CALIFORNIA DEPARTMENT OF FISH AND GAME

PENINSULAR BIGHORN SHEEP RECOVERY

2009 ANNUAL REPORT

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

photo by Janene Colby

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, California from January 1, 2009 through December 31, 2009.

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SUMMARY

This report highlights information collected by the California Department of Fish and Game (CDFG) over the reporting period, 1 January 2009 through 31 December 2009 relating to bighorn sheep (*Ovis canadensis*) in the Peninsular mountain ranges of southern California. The Peninsular bighorn sheep population contains nine designated recovery regions occupying portions of western Riverside and Imperial Counties and eastern San Diego County. CDFG conducted monitoring activities in seven of nine recovery regions located east of Highway 74: Central Santa Rosa Mountain (CSRM), Southern Santa Rosa Mountain (SSRM), Coyote Canyon (CoC), North San Ysidro Mountain (NSYM), South San Ysidro Mountain (SSYM), Vallecito Mountain (VM), and Carrizo Canyon (CC). CDFG jointly monitored CSRM with the Bighorn Institute (BI), while the Northern Santa Rosa Mountain (NSRM) and San Jacinto Mountain (SJM) recovery regions located west of Highway 74 were monitored solely by BI.

CDFG conducted ground monitoring of radio-collared sheep in the CoC, NSYM, and SSYM recovery regions at least three days per week. Ground monitoring of collared sheep in the CSRM, SSRM, VC, and CC recovery regions occurred as opportunity allowed. Ground monitoring efforts were focused on: 1) detection of mortality signals from collared sheep; 2) recording locations of collared sheep moving between recovery regions; and 3) observation of lambs associated with collared ewes to determine survival. Aerial telemetry monitoring was conducted from a Cessna 185 fixed-winged aircraft for all recovery regions two to three times per month. Aerial flights were used to monitor collared sheep for mortality and track movement.

Between 19 October and 4 November 2009, CDFG in conjunction with United States Fish and Wildlife Service (USFWS) and California Department of Parks and Recreation (CDPR) conducted three separate capture operations to fit new radio-collars on adult male and female bighorn sheep. A total of 34 bighorn sheep (2M/32F) were captured during these operations. Captures were conducted in Imperial and San Diego Counties during 19-21 October and San Diego County during 2-4 November. Specific capture locations included the Jacumba Mountain and In-Ko-Pah Gorge areas of Imperial and San Diego County and the San Ysidro Mountain and Coyote Canyon areas of San Diego County.

CDFG, in cooperation with USFWS lethally collected an adult male radio-collared bighorn sheep and a domestic goat due to disease concerns within Blaisdell Canyon in the San Jacinto Mountains on 19 September 2009. Both animals were immediately transported to the California Animal Health and Food Safety Laboratory (CAHFS) in San Bernardino, California for post mortem examination.

The number of radio-collared sheep occurring east of Highway 74 at the beginning of 2009 was 76 (9M/67F) and as of 31 December 2009 the number of collared sheep was 96 (8M/88F). At the start of the reporting period the seven recovery regions located east of Highway 74 contained an estimated 773 adult and yearling bighorn sheep.

PERSONNEL

CDFG Resource Management and Air Services Divisions

Oversight for recovery of peninsular bighorn sheep in 2009 was provided by Mr. Steve Torres, Senior Environmental Scientist with the Department's Resource Management and Policy Division. Statewide Bighorn Sheep Program management was carried out by the Resource Management and Policy Division's Dr. Ben Gonzales, Associate Wildlife Veterinarian. Dr. Gonzales also managed Bighorn Sheep Program funding and was the statewide bighorn sheep veterinary coordinator. Mr. Tom Evans, Warden/Pilot for the Department's Air Services Division piloted all aerial telemetry flights.

CDFG South Coast Region, Wildlife Management Program

Mr. Randy Botta, Associate Wildlife Biologist for the South Coast Region, provided oversight for field and aerial monitoring, assisted with aerial monitoring flights and mortality investigations, and supervised one field position working east of Highway 74. Mr. Botta also served as lead for capture plan development and field operations for the entire Peninsular Ranges. Field telemetry monitoring and mortality investigation and reporting were carried out by Ms. Janene Colby, Scientific Aid with the South Coast Region. Ms. Colby also provided assistance during capture and population survey efforts for the entire Peninsular Ranges.

RECOVERY PROGRAM OVERVIEW

Activities conducted during 2009 were tied to recovery elements contained in Section 2 of the recovery plan for peninsular bighorn sheep. Section 2 addresses the need to "Initiate or continue research programs necessary to monitor and guide recovery efforts". Activities conducted in 2009 are covered in sections II.D.2.1 (Monitor population status), II.D.2.1.2 (Monitor distribution), and II.D.2.1.4 (Monitor survivorship and cause-specific mortality) of the recovery plan.

Population Monitoring

As recommended in the recovery plan for peninsular bighorn sheep, CDFG maintains, to the extent possible, active VHF radio-collars on approximately 25-30% of all females in each recovery region. The number of new collars to be fitted in each recovery region to maintain this ratio of marked (radio-collared) females is based on aerial helicopter surveys conducted during the fall of even numbered years. Capture operations to fit needed collars on sheep are conducted during the fall of the proceeding survey year. At the beginning of the 2009 reporting period the seven recovery regions east of Highway 74 contained a total of 75 (7M/68F) active collars. The number of collars fitted to males and/or females and percentage of marked females in each recovery region were:

- CSRM = 13 (2M/11F) : 28%
- SSRM = 13 (0M/13F) : 25%
- CoC = 8 (1M/7F) : 30%

- NSYM = 12 (1M/11F) : 24%
- SSYM = 8 (2M/6F) : 23%
- VM = 10 (1M/9F) : 21%
- CC = 11 (0M/11F) : 17%

By the end of 2009 the seven recovery regions located east of Highway 74 contained a total of 94 (6M/88F) radio-collared adult sheep. Collars were lost through mortality in the SSRM, CoC, NSYM, SSYM, and CC recovery regions while collars became non-functional in the CSRM, SSRM, and CC recovery regions. The number of collars in each recovery region and the number fitted to males and/or females and percentage of marked females in each recovery region at the end of 2009 were:

- CSRM = 12 (1M/11F) : 26%
- SSRM = 11 (0M/11F) : 16%
- CoC = 12 (1M/11F) : 42%
- NSYM = 16 (1M/15F) : 24%
- SSYM = 15 (2M/13F) : 27%
- VM = 9 (1M/8F) : 8%
- CC = 19 (0M/19F) : 20%

Specific monitoring objectives for 2009 as described in the recovery plan for peninsular bighorn sheep were:

(1) Monitor the status, dynamics, and trends of bighorn sheep.

(2) Determine distribution and movement patterns of adult sheep. Identify whether or not there is significant movement of ewes within, and between recovery regions.

(3) Monitor adult survivorship and cause-specific mortality. Continue to collect data in a manner that will allow comparison of survivorship and cause-specific mortality among recovery regions, years, and management strategies.

(4) Identify and monitor disease, pathogens and vectors that may be limiting adult productivity and lamb survivorship.

Population Size and Estimation

As of 1 January 2009 the seven recovery regions located east of Highway 74 contained an estimated 773 adult and yearling bighorn sheep. This represented 88% of all adult and yearling sheep in the peninsular ranges at that time. Based upon the existing strategy of conducting helicopter population surveys during even numbered years, individual recovery region and range-wide population size estimates were not generated during 2009.

Capture and Radio-Collaring

The conservation of bighorn sheep in the Peninsular Ranges requires, at a minimum an understanding of habitat use, population dynamics, behavior, and spatial population structure. To gain this understanding marking or tagging individual bighorn sheep with VHF and GPS radiocollars, ear tags, and/or colored marker collars is necessary. Maintaining an adequate number of radio-collared (marked) sheep in each recovery region is needed to assess progress towards recovery goals, examine threats, and evaluate success of implemented management actions. A hand held net-gun fired from a helicopter is used as the primary means of entrapment to provide for dispersal of radio-collared bighorn sheep throughout the range.

During 2009 captures were conducted east of Highway 74 to support CDFG monitoring efforts and west of Highway 74 to support monitoring efforts being conducted by BI. Captures were conducted in Imperial and San Diego Counties during 19-21 October and San Diego County during 2-4 November. Specific capture locations included the Jacumba Mountain and In-Ko-Pah Gorge areas of Imperial and San Diego County and the San Ysidro Mountain and Coyote Canyon areas of San Diego County.

Capture and field processing crews consisted of personnel from CDFG and Landells Aviation, while base camp processing crews included personnel from CDFG, USFWS, CDPR, and BI. A total of 41 bighorn sheep (*n*=5M/36F) were captured during the three operations. Of these, 34 (2M/32F) were captured east of Highway 74 and 30 (30F) were fitted with radio-collars (Table 1). Specifically, ten female bighorn sheep were captured, sampled, fitted with telemetry collars and released without incident during 19-21 October 2009 in the Jacumba Mountains (*n*=4F) and In-Ko-Pah Gorge (*n*=6F). Seven bighorn sheep (*n*=3M/4F) were captured on 26 October 2009 in the San Jacinto Mountains. Six of the seven bighorn sheep (2M/4F) were sampled and fitted with telemetry collars. One male wearing a non-functional GPS telemetry collar was sampled, the collar removed and fitted with ear tags. All seven bighorn sheep were released without incident. Twenty-four bighorn sheep (2M/22F) were captured, sampled and released without incident during 2-4 November 2009 in the San Ysidro Mountains and Coyote Canyon. A total of twenty female bighorn sheep were fitted with telemetry collars in the South San Ysidro Mountains (*n*=9F), North San Ysidro Mountains (*n*=6), and Coyote Canyon (*n*=5F). Four bighorn sheep (*n*=2M/2F) in the North San Ysidro Mountains were captured, sampled and fitted with ear tags.

Post-capture ground monitoring east of Highway 74 was conducted at least three times per week by CDFG personnel. Aerial telemetry monitoring was conducted by CDFG on 22 October 2009 and between 3-18 November 2009 in the Jacumba and In-Ko-Pah Mountains. Aerial telemetry monitoring was also conducted in the San Ysidro Mountains and Coyote Canyon on 10 and 18 November 2009. One captured bighorn sheep was detected on mortality during ground telemetry monitoring; a 7 year old female was detected on mortality in the North San Ysidro Mountains on 8 November 2009 (captured and released on 4 November 2009). The mortality was immediately investigated and probable cause of death was determined to be capture myopathy.

Table 1. Distribution and number of radio-collars east of Highway 74 prior to and after captures (1 January 2009 – 31 December 2009)

	CSRM		SSRM		CoC		NSYM		SSYM		VM		CC	
	Ewe	Ram	Ewe	Ram	Ewe	Ram	Ewe	Ram	Ewe	Ram	Ewe	Ram	Ewe	Ram
1/1/2009	**11**	**2**	**13**	**0**	**7**	**1**	**11**	**1**	**6**	**2**	**8**	**1**	**11**	**0**
new collars	0	0	0	0	5	0	6	0	9	0	0	0	10	0
re-collars	0	0	0	0	0	0	0	0	0	0	0	0	0	0
mortalities	0	0	1	0	1	0	2	0	2	0	0	0	1	0
non-functional	0	1	1	0	0	0	0	0	0	0	0	0	1	0
12/31/2009	**11**	**1**	**11**	**0**	**11**	**1**	**15**	**1**	**13**	**2**	**8**	**1**	**19**	**0**

Distribution and Range Expansion

During 2009, CDFG monitored between 75 and 95 adult radio-collared bighorn sheep in seven recovery regions located east of Highway 74 to document habitat use, distribution, and movement. Field staff detected collared and un-collared bighorn sheep of various age classes and sex regularly moving between recovery regions and between different geographic areas in the same recovery region. Movement across natural landscapes and two lane highways were documented and collared sheep inhabited areas anywhere from a few days to several months.

Central Santa Rosa Mountains: CDFG monitored 13 adult radio-collared bighorn sheep (2M/11F) in this recovery region. Aerial monitoring of collared sheep was conducted at least once per month. Throughout 2009, collared sheep were primarily documented inhabiting the La Quinta and Martinez Canyon areas of the CSRM. Collared sheep in the La Quinta area were regularly detected in Sheep, Coyote, Bear, Devil, and Guadalupe Canyons. Unlike previous reporting periods, most of the collared sheep in the La Quinta area used the lower elevations of Bear and Guadalupe Canyons just west and southwest of Lake Cauhilla. Further to the south, collared sheep were detected in Martinez, Toro, and Agua Alta Canyons. One collared ewe was detected regularly moving between La Quinta and Martinez Canyon.

Movement of radio-collared sheep from the CSRM to either the NSRM or SSRM recovery regions was not detected by CDFG.

Southern Santa Rosa Mountains: CDFG monitored 13 adult radio-collared bighorn sheep (13F) in this recovery region. Monitoring was conducted by air one to two times per month with ground monitoring occurring as opportunity allowed. Collared sheep were regularly detected in or adjacent to either Sheep Canyon or Rattlesnake Canyon. Four of the 13 collared ewes primarily used Sheep and Barton Canyons but occasionally used the upper and mid-elevations of Travertine, Wonderstone, and Big Washes to the west. Use of these washes coincided with periods of vegetation green up and/or availability of surface water. The remaining collard ewes regularly used Rattlesnake and Palo Verde Canyons but seasonally were detected using Coachwhip and Smoke Tree Canyons as well as Palm Wash to the east. Due to the presence of year round water in Rattlesnake Canyon, collared sheep were consistently detected in or adjacent to the upper portion of this canyon. Use of canyons and washes to the east coincided with periods of vegetation green up and/or surface water availability.

Movement of SSRM radio-collared sheep to other recovery regions or notable movement within the recovery region was not documented in 2009.

Coyote Canyon: CDFG monitored 12 adult radio-collared sheep (1M/11F) in this recovery region. Aerial monitoring was conducted two to three times per month with ground monitoring occurring at least once per week. As in previous years, collared sheep in CoC were regularly documented during winter (November through April) on Coyote Peak and during summer (May through October) in or adjacent to Box Canyon. During summer, collared sheep obtained water from Coyote Creek between Lower and Middle Willows.

Movement of three radio-collared females from CoC to the adjacent NSYM recovery region was documented during 2009. As in 2008, these females occupied Coyote Peak during winter and the northern end of the NSYM during summer. Between May and June the collared females along with their lambs moved from Coyote Peak west to Box Canyon where they then crossed Coyote Creek at Lower Willows into the NSYM.

Northern San Yisdro Mountains: CDFG monitored 16 adult radio-collared bighorn sheep (1M/15F) in this recovery region. Monitoring was conducted by air two to three times per month with ground monitoring occurring at least two times per week. Of the collared sheep inhabiting the NSYM, three females and one male were regularly documented in Hellhole Canyon; eight females were regularly documented in Borrego-Palm Canyon; and four females were regularly documented north of Henderson Canyon. Collared females using Borrego-Palm Canyon occupied Indian Head Peak during the lambing period but moved out of the canyon in winter where they occupied adjacent east facing slopes. Several collared sheep inhabiting Hellhole Canyon were documented in lower Borrego-Palm Canyon during summer due to presence of available water. Collared sheep found north of Henderson Canyon were not documented south of the canyon during 2008 but one ewe made brief excursions to Salvador Canyon to the northwest. All four collared sheep obtained water from Coyote Creek at or below Lower Willows.

Movement of one collared female to the adjacent SSYM recovery region was documented during 2009. This sheep crossed Highway S-22 (Montezuma Grade) below Dry Canyon into Tubb Canyon of the SSYM recovery region.

Southern San Ysidro Mountains: CDFG monitored 15 adult radio-collared bighorn sheep (2M/13F) in this recovery region. Monitoring was conducted by air two to three times per month with ground monitoring occurring at least two times per week. Collared sheep in the SSYM were documented on Pinyon Ridge and Tubb Canyon during summer and on Yaqui Ridge during winter.

Movement of one radio-collared female from Yaqui Ridge to the VM recovery region across Highway 78 between Quartz Vain Wash and Nude Wash was documented during 2009. In addition, all but three of the collared females were documented moving between Pinyon Ridge and Yaqui Ridge across Highway S-3 at Yaqui Pass. Both collared males were regularly detected on Pinyon Ridge.

Vallecito Mountains: CDFG monitored 10 adult radio-collared bighorn sheep (1M/9F) in this recovery region. Monitoring was conducted by air two to three times per month with ground monitoring occurring one two times per month. As in 2008, collared sheep were documented throughout the recovery region from Split Mountain in the east to Plum Canyon in the west. From east to west sheep were documented in the following areas, Split Mountain, Alma Wash, Fish Creek Wash, Harper Canyon, Sunset Mountain, Whale Peak (June Wash), Nolina Wash, Bighorn Canyon, Mine Wash, Stag Cove, Lizard Wash, and Plum Canyon. The majority of collared sheep occupied the Split Mountain, Sunset Mountain, and Alma Wash areas throughout the year while others moved seasonally between these areas and other areas in the recovery region, including the Fish Creek Mountains, Whale Peak, and Bighorn Canyon.

Continued movement of several radio-collared females to the Fish Creek Mountains via Split Mountain was documented in 2009. Additionally, several collared sheep were documented moving across Highway 78 between the VM and SSYM. Crossing areas varied by sheep but were between Quartz Vain and Nude Wash and Stag Cove and Lizard Wash.

Carrizo Canyon: CDFG monitored 19 adult radio-collared bighorn sheep (0M/19F) in this recovery region. Monitoring was conducted by air two to three times per month with ground monitoring occurring as opportunity allowed. All 11 sheep collared previous to October 2009 were regularly documented during summer (May through October) in the lower portion of the canyon. Specific areas where collared sheep were detected in Carrizo Canyon included Sweeney Canyon, upper Carrizo Palm Canyon, and Goat Canyon. During winter (November through April) ten of the eleven collared females were documented in the Coyote Mountains. The remaining collared ewe remained in the lower portion of CC. All four of the female sheep radio-collared during October 2009 in the Jacumba Mountains moved into the Coyote Mountains by the end of the reporting period. Additionally, all six of the female sheep radio-collared in the In-Ko-Pah Gorge

area during October 2009 were still in the general area of capture at the end of the reporting period.

No movement of collared sheep to other recovery regions was documented during 2009. However, as noted above, the majority of collared sheep moved to the Coyote Mountains just prior to the lambing. In 2009, as in past years, collared sheep moved to Sweeney Canyon from locations within Carrizo Canyon in late October or early November and subsequently crossed Highway S-2 at Sweeney Pass into the Coyote Mountains. Collared sheep were regularly documented in or adjacent to Fossil Canyon, Painted Gorge, and Carrizo Mountain. By early July all collared sheep had moved from the Coyote Mountains back to Carrizo Canyon.

Survival and Lamb Mortality Monitoring

In 2009, CDFG detected and investigated 7 (0M/7F) adult radio-collared bighorn sheep mortalities east of Highway 74 (Table 2). Mortalities by recovery region were SSRM = 1; CoC = 1; NSYM = 2; SSYM = 2; and CC = 1. Causes of mortality and percentage of all mortalities were probable lion predation = 2 (29%); vehicle = 1 (14%); capture myopathy = 1 (14%); miscellaneous = 1 (14%); and unknown = 2 (29%). Causes and percentage of documented mortalities in 2009 were generally consistent with that documented since 1993 (Figure 1).

Table 2. Cause of death for radio-collared bighorn sheep – January 1 to December 31, 2009

Sheep ID	Location	Sex	Age (yrs.)	month	cause
0934	SSRM	F	9	February	Lion (probable)
167	SSYM	F	10	March	Vehicle
217	CoC	F	5	July	Unknown
166	SSYM	F	11	July	Unknown (non-predation)
223	NSYM	F	7	September	Lion (probable)
0972	NSYM	F	9	November	Capture Myopathy
102	CC	F	10	December	Squamous cell carcinoma

Of the7 mortalities involving radio-collared sheep documented in 2009, 4 (57%) occurred during winter and spring (November through May). This timing pattern was consistent with known sheep mortalities documented since 1993 (Figure 2). The number of collared sheep mortalities in 2009 was lower than that documented in 2008 and consistent with the range of four to eight mortalities documented over the previous five years.

Figure 1. Number of sheep mortalities by cause from 1993 – 2009.

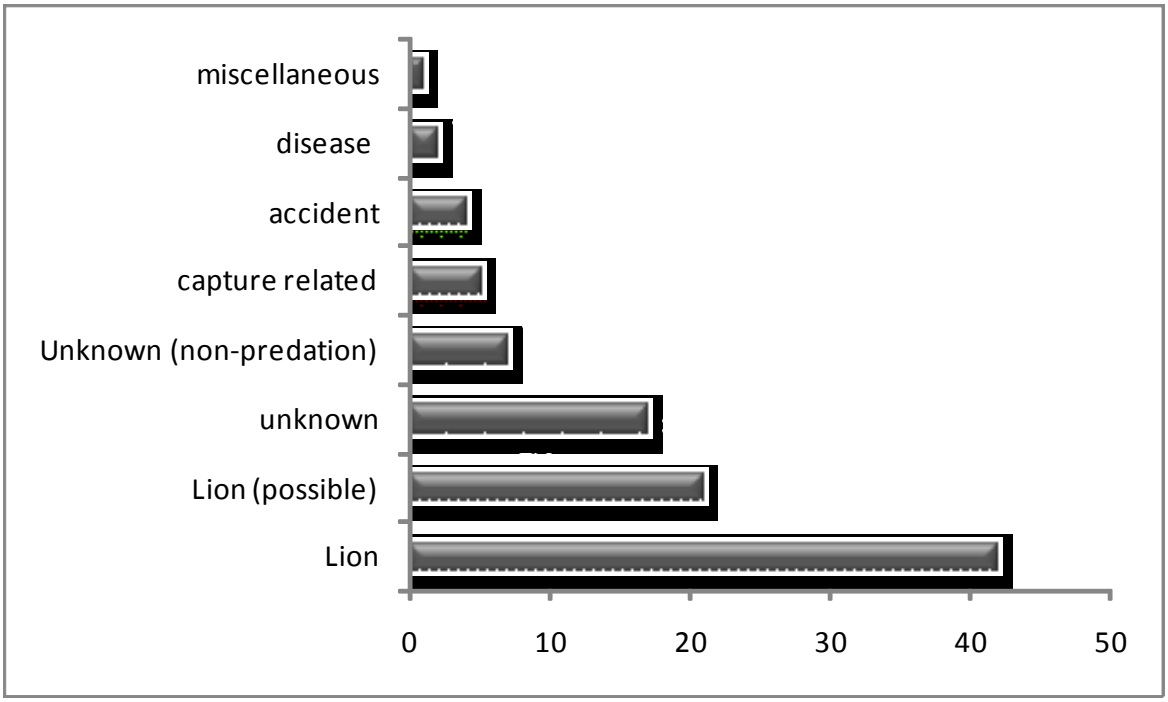
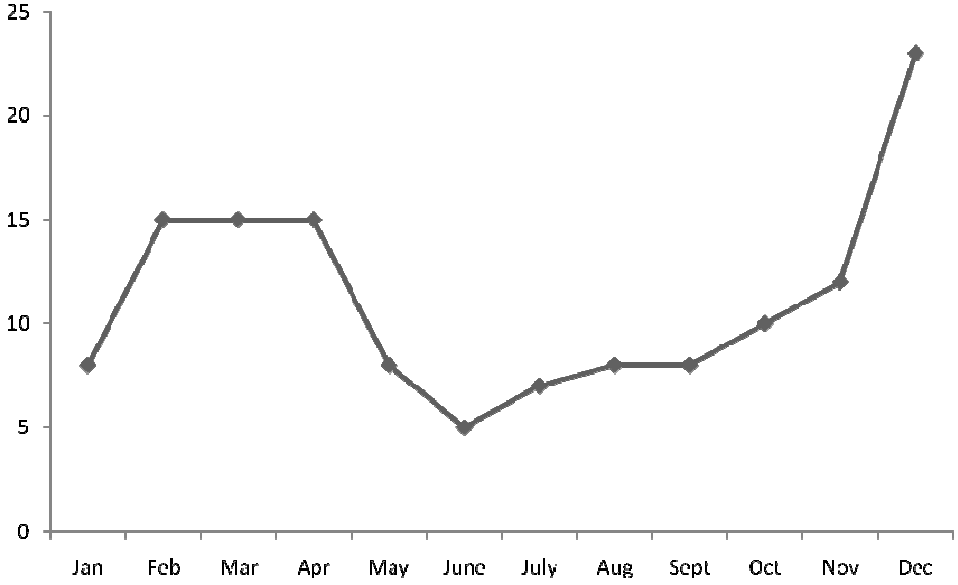


Figure 2. Number of sheep mortalities by month from 1993 – 2009



Lamb Mortality Monitoring

In 2007, CDFG documented several sick lambs and lamb deaths in Borrego-Palm Canyon located in the NSYM. As a result of anecdotal evidence of high lamb mortality, CDFG initiated a pilot study in 2008 in order test the feasibility and logistics of monitoring lamb survival in the NSYM and SSYM. In 2009 lamb survival monitoring was also undertaken in CoC. The objective of this work is to determine lamb survival to 3 and 6 months and examine the timing of parturition, lamb production, lamb:adult female ratios, and timing of sick lambs and lamb deaths.

CDFG monitored a total of 26 marked females; SSYM (*n* = 7), NSYM (*n* = 13), and CoC (*n* = 6) between January - May and August - September 2009. In the SSYM, there were 6 females with functional VHF radio-collars and 1 female with a non-functional collar. In the NSYM, there were 11 females with functional VHF radio-collars, 1 female with non-functional collar, and I female with ear tags. In CoC there were 6 females with functional VHF radio-collars. Lamb production for radio-collared females in 2009 was similar in the NSYM (100%) and CoC (100%) but lower in the SSYM (78%). Percent lamb survival to 3 and 6 months of age for marked females in the SSYM, NSYM, and CoC recovery regions in 2008 and 2009 are listed in Table 3.

Table 3. Percent lamb survival of marked females to 3 and 6 months of age in the SSYM, NSYM, and CoC recovery regions. Sample size for SSYM was 7 for 2008 and 2009. Sample size for NSYM was 12 in 2008 and 13 in 2009. Data were not collected for CoC in 2008 and sample size was 6 in 2009.

		2008		2009	
Area	Survival	3 months	6 months	3 months	6 months
SSYM	no	14.29%	14.29%	28.57%	85.71%
SSYM	yes	71.43%	57.14%	71.43%	0.00%
SSYM	unknown	14.29%	28.57%	0.00%	14.29%
SSYM	no + unknown	28.57%	42.86%	28.57%	100.00%
SSYM	yes + unknown	85.71%	85.71%	71.43%	14.29%
NSYM	no	33.33%	50.00%	46.15%	61.54%
NSYM	yes	33.33%	8.33%	53.85%	23.08%
NSYM	unknown	33.33%	41.67%	0.00%	15.38%
NSYM	no + unknown	66.67%	91.67%	46.15%	76.92%
NSYM	yes + unknown	66.67%	50.00%	53.85%	38.46%
CoC	no			33.33%	50.00%
CoC	yes			66.67%	16.67%
CoC	unknown			0.00%	33.33%
CoC	no + unknown			33.33%	83.33%
CoC	yes + unknown			66.67%	50.00%

2010 CDFG Proposed Activities

In 2010, CDFG will continue on-going monitoring activities involving:

(1) Monitoring the status, dynamics, and trends of bighorn sheep.

(2) Determining the distribution and movement patterns of adult sheep and identifying whether or not there is significant movement of ewes within, and between recovery regions.

(3) Monitoring adult survivorship and cause-specific mortality and data collection in a manner that will allow comparison of survivorship and cause-specific mortality among recovery regions, years, and management strategies.

(4) Identifying and monitoring disease, pathogens and vectors that may be limiting adult productivity and lamb survivorship.

Additionally, during fall 2010 CDFG will undertake the following activity:

(5) Initiate an aerial helicopter survey to derive mark-resight range-wide and individual recovery region population abundance estimates using marked (radio-collared and ear tagged) bighorn sheep.