ORIGINAL

CONSERVATION PLAN for the Etiwanda-Day Canyon Drainage System Supporting the Rare Natural Community of Alluvial Fan Sage Scrub

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Prepared by:
Joan M. Safford, Department of Landscape Architecture
and
Ronald Quinn, Ph.D., Department of Biological Sciences

With:
Graduate Assistants:
Anne Dove, Eileen Takata Schueman, Department of Landscape Architecture
Michael Brennan, Department of Biological Sciences

California State Polytechnic University. Pomona
3801 W. Temple Avenue, Pomona, California 91768

Prepared for:
Mary Meyer, Plant Ecologist
Department of Fish and Game, Region 5
330 Golden Shore, Suite 50
Long Beach, California 90802

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SECTION I: Introduction

Alluvial Fan Sage Scrub (AFSS), a distinctive and rare natural community, originally occurred across the alluvial fans and washes of the coastal side of the Transverse and Peninsular ranges of southern California. As agriculture followed by urban development swept across the valley floors, only pieces and fragments of this community of plants and animals now remain.

This report has been prepared through a collaborative effort between the California Department of Fish and Game, the United States Fish and Wildlife Service and the Departments of Landscape Architecture and Biological Sciences at the California State Polytechnic University Pomona as part of a larger effort to study and map remaining sites that have intact AFSS communities. A unique association of plants and animals, AFSS occurs where episodic flooding and erosion from adjacent mountain watersheds have shaped the landscape over thousands of years. The AFSS community is declining due to urban development, sand and gravel mining, and construction of dams, debris basins and flood control channels. Flood control structures and groundwater removal to supply development are both taking away some of the key elements that may be needed for maintaining AFSS as a distinct association of plants. Because of its rarity and continued losses of habitat, the California Natural Diversity Data Base (1997) has ranked AFSS as a very threatened (S1.1) natural community.

This report is intended as a model for identifying the most critical, or key ecosystem processes that will lead to recommendations for the establishment of a viable regional preserve system for AFSS, and to assist in developing conservation and protection goals. One study site was examined in detail, the Etiwanda-Day Canyon Drainage system located in southwestern San Bernardino County. Alluvial fans and washes occur in a complex geological and hydrological setting. They are also biologically complex, and no two stands of AFSS are exactly the same. Any proposals for a regional preserve system will have to account for these differences. One way this can be accomplished is to preserve many different sites across its regional range. There are, however, broad common patterns that AFSS communities share.

Our intent is for this report to be used by land use planners, local lead agencies, land management professionals, and biologists who may not be familiar with AFSS communities or their regional importance. This report is intended to assist in identifying and conserving AFSS communities and to lead to a working knowledge of the key ecosystem processes needed to maintain or restore it where it still does occur.

We are also proposing the use of Conservation Value Indices for AFSS Habitat Patches. These indices have been developed as a way to assess the conservation value of AFSS patches in the

region, used together with other information such as the results of biological surveys and information regarding settlement patterns, unique features of the site, view analysis and other studies. These indices will be the most valuable for those who are interested in other Alluvial Fan Sage Scrub sites, or sites with similar attributes to evaluate. We propose four readily measured indices based on geographic attributes.

We drew our recommendations from specific biological sampling and analysis conducted for our study site, the Etiwanda-Day Canyon drainage system north of Rancho Cucamonga (detailed in Appendix 1) and an understanding of alluvial fan and wash systems, vegetation patterns, disturbance regimes and human settlement patterns at both the regional, local and site scale. This site provided us with a large parcel with an edge touching an intact wildland area of chaparral managed by the United States Forest Service (USFS). The area has been intensively studied by a number of different agencies and individuals, so there was an abundance of information readily available. The site is typical of the region, having both a documented stand of AFSS but also its own unique features; it is also fragmented in a typical way, with power lines, roads, adjacent suburban development, flood control structures, water company withdrawals, high human caused fire risk, agricultural history, and ongoing recreation and grazing activities.

SECTION II: What is an Alluvial Fan?

"...at canyon mouths are fan shaped piles of rocks and gravel that have been carried by runoff from the mountains. These are known as alluvial fans. The alluvial fans spread out at their lower borders, and the edges of alluvial fans overlap. This part of a slope, where alluvial fans coalesce is known as the bajada, which is a Spanish word that means 'lower.' It refers to the lower aspect of the long slope that begins high up on the mountain bordering each valley. Particle size becomes smaller toward the center of the valley."

(Schoenherr, 1992, pages 426-427)

INTRODUCTION

The long, sweeping slopes that fall away from the Transverse Ranges above the Los Angeles basin are a series of overlapping alluvial fans and associated floodplains (see figure 1, below and figure 2, page 4). In fact, much of the Los Angeles basin was ringed with alluvial fans, formed from the runoff of the rivers originating in the San Gabriel, San Bernardino and Santa Ana Mountains. Fertile valley bottoms formed where fans met between opposing mountain ranges and hills. When the flooding rivers reached the ocean, they deposited rock, sand and silt deep enough and far enough to create the Los Angeles basin that we see today.

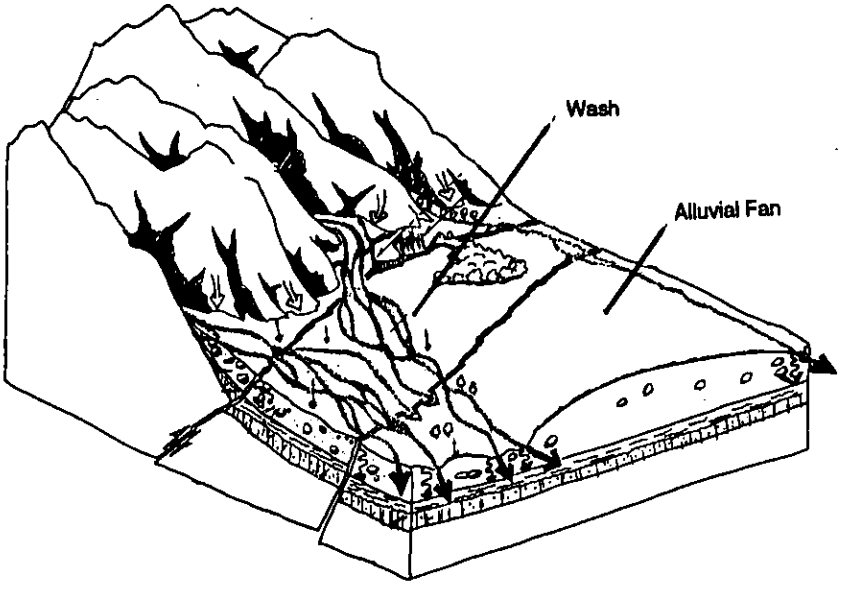


Figure 1

Block diagram - mountains and alluvial fan

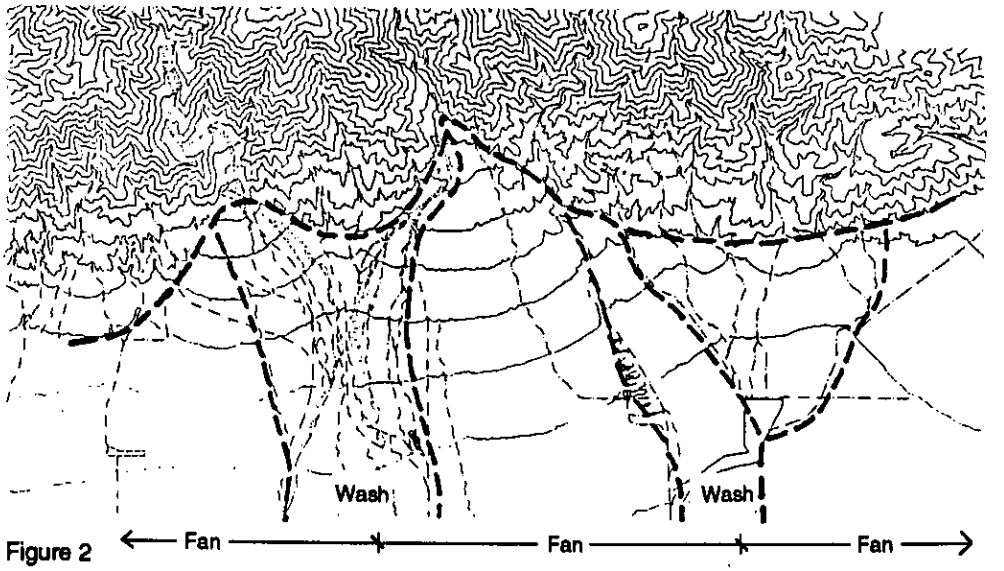


Figure 2

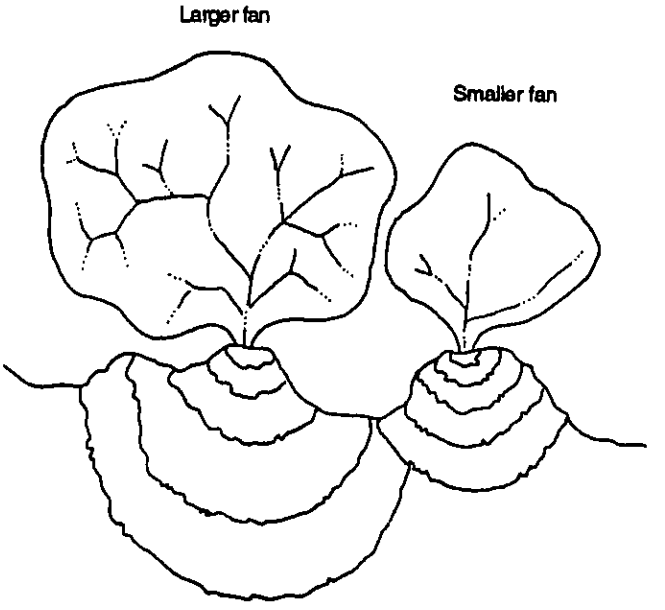
Mountain and alluvial fan topography

(Source: USGS Cucamonga Peak and Devore quadrangles, 1988)

Alluvial fans in arid and semi-arid climates have unique communities of plants and animals. Alluvial Fan Sage Scrub (AFSS) occurs where the episodic flooding and erosion from adjacent mountain watersheds have shaped the landscape in this way. Vegetation patterns are a direct response to the disturbance of these flood cycles, along with periodic fires. Human settlement patterns were also a response to these cycles until flood water diversions began to be put in place for agriculture and urban development.

GEOMORPHOLOGY OF ALLUVIAL FANS AND WASHES

Alluvial fans form over tens of thousands of years. Water transports sediment out of mountains and canyons and deposits these sediments on the valley floor. The water slows down as it leaves the steeper slopes of the mountains (Skinner, 1987). The fan-shaped structures that form as a result of the buildup of sediments are called alluvial fans. They are a combination of a cone and a semi-circular fan from an aerial perspective (Rachocki, 1981). At the edges, between each fan unit are the river washes, where periodic flooding occurs. The size of a fan is determined by the size of its supporting watershed (Skinner, 1987): since larger watersheds generally result in an overall greater volume of runoff, the amount of sediment transported through the larger system is also greater. Consequently, alluvial fans found at the bases of large watersheds can generally be expected to be larger than fans at the bases of smaller watersheds, as shown in figure 3 on the following page.

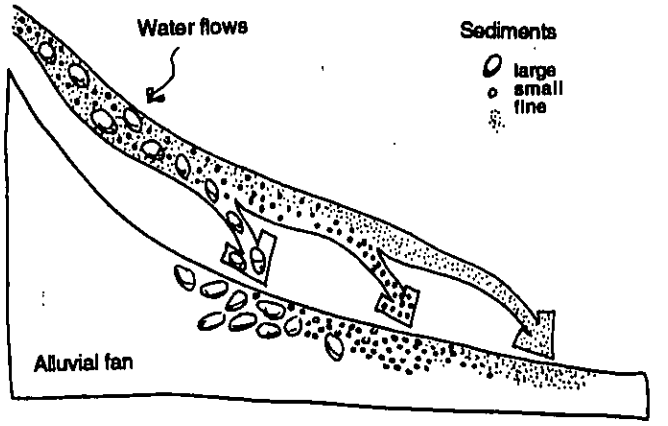


(Source: Skinner, 1987)

Figure 3

Fan size

As the water slows down as it leaves the mountains and moves across the fan or in a wash, its ability to transport sediment is reduced. Larger particles such as boulders and larger rocks are deposited first, closest to point where the water leaves the mountains. As the water moves further away from the mouth of the canyon or across the fan, the water velocity continues to decrease as does its ability to carry these larger particles (figure 4). Thus the areas furthest away from the mountains or hills have the finest grained sediment. As the result of this pattern of sedimentation, the narrowest part of the fan, which occurs at the outflow from the canyon or valley, has the deepest, coarsest buildup of alluvium while the shallowest, finest deposits spread out at the toe of the fan, furthest away from the mountains.



(Source: Rachocki, 1981)

Figure 4

Sediment deposition and particle size

In arid and semi-arid regions such as the Los Angeles basin, most of this sedimentation occurs in response to short, high volume periods of precipitation that are characteristic of a Mediterranean-type climate. As the sediment is deposited with each of these intense storms, these layers will eventually build into the shape of a fan over a long period of time. In the absence of deposition or disturbance from flooding, soil will develop (Rachocki, 1981).

The Transverse Ranges are made up of an active, complex tectonic system composed of the San Andreas fault and associated faults, which control most of the region's topography (Muns, 1987). Movement along these faults build the mountains higher. The continuous uplift and subsequent erosion provide an abundant source of sediment to build alluvial fans (Wood and Wells, 1997).

Water Laid Deposition and Mass Flow Deposition

Two types of deposition can occur in an alluvial system, water-laid and mass flow. Water-laid sediment occurs when runoff and small streams shift across the fan, cutting channels through it. It tends to be better sorted by size in response to the velocity and volume of water flowing through the system. Mass flow occurs as a matrix of sediment, more like mud than like water, forming what is called a debris flow.

Water laid drainage patterns can shift dramatically, cutting new channels within a relatively short amount of time (Wood and Wells, 1996). Sometimes streams can disappear from the fan surface and re-emerge at the surface further down the slope. Where the drainage patterns have shifted and braided, a series of diamond-shaped bars can develop, as shown in figure 5, below. As water continues to flow and shift across the fan, new channels, terraces and braid bars continue to form. The rapid flow of water across the surface (sheet flow) can create numerous small ridges on fans and in washes, giving them a washboard appearance, as shown in figure 6, page 7. The washboarding increases microclimates and topographic diversity at a small scale, influencing what plants will be able to grow there.

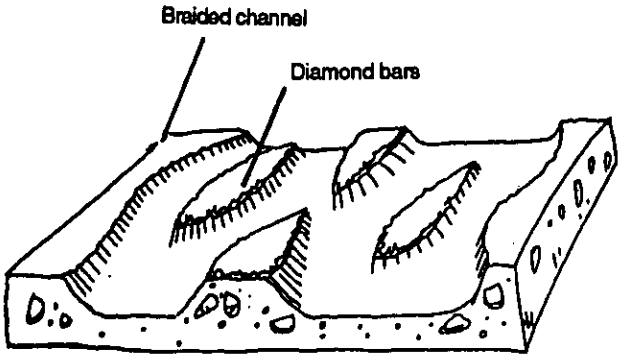


Figure 5 (Source: Rachocki, 1981)

Stream braiding

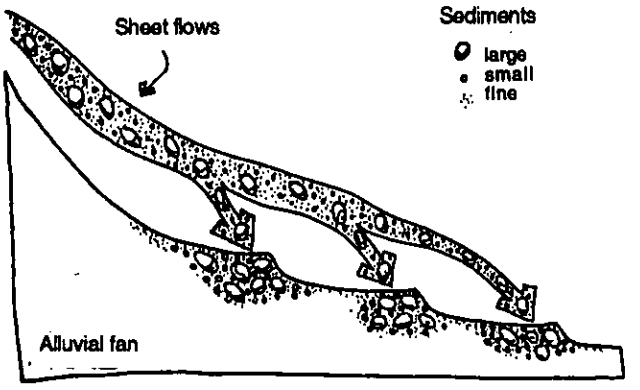


Figure 6 (Source: Rachocki, 1981)

Sheet flows and washboard appearance

While channels and terraces are created from water-laid erosion and deposition, other characteristic features develop in response to mass flow. Most of the sediment associated with mass flow has accumulated in channels during dry periods or following fires (Wood and Wells, 1997). Water picks up this sediment as it moves downstream. When there is enough accumulated sediment to form a thick mud containing more sediment than water, a debris flow is formed. Sediments deposited by mass flow tend to be less sorted, and occur as a mixture of fine and coarse sediment together. Where the mass flow builds up toward the bottom, or toe of the fan, a terrace is formed. Some of these terraces are very old, sometimes hundreds of years old. See figure 7, next page.

Stage 1: One alluvial fill

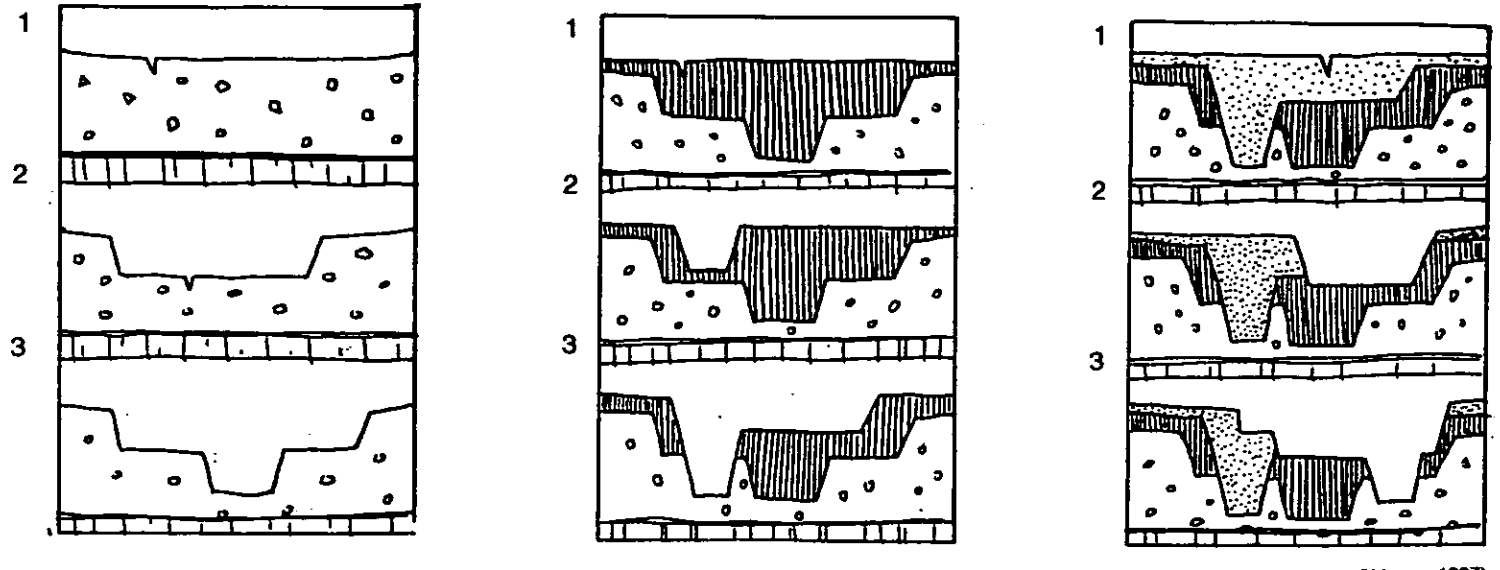
1. fill deposited, new stream course
2. channel after first season
3. terraces after second season

Stage 2: Two alluvial fills

1. second fill deposited, new stream course
2. channel after first season
3. channel deepens, revealing original fill

Stage 3: Three alluvial fills

1. third fill deposited, new stream course
2. channel after first season
3. channel deepens, revealing previous two fill



(Source: Skinner, 1987)

Figure 7

Creation of channels and terraces from erosion and deposition

WHAT IS ALLUVIAL FAN SAGE SCRUB?

"Alluvial scrub [AFSS] is an open vegetation adapted to the harsh conditions of the outwash environment. It grows on sandy, rocky alluvia deposited by streams that experience infrequent episodes of severe flooding. This vegetation dominates major outwash fans at the mouths of canyons along the coastal side of the San Gabriel, San Bernardino, and San Jacinto Mountains and lesser floodplain and riverine locations of southern California. Some alluvial scrub species occur also in sandy washes of coastal southern California apart from alluvial fans and large rivers.

Alluvial scrub is composed of an assortment of drought-deciduous subshrubs and large evergreen woody shrubs that are adapted to the porous, low fertility substrate as well as to survival of intense, periodic flooding and erosion."

(*Alluvial Scrub Vegetation in Coastal Southern California*, Ted L. Hanes, Richard D. Friesen, and Kathy Keane, 1988, page 187)

Alluvial Fan Sage Scrub (AFSS) is a distinctive type of shrubland that is found principally on the alluvial fans on the cismontane (coastal) sides of the Transverse and Peninsular Ranges of southern California (Barbour and Wirka, 1997). AFSS is a subtype of the more widely known Coastal Sage Scrub, which is distinguished from the chaparral community by a number of geographic, structural, physiological and taxonomic features (Axelrod, 1978). AFSS is sometimes also called Riversidean AFSS. Westman (1981) made a case for using geographic subdivisions to explain various types of Coastal Sage Scrub communities. The three southern geographic communities are Riversidean (Kirkpatrick and Hutchison, 1977), Venturan and Diegan (Axelrod, 1978). Riversidean represents the more inland group. The physical factors as outlined by Westman that contribute to the differences include soil, topography, climate, and structural and disturbance variables. In general, the communities vary along a gradient of drier in the south as compared to the north, and drier moving inland from the coast.

AFSS differs from Coastal Sage Scrub in specific ways, as outlined below, and generally grows slightly lower in elevation than chaparral. However, part of what makes AFSS distinctive is that plants from both Coastal Sage Scrub and chaparral are found together in response to the complex microclimates, topography and moisture availability regimes that exist on alluvial fans and in washes. AFSS is part of a complex mosaic of plant communities that includes riparian and dry wash adapted species as well.

Coastal Sage Scrub is generally restricted to sites below 1000 meters in elevation. A large number of Coastal Sage Scrub species are summer deciduous and drought adapted, with relatively shallow root systems that take advantage of any available surface moisture (Schoenherr, 1992). The shrubs are low, below 1.5 meters in height. As a plant community, it is more open (and easier to walk through) than chaparral (Keeley and Keeley, 1986). Chaparral plants by comparison are mostly evergreen shrubs that take advantage of moisture at greater depths within the substrate, and

can form what is accurately described by Schoenherr as "an impenetrable thicket of tangled branches" (1992, p. 340). In southern California, chaparral communities are generally more widely distributed than the more limited Coastal Sage Scrub.

Alluvial Scrub is sometimes used as a shorthand term of Alluvial Fan Sage Scrub. In her study of the San Gabriel River, R.L. Smith (1980) coined the term "alluvial scrub" and identified three seral stages of pioneer, intermediate and mature vegetation. The pioneer stage occurred in the most active portion of the wash, with intermediate and mature stages occurring at a greater distance and elevation relative to the floodway. Smith considered mature Alluvial Scrub to be between 35 and 50 years old.

The term Riversidean Alluvial Fan Sage Scrub was used to describe the coastal southern California plant community in Holland's *Preliminary Descriptions of the Terrestrial Natural Communities of California* (Department of Fish and Game, 1986). However, Holland indicated that both Riversidean Alluvial Fan Sage Scrub and Alluvial Fan chaparral needed additional descriptive work.

Hanes, Friesen and Keane (1989) greatly expanded our understanding of alluvial scrub by examining this community across ten sites in Los Angeles, San Bernardino and Riverside counties. In their article, *Alluvial Scrub Vegetation in Coastal Southern California*, they outlined how this community differs from Coastal Sage Scrub:

"Specifically:

- *Alluvial scrub has more mesic [wetter] species than most Coastal Sage Scrub stands;*
- *Alluvial scrub consists of numerous evergreen shrubs, a diverse assemblage of subshrubs, and a springtime ground cover of annual wildflowers, whereas Coastal Sage Scrub vegetation is composed primarily of drought-deciduous subshrubs with sparse, if any, annual wildflowers;*
- *Scalebroom (Lepidospartum squamatum), a shrub with high fidelity to alluvial substrates, is found throughout alluvial scrub communities, but seldom in Coastal Sage Scrub vegetation;*
- *Species commonly found in chaparral or desert plant assemblages, such as spiny redberry (Rhamnus crocea), lemonadeberry (Rhus integrifolia) , sugarbush (Rhus ovata), birch-leaf mountain mahogany (Cercocarpus betuloides), holly-leafed cherry (Prunus ilicifolia), California juniper (Juniperus californica), and Whipple's yucca (Yucca whipplei) are also common in the alluvial scrub community, but not Coastal Sage Scrub vegetation; and*
- *Small-statured riparian woodland species such as California sycamore (Platanus racemosa) and mulefat (Baccharis salicifolia) are laced through alluvial scrub stands along major drainages, but are not present in stands of Coastal Sage Scrub.*

The plant associations across the fans and washes are found in locations consistent with their physical needs and adaptive capabilities. In and along washes the well adapted scalebroom will be found. If water tables are high enough, riparian plants such as California sycamore will get a foothold. Common Coastal Sage Scrub plants such as California sagebrush (Artemesia californica), California buckwheat (Eriogonum fasciculatum) and poison oak (Toxicodendron diversilobum) will also be present; they will also be found along the small watercourses and stream channels that develop on the fans between the larger washes. Coastal Sage Scrub species adapted to drier conditions also occur on the alluvial fans and terraces. Chaparral plants such as Ceanothus sp., Adenostoma sp. and Rhamnus sp. will be found where there is an opportunity to take advantage of deeper moisture. Where water comes to the surface on the fan itself from a fault or small spring, a true cienega or small wetland may form."
(Hanes, Friesen and Keane, 1989. Page 187)

In the early 1990's, the Department of Fish and Game initiated a project aimed at better understanding the AFSS community through a quantitative, floristically based sampling program and mapping effort. Barbour and Wirka (1997) analyzed the results of 106 samples of alluvial scrub from 18 drainages in Los Angeles, Riverside and San Bernardino Counties using several classification programs. These programs group samples based upon similarities and differences in species composition and environmental variables. This analysis identified six "groupings" that represent distinctive plant associations that comprise AFSS. The environmental factors that was most highly correlated with differences in these groups were their geographic location, followed by percent cover of litter and percent cover of sand. The six groupings include the following:

Etiwanda alluvial fan group- a white sage-dominated upland group that occurs on the fan outside the active floodways;

Prickly group- this group includes a species-rich association with high cover of scalebroom and California buckwheat, as well as high cover of species such as yerba santa *(Eriodictyon sp.),* California juniper, matchweed *(Gutierrezia sp.), Croton sp.,* prickly pear/cholla cactus *(Opuntia sp.)* and yucca. This group typically included stands often typed as intermediate or mature alluvial scrub, outside the western Riverside County area.

Riverside group- this represents a distinctive geographic grouping of stands that are very open, with very low cover of California buckwheat and scalebroom, and a particularly high diversity of annual plants.

Pioneer group- this grouping supports previous findings that the "pioneer" stage of alluvial scrub near active floodways consists of an association of California buckwheat and scalebroom.

Alluvial chaparral group- the sampled stands are characterized by very dense, chaparral-like shrub cover dominated by chamise *(Adenostoma fasciculatum),* white sage *(Salvia apiana)*

apiana) and California sagebrush. Additional sampling of Alluvial chaparral-type stands is needed, as stands dominated by other combinations of chaparral species have been observed.

Riparian group- this group is distinguished from the pioneer group by having a higher species diversity, the presence of riparian tree species, and relatively low cover of scalebroom. This group is not as clearly defined as the others, any may not actually represent a true vegetation type.

NATURAL DISTURBANCE PATTERNS

The principal natural disturbances which affect AFSS are fires and floods. These types of Mediterranean shrublands are subject to fire regimes worldwide (Axelrod, 1978) and AFSS is not unique in this respect. AFSS typically adjoins chaparral at the higher elevations and coastal sage scrub, agricultural lands or urbanization at the lower elevations. Fires in the adjacent chaparral areas are both larger and more frequent then fires in Coastal Sage Scrub.

Many areas occupied by AFSS are also subject to periodic flooding (Smith, 1980). Such areas will typically include intermittent streams, flood channels and the lower alluvial terraces which immediately surround these features. The combination of complex, varied substrates ranging from silts to sand, cobble, rock and boulder, contribute to a complex vegetative structure and array of niches utilized by wildlife species. Flood prone areas will often be dominated by scalebroom, California buckwheat and California sagebrush (Hanes, Friesen and Keane, 1989). The increased water availability in the vicinity of these AFSS areas may allow for the presence of such tree species as California sycamore in addition to the previously mentioned chaparral species. The alluvial fans on which AFSS occurs may contain numerous corridors of riparian (associated with streams) vegetation where such species as California sycamore, mulefat, cottonwood *(Populus fremontii)* coast live oak *(Quercus agrifolia)* and poison oak may be found.

It is important to recognize that the present day changes in the combined disturbance regimes of fire and flooding coupled with wetter or drier soil conditions (from flood control structures and water harvesting) may be influencing the species composition of AFSS associations. Changes in soil moisture levels resulting from upstream flood control diversions and water removal from wells and their subsequent influence on AFSS communities have not been quantified through scientific studies. Diversions that impound water in one place may increase nearby soil moisture levels, water harvesting from wells may lower these levels elsewhere on the fan, therefore changing the composition of AFSS. There is not enough information to speculate on these patterns at the present time: more study is needed.

HUMAN SETTLEMENT PATTERNS

Ecological changes over time have occurred from human settlement patterns, contributing a human dimension to the disturbance patterns in AFSS. Native Americans presumably have lived and interacted with the alluvial environment for the past few thousand years at least. Changes began when fires were set deliberately to improve grazing or clearing for agriculture. Non-native plants were introduced and naturalized over time, particularly annuals. Missions were established in the more fertile inland valleys in the late 1700s. Eventually grazing, then agriculture expanded up the slopes of the alluvial fans, followed by urban development in the 1900s, accelerating throughout the twentieth century. Roads, power lines, water diversion and water capture have caused further changes, along with continued grazing, recreation activities, and the affects of air pollution (O'Leary, 1995).

Air pollution has increased in southern California since World War II. Population growth, cheaply priced fossil fuels and the widespread availability of cars combined to encourage suburban growth, and in turn these factors have affected the growth of plants. Westman (1979) found that oxidants reduce the total cover of Coastal Sage Scrub community shrubs.

Invasion of Non-native Plant Species

The invasion of non-native plants altered the composition of many of California's plant communities. The majority of invasive plants are forbs and annual grasses from Europe that came with agricultural development in the United States. Most of these species were introduced and spread with grazing. Among the most dominant weeds are *Bromus sp., Avena sp., Brassica sp.,* and *Erodium sp.* All of these types of plants successfully compete with native Coastal Sage Scrub species, often inhibiting the recolonization process of native shrubs following disturbance. Some of them mature weeks earlier than natives, taking better advantage of seasonal moisture (O'Leary, 1995).

SECTION III The Status of Alluvial Fan Sage Scrub Today

THE REGIONAL SCALE

The sloping surface of alluvial fans is etched with large and small watercourses, both old and new. Biological complexity is the result of this topographic complexity. Periodic disturbance through flooding and fire further complicate the pattern. Therefore, the plant communities are not a consistent, heterogeneous community but rather a shifting mosaic of associations across their range with interspersed patches of Grassland, chaparral, Oak Savanna/woodland, and AFSS associations.

Human activities have greatly reduced the amount of AFSS in the Los Angeles region. The few remaining patches have been mapped (Hanes, Friesen, and Keane, 1989) and are currently being mapped with greater accuracy in the Riversidean Alluvial Fan Sage Scrub Conservation Project Phase 1 Classification, being prepared for the California Department of Fish & Game (Barbour and Wirka, 1997) shown in figure 8 on the following page.

THE ETIWANDA-DAY CANYON DRAINAGE SYSTEM STUDY SITE

The area chosen as the basis for this study is within the Etiwanda-Day (including Deer) Canyon drainage system. The Etiwanda-Day Canyon AFSS stand has been studied extensively, so a good baseline of information was available. This study site can serve as a model for developing conservation guidelines for other patches of AFSS in the region. It is larger than most of the remaining AFSS sites, with federally owned national forest with an intact chaparral community on the north and development occurring on private land to the south and west. A cienega and atypical stands of nearly pure white sage give the site a unique character. Human settlement patterns, current water capture and flood control measures are typical for the region. More specific information on the study site is covered in Section IV.

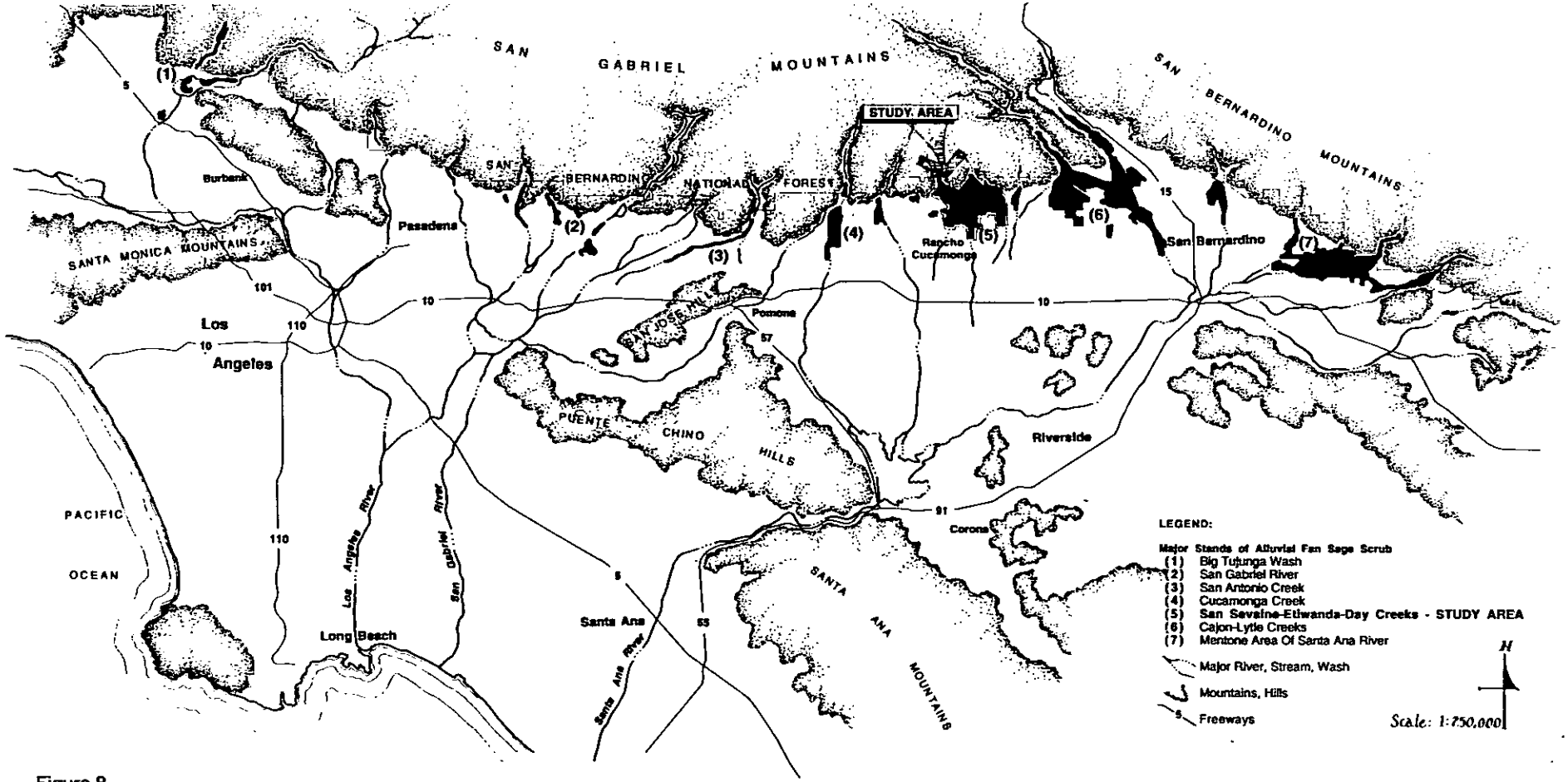


Figure 8

Preliminary regional distribution of remaining larger stands of AFSS in the Los Angeles basin and inland San Bernardino County

(Source: Barbour and Wirka, 1997)

CONSERVATION PLAN for the Etiwanda-Day Canyon Drainage System, Supporting the Rare Natural Community of ALLUVIAL FAN SAGE SCRUB

California Department of Fish & Game, US Fish & Wildlife Service, California State Polytechnic University, Pomona

SPECIES OF CONCERN

AFSS is home to a number of rare and sensitive species of plants and animals. The most notable of these species of concern is the state and federally listed endangered slender-horned spineflower *(Dodecahema leptoceras)* which generally inhabits silty openings on older alluvial terraces at the mouth of Big Tujunga Canyon in Los Angeles County, Lytle Creek and the Santa Ana Wash in San Bernardino Co. and San Jacinto Wash and Bautista Creek in Riverside County (Allen and Wells, 1996). The state and federally listed Santa Ana River woolly star *(Eriastrum densifolium ssp. sanctorum)* is endemic to sandy substrate in the Santa Ana River wash and its tributaries (CNDDB, 1997). The federally listed threatened California gnatcatcher *(Potioptila californica)* has been repeatedly sighted at the Etiwanda-Day Canyon AFSS stand (CNDDB, 1997; des Lauriers, 1997). Other confirmed recent sightings of California gnatcatcher have been made in AFSS habitat at Lytle Creek, Cajon Wash and Santa Ana River (Davis, 1997). The San Diego horned lizard *(Phrynosoma coronatum blainvillei)*, a California Species of Special Concern, occurs in the area surrounding the Etiwanda-Day Canyon study site as does the rare Plummer's mariposa lily *(Calochortus plummerae)*. It should be noted that both the San Diego horned lizard and the Plummer's mariposa lily occur in disturbed areas as well as undisturbed ones in and around the study area (des Lauriers, 1997). The Plummer's mariposa lily was abundant enough to appear on one of our sample units south of Day Canyon Station.

Additional Species of Concern:

Prepared by Mary Meyer, California Department of Fish and Game

San Bernardino Merriam's kangaroo rat (*Dipodomys merriami ssp. parvus*) was federally listed as an endangered species under an emergency rule as of January 27, 1998. It occurs in alluvial habitats in western San Bernardino and Riverside Counties, and prefers sandy areas in open stands of AFSS vegetation subjected to periodic flooding. It is estimated that only 2,000 acres of occupied habitat remains.

The rare plant Parry's spineflower (*Chorizanthe parryi* var. *parryi*) occupies older alluvial scrub habitat areas, and is locally abundant in areas such as Lytle Creek, Cajon Wash and Santa Ana River.

Nevin's barberry (*Berberis nevinii*) is a state listed endangered shrub that occurs in canyons and alluvial terraces in Los Angeles, San Bernardino, Riverside and San Diego Counties. Most occurrences have very small numbers of individuals, and reproduction in the wild is extremely rare.

Numerous avian California Species of Special Concern (CSC) occur in alluvial habitats. Examples include raptors such as Cooper's hawk *(Accipiter cooperi)*, golden eagle *(Aquila chrysaetos)*, white-tailed kite *(Elanus leucurus)*, and prairie falcon *(Falco mexicanus)*. Also included are the California horned lark *(Eremophilia alpestrisactia actia)*, loggerhead shrike *(Lanius ludovicianus)*, and Bell's sage sparrow *(Amphispiza belli belli)*. Reptile and amphibian CSC that

occur in alluvial habitats include western spadefoot *(Scaphiopus hammondi),* silvery legless lizard *(Aniella pulchra pulchra),* coastal western whiptail *(Cnemidophorus tigris multiscutatus),* coast patch-nosed snake *(Salvadora hexalepis virgultea),* San Bernardino ringneck snake *(Diadophis punctatus modestus)* and coastal rosy boa *(Lichanura trivirgata rosafusca).* A number of rare rodents are known to occur in alluvial habitats, including the northwestern San Diego pocket mouse *(Chaetodipus (=Peroganthus) fallax fallax),* southern grasshopper mouse *(Onychomys torridus),* Los Angeles little pocket mouse *(Perognathus longimemberis brevinasus)* and San Diego desert woodrat *(Neotoma lepida intermedia).* The San Diego blacktailed jackrabbit *(Lepus californicus bennettii)*(CSC) and several species of bats, occur in alluvial habitats or forage over these areas. This list is not intended to be all-inclusive- where alluvial habitats occur in proximity to other habitat types, including riparian areas and water sources, additional sensitive wildlife species may also occur.

Given the increasing threats of urbanization to the remaining AFSS stands, it is not unreasonable to expect to find that species supported by AFSS communities will become increasingly rare and endangered.

SUMMARY OF MAJOR REMAINING STANDS OF AFSS IN LOS ANGELES AND SAN BERNARDINO COUNTIES

Prepared by Mary Meyer, California Department of Fish and Game

Upper Santa Clara River drainage, Los Angeles County:

Stands of AFSS associated with the Santa Clara River and nearby tributaries have been mapped as part of the Santa Clara River Enhancement and Management Plan (RECON, 1996, preliminary report). On-the-ground sampling of AFSS was not conducted here, so floristic descriptions are lacking for most of these areas. Dominant plant species identified in the RECON report include scalebroom, big sagebrush *(Artemesia tridentata),* California buckwheat, chaparral broom *(Baccharis sarathroides)* and interior golden bush *(Ericameria linearifolia).*

SAN FRANCISQUITO AND HASKELL CANYONS 425 acres

Most of this acreage occurs along San Francisquito Canyon. A broad, sandy floodplain associated with San Francisquito was sampled by Wirka and Meyer (Barbour and Wirka, 1997), and was grouped with the Scalebroom Series, Pioneer Group. The area sampled was representative of a stand dominated by very mature scalebroom plants, many over three meters in height, located a considerable distance from the active channel. Portions of this area may represent habitat which was scoured by a 1930's dam failure. Development projects continue to expand into these areas, and it is likely a considerable portion of the habitat mapped in 1996 will be removed in the near future.

MINT CANYON QUADRANGLE 176 acres

Most of this acreage represents scattered patches of Scalebroom-dominated Pioneer phase associated with the main river channel, with some AFSS also occurring along Tick Canyon wash.

BEE CANYON AND AGUA DULCE CANYON 90 acres

Most of this acreage is associated with Bee Canyon. Quantitative sampling of Bee Canyon has not been conducted. However, considerable descriptive work has been undertaken, associated with a proposed housing development project and bridge widening (Marsh, 1991; Henrickson, 1992; Hovore and Associates, 1992). One of two remaining Los Angeles County occurrences of the state and federally endangered slender-horned spineflower occurs here.

Bee Canyon wash consists of a unique blend of AFSS species combined with Mojave desert and montane elements. Active channel areas are vegetated primarily by a Scalebroom dominated, Pioneer phase. Adjacent, rarely flooded terraces contain a very rich diversity of shrubs and forbs typical of several different plant associations representing coastal and desert influences. Coastal species such as California sagebrush and California buckwheat grow in combination with desert elements such as desert encelia *(Encelia actoni)*, desert scrub oak *(Quercus turbinella)*, California juniper, and sandpaper plant *(Petalonyx thurberi)*. More montane species such as big-berry manzanita *(Arctostaphylos glauca)* also occur here.

Several sensitive wildlife species occur in alluvial scrub habitats at Bee Canyon. Examples include San Diego horned lizard, coastal western whiptail, California horned lark and loggerhead shrike.

Bee Canyon occurs within a state-designated Significant Natural Area, LAX- 082.

UPPER SOLEDAD CANYON /ACTON AREA 516 acres

Most of this acreage is associated with the uppermost reaches of the Santa Clara River and nearby tributaries such as Arrastre Canyon and Mill Canyon. The alluvial vegetation in Upper Soledad Canyon is primarily Scalebroom-dominated and appears to be floristically similar to the Desert phase Scalebroom scrub group. It occupies an extensive system of broad, shallow, low gradient braided stream channels that cross the valley floor before entering the narrow downstream portions of Soledad Canyon.

Transverse Range, coastal side: Los Angeles Basin and San Bernardino

Estimates of remaining acreage of larger stands of AFSS in the Los Angeles Basin was prepared by Jeanne Wirka for the Department of Fish and Game (CDFG, 1996). These acreage values are preliminary, and additional ground truthing is in progress.

BIG TUJUNGA WASH 720 acres

The alluvial fan at Big Tujunga Wash represents one of the largest remaining in the Los Angeles Basin and is perhaps one of the best known examples of this community. In spring, it creates a breathtaking vista, with a backdrop of the steep, snow-covered San Gabriel Mountains rising above a boulder- and cobble- strewn fanhead valley dotted with deep green mounds of laurel sumac *(Rhus laurina),* punctuated by creamy torches of chaparral yucca.

At its deboucher where the canyon meets the valley floor, approximately 544 acres of AFSS remain. An additional 176 acres of primarily Pioneer stage alluvial scrub occurs in scattered patches along the narrow Tujunga Canyon floor. Hydrology in this system is modified by a dam nine miles upstream from the fan, a downstream debris basin (Hansen Dam), the 210 freeway, and associated levees. However, fluvially active areas still remain, and most of the upper fan still experiences extreme flood events with associated scour, debris flows and depositional events.

An array of different aged terraces support vegetation in various stages of development. The Tujunga Valley is a state-designated Significant Natural Area (LAX-018), due to an array of rare biological elements. The upper fan supports the last remaining Los Angeles basin population of slender-horned spineflower. Numerous sensitive wildlife species are known to occur in this area. Examples include the San Diego horned lizard and coastal western whiptail. Riverine environments associated with perennial and intermittent water sources support willow riparian forests, the endangered least Bell's vireo *(Vireo bellii pusillus)* and the rare south coast minnow/sucker aquatic fish community.

Both the upper and lower fan are privately owned. Some protected alluvial scrub occurs on open space lands associated with the Hanson Dam debris basin. Several attempts have been made to develop a golf course on the upper fan. The most recent proposal was denied approval by the City of Los Angeles in July of 1997. The area is designated as an important mineral reserve for sand and gravel, but the local general plan prohibits gravel mining for the next few years.

SAN GABRIEL RIVER 528 acres

The San Gabriel River passes through a narrow gorge before spilling onto the San Gabriel valley floor. Morris dam and associated downstream flood control structures have substantially altered hydrological processes here. Approximately three linear miles of AFSS occupy the floor of the

cement-banked primary channel, adjacent terraces and percolation basins. Stands of alluvial scrub at San Gabriel River were the first to be described as a unique association (Smith, 1980).

Vegetation samples were analyzed by Barbour and Wirka (1997). Vegetation on older terraces here were grouped with other Intermediate and Mature stands from Tujunga Wash, Cajon Wash and the Santa Ana River as representative of the Scalebroom-Yerba Santa-Chaparral Yucca association.

SAN ANTONIO CREEK — 209 acres

Vegetation in this area has not been quantitatively sampled. Most of this acreage occurs in the Claremont area, and represents remnant terraces that are no longer fluvially active due to the upstream San Antonio Dam and associated flood control structures. Additional AFSS occurs in the canyon above the dam.

DEER/DAY/ETIWANDA/SAN SEVAINE WASHES — 3,712 acres

A series of alluvial fans and intervening small washes spread across the foot of the San Gabriel Mountains, east of Rancho Cucamonga, draining steep terrain from the Cucamonga wilderness. Deer, Day, Etiwanda and San Sevaine washes have been substantially modified by flood control activities, including debris basins and levees. However, considerable habitat value remains. This area is described in greater detail elsewhere in this report.

LYTLE/CAJON WASH — 5,706 acres

Remaining stands of AFSS associated with Lytle and Cajon washes persist in a relatively unmodified hydrological system: no dams or debris basins have been constructed in the canyons and upper alluvial fan. Most of the remaining alluvial scrub habitat is upstream of Highland Avenue. Between Muscoy and Devore, a levee associated with the Southern Pacific Railroad tracks prevents flood flows from reaching older terraces along the eastern side of Cajon Wash. Along the western border of Lytle Wash adjacent to Riverside Boulevard north of Rialto, several deflecting levees direct sheet flows back toward the main channel.

Both alluvial fans and terraces have been modified by sand and gravel mining. Levees constructed to control flows through a large mining area on Lytle Creek have bissected habitat there and altered downstream sheet flow. Sand and gravel mining at Cajon Wash has utilized a technique that removes surface gravels without constructing deep pits. Once mining is completed, the operator is revegetating recontoured terraces with alluvial scrub species.

Vegetation sampled along Cajon and Lytle washes is structurally diverse and species rich, including younger stands in the Pioneer, Scalebroom-California buckwheat association and older terraces in the Scalebroom-Yerba Santa-Chaparral-Yucca group. Both Lytle and Cajon washes support emergent tree species such as mountain mahogany *(Cercocarpus betuloides),* California black walnut *(Juglans californica)* and California sycamore which further enhance wildlife habitat values.

Much of the remaining alluvial scrub along Lytle and Cajon washes is within a state-designated Significant Natural Area (SBD-013). Associated rare species include several existing small populations of the endangered slender-horned spineflower and populations of Santa Ana River woolly star exhibiting intermediate characteristics between the endangered subspecies *sanctorum* and more widespread subspecies. Lytle and Cajon washes support important habitat for the endangered San Bernardino Merriam's Kangaroo Rat. This species is now federally listed as an endangered species due to its restricted geographic range and dependence upon increasingly rare stands of alluvial scrub in southwestern San Bernardino and northwestern Riverside counties.

A 768 acre preserve has been protected at Cajon Wash, and serves as mitigation for mining impacts downstream. The California Department of Fish and Game holds a permanent conservation easement over this preserve. An additional 610 acre conservation bank has also been established here, and is currently being administered by the Calmat Corporation. This preserve system will protect approximately six linear miles of private lands supporting fluvially active AFSS, extending from Devore, south to Highland Avenue. Intervening parcels in Cajon wash are owned by the San Bernardino County Flood Control District. The County of San Bernardino also holds a conservation easement over 150 acres of Cajon wash, southwest of Institution Road, which serves as mitigation for the Sheriff's training facility.

Preliminary mapping in the Lytle/Cajon wash area did not include acreage estimates for Alluvial chaparral. The western border of Lytle Creek wash along Riverside Boulevard supports about 700 acres of dense stands of Alluvial chaparral, comprised of chamise, California sagebrush, white sage and yerba santa. Also not included in the mapping estimates are scattered remnants of Alluvial chaparral on the old Fontana fan, west of Lytle Creek.

SANTA ANA RIVER/MILL CREEK/MENTONE FAN — 4,367 acres

Approximately 4,367 acres of AFSS remain along the lower four miles of Mill Creek and below the deboucher of the mainstem of the Santa Ana River on the Mentone Fan through Norton Air Force Base. The Santa Ana River is the largest river system in southern California. The Mentone alluvial fan supports a wide array of alluvial surfaces, the oldest of which may represent geomorphic surfaces older than mid-to late-Holocene (3,000-10,000 years) (Wells and Wood, 1996).

One of the most unusual vegetative features of the Mentone fan is California juniper, a species more typical of desert environments. Stands of California juniper represent the largest known to occur within the coastal basin (1,006 acres, CDFG 1996). Seventeen sub-populations of the endangered slender-horned spineflower also occur here. Sandy areas along the main channel and alluvial terraces support the state- and federally-listed endangered Santa Ana River woolly star and the federally listed endangered San Bernardino Merriam's kangaroo rat. This area is a state-designated Significant Natural Area (SBD-011).

The hydrology of the mainstem of the Santa Ana River is going to be substantially altered by construction of the Seven Oaks dam, in progress. Once it is completed, large scale habitat rejuvenating flood events will be largely eliminated. Peak flows from the dam are expected to be about 5,000 cubic feet per second (cfs) during a post-dam 100 year storm event, versus historic flows of 58,000 cfs. A substantial reduction in younger surfaces supporting alluvial vegetation is likely to result, which is expected to reduce suitable habitat for the Santa Ana River woolly star and San Bernardino Merriam's kangaroo rat. As a result, it is likely that most of the remaining terraces will progress successionally toward more mature stages of AFSS and Alluvial chaparral.

Portions of the alluvial fan at Santa Ana River are under permanent protection. A 764 acre preserve has been established by the United States Army Corps of Engineers and local sponsors of the Seven Oaks dam, which includes scattered parcels along the mainstem of the Santa Ana River and nearby Plunge Creek. Another 760 acres of public lands on three parcels administered by the Bureau of Land Management (BLM) have been designated as an Area of Critical Environmental Concern (ACEC) and Research Natural Area. Portions of the BLM ACEC have been degraded by past unauthorized grading and other types of ground-disturbing activities. Another 700 acres primarily within the main river channel are owned and managed by San Bernardino County Flood Control. The remaining privately owned habitat is highly fragmented by sand and gravel mining and water spreading activities, and is threatened by proposed expansion of these activities.

SECTION IV:
THE STUDY SITE: The Etiwanda-Day Canyon Drainage System

This section summarizes the characteristics of the study site, and will be used in Section V to establish the basis for a conservation strategy and plan (please see figure 9 on the following page for an oblique aerial overview of the study site). The important site characteristics discussed here are vegetation (including sections illustrating the results of the plant sampling transects), natural and human caused disturbance, human settlement patterns, jurisdiction and land ownership, and present day activities.

The study site was defined by visiting a number of candidate sites suggested by the California Department of Fish and Game. Etiwanda-Day Canyon was chosen because it contained an entire fan unit with a wash on either side, and is adjacent to a large piece of protected USFS national forest. The outline of the study site shown in figure 10 defines a major parcel of undeveloped land surrounding the Etiwanda Preserve and covered with AFSS without regard to land ownership. Across the boundaries of the study site are a variety of different types of land use and development: we were interested in having a variety of uses, such as suburban development, floodwater diversion channels and protected open space in order to study the edge effects on AFSS. Because of recent conservation easements that increase the amount of land protected or managed for conservation, Etiwanda-Day Canyon also has a good chance of being one of the largest intact pieces of AFSS that will remain in the region, and there may be an opportunity to reconnect with adjacent stands in Lytle and Cajon washes if acquisition and restoration can occur at key points.

SITE CHARACTERISTICS

The Etiwanda-Day Canyon drainage system is located between three major drainages emanating from Deer Canyon on the west, Day Canyon, and Etiwanda Canyon on the east, as shown in figure 9 and figure 10 (page 25). Water flow from each of these canyons has cut channels, bordered by characteristic vegetation including trees and tall shrubs that are rare or absent from the rest of the site. Flood control measures, beginning in the early part of the century to gather water and in the latter part of the century to control flooding, has altered natural water flow patterns. Flood waters that once flowed from these channels are now collected behind debris basins and levees, and diverted into concrete floodwater diversion channels.

Figure 9

Oblique air photo of the Etiwanda-Day Canyon drainage system (Source: San Bernardino County Flood Control District, 1979)

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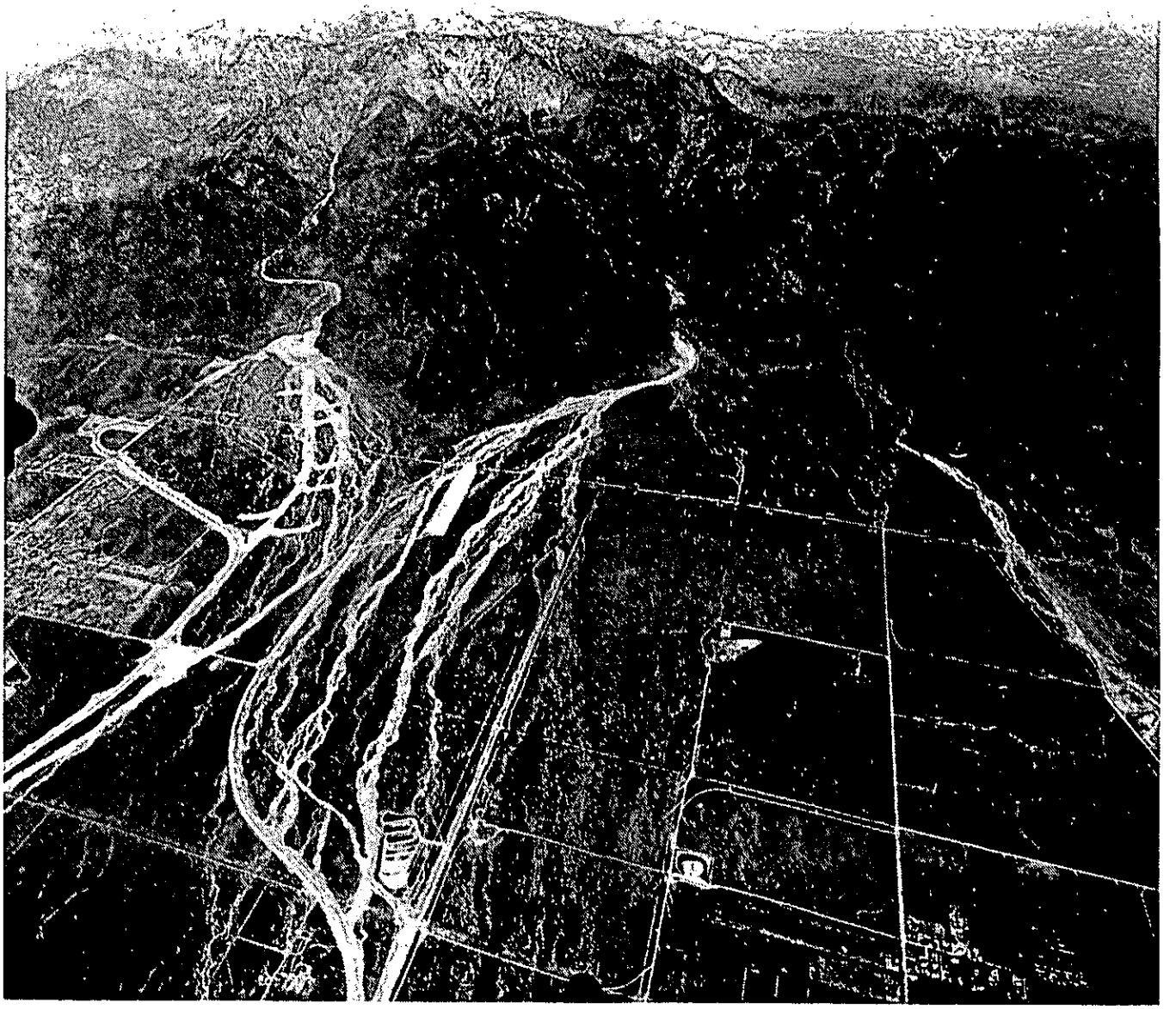

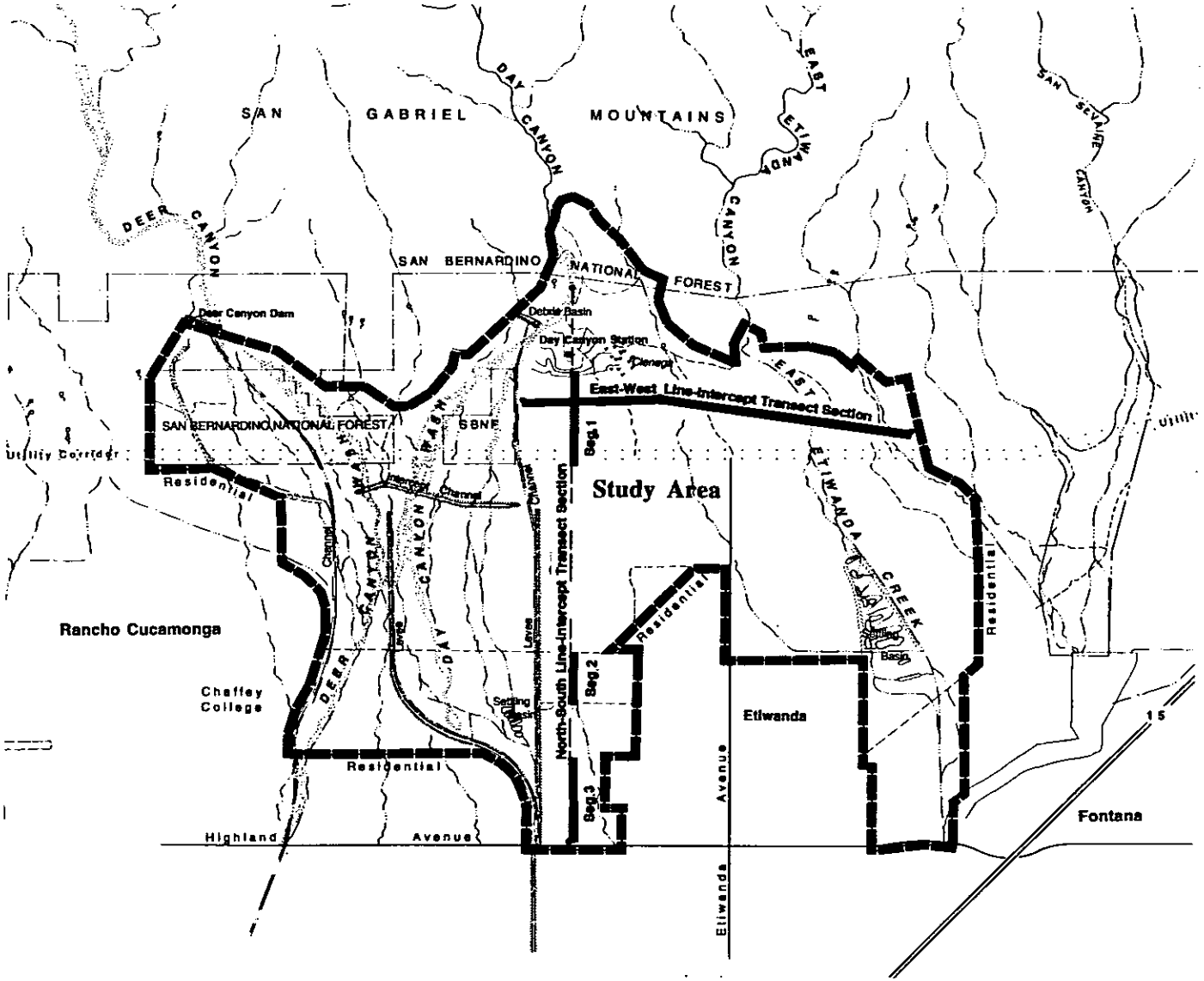

Figure 10

The Etiwanda-Day Canyon drainage system

Legend

Study area boundary

SCALE: 0 1 2 mi.

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(Source: USGS Cucamonga Peak and Devore quadrangles)

CONSERVATION PLAN for the Etiwanda-Day Canyon Drainage System, Supporting the Rare Natural Community of ALLUVIAL FAN SAGE SCRUB

California Department of Fish & Game, US Fish & Wildlife Service, California State Polytechnic University, Pomona

The information in this section of the report is based on the analysis of a plant transect sampling and bird census conducted on the study site, along with other research we conducted and information we collected. A biological report summarizing methodology, results and discussion related to this sampling is included in Appendix 1. Species lists from the site are in Appendix 2.

VEGETATION PATTERNS

The vegetation associated with the major stream channels has important conservation value due to its diversity of plants species, including trees and large shrubs, which serve as habitat for invertebrates, amphibians, reptiles, birds and mammals. Some of these riparian areas have been replaced by concrete stormwater channels and debris basins, such as the one at the mouth of Day Canyon, shown previously in figure 10. Because of these structures, the pattern of flooding on the site has changed. Water will still flow across the fan and in smaller channels during flood events, but this may not be enough to maintain remaining riparian stands or create new ones, changing the overall habitat value of the Etiwanda-Day Canyon area.

A natural feature of importance in the conservation value of the Etiwanda-Day Canyon area is a cienega, or freshwater seep, where subsurface water rises to or very near the surface. The only one of its type along the south face of the San Gabriel Mountains that remains in its natural state, this cienega supports a unique flora. A detailed investigation of the vegetation and hydrology of the cienega was undertaken by Stephan Fischer (1995). Although not investigated in the course of this study, it is probable that various invertebrates and vertebrates, particularly amphibians (see Appendix 2), that would be otherwise absent are present because of resources supplied by the cienega.

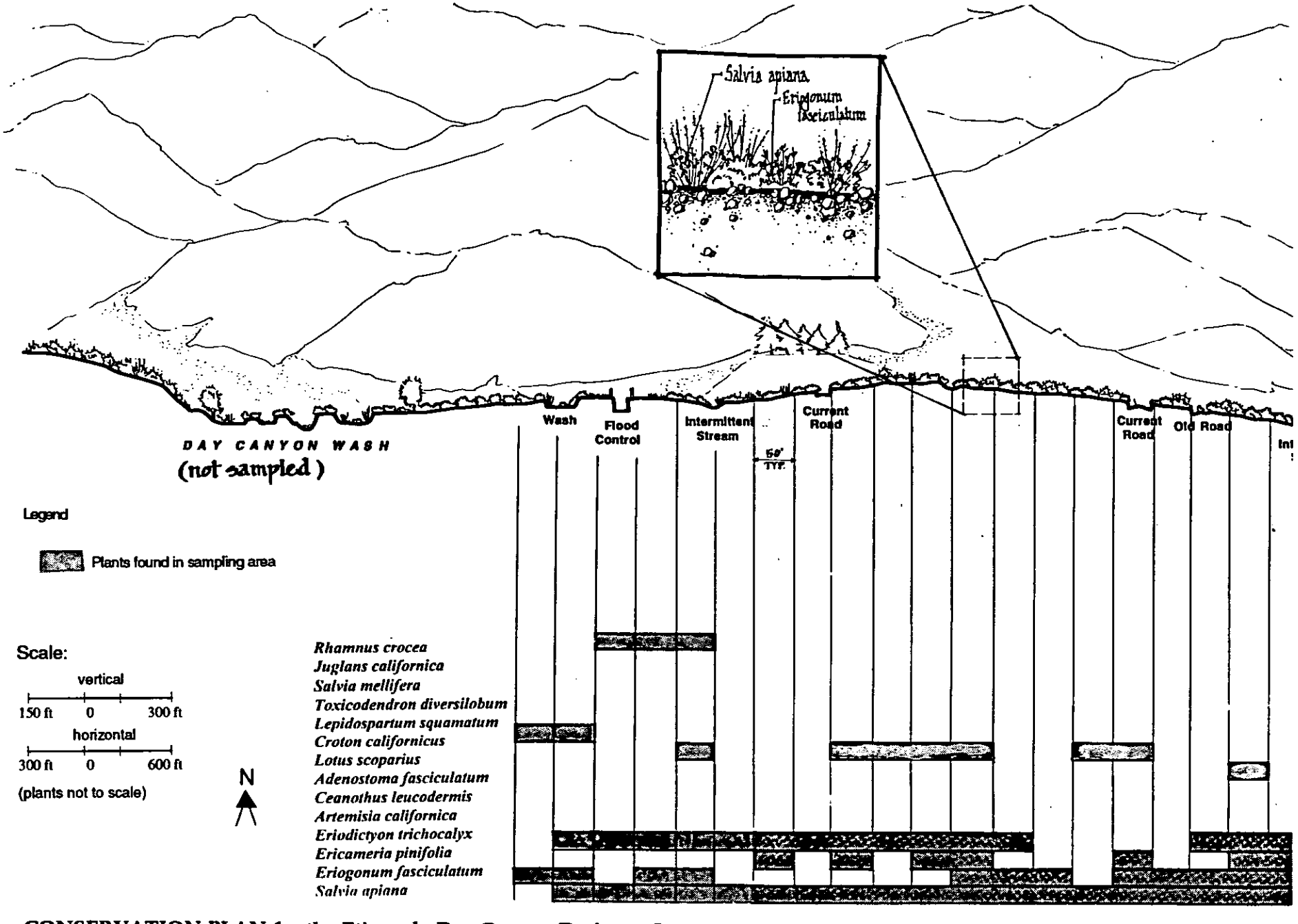
Areas immediately adjacent to Day Creek, all the way to the urban edge and south beyond Highland Avenue, support a plant community that is dominated by mountain mahogany and other shrubs that are generally taller and more varied in stature than vegetation on the rest of the site. In our view this vegetation type contributes to the conservation value of the site, and we have consequently focused some of our plant and animal studies in the southwestern portion of the study area where this vegetation is common. We have found a relatively high number of bird species in this vegetation as compared to less complex stands dominated by white sage. It is important to understand this community type because the channel flooding with which it is associated no longer occurs because of stormwater channels, and much of it has been removed by urbanization. Moreover, some of the remaining vegetation occupies a peninsula surrounded on three sides by suburban development.

Plant Transects: Sampling Protocols

Our understanding of the site has changed based on sampling and analysis of vegetation along two transects. As a result of the sampling, we have found that vegetation communities are more

diverse than we expected. Bird species sampling confirmed our initial assumptions, indicating that higher species diversity did occur in areas of more complex vegetation, with trees and tall shrubs. A process for evaluating sites and proceeding with a conservation plan can be generalized from this report. However, we can not understate the importance of continued sampling and study in order to understand each individual site and to further document the contribution of the AFSS community to regional biodiversity. AFSS cannot be accurately described and evaluated without a plant census done on the ground. This kind of survey should be completed by a knowledgeable biologist for any site under consideration before using the recommendations offered in this report.

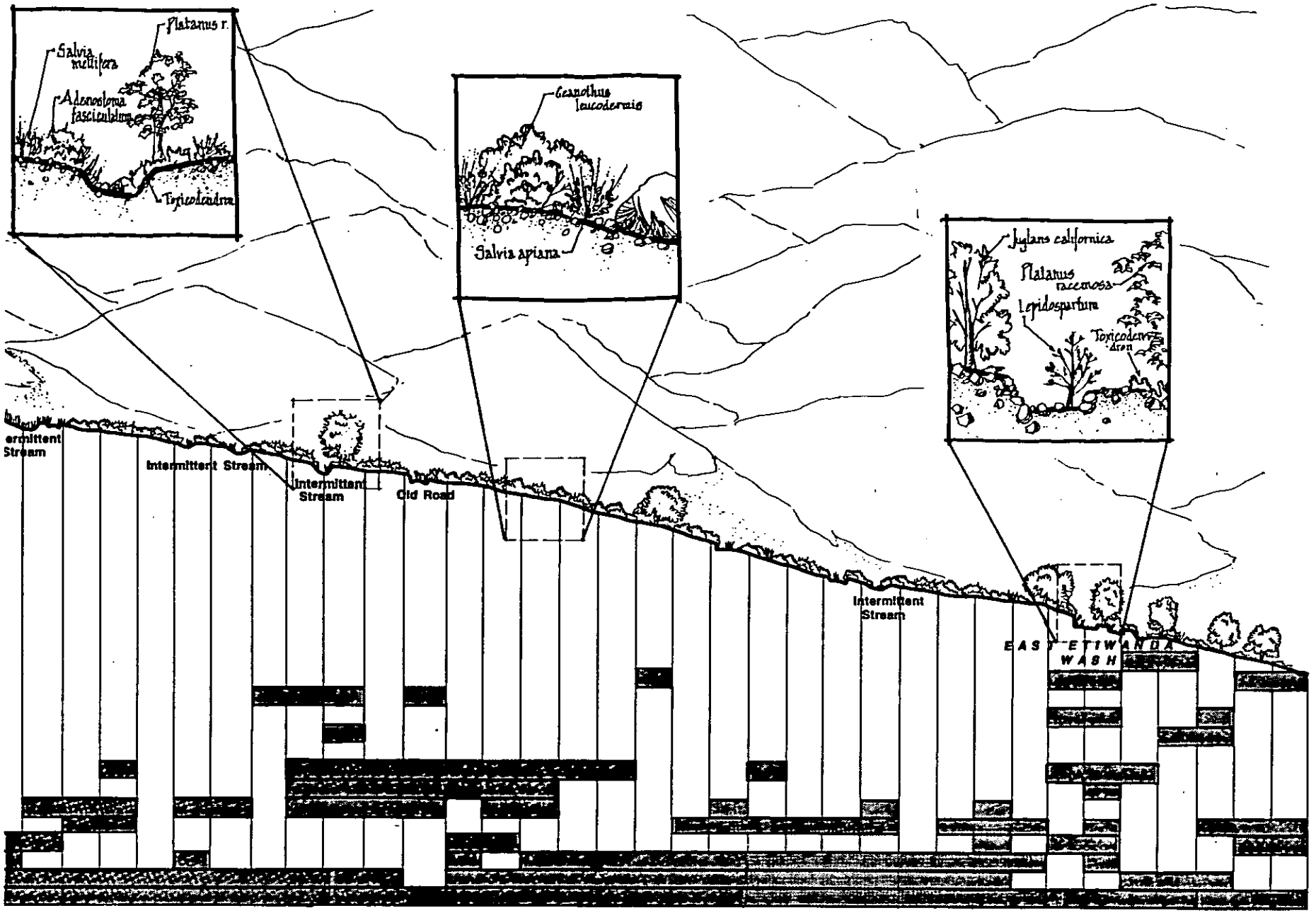
Section drawings showing the relationships between plant species for two transects completed for Etiwanda-Day Canyon drainage system are shown on the following pages. One line ran east-to-west across the site, staying at the same elevation on the fan, and is shown as the East-West Line Intercept Transect Section (East-West transect), as shown in figure 11, part 1 and 2, pages 28 and 29. The second transect, the North-South Line Intercept Transect Section (North-South transect), ran north-to-south from the base of the mountains to the developed area near Highland Avenue as shown in figure 12, part 1 and 2, pages 30 and 31. Sampling protocols for the two transects were based on physical and biological factors, and the sampling areas covered as long a distance as possible given the time and resources available for this study. Knowing that AFSS is a complex association of plant communities we wanted to capture as much diversity as possible. We were interested in characterizing an entire discrete fan unit, bissected by washes, to observe how the plant communities respond to varied topography. How plants respond to moisture availability across the fan is also an important factor, but further soil and substrate studies are needed to quantify these patterns, and only general observations were made along our transects. We also wanted to sample the edges of the site near developed areas to characterize human influences and to see what ornamental or invasive plant species may be establishing in the AFSS stand.



CONSERVATION PLAN for the Etiwanda-Day Canyon Drainage System, Supporting the Rare Natural Community of ALLUVIAL FAN SAGE SCRUB

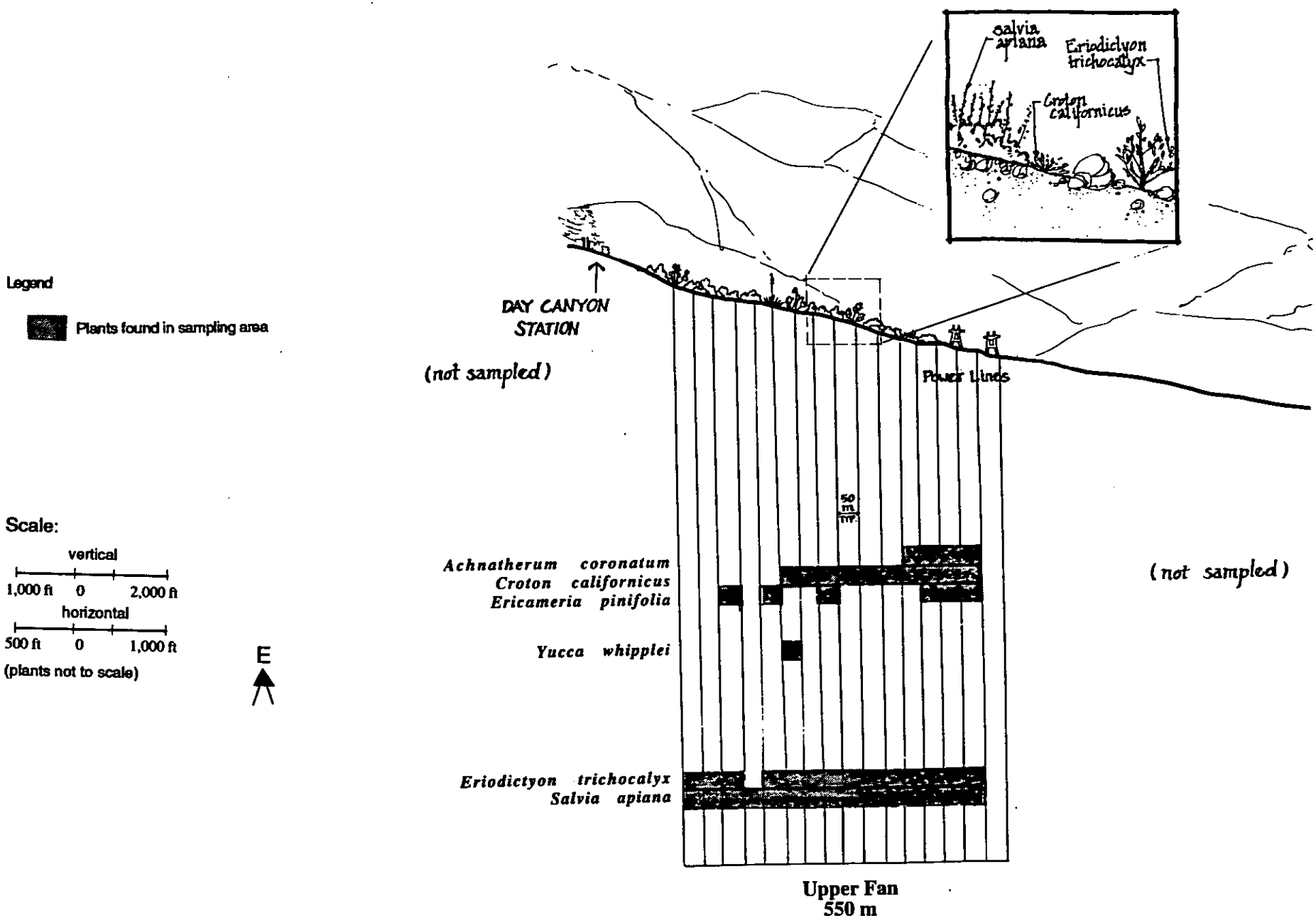
California Department of Fish & Game, US Fish & Wildlife Service, California State Polytechnic University, Pomona

Figure 11 East-West line-intercept transect section, part 1



California State Polytechnic University, Pomona, CA

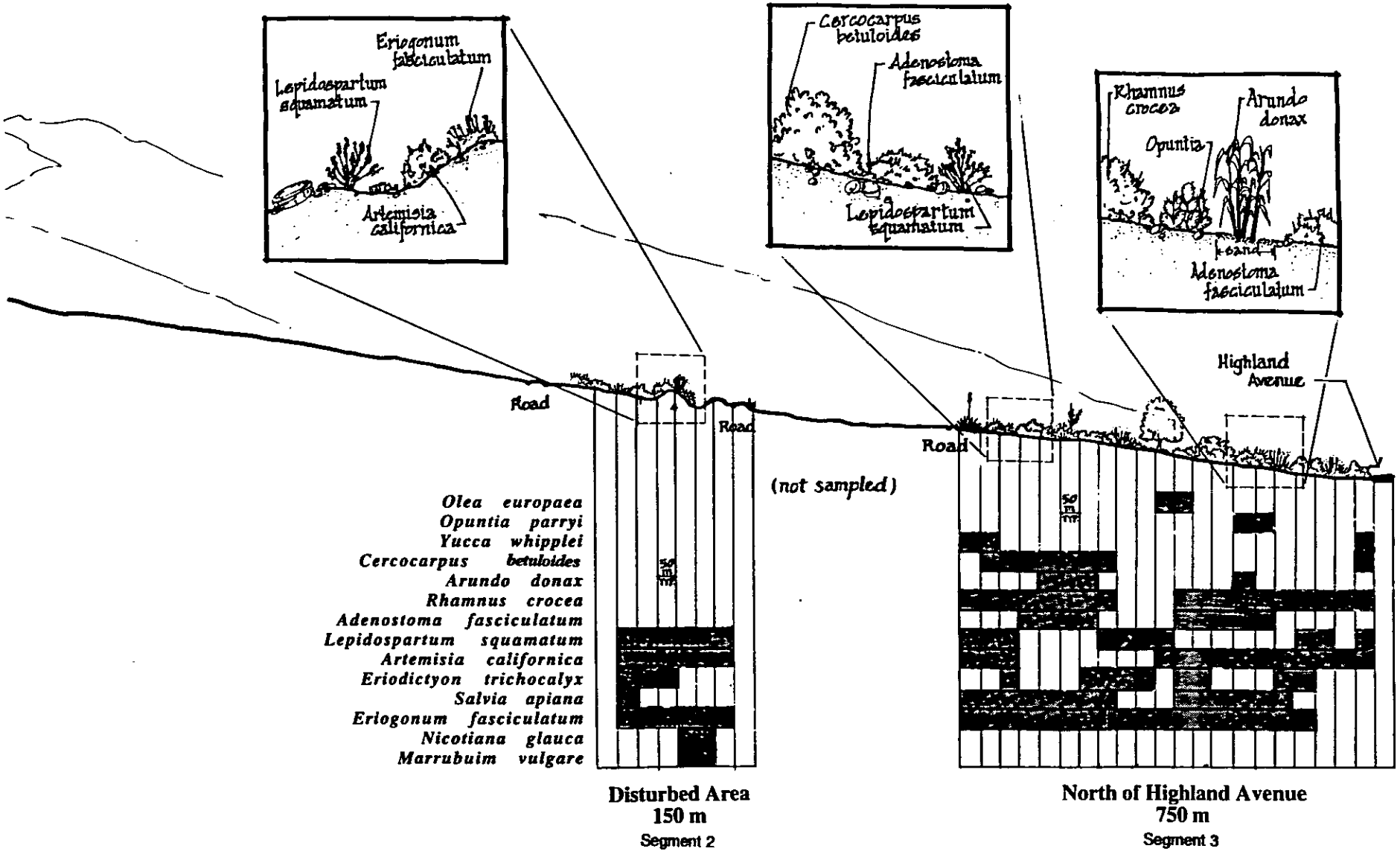
Figure 11 East-West line-intercept transect section, part 2



CONSERVATION PLAN for the Etiwanda-Day Canyon Drainage System, Supporting the Rare Natural Community of ALLUVIAL FAN SAGE SCRUB

California Department of Fish & Game, US Fish & Wildlife Service, California State Polytechnic University, Pomona

Figure 12 North-South line-intercept transect section, part 1



California State Polytechnic University, Pomona

Figure 12 North-South line-intercept transect section, part 2

The transects were placed for the following reasons (please see figure 10 for placement lines):

EAST-WEST LINE INTERCEPT TRANSECT SECTION (East-West transect)

1. AFSS stands are often wider in an east-west direction, because development has generally moved from lower elevations to higher up on the fans toward the mountains.
2. We could capture an entire fan unit with 2 parallel or adjoining washes.
3. To stay at the same position (elevation) across the fan.
4. The East-West transect was 2.700 meters in length, and sampled in a continuous line at 50 meter intervals.

NORTH-SOUTH LINE INTERCEPT TRANSECT SECTION (North-South transect)

1. Because that's the direction in which the water flows.
2. To look at the edge at the northern boundary, which is adjacent to a large, fairly stable (because it is large), reasonably intact and functional area managed by a federal agency.
3. To look at the edge effects at the southern boundary, which has adjacent remnant agriculture, vacant lots, and suburban and industrial uses next to AFSS communities.
4. To observe changes in the plant associations in response to moisture availability and soil substrates (if possible from general observations) that change from higher to lower on the fan and in washes.

The North-South transect was sampled at 50 meter intervals as well, but was divided into 3 major segments instead of a continuous line. This allowed us to cover a longer distance along the fan and still work within the time constraints of the study. Segment 1 included 550 meters of the upper fan, adjacent to the National Forest. Segment 2 included 150 meters of a disturbed site in the middle elevations of the fan in order to observe and document recovery of AFSS from disturbance. Segment 3 included 750 meters of the fan just north of Highland Avenue, where AFSS communities are closer to established development.

From the transects, general patterns can be observed. The species of plants found within the study site can be seen by looking at the bottom of the sections: the 50 meter sampling units are represented as vertical lines, the gray bars along the bottom show which species of plants were located along that line. The most common plants are along the bottom, for example on the East-West transect white sage was found across nearly the entire site. Plants found least often are shown as shorter bars, and in general reveal a pattern as the transect line moves across the fan from the wash, or up the fan toward the mountains.

Based on a cluster analysis (Shown in Appendix 1), there are six major vegetative associations at the Etiwanda-Day Canyon study site:

Two of these are dominated by white sage. 1) A structurally simple association dominated by white sage occurs primarily on the western half of the site between the paved road to Day Canyon Station and the Day Creek flood channel. 2) A more diverse and structurally complex assemblage containing shrub species occurs between the paved road to Day Canyon Station and East Etiwanda

Wash. 3) Another association occurs in or near the active flood channels of East Etiwanda Creek and Day Creek. This association also occurs on the site of an inactive gravel quarry approximately one kilometer north of Highland avenue in the city of Rancho Cucamonga. 4) Another, possibly disturbance based association, occurs east of East Etiwanda Wash and in the area near the Day Creek flood channel. 5) A fifth association is dominated by chamise and would best be classified as Alluvial chaparral. The Alluvial chaparral association typically occurs above the washes but there is a large island of chaparral vegetation in the middle of the site as well. 6) Another association is found on the lower terraces at East Etiwanda Wash in the middle of the site and is characterized by riparian species.

The location of these associations are related to topographic change and the location of natural and human induced change. As mentioned previously, moisture availability, especially the proximity to washes and in areas lower on the fan where water may be closer to the surface must necessarily play a part in where these associations are located, but could not be measured for this study.

The species richness and abundance of bird species, not unexpectedly, are more abundant in associations with more complexity, such as riparian areas. Avian richness and abundance were lower in associations that were structurally simple such as the stands dominated by white sage.

There are some non-native species of trees and shrubs present along with the expected non-native herbs and grasses, but not as many as expected along the edges of the development. giant arundo *(Arundo donax)* and sweet alyssum *(Lobularia maritima)* are the two species at the study site that appear to have penetrated relatively intact habitat. Given the floristic differences between the remaining stands of AFSS it is not unreasonable to expect a different set of problematic invasive plants in other AFSS stands.

The sections show the complexity of plant associations in AFSS. The effect of flooding and fire as disturbance variables that affect the distribution of plant associations is discussed below.

NATURAL AND HUMAN CAUSED DISTURBANCE PATTERNS

There is no evidence that floods have occurred across the major part of the study site in recent times. Examination of aerial photos (San Bernardino County Flood Control District, 1938) taken just after the floods of March 1938, the largest in historic times, shows no evidence of water leaving either the Etiwanda or San Sevaine channels and crossing the site. Flood waters following both channels washed out agricultural lands, now urbanized, to the south. We found no evidence that the second largest floods of this century, in 1969 (San Bernardino County Flood Control District, 1969), caused flooding between the major channels. Consequently we conclude that the patterns of plants and animals observed on the site between the channels have not been recently influenced by channel flooding.

Wildfires have occurred on portions of the study site in 1970 and 1984 (see figure 13, following page). The 1970 fire burned the majority of the site, and may be the cause of a reduction in the size of a patch of Alluvial chaparral dominated by Chamise in the north central portion of the area. This J-shaped patch of Alluvial chaparral is smaller on aerial photographs taken in the 1980s and 90s, as compared with photos from the 1930s.

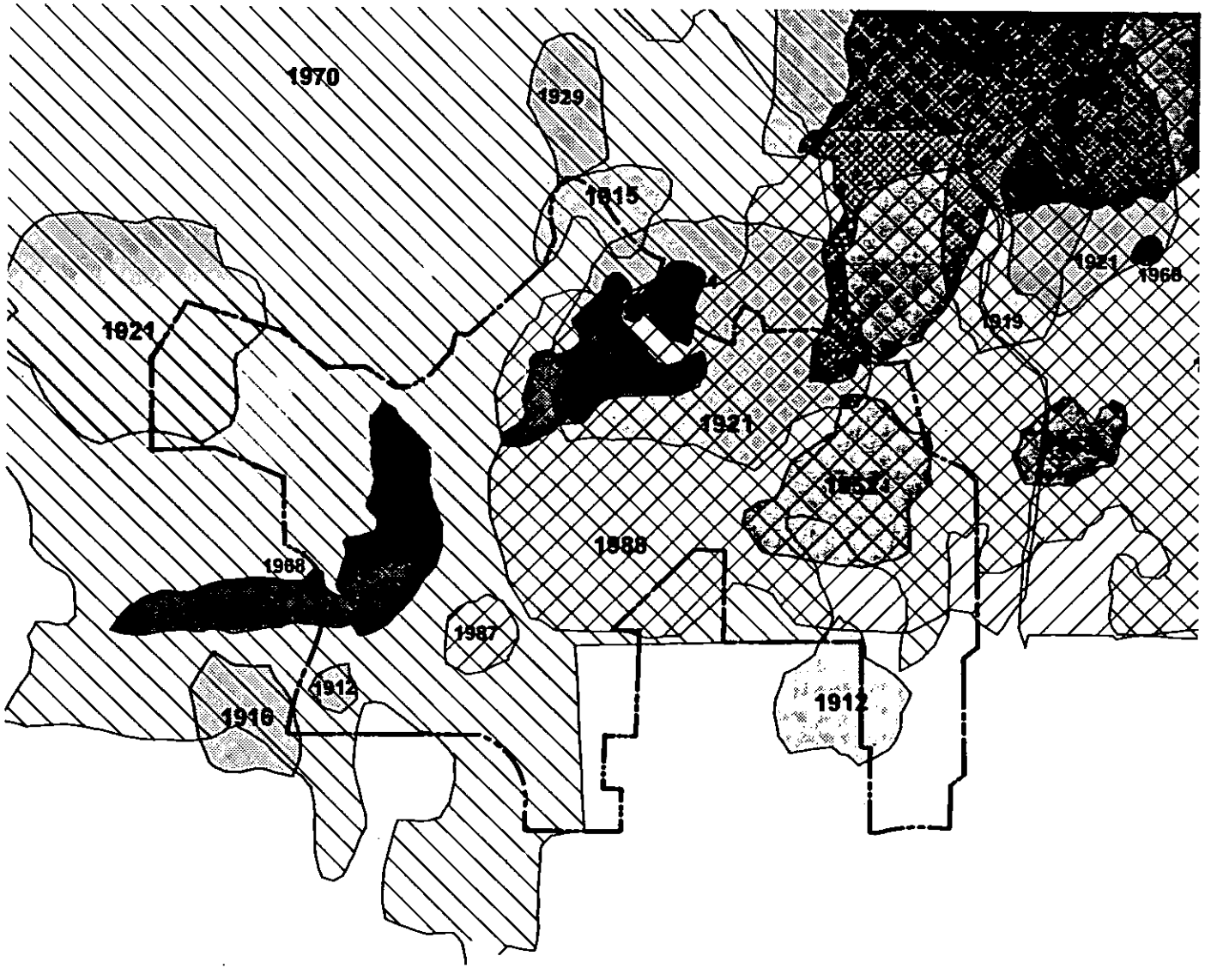
Fire intervals at the Etiwanda-Day Canyon study site have been relatively long (6-50 years) in this century. As human activity becomes more frequent in and around the site in the future, fire frequency might be expected to increase. The most recent fire, in December 1996, (not within the area shown in figure 13), was ignited by a downed power line under wet conditions and high wind intensity. If fires do indeed become more frequent, the long term composition of the plant communities could be changed. AFSS sites in general, and the Etiwanda-Day Canyon site in particular, are particularly vulnerable to rapidly spreading wildfires because of location and topography. Extreme fire weather in southern California occurs from late summer until the first rains of winter. This weather is characterized by dry, gusty Santa Ana winds. These northerly winds are particularly severe below steep mountain canyons with north-south orientations. This exactly describes the study site, where Santa Ana winds are at times severe, and it applies to most other AFSS sites as well. In the past fires ignited in the chaparral north of the study site during these windy conditions have been driven downslope into the AFSS. Wildfires occurring under these conditions are particularly difficult to control and extinguish.

Based on USFS fire maps for the Cucamonga Peak and Devore quadrangles, the AFSS stand at the Etiwanda-Day Canyon area undergoes a fire regime more typical of Coastal Sage Scrub than chaparral, although AFSS contains species from both communities. Chaparral species are typically better adapted to more intense fires than coastal sage scrub species (Keeley, 1986), and as shown in figure 13 the chaparral areas northeast of the study site are subject to more frequent (overlapping) burns. Also, in some stands of AFSS, chaparral species form thick mixed stands. Other areas that may only be a few meters away may have a relatively sparse canopy cover of Coastal Sage Scrub species. This renders it difficult to speculate on the effect of various fire regimes on AFSS as a whole. Preliminary data from the small, low intensity burn in December of 1996 mentioned previously, indicates a nearly 100% survivorship of white sage, scalebroom and Chaparral whitethorn *(Ceanothus leucodermis)* with pine-bush *(Ericameria pinifolius)* and California sagebrush having survivorship levels around 88%.

It is not known what effects a higher intensity burn would have on the community composition of AFSS. More frequent fires have been shown to convert chaparral to Coastal Sage Scrub (Zedler, 1983) and Coastal Sage Scrub to grassland (Haidinger and Keeley, 1993). Less frequent fires may lead to a conversion of Coastal Sage Scrub to grassland as well (Minnich, 1983) although others have found that the majority of Coastal Sage shrubs can persist for long periods without burning (Malanson and Westman, 1985). We have found an occurrence of large numbers of seedling Spiny Redberry in an area that has remained unburned since 1964 (des Lauriers, 1987). This unburned area occurs just below Day Canyon Station and is overwhelmingly dominated by white sage.

Figure 13

USFS fire maps, Cucamonga Peak and Devore quadrangles



(Source: USFS, San Bernardino National Forest, 1997)

This suggests that some of the complexity of AFSS is due to later postfire successional stages in addition to moisture availability. Additional information on fire resilience has been included in Appendix 3.

It is important to note that in May of 1997, sheep grazing occurred at the December 1996 burn site and numerous resprouting shrubs were severely damaged with pine-bush being the most affected while white sage was virtually untouched.

HUMAN SETTLEMENT PATTERNS

Of the many issues facing the future of Coastal Sage Scrub and AFSS in southern California are grazing, fire and clearing for a variety of purposes including development. All of these have been influenced by the population growth that the state of California has experienced over the last century. In 1890, the state's population was 1.4 million. By 1995, the estimated population of California had grown to 32 million people (O'Leary, 1995).

Native Americans

European settlement began in the mid-1700s with the establishment of the missions, but the Etiwanda-Day Canyon area holds historic and contemporary significance to Native American culture.

The Gabrielino Indians form part of the Gabrielino-Shoshone Nation, spanning the greater Los Angeles region including the Etiwanda area. Villages were located along the foothills and in the canyons of the Cucamonga area, one of which was recently identified in Fontana (County of San Bernardino, 1993). The numerous springs originating in the mountains provided the water needed to support human settlement in this arid area. A metate stone was reportedly discovered at the mouth of Day Canyon, indicating that the canyon was used by Native Americans.

Today, the North Etiwanda area is considered sacred by Native Americans due to the unusually high concentration of white sage on the alluvial fan area south of the former Day Canyon ranger station site. The study area site contains the highest density of white sage used for sacred ceremonial purposes. This plant is considered to be the most sacred ceremonial medicine plant, and one which is only found in the southern California region. Many Native Americans throughout the United States travel to this particular site for religious and ceremonial purposes which are connected to the presence of white sage (County of San Bernardino, 1993).

Hydrology and History: Etiwanda, Day, and Deer Canyons

The hydrology of Day and Deer Canyons has been changed as a result of water harvesting, floodwater diversion and sediment control purposes that began in the 1800s. Floodwater diversion structures such as concrete channels, and debris basins have become major components of most of the major watersheds on the Los Angeles Basin side of the San Gabriel Mountains. This has been especially true since 1938, when a major storm flooded many communities along the base of the San Gabriel Mountains.

However, the earliest hydrological alterations took place in the late 1800s, when water harvesting became the key variable in spurring new agricultural communities. During the 1860s and 1870s many claims were filed for water rights in Day, East (now Etiwanda), Deer. Young, Horse, and Smith Canyons along with many neighboring canyons. Many of the claimants' names were given to these canyons, such as Day, San Sevaine, and Smith. George Day claimed the water in what are now known as Day and Etiwanda Canyons, and immediately started harvesting water from them. The water from the two canyons was diverted to Day and Young ranches.

As speculative interests increased with the possibility of development, these water rights shifted hands several times as did land ownership. Several lawsuits and scandals also surrounded these transactions. Eventually, the majority of the water rights ended up in the hands of the Chaffey Brothers, who also acquired the land that would become the town of Etiwanda. As a result of this speculation, which coincided with a land boom throughout southern California, the Chaffeys surveyed the land into parcels for sale to settlers and called the area the Etiwanda Colony Lands, after a Canadian Indian chief near their home in Michigan, with the hope of attracting settlers from their region (Hickcox, 1981). With their water rights, the Chaffey Brothers created the Etiwanda Water Company, formed in 1882, the same year that Etiwanda officially became a town. Thus began a network of ditches, flumes, underground pipes and tunnels that provided water first for agriculture and then increasingly for suburban development.

The Etiwanda Colony Lands remained agricultural lands for several decades. During the time of the Depression, many people from the mid-West came to the Etiwanda area to do agricultural work. This pattern persisted until the Kaiser Steel plant opened around the time of World War II, during which time agricultural production dropped in the area (Hickcox, 1981). In the mid-1950s, another land boom hit southern California. Subdivisions were constructed, creating a new demand for water in the area, and during this period, several other water supply organizations were created.

In response to the flood of 1969, Day Creek, San Sevaine and Etiwanda Canyons floodwater diversion structures and debris basins were completed. In 1977, Etiwanda, Alta Loma and Cucamonga voted to incorporate into the city of Rancho Cucamonga. In 1979, the Cucamonga County Water District connected to the State Water Project, bringing in imported water and in 1980, the Royer-Nesbit water treatment plant in north Etiwanda opened. More information and background on the hydrology and history of the area is included in Appendix 4.

Jurisdictions And Land Ownership Patterns

The Etiwanda-Day Canyon drainage system is located west of Lytle Creek and Cajon Pass, north of the incorporated city of Rancho Cucamonga. The land ownership patterns of the study area are complex (shown in figure 14, following page), and this map will be referred to in Section V as part of the proposed conservation strategy.

The boundary of this part of the San Bernardino National Forest, under the ownership and jurisdiction of the United States Forest Service (USFS) lies at the base of the San Gabriel mountains, north of Rancho Cucamonga. Several small, disconnected parcels south of the forest boundary shown as USFS ownership on many maps have been sold or transferred to Edison, a private utility company. The area that lies between the national forest boundary and the City of Rancho Cucamonga is under the County of San Bernardino's jurisdiction and within the city's sphere of influence. There are three other jurisdictional areas that occur within the study site. The streambed areas fall under the Army Corps of Engineers and the California Department of Fish and Game. In addition, an area around the drainages falls under the jurisdiction of the San Bernardino County Flood Control District.

The area north of Highland Avenue consists of a mosaic of public and private land ownership, some of which is held by private individuals and some of which is owned by business organizations. South of these areas the San Bernardino County Flood Control District owns several parcels around the washes of Day and Etiwanda Creeks. Between these two areas is a patchwork of smaller parcels held by private individuals and businesses, with the exception of the areas around power utility corridors, which are owned by utility corporations.

There are four important areas that have been acquired for preservation management within and around the study site and are labeled in figure 14 if they fall within the boundaries of the study site:

1. Much of the area between Day Creek and Etiwanda Creek is owned by the San Bernardino Associated Governments (SANBAG). This 760 acre area, which encompasses much of the upper, central North Etiwanda fan, was acquired to serve as mitigation for the State Route 30 project. It is to be protected under a permanent conservation easement and is to be managed by the County of San Bernardino.
2. The Metropolitan Water District (MWD) has purchased and transferred to the USFS 880 acres at Day Canyon and City Creek as mitigation for the Inland Feeder Project.
3. Day Canyon Preserve consists of 200 acres set aside as a conservation easement through the San Bernardino County Flood Control District. The easement is held by the County of San Bernardino.
4. San Sevaine Water Project: 137 acres is required to be permanently protected as mitigation for floodwater diversion structures and debris basins in and around San Sevaine Creek.

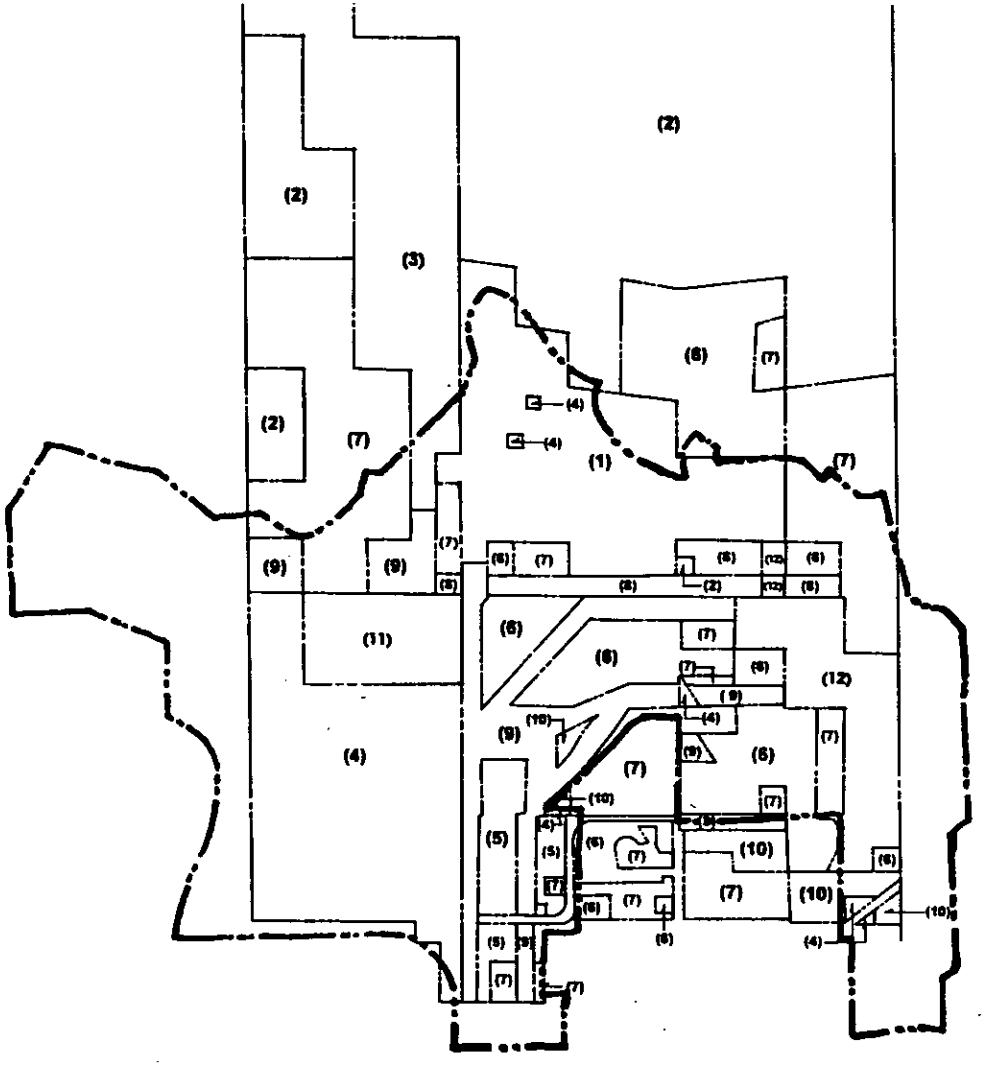


Figure 14

Land ownership patterns

Legend

(1) San Bernardino Association of Governments
(2) United States Forest Service
(3) Metropolitan Water District
(4) San Bernardino Co. Flood Control
(5) Regents of UC
(6) Private Businesses
(7) Private-Individuals/Couples
(8) Department of Water and Power, City of Los Angeles
(9) Southern California Edison
(10) Utility Corporations

SCALE: 0 1 2 mi. N

(Source: San Bernardino County Assessor's Office, 1997)

CONSERVATION PLAN for the Etiwanda-Day Canyon Drainage System, Supporting the Rare Natural Community of ALLUVIAL FAN SAGE SCRUB

California Department of Fish & Game, US Fish & Wildlife Service, California State Polytechnic University, Pomona

Present Day Human Activity

Evidence of human activity within the study area is plentiful. Remnants of past water harvesting and floodwater diversion structures from the 1800s are still present in the form of levees, berms, piled rocks, ditches, concrete pads, and exposed pipes. More recent concrete channels, dams, and debris basins are much larger scale and clearly seen from adjacent roads and freeways.

A complex network of roads and trails in various stages of use, from well-worn to abandoned, crisscross the site. Many of these have been built for fire control access or to reach concrete channels and debris basins, power lines, and water harvesting and storage structures. There are still old roads leading to abandoned structures that were part of early ranches and farms in the upper fan areas.

Housing tracts continue to be built in the vicinity of the study site, especially in the San Sevaine areas. Homes are continuing to be built on private parcels in the area, some of which are close to or adjacent to the forest boundary.

The perennial stream in Etiwanda Canyon is a popular recreation area, and unregulated recreation contributes to site disturbance. Dirt road and off road access is discouraged using berms that have been created by heavy equipment along some of the existing roads and through the use of locked gates, however vehicle use is evident throughout the site.

Or several occasions we observed sheep grazing on the site as well as commercial collection of white sage. Illegally dumped trash and other materials, primarily furniture, was found along roads within the site.

SECTION V
Conservation Strategies and Recommendations

This section proposes a process for establishing functioning preserves of AFSS in the region. Etiwanda-Day Canyon has been used as a study site and example for implementing this process in this report, but further funding is needed to prepare a similar plan for each of the remaining AFSS stands, studying each one individually but also linking them together in a larger context of the region.

The first two parts of this section lay the foundation for establishing guidelines for a conservation plan: Understanding Change Over Time, and the proposed Conservation Value Indices for AFSS Habitat Patches. In the third part, the guidelines are established and prioritized, and an inventory of land use for the Etiwanda-Day Canyon area is shown. The guidelines are applied, illustrating in priority order which parts of the Etiwanda-Day Canyon area which are still unprotected are the best candidates for acquisition or management, and long term management guidelines are proposed.

UNDERSTANDING CHANGE OVER TIME

The following series of three-dimensional block diagrams summarize the key systems operating on AFSS sites and show changes over time. These are illustrated using the Etiwanda-Day Canyon drainage system, but the general principles apply to other AFSS sites as well. The key systems are identified as: hydrologic systems, substrate (soil and underlying gravel and rock unique to alluvial fans), vegetation, disturbance, and anthropogenic (human) influences prior to European settlement. After the first diagram, each development phase is evaluated according to what has changed since the previous diagram and what has stayed the same. The development phases include the following diagrams and are grouped as: Pre-European Settlement, figure 15, page 43, the Agricultural Era, figure 16, page 45, and Suburban Development, figure 17, page 47.

Pre-European Settlement Conditions:

EXISTING CONDITION

Hydrologic System:
Water often comes in storm events, and carries varying amounts of sediment from very little to significant debris flows (especially following fires and earthquakes in higher elevations in the watershed.)
Geomorphic process create the familiar pattern of overlapping fans with adjacent washes.

Substrate:
Very porous, water sinks in quickly.
Frequent scouring, especially in washes, soil has little time to form higher on the fans.
Most washes have running water only during storms or if the water table is very high.

Vegetation:
Alluvial Fan Sage Scrub (AFSS) and Alluvial chaparral
Located on alluvial fans and washes.
A complex association of plants containing elements of both Coastal Sage Scrub and chaparral communities but also riparian species and specifically wash loving plants such as Scalebroom.
Disturbance, especially flooding and fire play an important role in the structure of the plant associations on the site, along with moisture availability.

Disturbance:
Flooding.
Fire.

Anthropogenic Influences:
Native American use over the last 10,000 years or more.

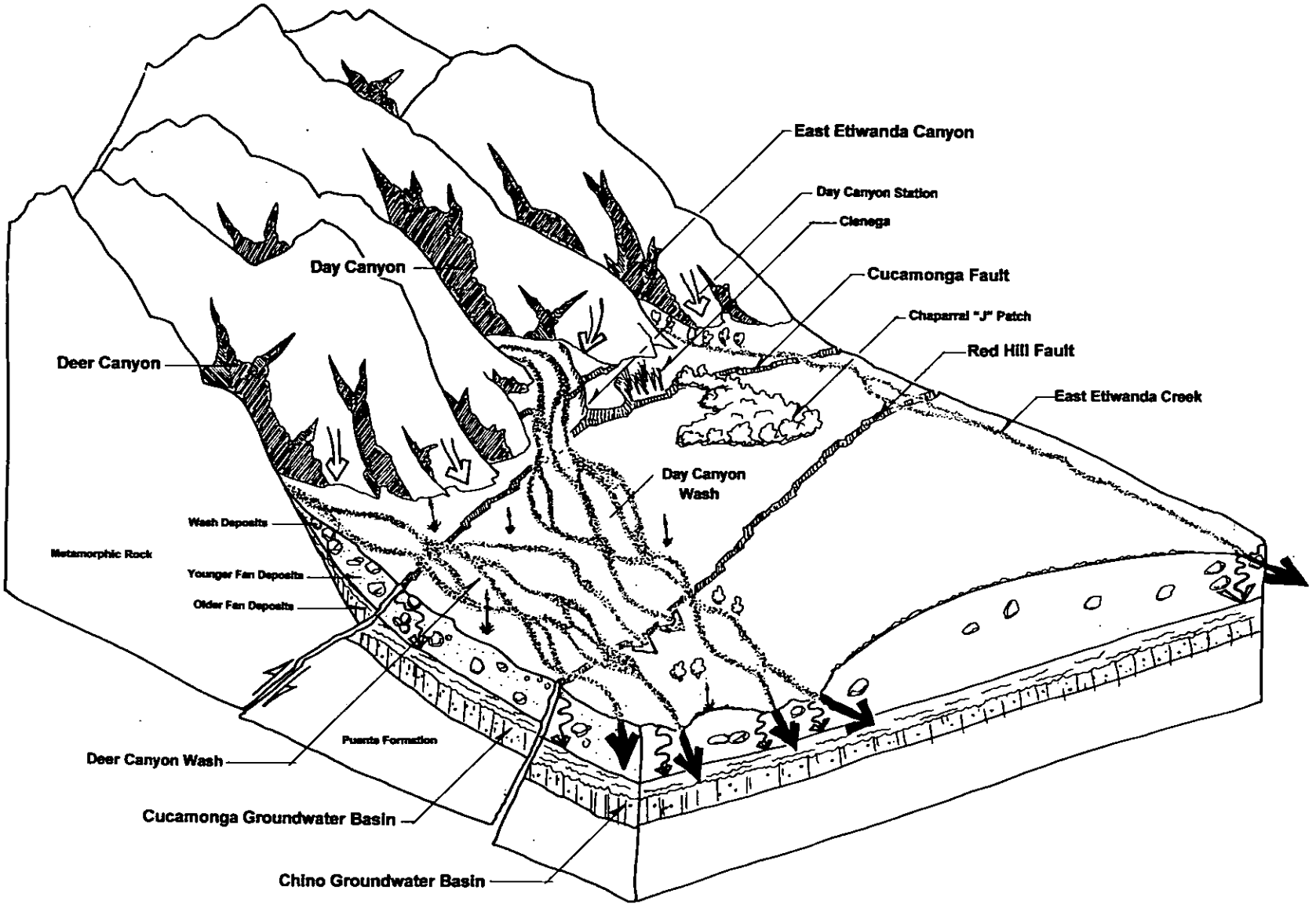


Figure 15

Pre-European settlement block diagram

The Agricultural Era:

CHANGES

Hydrologic System:
Water capture for irrigation and home use, includes changes to topography and use of flumes and underground pipes.

Substrate:
Orchard and Vineyard development begin to be developed on more fertile areas of the lower fans.

Vegetation:
Introduction of non-native forbs and grasses.
Grazing.

Disturbance:
Roads and water capture structures begin to fragment the fans.
Fire frequency increases.

STAYED THE SAME

Percolation of water.

Frequent enough flooding keeps development clearly off the biggest washes and flood prone areas which preserves large tracts of AFSS.

Water capture is used primarily for irrigation and home use, so is returned to the system.

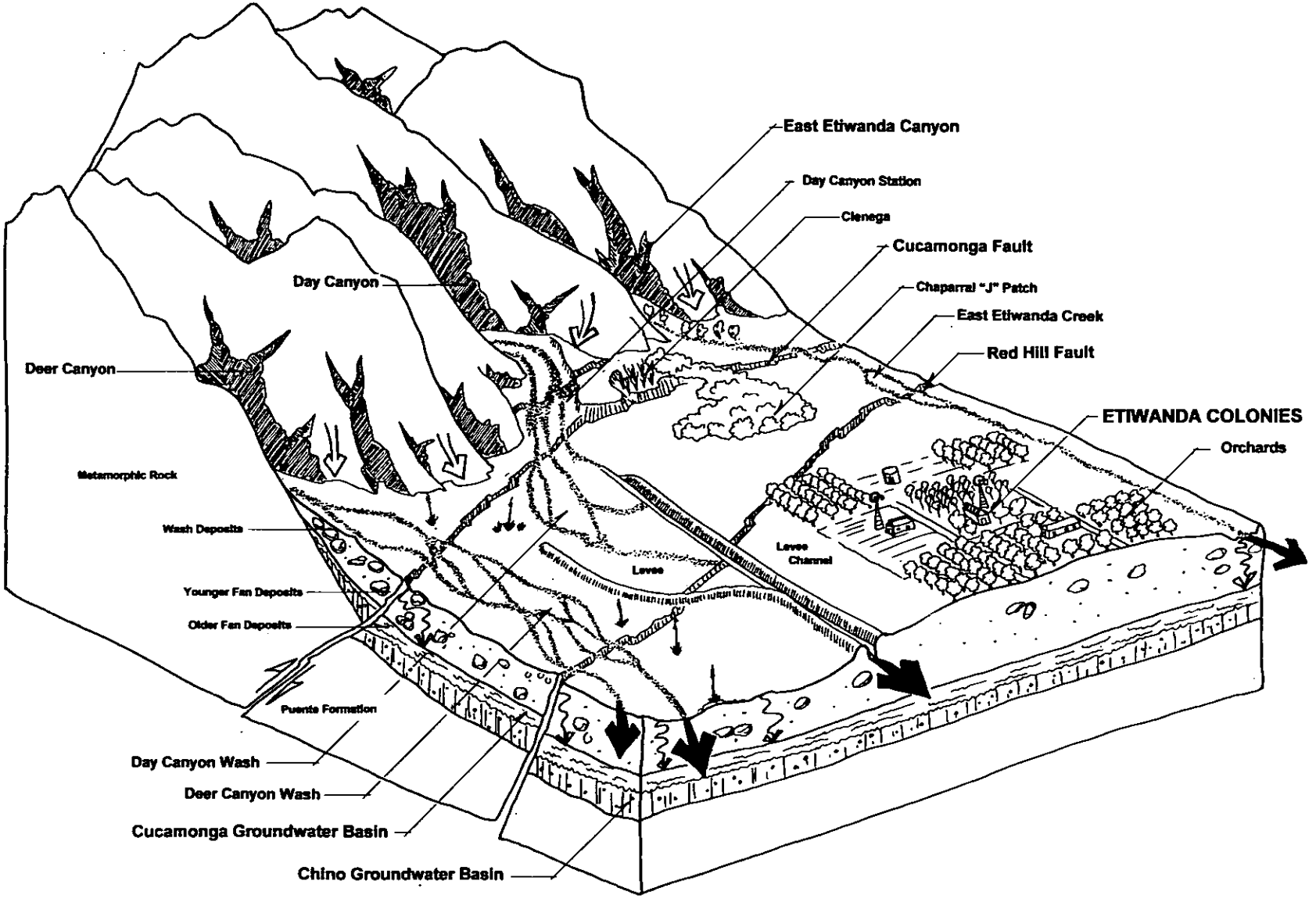


Figure 16

Agricultural era block diagram

The Suburban Development Era:

CHANGES

Hydrologic System:
Water capture increases to supply development.
Less water is used for irrigation, more for domestic systems which is treated through domestic sewage treatment and not necessarily returned to the site.
Structures to direct floodwater away from developments increasingly carry runoff away from the site as fast as possible, without allowing it to percolate.
More and more paving in suburban development creates impermeable surfaces where at onetime runoff was more quickly absorbed. More paving in turn creates more runoff in a shorter period of time, increasing flood levels downstream. Flood problems increase as more of the upper fans are developed.

Substrate:
Increasingly covered with impermeable surfaces.
Topography altered as structures such as debris basins and concrete channels are built to divert floodwater.

Vegetation:
Changes as flood and fire regimes change.
Additional invasive plants are introduced as ornamental plants increase along with suburban development.

Disturbance:
Fire frequency changes: fires are suppressed more vigorously to protect structures and watershed values, but the result is a more human caused pattern as fuel buildups over time allow some fires to burn more intensely.
Fragmentation of AFSS increases as development moves up the fan, replacing agricultural land and at times pushing into chaparral communities and blocking linkages between adjacent fan units from east to west, creating islands of AFSS.
Air pollution levels have been shown to alter the structure of Coastal Sage Scrub.

STAYS THE SAME:

The adaptive, disturbance related resiliency of AFSS. Has been shown on the study site to re-establish itself after fire, and on old roadbeds.

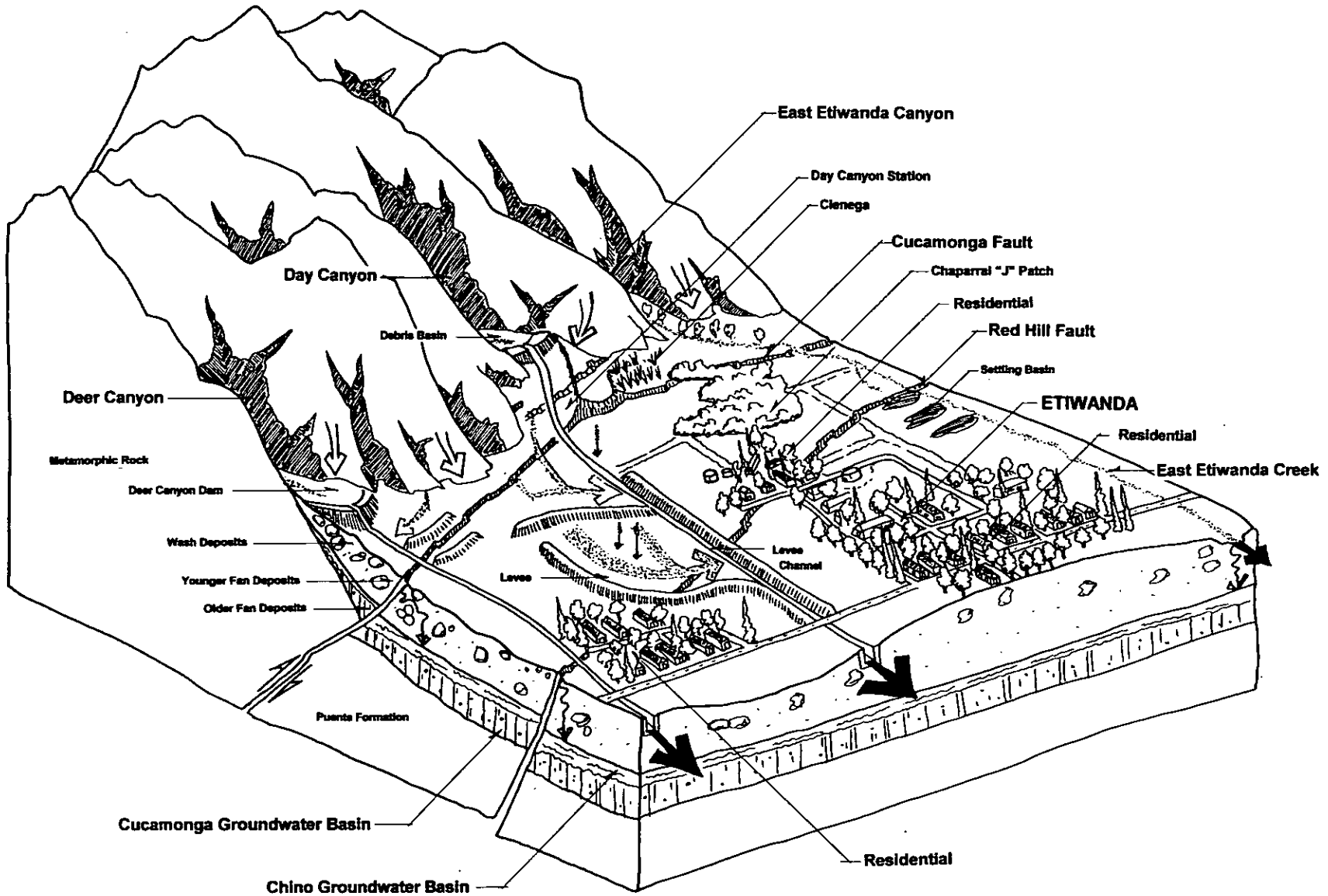


Figure 17

Suburban development block diagram

Summary: Understanding Change Over Time

Understanding changes over time establishes key ecosystem processes that must be maintained in order to preserve, maintain, or re-establish AFSS communities at Etiwanda and on other AFSS sites in the region. As per the block diagrams, these are grouped as follows, and will be discussed again under Guidelines:

Hydrologic System and Substrate Conditions:
The availability and location of water on alluvial fans, both from flooding and the movement of water underground and in the soil influences the location and composition of AFSS, especially in active washes. Human activities which divert floodwater and debris, and harvest water for suburban use, will ultimately change AFSS communities even if the land remains undeveloped.

Vegetation:
AFSS has already undergone a major change through the introduction of non-native grasses and annuals. More and more non-native species are being introduced because of nearby suburban development.

Disturbance Factors:
Part of what makes AFSS a distinctive plant community are the conditions of flooding and to a lesser extent fire on alluvial fans and in washes. Eliminating flooding and fire will change AFSS communities over time. Human development has introduced a number of different kinds of disturbance elements, including roads, grazing, mining, and both fire incidence and suppression, causing another type of change in AFSS.

Stays the Same:
AFSS can recover, if given the chance. There are still significant patches of AFSS in the region that can preserve a meaningful sample of this once abundant community.

CONSERVATION VALUE INDICES FOR AFSS HABITAT PATCHES

Introduction

This project addresses the overall conservation value of the Etiwanda-Day Canyon tract of AFSS. One goal of the study has been to develop criteria for assessing the value of others of the eight patches of alluvial sage scrub remaining at the southern base of the San Gabriel-San Bernardino Mountains of southern California (please see Section II for more information).
These patches have several things in common.

1. Each is a single, contiguous area.

2. Each lies adjacent or close to a northern expanse of non-urban, mountainous public land within the Angeles or San Bernardino National Forests.

3. All are bounded on the southerly, and sometimes easterly and westerly sides, by land that has been either urbanized or is likely to be so in the future.

4. They have been impacted to varying degrees by internal linear disturbances such as roads, power lines, and flood control channels.

5. They lie at similar elevations, and possess similar climates.

6. They are all closely associated with major drainages emerging from the mountains, and are consequently shaped and have been affected by periodic flooding and associated processes such as erosion and alluvial deposition.

The association with water flows largely explains the continued existence of these areas in a natural state. Those areas in active washes, clearly unsuited to urbanization, are owned in part by public flood control agencies, and water companies.

These patches differ in several properties that could affect their conservation value. They are different sizes and they contain varying degrees of human disturbance within their boundaries. They have quite different shapes, varying from the relatively blocky configuration and linear edges of our study area to others that are narrow and sinuous, and still others that have extremely irregular edges that penetrate far into their interiors.

Conservation Indices

We have developed four readily measured indices, based on geometric attributes, to assist in assessing the conservation value of alluvial sage scrub patches. These may be used, together with other information such as the results of biological surveys, to measure the value of a given patch, or to compare one patch with another. These indices are:

Indices #1	Total area size
Indices #2	Shape: Area to Perimeter Ratio, and Circularity
Indices #3	Adjacent Uses
Indices #4	Perimeter to Linear Disturbance Ratio

Five geometric variables were measured for the study area in order to use in measuring the Indices: total size, shape (circularity, discussed later), distance around the perimeter, distance along the boundary of each different adjacent use, and the length of linear disturbance elements. For comparative purposes these variables were also measured for San Sevaine, the next AFSS area to the east. In this example all areas were measured in acres, and all linear measurements were in miles. A summary of the values used for the Indices calculations are shown in Table 1, below.

	Etiwanda	San Sevaine
Area (Mi^2)	6.28	0.45
Perimeter	17.80	4.21
Natural perimeter (Mi)	9.66	1.86
Urban perimeter (Mi)	8.14	2.35
Linear disturbance (Mi)	53.50	1.20
N/U	1.19	0.80
A/P	0.35	0.11
$A/P / A/P\,\mathrm{max}$	0.49	0.58
P/L	0.33	3.50

Notes:
1. Etiwanda is approximately 14 times larger than San Sevaine.
2. The natural to urban perimeter (N/U) ratios are about the same for both sites.
3. The circularity indices of Etiwanda and San Sevaine are similar.
4. The ratio of perimeter to linear disturbance is lower for Etiwanda (0.33) than for San Sevaine (3.50).

Table 1: Conservation Indices for two Alluvial Fan Sage Scrub sites

Conservation Indices #1 TOTAL AREA SIZE

Area by itself can be a significant attribute. Other things being equal, larger areas have higher conservation value than smaller areas. In this respect Etiwanda-Day Canyon has greater poten-tial importance than San Sevaine, because it is 14 times larger, as shown in figure 18, page 52.

Conservation Indices #2 SHAPE

Shape is an important attribute of the conservation value of AFSS areas. For example patches adjacent to areas with no conservation value, or negative value, can be negatively affected by interactions across the boundary. Thus in a patch with an irregular boundary, where the patch is deeply invaded by peninsulas of negative habitat, more of the patch area will be close enough to a boundary to be negatively affected. Examples of negative effects across boundaries would be hunting by domestic pets, destruction of vegetation by informal pathways and vehicle use, collecting of natural materials, and invasion by exotic species of plants.

Area to Perimeter Ratio

Consequently, an area that approaches the orthogonal, with long straight boundaries around a blocky interior, will have less contact with outside areas in proportion to its area than a plot of the same size with irregular boundaries. The area to perimeter ratio (total area divided by perimeter distance, or A/P) for Etiwanda-Day Canyon is three times higher than for San Sevaine, because San Sevaine is much narrower in proportion to its length. This then is another measure suggesting that Etiwanda-Day Canyon has the higher conservation value of the two areas compared to one another.

Circularity Index

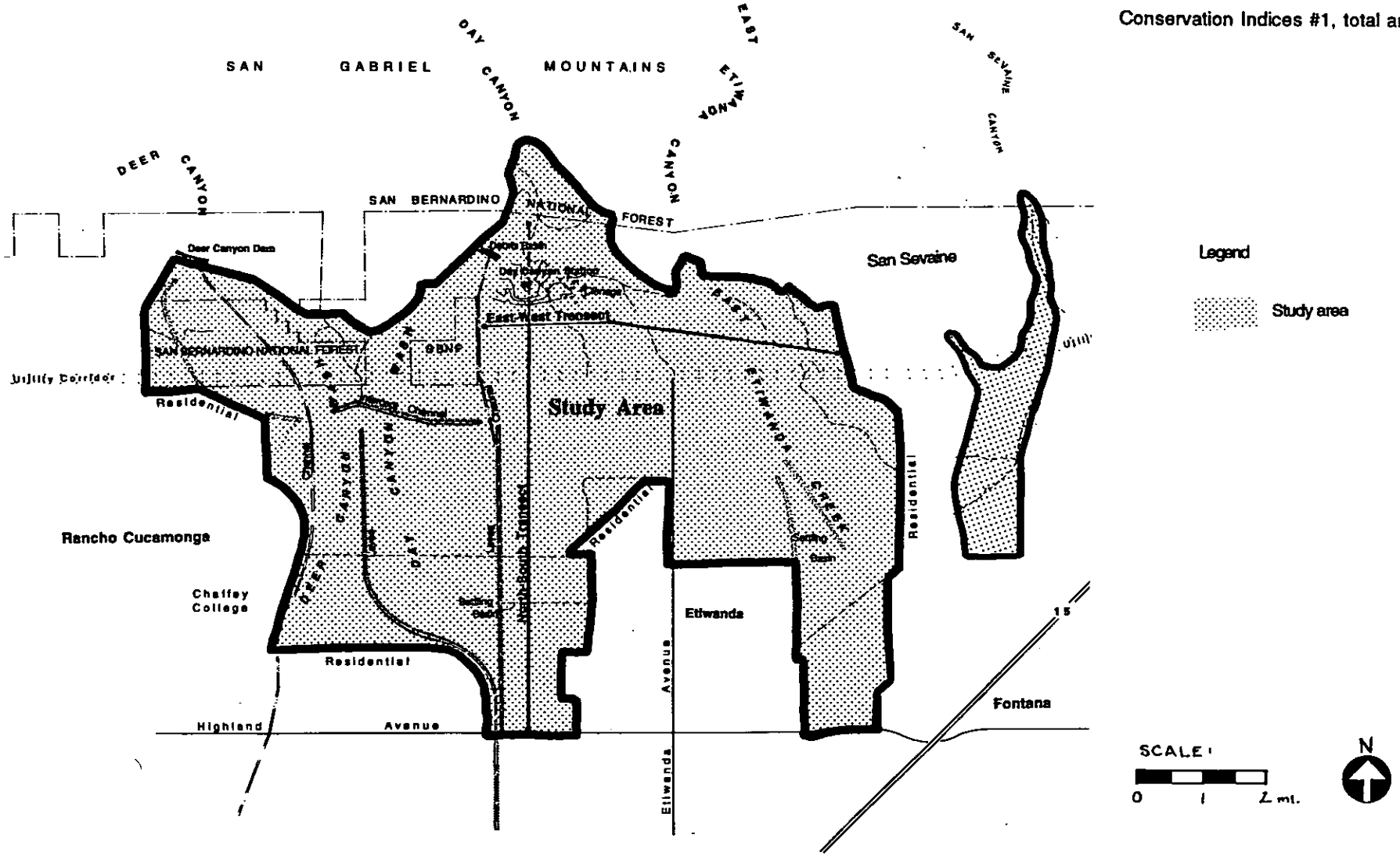
A second way to assess shape is a circularity index, the ratio between the actual A/P and the A/P of a circle with the same area. The A/P ratio of a circle is the smallest that is mathematically possible for the area enclosed. By this measure Etiwanda-Day Canyon and San Sevaine are similar in circularity , and have approximately equal proportional contact with their surroundings.

Conservation Indices #3 ADJACENT USES

Natural to urban perimeter ratios are about the same for both sites. It follows that the more total negative boundary that exists, the more AFSS will be influenced. The conservation value of any parcel is increased when connections between existing habitat exist or can be re-established, even if the site is surrounded by negative development and the connection takes the form of a corridor. Please see figure 19, page 53.

Figure 18

Conservation Indices #1, total area map



CONSERVATION PLAN for the Etiwanda-Day Canyon Drainage System, Supporting the Rare Natural Community of ALLUVIAL FAN SAGE SCRUB

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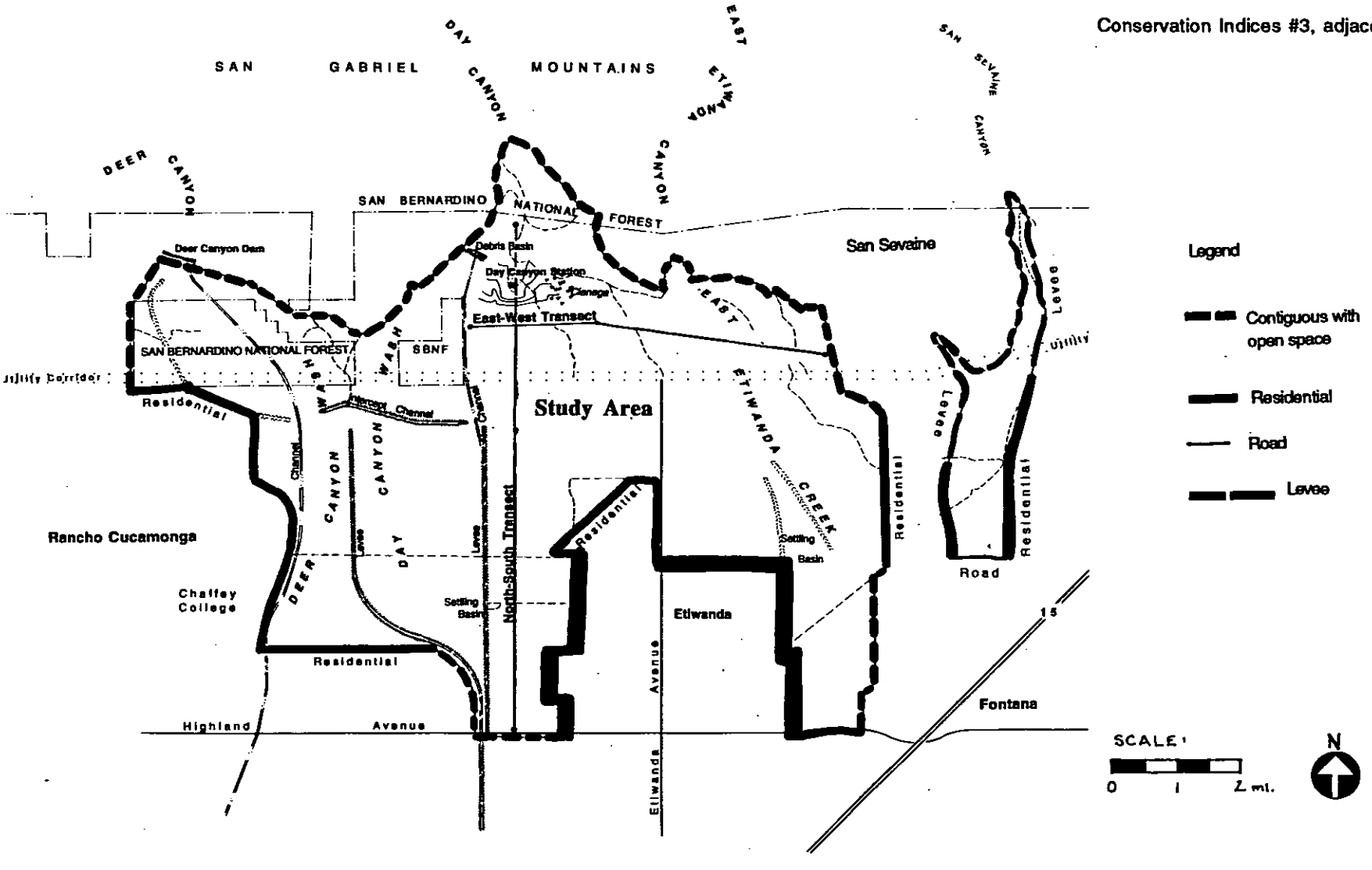
Figure 19

Conservation Indices #3, adjacent uses map



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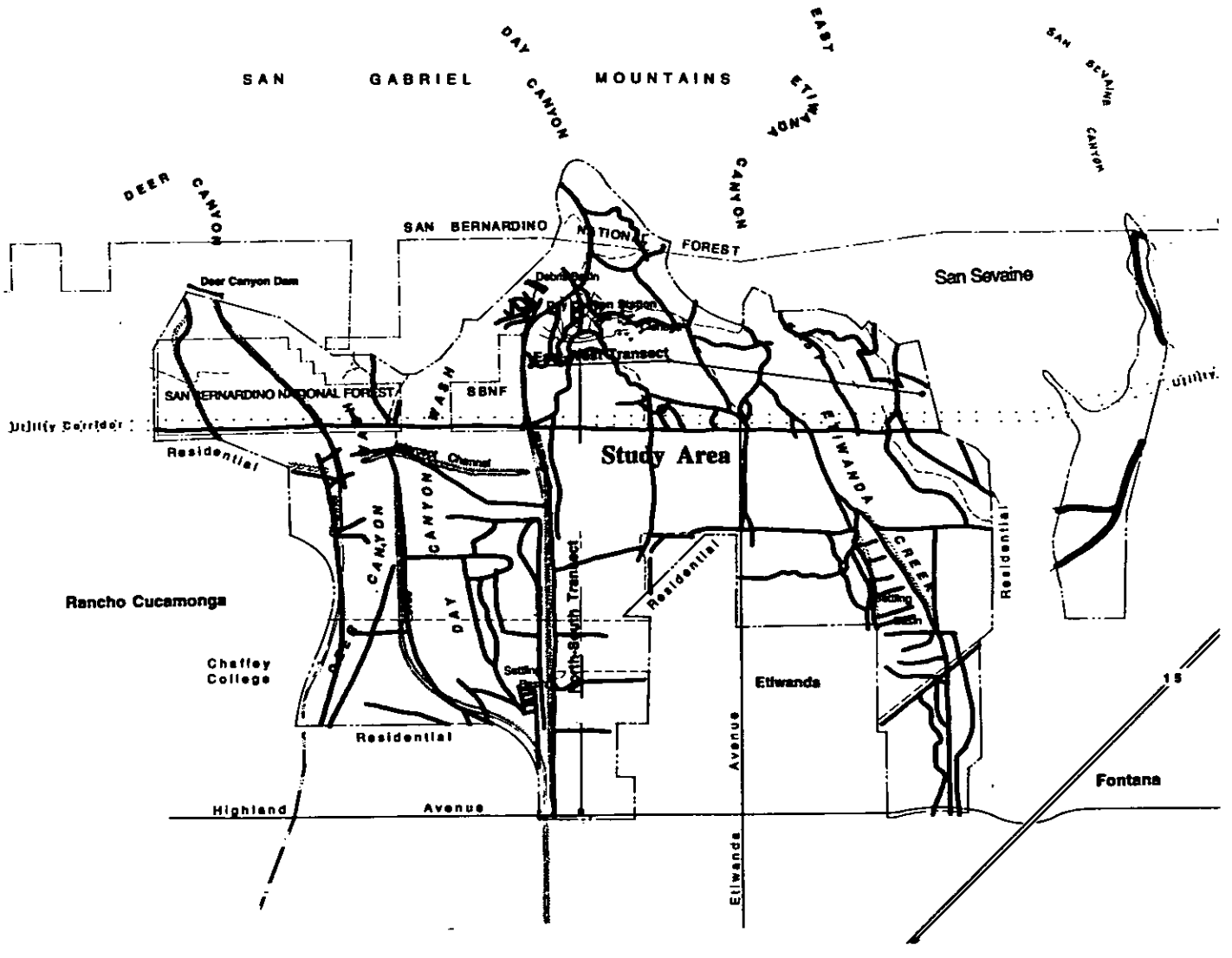
Conservation Indices #4 PERIMETER TO LINEAR DISTURBANCE RATIO

Linear disturbances within an area compromise its integrity to the degree that they separate natural populations and ecological functions on opposite sides of the disturbances. These disturbances such as roads, flood control channels, and utility corridors are narrow in proportion to their length. They may constitute strong or weak barriers, depending on the nature of the populations crossed and the type of barrier. For example a concrete flood control channel might be an absolute barrier for a reptile, a moderate barrier for a small bird reluctant to leave cover (Soule et al. 1988), or inconsequential for a large bird, mammal, or wind born seed. For this study all linear disturbances have been lumped together, as shown in figure 20 on the following page, and their potential relative importance in fragmenting the two areas has been measured by calculating the ratio between total perimeter and total length of linear disturbances. By this measure San Sevaine has ten times the relative internal disruption of Etiwanda-Day Canyon. This is true even though San Sevaine has relatively few linear disturbance elements, because it has a relatively small area.

Figure 20

Conservation Indices #4, perimeter to linear disturbance ratio map



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Conservation Indices Summary

The purpose of the Conservation Indices is twofold. First, they can be used as one factor in evaluating the conservation or restoration potential between two or more stands of AFSS. Second, they can be used to help establish guidelines for shaping a conservation plan.

San Sevaine was used for this example because it was near the study site and numbers were easily available off of our already existing base map and air photos. The method now needs to be incorporated in a future study of other more distant AFSS sites in order to be fully tested. In this particular test, Etiwanda-Day Canyon is the more important site to preserve because of its overall greater size and shape. At the next largest scale however, when mapping land development and ownership patterns across the fan beyond the study site, the relationship between the two parcels in the slightly larger context becomes even more important.

PRINCIPLES AND GUIDELINES

Using the results of the sampling and the research done for the study site, the diagrams that show change over time, and the Conservation Value Indices, principles and guidelines can be established and prioritized. The guidelines will apply to Etiwanda-Day Canyon specifically, but can also be used as the basis for establishing guidelines for conservation within all of the remaining stands of AFSS in the region. As has been mentioned often in this report, more sampling, and more specific studies like this one need to be completed for all of the remaining stands. Each stand has at the same time strong similarities and unique characteristics. Their relationships to one another and to other plant communities in the region also need further study. The principles and guidelines are grouped under 3 major headings: the importance of AFSS to human support systems, maintaining key ecosystem processes at all scales, and shaping the conservation strategy at all scales, which includes the use of the Conservation Indices..

Importance of AFSS to Human Support Systems

The guidelines listed here apply to conservation planning at varying scales, from regional to site specific planning scales.

PRESERVE OR MAINTAIN AS MANY DIFFERENT STANDS OF AFSS AS POSSIBLE.

Long-term, we still do not understand how this once abundant plant community contributes to the ecological health of the region. It is very close to being eliminated completely. Keep as many different pieces as possible. AFSS is geographically distinct and complex, even within smaller areas. Many different areas within the region must be protected in order to keep representative samples of AFSS intact.

UNIQUE FEATURES: IDENTIFY AREAS WITH UNIQUE CHARACTERISTICS.

At the Etiwanda-Day Canyon study site, these include features such as the cienega, nearly pure stands of white sage, or the persistent J-shaped patch of Alluvial chaparral on the Etiwanda-Day Canyon site. Because the causes of these unique features are not clearly understood, preserving them for future study is even more critical. Each stand has its own unique set of characteristics that need to be identified.

RECOGNIZE THE WATER QUALITY AND WATER ABSORPTION CAPABILITIES OF AFSS.

Limit development on remaining alluvial fans. Development creates more impermeable surfaces that in turn create greater floodwater volumes downstream from the fans. Water needs to be retained and absorbed high in the watershed where more opportunities exist for holding it. This also benefits local communities by recharging groundwater tables and helps maintain water quality. Alluvial fans have high water absorption capabilities, and activities on the fans and within washes can negatively affect water quality.

RECOGNIZE THE IMPORTANCE OF REMAINING STANDS OF AFSS TO VISUAL QUALITY IN THE REGION.

Consider the visual quality contribution of each parcel under consideration. In the case of the Etiwanda-Day Canyon drainage system, the entire fan unit is visible from both Interstate 10 and from the heavily traveled Devore Cutoff portion of Interstate 15 south of Cajon Pass as well as from much of the suburban and industrial development spreading out below. Prior to development, this blanket of AFSS would have spread for miles, as far as the eye could see along the base of the mountains, a key component of the regional character. Many of the largest remaining patches are on the edges of suburban development, but should be evaluated in terms of visual quality as well as in terms of key ecosystem processes.

Maintain Key Ecosystem Processes at all Scales

DISTURBANCE

Maintain disturbance regimes, including flooding when possible, and fire. More research needs to be conducted on the effect of prescribed fires of various intensity and whether they will help maintain AFSS communities in the absence of flooding. The disturbance caused by flooding is fundamentally different than disturbance caused by fire. Fire can remove mature vegetation and stimulate resprouting or new recruitment of shrub seedlings. It also releases quantities of nitrogen, fertilizing the area. Fire cannot simulate flood events which deposit fresh sediment and scour

surfaces, removing organic matter and nutrients that play a major role in vegetation development. In areas such as the Santa Ana River, frequent fire would probably eliminate the unique California juniper component, which has developed in a fire-free environment (Meyer, personal communication, 1997).

CONNECTIVITY

Maintain connections to adjacent habitat, preserving whole fan units with adjacent washes or nearby sites for lateral connections, and through corridors along wash systems to link with larger protected areas. In many areas along the alluvial fans where development has flowed over onto steeper slopes, the only open areas remaining are the washes because of the flooding hazard, and narrow corridors are all that is available to be preserved. This is another reason the Etiwanda-Day Canyon area is important: there is still undeveloped land available to make connections between washes across the fans. In addition, there is still the potential to connect to other, larger stands of AFSS in Lytle Creek and Cajon Wash along the eastern boundary of the study site.

INTEGRITY

Maintain integrity within the stands, limiting or eliminating fragmentation.

DIVERSITY

Maintain existing diversity of native species as much as possible. Because many of the remaining patches of AFSS are small, and diverse areas support the richest species mix and most abundant wildlife populations, increasing this diversity is also important. This makes riparian areas especially critical because of the seasonal presence of water and growth of riparian-dependent tree species. There is evidence that Coast Live Oak were once more plentiful in foothill areas, especially near drainages and may have been removed as firewood, and this should be investigated as a possible component of these areas. Chaparral, called Alluvial chaparral when it occurs within AFSS, is also an important component to maintain where it occurs. In the Etiwanda-Day Canyon area, there are also other unique communities that contribute to overall diversity, such as the Cienega and stands of white sage. From the sampling transects, it is also clear that proximity to washes and positions of plant communities on the fans changes the species composition in ways we do not always understand, another reason to preserve as large an area as possible in terms of diversity.

HEALTH

Biologists prefer to have statistically accurate sampling in order to determine the health, or condition of plant communities, and this should be done as much as possible. Some of the questions that need to be answered are: How many non-native plant species are present? How many native species are missing because the disturbance factors that help maintain healthy stands of AFSS are not allowed to occur? How have human activities changed the site over time? The sampling completed for the Etiwanda-Day Canyon site showed that along the sampling lines many of the components of a healthy stand of AFSS are present, with non-native invasive plants not as abundant as expected. In an old gravel pit along the north-south transect, AFSS plants were recolonizing. At an area low on the fan near Highland Avenue, there was an unexpectedly rich and diverse stand of AFSS but this is a peninsula area surrounded by development and has since been sold to a private owner.

Even in areas that have not been sampled, a determination of relative health can be made from looking at aerial photographs and speaking with knowledgeable individuals in the area. Healthy, intact stands of AFSS (like those already preserved in the Etiwanda-Day Canyon area) should be identified and given high priority for conservation. Low density or single home development on large tracts may still leave remaining areas of AFSS in good condition. Grazing, agriculture, or other activities may have removed AFSS plant species, but could still be used for restoration or for making connections once restored. Even heavily degraded stands of any plant community can still provide habitat for some bird and animal species of that community.

Shaping The Conservation Strategy at all Scales

The Conservation Indices outlined earlier can be used as guidelines for determining which areas are a higher priority for preservation.

TOTAL AREA SIZE

Larger areas with adjacent whole fan units are important to preserve. The more area the better.

SHAPE

The shape of sites can be critical for maintaining ecosystem functioning. Long straight boundaries around a blocky interior are better than invasive peninsulas of development or other negative habitat (including vacant lots). The more circular the shape the better: this minimizes contact to the maximum degree. Boundaries should be straightened through land trades or acquisitions. Parcels that could act as a buffer to intact AFSS or restore connections should be acquired.

ADJACENT USES

Uses across the boundary from AFSS affect the conservation value of remaining sites. Put a high priority on sites that still have boundaries with existing or protected natural areas, or where developed areas (such as agriculture) could be restored.

LINEAR DISTURBANCE

Linear disturbances within an area compromise its integrity to the degree that they separate natural populations and ecological functions on opposite sides of the disturbances. Eliminate fragmentation by ripping and putting old roads to bed. Limit new road construction, and invest in controlling unregulated off road vehicle use.

INVENTORY

An inventory of the Etiwanda-Day Canyon study site and surrounding areas is shown in figure 21 on page 62. Using black, gray and white tones (described below), different degrees of protection status are illustrated. This inventory will be used as the basis for the conservation strategy, and is meant to illustrate a process that could then be used to study all AFSS sites in the region.

Land ownership has not been confirmed at this point, other than legal boundaries for established areas such as conservation easements and the National Forest. In order to better understand the study site and illustrate the predicted mosaic of private and public land ownership patterns, information was obtained from the San Bernardino County Assessors Office in 1997 (shown in figure 14), but since that time some of the property may have changed owners. The use of the inventory is primarily to determine the general location of highly desirable candidate sites to establish a meaningful, functioning ecosystem in the Etiwanda-Day Canyon fan system, and further detailed study of actual, present-day ownership would be required before further action is contemplated.

Shading on the Inventory Map

Using recent aerial photographs and maps for location, existing suburban development was shaded very dark, as shown on the legend for figure 21. This includes the corridor along Highland Avenue along the southern edge, which is very near where the State Route 30 Freeway will be constructed. It has been assumed that existing construction would not be removed, and that all areas thus covered are not available for future consideration for conservation. Single homes or low density development that could be seen on the photo was also shaded dark.

If the area surrounding this type of development did not contain obvious structures but it was clear much of the AFSS vegetation had been removed through grading or grazing, it was designated with a diagonal line. This was also true of orchards, shown with diagonal lines going the opposite direction. All of these are possibly areas that could be managed or restored in order to maintain or establish critical connections.

The lighter gray shading in the legend designates the area owned and managed by the San Bernardino National Forest (the boundary of the Angeles National Forest is just to the west of the study site). The boundary of the National Forest is jagged, containing both private inholdings and disconnected parcels with privately owned land in between. National Forest lands can be considered to be protected and preserved for long term conservation, but private inholdings within the boundary could still be developed. Most of the time, the forest boundary does not begin until midway up the steep slopes above the fans, so many of the alluvial fans along the foothills have been completely covered over by development. This is another reason that the Etiwanda-Day Canyon area is unique: the edge where the mountains meet the fan and chaparral and AFSS are still contiguous and intact. The MWD property shown in figure 14 was recently acquired as mitigation and is now shown here protected as part of the San Bernardino National Forest.

A slightly lighter gray shade shows the major recent conservation acquisitions outlined in Section IV and shown in figure 14: the SANBAG property, and the Day Canyon Preserve. These can be considered for planning purposes as protected.

The San Sevaine Water Project area (shown as a gray screen covered by horizontal lines) is currently owned by the San Bernardino County Flood Control District, but 137 acres of active wash will eventually be designated for protection within this larger area. Remaining areas within the wash can not be considered protected.

The irregular dotted shading west of the Day Canyon Preserve (the long rectangular area running north and south) and the area at the lower end of San Sevaine (below the current developed areas and along Interstate 15) belong to the San Bernardino County Flood Control District. The area south of the Day Canyon Preserve and managed by the San Bernardino County Flood Control District has recently been leased for rock and gravel mining. While not protected by San Bernardino County for conservation, these areas consists of active wash and historically flood prone areas and could possibly be managed in a way that protects AFSS communities even if ownership was not obtained.

As shown on the map, development both west and east of the study site has covered the fan and reached the steeper slopes of the mountains. The development on the west is dense, and continues west across the fans with fewer and fewer undeveloped fragments within it. The development on the east however is not as extensive, although future development may occur (some is already under construction but had not been started at the time the aerial photographs were taken). This is the area where potential connections to Lytle Creek and Cajon Wash could occur.

The white areas remaining are undeveloped AFSS without regard to specific ownership of the property. As can be seen in figure 14, the white areas are a complex mosaic of private ownership by individuals, corporations, and public and private utilities. Powerlines run across the study site from east to west, and a number of floodwater diversion structures, including concrete channels run north to south. Prioritizing the importance of these white areas using the principles and guidelines established earlier in this section will be the basis for the conservation strategy.

Figure 21

Inventory Legend

Development Pattern/ Open Areas

Sources:

- Based on USFS air photos, 1994
- USGS Cucamonga Peak/ Devore Quads, 1968
- San Bernardino Co. Assessors office information
- California Dept. of Fish and Game

(Not all information/ lines confirmed)


Developed suburban and/ or commercial


Protected or managed for conservation


San Bernardino County Flood Control District


San Bernardino County Flood Control District, leased for gravel mining


Includes 137 acres of mitigation property for the San Sevaine Water Project


Agriculture


Undeveloped but degraded


Open, AFSS or chaparral

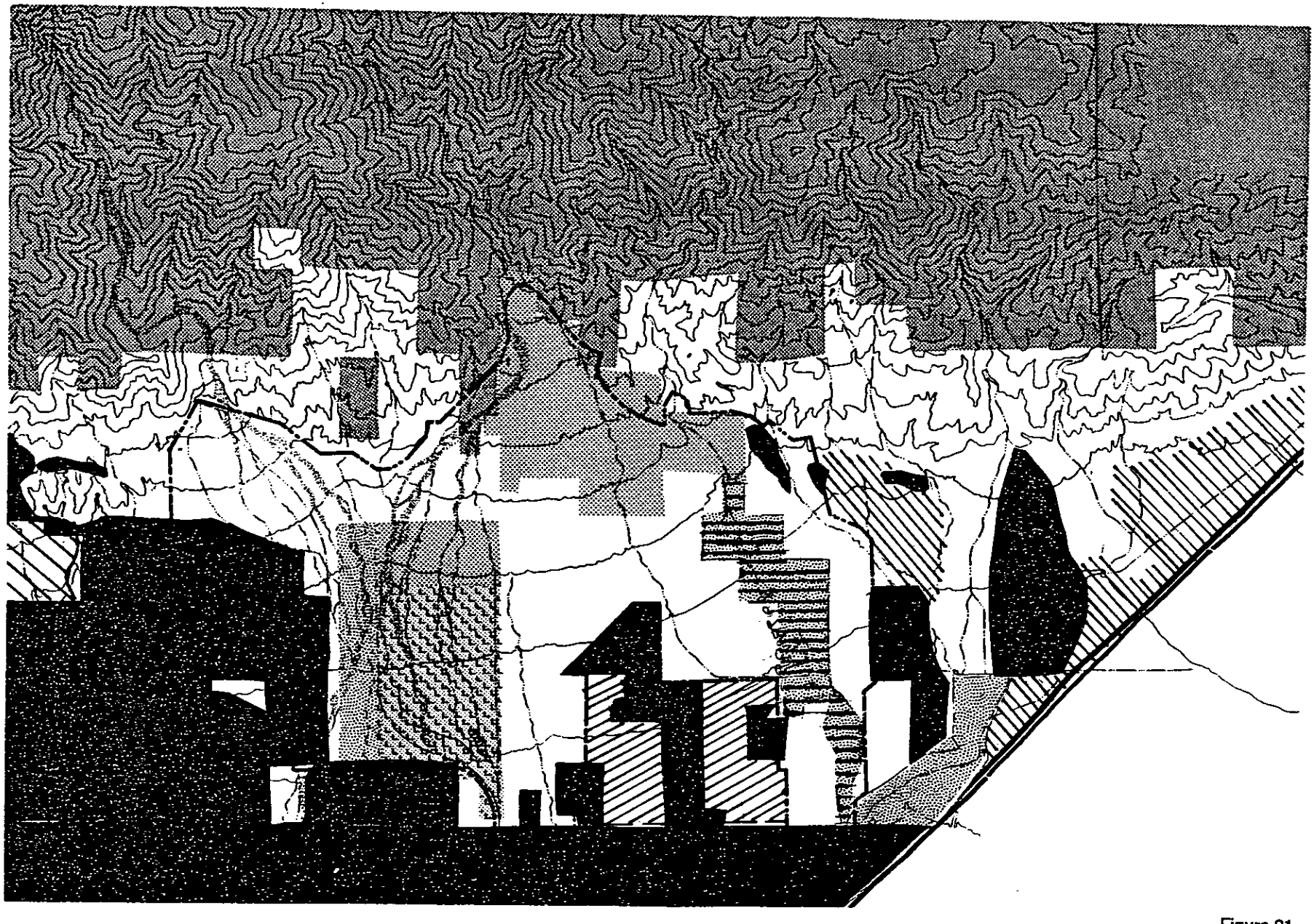


Figure 21

Inventory

CONSERVATION PLAN for the Etiwanda-Day Canyon Drainage System, Supporting the Rare Natural Community of ALLUVIAL FAN SAGE SCRUB

California Department of Fish & Game, US Fish & Wildlife Service, California State Polytechnic University, Pomona

CONSERVATION STRATEGY

Now the principles and guidelines can be applied, integrated with an overall understanding of the function of alluvial fans and AFSS communities and a knowledge of the human history of the area. The major goal: a viable preserve system that maintains both the regional diversity of AFSS stands and the key ecosystem processes necessary for functioning habitat.

Applying the Principles and Guidelines

The principles and guidelines can be used in order to establish highest, high, and moderate priorities for acquisition or conservation protection. It may not be absolutely necessary to purchase the property if the owners, especially individuals with single family homes, utility companies, flood control or water districts are willing to manage an area in a way that preserves its habitat value. However, acquisition is still the most desireable alternative.

The priority ranking used to create the Conservation Strategy, shown in figure 22, page 67, was developed for Etiwanda-Day Canyon specifically. Again, different AFSS stands within the region have unique characteristics, and priority rankings for these other areas need to be determined.

HIGHEST PRIORITY

Areas of active washes
• Areas 1 and 2 on the Conservation Strategy meet this criteria.

These are high hazard areas for development, and are important places where AFSS can experience the flooding disturbance needed for maintaining itself. They are often important connection corridors between patches of isolated AFSS. This includes the large areas owned by the San Bernardino County Flood Control District: it may be possible to meet the goals of both the County and conservation if this parcel is carefully managed.

Parcels that would preserve the boundary between AFSS (alluvial fans) and the steeper chaparral slopes (the northern boundary of the study area closest to the National Forest boundary shows an example of this important zone.)
• Areas 1, 3, 5 and 6 meet this criteria.

This would not only maintain connections to existing preserved habitat, but help create a cleaner, more consistent boundary for the National Forest, eliminating islands and adjacent edges of with development. However, an effort should be made to avoid creating islands, isolated patches with no connection to a larger, more stable parcel.

Connectivity: connect smaller, protected areas to one another or to other larger, more stable protected areas.

Connect areas to one another:
•Areas 1 and 4 strongly meet this criteria.

Any open areas on the eastern (San Sevaine) side
•Areas 5 (alluvial fan), and 6 (steeper slopes) are the key pieces for meeting this criteria.

There are already some possibilities of conserving active washes along San Sevaine, but these washes are already being channelized for floodwater diversion because of current development moving north up the alluvial fan toward the National Forest. Washes establish a north-south connection, but the San Sevaine area includes critical west to east connections to Lytle Creek and Cajon Wash. Already, the alluvial fan areas shown in area 5 have lost most of their original vegetation through agriculture, grazing and scattered development and would need to be restored. However, even if fan areas cannot be redesigned to include lateral connections, the steeper slopes above the fans, shown in area 6 and not owned by the Forest Service should be acquired or managed for conservation to keep these connections open.

HIGH PRIORITY

Any of the other undeveloped areas shown on the map as white that can be acquired
•Areas 7, 8, 9, 10, and 11 meet this criteria, along with scattered orchard and gravel mining parcels.

This includes areas with low density development, grazing, or orchards. Even severely altered AFSS has some habitat value to raptors and some sensitive rodent and reptile species which can still survive. It can also provide important buffer zones for more intact stands of AFSS, especially against the infiltration of non-native ornamental plants used in suburban developments. In some cases, even degraded parcels can be used for possible land swaps for more critical pieces that meet the criteria for conservation higher on the fan.

The results from the bird sampling show a significant increase in avian species richness and abundance of individual birds in the riparian areas. Based on these results we make two recommendations:

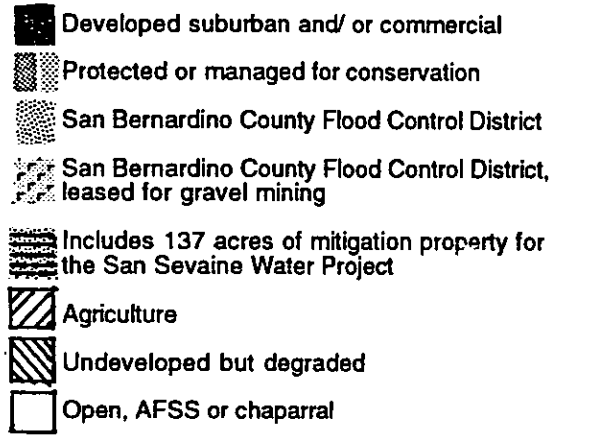
1. Areas within one hundred meters of flood channels and intermittent streams be given high priority, and
2. Areas with emergent shrubs such as Chaparral whitethorn, chamise and others also be given high priority for preservation.

MODERATE PRIORITY

Areas completely surrounded by existing development, unless they provide an opportunity for corridors, or could function as habitat for bird species in a given area where habitat is scarce.
In the case of Etiwanda-Day Canyon, the areas already surrounded by development at low elevations on the fan are given a moderate priority because of both proximity to development and probable high property costs for acquisition. .

Figure 22

Conservation Strategy Legend



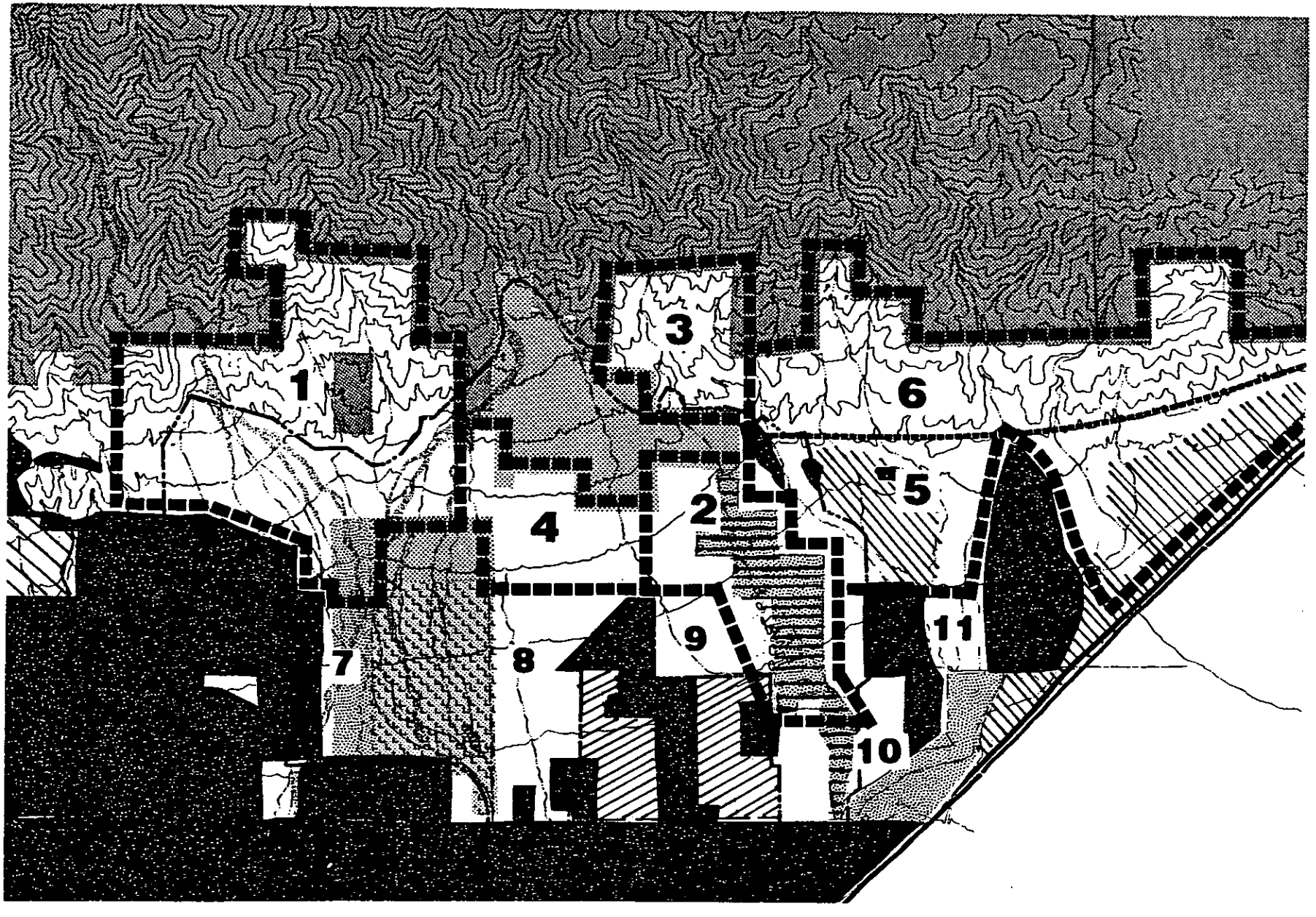


Figure 22

Conservation Strategy

CONSERVATION PLAN for the Etiwanda-Day Canyon Drainage System, Supporting the Rare Natural Community of ALLUVIAL FAN SAGE SCRUB

California Department of Fish & Game, US Fish & Wildlife Service, California State Polytechnic University, Pomona

CONSERVATION VALUE THROUGH LONG-TERM MANAGEMENT

It may be possible to negotiate conservation management for privately owned parcels even if the property cannot be acquired. For example, private and public utilities own numerous, fragmented parcels within the white area shown on the map, especially near power lines. The opportunity exists for the owners to manage for conservation in return for tax benefits. Conservation easements may also be used in order to allow single houses to be built in return for dedicating the key parts of the parcel to establish connections or be used for restoration.

An investment does need to be made to eliminate or control human activities within existing protected areas that actively degrade, fragment, or change existing AFSS communities, and to acquire critical parcels. Off road vehicle use needs to be controlled. Roads necessary for flood control, fire control or utility company personnel should be rendered inaccessible to the general public with locked gates. All others should be permanently blocked to traffic and ripped (torn up using a tractor) if possible, and allowed to recover.

AFSS does undergo changes when grazed, since domestic animals may often selectively eat particular plant species while avoiding others. Grazing of sheep on the site has reduced the survivorship of plants resprouting after fires especially. The short term gains from allowing grazing to occur need to be weighed against maintaining the rare and fragile stand of this once abundant community.

We recommend that non-native species of all types be closely monitored and controlled if necessary. The only non-native shrubs or trees present in the Etiwanda-Day Canyon Study Site are tree tobacco *(Nicotiana glauca)* and horehound *(Marrubium vulgare)* and the combined number of individuals of both of these species was only eight, six of which occurred in the abandoned gravel quarry. Giant arundo occurs in the sandy alluvium just east of the Day Creek flood channel. Sweet alyssum occurred in the vicinity of the paved road to Day Canyon Station. It is hypothesized that this species was introduced from a now abandoned settlement. The expected invasions of non-native species were not detected except in the active flood channels and washes, and disturbed areas and even then most of the non-natives are Eurasian annual grasses and herbs. Based on the fact that giant arundo is the only large non-native perennial to occur in mature intact AFSS well removed from any disturbance boundary in our study area, we believe this species is probably the most dangerous of all introduced exotics and eradication of this species should be given the highest of priorities. The presence of sweet alyssum in AFSS at a considerable distance from any disturbances indicates that this species could cause a problem by displacing native forbs. Given the differences between the remaining AFSS stands in the region, it is not unreasonable to expect a different set of non-native invasive plants in other AFSS stands.

CONCLUSION

AFSS is an increasingly rare, fragmented community; and an important component of regional biodiversity. Its physical character and location also gives this community a prominent role in future planning efforts for the region. While alluvial fans and washes have long been perceived as the source of "devastating" floods in the region, the fire-flood cycle is only temporarily diverted by the water harvesting and floodwater diversion structures that are currently in place. The sediment that was once washed down out of the mountains is the same sediment that built the fans over time, was carried away by rivers and built the Los Angeles basin, and brought along sand for its beaches. This same sediment is presently being stored upstream in debris basins. The vast water storage and recharge capabilities of this deep alluvium are increasingly being lost, and the impermeable surfaces that come with urban development only make flooding problems worse as water is swept immediately into concrete channels and carried out to sea.

Preserving AFSS communities must be an important component of regional planning that includes more than preserving the biodiversity of plant and animal communities, but grows to include the health and ecosystem functioning of the human communities as well.

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APPENDIX 1

Biological Report, prepared by Michael J. Brennan

Introduction:

The remaining stands of AFSS can be expected to become increasingly smaller and more fragmented in the near future. As virtually all of the remaining stands have a large degree of interface with urban and agricultural lands, it was expected that introduced species of all types would impact the edges of these stands. The study site at the mouths of Etiwanda and Day Canyons also contains numerous types of disturbed areas within the perimeter of the AFSS stand. These areas include gravel pits, abandoned agricultural fields and unpaved roads. In addition to having a high degree of dissimilarity from one another (Barbour et al, 1996), the remaining stands of AFSS can have complex mosaics of different vegetation patterns within the boundaries of each stand (Hanes et al, 1989). The Etiwanda/Day Canyon typifies this in that it contains a number of potentially unique associations. The combined factors of disturbance, heterogeneity, potential edge effects and readily available information determined the selection of the Etiwanda/Day Canyon area as our study site. The purpose of our vegetation sampling was threefold; 1) to describe the vegetative associations at various locations on the fan, 2) to assess the presence and magnitude of any edge effects in the AFSS stand, and 3) to assess the utilization patterns by avifauna in AFSS.

Methodology:

The alluvial fan sage scrub (AFSS) stand at the Day Canyon/ Etiwanda Site was sampled using four line-intercept transects which encompassed the entire 2.7 km east to west width of the SANBAG property and 1.5 km of the north to south distance between Highland Avenue in Rancho Cucamonga to the south and the San Bernardino National Forest Boundary to the north. The first transect runs in an approximately east to west direction and is divided into 54 sample units of 50 meters in length. The second transect runs 550 meters in a north/south direction from the Department of Water and Power utility corridor to the base of Day Canyon Station and is divided into eleven sample units of 50 meters in length. A third transect begins at Highland Avenue and continues north for a distance of 750 meters. The third transect occurs on property currently owned by the University of California Board of Regents and is divided into fifteen sample units of 50 meters in length. The fourth transect consists of four sample units and encompasses a disturbed area used for illegal dumping and an abandoned gravel quarry approximately 1.1 km north of Highland Ave. and 150 meters east of the Day Creek flood channel.

All species of trees, shrubs and subshrubs were included in the data as was the amount of open space. A polythetic agglomerative cluster analysis using a percent dissimilarity index was performed on the sample units using raw abundance values. The data were also analyzed by both species and sample units using a Detrended Correspondence Analysis. Both the cluster analysis and the DCA ordination were run using the Cornell Ecological Programs (Ludwig and Reynolds, 1996).

The avifauna at the Etiwanda/Day Canyon area was sampled once every ten days. There were seven observation sites within the study area. Four of the sites were arrayed in an east-west direction and three were arrayed in a north-south direction. The sites encompassed all types of vegetation found in the area (See Table 1). The sites were located approximately 400 to 800 meters apart. The observations were conducted in the

interval from 6:30 AM to 9:00 AM. The sites were censused in alternating orders starting with either site # 1 and moving consecutively to site # 7 or starting at site # 7 and moving consecutively to site # 1. As sampling was halted no later then 9:00 AM on all days in which bird censuses were conducted, a set if censuses at all 7 sites usually took two days to complete. Each site was sampled a total of six times. Recording of data occurred for five minutes following a preliminary five minute "settling down period". The static observation was supplemented by Emlen walks and field notes collected in transit to ensure that there were no species being consistently missed as a result of the methodology. All visible bird activity within a 60-meter radius was recorded as was the exact species of plant being utilized. An analysis of variance was used to assess the differences in both the total number of individual birds sighted as well as the number of species. A Bonferroni's multiple comparisons test was used to determine which observation sites differ significantly in either the number of individual birds or the number of species. A Shannon-Wiener diversity index was used to assess the avian species diversity at each observation site.

Table 1: Qualitative Description of the Bird Observation Sites

Site	Location	Vegetation Present
# 1	750 meters north of Highland Ave. and 200 meters east of the Day Creek channel	Complex and diverse with Adenostoma, and Cercocarpus mixed with AFSS species including Lepidospartum squamatum
# 2	1.4 km north of Highland Ave. and 100 meters east of the Day Creek flood channel	AFSS with Lepidospartum squamatum, Artemisia californica and Salvia apiana
# 3	2.0 km north of Highland Ave. and 250 meters east of the Day Creek flood channel	Complex and diverse with Platanus racemosa, Cercocarpus and AFSS including Lepidospartum squamatum
# 4	3.5 km north of Highland Ave. and 350 meters east of the Day Creek flood channel	Intermediate: Salvia apiana dominated with Ceanothus leucodermis and others
# 5	800 meters ESE of Day Canyon Station	Simple Salvia apiana dominated with Eriodictyon trichocalyx present also
#6	300 meters north of the utility corridor at the northern terminus of Etiwanda Ave.	Intermediate: with Ceanothus leucodermis, Adenostoma and Juglans californica in an association dominated by Salvia apiana
#7	150 meters north of the utility road that marks the southern boundary of SANBAG property and 200 meters west of East Etiwanda Wash	Complex and diverse: Platanus racemosa, Juglans californica, Salix sp., Ceanothus leucodermis, Adenostoma fasciculatum and others in an association dominated. by Salvia apiana

Results:

Based on the cluster analysis (see figures 1A and 1B) there are six major vegetative associations at the Etiwanda/Day Canyon study site. Two of these are dominated by *Salvia apiana*. A structurally simple association consisting primarily of *Salvia apiana, Eriodictyon trichocalyx, Ericameria pinifolius* and *Croton californicus*

occurs primarily on the western half of the site between the paved road to Day Canyon Station and the Day Creek flood channel. A more diverse and structurally complex assemblage containing *Ceanothus leucodermis*, *Eriogonum fasciculatum* and other shrub species occurs between the paved road to Day Canyon Station and East Etiwanda Wash. These first two associations are similar to the Etiwanda alluvial fan group identified by Barbour and Wirka (1997). A third association dominated by *Eriogonum fasciculatum*, *Lepidospartum squamatum* and *Artemisia californica* occurs in or near the active flood channels of East Etiwanda Creek and Day Creek. This third association also occurs on the site of an inactive gravel quarry approximately one kilometer north of Highland Avenue in the city of Rancho Cucamonga. The third association corresponds to the pioneer group, scalebroom-California buckwheat association identified by Barbour and Wirka (1997). A fourth and possibly disturbance-based association occurs east of East Etiwanda Wash and in the area near the Day Creek flood channel. This association is dominated by such disturbance colonizing species as *Eriogonum fasciculatum*, *Artemisia californica*, *Eriodictyon trichocalyx* and *Lepidospartum squamatum* but contains other species such as *Rhamnus crocea* and *Juglans californica* as well. A fifth association is dominated by *Adenostoma fasciculatum* and would best be classified as Alluvial Chaparral (Barbour and Wirka, 1997). The Alluvial Chaparral typically occurs above the washes but there is a large island of Alluvial Chaparral vegetation in the middle of the site as well. The sixth association is found on the lower terraces at East Etiwanda Wash in the middle of the site and is characterized by riparian species such as *Platanus racemosa* and *Toxicodendron diversilobum*.

The Detrended Correspondence Analysis ordinated the plant species (see figure 2) on axes that seem to follow a moisture gradient of sorts and a disturbance gradient. All of the mesic species such as *Toxicodendron diversilobum*, *Platanus racemosa* and *Arundo donax* have higher values on the abscissa than the more xeric species such as *Salvia apiana* and *Croton californicus*. The mesic species tend to occur in areas that are in or relatively near the washes and intermittent streams and it is presumed that such areas would have a greater avaliability of soil moisture than the areas located on the upper terraces away from the watercourses. Disturbance colonizers such as *Eriogonum fasciculatum* and *Lepidospartum squamatum* have higher values along the ordinate than the later successional species such as *Cercocarpus betuloides* or *Adenostoma fasciculatum*. The disturbance colonizing species tend to occur in greatest densities near roadsides, bulldozed areas and flood scoured channels.

The sampling units are similarly ordinated along gradients which paralleled disturbance and possible moisture availability (see figure 3). A large number of sample units dominated by *Salvia apiana* and containing only three or four other species, including the xerophytic *Croton californicus*, have low values on the abscissa. Conversely, the sample units in or adjacent to riparian areas contained such species as *Adenostoma fasciculatum*, *Platanus racemosa*, *Arundo donax* or *Cercocarpus betuloides* have high values on the abscissa. Sample units which occurred in disturbed areas such as the flood channels of East Etiwanda and Day Wash, gravel pits or flood control berms had high values on the ordinate. Such sample units typically were dominated by *Eriogonum fasciculatum* and had relatively little canopy coverage. Sample units which occurred in

areas with few disturbances of any kind had low values on the ordinate and contained species such as *Adenostoma fasciculatum, Rhamnus crocea* or *Ceanothus leucodermis*.

The avifauna in the Etiwanda/Day Canyon area exhibits a response to the vegetative structure (see table 2). The observation sites located in areas with emergent trees and tall shrubs contained more individual birds than those sites with a structurally simple cover of shorter statured shrubs. The sites located in the more vegetatively complex areas also contained more bird species than the vegetatively simpler sites. Site # 7 which was located in the riparian corridor on the west side of East Etiwanda Canyon had both the highest number of individual birds and the highest species richness. Site # 5 which was located in structurally simple vegetation dominated by white sage had both the fewest number of individual birds and the lowest species richness (Table 3). All other sites were located in areas with intermediate vegetative complexity. These sites did not significantly differ in the number of individual birds or bird species from either site # 5 or site # 7 (Table 4). These results are not unexpected given the preference by many bird species for areas of greater vegetative complexity.

Table # 2

Analysis of Variance Summary Table for Number of Individuals

Source	Sum of Squares	D.F.	Mean Squares	F-Ratio	Alpha Probability
Between Groups	124.80952	6	20.80159	2.69318	0.0296
Within Groups	270.33333	35	7.72381		
Total	395.14286	41			

Analysis of Variance Summary Table for Species Richness

Source	Sum of Squares	D.F.	Mean Squares	F-Ratio	Alpha Probability
Between Groups	44.90476	6	7.48413	2.86278	0.0224
Within Groups	91.5	35	2.61429		
Total	136.40476	41			

Table 3

Shannon-Wiener Diversity Indices For Each Bird Census Site

Site # 1	Site # 2	Site # 3	Site # 4	Site # 5	Site # 6	Site # 7
2.43	2.265	2.128	2.103	1.677	2.108	2.606

Table 4

Bonferoni's Multiple Comparisons Between Sites

Number of Individual Birds

	Site1	Site2	Site3	Site4	Site5	Site6	Site7
Site1	0	0.097	1.079	0.691	6.743	0.173	1.079
Site2		0	1.823	1.305	8.459	0.529	0.529
Site3			0	0.043	2.428	0.388	4.316
Site4				0	3.118	0.173	3.496
Site5					0	4.758	13.22*
Site6						0	2.115
Site7							0

Number of Bird Species

	Site1	Site2	Site3	Site4	Site5	Site6	Site7
Site1	0	0.128	1.562	0.128	6.248	0.797	1.562
Site2		0	2.582	0.51	8.16	0.51	0.797
Site3			0	0.797	1.562	0.797	6.248
Site4				0	4.59	0	2.582
Site5					0	4.59	14.05*
Site6						0	2.582
Site7							0

* $p < 0.05$

Discussion:

The results suggest that prior disturbance history can strongly affect the community structure of AFSS The types of disturbance may include fire, flooding, grading and off-road vehicle damage. Based on aerial photographs taken in 1938, sample units with high ordinate values on Figure 3 are shown to correspond nearly perfectly with areas that were scoured in the flood of 1938. *Eriogonum fasciculatum*, *Artemisia californica*, *Lepidospartum squamatum* and *Eriodictyon trichocalyx* are the chief disturbance colonizers. The results indicate that the *Lepidospartum* component of AFSS is dependent on periodic flood disturbances although this community was also encountered atop flood control berms and around gravel pits that may not see such flooding. Given the correlation of the *Lepidospartum* component of AFSS with the active flood channels, we recommend that any future flood control projects be built downstream from any AFSS stands so that the flood regime may be preserved wherever possible.

AFSS containing *Lepidospartum squamatum* and a few chaparral species occurs on undeveloped parcels in the Havenview Estates Subdivision west of Deer Creek in Rancho Cucamonga which were graded in 1987. Some of this vegetation was as high as 1.5 meters (as of June, 1997). The occurrence of mature AFSS containing *Lepidospartum* on sites which have been recently graded indicate that AFSS could possibly be resilient to disturbance. It is possible that grading may mimic the mechanical scarification produced

by debris flow during floods (Mary Meyer, personal communication). It is also possible that *Lepidospartum* and other AFSS elements such as *Eriodictyon trichocalyx* may be able to resprout from below ground shoots following grading that only removes less than 30 cm or so of soil (Curtis Clark, personal communication). Based on these field observations and the accompanying data, we recommend that the presence of upstream debris basins and concrete channels not be used as an excuse to severely downgrade the status of AFSS stands threatened by development. Given that AFSS and Alluvial Chaparral containing *Lepidospartum squamatum*, *Rhamnus crocea*, *Cercocarpus betuloides*, *Ceanothus crassifolius* and *Adenostoma fasciculatum* occur in areas which had been completely denuded of vegetation and graded as recently as nine years prior to our data collection, we recommend that highly disturbed AFSS sites (as well as Alluvial Chaparral) not be written off as AFSS appears to be quite resilient to most types of disturbance.

The use of all roads by off-road vehicles users and the prevalence of illegal dumping appears to increase the level of degradation in adjacent AFSS. Shrub mortality was observed due to vehicle damage and reduced utilization by avifauna also appeared to occur in the vicinity of illegal dumping and shooting areas. The San Diego Horned Lizard (*Phrynosoma coronatum blainvillei*) may also be adversely affected by roadside habitat degradation. The territories of individual animals are larger in such disturbed areas than they are in intact habitat (Tandora Grant and Allison C. Alberts, personal communication) thus indicating a lower carrying capacity for this species where destructive human activity occurrs. The problem of illegal dumping is especially acute along the MWD corridor that forms the southern boundary of the SANBAG property and as such, we recommend that all non-essential roads in AFSS areas be rendered impassible and permanently blocked to vehicular traffic. Roads necessary for flood control or utility company personnel should be rendered inaccessible to the general public with locked gates.

The only non-native shrubs or trees present in the disturbed areas are *Nicotiana glauca* and *Marrubium vulgare*. The combined number of individuals sampled of both of these species is only eight, six of which occur in an abandoned gravel quarry approximately one kilometer north of Highland Avenue in Rancho Cucamonga and one hundred meters east of the Day Creek flood channel. *Ricinus communis* occurs along roadside disturbances in the Etiwanda/Day Canyon area but this species did not occur on any of the sample units. *Arundo donax* occurs in the sandy alluvium just east of the Day Creek flood channel. The individuals are stunted and short statured but inflorescences were observed on some of them. A more typical specimen with a height of roughly two and a half meters occurs at the southern boundary of the site on the north edge of Highland Avenue in Rancho Cucamonga. Sweet Alyssum (*Lobularia maritima*) occurred in the vicinity of the paved road to Day Canyon Station. It is hypothesized that this species was introduced from a now abandoned settlement just west of the aforementioned road.

The expected invasions of non-native species were not detected except in the active flood channels and disturbed areas, and even then most of the non-natives are Eurasian annual grasses and herbs. The type of disturbance had little effect on the types of non-natives. Eurasian annual grasses and *Marrubium vulgare* occur adjacent to active flood channels as well as in the roadside disturbances on higher ground. Based on the fact

that *Arundo donax* is the only large non-native perennial to occur in mature, intact AFSS well removed from any recent disturbance boundary in our study area, we believe this species is probably the most dangerous of all introduced exotics and eradication of this species should be given the highest of priorities. The presence of Sweet Alyssum in AFSS at a considerable distance from any disturbances indicates that this species could be problematic in areas occupied by native annuals or species of concern such as the Plummer's Mariposa Lily (*Calochortus plummerae*) or the Slender Horned Spineflower (*Dodecahema leptoceras*). Given the floristic differences between the remaining AFSS stands, it is not unreasonable to expect a different set of non-native invasive plants in other AFSS stands. We therefore recommend that non-native species of all types be closely monitored.

Fire is likely to be an important factor in the community dynamics of AFSS. A sampling unit dominated by the fire following *Lotus scoparius* occurs on the upper terrace just west of East Etiwanda Wash in an area that burned in 1988 (J.des Lauriers, personal communication). Information from the U.S.F.S. fire maps for the Cucamonga Peak and Devore quadrangles indicates that fires in the chaparral at higher elevations just above the alluvial fans are much larger and twice as frequent as those in the AFSS proper. *Lepidospartum squamatum* that burned during an anthropogenic fire at the south-east corner of the site in December of 1996 exhibit a resprouting rate of virtually one hundred percent as does the *Salvia apiana* in the burn area. Other vigorous resprouters in the burn area include *Ceanothus leucodermis*, *Ericameria pinifolius*, *Artemisia californica* and *Eriodictyon trichocalyx* although sheep grazing on the site has reduced the survivorship of the resprouters.

This evidence indicates that AFSS may be highly resistant to fire induced changes in community structure. However, it should be kept in mind that the 1996 fire moved at a high rate of speed and was of a relatively low intensity. Fires of higher intensity decrease the survivorship of chaparral species as well as coastal sage species (Westman et al, 1981), and it is not unreasonable to expect a similar relationship between burn intensity and shrub survivorship among AFSS species. As many AFSS stands now have upstream debris basins and concrete flood channels, it seems likely that the flood regime has come to an end at some of some sites. It is possible that prescribed burning could be a viable tool for maintaining the integrity of some AFSS stands in the absence of the historical flood regime. While fire wouldn't remove or deposit alluvial fill in the manner of a flood disturbance, it might be useful in returning stands to an earlier successional phase thereby facilitating preservation of some of the unique vegetative associations. This would not be advisable in all AFSS stands, especially those in the Santa Ana/Mill Creek drainage which contain a juniper component. Fire would most likely eliminate the juniper from the AFSS stand at that location (Mary Meyer, personal communication). It is recommended that research on the fire dynamics of AFSS be conducted at the earliest opportunity. It is also recommended that burned areas in the vicinity of western San Bernardino County be given a grazing free recovery period of two to three years.

The results suggest that moisture availability is also an important factor in determining the community structure of AFSS. The riparian areas contain *Platanus racemosa*, *Toxicodendron diversilobum*, *Salix sp.* and *Baccharis salicifolia*

among others. Aerial photos and plant sampling of the Etiwanda/Day Canyon site show the presence of stands of such chaparral species as *Adenostoma fasciculatum*, *Cercocarpus betuloides*, *Ceanothus leucodermis* and others along the upper terraces adjacent to the intermittent streams and larger flood channels.

The results from the bird sampling show a significant increase in avian species diversity and abundance of individual birds in the riparian areas. We believe that a significant difference in avian diversity would exist between the structurally simple white sage dominated association and those associations with taller chaparral shrubs if the sample size was larger. Based on these results we make two recommendations: 1) areas within one hundred meters of flood channels and intermittent streams be given the highest priority for preservation and 2) areas with emergent shrubs such as *Ceanothus leucodermis*, *Adenostoma fasciculatum* and others also be given high priority for preservation.

Summary of Recommendations:

* Any future flood control projects should be built downstream from AFSS stands.

* The presence of upstream debris basins and concrete flood control channels should not be used as an excuse to severely downgrade the status of AFSS stands threatened by development.

* Disturbed AFSS sites should not be permanently devalued as AFSS appears to be extremely resilient to most types of disturbance.

* All non-essential roads in AFSS areas should be rendered impassible and permanently blocked to vehicular traffic.

* Roads necessary for flood control or utility company personnel should be rendered inaccessible to the general public with locked gates.

* Eradication of Giant Reed (*Arundo donax*) should be given a high priority.

* Sweet Alyssum (*Lobularia maritima*) could be problematic in areas occupied by native annuals and rare species.

* Non-native species of all types should be closely monitored in areas where species of special concern are either known or suspected to occur.

* It is possible that prescribed burning could be a viable tool for maintaining the integrity of AFSS in the absence of its historical flood regime.

* Burned areas in the vicinity of western San Bernardino County should be given a grazing free recovery period of two to three years.

* More study is needed on the fire dynamics of AFSS and it is recommended that such research be conducted at the earliest opportunity.

* Areas within one hundred meters of flood channels and intermittent streams should be given the highest priority for preservation.

* Areas with emergent shrubs such as *Ceanothus leucodermis*, *Adenostoma fasciculatum* and others should also be given high priority for preservation.

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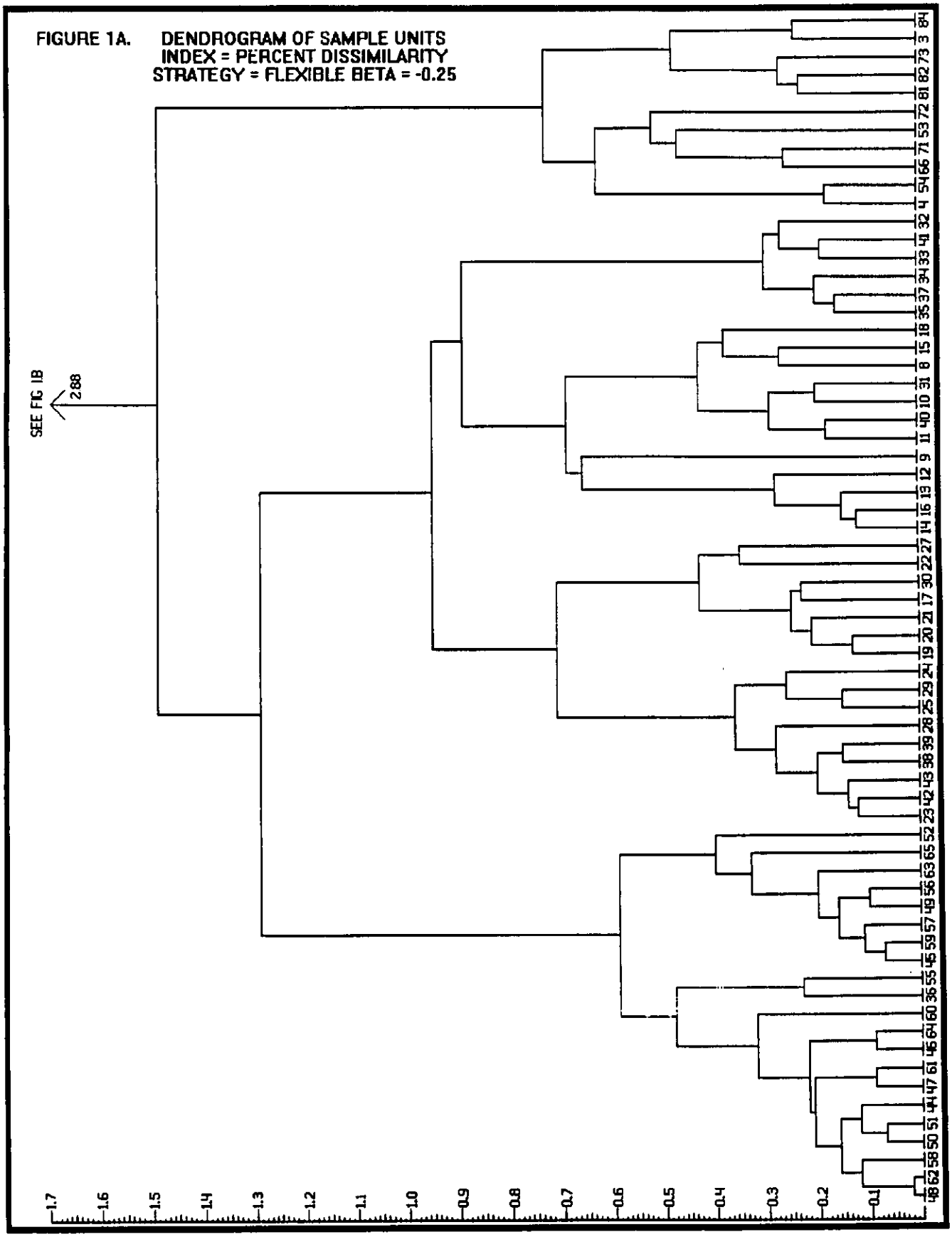


FIGURE 1A.
DENDROGRAM OF SAMPLE UNITS
INDEX = PERCENT DISSIMILARITY
STRATEGY = FLEXIBLE BETA = -0.25
SEE FIG 1B
2.88
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1

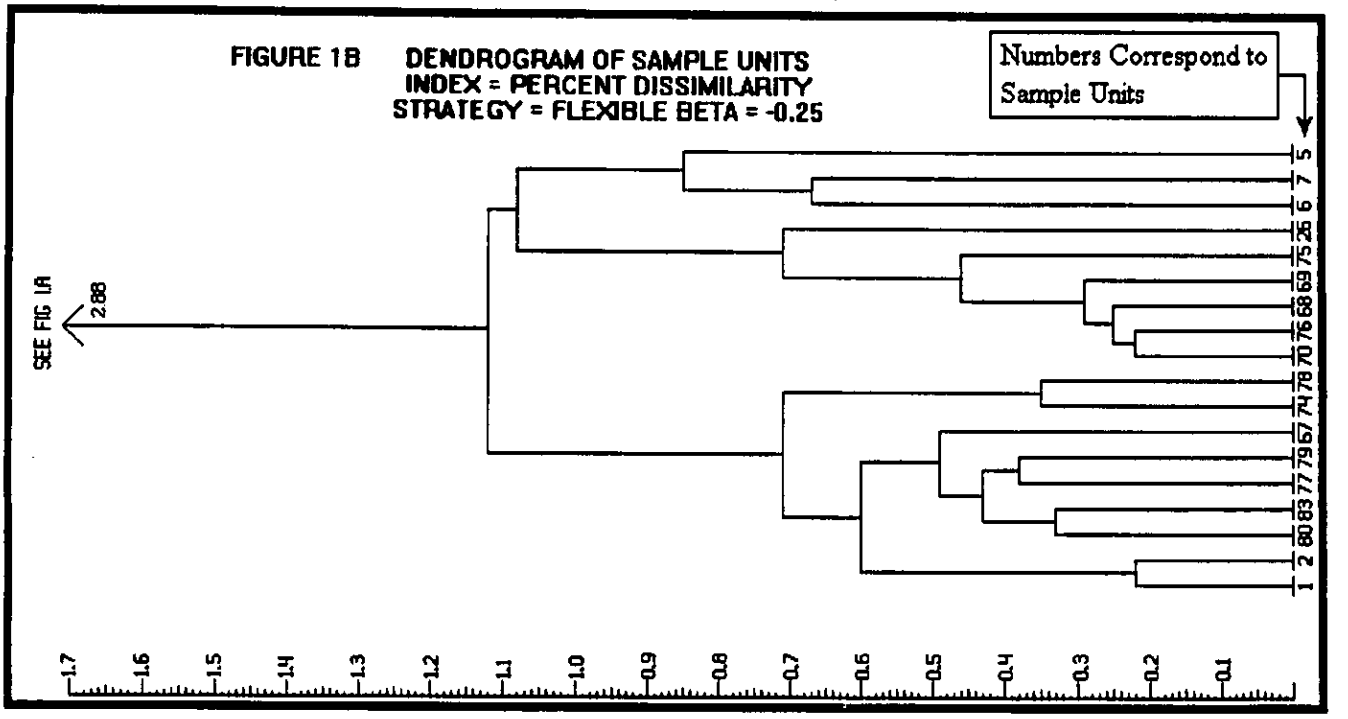


FIGURE 1B
DENDROGRAM OF SAMPLE UNITS
INDEX = PERCENT DISSIMILARITY
STRATEGY = FLEXIBLE BETA = -0.25
Numbers Correspond to Sample Units
SEE FIG 1A
2.88
1 2 80 83 77 79 67 74 78 70 76 68 69 75 25 6 7 5
1.7 1.6 1.5 1.4 1.3 1.2 1.1 1.0 0.9 0.8 0.7 0.6 0.5 0.4 0.3 0.2 0.1

Figure 2: Biplot of Species Scores

Eigenvalues: AX1 = .5217, AX2 = .2923

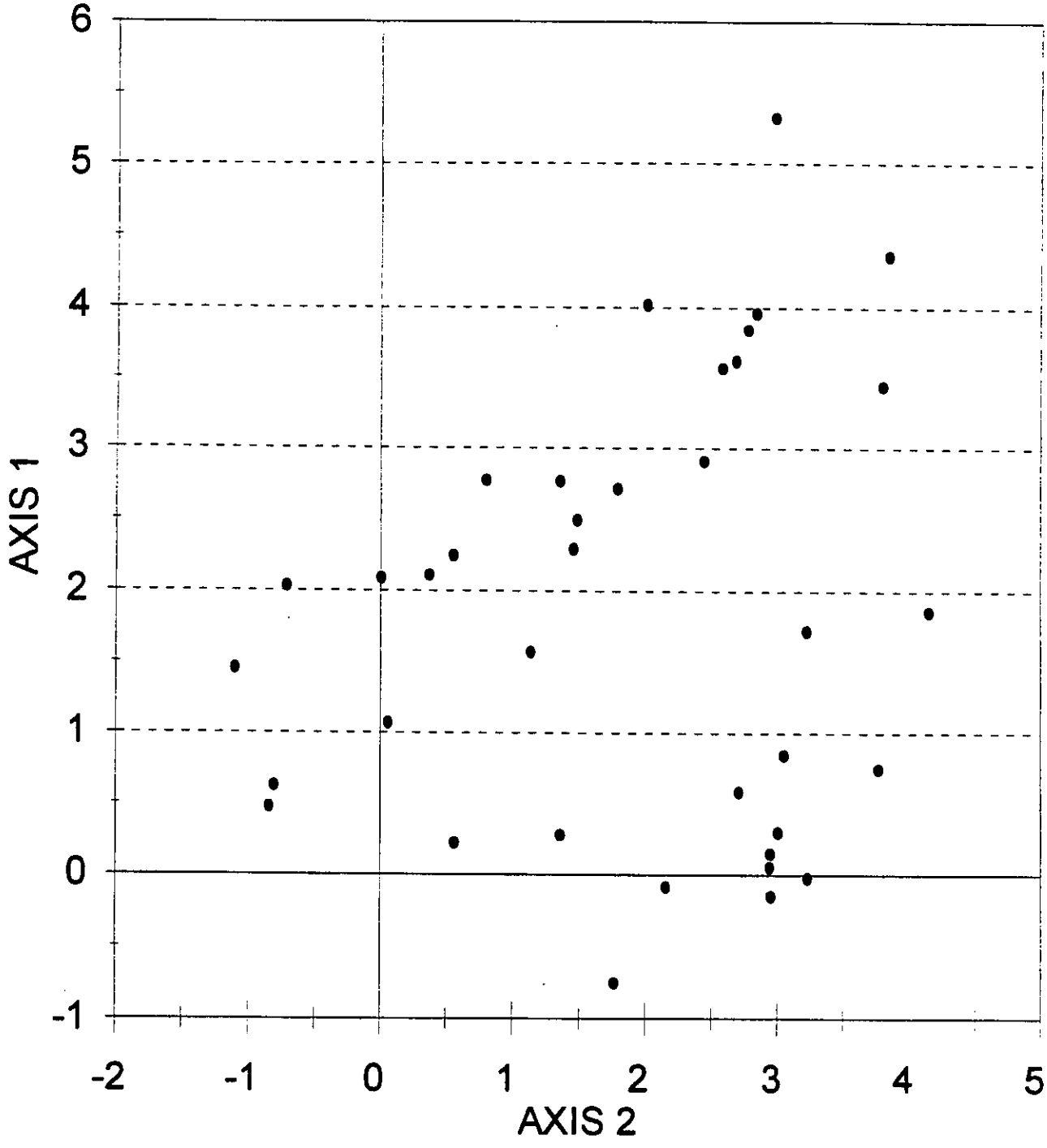
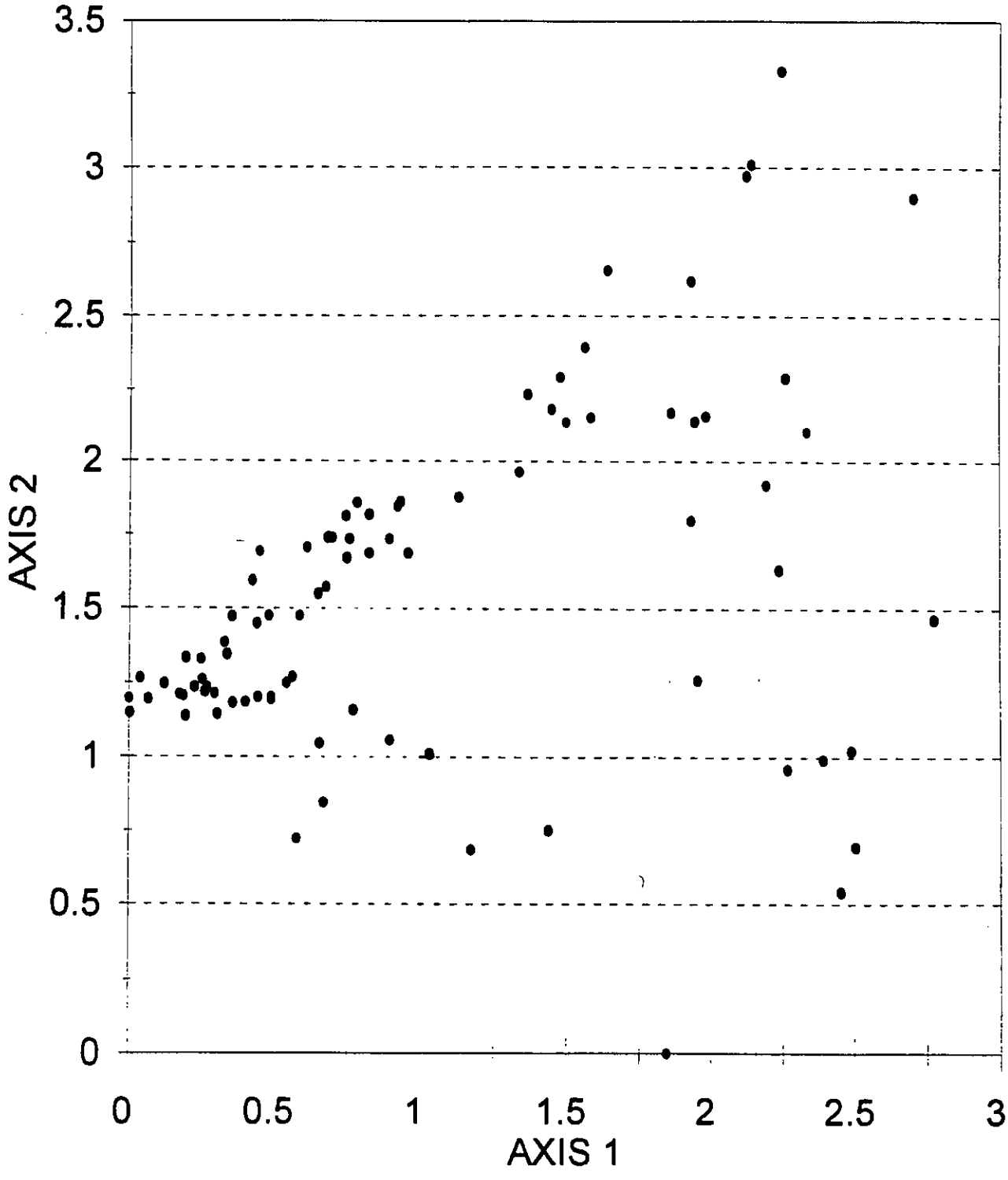


Figure 3: Biplot of Sample Unit Scores

Eigenvalues: AX1 = .5217, AX2 = .2923



APPENDIX 2
Species Lists

PLANTS OF DAY CANYON, ETIWANDA, SAN BERNARDINO, CO, CA.

Collections
1 = 1971. 164 spp. 2500-4400 ft. elevation.
2 = 1983-date. 276 spp. 2400-6400 ft. elev. Of the 347 taxa 89 appear in both collections.

The Myers Canyon fire burned the entire area on 23 Sept. 1970. The Texas Canyon fire burned East Etiwanda Canyon in ? 1987.

LICHENS
Collema tuniforme^ 2
Dermatocarpon lachneum^ 2
Dimelaena oreina^ 2
Lecanora muralis^ 2
Lecanora novomexicana^ 2
Physica millegrana^ 2
Physica subtilis^ 2
Umbilicaria phaea^ 2
Xanthoparmelia cumberlandia^ 2
Xanthoria elegans^ 2

ASPIDIACEAE - Fern (in part)
Dryopteris arguta 1 2
Polypodium californicum 1 2
Polystichum munitum ssp *curtum* 1 2

BLECHNACEAE - Fern (in part)
Woodwardia fimbriata 1 2

PTERIDACEAE - Ferns (in part)
Cheilanthes covillei 1 2
Pellaea andromedaefolia 2
Pellaea mucronata 1
Pteridium aquilinum var *pubescens* 1 2

SELAGINELLACEAE - Spike Moss
Selaginella bigloveii 1 2

ACERACEAE - Maple
Acer macrophyllum 1 2

AMARANTHACEAE - Amaranth
Amaranthus albus@ 2

AMAYLLIDACEAE - Amaryllis
Dichelostemma pulchella 1 2
Muilla maritima 1 2

ANACARDIACEAE - Sumac
Toxicodendron diversilobum 1 2

APIACEAE - Carrot
Osmorhiza brachypoda 1
Tauschia arguta 1

APOCYNACEAE
Apocynum cannibinum var *glaberrimum*^ 2

ASCLEPIADACEAE - Milkweed
Asclepias fascicularis 2

ASTERACEAE - Sunflower
Ageratina adenophora 2
Ambrosia psilostachya 2
Anaphalis margaritacea 2
Artemisia californica 2
Artemisia douglasiana 1 2
Artemisia dracunculus 2
Baccharis douglasii 2
Baccharis emoryi 2
Baccharis glutinosa (=*viminea*) 1 2
Baccharis pilularis ssp *consanguinea* 2
Brickellia californica 2
Centaurea melitensis# 2
Chrysopsis villosus (?) 2
Cirsium californicum 1 2
Cirsium occidentale 2
Cirsium vulgare 2
Corethrogyne filaginifolia var *bernardina* 2
Cotula australis# 2
Eriophyllum confertiflorum 1 2
Gnaphalium bicolor# 2
*Gnaphalium californicum** 1 2
Gnaphalium chilense 1
Gnaphalium luteo-album# 2
Gnaphalium microcephalum 2
Gnaphalium palustre@ 2
Gnaphalium peregrinum 1
Haplopappus parishii 2
Haplopappus pinifolius 2
Helianthus annuus ssp *lenticularis* 2
Helianthus gracilentus 2
Helianthemum scoparium 2
Heterotheca grandiflora 2
Heterotheca sessiliflora ssp *echioides*! 2
Hypochoeris glabra@ 2
Lactuca serriola@ 2
Lepidospartum squamatum 1 2
Lessingia grandulifera 2
Rafinesquia californica 1 2
Senecio douglasii var *douglasii* 2
Silybum marianum 2
Solidago californicum@ 2
Solidago occidentalis 2
Sonchus asper@ 2
Sonchus oleraceus 1 2
Stephanomeria cichoriacea 2

BERBERIDACEAE - Barberry
Berberis dictyota 2

BETULACEAE - Birch
Alnus rhombifolia 1 2

BORAGINACEAE - Borage

Amsinckia intermedia 1 2
Cryptantha intermedia 2
Cryptantha jamesii arbovita 2
Cryptantha muricata jonesii 1 2
Pectocarya linearis ferocula 2

BRASSICACEAE - Mustard
Arabis sparsiflora 1
Brassica geniculata 1 2
Brassica kaber 1
Brassica nigra 2
Brassica rapa ssp *sylvestris* 1
Brassica tournefortii 2
Capsella bursa-pastoris 2
Cardamine californica 1
Caulanthus amplexicaulus 1
Descurainia pinnata ssp *halictorum* 1
Erysimum capitatum 1 2
Lepidium virginicum var *pubescens* 1 2
Lobularia maritima 2
Raphanus sativus 2
Rorippa nasturtium-aquaticum 2
Sisymbrium altissimum 2
Sisymbrium officinale 1
Sisymbrium orientale 1
Streptanthus heterophyllus 1
Thelypodium lasiophyllum var *lasiophyllum* 1
Thysanocarpus curvipes var *curvipes* 1
Thysanocarpus laciniatus 1 2

CACTACEAE - Cactus
Opuntia littoralis parryi 2
Opuntia vaseyi 2

CAMPANULACEAE - Bellflower
Nemacladus ramosissimum 1

CAPRIFOLIACEAE - Honeysuckle
Arenaria (Moehringia) douglasii 1
Lonicera subspicata var *johnstonii* 2
Sambucus mexicana 1 2

CARYOPHYLLACEAE - Pink
Cerastium glomeratum 1
Silene antirrhina 1
Silene gallica 2
Silene laciniata 1
Silene verecunda 1

CHENOPODIACEAE - Goosefoot
Chenopodium album 1 2
Chenopodium ambrosioides@ 2
Chenopodium californicum# 2
Chenopodium murale# 2
Salsola kali 2

CONVOLVULACEAE - Morning Glory
Cuscuta californica 1 2

CRASSULACEAE - Stonecrop
Crassula connata! 2
Crassula erecta#
Dudleya cymosa ssp. *minor* 1 2
Dudlea lanceolata@ 2
Sedum spathufolium ssp *anomalum* 1 2

CUPRESSACEAE - Cypress
Calocedrus decurrens 1 2

CURCURBITACEAE - Cucumber
Cucurbita foetidissima@ 2
Marah macrocarpus 1 2

CYPERACEAE - Sedge
Carex alma 1 2
*Carex praegracilis** 2
Eleocharis acicularis@ 2
*Eleocharis montevidensis** 2
Eleocharis parishii@ 2
Eleocharis radicans@ 2
*Eleocharis rostellata** 2
Scirpus americanus@ 2
*Scirpus pungens** (=*olneyi*) 2

EQUISITACEAE - Horse Tail
Equisetum hymenale var *robustum* 1

ERICACEAE - Heath
Arctostaphylos glauca 1 2

EUPHORBIACEAE - Spurge
Croton californicus var *californicus* 1 2
Eremocarpus setigerus 2
Euphorbia albomarginata 2
Ricinus communis 2

FABACEAE - Pea
Astragalus pomonensis 1 2
Lathyrus laetiflorus ssp *laetiflorus* 1
Lathyrus vestitus ssp *puberulus* 2
Lotus argophyllus var *argophyllus* 1
Lotus crassifolius 2
Lotus procumbens 2
Lotus scoparius ssp *brevialatus* 1
Lotus strigosus 1
Lupinus agardhianus 1
Lupinus bicolor ssp *tridentatus* 1 2
Lupinus excubitus ssp *hallii* 1
Lupinus formosus var *formosus* 1
Lupinus hirsutissimus 1
Lupinus latifolius var *parishii* 1
Lupinus longifolius 1
Lupinus sparsiflorus 2
Lupinus truncatus 1
Melilotus indicus 1 2
Trifolium albopurpureum 1
Trifolium ciliolatum 1
Trifolium hirtum@ 2
Trifolium microcephalum 1

Trifolium tridentatum var *tridentatum* 1
Trifolium wormskioldii 2
Vicia americana var. *americana*@ 2
Vicia dasycarpa 1

FAGACEAE - Beech
Quercus chrysolepis 1 2
Quercus dumosa 2
Quercus kelloggi 2

GARRYACEAE - Silk-Tassel
Garrya veatchii 2

GERANIACEAE - Geranium
Erodium botrys 2
Erodium cicutarium 1 2
Geranium carolinianum 1 2

HYDROPHYLLACEAE - Waterleaf
Eriodictyon trichocalyx ssp *trichocalyx* 2
Eucrypta chrysanthemifolia 1
Nemophila menziesii 1 2
Nemophila pedunculata 2
Phacelia brachyloba 1
Phacelia cicutaria 1
Phacelia curvipes 1
Phacelia distans or tanacetifolia 1 2
Phacelia grandiflora 1
Phacelia imbricata ssp *imbricata* 1
Phacelia longipes 1
Phacelia minor 1 2
Phacelia ramosissima 2
Turricula parryi 2

IRIDACEAE - Iris
Sisyrinchium bellum 2

JUGLANDACEAE - Walnut
Juglans californica 2

JUNCACEAE - Rush
*Juncus balticus** 2
Juncus effusus# 2
*Juncus mexicanus** 2
*Juncus regulosus** 2
Juncus textilis# 2
Juncus xiphoides# 2

LAMIACEAE - Mint
Lamium amplexicaulae@ 2
Marrubium vulgare 1 2
Monardella lanceolata 2
Salvia apiana 1 2
Salvia mellifera 2
Salvia columbariae var *columbariae* 1 2
Stachys albens 2

LAURACEAE - Bay
Umbellularia californica 1 2

LILIACEAE - Lily
Calochortus plummerae 2
Calochortus splendens 2
Chlorogalum pomeridianum var *pomeridianum* 1
Lilium humboldtii var *bloomerianum* 1 2
Yucca whipplei ssp *parishii* 1 2

LOASACEAE - Stick-Leaf
Mentzelia laevicaulis 2
Mentzelia micrantha 1 2

LYTHRACEAE - Loosestrife
Lythrum californicum@ 2

MALVACEAE - Mallow
Malacothamnus fasciculatus var *laxiflorus* 2

MORACEAE - Mulberry
Cannabis sativa 2

MYRTACEAE - Myrtle
Eucalyptus globulus 1 2

ONAGRACEAE - Evening-Primrose
Camissonia bistorta 1 2
Camissonia californica 1
Camissonia confusa 1
Camissonia dentata 2
Camissonia hirtella 1
Camissonia micrantha 2
Clarkia deflexa 1 2
Clarkia purpurea ssp *quadrivulnera* 1 2
Epilobium adenocaulon var *parishii* 2
Epilobium paniculatum sublatum 2
Oenothera hookeri ssp *venusta* 2
Oenothera laciniata 2
Oenothera stricta 2
Zauschneria californica ssp *latifolia* 2

ORCHIDACEAE - Orchid
Habenaria unalascensis 1 2
Unidentified orchid@ 2

OROBANCHACEAE - Broom-Rape
Orobanche fasciculata 2
Orobanche uniflora var *minuta* 1

PAPAVERACEAE - Poppy
Argemone munita 2
Dicentra chrysantha 1 2
Eschscholzia californica var *crocea* 1

PINACEAE - Pine
Abies concolor 2
Pinus lambertiana 2
Pinus ponderosa 2
Pseudotsuga macrocarpa 1 2

PLATANACEAE - Sycamore

Platanus racemosa 1 2

POACEAE - Grass
Achnatherum coronatum! 2
Agoceris retrorsa 1
*Avena barbata** 1 2
Bromus carinatus 2
Bromus diandrus 1 2
*Bromus mollis** 2
*Bromus rubens** 1 2
Bromus tectorum 1 2
*Bromus trinii** 2
Dactylis glomerata 2
Distichlis spicata 2
Elymus condensatus 2
Elymus glaucus ssp *glaucus* 2
Festuca megalura 1 2
Festuca myuros 1
Festuca octoflora 1
Festuca pacifica 1
*Hordeum murinum** 2
Koeleria macrantha 1 2
Lolium multiflorum 1
Melica imperfecta 1 2
Muhlenbergia aspersifolia#
*Muhlenbergia rigens** 2
Oryzopsis miliacea 2
Piptatherum miliaceum! 2
Poa scabrella 2
Shismus barbatus@ 2
Stipa cernua# 2
Stipa coronata 1 2
Vulpia myuros ssp *myuros** 2

POLEMONIACEAE - Phlox
Allophyllum divaricatum 1
Eriastrum sapphirinum! 2
Gilia angelensis 1
Gilia capitata ssp *abrotanifolia* 1 2
Leptodactylon californicum
ssp *glandulosum* 1 2
Navarretia hamata 2

POLYGONACEAE - Buckwheat
Calyptridium monardum 1
Chorizanthe staticoides@ 1 2
Eriogonum elongatum 2
Eriogonum fasciculatum
ssp *fasciculatum* (?) 1
ssp *foliolosum* 2
Eriogonum saxatile 2
*Polygonum lapanthifolium** 2
Polygonum punctatum@ 2
Polygonum sp. 2
Pterostegia drymarioides 1
Rumex californicus@ 2
Rumex crispus 1 2

PORTULACACEAE - Purslane
Calandrinia breweri 1
Calandrinia ciliata var *menziesii* 1 2
Claytonia perfoliata var *perfoliata* 1 2

PRIMULACEAE - Primrose
Anagallis arvensis 1 2

RANUNCULACEAE - Crowfoot
Aquilegia formosa 2
Clematis ligusticifolia 2
Delphinium cardinale 1 2
Delphinium parishii ssp. *subglobosum* 2
Delphinium parryii ssp *seditosum* 1
Thalictrum polycarpum 1 2

RHAMNACEAE - Buckthorn
Ceanothus crassifolius 2
Ceanothus integerrimus 2
Ceanothus leucodermis 2
Rhamnus californica 1 2
Rhamnus crocea 2
Rhamnus ilicifolia 2

ROSACEAE - Rose
Adenostoma fasciculatum 1 2
Cercocarpus betuloides 1 2
Cercocarpus ledifolius 2
Potentilla glandulosa 2
Prunus ilicifolia 2
Rubus leucodermis 1
Rubus ursinus 2

RUBIACEAE - Madder
Galium angustifolium
ssp *gabrielense* 2
ssp gracillimum@ 2
Galium aparine 1 2
Galium nuttallii 1

SALICACEAE - Willow
Salix lasiolepis var lasiolepis 2

SAXIFRAGACEAE - Saxifrage
Boykinia rotundifolia 2
Heuchera maxima 2
Lithophragma affine ssp *mixum* 1
Ribes amarum 1 2
Ribes indecorum! 2

SCROPHULARIACEAE - Snapdragon
Antirrhinum coulterianum 1 2
Antirrhinum multiflorum 2
Castilleja martinii 1
Castilleja microstegia 2
Collinsia heterophylla var *heterophylla* 1 2
Cordylanthus filifolius 2
Keckiella cordifolia 2
Keckiella ternata ssp *ternata* 2
Mimulus brevipes 1
Mimulus cardinalis 1 2
Mimulus floribundus 1 2

Mimulus guttatus ssp *guttatus* 1 2
Mimulus longiflorus ssp *calycinus* 1 2
Orthocarpus purpurascens var *pallidus* 1
Penstemon centranthifolius 1 2
Penstemon spectabilis 2
Scrophularia californica var *floribunda* 1 2

SOLANACEAE - Nightshade
Datura metaloides 2
Nicotiana glauca 2
Solanum douglasii 1 2
Solanum xanti var *intermedium* 1 2

STERCULIACEAE - Cacao
Fremontodendron californicum 2

TYPHACEAE - Cattail
Typha latifolia 2

URTICACEAE - Nettle
Urtica holosericea 1 2

VERBENACEAE - Vervain
Verbena lasiostachys @ 2
Verbena menthaefolia 2

VISCACEAE - Mistletoe
Phoradendron tomentosum
ssp *macrophyllum* 1 2
Phoradendron villosum 1 2

Contributors to this list;

Greg Bartman
David Bixler
Rose Ann Cobos
Deborah Dorsett
Jeff Glazner
Michelle Havener
Robert Muns
Michele Myers
Jean Nelson
Wally Spaulding

Jim des Lauriers
Dept. Biology
Chaffey College
Alta Loma, CA.
91737.

Robert Thorne * = I.D. by, 1988.
Diana Six ^ = (lichens I.D. by)
John F. Wear & Nathan T Moorhatch
= ! I.D. May 1994
[Gerald Benny & Colin Wainwright
1971 (Students of Robert Thorne)]

Steve Fischer = @, CSU, Los Angeles (1995)
Jack Easton = #. Tierra Madre Consultants.

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BIRDS OF DAY CANYON
San Bernardino Co., CA
1981-date

a = can't miss.
c = seen each trip.
fc = seen on 50% of trips.
u = uncommon, be persistent.
r = rare.
ac = accidental.
n = nesting.

Heron, Great Blue	u
Mallard	r
Vulture, Turkey	u
Kite, black shouldered	uc
Hawk, Sharp-shinned	u
Hawk, Cooper's	fc, n
Hawk, Red-tailed	c
Hawk, Ferruginous	u
Eagle, Golden	r
Harrier, Northern	uc, n
Falcon, Prairie	r
Falcon, Peregrine	ac
Kestrel, American	fc
Quail, California	c, n
Quail, Mountain	c, n
Sora rail	r
Snipe, Common	r
Killdeer	u
Pigeon, Band-tailed	c
Dove, Rock	c
Dove, Mourning	c, n
Roadrunner, Greater	fc
Owl, Barn	u
Owl, Western Screech	r
Owl, Great horned	u
Owl, Short-eared	ac
Owl, Burrowing	u
Poorwill	u
Nighthawk, Common	c
Nighthawk, Lesser	u
Swift, White-throated	u
Hmgbird, Black-chinned	u
Hmgbird, Costa's	a, n
Hmgbird, Anna's	a, n
Hmgbird, Rufous	r
Kingfisher, Belted	r
Flicker, Northern	c, n
Sapsucker, Red-breasted	c, n
Woodpecker, Acorn	u
Woodpecker, Nuttall's	c, n
Woodpecker, Downy	u
Woodpecker, Hairy	u
Kingbird, Western	fc
Kingbird, Cassin's	r
Flycatcher, Ash-throated	c, n
Phoebe, Black	fc
Phoebe, Say's	u
Flycatcher, Dusky	u
Flycatcher, Willow	r
Flycatcher, Hammond's	u
Flycatcher, Pacific Slope	u
Pewee, Western wood	c
Lark, Horned	u
Flycatcher, Olive-sdd.	c
Swallow, Violet-green	fc
Swallow, Rough winged	fc
Swallow, Cliff	c
Swallow, Barn	c
Jay, Steller's	c
Jay, Scrub	a, n
Raven, Common	c, n
Crow, Common	fc
Chickadee, Mountain	fc
Titmouse, Plain	fc
Bushtit, Commmon	c
Nuthatch, White-breasted	u
Dipper	r, n
Wren, House	a, n
Wren, Bewick's	c, n
Wren, Canyon	fc
Wren, Rock	fc
Kinglet, Ruby-crowned	u
Mockingbird	a, n
Thrasher, California	c
Thrush, Hermit	fc
Robin	fc
Bluebird, Western	u
Wrentit	a, n
Gnatcatcher, Blue-gray	u
Gnatcatcher, California	r
(16 Apr 1994. McKernan)	
Waxwing, Cedar	u
Phainopepla	fc, n
Starling, European	c
Shrike, Loggerhead	fc
Vireo, Least Bell's	r
Vireo, Hutton's	u
Vireo, Warbling	c
Warbler, Orange-crowned	fc
Warbler, Nashville	u
Warbler, Yellow	u, n
Warbler, Wilson's	u
Warbler, Blk.Thtd, Gray	u
Warbler, Yellow-rumped	c
Yellowthroat	fc
Meadowlark, Western	fc, n
Oriole, Northern	c, n
Oriole, Hooded	u
Blackbird, Brewer's	fc
Cowbird, Brown-headed	fc
Tanager, Western	fc, n
Grosbeak, Black-headed	c
Grosbeak, Blue	fc
Bunting, Lazuli	a, n
Finch, House	c
Siskin, Pine	u
Goldfinch, Lesser	a
Goldfinch, American	u
Towhee, Rufous-sided	a, n
Towhee, California	a, n
Sparrow, Vesper	r
Sparrow, Lark	fc
Sparrow, Rufous-crowned	fc, n
Sparrow, Bell's Sage	fc, n
Junco, Dark-eyed	fc
Sparrow, Chipping	u
Sparrow, Brewer's	r
Sparrow, Black-chinned	u
Sparrow, White-crowned	fc
Sparrow, Golden-crowned	u
Sparrow, Song	fc
Sparrow, House	u

N = 122 species
Breeding verified.= 28 species

Compiled by;
James des Lauriers
Dept. Biology
Chaffey College
Alta Loma, CA 91737.

VERTEBRATES OF DAY CANYON, ETIWANDA, SAN BERNARDINO CO, CA.
1979 - date

AMPHIBIANS
Aneides lugubris - Arboreal Salamander
Batrachoceps attenuatus - Slender Salamander
Bufo boreas - Western Toad
Bufo punctatus - Red-spotted Toad
Hyla regilla - Pacific Tree Frog
Hyla cadaverina - Canyon Tree Frog
Rana aurora - California Red-legged Frog
Rana catesbeiana - Bullfrog
Rana muscosa - Yellow-Legged Frog
Scaphiopus hammondi -Western Spadefoot

LIZARDS
Aniella pulchra - Legless Lizard
Coleonyx variegatus - Banded Gecko
Crotaphytus collaris - Collared Lizard
Cnemidophorus tigris multiscutatus - California Whiptail Lizard
Eumeces skiltonianus - Western Skink
Gerrhonotus multicarinatus - Western Alligator Lizard
Phrynosoma coronatum blainvillei - San Diego Horned Lizard
Sceloporus occidentalis - Western Fence Lizard
Uta stansburiana - Side Blotched Lizard

SNAKES
Arizona elegans Glossy Snake
Coluber constrictor - Green Racer
Crotalus viridis - Pacific Rattlesnake
Diadophis punctatus modestus - San Bernardino Ringnecked Snake
Lampropeltis zonata - Mountain Kingsnake
Lampropeltis getulus - California Kingsnake
Lichanura trivirgata rosafusca - Coastal Rosy Boa
Masticophis flagellum - Coachwhip
Masticophis lateralis - Striped Racer
Pituophis melanoleucus - Gopher Snake
Rhinocheilus leconti - Longnosed Snake
Salvadora hexalepis virgultea - Coast Patchnosed Snake
Tantilla planiceps - Western Black-headed Snake
Thamnophis hammondii - Two-striped Garter Snake
Trimorphodon biscutatus - Lyre Snake

MAMMALS
Sorex ornatus - Ornate Shrew
Scapanus latimanus - Broadhanded Mole
Pipistrellus hesperus - Western Pipistrelle
Antrozous pallidus - Pallid Bat
Lasiurus cinereus - Big Red Bat
Ursus americanus - Black Bear
Mustela frenata - Long-tailed Weasel
Erosion cinereoargenteus - Gray Fox
Canis latrans - Coyote
Felis concolor - Mountain Lion
Lynx rufus - Bobcat
Spilogale putorius - Spotted Skunk
Procyon lotor - Raccoon
Bassariscus astutus - Ring-tailed Cat
Citellus beecheyi - Calif. Ground Squirrel
Sciurus griseus - Gray Squirrel
Perognathus californicus - Spiny Pocket Mouse
Thomomys bottae - Valley Pocket Gopher
Dipodomys agilis - Agile Kangaroo Rat
Reithrodontomys megalotis - Harvest Mouse
Onychomys torridus - So. Grasshopper Mouse
Peromyscus boylii - Canyon Mouse
Peromyscus maniculatus - Deer Mouse
Neotoma lepida - Desert Woodrat
Neotoma fuscipes - Dusky Footed Woodrat
Microtus californicus - Calif. Meadow mouse
Lepus californicus - Black-Tailed Jackrabbit
Sylvilagus bachmanni - Brush Rabbit
Sylvilagus auduboni - Cottontail Rabbit
Odocoileus hemionus - Mule Deer
Ovis canadensis nelsoni - Nelson's Bighorn Sheep

BIRDS
They appear on a separate list.

Compiled by: James des Lauriers
Dept. Biology
Chaffey College
Alta Loma, CA. 91737.

FLORA OF THE DAY CANYON SEDGE BOG, ETIWANDA, CALIFORNIA.

Amaryllidaceae	*Dichelostemma pulchella*	Blue Dicks
Amaranthaceae	*Amaranthus albus*^	Tumbleweed
Anacardiaceae	*Toxicodendron diversilobum*	Poison Oak
Apocynaceae	*Apocynum cannibinum* var *glaberrimum*^	
Asclepiadaceae	*Asclepias fascicularis*	Milkweed
Asteraceae	*Ambrosia psilostachya* var *californica*	Western Ragweed
	Artemisia californica	Calif. Sagebrush
	A. douglasiana	Mugwort
	A. dracunculus	Wild Tarragon
	Baccharis emoryi	Emory's Baccharis
	B. glutinosa	Mule Fat
	Cirsium vulgare	Bull Thistle
	*Gnaphalium californicum**	Green Everlasting
	Gnaphalium chilense^	
	Gnaphalium palustre^	
	Haplopappus pinifolius	Pine Bush
	Heterotheca grandiflora	Telegraph weed
	Helianthus annuus ssp *lenticularis*^	
	Hypochoeris glabra^	
	Lactuca serriola^	
	Lessingia glandulifera	
	Rafinesquia californica	Chicory
	Senecio douglasii var *douglasi*	Douglas Senecio
	Solidago californica^	California Goldenrod
	Solidago occidentalis	Western Goldenrod
	Sonchus asper^	Sow Thistle
	Sonchus oleraceus	
Boraginaceae	*Amsinckia intermedia*	Fiddleneck
	Cryptantha intermedia	
	Cryptantha jamesii var *arbovita*	
	Cryptantha muricata var *jonesii*	Popcorn Flower
	Pectocarya linearis var *ferocula*	
Brassicaceae	*Brassica geniculata*	Mediterranean Mustard
	Erysimum capitatum^	Wall Flower
	Lobularia maritima	Sweet Alyssum
	Rorippa nasturtium-aquaticum^	
	*Sisymbrium altissimum**	Tumble Mustard
	Sisymbrium officinale^	Tumble Mustard
Cactaceae	*Opuntia littoralis* var *vaseyi*	Prickly Pear
	Opuntia parryi	Cane Cholla
Caprifoliaceae	*Sambucus mexicana*	Elderberry
Chenopodiaceae	*Chenopodium album*	Pigweed
	Chenopodium ambrosioides^	

	Chenopodium californicum^	
Crassulaceae	*Crassula erecta*^	
Cucurbitaceae	*Cucurbita foetidissima*^	Calabazilla
	Marah macarocarpus	Bigroot
Cyperaceae	*Carex alma*	Sedge
	*C. praegracilis**	Sedge
	Eleocaris acicularis^	
	*Eleocaris montevidensis**	Spike rush
	Eleocaris parishii^	
	Eleocaris radicans (?)^	
	*Eleocaris rostellata**	Spike rush
	Scirpus americanus^	
	*Scirpus pungens** (=olneyi)	Bulrush
Euphorbiaceae	*Croton californicus* var *californicus*	Calif. Croton
Fabaceae	*Astragalus pomonensis*	Pomona Locoweed
	Lotus scoparius	Deerweed
	Lupinus bicolor	Two-color Lupine
	Melilotus indicus	Yellow Sweet Clover
	Trifolium ciliolatum^	
Geraneaceae	*Erodium cicutarium*^	Filaree
	Geranium carolinianum	Geranium
Hydrophyllaceae	*Eriodictyon trichocalyx* var *trichocalyx*^	Yerba Santa
	Phacelia distans	Fernleaf Phacelia
	P. minor	Wild Canterbury-Bell
	P. ramosissima var *suffrutescens*^	Branching Phacelia
Iridaceae	*Sisyrinchium bellum*	Calif. Blue Eyed Grass
Juncaceae	*Juncus balticus**	Wireweed
	*J. mexicanus**	
	*J. regulosus**	
	J. xiphioides^	
Lamiaceae	*Lamium amplexicaule*^	
	Marrubium vulgare	Horehound
	Salvia apiana	White Sage
	Salvia mellifera^	Black Sage
	Stachys albens	White Hedge Nettle
Liliaceae	*Chlorogalum pomeridianum*(?)^	Soaproot
Lythraceae	*Lythrum californicum*^	Loosestrife
Malvaceae	*Malacothamnus fasciculatus* var *laxiflorus*^	Bush Mallow
Onagraceae	*Camissonia bistorta*	
	C. dentata	
	C. micrantha	
	Clarkia purpurea ssp quadrivulnera	Purple Clarkia

	Epilobium adenocaulon var *parishii*	Willow Herb
	E. paniculatum sublatum	
	Oenothera hookeri ssp *venusta*	Hooker's Evening Primrose
	Zuaschneria californica var *latifolia*	California Fuschia
Orchidaceae	*Habernaria unalaskensis*	Rein Orchid
	Unidentified orchid	
Poaceae	*Avena barbata**	Slender Wild Oat
	Bromus diandrus	Ripgut
	*B. mollis**	Soft Cress
	*B. rubens**	Red Brome
	B. tectorum	Cheat Grass
	*B. trinii**	Brome Grass
	Distichlis spicata	Salt Grass
	Festuca megalura^	Fescue
	F. myuros^	Fescue
	*Hordeum murinum**	Barley
	Muhlenbergia asperifolia^	Deer Grass
	*Muhlenbergia rigens**	Deer Grass
	Oryzopsis miliacea	Rice Grass
	Schismus barbatus^	
	*Vulpia myuros myuros**	Fescue
Polemoniaceae	*Navarretia hamata*^	
Polygonaceae	*Eriogonum fasciculatum* ssp *foliolosum*	California Buckwheat
	*Polygonum lapanthifolium**	Knotweed
	Polygonum punctatum^	
	Pterostegia drymaroides^	
	Rumex californicus^	
	Rumex crispus	Curly Dock
Primulaceae	*Anagallis arvensis*	Scarlet Pimpernel
Rhamnaceae	*Rhamnus crocea*^	
	Rhamnus ilicifolia	Buckbrush
Rosaceae	*Rubus ursinus*	Black Berry
Rubiaceae	*Galium angustifolium* ssp *gracillimum*^	Bedstraw
	Galium aparine^	
Scrophulareaceae	*Mimulus floribundus*^	
	Mimulus guttatus ssp *guttatus*	Seep Monkey flower
Solanaceae	*Solanum douglasii*	White Nightshade
	Solanum xanti(?)^	
Urticaceae	*Urtica holosericea*	Stinging Nettle
Verbenaceae	*Verbena lasiostachys*^	
	Verbena menthaefolia^	
Typhaceae	*Typha angustifolia*	Cattail

DETERMINED BY: Robert Muns, Wally Spaulding, Greg Bartman, David Bixler, Jeff Glazner,

Michele Myers, Jean Nelson, Diana Younker, Jim des Lauriers;
Dept. Biology, Chaffey College, Alta Loma, CA. 91735.
* = det. by Robert Thorne, Rancho Santa Ana Botanic Garden,
Claremont, CA. 91711.
^ = det. Steve Fischer, CSU, Los Angeles. (1993-1995.)
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APPENDIX 3
Fire Resilience

Fire Resiliance

Westman and O'Leary measured resilience in Coastal Sage Scrub communities in response to fire. They looked specifically at four aspects of resiliency, which they defined as being the pace, manner, and degree of recovery of ecosystem properties following disturbance." Westman and O'Leary, 1986, p 179).

1. Elasticity; rate of recovery following a fire
2. Amplitude: threshold of disturbance beyond which recovery to the original state no longer occurs.
3. Malleability. Extent of alteration of the new stable-state from the original
4. Damping: Extent and duration of oscillation in an ecosystem parameter following disturbance.

One of the primary variables found to influence the relative resiliency of plant populations following fire disturbance was the vigor with which resprouting occurred. Weaker resprouting ability was associated with lower elasticity and less damping of population size. The exception to this were of very high intensity fires which killed a broad spectrum of shrubs regardless of resprouting abilities. Communities with a mixture of weak and strong resprouters had a lower amplitude under repeated disturbance, which became even lower with more frequent disturbance. Under this pattern of more frequent disturbance, malleability increases.

In terms of elasticity, they found through linear extrapolation that recovery in Coastal Sage Scrub is seven years.

APPENDIX 4
Hydrology And History: Day, Deer And Etiwanda Canyons

Hydrology And History: Day, Deer And Etiwanda Canyons

The hydrology of Day and Deer Canyons has been severely altered for water harvesting, flood control and sediment control purposes for several decades. Flood control devices have become major components of most of the major watersheds on the Los Angeles Basin side of the San Gabriel Mountains. This has been especially true since 1938, when a major storm flooded many communities along the base of the San Gabriel Mountains.

However, the earliest hydrological alterations took place in the late 19th century, when water harvesting became the key variable in spurring new agriculturally-based communities. During the 1860's and 1870's many claims were filed for water rights on these and neighboring canyons including Day, East (now Etiwanda), Young, Horse, and Smith Canyons. Many of the claimants' names were given to these canyons (Day, San Sevaine, Smith). George Day claimed the water in what are now known as Day and Etiwanda Canyons, and immediately started harvesting water from them. The water from the two canyons was diverted to Day and Young ranches.As speculative interests increased with the possibility of development, these water rights shifted hands several times as did land ownership. Several lawsuits and scandals also surrounded these transactions. Eventually, the majority of the water rights ended up in the hands of the Chaffey brotherswho also acquired the land that would become the town of Etiwanda. As a result of this speculation, which coincided with a land boom throughout southern California, the Chaffeys surveyed the land into parcels for sale to settlers and called the area the Etiwanda Colony Lands, after a Canadian Indian chief near their home, with the hope of attracting settlers from their region. With their water rights, the Chaffey Brothers created the Etiwanda Water Company, formed in 1882, the same year that Etiwanda officially became a town. In the Etiwanda Colony Lands, one share of stock in the Etiwanda Water Company came with every acre of each ten acre parcel. In order to provide this water, the Chaffeys had a water harvesting system installed. Concrete pipe was manufactured in Etiwanda to carry the water to the new subdivided parcels. Within a period of six months in 1882, 17.5 miles of cement pipe, ranging in size from six to twelve inches inside, was laid to supply Etiwanda with the water from reservoirs above. The water from these pipes irrigated 1,500 acres. By 1883, 20 miles of pipe had put down along with 5 miles of flumes. The water supply seemed consistent, even in drought, probably due to spring sources of water in the upper watershed. This is supported by accounts of a large earthquake along the ridge near Cucamonga Peak in 1899, after which the total amount of water flowing from Day Canyon increased (Hickcox, 1981).

The water harvesting system for Day Canyon consisted of two v- shaped, wooden flumes, made of 12" planks to supply the Etiwanda. In an article in the Ontario Fruit Grower in 1883, mention is made of the construction of tunnels to capture the underground flow of water from Day Canyon. From the flumes, the water traveled to the northern end of Etiwanda to a distribution point, known as a "sand box" (Hickcox, 1981 p.262). The water was then distributed through the concrete pipes to the properties. Once the water reached the properties, the water traveled down furrows to irrigate the crops and orchards, and to water the livestock. Household water was stored in independent cisterns.

In 1888, the State Engineer described the Etiwanda Colony Irrigation (water supply)system (Hickcox, 1981 p. 131):"The sloping plain of the colonies is 7,600 acres which is irrigated by water from Day,Young (aka Etiwanda), and Middle (aka Smith?) canyons. Flumes that are 24" wide with18" sides lead from the three canyons and tributaries. These converge north of the colony lands where the water is then distributed to the individual properties (over a distance of 2 3/4miles). A concrete-walled reservoir measuring 18' square and 7' deep stores this water until it is distributed into a pipe distribution system. They intended to install tunnels from the cienega and into the 'gravels of the canon bed.'".

In the early 1890's, another early settler named C.W. Smith dug two tunnels in the gravel beds in the wash of Day canyon. One of these tunnels was located in the upper canyon at 5600' and the other one was at the mouth of the canyon at 2800': The water was intended to support another land development venture. However, because the Etiwanda Water Company owned the water rights to the canyon, they were able to purchase the land and tunnels on it in 1903 as the result of a lawsuit. Soon after, the company constructed a pipe that linked the tunnels to their system.

This water system continued to be expanded. Funds were authorized in 1910 to construct ditches across the "debris cone" from the opening of the canyon to "the south line of section 8". This spreading area was designed to store water for summer. Another tunnel was constructed to move this water into the Etiwanda Water Company's system.

With the economic success of Etiwanda which was largely based on this water system, a school district, church, post office, and hotel were created. By 1890, two other water organizations, the Rochester Water Company Incorporated (1889), and the Grapeland Irrigation District (1890) formed to provide water to the other growing agricultural communities adjacent to Etiwanda.

The Rochester Water Company persisted until 1972 when Cucamonga County Water District purchased the company. At that time, the Rochester Water company had a waterharvesting system that included 14,000' of 8" pipe that moved water from the canyon to a 500,000 gallon reservoir. Most of this system was destroyed in the 1969 flood but a catchment at the mouth of Smith Canyon was reconstructed following this.

The Etiwanda Colony Lands remained agricultural lands for several decades. During the time of the Depression, many people from the mid-West came to the Etiwanda area to do agricultural work. This pattern persisted until the Kaiser Steel plant opened around the time of World War II, during which time agricultural production dropped in the area (Hickcox, 1981, 277). In the mid-1950's, another land boom hit southern California. Subdivisions were constructed, creating a new demand for water in the area. During this period, several other water supply organizations were created. The Cucamonga County Water District formed in 1955. The Southwest Water Company was allowed to provide water to Etiwanda as of 1956. In 1957, the Etiwanda Domestic Water Association was sold to the Southwest Water Company.

In response to the flood of 1969, Day Creek, San Sevaine and Etiwanda Canyons flood control basins were completed. In 1977, Etiwanda, Alta Loma and Cucamonga voted to incorporate into the city of Rancho Cucamonga. In 1979, the Cucamonga County Water District connected to the State Water Project (Feather River water). In 1980, the RoyerNesbit water treatment plant in north Etiwanda opened.