1995 SAN JOAQUIN HILLS BURN AREA

CALIFORNIA GNATCATCHER AND

COASTAL CACTUS WREN STUDY

prepared for:

CALIFORNIA CORRIDOR CONSTRUCTORS
P.O. BOX 57018
IRVINE, CALIFORNIA 92619-7018
(714) 753-1022

prepared by:

GRIFFITH WILDLIFE BIOLOGY
304 M-203
P.O. BOX 47
CALUMET, MICHIGAN 49913
(906) 337-0782

63 CALLE DE INDUSTRIAS, SUITE 424
SAN CLEMENTE, CALIFORNIA 92672
(714) 361-2860

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EXECUTIVE SUMMARY

The locations and breeding status of two sensitive obligate coastal sage scrub residents, California gnatcatcher (Polioptila californica californica) and coastal cactus wren (Campylorynchus brunneicapillus couesi), were determined in all potential habitat in a major portion of the San Joaquin Hills burn area surrounding the San Joaquin Hills Transportation Corridor (SJHTC) in Orange County, California in 1995. Data regarding breeding biology and behavior were collected in detail for the California gnatcatcher (CAGN). Four CAGN pairs and 6 other sites used by juveniles were located. Thirty-two coastal cactus wren (CCWR) home ranges were located, of which 24 were verified pairs. All occupied and unoccupied CAGN and CCWR habitat patches in the study area were delineated and labeled on topographic maps. Vegetative structure and composition and avian use of the labeled plots were described quantitatively. Incidental sightings of other sensitive fauna were recorded. The study was performed in accordance with the terms and conditions of the SJHTC Biological Opinion (USFWS 1994). The extensive baseline data on distribution, abundance, breeding success, behavior and habitat characteristics, collected in 1995 and successive years, can be correlated with site physiogeographic characteristics, fire history and development impacts to determine the effect of these factors and to better manage these federally listed species.

Key words: behavior, California, California gnatcatcher, Campylorynchus brunneicapillus couesi, coastal cactus wren, coastal sage scrub, development, distribution and abundance, fire, habitat, Orange County, Polioptila californica californica, San Joaquin Hills, transportation corridor.

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INTRODUCTION

The California gnatcatcher is an obligate resident of sage scrub habitat in southern California and northwestern Baja California, Mexico generally found below 250 m elevation. The species was originally described as distinct in 1881 but was subsequently lumped with the black-tailed gnatcatcher (Polioptila melanura) until Atwood (1988) concluded that it was specifically distinct based on differences in ecology and behavior, a finding later adopted by the American Ornithologist's Union (AOU 1989). A comprehensive overview of the natural and nomenclatural history of the California gnatcatcher is provided by Atwood (1988, 1990, 1991). The species was listed as threatened by the U.S. Fish and Wildlife Service (USFWS) in March 1993 due to habitat loss and fragmentation occurring in conjunction with urban and agricultural development (58 FR 16742).

The coastal cactus wren (proposed C.b. sandiegensis and C.b. anthonyi in part) is also an obligate resident of sage scrub but is further restricted to large localized patches of prickly pear cactus (Opuntia littoralis, O. oricola) and cholla (O. prolifera) within sage scrub. It too has a complicated nomenclatural history, one which is not finally resolved (Rea 1983, 1986; Rea and Weaver 1990). Currently, the name "coastal cactus wren" relies more upon the geographical than the taxonomic, and refers to wrens in coastal southern California and extreme northwestern Baja California, Mexico, which have consistently been treated by several authors as a distinct population, though at varying nomenclatural resolutions. The coastal cactus wren was listed by the USFWS in 1991 as a Category 2 candidate for addition to the List of Endangered and Threatened Wildlife due to low population numbers, limited distribution, and habitat loss and fragmentation. The species was down-listed to Category 3b (taxonomic problems) in 1994, primarily due to the lack of taxonomical separation from C.b. couesi, the cactus wren of the of the desert Southwest and Mexico (L. Hays, USFWS, pers. commun.).

The coastal sage scrub plant community in which the California gnatcatcher and coastal cactus wren almost exclusively occur (they are also found occasionally in adjacent chaparral) is a distinctive vegetation type with several subassociations, the southern limit of which coincides with the southern limit of the range of the California gnatcatcher and other biota at about 30 north latitude in Baja California (Atwood 1991 and references therein). Coastal sage scrub is composed of relatively small (<2m) mostly summer-deciduous shrubs and succulent plants, including California sagebrush (Artemisia californica), various species of sage (Salvia spp.), flat-topped buckwheat (Eriogonum fasciculatum), sunflower (Encelia californica), prickly pear and cholla cactus and various species of Haplopappus, often interspersed with larger evergreen shrubs such as lemonade berry (Rhus integrifolia) and laurel sumac (Malosma laurina) (O'Leary 1990). Coastal sage scrub habitat has been in noted decline since the 1940's and is now considered perhaps the most endangered habitat type in the continental United States due to past and planned urbanization and agricultural activities (Grinnell and Miller 1944, Atwood 1990). Only about 20% of the remaining habitat in southern California occurs on public lands; most of the remainder is slated for development (California Department of Fish and Game 1992).

In October 1993, the Laguna Beach wild fire consumed over 25,000 acres in the San Joaquin Hills, including 13,000 acres of natural vegetation, of which 6,800 acres were coastal sage scrub (County of Orange GIS, all figures approximate). Subsequently, about 470 acres of the 6,800 were found to be unburned or lightly burned (LSA 1994b). A fairly complete discussion of the effect of fire upon the coastal sage scrub community in general and upon the San Joaquin Hills in particular is contained in LSA (1994a) and Bontrager et al (1995a) respectively.

Previous avian studies in the San Joaquin Hills include several focused surveys for gnatcatchers and wrens along the SJHTC route beginning in 1988 as summarized in LSA (1994a). Most were limited in scope or design and are not directly comparable to this study, since none covered the entire burn area. The best population estimate is that prior to the fire, approximately 127 CAGN pairs and 282 CCWR pairs occurred in the 13,000 acre burn area (Bontrager et al 1995a). After the fire during the 1994 breeding season, 12 CAGN (9.4% of the pre-fire total) and 79 CCWR (28%) home ranges were located in these areas (LSA 1994b).

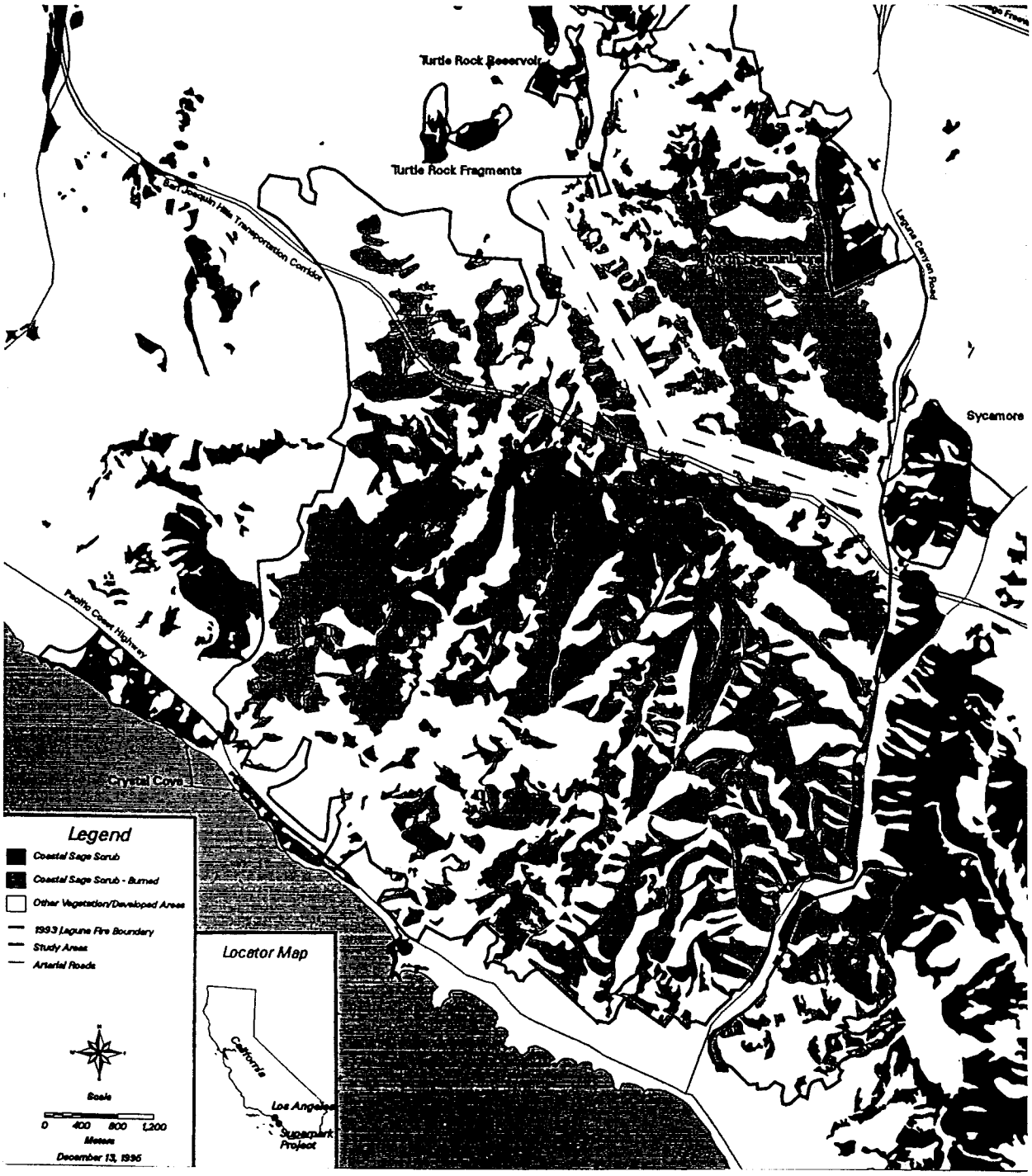
Our objective was to accurately assess the 1995 distribution and abundance of the California gnatcatcher and coastal cactus wren in a major portion of the San Joaquin Hills burn area and to collect data regarding breeding biology, behavior, and habitat characteristics for subsequent correlation with physiogeographic site characteristics, fire history, and anthropogenic disturbance and development, and to map, label and describe coastal sage scrub habitat patches for long-term monitoring of structural and compositional development and correlative use by the avian community. Sightings of other sensitive fauna and all birds were also recorded. Surveys were performed by P. Ashfield, J.C. Griffith and J.T. Griffith.

Our thanks go to C. Pinkston of California Corridor Constructors for his able administration of the project and to L. Hays of the USFWS for review of the study design. Thanks to D. Bontrager and D. Erickson for supplying their field notes from the edges of the burn area, and to D. Bontrager for his in-season coordination. Finally, thanks to Trish Smith of the California Nature Conservancy for facilitating our access to much of the study area. This study was funded by California Corridor Constructors in annual fulfillment of Term and Condition 11 of the SJHTC Biological Opinion (USFWS 1994).

STUDY AREA

The San Joaquin Hills lie in southwestern Orange County, California and encompass an area roughly bounded by MacArthur Boulevard and College Avenue on the north, Laguna Canyon Road on the south, Interstate 405 on the east, and the Pacific Ocean on the west (Figure 1). Most of the inland portion remains undeveloped, and is used for cattle ranching or local, regional, and state parks. Topographically, the area includes a few relatively flat coastal mesas along the Pacific shoreline and many steep-sided canyons and hillsides in the rugged interior. Elevations range from sea level to 365 m. The climate is typically Mediterranean, with warm dry summers and cool wet winters. The winter of 1994-95 was wetter and cooler than normal. The

Figure 1. 1995 San Joaquin Hills California gnatcatcher and coastal cactus wren survey study area (south of dashed line within burn perimeter).



Source: Bontrager et al 1995.

San Joaquin Hills contain a variety of plant communities including coastal salt marsh, freshwater marsh, riparian woodland, oak woodland, chaparral, grassland and coastal sage scrub.

We focused our study in a major portion of the approximately 13,000 acre burn area bisected by the San Joaquin Hills Transportation Corridor (refer to area south of dashed line within burn perimeter on Figure 1). A complementary study was conducted in 1995 by D. Bontrager in the adjacent northern mostly unburned portion of the San Joaquin Hills (Bontrager et al 1995b). The northeastern part of the burn area was also included in the Bontrager study area. The shared border between the two study areas was delineated in coordination with Mr. Bontrager under the direction of L. Hays, USFWS.

Within the entire burn area, approximately 470 acres of unburned or lightly burned sage scrub habitat remain (LSA 1994b). Plant species composition follows general descriptions, but several additional species are locally abundant in part because of the fire: bladderpod (Isomeris arboreus), bush mallow (Malacothamnus fasciculatus), coyote bush (Baccharis pilularis), deerweed (Lotus scoparius), Mexican elderberry (Sambucus mexicana), monkey flower (Mimulus spp.), morning glory (Calystegia macrostegia), toyon (Heteromeles arbutifolia), and wild cucumber (Marah macrocarpus). Very few areas of habitat are pristine; most have been disturbed to varying degree by fire, grazing or mechanical means, allowing the establishment of several invasive non-native plants, most notably artichoke thistle (Cynara cardunculus), fennel (Foeniculum vulgare), many grass species, mustard (Brassica spp.), Russian thistle (Salsola pestifera), and tree tobacco (Nicotiana glauca).

In sum, our study area is within the San Joaquin Hills, contains most of the burn area, and consists of hillsides of non-native grass, mustard, fennel, and thistle interspersed with well-defined large and small patches of native habitat saved from the fire in whole or part by topography or luck, to which patches the remaining gnatcatcher and cactus wrens are generally restricted.

METHODS

California Gnatcatcher and Coastal Cactus Wren Survey

We divided the study area into survey sections with borders clearly defined by roads, drainage, fire breaks, and corporate boundaries. We visited all upland areas in the survey sections and determined, independent of previous designations, all potential gnatcatcher and wren habitat. We visited sites occupied by gnatcatchers or wrens in 1994 and the unburned or lightly burned areas first (as shown in LSA 1994b). Potential habitat was surveyed on foot per Scientific Review Panel condition guidelines (SRP 1992). Daily survey areas had borders clearly defined by roads, topographic features and vegetation. Data was recorded on standardized forms (Appendix 1). Start/stop data were collected each survey day for time, temperature, cloud cover and wind speed. Surveys were not conducted in excessively cold, windy and/or rainy weather. Survey coverage was exhaustive; survey routes transected habitat patches so that visual and aural

coverage on successive passes overlapped slightly. The distance between transect paths was therefore greater during good survey conditions. Taped vocalizations of gnatcatchers or wrens were broadcast only if more passive detection means failed. Each sighting of gnatcatcher or wren was recorded in the field on enlarged 7.5 minute USGS topographic maps and data sheet with a daily sequential location number. For each numbered location, the time, species, means of detection, bands observed, breeding status, 3 dominant plants of home range, percent of home range with shrub cover and notes on subject behavior or other remarks were recorded. All sightings of other sensitive birds, animals, plants or events were recorded with location number and species only.

Upon completion, daily survey areas were delineated in the field on enlarged topographic maps and labeled with the date (year-day-month) and biologist's initials. All vegetation within the survey limits was described as occupied by gnatcatcher or wren, unoccupied habitat, or unsuitable habitat. Unoccupied habitat was split into two categories: 1. Unoccupied nesting habitat, and 2. unoccupied foraging and potential future (1-5 years) nesting habitat. Unoccupied nesting habitat was resurveyed at least once to verify absence. A comprehensive bird checklist was compiled each field day.

Surveys were performed from 04 April through 05 August 1995. The preferred survey period of 01 February - 01 May was shifted due to contractual, coordination, and study design approval delays.

Habitat Patches

All non-grassland upland habitat patches including habitat both occupied and unoccupied by gnatcatchers and wrens were mapped to enlarged 7.5 minute USGS quadrangle maps and uniquely labeled. At each location, the 3 dominant shrubs, percent shrub cover, average shrub height, general plant species composition and avian use of the site were recorded.

RESULTS

Average Daily Survey Conditions and Coverage

Daily survey average start and stop times were 0649 (range 0630-0800) and 1132 (range 0845-1400), respectively. An average of 4 hours and 44 minutes were spent surveying each field day. Start and stop temperatures (degrees Celsius) averaged 16 (range 10-21) and 22 (range 16-28) respectively. Percent cloud cover averaged 67% (range 0%-100%) at start and 39% (range 0%-100%) at stop. Wind speed averaged Beaufort force 0.5 (range 0 bf-2 bf) at start and 2.3 (range 1bf-3bf) at stop. Area covered averaged approximately 175 acres per day (range 40 acres to 400 acres). Suitable coastal sage scrub habitat was surveyed at a rate of no more than 25 acres per hour.

California Gnatcatcher

Distribution, Abundance and Status.--Three gnatcatcher pairs were located in the GWB portion of the burn area (numbers 1, 2, and 3 on Figure 2). Four additional sites supported 6 juvenile gnatcatchers (numbers 4, 5, 6 and 7 on Figure 2). None of the 7 1995 GWB gnatcatcher locations had been occupied in 1994. All but 1 of the 12 1994 occupied locations (where we focused our early search) were vacant in 1995.

Dave Bontrager reported gnatcatcher use of at least 4 sites in the northern most portion of the burn area lying within his Shady Canyon Tributary, Freeway Ridge, and Sand Canyon Reservoir study areas (Bontrager pers. commun., Bontrager 1995 and Bontrager et al 1995b). The 4 sites supported 1 pair, 2 transient female, and 2 juvenile gnatcatchers in 1995 (numbers DB 1, 2, 3 and 4 on Figure 2). Two locations in the Church Canyon area supported 4 juvenile gnatcatchers in the fall of 1995 (numbers DB 5 and DB 6 on Figure 2) (D. Bontrager, pers. commun.).

One gnatcatcher pair was reported to be using a portion of the burn area adjacent to Newport Coast Road by LSA in 1995 (number LSA 1 on Figure 2). The pair used unburned and burned habitat near the steam plant. A pair was present in 1994 in the same area. LSA also heard a single gnatcatcher late in the breeding season near the steam plant pair (perhaps a dispersing juvenile) and observed 2 gnatcatchers in the southwest portion of the burn area in September (numbers LSA 2 and 3, respectively, on Figure 2) (D.Erickson, pers. commun.). The 2 gnatcatchers sighted in September were using an area occupied by a pair in 1994. GWB located several juveniles in August near this area, and spotted a traveling family group in June nearby (see numbers 4-7, and 3, respectively), but did not record breeding season use of the LSA 3 location in 1995.

Gnatcatcher totals for the entire burn area in 1995 therefore are as follows (pooling GWB, Bontrager et al and LSA observations): 16 sites supporting at least 5 pairs, 2 transient females, and 15 juveniles. (Some of the late season sightings of gnatcatchers in areas not used by nesting pairs during the breeding season were assumed to be wandering juveniles and are counted as such.) Subsequent discussion refers only to the GWB data unless otherwise noted.

Breeding Biology.-- The 3 pairs of gnatcatchers observed by GWB all were successful in raising at least one brood in 1995 (each pair was accompanied by fledglings when first observed). The pairs had 1 fledgling, 2 fledglings, and 4 fledglings (Figure 2 numbers 1, 2, and 3 respectively). Pairs number 1 and 2 fledged their young in May, while pair number 3 fledged young in June. D. Erickson (pers. commun.) reports that the steam plant pair (LSA 1) fledged 4 young in May 1995.

Figure 2. 1995 San Joaquin Hills burn area California gnatcatcher and coastal cactus wren locations.

2a. Western portion. (Source: USGS 7.5' Tustin and Laguna Beach quadrangles)

2b. Eastern portion. (Source: USGS 7.5' Laguna Beach quadrangle)

2c. Northeastern portion (D. Bontrager area) (Source: USGS 7.5' Tustin quadrangle)

KEY

● California gnatcatcher

Gp Gnatcatcher pair

Gf Gnatcatcher transient female

Gj Gnatcatcher juvenile(s)

■ Coastal cactus wren

Wp Wren pair

Wsm Wren singe male

Wsi Wren single individual

Wj Wren juvenile(s)

Wtp Wren transient pair

Other

DB location from D.Bontrager

LSA location from D.Erickson

Figure 2a. 1995 San Joaquin Hills burn area California gnatcatcher and coastal cactus wren locations, western portion.

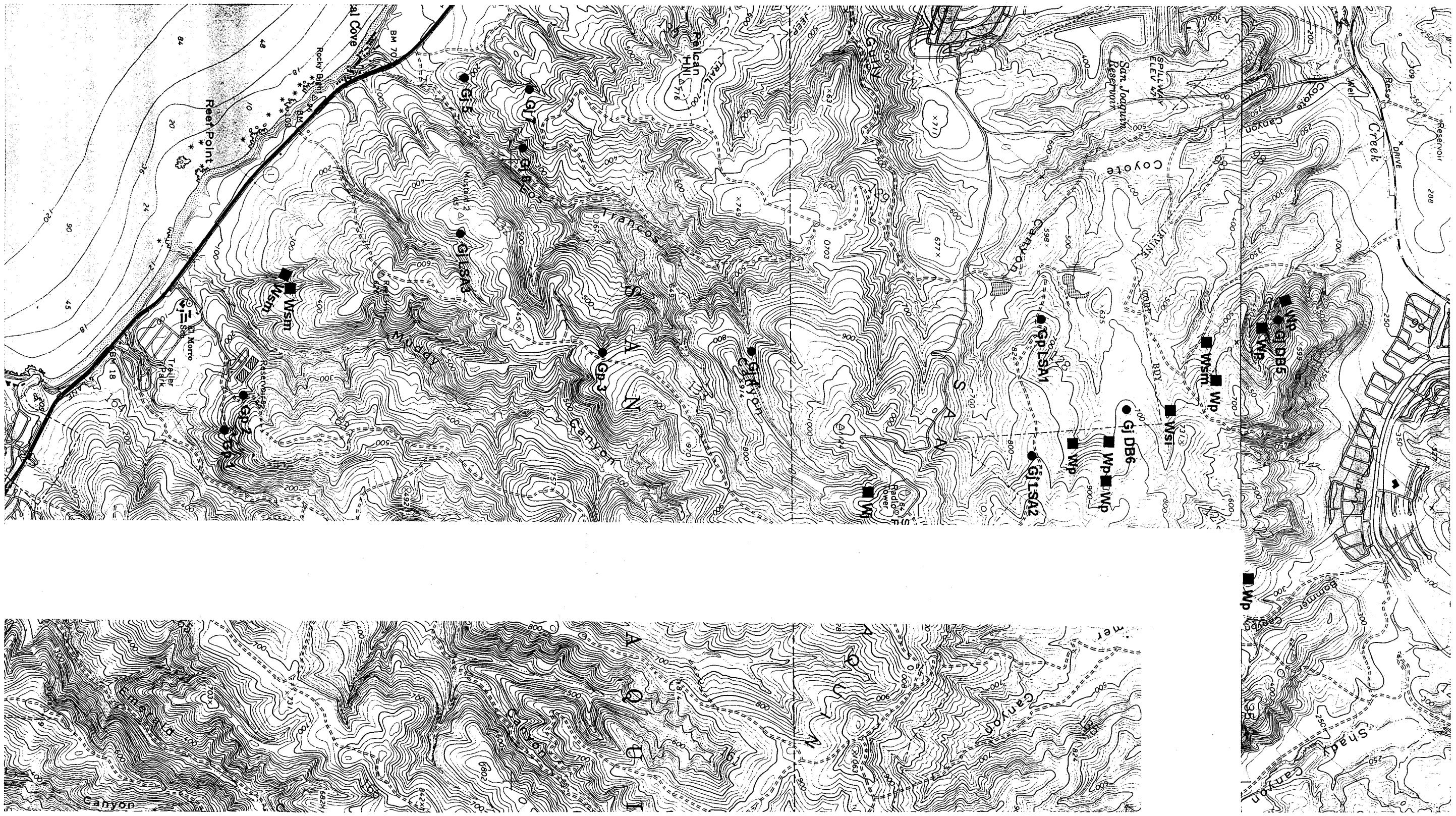


Figure 2b. 1995 San Joaquin Hills burn area California gnatcatcher and coastal cactus wren locations, eastern portion.

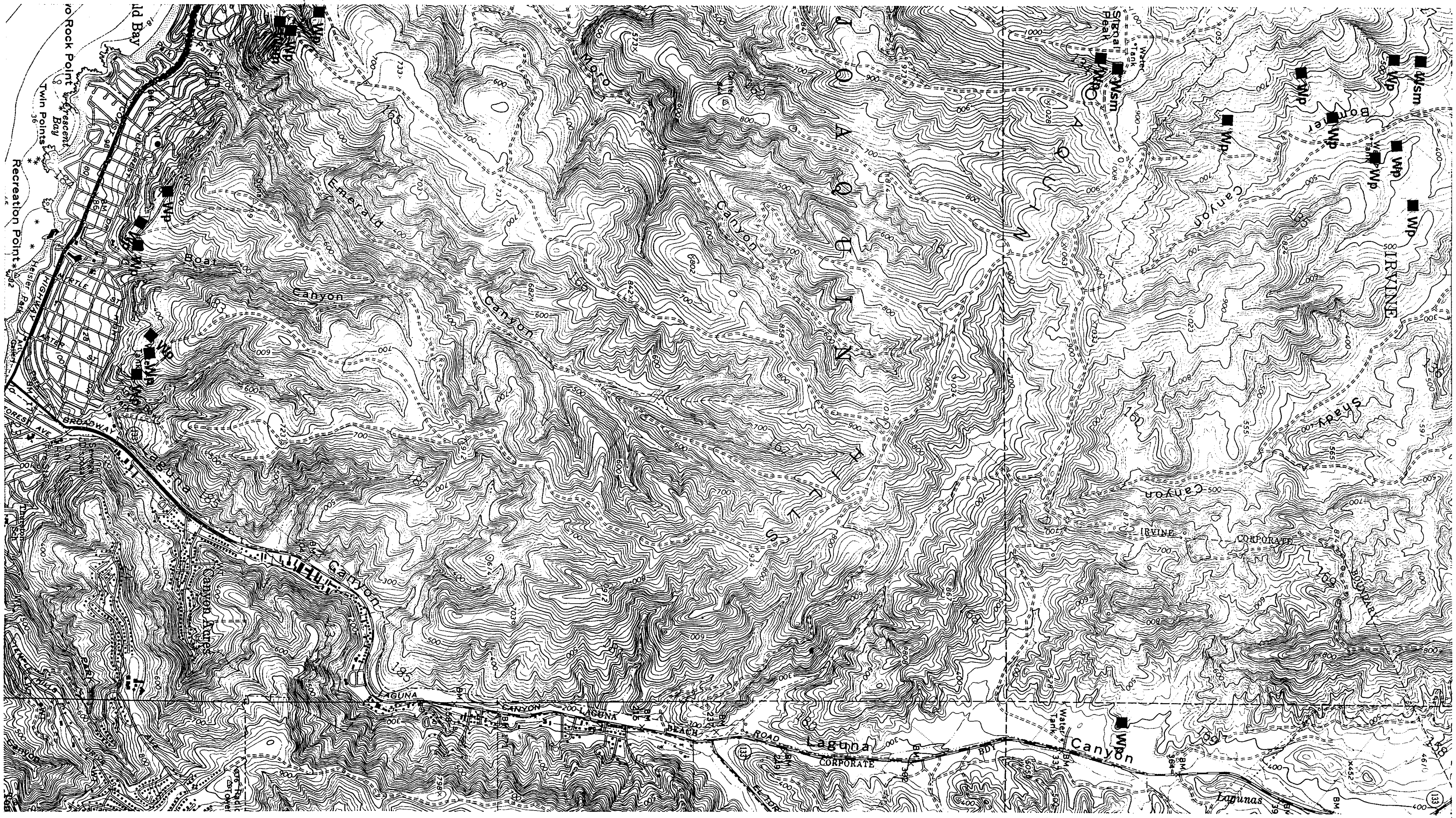
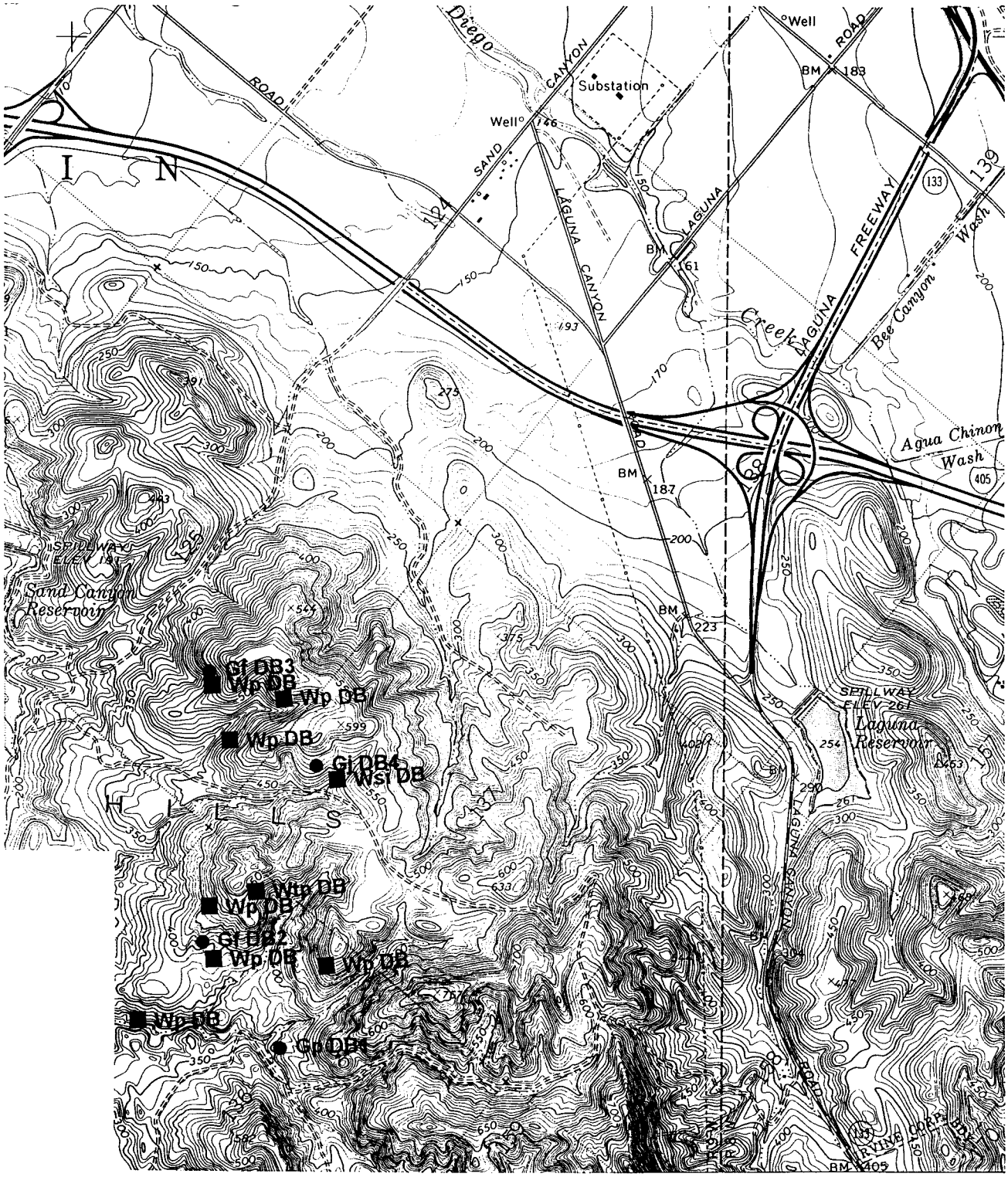


Figure 2c. 1995 San Joaquin Hills burn area California gnatcatcher and coastal cactus wren locations, northeastern portion.



Juveniles numbers 4-7 were all observed in August and could have dispersed from any of the home ranges of pairs 1-3 and LSA 1 as well as from the large breeding population of gnatcatchers nearby in coastal Crystal Cove State Park. [In fact, Bontrager (pers. commun.) documented juvenile dispersal from Crystal Cove into the burn area in 1995 (see specifics under the next heading).] Four of the juveniles seen in Church Canyon were seen in September, after the area had been intensively surveyed and resurveyed for breeding pairs or adults in April-June.

Banded Gnatcatchers.-- None of the gnatcatchers GWB observed were banded. Bontrager reported a banded transient female who moved from a location in the Freeway Ridge study area to the Shady Canyon Tributary study area on the morning of March 26 (Bontrager, pers. commun.). LSA reported that the adult female of LSA 1 was banded; this female was also present in 1994. Bontrager et al (pers. commun.) reported dispersal of 2 banded juveniles into Church Canyon (location DB6 on Figure 2). The 2 had been banded as nestlings in Crystal Cove State Park and were seen in Church Canyon on September 13, 1995.

Sighting Characteristics.-- All gnatcatchers were first detected by vocalization, and then identified visually.

Site Characteristics.-- Habitat patches used by gnatcatchers were dominated by several shrubs and weedy annuals (Table 1). The average percent shrub cover was 49% (n=6, r=30%-80%). The average shrub height was 0.9 meter (n=6, r=0.6m-1.25m).

The gnatcatcher family groups observed were foraging in weedy, atypical nesting habitat. One area was dominated by lemonade berry, toyon, and very young, small California sagebrush; the other was dominated by tall wreath plant (Stephanomeria virgata) and artichoke thistle (see Table 1). Since both pairs had fledged young already when observed, it is possible that the family groups had already moved away from nesting home ranges with higher quality habitat. However, very little high quality nesting habitat is available adjacent to the sightings (or anywhere throughout the burn area), and the pair using the area dominated by tall wreath plant and artichoke thistle had two very young (less than 1 week old) fledglings, making it unlikely that they had moved far, if at all, from their nest site.

The 4 locations where juveniles were recorded were dominated by shrubs more typically described as gnatcatcher habitat, such as canyon sunflower, California sagebrush, coyote bush, monkey flower and deerweed. Some weed species such as tall wreath plant and artichoke thistle were dominants, indicating that the areas were somewhat disturbed.

Table 1. Site characteristics of California gnatcatcher locations in the SJH burn area.

Gnatcatcher status	Dominant vegetation 1rst	2nd	3rd	Percent shrub cover	Average shrub height
FG	lemonade berry	toyon	California sagebrush	30	0.75 m
FG	tall wreath plant	artichoke thistle		40	1.25 m
JUV	canyon sunflower	laurel sumac	deerweed	60	1.25 m
JUVS	California sagebrush	artichoke thistle	prickly pear cactus	40	0.6 m
JUVS	tall wreath plant	lemonade berry	California sagebrush	80	1 m
JUV	coyote bush	monkey flower	California Sagebrush	45	0.6 m

FG=family group JUV(S)= juvenile(s)

Coastal Cactus Wren

Distribution, Abundance and Status.-- Thirty-two coastal cactus wren locations were mapped by GWB (Figure 2). Twenty-four of the 32 were confirmed pairs (at least two of the pairs were observed with fledglings). Six were single males, 1 was a single individual, sex undetermined, and 1 was a juvenile.

Nine locations supported coastal cactus wrens in the burned portions of the Bontrager study areas Sand Canyon Reservoir, Freeway Ridge and Shady Canyon Tributary (Bontrager 1995, Bontrager pers. commun.). Pairs occupied 7 of the 9 locations (3 of the pairs were observed with one or more fledglings), 1 location was used by a transient pair, and 1 area was used by a single individual, sex unknown (Figure 2--locations labeled DB).

Overall, there were 41 coastal cactus wren locations in the burn area in 1995 (pooling GWB and Bontrager data). Subsequent discussion refers only to the GWB data unless otherwise noted.

Banded Wrens.-- Five male wrens and 2 females were banded (Table 2).

Table 2. Bands observed on coastal cactus wrens in the SJH burn area in 1995.

Wren sex	status	Bands observed left leg	right leg
male	pair	metal	light green/purple
male	single	orange	dark green/metal
male	pair	metal/yellow	orange
male	pair	metal	white or yellow
male	pair+	metal/lt.green	orange
female	pair+	metal/yellow	yellow
female	pair	unknown*	

+This banded male and female were paired with one another.
*Bontrager study pair--band combination in Bontrager field notes.

Sighting Characteristics.--The type of detection was recorded for 17 of the wren locations. Ten of the wrens were first detected visually, and 7 were first detected by vocalization.

Site Characteristics.-- Habitat patches used by wrens were dominated by prickly pear cactus, canyon sunflower, Mexican elderberry, and artichoke thistle. Prickly pear cactus was listed as the first dominant 14 times (n=30), second dominant 12 times (n=30) and third dominant 3 times (n=27). No other plant species was as plentiful in wren home ranges. Canyon sunflower was listed as first dominant 4 times, second 3 times and third 1 time. Elderberry was listed as the first dominant 1 time, second 7 times and third 3 times. Artichoke thistle was listed as the first dominant 3 times, second 1 time and third 2 times. Other plant species dominating wren home ranges were flat-topped buckwheat, deerweed, laurel sumac, tree tobacco, lemonade berry, California sagebrush, monkey flower and cholla. Artichoke thistle and tree tobacco are present as dominants due to the 1993 burn and grazing.

The average percent shrub cover was 43% (n=26, r=20%-80%). The average shrub height was 1.1 meters (n=23, r=0.5m-2m).

Habitat Patches

Figure 3 shows the locations of all habitat patches in the GWB study area. Table 3 lists the types of habitat patches and the most common dominant shrubs, percent shrub cover, average shrub height, average number of shrub and annual plant species and average number of bird species for each habitat category.

All shrub species, annual species and bird species recorded in each habitat patch are listed in Appendix 2.

Figure 3. 1995 San Joaquin Hills burn area habitat patch locations.

a. Western portion (Source: USGS 7.5' Tustin and Laguna Beach quadrangles)

b. Eastern portion (Source: USGS 7.5' Laguna Beach quadrangle)

KEY

OH cagn	occupied habitat - California gnatcatcher
OH ccwr	occupied habitat - coastal cactus wren
UN cagn	unoccupied nesting habitat - California gnatcatcher
UN ccwr	unoccupied nesting habitat - coastal cactus wren
UF cagn	unoccupied foraging and future nesting habitat - California gnatcatcher
UF ccwr	unoccupied foraging and future nesting habitat - coastal cactus wren

Figure 3a. 1995 San Joaquin Hills burn area habitat patch locations, western portion.

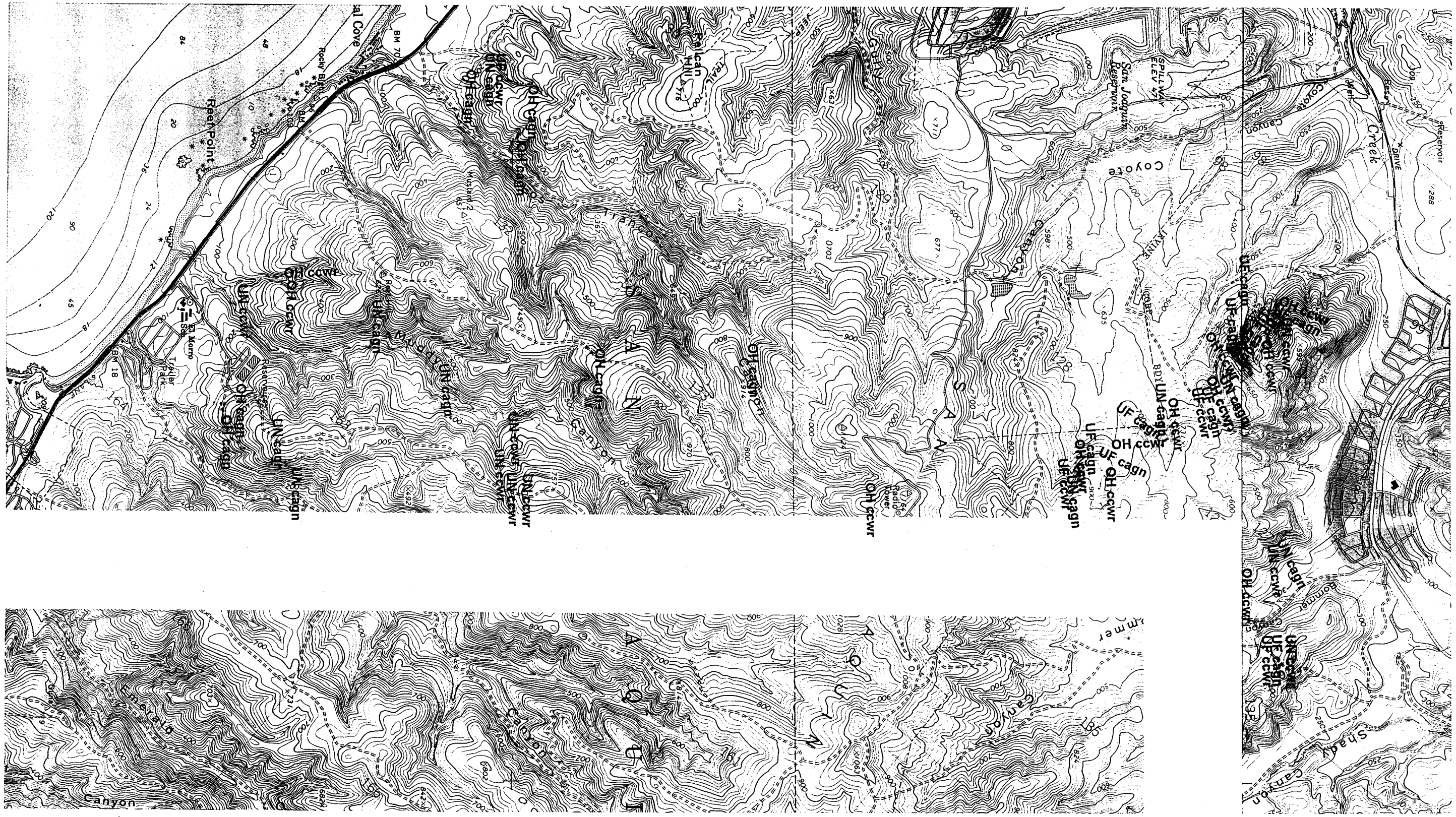


Figure 3b. 1995 San Joaquin Hills burn area habitat patch locations, eastern portion.

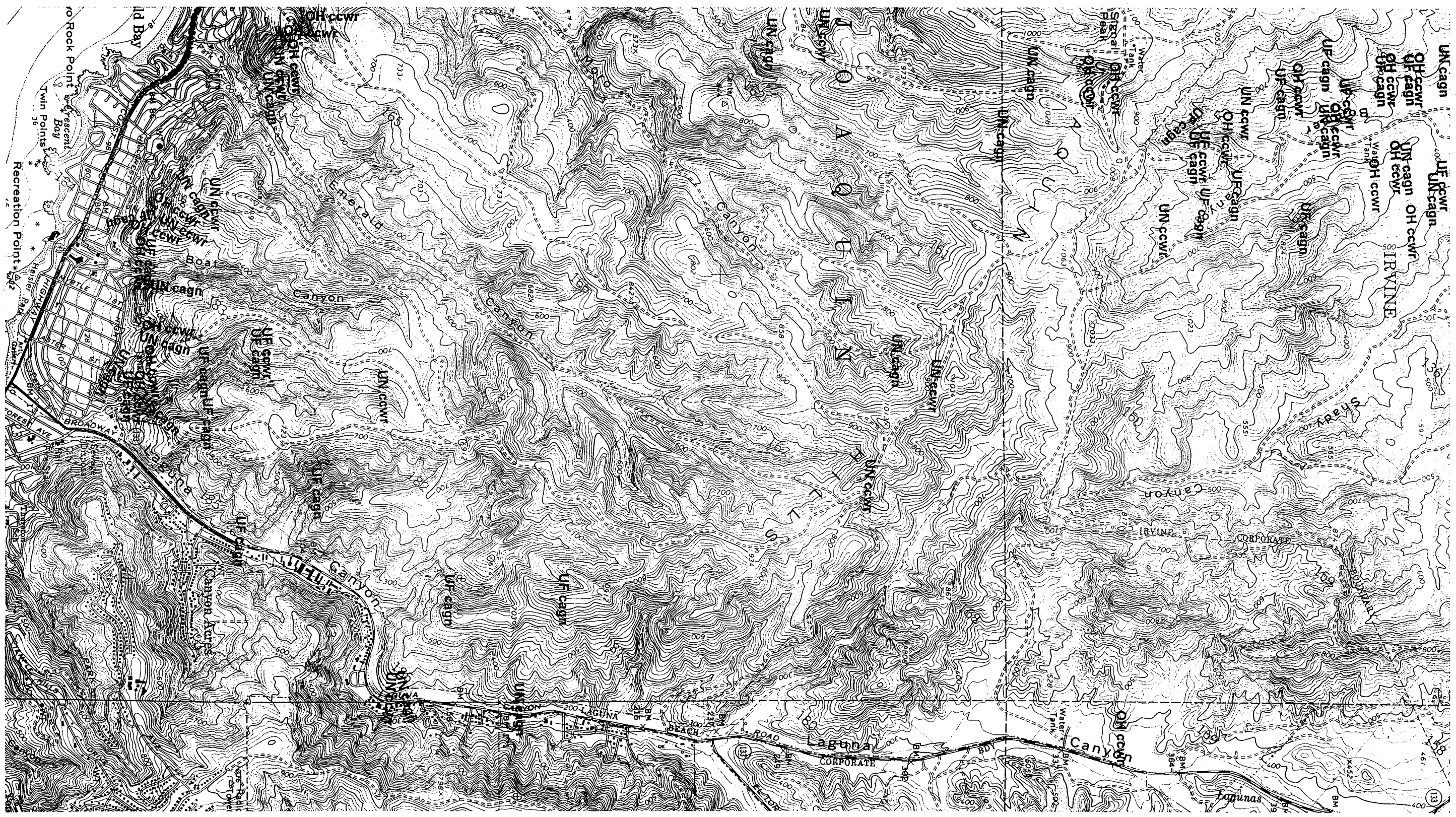


Table 3. 1995 SJH burn area habitat patch characteristics.

Type of habitat patch	Figure 5 location code	Number of patches	Dominant shrubs*	Average % shrub cover	Average avg. shrub height (m)	Average no. shrub species	Average no. annual species	Average no. bird species
occupied CAGN	OH cagn	7	arca cyca stvi rhin	49% (n=6) (r=30-80)	0.9 (n=6) (r=0.6-1.25)	5 (n=6) (r=2-9)	4 (n=6) (r=1-7)	6 (n=6) (r=4-9)
occupied CCWR	OH ccwr	32	opli samx enca cyca	43% (n=26) (r=20-80)	1.1 (n=23) (r=0.5-2)	7 (n=28) (r=3-14)	4 (n=19) (r=1-7)	9 (n=28) (r=3-19)
unoccupied nesting CAGN	UN cagn	24	arca enca mafa losc	62% (n=22) (r=20-75)	0.9 (n=23) (r=0.5-1.5)	9 (n=24) (r=3-14)	4 (n=18) (r=1-6)	7 (n=21) (r=2-19)
unoccupied nesting CCWR	UN ccwr	18	opli samx cyca enca	49% (n=16) (r=25-90)	1 (n=14) (r=0.5-2)	6 (n=16) (r=2-14)	4 (n=14) (r=1-8)	4 (n=16) (r=0-7)
unoccupied foraging CAGN	UF cagn	32	arca enca mala opli samx	49% (n=21) (r=20-100	0.8 (n=19) (r=0.4-1.5)	7 (n=28) (r=4-14)	3 (n=18) (r=1-6)	7 (n=25) (r=0-19)
unoccupied foraging CCWR	UF ccwr	9	arca opli samx	60% (n=8) (r=20-100	0.7 (n=5) (r=0.5-1)	7 (n=8) (r=4-12)	4 (n=5) (r=1-6)	9 (n=5) (r=2-19)

* arca--Artemisia californica (California sagebrush)
cyca--Cynara cardunculus (artichoke thistle)
enca--Encelia californica (canyon sunflower)
losc--Lotus scoparius (deerweed)
mafa--Malacothamnus fasciculatus (bush mallow)
mala--Malosma laurina (laurel sumac)
opli--Opuntia littoralis (prickly pear cactus)
rhin--Rhus integrifolia (lemonade berry)
samx--Sambucus mexicana (Mexican elderberry)
stvi--Stephanomeria virgata (tall wreath plant)

Sensitive Birds

Fourteen species of sensitive birds, totaling 352 locations, were mapped in the study area (Table 4, Figure 4). The birds were sighted incidentally during the focused survey for gnatcatcher and wren. The grasshopper sparrow was the most numerous sensitive species (142 locations), followed by the rufous-crowned sparrow (124 locations). One male federally and state endangered least Bell's vireo was present in riparian habitat along Highway 133, in Laguna Canyon, from April through July (GWB brown-headed cowbird daily trap check sheet notes). One Bell's sage sparrow was observed. The species is not known in general along the coast west of the mountains in northern San Diego County and Orange County [though there is a resident population in the southeast corner of Marine Corps Base Camp Pendleton, northern San Diego County (Griffith and Griffith 1996)]. The individual observed in the San Joaquin Hills may have been a vagrant.

Sensitive Animals

One species of sensitive animal, the Western spadefoot toad, was incidentally sighted in 2 locations (Table 4, Figure 4). We find it remarkable that no red diamond rattlesnakes or whiptail lizards were observed.

Bird Checklist

The total number of bird species recorded during the study period was 102 (Appendix 3). The average number of species observed each field day was 31 (r=20-45). Unusual sightings included a summer tanager, 2 parrots, and a Macaw. Only 2 brown-headed cowbirds were seen (both males), indicating that the 1995 San Joaquin Hills Transportation Corridor brown-headed cowbird removal program was successful (Griffith Wildlife Biology 1995).

Table 4. 1995 San Joaquin Hills burn area sensitive species incidentally observed.

Species	Category	Number of locations
White-tailed Kite (Elanus caeruleus)	NDDB	3
Northern Harrier (Circus cyaneus)	CSC	8
Cooper's Hawk (Accipiter cooperii)	CSC	5
Red-shouldered Hawk (Buteo lineatus)	ABL	1
Greater Roadrunner (Geococcyz californianus)	L	7
Ca. Horned Lark (Eremphila alpestris actia)	SRP	1
Loggerhead Shrike (Lanius ludovicianus)	ABL,L	3
Least Bell's Vireo (Vireo bellii pusillus)	SE,FE	1
Yellow Warbler (Dendroica petechia)	CSC*	4
Yellow-breasted Chat (Icteria virens)	CSC*	14
Blue Grosbeak (Guiraca caerulea)	L	38
So.Ca. Rufous-crowned Sparrow (Aimophila ruficeps canescens)	SRP	124
Bell's Sage Sparrow (Amphispiza belli belli)	SRP	1
Grasshopper Sparrow (Ammodramus savannarum)	ABL,L	142
Western spadefoot Toad (Scaphiopus hammondii)	SRP	2

Total bird species: 14 Total bird locations: 352
Total animal species: 1 Total animal locations: 2

ABL--Audubon Blue List; CSC--CDFG Species of Special Concern; FE--Federally Endangered; L--Local Concern; NBBD--CDFG Natural Diversity Database; SE--State Endangered; SRP--Scientific Review Panel.

Figure 4. 1995 San Joaquin Hills burn area sensitive species observed.

a. Western portion (Source: USGS 7.5' Tustin and Laguna Beach quadrangles)

b. Eastern portion (Source: USGS 7.5' Laguna Beach quadrangle)

KEY

wtki	white-tailed kite
noha	northern harrier
coha	cooper's hawk
rsha	red-shouldered hawk
grro	greater roadrunner
chla	California horned lark
losh	loggerhead shrike
lbvi	least Bell's vireo
yewa	yellow warbler
ybch	yellow-breasted chat
blgr	blue grosbeak
scrs	southern California rufous-crowned sparrow
bssp	Bell's sage sparrow
grsp	grasshopper sparrow
wsto	Western spadefoot toad

Figure 4a. 1995 San Joaquin Hills burn area sensitive species observed, western portion.

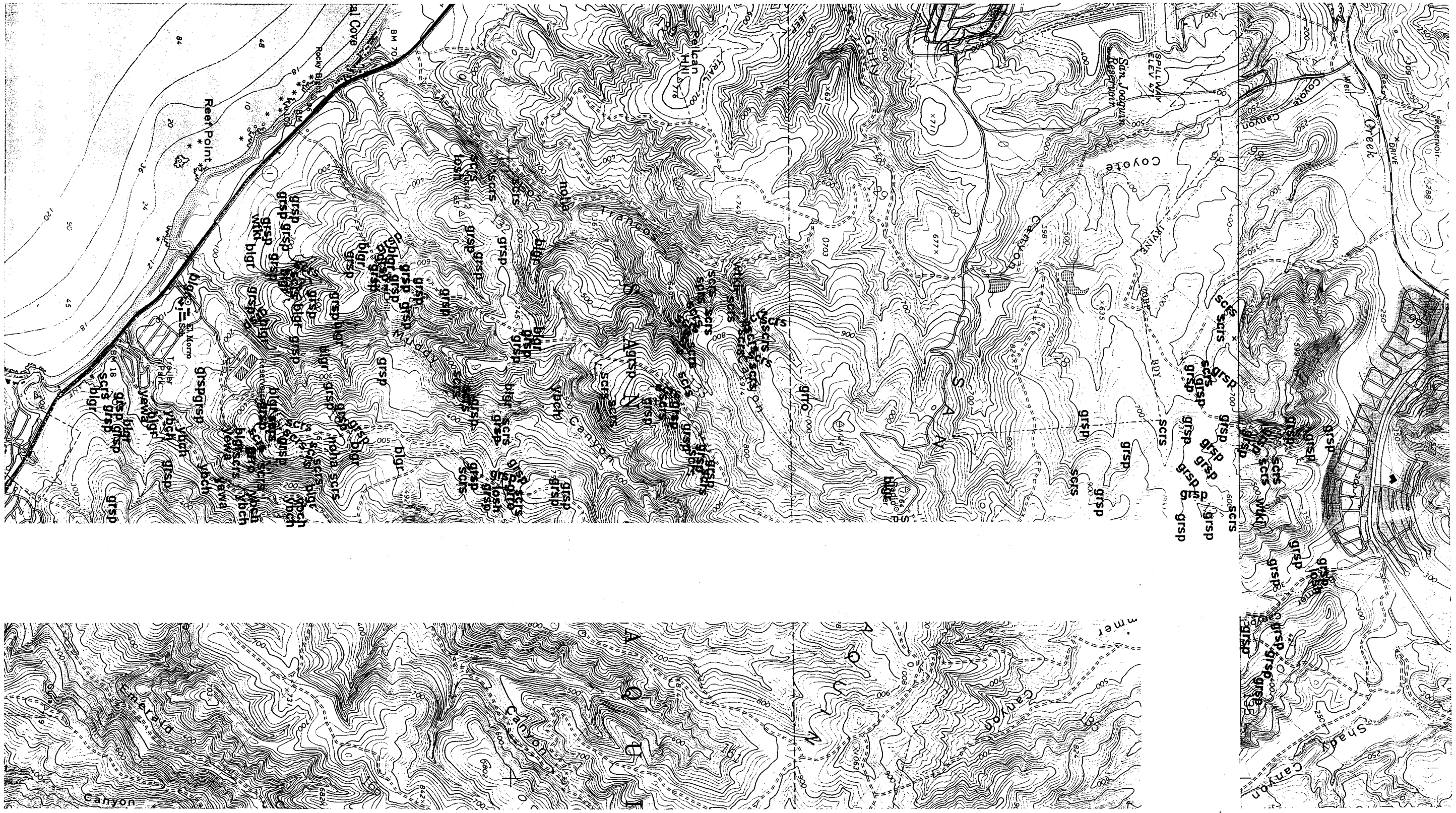
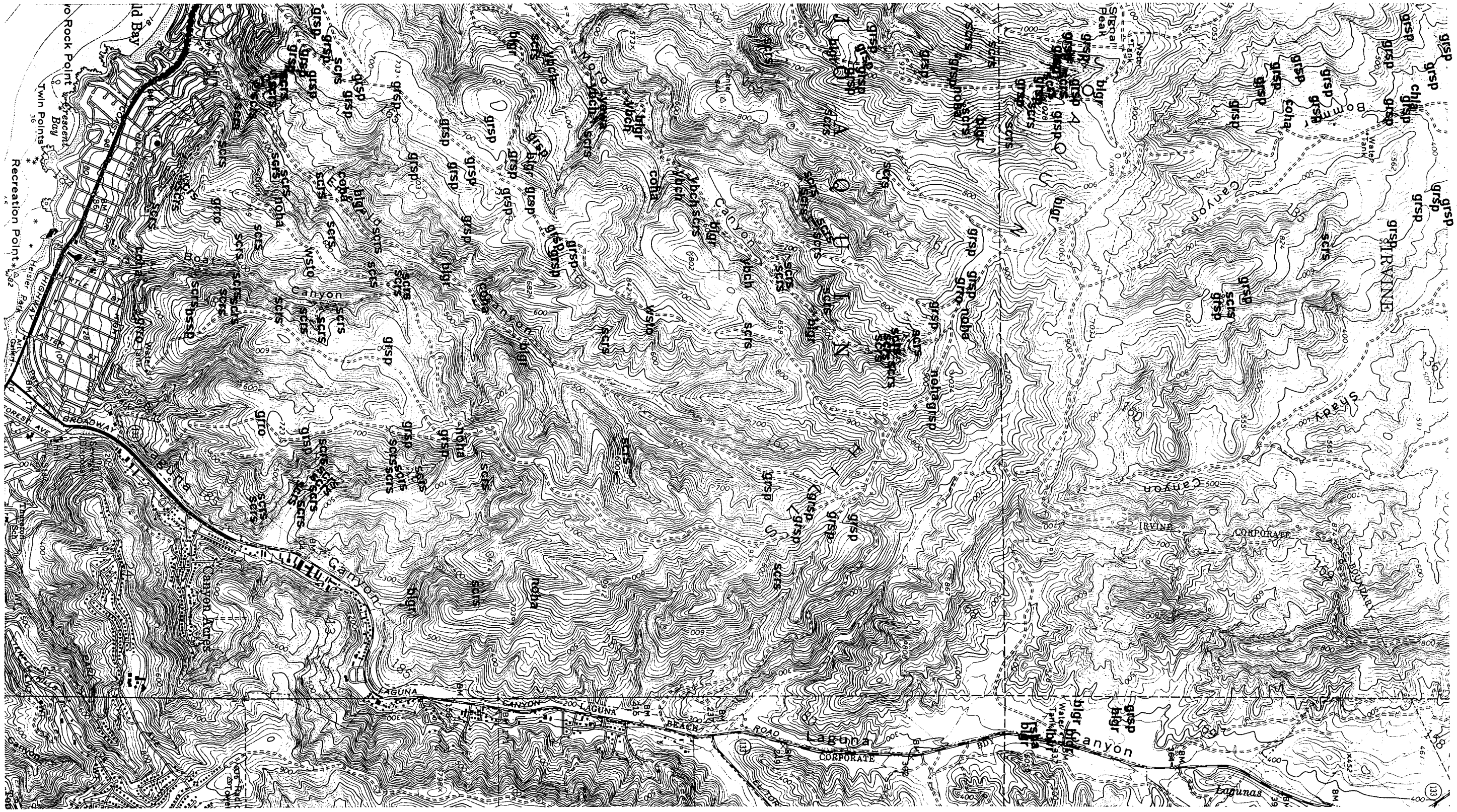


Figure 4b. 1995 San Joaquin Hills burn area sensitive species observed, eastern portion.



DISCUSSION

California Gnatcatcher

The number of California gnatcatchers pairs found in the burn area decreased from 12 in 1994 (Bontrager et al 1995a) to 5 in 1995. Only one home range used by a gnatcatcher pair in 1994 was again used in 1995 (LSA 1 on Figure 2), this in an area with substantial unburned habitat. The overall decrease in adult gnatcatcher locations from 12 pairs in 1994 to 7 locations (5 pairs and 2 transient females) in 1995 was most likely due to the extraordinarily cold and wet winter of 1994-1995, which, in combination with the lack of adequate shrub cover and forage due to the fire, probably caused high mortality among the gnatcatchers in the San Joaquin Hills. Bontrager et al (1995a) estimated the pre-fire gnatcatcher population within the burn perimeter to be 127 pairs. After the 1993 fire, the 1994 population decreased to just 9% (12 of 127) of 1992 total. The 1995 population further decreased to 5.5% (7 of 127) of the 1992 pre-fire total.

Los Trancos Canyon appears to have served as an important dispersal corridor from intact habitat at Crystal Cove State Park into the burn area. The juveniles dispersing into the burn area from the park and other unburned habitat at the perimeter of the burn (9 locations supporting at least 15 juveniles were recorded July through September), as well as the high success rate of pairs using the burn in 1995 (at least 4 of the 5 pairs found in 1995 successfully raised young), could produce an increase in 1996 in the number of breeding gnatcatchers in the burn area. GWB identified at least 24 unoccupied habitat patches suitable for nesting. Several of these were used by foraging juveniles in late summer. Thirty-two other habitat patches were identified as having nesting potential within 1 to 5 years, depending upon the coastal sage scrub vegetation recovery rate. (The wet winter of 1994-1995 had a positive impact on scrub recovery.) Based on 1995 home ranges occupied by pairs (5) and transient females (2), and the vacant nesting habitat available (24 patches), we predict that the burn area could support 25-35 gnatcatcher pairs each of the next several years. Another 32 habitat areas may be suitable within about 5 years, bringing the total number of possible home ranges to 55-70 by 2000 (assuming all potential habitat remains undeveloped and assuming adequate rainfall for normal shrub growth) .

Bontrager et al (1995a) predicted a short-term decline in the gnatcatcher population of the burned portion of San Joaquin Hills, followed by an increase within several years as the sage scrub habitat recovers.

Coastal Cactus Wren

The number of coastal cactus wrens found in the burn area also decreased in 1995. 1994 researchers recorded 79 pairs (Bontrager et al 1995a). Only 40 adult locations (of which at least 31 were pairs) were recorded in 1995. The wren population was estimated to be 282 pairs before the fire. Only 28% (79 of 282) remained in 1994 (ibid). By 1995 the wren population had decreased to only 14% (40 of 282) of the 1992 pre fire totals.

GWB identified at least 18 vacant wren habitat patches in the burn area suitable for nesting. Nine additional habitat patches could be suitable for nesting within 1-5 years, depending upon shrub recovery. Potentially, the burn area could currently support 60-70 pairs of wrens based on the 41 (40 adults and 1 juvenile) 1995 occupied areas and the 18 vacant suitable nesting habitat patches. Increases beyond 60-70 pairs will depend upon the recovery of the 9 potential future nesting patches and other habitat areas and the future pattern of development within the San Joaquin Hills. Cactus does not recover quickly from fire and since wrens are dependent upon cactus species (mainly prickly pear in the San Joaquin Hills) for nesting, their recovery will likely be much slower than gnatcatcher recovery, which is tied to the more dynamic shrubs of the coastal sage scrub. Another limiting factor for wren population growth is that, unlike gnatcatchers, there are no populations of wrens adjacent to the burn area to provide immigrants to the San Joaquin Hills.

MANAGEMENT IMPLICATIONS

Habitat Protection

1. All areas identified in this study as gnatcatcher habitat, whether currently occupied or not, should be preserved for at least 10 years. These occupied and developing habitat patches will serve in the short term as population stability and growth areas until large expanses of currently unsuitable habitat in set-aside areas recover, and in the long term as the source of immigrants to such newly suitable habitat in the San Joaquin Hills.

2. All areas identified in this study as cactus wren habitat, whether currently occupied or not, should be preserved. The cactus stands upon which the wrens rely require decades to develop; the species cannot afford to lose any more habitat in the San Joaquin Hills. If additional mature stands of cactus are slated for development, wren home range transplanting should be considered.

3. Much remaining habitat is located at the edge of the burn area adjacent to developed areas protected by fire breaks. We suggest that the limits of the fire breaks be delineated and defined by fencing or signs to prevent the incremental widening of such breaks.

Annual Study Design

1. Conduct a focused survey for the California gnatcatcher and coastal cactus wren in the entire burn area (or 1995 study area portion thereof), including apparently "unsuitable" habitat.

    a. Perform the surveys from 01 February through 01 May.
    b. Return to unoccupied breeding habitat twice to verify species absence.
    c. Follow SRP guidelines for coverage and condition limits.
    d. Record and determine the breeding status of all CAGN and CCWR individuals and observe legs to read bands if present.
    e. Record all incidental sightings of other sensitive fauna.
    g. Map all information on aerial photographs in the field.
    f. Compile a daily bird checklist.
    g. Return to nesting, unoccupied nesting, and foraging/future nesting habitat patches each fall to record non-breeding season habitat use and juvenile dispersal data.

2. Monitor all California gnatcatcher locations through 31 July.

    a. Locate all nests.
    b. Band all young.
    c. Record nest chronology, location, substrate and height and number of eggs laid, nestlings and fledglings.

3. Monitor habitat patches.

    a. Relocate 1995 patches and map new patches on aerial photographs.
    b. Record dominant shrubs, percent shrub cover and average shrub height.
    c. Record observed vegetation composition.
    d. Record avian use.

4. Enter all field data from 1995 and each subsequent year into a GIS database.

Collection of this baseline data, in combination with complementary studies, will yield unprecedented information about the way California gnatcatcher and coastal cactus wren populations respond to catastrophic fire and subsequent habitat recovery.

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Appendix 1. 1995 San Joaquin Hills burn area CAGN/CCWR survey data sheet.

Area:	Observer:	Date:	Pg ____ of ____
Time: /	Temp: /	CC: /	Wind: /

Loc.	Time	Spec.	Sign	Status	1	2	3	% Cover	Notes (bands)

Veg (circle): Arca Bapi Cyca Enca Erfa Haz Hear Losc Mafa Mala Mim Nigl Opli Rhin
Rico Saap Same Samx Sol Sti Todi ______________________

Annuals (circle): Ave Bmi Bro Cama Cen Cryp Dipu Erci Gal Gnca Lup Mama Mein Pha
Stvi ______________________

Birds at Location (circle): Caqu Modo Grro Anhu Cohu Psfl Blph Atfl Caki Weki Hola Nrws Clsw
Scja Bush Cacw Bewr Cagn Wren Nomo Cath Losh Ocwa Coye Bhgr Blgr Labu Rsto Cato
Rcsp Bcsp Lasp Grsp Sosp Weme Hoor Noor Hofi Lego ______________________

Average height of vegetation:

Loc.	Time	Spec.	Sign	Status	1	2	3	% Cover	Notes (bands)

Veg (circle): Arca Bapi Cyca Enca Erfa Haz Hear Losc Mafa Mala Mim Nigl Opli Rhin
Rico Saap Same Samx Sol Sti Todi ______________________

Annuals (circle): Ave Bmi Bro Cama Cen Cryp Dipu Erci Gal Gnca Lup Mama Mein Pha
Stvi ______________________

Birds at Location (circle): Caqu Modo Grro Anhu Cohu Psfl Blph Atfl Caki Weki Hola Nrws Clsw
Scja Bush Cacw Bewr Cagn Wren Nomo Cath Losh Ocwa Coye Bhgr Blgr Labu Rsto Cato
Rcsp Bcsp Lasp Grsp Sosp Weme Hoor Noor Hofi Lego ______________________

Average height of vegetation:

Loc.	Time	Spec.	Sign	Status	1	2	3	% Cover	Notes (bands)

Veg (circle): Arca Bapi Cyca Enca Erfa Haz Hear Losc Mafa Mala Mim Nigl Opli Rhin
Rico Saap Same Samx Sol Sti Todi ______________________

Annuals (circle): Ave Bmi Bro Cama Cen Cryp Dipu Erci Gal Gnca Lup Mama Mein Pha
Stvi ______________________

Birds at Location (circle): Caqu Modo Grro Anhu Cohu Psfl Blph Atfl Caki Weki Hola Nrws Clsw
Scja Bush Cacw Bewr Cagn Wren Nomo Cath Losh Ocwa Coye Bhgr Blgr Labu Rsto Cato
Rcsp Bcsp Lasp Grsp Sosp Weme Hoor Noor Hofi Lego ______________________

Average height of vegetation:

Extra Notes: ______________________

Appendix 2. 1995 San Joaquin Hills burn area habitat patch flora and fauna.

No.	occupied cagn			No.	occupied ccwr			No.	unoccupied cagn			No.	unoccupied ccwr		
	shrubs type	annls type	birds type		shrubs type	annls type	birds type		shrubs type	annls type	birds type		shrubs type	annls type	birds type
1	arca	ave	cagn	1	arca	brni	anhu	1	arca	brni	ccwr	1	arca	ave	
	cyca	brni	blgr		cyca	bro	bush		cyca	mein	rsto		losc	bro	
	hear	bro	labu		enca	mama	ccwr		enca		cato		mafa	cama	
	rhin	cama	rsto		erfa	mein	nomo		nigl		wcsp		mim		
	samx	gal	yewa		opli		cath		opli		rtha		nigl		
			wiwa		rhin		rsto		rhin				opli		
					rico		cato								
2	cyca	ave	cagn				hofi	2	arca	mama	anhu	2	cyca	ave	
	haz	brni	labu						enca		bush		opli	brni	
		bro	cato	2	arca	brni	ccwr		erfa		ccwr				
		cen	hofi		cyca	mein	rsto		losc		cath	3	cyca	brni	hofi
		mein			enca		cato		mala		cato		opli	cen	lego
		stvi			nigl		wcsp		opli				myla		wcsp
		hem			opli		rtha		rhin						hosp
					rhin				same						
3									oppa			4	arca	ave	
				3	arca	brni	grro						losc	bro	
4	arca	bro	anhu		enca	bro	anhu	3	arca	ave	anhu		mala	cama	
	enca	gnca	bush		losc	mama	ccwr		enca	bro	scja		mim	cen	
	erfa	stvi	bewr		mafa	grass	cato		erfa	dipu	ccwr		opli	cryp	
	losc	hem	cagn		mim	esca			losc	lup	ocwa		same	dipu	
	mafa		wren		nigl				opli	caca	cato		sol	gnca	
	mala		rsto		opli				rhin		rcsp			orpu	
	rhin		rcsp						same		hofi				
	same		hofi	4	arca	ave	anhu				amke	5	arca	brni	anhu
	sol		lego		enca	brni	scja						cyca	cen	nomo
					opli	bro	ccwr	4	arca	bro	scja		enca	mein	cato
5	arca	brni	caqu		rhin	erci	hoor		enca	mama	cato		opli	grass	hoor
	cyca	hem	modo		sol	mama	hofi		erfa	pha			rhin		hofi
	opli		cagn		pine	mein	lisp		mafa	grass					
	rhin		cato				rtha		rhin			6	arca	ave	anhu
	same		sosp						same				bapi	brni	blph
				5	cyca	ave	anhu						erfa	fovu	bhgr
6	arca	ave	caqu		enca	brni	ccwr	5	arca	gal	anhu		haz	gnca	cato
	cyca	bro	scja		nigl	bro	cato		enca	pha	labu		losc		
	rhin	stvi	bush		opli	gnca	hofi		hear	grass	rcsp		mim		
		hem	cagn		rhin	mama	lego		mafa		lego		nigl		
		fovu	cato		pine		wcsp		opli				opli		
			hofi		acacia		ruhu		rhin				rhin		
							rtha		same				same		
7	arca	brni	caqu						sol				samx		
	bapi		cagn	6	arca	ave	anhu						sol		
	losc		nomo		enca	bro	scja	6	arca	ave	anhu		SFI		
	mim		hofi		erfa	dipu	ccwr		bapi	brni	wren		todi		
	same				losc	lup	ocwa		erfa	bro					
					opli	caca	cato		mafa	cama		7	arca	ave	nrws
					rhin		rcsp		mala	erci			enca	brni	labu
					same		hofi		mim	fovu			haz	bro	cato
							amke		rhin				losc	cryp	
									saap				mafa	gnca	
				7	cyca	ave	modo		pamp				nigl		
					enca	brni	anhu						opli		
					losc	bro	ccwr	7	arca	ave	anhu		samx		
					mim	cama	labu		bapi	brni	blph		sol		
					nigl	gnca			erfa	fovu	bhgr		cufo		
					opli	pha			haz	gnca	cato				
					rhin				losc			8	arca	ave	modo
									mim				cyca	brni	cohu
				8	enca	cen			nigl				nigl	bro	bewr
					erfa				opli				opli	cama	nomo
					nigl				rhin				rhin	cen	labu

No.	occupied cagn			No.	occupied ccwr			No.	unoccupied cagn			No.	unoccupied ccwr		
	shrubs type	annls type	birds type		shrubs type	annls type	birds type		shrubs type	annls type	birds type		shrubs type	annls type	birds type
					opli				same				same	mama	hofi
					rhin				samx				samx		phal
									sol				oppa		
				9	arca	ave	caqu		SFI						
					bapi	brni	modo		todi			9	cyca	ave	nrws
					mala	bro	anhu						opli	brni	hofi
					opli	cama	weki	8	arca	brni	caqu		samx	cen	
					rhin	cen	clsw		enca	cen	anhu				
					sol	gal	ccwr		erfa	gal	atfl	10	bapi	ave	modo
						mama	nomo		hear	pha	labu		cyca	bro	labu
							cato		losc	mipi	rsto		mim	hem	
							hofi		mafa		cato		opli		
									mala		rcsp		samx		
				10	arca	ave	modo		mim		towa				
					cyca	brni	cohu		rhin		wiwa	11	arca	ave	nomo
					nigl	stvi	psfl		same		wavi		cyca	brni	blgr
					opli	fovu	atfl		sol				losc	bro	labu
					rhin		ccwr		sti				mala	cama	rsto
					samx		bewr						nigl	cen	lego
							nomo	9	arca	ave	modo		opli	hem	
							blgr		bapi	brni	blgr		rhin		
							labu		cyca	cama	labu				
							cato		opli	cen	cato	12	cyca	ave	modo
							rcsp		rhin	mein	rcsp		nigl	brni	anhu
							sosp		samx	hem			opli	bro	coye
							hofi		sol				rhin		cato
							lego						samx		sosp
								10	arca	ave	caqu		sol		hoor
				11	cyca	ave	modo		erfa	brni	atfl				
					nigl	brni	cohu		hear	bro	nomo	13	arca	ave	cato
					opli		psfl		losc	cama	cato		bapi	cama	hofi
					rhin		atfl		mafa	gnca	rcsp		haz	cen	noha
					sti		ccwr		mala				losc	gnca	tuvu
							bewr		mim				mala	stvi	
							nomo		opli				mim	scca	
							blgr		rhin				nigl		
							labu		erpi				opli		
							cato						rhin		
							rcsp	11	arca	ave	caqu		same		
							sosp		bapi	bro	modo		samx		
							hofi		enca	cen	bewr		sti		
							lego		hear	gnca	blgr				
									losc	stvi	labu	14	opli		modo
				12	cyca	ave	caqu		mim	hem	rsto		arca		anhu
					losc	brni	anhu		rhin		cato		sola		weki
					mala	cen	ccwr		same		hofi		rhin		bhgr
					mim	pha	bewr						samx		grsp
					nigl	cufo	nomo	12	arca	brni	caqu		nigl		bski
					opli		cath		enca	bro	nomo				howr
					rhin		blgr		haz	cen	rsto	15	opli	mama	anhu
					samx		labu		hear	dipu	hofi		samx		grsp
					sti		cato		losc	gnca	lego		qudu		weme
									rhin				nigl		cato
				13	cyca	ave	anhu		same						
					mim	brni	ccwr					16	opli		anhu
					opli	hem	rcsp	13	arca	ave	caqu		arca		nomo
									losc	bro	blgr		samx		weme
				14					mafa	cama	rsto				rwbl
									mala	hem	cato	17	opli		
				15	arca		modo		mim		rcsp		arca		
					cyca		anhu		opli				samx		
					erfa		caki		same						
					mala		ccwr		samx			18	opli		
					mim		bewr		sti				samx		
					nigl		wren		erpi				mim		
					opli		nomo								
					rico		coye	14	arca	ave	cato				

No.	occupied cagn			No.	occupied ccwr			No.	unoccupied cagn			No.	unoccupied ccwr		
	shrubs type	annls type	birds type		shrubs type	annls type	birds type		shrubs type	annls type	birds type		shrubs type	annls type	birds type
					samx		cato		cyca	brni	sosp				
					salix		lasp		losc	cama	lego				
					bagl		grsp		mafa	hem					
					brca		weme		mala	cufo					
							hofi		mim						
							lego		nigl						
							rcki		opli						
							rwbl		same						
							bski		samx						
							cora								
							howr	15	arca	bro	caqu				
									bapi	cama	anhu				
				16	opli	gnca	modo		erfa		bush				
					arca	mama	anhu		hear		bewr				
					same		caki		losc		labu				
					mim		clsw		mafa		rsto				
					cyca		ccwr		mala		cato				
					rhin		wren		mim		rcsp				
					samx		nomo		opli		hofi				
					rh sp		coye		rhin						
					nigl		bhgr		same						
							rsto		sti						
							cato		erpi						
							lasp								
							grsp	16	arca	ave	caqu				
							weme		bapi	brni	modo				
							hofi		erfa	bro	bush				
							lego		haz	stvi	bewr				
							rcki		mala		cath				
							rwbl		mim		cato				
							cora		opli		hofi				
									rhin						
				17	opli		ccwr		same						
					arca		cato								
					mim		hofi	17	opli		modo				
					mala		basw		arca		anhu				
					samx				sola		weki				
									rhin		bhgr				
				18	opli		ccwr		samx		grsp				
					mim		cato		nigl		bski				
					samx		hofi				howr				
				19	opli		anhu	18	arca		modo				
					arca		atfl		cyca		anhu				
					same		scja		erfa		caki				
					erfa		bewr		mala		ccwr				
					mim		wren		mim		bewr				
					rhin		bhgr		nigl		wren				
					samx		labu		opli		nomo				
					oppa		rsto		rico		coye				
					quag		cato		samx		cato				
					plra		noor		salix		lasp				
					salix		hofi		bagl		grsp				
							lego		brca		weme				
							huvi				hofi				
							rtha				lego				
							yrwa				rcki				
							howr				rwbl				
											bski				
				20							cora				
											howr				
				21	opli		cato								
					mala		noor	19	opli		anhu				
					samx		hofi		arca		atfl				
					oppa		nomo		same		scja				
					nigl		caqu		erfa		bewr				
							ccwr		mim		wren				

No.	occupied cagn			No.	occupied ccwr			No.	unoccupied cagn			No.	unoccupied ccwr		
	shrubs type	annls type	birds type		shrubs type	annls type	birds type		shrubs type	annls type	birds type		shrubs type	annls type	birds type
									rhin		bhgr				
				22	opli		cato		samx		labu				
					losc		nomo		oppa		rsto				
					arca		hofi		quag		cato				
					erfa		anhu		plra		noor				
					mim		bhgr		salix		hofi				
					rhin		wcsp				lego				
					mala		ccwr				huvi				
					samx						rtha				
					nigl						yrwa				
											howr				
				23	opli										
					samx			20	opli		cato				
					oppa				losc		nomo				
					nigl				arca		hofi				
									erfa		anhu				
				24	opli	cama	cohu		mim		bhgr				
					losc		ccwr		rhin		wcsp				
					arca		blgr		mala		ccwr				
					erfa		labu		samx						
					mim		cato		nigl						
					samx		grsp								
							noor	21	opli						
							hofi		arca						
							lego		same						
									erfa						
				25	opli	brni	caqu		saap						
					losc	pha	cohu		mim						
					arca	cen	scja		rhin						
					cyca		bush		samx						
					mala		ccwr		nigl						
					samx		nomo		salix						
					nigl		cath								
							ocwa	22	enca	brni	caqu				
							labu		opli	pha	modo				
							rsto		oppa	cen	anhu				
							cato		losc		psfl				
							lasp		arca		atfl				
							grsp		same		scja				
							weme		mafa		bush				
							noor		mim		bewr				
							lego		rhin		nomo				
							yewa		mala		cath				
									samx		blgr				
				26	losc	brni	modo				labu				
					arca	pha	anhu				rsto				
					rhin	urho	nrws				cato				
					quag		bush				rcsp				
					opli		ccwr				weme				
					samx		bewr				cgdo				
					nigl		nomo				ghow				
							labu				yewa				
							rsto								
							cato	23	arca						
							lasp		erfa						
							grsp		same						
							lego		losc						
							nuwo								
								24	arca	ave					
				27	opli	brni	caqu		losc						
					losc	pha	modo		mim						
					arca	bro	grro								
					same	cen	anhu								
					erfa		psfl								
					mafa		atfl								
					mim		ccwr								
					todi		bewr								

No.	occupied cagn			No.	occupied ccwr			No.	unoccupied cagn			No.	unoccupied ccwr		
	shrubs type	annls type	birds type		shrubs type	annls type	birds type		shrubs type	annls type	birds type		shrubs type	annls type	birds type
					sol		labu								
					rhin		cato								
					samx		hofi								
					hear										
					quag										
					plra										
				28	opli		modo								
					arca		grro								
					samx		anhu								
							psfl								
							ccwr								
							nomo								
							cato								
							lasp								
							hofi								
							wcsp								
				29	arca	esca	caqu								
					enca		modo								
					erfa		atfl								
					hear		bewr								
					nigl		nomo								
					opli		weme								
					same		hofi								
					samx										
					oppa										
				30											
				31	arca		caqu								
					hear		modo								
					mala		anhu								
					nigl		ccwr								
					opli		bewr								
					rhin		nomo								
					samx		cath								
							rsto								
							cato								
							rcsp								
							grsp								
							noor								
							lego								
				32	mala		anhu								
					samx		modo								
					opli		ccwr								
					hear		bewr								
					arca										
					mim										

Appendix 2. 1995 San Joaquin Hills burn area habitat patch flora and fauna.

No.	foraging and future nesting cagn		
	shrubs type	annls type	birds type
1	arca	brni	anhu
	cyca	bro	bush
	enca	mama	ccwr
	erfa	mein	nomo
	opli		cath
	rhin		rsto
	rico		cato
			hofi
2	enca	cen	bewr
	erfa		rsto
	hear		lego
	losc		yrwa
	mafa		
	rhin		
	same		
3	arca	cen	anhu
	enca	gal	caki
	hear	mama	rsto
	losc	pha	cato
	mafa		lisp
	mala		
	opli		
	rhin		
	same		
4	arca	ave	rsto
	enca	brni	wcsp
	losc	bro	
	mafa	cryp	
	opli	gal	
	rhin	lup	
	same		
5	enca	ave	modo
	losc	bro	cato
	rhin		wcsp
	same		
	cndu		
6	arca	ave	anhu
	enca	bro	cato
	losc		rcsp
	mala		amke
	mim		
	same		
	sti		
7	arca	ave	caqu
	enca	bro	rsto
	haz	dipu	cato
	losc	gnca	rcsp
	mafa	lup	wcsp
	mala		
	mim		
	sol		
	sti		
8	arca	ave	
	enca	brni	

No.	foraging and future nesting ccwr		
	shrubs type	annls type	birds type
1	arca	ave	rsto
	enca	brni	wcsp
	losc	bro	
	mafa	cryp	
	opli	gal	
	rhin	lup	
	same		
2	opli		modo
	arca		anhu
	same		atfl
	rhin		weki
	mala		scja
	samx		bush
			bewr
			labu
			cato
			noor
			hofi
			lego
			cora
3			
	opli		cato
	mala		noor
	samx		hofi
	oppa		nomo
	nigl		caqu
			ccwr
4	opli		
	arca		
	mim		
	mala		
	samx		
	salix		
5	opli		
	arca		
	same		
	erfa		
	saap		
	mim		
	rhin		
	samx		
	nigl		
	salix		
6	enca	brni	caqu
	opli	pha	modo
	oppa	cen	anhu
	losc		psfl
	arca		atfl
	same		scja
	mafa		bush
	mim		bewr
	rhin		nomo
	mala		cath
	samx		blgr
			labu
			rsto
			cato

No.	foraging and future nesting cagn		
	shrubs type	annls type	birds type
	losc	bro	
	mafa	cama	
	mala	grass	
	sti		
9	arca	ave	caqu
	enca	cama	rcsp
	erfa	cryp	
	losc	lup	
	mafa	grass	
	opli		
	rhin		
10	arca	ave	anhu
	enca	brni	scja
	opli	bro	ccwr
	rhin	erci	hoor
	sol	mama	hofi
	pine	mein	lisp
			rtha
11	cyca	ave	anhu
	enca	brni	ccwr
	nigl	bro	cato
	opli	gnca	hofi
	rhin	mama	lego
	pine		wcsp
	acacia		ruhu
			rtha
12	opli	gnca	modo
	arca	mama	anhu
	same		caki
	mim		clsw
	cyca		ccwr
	rhin		wren
	samx		nomo
	rh sp		coye
	nigl		bhgr
			rsto
			cato
			lasp
			grsp
			weme
			hofi
			lego
			rcki
			rwbl
			cora
13	opli		ccwr
	arca		cato
	mim		hofi
	mala		basw
	samx		
14	opli		modo
	arca		anhu
	same		atfl
	rhin		weki
	mala		scja
	samx		bush
			bewr
			labu
			cato
			noor
			hofi
			lego

No.	foraging and future nesting ccwr		
	shrubs type	annls type	birds type
			rcsp
			weme
			cgdo
			ghow
			yewa
7	arca	mavu	anhu
	mim	dame	nomo
	nigl		lasp
	opli		lego
	samx		cora
8	arca		
	erfa		
	opli		
	samx		
9	arca	ave	caqu
	bapi	brni	modo
	erfa	bro	bush
	haz	stvi	bewr
	mala		cath
	mim		cato
	opli		hofi
	rhin		
	same		

No.	foraging and future nesting cagn			No.	foraging and future nesting ccwr		
	shrubs type	annls type	birds type		shrubs type	annls type	birds type
			cora				
15	same	pha	anhu				
	mim		atfl				
	rhin		bhgr				
	mala		cato				
	samx		grsp				
			weme				
			hofi				
			lisp				
16							
17	opli						
	arca						
	mim						
	mala						
	samx						
	salix						
18	opli	brni	caqu				
	losc	pha	cohu				
	arca	cen	scja				
	cyca		bush				
	mala		ccwr				
	samx		nomo				
	nigl		cath				
			ocwa				
			labu				
			rsto				
			cato				
			lasp				
			grsp				
			weme				
			noor				
			lego				
			yewa				
19	opli	brni	caqu				
	losc	pha	modo				
	arca	broM	grro				
	same	cen	anhu				
	erfa		psfl				
	mafa		atfl				
	mim		ccwr				
	todi		bewr				
	sola		labu				
	rhin		cato				
	samx		hofi				
	hear						
	quag						
	plra						
20	arca	mavu	anhu				
	mim	dame	nomo				
	nigl		lasp				
	opli		lego				
	samx		cora				
21	arca						
	erfa						
	opli						
	samx						
22	samx						
	rhin						
	arca						

No.	foraging and future nesting cagn			No.	foraging and future nesting ccwr		
	shrubs type	annls type	birds type		shrubs type	annls type	birds type
23	arca						
24	arca erfa mim samx salix quag						
25	arca erfa haz same enca	cama	cato rcsp grsp				
26	arca hear mala nigl opli rhin samx		caqu modo anhu ccwr bewr nomo cath rsto cato rcsp grsp noor lego				
27	arca opli rhin samx		bush wcsp				
28	mala samx opli hear arca mim		anhu modo ccwr bewr				
29	same mala hear						
30	hear mala opli samx quag		modo scja labu cato hofi yrwa				
31	mala same basa mim samx		cohu blgr labu cato hofi lego amke yrwa howr				
32	opli arca same mim		anhu atfl weki bush				

No.	foraging and future nesting cagn		
	shrubs type	annls type	birds type
	cyca		bewr
	mala		nomo
	samx		labu
	quag		rsto
			cato
			noor
			hofi
			lego
			lisp
			howr
			wcsp

No.	foraging and future nesting ccwr		
	shrubs type	annls type	birds type

Appendix 3. 1995 San Joaquin Hills burn area avian species observed.

Species	Relative abundance	Time of year present
Mallard	rare	resident
Turkey Vulture	common	resident and migrant
White-tailed Kite	uncommon	resident
Northern Harrier	fairly common	resident
Cooper's Hawk	uncommon	resident
Red-shouldered Hawk	rare	resident
Red-tailed Hawk	common	resident
American Kestrel	fairly common	resident
California Quail	common	resident
Killdeer	uncommon	resident
Gull	rare	resident
Mourning Dove	common	resident
Common Ground Dove	rare	resident
Greater Roadrunner	fairly common	resident
Great Horned Owl	rare	resident
Vaux's Swift	rare	migrant
White-throated Swift	fairly common	resident
Black-chinned Hummingbird	rare	resident
Anna's Hummingbird	common	resident
Costa's Hummingbird	common	resident
Rufous Hummingbird	rare	migrant
Acorn Woodpecker	uncommon	resident
Nuttall's Woodpecker	fairly common	resident
Northern Flicker	rare	resident
Western Wood Pewee	rare	summer and migrant
Hammond's Flycatcher	rare	migrant
Pacific-slope Flycatcher	fairly common	resident
Black Phoebe	common	resident
Say's Phoebe	rare	winter and resident
Ash-throated Flycatcher	common	summer
Cassin's Kingbird	common	resident
Western Kingbird	fairly common	summer
California Horned Lark	rare	resident
Violet-green Swallow	rare	migrant
Northern Rough-winged Swallow	common	summer
Cliff Swallow	common	summer
Barn Swallow	uncommon	summer
Scrub Jay	common	resident
American Crow	rare	resident
Common Raven	common	resident
Plain Titmouse	rare	resident
Common Bushtit	fairly common	resident
Coastal Cactus Wren	fairly common	resident
Rock Wren	uncommon	resident
Canyon Wren	uncommon	resident
Bewick's Wren	common	resident
House Wren	fairly common	summer and winter
Ruby-crowned Kinglet	uncommon	winter
California Gnatcatcher	uncommon	resident
Blue-gray Gnatcatcher	rare	winter and resident
Swainson's Thrush	rare	migrant and resident
Hermit Thrush	rare	winter and migrant
Wrentit	fairly common	resident
Northern Mockingbird	common	resident
California Thrasher	fairly common	resident

Species	Relative abundance	Time of year present
Phainopepla	uncommon	summer
Loggerhead Shrike	uncommon	resident
Least Bell's Vireo	rare	summer
Solitary Vireo	rare	migrant
Hutton's Vireo	rare	resident
Warbling Vireo	uncommon	migrant and summer
Orange-crowned Warbler	common	summer and winter
Nashville Warbler	rare	migrant
Yellow Warbler	uncommon	migrant and resident
Yellow-rumped Warbler	fairly common	winter
Townsend's Warbler	rare	migrant
MacGillivray's Warbler	rare	migrant
Common Yellowthroat	common	resident
Wilson's Warbler	uncommon	migrant and summer
Yellow-breasted Chat	uncommon	summer
Summer Tanager	rare	migrant
Western Tanager	uncommon	migrant
Black-headed Grosbeak	fairly common	summer
Blue Grosbeak	common	summer
Lazuli Bunting	abundant	summer
Rufous-sided Towhee	common	resident
California Towhee	abundant	resident
Rufous-crowned Sparrow	common	resident
Black-chinned Sparrow	fairly common	summer
Lark Sparrow	common	resident
Sage Sparrow	rare	resident
Savannah Sparrow	fairly common	winter and resident
Grasshopper Sparrow	common	summer
Song Sparrow	common	resident
Lincoln's Sparrow	uncommon	winter
Golden-crowned Sparrow	fairly common	winter
White-crowned Sparrow	common	winter
Red-winged Blackbird	fairly common	resident
Western Meadowlark	common	resident
Brewer's Blackbird	rare	resident
Brown-headed Cowbird	rare	resident
Hooded Oriole	uncommon	summer
Northern Oriole	fairly common	summer
House Finch	abundant	resident
Lesser Goldfinch	abundant	resident
Lawrence's Goldfinch	uncommon	winter and migrant
American Goldfinch	rare	resident
Rock Dove*	rare	resident
European Starling*	common	resident
House Sparrow*	rare	resident
Parrot (unkown species)*	rare	resident
Macaw*	rare	resident

Total bird species 102

Relative abundance categories:
highest to lowest.

Abundant
Common
Fairly Common
Uncommon
Rare

* non-endemic species