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PROBLEMS

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

Mountain lions have historically preyed on livestock in California. The California Department of Fish and Game began recording mountain lion depredation incidents in 1971 to determine the scope of this problem. Livestock operations are economically important to California and predation can cause financial loss to individual ranchers. Depredation efforts have reportedly reduced California's mountain lion populations in the past, and the present effect needed documentation. Many aspects of depredation were studied, including frequency, trend, and prey species. The geographic distribution of livestock depredations was recorded to determine possible problem areas. The sex, age, and health of depredation lions were studied to determine if these were characteristic of a stock killer. The control policy and methods of control between 1971 and 1977 were evaluated for efficiency.

The Department of Fish and Game, at the request of the Legislature, developed an investigation and permit system to record incident data to determine the extent of the predation problem. The Department of Fish and Game felt the depredation information would assist in developing a management plan for the lion and improve the efficiency of livestock predation control. The historic and contemporary records and literature on livestock predation were studied.

HISTORICAL REVIEW

Mountain lion predation on livestock in California was recorded by the first Spanish missionaries (Young and Goldman, 1946) in the latter part of the 16th Century. The missions administered a cattle industry in California, mainly for hides. Lions, grizzlies and other predators found the domestic stock easy prey and the mission administration offered a bounty to local Indians and settlers of one bull for each lion killed. Livestock predation was still a problem in the mid-1800s especially in lower and southern California (Browne, 1869). Ranchers in the San Gabriel Valley were losing cattle during the 1890s and would organize hunting parties to take the stock killers (Holder, 1893). Hound dogs were the favorite method of capturing the lion. Sportsmen and livestock interests were concerned because of lion predation on deer and stock during this time, and both federal and state predator control activities were being conducted in California by the early 1900s. The U.S. Forest Service and later the Bureau of Biological Survey (U.S. Fish and Wildlife Service) employed hunters and trappers to take livestock predators beginning in 1909.

The California Department of Fish and Game, at the direction of the Legislature, started a bounty on mountain lions in 1907. A \$20 bounty was in effect between 1907 and 1913 but changed to \$30 for females and \$20 for males from 1914 to 1947. The bounty became \$60 for female and \$50 for male in 1945, and remained that until the bounty ended in 1963. The Department of Fish and Game expanded predator control efforts in 1919 with the hiring of Jay Bruce as the first lion hunter and in 1932 by employing predator trappers. This program reached its peak in 1948 when 5 lion hunters and 40 trappers were working for the Department (Shannon, 1961). The programming emphasis was mainly toward deer predators, but some of the effort was directed to areas of high livestock predation. Eighteen counties paid additional bounty on lions at some time.

Studies on deer populations in the 1940s changed ideas on their relationship to predators and by 1950 the DF&G was curtailing predator control activities (Shannon, 1961). The last lion hunter positions were abolished in 1959 and predatory animal control became the responsibility of the U.S. Fish and Wildlife Service. Mountain lion control activities removed about 150-200 cats per year between 1907 and 1963. The combined effect of the bounty, and State and Federal employees removed over 12,500 mountain lions between 1907 and 1963. Bryant (1917) felt the lion bounty was having a depressing effect on lion numbers, but Longhurst *et al.* (1952) interpreted the figures to indicate a

¹A contribution of Federal Aid in Wildlife Restoration Project W-51-R.

relatively stable population. Control efforts probably reduced population numbers in many areas but in others the effect was to harvest the annual increase. National parks and refuges were hunted by control agents during the bounty period as it was believed these areas served locally as lion population centers for adjacent areas. Control efforts were biologically and economically unsound. A breakdown of expenditures in 1956 showed that lion control cost about \$629 per animal (Shannon, 1961). The mountain lion was reclassified as a nonprotected mammal from 1963-1969 and as a game mammal from 1970 to March of 1972.

The Department of Interior issued a report on predatory mammal control in 1964 (Cain, Gabrielson, Cottam, Kimball and Leopold) stressed the need for target individual control and close supervision of control practices and feed-back. The Department of Fish and Game promoted these ideas in its current mountain lion depredation policies established in 1972 when the lion was reclassified as a protected nongame mammal. Section 455 of Title 14 of the California Administrative Code and Section 4851 of the Department of Fish and Game Code define current depredation policy. The Department of Fish and Game will investigate within 48 hours reported property destruction or damage due to mountain lions. A permit is issued to the person suffering the loss or his agent, if the predation is substantiated. The permit specifies the method of take, the duration and location of control effort, and the tagging and disposition of the carcass. The permit is good for a maximum of 10 miles from incident site and 10 days from the permit's issuance. The dead lion must be turned over to the Department of Fish and Game. The U.S. Fish and Wildlife Service will respond to requests from landowners in the 36 counties they contract with if the Department has issued a permit.

METHODS AND MATERIALS

Historic and contemporary depredation records and literature provided data for representing quantitative and qualitative depredation factors. Livestock predation frequency, location, prey species, and the characteristics (sex, age, health) of the predator have been recorded since 1971 on a state-wide basis. Depredation locations were compared with mountain lion statewide range information (Sitton, 1977; Sitton-Wallen, 1976) and livestock range in California to evaluate the problem scope. Necropsy reports on depredating lions aided in examination of the predators' profile. Lions were aged by tooth wear and physical conditions were determined by the amount of subcutaneous and visceral fat and the presence of wounds, injuries, anomalies, and parasite load. Interviews with Department of Fish and Game, U.S. Fish and Wildlife Service and private predator specialists and the results of their field depredation activities provided the information for cataloging depredations. Hounds and hunters were usually used by permittees to kill livestock predators. Collaboration with mountain lion researchers from other western states in Sparks, Nevada, January 1976 yielded comparative depredation data. Several livestock predators were translocated after having transmitter collars attached and their movements were followed.

RESULTS

One hundred thirty-four depredation incidents were confirmed between March 1971 and December 1977 with an increase in yearly frequency from 5 in 1971 to 39 in 1977. Forty-five mountain lions were killed under permit provisions with an increase in yearly frequency from 5 in 1971 to 12 in 1977 (Table 1). More depredations occurred in April (14 percent) and October (11 percent); February (6 percent) and September (6 percent) had the lowest livestock predation frequency (Table 2).

Table 1. Depredation incidents on livestock by mountain lion from 4/71 to 12/31/77.

	<u>Depredation Incidents</u>	<u>Mountain Lions Killed</u>
1971*	5	5
1972	4	1
1973	21	7
1974	21	3
1975	15	7
1976	29	10
1977	39	12
Total	134	45**

* 0.9 yr.

** 28 males
17 females

Sheep were killed in 42 percent of the verified predation incidents (Table 3). Other prey species include goats (22 percent), cattle (16 percent), poultry (5 percent), horses (4 percent) and pigs (3 percent). Depredation permits (2) were issued when pets were lost to lion predation and on seven permits the prey was defined only as livestock. Over 43 percent of the sheep were lost during June, July and August with winter showing the smallest loss. Over 40 percent of the cattle were lost in December, January and February with smaller losses in the summer months. Most goats are taken by

Table 2. Total incidents ranked by month.

Jan	9	=	6.71%
Feb	8	=	5.97%
Mar	11	=	8.21%
Apr	19	=	14.18%
May	9	=	6.71%
Jun	10	=	7.46%
Jul	11	=	8.21%
Aug	13	=	9.70%
Sep	8	=	5.97%
Oct	15	=	11.19%
Nov	9	=	6.71%
Dec	13	=	9.70%

Total 134 100.00%

Table 3. Mountain lion depredations and species of livestock killed from 4/71 to 12/31/77.

Sheep	57	=	42.53%
Goats	29	=	21.64%
Cattle	22	=	16.42%
Poultry	7	=	5.22%
Horses	6	=	4.48%
Pigs	4	=	2.99%
Pets	2	=	1.49%
Unspecified	7	=	5.22%
Total	134		100.00%

Note: This is only the number of incidents, not the actual number of animals killed.

Table 4. Mountain lion depredations and livestock losses by month.

Month	Sheep		Cattle		Goats	
	Number	Percent	Number	Percent	Number	Percent
Jan	3	5.26	3	13.64	3	10.34
Feb	0	0.00	3	13.64	3	10.34
Mar	2	3.51	1	4.55	4	13.79
Apr	5	8.77	4	18.18	6	20.69
May	2	3.51	1	4.55	3	10.34
Jun	8	14.04	1	4.55	1	3.45
Jul	7	12.28	1	4.55	1	3.45
Aug	10	17.54	0	0.00	0	0.00
Sep	4	7.02	1	4.55	1	3.45
Oct	9	15.99	2	9.09	3	10.34
Nov	3	5.26	2	9.09	1	3.45
Dec	4	7.02	3	13.64	3	10.34
Total	57	100.00	22	100.00	29	100.00

mountain lions in the winter (34 percent) and spring (34 percent) and the least during the summer (Table 4). Sheep are traditionally grazed in mountain lion ranges during the late spring and early summer, the months of high depredation incidence. April is a high loss period for all livestock; this is a time when a large number of young lions are present and also a large number of young prey are available.

Nearly one-half of all livestock predation occurred in four counties: San Luis Obispo, 19 incidents; Monterey, 17 incidents; Santa Barbara, 16 incidents; and Calaveras, 11 incidents (Table 5).

Table 5. Mountain lion depredation incidents, ranked by county, from 4/71 to 12/31/77.

San Luis Obispo	19	=	14.18%	Madera	3	=	2.24%
Monterey	17	=	12.69%	Tuolumne	2	=	1.49%
Santa Barbara	16	=	11.94%	Mariposa	2	=	1.49%
Calaveras	11	=	8.21%	Sonoma	2	=	1.49%
Placer	8	=	5.97%	Mono	2	=	1.49%
Lake	7	=	5.22%	Napa	1	=	.75%
Trinity	6	=	4.48%	Colusa	1	=	.75%
Riverside	5	=	3.73%	Los	1	=	.75%
Kern	4	=	2.99%	Tehama	1	=	.75%
Mendocino	4	=	2.99%	Humboldt	1	=	.75%
San Diego	4	=	2.99%	Alpine	1	=	.75%
Fresno	4	=	2.99%	Orange	1	=	.75%
Santa Clara	4	=	2.99%				
Shasta	4	=	2.99%				
Ventura	3	=	2.24%	Total	134		100.00%

Fifty-nine livestock predation incidents (44 percent) occurred in the coastal region from Ventura to Santa Clara County. The Sierra Nevada region yielded 37 incidents (28 percent), the north coast region from Napa and Sonoma counties through Humboldt, Trinity and Shasta counties 27 incidents (20 percent) and all incidents (8 percent) in the Southern California Region (Table 6).

Forty-five mountain lions (28 males and 17 females) have been taken by depredation permit. The sex and age of 19 lions were determined (12 males and 7 females) (Table 7). All males were three years or older including the following: three-year (5), four-year (4), six-year (1) and seven or over years (2). Female age classes were: One and one-half (1), two-year (2), four-year (1), five-year

(1), and seven or over years (2). Eighteen depredation lions were necropsied at the Department's field station (11 males and 7 females). The physical condition or health of these animals was rated with 9 males in good or excellent health and 2 males in fair condition (Table 8). Three of the males

Table 6. Mountain lion depredation incidents, ranked by region, from 4/71 to 12/31/77.

<u>South Coast Region Counties</u>		<u>North Coast Region Counties</u>	
San Luis Obispo	19 = 14.18%	Lake	7 = 5.22%
Monterey	17 = 12.69%	Trinity	6 = 4.48%
Santa Barbara	16 = 11.94%	Mendocino	4 = 2.99%
Santa Clara	4 = 2.99%	Shasta	4 = 2.99%
Ventura	3 = 2.24%	Sonoma	2 = 1.49%
	59 = 44.04% of State total	Tehama	1 = .75%
		Humboldt	1 = .75%
		Napa	1 = .75%
		Colusa	1 = .75%
			27 = 20.17% of State total
<u>Sierra-Nevada Region Counties</u>		<u>Southern California Region Counties</u>	
Calaveras	11 = 8.21%	Riverside	5 = 3.73%
Placer	8 = 5.97%	San Diego	4 = 2.99%
Kern	4 = 2.99%	Los Angeles	1 = .75%
Fresno	4 = 2.99%	Orange	1 = .75%
Madera	3 = 2.24%		11 = 8.22%
Tuolumne	2 = 1.49%		
Mariposa	2 = 1.49%		
Mono	2 = 1.49%		
Alpine	1 = .75%		
	37 = 27.62% of State total		
			134 = 100.00% of State total

Table 7. Age class of mountain lions taken on depredation.

<u>Sex</u>	<u>Age</u>						
	1	2	3	4	5	6	7+
Male			5	4		1	2
Female	1	2		1	1		2

Table 8. Condition of mountain lions taken on depredation.

<u>Males</u>			<u>Females</u>		
<u>Age</u>	<u>Condition</u>	<u>Problem</u>	<u>Age</u>	<u>Condition</u>	<u>Problem</u>
7+	Good	Abscess in jaw 50 cc fluid	7+	Good - pregnant	Worn & broken teeth tips
7+	Good	None	7+	Poor	Worn & broken teeth tips - Quills with fragments in lungs with lesions
6	Excellent	None			
4	Good	None			
4	Good	Spirocerca nodules			
4	Fair	None	5	Fair	None
4	Excellent	Numerous tapeworms	4	Good	None
			2	Good	None
3	Excellent	Spirocerca nodules	2	Good	None
			Juvenile	Good	None
3	Good	None			
3	Fair	Thin, but not excessively			
3	Good	Spirocerca nodules			

had heavy Spirocerca sp. nematode parasite loads (or burdens) with nodules present in the stomach, but these cats were in good to excellent health. Another male had an abscess on its jaw with 50-cc of fluid encapsuled, but its general condition was good and it had food in its stomach. A female seven plus years old in poor health had porcupine quills over a large portion of her ventral side with some fragments penetrating into the lungs, and worn and broken teeth. The other female seven plus also had worn and broken teeth, but was in good shape and pregnant. Most animals had light internal and external parasite "loads."

Five depredation lions were tagged and removed from the vicinity of livestock loss and released. Two were equipped with transmitter collars to follow their movements. None of the lions were taken on subsequent depredation permits. One collared lion was monitored in the vicinity of grazing livestock, but the cat was not involved in further livestock losses. One male lion captured on a depredation permit was taken to the San Diego Zoo and is now one of the zoo's two native California lions.

The mountain lion killing livestock will take its prey by stealth and the kill is usually made after a deliberate stalk. The lion secures its prey with a short rush and grab with its front feet. The prey is usually bitten at the base of the skull or on the side and back of the neck causing brain or spine injury with prompt fatal effect. The first portion consumed is usually the heart, liver and possibly lungs. Kills are quite distinct and there is no problem identifying the type of predator. More than one animal is usually taken during episodes of sheep predation and twenty to thirty animals may be taken over the course of a few days. Several instances of multiple goat predation have occurred but normally only one animal was killed. Cattle and horse predations involved one animal at a time. Livestock are generally taken on the range, but taking animals in pens or tethered is not uncommon. Several stock and pet predations have occurred within a few meters of occupied ranch houses.

DISCUSSION

Lion predation is a minor problem to the livestock industry in California yet it may have a significant impact on individual operations, especially with sheep. There were approximately five-million cattle and nine hundred thousand sheep in California in 1976 and only 29 verified incidents of predation occur for all livestock species. Not all depredations are reported since some livestock kills are not found, some ranchers absorb the loss without reporting to or getting permits from the Department of Fish and Game, and some ranchers have said they handle depredations outside the system. Incident rates and lions killed nearly doubled between 1973 and 1977 but with only seven years data it is impossible to say this represents a trend. The dry years of 1976 and 1977 caused changes in grazing practices and wildlife prey distribution which could affect the frequency of livestock loss as fewer water sources would concentrate livestock and wildlife usage. Mountain lion populations may be increasing in areas of high livestock loss and cause increased depredation. Monthly and seasonal frequency are associated with husbandry practice and possibly the yearly weather cycle.

Sheep represent about 43 percent of the depredation incidents. In total loss they represent over 90 percent of the individual animals taken. Many sheep losses are multiple. In one incident 40 sheep were killed by a lion in three nights. Cattle, goats and horses are usually single kills of immature animals. Several incidents involving calves indicated the cows tried to defend their young and this defensive behavior may serve to limit the lions predation on cattle. Attacks on horses have usually occurred on corralled animals. Free ranging horses apparently are able to avoid attack, and only one known incident of lion predation on a free ranging burro has occurred. Wild pig predation was noted in California (Sitton, 1976) and four incidents of predation on penned domestic pigs have been noted. Goats and pet predation bring the lion into close contact with man. Goats have been taken while tethered next to occupied ranch buildings. A lion was killed on a cabin porch after it had killed and was eating the owner's pet cat.

Small to moderate size livestock operations on the perimeter of high density lion populations (7-10 lions/100 square miles) are most often the victim of predations. Endemic lion predation problems occur on this type of operation in northern San Luis Obispo County, southern Monterey County, and in Santa Barbara County. Loss of sheep occurs in Placer County almost every year when they are placed on National Forest lands in the early summer.

There does not appear to be a "stock killer" type of mountain lion. All lions in the right circumstances can become a killer of livestock. Juvenile lions to lions over ten years old were verified stock predators. Most depredating lions were in good to excellent physical condition without injuries or disease. More depredating males were taken, but males are easier to catch and have larger territories than females (Sitton-Wallen, 1976) which would put them in contact with livestock more often. Translocation of livestock predators has been postulated as a management measure, but the high cost, the difficulty of finding relocation sites, the financial liability for the moved lion, the stress to the environment to which the lion is moved, and the possibility of genetic contamination reduce the value of this procedure. Livestock depredations are expected to continue as a minor problem in California.

The present control policy and methods of control provides relief to livestock owners suffering loss to mountain lions. Permit conditions grant adequate time and latitude to remove the offending lion while preventing removal of nontarget animals. Counties contracting with the Fish and Wildlife Service and counties with their own predator control programs offer professional assistance. Hunters with dogs are currently the most efficient method of taking the offending lion but knowledgeable trappers are also successful. Lions are sometimes killed by staking out the livestock carcass, at the place it was left by the lion. Nevada has successfully used sport hunting to ease the depredation

problem (Molini, 1976) reducing the number of lions killed per year from 100 to approximately ten. However, the present law precludes using sport hunting as a means to decrease depredation in California.

RECOMMENDATIONS

The permit procedures are adequate to meet depredation problems in California, but certain changes and additions could increase efficiency and biological data return. Recommendations are itemized below.

1. Supply predation investigations with a list of depredation control agents available to livestock owners (USF&WS agents and contracting counties, county predator control officers, available houndsmen and trappers).
2. Supply predation investigators with a field manual on how to determine which type predator caused loss.
3. Submit reports of unverified loss or negative verification.
4. Add specific information to report:
 - a. Number and kind (juvenile, breed, etc.) of livestock loss.
 - b. Time of loss.
 - c. Times depredating lion killed.
 - d. How lion was taken (dogs, trap, at carcass of kill, etc.)

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