Haag, T., S. Anelisie, A. Carlos, A. Srbek-Araujo, D. Sana, R. Morato, F. Salzano, and E. Eizirik. 2009. Development and Testing of an Optimized Method for DNA-Based Identification of Jaguar (*Panthera onca*) and Puma (*Puma concolor*) Faecal Samples for Use in Ecological and Genetic Studies. Genetica 136(3):505-512.

Abstract

The elusive nature and endangered status of most carnivore species imply that efficient approaches for their non-invasive sampling are required to allow for genetic and ecological studies. Faecal samples are a major potential source of information, and reliable approaches are needed to foster their application in this field, particularly in areas where few studies have been conducted. A major obstacle to the reliable use of faecal samples is their uncertain species-level identification in the field, an issue that can be addressed with DNA-based assays. In this study we describe a sequence-based approach that efficiently distinguishes jaguar versus puma scats, and that presents several desirable properties: (1) considerably high amplification and sequencing rates; (2) multiple diagnostic sites reliably differentiating the two focal species; (3) high information content that allows for future application in other carnivores; (4) no evidence of amplification of prey DNA; and (5) no evidence of amplification of a nuclear mitochondrial DNA insertion known to occur in the jaguar. We demonstrate the reliability and usefulness of this approach by evaluating 55 field-collected samples from four locations in the highly fragmented Atlantic Forest biome of Brazil and Argentina, and document the presence of one or both of these endangered felids in each of these areas.

Halfpenny, J.C. 1991. Identifying and Interpreting Mountain Lion Signs in the Field. Pg. 57 In: Mountain Lion-Human Interaction Symposium, C.E. Braun (ed.), Col. Div. Wildl., Denver. 114pp.

SYNOPSIS

Signs can be used for detecting the presence and interpreting the behavior of mountain lions. However, careful investigation by persons knowledgeable in tracking is needed to assure reliable results. Criteria for evaluation of tracks include general shape of prints (flat arc of toes with rounded, leading edge), no registration by claws, toes (number asymmetry, and size), interdigital pad (bi-lobing, front slope, posterior alignment), front versus hind foot differences, overstep, and tail drags. Criteria for evaluation of scat include large diameter, segments nearly as long as wide, and lack of pointed ends. Non-segmented scat results from moist protein diets. When made carefully, measurements of print and gait patterns provide useful information about sex, age, and individual identity. However, scientists should identify good measurements for each subspecies because of size differences. Additional clues for identifying the presence of mountain lions include scent marks, scat heaps, scratch trees, deer drags, feeding sites, buried carcasses, and feeding patterns on fresh kills. Fresh kills should be necropsied to determine spacing of canine teeth in bites and presence of damaged, blood engorged tissue indicative of wounds from predation on a living animal. Behavioral clues in trails include elusive behavior in available cover and movement by shortest path directly between tree wells.

Halfpenny, J.C., M.R. Sanders, and K.A. McGrath. 1991. Human-Lion Interactions in Boulder County, Colorado: Past, Present, and Future. Pgs. 10-16 In: Mountain Lion-Human Interaction Symposium, C.E. Braun (ed.), Col. Div. Wildl., Denver. 114pp.

During the 1980's, reports of interactions between humans and mountain lions increased along the east slope of the Front Range, especially in Boulder County, Colorado. However, the lack of data made evaluating the frequency and effect of interactions difficult. To assess the potential of future problems, an intensive solicitation of reports was started with radio, television, and newspaper advertisements in 1985. Information was requested on observers, physical and temporal settings, and mountain lions and their behavior. We received 398 reports to date. Interactions between humans and mountain lions were short (1.7 min), at close distances (44.5 m), at low elevations (1,829 m), and in or near city limits. The number of reports was slightly higher during winter when deer populations peaked around Boulder. The nature of reports has changed. After 1988, interactions during daylight hours and closer to population centers increased, which suggested mountain lions are habituating. Increased interactions in summer are notable because cubs learn from their mothers that being around humans is all right. Market and unrestricted deer hunting reduced deer herds in Boulder County to zero in 1906. Since that time, populations of people, pets, deer, and mountain lions have grown to the highest levels ever and are continuing to increase, making interactions with mountain lions an increasing reality. Although risk of an attack to

individuals is low (1 in 2,200,000 person-days in mountains), 2 attacks (1 fatal) and 38 recent interactions where mountain lions were dominant suggest that another attack will occur soon.

Halfpenny, J.C., M.R. Sanders, K.A. Green, and K. Coughlin. 1991. Age and Sex Profiles for Lions Involved in Human-Lion Encounters, Boulder County, Colorado. Pg. 95 In: Mountain Lion-Human Interaction Symposium, C.E. Braun (ed.), Col. Div. Wildl., Denver. 114pp.

SYNOPSIS

While seeking to establish their own range, young mountain lions may encounter humans around urban settings. Mountain lions, killed during encounters with humans, were necropsied to identify age, sex, and reproductive status. Additional track data were used to construct an age and sex profile of mountain lions involved in encounters. Our small sample suggests neither age nor sex bias in encounters.

Hall, E.R., and K.R. Kelson. 1959. Mountain Lion (Felis concolor). Pgs. 955-959 In: The Mammals of North America. Ronald Press Co., New York.

General description and measurements are provided. The fifteen recognized subspecies, type localities, and marginal records are detailed. A map delineates where the subspecies are found in the western hemisphere.

Hall, F.S. 1925. Killing of a Boy by Mountain Lion (Felis oregonensis oregonensis). Murrelet 6(2):33-37.

An authentic record of a mountain lion attacking, killing, and partially devouring a 14 year-old boy near Brewster, Okanogan County, Washington on December 17, 1924 is presented. The body was dragged a hundred feet or more to the base of a cliff where it was partially concealed beside a fallen tree. The lion had completely stripped the skin and flesh from the face and neck, no vestige of hair remaining, and had also eaten the hands and lower arms to the elbows and the flesh from the entire left leg from shoe top to hip joint. Upon finding the boy, identified as James Fehlhaber, his coat was placed over his face and help was sought back at the house. When they returned an hour later, the coat was missing. The coat was found the next morning in the lion's lair torn to shreds approximately 200 feet away, indicating that the lion had returned to its kill during their absence. About 5 weeks later, on January 20, 1925, a young lion was killed by a rancher in a coyote trap, about 4 miles from where the boy was attacked. Upon examination of the stomach, a considerable wad of human hair, bones, and other remains were found. The stomach of the lion and major portions of its contents were sent to the Smithsonian Institute for examination. A mass of hair, two small pieces of blue denim, and one piece of course white goods with seam which may have been a portion of a pocket were found. A discharged revolver cartridge was also found in the mass of hair. It was determined that the stomach contents contained remains of the Fehlhaber boy, and it is probably the first authentic record of a human being killed by a puma.

Halloran, A.F. 1957. Lion in Oklahoma-Past and Present. Oklahoma Game and Fish News 13(2):6-8.

Stanley Young and Edward Goldman's book, The Puma, Mysterious American Cat, is quoted concerning records of the puma in Oklahoma during the past century. A lion track was discovered in 1953 by game department biologist George Merrifield and a plaster cast was made. A mountain lion skull found in a Cimarron County cave in 1938 was donated to Dr. Bryan Glass, A&M College mammalogist, and represents the only Oklahoma lion skull known to science.

Hancock, L. 1978. Is the Controversial Cougar Worth Saving? Canadian Geographic 96(1):46-53. Feb.-Mar.

The author describes the cougar research performed by Percy and Penny Dewar which was to determine the size and mobility of the cougar population in a 2,600 km^2 area of Vancouver Island. Enough sightings had been recorded to say that the cougar exists in all provinces except perhaps Prince Edward Island and Newfoundland/Labrador. There had been three deaths caused by cougars in British Columbia. About 20 other cases had been recorded since 1916 in which the cougar had caused actual bodily harm. The natural history and habits of the cougar in British Columbia are described.

Hancock, L. 1980. A History of Changing Attitude to *Felis concolor*. Thesis, Simon Fraser University, Vancouver, British

Columbia, Canada.

Abstract

Felis concolor, called commonly cougar, mountain lion, panther or puma, is one of the most controversial yet little known animals in American history. This study describes both the animal and its public image over a period of 500 years. Specifically, it examines long-held theories concerning the animal in the light of current scientific knowledge; and it documents and analyzes changing attitudes of people towards the animal, first as individuals then as identifiable groups: native Indians, early explorers and travelers, early settlers, farmers and ranchers, guides and hunters, naturalists, biologists, wildlife administrators, writers, film-makers, advertising personnel, and the urban general public from elementary school age to maturity. An attempt is made in each historical period to identify the interest group or groups most responsible for the furtherance of favourable attitudes to the animal and to examine how groups have influenced each other to bring this about. The study area encompasses both North and South America but focuses especially on British Columbia. Data are derived from a detailed analysis of the historical literature, native myths and legends, films and advertisements, as well as questionnaire responses and taped interviews with members of each group studied. The historical attitudes of groups are assessed subjectively after analyzing all data; current attitudes of groups are assessed objectively after an analysis of questionnaires. The study shows that although native Indians expressed an ambivalent attitude to F. concolor, newcomers to the American continent sought the animal's total extermination. Eventually, during almost 500 years of association, the majority attitude changed. Only in the last 50 years have such changes been noticeable and only in the last 15 years have wildlife administrators begun to give the species any legal protection in response to a changed public attitude. Currently, most people desire the conservation of the species; some want the total preservation of all individual animals; a few want their total extermination. As a result, controversy has lessened primarily because of recent media dissemination of scientific knowledge pertaining to the species and people's increased awareness of the animal's value in the ecosystem. But controversy has increased where relic attitudes persist. Although independent factors have contributed to bring about attitude change, in most areas group pressure has been more effective. Naturalists and biologists were the first to express favourable attitudes to F. concolor but it was not until their research and opinions were widely publicized by the media (particularly television) during the 1960s and 1970s that the general public was sufficiently aware to become an influence on government wildlife administrators and politicians. The study concludes with recommendations for maintenance of both the animal's numbers and distribution and its presently favourable public image. Although the data demonstrate that most groups are now generally favourable to F. concolor and its conservation, maintenance of such attitudes depends on further research on the animal itself, and improved methods of communicating a positive image of it to the public, especially where relic attitudes persist.

Handley, C. O. Jr., R. Stafford, and E.H. Geil. 1961. A West Virginia Puma. J. Mammal. 42:277-278.

A skeleton of a puma was discovered in Higginbothams Cave No. Four, 1.3 miles west of Frankford, Greenbriar County, West Virginia, in August 1959. The skeleton lay on a surface of a mudbank, 30 feet above a subterranean stream. The bones were sent to the National Museum and were considered to be the Recent Felis concolor couguar Kerr, and the bones and teeth matched closely those of a skeleton of F. c. couguar from Capon Springs, West Virginia (USNM 848).

Hansen, K. 1995. Return of the Cougar. American Forests 101(1&2):25-28, 58-59.

The author joined Harley Shaw, research biologist with the Arizona Game and Fish Department, for a week of tracking lions in the Huachuca Mountains of southern Arizona. General information on the cougar is provided from many other researchers. Recommendations are given for people who live in lion country and for those individuals that may encounter a lion in the wild.

Hansen, R.M. and G. Carrow. 2005. Managing Links Between Carnivores, Human Behaviour, and Land Use. Page 211 *in* R.A. Beausoleil and D.A. Martorello, editors. Proceedings of the Eighth Mountain Lion Workshop, Olympia, Washington, USA.

Abstract

Past and present forestry activities, increasing tourism and accelerated general human use on the landscape have resulted

in an increase in conflicts between carnivores and humans. The park's risk management program has identified a trend of increasing risk to carnivores, visitors and park liability. The park's main challenge is to protect regional biodiversity by conserving wolves and cougars at the landscape level while addressing public safety responsibilities. The long-term viability of carnivores may be at risk. Land use practices appear to be reducing the landscape capacity to support deer, the primary prey of wolves and cougar. Increased human use is contributing to habituation in carnivores. Carnivore-human conflicts lead to the destruction of carnivores due to public safety concerns. Large carnivores such as cougars and wolves are a fundamental ecological component of the greater Pacific Rim coastal ecosystem. The size and shape of PRNPRC is such that the ranges of large terrestrial carnivores extend beyond the park boundaries. The presentation will use Geographical Information System maps, graphs and text to illustrate trend data related to carnivore conservation and public safety issues. Elements of the park's evolving risk management strategy including operational guidelines for carnivore-human conflict management and communications efforts to address the human dimensions will be highlighted. The last component of the presentation will describe a challenging new initiative to engage multiple levels of government, First Nations, the private sector and non- governmental groups in a collaborative effort to address the land use, wildlife and human dimensions of predator-prey management.

Harcombe, D.W. 1977. Oregon Cougar Study. Oregon Dept. Fish and Wildlife, Portland. 62pp.

The cougar was bountied in Oregon from 1912 to 1961, with 7,307 cougars bountied. During the final bounty year, 13 were bountied and all were taken in western Oregon. Until 1968, an open season with no limit was established. In 1968, the Oregon Legislature elevated the cougar to game animal status and for the first two years no cougar could be taken unless by a landowner protecting his livestock. The cougar became a trophy species in 1970 and 9 cougar were harvested during the first season. Most of the cougar population in Oregon was located in the southwestern and northeastern portions with Douglas fir-trailing blackberry habitat type predominating. It was the author's opinion that old-growth with low-density understory and good visibility played an important part in the food chain of the cougar and timber was more important than topographic cover. A total of 41 days of tracking found 15 cougar with an average of 2.7 days of searching per cougar track observed. A method for estimating numbers of pumas by means of summer track counts was provided.

Hardison, S. 1976. Carolina Cougar: An Update. Wildlife North Carolina 40(1): 15-17.

Five men apparently spotted a mountain lion on July 23, 1975 along the Cataloochee River Valley in the North Carolina portion of the Great Smoky Mountains National Park. The eastern mountain lion had been considered extinct outside of Florida for nearly 100 years.

Harlow, H.J., F.G. Lindzey, W.D. Van Sickle, and W.A. Gern. 1992. Stress Response of Cougars to Nonlethal Pursuit by Hunters. Can. J. Zool. 70(1):136-139.

Five cougars (Felis concolor) were captured and an adrenal response test was administered by injecting synthetic adrenocorticotropic hormone and monitoring plasma cortisol levels at 15-min intervals for 120 min. Three were selected for treatment and chased 5 or 6 more times to simulate the stress they might experience during a pursuit-only season; the other two served as controls and were chased only once more, at recapture. The adrenal response test was administered again at recapture. The cougars in the treatment group had a lowered plasma cortisol profile after the simulated pursuit season, indicating an altered physiological response of the adrenals to the stress of repeated chases.

Harmsen, B.J., R.J. Foster, S.C. Silver, L.E.T. Ostro, and C.P. Doncaster. 2009. Spatial and Temporal Interactions of Sympatric Jaguars (*Panthera onca*) and Pumas (*Puma concolor*) in a Neotropical Forest. J. Mammal. 90(3):612-620.

Abstract

We used extensive camera-trap surveys to study interindividual interactions among individually recognizable jaguars (*Panthera onca*) and plain-colored pumas (*Puma concolor*). Timed location data from a network of 119 trap stations in the Cockscomb Basin of Belize provide the 1st evidence of interspecific avoidance calibrated against intraspecific interactions among jaguars. Camera trapping has advantages over radiotelemetry in its potential to provide data on the complete array

of individuals within the study area. The 23 individually identified male jaguars showed high levels of overlap in ranges, with up to 5 different males captured at the same location in the same month. Low levels of avoidance between individuals and a high flux of individuals contributed to low consistency in home-range ownership over the long term (3 months to 2 years). Jaguars and pumas had similar nocturnal activity schedules. Both species used similar habitats within the Cockscomb Basin, indicated by a high correlation in capture rates per location between species. Apart from their overall spatial similarities, jaguars and pumas avoided using the same location at the same time. This interspecific segregation was detectable over and above the spatial and temporal segregation of individual jaguars.

Harmsen, B.J., R.J. Foster, S.M. Gutierrez, S.Y. Marin and C.P. Doncaster. 2010. Scrape-marking Behavior of Jaguars (Panthera onca) and Pumas (Puma concolor). J. Mammalogy 91(5):1225-1234.

Abstract

Marking behaviors of jaguars (Panthera onca) and pumas (Puma concolor) were investigated by linking sign from transect surveys to species, sex, and individual detected by camera traps along trails in the Cockscomb Basin Wildlife Sanctuary, Belize. The most commonly encountered big-cat signs were scrape marks. These were produced by cats raking the ground with their feet. Scrapes were associated more strongly with presence of male pumas than with female pumas or jaguars of either sex. Scats found in scrapes were genotyped to species level and indicated that jaguars produced larger scrapes than pumas and that pumas were more likely to scrape with their hind feet than with front feet. Scrapes were spatially clustered along trails, indicating that individuals scrape in response to other scrapes in the same area. High scraping frequencies were not associated with the presence of specific individuals, suggesting that scrape-marking behavior does not signal dominance in this area.

Harmsen, B.J., R.J. Foster, S. Silver, L. Ostro and C.P. Doncaster. 2010. Differential Use of Trails by Forest Mammals and the Implications for Camera-Trap Studies: A Case Study from Belize. Biotropica 42(1):126-133.

Abstract

Relative abundance indices are often used to compare species abundance between sites. The indices assume that species have similar detection probabilities, or that differences between detection probabilities are known and can be corrected for. Indices often consist of encounter frequencies of footprints, burrows, markings or photo captures along trails or transect lines, but the assumption of equal detection probabilities is rarely validated. This study analyzes detection probabilities of a range of Neotropical mammals on trails in dense secondary forests, using camera-trap and track data. Photo captures of the two large cats, jaguars (*Panthera onca*) and pumas (*Puma concolor*), were correlated solely with trail variables, while photo captures of their potential prey species had no correlation or negative correlation with trail variables. The Neotropical mammals varied greatly in their tendency to follow or cross trails based on footprints surveys. This indicates that camera locations on trails will have varying detection probability for these Neotropical mammals. Even the two similar-sized jaguars and pumas, occupying relatively similar niches, differed subtly in their use of trails. Pumas followed trails more completely while jaguars were more likely to deviate from trails. The ecological significance of these findings is that jaguars seem to be more willing to use the forest matrix away from trails than do pumas. We conclude that trail-based indices, such as photographic captures or tracks along trails, are not appropriate for comparison between Neotropical species, and not even between relatively similar species like jaguars and pumas.

Harris, C.E. 1991. Mountain Lion Management Plan (1991-1995). Idaho Department of Fish and Game, Boise. 43pp.

This plan will be utilized for assessing and managing the many and varied impacts of people on mountain lions and their habitats. The management effort is to ensure long-term annual returns from the mountain lion resource to the citizens and visitors of Idaho, maintain current mountain lion populations, and attempt to stabilize harvest and provide increased protection to the female segment of the population. Between 1915 and 1941, 251 mountain lions were killed in Idaho by hunters employed by the State, livestock associations, and the Federal Government, with the take by private individuals unknown. An annual average of 80 lions were turned in for bounty during 1945-1958. Average annual sport harvest (unregulated) was estimated at 142 lions from 1959 through 1971. An estimated 300 lions were taken during the 1971-72 season. Due to declining numbers, the mountain lion was classified as a big game species on July 1, 1972, and the lion harvest was regulated for the first time. An average of 80 lions were taken annually from 1973-76; 131 from 1978-81; and 270 for 1986-89. Hound hunting accounted for an average of 72% of the lion harvest for the 1985-89 seasons. This plan

places emphasis on reducing accelerated harvest rates, stabilizing harvest levels, and reducing female harvest. Data indicated that 756 hunters spent nearly $400,000 hunting lions in Idaho in 1983. Lion tag sales have almost doubled since 1983 and with associated cost increases, the 1988 lion season probably contributed approximately one million dollars to the Idaho economy. The goal was to maintain the age ratios of the harvest within 5% of 35% for the K-3 year age class, 44% for the 4-7 year age class, and 21% for the 8 year and older age class, but was not attained during the 1986-1990 planning period. The five year (1991-1995) goals, statewide management policies, management strategies, and top priority programs are outlined. Hunting opportunity, unit groupings, Big Game Management Units, and Mountain Lion Data Analysis Units are described.

Harrison, S. 1988. Predation Rates of Cougar Within the Junction Wildlife Management Area. 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.

Predation by cougars (Felis concolor) in the Junction Wildlife Management Area of central British Columbia was examined from December 1986 to July 1988. Radio collared cougars were monitored daily and predation rates were determined from kill site examination. Predation rates on bighorn sheep (Ovis canadensis californiana) and mule deer (Odocoileus hemionus hemionus) were determined for females with kittens and ranged from 0.7-2.1 ungulates/week. The rate of predation was dependent on a number of factors including the number and age of kittens, season, and extent of competition from scavengers. Coyote interactions with cougars at kill sites were found to be particularly important. In a 200 km^2 portion of the study area, 130 coyotes were removed over the 2 year period. The predation rate of a female (3 kittens) within the coyote removal area averaged 1.3 kill per week while that of a female (2-similarly aged kittens) in the non-removal area averaged 2.2 kill per week. Moreover, observations of cougars abandoning kills following harassment by coyotes, has led to an examination of the importance of scavengers, particularly coyotes, in regulating cougar predation rates.

Harveson, L.A. 1997. Ecology of a Mountain Lion Population in Southern Texas. Ph.D. Dissertation, Texas A&M Univ., Kingsville.

Base-line ecological characteristics are needed to establish a state-wide management plan for mountain lions (Puma concolor) in Texas. I studied spatial patterns, habitat use, food habits, and demographic characteristics of a mountain lion population on privately owned lands in southern Texas. During a 3-year period (Mar 1994-Mar 1997), 19 mountain lions were captured and radiocollared. Average annual ranges (100% minimum convex polygon, square kilometers) for adult female mountain lions (131.76) were smaller ($P < 0.01$) than for adult males (503.48). Male-male and male-female mountain lion annual range overlap was extensive and annual shifts were apparent ($P < 0.05$). Adult (4 F, 5 M) mountain lions did not use ($P < 0.0001$) habitats in proportion to availability. In general, riparian habitats were preferred ($P < 0.1$) and chaparral habitats were avoided ($P < 0.1$) or used proportionately by female and male mountain lions. Subadult male ($n = 4$) and female ($n = 6$) mountain lions dispersed at <13 months and dispersal distances (km) ranged from 11.0-95.6 and 6.3-23.1, respectively. Mountain lions consumed a variety of prey and preferred white-tailed deer (Odocoileus virginianus) ($P < 0.1$), avoided feral hog (Sus scrofa) ($P < 0.1$), and showed no selection for collared peccary (Tayassu tajacu) ($P > 0.1$). Mountain lion litters ($n = 13$) were uniformly distributed by season ($P > 0.05$) and minimum litter size (mean plus or minus standard deviation) was 1.77 plus or minus 0.83. Mountain lion density ranged from 0.59-0.74 (No/100 square kilometers). Mountain lions (radiocollared + nonradiocollared) died from hunting ($n = 23$), predator control practices ($n = 3$), and other causes ($n = 3$) on the study area. Annual survival for male and female mountain lions was 0.81 and 0.59, respectively. High mortality and low productivity of female mountain lions may limit population levels in southern Texas.

Harveson, L.A., M.E. Tewes, N.J. Silvy, and J. Rutledge. 1997. Mountain Lion Research in Texas: Past, Present, and Future. Pages 40-43 *in* W.D. Padley, ed., Proc. Fifth Mountain Lion Workshop: 27 February- 1 March 1996; San Diego, California.

Although mountain lions (*Puma concolor*) have been reported in all 10 ecological regions of Texas, research has been limited to the Trans-Pecos Region of west Texas. The Trans-Pecos Region has produced >75% of the statewide mountain lion mortalities in the last 10 years. Researchers have focused on mountain lion food habits, spatial patterns, population dynamics, parasites, and behavior. Currently, there are two research projects in Texas regarding mountain lion ecology (one in the Trans-Pecos Region and the other in the Rio Grande Plains of south Texas). In this manuscript, we provide a

review of mountain lion ecology in Texas, discuss ongoing research of mountain lions in south Texas, and identify research priorities for mountain lions in Texas.

Harveson, L.A., B. Route, F. Armstrong, N.J. Silvy and M.E. Tewes. 1999. Trends in Populations of Mountain Lion in Carlsbad Caverns and Guadalupe Mountains National Parks. Southwest. Nat. 44(4):490-494.

Abstract

In the United States, the mountain lion (*Puma concolor*) is limited to the western states and an isolated population in Florida. Recent reports suggest that numbers of mountain lions in the west are increasing; however, most estimates are based on biased harvest records, mortality reports, or sightings. Our purpose was to assess trends in mountain lion populations in two areas within the Chihuahuan Desert by use of multiple-sign surveys. Transects were monitored in spring and fall 1987 to 1996 in Carlsbad Caverns (CCNP) and Guadalupe Mountains National Parks (GMNP). Amount and type of mountain lion sign in each park differed and was likely related to the dominant substrate. A decreasing trend in mountain lion sign was observed on GMNP from fall 1987 to fall 1991 and an increasing trend in mountain lion sign was observed from Spring 1992 to Spring 1996. No trend was observed on CCNP from fall 1987 to spring 1996. Mortalities on adjacent lands may have reduced numbers of mountain lions at GMNP.

Harveson, L.A., M.E. Tewes, N.J. Silvy and J. Rutledge. 2000. Prey Use by Mountain Lions in Southern Texas. Southwestern Naturalist 45(4):472-476.

Abstract

We described the diets of mountain lions (*Puma concolor*) in a prey-rich ecosystem of southern Texas from 1994 to 1997. We estimated white-tailed deer (*Odocoileus virginianus*), collared peccary (*Pecari tajacu*), and feral hog (*Sus scrofa*) densities at 7.7, 4.9, and 6.2 animals/ km^2, respectively. Prey use was determined by identifying 75 mountain lions kills and contents of 25 scats. Mountain lions killed white-tailed deer in greater proportion than available, feral hogs less than available, and collared peccaries in proportion to availability. Resource managers in southern Texas should adjust harvest rates of large prey and enhance populations of buffer species to minimize the effects of mountain lion predation.

Harvey, J.W., M.R. Dunbar, T.M. Norton, and M.J. Yabsley. 2007. Laboratory Findings in Acute *Cytauxzoon Felis* Infection in Cougars (*Puma concolor couguar*) in Florida. Journal of Zoo and Wildlife Medicine 38(2): 285–291.

Abstract

Intraerythrocytic piroplasms, morphologically indistinguishable from *Cytauxzoon felis*, were identified in stained blood films from more than one third of free-ranging cougars (*Puma concolor couguar*) in southern Florida in a study that failed to demonstrate negative effects of piroplasm infection on measured hematologic parameters. However, a recent study with a nested 18s rRNA polymerase chain reaction (PCR) assay identified only 9% of the free-ranging cougars in southern Florida as infected with C. felis but found 83% of these animals were infected with an unnamed small *Babesia* sp. In this study, hematology and clinical chemistry parameters were determined during the initial appearance of piroplasms in stained blood films of three western cougars housed in northern Florida. One animal became ill, but the remaining two animals did not exhibit clinical signs of disease. The hematocrit decreased in all three cougars concomitant with the first recognized parasitemia. A regenerative response to anemia (increased polychromasia, increased mean cell volume, and increased red cell distribution width) was recognized in two cougars that were examined twice during the following 2 weeks. Thrombocytopenia and probable leukopenia occurred in one animal. The most consistent clinical chemistry findings were increased serum bilirubin concentrations and increased alanine aminotransferase and aspartate aminotransferase activities at the time of initial recognition of parasitemia. Serum protein findings were not consistent in these cougars. The use of PCR and determination of 18S rRNA gene sequences in the blood from these three animals revealed infection with *C. felis*, but not with the *Babesia* sp. In this report, we demonstrate that mild hemolytic anemia, and probably liver injury, occurs concomitant with the initial discovery of *C. felis* piroplasms in stained blood films.

Harvey, L.R. 2009. Doubting Thomases and the Cougar: The Perceptions of Puma Management in Northern Ontario,

Canada. Sociologia Ruralis 49(1):56-69.

Abstract

The purpose of this discussion is to provide a better understanding of the conflicting perceptions regarding cougar (*Puma concolor*) management in northern Ontario, Canada. Despite two alleged puma attacks, numerous cougar sightings throughout the region and the recent confirmation of the puma's existence in Ontario through DNA analysis, the existence of these animals in the north-east of Canada and the USA remains largely contentious. Findings derived from interviews conducted in northern Ontario and content analysis of media sources in Canada and the USA suggest that the ongoing debate over the existence of pumas in this region of Canada can be attributed to current wildlife management largely predicated on the grand narrative of the wildlife expert. This centralised, bureaucratic approach decreases the opportunity for constructive dialogue between stakeholders and mitigates the implementation of community-based wildlife management approaches. While this analysis largely focuses in Ontario, Canada, the debate provides insights into the human dimensions of wildlife management, especially elusive wildlife, in North America and elsewhere.

Hass, C.C. 2009. Competition and Coexistence in Sympatric Bobcats and Pumas. Journal of Zoology 278(3):174-180.

Abstract

Space use and diets of sympatric bobcats *Lynx rufus* and pumas *Puma concolor* were compared using sign surveys and scat analysis during 1997-2002 in south-eastern Arizona, USA. Bobcats appeared to use grassland, scrub, riparian and woodland habitats equally, but pumas had higher activity in riparian and woodland habitats. There was little evidence that bobcats avoided pumas in space use. Bobcats ate primarily rodents (33% of items in scats), lagomorphs (32%) and ungulates (16%), whereas pumas ate primarily ungulates (69%) and carnivores (21%). Pumas had a narrower dietary niche breadth than bobcats, and puma diet overlapped bobcat diet by 56%, suggesting that pumas may be more vulnerable to changes in prey density than bobcats. Pumas also killed and consumed bobcats, indicating that interference competition may be manifesting through intraguild predation.

Hauck, K. 2006. Prey and Habitat Availability to Support a Cougar (Puma concolor) Population in the Whiskey Jack Forest (Kenora Management Unit), Ontario: A Masters of Science (Forestry) Thesis, Faculty of Forestry, Lakehead University, Thunder Bay, Ontario, Canada. Page 113 in H.J. McGinnis, J.W. Tischendorf and S.J. Ropski editors. Proceedings of the Eastern Cougar Conference 2004, Morgantown, West Virginia, USA.

Abstract

Cougars (Puma concolor) are the largest cats found in Canada. Abundant now only in British Columbia and Alberta, cougars are possibly making a comeback in their former eastern range. One “sighting” (scat and tracks) of a cougar was confirmed from the Whiskey Jack Forest during January and February 1999, Herb Lake location. I surveyed 37 kilometres of transects in the Whiskey Jack Forest to determine prey and habitat potential to support a viable cougar population. Eleven transects, located in the northern section of Wildlife Management Unit (WMU) 7B, and 10 transects located in the southern section of WMU 6 were surveyed. Combining the Silver Lake and Jones Study Areas, results showed that ecosite 13 had the most abundant animal activity (1.94 animal tracks and trails/10 meters), followed by ecosites 11 (1.66 animal tracks and trails/10 meters), rock (1.46 animal tracks and trails/10 meters), ecosite 19 (1.42 animal tracks and trails/10 meters), and ecosite 14 (1.21 animal tracks and trails/10 meters). Snowshoe hare (Lepus americanus) was the most abundant prey species identified on all transects. Wolves (Canis lupus), a competitor of the cougar, were also abundant on many of the transects, indicating possible competition for habitat and prey resources. White-tailed deer (Odocoileus virginianus), the primary prey of cougar, were only found on one transect, which could indicate possible problems for permanent cougar residence in this area. Moose (Alces alces), however, were quite abundant on many of the transects, and have some potential to support cougars. Whether or not the area can support cougars is unclear. Increasing both the amount of time (consecutive winters) allocated to the study and the size of the study area surveyed would strengthen the study.

Hawkey, C.M. and M.G. Hart. 1986. Haematological Reference Values for Adult Pumas, Lions, Tigers, Leopards, Jaguars

and Cheetahs. Res. Vet. Sci. 41(2):268-269.

Normal haematological values and fibrinogen levels were obtained from a number of healthy adult Felidae in the collection of the Zoological Society of London. The group comprised 29 pumas (Felis concolor), 32 lions (Panthera leo), 27 tigers (P. tigris), 19 leopards (P pardus), 18 jaguars (P. onca) and 22 cheetahs (Acinonyx jubatus). The values provided a basis for identifying abnormalities in the blood of sick individuals of these species and for undertaking interspecies comparisons.

Hayes, C.L., E.S. Rubin, M.C. Jorgensen, R.A. Botta and W.M. Boyce. 2000. Mountain Lion Predation of Bighorn Sheep in the Peninsular Ranges, California. J. Wildl. Manage.64(4):954-959.

Abstract

We investigated survival and cause-specific mortality of 113 radiocollared bighorn sheep (*Ovis canadensis*) in the Peninsular Ranges of southern California from November 1992 through May 1998. Mountain lion (*Puma concolor*) predation was the most frequent cause of mortality, and was the cause of death for 69% (42/61) of all mortalities. Predation was documented during all months of the year except June, and 62% (26/ 42) of predation events occurred from December through March. Annual adult mortality rates due to predation ranged from 0.08 to 0.25 among 6 subpopulations of bighorn sheep, and the mean annual survival rate (0.79) was low relative to other bighorn sheep populations. Bighorn sheep in the Peninsular Ranges were listed as endangered by the U.S. Fish and Wildlife Service in 1998. We propose that a sustained high level of predation by mountain lions, such as was seen during this study, may impede the recovery of this population.

Haynes, L., D. Swann and M. Culver. 2003. Monitoring Mountain Lions in the Tucson Mountain District of Saguaro National Park, Arizona, Using Noninvasive Techniques. Page 141 *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

This presentation will summarize a three-year effort to noninvasively monitor mountain lions in the Tucson Mountain District of Saguaro National Park, Arizona from 2001 through the spring of 2003. Park managers are concerned about this mountain lion population, because the Tucson Mountains are becoming surrounded by human development. The continued existence of the population is threatened due to habitat loss, potential inbreeding, and disrupted demographics. Noninvasive methods used to monitor mountain lions included track surveys, infrared-triggered cameras, and molecular genetic analysis of hair (collected from hair snares) and scat (feces). In the first two years, 2001 and 2002, we documented a total of 19 sets of mountain lion tracks found during 2 winter surveys of 30 transects and during seasonal surveys of 4 transects. From track data we determined that mountain lions are consistently detected in most areas of the park; however, preliminary evidence suggests a paucity of adult males. One of the most important aspects of this project is the opportunity for educating volunteers from the general public who participate in the track surveys. In 2002, 31 of 35 hair snares distributed throughout the park had hair deposited on them. Planned genetic analysis will determine efficacy of using hair snares and scat to obtain biological information on mountain lions. We will present additional data from the 2003 track survey and we will provide recommendations for future monitoring and research efforts.

Hebert, D. 1988. The Status and Management of Cougar in British Columbia. Pgs. 11-14 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 historical summary and provincial-state comparison of the cougar bounty system and management status is presented. A bounty existed on the cougar from 1910-1957 and over 20,000 animals were harvested during that period. From 1930 to 1955, approximately 13,257 cougar (530/year) were harvested in British Columbia. On the average, 10% of the actual depredation involves cougar while 6% of the total number of complaints involves cougar. There were 15 verified cases of cougars attacking humans in British Columbia up to 1976. To date there had been an additional 2 deaths and 9 attacks on humans. The cougar achieved big game status in 1966. Thereafter, seasons became more restrictive, tags and compulsory inspection were introduced and females with kittens were protected. The average harvest declined from 530/year to 190/year during the period of compulsory inspection (1976-1988). During this period, 56.3% of the total kill

were males and 43.5% represented females. With a 6-10% harvest rate, the current proportion of females in the harvest was of some concern. It appeared that due to several mild winters in previous years and subsequent increase in prey population that the cougar population was stable or increasing and harvest based calculations indicate that there may be a minimum provincial population of 2,280-3,800 cougars.

Hedrick, P.W. 1995. Gene Flow and Genetic Restoration: The Florida Panther as a Case Study. Cons. Biol. 9(5):996-1007.

Populations of some endangered species have become so small that they have lost genetic variation and appear to have become fixed for deleterious genetic variants. To avoid extinction from this genetic deterioration, individuals from related subspecies or populations may have to be introduced for genetic restoration i.e., elimination of deleterious variants and recovery to a normal level of genetic variation. I construct a general population genetics framework from which to evaluate the potential for genetic restoration, and I discuss its specific application to the Florida panther. The translocation of Texas cougars into the free-ranging Florida panther population has been recommended to genetically restore the Florida panther, a subspecies of *Felis concolor* that appears to have both a low level of genetic variation and low fitness. Specific recommendations recently given by a scientific panel are to introduce enough animals so that there is approximately 20% gene flow in the first generation of translocation and approximately 2-4% in the generations thereafter. I evaluated these recommendations in a theoretical population genetics framework and found that they should result in the removal of most detrimental genetic variation and an increase in the standing genetic variation without a high probability of loss of any adaptive Florida panther alleles. Unless the population of the free-ranging Florida panthers is very small, the planned translocation should result in genetic restoration of the Florida panther.

Heist, E.J., J.R. Bowles and A. Woolf. 2001. Record of a North American Cougar (Puma concolor*)* from Southern Illinois. J Sci. 94(4):227-229.

Abstract

A cougar (Puma concolor) was recovered in the proximity of railroad tracks in Randolph County, Illinois on July 15, 2000. A necropsy indicated that the cougar died from injuries it received when struck by a train. The animal appeared to be in good health prior to the accident, and no indications of captive rearing were observed. Genetic data were used to verify that the cougar was of North American origin and not an escaped or released cougar of South American origin. This is the first confirmed occurrence of a cougar in Illinois in over 100 years.

Hemker, T.P. 1982. Population Characteristics and Movement Patterns of Cougars in Southern Utah. M.S. Thesis. Utah State Univ., Logan. 66pp.

Movements of 22 cougars (Felis concolor) were monitored by radio-telemetry between January 1979 and July 1981 in southern Utah. The population, composed of resident, transient, and juvenile cougars, remained relatively constant in size for 3 years. Densities (0.4-0.5 cougars/100 km^2) were considerably lower than has been reported elsewhere. Average annual home area size of resident females (685 km^2) and a single resident male (826 km^2) were substantially larger than other home area sizes reported. Home areas of resident females overlapped and resident male home areas may have overlapped as well. Despite the degree of overlap observed, with the exception of family groups, close spatial associations were rare. Dispersal of cubs appeared to be independent of adult resident density. Density of resident cougars appears to be regulated by a social pattern based on land tenure but limited by abundance of mule deer, their principal prey on this study area. The relative vulnerability to hunting of different cougar cohorts is discussed.

Hemker, T.P., F.G. Lindzey, and B.B. Ackerman. 1984. Population Characteristics and Movement Patterns of Cougars in Southern Utah. J.Wildl. Manage. 48(4):1275-1284.

Twenty-two cougars (Felis concolor) were monitored by radiotelemetry between January 1979 and July 1981 in southern Utah. The population comprised of resident, transient, and juvenile cougars, remained relatively constant during the study. Densities (0.3-0.5 cougars/100 km^2) were considerably lower and home-area size of four resident females (685 km^2, SE=257, range= 396-1454) and a single resident male (826 km^2) were larger than reported for other areas. Home areas of resident females overlapped, but with the exception of family groups, close spatial associations were rare. Dispersal of

male cubs appeared independent of resident adult density. Density of resident cougars was apparently regulated by a social pattern based on land tenure, but limited by the abundance of mule deer (Odocoileus hemionus), their principal prey.

Hemker, T.P., F.G. Lindzey, B.B. Ackerman, and A.J. Button. 1986. Survival of Cougar Cubs in a Non-hunted Population. In Cats of the World: Biology, Conservation, and Management. S.D. Miller and D. Everett (eds.). National Wildlife Federation, Wash. D.C.

Ten family groups of cougars (Felis concolor) were monitored by tracking and radio-telemetry between January 1979 and July 1982 in southern Utah. The study area was closed to cougar hunting after April 1979. Density of cougars in the area was low (0.5 cougars per 100 km^2). Litters ranged from 1-4 cubs, and averaged 2.4 at 3 months of age. Survival of cubs observed between 3 and 10 months of age (N=10) was 72% and from 10 months of age to dispersal at 16-19 months was 92% (N=13). Survival of cubs (N=18) to dispersal in 8 family groups monitored was 67%. Identified causes of death included accidents, poaching, and possible cannibalism. Two of 3 cubs orphaned at 6 months died before the normal age of dispersal. Analysis of movement patterns of family groups suggested that mortality of cubs would be even higher in hunted populations, particularly when hunting seasons coincide with birth peaks.

Hemmer, H. 1976. Fossil History of Living Felidae. The World's Cats 3:1-14.

Pumas were widely distributed in the Pleistocene of both North and South America. It is suggested that this species is derived autochthonously in North America from some earlier cats assigned to the genus Pseudailurus.

Henry, V.G. 1976. The Recovery Plan Concept of the Fish and Wildlife Service as it Relates to the Florida Panther. Pgs. 59-77 In: Proceedings of the Florida Panther Conference, P.C.H. Pritchard (ed.). Orlando, Fl. 121pp.

Background information concerning the Endangered Species Act of 1973 and the Fish and Wildlife Service's responsibilities under the Act is discussed. The recovery plan and team concept, the responsibilities of recovery teams and guidelines for preparation of recovery plans are explained in detail. The relationship of this concept to the Florida panther (Felis concolor coryi) and the status of recovery efforts for this species are presented.

Hernandez, L., and J.W. Laundre. 2003. Status of the Puma in the Mexican Chihuahuan Desert. Page 60 *in* L. A. Harveson, P. M. Harveson, and R.W.Adams, eds. Proceedings of the Sixth Mountain Lion Workshop. Austin. Texas.

Abstract

The puma (Puma concolor) was one of the most widely distributed large carnivores in the western Hemisphere. Currently, its range is greatly reduced but apart from the United States and Canada, the extent of this reduction is unknown. This is the case in Mexico, especially in the north, specifically, the Chihuahuan desert. As the Chihuahuan desert of Mexico provides a critical link between populations to the north and south, it is important to assess the status of that link. In April of 2000, we initiated a survey of the Chihuahuan desert to assess the status of the puma. We chose 15 widely dispersed priority areas (mostly isolated mountain ranges), as designated by the Consejo Nacional para el Estudio de la Biodiversidad (CONABIO). In each area, we attempt to determine the presence and prevalence of pumas via interviews with local persons, surveys of the areas for puma sign, and with the use of camera traps. Through these efforts, we will be able to assess the current status (absent/present; rare/occasional/common) of pumas in each area. We will relate this information with data on mountain range size, amount of human development, etc. and predict with a GIS analysis, the probable occurrence of pumas within the remaining areas of the Chihuahuan desert. Here, we will report the preliminary results of our survey efforts.

Hernandez, L., J.W. Laundre and M. Gurung. 2005. Use of Camera Traps to Measure Predation Risk in a Puma-Mule Deer System. Wildl. Soc. Bull. 33(1):353-358.

Abstract

Previous work indicated that automated camera traps may be useful in estimating predation risk among different microhabitats for mule deer (*Odocoileus hemionus*). We tested the prediction that the number of photographs taken by

automated camera traps was inversely related to the amount of food left by deer in feeding boxes or giving up densities (GUDs). We positioned camera traps adjacent to standard mule deer feeding boxes placed in open and edge microhabitats of 3 forest types: Douglasfir (*Pseudotsuga menziesii*), juniper (*Juniperus osteosperma*), and mountain mahongany (*Cercocarpus ledifolius*). We compared number of photographs taken with daily GUDs for the boxes for the 2 microhabitats. We found that GUD data of our study coincided with the previous work of lower GUDs in open versus edge microhabitats for Douglas-fir (288.6±17.1 g vs. 389.6±19.4 g; $P<0.001$) and juniper (218.9±26.3 g vs. 251.9±29.6 g, $P=0.027$) but not for mountain mahogany (272.4±29.5 g vs. 287.0±32.3 g, $P=0.414$). We also found significantly more total photos/camera taken in open microhabitat versus edge microhabitat in Douglas-fir (16.2±2.2 vs. 7.4±1.5; $P=0.004$). More photos/camera were taken in the open versus edge in the juniper forest type (15.6±3.9 vs. 11.5±3.9), but the difference was not significant. There was no difference in photos/camera between the 2 microhabitats in the mountain mahogany (18.4 ± 3.4 vs. 19.3 ± 1.9). Total number of photos/day/box also was significantly related to the GUDs for the 3 forest types ($P = 0.002–0.008$). The amount of variability explained by regression equations ($r^2_{adjusted}$) ranged from 22% for Douglas-fir to 29% for juniper. We concluded that the total number of photographs taken does reflect the results of GUD analysis and that automated camera traps could be used to assess predation risk among different microhabitats.

Hernández, L., S.G. Clark and J.W. Laundré. 2006. Impact of Puma Predation on the Decline and Recovery of a Mule Deer Population in Southeastern Idaho. Can. J. Zoology 84(11):1555-1565.

Abstract

We modeled the impact of puma (*Puma concolor* (L., 1771)) predation on the decline and recovery of mule deer (*Odocoileus hemionus* (Rafinesque, 1817)) in southern Idaho based on estimates of puma numbers, predation rates of pumas, and reproductive variables of deer. Deer populations peaked in 1992-1993, then declined more than 55% and remained low for the next 11years. Puma numbers peaked 4-6 years after deer populations peaked but then declined to original levels. Estimated puma predation on the deer population before and after the decline was 2.2%-3.3% and 3.1%-5.8%, respectively. At high puma densities (>3 pumas/100km^2), predation by pumas delayed deer recovery by 2-3 years. Percent winter mortality of fawns ($r^2 = 0.62$, $P < 0.001$) and adult female deer ($r^2 = 0.68$, $P < 0.001$) correlated positively with December-January snowfall. Incorporation of winter snowfall amounts in the model produced a pattern of deer population change matching estimated changes based on field survey data. We conclude that pumas probably were a minor factor in the decline of the deer population in our area and did not suppress deer recovery. We propose that winter snowfall was the primary ultimate and proximate factor in the deer decline and suppression of their recovery.

Hershkovitz, P. 1959. The Type Locality of Felis concolor concolor Linnaeus. Proc. Biol. Soc. Washington 72:97-99.

The type locality classification system of the puma is examined.

Hettlich, B.F., HP. Hobson, J. Ducoté, T.W. Fossum and J.H. Johnson. 2010. Esophageal Hiatal Hernia in Three Exotic Felines—Lynx lynx, Puma concolor, Panthera leo. Journal of Zoo and Wildlife Medicine 41(1):90-94.

Abstract

Hiatal hernia was diagnosed in three exotic felines—lynx (Lynx lynx), cougar (Puma concolor), and lion (Panthera leo). All cats had a history of anorexia. Thoracic and abdominal radiographs showed evidence of a soft tissue mass within the caudal mediastinum suggestive of a hiatal hernia in all animals. A barium esophagram was performed in one case. All animals underwent thoracic or abdominal surgery for hernia reduction. Surgical procedures included: intercostal thoracotomy with herniorrhaphy and esophagopexy (lynx and cougar), and incisional gastropexy (lion). Concurrent surgical procedures performed were gastrotomy for gastric foreign body removal and jejunostomy tube placement. Clinical signs related to the hiatal hernia disappeared after surgery and recurrence of signs was not reported for the time of follow-up.

Heywood, R. 1967. Vitamin A in the Liver and Kidney of Some Felidae. Br. Vet. J. 123:390.

SUMMARY

Liver and kidney vitamin A reserves of forty-one Felidae in a zoological garden have been recorded. It is suggested that when a meat diet is fed, with the calcium/phosphorus ratio corrected to 1:1, 200 i.u. of Vitamin A per kg provides for adequate liver storage. Liver vitamin A reserves were low in enteric disease. Storage of large quantities of vitamin A in the kidneys is not characteristic of all Felidae and only in the jungle cat and caracal lynx were appreciable quantities of fat being excreted, save in the tiger. The urine of two puma was tested and found to be negative for Vitamin A. A table is provided which lists the cause of death, liver and kidney weights and i.u. of vitamin A, ratio of body weight to liver weight, and fat found in proximal convoluted tubules for 41 specimens of Felidae, including 5 pumas.

Hibben, F.C. 1937. A Preliminary Study of the Mountain Lion (Felis c. oregonensis). Univ. New Mexico Biol. Ser. 5(3):1-59. Bulletin 318.

During one year's time, from October, 1934, and extending into September, 1935, an investigator was placed in the field to make a special study of the mountain lion in New Mexico and Arizona. It is stated that a mountain lion will, on certain very rare occasions, attack human beings, usually under stress of acute starvation or extreme old age. Indeed, in practically all cases of persons being killed by bears or lions of any kind, they were very seldom consumed. In fact, the author was unable to find a single case of attacks on humans in which the flesh was actually eaten. Lion country is usually characterized as rocky, with the steepest and most rugged of ravines and canyons. A lion seldom goes through a country; he will go around it by way of the ledges and rock rims. Very bushy, steep hillsides, with rock cliffs above and below, form the ideal country. They do not seem to favor very high country and are seldom found in high timberline or tundra country, but seem to prefer the lower ridges and slopes where the cover is thicker and the game more plentiful. Generally a lion is unwary about a trap, but will seldom come to a scent bait. The lion does most of his prowling at night and appears to be diurnal only during stormy weather or out of necessity. A deep dusk rather than total darkness suited them best. The cougar can and does swim rivers, but it is doubtful that he does so from any desire to sport in the water. The lion scrape or scratch is one of the most striking features of lion hunting in all its phases. It is made by the male lion for the most part and usually indicates the track of a male lion. Its absence on a track correspondingly indicates a female. This scraping habit of the lion produces a small mound of pine needles and rubble several inches in height, seldom higher. The dirt and needles are scraped up from one side with the paws to form the pile on which the urine is deposited. The act is in every sense a scent station which is put along the rims and ridges of his runs. The scrapes are usually in selected places under overhanging bushes or trees. The purpose of the scratch is probably a sex challenge, very similar to that of the dog. This is illustrated by the fact that a male lion, when actually courting a female, will scrape very frequently. From the tracks it is certain that a lion does not miss any opportunity to smell old scrapes, whether they are his own or those of a strange lion. Close observation of tracks makes it fairly certain that the male cougar scrapes with his hind feet. The lion seldom, if ever, buries his dung; although the dung is frequently found on top of these scrapes. About one scrape in five is topped with dung. There is some evidence that lions are monogamous. The evidence seems conclusive that the same lions often mate together year after year and return to the same hunting grounds. The female, when in heat, starts to hunt a male and circles the country by means of the rims and ridges, leaving her scent of a female in heat, perhaps on the very scrapes of the male. A wandering male, upon scenting the female scent signs, starts to trail her up and court her. If there are two males on the scene, there will likely be a fight. On completion of the mating action which may last all day, the couple go quietly about their prowling and hunting. The male and female remain together for perhaps two months, certainly not longer, and then separate again for a year or more. It is most likely that a female has a litter about every year and a half, as the dates of birth are so irregular. Thus, every third year she might give birth to kittens in the spring. It is evident that there are no set times for mating or birth, although the greatest number of records favor the spring. A female lion was killed on April 16 and was carrying 4 embryos some two months along. The young number 2-4, rarely 5, with 3 given as the average and sex ratios about evenly divided. They have a full set of teeth in about a month and are weaned in the wild at around two to three months of age. The female makes a kill in the neighborhood and then goes back and leads the kittens to the kill where they stay until it is consumed. In all but two of the fifty-odd kills examined during this survey, there were tooth-marks on the back and neck of the kill, which would have caused death. The neck of the victim is often fractured upon striking the ground. The attack is always from the top or from the side and not from beneath. The lion springs high and catches wherever he can with the vertebrae as his goal. The hind legs, with their ripping claws, undoubtedly play a large part. After the kill is made, the lion usually drags the carcass to a new spot downhill, as much as two or three hundred yards. The first meal is usually made from the belly, and the skin seems to be relished as one of the best parts. Usually the carcass is covered with leaves, sticks, and pine needles which may be scraped up over it. Deer kills may be buried, eaten upon, and reburied as many as 10 times. Such burying is the sure and only proof of a lion kill. This survey found 84% of the kills were bucks. All dung specimens examined contained hair. Large fragments of bone, hooves, quills, feet, and claws, as well as grasses were not uncommonly found. Mule deer comprised 54% of the stomach

and dung specimens examined. Whitetail deer comprised 28%; porcupines comprised 5.8%; cottontail comprised close to 4%; jackrabbit comprised 2%; domestic cow comprised 2%; unidentified or of little significance comprised 4.7%. Neither horse nor any type of bird or feathers were found.

Hibben, F.C. 1939. The Mountain Lion and Ecology. Ecology 20(4):584-586.

The record of lion dung specimens collected since the 3 year study began (see Hibben, A Preliminary Survey of the Mountain Lion, Univ. New Mexico Press, Bull. 318) had mounted to 3,000. The more important food items by percentages as evidenced by scatological and stomach examinations were as follows: Rocky Mountain mule deer (*Odocoileus hemionus macrotis*), 54%; Sonora white-tailed deer and Arizona white-tailed deer (*Odocoileus couesi*), 28%; Arizona porcupine (*Erethizon epixanthum couesi*), 5.8%; Common cotton-tail rabbit (*Sylvilagus nuttalli pinetis*, *S. auduboni arizonae*, *S. auduboni minor*, *S. auduboni cedrophilus*), 4%; Black-tailed jack-rabbit (*Lepus californicus eremicus*, *L. c. texianus*), 2%; Domestic cattle (of several species), 0.5%. The remaining 5.7% varied from different localities among the following: Texas or Mexican badger (*Taxidea taxus berlandieri*), Common striped skunk (*Mephitis estor*), Arizona gray fox (*Urocyon cinereoargenteus scotti*), Arizona coyote or Great Basin coyote (*Canis lestes*), Canadian, Pecos, Rio Grande beaver (*Castor canadensis frondator*), and Prairie dogs of different species (*Cynomys*). It was noted that there was an overwhelming majority of deer and an interestingly small count of domestic stock even though all collecting stations were in sectors heavily ranged by cattle, horses, sheep and goats which may suggest a special choice or propensity for the "natural" food. It was of interest to note the entire absence of any feather or bird kill of any kind. In addition, even though many game experts believe that a lion kills a deer a week, the author speculated that a deer a month would be a better estimate based on records of the daily wanderings of over 200 lions.

Hicks, A. 1980. Endangered Species Investigations. Determination of Extirpated Species, Evaluation of Their Potential for Reestablishment, and Restoration of them into New York State: Restoration of the Puma into New York- a Preliminary Problem Analysis and Recommendation. Perf. Rep., Proj. No. E-01-04. NY State Dept. Environ. Conserv. 87pp.

Mathematical models similar to a model developed by Kenneth R. Dixon and George W. Cornwell are created and applied to studies involving one-predator-one-prey systems. The theoretical origins of these models are first presented as developed by K.E.F. Watt. An analysis of the prey equation in the model is made by John Durgala to adapt it to represent the white-tailed deer of the Central Adirondacks. Using Dixon and Cornwell's model as a basis, David Smith has developed a similar model to reflect the mule deer-puma interactions in the Idaho Primitive Area as observed by Maurice Hornocker et al. Then, he has adapted this model to predict white-tailed deer-puma interactions in a Central Adirondacks setting with the addition of the prey terms developed by Durgala. Finally, after an extensive analysis of wolf characteristics, Carl Springer has used a wolf-moose model originally proposed by Dixon and Cornwell and adapted it to a Central Adirondacks setting with the aid of some of the values determined by Durgala. Appropriate recommendations and conclusions are made concerning the use of these models.

Hill, A. 1975. Comparison of Mycoplasmas Isolated from Captive Wild Felines. Res. Vet. Sci. 18:139-143.

The mycoplasmas isolated from captive wild felines showed a strong relationship to but were not identical with Mycoplasma felis. Exceptions were M. arginini and strain PU, isolated from pumas, which were distinct.

Hill, J.O., E.J. Pavlik, G.L. Smith III, G.M. Burghardt and P.B. Coulson. 1976. Species-Characteristic Responses to Catnip by Undomesticated Felids. J. Chem. Ecol. 2(2):239-253.

Abstract

Thirty-three large felids belonging to six different species were exposed to catnip and catnip extract. The species-characteristic response to catnip and the sensitivity of the response to various concentrations of catnip were examined. Putative relationships between catnip sensitivity, species range, age, estrous cycle, and behavioral complexity are discussed. The behavioral response to catnip shown by the domestic cat is seen in several different large felids. Lions and jaguars were extremely sensitive to catnip compared to tigers, cougars, and bobcats, who gave little or no response. Both males and females of the same species tested alike. Reproductive-age adults were more sensitive than either aged or immature animals. It was quantitatively demonstrated that catnip responsiveness is not limited to the domestic cat, that

it is not limited to the female, and that it varies dramatically between species and age of felids.

Hillaby, J. 1968. Where's That Cougar? New Scientist 37(589):646-648.

The author tells of a major automobile manufacturer which called one of its models the Cougar. Television commercials were broadcast all over with the voice of the announcer saying "There's a cougar bounty this spring... Get your cougar bounty now...". The first Jesuit priests on the continent were offered one bull per cougar skin. Over the years, federal bounties were supplemented by local awards ranging from 50 to 500 dollars, but more commonly 15 to 25 dollars. Jimmy Owen, a passionate cougar killer, was reported to have killed 600 on the Kaibab plateau. In 50 years, California paid about a quarter of a million dollars for more than 10,000 cougar scalps. The first specimens to be seen by Europeans were probably the "leones" on the coast of Honduras and Nicaragua which were pointed out to and recorded by Christopher Columbus. At least two victims of cougar attacks were known to have died shortly afterwards from rabies.

Hines, T.C., R.C. Belden, and M.E. Roelke. 1987. An Overview of Panther Research and Management in Florida. Pgs. 140-147 In: R.R. Odum, K.A. Riddleberger, and J.C. Ozier, (Eds.), Proc. of the Third Southeastern Nongame and Endangered Wildlife Symposium. Ga. Dept. Nat. Resour., Atlanta. 253pp.

This is a summary of Florida panther (Felis concolor coryi) research and management activities since 1976. Although some results are very preliminary, it appears that a viable but isolated population of panthers exists from Lake Okeechobee south in the Big Cypress/Everglades physiographic region. Some scattered documentation of animals exists outside this area but the significance of these animals is unclear. The threats that face the population include shrinking habitat, reduced prey base, disease and parasites, and possible reduced genetic diversity. Efforts are underway to subvert what appears to be a long term extinction process by identifying and mitigating threats wherever possible and by reintroducing panthers into formerly occupied range.

Hobson, M.D. and J.L. Cooke. 1990. Wildlife Research and Surveys: Effects of Predator Control on Desert Mule Deer Numbers. Final Rep., Proj. No. W-125-R-1, Job 50. Texas Parks and Wildl. Dept., 62pp.

The response of mule deer numbers to predator control on Black Gap Wildlife Management Area (BGWMA) was examined for 1982-1989. Twenty-five mountain lions and 62 coyotes were taken from BGWMA during the study period with most of the lions removed during the first 2 years. Coyotes were removed at a nearly uniform yearly rate over the study period. The trends of predator populations could not be determined with confidence, however, comparisons to rabbit trends implied that coyote numbers were substantially reduced on BGWMA while predators appeared to cycle with rabbits in Big Bend National Park (BIBE). Javelina numbers on BGWMA could not be estimated, but the distributions of indexed density did not show any trend during the study. Estimating mule deer numbers proved complex for the study period and a new perspective on interpretation of transect surveys is proposed which accounts for inconsistent animal density over the area, inconsistent group size, the lack of independence in animal behavior, and the critical density created by the transect design itself. Mule deer on BGWMA are thought to have increased from 1982 until 1986-87 and then declined through 1989. The causes of this change could have been some combination of predator control, vegetative change, and factors from outside of the study area, but the contribution from these potential influences could not be distinguished. Predator control on BGWMA proved expensive during the study period and, though an impact on the mule deer population was expected, the direct effect could not be measured definitively. Recommendations which include the ecological implications of the study are provided.

Hogan, M., N. Kelley, E. Karnes and L. Mann. 2005. Utilizing Captive Cougars in Conservation Education Efforts in Southern California. Page 224 *in* R.A. Beausoleil and D.A. Martorello, editors. Proceedings of the Eighth Mountain Lion Workshop, Olympia, Washington, USA.

Abstract

With the human population in Southern California continually on the rise resulting in loss and fragmentation of natural habitat, the challenges of mountain lion conservation become increasingly magnified. Live animal programs are powerful vehicles for reaching people and can serve research, education and conservation agendas well. As human habitat

increases pressure on wildlife habitat public education programs become a valuable platform for dissemination of conservation information. The Nature of Wildworks (NOWW) Wildlife Education Center in Topanga, California houses a variety of non-releasable native birds, mammals and reptiles including four mountain lions. The animals are presented in on-site and outreach public education programs. Our cougar education began with groundbreaking work at the Los Angeles Zoo during the development of the Wild in the City Program, an on-site live animal theater presentation, featuring two cougars, teaching the inner city population ways to live cooperatively with wildlife. This program now continues in outreach fashion for schools and other venues. The foundation of our educational activities is the California State Assembly Bill 1548, which mandates that environmental education now be a part of students curriculum. In coalition with the Mountain Lion Foundation and local non-profits, On-The-Edge programs are also presented to adult populations living adjacent to wilderness areas.

Holl, S.A., V.C. Bleich and S.G. Torres. 2004. Population Dynamics of Bighorn Sheep in the San Gabriel Mountains, California, 1967-2002. Wildl. Soc. Bull. 32(2):412-426.

Abstract

We analyzed long-term population data for bighorn sheep (*Ovis canadensis nelsoni*) occupying the San Gabriel Mountains in southern California. From 1967–1972 an estimated 500 bighorn sheep occupied that range. During 1968–1975 wildfires burned over half the occupied winter–spring ranges. Wildfires increased carrying capacity, and the population grew to 665 animals in 1976. During 1976–1982 adult mortality was low and recruitment was dependent on annual forage production and weather conditions during lambing. Rate of change indicated the population would double every 44 years, and it was considered to be stable. As vegetation matured and carrying capacity declined, mortality of adults and lambs increased and the population halved approximately every 8 years to 501±30 bighorn sheep in 1989. During 1989–1995 adult mortality increased and rate of change indicated the population would halve approximately every 2.8 years. From 1995–2002 the population was stable at 90 animals. Increased recruitment and an inverse relationship between number of adult ewes and recruitment rates between 1985 and 2001 suggested that neither habitat suitability nor disease was causing the dramatic population decline observed after 1989. We hypothesize that because of a declining mule deer (*Odocoileus hemionus californicus*) population, mountain lions (*Puma concolor cougar*) began to prey more frequently on bighorn sheep, which led to a dramatic decline in the sheep population after 1989.

Hollister, N. 1911. The Louisiana Puma. Proc. Biol. Soc. Washington. 24:175-178.

Three specimens of puma, two skulls from Mer Rouge, Moorehouse Parish and a skin and skull from Vidalia, Concordia Parish, identified the Louisiana puma as different from any that had yet been described. The Louisiana puma is much more closely related to the puma of Florida than to the northern form or to F. oregonensis azteca. It seemed certain that the distribution between Florida and Louisiana was at one time continuous. However, because they varied so much in color, it seemed best to regard it as a separate subspecies. The type species of Felis arundivaga sp. nov. is described including color, skull and teeth, and measurements. The rich rusty red back of the Florida puma and the pale, uniformly colored back and tail of the Texas puma readily distinguishes them apart from the Louisiana puma.

Holm, G.W. 2003. What Does Ten Years (1993-2002) of Mountain Lion Observation Data Reveal About Mountain Lion-Human Interactions within Redwood National and State Parks? Page 165 *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*) occur throughout Redwood National and State Parks (RNSP) and most other portions of northwest California. However, because they are not often observed, RNSP biologists have always been interested in recording mountain lion observations within the park. Prior to 4 mountain lion attacks in California between 1992-94, 2 resulting in fatalities, RNSP mountain lion observations were not compiled in a timely, consistent, or easily accessible manner. Since 1993, RNSP biologists have attempted to document and verify all mountain lion observations using a standard reporting form and database. Three hundred and seven mountain lion observations have been recorded within RNSP from 1993-2002 (mean ≅ 31; range 19-53). Most were observed between May and October during daylight hours, and involved a single mountain lion. While most observations (54%) involved a mountain lion near a road while people

were in a vehicle, the remaining observations (46%) occurred while people were on trails or at other park facilities. The ultimate response of most mountain lions (68%) encountered on trails was to avoid humans, yet twenty percent of trail encounters involved some level of curiosity by the mountain lion towards humans. Although no human attacks were reported, there were 8 reports of aggressive behavior towards humans, 6 reports of following humans, and 1 report of a dog on a leash getting attacked. The observation data does not accurately reflect the actual distribution or timing (seasonally or daily) of mountain lion activity, and should be interpreted with caution due to inherent problems with observer experience, and report quality and verification. However, the information does allow managers to quickly identify when and where mountain lion-human interactions have occurred, and more effectively focus management actions to prevent or reduce future mountain lion-human interactions within RNSP.

Holmes, B.R. and J.L. Laundre. 2003. Mountain Lion Use of Open, Edge, and Forest Habitat: Evidence for Optimal Foraging? Page 61 *in* L. A. Harveson, P. M. Harveson, and R.W.Adams, eds. Proceedings of the Sixth Mountain Lion Workshop. Austin. Texas.

Abstract

Previous quantitative assessments of habitat use by mountain lions (Puma concolor) have indicated that mountain lions prefer areas with woody vegetation that provide hiding cover, and avoid areas with less woody vegetation and less hiding cover. This suggests that, for mountain lions, forest structure that affects prey vulnerability is more important than type of forest. More recently, mountain lion kill locations of ungulates have been shown to have a positive relationship with preferred vegetation type, escape cover, and water. In south-central Idaho/northern Utah, predation data indicate that mountain lions are more successful at killing mule deer (Odocoileus hemionus) in edge habitat, even though overall, deer showed the highest utilization of open habitat. Powell (1994) stated that optimal foraging models needed to be combined with information on habitat preference to design models of habitat selection. If mountain lions are more successful at killing deer in edge habitat, then the prediction from optimal foraging theory is that mountain lions should use edge habitat significantly more than availability as well as significantly more than open or forest habitat. We used compositional analysis to test this prediction with mountain lion snow-tracking data. Mountain lions did not use habitat randomly (Chi-square = 48.3, $P < 0.0001$). The analysis supports the prediction that edge habitat is used significantly more than open habitat, but does not support the prediction that edge habitat is used significantly more than availability or forest habitat. With further research, optimal foraging may be the model that most adequately explains mountain lion habitat use.

Holmes, B.R. and J.W. Laundre. 2006. Use of Open, Edge and Forest Areas by Pumas *Puma concolor* in Winter: Are Pumas Foraging Optimally. Wildl. Biology 12(2):201-209.

Abstract

Optimal foraging theory predicts that an animal should optimize its time spent in food patches based on resource levels and, if preyed on by another species, predation risk. In large mammal predator-prey systems, previous studies have suggested that prey do consider predation risk when foraging and tend to avoid high-risk areas. In contrast, if large mammalian predators are trying to optimize their foraging, we predict that they should select these high-risk areas because such areas represent higher predation success. For pumas *Puma concolor* in southeastern Idaho, previous work showed that edges of forests were the most successful hunting areas for mule deer *Odocoileus hemionus* compared to open and forest areas. We tested the prediction that pumas should optimize their foraging strategies by selecting edge areas during periods of movement. We followed puma tracks in the snow and recorded for every 20 m whether the pumas had been in an edge, open or forest area. We used a resource selection function and composition analysis to test if pumas were preferentially selecting edge areas over open or forested areas. Based on the resource selection function, pumas were four times more likely to use edge than open areas, but used edge and forest areas equally. Results of the composition analysis indicated that pumas also used edge areas significantly more than open but similar to forest areas. As pumas were selecting edge areas and avoiding open areas to forage, these results indicated that pumas may be foraging optimally. However, the equal use of edge and forest areas did not support our predictions, and we discuss possible explanations of these results.

Holt, D.W. 1994. Larder Hoarding in the Cougar, Felis concolor. Can. Field Nat. 108(2):240-241.

A mountain sheep (Ovis canadensis), and two mule deer (Odocoileus hemionus) were killed, and hoarded by a cougar

(Felis concolor). The prey were hoarded within 19 m of a game trail, and 22 m of an open hillside. The carcasses lay within 5 m of each other, and were all less than one month old. The sheep was 9.5 years old, and the deer were 2.5 and 3.5 years old.

Holt, E.G. 1932. Swimming Cats. J. Mammal. 13(1):72-73.

The author had searched the literature with little success for instances of voluntary swimming by the larger cats. He provides two records of voluntary swimming; one of the jaguar and one for the puma. The puma was encountered in mid-stream on the Alto Orinoco in the neighborhood of Parguaza Hills. The river was at least one mile wide at this point and the puma became confused and tried to board the launch when intercepted. It seemed unlikely that the puma could have been cornered and driven into the river.

Hooper, C.A. 1955. Panther Panic. Pennsylvania Game News 26(6):28.

A black panther scare is over in Lawrence County, Pennsylvania. After several reports and media coverage, it was discovered to be a large house cat.

Hooper, T., F.A. Street-Perrott and D.R.P. Cooper. 2003. Are Exotic Pumas Breeding in Britain? Page 61 *in* L. A. Harveson, P. M. Harveson, and R.W.Adams, eds. Proceedings of the Sixth Mountain Lion Workshop. Austin. Texas.

Abstract

Introductions of alien big cats (ABCs) have a long history in Britain. The Romans probably imported lions (Panthera leo) and leopards (P. pardus) for their circuses. From the 12th Century onwards, ABCs were kept in the Royal Menagerie in the Tower of London. Pumas (Puma concolor) had been introduced by 1805, when an advertisement for Polito's Travelling Menagerie boasted of ‘noble male and female panthers (sic), from the river La Plata, South America' (Bostock, 1927). Pumas became common in small zoos during the 20th Century, because they bred easily in the British climate. Others were imported as mascots by American troops during the two World Wars, or were kept as 'designer pets'. In 1976, the Dangerous Wild Animals Act made it illegal to keep ABCs without a very expensive license. Unfortunately, this Act omitted to prevent owners from releasing their animals into the wild, a serious loophole belatedly closed by the Wildlife and Countryside Act 1981. At least 5 pumas and 2 melanistic panthers were freed in Wales. Since 1995, the Exotic Animals Register has systematically recorded sightings of ABCs and other non-native species in Britain, with cooperation from various police forces and volunteers. Hundreds of reports of exotic cats every year, including cubs, strongly suggest that both pumas and panthers are breeding successfully in the wild. We will describe the ecology of pumas in Britain, based on sightings, published reports, and detailed case studies from West Wales, including evidence for attacks on farm livestock.

Hooper, T. and A.B. Smith. 2006. Exotic Cats in Britain: An Historical Perspective. Pages 9-15 in H.J. McGinnis, J.W. Tisc Ropski, editors. Proceedings of the Eastern Cougar Conference 2004, Morgantown, West Virginia, USA.

Abstract

Over the past few decades, thousands of people in Britain have reported encounters with large exotic cats, including puma (Puma concolor), melanistic leopard (Panthera pardus), Eurasian lynx (Lynx lynx), and Asian jungle cat (Felis chaus). Most zoologists and naturalists dismiss these accounts as examples of mistaken identity, but others have pointed out that exotic cats may have been released or escaped from captivity. They disagree as to whether these former captives could survive and breed in the British countryside. In this report we review the historical factors that may have led to the escape or deliberate release of exotic felids in Britain over a period of at least 900 years.

Hopkins, R.A. 1984. The Role of the Puma in a Nonmigratory Large Mammal Community in the Diablo Range of California. Pgs. 134-137 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.

Only six studies had been conducted on the puma in California. These studies focused equal attention to radio-telemetry and track transecting. This study radio-collared and monitored the movements of six resident pumas (4 males, 2 females)

between 1978 and 1981. The density of adult pumas was estimated to be 1.9 to 2.3 per 100 km^2. The home ranges of female and male pumas was estimated to average 67 and 157 km^2, respectively, and female home ranges did not overlap while some male home ranges overlapped extensively. A stable and abundant year-round prey base contributed to the relatively high density and small home range data. The smaller home range of the female was used more intensively than the male, presumably due to reduced hunting radius of a female with cubs.

Hopkins, R.A. 1984. Current Techniques Used in the Research of Pumas. Pgs. 216-229 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.

SUMMARY

The collection and analysis of ecological data for pumas is still in its infancy. Development of reliable aging techniques and measures of recruitment are essential for the building of realistic stock recruitment models. Standardization of sampling schemes for radio-collared pumas and the analysis of these data are imperative for the comparison of behavior between studies. It is particularly important to increase the number of pumas radio-tagged and the number of relocations per individual per study. We must not overlook the value of models nor misuse them. They can be a valuable tool if we recognize and understand their limitations. Stock recruitment models and predator-prey models should receive priority attention.

Hopkins, R.A., M.J. Kutilek, and G.L. Shreve. 1986. Density and Home Range Characteristics of Mountain Lions in the Diablo Range of California. In Cats of the World: Biology, Conservation, and Management. S.D. Miller and D. Everett (eds.), National Wildlife Federation, Wash. D.C.

The population densities and sex-specific home ranges of mountain lions, Felis (Puma) concolor, were studied in the Mount Hamilton area of the Diablo Range in California. Six adult resident lions were captured, radio-collared, and located 543 times between November 1978 and June 1982. Population estimates for the core study area varied from 1.2-1.5 adults to 1.9-2.3 adult lions per 100 km^2. The mean home range size was 157.5 km^2 for males and 66.5 km^2 for females. Females had smaller home ranges than males but utilized them more intensively. The home ranges of females overlapped extensively with those of males. Male home ranges varied from having no overlap to extensive overlap with adjacent males. Territoriality in mountain lions may be facultative depending on the environmental regime.

Hopkins, R.A. 1989. Ecology of the Puma in the Diablo Range, California. Ph.D. Thesis. Univ. of Ca., Berkeley. 273pp.

A study of the ecology of an unexploited population of puma (Puma concolor) was conducted in the Mt. Hamilton area of the Diablo Range, California from March 1984 through June 1989. The study area comprised 550 km^2 of public and private lands about 20 km east of San Jose, California. Elevations vary from 300-1100 m with the majority of the land mass above 600 m. The study area is a mosaic of chaparral, oak woodland, north slope woodland, oak-bigberry manzanita woodland, annual grassland, and oak savanna communities. Twenty-four pumas (9 males, 15 females) were radio-tagged with a capture effort of 173 days for a success rate of 13.9% or 1 puma for every 7.2 days of hunting. One 3-5-year-old male died during the capture process for a capture mortality of 3.7%. Two methods were used to estimate population density: proportional and aerial. The proportional method sums the proportion of the home ranges of resident pumas that were in the core of the study area (335 km^2). The size of the core area will greatly affect the density estimate and hence this method had a large subjective component. Aerial flights provided an instantaneous picture of the spatial relationship for all radio-tagged pumas. Hence, the aerial method used a minimum convex polygon to enclose the locations of resident pumas from each flight. These weekly density estimates were then averaged for each year between 1985-89. The aerial method provided a more reliable estimate that was more than twice as large (3-5 adult pumas/100 km^2 vs. 0.9-2.0 pumas/100 km^2) as the more traditional, proportional method. The more objective aerial method is recommended for cases in which the number of resident pumas exceeds 5 and the capture effort has been concentrated in 1 area. The mean age at time of capture for pumas >24-months of age was 69 months for males (n=4) and 67 months for females (n=11). Three males and 7 females survived to greater than or equal to 7-years of age during the study. One female was a minimum of 13 years old. The sex ratio for all adult cats (n=17, 6 males:11 females) sexed during the study did not differ from parity. This small sample is nearly 2:1, but it may not be representative of the population. Eleven radio-tagged and 2 untagged (5 males: 8 females) pumas died of natural causes between March 1987 and April 1989. The mean age at death

for these pumas was 79 and 60 months for males and females, respectively. The mean age at death, excluding pumas <24-months of age, was 79 and 90 months for males and females, respectively. The average age of this unexploited population was much higher than reported for pumas in moderately to heavily hunted areas. Thirty pumas less than or equal to 18-months of age in 19 separate litters indicated a mean litter size of 1.6 cubs/litter. This was a conservative estimate since in many cases siblings may have gone undetected. The maximum litter size was 3, but no cubs under 3 months of age were observed. Only 1 litter out of 7 was known to have >1 cub survive to the yearling class. The mean litter size for this study was lower than reported for harvested populations. Pumas (n=14) in this area were aseasonal breeders with small peaks in late winter and early fall. Birth intervals for 2 adult females varied between 20-24 and 30-34 months. Subadult males were about 21-months of age at dispersal and moved 29-58 km from their natal range. The unexploited population of pumas in the Diablo Range consists of a relatively stable population of old individuals with a low turnover of residents. The relatively low productivity, low juvenile survival and older dispersers is typical of an unharvested population. Six methods were used to examine the pumas' home range: 1) minimum convex polygon (MCP); 2) bootstrapping of the MCP (BMCP); 3) modified minimum area polygon (MMAP); 4) harmonic mean (HM); 5) fast fourier transform (FFT); and 6) 95% bivariate normal ellipse (BVN). The average size of the annual home range varied from 61 km^2 (MMAP) to 117 km^2 (BVN), and 135 km^2 (MMAP) to 285 km^2 (BVN) for adult females and males, respectively. The MMAP and 95% FFT produced the lowest, and the BVN consistently produced the highest home range estimates. All of these methods but the BVN appeared to have some utility for examining the home ranges of large carnivores. The MCP, BMCP, and the MMAP were robust to deviation from the assumption of independence of locations. However, only the BMCP adjusted estimates for sample size. The HM and the FFT allowed for an assessment of the internal anatomy of the home range. The 50% FFT was relatively stable and may be a useful home range index for comparisons among puma studies. There were no seasonal shifts in home range use and pumas exhibited only small differences in their annual home ranges. Female home ranges had a weaker harmonic mean center than males indicating that they used their smaller home ranges more intensively. There was no home range overlap between adjacent males with concurrent locations. The home ranges of 4 females varied from 13-95% exclusive. However, the 2 females with the greatest amount of overlap shared <10% of their core area (50% HM). The diel activity pattern of pumas was monitored for 1,345.4 hours (males = 265.9 hrs, females = 1,078.5 hrs) using a strip chart recorder that measured variations in the radio signal. Pumas exhibited weak activity peaks at 0500-1000 hours and 1600-2100 hours with no difference between males and females (X^2 = 35.6, P = 0.046). This pattern was similar to that of a black-tailed deer (Odocoileus hemionus columbianus) in the area. Forty-five kills and 131 scats were collected 1983-89. Eighty-one scats were analyzed by a previous researcher (1983-85) and 50 scats were analyzed for this study (1986-89). Deer made up 82% (37 deer: 13 bucks, 17 does, 7 fawns) of the kills and 74% of the scats. Wild pig (Sus scrofa) were found in only 5% of the 1983-85 scat sample but occurred in 20% of the 1986-89 sample. Pigs, however, made up only 2% of the kill record. There was a higher frequency of pigs in the scats during the wet season (38%) than in the dry season (11%). A linear preference index indicated pumas preferred bucks and avoided does. The high incidence of pigs in the scats was consistent with the results of an earlier study (1978-80). Pig populations were known to fluctuate in the area and it is possible that the density of pigs influenced their use by pumas. Livestock was found in <7% of scats in all 3 studies (1978-80, 1983-85, 1986-89), and only 20 depredation incidences were reported 1971-89. A deer:puma ratio of 210-350:1 was calculated for this area. This relatively high ratio and the preference of pumas for a more reproductively expendable segment of the deer population (i.e. bucks) suggests that pumas did not exhibit a strong limiting force on the deer herd in the Diablo Range during the study.

Hopkins, R.A. and R.H. Barrett. 1991. Population Characteristics of the Mountain Lion in the Diablo Range, California. Pgs. 21-22 In: Mountain Lion-Human Interaction Symposium, C.E. Braun (ed.), Col. Div. Wildl., Denver. 114pp.

SYNOPSIS

A study of the ecology of an unexploited population of mountain lions (Felis concolor) was conducted in the Mt. Hamilton area of the Diablo Range, California, from March 1984 through June 1989. The study area comprised 550 km^2 of public and private lands about 20 km east of San Jose, a major metropolitan area in the state. Elevations varied from 300 m to 1,100 m and most of the land mass was above 600 m. The study area was a mosaic of chaparral, oak woodland, north slope woodland, oak-bigberry manzanita woodland, annual grassland, and oak savanna communities. Twenty-four mountain lions (9 males, 15 females) were radio-marked with a capture effort of 173 days for a success rate of 13.9% or 1 mountain lion for every 7.2 days of hunting. One 3-5 year old male died during the capture process for a capture mortality of 4.2%. Two methods were used to estimate population density. The proportional method was used to sum the proportion of home ranges of resident mountain lions in the core of the study area (335 km^2). The size of the core area greatly affected the density estimate and, hence, this method had a large subjective component. Aerial flights provided an

instantaneous picture of the spatial relation of all radio-marked mountain lions. Hence, the aerial method used a minimum convex polygon to enclose the locations of resident mountain lions from each flight. Weekly density estimates were averaged for each year between 1985 and 1989. The aerial method provided a more reliable estimate that was over twice as large (3-5 adult mountain lions/100 km^2 vs. 0.9-2.0 mountain lions/100 km^2) as the more traditional, proportional method. The more objective aerial method is recommended when the number of resident mountain lions exceeds five and the capture effort is concentrated in one area. The mean age at time of capture for > 24 months old mountain lions was 69 months for males (n=4) and 67 months for females (n=11). Three males and 7 females survived to greater or equal to 7 years of age during the study. One female was at least 13 years old. The sex ratio of all adult cats (n=17; 6 males:11 females) examined during the study did not differ from parity. The sex ratio was nearly 2:1 in this small sample but may not be representative of the population. Eleven radio-marked and 2 untagged (5 males:8 females) mountain lions died of natural causes between March 1987 and April 1989. The mean age at death for these individuals was 79 months for males and 60 months for females. The mean age at death, excluding mountain lions <24 months old, was 79 months for males and 90 months for females. The average age of this unexploited population was much higher than that of mountain lions in moderately to heavily hunted areas. Thirty greater than or equal to 18-month-old mountain lions in 19 separate litters rendered a mean litter size of 1.6 cubs/litter. This was a conservative estimate because in many cases siblings may have gone undetected. The maximum litter size was 3, but no cubs less than 3 months old were observed. Only one of seven litters was known to have more than one cub survive to the yearling class. The mean litter size was lower in this study than in harvested populations. Mountain lions (n=14) in this area were aseasonal breeders with small peaks in late winter and early fall. Birth intervals for 2 adult females varied between 20-24 and 30-34 months. Subadult males were about 21 months old at dispersal and moved 29-58 km from their natal range. The unexploited population of mountain lions in the Diablo Range consisted of a stable population of old individuals with a low turnover of residents. The low productivity, low juvenile survival, and older dispersers is typical of an unharvested population. The Mt. Hamilton Range supports 75-150 adult mountain lions. Currently the Diablo Range from southern Mt. Hamilton is undeveloped. However, subdivisions in Santa Clara County are beginning to push into the foothills of this range. State and county parks comprise 10% of the Mt. Hamilton area. These public lands are fragmented and too small to support a viable mountain lion population by themselves. Therefore, large contiguous parcels of private and public lands must be maintained with land uses compatible with conserving deer and mountain lion habitat. Cattle ranching should be encouraged to continue in the area because of the low level of livestock losses. The continued existence of mountain lions in the Diablo Range and in the state hinges on maintenance of large areas (1,250-16,700 km^2) of wildland interconnected by suitable dispersal corridors.

Hopkins, R.A. 2003. Mystery, Myth and Legend: The Politics of Cougar Management in the New Millennium. Page 145 *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 cougar as America's cat is a large, ghost like predator that usually hunts game as large as or larger than it is. As Teddy Roosevelt noted in the late 1800's, "No American beast has been the subject of so much loose writing or of such wild fables as the cougar". More than 100 years and dozens of scientific studies later, we are no better off in unraveling the "loose writing" and in some cases, the management objectives for this predator, than we were at the beginning of the twenty century. The life style of the cat has long resulted in polarized attitudes toward the development of policies for its management throughout North America. The general "truth" that has evolved with wildlife managers regarding increasing cougar numbers throughout the West over the last 2 to 3 decades is believed to be born from 30 years of research. While numbers of cougars may have increased in portions of their range over the last 2-3 decades, the general perception that cougars are more abundant in the western U.S. is based not on empirical data, but one based more on oral traditions passed on from one wildlife professional to another. Cougar management in the last two decades focused on the impact of prey populations and depredation of livestock more than on direct encounters with humans. However, an increase in human attacks in the 1990's has not only heightened public awareness of cougars, but appears to have explicitly shifted management in some western states to focus more on "controlling" the species. Lost in this debate and the objectives of the management of the species is the preservation of those elements that will truly lead to its conservation. California represents an interesting living lab, as cougars have not been sport hunted in this state since 1972; it also supports one of the largest cougar populations in the U.S. if not the largest, and clearly supports the largest human population. The lessons learned in California can serve as a model for continued efforts to focus management objectives on the conservation of the species and not solely on equating management with harvest as is so often done.

Hopkins, R.A., B.G. Dickson, B.H. McRae and P. Beier. 2005. Conservation Strategies for Cougars in Riverside County, California: From Models to Management. Page 205 *in* R.A. Beausoleil and D.A. Martorello, editors. Proceedings of the Eighth Mountain Lion Workshop, Olympia, Washington, USA.

Abstract

The conservation of wide-ranging carnivores depends critically on planning efforts that consider the habitat requirements of a species at multiple spatial scales. To maximize their utility, these efforts should rely on models constructed and validated using empirical data collected at scales relevant to animal behavior. In southern California, cougar *(Puma concolor)* populations persist in areas increasingly dominated by human influence. Often, habitat features only tenuously connect these populations, and man-made barriers to movement are common. To model suitable habitats, core areas, and landscape connectivity for cougars in this region, we applied data from field studies to a 35,000-km^2 landscape that included all of Riverside County. Results from these studies included information on cougar response to vegetation, topography, and roads at three spatial scales. Although our models identified sizable amounts of suitable habitat, many of these areas provided few key resources, were highly fragmented, and were separated by features that inhibited cougar movement. Circuit-theoretic models of connectivity identified multiple pathways where landscape resistance was minimized by the preservation of important core areas. Our results suggest that regional efforts to conserve and manage cougars should reflect the scale-dependent patterns of selection exhibited by this species. Our hope is that models such as ours will be used by Riverside County in the development of a multi-species habitat conservation plan to preserve areas for cougars and other sensitive species.

Hopkins, R.A., B.G. Dickson and B.H. McRae. 2008. Novel Spatial Tools for Connectivity Conservation: A Case Study Using Cougars in Southern California. Page 120 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

Additional management of cougars (*Puma concolor*) in North America focuses almost entirely on reducing conflicts with humans by reducing cougar populations – the kill strategy. While conservation is often mentioned or inferred within a statewide program to traditionally manage cougars, explicit strategies to achieve longterm conservation goals for the species are simply not discussed. There appears to be an overly simplistic presumption that as long as sport-take (or other control) efforts are sustainable, then conservation has been achieved. We argue that these "traditional kill strategies" not only do little to reduce conflict, but more importantly do little to conserve the species. In truth, the conservation of wide-ranging taxa depends critically on planning efforts that consider both habitat and connectivity needs of the target species. Fragmented landscapes that include expansive areas of urbanization can further complicate analyses and realistic conservation goals. Despite these challenges, contemporary efforts tend to rely on overly-simplistic decision rules and tools (e.g., GIS overlays, least-cost pathways, etc.). We believe the use of theoretically grounded spatial tools that permit a more integrated analysis of the landscape are needed in order to produce defensible land-use plans. We will present a suite of habitat and landscape connectivity models that were developed to better inform long-term conservation strategies for cougars in a highly fragmented region of southern California. The models were developed within the 35,000 km^2 study area using empirical and expert-based information to derive spatially-explicit models of core and dispersal habitats. These models were then integrated to predict important linkage zones among core areas using models from electronic circuit theory (i.e., Circuitscape), which predicts movement probabilities given the quality and configuration of dispersal habitat between core areas. Probabilistic model outputs were used to quantitatively compare the value of alternative pathways, and evaluate the implications of continued habitat loss and fragmentation. These results both illustrate an integrated approach to habitat conservation planning, and provide a framework to test a-priori hypotheses regarding animal movement. The portability of these principles can serve as a framework for long-term planning for this and other species in various regions in North America.

Horan, J. 1978. The Search for the Florida Panther. National Wildlife 16(4):36-39.

The tracks of two Florida panthers and panther scat were the only clues that were turned up during more than a month of searching the most likely panther areas of southern and central Florida. A seven member "panther recovery team" was appointed in 1976 by the federal government to improve the chances of survival of the Florida panther. Team estimates of panther numbers range from 10 or 15 to 100 or 200. Florida began paying bounties on the panther in 1832 and unrestricted hunting was allowed until 1950 and limited hunting until 1958. There is a possibility that captive breeding and release may be an integral part of the recovery effort, with the Everglades National Park receiving high priority for transplanted cats. Differing opinions of the team members are presented.

Hornocker, M.G., J.J. Craighead, and F.W. Pfeiffer. 1965. Immobilizing Pumas with Succinycholine Chloride and Pentobarbital Sodium. J. Wildl. Manage. 29:880-883.

Succinycholine chloride was administered intramuscularly to 13 mountain lions captured with the use of dogs in western Montana. The average for 19 different dosages was 1 mg/l7.4 pounds body weight. The average dosage for 12 adult lions in the wild (including 4 juveniles and 3 dosages for 2 lions brought in from the field and held in captivity) was 1 mg/13.1 pounds body weight. Two lions anesthetized with pentobarbital sodium, after initial immobilization with succinycholine chloride, received an average dosage of 10.9 mg/pound body weight. Succinycholine chloride is highly effective for immobilizing lions but should not be administered to treed animals that may be subjected to injurious or fatal falls.

Hornocker, M.G. 1967. An Analysis of Mountain Lion Predation Upon Mule Deer and Elk in the Idaho Primitive Area. Ph.D. Thesis, Univ. of British Columbia. 53pp.

This study was designed (1) to investigate the dynamics of a mountain lion population, and (2) to assess the impact of a population of lions on populations of big-game animals. The research was carried on in the Idaho Primitive area; intensive work was limited to the winter and early spring seasons. Lion population numbers were stable during the three-year study period, and available evidence indicates the present population level existed for some time prior to the start of the study. Intraspecific relationships, manifested through territoriality, acted to limit lion numbers and maintain population stability. Dispersal and mortality, particularly of young individuals, appeared to be important limiting mechanisms. The population was centered around a nucleus of mature individuals well-established on territories, but segments of the population were dynamic, exhibiting an inflow and outflow of individuals from season to season. These transients were composed predominantly of young animals. Strife appeared to be kept to a minimum by a "mutual avoidance" behavioral mechanism. Specific hunting territories were shared but appeared never to be used by more than one lion or family of lions at a time. Individuals, regardless of sex, appeared to respect that of another in a specific area. The "mutual avoidance" hypothesis is advanced as an important factor in the maintenance of lion populations. This mechanism provides for the distribution of lions in both space and time without costly fighting. It also appears to insure greater success in securing large prey animals. Population size of prey species--mule deer, elk, and bighorn sheep-- was established by making ground and aerial counts each year. Bighorn sheep numbers remained constant during the three-year period, but populations of deer and elk, the principal prey species, increased. The range was considered overstocked by deer and elk. Forty-four elk and 39 deer were recorded as definitely killed by lions during the three-year period. Only two kills of bighorn sheep were found; lion predation on this species appeared insignificant. Seventy-five percent of the elk killed by lions were 1½ years old or less and 9½ years or older; 57 percent of the deer kills were in these age classes. More "young" than "old" animals were killed. Lions were non-selective in their killing, except for "negative selectivity" in the case of a mature bull elk. Factors acting separately or collectively to increase prey vulnerability included prey density, behavior, age, health, inter- and perhaps intraspecific strife, and the lion's predatory characteristics. It was concluded that elk and deer populations were limited by the winter food supply and that predation by lions was inconsequential in determining ultimate numbers of elk and deer. Lion predation, however, is a powerful force acting to dampen and protract severe prey oscillations and to distribute ungulates on restricted, critical range. From the theoretical standpoint, it also appears to be a strong evolutionary force, acting to remove less fit individuals from the population. The effects and influence of such predation are considered of great significance in the maintenance of ecologic stability in wilderness environments.

Hornocker, M.G. 1969. Winter Territoriality in Mountain Lions. J. Wildl. Manage. 33:457-464.

This paper covers the first 4 years of a continuing study and reports on the preliminary findings concerning territoriality and its function in a mountain lion population in the Idaho Primitive Area in central Idaho. Forty-three different lions were captured and marked during four winter and early spring seasons. Thirty-one individuals were recaptured 89 times, making a total of 132 captures during the study. Nine resident adults, captured a total of 59 times, provided the bulk of data on home range and territoriality. Minimum size of the male's winter home range was constant from year to year, but it varied for females, depending upon their reproductive status. The smallest winter home range for a female during a single season was approximately 5 square miles and the largest was approximately 20 square miles. Males utilized larger areas and resident males occupied distinct winter territories without overlap while resident females shared some common areas. Male territories overlapped those of females. Lions exhibited a high degree of tolerant but unsocial behavior. No evidence of territorial defense was noted. Transient lions of both sexes moved freely through occupied territories. A mutual avoidance behavioral mechanism acted to distribute lions in both time and space. Visual and olfactory marks serve to facilitate avoidance between lions.

Hornocker, M.G. 1969. Stalking the Mountain Lion-to Save Him. Nat. Geographic 136:638-654. (Nov.)

The author and Wilbur Wiles had spent the previous five years in the Idaho Primitive Area tranquilizing, examining, weighing, marking, and releasing 46 different mountain lions, many again and again, to learn about their lives, movements, and habits. This article details the findings of this ongoing study.

Hornocker, M.G. 1970. The American Lion. Natural History 79(9):40-49, 68-71.

Authentic records of mountain lions exist from 47 of the 48 contiguous states and the District of Columbia. The author had for the previous six years studied cougars in an area encompassing 200 square miles in the Big Creek drainage basin at the center of the 1-1/4 million acre Idaho Primitive Area in central Idaho. Most of the research was conducted during the winter and spring, from November to May, when deep snows drive game animals as well as cougars to the lower elevations along major stream courses. Over the six year period, 51 different lions were captured, marked and released. Forty-four of them were released in the Big Creek study area. In all, 173 captures were made, the same animals captured several times during the course of the study. The lion population was stable, with 10 or less adults as full-time winter residents of the study area. These resident lions had firmly established territories. Females shared some areas, but males maintained rigid territories. Females had a minimum home range of 5 to 25 square miles and males 15 to 30 square miles. Strong territoriality was the primary factor which regulated mountain lion numbers. Mutual avoidance seemed to have evolved as a non-damaging means of spacing solitary lions. Although not common, cannibalism was documented and was considered an "internal" population control mechanism which operated when other checks were not effective. During the six-year period, five females produced 10 litters for a total of 25 kittens. Examination of 198 lion feces showed that deer and elk comprised 70% of the cougars winter diet. Of the elk killed, 75% were young (1.5 years or less) or old (8.5-9.5 years or more); 62% of the deer were young or very old. More adult males and fawns and calves were killed in proportion to their numbers in the total population. Availability of winter food, not mountain lion predation, was the key factor limiting elk and deer populations. Factors other than food supply controlled lion numbers. Territoriality limited the size of the lion population within the study area. Lions do lower the rate of increase of their prey before disease or starvation can take their toll. Lions also distribute prey species on restricted range which reduces overuse of the vegetation.

Hornocker, M.G. 1970. An Analysis of Mountain Lion Predation upon Mule Deer and Elk in the Idaho Primitive Area. Wildl. Monograph #21. 39pp.

The mountain lion population was stable during the five years that it was studied. Intraspecific relationships, manifested through territoriality, acted to limit numbers of lions and maintain population stability. Dispersal and mortality of young individuals appeared to be important limiting mechanisms. The population was centered around a nucleus of mature individuals well established on territories. Young transient lions entered and left the study area without apparent conflict. Numbers of bighorn sheep remained constant but populations of deer and elk, the principle prey species, increased and the range was considered overpopulated and over-browsed. Fifty-three elk and 46 deer were killed by lions during the four-year period, and only 2 bighorn sheep kills were found. Seventy-five percent of the elk killed by lions were less than 1.5 years old or more than 9.5 years old. Sixty-two percent of the deer killed were in those age classes. More "young" than "old" animals were killed. Fifty percent of all the elk and deer killed were considered in poor condition. Lions appear

to select young elk, select against mature bulls, and killed mule deer indiscriminately. Elk and deer populations were limited by the winter food supply, and predation by lions was inconsequential in determining ultimate numbers of elk and deer.

Hornocker, M.G., and J.C. Seidensticker IV. 1970. Population Dynamics and Predator-Prey Relations. Rep. to National Science Foundation. 40pp.

The objectives of this investigation were: 1) to instrument selected lions with radio transmitters within an established population to assess daily, weekly, and seasonal movements on both summer and winter ranges; 2) to collect information on territoriality in an attempt to gain further insight into specific mountain lion population dynamics; and 3) to obtain information on both winter and summer food habits and interpret the importance in the dynamics of both the lion and its prey populations. The work was not complete and no attempt was made to interpret the data presented.

Hornocker, M.G. 1971. Suggestions for the Management of Mountain Lions as Trophy Species in the Intermountain Region. Annual Proc. Western Assoc. of State Game and Fish Commissioners. 51:399-402.

OBSERVATIONS AND CONCLUSIONS:

(1) The mountain lion population has remained stable. This is accomplished by a fairly rigid social organization. The population is made up of resident adults, juveniles still with their mother, and transient (or non resident) adults.

(2) The density of lions is about one resident adult per 12-14 square miles in winter; this decreases greatly in summer when lions disperse from winter range.

(3) In general, the resident population is made up of approximately 50% adult females, 20% adult males, and 30% young-of-the-year.

(4) Resident females normally produce young at two-year intervals. Average litter size is 2.5.

(5) Resident females are essential to the maintenance of a population. Resident males are expendable if adjacent populations produce young which may become transient (or potential residents) on the area. These transient males may act as breeders for resident females.

(6) In the wilderness environment where the work was conducted, lions had little effect on ultimate numbers of mule deer and elk. Other factors acting separately or collectively acted to hold down ungulate populations. Winter food was believed the most critical, with weather an indirect factor.

(7) The evidence indicated that lion predation is actually beneficial to deer and elk populations. This is increasingly important in setting management objectives in any wilderness and semi-wilderness environment where these species interact.

Hornocker, M.G. and W.V. Wiles. 1972. Immobilizing Pumas with Phencyclidine Hydrochloride. Int. Zoo Ybk. 12:220-223.

This paper was presented as part of a long term ecological study of the puma and reports on dosages of phencyclidine hydrochloride administered to pumas captured during the study. All immobilizations occurred during the winter months utilizing trained dogs to capture the pumas. An average of 4.8 man-days of hunting and tracking were required for each capture. Fifty-one pumas were caught and marked over a six year period; thirty-two were recaptured 118 times, making a total of 169 captures during the study. Pumas were given intramuscular injections of Sernylan (phencyclidine hydrochloride) in aqueous solution, 100 mg per ml concentration.

RESULTS

A total of 89 dosages were administered and included 27 given to adult males, 27 to adult females, 16 to juvenile males, and 19 to juvenile females. Dosages for adult males and females averaged 1 mg of drug per 907 g (2 lb) body weight with a range of 1 mg per 372 g - 2kg (0.8-4.3 lb) in males and 453 g - 2.3 kg (1-5 lb) in females. Dosages for juveniles were heavier and averaged 1 mg per 538 and 509 g (1.3 and 1.2 lb) for males and females, respectively, with a range of 1 mg per 198-991 g (0.7 - 2.3 lb) in males and 198-679 g (0.7 - 1.8 lb) in females. The extremes in the ranges for both adults and juveniles were few- only one dosage in 27 adult males was heavier than 1 mg per 453 g (1 lb) and only one was lighter than 1 mg per 1.5 kg (3.5 lb). In juveniles, only 2 of 16 males and 2 of 19 females received a dosage heavier than 1 mg per 453 g (1 lb). The average time elapsed from the injection until pumas could be approached and managed was 10.6 minutes.

Hornocker, M.G. 1976. Cougars Up Close. Nat. Wildlife 14:43-47 (Oct.-Nov.)

The author's ten year landmark study of the cougar in the Idaho Primitive Area is presented. He and his associates have captured, examined, marked and released cougars over 300 times. Major findings included: 1) The lion population consisted of resident adults, juveniles still with their mothers and transient adults, (2) The lion population remained stable throughout the study due to a fairly rigid system of territorialism. Lions divided up the area and confined themselves mostly to their particular area, (3) In the wilderness area where the study was conducted, lions had little effect on deer and elk populations.

Hornocker, M.G., and G.M. Koehler. 1984. Reintroducing Orphaned Mountain Lion Kittens Into the Wild. Pgs. 167-169 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.

Two female and one male previously orphaned 6-7 month-old mountain lions were radio-collared and released back into a wild population to determine the feasibility. These kittens were captured prior to two months of age and weighed approximately 15 pounds. After 2½ months of secluded feeding they were released approximately 50 miles west of their capture site. The females weighed 44 and 48 pounds, and the male weighed 58 pounds at the time of release. The male had to be killed 28 days after its release because of a possible threat to personnel due to the animal returning to the field station where it was reared. This male had lost 14 pounds when killed and appeared to be starving. Radio contact was lost with one female a week after release and its carcass was found 35 miles northwest from the release point and the cause of death was undetermined. The other female had established a 14 square mile home range which centered 14 miles northeast of the release site and was still being monitored. It was believed that kittens younger than 6-7 months cannot survive on their own.

Hornocker, M. and T. Bailey. 1986. Natural Regulation in Three Species of Felids. Pgs. In: Cats of the World: Biology, Conservation and Management. S.D. Miller and D. Everett (eds.), Nat. Wildl. Fed., Wash. D.C.

Intrinsic regulatory mechanisms were documented in populations of three species of Felidae. In mountain lions (Felis concolor) and bobcats (Lynx rufus) a land tenure system which we have termed territorialism operating throughout the year acted to limit population density. In leopards (Panthera pardus) social behavior limited breeding density in a given area. These behavior systems, all in unexploited populations of long standing, operated with little strife. The authors submit that a highly evolved, peaceful social system has evolved for these species of cats. Such a system operates throughout the year and each individual's lifetime, not just seasonally.

Hornocker, M.G., K.M. Murphy, and J.W. Tischendorf. 1988. The Ecology of the Mountain Lion (Felis concolor missoulensis) in the North Yellowstone Ecosystem. Pg. 56 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 5-year study of mountain lion ecology in the Northern Yellowstone Ecosystem was initiated during winter 1987-88. Objectives include documenting population parameters, spatial relationships, predator-prey relationships, and the impacts of sport harvest. Predator control activities in and adjacent to Yellowstone National Park (YNP) from 1904 to 1925 reduced or eliminated lions from the study area. Lions existed at very low numbers from 1925 to 1980. Based on capture and telemetry information collected during 1987-88, a population with resident individuals is well established both within and adjacent to northern YNP. Fourteen lions were captured within YNP; 12 were instrumented with radio collars. Social

organization and spatial relationships appear similar to populations studied in Idaho, Montana, and Wyoming. The principal prey of lions within YNP during the winter was elk. Mule deer and small mammals were more important outside YNP where the availability of these items was greater than within. At least 5 adult female lions, 3 adult males, 5 kittens, and 1 orphaned male were present outside YNP. Mortalities to marked and unmarked lions included deaths to 1 orphan and 1 young adult by starvation, 3 adults to sport harvest (2 partially resident to YNP), and 2 kittens to unknown causes.

Hornocker, M.G., K.M. Murphy, and J.W. Tischendorf. 1988. Ecology of the Mountain Lion (Felis concolor missoulensis) in the Northern Yellowstone Ecosystem. Progress Rep., Wildl. Res. Inst., Moscow, Idaho. 30pp.

The objectives of this project were to: 1) document the social organization, structure, productivity, and mortality parameters of the population; 2) evaluate home range size, and daily and seasonal movements; 3) relate food habits, home ranges, and movements of mountain lions to topography and prey animal abundance and distribution; and 4) evaluate the impacts of sport harvest on the population trend, structure, and mortality of mountain lions in Paradise Valley. Preliminary data was not sufficient to draw any conclusions.

Hornocker, M.G., K.M. Murphy, and G.S. Felzien. 1991. The Ecology of the Mountain Lion (Felis concolor missoulensis) in the Northern Yellowstone Ecosystem. Progress Rep., Wildl. Res. Inst., Moscow, Idaho. 32pp.

The objectives of this project were to: 1) document the social organization, structure, productivity, and mortality parameters of the population; 2) evaluate home range size, and daily and seasonal movements; 3) relate food habits, home ranges, and movements of mountain lions to topography and prey animal abundance and distribution; and 4) evaluate the impacts of sport harvest on the population trend, structure, and mortality of mountain lions in Paradise Valley. Preliminary data was not sufficient to draw any conclusions. Three living panthers were of immediate concern. Land management practices and public use regulations that increase deer or hog populations and other non-contaminated prey could shift panthers away from contaminated prey species. Recommendations including management actions, testing actions, and source identification and elimination actions are presented.

Hornocker, M.G., K.A. Logan, L.L. Sweanor, J.F. Smith, and B.R. Spreadbury. 1991. Ecology of an Exploited Mountain Lion Population in a Desert Environment. Annual Rep., Proj. No. W-128-R-5, New Mexico Game and Fish Dept., Job 1. 41pp.

CONCLUSIONS AND RECOMMENDATIONS

During the past 71 months of research, 124 mountain lions have been captured, marked, and released. We handled those lions 212 times. We have fitted radio-collars on 60 lions (36 females, 24 males), and have located them 6,000 times. We have compiled data for 310 prey animals found on the study area and classified them as lion prey and probable lion prey (270), and prey that died of other causes (40). Research during the next 4 years will focus on documenting the changes in lion population dynamics and social behavior that result from the experimental removal, and documenting changes in the survival of desert mule deer and desert bighorns that may result in changes in the mountain lion population.

Hornocker, M.G. 1992. Learning to Live with Mountain Lions. National Geographic 182(1):38-65.

Mountain lions will never overgrow the countryside. They are very territorial and limit their numbers. The size of their territory is determined by the food supply. Lions kill deer and elk routinely, but most of their prey are very young or very old and are not of breeding age. Food supply, hunting, and weather determine deer and elk numbers. Every state with lions except Texas regulates the killing of lions. Consequently, lions have made an amazing comeback. A ten-year study led by Ken Logan and Linda Sweanor was initiated in the San Andres Mountains, an 80-mile-long range in the Chihuahuan Desert. The first five years (1985-90) were spent studying basic lion ecology. After determining the population dynamics were stable, 13 of the 20 resident lions in one-third of the study area were relocated to another part of the state, with the other sections left undisturbed. They wanted to document the rebuilding of the remaining lion population and wanted to know how the transplanted lions would react to their new location. In addition, it was important to document how the removal of such a major predator from the ecosystem would affect the cougar's main prey, the resident mule deer. Since 1985, a total of 148 lions had been marked and thousands of radiotelemetry observations have been made. The study area supported only 30 adult resident lions and 15 to 30 dependent kittens at any one time. Aggression was a major

difference between the lions of New Mexico and those of Idaho. In Idaho, both males and females lived peaceably, seldom fighting. In the San Andres, fighting- often to the death- is common. San Andres males also kill females and kittens. Another difference was that in New Mexico, kittens are born year-round and are usually independent by 14 months as opposed to Idaho where most kittens are born in spring and stay with their mothers for 18 to 20 months. After relocation of 11 adults and 2 subadults, one young male was found back home 4 months later in the San Andres Mountains which was a distance of 300 air miles. Four of these have settled in, two were killed by resident males, and two died from injuries sustained from hunting deer or elk. The remaining lions are wandering and continue to be monitored. Lion research in Yellowstone National Park, led by Kerry Murphy, provided an estimate that the northern Yellowstone region holds 18 resident adults. These cougars behave much like Idaho cats except that, as in New Mexico, kittens leave the mother earlier and much fighting occurs. California biologist Paul Beier examined records of unprovoked attacks in the United States and Canada between 1890 and 1990. Of the 53 documented attacks, nine were fatal. Thirty of the 53 attacks on humans occurred in British Columbia and twenty took place on Vancouver Island.

Hornocker, M.G., K.A. Logan, L.L. Sweanor, J.F. Smith, and B.R. Spreadbury. 1992. Ecology of an Exploited Mountain Lion Population in a Desert Environment. Annual Rep., Proj. No. W-128-R-7, New Mexico Game and Fish Dept. 38pp

CONCLUSIONS AND RECOMMENDATIONS

During the past 80 months of research, 154 mountain lions were captured and marked. We handled those lions 262 times. We fitted radio-collars on 79 lions (48 females, 31 males), and we have located them 78,000 times. We compiled data for 334 prey animals found on the study area and classified them as lion prey and probable lion prey (290), and prey that died of other causes (44).

Householder, B. 1960. The Mountain Lion. Arizona Wildlife and Sportsman 31:10.

Probably less than 300 lions are killed in Arizona each year, most by professional guides. The lion is the greatest predator in the west with each adult killing more than 3000 deer in their lifetime. Arizona is represented by at least three geographical races of lions: the Kaibab, the Brown or Yuma, and the Aztec, or Mexican. The Aztec (Felis concolor azteca) is the most common race in Arizona and ranges from the south rim of the Grand Canyon south to Guadalajara, Mexico. There are 30 subspecies of mountain lions in the New World and half of these are found in North America.

Howard, J.G., M. Bush, L.G. Simmons, and D.E. Wildt. 1984. Comparative Evaluation of Ejaculate Characteristics in Nondomestic Felids with Emphasis on Sperm Morphology. Proc. AAZV, Pgs. 168-170.

Detailed ejaculate traits for 28 species of nondomestic felids are presented. In general, they produced ejaculates with sperm concentrations (per ml of ejaculate) of $<300 \times 10^6$/ml with a wide range in sperm motility ratings with the majority of ejaculates containing relatively high proportions of morphologically abnormal spermatozoa. The mean total abnormalities/ejaculate ranged from 16.3 to 84.3%. Twenty-five of the 28 species averaged >30% pleiomorphic spermatozoa/ejaculate. Specific seminal traits for the puma from 7 ejaculates ranged from a volume of 1.9-6.5 ml; 40-85% motility, and 5-59 sperm/ml of ejaculate ($x10^6$). Spermatozoal morphology (mean values) consisted of 24.8% normal sperm, 75.2% abnormal sperm (25.7% primary and 49.5% secondary abnormality).

Howard, J.G., M.E. Roelke, J.L. Brown, A.E. Anderson, and M.A. Barone. 1992. Unique Male Reproductive Traits of the Florida Panther. Biol. Reprod. 46 (Suppl. #1):97, Abstract 187.

The Florida panther (Felis concolor coryi) is a severely threatened relict population of puma (also known as cougar or mountain lion) whose historic range included the Southeastern United States. Severe habitat destruction and human development have reduced the subspecies to < 50 animals living in the Big Cypress Swamp-Everglades National park ecosystems in southern Florida. The problem is exacerbated by recent findings demonstrating low genetic diversity within this subspecies, and without intervention, the Florida panther population has been predicted to be extinct within 25-40 years. The objectives of this study were to: 1) characterize reproductive traits in the male Florida panther; and 2) compare these data to other less threatened wild puma populations in North and South America and from captive pumas from unknown genetic origin. Testicular volume, semen traits and pituitary/gonadal hormones were measured in 5 puma populations: Florida (F. c. coryi, n=16); Chile (F. c. patagonica, n=2; F. c. puma, n=1); Colorado (F. c. hippolestes, n=7);

Texas (F. c. stanleyana, n=9); and North American zoos (F. c. spp., n=16). Seven of 16 (43.8%) Florida panther males were unilaterally cryptorchid compared to 1/35 (2.9%) in other puma populations. Overall, Florida panthers had lower ($P<0.05$) testicular volume, poorer ($P<0.05$) sperm progressive motility and more ($P<0.05$) morphologically-abnormal sperm (mean, 93.5%) than other populations. Florida panthers also demonstrated the highest ($P<0.05$) incidence of sperm with defects in the acrosome (>40%) and mitochondrial sheath (partial or complete aplasia; 75%). Transmission electron microscopy revealed discontinuities in the acrosome, extraneous acrosomal material under the plasma membrane and remnants of the golgi complex under the acrosome. No differences ($P>0.05$) were measured in mean circulating FSH, LH or testosterone between Florida panthers and other puma populations. Seminal traits and concentrations of FSH and LH were similar ($P>0.05$) between cryptorchid and non-cryptorchid Florida panthers, but cryptorchid males produced less ($P<0.05$) serum testosterone than non-cryptorchids. These results demonstrate that there are major physiological differences among populations of Felis concolor. Compared to other less-endangered puma subspecies, the Florida panther is distinguished by poorer sperm progressive motility and an extraordinary incidence of unilateral cryptorchidism and sperm acrosomal/mitochondrial defects.

Howard, W.E. 1988. Why Lions Need to be Hunted. Pgs. 66-68 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.

Biological facts rather than personal feelings should be used if we want to show genuine compassion for the welfare of the mountain lion. It is necessary for State Game Departments to use licensed hunters as predators to maintain healthy breeding populations of lions in remaining suitable lion habitat. Often ignored is the cruelty and suffering that occurs when surplus lion populations are left to their own population control devices. In disturbed environments people need to manage the plant and animal communities, not leave them to the whims of nature. The author believed that whenever a lion ventured beyond the geographic boundaries of its designated management range, it should automatically lose all protective status. In modified environments it is just as cruel to let mountain lions overpopulate as it is to stop harvesting cattle or sheep and let them die from starvation and disease. Current lion populations need to be harvested by people just as much as livestock, and hunting provides the best solution.

Howard, W.E. 1991. Mountain Lion and the Bambi Syndrome. Pgs. 96-97 In: Mountain Lion-Human Interaction Symposium, C.E. Braun (ed.), Col. Div. Wildl., Denver. 114pp.

In most modified environments, nature requires the assistance of human predators if many of the desirable species, including endangered species, are to be preserved in a healthy reproducing population. Surplus mountain lions can no longer use nature's way of regulating their numbers by dispersing from what now is often restricted mountain lion habitat, because people force these animals back to face territorial strife. Another essential reason for regulating mountain lion populations is to prevent serious conflicts from surplus mountain lions with livestock, pets, and humans. If the Bambi-ites do not condone mountain lion hunting, they must accept the responsibility for forcing an entire population to suffer the tragedies of population self-limitation by mountain lions rather than encourage that a few be harvested relatively humanely by hunters.

Hubbard, J. 1975. Felis concolor, Our Big and Mysterious Cat. New Mexico Wildlife. Jan/Feb.

The author draws heavily on Stanley Young and Edward Goldman's book, The Puma, Mysterious American Cat, for this account of the mountain lion. The name puma is from the language (Quechua) of the Incas of Peru. Pre-Columbian natives of lower California would locate a cache of prey hidden by the lion and eat from the carcass left by the cat. The lion was also eaten and it was reported that "it's flesh... was accounted the choicest which the wilderness afforded, not excepting even the tail of the beaver or more delicate morsels from the buffalo." The mountain lion was also revered by Indians in New Mexico and it is there that the only known shrine in the west exists. The shrine consists of a pair of lions, side by side, carved from native rock by the pre-Columbian ancestors of the present-day Cochiti Indians and preserved in Bandelier National Monument.

Husseman J.S., D.L. Murray, G. Power, C. Mack, C.R. Wenger and H. Quigley. 2003. Assessing Differential Prey Selection Patterns Between Two Sympatric Large Carnivores. Oikos 101(3):591-601.

Abstract

Several conceptual models describing patterns of prey selection by predators have been proposed, but such models rarely have been tested empirically, particularly with terrestrial carnivores. We examined patterns of prey selection by sympatric wolves (*Canis lupus*) and cougars (*Puma concolor*) to determine i) if both predators selected disadvantaged prey disproportionately from the prey population, and ii) if the specific nature and intensity of prey selection differed according to disparity in hunting behavior between predator species. We documented prey characteristics and kill site attributes of predator kills during winters 1999–2001 in Idaho, and located 120 wolf-killed and 98 cougar-killed ungulates on our study site. Elk (*Cervus elephus*) were the primary prey for both predators, followed by mule deer (*Odocoileus hemionus*). Both predators preyed disproportionately on elk calves and old individuals; among mule deer, wolves appeared to select for fawns, whereas cougars killed primarily adults. Nutritional status of prey, as determined by percent femur marrow fat, was consistently poorer in wolf-killed prey. We found that wolf kills occurred in habitat that was more reflective of the entire study area than cougar kills, suggesting that the coursing hunting behavior of wolves likely operated on a larger spatial scale than did the ambush hunting strategy of cougars. We concluded that the disparity in prey selection and hunting habitat between predators probably was a function of predator-specific hunting behavior and capture success, where the longer prey chases and lower capture success of wolf packs mandated a stronger selection for disadvantaged prey. For cougars, prey selection seemed to be limited primarily by prey size, which could be a function of the solitary hunting behavior of this species and the risks associated with capturing prime-aged prey.

Hutlet, J. 2005. The Cougar in Manitoba. Masters Thesis, Natural Resources Institute, University of Manitoba, Winnipeg, Manitoba.

Abstract

Due to the number of reported cougar sightings in Manitoba over many years, this study was undertaken to determine if experts believe that Manitoba can support a resident cougar population, and what laws and regulations can assist in protecting the cougar to ensure a stable population in the province. There have been many cougar sightings over the years, with one shot in 1973 and two killed in 2004, which confirms their existence in Manitoba. The cougar is a protected species under The Wildlife Act in Manitoba, but is not listed under the Endangered Species Act at this time. Although the Manitoba Endangered Species Advisory Committee recommended a status for the cougar as Vulnerable on 28 September 1992, this designation was not acted upon. The Wildlife Act protects the cougar against hunting, trapping, taking, killing, or capturing except as permitted by the Act or the regulations. The Manitoba Conservation Data Centre (CDC) lists the cougar as S2S3- halfway between S2 (rare throughout its range in Manitoba and may be subject to extirpation) and S3 (uncommon in the province). This study determined some of the factors that could better protect the cougar in Manitoba by analyzing expert opinions dealing with quality cougar habitat, and by suggesting management ideas for the safety and well-being of both the cougar and human population. Opinions on these matters were gathered from both Canadian and United States cougar experts and Manitoba habitat specialists using the Delphi method. This is a survey technique in which specific questions are posed to experts in the field to determine their opinions. Experts do not have contact with each other. The results are assessed and further questions on the matters are re-mailed to them for further discussion with hopes that a consensus can be reached. The Delphi method was successful in developing and identifying many issues, such as determining criteria for resident versus migrating cougars, corridor importance, habitat availability, and the importance of protective laws. The Delphi method proved most beneficial in areas where each panel had expertise and where the panel member was asked to answer specific, single-dimensional questions. After combining their testimonies, it was determined that Manitoba has sufficient habitat, corridors and prey to support a resident cougar population. However, monitoring and protection in these areas will be needed to ensure a future cougar population. It was also determined that although present laws protect the cougar in Manitoba to some degree, improved legal proposals, provincial initiatives, cooperation by landowners, citizen awareness, and ongoing research are all important factors for ensuring future cougar survival in Manitoba.

Ingles, L.G. 1939. In Defense of the Lion. American Forests 45(I):21-22.

Field naturalists, lion hunters, and authorities on mountain lions have never heard the cat scream and this claim appears to be fictitious. Also refuted is the lion's supposed propensity for attacking humans. Only a few authenticated cases of attacks exist and it was thought that the lion prefers almost any other kind of flesh to that of human beings. Domestic animals comprise less than 2% of the prey taken by lions. Scientists and expert lion hunters agree that the lion does not

distinguish between healthy and weak deer and kills whatever it can. However, a study of 11 deer examined that were killed by cougars in New Mexico showed that all of them were found to be abnormal and this was evidence that lions do eliminate the sick and diseased individuals. It seemed more sensible to authorize local lion control and place the lion on the list of large game animals.

Ingram, R. 1984. Oregon-Cougar Status Report. Pgs. 53-55 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 declared a game animal in 1967. The general feeling is that the population of mountain lions is continuing to expand and has increased substantially from pre-1970 levels. Harvest data for five years (1979-83) is provided. A total of 817 permits were authorized with 423 hunters taking a total of 198 lions.

Iriarte, J.A. 1988. Feeding Ecology of the Patagonian Puma (Felis concolor patagonica) in Torres del Paine National Park, Chile. M.A. Thesis, University of Florida, Gainesville.

The puma (Felis concolor) has the most extensive range of any terrestrial mammal in America. The focus of this paper is on the feeding ecology of the southernmost subspecies of puma, the patagonian puma, F.c. patagonica, in Torres del Paine National Park, Magallanes region, Chile. This study analyzes the seasonal variation and the spatial use of prey by the patagonian puma in the study area, based on 630 individual prey items that were found in 409 puma feces and in six puma stomachs. Mammalian species accounted for almost 92% of all items present in the puma feces and stomachs. The European hare (Lepus capensis) was the most common vertebrate prey item found in the puma diet, representing 51% of items in the puma feces. The guanaco (Lama guanicoe) represented 22% of frequency of occurrence of prey in the puma feces, although this species accounted for 64% of the total biomass consumed by pumas. Between 1975 and 1988 the guanaco population in the study area has increased from 100 to over 1,500 individuals. This increase could explain why the proportion of guanaco remains in puma feces increased from 7.6% to almost 24% between data collected by Yanez and his associates in 1983-84 and this study's 1987-88 data. Yearling and juvenile guanacos were taken more than expected from their abundance on the field by pumas, representing 65% of the puma-killed guanacos. Guanaco inhabiting areas of low guanaco density had life expectancies three times higher than those in areas of high guanaco density (94 vs. 32 months). The only livestock species found in the puma diet was sheep, representing 5% and 25% of the total prey found in feces and stomachs, respectively. The occurrence of guanaco and sheep in puma feces appears to be strongly correlated with their abundance in different areas of the park. Finally, North America ungulates (especially deer) represented 76% of the puma's diet, contrasting with 38% found in Central and South American studies. Mean weight of vertebrate prey (MWVP) values appeared positively correlated (r=0.875) with puma body weight and inversely correlated (r=-0.836) with food niche breadth in all America. In general, MWVP's values were lower in areas closer to the Equator. On the other hand, the occurrence of guanaco and sheep in puma feces appears strongly correlated with their respective abundances in each areas recognized within the park. In areas with the highest guanaco densities, their representation in the puma feces was the highest in the study area.

Iriarte, J.A., W.E. Johnson, and W.L. Franklin. 1988. Feeding Ecology of the Patagonian Puma (Felis concolor patagonia) in Torres Del Paine National Park, Chile. Pg. 53 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.

This paper focuses on the ecology of the southernmost subspecies of puma, the patagonian puma, Felis concolor patagonia in Torres del Paine National Park, Magallanes region, Chile. There are numerous studies on the feeding ecology of puma in the temperate and sub-tropical areas of North America, but few studies have been done in Neotropics. Despite the fact that the puma inhabits almost all of the Neotropical region, within this region it has only been studied in the northern parts of Mexico, in the Pantanal region in southern Brazil, in Manu National Park, Peru, in southern Chile, and in the chilean patagonia. Field studies were conducted at Torres del Paine National Park (51 degree's 3'S, 72 degree's 55'W) in the Ultima Esperanza province, Chile on the eastern foothills of the Andes and on the western edge of Patagonia. The 240,000 hectare park extends from glacier-covered mountains to desert- grasslands of Patagonia. Elevations range from 100 to 3,000 meters. The steppe biome is represented by the characteristic pampa grassland of the southern part of South America, which is extensive in both Chile and Argentina at elevations below 500 meters. This study analyzes the seasonal variation and the spatial use of prey by the patagonian puma in the study area, based on six-hundred and thirty individual prey items that were found in 409 puma feces and in six puma stomachs. Mammalian species accounted for

almost 92% of all items present in the puma feces and stomachs. The European hare (Lepus capensis) was the most common vertebrate prey item found in the puma diet, representing 51% of items in the puma feces. The guanaco (Lama guanicoe) represented 22% of frequency of occurrence of prey in the puma feces although this species accounted for 64% of the total biomass consumed by pumas. Between 1975 and 1988 the guanaco population in this study area has increased from 100 to over 1,500 individuals. This increase could explain why the proportion of guanaco remains in puma feces increased from 7.6% to almost 24% between 1986 and 1987-88 data. Yearling and juvenile guanacos were taken more than expected from their abundance on the field by pumas, representing 65% of the puma-killed guanacos. Guanaco inhabiting areas of low guanaco density had life expectancies three times higher than those in areas of high guanaco density (94 vs 32 months). The only livestock species found in the puma diet was sheep, representing 5% and 25% of the total prey. Guanaco and sheep in puma feces appear to be strongly correlated with their abundance in different areas of the park. Finally, in North American ungulates (especially deer) represented 76% of the puma's diet, contrasting with 38% found in Central and South American studies. Mean Weight of vertebrate prey (MWVP) values appeared positively correlated with puma body weight and inversely correlated with food niche breadth along the Americas. In general, MWVP's values were lower in areas closer to the Equator.

Iriarte, J.A., W.L. Franklin, W.E. Johnson, and K.H. Redford. 1990. Biogeographic Variation of Food Habits and Body Size of the American Puma. Oecologia 85:185-190.

SUMMARY

The puma (Felis concolor) has the most extensive range of any terrestrial mammal in the Western Hemisphere, covering 100 degrees latitude. Food habits of different puma subspecies vary with latitude. Subspecies from temperate habitats generally eat larger prey and specialize on a smaller number of prey taxa, whereas, in tropical habitats, they prey on smaller, more varied prey. In North America, ungulates (primarily deer) represented 68% of the puma's diet by frequency of occurrence. Mean weight of vertebrate prey (MWVP) was positively correlated (r=0.875) with puma body weight and inversely correlated (r=-0.836) with food niche breadth in all America. In general, MWVP was lower in areas closer to the Equator. Patterns of puma prey selection are probably influenced by prey availability and vulnerability, habitat characteristics, and potential competition from the jaguar (Panthera onca).

Jackson, C.F. 1922. Notes on New Hampshire Mammals. J. Mammal. 3:13.

A pair of cougars were discovered whose range extended along the east side of the Androscoggin River in the town of Cambridge to the southern shores of Lake Umbagog. A specimen was taken in the White Mountains in 1885 which is the last record the author had for the state. The latest Vermont record was reported as being 1894, and that of Maine was 1906.

Jackson, H.H.T. 1955. The Wisconsin Puma. Proc. Biol. Soc. Washington 68:149-150.

Upon critical examination of a dismounted specimen skull of a puma, it was found that the specimen represented an undescribed subspecies that inhabited the upper Mississippi Valley and Western Great Lakes region. The subspecies was named Felis concolor schorgeri after Dr. A. W. Schorger, professor of Wildlife Management at the University of Wisconsin. The type specimen, locality, geographic range, diagnostic characters, measurements, and specimens examined are listed.

Jalkotzy, M., O. Pall, and H.D. Carr. 1983. The 1982-83 Cougar Hunt in Alberta. Energy and Natural Resources, Fish and Wildl. Div., Calgary, Alberta, Canada.

The results of the 1982-83 cougar hunt and harvest in Alberta were summarized from compulsory registration forms. Cougar skulls submitted by successful cougar hunters were aged. Cougar license sales in 1982-83 were 18% lower than the annual average of 154 between 1977 and 1981 probably because of poor snow conditions during the winter season (with dogs). Twenty-one legally killed cougars were registered, representing a 17% success rate. This harvest was 32% less than the annual average of 31 between 1973 and 1981. Fifty-seven percent of the harvest was recorded south of the Bow River. The sex ratio of the legal registered harvest was 1 female: 2.3 males, a reversal from the 2 previous years when more females were harvested than males. The majority of the 16 skulls aged were prime adults (56%) while subadults and young adults represented 31% and 13%, respectively. One adult male cougar qualified for Boone and

Crockett trophy status. Preliminary analysis of the stomach contents of 27 cougars taken in 1981-82 and 1982-83 indicated that cervids made up the bulk of their diets (67% occurrence), whereas beaver (22%) and porcupine (19%) were of secondary importance.

Jalkotzy, M., O. Pall, J. Kansas and H. D. Carr. 1984. The Population Status of Cougars Near Sheep River, Alberta, 1983-84. 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 to help formulate a Provincial cougar management plan, a capture and radio tracking study commenced in March, 1982. The 750 km^2 core study area (the area regularly searched) was located 40 km southwest of Calgary in the Sheep River vicinity. By 30 April 1984, 28 cougars had been captured 41 times and radio collared despite very poor searching conditions and unseasonably mild winters. The mean weight for 7 adult females was 46 kg. For 5 adult males, it was 70. 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 for 28 collared cougars. The average size of the areas traveled for at least 1 complete year by 8 resident female cougars was 259 km^2. For the single adult male collared for more than 1 year, the size was 454 km^2. Field work had not progressed to the point that confident population densities could be determined. Legal hunting accounted for all 3 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.

Jalkotzy, M.G., and P.1. Ross. 1988. Cougar Hunting Regulations and Harvest in Alberta Between 1973 and 1987. Pg. 6 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 license and mandatory registration of all cougar kills has been required in Alberta since 1973. Hunting seasons have been reduced substantially since 1973. An average of 30 cougars were harvested each year between 1973 and 1987. Between 1978 and 1987, adult males and juvenile males comprised 31% and 16%, respectively, of the harvest. It appeared that cougar hunters select for male cougars in Alberta. Variability in harvests appeared to be often linked to differences in snow conditions. Ease of motorized access seemed to play an important role in where harvests were concentrated.

Jalkotzy, M.G., and P.I. Ross. 1988. Population Ecology of Cougars in Southwestern Alberta. Pg. 47 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.

Sixty-two cougars were captured 109 times in and around the 780km^2 study area. Home ranges of 14 adult females averaged 158km^2 compared to a variable range of 232.3km^2 to 1031.4km^2. Home ranges of females traveling with kittens were significantly smaller than that of lone females. Probably due to a non-migratory prey base, winter and summer home range boundaries were not appreciable. Overlapping of female home ranges was variable and sometimes extensive, while males overlapped less. Twenty-three litters were documented between 1981 and 1988. Litter size averaged 2.2 between 4 and 6 months of age and the sex ratio favored females 1.3 to 1.0. Births predominated during spring and summer and peaked in August. Juveniles became independent at an average age of 15 months with mean dispersal age at 16 months. Humans were the main source of mortality of the cougars radio-collared on the study area with 14 of 23 being shot. The total population of cougars in the study area was estimated at 30-32 in 1985-86, and 35-37 in 1988. Resident adults comprised 43-61% of the population and dependent kittens and juveniles comprised between 22-49%. Density estimates varied from 2.7 to 4.1 cougars/100 km^2 between 1984 and 1986.

Jalkotzy, M. and I. Ross. 1991. The Sheep River Cougar Project-Phase III, Cougar/Prey Relationships. Progress Report 1990-1991. Arc Associated Resource Consultants Ltd., Calgary, Alberta.

EXECUTIVE SUMMARY

Phase III of the Sheep River Cougar Project was initiated in 1989 to investigate the relationship between cougars and their prey in the Sheep River study area. This report summarizes the results of the second year of the scheduled three year project. In 1990-91, 215 man-days were spent in the field. Nine captures were made. Since the study's inception in 1982, 84 different cougars have been captured 150 times. Collared cougars were radio tracked on the ground for 194 man-days and 186 ground radio telemetry locations were logged. All portions of the study area were occupied by male and female resident cougars. Resident males occupied larger home ranges than resident females. The large turnover of resident cougars in the study area during 1990 and 1991 resulted in several shifts in home range boundaries. The resident adult population in the study area numbered 15 to 16, a decline of 2 resident females from 1990. The number of independent juveniles and subadults in the population increased from an estimated 4 in 1990 to 9 in 1991. The estimate of independent cougars in the study area in 1991 was 24 to 25, up slightly from 1990. When the 17 dependent young were added, there were about 41 to 42 cougars in the study area in March 1991. Fifty-nine kills made by cougars were identified in 1990-91. Mule deer (61%), white-tailed deer (19%), elk (7%), moose (10%), and bighorn sheep (2%) comprised 58 of the 59 kills. Two large ungulates, a cow moose and a cow elk, were scavenged. Twelve predation sequences involving 58 kills were recorded for 1 male and 7 female cougars between early January and mid-April, 1991. Cougars appear well adapted to a feast and famine feeding regime. Females with young tended to kill more frequently than solitary females. However, predation rates were extremely variable within all reproductive classes. The number of days between leaving a kill and making another varied from 0 to 23 days; 10 days between consecutive deer kills by adult females with kittens or juveniles was not uncommon. However, while they were on kills, cougars gorged. A mule deer fawn was usually completely consumed in 3 to 4 days by a solitary female. Snow tracking between kills indicated that small prey were an insignificant source of winter food for cougars in the study area. Fieldwork in 1991/92 will continue to be oriented towards the collection of cougar/prey relationships data. Most of our efforts will be expended collecting predation rate data from radio collared cougars.

Jalkotzy, M. and I. Ross. 1992. The Sheep River Cougar Project-Phase III, Cougar/Prey Relationships. Progress Report 1991-1992. Arc Associated Resource Consultants Ltd., Calgary, Alberta.

EXECUTIVE SUMMARY

Phase III of the Sheep River Cougar Project was initiated in 1989 to investigate the relationship between cougars and their prey in the Sheep River study area. This report summarizes the results of the third year of the scheduled three year project. Since the project has been extended for 2 additional years, a final report will not be completed until after the fifth year. In 1991-92, 276 man-days were spent in the field. Four captures were made. Since the study's inception in 1982, 87 different cougars have been captured 154 times. Collared cougars were radio tracked on the ground for 267 man-days and 194 ground radio telemetry locations were logged. Sixty-six kills made by cougars were identified in 1991-92. Mule deer (72%), white-tailed deer (8%), elk (8%), moose (2%), and bighorn sheep (2%) comprised 60 of the 66 kills. In addition, 3 beaver, 2 snowshoe hare, and 1 ruffed grouse were killed. No instances of scavenging were recorded. When converted to biomass, the small prey items represented <1% of all that was consumed. Eight predation sequences involving 57 kills were recorded for 5 female cougars between early December 1991 and early April, 1992. Young-of-the-year ungulates were important components of the winter diets of radio collared cougars. Twenty (38%) of the 52 deer killed by cougars were fawns. In addition, the 1 moose taken and 3 of the 5 elk killed were calves. All portions of the study area continued to be occupied by male and female cougars, as has been the case in previous years. The poor snow conditions experienced during the 1991-92 winter made finding cougar tracks a rare event. Because of this, an estimate of the size of the study area population was not made in 1992. At least 10 litters totaling 20 kittens were traveling with females in and around the study area during 1991-92. Two litters were traveling with unmarked females; the other 8 accompanied radio-collared females. Two of the 8 litters were of juveniles that had been initially documented in 1990-91, while the other 6 litters were <1 year old. Four cougars, 3 males and 1 female, were shot legally in the study area during the 1991-92 hunting season. None of these cougars was marked. Four marked cougars were shot outside the study area; all were male dispersers from earlier litters of radio-collared females in the study area. Fieldwork in 1992-93 will continue to be oriented towards the collection of cougar/prey relationships data. Most of our efforts will be expended collecting predation rate data from radio collared cougars.

Jalkotzy, M. and I. Ross. 1993. The Sheep River Cougar Project-Phase III, Cougar/Prey Relationships. Progress Report

1992-1993. Arc Associated Resource Consultants Ltd., Calgary, Alberta.

EXECUTIVE SUMMARY

Phase III of the Sheep River Cougar Project was initiated in 1989 to investigate the relationship between cougars and their prey in the Sheep River study area. This report summarizes the results of the fourth year of the scheduled five year project. A final report will be completed in 1994. In 1992-93, 102 days and 203 man-days were spent in the field. Two captures were made. Since the study's inception in 1981, 87 different cougars have been captured 156 times. Collared cougars were radio tracked on the ground for 100 days and 154 ground radio telemetry locations were logged. An average of 37 ground radio locations (range 30-44) was collected during the field season (Dec.-Apr.) for each of the 4 cougars which were subjects of the predation study in 1992-93. Forty-two kills made by cougars were identified in 1992-93. Mule deer (55%), white-tailed deer (2%), moose (19%), and bighorn sheep (19%) comprised 40 of the 42 kills. In addition, 2 snowshoe hares were killed. When converted to biomass, small prey items represented <1 % of all that was consumed. Seven predation sequences involving 40 kills were recorded for 1 male and 3 female cougars between early December 1992 and early April 1993. Three instances of scavenging were recorded. All portions of the study area continued to be occupied by male and female cougars, as has been the case in previous years. Excellent snow conditions resulted in 4,013 km of trails searched for cougar tracks during the winter. Because the radio-collared cougars used in the predation study were centrally located in the study area, the area searched intensively for cougar tracks was smaller than in previous years. There were at least 10 adult females including at least 7 residents living in this area; 5 of the residents were radio collared. There were 6 kittens travelling with resident females in the area searched. In addition to 1 radio-collared resident male, there were 3 other adult males identified during track searches. Since their tracks were seen on a number of occasions, they were considered residents. Tracks of young transient males were seen on 6 occasions. At least 9 litters totalling 10-12 kittens were travelling with females in and around the study area during 1992-93. Two litters were travelling with unmarked females; the other 7 accompanied radio-collared females. Four cougars, 3 males and 1 female, were shot legally in the study area during the 1992-93 hunting season. None of these cougars was marked. Natural mortalities accounted for at least 4 and probably 5 cougars in the study area in 1992-93. Two or 3 kittens were killed by male cougars, 1 kitten was killed by wolves and a young adult female died of unknown natural causes. One marked male disperser was shot during the hunting season 117 km north of his maternal home range. In addition, a radio-collared adult female that disappeared from the study area as a young adult in 1986, was snared 266 km to the north. She was 9 years old. Fieldwork in 1993-94 will continue to be oriented towards the collection of cougar/prey relationships data. Most of our efforts will be expended collecting predation rate data from radio-collared cougars.

Jalkotzy, M. and I. Ross. 1995. Cougar Responses to Human Activity at Sheep River, Alberta. Arc Wildlife Services Ltd., Calgary. 31pp.

EXECUTIVE SUMMARY

The goal of the Sheep River Cougar Project in summer 1994 was to acquire a better understanding of the effects of human activity on the activity and movements of cougars in the Sheep River drainage. The study area is located on the Eastern Slopes of the Rocky Mountains, southwest of Calgary, Alberta at approximately 50 degrees 39' N, 114 degrees 38' W. Human use of the study area was primarily confined to Secondary Road 546 and a network of equestrian and hiking trails. Intensive radio-tracking data collected from radio-collared cougars in summer 1994 were compared with telemetry data from the same cougars during winter 1993 and 1994. In addition, comparisons were made between radio-collared cougars which used the S.R. 546 corridor and those that did not during the summer months. Four radio-collared female cougars were intensively tracked in the Sheep River study area. Forty-four days were spent in the field and 213 radio telemetry locations were collected for F25, F73, F84, and F86. These included 21 radio locations which were collected during aerial telemetry flights between 19 and 24 September. Cougars in the Sheep River study area appear well-adapted to the level of human activity that occurs there during the summer. In summer 1994, radio-collared cougars did not abandon core home ranges along S.R. 546 solely to avoid contact with humans. Cougars whose summer home ranges overlapped with a 2-km wide corridor centered on S.R. 546 did not prefer or avoid corridor land. Although radio-collared cougars were recorded moving throughout the day in the study area, they were more active between late afternoon and early morning than during the mid-afternoon hours. Radio-collared cougars crossed roads and trails more often between late afternoon and early morning. Human activity in localized areas did not deter radio-collared cougars from entering the immediate vicinity in some cases. Cougars may be more sensitive to disturbance at kill sites than when they are traveling. Levels of

human activity in the Sheep River study area in the summer were variable and discontinuous. Campgrounds which were full on weekends were empty during cold, rainy weekdays. S.R. 546 was busy with vehicles on weekends and generally less so during the week. Other studies indicate that the cougar's tolerance of different types of human disturbance, particularly disturbances that are continuous, may be less than what we recorded in the Sheep River study area.

Jalkotzy, M.G., P.I. Ross and J. Wierzchowski. 2003. Regional Scale Cougar Habitat Modelling in Southwestern Alberta, Canada. Page 62 *in* L. A. Harveson, P. M. Harveson, and R.W.Adams, eds. Proceedings of the Sixth Mountain Lion Workshop. Austin. Texas.

Abstract

Regional scale habitat modeling for cougars (Puma concolor) has not been described in the Canadian Rockies. We developed habitat models using radio-telemetry data (n = 2,172) collected in the foothills of the Rocky Mountains in southwestern Alberta between 1981 and 1989. We constructed radio-location density maps for male and female cougars during winter and non-winter periods. Higher radio-location densities were assumed to represent areas of higher quality cougar habitat. Radio location density classes and the locations of kills were quantitatively defined in terms of a variety of environmental and human attributes. Significant attributes associated with high radio-location densities for both males and females in both winter and non-winter periods included lower elevations, increased terrain ruggedness, heavier stalking cover, and greater distances from high-use human features. Kills were found at lower elevations, closer to good prey habitat, and in areas with greater terrain ruggedness than would be expected by chance. The results of our modeling are being used in the development of a comprehensive conservation strategy for carnivores in the Rocky Mountains of the U.S. and Canada.

Janis, M.W., J.D. Clark and C.S. Johnson. 1999. Predicting Mountain Lion Activity Using Radiocollars Equipped with Mercury Tip-Sensors. Wildl. Soc. Bull. 27(1):19-24.

Abstract

Radiotelemetry collars with tip-sensors have long been used to monitor wildlife activity. However, comparatively few researchers have tested the reliability of the technique on the species being studied. To evaluate the efficacy of using tip-sensors to assess mountain lion (Puma concolor) activity, we radiocollared 2 hand-reared mountain lions and simultaneously recorded their behavior and the associated telemetry signal characteristics. We noted both the number of pulse-rate changes and the percentage of time the transmitter emitted a fast pulse rate (i.e., head up) within sampling intervals ranging from 1-5 minutes. Based on 27 hours of observations, we were able to correctly distinguish between active and inactive behaviors >93% of the time using a logistic regression model. We present several models to predict activity of mountain lions; the selection of which to use would depend on study objectives and logistics. Our results indicate that field protocols that use only pulse-rate changes to indicate activity can lead to significant classification errors.

Janis, M.W. and J.D. Clark. 2002. Responses of Florida Panthers to Recreational Deer and Hog Hunting. J. Wildl. Manage. 66(3):839-848.

Abstract

Big Cypress National Preserve constitutes approximately one-third of the range of the endangered Florida panther (Puma concolor coryi). Because recreational hunting is allowed in Big Cypress National Preserve, we examined 8 response variables (activity rates, movement rates, predation success, home-range size, home-range shifts, proximity to off-road vehicle trails, use of areas with concentrated human activity, and habitat selection) to evaluate how Florida panthers respond to human activity associated with deer and hog hunting. Data consisted of panther radiolocations collected since 1981 by the Florida Fish and Wildlife Conservation Commission and the National Park Service, which we augmented with radiolocations and activity monitoring from 1994 to 1998. A split-plot (treatment and control) study design with repeated measures of the variables for each panther taken before, during, and after the hunting season was used. We did not detect responses to hunting for variables most directly related to panther energy intake or expenditure (i.e., activity rates, movement rates, predation success of females; $P > 0.10$). However, panthers reduced their use of Bear Island ($P = 0.021$), an area of concentrated human activity, and were found farther from off-road vehicle trails ($P \leq 0.001$) during the hunting season, which was indicative of a reaction to human disturbance. Whereas the reaction to human activity on off-

road vehicle trails probably has minor biological implications and may be linked to prey behavior, the decreased use of Bear Island is most likely a direct reaction to human activity and resulted in increased use of adjacent private lands. Future habitat loss on those private lands could exacerbate the negative consequences of this response by panthers.

Jansen, D. 2003. Florida Panthers in a Wetland Ecosystem. Page 62 *in* L. A. Harveson, P. M. Harveson, and R.W.Adams, eds. Proceedings of the Sixth Mountain Lion Workshop. Austin. Texas.

Abstract

Pumas (Puma concolor) demonstrate a wide degree of adaptability in the diverse habitats they occupy. Today, a large portion of the Florida panther's (P.c. coryi) range is the wetlands found in Big Cypress National Preserve, and they are thriving in it. These wetlands were spared because they were less favorable for agriculture and urban development and now are a unit of the National Park Service. Some researchers have mischaracterized all but the northern portion of Big Cypress as unsuitable for panthers. Critics stated that it was a "population sink" and, at best, could support only a transient population, due to its sparse forest cover, nutrient-starved soils, and the resultant poor prey base. Although there was not a reproducing population in this area for many years, the primary causes weren't inherent in the ecosystem, as demonstrated by the panthers' positive response to a variety of management actions. Steps taken to lessen human impacts included the elimination of hunting deer with dogs and a reduction in the number of backcountry camps. The most important measure taken was the introduction of Texas mountain lions in 1995 to address the negative effects of inbreeding depression. Since then, the population in southern Big Cypress has gone from 2 to 20. The expanding panther population was sustained by a corresponding expansion in the deer herd. Deer responded to a longer wet season that increased nutritious wetland forage. As the wetlands got wetter, the panthers did better.

Jansen, D.K., and R.T. McBride. 2008. The Land of the Living Dead Comes Alive: The Florida Panther in Big Cypress. Page 189 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

Ten years ago, a major portion of Big Cypress National Preserve (BCNP), a unit of the National Park Service in south Florida, was described by Florida panther (*Puma concolor coryi*) experts as an area of unsuitable habitat for panthers and their prey. Portrayed as a “population sink”, there was opposition to include BCNP as a reintroduction site in the Florida panther genetic restoration project, which in itself was opposed by some experts in the field. Research and monitoring conducted on both the panther and its prey since then have shown that this 217,000-ha area supports a thriving panther population and that factors other than habitat quality accounted for the scarcity of panthers in the 1980s. With the ongoing development of private lands in south Florida, BCNP and the adjacent public lands are becoming the core habitat remaining for panthers. This paper points up the dangers of premature conclusions when data are scant, especially when it might impact agency decisions on the recovery of an endangered species.

Jenkins, J. H. 1971. The Status and Management of the Bobcat and Cougar in the Southeastern United States. Pgs. 87-91 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.

Several recent sight records in Alabama, Georgia, and South Carolina by competent biologists were reported. The cougar had long been wiped out in Maryland. Cougars are absent in Kentucky as well, although there was a vague record of one killed near Central City around 1960, which may have escaped from a roadside zoo. Although there are no substantial records of the cougar in the past 10 years in Virginia, a ranger reported sighting a cougar in 1970, but no tracks or scrapes have been found. There were no verified recent sightings or records of the cougar in North Carolina, but persistent sight records come in from the extreme Western mountains and the Eastern coastal counties. There was a flurry of cougar rumors in coastal South Carolina about 15 years earlier, but none were verified by tangible evidence. A cougar was sighted in 1964 by a game biologist on the Savannah River Project in west-central South Carolina. Another cougar was sighted by a wildlife biologist near Allendale, South Carolina, south of the Savannah River Project in 1955. Georgia has more than its share of cougar sight records, but these have been investigated without success. The author reported seeing a photo of a cougar kill made within a few miles of the Georgia line in eastern Alabama. The last record of specimens seems to have been in the 1920's when they were reasonably common in the Okefenokee Swamp. The

population in Florida was considered between 50 and 100. There are valid recent records in Alabama. Plaster casts of two tracks were verified from Clarke County in 1961. A cougar kill was recorded in 1948 and in 1956 by a game biologist on the Upper State Game Sanctuary. There were recent cougar specimen records for both Louisiana and Arkansas. Specimens were taken in 1966 (DeSoto Parish) and 1970 (Vernon Parish) in Louisiana, and one taken by deer hunters in 1969 near Hamburg, Arkansas just across the Louisiana line. Another specimen was reported around 1967 from Caddo Parish, Louisiana. Cougars were apparently present in both states in very low numbers.

Jessup, D.A., K.C. Pettan, L.J. Lowenstine and N.C. Pedersen. 1993. Feline Leukemia Virus Infection and Renal Spirochetosis in a Free-Ranging Cougar (Felis concolor). J. Zoo Wildl. Med. 24(1):73-79.

A young adult male free-ranging cougar (Felis concolor) was removed from a college campus in Sacramento, California. Blood samples taken shortly after capture revealed it to be anemic, lymphopenic, suffering from renal disease, and feline leukemia virus (FeLV) antibody positive. The animal was euthanized. On postmortem examination, generalized lymphadenopathy and lymphoproliferative disease were noted. FeLV was isolated in cell culture and demonstrated within lymph nodes and salivary glands by immunohistochemistry. Bilateral subacute tubulointerstitial nephritis was also noted, and silver staining revealed spirochetes. This is the first case report of FeLV infection of a free-ranging wild felid in North America.

Johnson, A.S. 1988. Arizona's Beleaguered Lions. Defenders Sept./Oct. Pgs. 32-34.

A few incidences of mountain lions approaching human beings and in some cases attacking and killing dogs which accompanied human beings were reported in the Mount Wrightson Wilderness Area of the Coronado National Forest south of Tuscon, Arizona. The Arizona Game and Fish Department closed the area and hired a professional hunter to track and kill the lion. A 30-pound immature lion in poor shape was killed and may have represented a kitten raised in captivity and released in the area. Arizona is the least restrictive lion hunting state except Texas, where no protection at all is provided. Arizona sells more lion permits than the other 10 western states combined, averaging more than 7,600 permits a year since 1979 as opposed to some 5,500 a year for the remainder of the West. Based on calculations of deer/lion ratios from previous studies, Arizona's estimated 170,000 deer indicate a lion population of somewhere between 472 and 850. However, the Arizona Game and Fish Department estimated the lion population to be between 1500 and 2500 which would mean that between 54,780 and 91,250 deer or 32 to 54% of all the deer in the state would be consumed each year. This plus the annual hunter kill of about 14,000 deer would mean an annual deer mortality of 40 to 60% which is more than any deer population can withstand. The author felt that the Arizona Game and Fish Department may be greatly overestimating the lion population in the state.

Johnson, H.G. 1942. Mountain Lion Bags New Kaibab Record. Arizona Wildlife and Sportsman 4:10-11.

A mountain lion killed a buck with the greatest spread of antlers ever recorded (46-11/16 inches) on a deer on the Kaibab National Forest. The record had been a 44-1/2 inch spread taken by a hunter. The kill was found by a lion hunter, and his dogs immediately set out on the lion's trail and he shot and killed the large tom. The buck was in the prime of life and in great physical condition. The author believed that lions frequently kill deer in prime physical condition which seemed to disprove the hypothesis that lion kill primarily the weak or sick.

Johnson, J.F. 1980. Mountain Lion Research (1976-80). Final Report. Proj. No. W-124-R-4, Job 1. New Mexico Dept. of Game and Fish. 16pp.

The objectives of this study resulted from earlier mountain lion research studies under Project W-93-R. Some of the objectives could not, however, be completed as desired, in part due to the small sample of radio-collared lions on the study area. The information obtained on sizes of home ranges varied from approximately nine square miles to 40 square miles per month. On an overall basis, lion home ranges varied from 21 square miles to 162 square miles. The total area occupied by males appeared slightly larger than that occupied by females. This may be due in part to the females' ranges being restricted as a result of being followed by young. One female, captured with cubs and monitored for an extended period of time, appeared to extend her range as her young increased in size. As lions were monitored during this study, a determination was made whether the particular individual was active or inactive. Insufficient information was obtained to state the activity period over a 24-hour period, but activity from 6:00 a.m. to 10:00 p.m. was established. Peak activity

periods appear to occur at approximately 6:00 a.m. and from 6:00 p.m. to 8:00 p.m. The least active periods appear to occur around 10:00 a.m. and 1:00 p.m. The composition of prey species identified by the study teams was composed primarily of mule deer. One domestic calf and one fox, which had been trapped by a rancher, were also taken. The physical condition of all animals taken appeared to be good at the time of death. Movements of radio-collared study lions appeared to be very erratic. Their movements would range from only several airline miles to 15 miles or more per day. Their staying within a more restricted area for a period of time caused study personnel to search more intently for signs of kills, but this later proved not to be a reliable method of locating kills.

Johnson, J.F. 1982. Mountain Lion Research. Final Report. Proj. No. W-124-R-4, Job 1, New Mexico Dept. of Game and Fish, Santa Fe. 16pp.

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Johnson, J.H.J., A.M. Wolf, T.L. Johnson, and J.M. Jensen. 1993. Gentamicin Toxicosis in a North American Cougar. J. Am. Vet. Med. Assoc. 203(6):854-856.

A cougar with gentamicin toxicosis developed pyrexia, dehydration, and renal damage during the treatment period. To minimize adverse reactions to aminoglycosides, animals should be monitored by sequentially measuring serum urea nitrogen and creatinine concentrations, creatinine clearance, urine volume, osmolarity, and protein content as well as evaluating urine sediment before and during treatment. Extrapolating drug dosages by metabolic scaling provides a method of calculating a drug dosage outside the range for which dosages have been reported for the species.

Johnson, K.A., and W.L. Franklin. 1984. Ecology and Management of the Patagonian Puma (F. c. patagonica) in Southern Chile. Pgs. 141-145 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 puma population in and around Torres del Paine National Park is a classic example of wildlife in conflict with man. This population is believed to have increased rapidly over the last several years. Depredation is causing serious concern among local ranchers who claim that pumas leave the park to kill and return for protection. Study objectives and methods are discussed.

Johnson, K.G., T.H. Logan, E.D. Land, M.A. Lotz, M.R. Dunbar, R. McBride, D.K. Jansen, and O.L. Bass Jr. 1997. Preliminary Evaluation of Florida Panther Genetic Restoration and Management. Page 87 *in* W.D. Padley, ed., Proc. Fifth Mountain Lion Workshop: 27 February- 1 March 1996; San Diego, California.

Eight non-pregnant female Texas cougars (*Puma concolor stanleyana*) were quarantined and then released at five locations in South Florida from 29 March-26 July 1995 for genetic restoration of the Florida Panther (*P.c. coryi*) population. Genetic restoration is intended to reduce inbreeding and restore genetic variability and vitality for a healthier, more resilient population of Florida panthers. Management strategies will be developed to maintain genetic diversity that is

historically typical of the North American population, and will restore the long-term, adaptive capacity of the panther population. Telemetry and biomedical data were collected on 18 radio-collared Florida panthers and eight female Texas cougars. No significant biomedical or health problems were detected during quarantine. Social interactions have occured between Texas cougars and both female and male Florida panthers. One litter of intercrossed kittens (F,M) were born in late September and the second intercrossed litter (F) was born in mid-October. Four female panthers denned during the previous year; seven neonate kittens (3F, 4M) were examined at three dens and five panther kittens were marked with transponders; all intercrossed kittens have been marked with transponders. One Texas cougar was struck and killed by a motor vehicle on 20-21 September; she was found to contain three half-term fetuses upon necropsy. Mortalities of instrumented panthers included three males and two females; two males died from intraspecific aggression, a female died of pleuritis, another female was struck and killed by a vehicle, and the third male's cause of death was unknown. Florida panthers showed spatial use patterns similar to previous years. No displacements of Florida panthers have occured nor have disruptions to the existing social organization been observed. Movements of Texas cougars were generally within habitat areas used by Florida panthers and the occasional movements in atypical areas such as mangroves and suburban areas were probably typical of animals exploring unfamiliar terrain. Evaluation of genetic restoration of the panther population will be based on the relative demographic and reproductive performance, morphological traits, and genetic characteristics of F1 and F2 intercrossed offspring.

Johnson, K.H., C. Wernstedt, T.D. O'Brien, and P. Westermark. 1991. Amyloid in the Pancreatic Islets of the Cougar (Felis concolor) is Derived from Islet Amyloid Polypeptide (IAPP). Comp. Biochem. Physiol. 98B(1):115-119.

1. Islet amyloid isolated from the pancreas of a 20-year-old cougar (Felis concolor) was dissolved and purified by gel permeation and reversed phase HPLC for amino acid sequence analysis. 2. N-Terminal amino acid sequence analysis of the purified protein revealed a primary structure (positions 1-28) identical to islet amyloid polypeptide (IAPP) from domesticated cats. 3. IAPP from the cougar, like IAPP from the human and domesticated cat, incorporates an inherently amyloidogenic AILS sequence at positions 25-28.

Johnson, M.K., R.C. Belden, and D.R. Aldred. 1984. Differentiating Mountain Lion and Bobcat Scats. J. Wildl. Manage. 48(1):239.

The objective of this study was to determine if thin-layer chromatographs of fecal bile acids could be used to distinguish between mountain lion and bobcat scats. Of all known samples, 64% of the bobcat and 79% of the mountain lion scats were correctly identified by thin-layer analysis. Twenty-one (88%) of the known mountain lion scats were correctly identified visually and 18 (86%) of these were also correctly identified chemically. For the samples for known bobcats, nine (64%) were correctly identified visually and seven (78%) of these were correctly identified chemically. No identification errors were made when visual and chemical identification matched. Although 4 different bile acids occur in both mountain lion and bobcat scats, only cholic and deoxycholic acids regularly occurred in mountain lion scats in concentrations detectable by thin-layer analysis. According to gas chromatography analysis, these two compounds also comprised higher ($P<0.05$) proportions of total bile acids in mountain lion scats than in bobcat scats. Total bile acid concentrations were so low in mountain lion scats that only cholic and/or deoxycholic acids were detected by thin-layer chromatography of extracts from a 1 g sample. This is distinctive for mountain lion scats. However, thin-layer analysis appears to be only about 80% accurate for mountain lion scats and about 65% for bobcat scats.

Johnson, M.L., and L.K. Couch. 1954. Determination of the Abundance of Cougar. J. Mammal. 35:255-256.

The use of the formula (N = 3K + [3K divided by 10]) to determine the abundance of cougar is described where K is the number of cougars killed each year and N is the total population. The result is an absolute minimal figure because it ignores theoretical factors of death by starvation, accidents, and other considerations.

Johnson, N. 1984. Idaho-Cougar Status Report. Pgs. 37-38 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 reached Big Game status in 1972, with a one lion limit per year. Tags were first required in 1975 even though they could be purchased after the take. The mountain lion harvest from 1973-1984 is presented. A mandatory report has been required since the 1973 season. A tag now has to be purchased prior to the take and the skull must be

brought in when complying with the mandatory check requirement.

Johnson, S.C. 1986. Centralization and Investigation of Cougar Sighting Data in Georgia. Final Report. Georgia Endangered Species Proj. W-47, Georgia Dept. Nat. Resources. Atlanta.

Investigation of cougar sighting reports from various sources has continued in Georgia since 1978. A total of 296 reports were investigated during this eight year period. Each report was assigned to one of five reliability categories based on the results of investigations. A total of 23 reports (7.8%) were assigned to Category 3, 237 reports (80.1%) to Category 4, and 36 reports (12.2%) to Category 5. Approximately 20 to 30 formal reports are received each year by the project leader from throughout the state. No physical evidence directly attributable to cougar has been received to date. The identification of several hair samples was pending as of the date of this report.

Johnson, W.E., D. Land, J. Mortenson, M. Roelke-Parker and S.J. O'Brien. 2003. Preliminary Results of Florida Panther Genetic Analyses. Page 108 *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

Previous genetic analyses showed that Florida panthers (*Puma concolor coryi*) had the lowest genetic diversity among all North American puma and subsequent modeling suggested that further declines could increase the probability of extinction. Currently, there are fewer than 100 panthers in south Florida. Although on-going habitat conservation strategies may provide long-term stability for today's population extents, these same strategies are unlikely to allow the population to grow to 500 or more individuals whereby genetic viability is more assured. As a result, a plan for Florida panther genetic restoration was created in 1994 and implementation began in the spring of 1995 with the release of 8 female Texas puma into areas occupied by panthers. Our objectives were to monitor the effectiveness of genetic restoration by developing an array of molecular genetic markers that characterized the status of current and past populations, to construct a pedigree among Florida panthers to follow inheritance patterns, to infer degrees of relatedness among individuals, and to help predict the future viability of the population. We have completed genotyping over 175 samples from Florida panthers at 23 microsatellite loci and these included individuals from canonical Florida panthers, the Everglades subpopulation (Piper stock), released Texas puma, crosses among all stocks, and captive animals of unknown ancestry from the early 1970's to the present. Genetic restoration has increased hetereozygocity within the population, but we have documented the loss of some panther matrilines. Certain morphological traits such as cryptorchidism, kinked tails, cowlicks, and atrial septal defects observed in canonical panthers are not present in the Texas puma descendants. We have identified several subgroups within our population and these subgroups seem to be partially the product of philopatric tendencies among dispersing female offspring. Male panthers may be physically and behaviorally capable of siring offspring earlier than suggested by radiotelemetry work and resident and resident males are not siring all litters with females within the respective males' home ranges. Intraspecific aggression, a common mortality agent for young male panthers, may not be removing panthers prior to producing offspring. Future monitoring should ensure sampling across all panther subgroups in order to adequately estimate total population genetic characteristics.

Johnston, L.A., A.M. Donoghue, S.J. O'Brien and D.E. Wildt. 1991. Rescue and Maturation In Vitro of Follicular Oocytes Collected from Nondomestic Felid Species. Biol. Reprod. 45:898-906.

Abstract

The potential for rescuing immature oocytes from the ovaries of females of rare felid species which die or undergo medical ovariohysterectomy was evaluated. Ovaries were recovered from 13 species representing 35 individuals in good-to-poor health. Although the majority of females were 10 yr of age or older and in fair-to-poor health, a total of 846 oocytes were recovered of which 608 (71.9%) were classified as fair-to-excellent quality. One hundred of these oocytes were used for initial maturation classification and as parthogenetic controls. Overall, of the 508 fair-to-excellent quality oocytes placed in culture, 164 (32.3%) matured to metaphase II in vitro. For species in which 3 or more individuals yielded oocytes, mean oocyte maturation rates were as follows: 36.2%, tiger; 27.9% leopard; and 8.3%, cheetah. In vitro insemination of oocytes resulted in fertilization (2 polar bodies, 2 pronuclei, or cleavage) rates of 9.1% to 28.6% (leopard) using homologous fresh spermatozoa and 4.0% (lion) to 40.0% (puma) using homologous frozen-thawed spermatozoa. Inseminations using heterologous (domestic cat) spermatozoa also resulted in fertilized oocytes in the tiger, leopard, snow leopard, puma,

serval, and Geoffroy's cat (range in fertilization rate, 5.0% for leopard to 46.2% for puma). Cleaved embryos resulted from the insemination of leopard oocytes with homologous sperm (n = 1 embryo) and puma oocytes with domestic cat sperm (n = 3 embryos). These results demonstrate that immature ovarian oocytes from rare felid species can be stimulated to mature in vitro despite an excision-to-culture interval as long as 36 h. These oocytes are capable of fertilization in vitro, although fertilization rates do not approach those achieved in parallel studies in domestic cats. Our observations of successful cross-species sperm-oocyte interaction in vitro (including the production of cleaved embryos) confirms that the oocytes of certain felid species have not developed mechanisms for excluding penetration or fertilization by heterologous felid spermatozoa.

Jones, J. K., Jr. 1949. The Occurrence of the Mountain Lion in Nebraska. J. Mammal 30(3):313.

Although now extinct in Nebraska, the mountain lion (*Felis concolor*) was once found in small numbers in the pine ridge area in the northern part of the state and occasionally south and east along major streams. Two definite records, one skull of an adult female (Sheridan County-1884) and a mounted specimen (Cherry County-1880) exist. The author reports that a lion was also seen along the Republican River, south of Franklin around 1888 and if true indicates they may have ranged into extreme southern Nebraska and northern Kansas. Swenk, M.H. (1907- Proc. Nebraska Acad. Sci.) reports that lions were also seen in southern Holt County as late as 1899.

Jordan, D.B. 1990. Mercury Contamination: Another Threat to the Florida Panther. End. Sp. Tech. Bull. 15(2):l, 6. USDI, U.S. Fish and Wildlife Service.

Extremely high levels of mercury, over 100 parts per million (ppm) have been found in the liver of a panther that died in the Everglades last summer. Although no generally acceptable explanation has surfaced, the mercury could be coming from the peat and muck soils that are common throughout Florida. These often flooded and highly anaerobic soils provide a suitable environment for the methylation of inorganic mercury. Methylmercury, a product primarily of anaerobic bacteria, is the biologically active and toxic form of mercury. Inorganic mercury is considered to be biologically harmless. The methylmercury enters the food web where the contaminant accumulates in the predators of aquatic animals. Liver and hair samples from archived dead panthers and live panthers were taken. Six of 10 liver samples and hair samples contained mercury levels of 7.8 ppm or higher. The presumed source of the contamination is the panther's prey, particularly raccoons, which bioaccumulate mercury through the aquatic food web.

Jordan, D.B. 1990. Draft Environmental Assessment- A Proposal to Issue Endangered Species Permits to Capture Select Florida Panthers (Felis concolor coryi) for the Establishment of a Captive Population. U.S. Fish and Wildl. Service Florida Panther Recovery Coordinator, Univ. of Florida, Gainesville. 13pp.

The purpose and need for action, location, and background of the Florida panther is presented. Six alternatives are offered along with a general description of the environment that could be affected by these alternatives. Included are the discussions of the physical, biological, social, and economic components of the environment. A section is devoted to answering specific questions and alleviating major concerns with regard to the intention of preparing an Environmental Assessment on the proposed establishment of a captive Florida panther population.

Jordan, D.B. 1994. Identification and Evaluation of Candidate Florida Panther Population Reestablishment Sites. In: Dennis Jordan, ed., Proc. of the Florida Panther Conf., USFWS. 18pp.

Population reestablishment is essential to achieve recovery of the Florida panther. With only one wild population remaining, at least two additional populations will have to be reestablished to achieve the Recovery Plan's objective of a minimum of three viable, self-sustaining populations within the panther's historic range. Actions have been initiated to identify and evaluate potential reintroduction sites throughout the panther's historic range. Fourteen tentative sites have been initially identified and undergone preliminary evaluation. Site evaluation factors for this initial analysis were: proportion of site in forest cover, human population density, and road density. Each site was considered to be of sufficient size and be comprised of a prey density sufficient to support a self-sustaining panther population. Six candidate sites achieved a higher ranking (total score on evaluation criteria) than did the panther-occupied area in south Florida. Additional evaluation and analysis is planned. The goal is to develop weighted, scientifically definitive evaluation factors.