CALIFORNIA DEPARTMENT OF FISH AND GAME

PENINSULAR BIGHORN SHEEP RECOVERY

2011 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

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, 2011 through December 31, 2011.

Report prepared by Janene Colby and Randy Botta

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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 2011 through 31 December 2011 relating to bighorn sheep (*Ovis Canadensis nelsoni*) 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 (Figure 1). CDFG conducted monitoring activities in seven of nine recovery regions located east of Highway 74: Central Santa Rosa Mountains (CSRM), Southern Santa Rosa Mountains (SSRM), Coyote Canyon (CoC), North San Ysidro Mountains (NSYM), South San Ysidro Mountains (SSYM), Vallecito Mountains (VM), and Carrizo Canyon (CC). CDFG jointly monitored CSRM with the Bighorn Institute (BI), while the Northern Santa Rosa Mountains (NSRM) and San Jacinto Mountain (SJM) recovery regions located west of Highway 74 were monitored solely by BI.

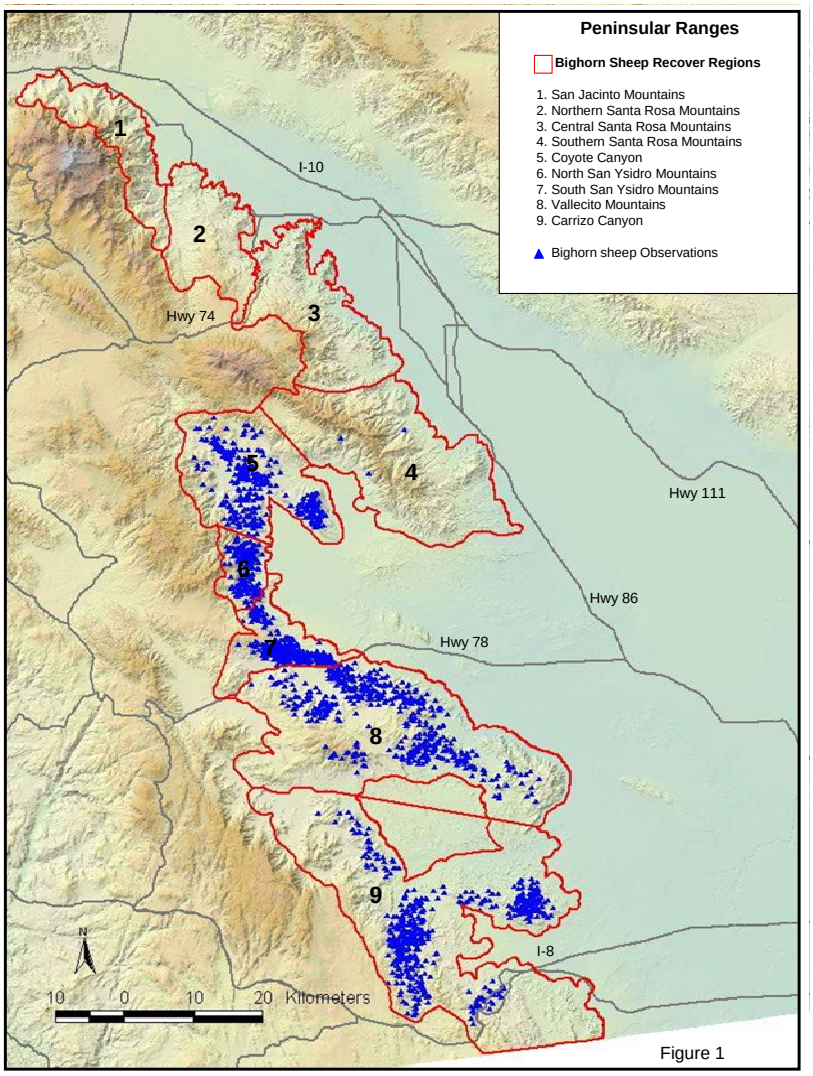


Figure 1

CDFG conducted ground monitoring of radio-collared sheep two to three times per week primarily in CoC, NSYM, and SSYM recovery regions. Ground monitoring of collared sheep in the CSRM, SSRM, VM, 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 and Vulcanair Partenavia P68 fixed-winged aircraft for all

recovery regions one to three times per month. Aerial flights were used to monitor collared sheep for mortality and track movements.

Bighorn sheep capture and radio-collaring efforts typically undertaken in odd numbered years were not conducted during the 2011 reporting period due to lack of a CDFG helicopter contract. Additionally, helicopter population surveys are normally conducted during even numbered years and were not a scheduled activity for this reporting period. However, data from the 2010 helicopter survey were used in preparing this report. The 2010 bighorn sheep helicopter surveys were conducted in the Peninsular Ranges of San Diego, Riverside and Imperial Counties during October 12-14, October 16-17, and October 26-29, 2010. Surveys were coordinated and funded by the CDFG Bighorn Sheep Program and South Coast Region. Logistic and personnel support was provided by the California Department of Parks and Recreation (CDPR) and BI. Survey results indicated that bighorn sheep in the peninsular ranges continued to increase in distribution and number. As of 1 January 2011, an estimated 849 adult bighorn sheep occupied the seven recovery regions located east of Highway 74 and the range-wide population was estimated at 955. The number of collared sheep occurring east of Highway 74 at the beginning of 2011 was 86 (4M/82F) and as of 31 December 2011 the number of collared sheep was 74 (4M/70F).

PERSONNEL

CDFG Resource Management and Air Services Divisions

Oversight for recovery of peninsular bighorn sheep in 2011 was provided by Mr. Steve Torres, Environmental Program Manager 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, Senior 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, Senior Wildlife Biologist for the South Coast Region, provided oversight for field monitoring activities, assisted with aerial monitoring flights and supervised one field position working east of Highway 74. Field telemetry monitoring and mortality investigation and reporting were carried out by Ms. Janene Colby, Environmental Scientist with the South Coast Region.

RECOVERY PROGRAM OVERVIEW

Activities conducted during 2011 were tied to recovery elements contained in Section 2 of the recovery plan for peninsular bighorn sheep. Section 2 of the recovery plan addresses the need to "Initiate or continue research programs necessary to monitor and guide recovery efforts". Activities conducted in 2011 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.

Telemetry 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; however, no capture operation was conducted in 2011. As a result, 4 recovery regions (CSRM, SSRM, VM and CC) fell well below the recommended percentage of marked females. At the beginning of the 2011 reporting period the seven recovery regions east of Highway 74 contained a total of 86 (4M/82F) active collars. The numbers of collars fitted to males and females and percentage of marked females in each recovery region at the beginning of 2011 were:

- CSRM = 10 (0M/10F) : 14%
- SSRM = 7 (0M/7F) : 8%
- CoC = 12 (1M/11F) : 24%
- NSYM = 14 (0M/14F) : 35%
- SSYM = 15 (2M/13F) : 36%
- VM = 10 (1M/9F) : 11%
- CC = 18 (0M/18F) : 13%

By the end of 2011 the seven recovery regions located east of Highway 74 contained a total of 74 (4M/70F) radio-collared adult sheep. Collars were lost through mortality in the CSRM, NSYM, and SSYM recovery regions while collars became non-functional in the SSRM, NSYM, VM, and CC recovery regions. The number of collars in each recovery region and the number fitted to males and females and percentage of marked females in each recovery region at the end of 2011 were:

- CSRM = 9 (0M/9F) : 13%
- SSRM = 1 (0M/1F) : 1%
- CoC = 12 (1M/11F) : 24%
- NSYM = 12 (0M/12F) : 30%
- SSYM = 13 (2M/11F) : 31%
- VM = 8 (1M/7F) :10%
- CC = 17 (0M/17F) :13%

Specific monitoring objectives for 2011 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. Determine locations, timing, and frequency of road crossing points within and among 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

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 2011. However, a summary of individual ewe subpopulation size and lamb:ewe ratio (lambs per 100 ewes) trends based on previous helicopter population surveys are included in this report for reference. Further, results of the 2011 Anza Borrego Desert State Park (ABDSP) July 2011 waterhole count for specific areas within individual recovery regions is also provided.

Central Santa Rosa Mountains: The 2010 helicopter survey estimated 71 (95% CI: 61.7 – 81.3) females in this subpopulation and it has remained stable from 2006 to 2010 ($y = 1.5x + 65.3$; $R^2 = 0.35$). From 2006 to 2010, the number of lambs per 100 ewes has remained above 35 and has increased to 51in 2010 ($y = 8x + 33.3$; $R^2 = 0.35$). ABDSP does not conduct a waterhole count within this recovery region.

S*outhern Santa Rosa Mountains:* The 2010 helicopter survey estimated 84 (95% CI: 47.4 – 121.4) females in this subpopulation and the trend is slightly decreasing from 2006 to 2010 ($y = -4.5 + 97.7$; $R^2 = 0.99$). From 2006 to 2010, the number of lambs per 100 ewes has remained above 20 and was 27 in 2010 ($y = 1x + 27.3$; $R^2 = 0.04$). The July 2011 ABDSP waterhole count conducted in Rattlesnake Canyon detected 84 sheep (14M/43F/27L). Results indicated a lamb:ewe ratio of 69%.

Coyote Canyon: The 2010 helicopter survey estimated 46 (95% CI: 29.9 – 62.3) females in this subpopulation and from 2002 to 2010 it has been increasing ($y = 5.25x + 13.31$; $R^2 = 0.66$; Figure 2-A). The number of lambs per 100 ewes has vacillated each year but has remained above 21 until 2010 when it dipped to 14 ($y = -12.3x + 69.1$; $R^2 = 0.97$; Figures 2-B & Figure 3). The July 2011 ABDSP waterhole count in Lower, Middle, and Upper Willows, Box Canyon, and Monkey Hill areas detected 97 sheep (26M/57F/14L). Results indicated a lamb: ewe ratio of 25%.

Northern San Ysidro Mountains: The 2010 helicopter survey estimated 40 (95% CI: 25.6 – 55.0) females in this subpopulation. The ewe subpopulation has been increasing steadily except for a slight dip in 2010 based on helicopter surveys from 2002 to 2010 (y

= 6.91x + 15.7; R^2 = 0.65; Figure 2-A). In contrast, the number of lambs per 100 ewes has rapidly declined from 53 in 2002 to 5 in 2010 (y = -12.3x + 69.1; R^2 = 0.97; Figures 2-B & Figure 4). The July 2011 ABDSP waterhole count in Palm Canyon and Hellhole Canyon detected 70 sheep (22M/45F/3L). Results indicated a lamb:ewe ratio of 7%.

Southern San Ysidro Mountains: The 2010 helicopter survey estimated 36 (95% CI: 28.0 – 43.4) females in this subpopulation and it has remained stable from 2002 to 2010 (y = 2.25x + 25.6; R^2 = 0.22; Figure 2-A). In contrast, the number of lambs per 100 ewes has steadily declined since 2002 (y = -4.5x + 47.7; R^2 = 0.50; Figures 2-B & Figure 6). But unlike in CoC and NSYM, lamb survival has remained above 20% according to helicopter survey results. The July 2011 ABDSP waterhole count in Tubb Canyon and on Montezuma Grade detected 76 sheep (37M/27F/12L). Results indicated a lamb:ewe ratio of 44%.

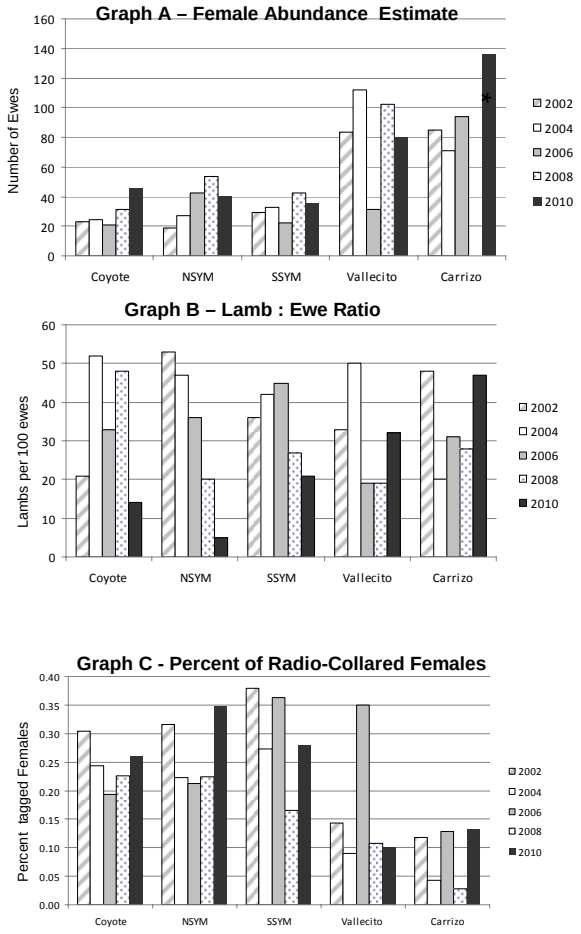


Figure 2. Graphs A, B, & C are based on CDFG biennial helicopter surveys of bighorn sheep from 2002 through 2010 conducted in Coyote Canyon (Coyote), Northern San Ysidro Mountains (NSYM), Southern San Ysidro Mountains (SSYM), Vallecito Mountains (Vallecito), and Carrizo Canyon (Carrizo) Recovery Regions. Graph A – Abundance estimate of females (including yearlings). *Not shown is the Carrizo 2008 estimate of 395 (95%CI 0-797); Graph B - Number of lambs per 100 ewes (including yearlings); Graph C - Percent of radio-collared Females (including yearlings).

Vallecito Mountains: Ewe subpopulation estimates have varied greatly from one survey year to the next in the Vallecito Mountains recovery region (y = -1.66x + 86.7; R^2 = 0.007; Figure 2-A). The 2010 helicopter survey estimated 80 (95% CI: 55.1 – 104.9) females; however, survey years with low numbers of marked sheep most likely inflates the population estimates (Figure 2-C). The number of lambs per 100 ewes has vacillated each year but has remained above 19% and at the beginning of 2011 was up to 32% (y = -3.3x + 40.5; R^2 = 0.17; Figure 2-B & Figure 7). ABDSP does not conduct waterhole counts in the VM.

Carrizo Canyon: The 2010 helicopter survey estimated 136 (95% CI: 78.9 – 193.5) females in this subpopulation. The number of marked ewes has been well below 13% and as low as 3% in 2008 which resulted in an inflated population estimate for that year

(Figure 2-A & C). When this outlier is removed the trend since 2002 is towards a slowly increasing population ($y = 14.5 + 56.4$; $R^2 = 0.79$). The number of lambs per 100 ewes was significantly higher (47%) than in the other 4 southern recovery regions and has remained stable since 2002 ($y = 0.6x + 33$; $R^2 = 0.006$; Figure 2-B & Figure 8). ABDSP does not conduct waterhole counts in CC.

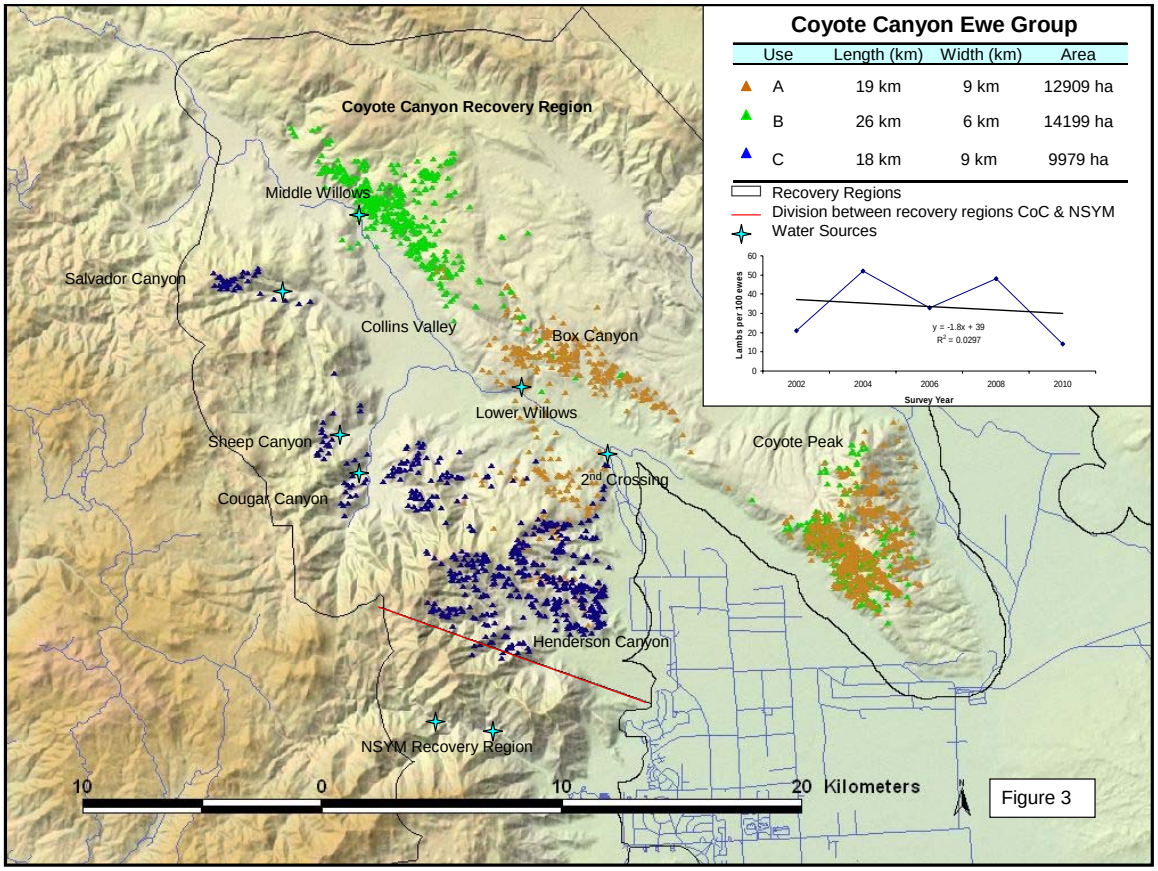
Distribution and Movement

During 2011, CDFG monitored 86 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 moving between recovery regions and between different geographic areas in the same recovery region. CDFG documented movements of ewes, and younger ewes in particular, from the NSYM to the CoC recovery region; from the SSYM to the NSYM; and back and forth between the VM and SSYM recovery regions. These movements appear to be regular seasonal movements rather than short exploratory bouts. Movements across two-lane highways in the NSYM, SSYM, and VM and across Interstate 8 (I-8) in the CC recovery regions were documented. The frequency of movement across roads seems to increase during the rut and during the lambing season in all recovery regions.

Central Santa Rosa Mountains: CDFG monitored 10 radio-collared female bighorn sheep in this recovery region. Aerial monitoring of collared sheep was conducted one to two times per month. Throughout 2011, 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 and occasionally detected in Deep Canyon and on Indio and Eisenhower Mountains. Further to the south, collared sheep were detected in Martinez, Toro, and Agua Alta Canyons. Movement of radio-collared sheep from the CSRM to either the NSRM or SSRM recovery regions was not detected.

Southern Santa Rosa Mountains: CDFG monitored 7 radio-collared female bighorn sheep in this recovery region. Six collars became non-functional within the first 6 months of the year leaving only one sheep with an active collar for the entire year. Monitoring was conducted by air one to two times per month. Collared sheep in the SSRM were occasionally documented between Sheep and Barton Canyons as well as the upper and mid-elevations of Palm, Big, Travertine, and Wonderstone Washes. Collared sheep were also detected in Coachwhip, Smoke Tree, and Palo Verde Canyons. Movement of SSRM collared sheep to other recovery regions or notable movement within the recovery region was not documented in 2011.

Coyote Canyon: CDFG monitored 12 radio-collared bighorn sheep in this recovery region (1 VHF-collared ram, 7 VHF-collared females, and 4 GPS-collared females). The average age of collared ewes in 2011 was 7 years with a range evenly dispersed from 3 - 12 years. Aerial monitoring was conducted one to two times per month with ground monitoring occurring at least once per week. In November of 2009, GPS collars were



placed on 4 ewes in CoC. Two GPS collars malfunctioned soon after placement, and the remaining 2 GPS collars were functional until the spring of 2011. In all cases throughout this report, while the GPS component of a collar may be noted as failing the VHF component remains independent and thus continues to function allowing monitoring via ground and aerial telemetry. By the end of 2011, 24% of the ewe population had active VHF-collars. Since 2002, the number of marked ewes has remained above 23% with the exception of 19% in 2006 (Figure 2-C).

There appears to be 3 general patterns of use within the Coyote Canyon Recovery Region (Figure 3):

A. Coyote Peak - Lower Willows - North Henderson - Females use Coyote Peak during the lambing season with use recorded from October/November through April/May. There are no water sources on Coyote Peak and GPS location data show no movement to water during this time-frame. Summer and fall months are spent near water sources at Lower Willows in Box Canyon and areas north of Henderson Canyon. The size of this use area is approximately 19 km x 9 km and encompasses 12,909 ha.

B. Coyote Peak - Middle Willows - This group of females also use Coyote Peak from October/November through April/May; however, there is little use of the Box and Henderson Canyon areas in the fall and summer. Instead, summer and fall months are mainly spent on the east slopes above Upper Willows in Coyote

Canyon where water is present. This ewe group does not appear to move west of Coyote Creek. The size of this use area is approximately 26 km x 6 km and encompasses 14,199 ha.

C. North Henderson – Collins Valley - These females do not use Coyote Peak during the lambing season but instead use the areas surrounding Henderson Canyon (most likely on the south-facing slopes). This area is shared with a number of ewes from the NSYM recovery region. During summer, water is accessed at Lower Willows, Cougar, Sheep, and Salvador Canyons, and 2nd crossing. The size of this use area is approximately 18 km x 9 km and encompasses 9,979 ha.

Sheep within this recovery region have not been documented crossing paved roads though they regularly cross dirt roads along the bottom of Coyote Canyon. Sheep have been documented to venture as far as 800 m into the flat areas of Collins Valley and Coyote Canyon. The only radio-collared ram in this recovery region was not observed in 2011, but has previously been documented using Coyote Peak, Henderson Canyon, Upper and Lower Willows and the eastern slopes of the SSRM.

Northern San Ysidro Mountains: CDFG monitored 18 marked sheep in this recovery region (2 ear-tagged males, 2 ear-tagged females, 12 VHF-collared ewes, and 2 GPS-collared ewes). The average age of marked ewes in 2011 was 8 years with a range of 2 to 13 years; 3 of which were ≤ 3-years-old. Monitoring was conducted by air two to three

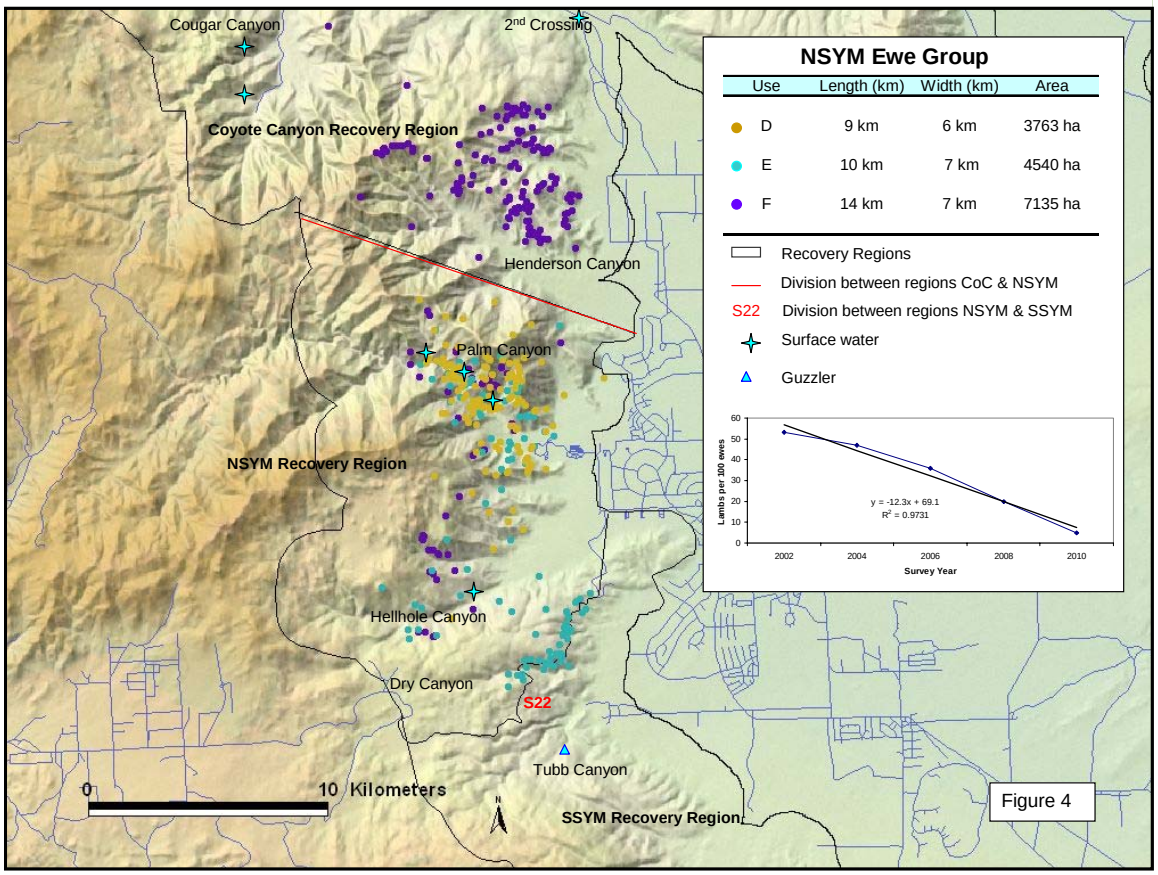


Figure 4

times per month with ground monitoring occurring at least three times per week. Opportunistic observations were obtained for ear-tagged sheep. One GPS collar became non-functional a few months after deployment in 2009 and the other remained functional through the spring of 2011. By the end of 2011, 30% of the ewe population had active VHF-radio collars. Since 2002, the number of marked sheep has remained above 21% (Figure 2-C).

There appears to be 3 general patterns of use within the Northern San Ysidro Mountains Recovery Region (Figure 4):

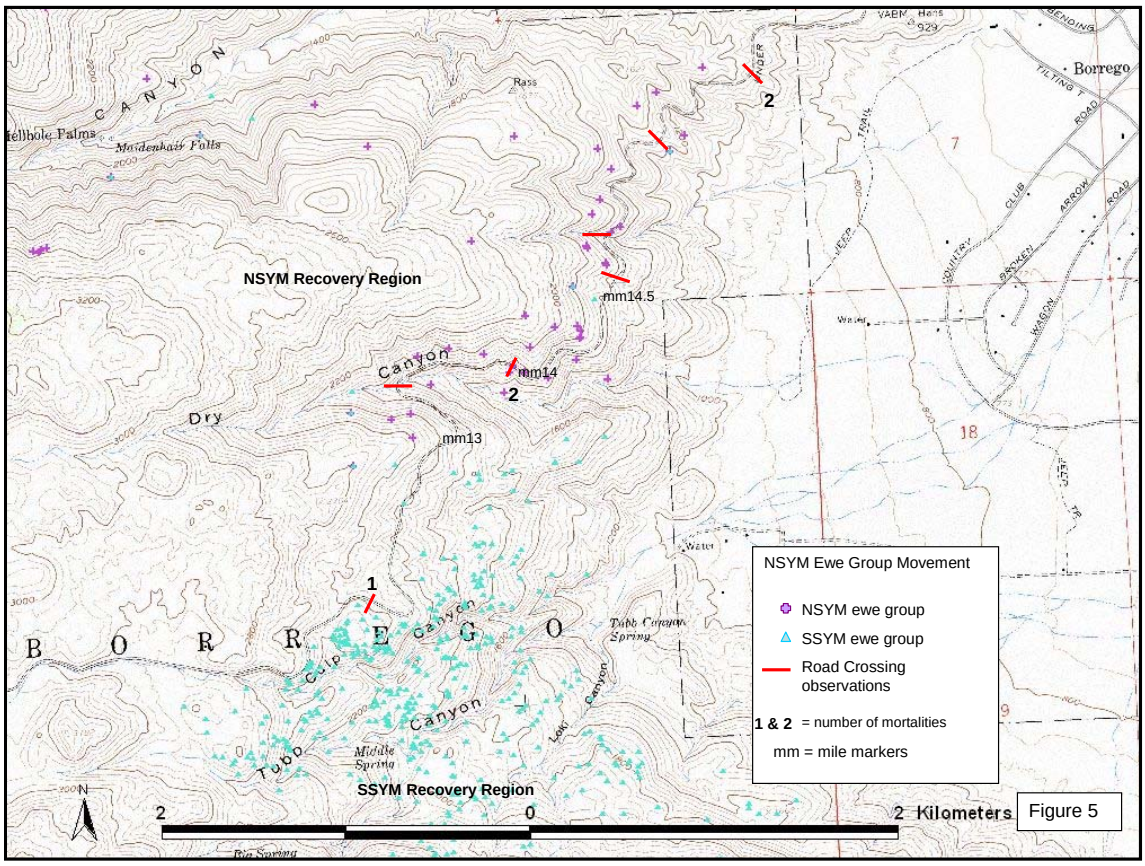
D. Palm Canyon – Hellhole Canyon –Habitat use for this group is concentrated within Palm Canyon with some use in Hellhole Canyon. Based on visual observations, the south-facing slopes of Palm Canyon are used as nursery grounds during winter and spring. Water can be found at numerous locations along the canyon bottom resulting in extensive sheep use during summer and fall. Water can also be found at a few locations within Hellhole Canyon. The size of this use area is approximately 9 km x 6 km and encompasses 3,763 ha.

E. Palm Canyon – Hellhole Canyon – Dry Canyon –These females have been documented using Dry Canyon for lambing and as a nursery ground during the winter and spring with summer and fall use in areas surrounding Hellhole and Palm Canyon. The females that utilize Dry Canyon during the lambing season cross Highway S22 on a regular basis. One of the most frequently crossed sections of Highway S22 is between mile marker (mm) 13 and 14.5 with several sheep deaths documented at a specific point just below mm14; however, no collared sheep deaths occurred in 2011 (Figure 5). While sheep use this area most in the winter and spring, rams often cross the highway during the rutting season with several documented vehicle collisions and deaths in recent years. The size of this use area is approximately 10 km x 7 km and encompasses 4,540 ha.

F. Hellhole Canyon to Henderson Canyon – Several females use the areas surrounding Hellhole Canyon and Palm Canyon in summer and fall and then concentrate their use in areas surrounding Henderson Canyon during winter and spring. Before ewe 257s GPS collar malfunctioned, data were collected showing use from Hellhole Canyon north to Sheep Canyon within the CoC recovery region. Ewe 258 ranged from south of Dry Canyon, below Highway S22, to north of Henderson Canyon. Ewe 260 was seen on Coyote Peak during the lambing season of 2010. All three of these ewes were under 4-years-of-age when these movements were documented. Ewe 199, the oldest of the four ewes uses the Henderson Canyon area during the early portion of the lambing season and then returns to Palm Canyon. The size of this use area is approximately 14 km x 7 km and encompasses 7,135 ha. The predominance of younger ewes in this group may account for the large area used relative to the ewes in group D or E (all > 9-years-old). Both the NSYM and the CoC ewes utilize the area just north of Henderson Canyon; however, ewes in the CoC recovery region utilize

water sources during the summer at 2nd crossing, Lower Willows, and Collins Valley whereas the ewes in the NSYM ewe group utilize water sources at Palm and Hellhole Canyons.

A major risk to sheep within this recovery region is movement across Highway S22. CDFG is currently examining the feasibility of placing rumble strips, flashing lights, and signs at locations along stretches of Highway S22 (Figure 5) to reduce this risk. Roads are not the only challenge sheep in this recovery region face. Palm Canyon is one of the most heavily used canyons by visitors to ABDSP. While sheep appear habituated to human use within this canyon, DFG staff has documented numerous occasions each year when park visitors have caused sheep to move away from water sources before they



could obtain water. Also, within the past few years, a large number of sheep have been documented entering the DeAnza Country Club and Golf Course development that abuts the NSYM. This development posses a threat to the health and survival of sheep in this recovery region due to possible ingestion of poisonous ornamental plants, accidents such as vehicle collisions, drinking contaminated water, and increased predation at the urban interface. Presently, CDFG is examining the feasibility of installing fencing along the border of ABDSP and DeAnza Country Club.

Southern San Ysidro Mountains: CDFG monitored 18 marked bighorn sheep in this recovery region (2 VHF-collared rams, 2 ear-tagged ewes, 1 non-functioning collared-

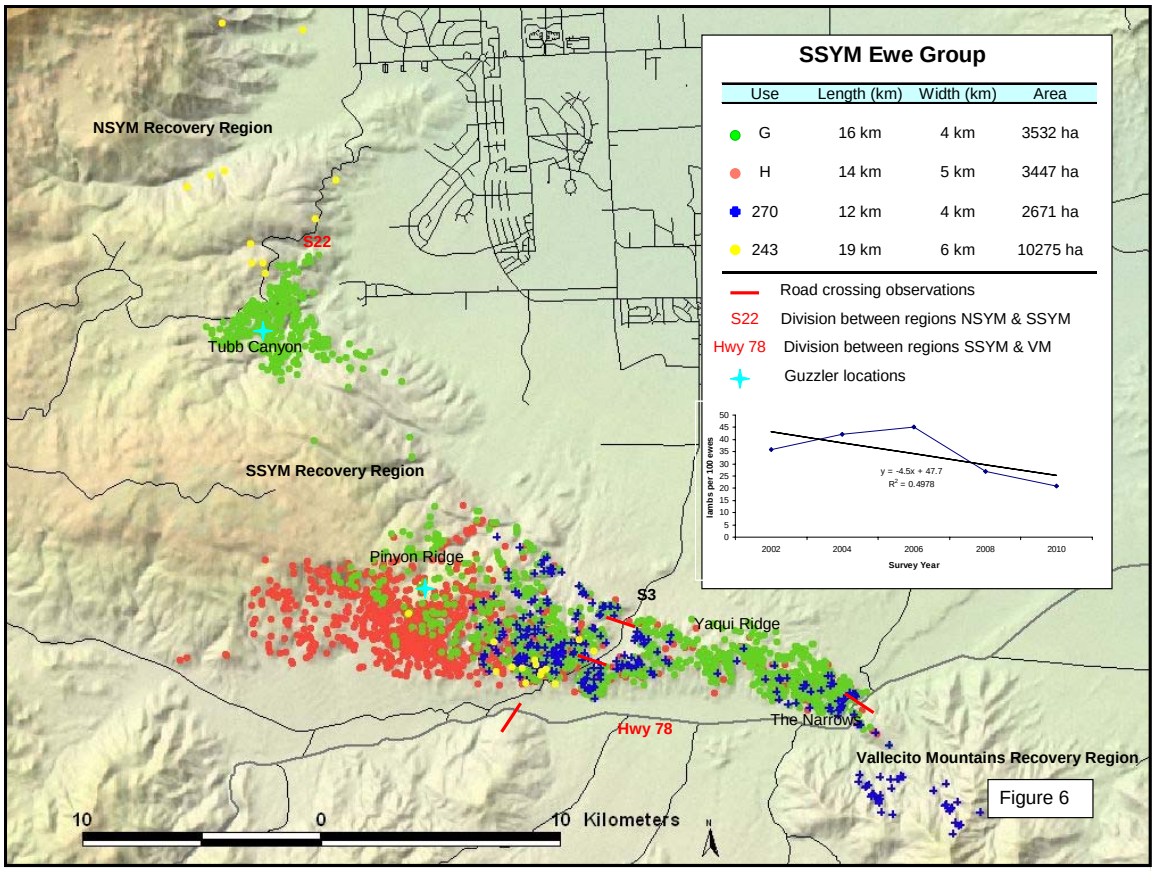


Figure 6

ewe, 7 VHF-collared ewes, and 6 GPS-collared ewes). The average age of marked ewes in 2011 was 8 years with a range of 3 to 15 years; and only 2 ewes were under the age of 4 years. Monitoring was conducted by air two to three times per month with ground monitoring occurring at least three times per week. Opportunistic observations were obtained for ear-tagged and non-functioning collared sheep. In 2009, GPS collars were deployed on 3 females; 3 additional collars were placed on females in 2010. One GPS collar became non-functional in 2010 with an additional 3 becoming non-functional in 2011. By the end of 2011, 31% of the ewes in the recovery region had active VHF-collars. Only 2 of 6 GPS collars remained functioning at the close of 2011. Since 2002, the number of marked ewes has remained above 25%, with the exception of 17% in 2008 (Figure 2-C).

There are two main patterns of movement and use within the Southern San Ysidro Mountains Recovery Region (Figure 6):

G. Tubb Canyon – These females use the Tubb Canyon area during the summer and fall. Upon the onset of winter, and just prior to lambing season these ewes move to Pinyon and Yaqui Ridge. Lambing occurs on Pinyon and Yaqui Ridge with one central area on Pinyon Ridge used for the nursery grounds. The size of this use area is approximately 16 km x 4 km and encompasses 3,532 ha. In the spring, these ewes may cross Highway 78 at the narrows into the VM recovery

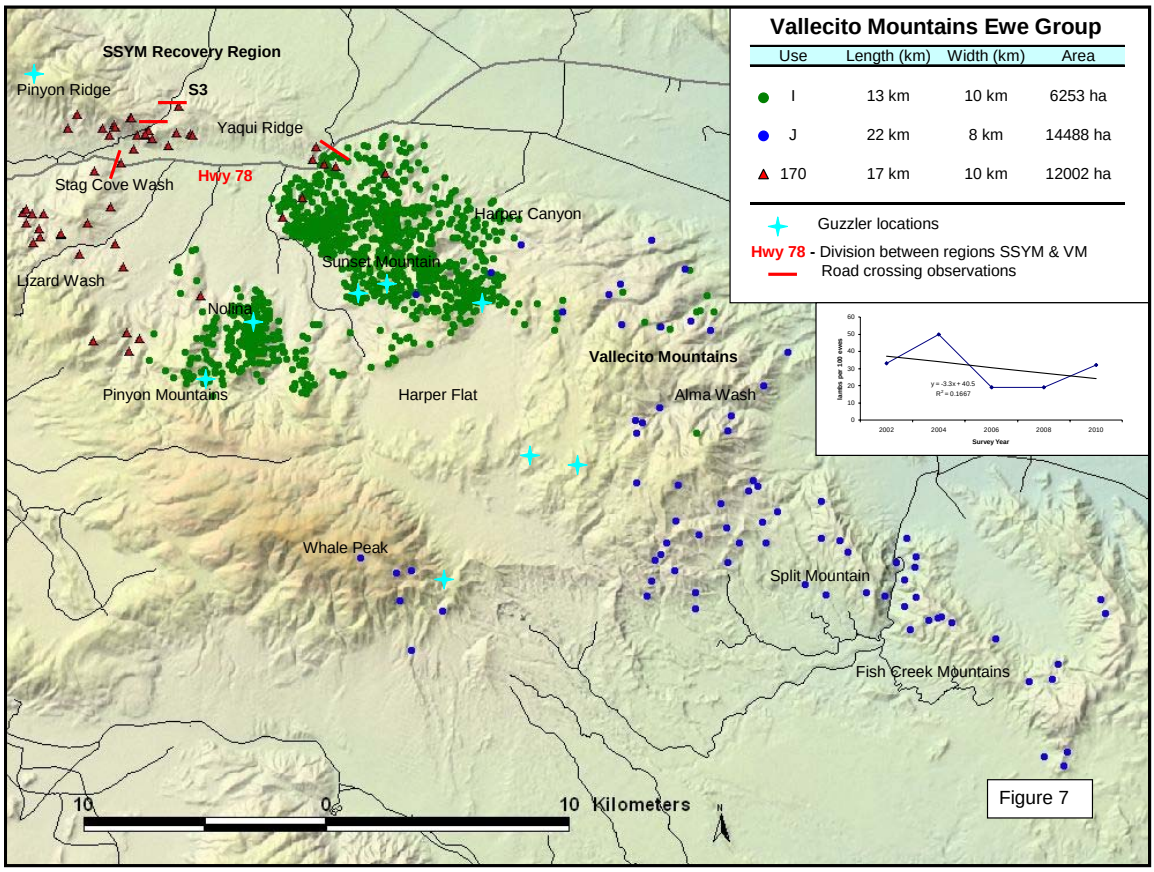
region. Time spent in the VM recovery region is usually brief, lasting anywhere from one to three days.

H. Pinyon Ridge – This group uses the area surrounding Pinyon Ridge during summer and fall with no documented use at Tubb Canyon. As with group G, lambing occurs on Pinyon and Yaqui Ridge with one central area on Pinyon Ridge used for the nursery grounds. The size of the area used is somewhat small at 14 km x 5 km and encompasses 3,447 ha. Several of these ewes have been documented crossing Highway 78 at the Narrows into the VM recovery region for several days at a time.

There are two radio-collared ewes that do not fit the pattern of use described above. Ewe 243 (Figure 6) was captured on Yaqui Ridge in 2009 as a yearling. She remained on Pinyon Ridge through the spring of 2010 and then moved to Hellhole and Palm Canyon within the NSYM recovery region during the summer and fall. In January 2011 she moved to Dry Canyon for two months before returning to the SSYM recovery region for the lambing season. This is the only collared ewe documented regularly using both the NSYM and the SSYM recovery regions. The area used by ewe 243 is approximately 19 km x 6 km and encompasses 10,275 ha. The second exception is ewe 270 who was captured on Yaqui ridge December 2010 as a 6-year-old. She remained in the SSYM recovery region until February 2011 at which time she moved across Highway 78 at the Narrows, gave birth, and joined the nursery group in the VM recovery region for 27 days. Instead of remaining in the VM, ewe 270 again crossed Highway 78, moved across Yaqui Ridge, crossed Highway S3, and joined the SSYM nursery group on Pinyon Ridge for the remainder of the spring. It is not clear where this ewe obtains water during the summer as her GPS collar became non-functional at the beginning of July 2011. The area used by ewe 270 is 12 km x 4 km and encompasses 2,671 ha.

Sheep within the SSYM recovery region frequently cross Highway S3 between Pinyon and Yaqui Ridge (Figure 6). While sheep have been observed crossing at numerous points along Highway S3, the two most common crossing points are at the north and south ends of Yaqui Pass. Most vehicle strikes have occurred at these points during the early spring when ewes are moving between the lambing and nursery grounds. Ewe 201 was struck and killed at the south end of Yaqui Pass in February 2011. There were no documented sheep deaths crossing Highway 78 at the Narrows in 2011 but several sheep have been killed at this location in the recent past. Presently, DFG is examining the feasibility of placing rumble strips, flashing lights, and signs at locations along Highways S3 and 78.

Vallecito Mountains: CDFG monitored 10 adult radio-collared bighorn sheep in this recovery region (1 GPS-collared ram, 1 GPS-collared ewe, and 8 VHF-collared ewes). The average age of marked ewes in 2011 was 10 years with a range of 4 to12 years. All ewes were greater than 9-years-old with the exception of the GPS-collared ewe. Monitoring was conducted by air two to three times per month with ground monitoring occurring as opportunity allowed. Presently, the majority of location data for this area has been obtained from a male and female sheep fitted with GPS collars in 2010. All VHF-



collared sheep were monitored by air with the exception of one ewe in Lizard Wash that had been monitored by ground as well until her collar became non-functional in April of 2011. By the end of 2011, only 10% of the ewes had active VHF-collars. The number of marked ewes has been well below 14% with the exception of 35% in 2006 (Figure 2-C).

There appears to be at least two main patterns of movement and use within the Vallecito Mountains Recovery Region (Figure 7):

I. Sunset Mountain – Pinyon Mountains - Habitat use of radio-collared sheep was concentrated mainly on Sunset Mountain with some use in the Pinyon Mountains and occasional movement into the Vallecito Mountains. GPS-collared ewe 272 had high site fidelity for the Sunset Mountain area with the exception of a brief stay east of Harper Canyon in May and 6 days in June surrounding Nolina Guzzler. The time frame of use in the Nolina Guzzler area coincides with the temporary shut-off of the Sunset Guzzler for repairs. It appears that ewe 272 uses the areas surrounding Sunset Wash during the lambing season. According to GPS data, ewe 272 has never crossed Highway 78 at the Narrows. GPS-collared ram 271 demonstrates a similar pattern of use with the exception of spending a larger portion of the summer surrounding the Nolina Guzzler. There are no documented locations for these sheep south of

Harper Flat. The size of this use area is approximately 13 km x 10 km and encompasses 6,253 ha.

J. Vallecito Mountains to Fish Creek - Two VHF-collared females spent time in the Vallecito and Fish Creek Mountains. There are presently not enough location data to discern a pattern of use for each season but the Fish Creek Mountains appear to be used during the lambing season. Ewe 177 occasionally moves to the Whale Peak area with use scattered throughout the year. A third VHF-collared ewe has only been located in the Vallecito Mountains. None of these ewes have been documented on Sunset Mountain or in the Pinyon Mountains and thus they may represent a separate ewe group within this recovery region. The size of this use area is approximately 22 km x 8 km and encompasses 14,488 ha.

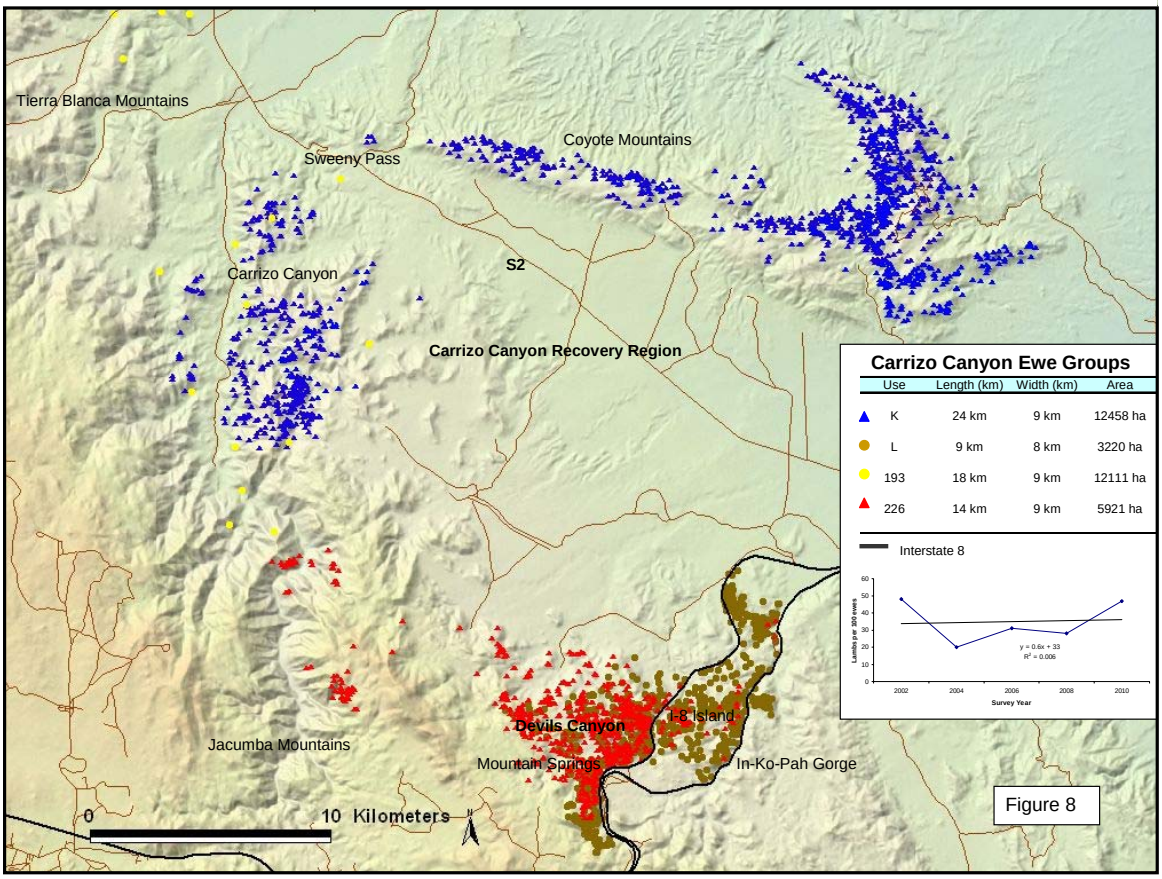
Ewe 170 (Figure 7) does not fit either of the above described use patterns. The majority of documented locations were in the VM recovery region in areas surrounding Lizard Wash and Plum Canyon. However, ewe 170 spent the entire lambing season within the SSYM recovery region. This ewe along with her lamb (as well as a few non-collared ewes) were observed crossing Highway 78 at Stag Cove Wash near Highway S3 (Figure 7) and observed on several occasions on either side of Highway 78 at the Narrows. Ewe 170 most likely crosses at these points on a regular basis. The use area for this ewe is approximately 17 x 10 km and encompasses both the SSYM and the VM recovery regions at 12,002 ha. Unfortunately, this ewe's VHF-collar became non-functional in 2011.

Carrizo Canyon: CDFG monitored 18 female radio-collared bighorn sheep in this recovery region (9 VHF and 9 GPS-collared ewes). The average age of marked ewes in 2011 was 8 years with a range of 3 to 11 years. In October of 2009, 9 females were captured and fitted with GPS-collars. Three of the GPS components of the collars became non-functional in 2010 and the remainder stopped functioning in the summer of 2011. All of the VHF-components continued to function and monitoring was carried out by air two to three times per month. Six ewes that occupied habitat surrounding the I-8 corridor were monitored from the ground several times per month. In 2011, 13% of the ewe population had active VHF-radio collars. The number of marked ewes has been well below 13% and as low as 3% in 2008 (Figure 2-C).

There are two main patterns of movement and use within the Carrizo Canyon Recovery Region (Figure 8):

K. Carrizo Canyon – Coyote Mountains – Twelve radio-collared ewes (including 3 GPS-collared ewes) use the Carrizo Canyon area from May through October. During winter and spring, 11 of the collared females were documented in the Coyote Mountains. Ground observations confirmed that this area is used for lambing and nursery grounds. Sheep cross into the Coyote Mountains somewhere around Sweeney Pass on Highway S2. The size of this use area is about 24 km x 9 km and encompasses 12,458 ha. Ewe 193 did not move to the

Coyote Mountains, but instead spent a large proportion of time within Carrizo Canyon. Aerial location data indicate she may use the Tierra Blanca Mountains during lambing season. The use area for this ewe is approximately 18 km x 9 km and encompasses 12,111 ha.



L. <u>In-Ko-Pah</u> - In October 2009, 6 ewes were captured and fitted with GPS-collars in the area surrounding the I-8 corridor near Mountain Springs in the Jacumba Mountains (Figures 8 & 9). Five of the 6 ewes stayed within the area encompassing 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 divergence of the east and west bound lanes. Usually, ewes were detected within the island during winter and spring and the remainder of the year near Mountain Spring located along the north side of west-bound lane of I-8. Movement in and out of the island from the west has been documented at various locations which include crossing directly over the freeway as well as using underpasses at Devils Canyon. Ewe 232 and 225 crossed the east-bound lane of I-8 and remained for short periods of time east of I-8. Ewe 232 likely used this are for lambing. The size of this use area is approximately 9 km x 8 km and encompasses 3,220 ha. Ewe 226 was documented as having a different use pattern than the above ewes. This ewe moved from the Mountain Spring area into lower Carrizo Canyon for the first part of lambing season, then

returned to the Mountain Spring and island area. The size of her use area is 14 km x 9 km and encompasses 5,921 ha.

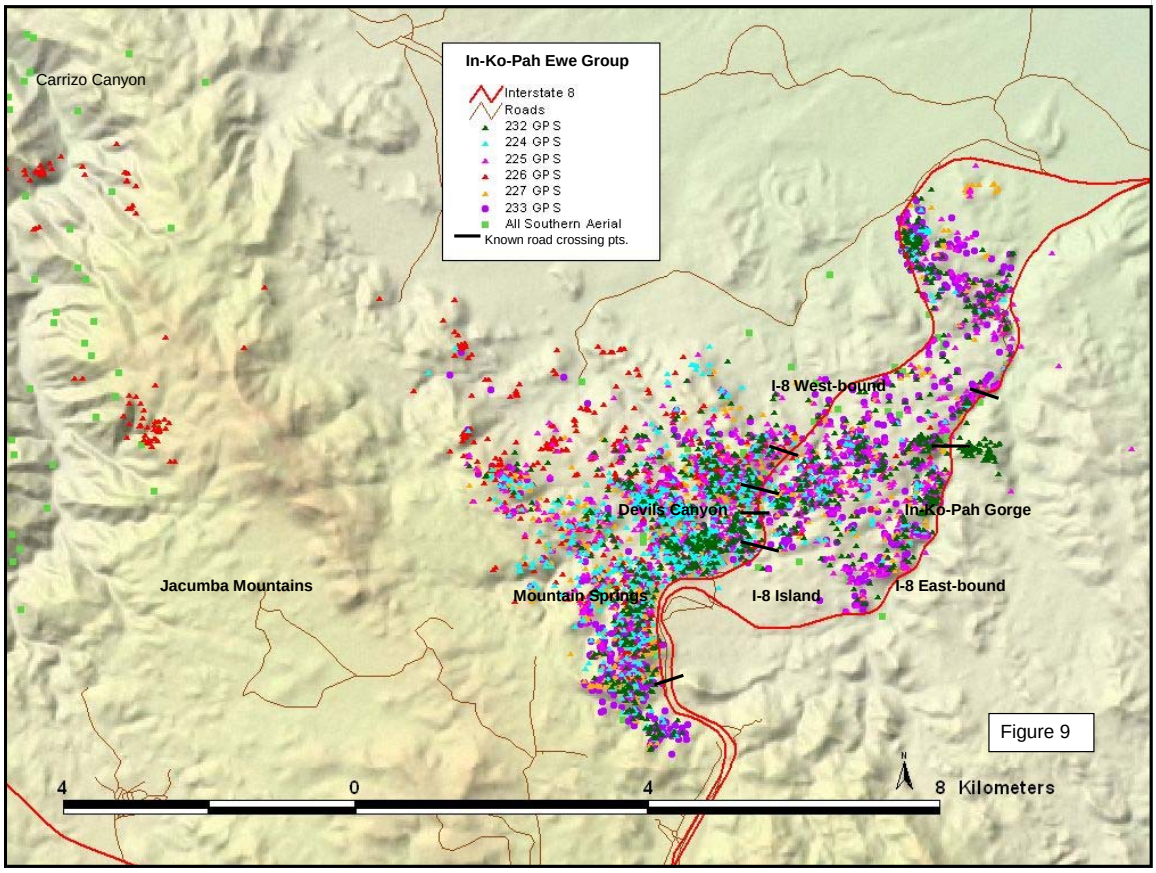


Figure 9

Survivorship

In 2011, CDFG detected and investigated the following mortalities east of Highway 74: 4 radio-collared females, 1 ear-tagged female and 1 male lamb mortality of a radio-collared female (Table 1). Mortalities by recovery region were CSRM = 1; NSYM = 3; and SSYM = 2. In the CSRM, one radio-collared ewe died of unknown causes (possibly related to old age) near Devils Canyon in February. In the NSYM, ewe 218 died of unknown causes and ewe 263 was killed in April by a radio-collared mountain lion being monitored as part of a University

Table 1. Cause of death for radio-collared bighorn sheep – January 1 to December 31, 2011

Sheep ID	Location	Sex	Age (yrs.)	month	cause
201	SSYM	F[a]	11	January	Vehicle
0610	CSRM	F	13	January	Unknown
245	SSYM	F[b]	4	February	Lion
263	NSYM	F	3	April	Lion
198[c]	NSYM	M	9 weeks	May	Pneumonia
218	NSYM	F	9	September	Unknown

[a] Pregnant female and her unborn male lamb struck and killed by a vehicle on S3.
[b] Ewe was observed sick and standing beside her stillbirth lamb the evening before she was killed.
[c] Male Lamb of radio-collared ewe 198.

of California, Davis study. Her lamb was found dead nearby but had not been preyed upon. In the SSYM, there were two sheep mortalities. In February, ewe 245 gave birth to a stillborn lamb and was observed to be in pain most likely due to a retained placenta. The next day she was killed by a mountain lion. Ewe 201 and her unborn lamb were struck and killed by a vehicle while crossing highway S3 at Yaqui Pass in February 2011.

In 2011, causes of mortality and percentage of all mortalities were lion predation = 2 (33%); unknown = 2 (33%), vehicle = 1 (17%); and disease = 1 (17%). Causes and percentage of documented mortalities in 2011 were lower than average for lion kills and consistent with that documented since 1993 for all other causes (Figure 10.)

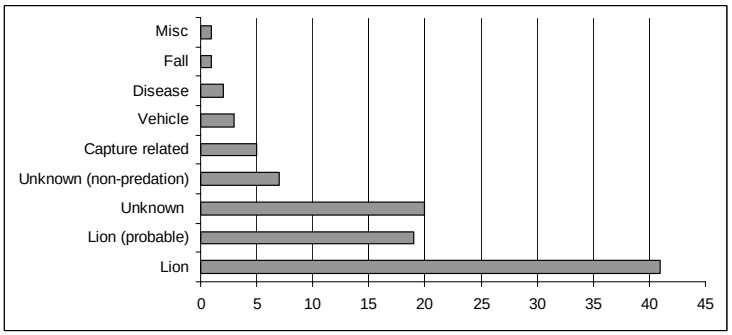


Figure 10. Percent of radio-collared bighorn sheep mortalities by cause 1993 - 2011

Of the 6 mortalities documented in 2011 involving marked sheep, 5(83%) occurred during winter and spring (November through May). This timing pattern is consistent with known sheep mortalities documented since 1993 (Figure 11). The number of collared sheep mortalities in 2011 was well below the average number of moralities between 1993 and 2011 (mean = 12.2 $\pm$ 5.7 SD, and range 5 – 25; Figure 12). The number of mortalities per year since 1993 has remained relatively constant except for a spike in the early part of the 1990s (Figure 12). The lack of radio-collared mortalities in the other recovery regions during 2011 may be the result of under-representation of radio-collared sheep within those regions.

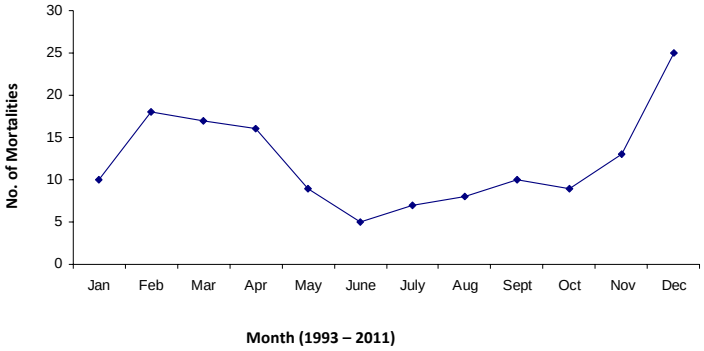


Figure 11. Number of radio-collared sheep mortalities by month from 1993 – 2011.

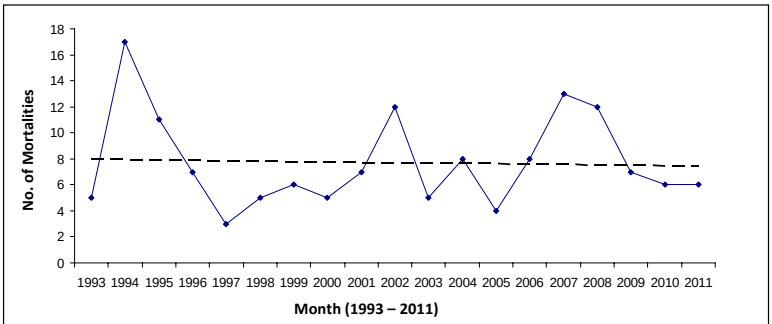


Figure 12. Solid line = Number of radio-collared sheep mortalities per year from 1993 to 2011. Average number of mortalities per year = 7.7 $\pm$ 0.83. Dashed line = trend line; number of mortalities per year has remained relatively constant since 1993 (y = -0.0298x + 8.035; R2 = 0.002).

Lamb Mortality Monitoring

In 2007, CDFG documented several sick lambs and lamb deaths in Borrego-Palm Canyon located in the NSYM. Results from the 2007 ABDSP waterhole count held in July indicated a low lamb: ewe ratio of 7% in Borrego-Palm Canyon relative to other locations (12% for the SSYM, 26% for CoC, and 78% for Rattlesnake Springs in the SSRM). Numerous hikers had also reported finding sick or dead lambs in Borrego-Palm Canyon during the spring of 2007. As a result of anecdotal evidence of high lamb mortality, CDFG initiated a pilot study in 2008 in order to test the feasibility and logistics of monitoring the NSYM, SSYM, and CoC. The main objective was to examine lamb survival to 3 and 6 months and examine the timing of parturition, lamb production, lamb: ewe ratios, and timing of sick lambs and lamb deaths. The field portion of the study was completed December 2011 and data analysis is in progress. A full report for the lamb mortality monitoring effort will be submitted to USFWS and CDPR upon completion anticipated by June 2012.

In 2011, field monitoring documented pneumonia in lambs in CoC, NSYM, SSYM, and confirmed in NSYM. In May 2011 in the NSYM, ewe 198s 9-week-old lamb was found dead after showing clinical signs of pneumonia starting at 5-weeks-old. Lab results concluded the lamb died of chronic bronchopneumonia suggestive of a combination of mycoplasma and a bacterial infection. In the NSYM, lamb: ewe ratios have steadily dropped since 2002. The dichotomy between an increasing ewe population and a decreasing lamb population may be explained by younger ewes moving into this recovery region from other adjacent recovery regions. For example, ewe 243 (age 3) from the SSYM recovery region spends each summer and fall within the NSYM recovery region. The SSYM has experienced steadily decreasing lamb: ewe ratios as well but still remains above 20%. There is also a concern that CoC may be starting to experience disease issues in lambs as well. Results for the lamb survival pilot study are pending, but preliminary results suggest all three of these subpopulations are experiencing lamb disease. Presently, lamb:ewe ratios in VM and CC remain high but there is a need to extend lamb disease monitoring into CSRM, SSRM, VM, and CC in order to understand whether disease in lambs is presently limited to a few ewe groups or whether it is range-wide.

2012 CDFG Proposed Activities

In 2012, CDFG will continue on going monitoring efforts involving:

- Monitoring the status, dynamics, and trends of bighorn sheep.

- 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.

- 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.

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

- Conducting fall captures to fit new or replacement radio-collars on adult males and/or females throughout the peninsular ranges, including SSRM, VM, and CC.

- Coordinating with Cal-trans on placement of rumble strips, flashing lights, signs, and directive fencing along the Interstate-8 corridor and Highways S3, S22, and 78.

- Coordinating with ABDSP for fencing between the State Park and DeAnza Country club.

- Develop secondary method to survey abundance with the use of remote cameras placed at guzzlers and water sources in order to fill the gaps in abundance monitoring for non-helicopter survey years.