JOB PROGRESS REPORT

State: California

Project Number: W-54-R-12 Project Title: Nongame Wildlife Investigations

Job Number: IV-6 Job Title: Bobcat Harvest Assessment

Period Covered: July 1, 1979 - June 30, 1980 Job Type: Survey and Inventory

SUMMARY:

An estimated total of 14,200 bobcats were taken during the 1979 hunting year and the 1979-80 trapping season. Approximately 6,700 bobcats were taken by trappers and 7,500 were taken by hunters. The total take was an increase of about 1,500 from the 1978-79 year with an increase in hunter take representing the difference. However, the 1979-80 total is considerably lower than the 1976-77 and 1977-78 total. These data were gathered through the process of tagging bobcat furs for export, the annual hunter survey, and U. S. Fish and Wildlife Service depredation control records.

Regulations were adopted to divide the state into three zones with different season lengths for bobcats and to set a sport hunting bag limit, and tagging and reporting requirements.

BACKGROUND:

Bobcat harvest has increased in California over the last decade. This reflects an abundant population of bobcats and high fur prices. The sale of bobcat fur now brings the highest dollar income to trappers of any species of fur harvested and sold in California. In order to determine the magnitude of the bobcat harvest and the resultant effect on bobcat populations throughout the state, a number of studies were initiated. Field studies of local population dynamics have been performed on unharvested populations in Siskiyou, Riverside and San Diego counties and on a harvested population in San Diego County. Reports on these studies have been made through other jobs. A statewide harvest monitoring system has been established where the age and sex structures of the harvested population are sampled (see Job IV-7) to determine the effect of the harvest on the various bobcat populations, and to identify the amount of harvest. This latter objective is the subject of this job.

OBJECTIVE:

Determine the annual bobcat harvest on a regional basis, for the purpose of managing populations through the manipulation of season lengths and chronology, take methods, and take limits.

PROCEDURES:

The commercial take is determined through assessment of mandatory, annual reports of licensed trappers and through a mandatory tagging program for all bobcat furs. Commercial fur takers report their take at the end of each license year (fiscal year) giving the quantity of take of each species by county. Anyone possessing or wishing to sell or to transport a bobcat fur must have it tagged. As part of the tagging process, the taker must supply information on the place, date and method of take and provide other biological information.

Sport take is determined through the Department's annual hunter survey questionnaire. This survey queried a 3 to 4% sample of approximately 522,000 licensed hunters about their hunting effort and success for various species. Information on total take, regional distribution of take, total effort of hunters, and percent successful hunters is gathered on bobcat hunting from this survey.

All depredation take must be reported to the Department. This information is received from the person doing the taking or from the public agency doing the depredation control work.

RESULTS:

Attached is the report cited below prepared to justify the export of harvested bobcat from California:

> Calif. Dep. Fish and Game. 1980. Information requested by the O.S.A., U.S.F.&W.S. for approval of the international export of bobcats from California during the 1980-81 season. State of Calif., Resources Agency, Calif. Dep. Fish & Game, Sacramento. Multilith report, June 1980. 14 pp.

The total estimated take of bobcats during 1979-80 was 14,200 individuals (Table 1). This was about 1,500 more bobcats than were taken during 1978-79 but 1,600 and 6,000 less than were taken during 1976-77 and 1977-78, respectively. Of the total, hunters took the majority (53%) of the animals with trappers taking slightly fewer (47%).

Over the last ten years, the distributional pattern of the sport take has been fairly stable with usually seven of the ten top counties from the decade ranking in the top ten in hunter take for any one year (Table 2). However, in 1979 only three of the decade's top ten--San Bernardino, San Diego and Mendocino counties--were in the top ten. Four of the seven counties were from the west slope of the Sierra Nevada where the relative trapper take is fairly low. Two of the seven were Los Angeles and Ventura counties, near metropolitan Los Angeles, where the density of bobcats appears to be relatively high but also where there is a considerable commercial harvest.

The distribution of the commercial take of bobcat has shown a shift of importance from the three northeastern California counties--Modoc, Siskiyou and Lassen--to the south coastal California counties (Table 3). At least two of northeastern California's three counties ranked in the top six during the seasons of 1971-72 through 1975-76. None of these counties placed in the top 10 in 1976-77 and they have averaged only one county in the top ten over the last four seasons with the highest ranking of a

Table 1. Estimated annual take of bobcats by hunting and trapping in California.

		Season[1/]			
		1976-77	1977-78	1978-79	1979-80
I.	Take by licensed trappers	5,400	5,146	8,326	7,809
	A. Trapper take	5,000	4,650	6,825	6,686
	B. Commercial hunter take	400	500	1,500	1,123
II.	Take by all hunters	10,500	15,300	5,811	7,462
III.	Animal damage control take	347	208	56	32
IV.	Total take (IA + II + III)	15,847	20,150	12,700	14,200

1/ Licensed trapper data for season indicated, hunter take for calendar year of first year listed, animal damage control take for year listed.

Table 2. Ten counties reporting highest hunter take of bobcat in hunter survey, 1971-80.

Rank	1971	1972	1973	1974	1975
1	Tehama	S. Luis Obispo	S. Diego	Mendocino	S. Diego
2	Tulare	Fresno	Shasta	Fresno	Mendocino
3	S. Diego	S. Bernardino	Kern	Kern	Riverside
4	S. Bernardino	Mendocino	Fresno	Glenn	S. Barbara
5	Humboldt	Kern	Tehama	Tehama	S. Luis Obispo
6	Kern	Inyo	Humboldt	S. Diego	Kern
7	S. Barbara	S. Diego	Mendocino	Madera	Tulare
8	Fresno	Lake	Madera	Lake	Madera
9	Siskiyou	S. Barbara	Tulare	Yuba	Lake
10	Trinity	Madera	El Dorado	S. Benito	Monterey

Rank	1976	1977	1978	1979[1/]	Top Counties 1971-79
1	Tulare	Los Angeles	Tulare	San Bernardino	San Diego
2	Fresno	Orange	Fresno	Tuolumme	Kern
3	Monterey	S. Barbara	Mendocino	Los Angeles	Mendocino
4	Humboldt	Kern	Humboldt	Nevada	Fresno
5	S. Diego	Humboldt	Kern	Ventura	Tulare
6	Kern	S. Diego	S. Diego	Inyo	San Luis Obispo
7	Butte	Contra Costa	S. Bernardino	Mariposa	Humboldt
8	Madera	S. Bernardino	Monterey	San Diego	San Bernardino
9	Mendocino	Mendocino	S. Luis Obispo	Calaveras	Madera
10	Riverside	S. Luis Obispo	Lassen-Shasta	Mendocino	Santa Barbara

1/ For 1979, hunter take only includes sport hunting take.

Table 3. Ten counties reporting highest trapper take of bobcat, 1971-80.

Rank	1971-72	1972-73	1973-74	1974-75	1975-76
1	Modoc	Merced	S. Diego	S. Diego	Humboldt
2	Shasta	Modoc	Modoc	Modoc	S. Diego
3	Merced	Shasta	Tehama	Lassen	Modoc
4	Lassen	Siskiyou	Tuolomne	Humboldt	Shasta
5	Siskiyou	Humboldt	Siskiyou	Inyo	Inyo
6	Riverside	Sierra	Humboldt	Siskiyou	Siskiyou
7	S. Bernardino	Tehama	Mendocino	Colusa	Riverside
8	S. Diego	S. Bernardino	Shasta	Riverside	S. Bernardino
9	Humboldt	Butte	Lake	Fresno	Solano
10	Plumas	S. Diego	Solano	Lake	Lake

Rank	1976-77	1977-78	1978-79	1979-80	Top Counties 1971-80
1	Humboldt	S. Bernardino	Humboldt	Santa Barbara	Humboldt
2	S. Bernardino	Humboldt	S. Bernardino	Tulare	Modoc
3	S. Barbara	Tulare	Shasta	San Diego	San Diego
4	Shasta	S. Barbara	Kern	Kern	Siskiyou
5	S. Benito	Kern	Siskiyou	San Bernardino	Shasta
6	Mendocino	Inyo	S. Barbara	San Luis Obispo	San Bernardino
7	Tulare	Mendocino	Inyo	Siskiyou	Inyo
8	Fresno	Modoc	Modoc	Mendocino	Mendocino
9	S. Diego	Shasta	Mendocino	Monterey	Tehama
10	Inyo	Monterey	Tehama	Ventura	Santa Barbara

fifth. The emergence of the importance of south coastal California counties in the commercial harvest of bobcat can be shown by the 1979-80 season results where Monterey, San Luis Obispo, Santa Barbara, Ventura and San Diego counties all ranked in the top ten.

The total take of bobcats range from none in San Francisco, Sutter and Yolo counties to about 1106 in San Bernardino County (Table 4). The harvest for the ten counties having the highest harvest was at least 450 bobcats. Only 22 of the 55 counties had a reported total take of less than 100 bobcats.

The increase in take of bobcats continues to mirror the increase and maintenance of high values for bobcat furs (Table 5). The average price paid per pelt was $114.20. This is the third highest average price ever, behind the $133.50 of the 1975-76 season and $120.00 of the 1978-79 season.

The number of trappers taking bobcats also increased to 920 resulting in an average take of 7.76 bobcats per successful bobcat trapper (Table 6). This is an average take 14% below last year's average and below the average take of each season since 1975-76. The average take for licensees from Modoc County has been well below the statewide average for the last three seasons at 4.19, 5.63 and 5.31 bobcats per lincesed trapper, respectively. As shown, there was a decrease in the average take in Modoc County from the 1978-79 season to the 1979-80 season. However, in Modoc County this decrease amounted to 26%, considerably more than the statewide average.

The harvest of bobcats by sport hunters amounted to approximately 7,462 (Table 7). This was determined through a response that amounted to 2.2% of the 522,400 licensed hunters in California during 1979. At the 80% confidence level the take was between 6,676 and 8,249. Also it was estimated 5,960 persons hunted bobcats and that 47% of these hunters were successful. These same hunters spent an estimated 65,340 days hunting for an average take of 0.114 bobcats per day. This is a slight increase in take per unit effort from 0.105 bobcats per day with 55,420 days hunted during 1978.

ANALYSIS:

After a noticeable reduction of 37% in take, mostly through the reduction in hunter take, during the 1978-79 season, the take increased by 12% this past season. This is probably the result of the maintenance of $100 plus average pelt prices for bobcat fur.

The effect of the increased take must be understood to assure that the bobcat resource is not over-utilized. There are some indications that some populations have been relatively under-utilized. This is especially true of the bobcat populations in south coastal California counties which have demonstrated a large increase in commercial take over the last decade. At the same time, the northeastern California counties, which traditionally have provided bobcats with higher pelt values, have not kept pace with the increased take shown elsewhere. This could be an indication that bobcat resources in the northeastern counties are being harvested at a higher

Table 4. Take of bobcat, by county, during 1979-80.

		Licensed Trapper Take	Commercial Hunter Take	Sport Hunter Take	Estimated Total Take
1.	Alameda	28			28
2.	Alpine	9	2	44	55
3.	Amador	12	1		13
4.	Butte	52	11	35	98
5.	Calaveras	14	8	262	284
6.	Colusa	20	4		24
7.	Contra Costa	2			2
8.	Del Norte	115	5		120
9.	El Dorado	17	21	69	107
10.	Fresno	212	40	140	392
11.	Glenn	25	1	45	71
12.	Humboldt	246	173	7	426
13.	Imperial	16	1		17
14.	Inyo	236	6	445	687
15.	Kern	338	57	33	428
16.	Kings	51			51
17.	Lake	168	11		179
18.	Lassen	213	60	30	303
19.	Los Angeles	147		496	643
20.	Madera	42	2	133	177
21.	Marin	1	14		15
22.	Mariposa	98	37	369	504
3.	Mendocino	269	69	247	585
4.	Merced	10			10
25.	Modoc	153	42	48	243
26.	Mono	90	1		91
27.	Monterey	260	43	3	306
28.	Napa	37		226	263
29.	Nevada	8		451	459
30.	Orange	10		90	100
31.	Placer	11	4	131	146
32.	Plumas	79	7	39	125
33.	Riverside	68	4	176	248
34.	Sacramento		1		1
35.	San Benito	178	22	158	358
36.	San Bernardino	305	66	735	1106
37.	San Diego	345	9	352	706
38.	San Francisco				
39.	San Joaquin	2			2
40.	San Luis Obispo	290	2	88	380
41.	San Mateo	60	1		61
42.	Santa Barbara	440	35	100	575
43.	Santa Clara	3	1		4
44.	Santa Cruz	29			29
45.	Shasta	170	49		219
46.	Sierra	7	1		8
47.	Siskiyou	286	78	57	421
48.	Solano	11			11
.	Sonoma	71	1		72
50.	Stanislaus	1	20	26	47

Table 4. (Con't)

	Licensed Trapper Take	Commercial Hunter Take	Sport Hunter Take	Estimated Total Take
51. Sutter				
52. Tehama	118	10		128
53. Trinity	48	13	77	138
54. Tulare	364	42	48	454
55. Tuolumne	21	24	696	741
56. Ventura	250	5	446	701
57. Yolo				
58. Yuba	12	9	37	59
59. Unknown	618	110		728
Total	6686	1123	6339	14,148

Table 5. Bobcat pelt prices

Season	Average Price	Highest Price[1/]
1970-71	$ 10.86	Not recorded
1971-72	$ 18.83	$ 30.00
1972-73	$ 29.33	$ 61.00
1973-74	$ 45.00	$110.00
1974-75	$ 50.00	$110.00
1975-76	$133.50	$300.00
1976-77	$ 76.00	$225.00
1977-78[2/]	$105.80	$285.00
1978-79[2/]	$120.00	$426.00
1979-80[2/]	$114.20	$313.00

1/ Highest single price reported as average price of top quality pelt is not available.
2/ Data taken only from California Trapper's Association fur sales which tend to be higher than average paid throughout season by all fur dealers.

* * *

Table 6. Average bobcat harvest per successful bobcat trapper per season in California, 1970-71 to 1979-80.[1/]

Season	No. of licensed trappers	No. of trappers harvesting bobcats	Harvest per successful trapper
1970-71	631	No Data Available	No Data Available
1971-72	539	59	9.97
1972-73	682	95	7.22
1973-74	878	172	7.23
1974-75	1,172	227	6.14
1975-76	931	283	7.78
1976-77	1,692	446	8.11
1977-78	1,889	550	8.08
1978-79	2,378	766	9.04
1979-80	3,221	920	7.76

1/ Data only available on the number of successful bobcat trappers and not on the number of trappers trying to catch bobcats.

Table 7. Statistical parameters of the hunter take of bobcat during 1979. Poisson distribution.[1/]

Frequency distribution: No. of bobcats taken	No. of hunters	Total bobcats taken
0	70	0
1	41	41
3	4	8
4	6	18
5	2	10
6	1	6
12	1	12
13	1	13
14	1	14
17	2	34
	$\Sigma f = 131$	$\Sigma yf = 164$

$$\bar{x} = \frac{\text{total bobcats taken}}{\text{total respondents}} = \frac{164}{11,481} = 0.01428447$$

Statewide bobcat bag = $(\bar{x})$ (total no. license buyers) = (0.01428447) (522,400) = 7462
Assuming that bobcat take follows a Poisson distribution, confidence limits may be assigned by knowing $\bar{x}$ and n (total no. of respondents)

$$\sigma(\bar{x}) = \sqrt{\frac{\bar{x}}{n}} = \sqrt{\frac{0.01428447}{11,481}} = 0.0011154297$$

Confidence interval of $(\bar{x}) = \bar{x} \pm t\,\sigma$

Level of Confidence	$(\bar{x}) \pm (t)\,(\sigma)$	Confidence Intervals for $(\bar{x})$	Confidence Interval for Total Take [2/]
80%	$0.01428447 \pm (1.35)(0.0011154297)$	$0.01428447 \pm 0.0015058301$	6676-8249
90%	$0.01428447 \pm (1.65)(0.0011154297)$	0.01428447 ± 0.0018404	6501-8424
95%	$0.01428447 \pm (1.96)(0.0011154297)$	0.01428447 ± 0.0021861	6320-8604
99%	$0.01428447 \pm (2.576)(0.0011154297)$	0.01428447 ± 0.0028732	5961-8963

1/ After Shimamoto (1976)
2/ Calculated by multiplying confidence intervals for $(\bar{x})$ by total number of license buyers (522,400)

rate than elsewhere and may be relatively heavily affected by the increase in harvest.

In assessing harvest figures for the impact of the take (assessing of population structure data to determine the impact of harvest is discussed in W-54-R-12, Job IV-7), the density of the harvest can be compared with the estimated bobcat density on a county by county basis (Table 8). Using density estimates given for California's various habitat types (Project W-54-R-10, Job IV-1.6) and the distribution of that habitat (Dept. of Fish and Game, 1978) an average county density can be calculated and compared to the average density of the harvest. The comparison results in a crude estimate of mortality due to harvest.

The total mortality rate of a bobcat population can't exceed 45 to 50% and still maintain a population of the same size under normal conditions (Table 9). However, in checking crude mortality rates (Table 8) gathered from the 1979-80 year, the mortality rate in nine counties was higher than .400 or 40%. This could mean that the population estimate was incorrect or that the population is being overharvested. Reviewing the original estimated population densities for the habitat, figures of 0.25 bobcats per square mile for pine-fir-chaparral, inland sagebrush and juniper-pinyon habitat types should be reduced to one-half that amount as shown by Zezulak (1980). In particular, this would affect the estimated population densities in Lassen and Modoc counties to the extent that the crude mortality due to harvest in both counties exceeds 50%. The other noticeable area of high mortality due to harvest is in the central Sierra Nevada where Nevada, Alpine, Calaveras, Tuolumne and Mariposa counties are above the acceptable level of 40%.

Because of the estimated nature of the estimated population densities for each county, this information by itself can't be used to judge the impact of harvest. It must be used in conjunction with data gathered in other studies, most notably population structure data as reported in Project W-54-R-12, Job IV-7. As a result of this information and that presented in other job reports, the bobcat season for 1980-81 will be shortened generally and the state will be divided into three different zones. The northeastern California zone (containing Lassen and Modoc counties and parts of Siskiyou and Shasta counties) will have a three-week season only. In south coastal California counties, where bobcat populations appear to be doing the best, there will be a two-month season while in the remainder of the state the season will be 1½ months in length.

The estimates of hunter take still seem high when compared with the hunting pressure on other species of birds and mammals. Despite recent efforts (Gould 1977, Belluomini 1978) to reduce response bias and to calculate confidence limits for the estimated harvest by hunters, the fact that only 1.1% of the respondents, which in turn only represent 2.2% of all the licensed hunters, said they hunted bobcats may bias any projections made from this sampling procedure. This possible problem was first noted by Shimamoto (1976) and no analysis of a possible bias has been made yet.

In order to try to better understand hunter take, the California Fish and Game passed regulations for the 1980-81 season which will require hunting tags and a mandatory return of those tags for the sport hunting of bobcats. Additionally, a limit of two such tags per sport hunter has been imposed.

Table 8. Estimated mortality rate of bobcats due to harvest in California during 1979-80 season.

		Estimated Bobcat Habitat (mi^2)[1]	Density of Bobcat Harvest (#/mi^2)	Estimated Pop. Density (#/mi^2)[2]	Mortality Rate Due to Harvest
1.	Alameda	166	.169	1.331	.127
2.	Alpine	705	.078	.145	.538
3.	Amador	521	.025	.691	.036
4.	Butte	1000	.098	.662	.148
5.	Calaveras	889	.319	.775	.412
6.	Colusa	489	.049	1.014	.048
7.	Contra Costa	194	.010	1.423	.007
8.	Del Norte	985	.122	.451	.271
9.	El Dorado	1634	.065	.463	.140
10.	Fresno	2576	.152	.652	.233
11.	Glenn	596	.119	.995	.120
12.	Humboldt	3164	.135	.361	.374
13.	Imperial	3168	.005	.111	.045
14.	Inyo	9462	.073	.191	.382
15.	Kern	4992	.086	.500	.172
16.	Kings	15	3.400	10.933	.311
17.	Lake	1041	.172	1.011[3]	.170
18.	Lassen	4100	.074	.145[3]	.510
19.	Los Angeles	2586	.249	1.043	.239
	Madera	1169	.151	.658	.229
	Marin	166	.090	1.259	.071
22.	Mariposa	1134	.444	.856	.519
23.	Mendocino	2930	.200	.558	.358
24.	Merced	208	.048	1.851[3]	.026
25.	Modoc	3442	.071	.124[3]	.573
26.	Mono	2597	.035	.206	.170
27.	Monterey	2175	.141	1.417	.100
28.	Napa	615	.428	.990	.432
29.	Nevada	936	.490	.433	1.132
30.	Orange	258	.388	.903	.430
31.	Placer	1106	.132	.442	.299
32.	Plumas	2432	.051	.367	.139
33.	Riverside	6240	.040	.409	.098
34.	Sacramento	67	.015	1.343	.011
35.	San Benito	744	.481	1.476	.326
36.	San Bernardino	19362	.057	.246	.231
37.	San Diego	3646	.194	1.097	.177
38.	San Francisco	0	0		
39.	San Joaquin	73	.027	1.205	.022
40.	San Luis Obispo	1656	.229	1.356	.169
41.	San Mateo	180	.339	.506	.670
42.	Santa Barbara	2066	.278	1.361	.204
43.	Santa Clara	785	.005	1.162	.004
44.	Santa Cruz	334	.087	.521	.167
45.	Shasta	3562	.061	.647	.094

Table 8. (Con't)

		Estimated Bobcat Habitat (mi^2)[1/]	Density of Bobcat Harvest (#/mi^2)	Estimated Pop. Density (#/mi^2)[3/]	Mortality Rate Due to Harvest
46.	Sierra	908	.009	.289	.031
47.	Siskiyou	5251	.080	.608	.132
48.	Solano	108	.102	1.667	.061
49.	Sonoma	992	.073	.887	.082
50.	Stanislaus	456	.103	1.355	.076
51.	Sutter	11	0		
52.	Tehama	2306	.056	.902	.062
53.	Trinity	3117	.044	.398	.111
54.	Tulare	2663	.170	.839	.203
55.	Tuolumne	2054	.361	.515	.701
56.	Ventura	1488	.471	1.065	.442
57.	Yolo	216	0		
58.	Yuba	383	.154	.671	.230
	Statewide	116119	.122	.544	.224

1/ from Dept. of Fish and Game report to the Endangered Species Scientific Authority, 1978.

2/ from density data presented in Project W-54-R-10, Job IV-1.6

3/ estimated population density for Lassen and Modoc counties modified as per density given by Zezulak (1981).

Table 9. Population models showing survival rate needed to maintain stable populations.[1/]

		YEAR 1	YEAR 2	YEAR 3	YEAR 4
MODOC CO. (1978-79, 1.3♂/♀)					
Adults in spring		100	73	73	73
Yearlings in spring		45	72	72	72
Producing adult	(90%)	39	29	29	29
Producing yearling	(90%)	18	28	28	28
Kittens at den		143	143	143	143
Kittens surviving	(50%)	72	72	72	72
Yearlings surviving	(50%)	23	36	36	36
Adults surviving	(50%)	50	37	37	37
KERN CO. (1978-79, 1.2♂/♀)					
Adults in spring		100	65	66	66
Yearlings in spring		28	65	63	61
Producing adult	(90%)	41	27	27	27
Producing yearling	(75%)	10	22	21	21
Kittens at den		128	123	120	120
Kittens surviving	(51%)	65	63	61	61
Yearlings surviving	(51%)	14	33	32	31
Adults surviving	(51%)	51	33	34	34
SANTA BARBARA CO. (1978-79, 1.25♂/♀)					
Adults in spring		100	61	64	63
Yearlings in spring		10	54	50	50
Producing adult	(80%)	36	22	23	22
Producing yearling	(60%)	3	14	13	13
Kittens at den		98	90	90	88
Kittens surviving	(55%)	54	50	50	48
Yearlings surviving	(55%)	6	30	28	28
Adults surviving	(55%)	55	34	35	35

1/ percentages of producing females are representative of breeders in these populations (Lembeck 1978, Zezulak 1981). Litter size is 2.5 young per female in all cases.

RECOMMENDATIONS:

1. Continue to monitor the take of bobcat by geographical area to use information in determination of management procedures needed to maintain bobcat populations.

2. Update the estimated density of bobcats as bobcat density figures are obtained through field research.

3. Evaluate the methods used to obtain the harvest of bobcats by hunters and correct for any inherent biases.

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Date: May 8, 1981