Reproductive Characteristics of Eastern Oregon Cougars

Abstract
Knowledge of reproductive characteristics and reproductive rates are a critical concern to wildlife managers, but such data are difficult to obtain for free-ranging predators. In order to obtain these data, we examined the reproductive tracts of 46 male and 51 female subadult and adult cougars (*Felis concolor missourensis*) killed by hunters during the month of December, 1976-1982. Among males, 24 (52%) showed evidence of spermatogenesis. Sexually mature males may lack sperm during a portion of the year. Of the 51 females, 23 (45%) were classified as reproductively active based on evidence of corpora lutea in ovaries or sites of embryo implantations in uteri. Corpora lutea of pregnancy appear to be short-lived. Four females (8%) were pregnant in December. Placental scars of females may be used to estimate the minimal level of fecundity in the population. Estimated mean litter size based on placental scars ($n=10$) was $2.4 \pm 1.08$ kittens. These data indicate that previously published guidelines for assessing sexual maturity of cougars based on body weight may lead to erroneous conclusions. The best estimator of cougar fecundity is provided by counts of placental scars.

Introduction
Large samples of reproductive data from populations of long-lived, free-ranging predators are difficult to obtain. Few data on reproductive characteristics of cougars have been published. Most of the information available, as summarized by Anderson (1983), refers to captive animals. Descriptions of reproductive characteristics of free-ranging cougars is limited to reports by Robinette et al. (1961) on ovarian analysis of 33 females among a much larger sample of cougars taken by hunters and government trappers from Utah and Nevada, and by Toweill et al. (1984) on reproductive characteristics of 18 males and 34 females from western Oregon. We report on some reproductive characteristics of 46 male and 51 female cougars killed by hunters in northeastern Oregon during the month of December, 1976-1982.

Methods
Carcasses or reproductive tracts of cougars taken by hunters were routinely collected by personnel of the Oregon Department of Fish and Wildlife as part of a program to gain biological information on the species. Carcass weights and measurements were recorded, and reproductive tracts (testes and epididymides for males; ovaries and uteri for females) were frozen for later analysis. Reproductive tissues were later thawed, fixed in 10% formalin, and stored in 70% alcohol. One testis with attached epididymus was wax-embedded, sectioned at a thickness of 7-8 micra, stained with hematoxylin and eosin, and examined microscopically for evidence of spermatogenesis. Ovaries were sectioned grossly at a thickness of approximately 1 mm and examined under a dissecting microscope for presence of Graafian follicles, corpora lutea, and corpora albicantia. Uteri were examined for embryos and sites of previous embryo attachment (placental scars). Some uteri were cleared by progressive dehydration in alcohol and immersion in methyl salicylate to facilitate identification of placental scars.
Results and Discussion

Usable reproductive tracts were collected from 46 (78%) of 59 male and 51 (82%) of 62 female subadult and adult cougars killed by hunters in northeastern Oregon during the month of December, 1976-1982, under an either-sex harvest regulation. The sex ratio did not differ (p < 0.05) from 1:1.

Reproductive Characteristics of Males

No effort was made to separate young unspotted cougars from adults based on size or body conformation, because materials received varied from entire carcasses to reproductive tissues only. Twenty-four (52%) of 46 males examined were sexually mature based on spermatogenesis or mature sperm in the epididymides. This ratio of spermatic animals is similar to the ratio of 44 percent spermatic males in a sample of cougars (F. c. oregonensis) from western Oregon collected during December and January (Toweill et al. 1984). Data indicating the age at which primary spermatocytes first appear in male cougars is lacking (Anderson 1983). Evidence of spermatogenesis or spermatozoa to identify males that were sexually mature may not have included all physically mature males in the sample. Among those that were aspermatic and which were weighed intact (n = 13) were males that weighed 59.4 and 66.2 kg, well over the arbitrary weight of 56.7 kg considered indicative of adult males by Robinette et al. (1961), suggesting that physically (sexually?) mature males may be aspermatic during a portion of the year. Among 21 adult males showing evidence of spermatogenesis or mature sperm in the epididymides and for which intact carcass weights were available, 19 percent (4) weighed less than 56.7 kg (47.2, 50.8, 51.5 and 53.1 kg, respectively).

Reproductive Characteristics of Females

Based on evidence of previous ovulation or sites of previous embryo implantation in the uterus, 21 (41%) of 51 females for which reproductive tracts were available were classified as reproductively active by these same criteria (Toweill et al. 1984).

Robinette et al. (1961) reported that female cougars in their sample from Utah and Nevada reached sexual and physical maturity at whole-body weights of about 80 pounds (36.4 kg). Application of this criterion to 21 female cougars judged immature based on analysis of reproductive tracts and for which whole body weights were recorded (x = 37.4 ± 4.2 kg, range = 31.8 - 47.3 kg) resulted in misidentification of 10 animals (48%) as sexually mature. Conversely, application of the whole-body weight criterion to 20 cougars (x = 41.4 ± 5.2 kg, range = 31.4 to 55.5 kg) shown by examination of reproductive tracts to be sexually mature resulted in misidentification of two animals (10%). These data suggest that use of body weight alone to assess the proportion of sexually mature animals in this population would have resulted in an overestimate of 47 percent, i.e., a net error of eight animals (20% of the sample). A portion of the error results from the fact that cougars are probably induced ovulators (Bonney et al. 1981). If so, copulation is necessary to trigger ovulation and formation of corpora lutea in the ovaries, and sexually mature females that have not mated would therefore show inactive ovaries. Although data from captive animals indicate that female cougars may first breed as early as 17 to 18 months of age (Eaton and Velander 1977:52), age at first breeding has more typically been reported up to 28 to 29 months of age (Eaton and Velander 1977:52), 29 months (Rabb 1959), and 27, 31, and 33 months (Young 1946:214). Further, it has been inferred from field studies (Hornocker 1971) that wild female cougars probably do not breed until they have established a home area. Thus, using ovarian structures as evidence of sexual maturity may underestimate the sexually mature segment of the population, since no structures are likely to occur in nonterritorial (and therefore, not reproductively active) females. Removal of territorial females may have little effect on a population if sexually mature but nonterritorial females are available to fill vacancies created.

Using the presence or absence of ovarian or uterine structures as indicators of reproductive history must be done cautiously because the period of persistence of these structures in cougars is unknown. Cougar ovaries are histologically similar to those of both the domestic...
cat (*F. domesticus*) and bobcat (*F. rufus*) (Mossman and Duke 1973), but ovarian structures associated with pregnancy in the cougar may regress much more quickly than in those species. Mossman and Duke (1973) believed that corpora lutea of cougars likely persisted about one year after parturition. However, Toweill et al. (1984:182) reported four instances wherein corpora lutea apparently regressed more quickly, including one instance where an adult female accompanied by two kittens (believed 6 to 10 months old based on whole-body weights of 25 kg) lacked corpora lutea although three sites of embryo implantation were identified. In each of the instances discussed by Toweill et al. (1984:182), and in four of the ten cougars with placental scars examined in this study, fewer corpora lutea than embryo implantation sites were found, suggesting a tendency towards more rapid regression of corpora lutea than placental scars following parturition.

Four (8%) of the females examined were pregnant when killed in December, a pregnancy rate slightly higher than that calculated for December from all other sources by Anderson (1983:32). In each case, number of embryos and placental scars was equal. Placental scars only were found in the uteri of six (12%) of the females examined. Based on placental scars, an estimated litter size of 2.4 ± 1.08 (range 1 to 4) kittens was derived, similar to the mean litter size of 2.8 kittens (n = 11) calculated by similar methods for western Oregon cougars (Toweill et al. 1984:181). However, both values are lower than the average of 3.32 ± 1.02 kittens in prenatal litters as calculated by Anderson (1983:34) from a wide range of sources.

### Management Implications

Often the only way to assess the productivity of mammalian populations is to determine the proportion of reproductively active animals in a representative sample. Data obtained during this and a companion study (Toweill et al. 1984) suggest that analysis of the reproductive tracts of female cougars obtained by hunters can be used cautiously to interpret the minimal prior-year fecundity in a cougar population. More knowledge of the temporal relationship between persistence of corpora lutea of pregnancy and placental scars is needed.

The ability to assess recent fecundity is extremely important as cougar management plans are considered, but simple generalizations are difficult to apply since adult female cougars may produce litters during any month of the year (Robinette et al. 1961) and at intervals ranging from < 12 (Eaton and Velander 1977:65) to ≥ 24 months (Robinette et al. 1961, Hornocker 1970). Because placental scars may persist longer than corpora lutea of pregnancy, counts of placental scars may be the best estimator of prenatal litter sizes and pregnancy rates.

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