

OREGON

Size and Reproductive Characteristics of
Western Oregon Cougars

Dale E. Towell
Idaho Department of Fish and Game
Boise, Idaho

Chris Maser
Bureau of Land Management
Corvallis, Oregon

Murray L. Johnson
Burke Museum, University of Washington
Seattle, Washington

Larry D. Bryant
U.S. Forest Service, Range and Wildlife Habitat Laboratory
LaGrande, Oregon

Abstract

We examined 87 cougars (Felis concolor oregonensis) collected from Oregon's Cascade Mountains by sport hunters and U.S. Fish and Wildlife animal control personnel between 1978 and 1984. The sex ratio favored males (1.2 males:female), but did not differ significantly from 1:1. Females were more commonly killed during December and males were commonly taken during January. Male cougars averaged nearly 1.5 times the weight of females, and were also significantly larger in total body length and heart girth. Of 18 males whose testes were examined microscopically, 8 (44 percent) showed spermatozoa in the epididymides and were considered sexually mature. Reproductive tracts of 34 females were examined, 22 (65 percent) from animals believed to be adults. Over one-third of the 22 adult tracts examined showed no evidence of past reproductive activity. Mean litter size, based on placental scars present in the uteri of 11 cougars, averaged 2.8 kittens. Variability in numbers of Graafian follicles and corpora lutea precluded their use in estimation of individual fecundity.

Introduction

Reproductive biology of the cougar is poorly understood, partly because of the secretive nature of these big cats and partly because of the difficulty in assigning accurate ages to specimens obtained from the wild. We present data on weights, measurements, and reproductive characteristics of 47 male and 40 female cougars killed by hunters and agency personnel in western Oregon between 1978 and 1984.

Study Area

The study was conducted in the Western Cascades physiographic province (Franklin and Dyrness 1973) a rugged, deeply dissected, mountainous region with numerous main ridge crests; elevations ranged from 600 to 1,500 m. Climate was dominated by moist westerly maritime winds that resulted in mild but wet winters and mild summers. January mean minimum temperature averaged about 4°C and July mean maximum temperature averaged about 27°C; annual precipitation was about 150 cm (Lahey 1979). Vegetation was typical of temperature in coniferous forests. Most of the area lay within the western hemlock (Tsuga heterophylla) zone, and was characterized by extensive forests dominated by Douglas-fir (Pseudotsuga menziesii) and western redcedar (Thuja plicata). These forests were managed primarily for production of wood fiber and harvest of trees though clearcutting has created a checkerboard pattern of mature and regenerating stands of Douglas-fir.

Black-tailed deer (Odocoileus hemionus columbianus) and Roosevelt elk (Cervus elaphus roosevelti) were common throughout the area. Cougar densities were estimated at one cougar per 65 to 90 km² (Harcombe 1977).

Methods and Materials

The cougar, classified as a "Game Animal" in Oregon, has been managed as a trophy species by the Oregon Department of Fish and Wildlife since 1968. No sport hunting was allowed during 1968 or 1969. A limited number of trophy hunting permits were issued annually to applicants through a random drawing beginning in 1970 (Harcombe 1977). Each permit allowed harvest of one cougar unaccompanied by kittens, and was restricted to specific game management units. Hunts were restricted to mid- to low-elevation areas (roughly 1,000 m or lower). Successful

applicants were placed on a 3-year waiting list before being allowed to apply for another hunt permit. Seasons were restricted: December 1-31 (1970-1979), December 1-January 15 (1979-80), and December 1-January 31 (1980-81 through 1983-84).

Each successful hunter was required to present any cougar killed to an office of the Oregon Department of Fish and Wildlife within 48 hours after harvest for data collection and tagging. Hunters who could not present cougars intact were required to present the skull and hide, and were requested to provide the reproductive tract, of each animal.

Cougars killed as a result of livestock depredations were frozen intact for later analysis.

Data collected from each specimen included location site and date of kill, carcass weight (skinned or intact), total length, tail length, hind foot length, ear height from notch, heart girth, pad length, and pad width. Measurements were recorded in pounds and inches, and converted to metric units for analysis. Testes of males and complete reproductive tracts of females were frozen for later analysis.

When thawed, testes with attached epididymides and ovaries were fixed in 10 percent formalin solution and stored in 70 percent ethyl alcohol. Testes with epididymides were embedded, sectioned, stained, permanently mounted, and examined microscopically for evidence of spermatogenesis. Ovaries were sectioned and examined macroscopically for Graafian follicles, corpora lutea, and corpora albicantia; follicles and corporal bodies were measured at greatest diameter to the nearest mm. Uteri were examined visually for embryos and sites of embryo implantation (placental "scars"); some uteri were cleared through progressive dehydration in alcohol and immersion in methyl salicylate to facilitate identification of implantation sites.

Results and Discussion

Eighty-seven cougars were examined between 1978 and 1984. Numbers examined annually ranged from 6 (1981-82) to 23 (1982-83). Most of the cougars examined were killed in Douglas (60 percent) and Lane Counties (24 percent); other counties represented were Curry (2 cougars), Coos, and Hood River (1 cougar each). Animals killed every month of the year except August were included (Table 1), although 75 percent of the sample was taken during December and January.

Table 1. Sex of cougars by month of harvest from Oregon's Cascade Mountains, 1978 through 1984.

Sex	Month of Harvest												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Males	19	0	3	4	0	0	1	0	3	1	2	14	47
Females	8	1	3	0	1	1	1	0	1	0	0	24	40

Sex ratio of cougars in the sample, 1.2 males/female, did not differ significantly from parity (chi-square 0.56, 1 df). A slight preponderance of males has been noted from many samples (see Anderson 1983), but reported differences from parity do not consistently favor either sex. Among-hunter harvested animals, females were taken about twice as often as males in December; the reverse was true in January (Table 1), when differences were significant (chi-square 4.48, 1 df).

Male cougars, believed 24 months of age and older based on body size and conformation, averaged 1.45 times the weight of females believed 24 months and older (Table 2). This weight differential, while not significant, is similar to the ratio of 1.4 reported by Anderson (1983) for five subspecies of cougars. Anderson reported that F. c. oregonensis departed from that ratio based on a very small sample provided by us (Anderson 1983:21). A subsample, including only cougars known to be sexually mature, was examined to determine the accuracy of separating adult cougars from subadults based on body size and conformation (Table 2). Weight differences between sexes for this subsample was significant (chi-square 4.89, 1 df). Mean and minimum weights of cougars of both sexes in this sample increased, which suggested that either subadult cougars could not be effectively separated from adults based on body size and conformation, or that selection of sexually mature animals favored older adult cougars.

Table 2. Carcass weights (in kg) of male and female cougars from Oregon's Cascade Mountains.

Sex	Sample Size	Mean Weight	Standard Deviation	Minimum Weight	Maximum Weight	Source
Males						
	5	63.2	10.28	52.0	76.0	1
	4	61.0	8.50	49.0	72.6	2
	23	54.6	10.21	38.6	72.6	3
Females						
	4	48.0	10.10	38.0	62.0	1
	11	38.9	9.14	30.4	62.6	2
	19	37.7	7.73	29.5	62.6	3

1 Sample reported by Anderson (1983:21).

2 Cougars known to be adults by spermatozoa in epididymides (males) or ovarian bodies indicative of reproductive maturity (females).

3 Cougars believed 24 months of age or older based on body size and conformation.

Standard body measurements (total length, tail length, length of hind foot, ear height from notch, and heart girth) of sexually mature cougars and cougars believed to be 24 months and older based on body size were examined. All standard measurements of males consistently exceeded those of females, but differences were not statistically significant (Table 3). Pad length and pad width measurements were not recorded consistently among observers, and were not analyzed.

Sexual dimorphism of cougars in the Cascade Range of Oregon is similar to that reported elsewhere (see Anderson 1983). Sexual dimorphism may reflect intraspecific niche separation between sexes for space, food, or other limited resources. Studies of cougars in other areas (see Anderson 1983) have shown that the larger body size of males is commonly associated with larger home range areas, perhaps related to differing energetic demands (Harestad and Bunnell 1979). Although limited dietary information is available for cougars from Oregon's

Table 3. Standard body measurements (in cm) of cougars collected from Oregon's Cascade Mountains. Sample sizes are in parentheses.

Sex	Total Length	Tail Length	Hind Foot Length	Ear Height from Notch	Heart Source Girth
Males					
	216.3 (5)	76.4 (5)	28.1 (6)	9.0 (7)	82.5 (5) 1
	205.9 (33)	76.5 (29)	28.4 (26)	8.9 (30)	76.5 (26) 2
Females					
	186.3 (11)	68.5 (11)	26.2 (9)	8.9 (9)	64.1 (9) 1
	187.6 (25)	69.2 (21)	26.7 (18)	8.8 (20)	64.6 (16) 2

- 1 Cougars known adult by spermatozoa in the epididymides (males) or ovarian bodies indicative of reproductive maturity (females).
- 2 Cougars believed to be 24 months of age or older based on body size and conformation.

Cascade Mountains (Toweill and Meslow 1977, Toweill and Maser in press), these data are insufficient to test this hypothesis.

Eight of 18 male cougars (44 percent) believed older than 24 months (all killed during December or January) had mature spermatozoa in testes and epididymides, indicative of sexual maturity and breeding condition. Three males showed spermatogenesis and low numbers of spermatozoa in proximal epididymides, but were considered sexually inactive. Age at which primary spermatocytes first mature in cougars has not been documented (Anderson 1983). Weights of the sexually mature males ranged from 49.0 to 72.6 kg while weights of two of the maturing but sexually inactive cougars were 47.6 and 59.0 kg, respectively (Table 2).

Reproductive tracts of 34 (85 percent) female cougars were available for examination. Of these, 65 percent (22 tracts) were believed to have come from animals 24 months of age or older, based on body size and conformation. No evidence of reproductive activity (mature Graafian follicles, corpora lutea, or embryo implantation sites on the walls of the uterus) was found in 36 percent of the 22 tracts of presumably mature females. Of the 14 female reproductive tracts that showed evidence of previous reproductive activity, 11 exhibited an average of 2.8 sites of fetal implantation on the walls of the uteri

(placental "scars"), with a range of 1 to 4 per individual. Three showed no implantation sites. Numbers of mature follicles and corpora lutea varied; because of the presence of numerous small areas of fibrosis in active ovaries, no effort was made to determine numbers of corpora albicantia. There was some indication that the existence of ovarian structures such as residual signs of pregnancies, was inconsistent. For example, the uterus from one adult female collected along with two 25 kg juveniles showed three sites of embryo attachment, but no evidence of mature follicles or corpora lutea was found in the ovaries. The uterus of another female showed three implantation sites and mature follicles, but only one corpus luteum was identified. The uterus of a lactating female showed three implantation sites, but only two corpora lutea were identified in the ovaries of this animal.

Cougars are probably induced ovulators (Bonney et al. 1981) that reach sexual maturity at about 20 to 30 months (Young and Goldman 1946, Rabb 1959, Robinette et al. 1961, Eaton and Velander 1977), but which may not breed until they have established a territory (Hornocker 1971). Ovaries are histologically similar to those of the domestic cat (F. domesticus) and bobcat (F. rufus); corpora lutea are thought to persist about 1 year (Mossman and Duke 1973). Atretic and primary follicles were reported by Bonney et al. (1981) during diestrus; corpora lutea, however, were not observed during estrus. Placental "scars" were thought to persist about 1 year (Robinette et al. 1961).

Because juvenile cougars may remain with their mother until 12 to 20 months (Hornocker 1971) and adults accompanied by juveniles apparently do not breed, regression of corpora lutea and sites of embryo implantation may occur in sexually active adults still accompanied by juveniles. Although Robinette et al. (1961) reported that apparently virginal uteri were uncommon in cougars exceeding about 42 kg, inconsistencies observed during this study indicate that caution must be used in determining fecundity from cougar carcasses. Sites of embryo implantation on the walls of the uterus probably persist sufficiently long to allow an estimate of annual production for population modeling purposes, but estimation of fecundity rates for individual females should be made with caution.

Acknowledgements

We thank Oregon Department of Fish and Game personnel who assisted in collection of cougar viscera: R. Anglin, R. Bartels, L. Conn, B. Ferry, J. Greer, C. Smith, H. Sturgis, and R. Werner. J. Beecham, C. Nellis, and L. Nelson reviewed the manuscript and offered helpful suggestions. We also thank St. Joseph's Hospital, Tacoma, Washington, for assistance in preparation of histological specimens, and the Idaho Department of Fish and Game for providing time for preparation of this manuscript.

Literature Cited

- Anderson, A.E. 1983. A critical review of literature on puma (Felis concolor). Spec. Rep. 54, Colorado Div. Wildl., Ft. Collins. 91 pp.
- Bonney, R.C., H.D.M. Moore, and D.M. Jones. 1981. Plasma concentrations of oestradiol-17 and progesterone, and laparoscopic observations of the ovary in the puma (Felis concolor) during oestrus, pseudopregnancy and pregnancy. J. Reprod. Fert. 63:523-531.
- Eaton, R.L., and K.A. Velandier. 1977. Reproduction in the puma: biology, behavior and ontogeny. World's Cats 3:45-70.
- Franklin, J.F., and C.T. Dyrness. 1973. Natural vegetation of Oregon and Washington. USDA For. Serv. Gen. Tech. Rep. PNW-8. 417 pp.
- Harcombe, D.W. 1977. Oregon cougar study. Oregon Dep. Fish Wildl., Portland. 62 pp.
- Harestad, A.S., and F.L. Bunnell. 1979. Home range and body weight--a re-evaluation. Ecology 60:389-402.
- Hornocker, M.G. 1971. Suggestions for the management of mountain lions as trophy species in the Intermountain region. Proc. West. Assoc. Game Fish Comm. 51:399-402.
- Lahey, J.F. 1979. Climate. pp. 45-54 In Highsmith, R.M. Jr., and A.J. Kimerling, eds. Atlas of the Pacific northwest. Sixth Ed. Oregon State Univ. Press, Corvallis. 135 pp.
- Mossman, H., and K. Duke. 1973. Comparative morphology of the mammalian ovary. Univ. Wisconsin Press, Madison. 461 pp.

- Rabb, G.B. 1959. Reproductive and vocal behavior in captive pumas. *J. Mamm.* 40:616-617.
- Robinette, W.L., J.S. Gashwiler, and O.W. Morris. 1961. Notes on cougar productivity and life history. *J. Mammal.* 42:204-217.
- Toweill, D.E., and E.C. Meslow. 1977. Food habits of cougars in Oregon. *J. Wildl. Manage.* 41:576-578.
- Toweill, D.E., and E.C. Meslow. 1977. Food habits of cougars in Oregon. *J. Wildl. Manage.* 41:576-578.
- Young, S.P., and E.A. Goldman. 1946. The puma, mysterious American cat. *American Wildl. Inst.*, Washington, D.C. 358 pp.