

CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE
PENINSULAR BIGHORN SHEEP 2013 ANNUAL REPORT

*A cooperative effort by the California Department of Fish and Wildlife, U.S. Fish and Wildlife Service,
and California Department of Parks and Recreation*



Photo by CHP Officer Miguel Lizarraga

*This report presents information on the status, distribution, and management of peninsular bighorn
sheep in eastern San Diego County and portions of
Riverside and Imperial Counties*

Report prepared by Janene Colby and Randy Botta

TABLE OF CONTENTS

BACKGROUND.....2

PROJECT PERSONNEL.....2

CAPTURE AND RADIO-COLLARING.....3

POPULATION MONITORING.....4

POPULATION SIZE AND ESTIMATION.....5

DISTRIBUTION AND MOVEMENT.....6

Central Santa Rosa Mountains.....6

Southern Santa Rosa Mountains.....6

Coyote Canyon.....6

Northern San Ysidro Mountains.....7

Southern San Ysidro Mountains.....7

Vallecito Mountains.....7

Carrizo Canyon.....7

 Carrizo Canyon Ewe Group.....8

 Tierra Blanca Ewe Group.....10

 In-Ko-Pah Ewe Group.....10

 Jacumba Ewe Group.....12

CAUSE SPECIFIC MORTALITY AND SURVIVAL.....12

LAMB SURVIVAL AND RECRUITMENT.....15

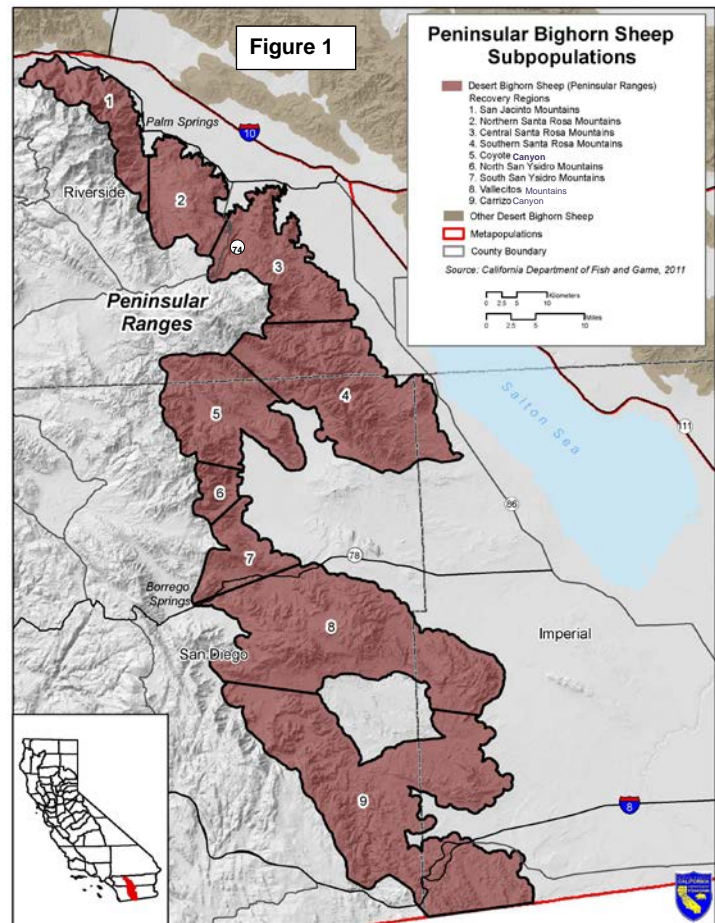
SUMMARY.....15

FUTURE ACTIONS.....16

BACKGROUND

This report highlights information collected by the California Department of Fish and Wildlife (CDFW) on bighorn sheep (*Ovis canadensis nelsoni*) capture and radio-collaring, cause specific mortality and survival, distribution and movement, and percentage of collared bighorn sheep in the Peninsular Mountain Ranges of southern California from 1 January 2013 through 31 December 2013.

The Peninsular bighorn sheep population contains nine designated recovery regions occupying portions of western Riverside and Imperial Counties and eastern San Diego County (Figure 1). The 9 recovery regions are: 1) San Jacinto Mountains (SJM), 2) Northern Santa Rosa Mountains (NSRM), 3) Central Santa Rosa Mountains (CSRM), 4) Southern Santa Rosa Mountains (SSRM), 5) Coyote Canyon (CoC), 6) Northern San Ysidro Mountains (NSYM), 7) Southern San Ysidro Mountains (SSYM), 8) Vallecito Mountains (VM), and 9) Carrizo Canyon (CC).



CDFW conducted aerial telemetry monitoring activities from a Cessna 185 fixed-winged aircraft in all 9 recovery regions twice a month. Aerial flights were used to monitor collared sheep for activity status (alive/dead), estimate locations, and download GPS location data.

CDFW conducted ground monitoring of radio-collared sheep weekly in CoC, NSYM, SSYM, CC, and as time allowed in the VM. CDFW jointly monitored the SJM and CSRM as time allowed with the Bighorn Institute (BI), while the Northern Santa Rosa Mountains (NSRM) was ground monitored solely by BI. Ground monitoring efforts were focused on: 1) mortality investigations, 2) observations of sheep composition, health, and status, and 3) spatial and temporal movements of collared sheep across Interstate 8 and the US/Mexico border.

PERSONELL

CDFW Resource Management and Air Services Divisions

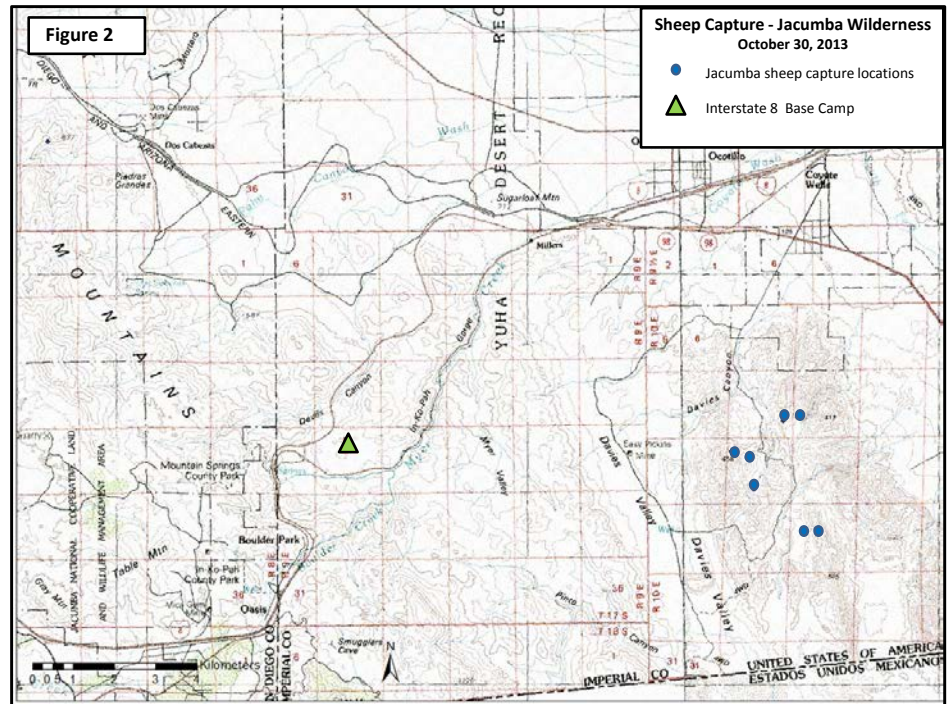
Oversight for recovery of peninsular bighorn sheep in 2013 was provided by Mr. Steve Torres, Environmental Program Manager and Dr. Ben Gonzales, Senior Wildlife Veterinarian with the Department's Resource Management and Policy Division. Dr. Gonzales also acted as veterinary coordinator on capture operations and population health and disease issues. Mr. Tom Evans, Warden/Pilot for the Department's Air Services Division piloted all aerial telemetry flights.

CDFW South Coast Region, Wildlife Management Program

Mr. Randy Botta, Senior Environmental Scientist (Specialist) for the South Coast Region, provided oversight for field monitoring activities, managed all capture activities, assisted with aerial telemetry flights, and supervised one field position working east of Highway 74. Field telemetry monitoring, assisting with aerial telemetry flights, mortality investigations, data analysis, mapping of sheep locations, and reporting were carried out by Ms. Janene Colby, Environmental Scientist with the South Coast Region.

CAPTURE AND RADIO-COLLARING

As part of the on-going Peninsular Ranges bighorn sheep monitoring and recovery program and U.S. Customs and Border Patrol (CBP) border mitigation monitoring project, CDFW in cooperation with the U.S. Fish and Wildlife Service (USFWS) conducted a bighorn sheep capture during 30-31 October and 1 November, 2013 within the CC recovery region (Region 9). The project objective was to capture and fit Very High Frequency (VHF) and Global Positioning System (GPS) radio-collars to a subset of adult male and female

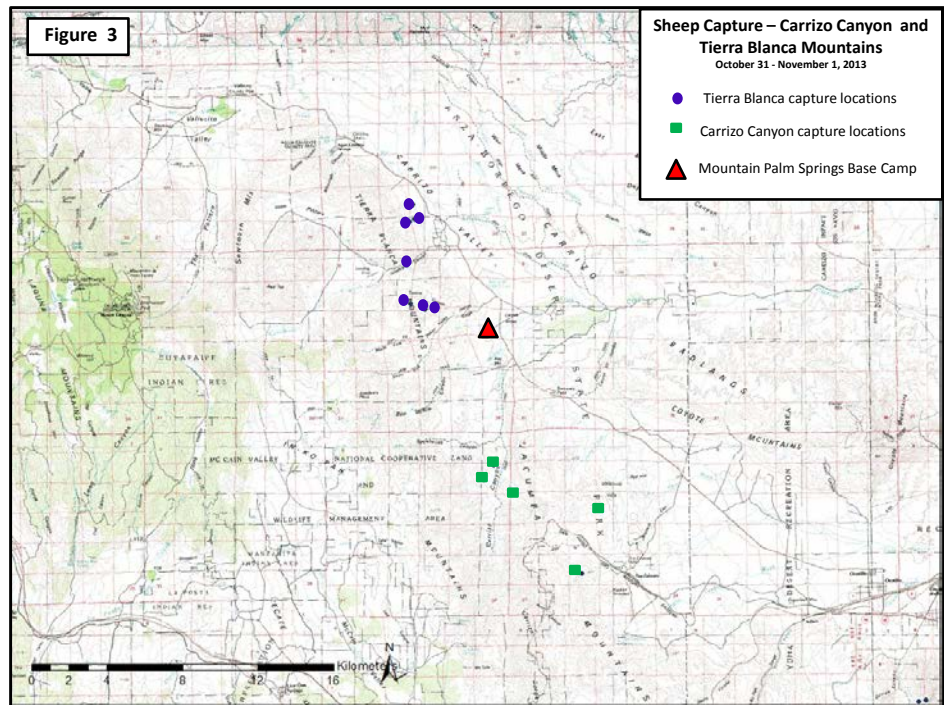


bighorn sheep in CC to: 1) increase the number of collared females and add collared males to identify whether CBP and public use activities modify movement and behavior, 2) maintain collars on approximately 25-30% of the female population for mark-resight surveys by collaring new females, 3) better define the temporal and spatial movement patterns of bighorn sheep crossing the west and east bound lanes of Interstate 8 (I-8), 4) determine the temporal and spatial movement patterns of bighorn sheep crossing into and out of Mexico, and 5) better define sheep distribution and female group organization.

Captures were conducted in the CC recovery region with specific capture locations being the Jacumba Wilderness (Figure 2), Carrizo Canyon areas of the Jacumba Mountains, and the Indian Canyon area of the Tierra Blanca Mountains (Figure 3). Capture of all bighorn sheep was carried out by Leading Edge Aviation under contract with the Carlsbad U.S. Fish and Wildlife Service Office (CFWO). Base camp processing of captured bighorn sheep was carried out by personnel from CDFW, CFWO, Bureau of Land Management (BLM), and University of California, Davis.

During the three day operation a total of 19 bighorn sheep (12 females/7 males) were captured. This included 7 bighorn sheep in the Jacumba Wilderness (4 females/3 males), 5 bighorn sheep in Carrizo Canyon (3 females/2 males) and 7 bighorn sheep (5 females/2 males) in the Tierra Blanca Mountains.

Of the 19 bighorn sheep captured, 16 (9 females/7 males) were fitted with Very High Frequency (VHF) radio-collars with attached Global Positioning System (GPS) units, 2 bighorn sheep (2 females) were fitted with VHF radio-collars only, and 1 bighorn sheep (1 female) received ear tags only. Additionally, during the capture the helicopter crew recorded the number and composition of all bighorn sheep sighted. A total of 93 bighorn sheep (50 females/9 lambs/34 males) were observed. This included 22 bighorn sheep (13 females/9 males) in the Jacumba Wilderness, 19 bighorn sheep (6 females/2 lambs/11 males) in Carrizo Canyon, and 52 bighorn sheep (31 females/7 lambs/14 males) in the Tierra Blanca Mountains. For further details, refer to Peninsular Bighorn Sheep Post-Capture Report 2013.



POPULATION MONITORING

As recommended in the recovery plan for peninsular bighorn sheep, CDFW maintains, to the extent possible, active VHF radio-collars on approximately 25-30% of all females in each recovery region. Maintaining at least 25% collared females is important for generating reliable mark-resight population estimates based on helicopter surveys. Since 1993, CDFW has conducted helicopter surveys in the fall of even numbered years and captures to fit needed collars on sheep during the fall of odd numbered years; however, a range-wide helicopter survey was not conducted in 2012 due to lack of a CDFW helicopter contract and no captures were conducted in 2011. As a result, recovery regions 1 through 8 all fell below 10% collared females by the end of 2013. Only sheep in recovery region 9 (CC), fitted with collars in 2012 and 2013, have a higher percentage of collared females (15%). At the beginning of the 2013 reporting period, the 7 recovery regions east of Highway 74 contained a total of 62 (8M/54F) active collars and at the end of 2013 there were a total of 43 (7M/36F) active collars. Collars were lost through mortality in the CSR, CoC, SSYM, and CC while collars became non-functional in CSR, CoC, NSYM, SSYM, VM, and CC. The number of collars fitted to males and females and the percentages of marked females in each recovery region at the beginning and end of 2013 are listed in Tables 1 & 2 on the next page.

Table 1. Distribution and numbers of active radio-collared female (F) and male (M) bighorn sheep within recovery regions east of highway 74 at the beginning and end of 2013. CSRМ = Central Santa Rosa Mountains (Region 3), SSRМ = Southern Santa Rosa Mountains (Region 4), CoC = Coyote Canyon (Region 5), NSYM = Northern San Ysidro Mountains (Region 6), SSYM = Southern San Ysidro Mountains (Region 7), VM = Vallecito Mountains (Region 8), CC = Carrizo Canyon (Region 9). The estimated percentage of females radio-collared (% F Collared) at the end of 2013 is based on the ewe abundance estimates from the most recent range-wide helicopter survey in 2010.

	CSRМ		SSRM		CoC		NSYM		SSYM		VM		CC *	
	F	M	F	M	F	M	F	M	F	M	F	M	F	M
1/1/2013	8	0	1	0	12	1	4	0	10	1	4	0	15	6
additions	0	0	0	0	0	0	0	0	0	0	0	0	11	7
recollared	0	0	0	0	0	0	0	0	0	0	0	0	0	0
mortalities	-1	0	0	0	-3	-1	0	0	-3	-1	0	0	-4	-5
censored	-1	0	0	0	-5	0	-4	0	-5	0	-2	0	-1	-1
12/31/2013	6	0	1	0	4	0	0	0	2	0	2	0	21	7
% F Collared	9%		1%		9%		0%		5%		2%		15%	

* Refer to Table 2 for break-down within CC region

Table 2. Distribution and numbers of radio-collared female (F) and male (M) bighorn sheep within recovery region 9 (Region Total). The sheep within this region have been subdivided based on the common areas used by females for lambing/nursery grounds and for obtaining water during the summer months. Carrizo = Carrizo Canyon, T. Blanca = Tierra Blanca Mountains, In-Ko-Pah = In-Ko-Pah Gorge (I-8 Corridor), and Jacumba = Jacumba Wilderness south of Interstate 8 to the Mexican Border. The estimated percentage of females radio-collared (% F Collared) at the end of 2013 is based on the ewe abundance estimate from the most recent range-wide helicopter survey in 2010.

	Carrizo		T. Blanca		In-Ko-Pah		Jacumba		Region Total	
	F	M	F	M	F	M	F	M	F	M
1/1/2013	5	2	0	0	10	4	0	0	15	6
additions	3	2	4	2	0	0	4	3	11	7
recollared	0	0	0	0	0	0	0	0	0	0
mortalities	-1	-1	-3	-1	0	-3	0	0	-4	-5
censored	-1	-1	0	0	0	0	0	0	-1	-1
12/31/2013	6	2	1	1	10	1	4	3	21	7
% F Collared									15%	

POPULATION SIZE AND ESTIMATION

A range-wide population survey has not been conducted since 2010: a detailed review of population estimates, ewe abundance, and lamb:ewe ratios from 1993 to 2010 can be found in the 2012 Annual Report. Anza-Borrego Desert State Park (ABDSP) conducts annual water hole counts in some areas of the SSRM, CoC, NSYM, and SSYM and the results from 2011 to 2013 are summarized in Table 3.

Table 3. ABDSP July water hole count results from 2011 to 2013 in the Southern Santa Rosa Mountains (SSRM), Coyote Canyon (CoC), Northern San Ysidro Mountains (NSYM), and Southern San Ysidro Mountains (SSYM). Sheep are counted by volunteers each 4th of July weekend for 3 consecutive days and the number of sites counted in each region depends on the number of counters available on any given year (with the exception of the same one site in the SSRM). Sites counted within each region do not cover all available water sources within each region and therefore should only be used as an index of population rather than a population estimate within each region. Count results are listed as: number of adult females (No. Ewe), number of lambs (No. Lamb), number of yearling males (No. YM), number of yearling females (No. YF), number of adult males (No. Ram), total sheep counted (Total), percent of lambs per 100 ewes (Lamb/Ewe), percent of male and female yearling per 100 ewes (Yrling/Ewe), and percent of rams per 100 ewes (Ram/Ewe).

Year	Region	No. Ewe	No. Lamb	No. YM	No. YF	No. Ram	Total	Lamb/Ewe	Yrling/Ewe	Ram/Ewe
2011	SSRM	39	27	5	4	9	84	69%	23%	23%
2012	SSRM	24	11	4	1	9	49	46%	21%	38%
2013	SSRM	23	13	3	1	9	49	57%	17%	39%
2011	CoC	57	14	2	0	24	97	25%	4%	42%
2012	CoC	53	16	6	6	20	101	30%	23%	38%
2013	CoC	58	11	3	3	27	102	19%	10%	47%
2011	NSYM	42	3	4	3	18	70	7%	17%	43%
2012	NSYM	27	10	1	3	23	64	37%	15%	85%
2013	NSYM	48	5	5	5	35	98	10%	21%	73%
2011	SSYM	26	12	3	1	34	76	46%	15%	131%
2012	SSYM	22	8	7	1	16	54	36%	36%	73%
2013	SSYM	33	13	4	1	24	75	39%	15%	73%

DISTRIBUTION AND MOVEMENT

During 2013, CDFW monitored 62 adult radio-collared bighorn sheep in 7 recovery regions located east of Highway 74. However, the ability to document habitat use, distribution, and movement patterns was greatly limited by the small number of radio-collared sheep within all but the CC recovery region. Regions 4 through 8 will only briefly be discussed and further details can be found in the 2012 Annual Report. The addition of new radio-collared sheep within the CC recovery region in 2012 & 2013 has allowed greater resolution in discerning patterns of movement and ewe group dynamics than in past years and preliminary results will be discussed in greater detail in this section.

Central Santa Rosa Mountains: CDFW monitored 8 radio-collared female bighorn sheep twice monthly by air in this recovery region. Collared sheep were primarily documented inhabiting the La Quinta and Martinez Canyon areas of the CSR. One radio-collar became non-functional and a 16-year-old female died of unknown causes most likely related to advanced age. The remaining 6 collars are expected to become non-functional before the end of 2014 leaving no active collars within this recovery region.

Southern Santa Rosa Mountains: CDFW monitored 1 radio-collared female bighorn sheep twice monthly by air in this recovery region. Aerial locations placed this female in the area surrounding Wonderstone Wash during lambing season. There have been no other radio-collared sheep within this region since 2011.

Coyote Canyon: CDFW monitored 13 radio-collared bighorn sheep in this recovery region (1M/12F). Aerial monitoring was conducted one to two times per month with ground monitoring occurring when time allowed but mainly during lambing season. Females within this region continued to show the same general patterns of use which were described in detail in the 2012 Annual Report. Briefly, females within this region either used Coyote Mountain or the North Henderson Canyon area for lambing and nursery grounds. During summer and fall, females moved to areas with water sources in

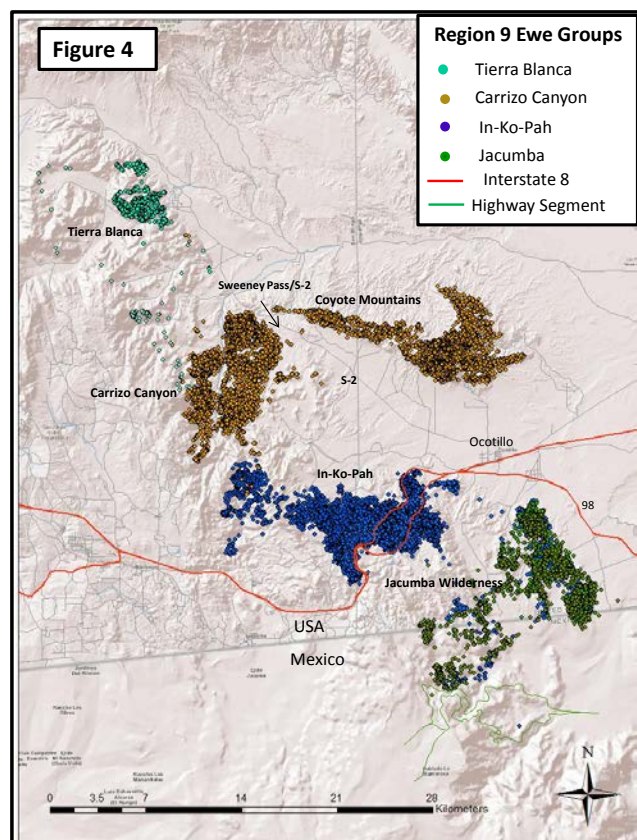
Coyote (Middle and Lower Willows), Salvador, Sheep, and Cougar Canyons. Four radio-collars were lost through mortalities (1M/3F) and 5 collars became non-functional. By the end of 2013, only 4 active collars remained which represents only 9% of the estimated adult female population within this recovery region.

Northern San Ysidro Mountains: CDFW monitored 4 radio-collared females within this recovery region. One radio-collar became nonfunctional in early June with the remainder becoming nonfunctional in September and November. Aerial monitoring was conducted one to two times per month with ground monitoring occurring primarily during lambing season. During the spring and early summer, females were observed using Hellhole, Dry, and Borrego-Palm Canyon (BPC) for lambing and nursery grounds: Summer and fall months were focused around water sources in Hellhole Canyon and BPC. Starting in 2009, sheep began shifting fall use from areas surrounding the creek within BPC to foraging at the DeAnza Country Club golf course and surrounding homes. This change in foraging behavior may have been due to the lack of monsoon rains which typically occur in August each year and provide a green up after the long dry summer months. In 2012, groups of 10 to 32 sheep (including four 10-month-old lambs) used the DeAnza development on a daily basis from early September through December. However, in 2013, there were substantial August rain storms, and as a result, sheep were rarely seen foraging at DeAnza. Presently, there are no active radio-collars in the NSYM.

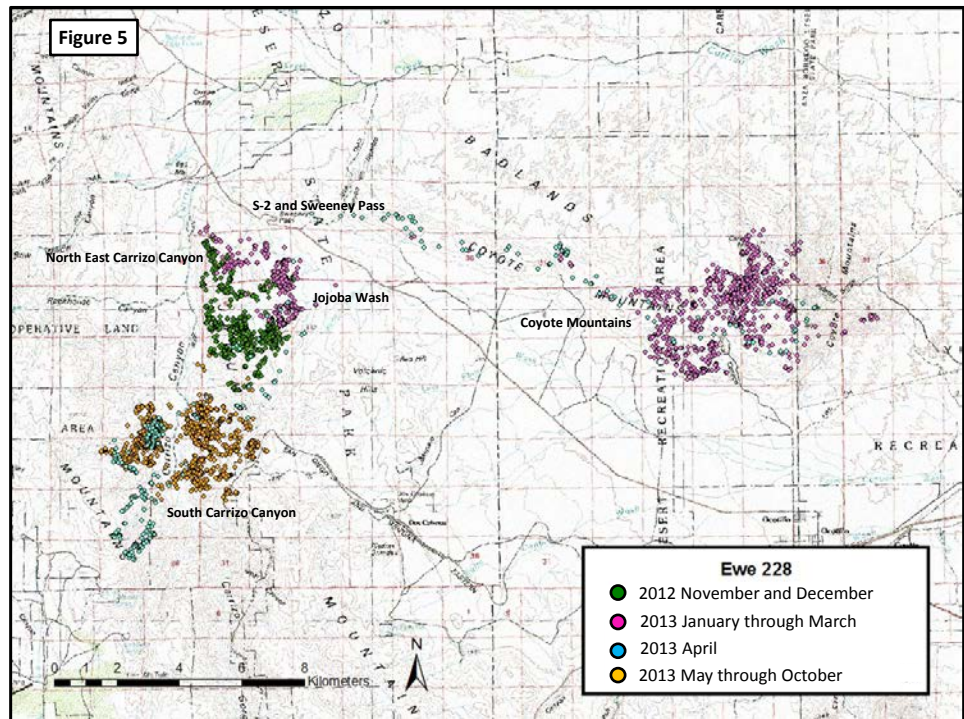
Southern San Ysidro Mountains: CDFW monitored 11 radio-collared bighorn sheep in this recovery region (1M/10F). Aerial monitoring was conducted one to two times per month with ground monitoring occurring when time allowed but mainly during lambing season. Females within this region continued to show the same general patterns of use with nursery and lambing grounds on Yaqui Ridge and Pinyon Ridge and summer use surrounding Tubb Canyon and the southern slopes of Pinyon Ridge. Sheep were documented crossing County Road S-3, and Highway 78 with peak use during the lambing season. Four radio-collars were lost through mortalities (1M/3F) and 5 collars became non-functional. By the end of 2013, only 2 active collars remained which represents only 5% of the estimated population within this recovery region.

Vallecito Mountains: CDFW monitored 4 female radio-collared bighorn sheep in this recovery region. Monitoring was conducted by air twice a month with ground monitoring occurring as opportunity allowed mainly during the lambing season. Three radio-collared females were identified using the slopes surrounding the Elephant Tree area as lambing and nursery grounds while the 4th female used the area surrounding Sunset Mountain. Two radio-collars became non-functional before the end of 2013 and the remaining 2 collars are expected to become non-functional before the end of 2014 leaving no active collars within this recovery region.

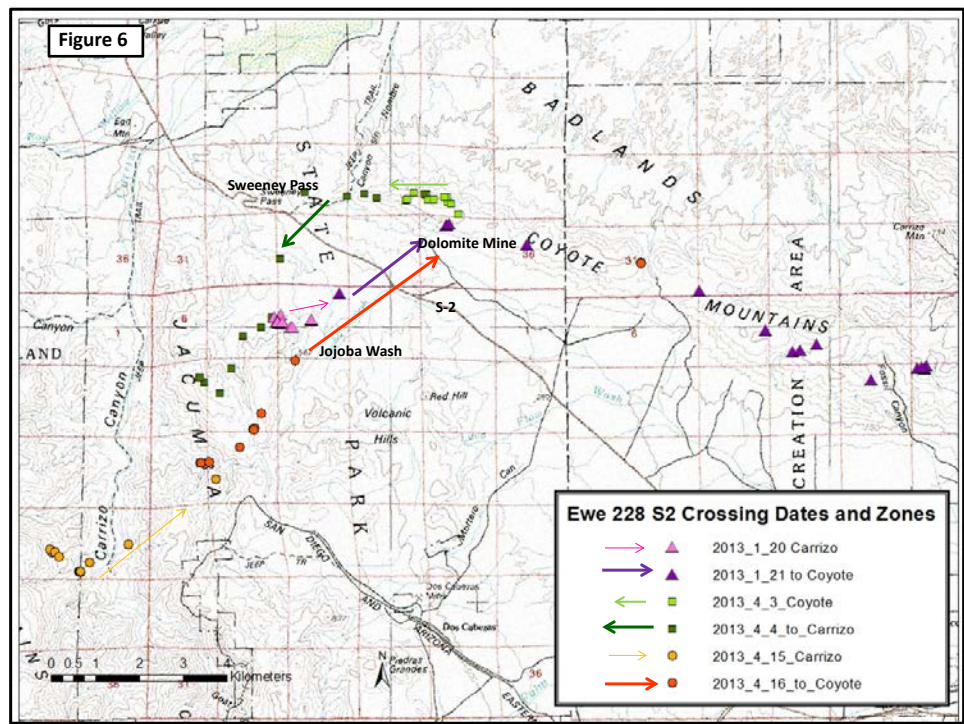
Carrizo Canyon: CDFW monitored 21 radio-collared bighorn sheep (6M/15F) at the onset of 2013 with the addition of 18 new radio-collared bighorn sheep (7M/11F) in October/November of



2013. Unfortunately, 9 radio-collars were lost through mortalities (5M/4F), and 2 collars became nonfunctional (1M/1F) ending the year with 28 active collars (7M/21F) representing 15% of the population. Monitoring was conducted by air twice a month and ground monitoring occurred one to two times a week in order to record observation on health status, pregnancy status, and movements of all radio-collared sheep and to remotely download data from sheep deployed with GPS collars.

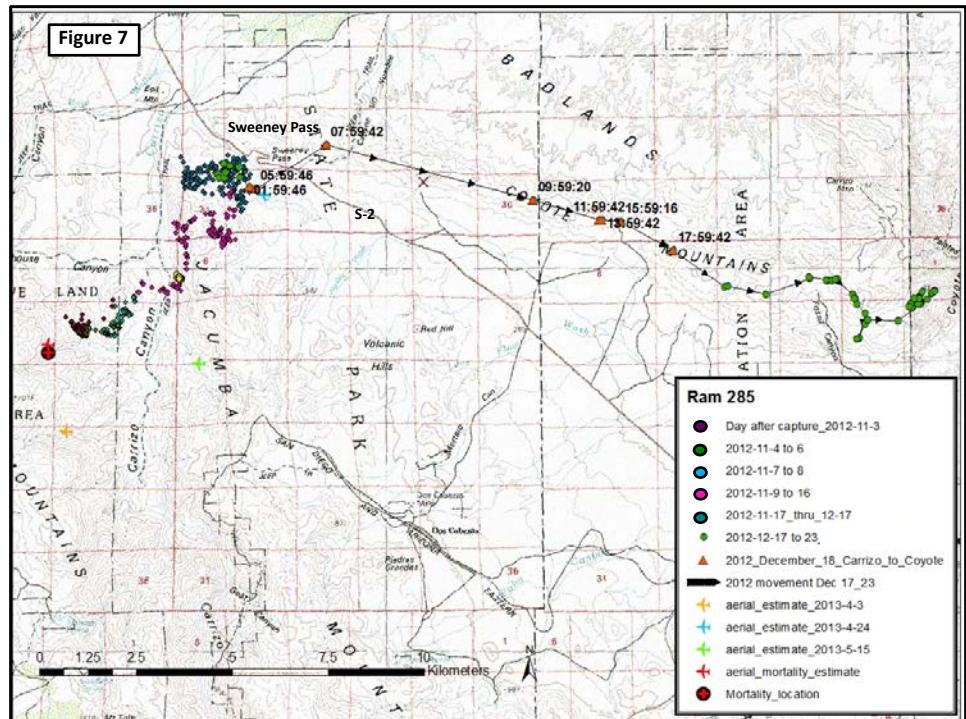


Based on direct observations as well as GPS data there are at least 3 and possibly 4 subpopulations, or ewe groups, within recovery region 9 (Figure 4). The Carrizo Canyon and the In-Ko-Pah ewe groups have been well documented based on data collected from GPS-collared sheep since 2009. Preliminary GPS location data collected from sheep captured in November 2013 within the Jacumba Wilderness south of Interstate 8 (I-8) and the Tierra Blanca Mountains north of Carrizo Canyon indicate two additional ewe groups within region 9.

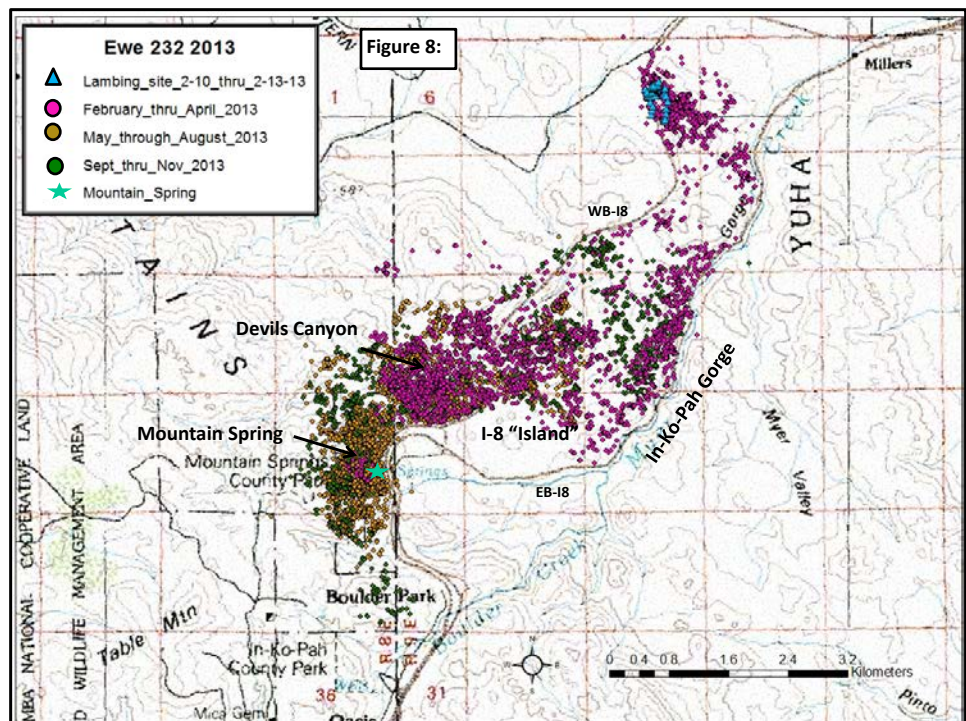


Carrizo Canyon Ewe Group: In 2013, observations and GPS data were collected on 8 females and 4 males; however, by the end of the year, 4 collars were lost through mortalities (1M/1F) and nonfunctioning collars (1M/1F). Females within this subpopulation had a very distinct pattern of seasonal movements (Figure 5). Typically, from May to October, when weather conditions can be hot and dry, sheep moved to the southern end of Carrizo Canyon where there were numerous water sources. In November and December, as lambing season approached, females moved to the

northeastern portion of Carrizo Canyon. In January, just prior to parturition, they moved to the eastern portion of the Coyote Mountains, a distance of approximately 20 km. Based on a combination of visual observations, tracking, and GPS data, the common route to the Coyote Mountains was through Jojoba Wash, across S-2 where the wash meets the road, and to the ridgeline near Dolomite mine (Figure 6). The distance between the two ranges at this point is approximately 4 km of flat terrain.



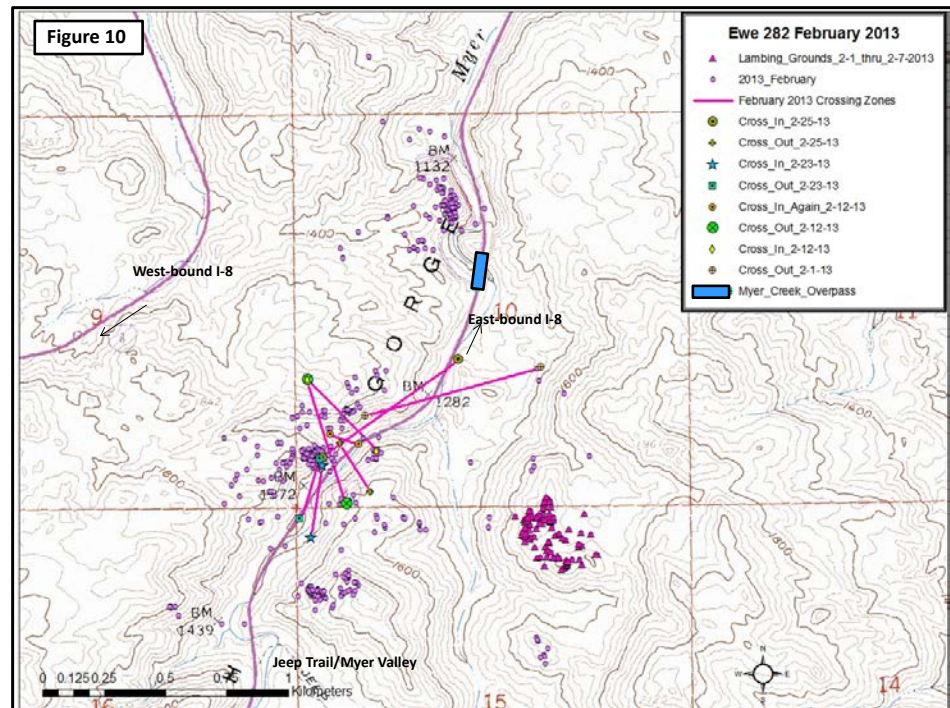
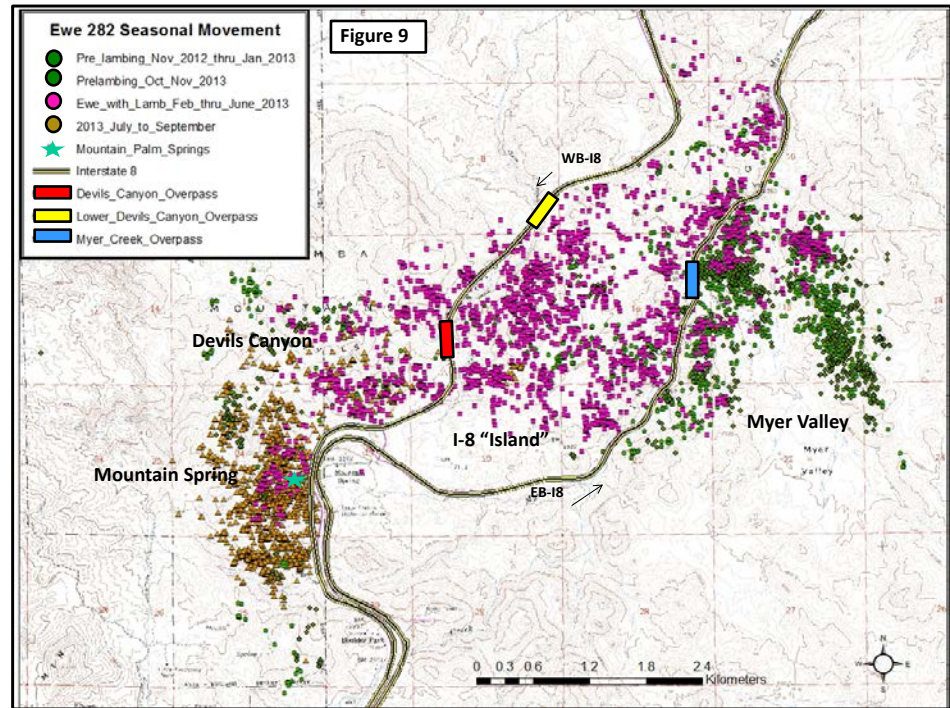
In 2013, Ewe 228 crossed at this location between 0100 and 0300 hours. Once sheep reached the ridgeline they quickly moved to the eastern end of the mountains in the area surrounding Painted Gorge and Carrizo Peak. Females typically had their lambs in January and February in the Coyote Mountains and did not move back to the southern end of Carrizo Canyon until April or May: the return route was similar but the crossing location was closer to Sweeney Pass. Females would sometimes move back and forth between the two areas several times before settling in to stay for the season. For example, ewe 228, stayed in the Coyote Mountains from January to April, crossed back and forth between the two ranges several times before finally settling back into Carrizo Canyon for the summer (Figure 6). Females within this ewe group did not appear to move north of Carrizo Canyon into the Tierra Blanca Mountains or south into In-Ko-Pah Gorge. Presently, there is limited GPS data on ram movements due to problems with GPS collar functionality and mortalities. Thus far most rams appeared to stay in the areas surrounding Carrizo Canyon; however, ram 285 was documented in the Coyote Mountains in December (Figure 7).



Tierra Blanca Ewe Group: During the 2013 capture, 4 females and 2 males were deployed with GPS collars in the Tierra Blanca Mountains. Unfortunately, 1 ewe died of capture myopathy 3 days post-capture and another 2 ewes and 1 ram were killed by mountain lions before the end of the year.

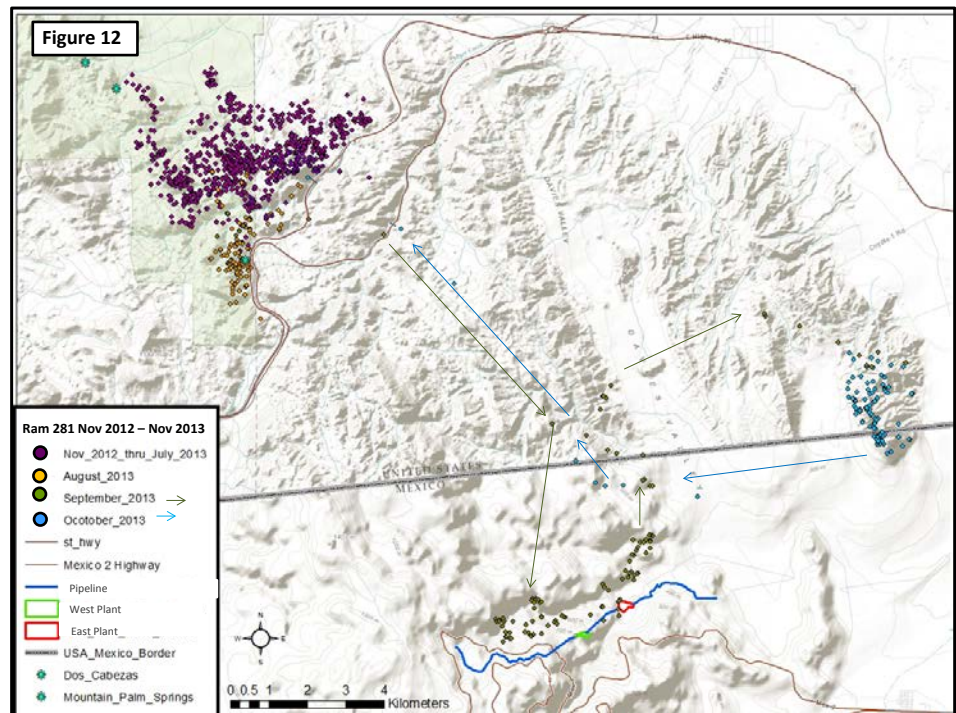
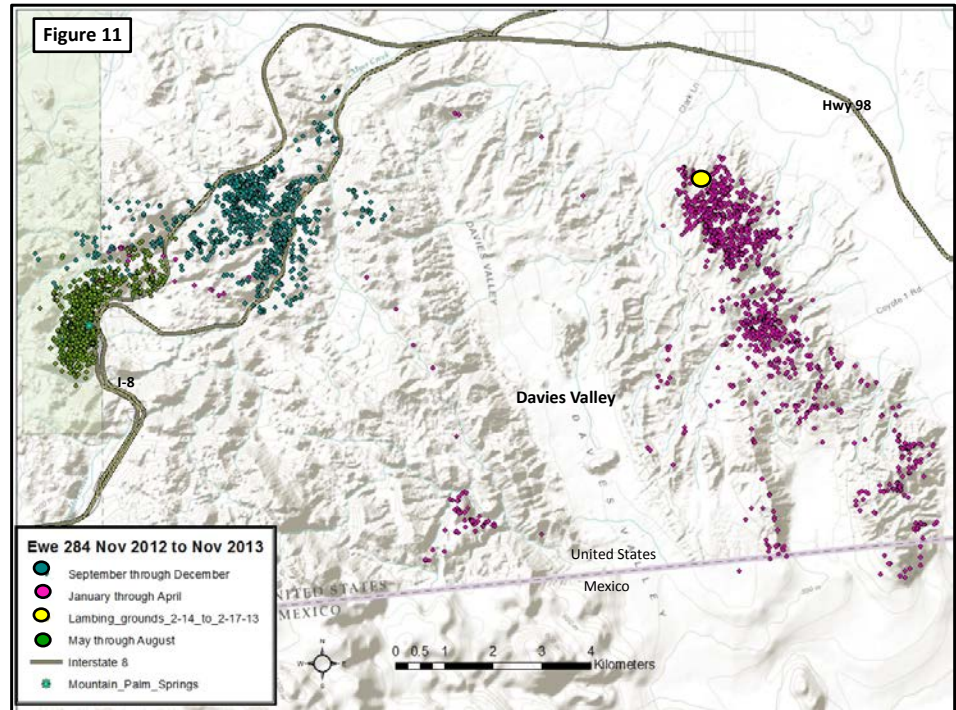
However, preliminary GPS location data and direct observations demonstrated different seasonal movements and lambing/nursery grounds from the Carrizo Canyon ewe group. Typically, ewes and lambs were observed from Indian Canyon to Moonlight Canyon. Water sources are located at Canebrake Canyon and near Agua Caliente County Park.

In-Ko-Pah Ewe Group: In 2013, observations and GPS data were collected on 10 females and 4 males; however, 3 males were lost to mortalities before the end of the year. This ewe group inhabited the areas surrounding Mountain Springs, Devils Canyon (west-bound side of I-8), In-Ko-Pah Gorge (east-bound side of I-8), and within the island created by the divergence of the east- and west-bound lanes of I-8 (henceforth referred to as the Island). The maps of ewes 232 and 282, illustrate the two typical seasonal movement patterns of females within this ewe group (Figures 8 & 9).



& 9). During summer (May – August) sheep occurred west of I-8 in the areas surrounding the water source at Mountain Spring and within nearby Devils Canyon. The months prior to parturition (September – December), were referred to as the “pre-lambing” season and during this time, females often moved back and forth between the summer use area surrounding Mountain Spring to areas closer to their lambing and nursery grounds. Lambing season was typically in January and February and most lambing locations were documented in the northern most portion of the Island and in areas surrounding

Devils Canyon. However, some ewes moved across the east-bound lanes of I-8 to have their lambs in the area surrounding Myers Valley. Ewe 282 (Figure 9) spent pre-lambing and the first month of lambing season in the Myer Valley area (just south of the I-8) and often crossed the east-bound lanes of the freeway with her lamb (Figure 10). Ewe 284's movement pattern for the lambing season was atypical (Figure 11). In December this ewe moved across the east-bound lanes of I-8 and headed south into Mexico before settling into the mountains east of Davies Valley where she had her lamb. At the end of April, she and her lamb returned to the In-Ko-Pah ewe group. This is a young ewe and she may have originally been associated with the Jacumba ewe group but is now associating with the In-Ko-Pah group outside of the lambing season.



Thus far, location data have been collected on 4 males within this subpopulation. All 4 males spent the majority of 2013 in the area surrounding Mountain Spring and Devils Canyon.

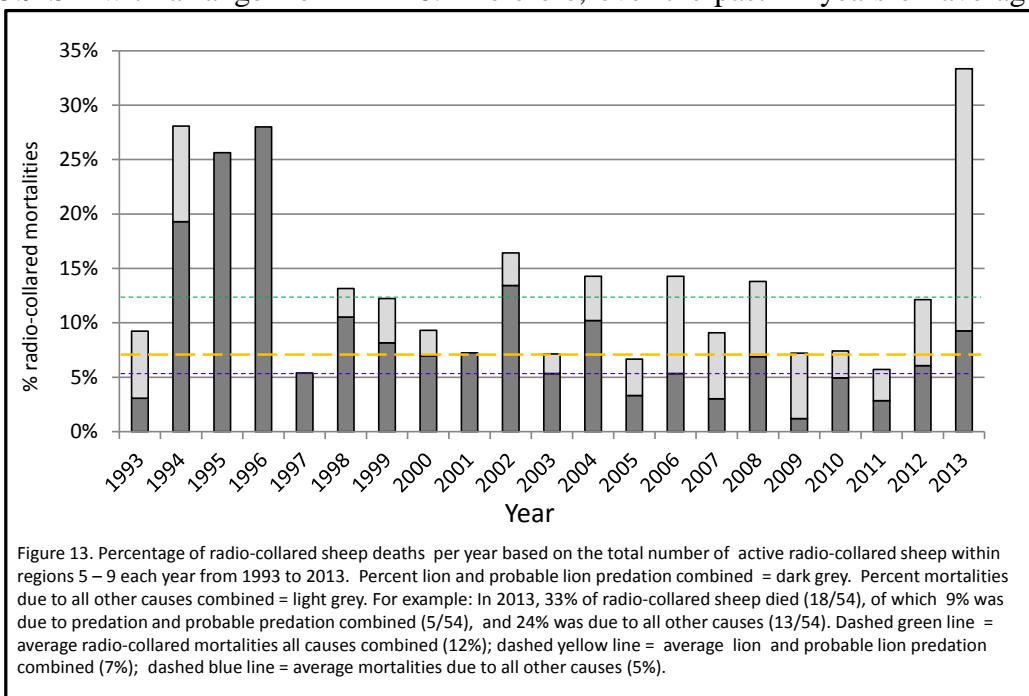
Ram 276 spent some time in the southern portion of Carrizo Canyon during the months of March and April before returning to the Devils Canyon area. Rarely, did these rams cross the Interstate into the Island; however, on September 4, 2013, ram 281 (Figure 12) crossed the Interstate and within 24 hours was in Mexico. The majority of September was spent in a canyon that parallels Highway 2 in Mexico. At the end of September, the ram moved back across the border and moved into the Jacumba Mountains east of Davies Valley. In this area the ram crossed back and forth into Mexico 9 more times before heading back north across I-8 to return to the Devils Canyon area.

Preliminary analysis of GPS location data indicated freeway crossing events occurred most often during the pre-lambing season October – December and again during lambing season February – April. Sheep crossed the freeway most often between the hours of 0500 and 0900 and 1500 to 1700. From the west, sheep can avoid crossing the surface of the west-bound lanes of the I-8 by going through the canyon beneath Devils Canyon overpass #1 and #2; however, they are just as likely to cross the surface of the Interstate anywhere along the road between the two overpasses (based on direct observations and GPS data). Sheep were documented crossing all along the east-bound section of I-8 through the In-Ko-Pah Gorge; however, the most common area of crossing was the area surrounding the jeep trail that enters Myer Valley to the Myer Valley overpass (Figure 10). Ewe 282 and her lamb crossed I-8 at this location a minimum of 8 times in February (see photo on cover of report) according to hourly GPS data.

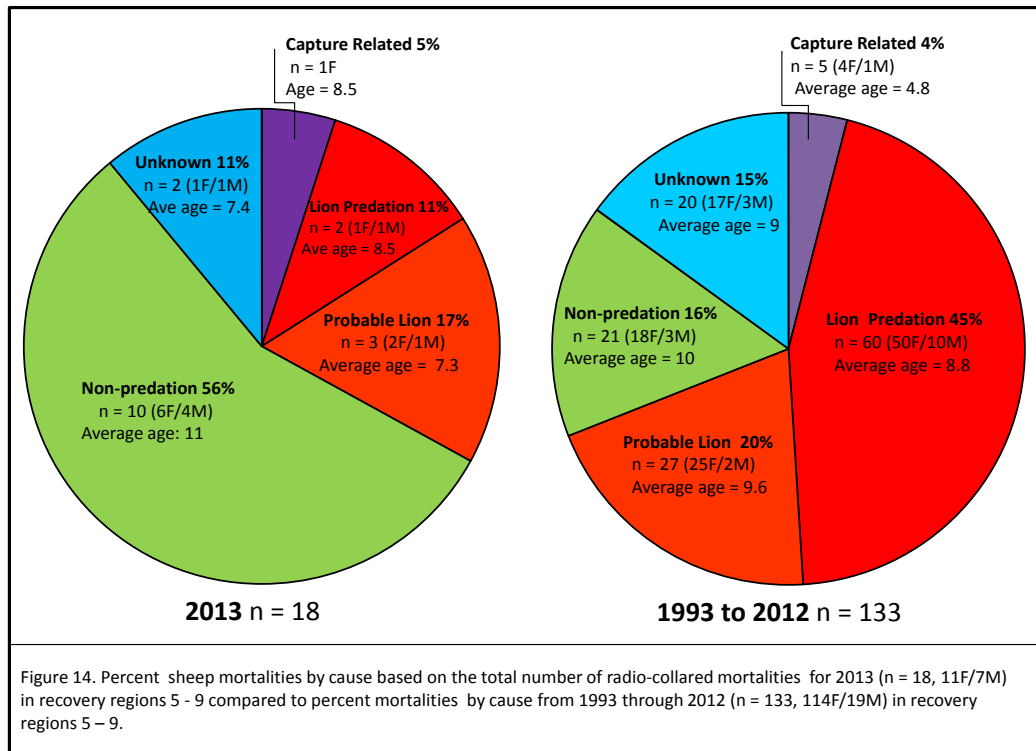
Jacumba Ewe Group: During the 2013 capture, 4 females and 3 males were deployed with GPS collars in the Jacumba Wilderness. Unfortunately, obtaining GPS data has proved to be difficult due to the amount of time these sheep have spent in Mexico. Remote data downloads were obtained either by fixed-wing plane or from the ground and neither method could be used when sheep were in Mexico. Preliminary data obtained for the first few months post-capture indicate that this is most likely a separate ewe group (Figure 4).

CAUSE-SPECIFIC MORTALITY AND SURVIVAL

2013 marked the highest number of radio-collared deaths (18) over all other years as well as the highest percentage of deaths (33%) relative to the number of active radio-collared sheep in regions 5 through 9 (Figure 13). For example, the average number of active radio-collared sheep in these 5 regions from 1993 to 2013 ($n = 21$) was 56.8 ± 14.7 SD with a range from 25 – 83 and the average number of mortalities was 7.2 ± 3.9 SD with a range from 2 – 18. Therefore, over the past 21 years on average 12% of active radio-collared sheep die in comparison to 33% in 2013. Over all years, on average, 7% of all active radio-collared sheep die due to lion predation and probable predation combined whereas non-predation and all other causes combined accounted for only 5%. In 2013, lion predation and probable predation deaths combined accounted for 9% (5/54) of the active radio-collared population; however, the majority of deaths (24%) was due to all other causes combined (13/54).



From 1993 to 2012, lion predation and probable predation combined accounted for 65% (87/133) of all sheep mortalities by cause in regions 5 through 9 and non-predation accounted for only 16% (21/133) (Figure 14). This trend was reversed in 2013 with non-predation caused deaths accounting for 56% (10/18) of all mortalities and lion predation and probable predations combined accounting for only 28% (5/18). A large number of older radio-collared sheep, without the addition of new collars in regions 5 through 8, may account for the higher percentage of non-predation caused mortalities relative to all other years. For example, 5 of the 10 deaths which were attributed to non-predation causes were directly or indirectly due to advanced age. Unknown causes of mortalities and capture related mortalities in 2013 were comparable to that in past years.

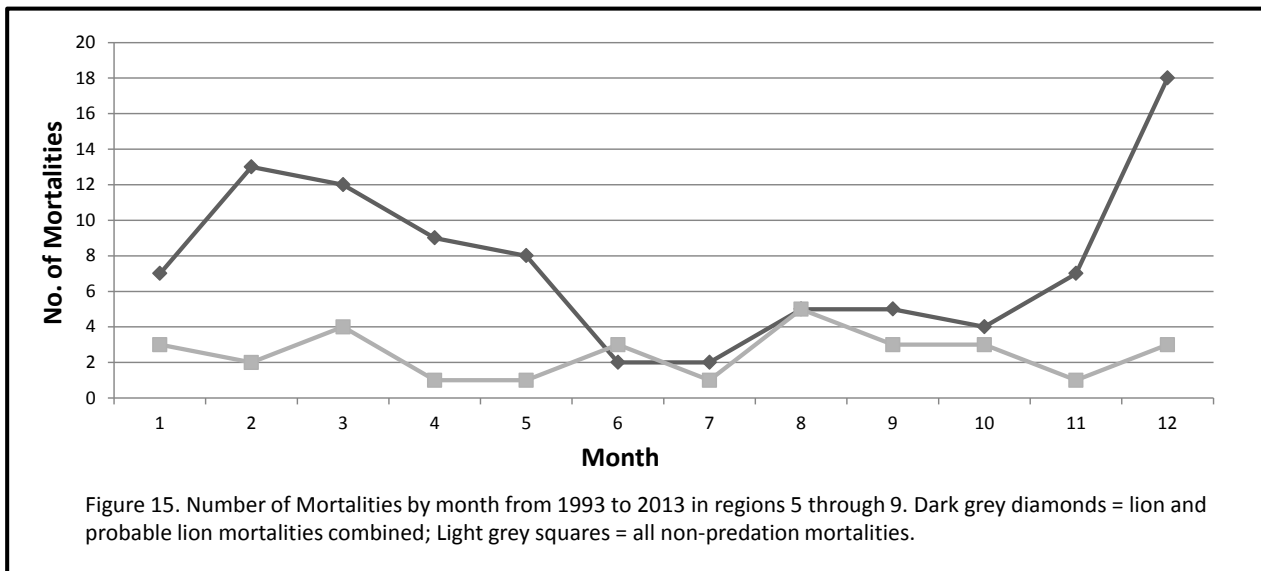


Mortalities by recovery region were CoC = 4 (1M/3F); SSYM = 4 (1M/3F); VM = 1F; and CC = 9 (5M/4F). The general cause of each sheep death is listed in Table 4. Three of the 5 deaths attributed to lion/probable lion kills were from the Tierra Blanca ewe group which had been radio-collared on November 1, 2013. Tierra Blanca Ewe 299 was most likely killed by a lion just 21 days post-capture. The ewe had not been seen since capture and a capture related injury/myopathy cannot be ruled out as a contributing factor that may have made her more vulnerable to predation. Tierra Blanca Ewe 306 was killed by a lion approximately 40 days post-capture: she was seen 7 days post-capture and appeared to be in good condition. Tierra Blanca Ram 302 was killed by a lion 41 days post-capture. The death may have been compensatory based on the finding of severe osteomyelitis of the left mandible. Based on GPS location data the ram's movements appeared to have been restricted for the last 10 days prior to his death which may have been due to a declining state of health based on the chronic bone infection in the mandible. The remaining 2 deaths attributed to lion/probable lion were from the In-Ko-Pah ewe group and SSYM subpopulation. Ram 281 was the first radio-collared death attributed to lion/probable lion within the In-Ko-Pah ewe group. He had been radio-collared since 2012 and had been seen in good health prior to his death. SSYM Ewe 273 had been radio-collared for several years and had been seen in good health just 10 days prior to her death which was attributed to a probable lion kill.

Table 4. Cause of death for 18 radio-collared bighorn sheep - January 1 to December 31 (Regions 5 – 9).

Sheep ID	Location	Sex	Age (yrs.)	Month	Cause
117	Vallecito	F	17	January	Age related (non-predation)
283	In-Ko-Pah	M	7	January	Unknown (non-predation)
244	SSYM	F	10	February	Dystocia/Injury (non-predation)
255	CoC	F	5	March	Unknown
273	SSYM	F	10	March	Lion (probable)
212	CoC	M	13	May	Age related (non-predation)
276	In-Ko-Pah	M	9	May	Injury (non-predation)
285	Carrizo	M	9.5	June	Unknown
180	CoC	F	11.5	August	Age related (non-predation)
246	SSYM	F	8.5	August	Unknown (non-predation)
231	Carrizo	F	8.5	September	Unknown (non-predation)
155	CoC	F	14.5	October	Age related (non-predation)
206	SSYM	M	11.5	October	Age related/infection (non-predation)
300	Tierra Blanca	F	8.5	November	Capture Myopathy
299	Tierra Blanca	F	3.5	November	Lion (probable)
306	Tierra Blanca	F	9.5	December	Lion
302	Tierra Blanca	M	7.5	December	Lion
281	In-Ko-Pah	M	8.5	December	Lion (probable)

From 1993 to 2013, sheep mortalities attributed to lions typically occurred from November to May with the peak in December (Figure 15). 2013 was not an exception to this rule with the majority of lion and probable lion kills occurring in December (3/5) with one in March and one in November. Non-predation mortalities do not display such seasonality with mortalities occurring throughout the year with only a slight increase in August (Figure 15). In 2013, 5 non-predation mortalities occurred from August through October with the other 5 occurring from January through May.



LAMB SURVIVAL AND RECRUITMENT

CDFW has monitored lamb survival of radio-collared ewes in the CoC, NSYM and SSYM recovery regions since 2008, and the In-Ko-Pah (IKP) ewe group (within the CC recovery region) since 2010. Details and descriptive statistics concerning lamb production, timing of parturition, lamb survival to 3 months, onset of lamb sickness, and timing of lamb deaths can be found in the 2012 Annual Report. Intensive lamb monitoring did not occur in 2013 due to time constraints and the lack of radio-collared females within CoC, NSYM, and SSYM; however, group observations of ewes within these subpopulations did occur in 2013 in order to obtain lamb:ewe ratios and yearling:ewe ratios as an index of lamb survival and recruitment. Lamb survival and recruitment continue to be extremely low in both CoC and NSYM due to pneumonia (Table 5). Recruitment of 2012 lambs to yearlings was 7% in CoC; 13% in NSYM; 38% in SSYM, and 45% in IKP. Lamb survival to 3 months in 2013 was 26% in CoC; 7% in NSYM; 93% in SSYM; and 51% in IKP.

Table 5. Index of lamb survival (3M Survival) and recruitment of lambs to yearlings (Recruitment) from 2008 – 2013 in CoC, NSYM, SSYM, and CC regions. Three-month lamb survival was calculated from lamb:ewe ratios from group observations obtained from May-June of one year and matched with yearling:ewe ratios (recruitment) from January - June the following year. For example in 2012 in CoC, 36% of lambs survived to 3-months-old (3M Survival), and 7% survived to yearlings (Recruitment) in 2013. *Data for 2013 recruitment has not been calculated. In CC, lamb survival statistics did not begin until 2010.

Year		CoC		NSYM		SSYM		CC	
3M Survival	Recruitment	3M Survival	Recruitment	3M Survival	Recruitment	3M Survival	Recruitment	3M Survival	Recruitment
2008	2009	66%	21%	43%	21%	64%	29%		
2009	2010	51%	31%	30%	24%	41%	18%		
2010	2011	37%	24%	14%	19%	61%	28%	79%	39%
2011	2012	56%	4%	21%	3%	58%	17%	63%	20%
2012	2013	36%	7%	13%	13%	63%	38%	70%	45%
2013	*	26%	*	7%	*	93%	*	51%	*
All Years Average		48%	21%	26%	15%	63%	27%	62%	35%

SUMMARY

At the beginning of the 2013 reporting period, the 7 recovery regions east of Highway 74 contained a total of 62 (8M/54F) active collars. CDFW in cooperation with USFWS conducted a bighorn sheep capture during 30-31 October and 1 November, 2013 within the CC recovery region and a total of 18 sheep were deployed with radio-collars (7M/11F). Radio-collared sheep were lost throughout the year due to mortalities and nonfunctioning collars and the year ended with a total of 43 (7M/36F) active collars. As a result, all 7 recovery regions east of Highway 74 fell well below the recommended percentage of marked females with only 9% in the CSRM, 1% in the SSRM, 9% in CoC, 0% in the NSYM, 5% in the SSYM, 2% in the VM, and 15% in CC.

Due to the lack of radio-collared sheep in 6 of 7 recovery regions east of Highway 74, information concerning movement and distribution was limited except within the CC recovery region. CDFW has identified at least 3 and possibly 4 subpopulations, or ewe groups, within recovery region 9. The ewe groups identified are: Tierra Blanca, Carrizo Canyon, In-Ko-Pah, and Jacumba. The In-Ko-Pah ewe group's home range is bisected by I-8 and movement across the Interstate increases during the pre-

lambing and lambing season. Preliminary data on the Jacumba group show that their home range is bisected by the US/Mexico border.

2013 marked the highest number of radio-collared deaths (18) over all other years as well as the highest percentage of deaths (33%) relative to the number of active radio-collared sheep in regions 5 through 9. Loss due to mortality was especially high within the Tierra Blanca Mountains where 3 of 4 females radio-collared in November died and 1 of 2 males died; 1 female died due to capture myopathy and the remaining 3 died due to lion or probable lion predation.

Lamb survival and recruitment continues to be extremely low in the CoC and NSYM ewe groups. The ability to continue monitoring lamb disease and any potential adult die-offs will be dependent on deploying radio-collars in the near future. Presently, lamb survival and recruitment are stable within the nearby SSYM and farther south within the CC recovery region.

FUTURE ACTIONS

Maintaining at least 30% collared females within each subpopulation is critical in order to obtain accurate data concerning sheep status, trends, distribution, movements, survival, and cause-specific mortality. The lack of radio-collared sheep in several of the recovery regions limits the ability of CDFW to assess current threats to sheep recovery in the Peninsular Ranges. Placement of new radio-collars range-wide to maintain 30% marked females in each recovery region is a priority for CDFW. As planned, collars will be fitted to sheep in the CC, VM, NSYM, and SJM recovery regions during fall 2014. Collars will be fitted to sheep in the remaining subpopulations during fall 2015 with a range-wide helicopter survey to follow during fall 2016.

Management strategies for 2014 include monitoring activities to detect mortalities, ground observations to assess group composition, health, lamb:ewe and yearling:ewe ratios, collecting location and movement data, conducting water hole counts in July in the VM and CC recovery regions, and capture activities.



Special thanks to: Jeff Young, CHP Officer Miguel Lizarraga, and Jackie Selby for photos and sheep observations; Scot Martin (ABDSP) for field assistance; L.Louise Jee (ABDSP) for GIS support and information; Kelly McCague (ABDSP) for aerial assistance, Mike Puzzo (ABDSP) for remote camera assistance, and Sally Theriault and Steve Bier (ABDSP) for relaying sheep sighting information from Park visitors to CDFW.