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Mountain Lions: Preliminary Findings on Home-Range Use and Density in the Central Sierra Nevada

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Most deer populations of the Sierra Nevada of California have been declining for the past three decades. Research and habitat treatment aimed at reversing this trend have been concentrated on the North Kings population of migratory California mule deer (*Odocoileus hemionus californicus*) in eastern Fresno County. The population was estimated at 17,000 animals in 1950¹ and by 1972 had declined almost 80 percent to an estimated 3500 animals.² Intensive efforts to improve the habitat have failed to reverse or even stop the decline.³ The population in January 1986 was estimated at 2,000 animals.⁴

In the early 1970's composition counts indicated that low fawn survival was the principal cause of the continued decline in the North Kings population. Predation by mountain lions (*Felis concolor californica*), black bears (*Ursus americanus*), and coyotes (*Canis latrans*) has recently been identified as the principal cause of fawn mortality.⁵ Of the 90 fawns radio-equipped in the population since 1978, 43 (48 pct) have been killed by predators. Of the fawns killed by identified predators, 47 percent were taken by mountain lions. Between August 1983 and November 1985, we radio-equipped 23 does and monitored them for 22.5 deer-years. Of these 23 does, 5 were killed by mountain lions—an average of 22 percent per deer year.⁴ Although predation is probably not responsible for the decline of the deer population, it is probable that predation—especially by mountain lions—is pre-

venting its recovery. This level of predation seems to indicate a high mountain lion density, or at least a high mountain lion: deer ratio.

Recent track surveys^{6,7} indicate that mountain lion densities equal to that of the North Kings area are widespread in California. This contrasts with earlier findings suggesting that mountain lions were in low numbers in California. In 1922, Bruce⁸ estimated a total of 600 mountain lions in the State. In 1976, the California Department of Fish and Game estimated the State's population at 2400 animals,⁹ based on an estimated average density of about three lions per 259 km² (100 mi²) and 181,300 km² (70,000 mi²) of mountain lion habitat in California. Koford¹⁰ estimated that there were only 1,000 mountain lions in California in 1977, based on an estimate of one lion per 518 km² (200 mi²) over 38,850 km² (15,000 mi²) of mountain lion habitat in the state. In 1985 the California Department of Fish and Game reported 4,800 animals in the State, with an annual increase of about 8 percent.¹¹

With this wide disparity in density estimates, we lacked sufficient information to understand the relationship between mountain lions and the North Kings deer population. Therefore, we undertook a study of mountain lions and their movements in the range of the North Kings deer population in 1983.

This note reports a study to (a) determine the daily and seasonal movements of mountain lions, in the central Sierra Nevada, with emphasis on

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Between August 1983 and December 1985, 19 mountain lions were captured, radio equipped, and monitored daily within a portion of the North Kings deer herd range on the west slope of the central Sierra Nevada in California. The density of adult mountain lions was estimated to be one per 33.3 km²; that of adults and kittens together was estimated to be one per 20.9 km². Home-ranges averaged 265 km² for adult females and 350 km² for adult males. Home range overlap was high among females, among males, and between males and females. Some mountain lions migrated elevationally with the deer, but others remained at low elevations throughout the year. The preliminary results of this study suggest that mountain lions could be limiting the North Kings deer herd.

Retrieval Terms: mountain lion, *Felis concolor*, predators, home range, population density, Sierra Nevada

the temporal correlation with seasonal range use by deer; (b) determine seasonal and annual home range sizes; and (c) estimate mountain lion density. The effort was not intended to be a major study of mountain lion ecology—only an aid to understanding the role of the North Kings deer population to recover from its decline. Preliminary findings suggest that mountain lions could easily be limiting the North Kings deer herd.

STUDY AREA AND METHODS

The range of the North Kings deer population is located in eastern Fresno County, California, primarily within the Sierra National Forest. It includes approximately 2070 km² (800 mi²), ranging in elevation from 200 to 3300 m (650 to 10,800 ft). The winter range varies in elevation from 200 to 1000 m (650 to 3300 ft) and vegetation varies from foothill woodland, through chaparral, to the lower ponderosa pine (*Pinus ponderosa* Dougl. ex Laws.) forest.¹² The summer range starts at about 1,600 m (5250 ft) and extends to over 3,000 m (9840 ft). The habitat types range from ponderosa pine forest, through white fir (*Abies concolor* Lindl.), mixed-conifer and up to lodgepole pine (*Pinus murrayana* Grev. & Balf.) forest.

We captured the mountain lions by locating fresh tracks, trailing and treeing with dogs, and tranquilizing with dart-delivered drugs. Radio transmitters were attached to the animals with collars. Each animal was weighed and described. During the 1985 capture phase of the study all mountain lion sign was recorded and mapped. Sightings, differences in track size, tracks associated with scratches, and the presence of kitten tracks with adult tracks were used by experienced personnel to determine sex and age of lions from sign. Evidence of each individual was then compared to known locations of radio-equipped and other known mountain lions in the area to separate specific animals.

We attempted to radio-locate each transmitter-equipped animal each day. When a signal was received, the animal's

location was determined by triangulation, drawn on maps in the field to allow the observer to detect errors or unusual movements at once. If a location was in question, additional radio directions were taken to verify the animal's location. Occasionally the observer walked to a location close to the animal to verify the accuracy of the radio location or determine whether the animal was alive and well.

Because of rough terrain and the line-of-sight nature of the VHF frequency radio signals, we could not locate all mountain lions each day. To mitigate this problem, we used aircraft to locate the animals as often as twice per week. This procedure helped reduce bias introduced by underestimating a lion's use of inaccessible terrain.

Radio locations were marked on field maps, recorded on field sheets, and entered into a computer data base by using the Universal Transverse Mercator System. The elevation at each location was also recorded. Locations were graphically plotted on the maps.

Monthly, seasonal, annual, and total home ranges were determined from these radio locations. Total home range includes all the area used during the entire period that the animal was radio equip-

ped. Home range boundaries were determined by connecting sequential radio locations with a straight line, which represents the shortest distance the animal could have traveled between locations. After all locations were connected, the outermost lines were used to delineate the home range boundary. This process provides a biologically reasonable representation of home range boundaries when 50 or more radio locations are available on one animal.

RESULTS

During this study, our activities were restricted by road access, weather, and possible conflicts with other activities to approximately 557 km² (215 mi²). Mountain lion capture was done during three periods. By the end of 1985, a total of 19 mountain lions—17 adults and 2 kittens—had been captured and radio-equipped; 3 in August of 1983, 3 in February and March of 1984, and 13 during March through August of 1985 (table 1). Five of the radio-equipped mountain lions have died—two and possibly three were illegally shot, one died of unknown causes, and one died as a result of

Table 1—Basic data for mountain lions radio-equipped during the study, central Sierra Nevada, California.

Animal identification	Date of capture	Sex	Age at capture (yrs) ¹	Body weight (kg)	Observations	Home range (km) ¹	Proportion ²	Notes
83-620	8-14-83	Female	3	42.5	58	31	—	Died 10-1-83
83-640	8-15-83	Male	4	63.5 ¹	428	787	45.4	
83-200	8-17-83	Female	3-4	50.0	613	204	96.8	Died 11-4-85
84-220	2-25-84	Male	4-5	55.0	189	334	—	Died 9-23-84
84-600	2-27-84	Female	3-4	39.0	362	320	65.0	Died 2-4-86
84-226	3-03-84	Female	7+	40.0	365	252	20.0	
85-230	3-23-85	Female	2-3	35.5	119	200	98.5	
85-240	3-26-85	Female	5	44.0	126	444	67.5	
85-420	3-28-85	Female	2-3	35.5	133	185	83.8	
85-456	4-11-85	Male	5	56.5	112	223	97.7	
85-620	4-11-85	Male	4	49.0	98	179	79.7	
85-550	4-19-85	Male	3	52.5	74	270	29.7	
85-510	5-08-85	Female	0.7	18.0	131	—	—	Kitten
85-390	5-10-85	Female	3	35.5	91	142	34.7	
85-225	5-15-85	Female	1-2	30.8	56	402	71.0	
85-165	5-16-85	Male	6	56.0	27	429	54.3	
85-195	6-02-85	Male	7-8	54.5	80	230	81.5	Died 12-10-85
85-740	8-21-85	Female	0.9	—	54	—	—	Kitten
85-560	8-23-85	Female	1.5	31.0	54	236	41.5	

¹Estimated.

²Proportion of the animals total home range that was within the study area.

