing capture and tracking program. The current wild population is estimated at 30-50 animals. The recommendations in this plan call for: 1) immediate initiation of a captive breeding program as called for in the approved recovery plan dated June 22, 1987; 2) continuation and expansion of management and monitoring of the wild population; 3) continuation and expansion of the reintroduction program and 4) continuation and expansion of the habitat conservation program. The purpose of the captive breeding program is to place in captivity representative individuals from the wild population which would be selectively bred to expand their numbers. This population would serve to enhance the genetic and demographic structure of the Florida panther in captivity and serve as a source of individuals which may be used in prescribed management interventions of the wild population, as well as serve as a source of stock for re-establishment of the panther into its historic range. The captive breeding program would take from the wild 4 adults, and 6 kittens in 1990 and 1 pair of older animals (adults or juveniles) and 6 kittens per year through 1992. The purpose is to obtain genetic representation from each of the known remaining potential founder animals. There are estimated to be 19 potential founder lineages represented in the living wild population. Requirements for additional animals (l pair of older animals and 2-4 kittens per year for 3 years may be needed) in future years (l993-l995) would depend on whether there is sufficient representation of this wild founder stock in the captive population. The captive populations would be managed cooperatively through the Captive Breeding Specialist Group of the IUCN, the participating zoos and the Florida Panther Interagency Committee (FPIC). A SSP working group comprised of biologists from these organizations would work under the leadership of the Technical Subcommittee of the FPIC. All activities would be conducted through the oversight of the FPIC consistent with the approved recovery plan and species survival plan. This approach will allow us to evaluate experimentally the results of the program without an irretrievable commitment of the wild population. An annual meeting would be held to review the past year's results and plan the next year's activities including selection of individual animals for the captive program. This plan will require an initial investment of $50,000 above existing expenditures by the involved agencies. In addition, it will be necessary to construct an expanded conditioning facility at White Oak Plantation over the next 3 years which would cost approximately 200,000. In addition, it is recommended that additional research be funded over the next 5 years to enhance the captive breeding program including: development of reproductive technology to reduce the need for future removals of animals from the wild (Wildt proposal, $136,000 total for 2 years) and 2) genetic investigations to determine lineages of the Florida Panther (O'Brien proposal, $140,000 total for 2 years). The funding of these research proposals is not considered to be a prerequisite to the captive breeding program but could increase its effectiveness in the future. Finally, the participating zoos contribution would be approximately $1,000,000 in facilities and $500,000 per year in operating costs towards the captive breeding program. This major contribution to the public interest should be fully recognized. The result of this investment would be to prevent the certain extinction of the Florida panther and provide for its recovery. Once the objective of 500 breeding adults is achieved, consideration would be given to removing the species from the Endangered Species list. It should be clearly understood that this plan represents a biological compromise necessary that maintains the existing wild population while developing a captive population to ensure long term survival of the taxon. There is a clear biological tradeoff involved. If all the Florida panthers were removed from the wild immediately then there would be less of a loss of genetic diversity because most of the remaining founders would be protected. Our proposed strategy would capture animals at a slower rate over a 3-6 year period and it is likely that mortality of some founders would occur during this time. This loss would be minimal but clearly represents a loss of genetic diversity that could be preserved if all animals were taken immediately. The consensus of the SSP working group members and the Technical Subcommittee was that the more

conservative incremental strategy was an experimental approach that would provide safeguards to the wild population and allow on going evaluation during removal. This consensus on strategy was based on the: 1) ability to protect habitat through regulatory provisions would be compromised by removal of all animals; 2) opportunities to learn more about developmental, social, and behavioral aspects of panther biology that will be important to successful reintroduction would be lost; 3) learned behavioral features, potentially critical to survival in the wild, would be compromised or lost.

Sealander, J.A. 1951. Mountain Lion in Arkansas. J. Mammal. 32(3):364.

The author states that the Arkansas Gazette of December 3, 1949, ran an account of a mountain lion shot about 8 miles west of Mount Ida, Montgomery County, around the latter part of November or early December. A photograph of the animal was taken and secured and revealed the record to be an authentic one. The specimen measured 7 feet in length and weighed 134 pounds according to the author and appeared to be a female from the photograph. The Arkansas Gazette account reports that this mountain lion was the second reported within a week. Another was supposedly trapped by a farmer near Warren, Bradley County, who said that the tracks indicated three more were at large in the vicinity.

Sealander, J.A. 1956. Mammals of Arkansas. Am. Midl. Nat. 56(2):285-286.

The cougar was thought to have become extinct in Arkansas around 1920 when deer populations were low. However, a number of sight records since 1945 and one recorded kill in 1949 indicate that the puma was not completely exterminated. There appeared to be a rise in the puma population corresponding to the increase in deer numbers in Arkansas. Most of the pumas have been reported around areas of heaviest deer concentrations.

Sealander, J.A., and P.S. Gipson. 1973. Status of the Mountain Lion in Arkansas. Proc. Arkansas Acad. Sci. 27:38-41.

Two authenticated kill records of the mountain lion, Felis concolor, in Arkansas are reported as well as numerous reliable sight records spanning an approximately 30-year period. Distribution of sightings in the state is discussed in relation to an expanding deer population. The cougar probably never was exterminated in Arkansas but it still may be considered endangered.

Seidensticker, J.C. IV, M.G. Hornocker, R.R. Knight, and S.L. Judd. 1970. Equipment and Techniques for Radiotracking Mountain Lions and Elk. Idaho Coop. Wildl. Res. Unit, For., Wildl.,and Range Exp. Station, Bull. No. 6. Univ. of Idaho, Moscow. 20pp.

The radio equipment and tracking procedures used to gather quantitative data on the movements and other activities of mountain lions (Felis concolor) and elk (Cervus canadensis) in the mountains of central Idaho are described.

Seidensticker, J.C. IV. 1973. Mountain Lion Social Organization in the Idaho Primitive Area. Ph.D. Thesis. Univ. of Idaho, Moscow. 161pp.

As part of a comprehensive study of mountain lion ecology, the social organization of a lion population in the Idaho Primitive Area was investigated using radio telemetry. The general population dynamics and relationships had been established through recapture methodology over the five previous winters. After independence from the female, mountain lions dispersed showing no attachment to any particular area. The "transient" females did not reproduce, and the "transient" males only rarely bred. When an area adequate in size and resources and free of too many but not independent of other residents was located, the young lion restricted itself more and more to that area. Only with attachment to site did the lion enter the reproductive phase of its life (population component termed "resident"). Home area utilization by resident lions was influenced by the localizing effects of the large ungulate kills and, for females, kitten mobility. The localizing effect of kittens was diminished their second winter; home area utilization by females during these different stages of kitten development differed considerably as a result. In the short run, a lion's home area was in a constant state of flux in terms of location of mule deer and elk (the most important prey resource nine

months of the year) in situations where they could be successfully stalked and killed. But over the long run, the conditions in certain areas were such that lions tended to be more successful there in making kills. This demonstrated the advantage of familiarity with the home area, especially for females rearing kittens. Resident lions occupied fairly distinct but usually contiguous winter/spring and summer/fall home areas. No substantial part of any resident lion's winter home area was maintained to the exclusion of all other conspecifics. Resident male home areas overlapped but little. Those of resident females often overlapped completely and were overlapped by resident male areas. Transient lions of both sexes moved about these areas but did not remain. In summer the pattern was the same. Land-tenure was based on prior right, but the system was not static. Home areas were altered in response to the death or movement of other residents. Young adults established only as vacancies became available. The mountain lion's essentially solitary existence was maintained visually and chemically. A lion's response to close approach of another was dependent upon its population and reproductive status. Over the seven winters from 1965 to 1972, the resident male portion of the lion population remained stable; resident female numbers were constant for three winters but later deaths were never quite compensated. Dispersal of young lions raised on the study area was independent of resident adult density. It was concluded that the lion land-tenure system acted to maintain the density of breeding adults below a level set by the food supply in terms of absolute numbers of mule deer and elk. Variation in lion environmental structure resulted in variation in the suitability of home areas and affected the amount of terrain a resident lion utilized. The amount of terrain used by a resident lion as well as the degree of home area overlap between resident females, i.e., density of breeding population, was set by a vegetation-topography/prey numbers-vulnerability complex. The evolution and adaptive values of mountain lion social organization are discussed.

Seidensticker, J.C. IV, M.G. Hornocker, W.V. Wiles, and J.P. Messick. 1973. Mountain Lion Social Organization in the Idaho Primitive Area. Wildl. Monogr. 35:1-61.

SUMMARY

As part of a comprehensive study of mountain lion ecology, the social organization of a lion population in the Idaho Primitive Area was investigated using radio-telemetry. It was important that general population dynamics and relationships had been established through recapture methodology over the 5 previous winters. The response by mountain lions to investigators depended upon disturbance intensity and the reproductive status of the lion. It was clear from monitoring the movements of radiotagged lions that they did not respond to investigator activities in any way that would bias conclusions. After independence from the female, mountain lion kittens dispersed, showing no attachment to any particular area. The "transient" females did not reproduce, and the "transient" males only rarely bred. When an area adequate in size and resources and free of too many but not independent of other residents was located, the young lion restricted itself more and more to that area. Only after establishment of a home area did the lion enter the reproductive phase of its life (population component termed "resident"). The home area utilization by resident lions was influenced by the localizing effects of the large ungulate kills and, for females, kitten mobility. The localizing effect of kittens was diminished their second winter; home area utilization by females during these different stages of kitten development differed considerably as a result. In the short run, a lion's home area was in a constant state of flux in terms of location of mule deer and elk (the most important prey resource 9 months of the year) in situations where they could be successfully stalked and killed. But over the long run, the conditions in certain areas were such that lions tended to be more successful there in making kills. This demonstrated the advantage of familiarity with the home area, especially for females rearing kittens. Resident lions occupied fairly distinct but usually contiguous winter-spring and summer-fall home areas. No substantial part of any resident lion's winter home area was maintained to the exclusion of all other conspecifics. Resident male home areas overlapped but little. Those of resident females often overlapped completely and were overlapped by resident male areas. Transient lions of both sexes moved about these areas. In summer, the pattern was the same. Land tenure was based on prior right, but the system was not static. Home areas were altered in response to the death or movement of other residents. Young adults established residences only as vacancies became available. The mountain lion's essentially solitary existence was maintained visually and chemically. A lion's response to the close approach of another lion depended upon its population and reproductive status. Females with small kittens were most sensitive to another's presence. Females with large kittens, females without kittens, and males were less disturbed by the presence of another lion. Avoidance between adult males, males and females with small kittens, and females without kittens was total. Over the seven winters (1965-l972), the resident male portion of the lion population remained stable; resident female numbers were constant for three winters but later deaths were never quite compensated. Dispersal of young lions reared on the study area was independent of resident adult density. It was concluded that the land tenure system maintains the density of breeding

adults below a level set by food supply in terms of absolute numbers of mule deer and elk. Variation in lion environmental structure resulted in variations in the suitability of areas and affected the amount of terrain a resident lion utilized. The amount of terrain used by a resident lion as well as the degree of home area overlap between resident females, i.e., density of breeding population was set by a vegetation-topography/prey numbers-vulnerability complex. The form of mountain lion sociality has been molded by a wide variety of factors. In the analysis of its adaptive value, we have considered how reproductive requirements, mobility, mode of prey acquisition, food supply (type, availability, and vulnerability), habitat characteristics, and other predators and scavengers through the energy budget and reproductive success affected social interactions and communications, dispersal, land tenure, and home area utilization.

Seidensticker, J., and S. Lumpkin. 1992. Mountain Lions Don't Stalk People. True or False? Smithsonian 22(11):113-122.

Four Americans have been killed and 14 injured by mountain lions in the past 21 years. On Vancouver Island and the general vicinity of Vancouver, British Columbia, 33 people have been killed or injured since 1916. A symposium on interactions between mountain lions and people was recently held in Denver, Colorado. It was reported that authentic records exist for 53 mountain lion attacks resulting in 11 deaths during the past 100 years. Standing up and "putting on a good face" may deter big cat attacks, whereas bending down and breaking off eye contact may stimulate an attack. It appeared that most people did not want to kill mountain lions but rather wanted information about how to reduce the risks of living around them.

Sharma, D. 2002. Individual-Based Modeling: Comparing Model Outputs to Telemetry Data with Application to the Florida Panther. M.S. Thesis, Univ. Tennesee, Knoxville.

Abstract

Mean distance of the locations of an animal from the boundaries of its home range was presented as a measure of its space-use preference. Methods for evaluating the predictive ability of an individual-based model were also presented. These methods were applied to data on the Florida panther and some interesting results were obtained. A strong negative correlation was observed between age and home range size of the panther, indicating constrained mobility of the panther during its old age. Space-use preference was also highly dependent on age of the panther. A general trend was found for panthers, which indicates they stay away from the boundaries of their home range during old age. It was also observed that sex of the panther and season of the year do not have any effect on the space-use preference. A random movement model was used to simulate panther movement; applicability of this model to panther data was evaluated based upon its ability to depict the animal's space-use preference and shift of activity center over time. It was concluded that comparison of modeled and observed movement data accumulated over a long period of time might give misleading results. Data should be subdivided into different age periods and the model should be tested in each period.

Shaw, H.G. 1971. Ecology of the Mountain Lion in Arizona. Proj. No. W-78-R-15, Wk. Pl. 2, Job 13. Progress Rep., Arizona Game and Fish Dept., 7pp.

SUMMARY

Fifty-four dog-hunting days and 25 trapping days were spent in the vicinity of the Sycamore Canyon study area. No lions were caught. Tracks and other sign indicated that as many as four lions were using the area. The only fresh lion kill found in the study area was a coyote. A freshly-killed yearling cow elk was found outside of the study area near the Beaver Creek watersheds. Helicopter surveys of prey species yielded 84 elk, 363 mule deer, 16 white-tailed deer, and 12 turkeys. Turkey counts were definitely low. At least 200 turkeys were using the area during mid-winter as determined from ground observations. Due to the large number of livestock operators with permits on the Sycamore area, extremely difficult hunting conditions, and the current low density of lions, a change of study areas has been recommended.

Shaw, H.G. 1972. Ecology of the Mountain Lion in Arizona. Proj. No. Arizona W-078-R-16, Wk. Pl. 2, Job 13. 8pp.

SUMMARY

The period reported was from 7-1-71 to 6-30-72. Six lions were marked during this segment. Four of these were fitted with transmitter collars and tracked from airplane for varying lengths of time. Four fresh deer kills and three cattle kills (only one on the study area) were inspected during the winter. Helicopter surveys indicated a density of just under 10 deer per square mile for the study area. Of 15 lion scats collected in Sycamore Canyon, five contained porcupine remains, seven contained deer and three contained squirrel (probably Abert). Of 11 scats from Spider-Cross U, three contained porcupine, five contained deer and three contained cattle remains.

Shaw, H.G. 1973. Ecology of the Mountain Lion in Arizona. Proj. No. Arizona W-078-R-17, Wk. Pl. 2, Job 13. 31pp.

The period reported was from 7-1-72 to 6-30-73. Eight adult lions and three kittens have been captured to date. Of these, four of the adults and two kittens are known to be dead. Two large toms were killed by hunters outside of the study area. A female and her kittens were lost in capturing and handling. A second female died of unknown causes. One hundred thirty-seven radio locations of marked lions have been made. These have disclosed the overall ranges of the lions, but, with a few exceptions, have been of little help in locating kills. The home range of one female covered approximately 26 square miles. Ranges of males have covered 75-100 square miles. One tom is known to have made a long excursion outside his apparent normal range. Of 24 verified lion kills, 13 (54%) were mule deer, and 10 (42%) were cattle. One cottontail rabbit was killed by a large tom but not eaten. Of 26 lion droppings from the present study area, 12 (46%) contained deer remains and 10 (38%) contained cattle. Porcupine and javelina remains also occurred in small amounts, but no rabbit or rock squirrel remains have yet appeared in scats. Deer density estimates ranged from 5-10 deer per square mile depending upon the sampling method used.

Shaw, H.G. 1974. Ecology of the Mountain Lion in Arizona. Proj. No. W-78-R-18, Wk. Pl. 2, Job 13. Progress Rep., Arizona Game and Fish Dept., 5pp.

SUMMARY

Six lions were captured and marked during the past segment. Four (three females and one male) were lions that had not been previously captured. A female was recaptured which had been handled only once very early in the study and had furnished little movement information. A large male was recaptured that had been handled twice during the previous segment. Twelve mature lions have been captured on the study area to date, six toms and six females. Three of the females are known to have had kittens at the time of capture. Radio-tracking equipment operated far more successfully during this segment than last and furnished a total of 364 air-to-ground lion-locations. The total for the study is now 501 lion-locations. One female has now been tracked for eight months. Three other radios are still active and have been functioning for three to six months. Helicopter surveys in January yielded density estimates identical to the previous year (4.8 deer/mi.^{2}). Fawn survival appeared to be slightly improved (54%). Number of sample plots used in the survey was increased from 18 to 27 with little increase in total helicopter time. Success in locating deer or livestock killed by lions improved during the past segment. Nineteen kills were found, bringing the cumulative total for the study to 43; 23 deer, 19 cattle, and one rabbit. Seventeen kills have been attributed to 10 individual marked lions. Of these 10 lions, seven (3 males, 4 females) have been connected with at least one cattle kill, and one (male) with a rabbit. Only two lions (one male, one female) have had both deer and cattle kills attributed to them. Of the deer kills, five were bucks, 10 does, three fawns, and five unclassified. Bucks have thus shown up in the kill slightly in excess of their proportion in the herd. Sample size of kills, however, is still too small to be conclusive. Ages of deer killed have been fairly evenly distributed with three under six months, four yearlings (6 mo. - 1-1/2 yr.), two 1-1/2 - 2-1/2 years, seven 3 - 5-1/2 years, one 6 - 8 years, and three over eight years. Three deer were unaged. Cattle kills have all been in the yearling-or-under age class with the majority of the animals (all but two) under six months of age. Only one animal killed, a deer, definitely had a disabling malformation. This was a crippled leg as indicated by a long, curved, unused hoof. Many of the kills were too fully consumed or decomposed when found to allow accurate determination of the condition of the animal at death.

Shaw, H.G. 1975. Ecology of the Mountain Lion in Arizona. Proj. No. W-78-R-19, Wk. Pl. 2, Job 13. Progress Rep.,

Arizona Game and Fish Dept., 3pp.

SUMMARY

Six new adult lions (four females, two males) were captured on the study area. Of these, two are known to be dead. This raises the total of mature lions handled on the area to 18, seven of which are known to be dead. Three litters of kittens were known to have been born on the area during the year. One of these contained three young; the exact size of the other two litters is as yet unknown. Approximately 900 radio-locations of marked lions have now been made on the study area. Detailed analyses of these movements data have not been completed. No effort was made to census deer populations on the study area during this segment. Mid-winter sex and age classification counts were made from the ground. Considerable time was spent in developing estimates of cattle numbers on the study area, using ranch and U.S. Forest Service records. These were reported in a paper presented during June covering kill data gathered to date. Twenty-three lion kills were located during the project year. Of these, 16 were deer, six were cattle, and one was a pronghorn. Eighteen of the 23 kills were located through radio-tracking of marked lions. Total kills located during the study is now 56. Sixty-four percent of these are deer, 32 percent are cattle, and the remainder is made up of pronghorns and rabbits.

Shaw, H.G. 1977. Impact of Mountain Lion on Mule Deer and Cattle in Northwestern Arizona. Pgs. 17-32 In: Phillips and Jonkel, eds., Proc. of 1975 Predator Symposium. Mont. For. and Cons. Exp. Sta., Sch. For., Univ. Montana, Missoula. 268pp.

During 4 years of study, 16 adult mountain lions (Felis concolor azteca) were captured on a 406 km^2 study area in Arizona. Eleven kittens are known to have been produced on the area. Seven adults and 4 kittens are known to have died. An average population of 7 resident adult lions was estimated for the area. The species composition of 58 kills made by lions was 64% mule deer, 32% cattle, and 4% other species. Sixty-two percent of the examined lion scats contained deer, 34% cattle, and 4% representing other species. Selection of calves over other prey was noted. Estimate of total kill per year ranged from 77 to 193 deer and 21 to 97 cattle per year, depending on the method used to estimate frequency of kill.

Shaw, H.G. 1978. Ecology of the Mountain Lion in Arizona. Proj. No. W-78-R-22, Wk. Pl. 2, Job 13. Perf. Rep., Arizona Game and Fish Dept., 2pp.

SUMMARY

Fifteen lions were captured or observed by project personnel. Of these, two were snared, 12 were captured with dogs, and one was observed accompanying a marked lion. Both of the snared lions were observed several months after initial capture, and both had suffered permanent foot injuries from the snares. Seven recaptures of five marked lions were made. Three of the marked lions were subsequently killed by hunters. One small kitten was killed by dogs at the capture site. Nine additional lions were known to have been killed by hunters on the Kaibab Plateau during the project year. A total of 23 lions, thus, were either captured or killed on the study area from July 1977 to June 1978. At least six additional lions were estimated to be on the Kaibab during June 1978 as evidenced by track counts, yielding at least 29 lions on the North Kaibab during some portion of the 1977-78 fiscal year. Radio tracking was conducted from a Piper Super Cub on 83 days and a total of 169 locations were made on the four instrumented lions. Only four kills, all mule deer, were located during the project year. One probable turkey kill was also documented. Eighteen scats were collected and analyzed. Fourteen (78 percent) contained varying amounts of mule deer remains. Eight (44 percent) contained remains of rabbits, rodents, or unknown small mammals. Three (17 percent) held remains of badger. Only one scat (6 percent) held remains of cattle.

Shaw, H.G. 1979. A Mountain Lion Field Guide. Proj. No. W-78-R, Special Report No. 9, Arizona Game and Fish Dept., 32pp.

This report is intended as a field guide to the identification of sign left by mountain lions and to the assessment of the characteristics of a lion population in an area. This guide also presents methods for interpreting evidence associated with carcasses of big game and livestock and for judging the likelihood of lion predation. There is no attempt to fully

document statements and opinions presented herein. The information and recommendations presented are based on the experience and professional judgment of the author as acquired during six continuous years of intensive study and field work on mountain lions in Arizona.

Shaw, H.G. 1979. Ecology of the Mountain Lion in Arizona. Proj. No. W-78-R-23, Wk. Pl. 2, Job 13. Ariz. Game and Fish Dept. 2pp.

SUMMARY

Over a 2-year period, existence of 36 lions on the study area has been documented. Of these, 17 have been killed by hunters, 2 have died of study-related causes, 1 emigrated from the area, and 6 are believed to have died from natural causes. This leaves a known population of 8 lions in the area. This, undoubtedly, is a minimum estimate of the population, but it suggests strongly that a decline in lion numbers on the Kaibab plateau has occurred during the past 2 years. Track counts over 169 miles of road during June 1978 yielded 7 lion tracks, or 1 track/24 miles. Similar counts over 146.3 miles of road during June 1979 yielded no tracks. This further supports the evidence of a decline in lion numbers on the area. Thirteen kills, all mule deer, have been documented during the 2-year period. One probable turkey kill was found. Of 53 lion scats analyzed to date, 45 (85 percent) contained mule deer remains, 14 (26 percent) held varying amounts of rabbit or rodent remains, and 4 (7.5 percent) contained cattle. Three scats collected during the first year of work contained badger remains. This was not repeated in the second year. Radio-location of lions has continued concurrently with work on radioed deer. Five females were tracked and yielded 155 locations. Three males were caught and collared but two of these were taken by hunters soon after capture and the third experienced radio failure within 2 weeks of capture. No radio locations of mature male lions have yet been made. Two collars remain on females and are currently being tracked. Failure of transmitter collars has plagued the radio tracking effort on the Kaibab since the study began. This year 4 of 8 transmitter collars have failed well short of anticipated life span, 3 of these within 4 months. This record is in sharp contrast to the excellent longevity of the deer collars put in service in March 1978. Only one unaccounted for collar can be suspected of failing in over 16 months. Both deer and lion transmitters have similar specifications and are of the same manufacture (Telonics, Mesa, AZ).

Shaw, H.G. 1980. Ecology of the Mountain Lion in Arizona. Final Report. Proj. W-78-R, Wk. Pl. 2, Job 13. Arizona Game and Fish Dept. 14pp.

The mountain lion (Felis concolor) population on the North Kaibab declined from approximately 40 adults to approximately 15 between 1977 and 1980. A slight increase in lion numbers may have occurred during the spring of 1980. Sport-hunting and nutritional stress was the apparent causes of the decline. Lions removed 15-20% of the peak deer population during 1977-78. By 1980, they were probably taking less than 10%.

Shaw, H.G. 1981. Comparison of Mountain Lion Predation on Cattle on Two Study Areas in Arizona. Pages 306-318 In: Proc. Wildl.-Livestock Relationships Symp. For., Wildl., and Range Exp. Station, Univ. of Idaho, Moscow.

Predation by mountain lions (Felis concolor) on cattle and mule deer on two study areas are compared. Use by cattle by lions varied with season and with area. Relative availability of major prey classes was the main determinant of seasonal and area differences. A preference of deer over cattle was exhibited by lions in both areas. Possible deer and livestock management implications of these findings are discussed.

Shaw, H.G. 1984. Cattle Growers and Lions. Pgs. 119-129 In: J. Roberson and F. Lindzey (eds.), Proc. of the Second Mountain Lion Workshop. Utah Div. Wildl. Res. and Utah Coop. Wildl. Research Unit. Zion National Park. 271pp.

A total of 1006 questionnaires were mailed to members of the Arizona Cattle Growers Association as part of a survey to assess rancher-mountain lion problems in the state. As of May, 1984, 188 questionnaires had been returned and tabulated (18.7%). Mountain lions were classified as predators with bounties paid to anyone killing a lion until 1970 when the status was changed to Big Game. Arizona is unique in the amount of cattle lost to lions, due to yearlong cow-calf operations in lion country. Lions in all problem areas eat beef. The cost of lion control is expensive and because there are probably as many lions in Arizona now, after 80 years or more of heavy hunting, indications are that

lion control is physically impossible and economically not feasible. Nearly 900 cattle were believed taken by lions from 119 ranches in 1983. The sporting kill of lions in Arizona ranges around 250-300 each year and the 297 lions reported killed by ranchers approximate this annual average sporting harvest taken from hunter questionnaires. Eighty-two of the 297 lions were believed to not have been reported in any way by the ranchers due to fear of increased regulation and harassment by agencies or preservationists. Sixty percent of the cattle kills inspected on Spider Ranch were calves under 3 months of age and 80% were under 6 months of age. This suggested that by keeping calves out of lion country would help and that switching to a steer operation may be a consideration. An option may be for some ranchers to consider lion guiding, but the costs of hunts are low and overhead is high.

Shaw, H.G. 1987. Mountain Lion Field Guide. Arizona Game and Fish Department Special Report #9, Third Edition. 47pp.

This booklet provides information on mountain lion characteristics, biological considerations, reading sign, kills, estimating populations, criteria for age estimation, capture, and depredation problems.

Shaw, H.G., N.G. Woolsey, J.R. Wegge, and R.L. Day, Jr. 1987. Factors Affecting Mountain Lion Densities and Cattle Depredation in Arizona. Project W-78-R, Wk. Pl. 2, Job 29. Final Rep.,Arizona Game and Fish Department.

A total of 144 track count routes were run in 24 Management Units representing 11 habitat complexes. Representatives were interviewed from 29 ranches encompassing the survey routes. Lion track densities were found to be related to habitat type and to vary significantly between Management Units. Lion track densities were related to densities of mule deer and unrelated to other prey or to additive densities of prey. Tracking condition and method of travel of observers affected track count results. Track condition was not significantly related to habitat type. Rancher impressions of losses were directly related to lion density. Highest claims of losses occurred on ranches with low-calf operations in interior chaparral habitats. Calving out of lion country and allowing calves to gain initial growth away from lion habitat reduced losses for those few ranches with ranges suitable to this management strategy. Other options (use of horned cows, steer only operations) were difficult to evaluate. In general, ranchers using such options were also exerting lion control efforts. They were also the ranchers that claimed the highest rates of cattle losses. A track count using experienced personnel appears to be a viable method to assess relative lion densities over large areas. It is probably too labor intensive to be used by regional personnel. Recommendations for refinement of the technique are included.

Shaw, H. and S. Negri. 2005. International Cougar Management Guidelines: Processes for Collaboration and Implementation. Journal of International Wildlife Law & Policy 8(4):367-373.

Abstract

This article briefly describes the development of international cougar management guidelines for use in the United States, Canada, and Mexico. Release of the guidelines in mid-2005 is intended as the prelude to a further round of redrafting and revision, based on the experience of managers in the field, new scientific developments, and comments from various stakeholders. The guidelines are notable as the outcome of extensive scientific collaboration and careful consultation with wildlife agency administrators. The guidelines draw on the work and experience of cougar specialists in western North America through the regular meetings of the Mountain Lion Workshop.

Sheriff, S.L. 1978. Computer Model for Mountain Lion Populations. M.S. Thesis. Colorado State Univ., Fort Collins. 287pp.

"Lionpop" is a computerized model for mountain lion populations. It contains three components: 1) the input component for placing acquired data into the memory of the computer, 2) the population simulator, which consists of a series of mathematical statements that represent biological processes and events that determine the size and composition of any mountain lion population, and 3) the output component, which is used to print computed results from the simulation trial. Lionpop uses reproduction, natural mortality, harvest, immigration and emigration data from any given mountain lion population to simulate that population. Information about the population size, age class structure, birth rates, and harvest statistics are outputs of Lionpop. Lionpop was tested in two phases: 1) data was

used that was collected on the lion population in the Idaho Primitive Area and 2) data compiled through personal conferences with ten biologists from the western U.S. and Canada who have worked with lion populations and one who had worked with a Black Bear population. The tests of Lionpop were successful and no major errors were detected. Lionpop can be used for the management of populations of lions or other species that have life histories and biological properties similar to those of lions. It can be used to test the effects of different management regimes on a simulated population; to test mental models that the user has formulated about a given population; or to test the sensitivity of the simulated population to changes in different population parameters.

Shoemaker, H.W. 1943. The Panther in Pennsylvania. Pennsylvania Game News 13(11):7, 28, 32.

The last panther killed for bounty in Pennsylvania was taken in the Moshannon region of Centre County in 1886. Many supposed accounts of cougar sightings are listed by the author.

Shoemaker, H.W. 1948. The Pennsylvania Lion. Pennsylvania Game News 17(12):6, 27.

The panther had become a rarity in Pennsylvania by 1860. The last panther in the northern section was killed in February 1874 and was a male. A female that was with it escaped and was probably the same one which was killed in northern Berks County in August of the same year. Another hunter killed a panther on Jack's Mountain in November of 1873. Two panthers were killed on Mosquito Creek in Clearfield County in February 1880. Four kittens were removed from their "ledge" in Treaster Valley in 1892 and two others were removed the following year.

Shoemaker, H.W. 1949. The Panther on Terrace Mountain. Pennsylvania Game News 20(2):8-9.

The author states that there had been at least a hundred reputable mountaineers who would have told of having heard or seen panthers in Pennsylvania during the past five years. He reports that the last to be killed were a nest of cubs at Treaster Valley, Mifflin County, in the spring of 1893. Four cubs were usually born early in April, with the rutting season at Christmas time. In Pennsylvania, males outnumbered females five to one. In Indian days, the panther was hunted more persistently than other animals and its hide was used for many purposes. The "great medicine" was always kept in a paunch made from the hide of panthers. Its meat was relished even above the flesh of the bison. Its blood gave courage to warriors when "drunk fresh". Its claws, hung around the neck by a cord, were amulets of good luck and the teeth were much prized as decorations. Shoes fashioned from its paw made young Indians grow tall and strong. The tongue was a favorite tid-bit at banquets of the chiefs. A decoction made from its eyes prolonged life and the bones made excellent cutlery. The tuft of the tail made the warriors war plume.

Shorma, G. 1988. Status of the Mountain Lion in Wyoming. Pgs. 38-39 In: R.H. Smith (ed.), Proc. of the Third Mountain Lion Workshop. Arizona Chapter, The Wildlife Society and Arizona Game and Fish Department, Prescott, Arizona. 88pp.

Indications are that Wyoming has a widespread and increasing mountain lion population. Increased reports and complaints of livestock depredation losses is reason for concern since Wyoming reimburses livestock owners for animals killed by mountain lions. The population was estimated to range from 930 to 1173 animals. Mountain lions in Wyoming are managed on and harvested under a sustained yield basis. Any lion which damages private property may be immediately killed at any time. License income in 1987 was $12,040 compared to Department expenditures of $288,846.

Shrader-Frechette, K. 2004. Measurement Problems and Florida Panther Models. Southeastern Nat. 3(1):37–50.

Abstract

Conservation planning is only as good as the science on which it relies. This paper evaluates the science underlying the least-cost-path model, developed by Meegan and Maehr (2002), for the Florida panther, *Puma concolor coryi*. It also assesses the resulting claim that private lands in central Florida are desirable for panther colonization (Maehr et al. 2002,; Maehr 2001,; and Maehr and Deason 2002). The paper argues that panther conservation planning, as proposed by Maehr, is flawed because of its (1) poor analysis of panther-habitat requirements, owing largely to use of

only daytime telemetry, a black-box model, and failure to take account of spatial and temporal uncertainties; (2) use of stipulative and misleading definitions of key biological terms, such as "forest obligate" and panther "dispersal"; (3) employment of question-begging value judgments to rank habitat; (4) weak testing of the model; (5) inconsistency in evaluation of forest habitat; (6) inconsistency in evaluation of agricultural lands; and (7) inconsistency in assessing effects of highways on panther habitat.

Shroufe, D. 2006. Western Association of Fish and Wildlife Agencies Comment on the Cougar Management Guidelines—First Edition. Wildlife Society Bulletin 34(5):1479.

Abstract

The Cougar Management Guidelines—First Edition was reviewed in the Book Review section of The Wildlife Society Bulletin (Anderson 2006). These guidelines were conceived at the Sixth Mountain Lion Workshop held in 2000. Although member agencies of the Western Association of Fish and Wildlife Agencies (WAFWA) commented on drafts of the guidelines, few, if any, of the concerns raised by member agencies were addressed in the final document. The WAFWA recognizes the need to review and improve the management of all wildlife species; however, when comprehensive management guidelines are developed, all stakeholders—particularly the agencies with management authority—must actively be involved. The WAFWA does not endorse or otherwise sanction the Cougar Management Guidelines. The decision to incorporate Guidelines recommendations rests solely with the individual state or provincial wildlife agency.

Shuey, M.L. 2005. Land-Cover Characteristics of Cougar / Human Interactions in and Around an Urban Landscape. Pages 117-126 *in* R.A. Beausoleil and D.A. Martorello, editors. Proceedings of the Eighth Mountain Lion Workshop, Olympia, Washington, USA.

Abstract

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

Shufeldt, R.W. 1921. The Mountain Lions, Ocelots, Lynxes and their Kin. American Forests 27(334):629-636, 659.

No example of the cougar had been shot or seen within the New England States for a period of over 50 years. Theodore Roosevelt had hunted and killed more cougars than any man of his time. According to Roosevelt, the cougar females far outnumber the males. It was quoted that it is quite easy to follow a fleeing puma because it always travels in straight lines. The author had seen the cougar withdraw its attack by steadily staring it in the eyes.

Siegler, H.R. 1971. The Status of Wildcats in New Hampshire. Pgs. 45-52 In: Jorgensen, S.E. and L.D. Mech (eds.). Proc. of a Symposium on the Native Cats of North America, Their Status and Management. U.S. Dept. Int., Fish and Wildlife Service, Twin Cities, Minnesota.

The cougar disappeared in New Hampshire in the late 19th century. A number of recent sightings have been reported but not verified. The legislature passes a bill in 1967 that prohibited shooting, hunting, taking or possessing any mountain lion or part of the carcass in the state, except if acting in protection of his person or property. In 1850, New Hampshire was approximately 50% agriculture. However in 1971, forest growth had increased to the extent that about 87% of the state was now forested. The author felt that this factor contributed to the possibility of a cougar comeback

in the state.

Sikich, J.A., S.P.D. Riley, E.C. York and R.M. Sauvajot. 2008. Mountain Lion Movements Relative to Development, Roads, and Trails in a Fragmented, Urban Landscape. Page 252 in Toweill, D. E., S. Nadeau and D. Smith, editors. Proceedings of the Ninth Mountain Lion Workshop, May 5-8, 2008, Sun Valley, Idaho, USA.

Abstract

Habitat loss and fragmentation due to urbanization can have significant impacts on wildlife movement and survival. Large carnivores, such as mountain lions (*Puma concolor*), are especially vulnerable to the effects of urbanization because of their extensive spatial requirements, low density, and potential for conflicts with humans. Since 2002, we have been using GPS collars to study the behavior, ecology, and conservation of mountain lions in and around Santa Monica Mountains National Recreation Area, a national park west of Los Angeles. Collars have generated over 30,000 locations for 8 mountain lions and allowed us to collect detailed information on activity and movement patterns. We measured the degree to which mountain lions used developed areas, altered open lands (golf courses, low-density residential areas, landscaped parks, etc.), and areas within various distances (100, 250, 500, and 1000m) from urbanization. On average, mountain lion home ranges included less developed area or habitat close to development and more area >1km from development than the study area as a whole (e.g., 48% of home ranges consisted of area >1 km from development vs. 40% of the study area). However, 3 mountain lions utilized urban and altered areas significantly more than other animals, with home ranges consisting of more than 10% developed area. One of these lions made multiple trips into habitat fragments that were isolated from core park areas by roads and development, and another showed increased use of highly urbanized areas while attempting to disperse. Mountain lions regularly crossed all of the major 2-lane paved roads through the Santa Monica Mountains. Although in some instances crossings occurred under roads along streams, or over roads above tunnels, most of the road crossings were on the road. Two male lions were killed along one stretch of road during the 5 years of our study. GPS locations and track counts show that mountain lions will move along recreational roads and trails frequented by people, but mostly at night when human activity is low. Most mountain lion travel routes were in the dense brush along game trails and on gentle slopes or in canyon bottoms. Even though mountain lions utilized habitat near urban areas with many roads and trails and recreating humans, there have been minimal encounters and conflicts with people.

Sileo, L., M. Dunbar and M. McCollum. 1997. Occurrence of Selected Endocrine Disruptive Chemicals and Their Association with Congenital Anomalies of the Florida Panther. Annual Performance Report. U.S. Geological Survey, Madison, Wisconsin, USA. 19pp.

Abstract

Thirty-four heparinized whole blood or serum samples from both normal and cryptorchid male Florida panthers (*Felis concolor coryi*) and dams of both normal and cryptorchid males are presently being analyzed for the presence of selected organochlorines, including polychlorinated biphenyls and other chemicals that may be endocrine disruptive. Hormone determinations for 89 serum samples representing 14 normal and 16 cryptorchid male panthers were completed. The serum estrogen and testosterone concentrations were found to be considerably lower than previously published values reported for Florida panthers. The serum concentrations of estradiol and testosterone for male Florida panthers are consistent with those in other wild felids. Testicular tissues from seven panthers were examined histopathologically. However, severe autolysis precluded reliable interpretations of most samples. Interpretation of test results of chemical concentrations that may be founding Florida panthers and testing of hormone concentrations in selected female Florida panthers will be conducted next fiscal year if funding is available.

Simpson, C.D. and R. Browning. 1981. Food Habits of Mountain Lion (Felis concolor) in the Guadalupe Mountains National Parks, Texas. Final Report. National Park Service, Santa Fe, New Mexico. 9pp.

This study of food habits of the mountain lion was conducted in the Guadalupe Mountains National Park, Texas, to determine diets of local lions and assess the degree of predation on livestock on neighboring ranches. Predation upon domestic sheep has occurred on a regular basis on ranches immediately to the north of the park and on three separate occasions lions have killed sheep in excess of their feeding needs. Ninety-five lion scats were collected between 1978

and 1981 from all areas of the park. Six wildlife species and one domestic species were identified in the diets of Guadalupe mountain lions. In addition, unidentifiable feathers from medium-sized birds were found in 2 scat samples. Mule deer (65%) and elk (15%) comprised over 75% of the mountain lion's annual diet. The desert cottontail and porcupine were also frequently taken. The single scat sample which showed feeding on domestic sheep indicated that, at least for resident lions, sheep are not an important part of the diet.

Simpson, G.G. 1941. Vernacular Names of South American Mammals. J. Mammal. 22(1):1-17.

The word puma is derived from the Quechau language. Most South Americans call pumas "lions" (leones) but it is generally agreed that puma is the best name for them.

Sinclair, E.A., E.L. Swenson, M.L. Wilfe, D.C. Choate, B. Bates and K.A. Crandall. 2001. Gene Flow Estimates in Utah's Cougars Imply Management Beyond Utah. Animal Conservation 4:257–264.

Abstract

We present results from a study of genetic variation in Utah's cougar population. Estimates were based on data for 50 animals at nine microsatellite loci with five individuals sampled for each of ten management units throughout Utah. Levels of variation were moderate (average genetic diversity across populations was estimated to be 0.4687 for all 50 individuals), and comparable with other large mammals. But this level of variation for the microsatellite loci translated into an inbreeding effective population size of only 571 animals, much lower than the current estimates of census sizes of around 2000-3000. A lack of differentiation among the sampled populations across Utah (average N_em = 6.2) indicates that gene flow occurs over a large area. Since cougars are capable of movement beyond the Utah state borders (and certainly across management units), a better understanding of migration rates and patterns of dispersal will be achieved by sampling a much larger geographic region incorporating much of the western USA. Successful management and conservation of this species will then require a far more integrated approach, involving agencies across a number of states, as opposed to current management practices involving individual units within states.

Sitton, L.W. 1972. Investigations on the Status of the California Mountain Lion. Cal-Neva Wildlife:31-34.

The paper reviews the historical legal status of mountain lions (Felis concolor californica) within California, and outlines the study program initiated by the California Department of Fish and Game. Methods of population determination, capture and telemetric follow-up are given and accumulated data is discussed. An estimated 1,224 lions exist in 14,325 square miles of lion habitat. This is about 40% of the State's lion habitat. Project purposes and the future guidelines upon which the study will proceed are explained.

Sitton, L.W. 1973. Interim Report on Investigations into the Status of the California Mountain Lion-Phase 1. Wildlife Management Administrative Report No. 73-4, Project W-51-R. 24pp. California Dept. Fish and Game.

SUMMARY

Since the mountain lion was classified as a bountied predator in 1907, it has undergone reclassification a number of times. In 1963, the lion was classified as a nonprotected mammal and remained so until 1969 when it changed to game mammal status. The first lion game season was for the entire 1970-71 license year. Tag sales totaled 4,726 and 83 lions were taken. The second season lasted from November 15, 1971 through February 29, 1972. Tag sales totaled 223 and 35 lions were taken. A one-lion bag limit was also in effect during the second season. A four-year moratorium on lion hunting was established in March 1972. A population survey of the mountain lions within California began in June, 1971. Survey techniques included interviews, field investigation questionnaires, lion bounty records from 1907-1963, and radio tagging-monitoring studies. Over 800 interviews were conducted, and many months of actual field study were directed to investigating the claims of those interviewed. All input data was analyzed and used as the basis of material and figures presented in this paper. There are approximately 74,000 square miles of lion habitat within California with an estimated population of 2,400 lions. Three major areas of high lion concentration occur: the coast range from Mendocino County to Del Norte County, the coast range in Monterey-San Luis Obisbo-

Santa Barbara-Ventura counties, and the southern Sierra Nevada in Fresno and Tulare counties. Increased sign, depredation applications, successful hunts and intrusion of lions into urbanized areas together with the opinion of those lion-knowledgeable individuals interviewed seems to indicate that the lion population has doubled in the last 12-14 years. It is felt that the elimination of the state hunter in 1959 and the bounty system in 1963 was the major factor in this increase. Five depredation permits were issued in 1971 and five lions were taken. In 1972, four permits were issued with only one lion dispatched. Thus far in 1973, six permits have been issued with two of the lions taken. It is felt that the cougar is presently near carrying capacity levels and that new recruitment into the population may result in increased depredation complaints. Self-limiting population control mechanisms resulting from the territorial needs of the lion may offer an internal control against depredation problems. Four lions were recorded road kills during the last 14 months. The effort to relocate problem lions into other isolated areas of the state resulted in one lion successfully relocated from Los Angeles County into Alpine County. Three other attempts failed when the offending lions did not return to problem sites. Two of these lions were involved in livestock losses and the other wandered into residential Palm Springs. The pursuit of lions without taking or harming them as allowed in Assembly Bill 660 was initiated October 1, 1972 and continued through February 29, 1973. Three permits were issued, two for the same individual. The purpose of the allowed pursuit was to gain data on local lion populations in two instances and for photography in the other. Popular opinion of mountain lion hunting seems to be slightly in favor of the maintenance of the moratorium in those interviewed. Most of those contacted, however, were apathetic on the question, citing lack of information or interest in the subject. A significant group of those interviewed who did have opinions favored a bag limit--season harvest concept of management for lions. The major prey species for lions throughout the state is mule deer, with incidental predation noted for horses, burro, cattle, sheep, pigs, chickens, turkeys, housecats, dogs, squirrels, skunks, beaver, porcupines, rabbits, hares, foxes, feral pigs, pigeons, peacocks, and in one instance, goldfish from a watering trough. Evidence seems to indicate that the lion is a rather opportunistic feeder. The Department has captured six lions for preliminary telemetric range studies. Five of the lions were equipped with transmitter collars and their movements monitored. Data returns on this monitoring study indicate a range of approximately 40-50 square miles for adult male and 20-30 square miles for females.

Sitton, L.W. and S. Wallen. 1976. California Mountain Lion Study. Ca. Dept. Fish and Game. 40pp.

SUMMARY

The Department of Fish and Game initiated a mountain lion study in June 1971 as a Federal Aid to Wildlife Restoration Project. The objectives of this study were to obtain sound population estimates and basic information necessary for management of the species. The study was conducted in two phases:

PHASE I (Statewide Population Survey)

The Department, by contacting knowledgeable people and checking selected areas, determined that there are approximately 74,000 square miles of lion habitat in California with an estimated population of 2,400 mountain lions. Major areas for the mountain lion are: (1) The coast range of Mendocino to Del Norte counties, (2) the southern Sierra Nevada Range in Fresno and Tulare counties, and (3) the coast range from Monterey to Ventura counties.

PHASE II (Intensive Area Study)

An intensive study was conducted on 175 square miles of coast range in Monterey County to determine as precisely as possible the total mountain lion population and their range requirements. This was done by capturing and fitting the lions with radio transmitter collars that could be monitored. Fourteen lions were collared and two cubs were ear tattooed only. The population is thought to be between 16 to 20 animals where the Department had previously estimated 15 in Phase I. Significantly, there is more overlap of ranges than was expected with a density equal to 10 lions/hundred square miles. Depredation: Complaints of mountain lion depredation on livestock are investigated by Department personnel. Confirmed instances of livestock losses caused by mountain lion average 15 per year. Permits are issued to landowners that allow problem animals to be killed. Twenty-four mountain lions have been dispatched since 1971 under this system.

Sitton, L.W. 1977. California Mountain Lion Investigations with Recommendations for Management. Ca. Dept. of Fish

and Game. 35pp.

SUMMARY

The Department of Fish and Game estimates the mountain lion population in California is approximately 2,400 animals. This includes adult, young, and transient animals. The estimate was made after the first phase of investigations, when mountain lion habitat was examined for signs of lions and knowledgeable residents were interviewed for information on lion abundance in specific areas. With this information the mountain lion range in California and relative lion densities were determined. Major mountain lion areas are: (1) The coast range of Mendocino to Del Norte counties, (2) the southern Sierra Nevada range in Fresno and Tulare counties, and (3) the coast range from Monterey to Ventura counties. Lions were found in most other forested and brushland areas of the state, but populations were lower. Beginning in 1973 an intensive study was conducted on 175 square miles of coast range in Monterey County to determine the total mountain lion population, as a check on the original survey results, and lion range requirements. This was done by capturing and fitting the lions with radio transmitter collars. Seventeen lions were collared and two cubs were ear tattooed only. The population is 16 to 20 animals where the department had previously estimated 20 in the statewide survey phase of the project. Significantly, there is more overlap of ranges than was expected, with an estimated density equal to 9.2-11.4 lions/100 square miles. In 1976 an effort was made to gather specific information on an area in the southern Sierra Nevada range. Two volunteer houndsmen were used to tree, mark and retree mountain lions within a 130-square mile area of Tulare and Kern counties. Eleven different lions were treed in a six-month period, and it is estimated from the tracks that were found and measured during the same period that at least 17 mountain lions used the area. This represented approximately half of the Hot Springs quadrangle. In the statewide survey, the lion population estimate for the entire Hot Springs quadrangle was 25, an average of about one lion per 15 square miles of habitat for Tulare and Kern counties. The intensive investigation of the Monterey and southern Sierra areas have shown that the original statewide survey estimates were reasonable and in the case of the Monterey study area and the Hot Springs quadrangle conservative. Complaints of mountain lion depredation on livestock are investigated by department personnel. Confirmed instances of livestock losses caused by mountain lions average 15 per year. Permits may be issued for landowners to kill problem animals. Thirty-two mountain lions have been killed since 1971 under this system.

Sitton, L.W., S. Sitton, and D. Weaver. 1978. Mountain Lion Predation on Livestock in California. Trans. Annu. Mtg., Ca./Nev. Sections, Wildlife Society. pp. 174-186.

The Department of Fish and Game studied depredation by mountain lions on livestock from 1971 through 1977 to determine the scope of the problem. Information was needed on the physical characteristics of a stock killer, the frequency and trend of predation, the livestock types preyed upon, and the geographic distribution of incidents to develop a sound depredation policy. Historic and contemporary records and literature on livestock predation, Department of Fish and Game necropsy reports, collaboration with mountain lion researchers in other western states, and telemetry studies on relocated livestock predators were used to compile this report. Department of Fish and Game verified 134 incidents of mountain lion predation on livestock which occurred between April 1971 and December 1977. Forty-five mountain lions (28 males and 17 females) were killed on depredation during this time. Approximately 42 percent of the predation incidents involved sheep, 22 percent goats and 16 percent cattle, with horses, pigs, poultry, and pets composing most of the remaining prey. California's south coast region from Santa Clara to Ventura County reported 44 percent of the predation incidents, 28 percent from the Sierra Nevada, 20 percent from the north coast from Napa and Sonoma Counties to Humboldt County and nearly 8 percent from southern California. There does not appear to be a stock-killer profile of common sex, age, or health factors. Present depredation policy appears adequate to handle the problem, but efficiency could be increased by coordinating incident verification investigations and available depredation resources, such as U.S. Fish and Wildlife Service and county predator control agents.

Smallwood, K.S., and E.L. Fitzhugh. 1988. Differentiating Mountain Lion and Dog Tracks. Pgs. 58-63 In: R.H. Smith (ed.), Proc. of the Third Mountain Lion Workshop. Arizona Chapter, The Wildlife Society and Arizona Game and Fish Department, Prescott, Arizona. 88pp.

Current techniques used for mountain lion and dog track discrimination are described. The reliability of track traits was evaluated and was found that most should be used with other traits to increase differentiation. A quantitative analysis

of some track traits was performed. Of the traits tried in the analysis, the angle of the long axis of the outer toes with respect to each other best discriminated dog and lion tracks and was indifferent to the front and rear track distinction. A dog and lion track classification key is provided for distinguishing between similar dog and mountain lion tracks.

Smallwood, K.S. and E.L. Fitzhugh. 1991. The Use of Track Counts for Mountain Lion Population Census. Pgs. 59-67 In: Mountain Lion-Human Interaction Symposium, C.E. Braun (ed.). Col. Div. Wildl., Denver. 114pp.

Abstract

Interactions of mountain lions (Felis concolor) with humans have been increasing in recent years in the western United States and Canada for unknown reasons. Multiple hypotheses are needed to identify causes to overcome investigator bias from strong political and ideological pressure. Testing the appropriate hypotheses requires accurate and precise population dynamics of mountain lions. In this paper we (1) review methods for the study of large carnivores; (2) examine factors that impede estimating mountain lion populations by track counts; and (3) use road track counts of mountain lions in California in 1986 to illustrate biases and index-population relations. Region and topography, but not dust or distance from human settlements and urban areas, affected the frequency of mountain lion track sets. We found fewer tracks at higher elevations and more in Douglas-fir (Pseudotsuga menziesii) habitat. We conclude that (1) the efficiency of mountain lion track censuses can be improved with selective route placement; and (2) biases and index-population relations need to be further investigated and understood.

Smallwood, K.S. 1993. Mountain Lion Vocalizations and Hunting Behavior. Southwestern Naturalist 38(1):65-67.

The author reports that no descriptions of mountain lion vocalizations in association with attacks on prey were found in the literature. The author and a companion saw a lion pursue and capture a female black-tailed deer while they were hunting on the west slope of Goat Mountain in northern Lake County, California in 1983. The episodic pursuit is described in detail. The author describes other related reports of vocalizations (personal communication). Four hypotheses were proposed to describe the function of the behavior of vocalizing during pursuits and literature is cited to add credibility to the suggested hypotheses.

Smallwood, K.S. and E.L. Fitzhugh. 1993. A Rigorous Technique for Identifying Individual Mountain Lions (Felis concolor) by Their Tracks. Biological Conservation 65:51-59.

We introduce a rigorous technique to make individual animal identification by tracks more objective than previously possible. With measurements from acetate tracings of two to six tracks from each rear foot of nine mountain lions Felis concolor, multiple-group discriminate analysis accurately grouped 100% and 92% of the tracks from the left and right rear feet, respectively. From bootstrap analyses we concluded that mountain lion track set discrimination was best achieved with the spread of the outer toes, heel width, and the midline width of the heel pad. After further research, this technique can be used to improve population studies of mountain lions and other large animals.

Smallwood, K.S. 1994. Trends in California Mountain Lion Populations. Southwest. Nat. 39(1):67-72.

The status of the California mountain lion (*Felis concolor californica* May) population has been controversial and central to disputes regarding its management. Track survey methods and transects were developed during the 1980s to provide the only standard estimate of mountain lion population trends in California. In 1992, I repeated the 1986 statewide survey for mountain lion track sets, in which a track set is any continuous trail of tracks made by the same animal. Track set density increased 31.3% in the mountains of southern California, but they decreased 52% in northern California, and 61% in areas where timber was removed since 1986. Most of the areas preferred by resident mountain lions in 1986 were avoided in 1992 after they were clearcut. Whereas residents preferred unharvested and non-forest areas in 1992, track set densities of deer were the same with or without timber loss. Mountain lion track set density might have decreased due to degradation of habitat quality other than prey availability, or it might have decreased as part of a natural population cycle, which is common among species of Carnivora. When this decrease was added to the changes observed at three sites monitored since 1980, the pattern resembled nearly one complete cycle. Plans for management and research of mountain lions should include the effects of habitat loss and natural

population dynamics.

Smallwood, K.S. and E.L. Fitzhugh. 1995. A Track Count for Estimating Mountain Lion *Felis concolor californica* Population Trend. Biol. Cons. 71(3):251-259.

Reliable estimates of status and population trend are critical for conservation of large terrestrial carnivores, but are usually lacking due to the high costs of sampling across large geographic areas. For detecting population trends of mountain lion *Felis concolor californica*, we evaluated counts of track sets on 48 randomly chosen quadrats in California. Each quadrat contained 33.8 km of transect on dusty, dirt roads, which were chosen by local wildlife biologists. A count of track sets by one person on all quadrats was more efficient than recording presence/absence by local survey teams. We estimated an efficient sample size of 44 quadrats in California after applying our data to a general formula for contagious distributions. This sample size can be reduced substantially by choosing new transect locations based on associations of tracks with topography and habitat. Tracks were most likely found on roads along 1st- and 2nd-order streams, on mountain slopes and knolls/peaks, and in oak woodland and montane hardwood-conifer forest. A changing mountain lion population can be detected with an inexpensive, periodic track survey and self-stratifying, non-parametric tests. Each track survey across California can be finished in 30 days. The many mountain lions and the variety of environmental conditions included at this extraordinarily large spatial scale permit estimates of: (1) trends among population strata in quadrats that are clustered according to typical number and age/sex class of track sets; (2) population size and demography after individuals are identified by their tracks, and after linear density on roads is calibrated from spatial density at intensive study sites; and (3) spatio-temporal associations with bobcat *Felis rufus*, black bear *Ursus americanus*, coyote *Canis latrans*, and fox *Vulpes vulpes* and *Urocyon cinereoargenteus*.

Smallwood, K.S. 1997. Interpreting Puma (*Puma concolor*) Population Estimates for Theory and Management. Environmental Conservation 24(3):283-289.

Summary

Estimates of population size have been essential for ecological theory and wildlife management, but they depend on spatial scales of observation. Reported aspects of study and interpretive design were tested to see if they could explain variation in puma (*Puma concolor*) density. Comparison of puma studies revealed information shortfalls and possible confounding effects in research trends. Vegetation descriptions and other biological and physical aspects of the study site explained none of the 30-fold range of variation in puma density, nor did sampling and estimation methods and other aspects of study and interpretive design. Most (78%) of the variation in puma density estimates can be explained by the spatial extent of study area. Given the effect of scale, puma density estimates have been inappropriately extrapolated to larger geographic areas for management purpose trend without study at multiple sites over longer periods of time. Field studies would contribute more to knowledge of puma by spanning larger areas, a greater variety of land uses and habitats, and more of puma's range of distribution.

Smallwood, K.S. and B. Wilcox. 1997. Study and Interpretive Design Effects on Mountain Lion Density Estimates. Page 93 in W.D. Padley, ed., Proc. Fifth Mountain Lion Workshop: 27 February- 1 March 1996; San Diego, California.

Density estimates have been considered essential for sound ecological theory and wildlife management. We therefore synthesized reported mountain lion density estimates and accompanying study attributes to assess their use in management. Habitat and other biological and physical aspects of the study site explained virtually none of the 30-fold range of variation in mountain lion density, nor did sampling methods and other aspects of study and interpretive design. Most (78%) of the variation in mountain lion density estimates can be explained by the spatial extent of study area, but the reason for this relationship remains unknown. Without making adjustments for the effect of spatial scale, mountain lion density estimates cannot be meaningfully compared and extrapolated to larger geographic areas. Field studies would contribute more to our knowledge of mountain lion by spanning larger areas, a greater variety of land uses and habitats, and more of their distributional range. Local detail in mountain lion distribution needs to be connected to the larger extent of their range, with many more studies, sampling methods that are efficient across large areas, and by not just selecting sites where the animals are known to occur.

Smallwood, K.S. and B. Wilcox. 1997. Ten Years of California Mountain Lion Track Survey. Page 94 in W.D. Padley, ed., Proc. Fifth Mountain Lion Workshop: 27 February- 1 March 1996; San Diego, California.

During the summer of 1995 we conducted the fourth statewide mountain lion track survey since 1985. Surveys were conducted in 1985 and 1986 by wildlife biologists from multiple natural resources agencies, mostly from the California Department of Fish and Game. Smallwood surveyed transects in 1986, 1992, and 1995. Assuming the number of track sets is indicative of the mountain lion population, mountain lions in California decreased in number substantially from the mid 1980's to the 1990's. Regional trends have been dramatic, including alarming declines east of the Sierra Nevada and in southern California. Declines in 1992 were followed by an increase across the northwest part of the state, the central coast, and the Sierra Nevada. The track sets found were clustered within small geographic areas; no tracks were found across the vast majority of the mountain lion range that was sampled during 1992 and 1995. The clusters of track sets changed locations between surveys since the 1980's. Mountain lions traveled along certain aspects of the dirt roads in directions and at locations according to habitat, topographic, and interspecific (prey and competitors) conditions. The mountain lion population can be efficiently monitored across large areas, and it can serve as an indicator of large-scale ecological conditions by further developing track count methodology.

Smith, A.B., F.A. Street Perrott and T. Hooper. 2003. The Distribution of Perceived Encounters with Non-Native Cats in South and West Wales, UK: Relationship to Modeled Habitat Suitability. Page 167 *in* S.A. Becker, D.D. Bjornlie, F.G. Lindzey, and D.S. Moody, eds. Proceedings of the Seventh Mountain Lion Workshop. Lander, Wyoming.

Abstract

Reports of perceived encounters with exotic cats in the British countryside have greatly increased in recent years. The species described (notably melanistic leopards, pumas and lynxes) were widely bred in the UK prior to the 1976 Dangerous Wild Animals Act, and do not correspond to those most familiar to the general public (such as lions, tigers and cheetahs). Some of them are still being illegally imported or reared for 'canned hunts'. Following the recent discovery of leopard tracks in West Wales, and calls for action by Members of the UK Parliament and the Welsh National Assembly, the Welsh Agriculture Department has officially begun to collect statistics on sightings and livestock kills. In this independent study, we have analysed a database of 170 georeferenced encounter reports obtained from the police, news media and members of the public. In the absence of confirmatory DNA, physical or photographic evidence, encounter reports require very careful screening for reliability, based on the characteristics of the witness(es); the validity of the identification, taking into account perceived cat size and shape (morphotype) and behaviour; indicators of scale, distance and lighting conditions; and the suitability of the habitat. The distributions of potential habitats within South and West Wales have been modeled with a GIS using standard habitat characteristics, such as prey-species presence, disturbance levels, geomorphology and land-use data. The spatial pattern of encounters does not show the clustering that might be expected if they represent a purely sociological phenomenon. Instead, the distributions of specific morphotypes appear to be closely related to the degree of habitat suitability, thereby strengthening the case for the presence of nonnative cat species in the UK.

Smith, A.B., F.A. Street-Perrott, and T. Hooper. 2006. A Method for Grading Sightings of Non-Native Cats: Application to South and West Wales, United Kingdom. Pages 66-79 in H.J. McGinnis, J.W. Tischendorf and S.J. Ropski editors. Proceedings of the Eastern Cougar Conference 2004, Morgantown, West Virginia, USA.

Abstract

Sightings of exotic cats in the United Kingdom have been reported since the 18th century, increasing dramatically in recent years. Methods for grading visual reports of carnivores developed in Europe were modified to evaluate reports of leopards (Panthera pardus) and pumas (Puma concolor). Two hundred thirty-eight sightings from South and West Wales, dating from October 2001 through March 2004, were collected. Each record was evaluated for 8 factors related to the quality of sightings, presence of material evidence, and knowledge of the observers assigned and assigned a point value between 0 and 5 for each factor. The maximum score for an encounter was thus 40 points. Higher-quality sightings appear to represent genuine encounters with non-native cats. Twenty-eight sightings were identified as puma; 97 as leopard, 94% of which were black. The number of leopard sightings has increased since the late 1990s. We conclude that sightings are a good tool for developing an understanding of the presence, ranges and behaviours of exotic felids.

Smith, G. 1968. The Florida Panther. Florida Wildlife 21(8):30-31.

General information on the Florida panther is provided.

Smith, G. 1970. Mystery Cat. Florida Wildlife 24(3):4-6.

In the spring of 1967, a panther was killed in the Ocala National Forest. In March 1968, the Citrus County Chronicle, a weekly newspaper, carried a photograph of a full-grown panther killed by a sheriff's deputy. The panther had been reportedly attacking cattle on a farm near Iverness. The United States Fish and Wildlife Service estimated the panther's total numbers at between 100 and 300 and gave its distribution as "Collier, Lee, Levy, Hendry and Monroe counties and rumored around St. Marks Refuge in Wakulla County, Florida". The author provides a few accounts of panther sightings that are believed to be authentic.

Smith, L.C. 1960. I Saw a Pennsylvania Panther. Pennsylvania Game News 31(9):12-15.

The author states that his grandfather was probably responsible for the last panther shot in the state (Clearfield County). The author tells of how he and a companion had spotted a panther in 1906, even though they had been considered extinct for many years.

Smith, R.H. 1975. Aging Arizona Big Game Animals by Annuli in Dental Cementum. Proj. No. W-78-R-19, Wk. Pl. 1, Job 8. Perf. Rep., Arizona Game and Fish Dept., 2pp.

SUMMARY

Approximately 65 upper first premolars were collected from hunter-killed black bears and from bears live-captured and marked on the Four Peaks study area. The collection of javelina continued during the Three Bar pistol-only hunt. To date, teeth from all species examined, with the exception of the mountain lion, show visible incremental lines in the cementum of the tooth root. Canines from some lion teeth have shown the annulations, others known to be mature lions have had none. There are too few known-age specimens to permit a comparison between known-age and cementum-estimated age.

Smith, T.E. 1981. Food Habits and Scrape Site Characteristics of Mountain Lions in the Diablo Range of California. M.A. Thesis, San Jose State Univ., 34pp.

Two hundred and twenty scat samples were collected during the study. Scats were typically deposited at the rear of the scrape mound, but occasionally were found on top or to the side. Most fresh scrapes had a faint odor of urine in the scrape pile. Although all scrapes were not measured, most were within 15-30 cm wide and 15-46 cm long. Scrape sites consisted of up to nine scrapes, usually 1 or 2 m apart. They were always located on relatively level ground, typically in leaf litter but were found in other types of debris as well. They were rarely made in bare soil or sand. Scrapes were nearly always made by resident male mountain lions. One occurrence of a female scrape was recorded and she was later found to be an older animal without kittens. Scrape associated scats were most often collected at reused scrape sites. Of the 361 known scrape sites, a minimum of 83 (23%) were reused (revisited). Most of these sites were stream side benches, intermittent creek bottoms, and ridges that were usually located where topography and/or vegetation funneled the movements of one or more lions into a common path. Fifty-nine (71%) of these reused sites were in creek bottom locations. Of the 220 mountain lion scats analyzed for prey content, 10 small volume, amorphous scats contained small amounts of felid hair only and these scats were discarded from final tabulations due to the lack of prey remains. Black-tailed deer were the most frequently occurring item in the seasonal and year-round diet. The most important alternate prey species was the introduced wild pig. Thirty-four sheep were killed as a result of attacks by three mountain lions during the study resulting in the occurrence of wool in 7 scats. Grass occurred in three scats in quantities that suggested deliberate ingestion. The frequency of occurrence of spring fawn utilization probably lies between 29 and 42 percent. Form and/or diameter were noted in 186 of the 215 scats collected. Twenty-three percent were loose, runny, amorphic fecal deposits varying in volume from an estimated 10 to 100cc. The most

common volumes ranged from approximately 10 to 50cc. These scats were typically dark brown to black in color, containing small amounts of hair but rarely bone, in a tar-like matrix. The frequency of occurrence of wild pigs in the diet showed significant differences between seasons with peaks during the fall and winter months and decline during spring and total absence during the summer months. Other alternative prey species occurred most frequently in winter and declined through spring and summer. Wild pig was the only alternate prey recorded in the fall. The regional grouping of scat samples revealed a statistically significant difference in the utilization of wild pig between the chaparral-oak woodland habitats in the southeast region and the oak dominated habitats in the northwest region.

Smith, T.E., R.R. Duke, and M.J. Kutilek. 1984. The Ecology of the Mountain Lion in the Guadalupe Mountains of Texas and New Mexico. Pgs. 174-175 In: J. Roberson and F. Lindzey (eds.), Proc. of the Second Mountain Lion Workshop. Utah Div. Wildl. Res. and Utah Coop. Wildl. Research Unit. Zion National Park. 271pp.

To date 12 males and 10 females comprising 14 adults, 3 yearlings, and 5 kittens had been captured and radio-collared. Nine were currently alive with functional transmitters. Home range for 4 adult males was 144km^2 (56mi^2) while that of 3 adult females was 48km^2 (18mi^2). A small amount of home range overlap was noted among mature adult males. A population size of 58 mountain lions was estimated to exist in the study area (1000km^2). Analysis of 118 scats revealed a 78% frequency occurrence for deer. Forty-seven lions died between June, 1982 and July, 1984 in the study area. Forty-four of these were trapped or shot with the aid of hounds.

Smith, T.E., R.R. Duke, M.J. Kutilek, and H.T. Harvey. 1986. Mountain Lions (Felis concolor) in the Vicinity of Carlsbad Caverns National Park, New Mexico, and Guadalupe Mountains National Park, Texas. Final Report. Prepared by Harvey and Stanley Associates, Inc. for USDI, National Park Service. Alviso, Ca. 137pp.

A three year study of mountain lions was conducted in the vicinity of Carlsbad Caverns National Park, New Mexico, and Guadalupe Mountains National Park, Texas in order to provide basic ecological information to the National Park Service. Accurate information was needed to enable the Park Service to refine and develop management plans in part because mountain lions were known to be killing sheep on ranches north of the boundaries of the two parks, and the role of mountain lions from these parks was not known. Twenty-two mountain lions were captured, fitted with radio-collars, released and monitored during the course of the study. The home ranges, movements, dispersal, activity, reproduction, and food habits of these animals were studied and reported. An estimated maximum of 58 lions (24 adult, 12 yearling, and 22 kittens) occupied the study area of 400 mi^2 (1036 km^2) within the two parks and sections of the Lincoln National Forest at any one time. The average home range for adult males was 80 mi^2 (207 km^2), and for females was 23 mi^2 (59 km^2). In general, adult males traveled further than adult females, and females with 5-12 month old offspring traveled even less. Deer were the principal prey species for mountain lions, occurring in 82% of all scat (feces) collected. During the study period, 65 mountain lions (including 11 radio-collared animals) were killed on or near ranches bordering the National Parks. Some of these animals were adults from within the National Parks, some were young produced within the parks, and apparently others were from outside the study area. Six of the eleven radio-collared mountain lions which were killed were known or believed to have killed sheep, but whether the others did is unknown. Despite the large numbers of lions killed bordering park lands, no detectable changes occurred in mountain lion density during the study, which suggests that reproduction and immigration from other areas replaced the mountain lions which were killed.

Smythe, L. 2008. Recent Records of Pumas (*Puma concolor*) on the Kofa National Wildlife Refuge, Arizona. J. Arizona-Nevada Academy of Science 40(2):155-156.

Abstract

Pumas (*Puma concolor*) have long been considered transient species in southwestern Arizona. A sighting of three pumas in 2003 on the Kofa National Wildlife Refuge was the first verifiable record since 1944 and prompted further investigation into the presence and distribution of pumas on the refuge. Refuge personnel compiled 76 photographs of pumas since January 2004 and documented presence of five individuals, including a breeding female, in 2006 and 2007.

Sondgeroth, K., C. Leuteneggar and S. Vandewoude. 2005. Development and Validation of Puma (*Felis concolor*)

Cytokine and Lentivirus Real-Time PCR Detection Systems. Vet. Immunol. Immunopathol. 104(3-4):205-213.

Abstract

Studies of immune correlates of disease outcome associate humoral immune response mediated by T-helper 2 cytokines (IL-4, IL-10) with more virulent disease relative to a cell-mediated response driven by T-helper 1 cytokines (IL-2, IFN-gamma), particularly in viral and other intra-cellular infections. Specifically, the kinetics of both human immunodeficiency virus (HIV) and feline immunodeficiency virus (FIV) infection are closely associated with Type 1 versus Type 2 cytokine profiles. Puma (*Felis concolor*) lentivirus (PLV) is closely related to FIV, but based on phylogenetic and clinical studies, is more ancient and less pathogenic. The aims of this study were to validate feline real-time PCR primer/probe systems for puma cytokines and PLV as sensitive, quantitative assays for use in investigations of PLV pathogenicity. We demonstrate that primer/probe systems for IL-4, IL-10, IFN-gamma, TNF-alpha, GAPDH, and the pol region of PLV-1695 amplify puma cytokines and PLV-1695 with high amplification efficiency and sensitivity. Detection of PLV-1695 provirus in experimentally inoculated domestic cats proved to be of equivalent sensitivity, specificity, and positive and negative predictive value to co-culture of one million peripheral blood mononuclear cells (PBMC). Evaluation of cytokine induction during naturally occurring PLV infection will allow insight into mechanisms of host control associated with apathogenic infection. In addition, determination of viral loads during different stages of PLV infection or in different tissues from domestic cats or pumas will further elucidate capacity of these viruses to replicate and establish infection.

Soria-Díaz, L., O. Monroy-Vilchis, C. Rodríguez-Soto, M. Zarco-González, and V. Urios. 2010. Variation of Abundance and Density of *Puma concolor* in Zones of High and Low Concentration of Camera Traps in Central Mexico. Animal Biology 60(4):361-371.

Abstract

Little is known about the status of *Puma concolor* populations in Central and South America. Due to this reason, the present study contributes to the knowledge on puma populations providing information on abundance and density in Sierra Nanchititla, Mexico, as well as comparing recorded values against those obtained from zones of high and low concentration of camera traps. The sampling was carried out during a period of 30 months, which were divided into 3-month independent blocks. For the 8 first blocks, ten camera traps were set in an area where the separation among cameras was 1.6 km, and in the 2 last blocks 17 camera traps were set in an area where the separation was 4.6 km. The abundance was estimated between 2 and 5 individuals for the area with the highest concentration of cameras, lower than the abundance obtained in the area with the lowest concentration of cameras, i.e., 6 individuals. The density of the area with the highest camera concentration had a variation between 2.74 and 6.86 individuals/100 km^2 in an effective survey area of 72.8 km^2 and for the area of lowest concentration it was 1.21 individual/100 km^2 in an effective survey area of 492.6 km^2.

Spalding, D.J. 1971. The Wildcats of British Columbia. Pgs. 59-67 In: Jorgensen, S.E. and L.D. Mech (eds.). Proc. of a Symposium on the Native Cats of North America, Their Status and Management. U.S. Dept. Int., Fish and Wildlife Service, Twin Cities, Minnesota.

Three subspecies of the cougar are found and include: F.c. oregonensis, F.c. missoulensis, and F.c. vancouverensis. Interpretation of bounty records was difficult due to fluctuations, in part, being a response to changing bounty prices. The known harvest of 920 cougar in 1948 (725 bountied, 195 killed by Branch officers) was the highest annual kill accurately recorded. The subsequent drop in the number of cougars bountied (1952-1956) may represent a condition of over-harvest or more probably reduced deer numbers on Vancouver Island and lowered hare populations in the Chilcotin. At present most cougar populations are static or increasing, except in the South Central and Southeastern sections of the province where populations are declining. These declining populations are being over-hunted. Two people (both young boys) have been killed by cougar, and the author has accumulated a total of 23 known attacks on humans, where data on sex, age and/or condition of the cougar was known. Ten of the 17 classified to sex were females, nine of which were young animals. Ten of the 22 classified as to condition were in good physical condition. This indicated that young cougar, frequently in good condition attack humans, and there is a tendency for females to predominate in the sample. In contrast, male cougar apparently outnumber females in the wild. The cougar was recognized as a big game animal in 1966, but no restrictions were placed on hunting, harvest limits, or seasons, and

no tag license was required. In 1970, harvest control was implemented with trophy fees and guides required for nonresidents, bag limits in some areas, and a tag license fee was required. Livestock losses are considerable and may amount to $25,000 per year.

Spalding, D.J., and J. Lesowski. 1971. Winter Food of the Cougar in South-Central British Columbia. J. Wildl. Manage. 35:378-381.

One hundred thirty-two cougar stomachs and 73 cougar-killed mule deer were examined from 1958 to 1967 in south-central British Columbia. Deer was the predominant food item, but when other prey was abundant locally, cougars took advantage of these alternate food sources such as snowshoe hares, moose, and domestic stock. Cougars seem to take antlered mule deer, as well as the old of both sexes, in greater numbers than exist in the deer population. Of the 132 stomachs examined, 99 had identifiable food remains, 12 were empty, and 21 either contained unidentified contents or grass. The heaviest stomach weighed during this study was 3,176 grams (approximately 7.1 pounds) of mule deer. Data seemed to indicate that cougars showed a preference for bucks 1.5 years and older.

Spatz, C. 2007. The Fools Progress: Kittatinny/Shawangunk Ridge Corridor. Page 3 in Abstracts of Presentations of the 3rd Midwestern-Eastern Puma Conference, Trent University, Peterborough, Ontario.

Abstract

The Kittatinny Ridge parallels the Delaware River for fifty miles along New Jersey's northwestern boundary with Pennsylvania - from High Point State Park south to the Delaware Water Gap National Recreation Area - a protected corridor of contiguous state parks, state forests, and federal land. It is the middle section of a monocline that begins in southern New York State as the Shawangunks, becomes the Kittatinny at the state line with New Jersey, and slants across central Pennsylvania as Blue Mountain, petering out just east of Harrisburg. The ridge forms a 250 mile-long green corridor between the outer reaches of the mid-Atlantic suburbs and the vast, forested regions of the Catskills, the Poconos, and the Alleghany Plateau. It is the eastern most flank of the Appalachian Mountain chain, along which the Appalachian Trail traverses for 200 miles. Despite the state's reputation as a rictus of industrial parks and interstates straddled with sprawl, northwestern New Jersey boasts some of the densest concentrations of black bear and white-tailed deer in North America. While puma sightings have occurred sporadically in the region for fifty years, reports spiked dramatically in 2006. For twenty years I heard reports of elusive pumas roaming the Northern Shawangunks' ten miles of linear cliffs and its 40,000 protected acres of hemlock groves, glacial sky lakes, and pitch pine barrens. When I moved to the Gunks in 2000, I began collecting puma sightings on the ridge, as well as in the adjacent 700,000 acre Catskill State Park, but only once was able to get within a day of a report to look for sign. That changed last summer, when puma sightings began occurring almost weekly 60 miles south in Vernon, NJ. I began following up the sightings, scouring for evidence, and moving a single remote camera around these reports. I contacted the Eastern Cougar Foundation for advice and support, and started speaking with a number of New Jersey game officials, from a retired Fish & Wildlife commissioner to biologists to spokes people in their Trenton press office about the state's puma search. To date, their efforts have yet to yield evidence despite a number of attempts with traps and cameras. In September, sightings began appearing west of Vernon along the Kittatinny Ridge at High Point State Park. I spoke there with park rangers, received confirmations of the reports, and met with the park's superintendent to propose a small remote camera project, which was approved in late November by the NJ Division of Parks & Forestry. Following a well-attended January, 24th lecture by ECF Vice President Kerry Gyekis for the Shawangunk Ridge Biodiversity Partnership's annual winter lecture series at SUNY New Paltz, I am pursuing preliminary plans for a remote camera project in the Gunks, including writing grants for cameras with assistance from the ECF. Like many enthusiastic amateurs before me, I am coming to the slow realization that the bevy of puma sightings yield little sign, that it is statistically unlikely that dispersers from the Midwest or Canada have reached so deeply into the mid-Atlantic, and that sightings are frequently misidentifications of bobcat. Still, I continue to track promising reports, driven by the undying hope that remnant natives or releases are out there. In light of some historical conflicts between government wildlife agencies and individuals seeking to establish puma confirmations/research, Jay Tischendorf has invited me to highlight my approach in pursuing these camera projects for the conference.

Spencer, R., and K.R. Dixon. 1992. Home Range and Movements of Cougars in a Non-hunted Population in Western

Washington. Bull. Ecol. Soc. America 73(2):352.

Twelve cougars were trapped and radio-collared in a protected (non-hunted) watershed in western Washington state. The cats were tracked until their death. Cats leaving the protected area incurred a higher mortality rate from both hunting and vehicle collisions. Seasonal changes in home ranges showed smaller winter home ranges and elevational changes that followed that of elk, their primary prey.

Spencer, R., K. Allen, L. Sheeler-Gordon, S.R. Anderson and K.R. Dixon. 2003. Home Ranges and Movements of Cougars in a Non-hunted Population in Western Washington. Pages 75-76 *in* L. A. Harveson, P. M. Harveson, and R.W.Adams, eds. Proceedings of the Sixth Mountain Lion Workshop. Austin. Texas.

Abstract

Since 1974, 43 cougars (Puma concolor) were immobilized and radio equipped in protected (non-hunted or "refugia" areas) and unprotected (hunted) watersheds in the western Cascade Mountains of Washington State. The cougars were tracked (some for as long as 5 years) until their death. Home ranges were calculated for the 17 cougar with sufficient numbers for radio relocations. We determined and compared home ranges of males and females; results showed adults had larger home ranges than juveniles and male home ranges were larger than females. There were no clear relationships between home range size and season. A limited number of females, collared up to 5 years, showed yearly "shifts" in home range use areas. Overlaps among adult males, adult females, subadults, and kittens were analyzed. Some home ranges showed overlaps in space but not in time. Other objectives of the study included determination of: 1) dispersal distances of primarily subadult males and some females, 2) documentation of mortality sources for resident and dispersing subadults (primarily males), 3) cougar age at dispersal, and 4) the number of live months after dispersal (LMAD). We evaluated hypothesized factors that likely influenced dispersal patterns, direction, and mortality. We also examined 74 prey items and determined age and sex of deer (Odocoileus spp.) and elk Cervus elaphus) taken by cougar. There was significant selection for old deer (> 7 years old) and young (< 1 year old) elk.

Spreadbury, B. 1988. Cougar Ecology in Southeastern British Columbia. Pg. 48 In: R.H. Smith (ed.), Proc. of the Third Mountain Lion Workshop. Arizona Chapter, The Wildlife Society and Arizona Game and Fish Department, Prescott, Arizona. 88pp.

Thirty-four cougars (Felis concolor) were studied from May 1985 to November 1987 on a 540 km^2 study area in the Elk and Fording Valleys of southeastern British Columbia. Winter population densities were estimated as 3.5 cougars/100 km^2 in 1985-86 and 3.7 cougars/100 km^2 in 1986-87. Kittens comprised 55% to 58% of the population each winter. Mean litter size was 3.14 kittens/litter. Juveniles dispersed distances of 31-163 km from the study area. Sex ratios of both kittens and adults did not differ significantly from equality. Mortality the first and second winters, respectively, was 5.3% and 15%, of the population. Most mortality within the study area (57%) was human-related despite closing of the season during the study. Mortalities of resident males were quickly compensated for by immigration. Spatial distribution of seven adult cougars was determined through telemetry. Mean yearly home areas were 55 km^2 (S.D. = 25.18) for 4 females and 151 km^2 for two males. No overlap was noted between male home areas and only slight overlap was noted in 2 of the 4 female home areas. Cougars utilized lower elevations during winter months than during spring-summer-fall months. Cougar food habits were studied using cougar kills, and gastrointestinal contents and parasitology data collected from vehicle-killed cougars. Elk were found to be the major prey item, 66% of the sample. Selection of elk calves over cows and bulls was noted. Cougars did not appear to select for prey in poor condition. Eighty-six percent of the elk killed during winter 1985-86 were less than 1.5 years of age or 8.5 years of age or older. Rodents and other small prey were believed to have been underrepresented in the sample, a conclusion supported by parasitology data.

Spreadbury, B.R., R.R.K. Musil, J. Musil, C. Kaisner and J. Kovak. 1996. Cougar Population Characteristics in Southeastern British Columbia. J.Wildl. Manage. 60(4):962-969.

Abstract

We studied a cougar (*Puma concolor*) population from May 1985 to November 1987 on a 540 km^2 study area in

southeastern British Columbia (BC) to collect detailed ecological data to assist in refining regional species management. We used capture-recapture and radiotelemetry techniques, observed 34 different cougars, and estimated winter population densities of 3.5 cougars/100 km^2 (1985-86) and 3.7 cougars/ 100 km^2 (1986-87). Sex ratios of 20 kittens and 12 adults did not differ significantly from equality ($P > 0.05$). Kittens made up 55-58% of the population each winter. Mean litter size was 3.1 ± 1.2 [SD] kittens/ litter (n = 7). Birth intervals were 15-23 months. Eight juveniles dispersed 12-163 km from the study area. Mortality was 5.3% of the population the first winter, and 15% the second winter. Four of 7 mortalities were human-related (vehicular) despite the area being closed to hunting. Home range sizes of 4 resident females were 31 ± 10 km^2 [SD] in winter, 35 km^2 ± 14 in summer, and 55 km^2 ± 25 yearly with low or no home range overlap. Two resident males yearly home ranges averaged 151 km^2. No male home range overlap was documented.

Squires, W.A. 1950. The Eastern Panther is Not Extinct. Can. Geogr. J. 41(4).

The Hon. R.J. Gill, Minister of Lands and Mines, declared that there are still panthers in New Brunswick in January, 1948. Much of the credit for proof of the survival of the eastern panther was given to Bruce Wright, Director of the Northeastern Wildlife Station at Fredericton. In March, 1947, Jim Robinson, a guide, showed Mr. Wright the tracks of an adult male, a female, and one cub not far from the new Fundy National Park. Tracks were also found in mud in July, 1947, and plaster casts were identified at the Smithsonian Institution in Washington. Although no specimen exists in any museum collection, several historic accounts are presented which indicate that several panthers had been seen or killed in New Brunswick.

Steinhart, P. 1986. Does Anyone Know Anything About Mountain Lions? Pacific Discovery 39(1):6-15.

Until 1959, California employed up to five state lion hunters at a time and continued to offer bounties on lions until 1963. In fifty-six years, the state paid bounties on 12,500 lions. Sport hunting was outlawed in 1972 and it is believed that lion numbers are increasing rapidly in California. Human/lion encounters are increasing and so are reports of lions killing livestock. In 1972 there were five livestock killings reported compared to ninety-four in 1985. The California Department of Fish and Game estimated that there were 4,800 lions in California, plus or minus 700, from a survey in 1972. Rick Hopkins, a University of California graduate student, has been studying a lion population on Mount Hamilton, east of San Jose, for eight years. His studies showed no increase in lion densities or numbers and he believes the lion population hasn't changed in the last forty years. Maurice Hornocker's mountain lion studies in Idaho, Rick Hopkins studies in California, and Don Neal's studies in the Sierra National Forest in California are discussed.

Steger, G.N. 1988. Movement and Survival of 14 Month Old Orphaned Mountain Lion Kittens. Pg. 73 In: R.H. Smith (ed.), Proc. of the Third Mountain Lion Workshop. Arizona Chapter, The Wildlife Society and Arizona Game and Fish Department, Prescott, Arizona. 88pp.

Two orphaned mountain lion kittens were radio-collared and established home ranges that resembled, in size, shape, and pattern of use, those of established adult female lions within the study area. The minimum adult lion density in the area where the kittens settled was estimated to be 7.8 per 100 mi^2. Telemetry records showed that eight adult female and 6 adult male lions utilized all or part of one of the kittens' home range and 6 adult females and 4 adult males utilized the other kittens' home range while the kittens established their new home ranges.

Stephen, C., D. Haines, T. Bollinger, K. Atkinson and H. Schwantje. 1996. Serological Evidence of Toxoplasma Infection in Cougars on Vancouver Island, British Columbia. Can. Vet. J. 37(4):241.

The results of the indirect immunohistochemical testing confirmed the presence of antibodies specific to T gondii in these cougars, thus establishing past exposure to the parasite. Since we do not know the magnitude if titers in cougars that correlate with recent versus past exposure to T. gondii, no comment can be made as to the time of their exposures. Although the results demonstrate that cougars could reasonably be considered as potential sources of infectious oocysts on southern Vancouver Island, they do not identify cougars as the source of parasites in the 1995 outbreak in Victoria.

Stiver, S.J. 1988. Status of Mountain Lions in Nevada. Pgs. 26-29 In: R.H. Smith (ed.), Proc. of the Third Mountain

Lion Workshop. Arizona Chapter, The Wildlife Society and Arizona Game and Fish Department, Prescott, Arizona. 88pp.

Historical records indicate that although the mountain lion was widely distributed in Nevada, no evidence suggests that densities or numbers were high. Lion populations appeared to rise with increasing mule deer populations in the 1930's and 1940's. By the 1950's, Animal Damage Control harvests had increased from 46 animals killed between 1917 and 1931, to an average of 90 lions per year in the 1950's. The mountain lion was given game animal status in 1965, and in 1968 tags were required to harvest a lion. In 1970, a limit of one lion per hunter was set and a mandatory checkout was established. It was estimated that 6,042 square miles have high densities averaging 0.04 lions per square mile and 21,690 square miles have low densities averaging 0.025 lions per square mile. The lion population in Nevada was estimated to be 792 lions in 1983, but subsequent analysis of lion populations indicated that this is probably a conservative number. Females with spotted kittens and spotted kittens may not be taken and trapping is illegal. All lions killed must be validated by a Department representative within 72 hours of the kill.

Stocek, R.F. 1995. The Cougar, Felis concolor, in the Maritime Provinces. Can. Field Nat. 109(1):19-22.

The cougar (Felis concolor) is a very rare animal in New Brunswick and Nova Scotia. Yet sightings of this felid are being reported with increasing frequency. Five hundred and one cougar reports (from 1977 to 1993 inclusive) were analyzed to characterize the distribution of sightings, habitat, season and time, animal activity, vocalization, physical description and multiple sightings. Many apparently reliable observations suggest that there could be a small number of cougars, of unknown origin, in these two Maritime provinces. None are reported in Prince Edward Island.

Stone, H.S., D. Coblentz, S. Morse, K. Hansen, and H.G. Shaw. 1997. The Fort Huachuca-Canelo Hills Track Count: A Model for Volunteer Based Mountain Lion Monitoring. Pages 76-82 in W.D. Padley, ed., Proc. Fifth Mountain Lion Workshop: 27 February- 1 March 1996; San Diego, California.

We present the results of an ongoing volunteer-based track count project which monitors the presence of mountain lion (*Puma concolor azteca*) on the Fort Huachuca Military Reservation in the Huachuca Mountains of southeastern Arizona, and more recently, possible lion movement corridors through the neighboring Canelo Hills. The Fort Huachuca track count has been conducted yearly since 1989. Five routes that cover 15.3 miles (providing a sampling rate of about one mile of route per 2.3 square miles of lion habitat) are monitored twice during a two week period in early June. The track count has been successful in documenting the presence of lions, with an average track per route mile ratio of about 0.24. The track count in the Huachuca Mountains raised a number of questions about possible wildlife corridors to the neighboring mountain ranges and, starting in August 1995, the track count program was expanded to evaluate the inter-mountain movement of lions. Initially, we have concentrated on possible corridors through the Canelo Hills, which lie to the west of the Huachucas and form a natural link to the Santa Rita and Whetstone mountains. Using the same track count method that has proved successful on Fort Huachuca, this program has been conducted monthly between August 1995 and April 1996. Over this time period more than 110 volunteers have participated in the program and more than 60 miles of routes have been covered. While this project is still in its infancy, lion presence has been documented along a number of routes, suggesting that the method may be a useful tool for evaluating the inter-mountain movement of lions. In addition to an analysis of the collected data, we also discuss the important social and educational role served by the track counts.

Stone, L. 1883. Habits of the Panther in California. The American Naturalist 17(11):1188-1190.

It is stated that a panther will always run from a dog no matter how small it is and a panther will always jump up in a tree when a dog is closing in. The McCloud River Indians say that the panther always kills the grizzly bear when they fight and that panthers are always trying to kill bear cubs and the bears are always seeking to kill the panther's kittens.

Stone, W. 1899. The Pumas of the Western United States. Science 9(210):34-35.

Arguments and evidence are presented that suggest the proper names for the Northwest Coast form of the puma should be Felis oregonensis (Raf.) and Rocky Mountain puma should be Felis oregonensis hippolestes (Merr.). The

author contrasted two descriptions in the literature; that of Rafinesque (1832) and Merriam (1897).

Stoner, D.C. and M.L. Wolfe. 2003. Defining and Delineating *De Facto* Refugia: A Preliminary Analysis of the Spatial Distribution of Cougar Harvest in Utah and Implications for Conservation. Page 136 *in* S.A. Becker, D.D. Bjornlie, F.G. Lindzey, and D.S. Moody, eds. Proceedings of the Seventh Mountain Lion Workshop. Lander, Wyoming.

Abstract

Cougars (*Puma concolor*) in Utah are managed at two scales, often with differing objectives. The statewide population is managed for persistence and sustainable hunting opportunities, while at the finer scale of an individual management unit, a sub-population may be managed to accomplish density reductions, depending on local priorities. However, cougars have large and variable spatial requirements, and management unit boundaries may not coincide with actual demes. Compounding these constraints, the lack of cost-effective and reliable enumeration techniques increases the risk of inadvertent over-harvest. Current research suggests that for species difficult to enumerate, greater emphasis be placed on metapopulation-scale management in order to minimize the effects of uncertainties with respect to demography and dispersal behavior. Because harvest is the primary variable that managers can manipulate and measure, it is important to understand how recruitment patterns in minimally exploited populations may influence the persistence and recovery of heavily exploited populations. In this paper we discuss some of the factors that account for the spatial distribution of harvest and how this information can be used to develop management strategies in the absence of census data. We used 6 years of radio-telemetry data from a lightly exploited population in the Oquirrh Mountains of north-central Utah to quantify the effect of a small sanctuary (480 km²) on cougar survivorship, fecundity, and dispersal. We then mapped the locations of cougars harvested across the state from 1996-2001, and attempted to: (1) identify the factors that influence these patterns, and (2) determine the size and distribution of potential harvest sinks and *de facto* refugia in the state. Finally, we identified habitat patches on the periphery of the state that straddle management jurisdictions, representing areas of possible inter-state cooperation. We recommend that managers consider a metapopulation perspective and attempt to distribute harvest pressure in a spatially and ecologically relevant manner. In the absence of large (2400 km²), contiguous refugia, small sanctuaries adjacent to areas of high exploitation may be mapped and utilized as a deterrent against potential over-exploitation.

Stoner, D.C. and M.L. Wolfe. 2003. Cougar Exploitation Levels and Landscape Configuration: Implications for Demographic Structure and Metapopulation Dynamics. Page 161 *in* S.A. Becker, D.D. Bjornlie, F.G. Lindzey, and D.S. Moody, eds. Proceedings of the Seventh Mountain Lion Workshop. Lander, Wyoming.

Abstract

Currently eleven states and two Canadian provinces utilize sport hunting as the primary mechanism for managing cougar (*Puma concolor*) populations. However the impacts of sustained harvest on demographic structure and population persistence are not well understood. Additionally, the range of non-biological factors influencing the rate of population recovery has not been thoroughly examined. We have been monitoring the cougar populations on Monroe Mountain in south-central Utah, and in the Oquirrh Mountains of north-central Utah since 1996 and 1997, respectively. The critical management distinction between these sites is the degree of exploitation. The Monroe population is subjected to heavy annual hunting pressure and is characterized demographically by a younger age distribution, low survivorship, low fecundity, and declining density. In contrast, the population inhabiting the northeastern slope of the Oquirrhs is subjected to little or no hunting pressure and exhibits an older age distribution, relatively high survivorship and fecundity, a stable density, and a high emigration rate. Due in part to these differences, the Oquirrh and Monroe populations appear to exhibit source and sink dynamics within the regional metapopulation. Therefore the temporal scale of population recovery may depend on the interaction between the dominant harvest regime and the degree of landscape connectivity with neighboring patches. Aside from harvest, the interaction between patch configuration and anthropogenic fragmentation may be highly influential in the long-term prognosis for these populations. We discuss the implications of these demographic distinctions in light of enumeration uncertainties, habitat fragmentation, and landscape structure.

Stoner, D.C., M.L. Wolfe and D.M. Choate. 2006. Cougar Exploitation Levels in Utah: Implications for Demographic Structure, Population Recovery, and Metapopulation Dynamics. Population Dynamics and Viability in the Pacific Northwest. J. Wildl. Manage. 70(6):1588-1600.

Abstract

Currently, 11 western states and 2 Canadian provinces use sport hunting as the primary mechanism for managing cougar (*Puma concolor*) populations. Yet the impacts of sustained harvest on cougar population dynamics and demographic structure are not well understood. We evaluated the effects of hunting on cougar populations by comparing the dynamics and demographic composition of 2 populations exposed to different levels of harvest. We monitored the cougar populations on Monroe Mountain in south-central Utah, USA, and in the Oquirrh Mountains of north-central Utah from 1996 to 2004. Over this interval the Monroe population was subjected to annual removals ranging from 17.6–51.5% (mean ± SE = 35.4 ± 4.3%) of the population, resulting in a >60% decline in cougar population density. Concurrently, the Oquirrh study area was closed to hunting and the population remained stationary. Mean age in the hunted population was lower than in the protected population (F = 9.0; df = 1, 60.3; P = 0.004), and in a pooled sample of all study animals, females were older than males (F = 13.8; df = 1, 60.3; P < 0.001). Females from the hunted population were significantly younger than those from the protected population (3.7 vs. 5.9 yr), whereas male ages did not differ between sites (3.1 vs. 3.4 yr), suggesting that male spatial requirements may put a lower limit on the area necessary to protect a subpopulation. Survival tracked trends in density on both sites. Levels of human-caused mortality were significantly different between sites (χ^2 = 7.5; P = 0.006). Fecundity rates were highly variable in the protected population but appeared to track density trends with a 1-year lag on the hunted site. Results indicate that harvest exceeding 40% of the population, sustained for ≥4 years, can have significant impacts on cougar population dynamics and demographic composition. Patterns of recruitment resembled a source–sink population structure due in part to spatially variable management strategies. Based on these observations, the temporal scale of population recovery will most likely be a function of local harvest levels, the productivity of potential source populations, and the degree of landscape connectivity among demes. Under these conditions the metapopulation perspective holds promise for broad-scale management of this species.

Stoner, D.C., W.R. Rieth, M.L. Wolfe, M.B. Mecham and A. Neville. 2008. Long-Distance Dispersal of a Female Cougar in a Basin and Range Landscape. J. Wildl. Manage. 72(4):933-939.

Abstract

We used Global Positioning System technology to document distance, movement path, vegetation, and elevations used by a dispersing subadult female cougar (*Puma concolor*) through the fragmented habitat of the Intermountain West, USA. Over the course of 1 year, female number 31 moved 357 linear km, but an actual distance of 1,341 km from the Oquirrh Mountains, Utah to the White River Plateau, Colorado, constituting the farthest dispersal yet documented for a female cougar. This cougar successfully negotiated 4 major rivers and one interstate highway while traversing portions of 3 states. Our data suggest that transient survival, and therefore total distance moved, may be enhanced when dispersal occurs during the snow-free season due to low hunting pressure and greater access to high elevation habitats. Long-distance movements by both sexes will be required for the recolonization of vacant habitats, and thus inter-state management may be warranted where state boundaries do not coincide with effective dispersal barriers.

Stoner, D.C. and M.L. Wolfe. 2008. Source-Sink Dynamics and the Recovery of Overexploited Cougar Populations. Page 184 in Toweill, D. E., S. Nadeau and D. Smith, editors. Proceedings of the Ninth Mountain Lion Workshop, May 5-8, 2008, Sun Valley, Idaho, USA.

Abstract

The cougar (*Puma concolor*) is a large New World felid that has demonstrated remarkable resilience to anthropogenic impacts, remaining one of the most prevalent large carnivores in North American ecosystems. Presently, cougars are subjected to annual harvests over much of their current range, yet the impacts of sustained hunting on demographic structure and population persistence are not well understood. We have been monitoring two cougar populations in Utah, USA, since 1997. We compared demographic characteristics between an exploited and a protected population to examine the behavioral mechanisms of population recovery and productivity. The treatment population had a younger age distribution, low survival, declining density, and variable fecundity, and generally fit the profile of a sink population. In contrast, the reference population exhibited the opposite trends in nearly every parameter and appeared

to act as a source. Under these conditions, sustained exploitation created an ecological trap on the treatment site. Data five years posttreatment suggests that following the implementation of a constant number of permits, the sink population recovered in phases and began functioning as a source. We offer empirical evidence for the occurrence of source-sink dynamics in an exploited cougar population, and argue that in conjunction with the principles of landscape ecology, the source-sink model of population regulation holds promise for the conservation of exploited cougar populations.

Storer, T.I. 1923. Rabies in a Mountain Lion. Ca. Fish and Game 9(2):45-48.

The author was aware of only one attack of a mountain lion on a human being in California. A seven year old boy was attacked and killed on June 19, 1890 in Quartz Valley, Siskiyou County, by two lions while playing some distance from his home. A lion, evidently infected with rabies, attacked and killed two persons in 1909, including one adult near Morgan Hill, Santa Clara County. This account had only been recorded in the Morgan Hill Times on July 9, 1909 (Vol. XI, No. 8), and this article is presented verbatim except for the final paragraph which was only of local interest. After investigation it was determined that the probable cause of death of the two victims was rabies as over 7 weeks had elapsed from the time of the injury to death.

Stoskopf, M.K., J.D. Strandberg, and F.M. Loew. 1979. Renal Oxalosis in Large Felids Maintained on a Commercial Diet. Annu. Proc. Am. Assoc. Zoo Vet., 1978:154-161.

Felids are known to be susceptible to ethylene glycol toxicity resulting in renal oxalosis. A case history is presented in which a nine year-old puma became ill with the clinical picture being that of a hemorrhagic urocystitis. The animal maintained hydration but became anorectic. Urinalysis revealed numerous triple phosphate and calcium phosphate crystals. After 3 weeks of Ampicillin therapy, the cat was discharged at 4 weeks with normal urinalysis. Three weeks later the cat was presented again with partial anorexia, and became completely anorectic after one week. The cat was again placed on antibiotics for the supposed recurrence of the bacterial urocystitis. Due to recently confirmed renal oxalosis at the Knoxville Zoo, a systematic search for oxylate containing plants and/or possible unintentional uses of antifreeze containing ethylene glycol was conducted but proved negative. The puma died two days later after developing ulcerations of the tongue and gums. Upon gross examination at necropsy, an acute gastritis and a chronic active nephritis was diagnosed. Focal subendocardial hemorrhages and lingual ulcers were also noted. It was found that the manufacturer of the prepared meat product that was used to feed the puma had been contaminated with ethylene glycol.

Strickland, D. 1980. Mountain Lion Populations. Wyoming Game and Fish Department. Cheyenne. 5pp.

Although limited data was available, the author estimated the mountain lion population and allowable harvests. Habitat densities were based on Kuchler Vegetation Types and past lion observations, harvests, and sign. Statewide lion numbers were estimated to range from 930 to 1,173 animals. A conservative harvest level of 10% of the population was recommended.

Suminski, H.R. 1982. Mountain Lion Predation on Domestic Livestock in Nevada. Proc. Tenth Vert. Pest Conf. (R.E. Marsh, ed.). Univ. of Ca., Davis. pp. 62-66.

The mountain lion has long been considered a serious predator on domestic livestock, primarily sheep, in the state of Nevada. For the past five years (FY 77-81), documented losses to lions have averaged 375 animals. While this number is not large, most losses are sustained by only a few individual livestock operators, and the losses constitute a serious economic hardship for these individuals. Averages of 23 lions have been taken in response to livestock depredation complaints during each of these five years. Controlling livestock loss to mountain lions is the responsibility of the Animal Damage Control branch of the U.S. Fish & Wildlife Service. ADC personnel work in cooperation with the Nevada Department of Wildlife, Nevada Predatory Animal and Rodent Control Committee and livestock producers in an effort to keep both livestock losses and the number of lions taken on depredation complaints at an acceptable level.

Swanson, B.J. and P.J. Rusz. 2006. Detection and Classification of Cougars in Michigan Using Low Copy DNA Sources. American Midland Naturalist 155:363-372.

Abstract

Sporadic reports of cougars (Puma concolor) have occurred in Michigan since its official classification as extirpated in the 1930s. We collected 297 scats from 12 areas in Michigan with heavy sighting reports of cougars. Ten scats produced DNA profiles consistent with cougars. One scat was identified as having a North American origin; the other nine scats produced no useable sequences. One pre-Columbian sample, from a Native American burial site; also matched the current North American genotype. Based on the distance between cougar scats, we conclude that there were at least eight cougars in Michigan during the 3 y of this study. The mtDNA sequences also suggest that at least some of the matrilines currently and historically found in Michigan are the same as those found in current and historical western populations.

Swanson, K., D. Land, R. Kautz and R. Kawula. 2005. Use of Least Cost Pathways to Identify Key Highway Segments for Florida Panther Conservation. Pages 191-200 *in* R.A. Beausoleil and D.A. Martorello, editors. Proceedings of the Eighth Mountain Lion Workshop, Olympia, Washington, USA.

Abstract

Highways fragment wildlife habitat and collisions with vehicles are an added source of wildlife mortality. Often, wildlife populations can absorb this unnatural mortality without suffering declines, but for endangered large mammals like the Florida panther *(Puma concolor coryi),* additional fragmentation of remaining habitat or additional sources of mortality (e.g. roadkill) could imperil their existence. A landscape approach is critical to minimize impediments to panther movements caused by highway improvements, changes in traffic volume, or the construction of new roads. Least cost path (LCP) modeling uses landscape features, which have been classified according to their value to panthers, to construct pathways that minimize impediments to panther movements between two areas. We modeled LCP's between six major use areas in southern Florida. We chose these areas because they represent the extents of occupied panther habitat where both male and female panthers live, plus we have also documented panthers traveling between these areas. Seventeen key highway segments were identified where these LCP's intersected improved roadways; these highway segments matched up well with documented panther roadkill locations. We believe that our methodology can be used to better inform panther conservation planning that will be necessary as current road networks are improved or new roads are constructed. We did not attempt to map all possible panther/highway areas but we do recommend this technique for informing conservation planning in other areas as needs arise. We are finalizing a more thorough report on this work and it will be available for download from www.panther.state.fl.us under the Reports section in the near future.

Sweanor, L.L. 1990. Mountain Lion Social Organization in a Desert Environment. Appendix E., Annual Rep., Proj. No. W-128-R-5, Job 1. New Mexico Dept. of Game and Fish, Santa Fe. 130pp.

The purpose of this 3-year study was to describe the social organization of mountain lions within the San Andres Mountains in south-central New Mexico. Fifty-one individual mountain lions were captured, marked, and released on the study area. Twenty-three were initially captured as young kittens at den sites, 1 kitten was bayed by a hound, and 27 (22 adults, 4 subadults, 1 kitten) were captured in leghold snares. The cumulative total included 12 adult males, 10 adult females, 1 subadult male, 3 subadult females, and 25 kittens (14 males, 11 females). Ninety-five percent of the entire resident lion population within the San Andres Mountains was apparently captured by the end of the third year. Thirty lions (10 adult females, 12 adult males, 3 subadult females, 2 subadult males, 3 kittens) were fitted with radio-collars with a total of 2,241 locations obtained (58.5% ground and 41.5% aerial). Adult residents and juveniles comprised an average of 53% and 41% of the lion population, respectively. Sex ratios did not differ significantly from equality. The total population density based on the area searched (1,935 km^2) averaged 2.0 lions/100 km^2 for the second and third years of the study and 1.0 lion/100 km^2 for adult lion density. Sixteen mortalities were documented with the largest percentage (38%) caused by intraspecific strife. Seven females gave birth to a total of 9 litters during the study with an average litter size of 2.9 kittens. Average annual home range size varied widely among individual lions and ranged from 40 to 235 km^2 for resident females, and 119 to 678 km^2 for resident males. Female home ranges averaged 36% the size of males with a general trend toward larger home range size as kittens become older.

Solitary females generally had the largest home ranges. Peaks of activity occurred during crepuscular hours. The amount of home range and core area overlap between males was significantly greater than the spatial overlap observed between adult females. The total area each adult female shared with males averaged 87%. Flight location data indicated that resident males were likely to be in closer proximity to other resident females than males and resident females were most likely to be in closest proximity to other adult males than females. A total of 352 scrape sites utilized by 4 resident male lions with adjacent home ranges were documented. Shared scrape sites ranged from 23% to 40% for each of the 4 males.

Sweanor, L.L. 1990. Mountain Lion Social Organization in a Desert Environment. M.S. Thesis. Univ. of Idaho, Moscow. 172pp.

Research was conducted on a mountain lion population in the San Andres Mountains of south-central New Mexico from August 1985 through mid-September 1988. The 1,935 km^2 study area was characterized by Chihuahuan desert. Population characteristics and social organization were determined using capture-recapture, ground tracking, and radio-relocation data. Fifty-one lions (24 females, 27 males) were captured 71 times. A total of 2,241 locations were obtained on 30 radio-collared lions (15 females, 15 males). The population was comprised of resident adults, resident subadults, and juveniles (kittens). During the 3 years, adult residents and juveniles comprised an average of 53% and 41% of the lion population, respectively. The sex ratio for 25 kittens born to 9 litters was 44:56 and did not differ from equality (p>0.l). The sex ratio for resident adults averaged 48:52 during the 3 years. Population density averaged 2.0 lions/100 km^2 for the second and third years of the study; adult density averaged 1.0 lions/100 km^2. Sixteen lion mortalities were documented; 6 (38%) were caused by intraspecific killing. Annual home ranges (using the harmonic mean home range estimator) averaged 114 km^2 for 7 resident females and 317 km^2 for 8 resident males. Annual and seasonal home ranges for resident females were significantly smaller than home ranges of resident males ($p<0.05$). There was no apparent difference in spring-summer and fall-winter home ranges for males or females ($p=0.5$). Females with young kittens (<6 months) traveled shorter distances than solitary females or females with older kittens ($p<0.025$). Subadult females moved greater daily airline distances than adult females without small kittens ($p<0.005$). Adult males traveled greater daily airline distances than adult females ($p<0.005$). Daily airline distances averaged 1.82 km for 6 adult females and 4.10 km for 10 adult males. Dispersal distances for 2 female and 2 male kittens born on the study area averaged 51.5 km and 104 km, respectively. Lions exhibited crepuscular behavior. A majority (mean=67%) of lions were active during 05:00 - 07:00 and 18:00 - 20:00 hours, whereas on average, only 13% were active during 09:00 - 16:00 hours. Adult female lions demonstrated annual home range fidelity. Spatial overlap between adult females averaged 6.6% and 2.8% of the 90% core use areas, respectively. Female home ranges overlapped up to 2 other females. Annual male home range fidelity varied. Most males showed some home range shifting during the 3 year study; shifts primarily appeared to be in response to other males. Spatial overlap between adult males averaged 46.8% and 15.6% of their 90% and core use areas, respectively. Male home ranges overlapped up to 3 other males. Home range overlap between adult males was greater than that found for females ($p<0.005$). Resident females shared an average of 87% and 73% of their 90% and core use areas with up to 3 resident males. Social interactions outside the mother-offspring family unit were rare. Resident lions were located within 1 km of other residents (but not necessarily in association) during only 7% of the aerial locations. Simultaneous locations indicated that resident lions were most likely to be in closest proximity to residents of the opposite sex ($p<0.001$). Independent lions were documented in association on 38 occasions. Association frequency averaged 4.3% for each lion. At least 39% of associations involved breeding pairs, >11% involved aggressive encounters between males and females, and >8% involved aggressive encounters between males. Scars found on all captured males indicated that fighting occasionally occurred. Three kittens from 2 litters became independent from their mothers at 10.8-14 months of age. A fourth kitten was orphaned at 10 months but managed to survive. Lions communicated through various visual, tactile, vocal and olfactory means. Scrapes were primarily made by resident males. Of 352 scrape sites used by 4 resident males with adjacent home ranges, 23-40% was shared. Males scraped throughout their home ranges. Land tenure in this study population appears to be based primarily on prior rights; however, those rights may be contested. Spacing is maintained through passive and aggressive means. Increased intraspecific aggression may be caused by a low resource base. Population regulation mechanisms and conservation strategies are discussed.

Sweanor, L, K. Logan and M. Hornocker. 1996. Cougar Social Organization. Chapter 3 In: Cougars in the San Andres Mountains, New Mexico. Proj. No. W-128-R, Final Report, New Mexico Dept. Game and Fish, Santa Fe.

We conducted cougar research on the 2,059 km^2 San Andres Mountains (SAM), New Mexico from August 1985

through March 1995. The SAM was divided into a 703 km^2 treatment area (TA) and a 1,356 km^2 reference area (RA). Cougars were protected from human exploitation in the SAM except for a 6.5- month period (Dec. 1990 to June 1991) when 58% of the independent cougars were removed from the TA. Population characteristics and social organization were determined using capture-recapture, ground-tracking, and radio-location data. We counted a total of 294 cougars, of which we captured and marked 241. Radio-collars were put on 126 cougars (49 males, 77 females). We recorded a total of 13,947 cougar locations. The population was comprised of, on average, 58% adults, 7% subadults, and 35% cubs. The male:female sex ratio of adult, subadult and cub cougars did not differ significantly from 1:1 ($P > 0.10$), however the adult and subadult classes favored females. Except for a short period during and after cougar removal in the TA, January population density estimates generally increased over time; they ranged from 1.2 to 2.0 adults/100 km^2 from 1989 to 1995. Home ranges were estimated using both the adaptive kernel (ADK) and minimum convex polygon (MCP) home range estimators. Annual home ranges based on the 90% ADK averaged 192.2 km^2 for adult males and 71.9 km^2 for adult females. Female annual home ranges were significantly smaller than male annual home ranges ($P< 0.0001$). Male home range size generally increased with increasing cougar density, whereas female home range size decreased. Female home range size during an entire reproductive cycle (birth of 1 litter to birth of subsequent litter) averaged 64.9 km^2. Cyclic and annual home range sizes for the same group of females were not significantly different ($P > 0.1$). Female home range size increased as the age of dependent cubs increased, and was largest when a female was solitary. Home range sizes of females with young cubs (<= 6 months) were significantly smaller than those of females that were solitary ($P < 0.05$). On average, adult females exhibited stronger annual home range fidelity than males. The percent of an adult male's home range that was utilized by that same male from year to year averaged 51.6% and 57.5% based on the 90% MCP and 90% ADK, respectively. For adult females, the amount of overlap averaged 60.3% and 62.2% based on the 2 methods, respectively. Males had significantly less annual home range overlap (90% MCP, $P = 0.09$) than females. Distances between mean annual locations for adult males and adult females averaged 5.7 km and 2.6 km, respectively. The distances between means of annual locations were significantly greater for males than for females ($P < 0.001$). Distances between means of locations when females were raising young cubs (<= 6 mo.), raising older cubs (7-12 mo.), and solitary averaged 3.1, 2.0, and 2.9 km, respectively, and they were not significantly different ($P > 0.10$). Cubs became independent and dispersed at, on average, 13.4 and 15.6 months of age, respectively. All males dispersed from their natal home ranges; in contrast, some females were philopatric. Dispersal distances for males and females from their natal to independent home ranges averaged 101.3 and 28.3 km, respectively. Males dispersed significantly farther than females ($P < 0.025$). The directions of dispersal were uniformly distributed around a 360 degree circle ($P > 0.05$). Dispersal duration ranged from 0.2 to 7.8 months. Annual home range overlap between adult males was generally greater than that found for adult females. The mean of means in annual home range (90% ADK) overlap was 62.8% between adult males and 49.2% between adult females. The amount of within-gender overlap increased with increasing cougar density. Adult males shared their annual home ranges (90% ADK) with, on average, 2.9 to 4.3 other adult males. Each adult female shared part of her annual home range with, on average, 2.1 to 3.9 other adult females. The percent area adult females shared with adult males was greater than the percent area each male shared with adult females, as well as greater than the percent area shared between cougars of the same sex. Adult females shared an average of 89.1 to 96.6% of their home ranges (90% ADK) with 3.0 to 3.5 adult males each year. Analysis of the movements of cougars over 6- to 12-month periods indicated that cougar home ranges (particularly those of males) were dynamic and cougars of the same gender did not generally utilize shared areas at the same time. Social interactions outside the mother-offspring family unit were rare. Independent cougars were located in association during only 4.9% of locations. The majority of associations (76.0%) were between males and females, of which 73.5% were for apparent breeding purposes. Of all the associations, 20 (7.6%) resulted in mortalities; mortalities included 5 adult males, 4 subadult males, 9 adult females, 2 subadult females, and 1 dependent cub. All mortalities were caused by adult immigrant or adult resident male cougars. Ten cubs from 5 litters were also killed by males, apparently while their mothers were not with them. Scars found on all captured adult males indicated fighting was fairly common. Cougars communicated through visual, tactual, auditory, and olfactory mechanisms. Vocalizations included apparent distress calls (mews and chirps by nursing cubs), contact calls between family members (purrs, whistles), advertisement calls (ouch calls and caterwauls), and threat calls (hisses, spits and growls). Cougars, almost exclusively males, left visual and olfactory markers (scrapes) throughout their home ranges. Individual scrape sites could be utilized by more than 1 resident male, and were visited by females. Land tenure in this study population was primarily based on prior rights; however, in males, prior rights were often contested. Cougars spaced themselves through territorial behavior in males and mutual avoidance behavior in females. The territorial and avoidance components of the land tenure system may be mechanisms which regulate the rate at which the cougar population increases toward carrying capacity.

Sweanor, L.L., K.A. Logan, and M.G. Hornocker. 1997. Dispersal of Cougars (*Puma concolor*) in Metapopulation Dynamics. Page 94 in W.D. Padley, ed., Proc. Fifth Mountain Lion Workshop: 27 February- 1 March 1996; San Diego, California.

We intensively studied an unhunted cougar population on the San Andres Mountains (SAM, 2060 km^2) in southern New Mexico from 1985-1995. We examined the role of dispersal in order to (1) adequately describe cougar population dynamics and social organization in the SAM, and (2) determine the importance of dispersers to other subpopulations within dispersal distance of the SAM. Characteristics of dispersing cougars, including age, sex and direction and distance traveled were based on 33 radiocollared progeny (20 F, 13 M) and 1 eartagged male born between June 1986 and September 1992. Known age of independence for 12 of these progeny averaged 13.5 months for females (n=6, SD=1.6) and 14.0 months for males (n=6, SD=1.5). Known age at dispersal for 8 progeny averaged 13.6 months for females (n=2, SD=0.9) and 15.7 months for males (n=6, SD=1.4). Twelve of 20 (60%) female progeny did not disperse from their natal areas, whereas all 14 of the male progeny dispersed. One of 20 females and 6-7 of 14 males dispersed outside the SAM. Distances traveled by progeny from the arithmetic center of their natal home range (NAC) to the arithmetic center of their independent home range (IAC) averaged 12.4 km for females (n=19, SD=19.6) and 101.3 km for males (n=7, SD=26.0). Dispersing males traveled by significantly further from their NACs to their IACs than dispersing females (t=2.86, df=13, P=0.007). Dispersal directions from NACs to IACs were uniformly distributed about a 360 degree circle for both females (n=7, U^2=0.08, P=0.48) and males (n=8, U^2=0.06, P>0.05). Recruitment and emigration rates were quantified based on a 5.1 year time span (February 1990 to 23 February 1995) and 114 tagged progeny (63 F, 41 M) out of 137 detected progeny born from 1 February 1988 through 19 November 1992. From 1990-1995, 21 progeny (17 F, 4 M; mean=4.1/year) and 22 immigrants (8 F:14 M; mean=4.3/year) were recruited into the adult SAM population. For the same period, we estimated that 47 progeny (26 F, 21 M; mean=9.2/year) successfully dispersed (i.e. dispersed and reached adulthood) outside the SAM. The majority of female (60%) and male (81%) cubs which are born on the SAM and survive to adulthood apparently disperse outside of the SAM. The SAM cougar population is an important source of immigrants to other cougar populations within dispersal distance of the SAM. The role of dispersal is important to the understanding of cougar metapopulation dynamics and the implementation of regional conservation strategies.

Sweanor, L.L., K.A. Logan, and M.G. Hornocker. 1997. Reproductive Biology of Female Cougars (*Puma concolor*) in the San Andres Mountains, New Mexico. Page 95 in W.D. Padley, ed., Proc. Fifth Mountain Lion Workshop: 27 February- 1 March 1996; San Diego, California.

As part of an intensive 10 year study of cougar population dynamics, we quantified the reproductive biology of an unhunted cougar population on the San Andres Mountains (2060 km^2) in southern New Mexico. From 1986 through 1994 we documented the birth of 220 cubs from 79 litters by 39 females; 174 of the cubs (76%) were subsequently captured and tagged. Mean litter size for 53 litters which were first observed 9-49 days (mean=32.3, SD=8.9) after birth was 3.02 cubs (range 2-4, SD=0.7). Twenty-six of the 53 litters were observed at birth nurseries, the other 28 litters were observed at secondary nurseries. For 21 litters first observed from 52-127 days (mean=175.7, SD=112.0) after birth, litter size was smaller, averaging 2.19 cubs (range=1-3, SD=0.8). The sex ratio for cubs from 50 litters observed at 9-49 days (mean=31.6, SD=8.6) after birth was 73 F:75 M. However in 15 litters first observed at 52-427 days (mean=198.9, SD=121.6) after birth, a greater number of females were observed (20 F:14 M). The gestation period for 31 litters based on documented mating was 91.5 days (range=83-103, SD=4.0). Litters were born during every month except February (n=78). The greatest number of litters were born during the months of August and September (n=11 litters each). Sixty-five litters (83%) were born during the months of May through November. Known age females were on average 21.4 months old (n=7, range=19-27, SD=3.1) when we first documented them in association with male lions. Known age females produced their first litters at 22-40 months of age (n=12, mean=29.1, SD=6.0). Litter size for first litters (n=8) averaged 3.4 cubs and was greater than the average litter size of 3.0 for 22 subsequent litters born by 14 females (t=1.43, df=28, P=0.08). Thirty-nine of 53 adult-aged females produced from 1-5 litters each. Ten of the reproducing females (26%) produced 110 of the cubs (50%). Interbirth intervals for litters in which at least 1 cub survived to independence (n=14) or to 12 months of age (n=1) averaged 17.4 months (range=12.6-22.1, SD=2.6). On average, 75% of the adult female cougars were raising cubs each year (range=63-100%, SD=12.7). It took 5 females an average of 100.0 days (range=17-308, SD=118.1) to successfully rebreed after the loss of a litter. Sport-hunting of females may adversely affect a cougar population by killing the most productive females and/or orphaning cubs.

Sweanor, L.L., K.A. Logan, and M.G. Hornocker. 2000. Cougar Dispersal Patterns, Metapopulation Dynamics and Conservation. Cons. Biol. 14(3):798-808.

Abstract

We examined cougar (*Puma concolor*) dispersal, emigration, and immigration in the San Andres Mountains, New Mexico, from 1985 to 1995 to quantify the effects of dispersal on the local population and surrounding subpopulations. We captured, tagged, and radio-collared animals to detect the arrival of new immigrants and dispersal characteristics of progeny. We found that cougars in southern New Mexico exhibited a metapopulation structure in which cougar subpopulations were separated by expanses of noncougar habitat and linked by dispersers. Of 43 progeny (n = 20 males, 23 females) studied after independence, only 13 females exhibited philopatric behavior. Males dispersed significantly farther than females, were more likely to traverse large expanses of noncougar habitat, and were probably most responsible for nuclear gene flow between habitat patches. We estimated that an average of 8.5 progeny (i.e., cougars born in the study area) successfully emigrated from and 4.3 cougars successfully immigrated to the San Andres Mountains each year. Concurrently, an average of 4.1 progeny were recruited into the San Andres cougar population. Protected cougar subpopulations can contribute to metapopulation persistence by supplying immigrants to surrounding subpopulations that are affected by fragmentation or offtake by humans. Cougar population dynamics and dispersal behavior dictate that cougar management and conservation should be considered on a regional scale.

Sweanor, L.L., K.A. Logan and M.G. Hornocker. 2003. Puma Responses to Close Encounters with Researchers. Page 107 *in* S.A. Becker, D.D. Bjornlie, F.G. Lindzey, and D.S. Moody, eds. Proceedings of the Seventh Mountain Lion Workshop. Lander, Wyoming.

Abstract

Recent books and articles have provided information on relatively rare, but violent attacks where people were injured or killed by pumas. However, there is a paucity of data on the type and variation in behavior wild pumas exhibit when approached by humans. During a 10-year puma study in New Mexico, we approached pumas and visually observed their behavior on 262 occasions. The study area was remote and was closed to most human activity; consequently the pumas living there had rare opportunities for contact with people. We categorized the approach based on the status of the puma, the number of people involved, the distance between the puma(s) and people, and the puma's subsequent response to the approach. Pumas we approached included adult females with nursing (<9 weeks old) cubs (n = 71), adult females with weaned cubs (n = 46), breeding pairs (n = 5), solitary adult males (n = 37), solitary adult females (n = 63), solitary subadult males (n = 9), solitary subadult females (n = 19) and weaned cubs in the absence of their mother (n = 11). Approach distance ranged from 3-350m (x = 61m), number of observers ranged from 1-8 people (x = 1.8 people), and duration of observation ranged from less than a minute to over 2 hours. We noted whether the puma(s) left the area, stayed put, approached, or exhibited threat behavior (e.g., hissed, growled, charged). Pumas exhibited threat behavior in 16 instances (6% of observations). Females accompanied by cubs exhibited most (n = 14) of the threat behavior. Although all threats occurred when human observers were 3-50m away (x distance = 18m, SD = 13.6), in another 155 observations when humans approached similar distances (range 3-50m, x = 22m, SD = 13.4m), pumas showed no threat response. In these cases, the puma(s) either left the area (n = 114), watched but stayed put (n = 36) or showed no detectable response (n = 5). Information on the responses exhibited by pumas to human approaches provides insight into the range in behaviors exhibited by pumas in environments where pumas have not become accustomed to or possibly habituated to humans or human activity. This may aid our interpretation of puma behavior, as well as our understanding of the variation in behaviors expected from pumas, in more human-dominated environments.

Sweanor, L.L., K.A. Logan, J.W. Bauer and W.M. Boyce. 2003. Puma Activity and Movements in a Human-Dominated Landscape: Cuyamaca Rancho State Park and Adjacent Lands in Southern California. Page 168 *in* S.A. Becker, D.D. Bjornlie, F.G. Lindzey, and D.S. Moody, eds. Proceedings of the Seventh Mountain Lion Workshop. Lander, Wyoming.

Abstract

Although puma attacks are exceedingly rare, statistics indicate dangerous encounters between humans and pumas

are on the rise. In California there have been 7 verified puma attacks resulting in 2 human deaths during the last 10 years; 2 of those attacks and 1 death occurred in Cuyamaca Rancho State Park (CRSP). Because of the high number of reported puma sightings in CRSP each year (range = 18-50 from 1993-2002) and the large, increasing number of human visitors (over 500,000 people visited the 50-square-mile park in 2001), park authorities were concerned about the potential for further dangerous puma-human encounters. A study was initiated in January 2001 to understand puma behavior relative to human activity, to help minimize conflicts between pumas and humans, and to assist the development of long-term conservation strategies for pumas in the CRSP area. Specific objectives of the project were to: determine the number and characteristics of pumas using CRSP; map puma home ranges and determine important puma habitats and their juxtaposition relative to human use areas; examine puma movements (e.g., daily, seasonal) relative to areas of human activity (e.g., trails, roads, campgrounds); examine puma diet to determine what prey species are most important as puma food and to what extent, if any, domestic animals contribute to their diet; and use the data to formulate management recommendations. To obtain information on puma home ranges, movements and behavior, and to find prey killed by pumas, independent and adult pumas are being captured and fitted with Televilt GPS collars. As of March 2003, 11 pumas (6 adult males, 5 adult females) had been captured in and around CRSP and fitted with GPS collars. To date, collars have yielded over 6400 locations. Additionally, human use of trails is being measured seasonally by placing infrared counters (TrailMaster monitors) along 4 trail systems within CRSP. This paper reports on project progress to date.

Sweanor, L.L., K.A. Logan, J.W. Bauer and W.M. Boyce. 2004. Southern California Puma Project – Final Report for Interagency Agreement No. C0043050 (Southern California Ecosystem Health Project Between California State Parks and the UC Davis Wildlife Health Center).

Executive Summary

This report for California State Parks (CSP) provides results and recommendations based on the first 3 years of an ongoing research project examining the relationships between pumas, people, and the environment they share in eastern San Diego County in southern California. This report focuses on the relationship between pumas and people in Cuyamaca Rancho State Park (CRSP), with limited emphasis on Anza Borrego Desert State Park (ABDSP) and the surrounding region.

Twenty pumas (9 males, 11 females) have been included in the study since fieldwork began in 2001. Eleven were captured in CRSP, 5 within 15 km of CRSP, and 3 in ABDSP. GPS radiocollars were placed on 15 animals, two animals received VHF radiocollars, and 3 were not collared (1 adult female, 2 juveniles). Eleven of the 20 pumas have died, 5 have been lost from the study, and 4 currently have functional radiocollars (3 GPS, 1VHF). Causes of mortality include depredation control (n=4), hit-by-car (n=1), Cedar Fire (n=1), killed by puma (n=1), and unknown (n=4, disease suspected). At least 8 adult pumas used CRSP in early 2003. This density (2.3-2.8 adults/100 km2) was high relative to other studies, but it dropped to a low level (about 0.8 adults/100 km2) later in the year. Annual survival rates for CRSP pumas were low (0.56-0.71) compared to other areas. Puma home ranges extended beyond CRSP, with 17% to 43% of each puma's home range including private property. Pumas (inside and outside of CRSP) fed on a variety of wildlife including deer, bighorn sheep (ABDSP only), coyote, raccoon, wild turkey, and bobcat. Deer were the most common prey, and pumas also scavenged deer carcasses placed in the field as bait. Domestic animals (goose, chicken, cat, dog, pig, sheep, goat, and alpaca) were found in prey caches from 7/17 collared pumas. Pumas and people tended to have opposite activity periods in CRSP. Pumas moved very little during daylight hours when people were most active. Pumas were most active at night and around dawn and dusk, time periods when people were least active. The greatest opportunity for a puma-human encounter was probably during crepuscular periods (times within 1.5 hours either side of sunrise or sunset), when puma activity was increasing and human activity was waning. However, there were no incidents or attacks from 2001-2003, and observations of pumas were less frequent than in the years preceding this study. The extensive trail and fire road system in CRSP makes it difficult for a puma to be very far from a trail or fire road – most puma locations were within 100 to 300 m. However, pumas were located closer to trails and fire roads during the night and crepuscular periods than during the day, suggesting they may have been avoiding areas with high human activity. Pumas were rarely in close proximity to buildings or campgrounds within CRSP. Collared pumas were documented within 100 m of a building or campground on 6 of 996 locations; these were at night (n=4) or during crepuscular times (n=2). Pumas typically avoided chaparral habitats during night and crepuscular periods when they were most likely hunting or traveling. They avoided grass cover during the day when they were most likely bedding. Edge habitats, particularly chaparral-woodland and woodland-grass, were important to females during all time periods, and to males at night. Most prey cache sites (73%) were found within 300

m of a trail or fire road. No caches were close to campgrounds or CRSP housing, but 3 caches were within 150 m of a private residence, a girl scout camp (Camp Wolahi), and a lodge (Cuyamaca Lodge). Caches were found in all cover types, but must frequently in woodland or chaparral-woodland. The proximity and visibility of pumas around buildings, campgrounds, trails and fire roads may change because of the Cedar Fire. Fire-fighting activities were focused around structures, and this also served to protect the vegetation in the immediate area. In contrast, most of the remainder of the park burned removing cover and dramatically increasing visibility. In the short term, deer and pumas may be nearer structures and campgrounds because these areas provide food and cover.

Recommendations

1. Continue and expand educational programs on pumas. Components should include information on puma biology and behavior, how to avoid or respond during a puma encounter, and proper animal husbandry practices when living in puma habitat. Information gathered from this puma research project should be incorporated into the educational program. This study indicates that pumas generally avoid areas of human activity; however, there are occasions when pumas are active in the same areas as people. Consequently, people should be informed on how to act in puma country in order to reduce their chances of a negative encounter. A recent analysis of human behavior that may reduce the chance of an attack can be found in Fitzhugh et al. (in press). Because pumas living within CRSP range beyond park boundaries and onto private lands, CSP and CDFG should accept the responsibility of helping to educate the adjoining landowners about the importance of proper animal husbandry. The biological integrity of the CRSP puma population is affected by what happens outside, as well as inside, CRSP.
2. CSP personnel should take the findings of this report into consideration when reopening or creating new trails or campgrounds in CRSP. Pumas seek adequate vegetative cover when hunting, traveling and bedding. Edge cover types may be most important while hunting, whereas the dense cover provided by chaparral, woodland and chaparral-woodland edge may be important for bedding. Considering the recent changes in vegetative cover caused by the Cedar Fire, pumas may be even more dependent on the small patches of adequate cover that remain. Consequently, it may benefit pumas and reduce the chance for puma-human interactions if human use of those patches is discouraged (e.g., trails through those areas are closed or rerouted; unburned areas such as the East Mesa Tragedy Burn remain closed to the public).
3. Puma prey caches are often within 300 m of trails, and on rare occasions, in close proximity to buildings. When a prey cache is found, it should not always be considered as a serious problem. Based on the density of trails and fire roads within CRSP, it is difficult for a puma to avoid those areas entirely. If a puma cache is observed in close proximity to a human activity area (<100 m) and the cache consists of a wild, acceptable prey (e.g., deer), we recommend that the prey be dragged a distance away from the activity area (100-300 m). Alternatively, the area can be temporarily closed to human access so the puma can return to feed with a reduced chance of a puma-human encounter. If a prey item is completely removed, the puma will simply be forced to hunt and kill another animal. If the prey is dragged a distance away from the activity area, the puma should be able to locate the new cache site and feed on the prey without being disturbed by, or disturbing, humans.
4. The data that has been gathered to date on puma activity and behavior patterns in CRSP is unique. In light of the dramatic changes in CRSP due to the recent Cedar Fire, as well as the need for a better understanding of puma-human interactions (given that more and more people are visiting CRSP and moving into the San Diego backcountry), it is important that CSP continues to support puma research in CRSP. It is very important to see how pumas and people respond to the changes that have occurred, and the management actions that are implemented, in CRSP. The information gleaned from this ongoing study will be useful not only to CRSP, but for all of the people who live and recreate in puma country.

Sweanor, L.L., K.A. Logan and M.G. Hornocker. 2005. Puma Responses to Close Approaches by Researchers. Wildl. Soc. Bull. 33(3):905-913.

Abstract

We documented behaviors that wild pumas (*Puma concolor*) exhibited when approached by researchers during a 10-year study of a puma population in New Mexico. We approached and visually observed responses of 75 radiocollared pumas on 251 occasions and 7 noncollared pumas on 5 occasions. These pumas seldom had contact with people, except in the context of puma research activities. Pumas we approached included adult females with nursing (*n*=71) and weaned (*n*=46) cubs, solitary independent females (*n*=77), solitary independent males (*n*=46), breeding pairs

(*n*=5), and weaned cubs in the absence of their mother (*n*=11). Approach distance ranged from 2–400 m (median=30.8 m), number of observers ranged from 1–8 people (median=2), and duration of observation ranged from <1 to >120 minutes. Pumas exhibited threat behavior (e.g., hissed, growled, approached, charged) in 16 instances (6% of observations). Females accompanied by cubs exhibited 14 of the 16 threats. Although we observed all threats when we were 2–50 m away (median=18.5 m), in another 156 observations when we approached to within similar distances (range = 3–50 m, median = 20.0 m), pumas showed no threat response. In these cases, the pumas left the area (*n*=114), watched us without leaving (*n*=37), or showed no detectable response (*n*=5). These responses by pumas to human approaches provide insight into the range in behaviors exhibited by pumas in environments where they have not become habituated to humans. This may aid our understanding of puma behavior, including interpretations of behaviors that might be exhibited by pumas in more human-dominated environments.

Sweanor, L. and J. Beecham. 2007. Cougar Management Guidelines and Implementation and Refinement Program. Pages 11-12 in Abstracts of Presentations of the 3rd Midwestern-Eastern Puma Conference, Trent University, Peterborough, Ontario.

Abstract

To address concerns that agencies and stakeholders were having difficulty keeping up with current knowledge on cougar management and research, a facilitated meeting of cougar experts from both academia and wildlife management agencies was held in Boise, Idaho in October 2002. The meeting was the start of a 2-year effort that resulted in The "Cougar Management Guidelines." The participants' goal was to benefit cougar management through guidelines that integrate cougar management history, reliable research results and methodologies, and attendant strategies for cougar management. Guideline contributors included wildlife professionals with numerous publications and decades of direct experience in cougar management and research. The intent for these guidelines is to help management agencies develop regional and adaptive management approaches to cougar management and habitat conservation. The intended target audience for the guidelines is agency wildlife managers in Canada, the western United States, and Mexico. The Cougar Management Guidelines are viewed as a "living document," to be maintained, updated, and rewritten as new information dictates. Consequently, we are presently embarking on a process to accumulate comments on the current guidelines, on the application of the guidelines in state and provincial cougar management programs, and on adaptive management results. These will be used to improve future editions of the Cougar Management Guidelines. This presentation will cover the development, goals, and content of the guidelines, discuss the potential of the guidelines to help cougar management programs, and outline our implementation and refinement process.

Sweanor, L.L., K.A. Logan, J.W. Bauer, B. Millsap and W.M. Boyce. 2008. Puma and Human Spatial and Temporal Use of a Popular California State Park. J. Wildl. Manage. 72(5):1076-1084.

Abstract

Because of increasing concerns about puma (Puma concolor) attacks on people and the desire to minimize dangerous puma–human encounters while conserving puma populations, we examined spatial and temporal relationships between pumas and people that used Cuyamaca Rancho State Park (CRSP), California, USA. From 2001 to 2003, we studied 10 adult pumas outfitted with Global Positioning System collars. Although number of visitors to CRSP was increasing, no dangerous puma–human encounters were reported during our study. Male and female pumas typically moved short distances during the day (mean of means of individual hourly movements = 168 m and 131 m each hr, respectively) and moved the most at night (mean of means = 690 m and 390 m each hr, respectively). Of 10 pumas, 9 were least active during the day and most active during the evening or at night. In contrast, most visitor use of trails ($\bar{x}$ = 85%) occurred during the day. Based on puma and human activity patterns, risk of a puma–human encounter was greatest during the evening. Puma prey caches were randomly distributed in relation to trails and park facilities; however, 8 of 33 caches were still within 100 m of a trail and 2 were within 300 m of a facility. Individual puma behavior relative to human activity areas was variable. Some pumas appeared to temporally avoid human activity areas; others used the park randomly in relation to human activity areas; none appeared to be attracted to human activity areas. Pumas that did not show detectable responses to human activity may have been exhibiting some level of habituation; if so, this level of habituation did not result in puma–human conflicts. When human activity peaked during the day, adult male and female pumas were within 100 m of a trail an average of 9%and 19% of the

time they were located in the park, respectively. Thus, there were opportunities for puma–human encounters. Management personnel can take a proactive approach to deal with puma–human interactions through education and protocols that help to minimize probability of conflicts; this may provide the best chance for a continued puma presence in habitat used by pumas and people.

Sweitzer, R.A., S.H. Jenkins and J. Berger. 1997. Near-Extinction of Porcupines by Mountain Lions and Consequences of Ecosystem Change in the Great Basin Desert. Conservation Biology 11(6):1407-1417.

Abstract

In North America's Great Basin Desert changes in plant communities that occurred after the introduction of domestic livestock in the late 1800s resulted in the irruption of mule deer (*Ocodoileus hemionus*) and expansion of mountain lions (*Felis concolor*). We report on a situation in which mountain lion predation caused the near-extinction of another native species, porcupines (*Erethizon dorsatum*). We used demographic information collected over 8 years on an individually identified population and long term climatic data in a stochastic population model to examine the hypothesis that predation and not weather-induced starvation or random population fluctuations threatened the persistence of a naturally small population of porcupines. Whether drought-related reductions in mule deer densities induced mountain lions to prey on porcupines is unclear, but our results suggest predation and not climatic conditions caused the decline of a once robust population of over 80 to <5 animals in only 3 years. These data represent an unusual case in which predation by a native predator caused the near-extinction of a native prey species, suggesting that one unforeseen consequence of ecosystem change in western North America may be the impending loss of small, native vertebrate populations.