Factors explaining the decline of black-tailed deer: A comparative study on public and private lands in northern California

Agreement #: P0880013 between the University of California and the California Department of Fish and Game

Project Progress Report
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DRAFT – INTERNAL USE ONLY

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Progress report until September 30, 2011

1) Adult deer

Summary:

The total number of collared female deer over 1 year of age for the entire project is currently 41. A previous CDFG project in the area also collared 23 adult female deer, for a total of 63 total collared adult female deer (note that ID 5740 collared during the first project was recaptured and re-collared during the second project). All deer have been collared on public land. We have recorded 15 mortalities to date (36.6% mortality rate), and 3 deer of unknown status. Seven deer from the initial 2009 capture group survived 2 years and their GPS collars have automatically dropped and have been recovered. We currently have 16 surviving collared deer and 3 deer of unknown status that may have suffered collar failure.

a) Status of adult collared deer 2009-2011:

Since captures began in June 2009, we have successfully captured 41 female deer older than 1 year of age (Table 1). All 41 individuals have been captured on public land and fitted with GPS collars (Telonics and Lotek).

During the first year of the study (2009), we captured a total of 15 individuals. We have recorded 8 mortalities from this group, and 7 deer survived for 2 years, after which the GPS collars automatically dropped off before exhausting their battery life and were recovered. The mortality rate of 53.3% in this group is unusually high for adult female deer.

An additional 14 individuals were captured in 2010 to increase our sample of collared animals and to replace animals that died during the previous year. Of these 14 deer 4 have died of natural causes (28.6% mortality), one died from capture related causes, and 3 deer may have suffered collar failure and their status is unknown.

During the 2011 summer field season an additional 12 individuals were captured to replace mortalities and to maintain optimal sample size. One of these deer died from capture related causes and one deer died from natural causes

(Table 1). As of September 2011, 16 deer are alive with active GPS collars and the status of 3 deer is unknown (Table 1).

b) Cause of mortality assessment:

Cause of mortality is assessed in the field by trained crews based on track and sign, scat, tooth punctures and feeding evidence, evidence of carcass caching, and disposition of the carcass. Additionally swab samples are taken to identify predator and scavenger species through DNA analysis.

The DNA analysis from 2009 and most 2010 adult mortality sites has been completed by Dr. Ben Sack's lab at UC Davis. However, due to the fact that many adults died in the late winter and early spring, the preliminary DNA results need to be analyzed with both the kill site assessment and body condition assessment (from bone marrow fat) before being reported. Heavy scavenging by black bears in the study area has likely resulted in some DNA tests being confounded between predator and scavenger identity. Black bear scavenging can make it difficult to identify the actual cause of death and determine whether it was predation, starvation, or disease. However the combination of field assessment, DNA analysis, measuring body condition from femur marrow fat levels, and comparing collared deer mortality sites to known mountain lion predation sites from collared mountain lions that have been scavenged by bears allows a reasonable assessment of cause of mortality. Our main challenge remains reaching winter mortalities within a reasonable time (see below). Preliminary results indicate that the combined use of DNA analysis of mortalities that were recovered within 24 hours and our mortality site assessment will be an accurate assessment of cause of mortality and predator identity.

c) Monitoring:

Monitoring remains a challenge due to the enormous wear and tear on field vehicles. The project currently has one DFG truck that is used primarily for deer work and one DFG truck that is used primarily for mountain lion work. Additionally a third truck was leased through UC Davis for the 2011 summer field season at substantial costs to supplement capture, monitoring, and other survey efforts.

Winter access to the study area to monitor deer and retrieve mortalities has been a challenge during the first 2 years of the project. In order to adequately monitor deer during the winter monitoring flights must be scheduled every 10 days and snowmobiles must also be available to monitor when weather conditions prevent flights. Additionally, in order to assess cause of mortality accurately winter deer mortalities must be retrieved as soon as possible after detection. This requires snowmobiles and support personnel for safety during mortality retrieval in winter conditions. Options for flights and snowmobile use are currently being discussed and finalized with DFG.

Table 1: Status of adult black-tailed deer Mendocino black-tailed deer project; updated September 20, 2011.

No	ID	Group	Capture Date	Sex	Age (Est) [1]	Age (cementum)	Weight (lbs.)	Last Date Observed	Status	Comments[2]
1	**8796**	M1	8-Jun-09	F	3	6	115	10-Oct-09	dead	predation (unknown)
2	**5740**	M1	9-Jun-09	F	7	pending	98	16-Nov-09	dead	unknown
3	**8805**	M1	9-Jun-09	F	2	3	95	18-Mar-10	dead	unknown
4	**8809**	M1	9-Jun-09	F	3	3	123	30-Mar-11	dropped collar	survived for 2 years
5	**8810**	M1	9-Jun-09	F	5	3	115	18-May-11	dropped collar	survived for 2 years
6	**8801**	M1	10-Jun-09	F	4	3	104	7-Apr-11	dropped collar	survived for 2 years
7	**8808**	FH7	10-Jun-09	F	2	pending	72	8-Aug-09	dead	predation (unknown)
8	**8798**	FH7	10-Jun-09	F	4	6	115	7-Apr-11	dropped collar	survived for 2 years
9	**8803**	FH7	11-Jun-09	F	2	2	82	30-Mar-11	dropped collar	survived for 2 years
10	**8804**	FH7	11-Jun-09	F	4	10	105	12-Feb-10	dead	predation (bear)
11	**8800**	FH7	11-Jun-09	F	5	4	132	7-Apr-11	dropped collar	survived for 2 years
12	**8802**	M1	8-Aug-09	F	2	3	106	3-Jun-10	dead	predation (mtn. lion)
13	**8835**	M1	13-Aug-09	F	2	3	101	18-Mar-10	dead	unknown
14	**8817**	FH7	14-Aug-09	F	1	pending	92	11-Aug-11	dropped collar	survived for 2 years
15	**8834**	M1	21-Dec-09	F	5.5	11	150	18-Nov-10	dead	predation (unknown)
16	**8815**	FH7	20-Jun-10	F	4	5	108	6-Dec-10	dead	likely poaching
17	**7584**	FH7	21-Jun-10	F	3	4	90	28-May-10	unknown	likely collar failure, heard in July with very rapid pulse rate
18	**8820**	FH7	21-Jun-10	F	3	3	115	5-Jul-11	dead	predation (unknown)
19	**7586**	M1	22-Jun-10	F	3	3	80	14-Jul-11	unknown	large range movement or collar failure

No	ID	Group	Capture Date	Sex	Age (Est) [1]	Age (cementum)	Weight (lbs.)	Last Date Observed	Status	Comments[2]
20	**8821**	FH7	22-Jun-10	F	2	pending	75	9-Jul-11	unknown	possible collar failure
21	**7597**	FH7	23-Jun-10	F	4	10-11	95	3-Jul-11	dead	unknown
22	**8823**	FH7	24-Jun-10	F	4	3	85	15-Sep-11	alive	
23	**7588**	FH7	24-Jun-10	F	6	5	105	15-Sep-11	alive	
24	**8826**	FH7	25-Jun-10	F	7	10	114	15-Sep-11	alive	
25	**7585**	M1	16-Jul-10	F	6	5	112	15-Sep-11	alive	
26	**7583**	FH7	28-Jul-10	F	4	3	96	15-Sep-11	alive	
27	**8811**	FH7	24-Aug-10	F	6	9	109	24-Aug-10	dead	capture related
28	**8819**	FH7	24-Aug-10	F	5	6	106	15-Sep-11	alive	
29	**7885**	FH7	26-Aug-10	F	3	2	88	7-Apr-11	dead	unknown
30	**8828**	M1	21-Jun-11	F	4	pending	110	15-Sep-11	alive	
31	**8816**	M1	21-Jun-11	F	4	pending	99	15-Sep-11	alive	
32	**7879**	M1	22-Jun-11	F	7	pending	115	22-Jun-11	dead	capture related
33	**7893**	M1	22-Jun-11	F	3.5	pending	88	15-Sep-11	alive	
34	**8822**	M1	25-Jun-11	F	3	pending	120	15-Sep-11	alive	
35	**8813**	M1	25-Jun-11	F	6	pending	84	15-Sep-11	alive	
36	**7037**	M1	25-Jun-11	F	3	pending	75	15-Sep-11	alive	
37	**7884**	M1	26-Jun-11	F	5.5	pending	94	15-Sep-11	alive	
38	**8797**	M1	26-Jun-11	F	8	pending	100	9-Sep-11	alive	
39	**7308**	M1	6-Jul-11	F	4	pending	88	20-Aug-11	dead	predation (mtn. lion)
40	**7079**	FH7	9-Jul-11	F	6	pending	105	15-Sep-11	alive	
41	**7882**	FH7	9-Jul-11	F	5	pending	78	15-Sep-11	alive	

[1] Age at capture estimated from tooth wear and replacement; confirmation using cement-annuli from extracted tooth pending where indicated

[2] Predator identity pending final DNA analysis and mortality site assessment comparison

2) Fawns

a) Monitoring & status 2009 cohort:

Of the 15 fawns (5 males/10 females) captured and tagged during 2009, only 2 (R1116 and R1055) survived to become yearlings (Table 2). VHF ear-tags of both these fawns are no longer active and thus their status can no longer be monitored.

b) Monitoring & status 2010 cohort:

During 2010, we captured and tagged 26 fawns (12 males/14 females) (Table 3). Higher capture success was due to a combination of increased capture efforts as well as experience of the capture crews.

Of the 26 fawns captured, 18 died, 7 survived to become yearlings, and 1 was last heard in the winter of 2011 and its status is unknown. The batteries in the VHF ear tags of this cohort are not active and they can no longer be monitored.

c) Monitoring & status 2011 cohort

In the 2011 field season we captured 45 fawns (24 males/21 females) (Table 4). This is a significantly higher sample size than previous years, 19 more than 2010 and 30 more than 2009. The higher capture success was due to increased capture efforts during a week of combined fawn and adult deer capture, experienced capture crews, and the rental of a third project truck. Capture success is heavily linked to capture effort, and the increased effort and experience resulted in higher sample size.

Of the 45 fawns that were captured, 21 have died (47.7% mortality), 1 experienced tag failure, and 23 survive as of September 15, 2011. The larger number of surviving fawns, which are almost equal to the entire 2009 fawn sample, will require extensive efforts to monitor during winter (see also comment in adult section).

There are differences in both annual mortality rates between 2009 (84.7%) and 2010 (72.4%), and summer mortality rates between all years (2009 [69.5%];

2010 [56.4%]; 2011 [45.7%]). These differences raise the importance of sample size (summer survival in particular, see Figure 1) and the potential of substantial annual variation in fawn survival depending on environmental conditions. We would like to highlight that this observed variation, along with the small sample size in 2009, may require an additional year of fawn capture and monitoring beyond the current end date of our project to obtain meaningful survival estimates for black-tailed deer in the study area.

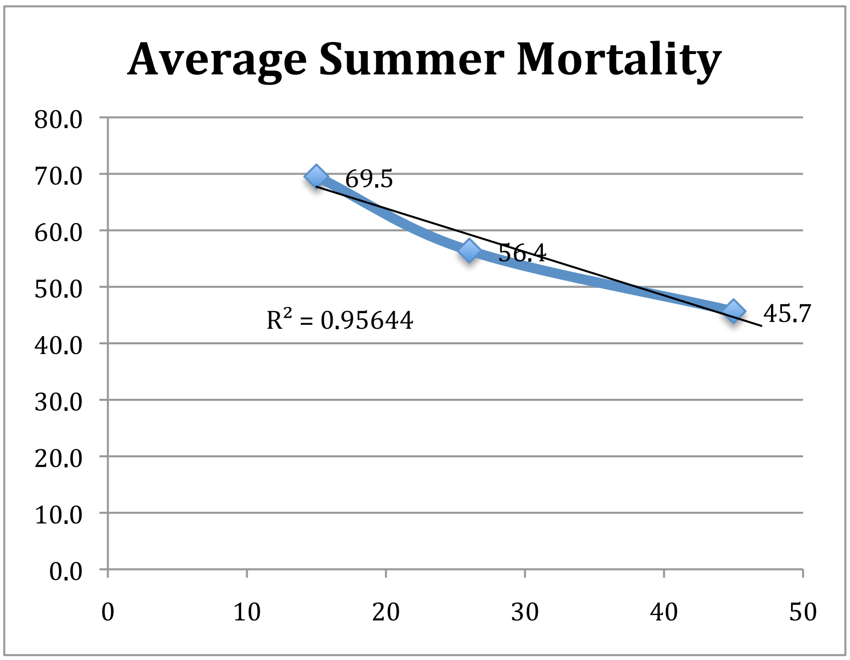

Figure 1: Average summer mortality as a function of sample size (number of fawns tagged with VHF ear-tags).

Table 2: 2009 Cohort - Status of black-tailed deer fawns Mendocino black-tailed deer project

Number	ID	Group	Capture date	Sex	Age (estimated)	Weight (kg)	Date last observed	Status
1	R1130	M1	30-Jun-09	male	<1 week	2.7	30-Jun-09	dead
2	Y10	M1	1-Jul-09	female	5-7 days	3.1	6-Jul-09	dead
3	R1110	M1	1-Jul-09	female	5 days	4.5	1-Jul-09	unknown(tag failure)
4	R1123	M1	1-Jul-09	female	<1 week	3.1	1-Jul-09	dead
5	R1125	M1	2-Jul-09	female	4-5 days	4.3	22-Sep-09	dead
6	R1109	M1	3-Jul-09	male	<3 days	2.3	4-Jul-09	dead
7	R1121	M1	3-Jul-09	female	<3 days	2.3	9-Jul-09	dead
8	R1071	M1	6-Jul-09	male	<1 week	3.9	16-Nov-09	dead, tag recovered on summer range July '10
9	R1119	FH7	7-Jul-09	female	>1 week	3.5	29-Jul-09	dead
10	R1068	M1	8-Jul-09	female	1 week	3.1	14-Sep-09	dead
11	R1116	M1	9-Jul-09	female	5 days	2.7	15-Aug-10	survived to yearling
12	R1054	M1	9-Jul-09	female	>1 week	3.9	10-Jul-09	dead
13	R1055	M1	11-Jul-09	female	>1 week	4.1	24-Jul-10	survived to yearling
14	R1191	FH7	12-Jul-09	male	>1 week	5	25-Aug-09	dead
15	R1185	FH7	14-Jul-09	male	<1 week	4.4	14-Jul-09	dead

Table 3: 2010 Cohort - Status of black-tailed deer fawns Mendocino black-tailed deer project

No.	ID	Group	Capture date	Sex	Age (estimated)	Weight (kg)	Date last observed	Status
1	Y13	FH7	21-Jun-10	female	1-2 weeks	4.5	21-Jun-10	dead
2	Y14	FH7	22-Jun-10	male	4-7 days	3.6	22-Jun-10	dead
3	Y21	FH7	22-Jun-10	female	5-7 days	3.2	5-Jul-10	dead
4	Y15	FH7	22-Jun-10	male	1-2 weeks	5.4	9-Jul-10	dead
5	Y16	FH7	22-Jun-10	female	1-2 weeks	4.7	13-Jul-10	dead
6	Y71	FH7	23-Jun-10	male	2 days	2.2	9-Jul-10	dead
7	Y4	FH7	25-Jun-10	female	>1 week	2.4	9-Jul-10	dead
8	Y52	FH7	26-Jun-10	female	2 days	2.6	22-Jun-11	survived to yearling
9	Y5	FH7	26-Jun-10	male	3-4 days	3.3	7-Dec-10	dead
10	Y6	FH7	26-Jun-10	male	2-3 days	3.4	22-Jun-11	survived to yearling
11	Y7	M1	30-Jun-10	female	>1 day	2.7	9-Aug-10	dead
12	Y1	M1	30-Jun-10	female	>1 day	2.8	5-Jul-11	survived to yearling
13	Y8	M1	30-Jun-10	male	5-7 days	4.4	9-Jul-10	dead
14	Y9	M1	3-Jul-10	female	2-4 days	3.1	22-Oct-10	dead
15	Y12	M1	5-Jul-10	female	4-6 days	2.9	28-Feb-11	dead
16	Y10	M1	7-Jul-10	female	~1 week	4.1	6-Jan-11	unknown
17	Y19	FH7	8-Jul-10	male	3-5 days	6.5	2-Jul-11	survived to yearling
18	Y11	FH7	8-Jul-10	female	2-4 days	2.8	2-Jul-11	survived to yearling
19	Y23	FH7	8-Jul-10	female	2-4 days	2.8	29-Jul-10	dead
20	Y20	FH7	9-Jul-10	female	~10 days	3.15	15-Jul-10	dead
21	Y24	FH7	9-Jul-10	male	~10 days	3.4	9-Jul-10	dead
22	Y22	FH7	10-Jul-10	male	3-5 days	3.9	18-Jul-10	dead
23	Y86	FH7	12-Jul-10	male	~5 days	3.6	12-Aug-10	dead
24	Y25	FH7	12-Jul-10	female	~5 days	3.2	22-Jul-11	survived to yearling
25	Y85	M1	15-Jul-10	male	5-8 days	5	24-May-11	likely survived to yearling
26	Y18	FH7	19-Jul-10	male	4-5 days	3.1	7-Aug-10	dead

Table 4: 2011 Cohort - Status of black-tailed deer fawns Mendocino black-tailed deer project

Number	ID	Group	Capture date	Sex	Age (estimated)	Weight (lbs.)	Weight (kg)	Date last observed	Status
1	Y68	M1	15-Jun-11	M	4-5 days	8.00	3.63	15-Sep-11	Alive
2	Y64	M1	16-Jun-11	M	3-4 days	6.17	2.80	15-Sep-11	Alive
3	R1118	M1	19-Jun-11	M	4 days	6.61	3.00	15-Sep-11	Alive
4	Y87	M1	19-Jun-11	F	4-5 days	8.00	3.63	21-Jun-11	Dead
5	R1115	M1	20-Jun-11	F	7-8 days	9.25	4.20	15-Sep-11	Alive
6	Y62	M1	20-Jun-11	F	5 days	7.72	3.50	6-Jul-11	Dead
7	Y73	M1	20-Jun-11	F	2 days	4.41	2.00	18-Aug-11	Dead
8	Y56	M1	20-Jun-11	M	5 days	4.85	2.20	20-Jun-11	Dead
9	Y54	M1	20-Jun-11	M	5-6 days	7.50	3.40	15-Sep-11	Alive
10	Y57	M1	21-Jun-11	F	5-8 days	9.00	4.08	15-Sep-11	Alive
11	Y95	M1	21-Jun-11	M	5-7 days	9.25	4.20	21-Jun-11	Dead
12	Y11	M1	22-Jun-11	M	7-8 days	10.00	4.54	22-Jun-11	Unknown, likely tag failure
13	Y96	M1	22-Jun-11	F	2-3 days	6.00	2.72	15-Sep-11	Alive
14	Y75	M1	23-Jun-11	F	2-4 days	6.39	2.90	10-Sep-11	Alive
15	Y92	FH7	23-Jun-11	M	4 days	8.00	3.63	15-Sep-11	Alive
16	Y32	M1	24-Jun-11	M	10 days	9.50	4.31	11-Jul-11	Dead
17	Y94	M1	24-Jun-11	M	4-5 days	9.00	4.08	15-Sep-11	Alive
18	Y97	FH7	24-Jun-11	M	4 days	5.10	2.31	31-Jul-11	Dead
19	Y98	M1	25-Jun-11	F	3 days	5.50	2.49	30-Jun-11	Dead
20	Y100	M1	25-Jun-11	M	3 days	9.00	4.08	15-Sep-11	Alive
21	R1117	M1	26-Jun-11	F	3-5 days	5.50	2.49	25-Jul-11	Dead
22	R1106	M1	27-Jun-11	F	7 days	7.00	3.18	4-Aug-11	Dead
23	R1072	M1	27-Jun-11	M	3-5 days	6.50	2.95	13-Sep-11	Alive
24	Y53	M1	28-Jun-11	F	3-4 days	8.60	3.90	15-Sep-11	Alive
25	Y55	M1	28-Jun-11	F	5-6 days	8.38	3.80	15-Sep-11	Alive
26	Y74	FH7	28-Jun-11	M	NR	8.00	3.63	15-Sep-11	Alive
27	R1120	FH7	28-Jun-11	F	3-4 days	5.51	2.50	9-Jul-11	Dead
28	Y93	FH7	28-Jun-11	M	1-3 days	5.95	2.70	15-Sep-11	Alive
29	Y59	M1	29-Jun-11	F	4-5 days	8.50	3.86	30-Jun-11	Dead
30	Y66	M1	29-Jun-11	M	3-4 days	6.50	2.95	2-Jul-11	Dead
31	Y90	FH7	29-Jun-11	F	3-4 days	7.05	3.20	5-Jul-11	Dead

Number	ID	Group	Capture date	Sex	Age (estimated)	Weight (lbs.)	Weight (kg)	Date last observed	Status
32	Y88	FH7	30-Jun-11	M	7-10 days	13.89	6.30	1-Jul-11	Dead
33	Y67	M1	1-Jul-11	M	4-5 days	8.50	3.86	15-Sep-11	Alive
34	Y61	FH7	1-Jul-11	F	4-6 days	9.26	4.20	7-Jul-11	Dead
35	Y60	FH7	1-Jul-11	M	6 days	9.04	4.10	7-Jul-11	Dead
36	Y50	FH7	1-Jul-11	M	4 days	7.72	3.50	16-Jul-11	Dead
37	Y48	FH7	1-Jul-11	F	5 days	9.04	4.10	15-Sep-11	Alive
38	Y99	FH7	1-Jul-11	M	4-5 days	9.70	4.40	3-Jul-11	Dead
39	Y69	FH7	1-Jul-11	M	5 days	7.28	3.30	13-Sep-11	Alive
40	Y49	FH7	2-Jul-11	F	3 days	6.61	3.00	5-Jul-11	Dead
41	Y63	M1	3-Jul-11	F	7-10 days	11.00	4.99	15-Sep-11	Alive
42	Y46	FH7	3-Jul-11	M	4-5 days	7.72	3.50	15-Sep-11	Alive
43	Y65	FH7	4-Jul-11	M	5-6 days	9.26	4.20	15-Sep-11	Alive
44	R1052	M1	7-Jul-11	F	3-4 days	7.50	3.40	15-Sep-11	Alive
45	Y89	FH7	9-Jul-11	F	5 days	8.50	3.86	17-Jul-11	Dead

d) DNA analysis from mortality sites:

The DNA analysis from 2009 and most 2010 mortality sites has been completed by Dr. Ben Sack's lab at UC Davis. However, the preliminary results need to be analyzed with the kill site assessment before being reported, as heavy scavenging by black bears in the study area has resulted in some DNA tests being confounded between predator and scavenger identity. Preliminary results indicate that the use of both DNA analysis of mortalities that were recovered within 24 hours and our mortality site assessment will be an accurate assessment of cause of mortality and predator identity.

3) Vegetation surveys

During the 2010 field season we conducted vegetation surveys to assess deer habitat quality and composition in fawning areas. Vegetation surveys were conducted during July and August. Habitats on ridgelines near Forest Highway 7 (east of the Black Butte river drainage) and near forest highways M1 and M61 (west of the Black Butte river drainage) were included in survey efforts.

In the 2011 field season we surveyed vegetation on summer range outside of fawning areas to compare the vegetation type and quality between fawning areas and other areas of the range. Habitats surveyed included lower elevation oak meadow complexes, ponderosa pine forests, and true fir forests.

Vegetation surveys were located by selecting a random starting point within the survey area and spacing transects systematically from this starting point, allowing systematic coverage of the area and preserving random selection assumptions necessary for statistical analysis.

Three types of surveys were conducted in both years (see Table 5). First, *line intercept surveys* were used to determine the cover and volume of shrub species. Second, *comparative yield (CY) and dry weight ranking methods (DWR)* (0.25 m^2 quadrat surveys) were used to estimate the available biomass and composition of forbs and grasses. Third, *twig count surveys* (1x3 m strip transects) were conducted to estimate available shrub browse biomass. All surveys are established and well tested methods. Surveys were conducted by UC Davis research personnel, interns, and CDFG scientific aides.

Table 5: Vegetation survey effort 2010-2011

Year	Survey Type	Surveys Completed
2010	Line Intercept Transects	96 transects (100 meter transects)
	Grass/Forb Quadrats (CY & DWR)	960 quadrats (0.25 m^2)
	Twig Count	288 strip transects (1x3 m)
2011	**Survey Type**	**Surveys Completed**
	Line Intercept Transects	84 transects (100 m transects)
	Grass/Forb Quadrats (CY & DWR)	840 quadrats (0.25 m^2)
	Twig Count	252 strip transects (1x3m)

Approximately 15 species of shrubs occurred regularly on survey transects, including two species of Ceanothus, three species of Arctostaphylos (Manzanita species), three species of Prunus (e.g. bitter cherry), two species of Symphoricarpos (snowberry), two species of Ribes (e.g. gooseberry), a Rubus species (black-cap raspberry), and a species of Holodiscus (ocean spray). Grasses and forbs were divided into broad categories, including exotic annual grasses, bunchgrasses, and forbs. Several genus of interest were also noted including Madia (tarweed species), Taeniatherum (medusa head grass), and several invasive Bromus species (e.g. ripgut brome).

Samples of key browse species, including Ceanothus genus species (i.e. mountain whitethorn ceanothus (*Ceanothus cordulatus*)), Prunus genus species (i.e. bitter cherry), and Arctostaphylos species (i.e. common Manzanita), were also collected across the study area from browsed and unbrowsed plants to be tested for forage quality.

4) Diet analysis

Deer pellets were collected from fawning areas in August 2010 and August and September 2011, and will be sent to the Wildlife Habitat Nutrition Laboratory at

Washington State University for a microhistological diet analysis. The results of this diet analysis will be used with the results of the vegetation surveys to compare selected forage to available forage and potentially for an estimation of the carrying capacity of summer ranges in the area. Diet analysis will also be compared to rain and snow patterns to assess possible weather effects on diet composition and quality.

5) Camera traps

Passive infrared trail cameras were deployed throughout black-tailed deer summer range in 2010 and 2011 to determine predator composition and abundance during the fawning period within key fawning areas. Cameras were placed using randomly selected cells within a grid centered on known fawning areas. Once the randomly selected point was located cameras were placed within 250 meters of the original point at a location most likely to capture photographs of predators (e.g. game trails, scrapes, springs, etc.). No bait was used. Cameras were deployed three times during the field season.

During the 2010 field season cameras were deployed from late May through late October, except a 2-3 week period in June due to intensive fawn capture efforts. In the 2011 field season cameras were deployed from mid to late June and will be removed in mid October.

Every major predator in the study area was photographed. Species detected included black bear, coyote, bobcat, black-tailed deer, mountain lion, elk, feral pig, grey fox, fisher, 2 species of skunk, raccoon, black-tailed jackrabbit, and human. The most notable events were detection of an elk (subspecies currently undetermined), and the low number of mountain lion detections. Elk have not previously been documented as occurring at this elevation in the Mendocino National Forest. The low number of mountain lion detections may be due to lion territories that are significantly larger than the sample area and that many lions collared in our study very rarely use high elevation habitat.

Although the data is still being entered and analyzed, a preliminary summary of trail camera effort is included below in Table 6.

Table 6: Deer study camera trapping effort 2010-2011

Year	Metric	Estimated Effort
2010	Total Camera Deployments	90 deployments
	"Trap Nights" (24 hour period)	Approx. 1,660
2011	Total Camera Deployments	89 deployments
	"Trap Nights" (24 hour period)	Approx. 2,670
TOTAL	*Camera Deployments*	179 deployments
	Trap Nights	4,330 trap nights

6) Pilot Study – DNA capture-recapture deer density estimation

Field crews conducted a pilot study to refine methods for black-tail deer density estimation using DNA from deer pellets. Sixteen transects (approx. 1.2 km per transect) were established in summer range areas. Methods for determining transects using random starting points and establishing transects on existing deer trails to increase pellet detection were tested in September of 2011.

Approximately 20.5 km of transect were established and sampled twice, and approximately 450 pellet samples were taken. The pilot study also allowed us to refine recommended field methods from other areas into a robust protocol that can be used in future research and for future deer density estimations in our study area.

7) Scouting for mountain lion sign

The scouting of mountain lions and their sign includes three significant areas. The first is constant scouting for mountain lion sign, including tracks, scat, and scrapes. The project has recorded 326 scrapes. We have also located the individual tracks of what we believe are at least 10 different adult lions. The location of tracks and scrapes is used to inform our trapping and hound capture efforts to increase success and efficiency.

The second aspect of scouting for sign is the monitoring of likely trails and recurring scrape areas by trail camera. Through this we have recorded dozens of photos of mountain lions, including 33 at our two year-round monitoring stations.

The main problem of scouting with motion-triggered cameras is theft, especially during the deer hunting season. We also monitor fawning areas for predator abundance each summer, and during 1,660 nights of monitoring in 2010 we only recorded one photo of a mountain lion, an adult female. These cameras are generally located at high elevations and are less likely to record mountain lions, which, based on telemetry data, are more likely to use low to mid-range elevations of 400-1650 meters during this time of the year.

The third aspect of scouting for sign is to place bait carcasses and monitor with motion-triggered cameras. This method appears less suited to detect mountain lions during seasons in which black bears are active, due to the quick discovery of the bait carcasses by black bears. For the year, we set out a total of 33 bait carcasses.

8) Mountain lion capture

Capture effort over the course of the year has been extensive. We have had houndsmen in the study area for 8 weeks, including Cliff Wiley on capture for 3 weeks and Blue Milsap for five weeks. Four other weeks of hound capture had to be cancelled due to inclement weather. We previously had 6 weeks of hound capture for a total of 10 weeks of hound capture over the course of the study.

We have captured 6 mountain lions to date. All captured mountain lions have been processed by either CDFG project lead David Casady or lead biologist Max Allen, with both Allen and Casady being present for all but one capture. Table 7 below summarizes individual information for each captured mountain lion.

Table 7: Mountain lion capture information

Mountain Lion	Original Capture Date	Sex	Current Age (Years)	Weight (Pounds)
F1	June 24, 2010	Female	7.4	71
M36	April 21, 2011	Male	Deceased	106
F23	June 10, 2011	Female	4.1	109
F17	August 6, 2011	Female	1.8	66
F19	August 8, 2011	Female	4	72
M33	August 17, 2011	Male	7.1	127

Trapping efforts were continual through the first year and a half of the study, and led to two mountain lion captures (F1 and M36), as well as one recapture. The trapping of lions is dependent on lions finding and feeding on bait carcasses. Once a lion finds and feeds on a carcass, we place the bait into a cage trap. The drugging of bears is not allowed during or one month prior the black bear hunting season, which cuts three months out of the trapping season. From the 33 bait carcasses previously mentioned, we had a total of 265 trap nights. Mountain lions appeared at 6 of these carcasses, with two of the carcasses having multiple lions.

Despite the expertise and effort of our houndsmen, we have had very little capture success over the course of the project. In comparison, hound capture success for hunters in Wyoming and Idaho is 3 days per lion harvested (C. White pers. comm., D. Thompson pers. comm.), and does not include lions treed but not harvested. Our capture efforts have been more successful and efficient with the addition of Blue Milsap as houndsman.

Figure 2: Mountain lion capture photos

9) Mountain lion predation on black-tailed deer

We are using intensive monitoring methods to determine the predation patterns of mountain lions on black-tailed deer. Our collars take a GPS fix every 2 hours, and upload the locations via satellite every 3 days. We then plot the locations and determine “clusters” of activity. The clusters are then investigated, using a grid search method, for signs of mountain lion predation. When a feeding site is found, the location and habitat characteristics are recorded, along with the health and age of the deer.

Our original collars had lower GPS acquisition fixes through the ARGOS satellite monitoring than we had anticipated. The collar on lion F1 returned an Argos fix rate of 23.7% over the course of 6 months. The fix rate had a boom-or-bust cycle where we would receive accurate information for 3 days, then stretches up to a week without a single waypoint. This caused serious difficulties with our monitoring efforts, and because of this, we returned all of our collars and re-fitted them with external antennas. This has greatly increased our fix rate to over 80% for each of the deployed collars.

Our methods used for checking kill sites have now been fine-tuned and are working very well. These methods allow us to find and document the kills made by mountain lions in the study area in a quick and efficient manner. We have been successful in finding 123 feeding sites from the six collared mountain lions, including 56 adult black-tailed deer, and 26 Black-tailed deer fawns. The overall results are broken down in the following graph.

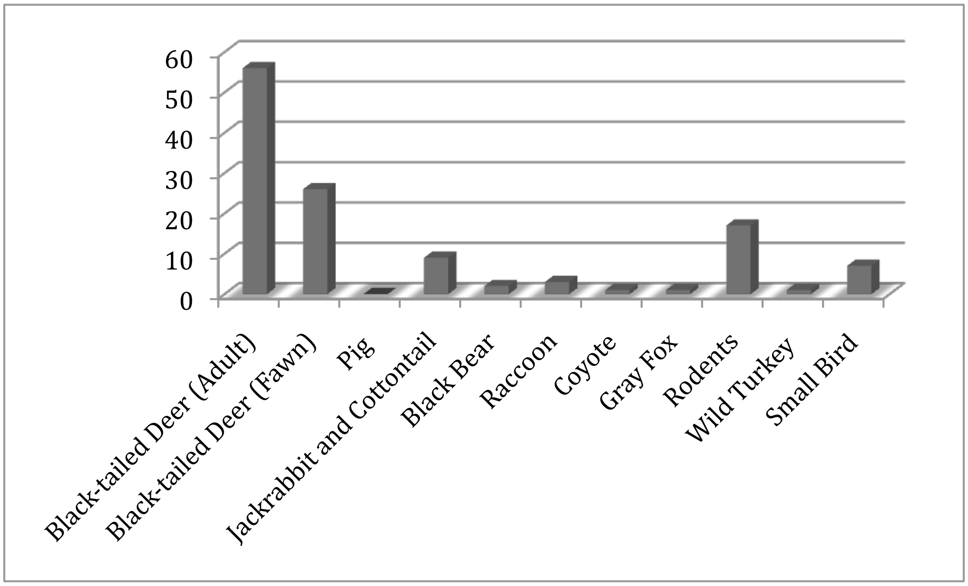

Figure 3: Number of prey species identified at mountain lion GPS location clusters

10) Outlook

a) Deer:

We currently have 5 Lotek collars that need to be refurbished for re-deployment, 2 Lotek collars that need repair and refurbishment for re-deployment and 3 Telonics collars that can be re-deployed once they are refurbished. Deer and fawns that are currently collared and tagged will be monitored every 10 days during the winter months, and mortalities will be recovered and assessed as soon as possible. Future capture efforts will be determined by the status of the contract extension application currently being submitted.

b) Mountain lions:

Capture efforts have become much more successful with the use of Blue Milsap as houndsman. Re-capture efforts should be less time-consuming, allowing for additional time to find and collar another mountain lion. Recaptures of F1 and F23 are currently scheduled for mid-November. At this point, our efforts will focus on finding kill sites of the collared lions in order to determine the impact of mountain lion predation on black-tailed deer in the study area.