# IMPLEMENTATION STRATEGY TO

# RESTORE THE SAN GABRIEL MOUNTAINS

# BIGHORN SHEEP POPULATION

ORIGINAL

June 2004

California Department of Fish and Game
Los Angeles County Fish and Game Commission
U.S.D.A. Forest Service

The implementation strategy is a series of recommendations designed to restore the San Gabriel Mountains bighorn sheep population. The strategy does not commit staffing or funding. This implementation strategy was developed in cooperation with:

_____ Date: _____

California Department Fish & Game
Region 5, Regional Manager

_____ Date: _____

California Department Fish & Game
Region 6, Regional Manager

_____ Date: _____

Chairperson, L.A. County Fish and Game Commission

_____ Date: _____

Angeles N. F. Forest Supervisor

_____ Date: _____

San Bernardino N. F. Forest Supervisor

**San Gabriel Mountains Bighorn Sheep Restoration Team**

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Dr. Vern Bleich, Steve Torres, and Doug Updike from the California Department of Fish and Game and Thomas Zmudka from the Bureau of Land Management provided additional technical advice. District Rangers Gabriel Garcia and Marty Dumpis from Lytle Creek and the San Gabriel River Ranger Districts, respectively, provided additional support and advice.

John Aziz, Susan Crew, Clint Kearns, CDFG Volunteers; Royal Brown, Vand Balke Ski Club; Dick Conti, George Kerr, Society for the Conservation of Bighorn Sheep; Ann and Jerry Coissant, Chris Solek, San Gabriel Mountains Regional Conservancy; John Hybarger, Los Angeles County Fish and Game Commission; Chistopher Papouchis, Mountain Lion Foundation; Steve Segreto, Forest Service; Glenn Tessers, California Deer Association; and Mary Lynn West, Safari Club International participated in the stakeholders group which reviewed and provided valuable comments on the draft restoration strategy.

## EXECUTIVE SUMMARY

**SPECIES STATUS:** The San Gabriel Mountains bighorn sheep population (*Ovis canadensis nelsoni*) occurs in Los Angeles and San Bernardino Counties on land administered by the Angeles and San Bernardino National Forests. The population is designated a fully protected population under California Fish and Game Code §4700 and relisted by the Regional Forester as a Sensitive Species. Additionally, it is identified as a Management Indicator Species in the Forest's Land and Resource Management Plans. There are approximately 90 animals, distributed among four groups in this mountain range.

**LIMITING FACTORS:** Based on an analysis of existing information, it is hypothesized bighorn sheep declined initially because post-fire succession on chaparral-dominated winter-spring ranges reduced habitat suitability. Additionally, mule deer (*Odocoileus heminonus californicus*) declined during a similar period because of post-fire succession on chaparral ranges and mountain lion (*Puma concolor cougar*) predation. Mule deer declined below a threshold and mountain lions switched and preyed on bighorn sheep as an alternative prey species. The bighorn sheep population is currently limited by low habitat suitability on winter-spring ranges on the Angeles National Forest and mountain lion predation.

**RESTORATION OBJECTIVE:** Restore the San Gabriel Mountains bighorn sheep population to a self-sustaining level that provides diverse recreation and educational opportunities.

**Establish a self-sustaining population.** A self-sustaining population will be established when both criteria described below have been achieved. At this point, the population would be sufficiently large enough that it would not qualify for listing as a federal threatened or endangered species.

**Criterion 1**. Based on monitoring results, at least 30 ewes are present in South Fork Lytle Creek; Deer, Cucamonga, and Barrett-Cascade Canyons; Cattle Canyon, East Fork San Gabriel River, and San Gabriel Wilderness, and 15 ewes are present in the Middle Fork of Lytle Creek for 6 consecutive years.

**Criterion 2.** Based on monitoring results, at least 322 bighorn sheep are well distributed among the groups of bighorn sheep for 6 consecutive years.

**Remove the Population from the Sensitive Species List.** The San Gabriel bighorn sheep population should be removed from the Sensitive Species list when the criterion described below is achieved.

**Criterion 1.** Based on monitoring results, at least 500 bighorn sheep are well distributed among the subpopulations, for 6 consecutive years. Well-distributed means at least 260 bighorn sheep in the Cucamonga Peak group and greater than or equal to 80 bighorn sheep in the Mount San Antonio, Iron Mountain, and Twin Peaks groups.

**ACTIONS NEEDED:** The population has been stable from 1995-2002, apparently limited by adult mortality. Therefore, mortality must be reduced by reducing the incidence of predation. Concurrently, habitat availability and suitability must be increased on winter-spring ranges to increase adult and lamb survivorship. Additionally, potential impacts from recreation, primarily during summer, must be evaluated and mitigation implemented, where necessary.

**RESTORATION COSTS:** Estimated costs, developed for the first five years, were $3,889,176.00. Costs beyond this were not developed because if all the habitat restoration projects are completed they would benefit bighorn sheep for approximately 12 years.

## Table of Contents


| | Page |
|---|---|
| **EXECUTIVE SUMMARY** | iv |
| **SECTION 1. INTRODUCTION** | |
| Purpose of the Implementation Strategy | 1-1 |
| Organization of the Implementation Strategy | 1-2 |
| **SECTION 2. SAN GABRIEL BIGHORN SHEEP POPULATION** | |
| Distribution | 2-1 |
| Population Dynamics | 2-3 |
| Habitat Requirements | 2-5 |
| Diet and Nutrition | 2-9 |
| **SECTION 3. MANAGEMENT STATUS AND DIRECTION** | |
| State Direction | 3-1 |
| Federal Direction | 3-2 |
| **SECTION 4. IMPLEMENTATION STRATEGY** | |
| Management Guidelines | 4-2 |
| **SECTION 5. ESTIMATED COST AND IMPLEMENTATION SCHEDULE** | |
| Estimated Cost | 5-1 |
| Implementation Schedule | 5-1 |
| **SECTION 6. MONITORING AND RESEARCH** | |
| **Monitoring** | 6-1 |
| **Research** | 6-2 |
| **SECTION 7. REFERENCES** | |
| **References** | 7-1 |

# SECTION 1. INTRODUCTION

## PURPOSE OF THE IMPLEMENTATION STRATEGY

This implementation strategy identifies management actions that should result in the restoration of a well distributed, self-sustaining population of bighorn sheep (*Ovis canadensis nelsoni*) in the San Gabriel Mountains.

The strategy was developed by an interagency team of wildlife biologists, program managers, and District Rangers in response to a recent assessment of the population prepared for the Los Angeles County Fish and Game Commission ([Commission] Holl 2002). That assessment determined:

- the population had declined 88% from estimates in the early 1980s;
- the population had not increased from 1995 to 2002;
- the long-term viability of the population was questionable and the population met the criteria for listing under the federal Endangered Species Act; and
- management actions by California Department of Fish and Game (CDFG), Angeles National Forest (ANF) and San Bernardino National Forest (SBNF) could influence recovery of the population.

The implementation strategy identifies the responsible agencies, management actions, an estimated budget, and schedule for implementing those actions. The strategy covers the first five years. A longer strategy was not developed because if all the habitat restoration projects are completed, habitat suitability will be improved on most winter-spring ranges for approximately 12 years. Progress of this strategy will be monitored continuously (See Section 6). Additional actions needed to restore the population after the first five years will be determined in the future.

The recommended management actions follow the organization described in the 1983 management guidelines (Holl and Bleich 1983). The 1983 management guidelines, recent assessment (Holl 2002), and this strategy are consistent with and comply with CDFG requirement to assess and describe populations of bighorn sheep (California Fish and Game Code [CFGC] §4901). Those documents are also consistent with the 1982 National Forest Management Act (NFMA) regulations (36 CFR 212.19). The ANF and SBNF are currently updating their Forest Land and Resource Management Plans (LRMP). Recommendations in this restoration strategy should be incorporated into those revised plans.

The strategy does not commit staffing or funding; however, the interagency restoration team expects agencies to be accountable for the success or failure of actions identified in this plan. The interagency team intends to monitor all efforts to implement the recommended actions and the success of those efforts will determine if the strategy is effective in restoring this population. The results of those monitoring efforts may be used by the U. S. Fish and Wildlife Service to determine the effectiveness of this

restoration strategy, should a petition be submitted to list this population under the federal Endangered Species Act (FR 68[60]:15100-15115).

### Compliance with the National Environmental Policy Act and California Environmental Quality Act

This implementation strategy is not considered a project because it is not a policy, it will not result in a change in the environment, it is not a plan, and it does not require a permit or approval. Therefore, it does not require compliance with the National Environmental Policy Act (NEPA; 40 CFR 1508.18) or California Environmental Quality Act (CEQA; CEQA Guidelines §15378). Recommendations from this strategy that are incorporated in the revised land and resource management plans will be subject to NEPA. As actual projects are proposed, or requests for permits prepared, the responsible agency will prepare the assessments necessary to comply with NEPA or CEQA.

## ORGANIZATION OF THE IMPLEMENTATION STRATEGY

Section 2, San Gabriel Bighorn Sheep Population: provides a summary of the natural history of this population. The summary is based on published literature and unpublished reports, with an emphasis on information from the San Gabriel Mountains.

Section 3, Management Status and Direction: summarizes the state and federal management direction affecting this population. The purpose of this section is to support the proposed management actions.

Section 4, Implementation Strategy: identifies the actions the team identified as necessary to restore this population to a well-distributed self-sustaining population. The actions are tiered to and update the management guidelines prepared for this population (Holl and Bleich 1983).

Section 5, Estimated Cost and Schedule: identifies the estimated cost and schedule to implement the first five years of the restoration strategy.

Section 6, Monitoring and Research: identifies monitoring protocol, feedback mechanisms and adaptive management; and research topics that could be addressed to assist in the management of this population.

Section 7, References: Identifies references used in the implementation strategy.

# SECTION 2. SAN GABRIEL BIGHORN SHEEP POPULATION

This section does not provide a comprehensive description of bighorn sheep or this population. It is designed to support the rationale included for each management action described in Section 3. If more detailed information is required, it is recommended the references in Section 7 are obtained and thoroughly reviewed.

## DISTRIBUTION

Bighorn sheep habitat in the San Gabriel Mountains is on public land administered by the ANF and SBNF. The distribution of bighorn sheep in the San Gabriel Mountains is described by eight winter-spring ranges that are aggregated into four groups of sheep, based on summer ranges (Holl 2002). The four groups of sheep include: Cucamonga Peak, San Antonio Peak, Iron Mountain and Twin Peaks (Figure 2-1).

The boundaries of the winter-spring ranges were developed using a point density analysis (ArcInfo) of all bighorn sheep groups observed during the annual surveys from 1979 to 2002. The boundaries represent 90% of the highest density of those observations. Bighorn sheep use the winter-spring ranges year around; however, densities are lower during summer and fall when some animals migrate to higher elevation summer ranges. Summer range boundaries are based on field observations and qualitative descriptions of movement between seasonal ranges (Holl 2002, Holl and Bleich 1983, Deforge 1980, and Weaver et al. 1972).

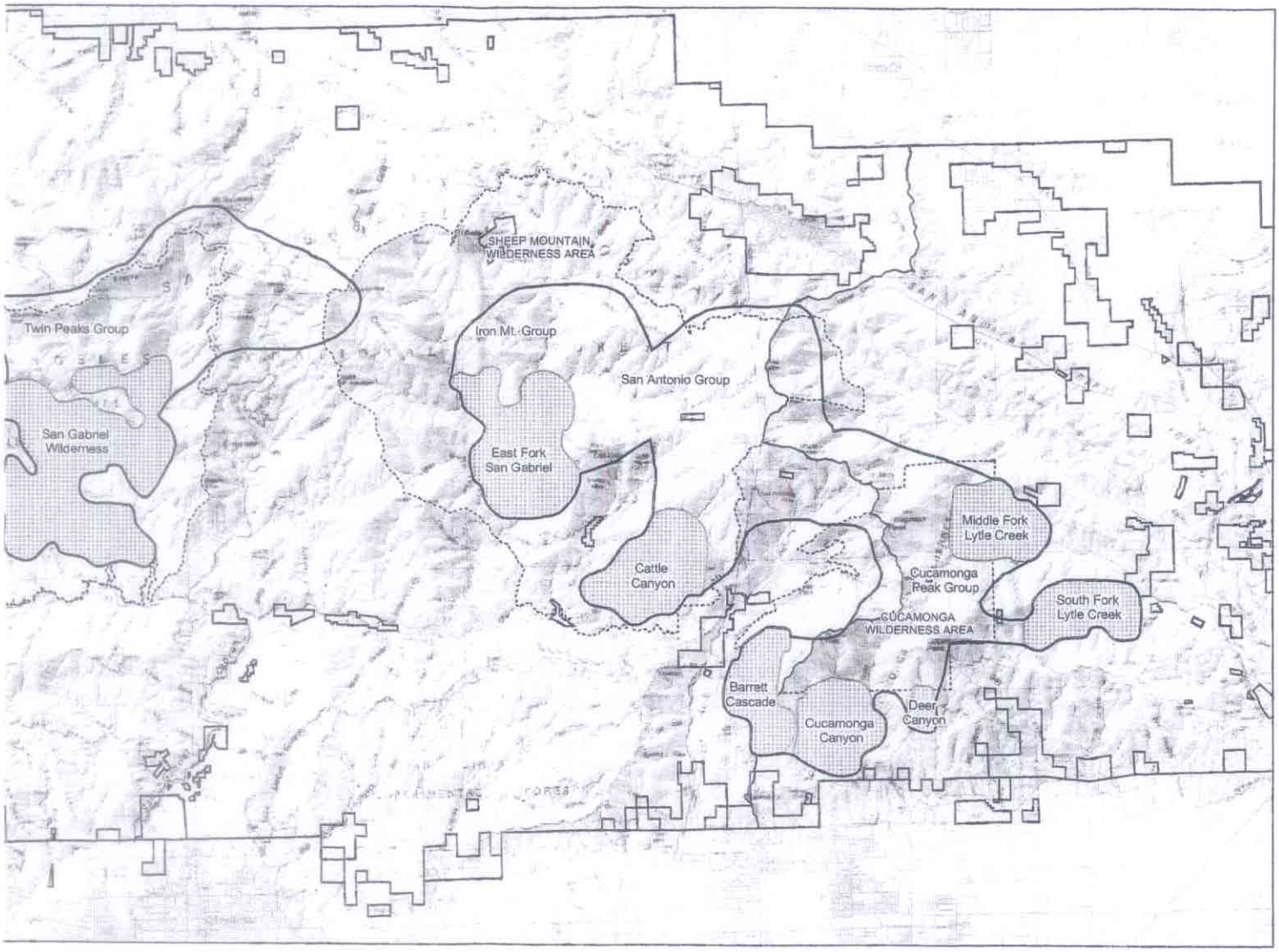
**Cucamonga Peak Group.** This group includes sheep from the Middle and South Forks of Lytle Creek, and Deer, Cucamonga, and Barrett-Cascade Canyons winter-spring ranges. Their summer range includes Cucamonga, Ontario, Bighorn, Timber, and Telegraph Peaks, Thunder Mountain and Baldy Notch. Summer range of the Cucamonga Peak group probably overlaps summer range of the Mount San Antonio group, described below.

**Mount San Antonio Group.** This group includes bighorn sheep from Cattle Canyon that summer on Bighorn Ridge and San Antonio Ridge, Baldy Notch, Mounts San Antonio and Harwood, and Dawson Peak and Telegraph Peak. Rams may summer as far north as Wright Mountain. Summer range of the Mount San Antonio group probably overlaps summer range of the Cucamonga Peak and Iron Mountain groups.

**Iron Mountain Group.** This group includes sheep from the East Fork of the San Gabriel River winter-spring range that summer on Iron Mountain, San Antonio Ridge, Pine Mountain Ridge, and Mount Baden-Powell.

**Twin Peaks Group.** This group includes sheep from the San Gabriel Wilderness winter-spring range that summer on Twin Peaks, Mount Waterman, Kratka Ridge, and

# lountains Bighorn Sheep Winter-Spring and Summer Ranges




. Boundary

Service Boundary

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0 5 10

Miles

the steep slopes along the northern portion of Highway 39. Summer range of the Twin Peaks group probably does not overlap with any other groups of bighorn sheep.

### Area and Land Uses of Seasonal Ranges

The area of bighorn sheep ranges is described as the total area occupied and winter-spring ranges. Total area includes winter-spring ranges and summer ranges. The total area occupied by bighorn sheep is approximately 89,104 acres on the ANF and SBNF. Approximately 73% of the total area is in the Cucamonga, Sheep Mountain, or San Gabriel Wildernesses (Table 2-1). As a subset of the total area occupied, winter-spring ranges total 23,479 acres. Substantial portions (greater than 40%) of the Middle Fork of Lytle Creek, Barrett-Cascade Canyons, Mount San Antonio, Iron Mountain, and Twin Peaks are in Wilderness. Wilderness is the only land use shown because it is a dominant land use of bighorn sheep habitat and it limits or requires additional administrative processes to implement management activities. Other land uses are described in land and resource management plans (Angeles National Forest 1989, San Bernardino National Forest 1988).

**Table 2-1. Area and land uses of bighorn sheep ranges in the San Gabriel Mountains.**

| | Total Area | | Winter-Spring Range | | |
|---|---|---|---|---|---|
| **Group** | Area (ac) | % Wilderness | Name | Area (ac) | % Wilderness |
| **Cucamonga Peak** | 26,893 | 45.1 | Middle Fork | 2,076 | 48.7 |
| | | | South Fork | 1,939 | 0 |
| | | | Deer Canyon | 368 | 0 |
| | | | Cucamonga | 2,127 | 9.1 |
| | | | Barrett-Cascade | 1,876 | 44.4 |
| **Mount San Antonio** | 18,754 | 74.8 | Cattle Canyon | 2,848 | 99.9 |
| **Iron Mountain** | 15,750 | 100 | East Fork | 4,251 | 100 |
| **Twin Peaks** | 28,811 | 81.7 | San Gabriel Wilderness | 7,994 | 100 |
| **Subtotal** | 90,208 | | | 23,479 | 73.1 |
| **Overlap**[1/] | 1,104 | | | | |
| **Total** | 89,104 | 73.5 | | 23,479 | 73.1 |

1/There are an estimated 698 acres of overlap between the Cucamonga and Mount San Antonio summer ranges and 406 acres between Mount San Antonio and Iron Mountain summer ranges.

## Movement Between Seasonal Ranges

Limited data are available describing range fidelity and movement between seasonal ranges in the San Gabriel Mountains. Based on radio-telemetry data, five ewes had an average home range of 1.5 $mi^2$ (Deforge 1980). Three ewes remained in the South Fork of Lytle Creek, one ewe moved between South Fork and Middle Fork of Lytle Creek, and the fifth ewe remained in the Middle Fork of Lytle Creek. An adult ram had a home range of 6.9 $mi^2$ and moved between Cucamonga Canyon and the South Fork of Lytle Creek. These data indicate there is limited movement of ewes between winter-spring ranges and rams may move extensive distances between seasonal ranges. These results are similar to previous studies demonstrating that ewes have a high fidelity to seasonal ranges, while rams have substantially less fidelity for seasonal ranges (Geist 1971, Rubin et al. 1998).

There are no physical structures that create barriers to movement between any of the winter-spring ranges or within summer ranges. It is hypothesized, movement between seasonal ranges occurs along the extensive ridge systems that connect winter-spring and summer ranges. The greatest amount of movement probably occurs by adult rams during the breeding season (October through November) (Holl and Bleich 1983, DeForge 1980, Weaver et al. 1972).

## POPULATION DYNAMICS

No data are available to develop numerical population estimates prior to 1967. However, observations of biologists, naturalists, and hunters indicate the population was well-distributed and locally abundant in this mountain range (Holl and Bleich 1983). The San Gabriel Mountains bighorn sheep population has changed substantially between 1967 and 2002 (Figure 2-2) and those changes have been analyzed and described in detail (Holl et al. 2004).

During 1967-1972, there were an estimated 500 bighorn sheep in the San Gabriel Mountains, making it the largest population throughout the entire range of Nelson's bighorn sheep. Following extensive fires between 1968 and 1975, that improved habitat suitability, the population increased to an estimated $740 \pm 49$ in 1980. After 1982, the population declined, at a rate of halving every eight years, to an estimated $500 \pm 30$ bighorn sheep in 1989. That decline was hypothesized to be in response to post-fire plant succession that reduced habitat suitability. Between 1989 and 1995, the population declined at a rate of halving every 2.8 years, to approximately an estimated 90 bighorn sheep. This represented an 88% decline from the 1982 population estimate. There were no substantial changes in habitat suitability between 1989 and 1995 and there is no evidence that disease is a significant problem in this population. Therefore, the sharp decline during 1989-1995 was hypothesized to be from mountain lion (*Felis concolor cougar*) predation (Holl et al. 2004). Between 1995 and 2002, the population was stable at approximately 90 animals.

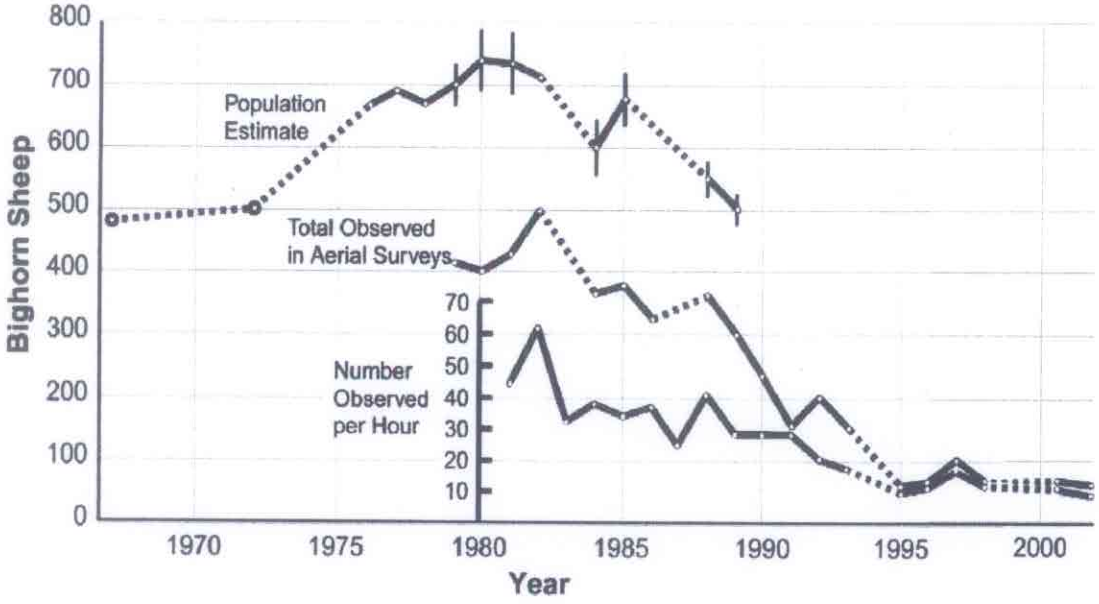



**Figure 2-2. Changes in population estimates for the San Gabriel Mountains bighorn sheep population, 1967-2002.**

## Population Viability

The San Gabriel Mountain bighorn sheep population is isolated from all other groups of bighorn sheep (Holl 2002). This is an important genetic consideration because there is no opportunity for the natural immigration of new genetic material into this population.

The current population of bighorn sheep in the San Gabriel Mountains is substantially below all known historic estimates. Currently, there are an estimated 20 bighorn sheep in the Cucamonga Peak group, 25 in the Mount San Antonio group, 25 in Iron Mountain, and 20 in the Twin Peaks group. All but one of those groups (Iron Mountain) contains fewer than 15 females (Holl 2002). In the San Gabriel Mountains, the effective population size ($N_e$) is currently estimated to be 60 animals (Holl 2002). Low population densities of bighorn sheep, impenetrable stands of chaparral contributing to habitat fragmentation and poor habitat quality on individual winter-spring ranges and mountain lion predation contribute to the lack of population recovery.

A review of other bighorn sheep populations indicates populations with fewer than 50 individuals were more susceptible to extinction than larger populations (Berger 1990). More recently, Ernest et al. (2002) estimated that populations with less than 15 females had a 60-70% probability of extinction after 5 years. Franklin (1980) suggested $N_e$ should be 50-500 animals to maintain genetic variation for future evolutionary change.

Therefore, the viability of subgroups on individual winter-spring ranges, and ultimately the entire population, is questionable.

### Reproduction

Observations in 1980 and 1981 determined that lambs are born between early April and mid-June, with the majority born between April 15 and May 15 (Holl and Bleich 1983). Based on a 180 day gestation period, breeding occurs between early October and mid-December, with the majority of breeding occurring from mid-October to mid-November (Holl and Bleich 1983, DeForge 1980).

### Lamb Recruitment

When the population was stable from 1976 to 1982, lamb recruitment rates were affected by annual forage production and weather during lambing. Large amounts of rain in November and December increased forage and warm, dry weather during April and May resulted in high recruitment rates the following year. Conversely, small amounts of rain in November and December and cold, wet weather during April and May resulted in low recruitment rates the following year (Holl 2002, Holl et al. 2004).

When the population declined substantially from 1983-1995 lamb recruitment rates were inversely related to the number of adult ewes, indicating the population was below carrying capacity. From 1992 to 1999, recruitment rates averaged 41.1 lambs per 100 ewes. Average recruitment rates declined to 24.3 lambs per 100 ewes from 2000 to 2002 because of the extended drought in southern California (Holl et al. 2004 2004).

### Adult Mortality

There were little changes in the number of adult bighorn sheep counted from 1979 to 1982, indicating adult mortality was low. A decline in the number of adults counted from 1983 to 1995 indicated adult mortality increased substantially. The number of adults counted annually was consistent between 1995 and 2002 (Holl 2002). Although lamb recruitment rates had increased, it was concluded adult mortality was sufficiently high during this period to preclude a population increase (Holl et al. 2004). Declining habitat quality from 1983 to 1988 was associated with increased adult mortality. After 1988, an increase in mountain lion activity was believed responsible for the high rates of adult mortality (Holl et al. 2004).

## HABITAT REQUIREMENTS

Unlike most other desert bighorn sheep populations, bighorn sheep in the San Gabriel Mountains occur in chaparral (Holl and Bleich 1983), a fire-dependent ecosystem (Barbour and Major 1977). The description of seasonal ranges is based on the habitat requirements of ewes (Holl and Bleich 1983) because their requirements are more restrictive than rams and their requirements are based on a predator evasion strategy,

while the habitat requirements of rams are based on optimizing forage quality and are less restrictive than ewes (Bleich 1993).

## Winter Spring Ranges

The habitat requirements of bighorn sheep on winter-spring ranges was determined from extensive observations of sheep in the Cucamonga and Mount San Antonio groups during 1978-1981 (Holl and Bleich 1983). Winter-spring ranges are generally below 5,400 feet elevation, on southeasterly to southern aspects. Steep slopes (>80%) with abundant rock outcrops are preferred. Chaparral vegetation with less than 30% cover is preferred. Chaparral generally consists of different associations of chaparral whitethorn (*Ceanothus leucodermis*), birch-leaf mountain mahogany (*Cercocapus betuloides*), holly-leafed cherry (*Prumus illicifolia*), coffeeberry (*Rhamnus californica*), white sage (*Salvia apiana*), and California buckwheat (*Eriogonum fasciculatum*). The steep rocky slopes with sparse vegetation, in combination, provide a required habitat variable, termed escape terrain (Bleich 1999, McCarty and Bailey 1994, Holl and Bleich 1983, others). Additionally, it was determined that the number of ewes was directly proportional to the amount of escape terrain available on winter-spring ranges (Holl and Bleich 1983). McKinney et al. (2004) also determined there was a direct relationship between the amount of escape terrain and the number of ewes and lambs.

Escape terrain is a required habitat component because bighorn sheep detect predators with their eyes and escape them by fleeing on the rock outcrops. The distribution of ewes is dependent on the presence of escape terrain from just before birth of lambs through weaning (April through August). During this period, they are rarely more than 300 feet from escape terrain. Ewes without lambs or during other periods of the year and rams are frequently observed farther from escape terrain than ewes with young lambs.

## Summer Ranges

Summer range habitat requirements are based on fewer observations of bighorn sheep and therefore, are not as well understood as winter-spring range habitat requirements. Bighorn sheep are distributed from 3,000 feet elevation up to 10,000 feet elevation. Habitat requirements at lower elevations are similar to those described for winter-spring ranges. At higher elevations, ewes may use stands of conifer trees that are within 300 feet of escape terrain, that have less than 30% canopy cover and more than 20% understory cover of shrubs, grasses, and forbs. The amount of use by ewes declines as the size and canopy cover of conifer forest increases and the amount of understory declines. For instance, conifer stands with greater than 60% canopy cover and occupying more than 50% of the area has a very low probability of use by ewes (Holl and Bleich 1983). Rams commonly use conifer stands and less steep areas that are avoided by ewes.

## Effects of Fire

Numerous studies have investigated the relationship between fire, chaparral succession, and the response of wildlife populations. Fire improves forage quality by increasing the amount of grasses available in spring and increasing the nutrient content in resprouting and seedling shrubs (Taber and Dasmann 1958). Fires would also benefit bighorn sheep by reducing the density and canopy cover of shrubs that would improve their ability to detect and escape predators and increase the amount of habitat available (Holl and Bleich 1983, Holl et al. 2004).

Evaluation of changes in the distribution of bighorn sheep in the San Gabriel Mountains determined they were attracted to areas burned by the Tecolote Fire (1987). It is hypothesized sheep have been attracted to habitat burned in the Narrows Fire (1997); however, additional observations will be required to obtain a statistically significant result. It was also determined that habitat use declined as post-fire succession increased shrub cover following the Village Fire in 1975 (Holl et al. 2004). These data and population increase following the 1968-1975 fires led to the hypothesis that fire increased the suitability of bighorn sheep habitat on winter-spring ranges (Holl et al. 2004). These evaluations indicated fires improved habitat suitability for approximately 12 years, after which, the number of sheep declined as post-fire shrub cover increased and reduced habitat suitability. No data are currently available to evaluate the effects of fire on summer ranges.

### Effects of Historical Fires on Winter-spring Ranges

Post-fire plant succession in the San Gabriel Mountains chaparral has been described (Hanes 1971, 1976). Fire return intervals and the number of acres burned in southern California chaparral is a controversial subject (Keeley and Fotheringham 2003) Stephenson and Calcarone 1999 ) and will not be resolved by this implementation strategy. It is generally agreed that the number of ignitions have increased because of higher amounts of human activity. Fire suppression, during less than extreme weather conditions, has effectively contained those fires. There is disagreement about the burning pattern of large fires. One hypothesis states suppression has reduced the number of frequent small wildfires, resulting in fewer but larger wildfires (Minnich 1983). The competing hypothesis states large fires have always occurred in southern California (Keeley and Fotheringham 2003).

The number of fires ignited by natural or human causes in bighorn sheep habitat was not evaluated for this analysis. Additionally, small fires (less than 50 acres) were not evaluated because they would not affect sufficient habitat on any winter-spring range to affect habitat suitability. Fire history data from the ANF and SBNF showed that 22 fires greater than 50 acres burned in bighorn sheep habitat since 1910. Extensive amounts of multiple winter-spring ranges were affected by fires in 1910-1919, 1950-1959, and 1970-1979 (Figure 2-3). These fires should have improved habitat suitability and benefited

bighorn sheep. Except for the San Gabriel Wilderness winter-spring range, fires provided little benefit to habitat suitability between 1920 and 1949. Similarly, except for the Narrows Fire in 1997, fires did not substantially improve habitat suitability between 1980 and 2002 (Figure 2-3).

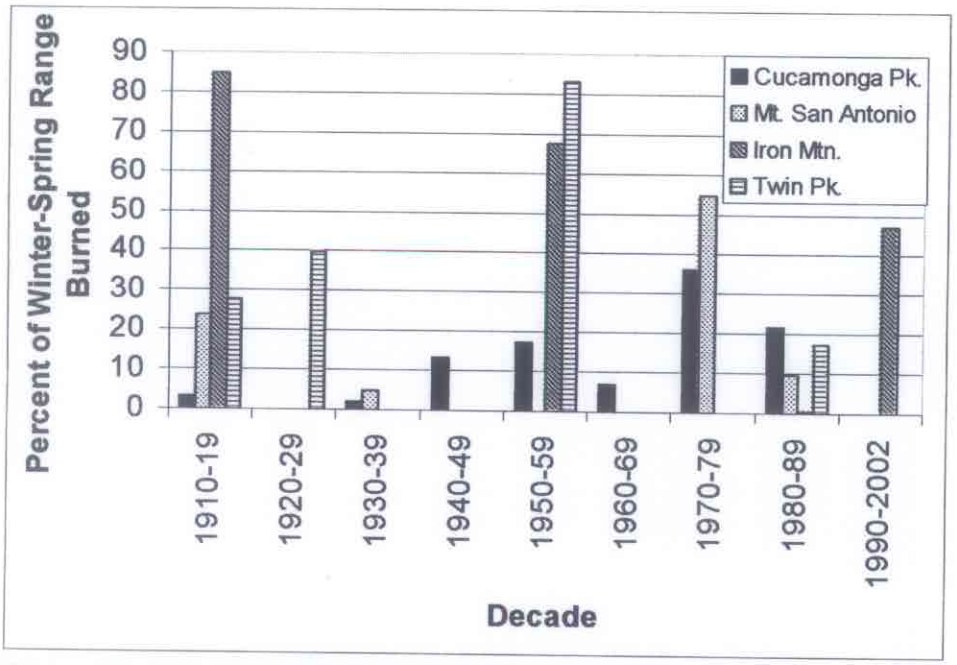
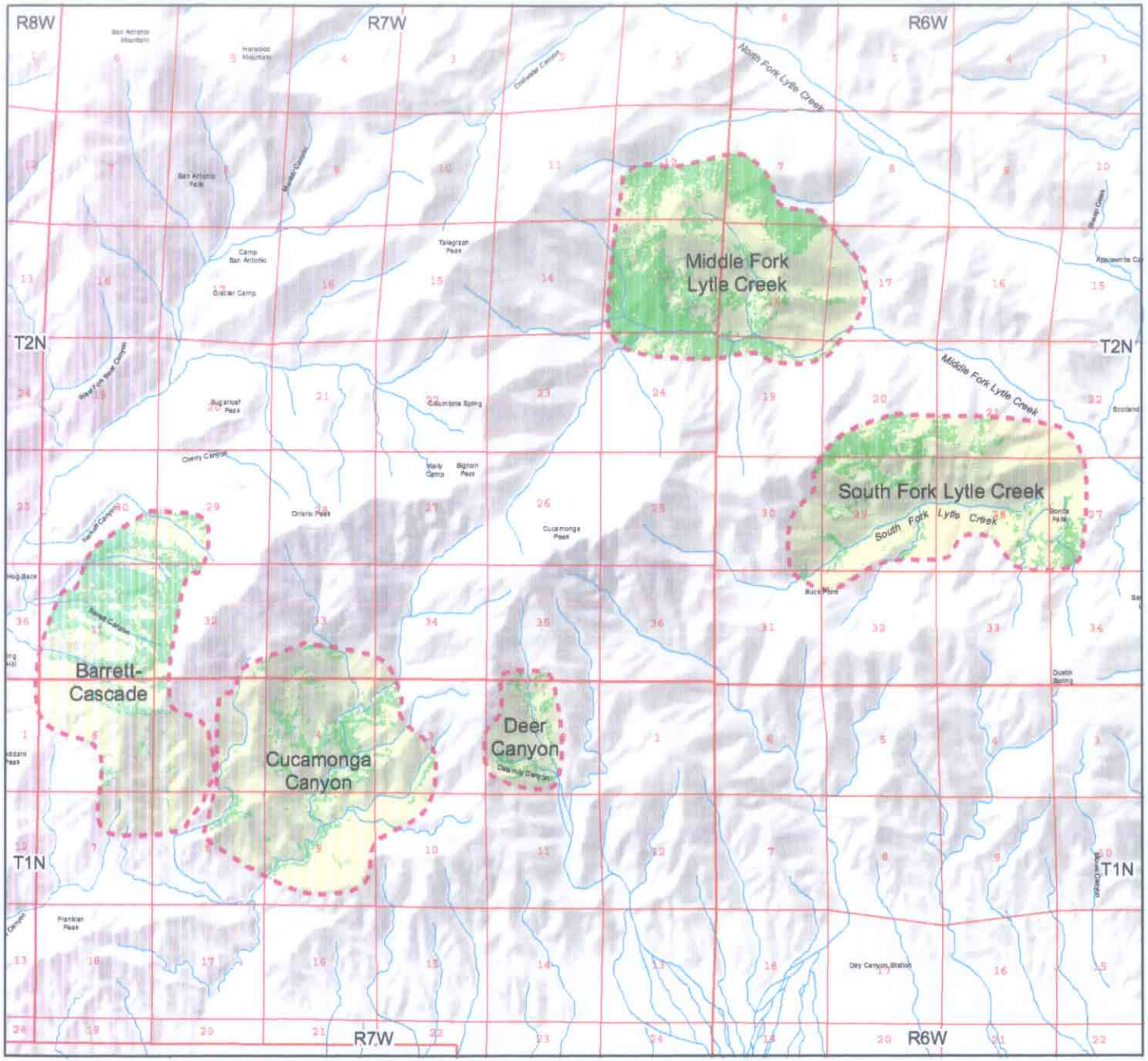



**Figure 2-3. Percent of bighorn sheep winter-spring ranges burned every decade in the San Gabriel Mountains**

**Recent Fires**

Approximately 250 acres were improved by a prescribed fire in the South Fork of Lytle Creek in 2002. A recent analysis of infrared images of the Grand Prix and Padua fires (Thomas Zmudka, BLM) indicated that all winter-spring ranges used by the Cucamonga group of bighorn sheep were affected by those fires (Figure 2-4). This figure indicates areas of unburned vegetation (green) and areas of burned vegetation and non-vegetated areas (e.g. rock outcrops and washes). These large fires were similar to the Meyers Fire (1970) which also burned most of those winter-spring ranges and probably improved habitat suitability at that time. Field evaluations of the changes created by those fires have not been initiated; however, it is thought that the changes in habitat suitability will benefit all bighorn sheep in the Cucamonga group (Table 2-2). Habitat suitability remains very low on all other winter-spring ranges on the ANF, which account for 64% of those seasonal ranges.

Figure 2-3. Effects of the Grand Prix and Padua Fires on the Cucamonga Group of Bighorn Sheep in the San Gabriel Mountains




**Legend**

Winter-Spring Range

**Vegetation Indicator**

Burned or Sparse Vegetation

Unburned Green Vegetation

The vegetation categories represented on this map are based on the Normalized Difference Vegetation Index (NDVI). NDVI values <= zero were used to represent areas with little or no green vegetation. These areas may include burned vegetation, low vegetation cover, and rocky slopes or washes. NDVI values greater than zero were used to represent unburned green vegetation. The NDVI values were derived from ASTER 15m satellite imagery (11/18/03).

N

0 0.5 1 2

Miles

BUREAU OF LAND MANAGEMENT
California Desert District
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www.ca.blm.gov/cdd
Date Prepared: 2/10/2004
Project: bhs_ndvi_analysis.mxd

Prepared by Tom Zmudka (02/10/04)

**Table 2-2. Habitat changes for the Cucamonga group of bighorn sheep from the Grand Prix and Padua fires.**

| Winter-spring Range | Total Area (ac) | Acres Unburned | % Unburned |
|---|---|---|---|
| **Middle Fork** | 2,076 | 864 | 41.7 |
| **South Fork** | 1,939 | 322 | 16.6 |
| **Deer Canyon** | 368 | 53 | 14.3 |
| **Cucamonga Canyon** | 2,127 | 259 | 12.2 |
| **Barrett-Cascade Canyons** | 1,876 | 535 | 28.5 |

## DIET & NUTRITION

### Diet Composition

The composition of bighorn sheep diets in the San Gabriel Mountains has been determined using a microhistological analysis of plant fragments identified in fecal pellets collected from sheep occurring on winter-spring ranges, year around (Perry et al. 1987). Browse species comprised 60% of the diet, annually. From January through March, browse provided 80% of the diet and the lowest contribution was in August, when browse provided approximately 45% of the diet. Dominant browse species included birch leaf mountain mahogany, white sage, California buckwheat, and holly-leafed cherry. The data indicated that birch leaf mountain mahogany was preferred by sheep, while California buckwheat, holly-leafed cherry, and white sage were consumed in proportion to their availability. Grasses provided 22.5% of the diet, annually. During spring, summer, and fall grasses comprised approximately 27% of the diet, while in winter they comprised less than 10% of the diet. The technique used to estimate the diet probably did not accurately identify the proportion of forbs in the diet because these are easily digested and underrepresented in fecal pellets.

### Diet Quality

Diet quality was estimated by measuring fecal nitrogen in pellets collected from free-ranging bighorn sheep (Perry et al. 1987). The underlying assumption in this method is that fecal nitrogen is an accurate predictor of dietary nitrogen intake. This method may not provide accurate results when ruminants consume forage containing protein-binding phenolics, which tend to increase fecal nitrogen (Wehausen 1995) or when they consume varying levels of inorganic matter (Seip and Bunnell 1985, Wehausen 1995). Bighorn sheep in the San Gabriel Mountains use mineral licks, which seasonally increase the level of ingested organic matter (Holl and Bleich 1987).

Nevertheless, the percent crude protein increased during spring, reaching its maximum level in April. Protein levels then declined through the summer, reaching their lowest levels in September. The changes in crude protein levels indicate diet quality was highest when lambs were born (April through mid-June). High quality forage is necessary for ewes during the third trimester of pregnancy and during early lactation

because these are the most nutritionally demanding events during the year (Moen 1973, Holl and Bleich 1983).

## Mineral Licks

Mineral licks are an important source of dietary supplements for many ungulate populations. At least 15 licks were identified in the San Gabriel Mountains (Weaver et al. 1972, Holl and Bleich 1987). Thirteen of the licks were associated with seeps, one was adjacent to the East Fork of the San Gabriel River, and one was solid rock along Forest Road 2N06 on the ANF. Based on soil analysis, it was concluded sheep were seeking calcium and magnesium (Holl and Bleich 1987). Other studies supported the findings in the San Gabriel's and still others indicated mineral licks were sought for sodium and/or bicarbonate (Bechtold 1996). The water associated with seeps in the San Gabriel's was not sampled for bicarbonate.

The use of mineral licks was seasonal, use initiated in April, peaked in June, and ended in September. Mineral lick use was also directly correlated with the moisture content in chamise (*Adenostoma fasciculatum*), indicating mineral lick use was highest when the moisture content of browse was highest (Holl and Bleich 1987). The seasonal timing of mineral lick use, the high moisture content of browse species, and high levels of fecal nitrogen, also indicated that sheep are using licks when their forage contained high levels of soluble sugars and proteins. As these nutrients are broken down, the rumen pH is reduced. Bicarbonate was not measured; however, given its ability to bond with sodium, calcium, or magnesium, it may be that sheep were seeking an "antacid" to increase rumen pH (Bechtold 1996). The actual need for mineral licks is unknown; however, because they are used regularly, they are thought to provide an important dietary supplement to bighorn sheep in this mountain range.

# SECTION 3. MANAGEMENT STATUS AND DIRECTION

This section summarizes the management status and current direction for bighorn sheep in the San Gabriel Mountains. This section is not intended to provide all of the direction affecting bighorn sheep nor does it attempt to interpret that direction. All references to specific regulations, policies, manuals, or handbooks should be thoroughly reviewed to ensure the latest direction is applied to management situations.

## STATE DIRECTION

Management direction at the state-level is described in the CFGC.

### Fully Protected Species

All subspecies of bighorn sheep in California are fully protected species (CFGC §4700), except designated populations of Nelson's bighorn sheep. Bighorn sheep in the San Gabriel Mountains have not been designated by the State Fish and Game Commission for legal harvest. As a fully protected species, individuals are prohibited to take a bighorn sheep and CDFG may not authorize the take of a fully protected species.

### Bighorn Sheep

Management direction for bighorn sheep is described in CFGC §4900-4904. It is state policy to encourage the preservation, restoration, utilization, and management of California's bighorn sheep. CDFG is required to determine the status and trend of populations by management units and develop a plan for each unit. The plan should include:

- demographic information,
- survey of range conditions and sources of competition,
- assessment of the need to relocate or reestablish animals,
- description of the prevalence of diseases, and
- recommendations for achieving the state policy.

A statewide management plan was prepared by CDFG for all bighorn sheep populations (California Department of Fish and Game 1983). This management plan is very broad and does not address the current situation in the San Gabriel Mountains. The administrative report (Holl and Bleich 1983) that summarized the knowledge of bighorn sheep in the San Gabriel Mountains and provided a series of management guidelines and recommendations met the requirements of the plan described above. The current strategy updates and supplements the 1983 administrative report and the assessment prepared for the Commission (Holl 2002).

## FEDERAL DIRECTION

Management direction at the federal level is described in Forest Service handbooks and manuals, the implementing regulations for the National Forest Management Act (NFMA) and the ANF and SBNF land and resource management plans (Angeles National Forest 1987, San Bernardino National Forest 1988). The Forests are currently revising their land and resource management plans; therefore, current planning regulations are summarized. At this time, it is estimated that the revised land and resource management plans will be approved in 2004.

### Forest Service Manual

The San Gabriel Mountains bighorn sheep population was relisted as a Sensitive Species, May, 2003. Species are listed as sensitive to ensure they do not become federally-listed as threatened or endangered and impacts on them are evaluated in Biological Evaluations prepared for projects that may affect them (FSM 2670).

### 1982 NFMA Regulations

The ANF and SBNF are required to maintain viable populations of existing native and desired non-native vertebrate species. Viable populations have the estimated numbers and distribution of reproductive individuals to ensure the continued existence of the population is well distributed. Additionally, habitat must be provided and well-distributed to support a minimum number of reproductive individuals and that habitat must be well distributed so those individuals can interact with others in the planning area. (NFMA §219.19). Because bighorn sheep are a management indicator species on both Forests, the Forests are required to establish objectives for the maintenance and improvement of habitat.

### Land and Resource Management Plans

Bighorn sheep are management indicator species (MIS) on both Forests. MIS are selected because their population changes are believed to indicate the effects of management activities. The status of MIS should be reviewed regularly to identify areas where management actions may be affecting those species. Specific standards and guidelines and land use decisions affecting bighorn sheep are identified in each land and resource management plan (Angeles National Forest 1987, San Bernardino National Forest 1988). Management direction for bighorn sheep should be incorporated into the revised plans.

### Wilderness Management

Approximately 73 percent (65,450 acres) of the area occupied by bighorn sheep is in the Cucamonga, Sheep Mountain, and San Gabriel Wilderness'. All wilderness areas are subject to unique national policies designed to preserve those characteristics that led to their congressional designation. The Wilderness Act of 1964 defines wilderness as

areas untrammeled by people that offer outstanding opportunities for solitude and directs agencies to manage wilderness to preserve natural ecological conditions (FSM 2320.1 [1]). Untrammeled is defined as: where human influence does not impede the free play of natural forces or interfere with natural processes in the ecosystem (FSM 2320.5[2]). Key national policies that affect bighorn sheep management in the San Gabriel Mountains are summarized below:

- protect indigenous wildlife from human caused conditions that could lead to federal listing as threatened or endangered species (FSM 2323.31[20]),
- the State has jurisdiction and responsibilities for the protection and management of wildlife in wilderness. It is Forest Service policy to work closely with State wildlife agencies (FSM 2323.32),
- reduce to an acceptable level, the risks and consequences of wildfire within wilderness or escaping from wilderness (FSM 2323.21[2]), and
- Section 4 of the Wilderness Act and FSM 2326.02 restrict the use of motorized equipment, motorized vehicles, and landing aircraft in wilderness to that which is necessary to meet the minimum requirements for administration of the area.

# SECTION 4. IMPLEMENTATION STRATEGY

This implementation strategy was developed during a series of workshops attended by CDFG and Forest Service wildlife biologists, program managers, and District Rangers. The strategy is based on existing management guidelines (Holl and Bleich 1983), an assessment of the implementation of those guidelines (Holl 2002), other studies, and the professional judgment of the participants at the workshops. In many cases, the existing management guidelines were still considered applicable, with some revisions. Therefore, the text in the 1983 guidelines should be reviewed prior to applying it to a project.

Approximately 73% of bighorn sheep habitat in the San Gabriel Mountains is in Wilderness. These Congressionally-designated areas were established to provide areas where human influence does not interfere with natural processes and offer outstanding opportunities for solitude. The restoration team recognized that management activities had altered all areas occupied by bighorn sheep in the San Gabriel Mountains.

All fires are aggressively suppressed, substantially altering an important component in a fire-dependent ecosystem (Stephenson and Calcarone 1999). As a result, the current fire regime is no longer a natural process in bighorn sheep habitat. Implementation of contrasting policies effecting mountain lions also affected the predator-prey system in this ecosystem. Bounty policies during the first 60 years of the 20th Century removed a large number of mountain lions from this ecosystem. Therefore, a source of bighorn sheep mortality was probably substantially reduced. Full protection of the mountain lion in 1972, allowed that predator to increase and contribute to the dramatic decline of mule deer and bighorn sheep in the San Gabriel Mountains.

As a result, this implementation strategy was based on a balanced approach that sought to establish a new equilibrium in this ecosystem that would:

- restore the bighorn sheep population to a self-sustaining level;
- establish a fire regime, particularly in wilderness, that contributes to a functioning chaparral ecosystem;
- establish a predator-prey system that minimizes the extreme variation in population numbers that occurred during the past 50 years; and
- encourage recreation experiences that emphasizes opportunities to observe bighorn sheep and minimize disturbance to them.

The implementation strategy includes revised descriptions of the management guidelines that were developed in 1983. The rationale for implementation of each guideline is based on current policies. Policy changes recommended by this implementation strategy should be incorporated into the revised land and resource management plans for each Forest.

## MANAGEMENT GUIDELINES

**4.1 Management Goal: Restore the San Gabriel Mountain bighorn sheep population to a self-sustaining level that provides diverse recreation and educational opportunities.**

The criteria to achieve a self-sustaining population and to delist the population from the Regional Forester's Sensitive Species list are described below.

**4.1.1 Establish a self-sustaining population.** A self-sustaining population will be established when both the criteria described below have been achieved. At this point, the population would be sufficiently large enough that it would not qualify for listing as a federally threatened or endangered species.

**Criterion 1**. Based on monitoring results, at least 30 ewes are present in the five areas described in Table 4-1 and 15 ewes are present in the Middle Fork of Lytle Creek for 6 consecutive years (one generation).

**Rationale:** Thirty ewes was selected because it was estimated that in the Peninsular Ranges, ewe groups greater than 30 individuals had an extinction risk less than 10% (Ernest et al. 2002). This is slightly higher than the number of ewes (25) identified in the Peninsular Ranges bighorn sheep recovery plan (U. S. Fish and Wildlife Service 2000) and the average number of ewes (22-29) in herd units identified in the Sierra Nevada bighorn sheep recovery plan (U. S. Fish and Wildlife Service 2003). Additional sheep were included in the San Gabriel Mountains because there were fewer recovery units (6) in that mountain range compared to the Peninsular Ranges (9) or Sierra Nevada (14). Deer, Cucamonga, and Barrett-Cascade Canyons were aggregated into one group because of their close proximity and lack of information about movement of bighorn sheep between these areas. Fewer ewes were identified in the Middle Fork of Lytle Creek because no more than 23 sheep were observed in this area during 1976-2002 surveys.

**Table 4-1. Distribution of bighorn sheep in the San Gabriel Mountains to achieve a self-sustaining level.**

| | Self-Sustaining Population | | | |
|---|---|---|---|---|
| **Winter-Spring Range** | Ewes | Rams | Lambs | Total |
| Middle Fork | 15 | 10 | 5 | 30 |
| South Fork | 30 | 16 | 9 | 55 |
| Deer/Cucamonga/Barrett-Cascade | 30 | 33 | 9 | 72 |
| Cattle Canyon | 30 | 16 | 9 | 55 |
| East Fork San Gabriel | 30 | 16 | 9 | 55 |
| San Gabriel Wilderness | 30 | 16 | 9 | 55 |
| Total | 165 | 107 | 50 | 322 |

**Criterion 2.** Based on monitoring results, at least 322 bighorn sheep are well distributed among the groups of bighorn sheep for 6 consecutive years. The approximate distribution of the sheep is shown in Table 4-1.

**Rationale:** This distribution assumes an average ram:ewe ratio of 0.65, as determined from surveys conducted between 1976 and 2002. Ram:ewe ratios for individual winter-spring ranges were adjusted to be consistent with the results of those surveys. Therefore, there is a higher ratio in the Middle Fork of Lytle Creek and Cucamonga Canyon compared to the other winter-spring ranges. It also assumes a lamb:ewe ratio of 0.3:1, the mean recruitment rate when the population was stable during 1976-1982 and 1995-2002. Therefore, recruitment equaled adult mortality. Berger (1990) determined that populations greater than 100 individuals persisted for up to 70 years. Based on current knowledge, however, a target population level of 322 bighorn sheep may not be sufficiently large enough to allow for genetic adaptation to evolutionary forces Franklin 1980).

**4.1.2 Remove the Population from the Sensitive Species List.** The San Gabriel bighorn sheep population should be removed from the Sensitive Species list when the criterion described below is achieved.

**Criterion 1.** Based on monitoring results, at least 500 bighorn sheep are well distributed among the subpopulations, for 6 consecutive years. Well-distributed means at least 260 bighorn sheep in the Cucamonga Peak group and greater than or equal to 80 bighorn sheep in the other three groups.

**Rationale:** From 1967 to 1972, there were an estimated 500 bighorn sheep in the San Gabriel Mountains (Figure 2-2). Population increases associated with the 1970 fires were not yet evident. In 1969, 7,238 acres (31%) of the winter-spring range habitat was less than 12 years old. However, 92% of this area was in the San Gabriel Wilderness. Most other winter-spring ranges had not been affected by fire. In 1989, there were an estimated 501±30 bighorn sheep and 14.8% of the habitat (3,491 acres) was less than 12 years old. The majority of this, 78.8% was in the San Gabriel Wilderness and Barrett-Cascade winter-spring range; the other winter spring ranges were affected little by fires. Based on available data, mountain lion predation was not a significant contributor to mortality, at that time (Weaver et al. 1972, Holl et al. 2004). Therefore, in the absence of habitat enhancement or predation, it is estimated the San Gabriel Mountains have a carrying capacity of approximately 500 bighorn sheep. Mountain lion predation will continue to affect this population. There are however, no data at this time to determine what that effect will be. Habitat enhancement will increase carrying capacity and may compensate for additional mortality from predation.

Based on surveys during 1976-2002, the mean ram:ewe:lamb ratio was 0.65:1:0.3 and 63% of the rams are Class III+. Assuming 90% of all adult ewes and Class III+ rams breed, a population of 500 bighorn sheep would have an estimated effective population size (Ne) of 380. Franklin (1980) suggests that for species with unequal sex ratios the following equation is used to estimate $N_e = 1/(1/n_m + 1/n_f)$. Using the assumptions above,

this equation provides an $N_e$ of 399, very similar to the first estimate. The estimated $N_e$ is below the recommendation of 500 (Franklin 1980); however, it is consistent with the estimated carrying capacity of this mountain range.

**4.2 Manage the San Gabriel's as a single population.**

This guideline remained unchanged from 1983.

**Rationale:** Analysis of mitochondrial DNA indicated bighorn sheep from the San Gabriel Mountains had the most common haplotype identified in desert sheep populations. They could be distinguished however, from bighorn sheep in the Peninsular Ranges and other populations in the eastern Mojave Desert (Ramey 1995). Based on a limited comparison of skull measurements, there is an indication the San Gabriel population may have some unique characteristics (Wehausen and Ramey 1993).

There has been no genetic analysis below the population level in the San Gabriel Mountains. Mitochondrial sequence analysis in the Peninsular Ranges identified distinct ewe subpopulations that defined the basic demographic and genetic units (Boyce et al. 1999). Given the disjunct distribution of ewe groups in the San Gabriel Mountains, it is hypothesized that similar results would be obtained in this mountain range. Until additional data are available, the four groups of bighorn sheep currently identified (Twin Peaks, Iron Mountain, Mount San Antonio, and Cucamonga Peak), will be considered the basic demographic and genetic units.

Interstate highways, communities, and large expanses of unsuitable habitat isolate the San Gabriel Mountains bighorn sheep population from all other bighorn sheep populations (Holl and Bleich 1983, Holl 2002). This is important because there is little chance for the immigration of new genetic material into this population. This differs from metapopulations of other desert bighorn sheep (Bleich et al. 1990), where the immigration of new genetic material is facilitated by the widespread movement of breeding rams (Schwartz et al. 1986).

The viability assessment for this population indicated the long-term viability was questionable (Holl 2002). Therefore, it is important the population size be increased quickly, ensure there are no barriers to the movement of adults within the population, and individual groups of bighorn sheep are not isolated.

The San Gabriel Mountains bighorn sheep population occurs on two National Forests. Each Forest is considered a distinct planning area under NFMA regulations and each is required to maintain viable populations of native species (36 CFR 219.19). It is hypothesized that rams move extensively between the Forests, particularly during the breeding season. Therefore, the Forests should consider this a single population, with an objective of maintaining a minimum of 322 bighorn sheep in the population, as described in Table 4-1. Until additional genetic information is available, the population should not be treated as a metapopulation, where individual groups are allowed to exist in a state of balance between extirpation and colonization.

**4.3 Survey the population annually.**

The San Gabriel bighorn sheep population should be surveyed, as described in 1983 plan.

**4.3.1 Conduct the March survey.** CDFG will survey the population annually, in March, to determine age and sex ratios and provide a population estimate. At this time, only the helicopter surveys should be conducted. Flight times described in the 1983 guidelines may not be valid because fewer sheep are in the population. Population estimates should be reported as the total number of sheep observed (minimum estimate), the number of sheep observed per hour of flight time, and the total number of sheep observed x 1.27. The value 1.27 is the slope of the line obtained by regressing the total number of sheep observed from the helicopter and the population estimates from 1979 to 1989 (Holl unpublished data). This population estimate assumes observability of bighorn sheep is consistent between all years. Concurrent ground and helicopter surveys may be conducted in the future, if the population increases and the chaparral cover does not substantially restrict access to observation points.

**Rationale:** The March survey contributes to a critical database. It is one of the oldest continuous databases on a large mammal population in California. It provided the scientific basis for evaluating changes in the population and determining the response to past management decisions. It will also be the baseline and prime source of new information to monitor the effectiveness of future management activities designed to restore the population.

**4.3.2 Monitor radio-collared bighorn sheep.** CDFG should continue to capture and place radio-collars on bighorn sheep. Captures should be conducted throughout the mountain range to determine the extent of movement between winter-spring and summer ranges. The location of radio-collared sheep should be determined several times each month to identify the timing of movement, the relationship between winter-spring and summer ranges, the extent of summer ranges, and mortality patterns.

**Rationale**: There are limited data on the distribution of bighorn sheep summer ranges, movement of ewes and rams between winter-spring and summer ranges, and the location of movement corridors, particularly during the breeding season. These data would ensure that these seasonal ranges and movement corridors are identified and land uses do not adversely affect these areas. Additionally, mortality sensors on the radio-collars would facilitate the location of sheep so cause of death can be determined and critical measurements (e.g. sex, age, physical condition) can be determined.

**4.4 Classify this population as a Forest Service Sensitive Species.**

The Forest Service reclassified the population as a Sensitive Species in May, 2003. All projects that occur in bighorn sheep habitat will be assessed in biological evaluations to determine if there is a significant impact on bighorn sheep, determine if the

project will result in a trend toward federal listing, and provide recommendations to decision-makers.

**4.4.1 Prepare a petition for emergency listing as federal endangered species.**

**Rationale:** The long-term viability of the San Gabriel Mountains bighorn sheep population is questionable. This implementation strategy is designed to restore the population to a level where the viability is not questionable. If this plan has not been implemented and the population declines to less than an estimated 80 sheep, a petition for emergency listing should be prepared immediately.

**4.5 A population management plan should be considered.**

As described in 1983, this guideline proposed a limited harvest of bighorn sheep and is no longer valid.

**Rationale:** This guideline should not be reconsidered until the population has been removed from the Regional Forester's Sensitive Species list. All efforts to manage the population will focus on restoration to achieve the goal described in 4.1.

**4.6 Maintain the distribution and integrity of escape terrain.**

This guideline remained unchanged from the 1983 plan. Escape terrain is defined as slopes greater than 80% slope with numerous rock outcrops (Holl and Bleich 1983).

**Rationale:** Escape terrain is the single-most important element of bighorn sheep habitat. It was determined there was a linear relationship between the amount of escape terrain available and the number of ewes on a winter-spring range and approximately 35.6 acres of escape terrain were necessary to support one ewe on that seasonal range (Holl and Bleich 1983). McKinney et al. (2004) also demonstrated there is a predictable relationship between the amount of escape terrain and the number of females in bighorn sheep populations.

**4.7 Restore and maintain habitat suitability.**

**4.7.1 Implement prescribed burns on winter-spring ranges.** The Grand Prix and Padua fires burned in all of the winter-spring ranges occupied by the Cucamonga group of bighorn sheep. Although accurate maps have not been developed to evaluate the effects of that fire, preliminary mapping indicates habitat suitability improved on all winter-spring ranges (Figure 2-3 and Table 2-2). The SBNF and CDFG should establish an effective monitoring program, using radio-collared bighorn sheep, vegetation mapping and monitoring, diet quality analysis, and the annual survey to accurately evaluate the response of bighorn sheep to the recent fire.

The ANF should implement prescribed burns to improve habitat on winter-spring ranges that have not been affected by fires. The objective of the strategy should be to

have a minimum 40% of the chaparral, within the 90% boundaries of winter-spring ranges, less than 12-years old. This would allow for large portions of winter-spring ranges to be treated and ensure that a rotation schedule is implemented throughout bighorn sheep habitat. It is not necessary for all winter-spring ranges to be treated; however, to be effective burned areas should be well distributed among most winter-spring ranges.

Burning should result in less than 30% canopy cover of shrubs in all treated areas. Habitat restoration should focus on stands of mixed chaparral that are greater than 20 years old and are within 300 feet of escape terrain (Holl and Bleich 1983). The fire regime should not result in excessive heat; the objective is to increase the amount of grass, herbaceous vegetation, and shrub seedlings and encourage resprouting of shrubs. This vegetation response will provide high quality forage and be sufficiently open that bighorn sheep can detect and have an opportunity to escape predators. Treatments should also include birch-leaf mountain mahogany and California buckwheat-sage associations; however, the fire regime should be less intense in these stands. Underburning in live oak and big cone fir stands is appropriate.

Four habitat restoration projects are planned during the next five years, totaling approximately 2,000 acres of winter-spring ranges (Table 4-2). The projects would affect 35% of the Cattle Canyon winter-spring range. Approximately 74.5 acres of the Barrett-Cascade winter-spring range were affected by the Padua fire. The proposed project would result in 98% of that winter-spring range improved by fire. Approximately 2,024 acres (47.6%) of the East Fork San Gabriel River winter-spring range was affected by the Narrows fire in 1997. Assuming no other fires affect that area, the benefits of that fire will be eliminated by 2009. Therefore, the proposed project would affect 12% of the East Fork San Gabriel River winter-spring ranges.

**Table 4-2. Habitat restoration projects planned on the ANF during the first five year period.**

| Forest | Implementation Year | Burn Name | Acres Treated |
|---|---|---|---|
| ANF | 2006 | Cattle Canyon | 500 |
| ANF | 2007 | Cattle Canyon | 500 |
| ANF | 2008 | Barrett-Cascade | 500 |
| ANF | 2009 | East Fk. San Gabriel | 500 |

**Rationale:** Data from the Tecolote Fire (1986) demonstrated that bighorn sheep were attracted to recently burned areas and data from the Village Fire (1975), demonstrated that bighorn sheep use of burned areas declines as plant succession increases the amount of shrub cover. It was also hypothesized that the extensive wildfires between 1968 and 1975 resulted in an increase of bighorn sheep in the San Gabriel Mountains and post-fire succession resulted in the initial population decline (Holl

2002, Holl et al. 2004). The Grand Prix and Padua fires and low suitability habitat on the ANF provide an unprecedented opportunity to test the habitat improvement hypothesis raised by Holl et al. (2004). Implementing habitat improvement projects in the Barrett-Cascade and Cattle Canyon winter-spring ranges and the 2003 fires will result in approximately 48% of all winter-spring ranges treated. This will provide the interagency team with the experimental and control conditions necessary to test the hypothesis and should result in sufficient population increases that the population's viability will not be questionable.

Prescribed fire may be used to reduce to an acceptable level, the risks and consequences of wildfire within wilderness or escaping from wilderness (FSM 2323.21[2]). Currently, the ANF land management plan, Prescription 9 [Wilderness] (Angeles National Forest 1987) allows planned ignitions to reduce the unnatural buildup of fuels within wilderness and to maintain habitat of bighorn sheep, as part of the wilderness character. The SBNF land management plan (San Bernardino National Forest 1988) also provides management direction for the use of prescribed fire in wilderness areas. Forestwide standard and guideline 57 directs the Forest to manage habitat for Sensitive Species to enhance populations and manage for long-term population viability. Standard and guideline 54 directs the Forest to manage vegetation to correct habitat deficiencies in important sheep habitat. Management prescriptions in the Cucamonga management area allow for the management of chaparral to minimize habitat deficiencies (Prescriptions 23 and 25).

### 4.7.2 Implement winter-spring range projects after year five.

The Forest Service should evaluate the effectiveness of the Grand Prix and Padua fires and first five years of prescribed burning and develop a schedule of habitat restoration projects for the next five years.

**Rationale:** Currently available data demonstrated bighorn sheep are attracted to burned areas and use declines as post-fire succession increases shrub cover. The Grand Prix and Padua fires and completion of all prescribed burns identified in Table 4-2 will result in 48% of the winter-spring ranges treated. Monitoring the response of bighorn sheep to these treatments will confirm or reject the hypothesis that fire improves habitat suitability for bighorn sheep in the San Gabriel Mountains. These treated areas will provide high suitability habitat for approximately 12 years following a fire. Because of current fire suppression direction, no data are available to establish a long-term rotation schedule, at this time. Therefore, treatments beyond the first five years will be based on an adaptive management strategy that is developed from monitoring the response of sheep to fire.

### 4.7.3 Evaluate availability of mineral licks.

The Forest Service should evaluate the availability of mineral licks in the mountain range and correct deficiencies, if possible.

**Rationale:** Licks are known to occur in the Middle Fork of Lytle Creek, South Fork of Lytle Creek, Cucamonga Canyon, Cattle Canyon, East Fork of the San Gabriel River, and the saddle between Dawson Peak and Mt. San Antonio. There are probably other, as yet unidentified licks, in this mountain range.

The known mineral licks should be surveyed and evaluated to determine if they are available to and being used by bighorn sheep. A brief survey in the South Fork of Lytle Creek in late summer 2002 indicated the seep associated with the mineral lick at the "Narrows" may have dried up. The recent drought may have reduced flows from the soil. Alternatively, the alders (*Alnus* spp) growing near the lick may have reduced the water table, contributing to the dry condition. The large, dense alders may have also restricted the vision of bighorn sheep so they would no longer visit the lick.

**4.7.4 Evaluate the need for habitat restoration projects on summer ranges.**

The Forest Service should evaluate summer ranges to identify opportunities to improve habitat suitability, particularly forage production.

**Rationale:** Habitat restoration projects currently target winter-spring ranges which are also used by some bighorn sheep during summer. If winter-spring ranges have been treated and bighorn sheep lamb recruitment rates have not increased, it may indicate low habitat suitability on summer ranges. Summer ranges are important because they are used by ewes during the peak of lactation, the most energetically-costly event of the year. Therefore, poor forage conditions on summer ranges may adversely affect lamb recruitment.

Radio-collared bighorn sheep would provide additional information on the distribution and use of important habitat associations on summer ranges. If lamb recruitment rates have not increased in bighorn sheep groups where winter-spring ranges have been treated, summer range conditions should be evaluated to identify opportunities for habitat restoration projects.

**4.8 Prohibit rural and urban recreation opportunities in bighorn sheep habitat.**

This guideline remained unchanged from 1983 plan.

**Rationale:** Rural and urban recreation opportunities, as defined by the Recreation Opportunity Spectrum (ROS) are highly developed and are associated with high levels of use (Holl and Bleich 1983, Appendix C). These highly modified environments will result in the direct loss of habitat or high levels of recreation use could result in avoidance by bighorn sheep and the indirect loss of habitat.

**4.9 Discourage cross country travel in sheep habitat.**

This guideline remained unchanged from the 1983 plan.

**Rationale:** Flight and avoidance are the most commonly observed reaction of wildlife to human activities. Altmann (1958) evaluated flight responses of large ungulates by measuring the "flight distance". Flight distance was defined as the distance that a person could approach a wild animal without causing it to flee. She noted that reproductive status, habitat, and the experience of individual animals influenced the flight behavior.

Ewes with young lambs flee from hikers at greater distances than rams or ewes with older lambs (greater than 6-months old) (Weaver and Light 1973, Wehausen 1979, 1983, Holl and Bleich 1983, Papouchis et al. 2001). In the San Gabriel Mountains, ewe groups became concerned and would not bed down when people were within approximately 375 feet in summer and 225 feet during winter. The juxtaposition of bighorn sheep, escape terrain, and people are important factors when evaluating flight responses. Flight distances were greater the farther bighorn sheep were from escape terrain (Wehausen 1979, 1983, Papouchis et al. 2001) or when people approached bighorn sheep from above them (Hicks and Elder 1979, Graham 1980, MacArthur et al. 1982).

The type of human activity can also influence flight behavior. Studies of mule deer and bighorn sheep have demonstrated that these species are more apt to flee from hikers than motor vehicles or mountain bikers (Eckstein et al. 1979, MacArthur et al. 1982, Freddy et al. 1986, Papouchis et al. 2001). Additionally, sheep fled farther from hikers than mountain bikers (Papouchis et al. 2001). In these studies it was determined that motor vehicles and mountain bikes tended to stay on designated trails or roads, resulting in repeatable patterns that were predictable to bighorn sheep. Hikers did not always follow trails, and often approached sheep to take photographs, resulting in unpredictable behavior. Other studies provide additional examples of bighorn sheep that became habituated to human activities that were very predictable and non-threatening (Geist 1971a, 1971b, Leslie and Douglas 1980, MacArthur et al. 1982).

Hikers with leashed (MacArthur et al. 1982) and unleashed dogs (Wehausen 1979) elicited a stronger flight response than hikers without dogs. In these cases, it was hypothesized that bighorn sheep were avoiding a potential canid predator, as represented by the dog. Similar observations of stronger responses of mule deer to people with dogs compared to people without dogs have also been reported (Miller et al. 2001).

MacArthur et al. (1982) demonstrated that heart rates in bighorn sheep increased in response to disturbance. The increases coincided with behavioral responses, such as flight. Most studies that evaluated human disturbance and its effect on reproductive success in mule deer and bighorn sheep could not find an adverse relationship (DeForge 1972, Hicks and Elder 1979, Wehausen 1979, Ferris and Kutilek 1989). Only one study, identified a decline in the reproductive success of a large ungulate. Yarmoloy et al. (1988) documented a decline in reproductive success of mule deer that were harassed by all-terrain vehicle riders.

### 4.9.1 Evaluate the effects of recreation on bighorn sheep.

The Forest Service should determine if there are areas of high recreation use that overlap with high suitability sheep habitat and determine the impact on bighorn sheep. This would require coordination with recreation specialists to determine levels of recreation use in bighorn sheep habitat, mapping those levels of use, and determining where high levels of recreation use intersect high suitability sheep habitat.

**Rationale:** Estimates of recreation use in wilderness are provided by visitor use permits, issued by Forest Service offices. These use estimates are conservative because the Forest Service estimates 25% of the people in the wilderness do not obtain a wilderness permit. Daily use in the Cucamonga Wilderness is limited to 75 day users and 86 campers. Most camping occurs at designated sites. Currently there is minimal or no enforcement of wilderness regulations or policies. Recent reports (ANF 2001, files) of recreation use indicate the majority of use occurs between May and September and is restricted to day hiking on weekends (Table 4-3). Estimates of use in the Cucamonga Wilderness (SBNF 2002, files) indicate the average size of a hiking group is 4 people and the average stay of weekend users is 2.48 days. In contrast to the 2001 reports, 56% of the groups stay overnight.

Information from the ANF (files) indicates most wilderness visitors go to a limited number of areas (Table 4-4). These areas are generally close to the major trailheads and the shorter distances are consistent with the prevalence of day use identified in Table 4-3. Until data were available from the SBNF, it is assumed the most frequently used destinations in the Cucamonga wilderness would be 3rd Stream Crossing and Comanche Camp.

**Table 4-3. Estimated recreation use patterns for 2001 in wilderness areas in the San Gabriel Mountains (source, ANF).**

| Wilderness Area | Total Visits | % Visits May-Sept. | % Weekend | % Day Use |
|---|---|---|---|---|
| Cucamonga | 6400 | 71.3 | 82.4 | 83.5 |
| Sheep Mountain | 2691 | 74.6 | 82.0 | 80.2 |
| San Gabriel | 955 | 62.5 | 81.0 | 84.0 |

**Table 4-4. The estimated percent use of destinations within each wilderness (source, ANF).**

| Cucamonga | | Sheep Mountain | | San Gabriel | |
|---|---|---|---|---|---|
| Destination | Percent | Destination | Percent | Destination | Percent |
| Ice House Saddle | 57 | Bridge to Nowhere | 43 | L. Bear Cr. | 26 |
| 3rd Stream Crossing | 12 | Mt. Baldy | 19 | Devils Canyon | 24 |
| Comanche Camp | 7 | Mine Gulch | 13 | Mt. Waterman | 18 |
| Kelly Camp | 6 | Pacific Crest Trail | 6 | Twin Peaks | 16 |
| Cucamonga Pk. | 6 | Iron Fk. | 5 | U. Bear Cr. | 12 |
| Ontario Pk. | 4 | Allison Mine | 3 | Smith Mtn. | 4 |
| Telegraph Pk. | 4 | Iron Mountain | 3 | | |
| Timber Mtn. | 4 | Upper Fish Fk. | 3 | | |

Data on the effect of high levels of recreation on the distribution of bighorn sheep are inconclusive and often conflicting. It was suggested that human disturbance was the most important factor limiting bighorn sheep in the Sierra Nevada Mountains; however, little supporting data were available (Hicks and Elder 1979, Wehausen 1979). In the Pusch Ridge Wilderness (Arizona) it was stated bighorn sheep abandoned large portions of habitat in response to recreation and development (Etchenberger et al. 1989); however, there are little data to support this statement. In the San Gabriel Mountains, a ewe was apparently fatally shot in 1976 in the South Fork of Lytle Creek. The loss of that ewe resulted in the abandonment of the headwaters of that canyon by a band of sheep for over 18 months (DeForge 1980).

Studies of the distribution of bighorn sheep in the Mount San Antonio area indicated high levels of recreation use had displaced bighorn sheep (Light and Weaver 1973). Their studies indicated areas of concentrated bighorn sheep use included the north aspect of Mount San Antonio and Mount Harwood, above Stockton Flat campground, and the eastern ridges along Coldwater Canyon. They concluded that bighorn sheep had retreated from the southeast face of Mount San Antonio, where there were high levels of recreation use. Based on these studies, light to moderate recreation use (< 500 visitors-days per summer) had little effect on the distribution of bighorn sheep. However, high use (500-2,000 visitor-days) apparently resulted in bighorn sheep avoiding these areas (Light and Weaver 1973, Graham 1971). Similarly, Papouchis et al. (2001) concluded that most bighorn sheep in Canyon Lands National Park avoided a heavily used road corridor.

Hamilton et al. (1982) compared the distribution of bighorn sheep along a heavily used trail (Devil's Backbone Trail; 6,401 summer visitors) and a lightly used trail (Cucamonga Peak Trail; 24 summer visitors). An evaluation of the distance 36 groups of bighorn sheep were observed from the trails failed to identify a significant difference.

**4.9.2 Minimize disturbance to bighorn sheep from recreation.**

The Forest Service should minimize disturbance on bighorn sheep where excessive levels of recreation use have resulted in habitat avoidance. Data from Task 4.9.1 should be used to identify areas where high levels of recreation are potentially affecting the distribution of bighorn sheep. A study should be designed and implemented to determine if those high levels of recreation use are affecting bighorn sheep. If recreation is adversely affecting bighorn sheep, techniques to minimize disturbance, such as increased public education, establishment of carrying capacities for recreation use in sensitive areas, trail rerouting, or seasonal closures of sensitive areas (including roads) should be evaluated and implemented where necessary.

**4.10 Prohibit new roads and trails within 300 feet of mineral licks.**

**Rationale:** Mineral licks are important seasonal resources for bighorn sheep in the San Gabriel Mountains (Weaver et al. 1972, Holl and Bleich 1987). These resources are isolated points in the landscape and often there are not alternative resources available. At Anza Borrego State Park bighorn sheep visitation of a watering area was substantially reduced by the presence of vehicles and recreationists (Jorgensen 1974). In the River Mountains (Nevada) bighorn sheep avoided using a water source in response to construction activities and moved to an alternate water source (Leslie and Douglas 1980). In the South Fork of Lytle Creek, bighorn sheep avoided using a mineral lick when people were near the lick (Hamilton et al. 1982). These studies demonstrate that recreation can result in bighorn sheep avoiding these point resources; therefore, disturbance should be avoided or minimized at mineral licks.

**4.10.1 Evaluate disturbance at Mount San Antonio/Dawson Peak mineral lick.**

A mineral lick is at the saddle between Mount San Antonio and Dawson Peak, where the Devil's Backbone trail is located. The Forest Service should evaluate disturbance to bighorn sheep from hikers using this trail. If there is an impact, the trail should be relocated to the north side of the saddle to minimize disturbance to bighorn sheep.

**Rationale:** see 4.10

**4.11 Mitigate impacts created by commercial operators and transportation projects.**

The Forest Service should require these project proponents to thoroughly evaluate if their project affects bighorn sheep and identify effective measures to avoid, minimize, reduce, restore, or compensate for impacts on bighorn sheep in biological evaluations or annual operating plans.

**Rationale:** Bighorn sheep are now listed as a Sensitive Species and impacts on them are required to be assessed in biological evaluations that are prepared for new projects. Transportation projects, such as the reopening of State Route Highway 39, have

the potential to disrupt a movement corridor and create a barrier between the Iron Mountain and Twin Peaks groups of sheep. This could result in the isolation of the Twin Peaks group of sheep. Bighorn sheep are also known to use the Mt. Baldy, Kratka Ridge, and Mount Waterman ski areas during summer when these areas are also promoting recreation opportunities. High levels of recreation use may have an adverse impact on bighorn sheep. Adverse impacts on bighorn sheep which result in a trend toward federal listing will result in preparation of a petition to list this population as a federal endangered species.

**4.12 Approve all necessary activities in wilderness areas.**

The Forest Service must obtain all approvals necessary to implement the management activities in wilderness identified in this strategy to restore this population.

**Rationale**: Approximately 73% of bighorn sheep habitat in the ANF and SBNF is in wilderness. The use of motorized vehicles and mechanized equipment (e.g. helicopters required for monitoring bighorn sheep and mountain lions) requires approval by the Regional Forester (FSM 2326). The use of prescribed fires can be approved by Forest Supervisors because this activity was evaluated and approved for use in the land management plans (Angeles National Forest 1987, San Bernardino National Forest 1988). However, confusion over the approved use of prescribed fire in wilderness was identified as a significant regulatory constraint affecting this population (Holl 2002).

The Regional Forester has authorized the use of mechanized equipment and landing helicopters in wilderness for 18 months (September 2003-March 2005). This approval was necessary to implement the monitoring described in 4.3.2 and 4.15. Approval for additional years of monitoring will require an additional evaluation and may require compliance with NEPA. To avoid confusion, all actions necessary to obtain future approval for operation in the wilderness must be initiated at least one year prior to the project initiation date.

**4.13 Prohibit domestic sheep grazing allotments and domestic goats within 9 miles of sheep habitat.**

The distance recommended in 1983 was 2 miles. The distance was increased and domestic goats (*Capra hircus*) were included, based on more recent information.

**Rationale**: There is additional evidence demonstrating high mortality in bighorn sheep populations when they are near domestic sheep (*Ovis aries*) (U. S. Fish and Wildlife Service 2003). Recent evidence also supports applying the standard to domestic goats (U. S. Fish and Wildlife Service 2000, 2003). Bighorn sheep are highly susceptible to pneumonia, generally caused by *Pasturella* bacteria (Post 1971). Domestic goats do not appear to carry the toxic strains of *Pasturella*, regularly (Foreyt 1994); however, they may carry it if they were in recent contact with domestic sheep. During a *Pasturella* pneumonia outbreak in bighorn sheep in Hells Canyon, Idaho, a feral goat was captured with strains of *Pasturella* identical to those in the infected bighorn sheep. One of the strains was toxic to bighorn sheep but not the goat (Cassirer et al. 1996). Recently

(December 2003-January 2004), domestic goats escaped their fenced allotment and mixed with a herd of approximately 100 bighorn sheep in the Silver Bell Mountains, outside Tucson, Arizona. Thirty bighorn sheep were blinded from keratoconjunctivitis, resulting in eight deaths and 15 bighorn sheep contracted contagious ecthyma, resulting in one death. The diseases were contracted from the domestic goats (Jim Heffelfinger, Arizona Game and Fish Department).

Any domestic sheep or goat allotments should be prohibited within nine miles of bighorn sheep habitat. The increased distance is based on the conclusive evidence that contact between domestic sheep and goats results in high mortality in bighorn sheep, certain diseases (e.g. chronic sinusitis, Bunch et al. 1978) are transmitted by flies which move beyond allotment boundaries, and the Bureau of Land Management and Peninsular Ranges bighorn sheep recovery plan (U. S. Fish and Wildlife Service 2000) have adopted that distance to protect bighorn sheep.

### 4.14 Institute predator control if there is an unacceptable loss of sheep to predators.

CDFG will be responsible for determining if, when, where, and how mountain lions will be removed to reduce predation on bighorn sheep.

**Rationale:** Mountain lion predation has been hypothesized to be an important contributing factor to the decline and lack of recovery of the San Gabriel Mountains bighorn sheep population (Holl 2002, Holl et al. 2004). The small number of bighorn sheep remaining in this range increases their susceptibility to the risk of extinction (Berger 1990, Ernest et al. 2002). Bighorn sheep in this mountain range are a fully protected species (CFGC §4700) and the mountain lion is a specially protected mammal (CFGC §4800). Mountain lions may be taken if they are perceived to be an imminent threat to a fully protected bighorn sheep population (CFGC §4801-5809).

#### 4.14.1. Predator Removal

Predator removal implies the take of an individual animal by lethal means. It is considered a short-term solution designed to alleviate a specific and quantifiable problem. The goal of predator removal is to establish a new equilibrium between bighorn sheep and their predators. It is anticipated that predator removal should not be necessary after the San Gabriel bighorn sheep population has achieved the self-sustaining level defined in Management goal 4.1 and all management programs are in place.

Two levels of predator removal have been developed to ensure a swift and sustained recovery of this population. The intent of level one is to relieve the herd from predation when the risk of extinction is greater than 50%. The intent of level two is to protect subpopulations which have a less than 50% risk of extinction, but have not reached a self sustaining level. Predator removal at both levels will be based upon the determination that predation is an imminent threat to the survival of the San Gabriel bighorn sheep population.

**Level 1 Predator Removal.** Removal of a problem predator by lethal means would be implemented immediately if there are fewer than 15 adult female bighorn sheep in a given subpopulation, and predation is a confirmed mortality factor. In this circumstance, protection of individual bighorn sheep is critically important for ensuring population survival in the San Gabriel Mountains. Predator removal should be implemented solely to benefit the subpopulation of concern. It may continue until the subpopulation has established a growth rate (as determined from ongoing monitoring programs) that results in a self-sustaining population (see Management Goal 4.1).

**Level 2 Predator Removal.** Predator removal may be implemented if there are greater than 15 ewes in one or more of the four subpopulations, to further facilitate long-term goals of population recovery. At this level, the subpopulation has not reached a self sustaining level (see Management Goal 4.1). Therefore, predation may be considered an immediate threat to long-term survival of the overall population if predation is the primary cause of mortality and low survivorship is limiting population recovery.

CDFG will discontinue predator removal when available evidence indicates that predation is no longer an imminent threat to this population. Lethal removal of predators will be accompanied by careful monitoring to determine if predator control achieves the desired protection of bighorn sheep. That is, mortality rates or survival rates and population estimates will be assessed before and after the above actions are taken.

### 4.14.2. Mountain Lion Removal

CDFG is assessing the distribution of mountain lions by conducting track count surveys in bighorn sheep habitat. Based on these surveys, mountain lion trapping should be initiated in 2004. All captured mountain lions will receive Global Positioning System (GPS) radio-collars. Lion movements will be monitored regularly, using satellite technology, to determine patterns of travel and locations of kill-sites. Radio collars will transmit data on lion locations every 72 hours and these data points will be plotted on 1:24,000 USGS topographic maps. Two or more data points within a 600-foot$^2$ circle that occur within a 16-hour (primarily nocturnal) period will be classified as "location clusters" (Anderson and Lindzey 2003). Location clusters have been associated with prey that have been killed and cached. Personnel will evaluate the physical remains at each location cluster to determine the prey species and cause of death (kill site). If physical evidence of lion-killed bighorn sheep is verified, and the site evaluation indicates that individual mountain lion is responsible, it will be removed by lethal means, under the provisions of the CFGC § 4801.

Circumstances may interfere with an effective kill-site investigation. Therefore, if analysis of mountain lion movements (by radio-telemetry, track studies of collared and un-collared animals, or by visual observation) reveals reasonable evidence of a bighorn sheep kill-site within known bighorn sheep range, the CDFG may take a suspected lion under the provisions of the CFGC § 4801.

### 4.14.3 Removal of other predators

Federal, state, and local agencies should also remove other predators that may be contributing to excessive levels of mortality in this population.

**Rationale:** Predation by coyotes (*Canis latrans*), feral (or free-ranging) domestic dogs (*Canis familiaris*), and/or bobcats (*Lynx rufus*) may also impact the viability of the San Gabriel bighorn sheep population. Free-ranging dogs have been observed frequently in the Middle Fork of Lytle Creek, San Sevaine Flats, Mt. Baldy Village, and nearby foothill communities. CDFG determined an adult female bighorn sheep was killed in Mt. Baldy Village by free-ranging dogs in December 2002. Local ordinances prohibit domestic dogs that are left unattended and/or running at large (San Bernardino County Ordinance 2100, Sec. 32.0108, Los Angeles County Code, Title 10). CDFG and the Forest Service have additional regulations that restrict free-ranging dogs and forbid harassment of wildlife by domestic dogs. (CFGC §3950-3961, Code of Federal Regulations § 30.11, Title 50) that should be strictly enforced to prevent predation and harassment of bighorn sheep.

An expanded version of the guidelines specified under Sections 4.14.1 through 4.14.3 are included by reference in this strategy (California Department of Fish and Game 2003).

**Humane euthanasia**

According to the American Veterinary Medical Association (AVMA), "...euthanasia is the act of inducing humane death in an animal." (AVMA, 2001). If CDFG determines that a predator must be removed, humane methods will be utilized in the field as determined by AVMA guidelines, and in accordance with CFGC § 4809. Additionally, necropsies will be completed on all predators removed from the San Gabriel Mountains during implementation of this strategy.

### 4.15 Project Management

### 4.15.1 Project Management

CDFG, the Forest Service, and Commission should maintain the interagency team and meet at regularly scheduled intervals to coordinate activities, discuss issues, concerns, and opportunities, and plan future activities.

### 4.15.2 Public Education

CDFG and the Forest Service should implement a public education program describing the status of the population and actions that may be implemented to restore the population. This may include periodic reports, news articles, website, and information signs.

**Rationale:** The San Gabriel Mountains bighorn sheep population is adjacent to the largest metropolitan area in California. This offers a unique opportunity to educate a large number of people. Additionally, a broad level of public support may be needed to obtain the support and funding necessary to achieve the population management goal.

# SECTION 5. ESTIMATED COST AND IMPLEMENTATION SCHEDULE

This section describes the estimated cost and schedule for the five-year strategy. The estimated cost and schedule are based on the actions identified in Section 4 and assumes a start date of 2004. The estimated cost does not include funding for actions that are based on evaluations and may or may not be implemented in the future. Because of the current status of the San Gabriel Mountains bighorn sheep population and agency staffing levels, the estimated cost and implementation schedule assumes work will be contracted to increase the probability that it is are completed as scheduled.

## ESTIMATED COST

An annual inflation rate of 3% was added to years 2 through 5. The total estimated cost is $ 3,889,176.00 (Table 5-1). It is assumed that funding would be required from sources outside of the traditional federal or state appropriation process for the participating agencies.

## IMPLEMENTATION SCHEDULE

The schedule is described in Figure 5-1.

**Table 5-1. Estimated budget to implement the San Gabriel Mountains bighorn sheep restoration strategy.**

| | | Year | | | | | |
|---|---|---|---|---|---|---|---|
| | Responsible | One | Two | Three | Four | Five | Total |
| Task | Agency | | | | | | |
| 4.3 Survey the Population | | | | | | | |
| 4.3.1 Conduct annual March survey | DFG | 16,049 | 30,548 | 16,225 | 16,887 | 17,260 | 96,969 |
| 4.3.2 Monitor radio-collared sheep | DFG | 170,819 | 176,273 | 171,474 | 180,820 | 179,276 | 878,662 |
| 4.7 Restore and maintain habitat | | | | | | | |
| 4.7.1 Implement Habitat Restoration | | | | | | | |
| | ANF | 0 | 86,000 | 160,000 | 270,000 | 208,000 | 724,000 |
| | SBNF | 32,000 | 32,960 | 33,949 | 33,967 | 36,000 | 168,876 |
| 4.7.2 Implement winter-spring | | | | | | | |
| range projects after five years | | | | | | | |
| | ANF | | | | | 122,000 | 122,000 |
| | SBNF | | | | | TBD | |
| 4.7.3. Evaluate availability of mineral licks | | | | | | | |
| | ANF | | 11,000 | 12,500 | | | 23,500 |
| | SBNF | | 11,000 | 11,000 | | | 22,000 |
| 4.7.4. Evaluate need for summer range projects | | | | | | | |
| | ANF | | | 16,000 | | | 16,000 |
| | SBNF | | | 16,000 | | | 16,000 |
| 4.9 Discourage cross-country travel in sheep habitat | | | | | | | |
| 4.9.1 Evaluate effects of recreation on bighorn sheep | | | | | | | |
| | ANF | | 13,500 | 14,000 | | | 27,500 |
| | SBNF | | 4,422 | | | | 4,422 |
| 4.9.2 Minimize recreation disturbance on bighorn sheep | | | | | | | |
| | ANF | 1,500 | 1,500 | 1,900 | 2,100 | 2,300 | 9,300 |
| | SBNF | 10,582 | 15,322 | 11,227 | 11,563 | 11,910 | 60,604 |
| 4.10 Prohibit new roads and trails within 100 m | | | | | | | |
| of mineral licks | | | | | | | |
| | ANF | | | | | TBD | |
| | SBNF | | | | | TBD | |
| 4.10.1. Evaluate disturbance at | | | | | | | |
| Mount San Antonio/Dawson Peak mineral lick | | | | | | | |
| | ANF | | | 10,000 | | | 10,000 |
| 4.11 Mitigate impacts from commercial operators | | | | | | | |
| and transportation projects | | | | | | | |
| | ANF | | 36,000 | | | | 36,000 |
| 4.12 Approve all necessary activities in Wilderness | | | | | | | |
| | ANF | 30,500 | | | | | 30,500 |
| | SBNF | 35,000 | | | | | 35,000 |
| 4.14 Implement Predator Management | | | | | | | |
| 4.14.2 Mountain lion removal | DFG | 213,452 | 210,453 | 230,989 | 225,212 | 201,765 | 1,081,871 |
| 4.14.2 Coordinate with County Animal Control | | | | | | | |
| | DFG | 3,265 | 600 | 700 | 700 | 700 | 5,965 |
| | ANF | 1,250 | 2,000 | 2,500 | 3,000 | 12,000 | 20,750 |
| | SBNF | 8,625 | 8,885 | 91,901 | 9,425 | 9,710 | 128,546 |
| 4.15 Project Management | | | | | | | |
| 4.15.1 Interagency coordination | | | | | | | |
| | DFG | 12,000 | 12,100 | 12,250 | 12,400 | 12,600 | 61,350 |
| | ANF | 6,500 | 7,500 | 8,500 | 9,500 | 3,000 | 35,000 |
| | SBNF | 16,455 | 13,150 | 17,455 | 17,980 | 10,221 | 75,261 |
| | Commission | 25,000 | 26,000 | 27,000 | 28,000 | 29,000 | 135,000 |
| 4.15.2.Public education | | | | | | | |
| | DFG | 1,200 | 1,300 | 1,400 | 1,500 | 1,600 | 7,000 |
| | ANF | 0 | 15,000 | 1,200 | 1,200 | 22,500 | 39,900 |
| | SBNF | 0 | 15,000 | 1,200 | 0 | 1,000 | 17,200 |
| | | | | | | | |
| | | | | | | | |
| Total | | 584,197 | 730,513 | 869,370 | 824,254 | 880,842 | |
| Grand Total | | | | | | | $3,889,176 |

**Figure 5-1. Schedule to implement the San Gabriel Mountains Bighorn Sheep Implementation Strategy.**

| | Year | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | One | | | | Two | | | | Three | | | | Four | | | | Five | | | |
| | Quarter | | | | Quarter | | | | Quarter | | | | Quarter | | | | Quarter | | | |
| **Task** | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| **4.3 Survey the Population** | | | | | | | | | | | | | | | | | | | | |
| **4.3.1 Conduct annual March survey** | | | | | | | | | | | | | | | | | | | | |
| Plan & compliance | | | | | | | | | | | | | | | | | | | | |
| Implement | | | | | | | | | | | | | | | | | | | | |
| **4.3.2 Monitor radio-collared sheep** | | | | | | | | | | | | | | | | | | | | |
| Plan & compliance | | | | | | | | | | | | | | | | | | | | |
| Implement | | | | | | | | | | | | | | | | | | | | |
| **4.7 Restore and Maintain Habitat Suitability** | | | | | | | | | | | | | | | | | | | | |
| **4.7.1. Implement prescribed burns on winter-spring ranges** | | | | | | | | | | | | | | | | | | | | |
| ANF prescribed burns | | | | | | | | | | | | | | | | | | | | |
| Plan & compliance | | | | | | | | | | | | | | | | | | | | |
| Implement | | | | | | | | | | | | | | | | | | | | |
| **4.7.2 Implement winter-spring range projects after year five** | | | | | | | | | | | | | | | | | | | | |
| Plan and compliance | | | | | | | | | | | | | | | | | | | | |
| Implement | | | | | | | | | | | | | | | | | TBD | | | |
| **4.7.3. Evaluate availability of mineral licks** | | | | | | | | | | | | | | | | | | | | |
| Plan and compliance | | | | | | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Implement | | | | | | | | | | | | | | | | | | | | |
| **4.7.4 Evaluate the need for habitat restoration projects on summer ranges** | | | | | | | | | | | | | | | | | | | | |
| Plan and compliance | | | | | | | | | | | | | | | | | | | | |
| Implement | | | | | | | | | | | | | | | | | | | | TBD |
| **4.9 Discourage cross-country travel in sheep habitat** | | | | | | | | | | | | | | | | | | | | |
| **4.9.1 Evaluate the effects of recreation on bighorn sheep** | | | | | | | | | | | | | | | | | | | | |
| Plan and compliance | | | | | | | | | | | | | | | | | | | | |
| Implement | | | | | | | | | | | | | | | | | | | | |
| **4.9.2 Minimize recreation disturbance on bighorn sheep** | | | | | | | | | | | | | | | | | | | | |
| Plan and compliance | | | | | | | | | | | | | | | | | | | | |
| Implement | | | | | | | | | | | | | | | | | | | | |
| **4.10 Prohibit new roads and trails within 100 m of mineral licks** | | | | | | | | | | | | | | | | | | | | TBD |
| **4.10.1 Evaluate disturbance at Mount San Antonio/Dawson Peak mineral lick** | | | | | | | | | | | | | | | | | | | | |
| Plan and compliance | | | | | | | | | | | | | | | | | | | | |
| Implement | | | | | | | | | | | | | | | | | | | | |
| **4.11 Mitigate impacts from commercial operators and transportation projects** | | | | | | | | | | | | | | | | | | | | |
| Plan & compliance | | | | | | | | | | | | | | | | | | | | |
| **4.12 Approve all necessary activities in Wilderness** | | | | | | | | | | | | | | | | | | | | |

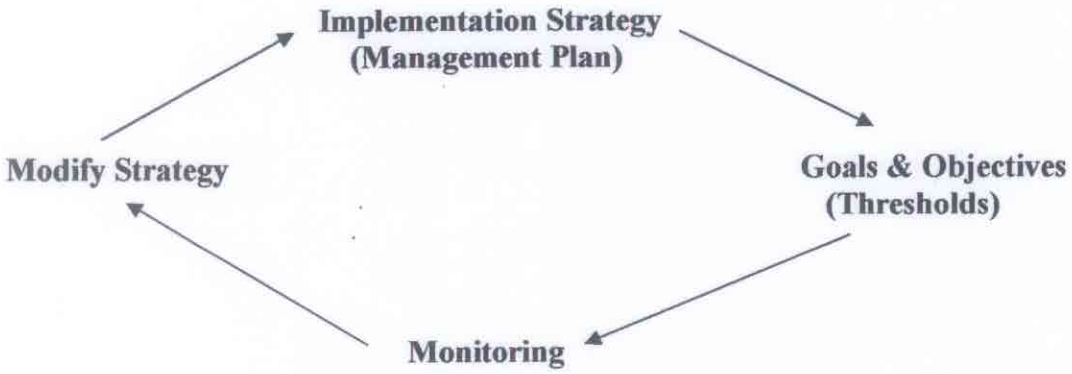
| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Plan and compliance | | | | | | | | | | | | | | | | | | | |
| **4.14 Implement Predator Management** | | | | | | | | | | | | | | | | | | | |
| **4.14.1 Capture and monitor lions** | | | | | | | | | | | | | | | | | | | |
| Plan & compliance | | | | | | | | | | | | | | | | | | | |
| Implement | | | | | | | | | | | | | | | | | | | |
| **4.14.2 Coordinate with County Animal Control** | | | | | | | | | | | | | | | | | | | |
| Plan & compliance | | | | | | | | | | | | | | | | | | | |
| Implement | | | | | | | | | | | | | | | | | | | |
| **4.15 Project Management** | | | | | | | | | | | | | | | | | | | |
| **4.15.1** Interagency coordination | | | | | | | | | | | | | | | | | | | |
| **14.15.2** Public education and coordination | | | | | | | | | | | | | | | | | | | |

# SECTION 6. MONITORING AND RESEARCH

This section describes the monitoring framework and process for identifying future research projects necessary to implement this strategy.

## MONITORING

Monitoring is a management tool used to determine if the strategy is being implemented (implementation monitoring) or to determine if the management actions are achieving their goals (effectiveness monitoring). In this strategy, monitoring is not used strictly to obtain new scientific information. Monitoring is used by managers as a feedback mechanism to evaluate the success of their actions and provide information necessary to modify those actions in the future (= adaptive management). The role of monitoring is summarized in the adaptive management strategy, below.




Monitoring will also be used to asses the likelihood that the implementation strategy will meet the population goals. This may be used in the future by U. S. Fish and Wildlife Service to assess the certainty that the strategy is being implemented and effective. This is now required when they evaluate petitions to list species under the federal Endangered Species Act (FR 68[60]:15100-15115).

### Implementation Monitoring

Implementation monitoring should be used to determine if the actions identified in Section 4 are implemented based on the estimated cost and schedule described in Section 5. Implementation monitoring will provide an index of certainty that the actions described are achieved.

An annual action plan should be jointly developed by CDFG and Forest Service to identify how and when actions will be implemented. All deviations from this implementation strategy will be identified in the action plan. At the end of the year an accomplishment plan should be jointly prepared briefly describing all actions that were and were not accomplished and explanations of why planned activities were modified or

not completed. At a minimum, the annual action plan and accomplishment plan should identify the individual action item, funding provided by agencies and other sources, the date completed, and necessary explanations. The annual action plan and accomplishment report should be submitted to the CDFG Regional Managers, Forest Supervisors, and Commission. Those individuals or organization may meet with members of the implementation team to determine if additional actions are necessary.

### Effectiveness Monitoring

Effectiveness monitoring should be used to measure success of each action as they are implemented. Effectiveness monitoring will be used to determine if any of the standards or thresholds in the implementation strategy should be modified (e.g. treat 40% of a winter-spring range) or when an action may no longer be necessary (e.g. mountain lion management). All effectiveness monitoring should rely on existing data as much as possible (e.g. previous studies, results of the annual population survey, locations of radio-collared animals, weather data, fire statistics) to ensure monitoring is integrated and to reduce costs.

Initially, effectiveness monitoring would rely on the annual survey and location and movement information from radio-collared animals. As additional actions are implemented, monitoring efforts should be reviewed and new monitoring plans prepared. This will change the resolution of information available and provide more specific data (e.g., age-specific mortality rates, relationships between subgroups of sheep, habitat requirements). It is recognized that some cause-and-effect evaluations may require multiple years of monitoring before valid conclusions are reached. Recommendations to change standards, thresholds, or procedures in the implementation strategy will be based on effectiveness monitoring. The results of all effectiveness monitoring will be reported in the accomplishment report submitted to CDFG Regional Managers, Forest Supervisors, and Commission.

### Stakeholder Participation

The stakeholders provided valuable information and support during development of the draft restoration strategy and expressed a strong interest in maintaining their involvement during implementation of the strategy. The stakeholders will receive regular progress reports and provide input on the implementation monitoring. The stakeholders will meet at least twice annually to discuss issues with the agency representatives.

## RESEARCH

Research will focus on addressing questions and hypotheses that are necessary to manage the San Gabriel Mountains bighorn sheep population. Some research has been included in the five-year implementation strategy (e.g. evaluating the disturbance of recreation at the mineral lick on Mount San Antonio/Dawson) and evaluating movement

of radio-collared bighorn sheep and mountain lions. Additional research may be needed to address questions such as:

- genetic descriptions of subgroups within the population,
- genetic relationship to other groups of bighorn sheep,
- extent of summer ranges,
- movement corridors between summer and winter ranges,
- diet composition and nutritional differences between winter-spring and summer ranges,
- relationships between bighorn sheep, mule deer, and mountain lions,
- distribution and abundance of mountain lions in and adjacent to the San Gabriel Mountains, and
- response of bighorn sheep to different types and intensities of recreation.

The current budget estimate does not include funding for these research topics because the focus of this implementation strategy is to use the available resources to increase the size of the bighorn sheep population. Until the population has increased, most research efforts will be subordinate to actions designed to benefit the bighorn sheep population. Additional funding may be requested if monitoring data indicates a threshold or standard should be modified and research is necessary to assist in making the decision to modify that threshold or standard. The implementation strategy does not affect academic institutions that may conduct research using their own funding mechanisms.

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